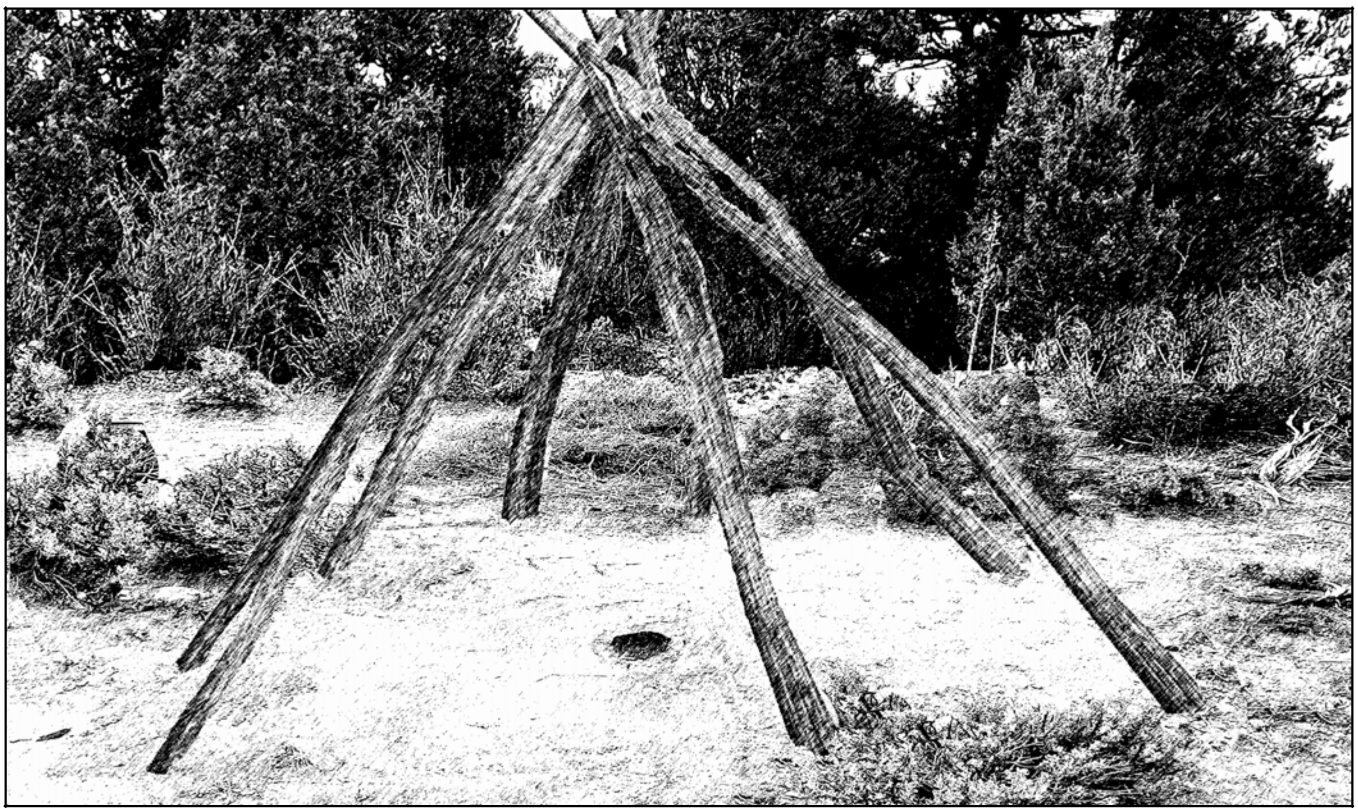
Data Retrieval from Sites 5RB4558 and 5RB8902 for the Proposed Strawberry Creek and Grand Hogback Land Sale in Garfield and Rio Blanco Counties, Colorado

August 2020



DARG
Dominquez Archaeological Research Group

Cover --
Artist conception of small conical pole lodge
5RB8902 Locus 3, Feature 3

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BLM-WRFO #20-158-01 / OAHP #MC.LM.R858

Prepared for
WHITE RIVER FIELD OFFICE BUREAU OF LAND MANAGEMENT AND WHITE RIVER LODGE

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Submitted to
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ABSTRACT

This project was undertaken to mitigate the adverse effects of a proposed land sale on two prehistoric camp sites (5RB4558 and 5RB8902) located in the Strawberry Creek area of Northwest Colorado. These sites were determined eligible as part of a 2018 inventory. A research design for the mitigation of the sites was prepared by Lukas W. Trout, Archaeologist for the Bureau of Land Management's White River Field Office. The research emphasis and the objectives outlined in that design were two-fold: (1) *archaeological and environmental data recovery and description*, and (2) *the synthesis and interpretation of the recovered archaeological materials.*

Fieldwork for the data recovery occurred between May 1st and June 15th 2020. Thermal features were excavated at each site, and provided radiocarbon data of the their occupation during the same period about 1700 years ago. Macrobotanical samples gathered from the hearth features provided information about the season of occupation and the plants being used. Pollen samples indicated plants growing in the surrounding landscape and implied conditions of a wet environment present during that period. Fire-altered rocks recovered from the feature at 5RB4558 were subjected to protein analyses and indicated the cooking of lean meat.

Excavation of the required 2x2-meter units around the thermal feature in 5RB8902 revealed post impressions of a surface habitation structure. Expansion of the excavation area into a 3x3-meter square revealed impressions of eight posts situated in a circular pattern two-meters in diameter with an apparent doorway facing east – characteristics of a small, conical, post-framed lodge. It was apparently assembled just after or during a storm that softened the clayey surface soil so that post and other impressions were formed. Namely, the additional excavations also revealed several moccasin prints and a deer track preserved in the hardened clay of the structure's floor.

This study has presented information that can be used to better identify cultural components of single- or several-component open camps. As well, it has provided evidence that radiocarbon dating of the small camps (and not comparative diagnostic analysis) is the only way to accurately determine the regional distribution of various cultural groups' activities and thus glean some idea of their purpose.

The data retrieval procedures for each site were completed as per the research design. Accordingly, the scientific potentials of 5RB4558 and the BLM portion of 5RB8902 have been exhausted and no further work is recommended.

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1.0 INTRODUCTION

Dominquez Archaeological Research Group (DARG) at the request of White River Lodge (as represented by Westwater Engineering) and the White River Field Office Bureau of Land Management (WRFO) pursued this project to meet requirements of a data recovery plan for two National Register of Historic Places (NRHP) eligible sites within an area slated for disposal by public sale. The relative BLM parcels proposed to be sold were surveyed for cultural resources in 2018 (OAHP Report #MC.LM.R802; Conner et al. 2017). Two of the sites located during this inventory, 5RB4558 and 5RB8902, were determined eligible for the National Register of Historic Places. Accordingly, the purpose of this data recovery was to mitigate the adverse effects of the land sale to both sites as per Section X.H.2 of the State Protocol Agreement. Such work was undertaken to meet the requirements of the Federal Land Policy and Management Act of 1976, the National Historic Preservation Act (as amended in 1992), and the National Environmental Policy Act (NEPA) of 1969.

This project was funded by White River Lodge and conducted under Section 110 of the National Historic Preservation Act (NHPA, 16 U.S.C. § 360). It was authorized by Bureau of Land Management (BLM) ARPA Permit No. C-67009 and through project authorization by the BLM Colorado State Archaeologist and the WRFO. Information presented in this report will have professional/public dissemination through presentations at professional meetings and as a report in the dargnet.org website.

2.0 PROJECT LOCATION

Sites 5RB4558 and 5RB8902 are located in Rio Blanco County, Colorado, [redacted] northwest of Meeker, Colorado. [redacted].

3.0 RESEARCH DESIGN

The Treatment Plan for the data recovery from the two sites was prepared by Lukas W. Trout, Archaeologist for the Bureau of Land Management's White River Field Office. It is entitled: *Data Recovery Treatment Plan: Data Retrieval from Sites 5RB4558 and 5RB8902 For the Proposed Strawberry Creek and Grand Hogback Land Sale in Garfield and Rio Blanco Counties, Colorado,* and is included as Appendix A. The research emphasis and the objectives outlined in that document were two-fold: (1) *archaeological and environmental data recovery and description,* and (2) *the synthesis and interpretation of the recovered archaeological materials.* The following report will address the applicable portions of the Plan.

4.0 ENVIRONMENT

This section is subdivided into summaries of the geology, physiography, soils, biota, and climate. It also provides a discussion of how the environment may have affected prehistoric and historic occupation of the area.

4.1 Geology and Physiography

The two sites occur within the Axial Fold Belt, a low arch between the Uinta and the White River anticlines (or uplifts). They are in the central-east portion of the fold belt and at the southern boundary of a large anticline -- the Axial Basin Anticline -- and intervening synclines. Other well known anticlines in the region include Blue Mountain, Cross Mountain, and Danforth Hills. Geologically, the Axial Basin Anticline began to rise during the Paleocene and separated the Green River Basin into two parts. Its upward movement was reactivated during the Tertiary, and since then, most of the Tertiary-age rocks have been eroded away (Young and Young 1977:57). The sites are located on the east side of the Strawberry Creek Valley, which exhibits exposures of Cretaceous and Tertiary age sedimentary rocks including sandstones and shales of the Williams Fork Formation and claystones, sandstone, shales and coal beds of the Wasatch and Fort Union Formations. The Wasatch Formation is the bedrock in the area of the two sites.

Physiographically, the central ridge spine of Danforth Hills separates waters that flow north into the Yampa River from those – like Strawberry Creek – that flow south into the White River. The gently sloping valley floor of Strawberry Creek is entered from the east by numerous narrow ridges and a dissected, dendritic drainage system. Characteristically, the steep-walled canyons and gulches from Devil’s Hole Gulch drain southwestward from Danforth Hills into the valley.

4.2 Soils and Vegetation

Various soils are present in the project areas. Six soil types are within the four parcels at the north and include: Bucklon-Inchau complex, 25 to 50 percent slopes; Cochetopa loam, 9 to 50 percent slopes; Cochetopa-Jerry complex, 25 to 50 percent slopes; Jerry loam, 12 to 50 percent slopes; Rhone loam, 5 to 30 percent slopes; and, Silas loam, 3 to 12 percent slopes. Two of these, the Jerry-Thornburgh-Rhone complex and the Rentsac-Moyerson-Rock outcrop complex make up the majority of the soils and consist of stony, clayey loams that range from shallow to deep well-drained soils (USDA NRCS Web Soil Survey, accessed 3/15/2018).

Elevations of the areas surrounding the sites range from 6500 to 8700 feet, and include Upper Sonoran, Transitional, and Montane vegetation zones. Four main plant communities are present: mixed sagebrush/grasslands, pinyon-juniper woodland, and Transitional Zone Brush, and Aspen-Pine forest. It is assumed that the plant species present today were there in the past; however, the proportionate representations of the vegetation communities has undoubtedly been altered in modern times by grazing of domestic animals or displaced deer populations.

Sagebrush/grassland communities occur in the drainage bottoms and in open parks on

Plate 4.1. View of mixed sagebrush and mountain brush with stands of pinyon/juniper at midrange elevations. Thick vegetation occurs in the sagebrush/grasslands, whereas stands of pinyon/juniper offer open ground.

the ridge tops. Big sagebrush dominates this plant community. Stands of pinyon and juniper occur mainly on the ridge tops and south-facing slopes where bedrock has been exposed. Within such woodlands there is very little understory, although any of the plants associated with the sage shrubland community can be found here as well (Plate 4.1). Transitional Zone brush densely covers most of the north-facing ridge slopes and is interspersed within the pinyon/juniper stands and sage-grasslands on ridges and south slopes. As elevation increases and slope erosion is much less pronounced, Transitional Zone brush dominates. Besides oakbrush, the midrange elevations contain a mix of chokecherry, smooth maple, serviceberry, and wild rose. Higher elevation ridges in the southern study areas have groves of aspen, and aspen mixed with pine. Ground cover ranges from 80 to 100 percent throughout the area except on south-facing slopes at lower elevations that can have upwards of 80 percent visibility.

The higher elevations proffer numerous edible and otherwise useful plants. Serviceberry, chokecherry, snowberry, elderberry, currant, and wild rose bushes yield berries, while aspen, mountain mahogany and skunkbush were useful as fuel and in tool making. Mushrooms, edible greens such as arrowroot, watercress, dock, and nettles, and plants having medicinal use such as false hellebore, cebadilla, nettles, and mullein are also available. The lower elevations also harbor many useful plant species. The pinyon was valued for its nuts, pitch, and use as a fuel, while the juniper provided berries for food, decoration and medicine, and bark for use in bedding, clothing, etc. (Elmore 1976:15; Moore 1979:93). In addition to yielding food, fuel, and raw materials, the pinyon/juniper forest was probably the main source of shelter.

At lower elevations, in the surrounding areas, shrubs such as saltbush (Atriplex) and squawbush (Rhus) yield edible seeds and berries; squawbush and yucca were useful in basket making; yucca was also used as soap (Elmore 1976:37-43; Harrington 1972:59). Prickly pear fruits and pads provide both food and moisture. Edible bulbs are produced by the sego lily and wild onion (Harrington 1972:17). Mustards such as bladderpod and pepperweed yield early edible shoots and later produce edible seeds. The prehistoric harvest of various grasses – dropseed, Indian ricegrass, and wildrye – as well as goosefoot (Chenopodium), pigweed (Amaranthus), and sunflower (Helianthus) is well documented in the ethnobotanical record (Lindsay 1980:222). Also, the lower elevation riparian communities offer diverse useful floral resources – cottonwood, tamarisk, willow, phreatophytic shrubs, sedges, rushes, cattails, reed grass, and arrowroot.

4.3 Fauna

Numerous wildlife species inhabit the study area. Migratory mule deer and elk are the most commonly seen large mammals. Predators include coyotes, black bear, mountain lion, red and grey fox, and badger. Besides the large mammals that range throughout and the aforementioned predators, present also are the cottontail rabbit, Nuttall's chipmunk, deer mouse, thirteen-lined ground squirrel, the golden-mantled squirrel, Apache pocket mouse, northern pocket gopher, long-tailed vole, western jumping mouse, and 39 bird species. Birds observed commonly include the sage grouse, jay, horned lark, raven, red-shafted flicker, long-eared owl, golden eagle, and various other raptors. Goose, duck, grouse, pheasant, and dove are reported in the area as well.

4.4 Climate and Land Use

Climatically, the region is characterized as having a steppe-type climate. Within the study areas' elevations, the average annual rainfall ranges roughly between 12 and 24 inches. On the ridge tops above 8000 feet, the average is 25.66 inches and the average annual temperature is 35.5° F. Temperatures have varied between -20 degrees F. in winter and 90 degrees F. in summer with a frost free seasonal range of 70 to 100 days. Meeker weather averages: Annual high temperature: 58.8°F; annual low temperature: 28.3°F; average temperature: 43.55°F; average annual precipitation - rainfall: 16.07 inches.

Agriculture is limited by the low rainfall, short period of frost-free days, and low winter temperatures (USDA SCS 1982). The optimum growing season for native plants is May-June, during which time temperatures average around 55-60 degrees Fahrenheit. Frosts occur frequently between mid-September and early June, resulting in a growing season of roughly 45-100 days (ibid.). For much of the year, the climate of the study area is cool and dry; only during the mid-winter months is the climate severe enough to have limited prehistoric occupation.

It is certain that hunting and foraging formed the basis of the aboriginal subsistence pattern in this area for most of Prehistory. Historic Euro-American land use of the area included ranching, which involved the collection of juniper poles for fencing and pinyon timbers for building; the cutting and limbing of these trees was evident in the study areas. Presently, the area is being grazed by cattle and sheep, hunted for wild game, and explored for mineral resources.

5.0 PALEOCLIMATE

A graphic illustration of regional climatic studies by Petersen (1981) for the La Plata Mountains and by Chen and Associates for the Battlement Mesa area (Conner and Langdon 1987:3-17) is presented in Figure 5.1. As one can see, the two graphs are not in complete agreement, but they offer comparable assessments of the region's paleoclimate based on the present knowledge of the geomorphology. In addition, the following is a distillation of the discussion of general climatic shifts derived from geologic implications as reported in the Class I for the GJFO (Conner et al. 2011:2-8 through 2-50).

In summary, the end of glacial conditions came around 13,400 BC (dates are calibrated). An early drought, called the Clovis Drought by Haynes (1991), caused erosion and is associated with most of the Pleistocene extinctions. Glacial conditions returned in the Younger Dryas between 11,000 and about 9000 BC. Severe drought in the early Holocene lasted from 9000 to 5500 BC, interrupted once around 7450 BC, which coincides with Pryor Stemmed occupations in the region. After 5500 BC, climates ameliorated. Conditions between 5500 and 3100 BC approached, but did not exceed, conditions during the Late Glacial; changing plant communities, frost heave, syngenetic (in-place) weathering, and changing lake levels all point to cooler conditions. Droughts interrupted the generally cooler-moister conditions after 5500 BC, with major periods of drought identified between and 1850 to 950 BC, 275 BC to 165 AD, 900 to 1350 AD. After about 150 years ago, conditions have caused deflation, and alluvial deposits have moved in fits and starts downstream, via avulsion.

Geologic evidence can identify changes in climate within a scale of hundreds of years, but lacks precision when compared to tree ring data, but the two compare nicely. The sequence of deposition and erosion is easy to see, but dating the sequence with radiocarbon determinations obtained mostly from cultural features presents its own challenges. Furthermore, although the changes due to climate change are visible in the stratigraphic record, the boundary conditions that favor deflation over deposition in loess deposits or trigger fine clastic deposition in alluvial valleys are not precisely known. Nevertheless, a coarse summary of climate based on alluvium and aeolian deposition can be suggested, and is generally supported by tree ring data for at least the last 2000 years.

The Holocene paleoclimatic data just adduced are of great value for exploring the general relationship between environment and prehistoric cultural occupation of the Western

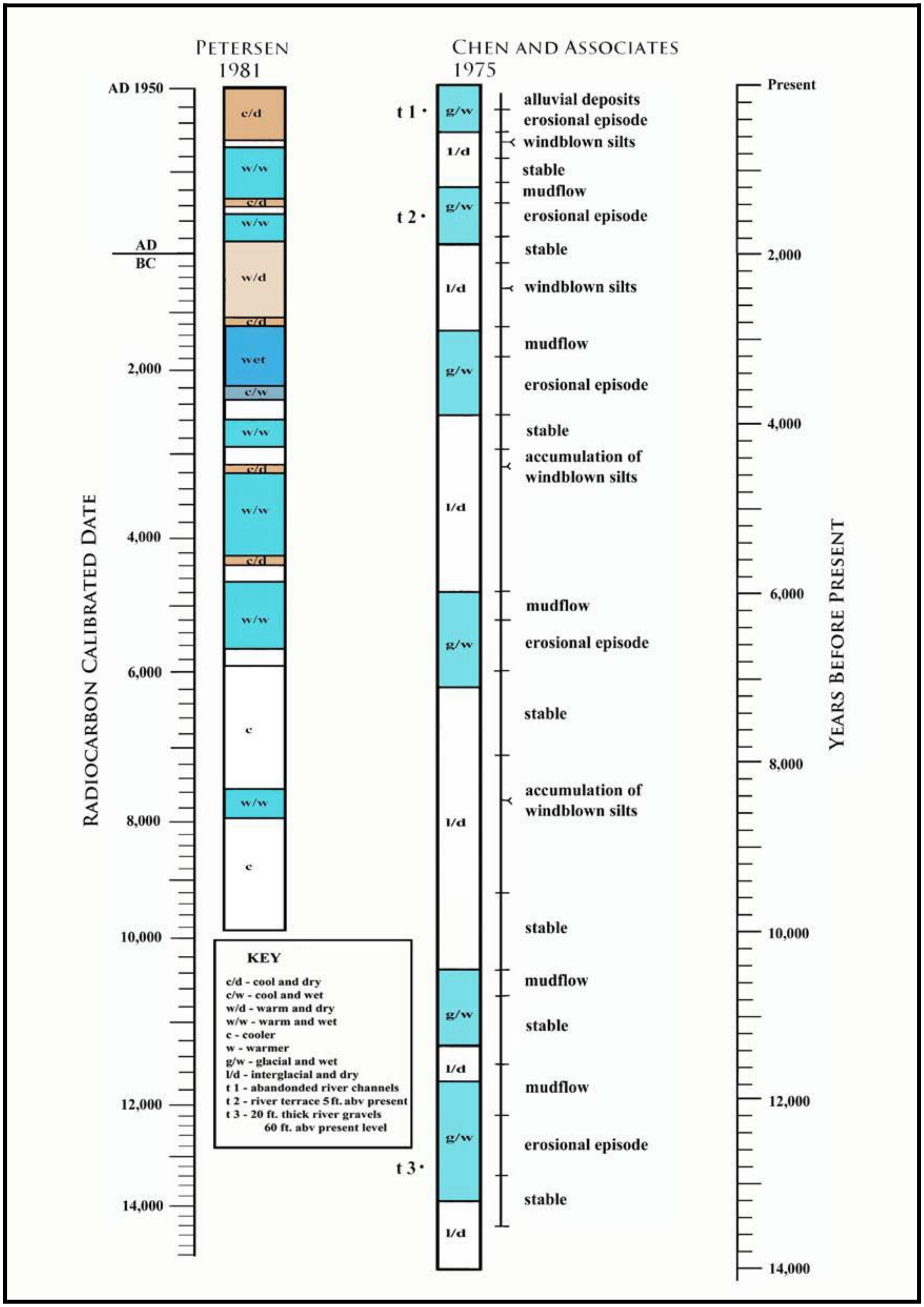

Figure 5.1. Illustration of regional climatic studies by Petersen (1981) for the La Plata Mountains and by Chen and Associates for Battlement Mesa Community (Conner and Langdon 1987:3-17).

Slope. However, the temporal resolution stemming from radiocarbon-dated stratigraphic sequences is less than ideal for correlation with better known cultural events occurring within the past two millennia. The Palmer Drought Severity Index (PDSI) employs precipitation, temperature and the Available Water Content (AWC) of soil types to assess agricultural potential on an annualized basis (Palmer 1965; Alley 1984). When the modern instrumental record is calibrated with available tree-ring indices, the PDSI for specific regions can be extended to prehistoric times. Edward R. Cook of the Lamont-Doherty Earth Observatory has recently recalibrated the PDSI for 1825 annually resolved grid points for North America (Cook, as presented in Berry and Benson 2008). The relevant node (Number 117) for northwestern Colorado is depicted in Figure 5.2, averaged to decadal means.

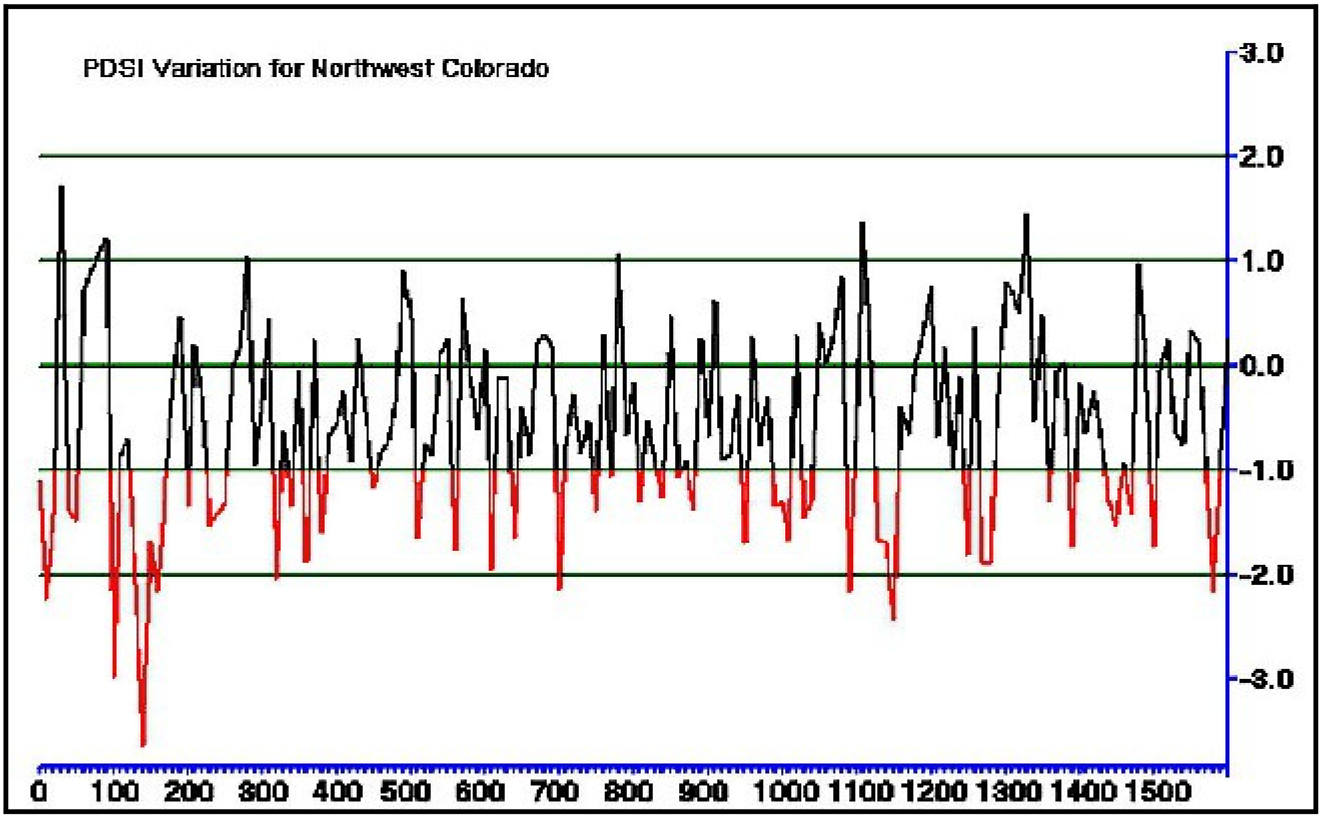

Figure 5.2. PDSI for Northwestern Colorado from 1- 1600 AD. Annual data decadally averaged (Cook, as presented in Berry and Benson 2008).

Drought conditions are indicated in red for negative departures greater than 1-sigma. Correlation with cultural events is straightforward in areas such as southwestern Colorado where cultural events are by and large also subject to tree-ring dating. However, Western Slope archeological remains rely upon radiocarbon dating, which typically lacks a similar level of resolution. The situation can be markedly improved in the future if the controlling federal agencies set standards of radiocarbon sample selection to be employed by CRM contractors. A ten-year temporal granularity is achievable if enough dates of credible materials from critical proveniences are recovered over time.

Botanical annuals are the preferred materials and typically require Accelerator Mass Spectrometry (AMS) analyses. And multiple, same provenience sampling allows for date averaging with a consequent reduction, thus increased precision, in standard errors. Many of the questions regarding environment-cultural interaction (e.g., PDSI in relation to population movement or abandonment) cannot be addressed given the current state of the cultural radiocarbon record. This situation is ultimately resolvable and should be a high priority.

6.0 RESEARCH BACKGROUND

Local and regional archaeological studies suggest nearly continuous human occupation of northwest Colorado for the past 12,000 years. Manifestations of the Paleoindian Era, big-game hunting peoples (ca. 11,500- 6400 BC); the Archaic Era hunter/gatherer groups (ca. 6500 - 400 BC); the Formative Era horticulturalist/forager cultures (ca. 400 BC- AD 1300); the Protohistoric Era [Late Prehistoric] pre-horse hunter/gatherers (Early Numic [Ute, Shoshone, Comanche], ca. AD 1300 - AD 1650) and historic horse-riding nomads (Late Numic, ca. AD 1650 - AD 1881) have been documented. An overview of the prehistory of the region is provided in a document published by the Colorado Council of Professional Archaeologists entitled *Colorado Prehistory: A Context for the Northern Colorado River Basin* (Reed and Metcalf 1999). Additional information can be obtained from *Ethnographic Landscape Study Northwest Piceance Creek Basin* (Conner et al. 2016).

A temporal illustration emphasizing the overlap of the subsistence strategies employed by the diverse cultural groups over the past 16,500 years is presented in Figure 6.1. It acknowledges the potential of the extension of the Late Archaic hunter-gather occupation coeval with Formative Era cultures.

Historic records indicate occupation or use by EuroAmerican trappers, settlers, miners, and ranchers as well. Overviews of the historical record are found in the Bureau of Land Management’s publication *Frontier in Transition* (O’Rourke 1980) and in the Colorado Council of Professional Archaeologists entitled *Colorado History: A Context for Historical Archaeology* (Church et al. 2007), which was used as the primary guide for this project in the evaluation of historic sites.

6.1 Hunter-gatherer Subsistence Strategies

Most of the prehistory of the region has relied upon the categorization of resources being the result of occupations by hunter-gathers. Methodological approaches in the examination of archaeological phenomenon similar to that of the study area have been employed in the Great Basin and Green River Basin (Thomas 1983; and Ebert 1985). Through

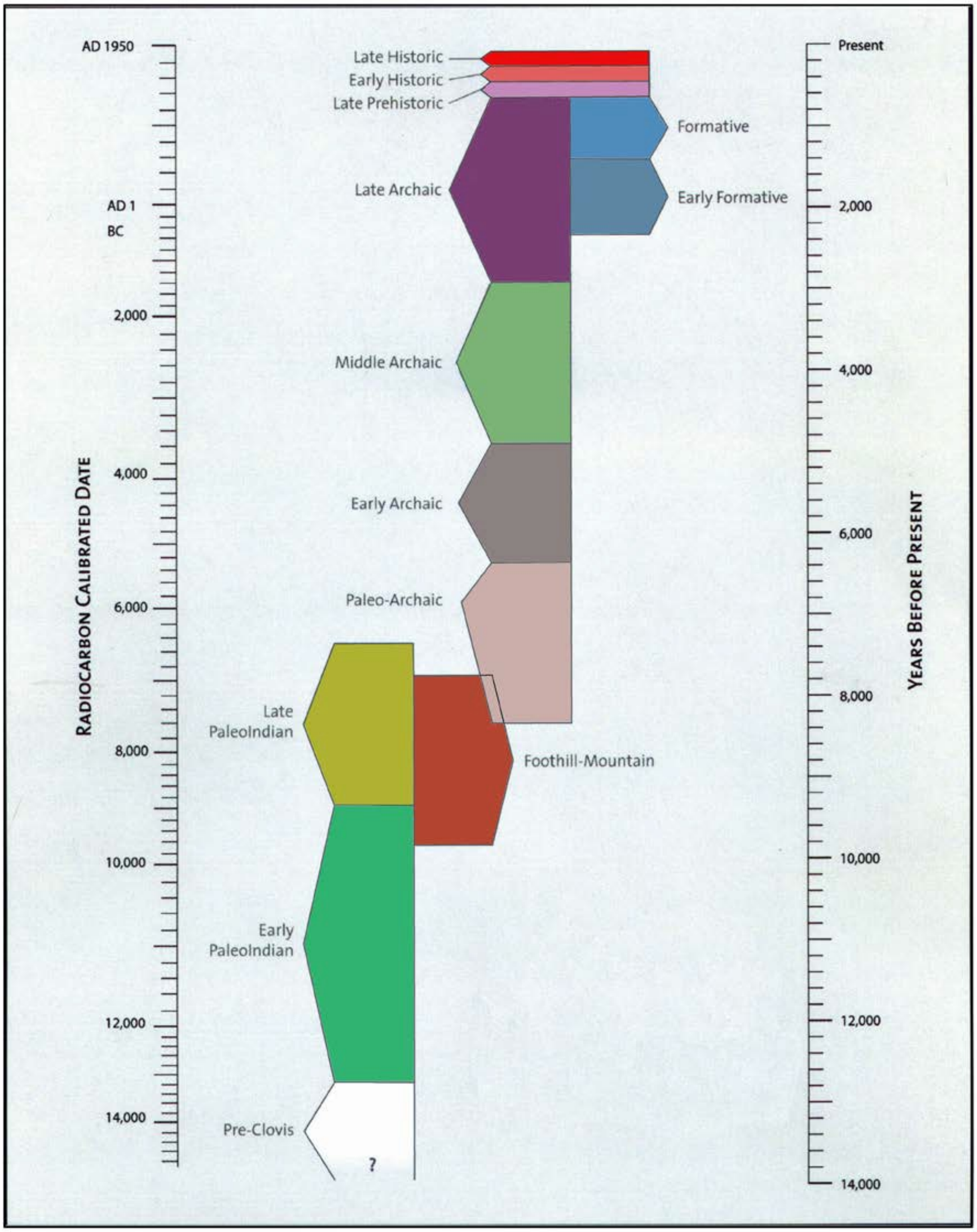

Figure 6.1. Temporal chart emphasizing the overlap of the subsistence strategies employed by the diverse cultural groups over the past 16,500 years (Conner et al. 2016:18).

earlier findings, expectations of field surveys are that camp sites will present expressions of the following hunter-gatherer subsistence strategies (Ebert 1992:134):

1. A strategy of high residential mobility in which foragers exploited the area, using serially occupied residential camps from which foraging trips of a day or less were undertaken.
2. A strategy of seasonal fusion and fission, in which large multifamily residential camps were occupied during one portion of the year. Foraging as well as logistic forays were undertaken from these camps. At other times the camps broke up into small, residentially mobile foraging groups.
3. A strategy of minimal residential mobility coupled with high logistic mobility, represented by large permanent residential bases with high investment in facilities and highly specific, repeatedly used logistic field camps and staging locations.
4. A strategy (or more realistically a component thereof) consisting of temporary camps of highly mobile and logistically organized special-purpose groups passing through the area, with neither residential bases nor procurement activities related to the area at all.

As well, Thomas has indicated that the archaeological record can be expected to be a composite overlay of episodes of behavior resulting from the many uses of a place, and that it may be difficult to distinguish overlaid field camps from residences simply through the functional interpretations of all items found (Ebert 1992:134).

Findings from monitoring and excavations along the Collbran Pipeline provided new perspectives on the prehistoric occupations of the region and provided methodological direction for this and future studies (Conner et al. 2014). The first and most obvious is that various styles of houses (pithouses, house pits, sheltered houses and surface structures) were constructed throughout the Archaic occupation of the mountains of Colorado. All exemplified sophistication in that they demonstrated a commitment in time and effort, and exhibited a multi-generational knowledge base. These Archaic sites with substantial architecture likely functioned as base camps that were used year-round or at least for most of a year. This is where food was stored, where women, children and the infirm were positioned, and from which resource gathering forays were staged. It also appears that most represent a hamlet type orientation for sheltering small groups. Many of these house localities display reoccupation over hundreds of years, as illustrated by excavations at 5GF1185 (Conner et al. 2015). This implies periodic abandonment or shifts in base camp locations in response to environmental conditions.

The finds from regional, early Middle Archaic houses (ca. 5000-4000 RCYBP) have included obsidian from sources located as far away as New Mexico and Idaho, which indicates either a sophisticated trade network or long distance travel during that time. Similarly, the Late Archaic pithouses of the Battlement Mesa Complex have evidence of trade for or resource procurement of Gilsonite [non-trademarked mineral name is uintaite or uintahite], a form of natural asphalt found only in the Uintah Basin of Utah. It is a product the aboriginals heated and used to line baskets.

Seed-based procurement, processing and likely manipulation of cheno-ams and Indian ricegrass is central to the proposed sedentary economies of the Archaic period. Additionally, the reliance on these seed plants and the methods of manipulation likely contributed to the acceptance, dispersal and development of high altitude maize during the Late Archaic-Early Formative transition.

In summary, the debates over the various types of hunter-gatherer methods of procurement strategies typically involve two culturally defined types: residentially mobile foragers, a term that applies to mobile groups that rely on seasonal rounds; and logistically mobile collectors, a term for sedentary or semi-sedentary groups who relied on, manipulated and stored seed resources. The return to a seasonal-round strategy for a collector based culture during environmental extremes is insufficient to describe the latter's response to dramatic changes in effective moisture. Their abandonment and reestablishment of a base camp in response to resource depletion or environmental change was a horizontal movement to a similar environmental niche for the former and a vertical movement in elevation for the latter. That is, during dry periods the Archaic collector moved to higher elevations or down along permanent drainages, and during wet periods movement was to the lower elevations near secondary water sources (springs, small drainage catchments, etc.). Such would be in response to the increased ground water and seed resources there, along with an associated increase in faunal resources. Seasonal vertical movement between the higher and lower elevations was probably greater during periods of dry extremes.

7.0 REVIEW OF INVENTORY FINDINGS

The following are the original site descriptions and evaluations from the inventory reports.

Site **5RB4558** (Parcel A) is a prehistoric open camp previously recorded in 2003 by Jeff Brown of BLM-WRFO as part of the "Cultural Resource Evaluation of the Proposed Smith Land Sale." Brown briefly described the site setting as: ... lying east of Strawberry Creek and south of Devils Hole Gulch at the crest of a small bench and appears to be eroding from this bench. Elevation 6560 feet with vegetation including pinyon/juniper forest, sagebrush, forbes, and cactus. Site size estimated to be 100 sq.m. with the nearest water 100m south. He continues:

> "Site consists of a light scatter of lithic debris, a ground stone mano, a thumb scraper, a scraper fragment and a possible hearth feature. The site lies just below the lip of a [pinyon/juniper forested] terrace or bench on a west facing sloping ridge above Strawberry Creek. This bench is one of a series of small flat steps occurring along this ridge, which extends approximately 1/2 mile east/west. The lithic debris appears to be eroding from the bench and washing down a series of drainage channels to the south and west. Erosion is quite heavy along the face of the ridge. The possible hearth feature is .5m in diameter and contains identifiable charcoal fragment and fire-cracked rock. This feature has readily observable edges and appears to be a small pit dug into

the soil. The feature is in a small erosional channel and is being washed down..."

Grand River Institute revisited the site as part of the project and upgraded the location data. The site boundary was increased to encompass materials to the east and west of the locus containing the hearth feature. The artifacts located by the revisit do not directly parallel the original recording, which is to be expected because sheet wash occurs along the slope that contains the site. However, one of the new finds is significant. It is a projectile point that exhibits a long serrated blade and a slightly bifurcated stem (Plate 7.1). This type is found as far south as the Uncompahgre Plateau where is has been identified as a Roubideau type by Buckles (1971:1220), which he has stratigraphically dated its use ca. 3000-500 BC.

Plate 7.1. Projectile found in Locus 1, 5RB4558.

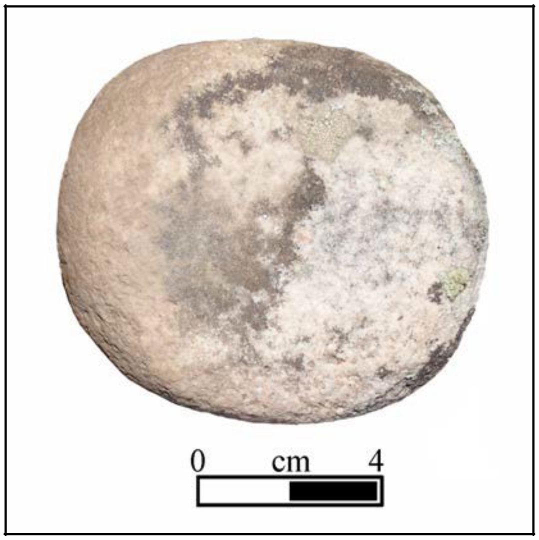

Plate 7.2. 5RB4558, disc mano.

Of the other lithic artifacts present are a few tools such as scrapers and large utilized flakes; but, only a few debitage flakes were noted, which implies tool rejuvenation rather than manufacture. Fragments of a metate and a comal are also present. The metate fragments are thin and exhibit bifacial use. A disc mano was newly identified (Plate 7.2), but a previously reported, large ovate mano was not relocated. These ground stone types are also present at newly recorded site 5RB8902, which suggests the sites were occupied by the same cultural group, probably about the same time.

Evaluation and Management Recommendations

The condition of the site is poor. Soils are generally shallow and deflated by sheet wash erosion and possibly grazing. Pole collection by early ranchers is evidenced by remnant slash. A small hearth feature is present, exposed by a rill that contains charcoal and ash and is likely to yield datable charcoal and possibly paleoenvironmental data. Accordingly, because it is likely to yield significant information, the site is field evaluated as eligible. Recovery of the hearth feature and diagnostic artifacts are recommended.

Site **5RB8902** (Parcel 1) is a prehistoric open camp located on the south side of a ridge that slopes gently to the west. The site ranges between 6640 to 6680 feet in elevation. The nearest water source is an intermittent drainage located 55m to the south. It drains into Strawberry Creek, a larger intermittent drainage to the west. Sulphur Creek, the nearest permanent water source, is located 2 miles to the east of the site. Vegetation at the site is pinyon and juniper forest with a limited understory of short bunch grasses. Mountain mahogany is present along the periphery of the pinyon juniper community. The soils at the site are deep, well drained dark grayish brown loams. Exception to this is the Rentsac-Moyerson-Rock outcrop complex which is also brown loam, however it is shallow and well-drained. The rock outcrop consists of exposures of sandstone, siltstone, hard shale or limestone.

The site encompasses an area measuring 55 (N-S) by 145 (E-W) meters – the west portion of which occurs on private land. It consists of three loci that apparently represent separate camping areas potentially by the same cultural group during the same time period. Characteristics of the loci include comparable ground stone types, clusters of heat-fractured cobbles, and a low density of lithic tools and flakes.

Five whole and fragmentary manos (grinding stones) were found in Locus 1 (L1) and Locus 2 (L2). Two (one at each loci) are large disc- to ovate-shaped (Plate 7.3). All are cobbles shaped by pecking and grinding, and were bifacially utilized.

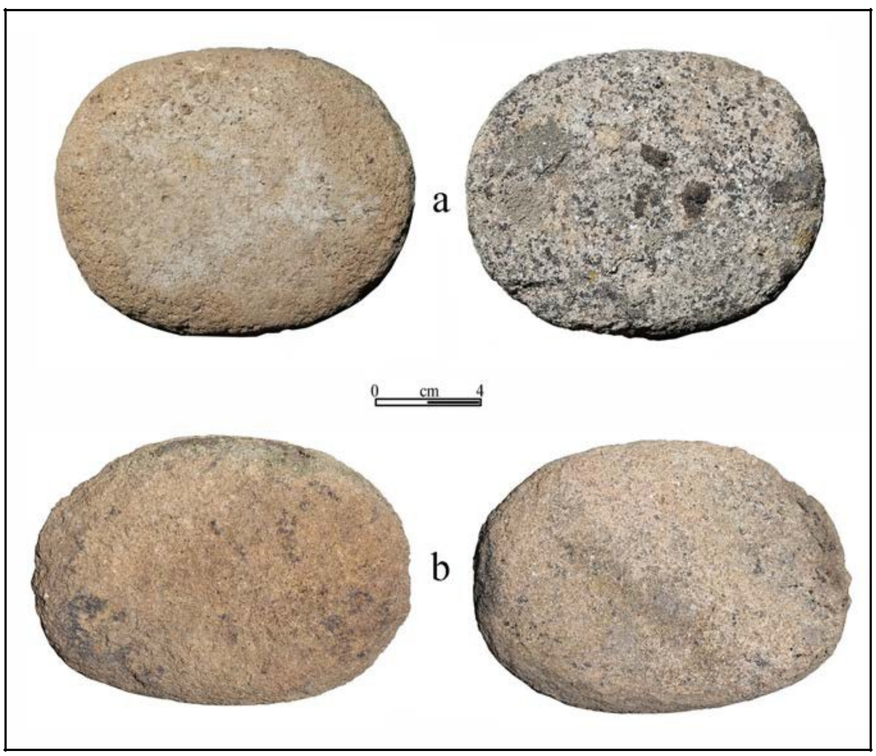

Plate 7.3. 5RB8902, large disc and ovate manos from Locus 1 (a) and Locus 2 (b).

Metate fragments documented at L1 and L2 were bifacially utilized, and characteristically thin (3.4 cm). As such, they were likely portable (Plate 7.4). These and the manos are of types similar to ones found in pithouses near the town of Battlement Mesa (5GF126 and 5ME16786). Dated to 2760±70 BP, the pithouses represent a pre-agricultural sedentary group that either manipulated or perhaps cultivated native plants including, but not limited to, Chenopodium-Amaranthus (goosefoot and other pigweed) and Oryzopsis (Indian ricegrass). The former, for example, are forbs that can produce a pound or more of seeds from a few plants during late summer (for use or storage) and edible greens from early spring to late fall. Resource procurement camps of this Late Archaic culture have been identified regionally, and 5RB8902 may be such. One projectile point fragment was found that may also indicate that the site is related to the Battlement Mesa Culture. It is a blade fragment made of a fine-grained, red chert. Its image was graphically overlain on a photo of a corner-notched point found in a pithouse at 5GF126, and is distinctly comparable in size (Plate 7.5).

Plate 7.4. Metate fragment from 5RB8902, Locus 1 showing distinctive thin characteristic. Another representative of this type was found in Locus 2.

Plate 7.5. The colored portion of this plate is a projectile point blade fragment that has been graphically overlain on a photo of a projectile point found in the pithouse of 5GF126.

Other lithic artifacts consist of only a few tools and flakes. Tool manufacturing was not a primary activity as only 10 flakes were recorded, the smaller of which probably only represent tool sharpening and the larger utilized as expedient tools. One uniface in this category is knife-shaped. Three wood- or bone-working tools were found in L1 and L2 including a large flake used as a spokeshave (L1), and two small primary flakes (L2) that exhibit a burin tip and a chisel edge (Plate 7.6).

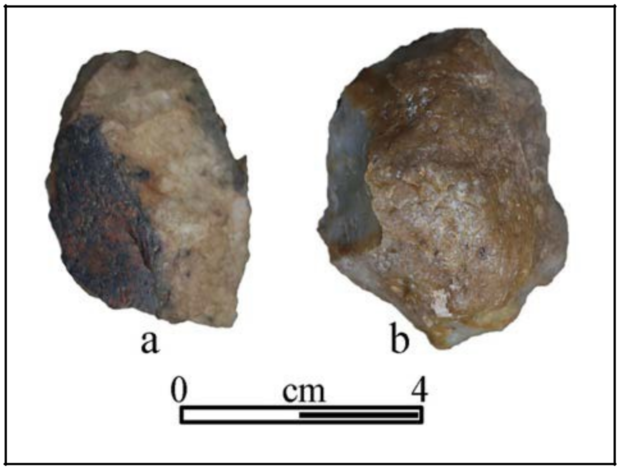

Plate 7.6. Artifacts found together at 5RB8902 in Locus 2 that are apparently wood- or bone-working tools: left, small scraper with burin tip; right, chisel edge utilized flake.

Several concentrations of fractured, heat-reddened cobble fragments occur in all three loci. The cobbles are clearly water worn and have been transported to their current locations by the inhabitants. There is no ash or evidence of thermal activity such as reddened sediment in direct association, but it is apparent that they had been heated in a fire and subsequently concentrated through dumping at their current location. A few small chunks of charcoal were found eroding near the fractured cobbles in L1 (located on private property). Several were collected from the surface for AMS dating, and as a result, a conventional age of 1720±30 BP (Cal 240-400 AD) was obtained (ICA Sample ID 18C/0628). Test excavation may supply additional charcoal chunks from the dumping area designated as Feature 1 (L1).

Based on the fragments, the heat-altered cobbles are estimated to have been between 6-12cm in diameter. Similar sized cobbles have been documented as being used by Utes as boiling stones (Smith 1974: 64, 66, 87):

> "Cooking was done by roasting over the coals or by stone boiling in baskets or pottery vessels either procured by trade or home-made.
>
> Clay pots were used for boiling meat, sometimes with seed or Yampa flour added. The pot was placed near the fire, and hot ashes were heaped around it. Sometimes hot stones were placed in with the food to make it boil faster."

In sum, because of their size, fractured condition and their location within the site's loci, they were used for cooking. In fact, besides their use in boiling meat, several show indications of use as either hammer-stones or anvils for breaking bones to extract marrow (Plate 7.7). A larger cobble utilized as a chopper may also have been employed in bone processing.

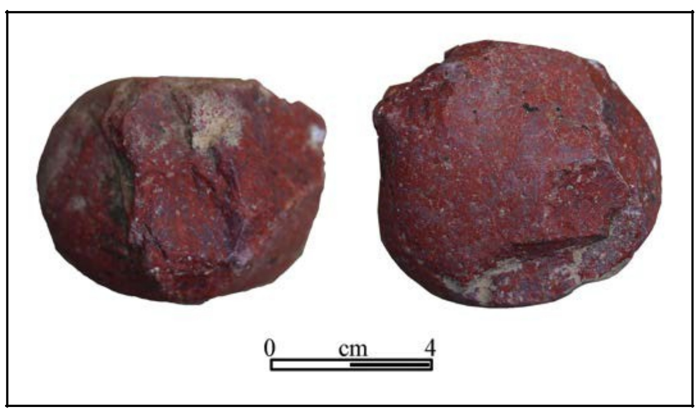

Plate 7.7. 5RB8902, Locus 2, hammerstone apparently used for breaking bones to extract marrow.

Evaluation and Management Recommendations

The condition of the site is poor. Soils are shallow and deflated by sheet wash erosion and possibly grazing. Pole collection by early ranchers is evidenced by remnant slash. A small hearth feature is present and has yielded significant information and may yield additional important information relating to paleoenvironmental data. Accordingly, the site is field evaluated as eligible. Recovery of the hearth feature is recommended.

8.0 DATA RECOVERY

Fieldwork for the data recovery occurred between May 1st and June 15th 2020, and was conducted by Carl Conner (Principal Investigator) and Natalia Conner. The method used was a step by step procedure as outlined in the Treatment Plan (presented in Appendix A). At each site, the surface artifact and thermal feature distributions were re-assessed, and in the case of 5RB8902, a determination of the portions that occur on private and BLM administered land was made. The original mapping of 5RB8902 included two loci (1 and 2) that occur on private land, and thus were not included in the data retrieval processes; however, the data derived from the inventory's recording are included to provide an accurate depiction of the archived artifactual remains and temporal association of the site's occupations.

Trowel testing was employed at 5RB4558 and 5RB8902 in the search for buried cultural deposits. The transect-based test placements were determined by vegetation/terrain and the distribution of surface artifacts and/or exposures of ash-stained soil. It is notable that the soils at both sites are shallow-to-very shallow (< 10cm), and occur on a base of clayey Wasatch bedrock, which dictated the termination level for excavation in the test units.

At 5RB4558, no additional thermal features or indications of buried cultural materials were found during the surface inspection and trowel testing – other than the hearth feature identified during the inventory. Figure 8.1 is a map showing the trowel test locations within 5RB4558. Surface identified tools were collected at this point, and their distribution is also shown in Figure 8.1.

A 2x2-meter grid was laid out around Feature 1, and surface clearing ensued. The shallow nature of the silty, sandy topsoil dictated that removal be made by careful troweling and use of brushes. That first step revealed an oval thermal feature (47cm x 38cm) set on the side of a small drainage (Figure 8.2). It included fill of wood charcoal (pinion or juniper) and small chunks of sandstone rock that at its maximum was only 7cm deep. Samples collected from the feature included rocks (for protein analysis), carbon (for AMS radiocarbon dating), macro-botanical (flotation for seed collection and identification), and pollen (for processing and identification).

At 5RB8902, surface inspection and trowel testing was conducted on the east side of the site within BLM administered land. No additional artifacts were identified, but a small area of ash-stained soil was found in Locus 3 that prompted a test (TU#5). Figure 8.3 shows the 2020 test locations in relation to the inventory mapping of the site. During that 2017 inventory, a sample of surface charcoal found eroding near the fractured cobbles in L1 was collected and AMS dated, resulting in a conventional age of 1720±30 BP (Cal 240-400 AD; ICA 18C/0628).

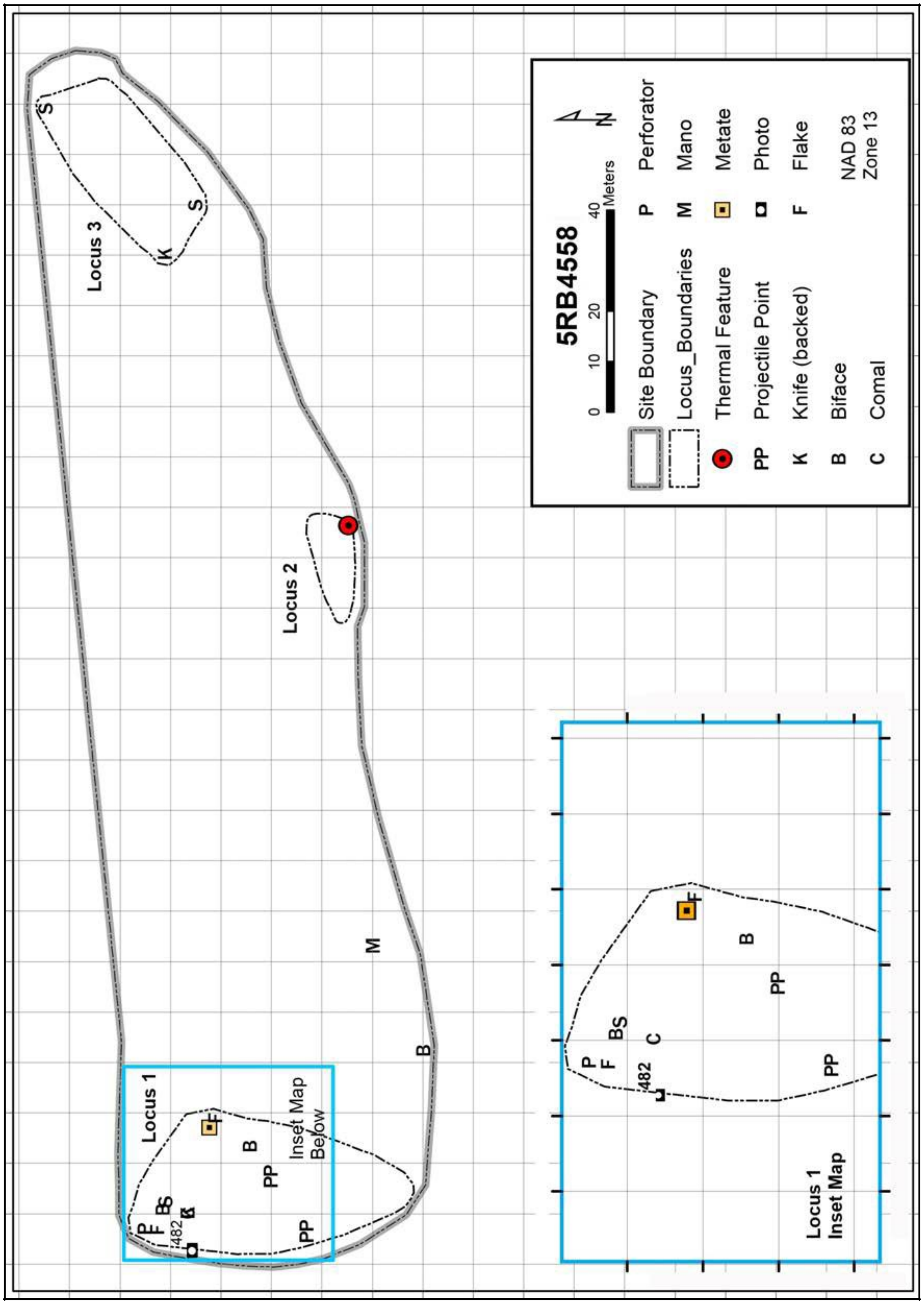

Figure 8.1. Map showing distribution of collected artifacts from 5RB4558.

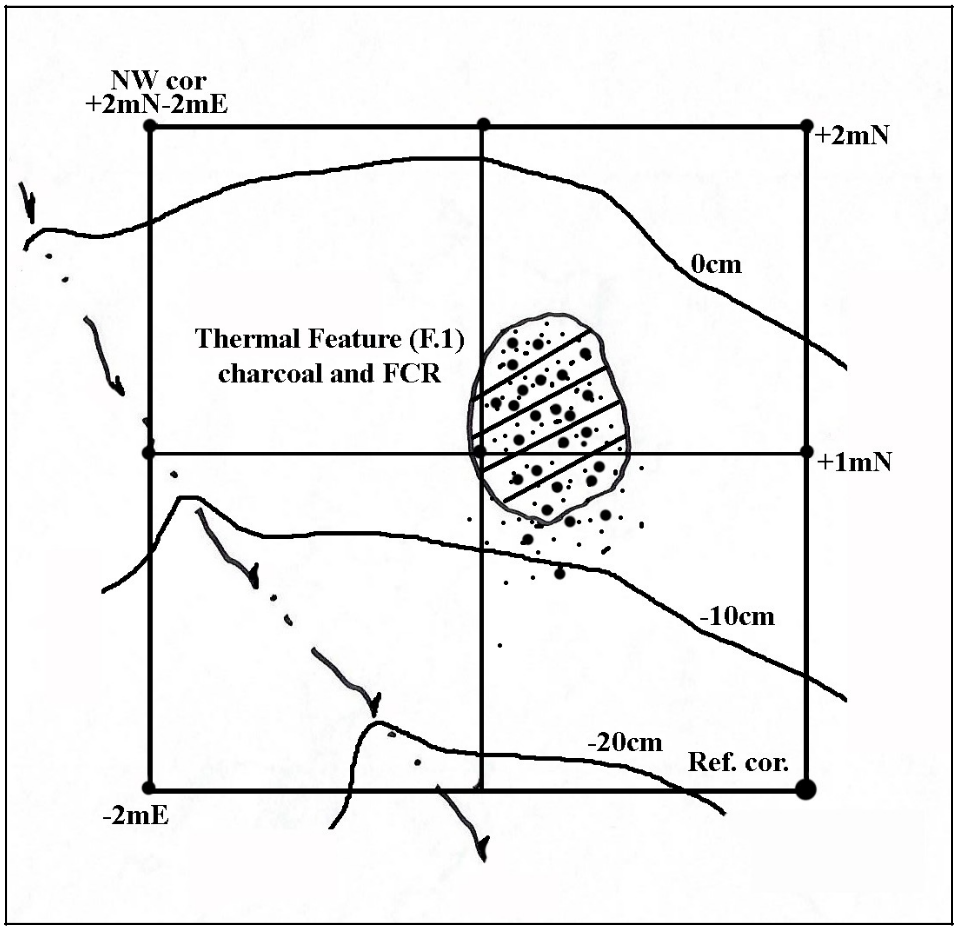

Figure 8.2. Test Unit (2m x 2m) relative to Feature 1, 5RB4558. Illustration shows approximate size of the thermal feature that contained ash, wood charcoal, and fire-cracked rock. Surface soils were sandy-silty and covered a bedrock base of clayey deposits of the Wasatch Formation.

As part of the testing procedure for TU#5, brushing away the silty, sandy soil in and around the ashstain revealed a small thermal feature about 30cm in diameter. It was noted that an informal collar of clay was present around most of the hearth that was the remains of the shallow diggings to form the feature. It was clear this small hearth was constructed when the surface clayey soil was wet, and the possibility was presented for other features to be preserved in the clayey soil under the thin surface layer. Soon after the shallow thermal feature was identified, samples were collected that included carbon (for AMS radiocarbon dating), macro-botanical (flotation for seed collection and identification), and pollen (for processing and identification). Then, as prescribed in the research design, a 2x2-meter grid was laid out to include the thermal feature (5RB8902 Feat. 2), and surface clearing ensued. After clearing the grid units on the north side of the hearth, a deer track was observed near the center pin. Additional brushing, exposed apparent human tracks and an impression of where a person was seated within a structure (Plates 8.1 and 8.2).

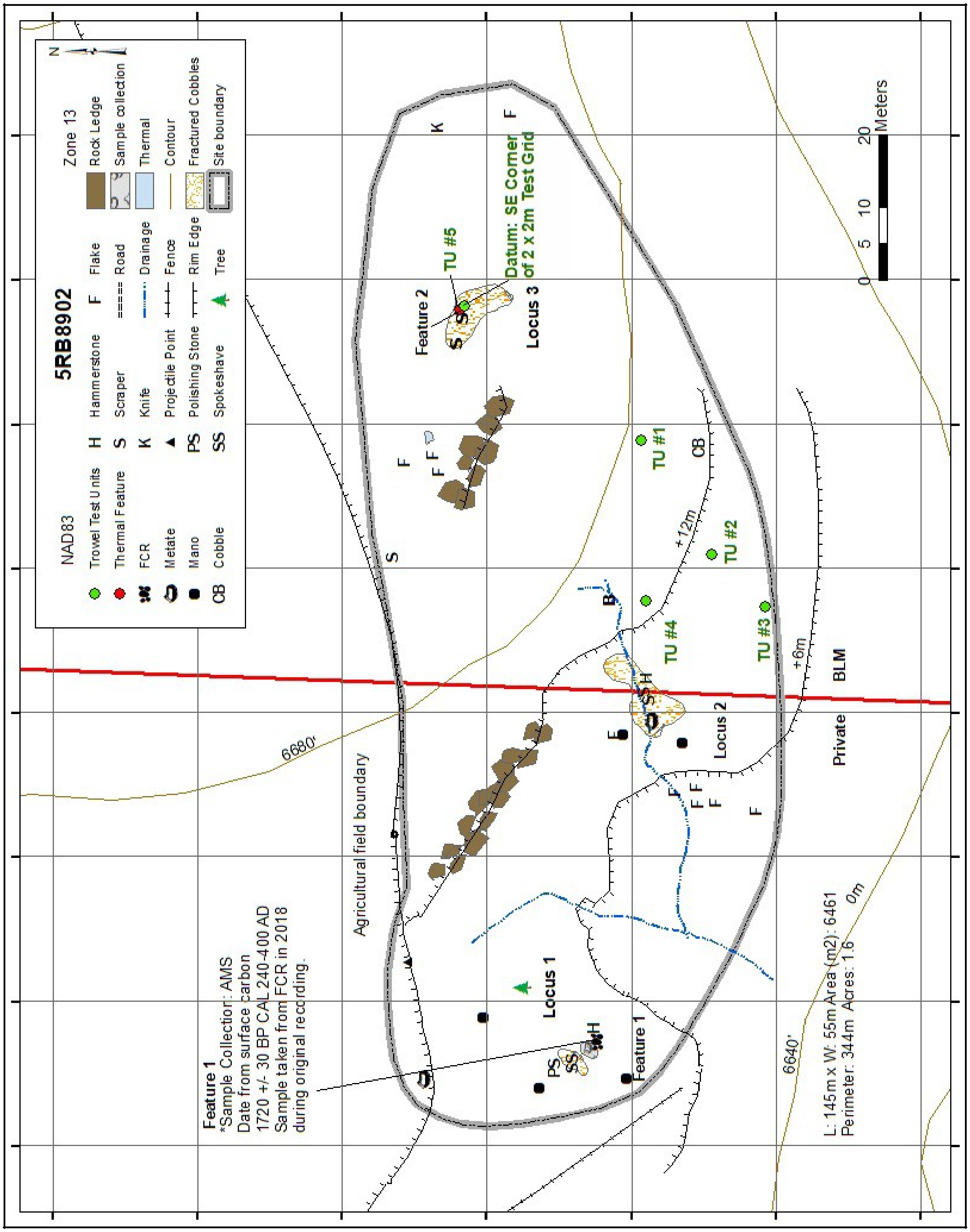

Figure 8.3. Map showing distribution of test units and location of 2mx2m datum at 5RB8902.

Photos were taken of the tracks (human and deer) and suspected seat impression on the floor of the structure (Plate 8.1 and 8.2). (Additional photos are provided in the Appendix B Photo Gallery of the Conical Pole Lodge.)

Plate 8.1. Floor of lodge, with thermal feature outline below yellow tape, deer track at west end of tape, relatively obvious moccasin tracks west of hearth (not so obvious ones throughout), and on the west side is a circular depression that apparently represents a seat position of the inhabitant and a flattened area to the north that may be a sleep position. Yellow tape is 1-meter, trowel position indicates north.

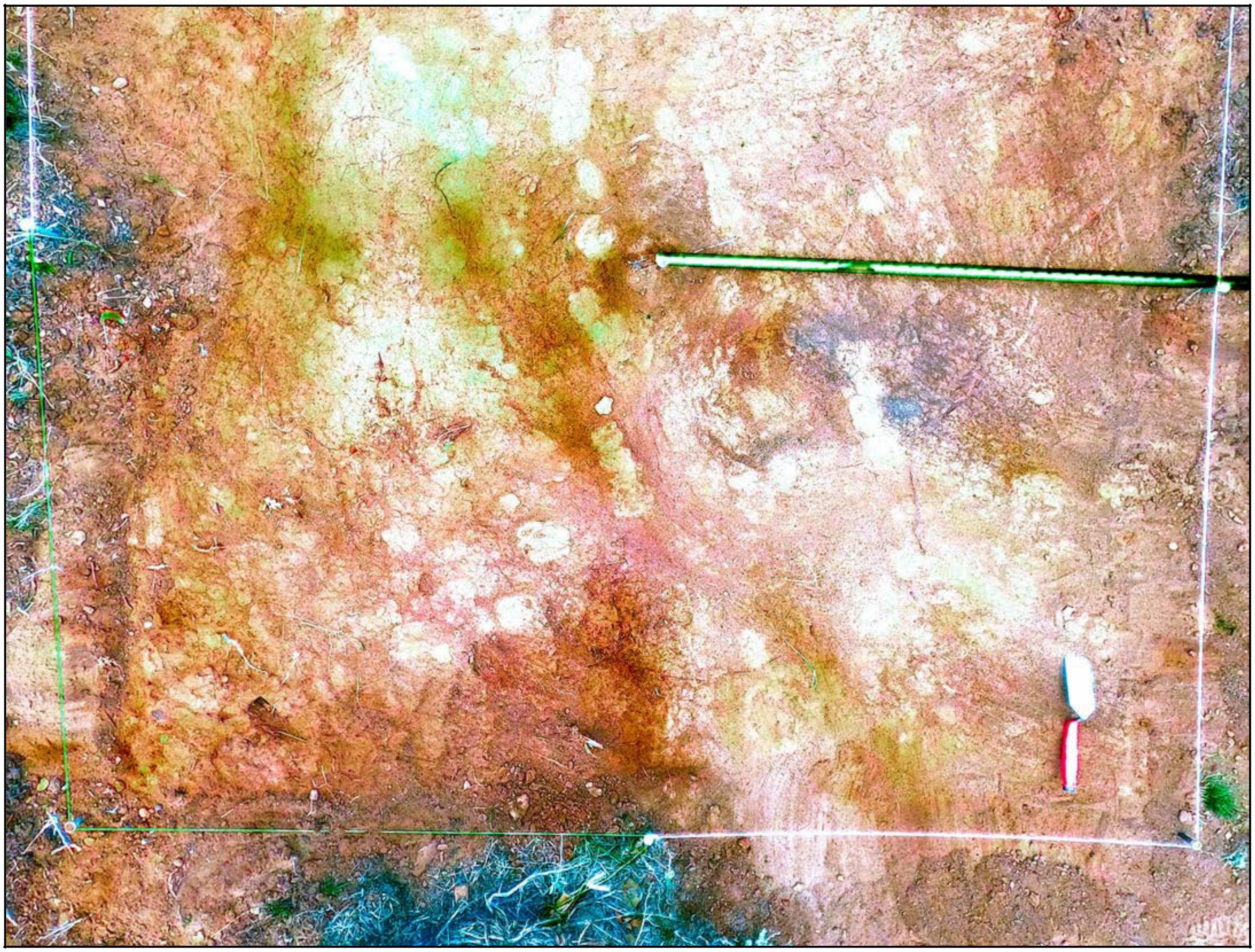

Plate 8.2. D-Stretch enhanced photograph of the lodge floor. Thermal feature outline below yellow tape (ash stain to the right of feature may represent a clean-out effort), deer track at west end of tape, relatively obvious moccasin tracks west of hearth (not so obvious ones throughout), and on the west side is a circular depression that apparently represents a seat position of the inhabitant and a flattened area to the north that may be a sleep position. Yellow tape is 1-meter, trowel position indicates north.

Next, in the northeast corner of the 2x2-meter grid, a post impression was found and the search for additional ones ensued. As a result, three were discovered within the 2x2-meter grid and a fourth along its west edge. The feature excavation was then expanded about 30cm to the west, north and south of the grid in hopes of finding additional post impressions, which proved to be the case (Figure 8.4). Three more were identified, which brought the total to eight. Figure 8.4 provides a schematic of the pole distribution and Plate 8.3 is an enhanced view of the lodge, view southeast (out the doorway).

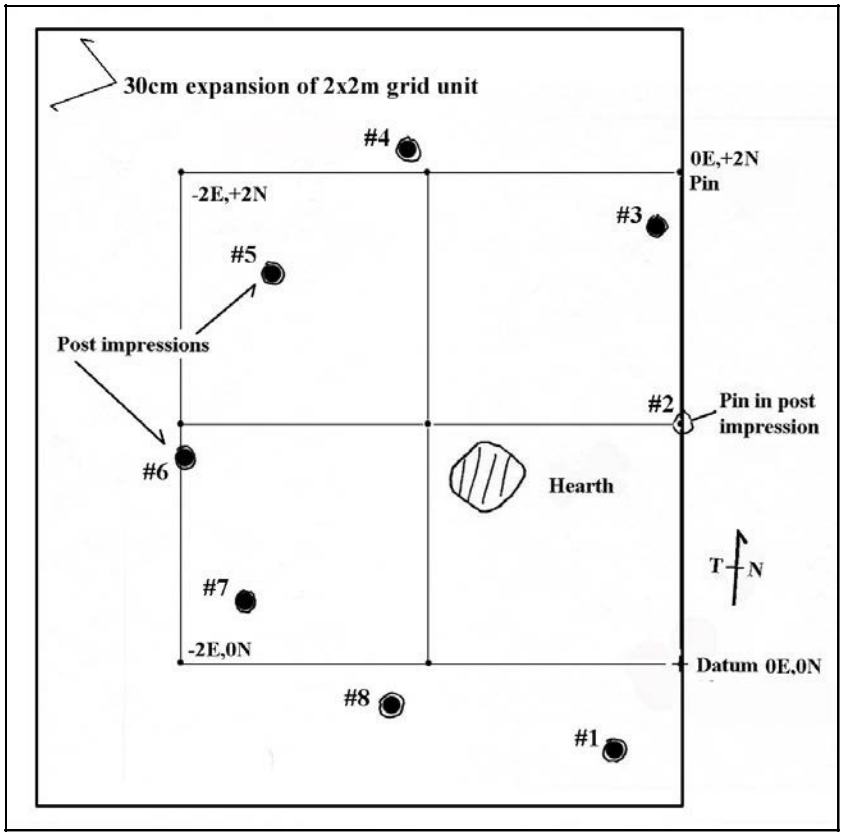

Figure 8.4. Post impressions recorded at 5RB8902 indicating a roughly 2m radius for a conical pole structure (F.3) in relation to central hearth location (F.2).

Plate 8.3. Enhanced photo showing hardened clayey surface of the lodge floor. View is southeast, center yellow tape points north. Flags are placed near post impressions.

The post impressions were photographed and the photos subjected to D-Stretch enhancements. The following Plates (8.4 - 8.11) provide close-up views of the impressions as numbered in Figure 8.4.

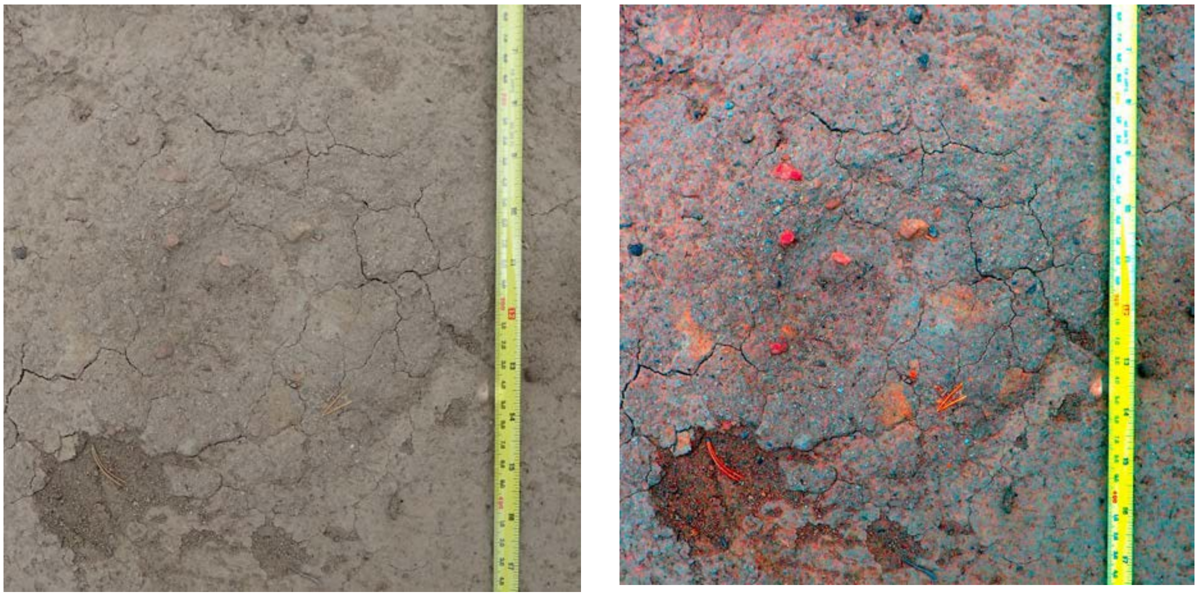

Plate 8.4. Post impression #1 and enhancement using D-Stretch.

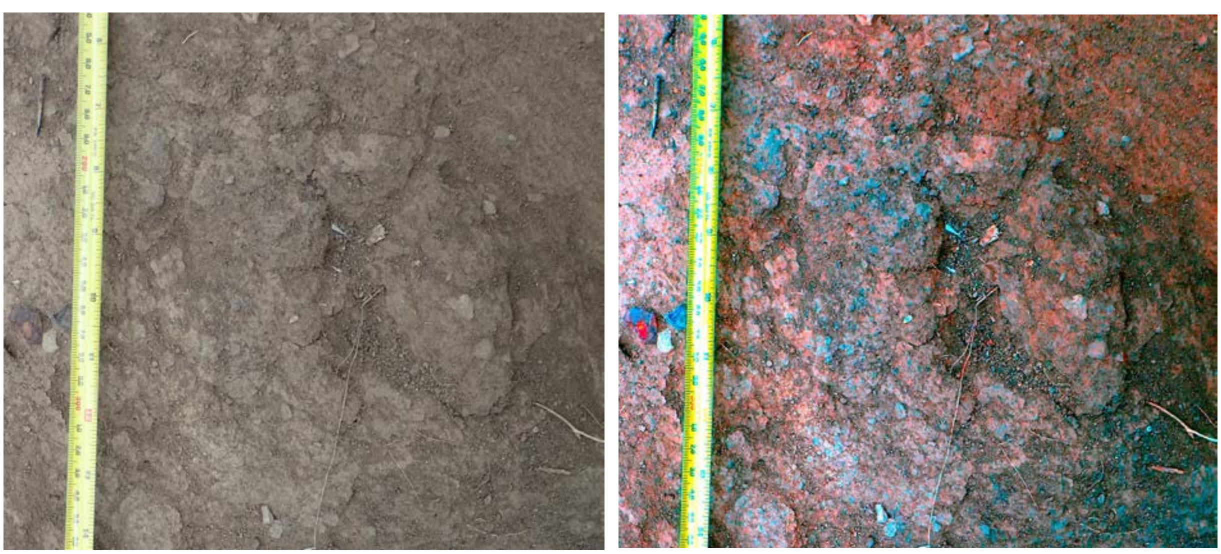

Plate 8.5. Post impression #2 and enhancement using D-Stretch.

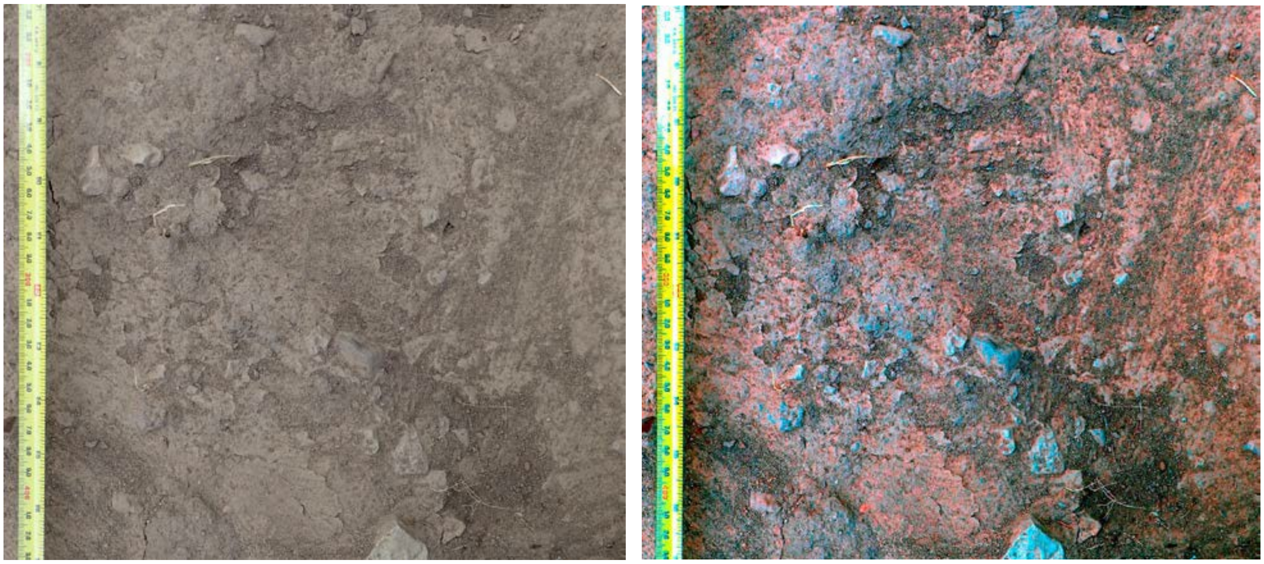

Plate 8.6. Post impression #3 and enhancement using D-Stretch.

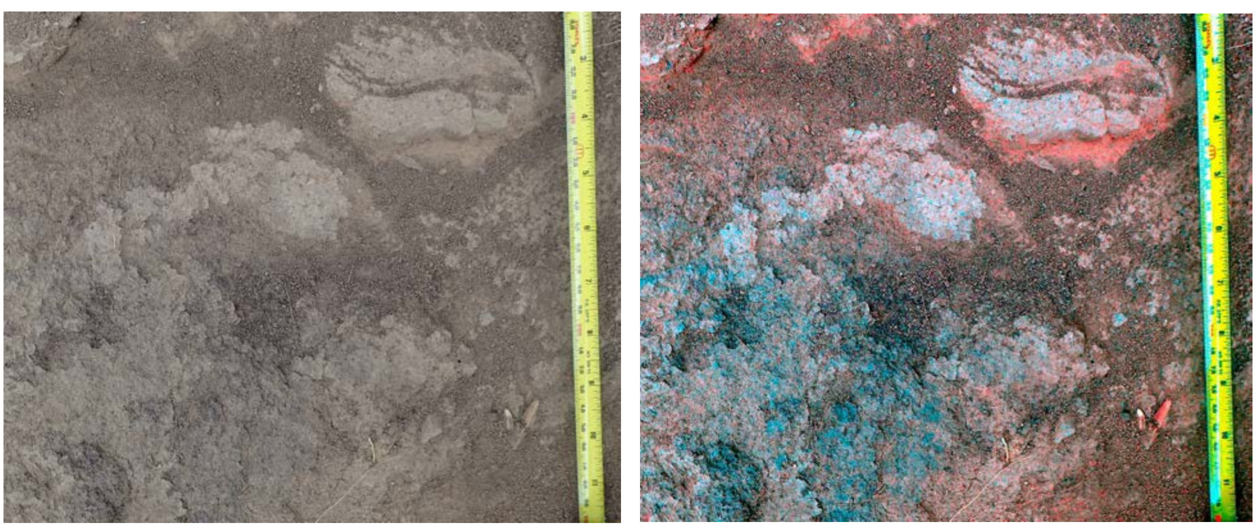

Plate 8.7. Post impression #4 and enhancement using D-Stretch.

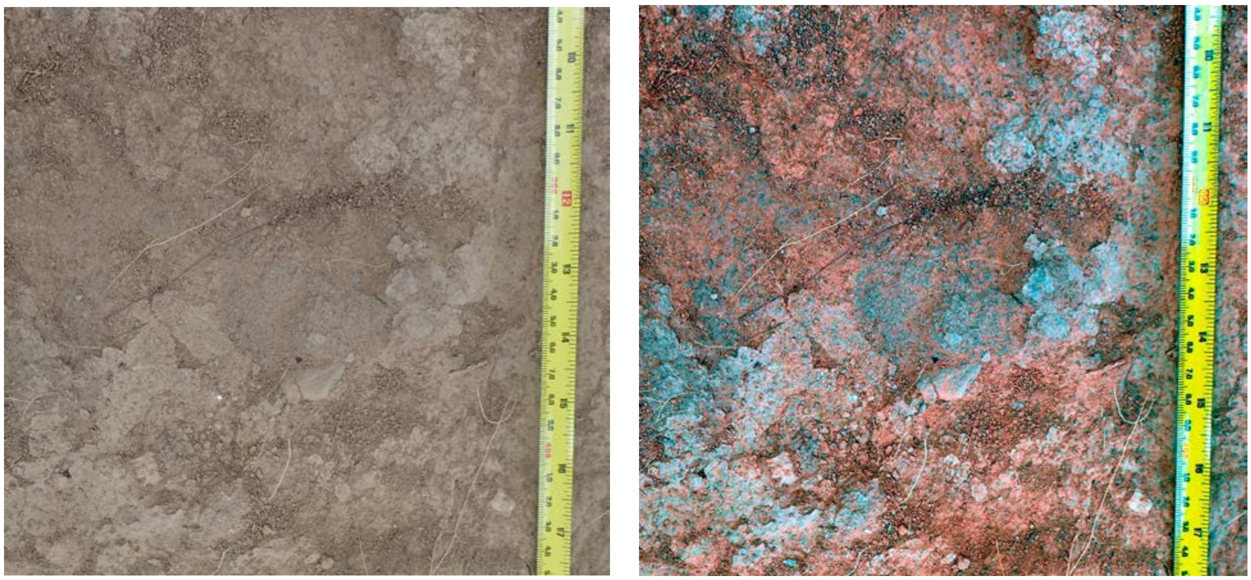

Plate 8.8. Post impression #5 and enhancement using D-Stretch.

Plate 8.9. Post impression #6 and enhancement using D-Stretch.

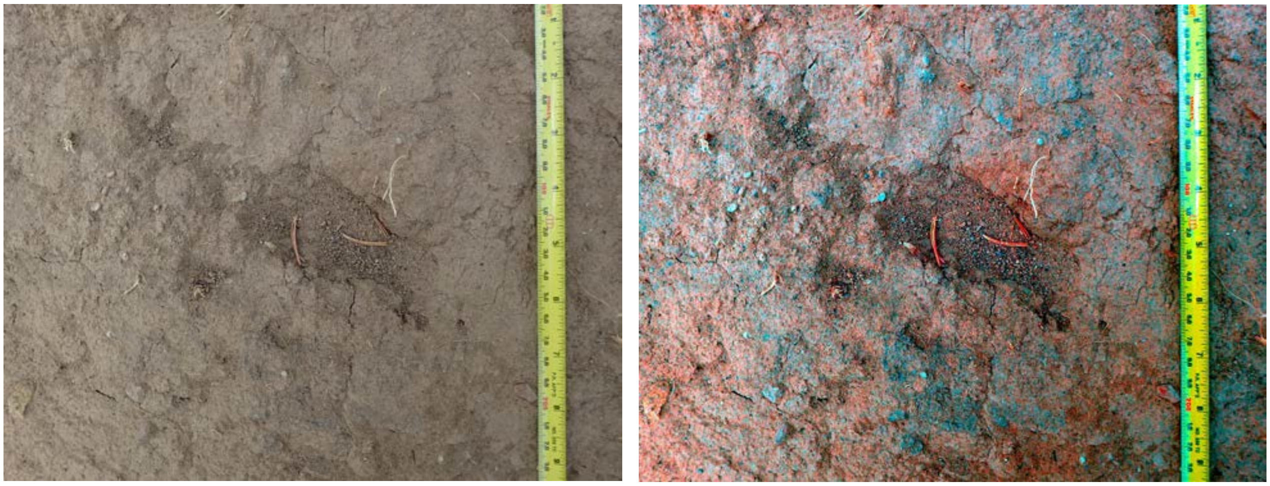

Plate 8.10. Post impression #7 and enhancement using D-Stretch.

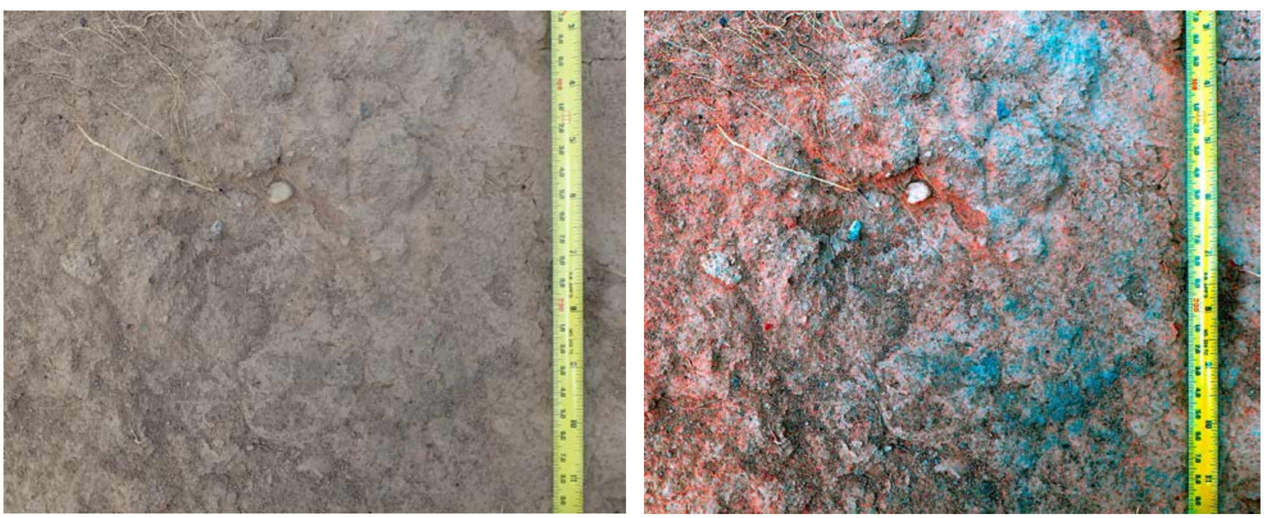

Plate 8.11. Post impression #8 and enhancement using D-Stretch.

Profiles were drawn for the lodge floor illustrating two angles of slope: from the northwest to the southeast (Figure 8.5), and from west to east (Figure 8.6). Also, a contour map was made of the near area of excavation showing the selection of the location of the lodge in relation to the low ridge on its northwest (Figure 8.7).

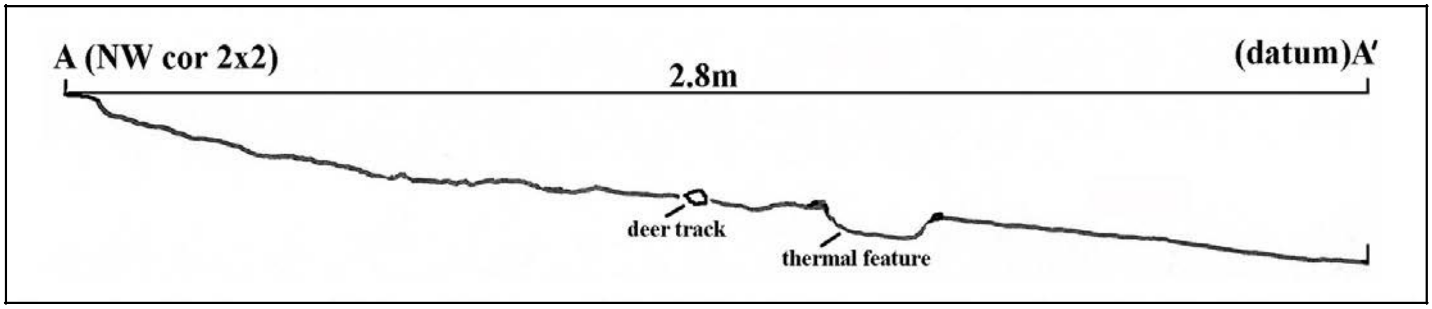

Figure 8.5. Profile A-A': NW corner of 2mx2m grid to Datum (SE Corner).

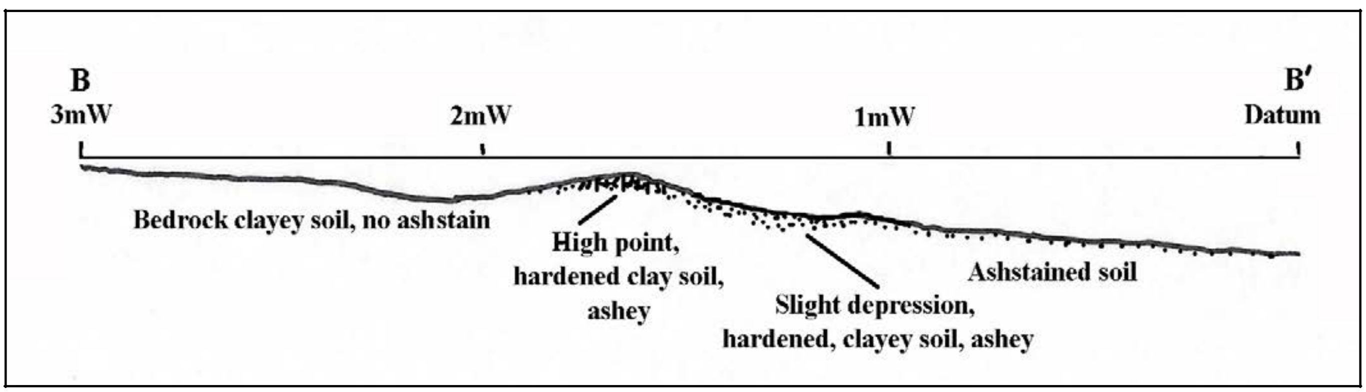

Figure 8.6. Profile B-B': Grid baseline from Datum to point 3m west (along UTM grid).

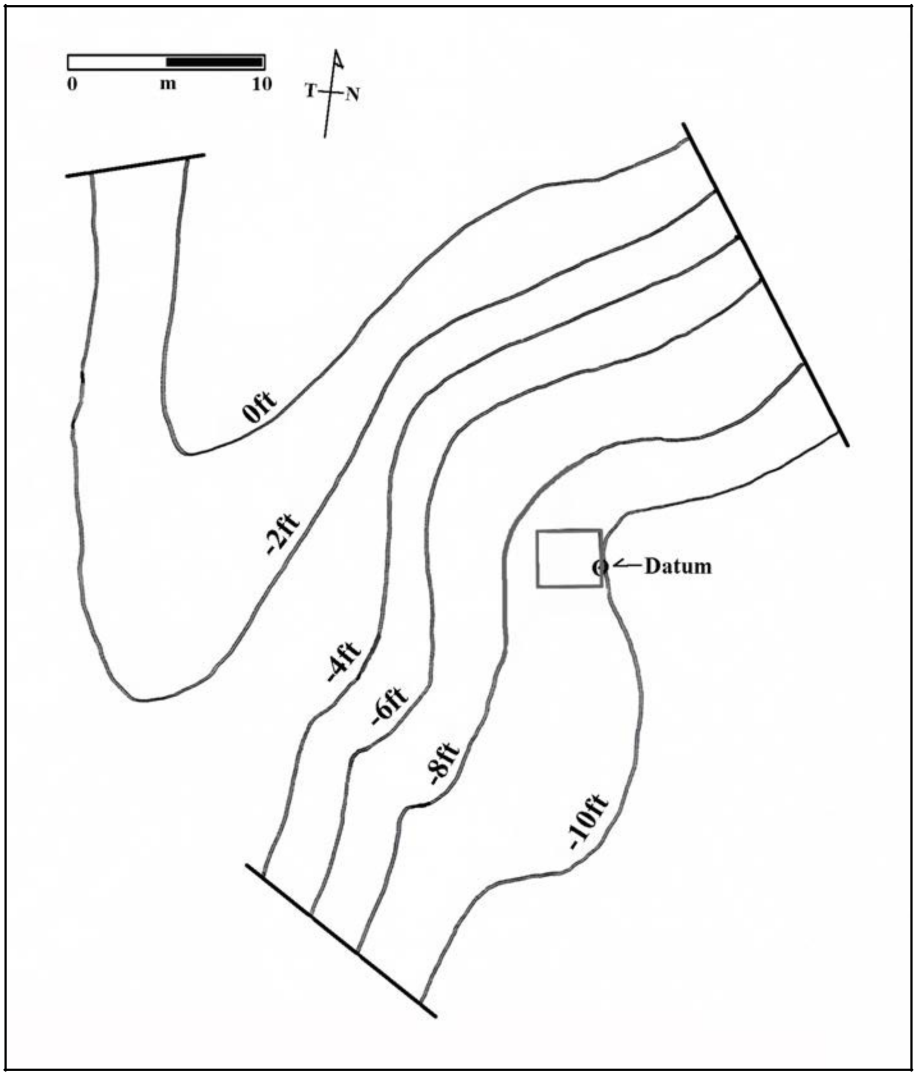

Figure 8.7. Contour map relative to the location of conical lodge (Feature 3) excavation at 5RB8902. Notably, placement of the lodge in relation to the low ridge was likely for protection from wind, orientation to the morning sun, and provision for drainage on its east side.

9.0 ANCILLARY SPECIMEN ANALYSES

Ancillary samples were recovered for analysis to determine cultural/temporal affiliation, subsistence, and paleo-environmental conditions. To those ends, radiocarbon, pollen and macrobotanical samples were recovered from 5RB4558 Feature 1 and 5RB8902 Feature 2 (thermal feature in Feature 3, conical wood-post structure). As well, a sample of fire-cracked rock was collected from the former for organic compound residue analysis (Feature 2 had no fire-cracked rock). Radiocarbon samples were submitted to International Chemical Analysis (ICA) of Miami, Florida for processing. Pollen and organic residue samples were submitted to PaleoResearch Institute of Golden, Colorado. Finally, macrobotanical samples were assessed by Courtney Groff, geoarchaeologist and botanical specimen analyst of Meeker, Colorado.

9.1 RADIOCARBON

Radiocarbon samples from the two sites were dated using AMS (Accelerator mass spectrometry). It is a form of mass spectrometry used by archaeologists to determine the concentration of ^{14}C in a carbon sample. It outperforms other techniques of dating because of the small size of the sample required to produce a date.

The three samples submitted to ICA from the two sites were sufficient to yield dates with low standard deviations (Appendix C). The *Calib Radiocarbon Calibration Program* (Copyright 1986-2017 Stuiver and Reimer 1993) was used to calibrate the approximate AD/BC dates (calibrated calendar ages) of the "before present (BP)" radiocarbon age derived from the analyses (see, Stuiver and Reimer1993). The updated 1993 program (revision 3.0) was used for such, which incorporates refinements and a new calibration data set covering about 22,000 calibrated years (about 18,400 ^{14}C years). The new data, and corrections to the previous data set, were developed over a 6-yr (1986–1992) time-scale calibration effort of several laboratories (Reimer et al. 2013). The results of the ICA analyses are:

5RB4558, Sample from Feature 1
ICA Lab code: 20C/0574
Description: Charcoal from pinyon or juniper wood
Radiocarbon Age : 1750±30 BP
Calibration data set: intcal13.14c (Reimer et al. 2013)
One Sigma Ranges: [start -end] relative area
[cal AD 245: cal AD 265] 0.23459
[cal AD 271: cal AD 331] 0.76541
Two Sigma Range: [start - end] relative area
[cal AD 224: cal AD 384] 1.0

5RB8902, Sample from Feature 1
ICA Lab code: 18C/0628
Description: Surface float of wood charcoal
Radiocarbon Age 1720±30 BP
Calibration data set: intcal13.14c (Reimer et al. 2013)
One Sigma Ranges: [start - end] relative area
[cal AD 258: cal AD 284] 0.329189
[cal AD 290: cal AD 295] 0.056888
[cal AD 321: cal AD 358] 0.421226
[cal AD 363: cal AD 381] 0.192696
Two Sigma Range: [start - end] relative area
[cal AD 248: cal AD 391] 1.0

5RB8902, Sample from Feature 2
ICA Lab code: 20C/0575
Description: Charcoal from sagebrush
Radiocarbon Age 1730±30 BP

Calibration data set: intcal13.14c (Reimer et al. 2013)
One Sigma Ranges: [start - end] relative area
[cal AD 253: cal AD 303] 0.582729
[cal AD 314: cal AD 346] 0.372614
[cal AD 371: cal AD 376] 0.044657
Two Sigma Range: [start - end] relative area
[cal AD 243: cal AD 386] 1.0

These three dates were statistically tested and found to be the same within 95% certainty. A modeled average of the three dates utilizing the *Calib* program results in:

One sigma ranges of: [start - end] relative area
[cal AD 294: cal AD 294] 0.009001
[cal AD 314: cal AD 385] 0.990999 [mean 349.5]
Two Sigma Range: [start - end] relative area
[cal AD 266: cal AD 391] 1.0 [mean 328.5].

The samples were from charcoal which, of course, introduces the possibility of old wood use or built-in bias, both of which may yield dates older than the actual behavioral event. The fact that three dates were derived from small features at 5RB4558 and 5RB8902 (and sagebrush was used for fuel in Feat. 2 of 5RB8902) provides a reasonable demurrer that large pieces of old wood were burned in the fires. A comparable site, but from the Early Numic period, is 5ME16097 that was excavated as part of the Collbran Pipeline Project (Conner et al. 2014). It contained evidence of an apparent surface structure represented by a 4m diameter area cleared of rocks that was considered to contain the floor of a possible conical lodge. Within the cleared area was a small hearth feature and a cluster of boiling stones (characteristics very similar to that of 5RB4558 and 5RB8902).

At 5ME16097, cultural affiliation and age were derived from radiometric analysis of a sample from the small internal thermal feature and a comparative analysis of the recovered diagnostic artifacts. A radiometric date of 370±40 BP (Cal BP 470 and Cal AD 1480; Beta-248418) was produced by the feature. Ceramic sherds and two projectile point fragments – a Cottonwood Triangular and a Desert Side-notched – corroborated the interpretation of what appears to have been a single component occupation. Although the ^{14}C date and collected diagnostics apparently provided a likely and reliable estimate of the time of occupation of 5ME16097, the date could have been questioned based on the potential for an "old wood problem," which has important ramifications for dating Numic sites and carbon from other small thermal features. To that end, an additional dating method was tapped for comparison. A thermoluminescence sample composed of an Uncompahgre Brown Ware sherd and its associated soil were collected and sent to the Luminescence Dating Laboratory (University of Washington, Seattle). It produced an uncorrected TL-OSL date of AD 1460±60 – comparative to that of the ^{14}C date, and one that essentially negated the "old wood problem" from the determination of the period of occupation of the site. That problem simply does not apply (or is negligible) when considering fuels like sagebrush or small branches of wood are used.

9.2 POLLEN [From report by Linda Scott Cummings, assisted by R. A. Varney, Paleoresearch, Inc.; Appendix D]

Sites 5RB4558 and 5RB8902 are both open campsites located approximately a mile apart on the south side of a ridge that slopes gently to the west. Radiocarbon ages were returned as 1750±30 BP for Feature 1, 5RB4558 and 1730±30 BP for Feature 2, 5RB8902. Feature fill samples were collected from one feature at each site and submitted for pollen analysis. In addition, fire-cracked rock from Feature 1 at 5RB4558 was submitted for organic residue analysis to identify a signature that might identify cooking foods.

9.2.1 Methods

Sediments often present unique challenges for pollen preservation and recovery, meaning that larger samples are required for land sediments than for pollen recovery from lake sediments or peat bogs. A chemical extraction technique based on flotation is the standard preparation technique used in this laboratory for recovering pollen grains from sediments. This particular process was developed for extracting pollen from soils where the ratio of pollen to inorganic material is relatively low. It is important to recognize that it is not the repetition of specific and individual steps in the laboratory, but rather mastery of the concepts of extraction and how the desired result is best achieved, given different sediment matrices, that results in successful recovery of pollen for analysis.

Hydrochloric acid (10%) was used to remove calcium carbonates present in the sediment samples, after which, they were screened through 250-micron mesh. Multiple water rinses were utilized until neutral employ Stoke=s Law for settling time. A small quantity of sodium hexametaphosphate was used to suspend clay-sized particles prior to additional rinsing using Stoke=s Law. This process was repeated with ethylenediaminetetraacetic acid (EDTA), which removes clay, soluble organics, and iron. Finally, the samples were freeze-dried under vacuum.

Once dry, the samples were mixed with sodium polytungstate (SPT), at a density of 1.8 g/ml, and centrifuged to separate the organic material including pollen and starch, which floats, from the inorganic remains and silica, which do not float. The light fraction was recovered and the process was repeated, as many times as necessary. This pollen-rich organic fraction was rinsed, then all samples received a short (25 minute) treatment in hot hydrofluoric acid to remove remaining inorganic particles. The samples were acetylated twice for 10 minutes each time to remove extraneous organic matter. The samples were rinsed with RODI water to neutral. Following this, a few drops of potassium hydroxide (KOH) were added to each sample, which was then stained lightly with safranin. Due to the presence of large quantities of minute organic debris, the samples were centrifuged at high speeds for short intervals to remove this debris for better viewing.

A light microscope was used to count pollen at a magnification of 500x. Pollen preservation in these samples varied from good to poor. An extensive comparative reference housed at PaleoResearch Institute aided pollen identification to the family, genus, and species level, where possible.

Pollen aggregates were recorded during pollen identification. Aggregates are clumps of a single type of pollen and may be interpreted to represent either pollen dispersal over short distances or the introduction of portions of the plant represented into an archaeological setting. The aggregates were included in the pollen counts as single grains, as is customary. An AA@ next to the pollen frequency on the percentage pollen diagram notes the presence of aggregates. The percentage pollen diagram was produced using Tilia Version 2.1.1. Total pollen concentrations were calculated in Tilia using the quantity of sample processed in cubic centimeters (cc), the quantity of exotics (spores) added to the sample, the quantity of exotics counted, and the total pollen counted and expressed as pollen per cc of sediment.

The microscopic charcoal frequency registers the relationship between pollen and charcoal. The total number of microscopic charcoal fragments was divided by the pollen sum, resulting in a charcoal frequency that reflects the quantity of microscopic charcoal fragments observed, normalized per 100 pollen grains.

Pollen analysis also included observing and recording starch granules and, if they were present, their assignment to general categories. We did not, however, search for starches outside the pollen count. An additional search for starches is performed only when starch analysis is part of the suite of analyses performed. Starch granules are a plant's mechanism for storing carbohydrates. Starches are found in numerous seeds, as well as in starchy roots and tubers. The primary categories of starches include the following: with or without visible hila, hilum centric or eccentric, hila patterns (dot, cracked, elongated), and shape of starch (angular, spherical, etc.), others are more common and tend to occur in many different types of plants.

9.2.2 Pollen Summary and Discussion

Sites 5RB4558 and 5RB8902 are located near an unnamed intermittent drainage that flows into Strawberry Creek, another intermittent drainage that flows west into Sulphur Creek. Sulphur Creek is the closest permanent water source. Local vegetation includes a sparse pinyon juniper forest, mountain mahogany, and an understory of short bunch grasses. A moccasin print was observed at one of these sites. Nearly identical radiocarbon dates were obtained for Feature 1 at 5RM4558 (1750±30 BP) and Feature 2 at 5RB8902 (1730±30 BP). Both pollen and organic residue (FTIR) analyses were conducted on Feature 1, 5RB4558, while only pollen analysis was requested for Feature 2 at 5RB8902.

The pollen record is dominated by Pinus pollen (Figure 9.1, Table 9.1), representing pine trees, in both samples. Sample 1, representing Feature 1 at 5R4558, also contained a large quantity of Juniperus pollen, suggesting a local vegetation community of mixed pinyon pine and juniper. Sample 2, collected in Feature 2 at 5RB8902, exhibited significantly less

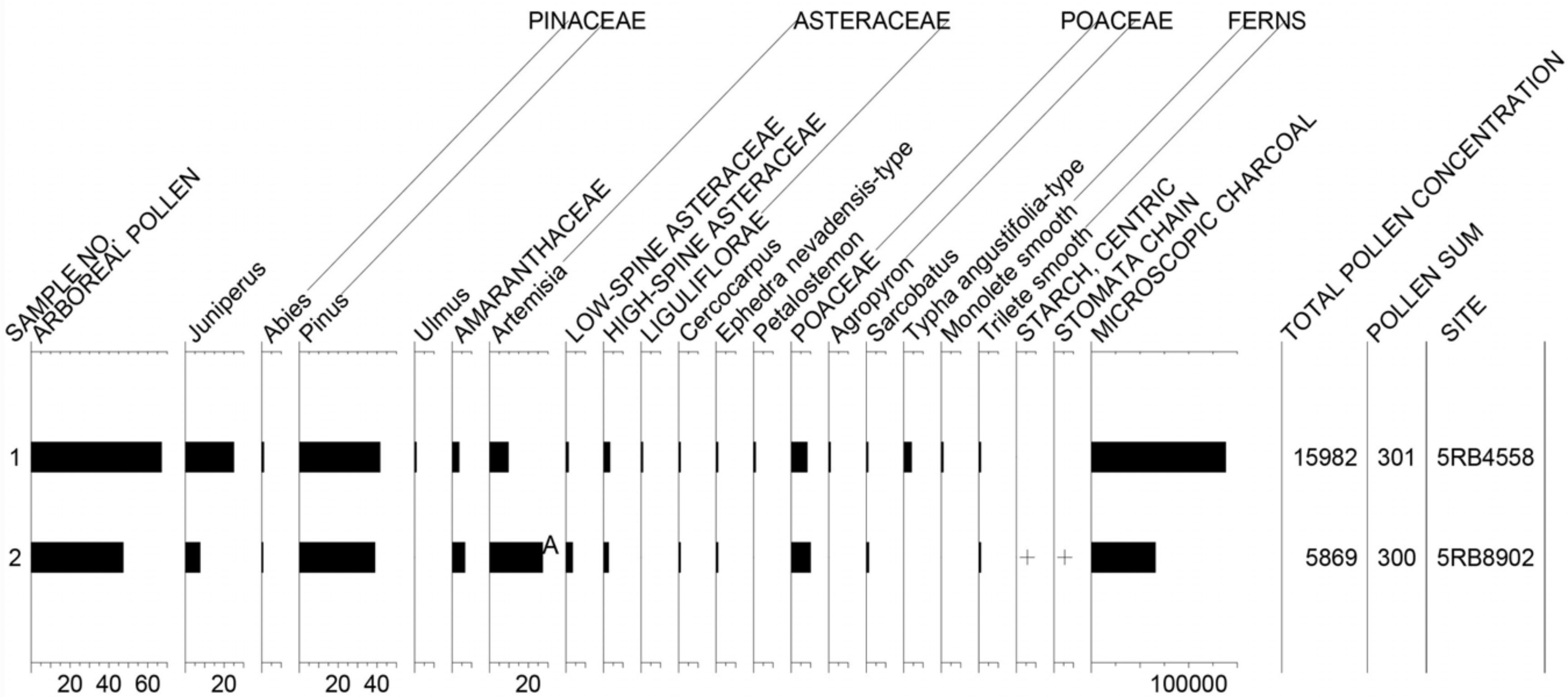

FIGURE 9.1. POLLEN AND STARCH DIAGRAM FOR 5RB4558 AND 5RB8902.

Table 9.1. Pollen Types Observed in Samples from 5RB4558 and 5RB8902.

Scientific Name	Common Name
ARBOREAL POLLEN:	
Juniperus	Juniper
Pinaceae:	Pine family
Abies	Fir
Pinus	Pine
Ulmus	Elm
NON-ARBOREAL POLLEN:	
Amaranthaceae	Amaranth family (now includes Chenopodiaceae, these two families were combined based on genetic testing and the pollen category (Cheno-ams)
Asteraceae:	Sunflower family
Artemisia	Sagebrush
Low-spine	Includes ragweed, cocklebur, sumpweed
High-spine	Includes aster, rabbitbrush, snakeweed, sunflower, etc.
Liguliflorae	Chicory tribe, includes dandelion and chicory
Cercocarpus	Mountain mahogany
Ephedra nevadensis-type (includes E. clokeyi, E. coryi, E. funera, E. viridis, E. californica, E. nevadensis, and E. aspera)	Ephedra, jointfir, Mormon tea
Petalostemon	Prairie clover
Poaceae:	Grass family
Agropyron	Wheatgrass
Sarcobatus	Greasewood
Typha angustifolia-type	Narrowleaf cattail
STARCHES:	
Centric starch	Typical of starches produced by grass seeds, other seeds, and some roots/tubers (usually the developing starch grains)
SPORES:	
Monolete smooth	Fern
Trilete smooth	Fern
OTHER:	
Stomata guard cells	Cells surrounding the stomata (opening) in a plant leaf
Microscopic charcoal	Microscopic charcoal fragments
Total pollen concentration	Quantity of pollen per cubic centimeter (cc) of sediment

Juniperus pollen, suggesting a change in local vegetation across the landscape. Both samples revealed small quantities of *Abies* pollen, representing long distance wind transport of fir pollen from a mountainous community at higher elevation. Only Sample 1 yielded *Ulmus* pollen, reflecting local growth of elm trees, probably in a drainage.

The non-arboreal portion of the pollen record is dominated by *Artemisia* pollen in Sample 2, collected in Feature 2 at 5RB8902. This indicates sagebrush as a dominant member of the local vegetation and appears to define the primary difference in local vegetation between the occupation or use of these two features. Feature 1 was situated in an area where local vegetation included a larger population of juniper and limited amount of sagebrush, perhaps creating a more closed canopy along with the pine. In contrast, Feature 2 lies in an area that appears to have been more open where local vegetation was dominated by sparsely spaced pine trees with a large amount of sagebrush growing in the open areas.

Both samples exhibited small to moderately small quantities of Amaranthaceae, Low-spine *Asteraceae*, High-spine *Asteraceae, Cercocarpus, Ephedra nevadensis*-type, *Poaceae*, and *Sarcobatus* pollen representing plants in the goosefoot family, ragweed or cocklebur and similar plants, plants in the sunflower family that likely included rabbitbrush and/or snakeweed, mountain mahogany, *ephedra*, grasses, and greasewood. Only Feature 1 yielded small quantities of *Liguliflorae, Petalostemon, Agropyron*, and Typha angustifolia-type pollen representing plants in the chicory tribe of the sunflower family, prairie clover, western wheatgrass, and cattail. The moderate quantity of *Poaceae* pollen observed in both samples indicates that grasses grew in abundance across the landscape. Fern spores were observed in both samples, suggesting local presence of at least a few ferns, probably growing in a drainage. Sample 2, collected in Feature 2, displayed a chain of well-silicified stomata guard cells that survived HF digestion. Stomata are common on the surface of plant leaves and are part of the respiratory system.

Microscopic charcoal was much more abundant in Feature 1 than in Feature 2. Total pollen concentration also was greater in Feature 1, where it was calculated as nearly 16,000 pollen per cubic centimeter (cc) of sediment. Feature 2, on contrast, displayed a total pollen concentration of only slightly more than 5,800 pollen/cc of sediment. Feature 2 also yielded centric starch grains, suggesting processing starch food. This morphology of starch is very generic, occurring not only in grass seeds, but also some other seeds and some roots/tubers.

9.3 ORGANIC COMPOUND ANALYSES – Fourier Transform Infrared Spectroscopy(FTIR) [From report by Linda Scott Cummings, assisted by R. A. Varney, Paleoresearch, Inc.; Appendix D]

9.3.1 Introduction

One sample of fire-cracked rock was obtained from 5RB4558 that was analyzed using Infrared Spectroscopy (IR), a technical method that measures atomic molecule vibrations. It is currently one of the more powerful methods used in organic and analytical chemistry for identification of organic compounds. The infrared spectrum is produced by passing infrared radiation through a sample, whether the sample is from a liquid, paste, powder, film, gas or surface. Measurement of this spectrum is an indication of the fraction of the incident radiation that is absorbed at a particular energy level (Stuart 2004). The spectrum provides information on infrared radiation absorption and the structure of the organic molecules. Analysis of specific regions and peaks in the infrared spectrum enables identification of organic compounds, including both plant and animal fats/lipids, plant waxes, esters, proteins, and carbohydrates.

The Fourier Transform Infrared Spectrometer collects raw data, then, using Fourier transformations, creates the output that we see as a spectrum. Advantages of using this technique over others include the simultaneous measurement of all wavelengths and a relatively high signal-to-noise ratio with a short measurement time. Since molecular structures absorb vibrational frequencies (i.e., wavelengths) of infrared radiation, we can use the bands of absorbency to identify organic compound compositions.

The spectrum is divided into two groups, the functional and the fingerprint regions. These groups are characterized by the effect of infrared radiation on the respective group=s molecules. The functional group region is between 4000 and c. 1500 wave numbers (cm-1), and the fingerprint region is below 1500 cm-1. The molecular bonds display vibrations that we can interpret as characteristic of fats, lipids, waxes, lignins, proteins, amino acids, carbohydrates, and polysaccharides. The portion of the infrared spectrum most useful for this research and in the identification of organic compounds (e.g., carbohydrates, lipids, proteins) is termed the mid-infrared, between 4000 and 400 cm-1 (Isaksson 1999:36-39). Recorded wavelengths of the electromagnetic spectra are what we compare to reference collections housed in the PaleoResearch Institute (hereafter PRI) library. That is, we compare the results from the sample with the reference collection aiming to identify the closest match. For example, lipids, fats, and plant waxes are indicated identifiable between 3000 and 2800 cm-1. This portion of the spectrum can be suggestive of the presence of animal fats, plant oils, oily nuts (e.g., hickory, walnut, or acorn), or plant waxes. Additional peaks representing fats/lipids and allied substances, including esters, are noted in the fingerprint portion of the spectrum.

Samples from archaeological contexts are difficult to analyze because they often contain complex compound mixtures, whether from multiple uses or burial in contexts such as trash mounds. For instance, groundstone tools and ceramic cooking vessels are often multipurpose artifacts used to process (e.g. crush, grind, cook) a variety of foodstuffs, ingredients, and/or medicines. Multipurpose artifacts can yield a spectrum of overlapping absorption bands with few distinctive characteristics.

FTIR has shown itself to be a useful technique for examining organic compounds recovered from fire-cracked rock (FCR) because so few other techniques can be used. Organic compounds often are deposited on rocks during cooking. Fats, lipids, waxes, and other organic molecules may be deposited onto rock surfaces as a result of (a) dropping, (b) oozing from foods being cooked or baked in a pit, or seepage out of or spill over from cooking vessels. Re-use of rocks is possible, in which case the organics recovered from the FCR might represent multiple cooking episodes. The PRI extraction method gently removes these organic molecules from the ground stone, ceramics, and/or rocks so they can be measured with FTIR and subsequently identified. Organic molecules also can be extracted from sediments, then measured, and identified. This is useful in the identification of dark horizons to determine whether they result from the decay of organic matter, whether plant or animal, or are dark because they contain ash. Below is a discussion of the common organic compounds that can be identified in archaeological samples using FTIR.

9.3.2 Methods

A mixture of chloroform and methanol (CHM) was used as the solvent to remove lipids and other organic substances that had soaked into the fire-cracked rocks. The rock was broken, then placed in a glass container with CHM solvent, covered, and allowed to sit for several hours, after which the solvent was poured into a small aluminum evaporation dish, where the solution was allowed to evaporate leaving organic residues behind. To evaporate the entire quantity of CHM, the aluminum dishes are filled repeatedly until all the solution has been evaporated. The aluminum dishes were tilted during evaporation to separate the lighter fraction (lighter molecular weight compounds) from the heavier fraction (heavier molecular weight compounds), leaving the residue of absorbed chemicals in the aluminum dish after the solvent has evaporated. Then the aluminum dish containing the residue was placed residue side down on the FTIR ATR diamond crystal, and the spectra were collected along the upper, middle, and lower bands of residue in each dish. These spectra were merged, creating a single spectrum for analysis.

FTIR is performed using a Bruker Alpha optical bench FTIR with an ATR (attenuated total reflection) accessory and a diamond crystal. The aluminum dish containing the sample residue was placed residue side down approximately on the diamond crystal in the path of a specially encoded infrared beam that passes through the crystal, producing a signal called an "interferogram." The interferogram contains information about the frequencies of infrared light that are absorbed and the strength of the absorptions, reflecting the sample=s chemical make-up. A computer reads the interferogram, uses Fourier transformation to decode the intensity information for each frequency (wave numbers), then presents the data as a spectrum. Lighter and heavier fractions are designated upper (lighter fraction) and lower (heavier fraction), respectively, in the subsequent analysis. These data were saved in an Excel file, then processed using a template to sort the peak numbers by organic compounds (fats/lipids, proteins, carbohydrates, and other) for interpretation and discussion.

9.3.3 Findings

The FTIR analysis yielded low amplitude peaks typical of proteins and amino acids.

Although the highest amplitude peak, at 999 wave numbers (cm-1) is typical of cellulose, it is also part of the complex of numbers for four amino acids. A low amplitude peak suggesting the presence of softwood lignin could indicate use of pine or juniper as fuel in this feature. Given the high amplitude of this peak and the relatively low amplitude of peaks also typical of amino acid, this peak is interpreted to represent cellulose (plant matter), with the possibility that several amino acids contributed to this particular peak. Very low amplitude peaks are noted in the ranges of fats/lipids and saturated esters, but the "rule of three" is never satisfied for esters. This rule states, briefly, that for the peaks to be interpreted as representing saturated (or aromatic) esters, peaks must be observed in three specific ranges. This is not the case in these samples. The FTIR signature for this rock is interpreted as containing cellulose from deteriorating plant matter and a variety of amino acids suggesting cooking lean meat.

9.3.4 Summary and Conclusions for Pollen and FTIR Analyses

Pollen analysis of two samples, representing Features 1 and 2 at sites 5RB4558 and 5RB8902, respectively, suggests these two features were situated in slightly different vegetation zones. Local vegetation appears substantially different during use of these two features, with juniper being more common on the landscape near Feature 1 and sagebrush being more common near Feature 2. Starches recovered in the Feature 2 sample suggest processing seeds or roots/tubers. The FTIR signature suggests cooking lean meat in Feature 1.

9.4 Macrobotanical Analyses

Macrobotanical samples were processed in house and analyzed by Courtney Groff. Sample 5RB4558 consisted almost entirely of burnt constituents. Juniper samples are by far the most prevalent and include adult and juvenile leaves, immature male cones, and female seed cones. It appears that juniper was the main fuel source for this sample. A few (<15) seed specimens from the genus *Chenopodium* (Goosefoot) were recovered from the sample, and exhibit signs of charring. Possible seeds of the genus *Asclepias* (Milkweed) (<10 specimens) were recovered, although none exhibit any evidence of charring and therefore were likely deposited after the use of the thermal feature.

Sample 5RB8902 contained mostly *Artemisia tridentada* (Big Sagebrush) components such as leaves, flowers, and woody parts. The majority of the sagebrush specimens are unburnt; however, some of the charred fuels recovered from the sample appear to be burnt specimens of sagebrush woody parts, and it appears that this may be the main fuel source from this sample. Other specimens recovered from the sample are from the genus *Juniperus* (juniper) and include adult and juvenile leaves and immature male cones. Identifiable juniper specimens were unburnt, or only possibly slightly charred. Samples of what appear to be very small fruticose lichens were recovered as well as many specimens of the same herbaceous seedling. Neither the lichens or the seedlings exhibit evidence of charring and are assumed to be a recent intrusive into the feature.

10.0 ARTIFACT ASSEMBLAGE

Based on the radiocarbon data and the distribution of tool types, the two sites appear to be single component manifestations, and therefore, the artifacts that are contained within each apparently belong to a single culture. This section discusses the various lithic tools and ground stone artifacts that were recorded both during the inventory's original site recordings and the collected artifacts that were part of the data recovery proceedings. Appendix E has a list of the collected artifacts along with the OAHP revisit forms.

10.1 Lithic Artifacts

The lithic artifacts at the sites included projectile points, knives, scrapers, and small wood- or bone-working tools that were all made from chert materials. Cobble manos of quartzitic and granitic materials were recorded as were "portable" metates of sandstone. Also, cobbles of a relatively small size that exhibited heating scars or discolorations were classified as boiling stones.

10.1.1 Temporally Diagnostic Projectile Points

Two projectile points were recovered from 5RB4558 (Plate 10.1). They were found to match points collected from the Wardell Site (48SU301) that were classified as Avonlea types (Frison 1991: 215, Figure 3.43). A Besant-like point (but much smaller) with wide side-notches and a relatively thick cross-section was collected as .s1 (left Plate 10.1). An Avonlea type point that may have topped an arrow is shown in Plate 10.1, right (.s2). It is much thinner and lighter than that on the left, and may have been used with a bow and arrow. Frison comments that the thinner points were possibly less effective to kill bison because they were less likely to penetrate between the ribs like the heavier atlatl darts and thrusting spear points (ibid.:216). One projectile point mid-section was present at 5RB8902, but could not be relocated during the data retrieval phase. The dimensions of that point mid-section indicate it is of the size and outline that would fit the scale of points shown in Plate 10.1.

Plate 10.1. Projectiles recovered from 5RB4558: Left (.s1); Right (.s2).

10.1.2 Bifaces

Three bifaces were collected from surface contexts at 5RB4558 (Plate 10.2). They represent a variety of types and potential uses. Specimen "a" has a white patina that develops on white chert after a long period of time. It is small and slightly reworked along the base, and was likely hafted for use. Specimen "b" is large, probably close to 10cm when complete. The thinning along the bottom, residual lump at mid-section, and the notch on the right lateral (Plate 10.2) suggests that it was also hafted. Use-wear appears on both lateral edges above the midsection. Those characteristics indicate it was likely a butchering tool with the knife edge used to cross-cut ligaments and strip muscles and tissue from bones. Notably, this artifact was made from a cobble as indicated by the remaining primary surface visible on lower left lateral edge. Specimen "c" is a fragment of what may have been a large leaf-shaped biface. It exhibits use-wear along a single edge that has step-fractures indicating it was used in cutting along a hard surface such as bone. A similar sized and style of biface was recovered from the Ruby site, 48CA302 (Frison 1971:84; Fig.5).

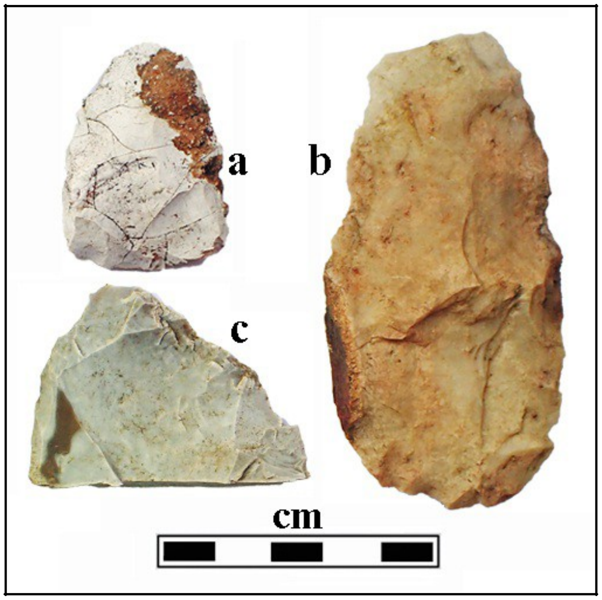

Plate 10.2. Bifaces recovered from 5RB4558: a) .s3; b) .s4; c) .s5.

10.1.3 Unifaces

Tool manufacturing was not a primary activity as only a few flakes were recorded at each site and most appeared to be utilized as expedient tools. As tools made from flakes, they can be characterized as unifacial. Few exhibited flaking on the dorsal sides that were other than those made from core reduction. Small perforating protrusions were notable and were apparently intentionally constructed. Examples of recognizable flake tools collected from 5RB4558 are shown in Plate 10.3. As expedient tools, they were not expected to last long. Specimen .s8 (a) was used as a scraper until the distal end broke. Specimen .s7 (b), a primary flake from a cobble, has less curvature and exhibits use as a cutting tool before it snapped midway. Specimen .s9 is a large flake of petrified wood that functioned as a "backed" knife.

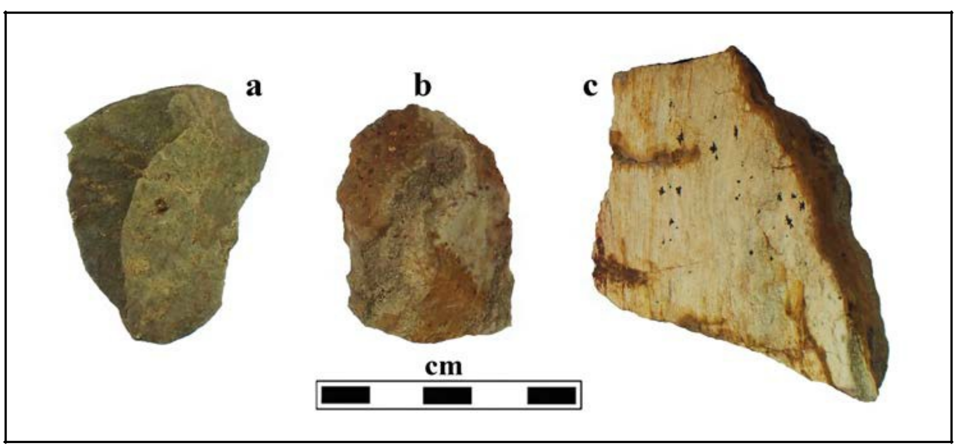

Plate 10.3. Flake tools collected from 5RB4558: a) scraper with broken end, b) base of a small knife broken midway, and c) large, natural flake of petrified wood exhibiting use-wear along one edge.

Two examples of small tools made from primary flakes taken from cobbles were recorded at 5RB8902 that were slightly worked to form sharp edges and burin features. Recorded in L2 they exhibit a burin tip (a) and a chisel edge (b) as pictured in Plate 10.4. These were likely used for woodworking in the production of arrows and for making bone tools or ornaments. Also, one uniface in this category was knife-shaped. Three wood- or bone-working tools were found in 5RB8902 L1 and L2 including a large flake used as a spokeshave (L1).

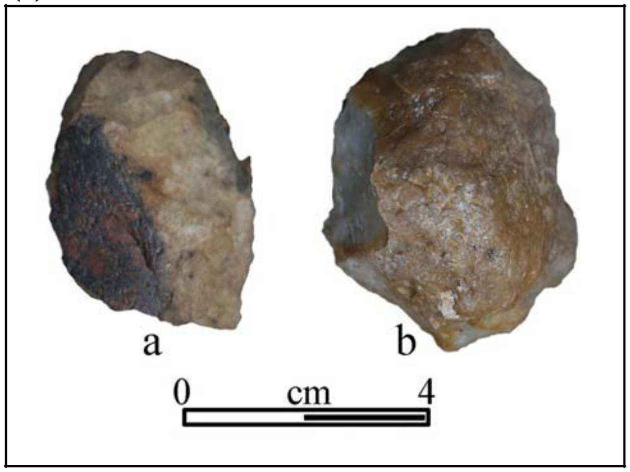

Plate 10.4. Artifacts found together at 5RB8902 in Locus 2 that are apparently wood- or bone-working tools: left, small scraper with burin tip; right, chisel edge utilized flake.

Examples of small flakes and a slightly modified large flake from 5RB4558 that were utilized as cutting and perforating tools are shown in Plate 10.5. Notable in that plate are flakes of Morgan Formation chert, likely obtained from the Cross Mountain quarries north of the Yampa River. Also, Specimen .s6, a chert chunk recovered from a cobble deposit was slightly flaked for use as a large perforator with a lateral cutting edge. The smooth character of its edges suggests use on soft materials (hides) – probably a finishing tool for clothing or moccasins.

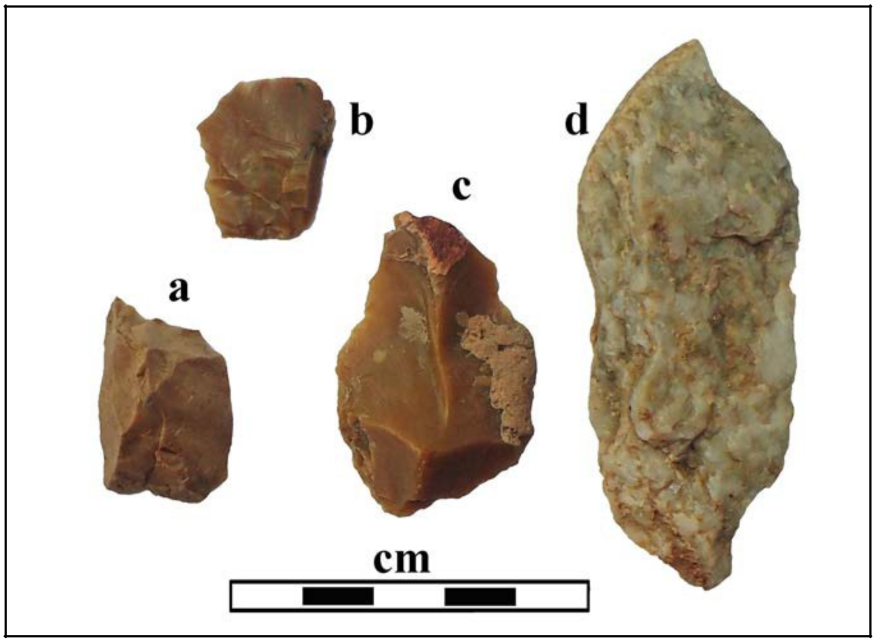

Plate 10.5. Utilized flakes and uniface tools recovered from 5RB4558: a) .s11, perforator; b) .s12, utilized flake (cutting edges); c) .s10, small scraper (distol); d) .s6, a chert chunk recovered from a cobble deposit that was slightly flaked for use as a large perforator with a lateral cutting edge. Smooth character of its edges suggests use on soft materials (hides). Specimen b and c are Morgan Formation chert.

10.2 Ground Stone

Artifacts that represent grinding, milling, and cooking activities include hand grinding stones (manos), nether milling stones (metates), and cooking slabs (griddles or comals). It is notable that manos have also been employed by various people in hide processing (Adams 2002:96-97), and metates were often used in food preparation other than grinding seeds (Schroth 1996:58). Both 5RB4558 and 5RB8902 contained ground stone artifacts of the three types.

10.2.1 Manos

Two mano types make up the majority of the assemblage: disc- and oval-shaped. A fragment of a sub-rectangular loaf type was recorded at 5RB8902 as well, but it appeared older due to a surface cover of caliche. That fact might be indicative of its collection by the occupants from other contexts (an older site).

A disc mano was newly identified during the initial recording of 5RB4558 (Plate 10.6), but a previously reported, large ovate mano was not relocated. The former is part of the collected artifacts from this site. The two primary mano types were found at the newly recorded site 5RB8902, which suggested at the time of recording that the sites were occupied by the same cultural group -- at about the same time. Plate 10.7 depicts the two types found at Locus 1 of 5RB8902 (not collected because of their location on private property). The manos shown in these plates are cobble types of well-cemented quartzitic and granitic materials that were selected by the inhabitants for their qualities of hardness and durability.

Plate 10.6. 5RB4558.s13, disc mano (collected).

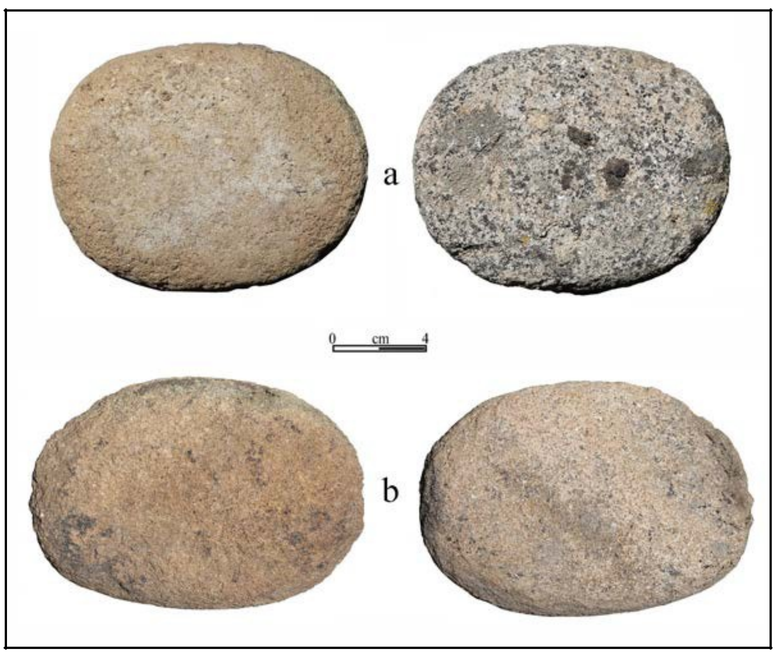

Plate 10.7. Views of both sides of a disc mano and an ovate mano recorded at 5RB8902 Locus 1 (a) and Locus 2 (b). Not collected (private land).

10.2.2 Metates

Fragments of metates and comals were found in both sites (5RB4558 L1 and 5RB8902 L2). The metate fragments are thin and exhibit bifacial use (a rough-surfaced side for the initial grinding, a second, less-rough side for further refinement). Their characteristics of light weight, sandstone material and utilization on both surfaces suggest that they were brought to the site and were – except for breakage – expected to be carried away. Plate 10.8 shows the fragments of the one recorded at 5RB8902 (uncollected, private land), and Plate 10.9 displays the comparable type recovered from 5RB4558.

Plate 10.8. Bifacial fragment (both sides) of a portable metate recorded at 5RB8902 (uncollected).

Plate 10.9. Two fragments of a bifacial portable metate recorded at 5RB4558 as .s14 (collected). Their thickness and characteristics are the same as that of the uncollected one recorded at 5RB8902.

10.2.3 Comal

A fragment of a thin cooking slab was recovered from 5RB4558 (.s15). It exhibits grinding and smoothing on both sides, fire-crazing and discoloration on one side (Plate 10.10).

Plate 10.10. Fragment of a comal recovered from 5RB4558 Locus 1 near the metate fragments shown in Plate 10.9. Fire clouds on one side suggest its use as a cooking slab for small cakes made of ground seeds and/ or mashed tubers.

10.2.4 Boiling Stones

Several concentrations of fractured, heat-reddened cobble fragments occur in all three loci of 5RB8902. The cobbles are clearly water worn and have been transported to their current locations by the inhabitants. There is no ash or evidence of *in situ* thermal activity such as reddened sediment in direct association, but it is apparent that they had been heated in a fire and subsequently concentrated through dumping at their current location. A few small chunks of charcoal were found eroding near the fractured cobbles in L1 (located on private property) that were dated 1720±30 BP (Cal 240-400 AD; ICA ID 18C/0628). [As discussed later, extensive use of boiling stones was recorded at the Wardell Site.]

Based on the fragments, the heat-altered cobbles are estimated to have been between 6-12cm in diameter. Similar sized cobbles have been documented as being used by Utes as boiling stones (Smith 1974: 64, 66, 87):

> "Cooking was done by roasting over the coals or by stone boiling in baskets or pottery vessels either procured by trade or home-made.
>
> Clay pots were used for boiling meat, sometimes with seed or Yampa flour added. The pot was placed near the fire, and hot ashes were heaped around it. Sometimes hot stones were placed in with the food to make it boil faster."

In sum, because of their size, fractured condition and their location within the site's loci, they were used for cooking. In fact, besides their use in boiling meat, several similar sized cobbles show indications of use as either hammerstones or anvils for breaking bones to extract marrow. A larger cobble identified as a chopper may also have been employed in bone processing, as well.

10.3 Lithic Material

Bedrock in the study area is host to a variety of lithic material in the form of cobble and pebble conglomerates. It appears that prehistoric subsistence within much of the study area is due to availability of these lithic resources from these secondary procurement locations. The lower 250 meters of the Wasatch Formation (Eocene and Paleocene) contains abundant conglomerate and conglomeratic sandstone layers up to 15 meters in thickness (Izett et al. 1985). Pebbles and cobbles in the conglomerate are described as consisting of chert, limestone, and quartz (ibid.). Exposures of the Wasatch Formation are chiefly visible on the southwestern flanks of Strawberry and Deep Channel Creeks (southwest of Strawberry Creek Road). Sites in the general area are often found near conglomerate lenses (or erosional surface thereof) within these exposures.

A second conglomerate outcrop observed in the general area occurs in the Paleocene-age Fort Union Formation (Izett et al. 1985). It is described as a persistent, six meter thick conglomerate unit found at the Formation's base, and contains quartzite, chert, quartz, granite, fossilized wood, and porphyry cobbles and pebbles. It is also stated that this layer may be equivalent to part of the Ohio Creek Formation as described by Gaskill and Godwin (1963).

While conglomerate exposures were not observed in relation to visible outcropping areas of this formation in the study areas, utilized/tested pebbles and cobbles were common artifacts of prehistoric cultural manifestations in the sites. Procurement of these resources was likely from nearby exposures of the Fort Union and Wasatch formations. Chert was the only observed lithic tool material. Colors of the chert included shades of red, orange (pumpkin), beige, white and green. The orange-colored chert is derived from the Morgan Formation and known prehistoric quarries of this material occur around Holy Cross Mountain located in northwest Colorado, north of the Yampa River.

Sandstone metate fragments and quartzitic and granitic cobble manos were recorded on the sites. The manos were not only similar in material type, but also in shape and apparent utilization as well. Because the presence of cobbles similar to those used as manos was not pronounced within any of the conglomerate lenses observed in the area, it is believed those cobbles were likely procured from the White River.

11.0 DISCUSSION AND ARCHAEOLOGICAL INTERPRETATIONS

Overall, this project has provided an opportunity to investigate the prehistoric occupation and use of a long north-south valley that roughly joins the Powder Wash area to the Piceance Creek area. Previous recorded resources in the general area indicate that it was intensively occupied by Utes during the Protohistoric and Historic periods. This project has added new evidence of a much earlier occupation of people present 1700 years ago who exhibit the same high mobility as the Utes.

In review of the regional literature, the Wardell site, located in southwestern Wyoming within the Green River Basin near Big Piney, proved to have important information bearing on the interpretation of the two sites subject to data retrieval. Officially named the Wardell Buffalo Trap, 48SU301, it is exceptional in many aspects (Frison 1973). As summarized in Frison 1991 (pp. 212-217), it contained the "earliest known evidence of a communal bison kill involving use of bow and arrow." Projectile points recovered from the site were classified as Avonlea type. The dates for the Avonlea appearance in the northern Rocky Mountains overlap in content and hunting characteristics that of the Besant Culture represented by distinctive, large, side-notched (some corner-notched) dart points, corral kill sites, and the occasional Woodland ceramics (Kornfeld 2010:125).

The Wardell kill site is situated in a small side canyon along the main Green River drainage. Trapping the bison was based on a sophisticated system that included construction of a corral built of logs and posts within a "box" side-canyon. The hunt involved interception of bison moving to water at the river and directing them into a containment structure for their harvest using bows and arrows and atlatls. Use of the corral over a 500-year period (about AD 300-800) was indicated by five feet of stratified bison bone levels that were radiocarbon dated (ibid.:212). Hundreds of projectile points were recovered from the corral-capture portion of the site. Interestingly, the bison bones indicated entrapments occurred during early fall and the majority of the identified bones were above the age of yearlings (ibid.:215).

Near the bison corral, a large butchering, processing and camping area was found about 65m distant. It exhibited three types of thermal features for food preparation: large, shallow features; unlined, conically excavated pits; and, slab-lined pits. Stone heating was done in the shallow features; deep boiling pits (possibly lined with skins and filled with water and boiling stones) were used to boil bones and potentially to cook meat; and, roasting pits (averaging 60cm in diameter and 30cm deep) were also probably lined with skin and likely covered for roasting (ibid.:216).

Woodland (cord-marked) ceramic sherds were part of the artifact assemblage found in the camp area of Wardell (Kornfeld et al. 2010:62,130). Other sites containing Besant points in layers dating ca. 1750 BP that have produced Woodland ceramics include the Greyrocks site and the Butler-Rissler site – both located in southeast Wyoming along the Platte River (ibid.:62). Artifact types recovered from cave and rockshelter sites in Wyoming that dated ca.

AD200-500 include many perishable items found along with large side- and corner-notched points. Coiled basketry fragments (Great Basin type) have been recovered, as well as extensive debris for woodworking, bark cordage, sinew, hide, feathers, shell, atlatl and arrow fragments, and digging sticks of wood and antler (Kornfeld et al. 2010:215-217).

Habitation structures have not been well documented at these or other Avonlea sites of this period probably because of their low archaeological visibility. Importantly, however, for the Ruby site (48CA302, a buffalo corral impoundment dated 1670±135 BP, AD 280; GX-1157) located in east-central Wyoming, Frison (1971) reports a large ceremonial structure (with altar) closely associated with an impound and drive line. Such a structure connects religiosity and the buffalo hunting culture, which is discussed later in this report.

Due to the appearance of human tracks of a person wearing moccasins in the lodge at 5RB8902, a literature review on the subject of moccasins of the region uncovered a comparative collection of over 230 that had been recovered from the Promontory Caves located by the Great Salt Lake by Julian Stewart in 1930–31 (Stewart 1937). Those artifacts, which date to the 13th century, became part of a study to create an anthropometric model for understanding the composition of the caves' population by using moccasin size as a proxy for foot size (Billinger and Ives 2015). The patterns of the moccasins are ones in which a sole piece folds upward to meet the portion of the piece that covers the instep and toes and is joined by a seam at the heel (Plate 11.1). Moccasins made of bison and pronghorn were identified in the collection – reflective of the animals being hunted, as few smaller animals were represented in the faunal collection. Some moccasins exhibit intricate quill-work, fringes and ankle wrappings. Stewart found this style comparable to ones made

Plate 11.1. "Fig. 2. Typical Promontory style (BSM 2 [Bb]) moccasins at the time of their recovery (2013) in Cave 1: (a) and (b) uppers of moccasins 42BO1 FS945 and 42BO1 FS969 respectively; (c) and (d) soles of moccasins 42BO1 FS945 and 42BO1 FS 969, respectively. Notice the whole sole patch and toe wear of 42BO1FS945 and the heel and sole patches for 42BO1 FS969" (Billinger and Ives 2015: Fig. 2, p.3).

in northern British Columbia by Dene peoples such as the Tahltan. "A similar moccasin, dating to 1430±40 ^{14}C yr BP (cal AD 558–663), was preserved in a southern Yukon ice-patch, suggesting that potential precursor forms existed in a region widely regarded as part of the proto-Dene (or proto- Athapaskan) homeland" (Billinger and Ives 2015:3).

Other moccasins have been identified in collections from the Southwest and later as Plains Indian styles, but they are constructed in completely different fashions, often with little of the refined tanning and sewing seen in many Promontory moccasins (Ives 2014). Renewed work with other aspects of these assemblages and sites continues to reinforce Stewart's belief that a northern hunting population of Apachean origin occupied the caves [a position reiterated even in Stewart's (1955) last remarks on the subject]. Stewart's suspicions are supported by evidence of other artifacts at Promontory Caves that are uncharacteristic of the Great Basin but typical of Subarctic and Plains locales (tabular bifaces used in the final softening of leather, knotless netting identical to those found in Dene hunting bags, and sinew backed bows). Other studies including rock art, pottery sherd geochemistry, and obsidian sources (primarily Malad Peak) also indicate that late period Promontory peoples had external ties consistent with Apachean migration dynamics (Billinger and Ives 2015:4).

Measurements of the tracks west of the hearth in the conical lodge (Feature 3) of 5RB8902 are 16-18cm in length (Plate 11.2). That length places them in the smaller size range of moccasins found at Promontory Caves, which was from 11.4cm to 30.5cm (Billinger and Ives 2015:6) .

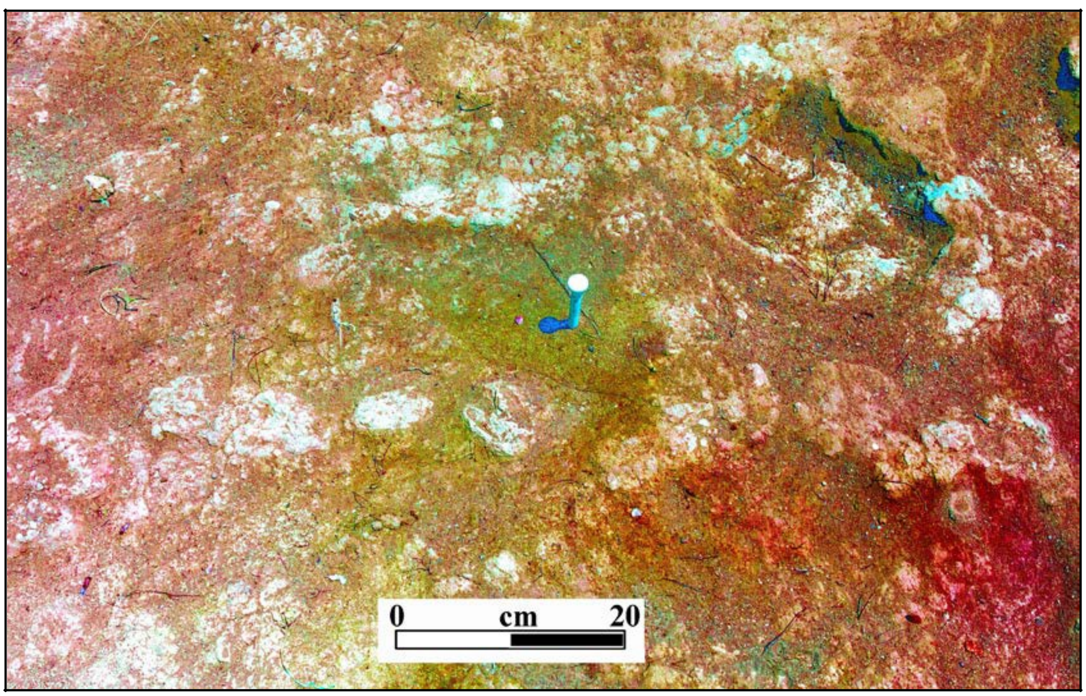

Plate 11.2. 5RB8902 Feature 3, conical lodge floor section near grid center (pin in center of 2m x 2m excavation grid), view east: an enhanced photo of moccasin tracks with deer track between. Hearth depression is upper right.

Stature size of a person wearing moccasins 18cm long would be about 111.1cm, with a foot length of 16.7cm (Billinger and Ives 2015: Table 2, p.7). Using stature-age range estimates from graphs (ibid.:7-8), that size would place the wearer in the subadult group and approximately seven years old. Examples of this size of foot wear were identified in Figure 3 (ibid.: p. 5) and are presented here as Plate 11.3.

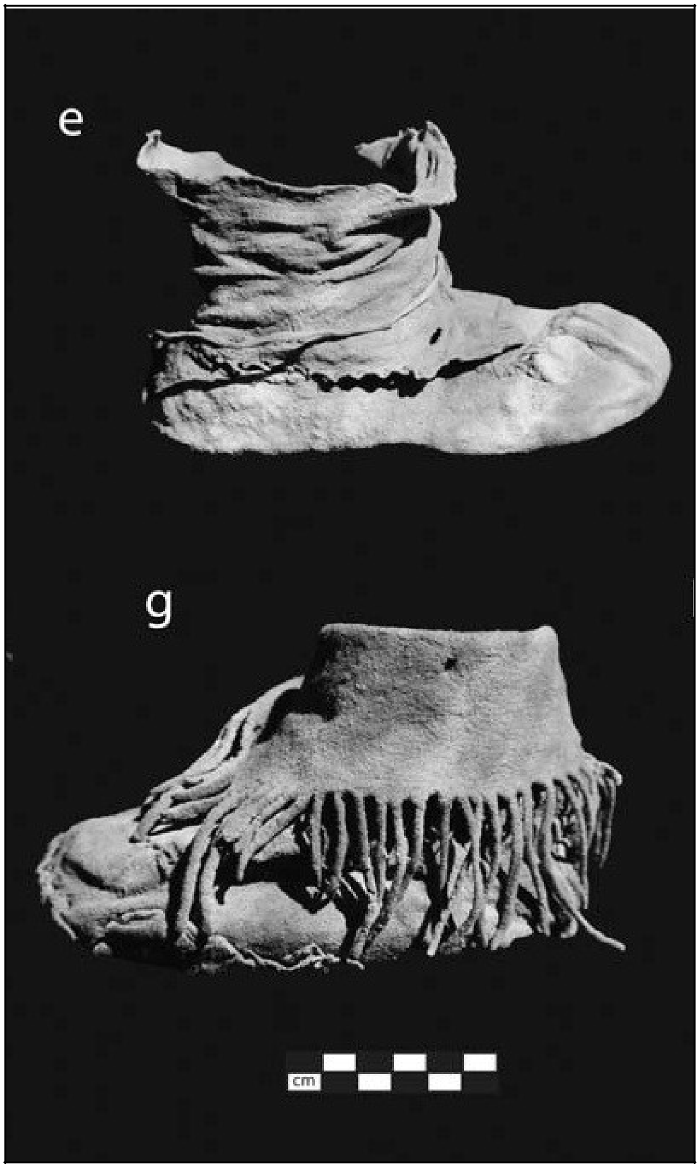

Plate 11.3. Apachean style moccasins, part of the Promontory Caves collection, that are of comparative size (18cm) to the foot prints on the conical lodge floor at 5RB8902 (Billinger and Ives 2015: Copy of center portion of Fig. 3, p.5). Notably, moccasin "e" has an ankle wrap addition and "g" an obvious fringe decoration.

Further review of the structure floor revealed apparent impressions of additional tracks. The original two that were identified measure 19.5 cm each in length and are shown in blue of Plate 11.4. Using Table 2 from Inferring Demographic Structure with Moccasin Size Data (Billinger and Ives 2015: Table 2), the prints belong to a child 6-7 years old with height of about 4 feet (121.6cm). In the northwest corner of the 2m x 2m grid are two larger tracks that were later identified (shown in florescent green). The one in better condition was measurable and is about 25cm in length. According to Billinger and Ives (2015: Table 2, p.7), these would belong to a person about 156 cm or 5 feet 1.5 inches in height (likely an adult woman). Another track northeast of the center pin looks to be a footprint rather than a moccasin track (red outlined area). It measures about 13cm long and those measurements in the Table (ibid.) indicate a child about 34 inches tall (87.3cm) and two years old.

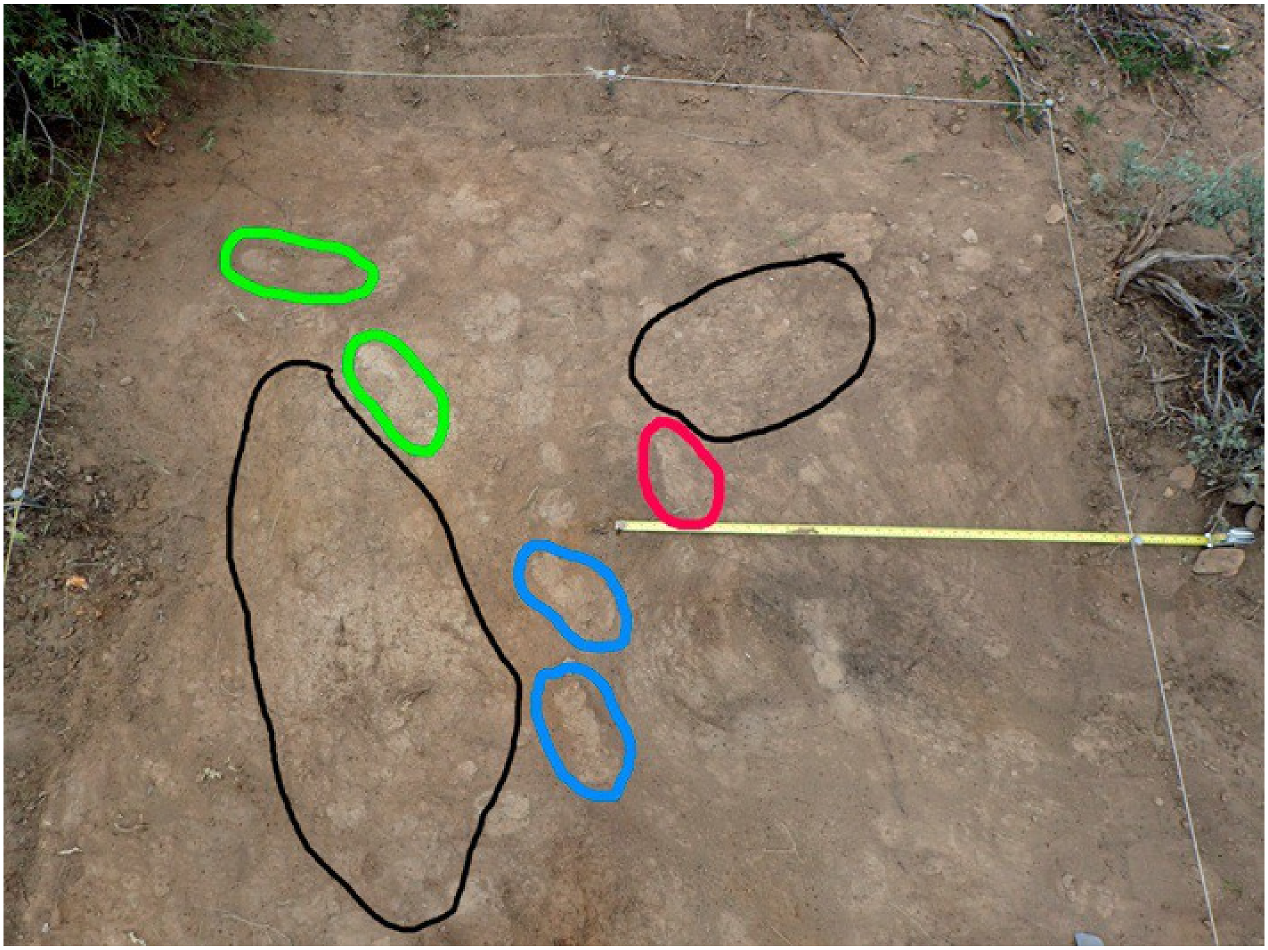

Plate 11.4. Outlines of measured moccasin prints (green and blue), a footprint (red), and slight impressions of possible sleep positions of two persons (black outlines). Facing north.

In summary, it appears that an adult woman (possibly about 21 yrs old considering the projected ages of the children) and two children (one ~2 years old, another ~7 years old) were occupants of the small conical wood structure. Notably, the age spacing of the children would fit with a mother nursing a child for about 4-5 years, a norm for hunter-gatherer reproductive rates. The tracks are the result of a hardening and depressing of the surface of a clayey soil. Subsequent, slight wind and water erosion of the less compacted soil around the tracks elevated them about 1-3mm. Their fragile condition would make it difficult if not impossible for their preservation through molding and casting.

There are also two slight impressions of apparent persons lying down in the structure (black outline). One occurs in the two western 1m x1m units where a person has lain over from a seat impression (in the SW 1mx1m) onto their left side. Another very light impression is of a smaller person in the northeast 1m x1m unit. These impressions are very faint and difficult to clearly document.

11.1 Climatic Determinants for Bison Hunter Occupation

The two sites subject of this project are the product of a 1700 year old, highly mobile, bison hunting culture, many of the characteristics of which are observable in the archaeological record of the Historic Ute peoples occupation of western Colorado. For the first millennium AD, it is the bison hunting people that occupied much of the northern Rocky Mountains who are the prime suspects as the occupants of these and likely many other sites in the region.

The presence of the bison hunters would be influenced by climatic conditions that affected bison – their primary meat supply. Jorns et al. (2019) address the effects of climatic conditions on bison in their article "Climate structures bison dietary quality and composition at the continental scale." Wherein they state "bison in a warmer climate are likely to suffer increased nutritional stress" from the loss of protein obtained in a healthy grassland environment and are forced to replace that by increased foraging. It follows that cooler and wetter climate conditions would increase the grassland/wetland variables favorable to increasing populations of bison.

The large Plains bison have in the past been considered to be strict grazers consuming only grasses and other monocots, and sedges (mainly found in wetlands). However, new analyses of bison fecal material by a study of populations in Kansas and South Dakota indicate high-protein, palatable eudicots (flowering plants) are included in their diet as well (Craine et al. 2015). In warmer conditions of spring and fall, these protein-rich plants account for as much as 60% of the bison diet. However, the most important item in their diet remains C4 grasses.

What are C4 grasses? A defining report was published on the internet by the New South Wales Government, Department of Primary Industries (https://www.dpi.nsw.gov.au/agriculture/pastures-and-rangelands accessed July 13, 2020), which states as follows:

> The perennial grasses can be classified as either C3 or C4 plants. These terms refer to the different pathways that plants use to capture carbon dioxide during photosynthesis. All species have the more primitive C3 pathway, but the additional C4 pathway evolved in species in the wet and dry tropics. The first product of carbon fixation in C3 plants involves a 3-carbon molecule, whilst C4 plants initially produce a 4-carbon molecule that then enters the C3 cycle. Why are these differences important?
>
> These differences are important because the two pathways are also associated with different growth requirements. C3 plants are adapted to cool season establishment and growth in either wet or dry environments. On the other hand, C4 plants are more adapted to warm or hot seasonal conditions under moist or dry environments. A feature of C3 grasses is their greater tolerance of frost compared to C4 grasses. C3 species also tend to generate less bulk than C4 species; however, feed quality is often higher than C4 grasses. Differences between C3 and C4 species are shown in Table 1.

Table 1: Features of C3 and C4 grasses

	C3	C4
Initial molecule formed during photosynthesis	3 carbon	4 carbon
Growth period	Cool season or year long	Warm season
Light requirements	Lower	Higher
Temperature requirements	Lower	Higher
Moisture requirements	Higher	Lower
Frost sensitivity	Lower	Higher
Feed quality	Higher	Lower
Production	Lower	Higher
Examples	weeping grass and common wheatgrass	kangaroo grass, red grass and wire grass

The presence of both C3 and C4 species can be desirable in a pasture as they can occupy different niches (e.g. C3 species are often more abundant in the shade of trees and on southerly aspects, while C4 species often dominate full-sun conditions and northerly aspects) and thereby provide greater groundcover across a range of conditions. It is common to find both C3 and C4 species in one paddock. This has advantages in providing a broader spread of production.

In summary, the climatic conditions that would increase the food supply for bison are cool and wet. Such would increase the nutrients for a healthy bison population and concomitantly increase their rate of reproduction. The opposite is true of a warming climate, which would not only decrease the nutrient quality of the critical C4 grasses, but also decrease its abundance. Those conditions would bring protein stress to the species and reduce growth and reproduction. Climatic warming reduces grass protein concentrations and bison may have to attempt to compensate by grazing less and browsing more (Craine et al. 2015), or moving to better environs.

In the two environmental models shown in 5.1 (p. 6-7 this report), there appears to be a general agreement for the relative time period of the occupation of the two sites as a wet climatic period. The Chen and Associates graph shows a period of about 700 years from ca. AD 100-800 for a cooler and wetter climate (Fig. 5.1, this report). The PSDI variation for Northwest Colorado indicates a relatively wet period occurred between AD 150-300 followed by a highly variable 80 years of moderate wet and dry episodes, then a mostly wet period until AD 500 (Fig. 5.2, this report). It is during this roughly 300-year period that a relatively intense occupation is observable in the archaeological record of caves and rockshelters in the Bighorn Mountain and Basin areas

(Kornfeld et al. 2010:125). Another period of relatively low occurrence of drought is seen in the PDSI graph between AD 700-950 and may have produced favorable conditions for bison and bison hunters. The Chen and Associates graph for that time shows mudflows were occurring at Battlement Mesa between AD 600-800, implying higher ground water levels, followed by a stable but drying period until about AD 1050 when wind-blown silts appear in the geomorphological record.

The point being that during the wetter episodes greater numbers of bison are likely to have been present in northwest Colorado, which may represent expansion of local populations but may also include migrating herds from the northern Rocky Mountains. If colder conditions were coupled with the wetter conditions, bison herds would naturally be moving either down in elevation and/or in latitude to obtain the same quality of food resources. The same applies to human populations following the herds.

11.2 Cultural Distribution: The Role of Rock Art

It is known from the presence of a large ceremonial structure at the Ruby site (48CA302) dated 1670±135 BP (GX-1157) that "extensive religious activity" was conducted by the bison hunters of that period (Frison 1971). Other sites may have similar structures, but as yet have not been found. Another expression of a belief system is found in rock art, one that is somewhat easier to trace in the archaeological record, and one that can be used to examine the distribution of a particular style or theme on a regional basis.

Sally Cole describes the importance of rock art (Cole 2016):

> Prehistoric rock art is interpreted as part of ancient communication systems wherein information was presented and exchanged on a variety of levels, group identities were reinforced, and places and events were integrated into the rituals and histories of peoples. This draws on the strength of rock art – it is fixed in place and imagery and the patterns of use can be studied in relation to sites, local communities, and the larger cultural landscape in which images were displayed and observed. To the extent that rock art was public – openly visible to passers-by (unless restricted by social conventions invisible to archaeology) – it may have communicated beyond momentary events, across cultural boundaries, and influenced the world views of future generations. The communication qualities have proven useful for archaeological research on a number of levels including: utilizing rock art as cultural and social markers; determining the presence and significance of socio-religious systems (Francis and Loendorf 2002; Geib and Fairley 1992; Hurst 1940–1942, 1948; Keyser 1984; Kidder and Guernsey 1919; Spangler 2004); evaluating socioeconomic patterns and organization (Matheny et al. 2004; Robins 1997); and addressing questions of cultural affiliation for site interpretation and under the Native American Graves Protection and Repatriation Act (Bernardini 2005; Powell et al. 1998).

For the purposes of archaeological study, petroglyphs and rock paintings (and a variety of material culture types) are organized by style. For rock art, stylistic categories are comprised of repetitive types of imagery (forms, techniques, colors, organization, and themes) found in regional and chronological contexts. Directly dated rock art is rare.

Accordingly, a search for bison related images in rock art that are not attributable to the Historic period was undertaken. Several interesting candidates were found that appear to relate to the Besant-Avonlea type bison hunter occupations: 5GF303, a small panel located south of the Colorado River near the town of Silt; 5RB687, located in Canyon Pintado National Historic District south of Rangely; and 5MN1034, located in Paradox Valley.

The panel at 5GF303 has interesting motifs that include a bison with an atlatl arrow stuck in its hump, and two anthropomorphs – one that appears to be male, left, and the other female, right (Plate 11.4). The figures are eroded and difficult to make out, but the male apparently exhibits genitalia and a feathered headdress, and the female has a (fringed?) skirt and a "squash-blossom" hairstyle. These are characteristics found in representations of Formative period figures of the region. The hooves being pecked as tracks suggests this site is representative of the Hoofprint Tradition type defined by Keyser and Klassen (2001:177-189), for which they have relative dates of AD 200-1500. The apparent atlatl arrow would push the date back to the early part of that period. The tracks are associated with both hunting magic and female fertility, which are linked at many sites (ibid:188).

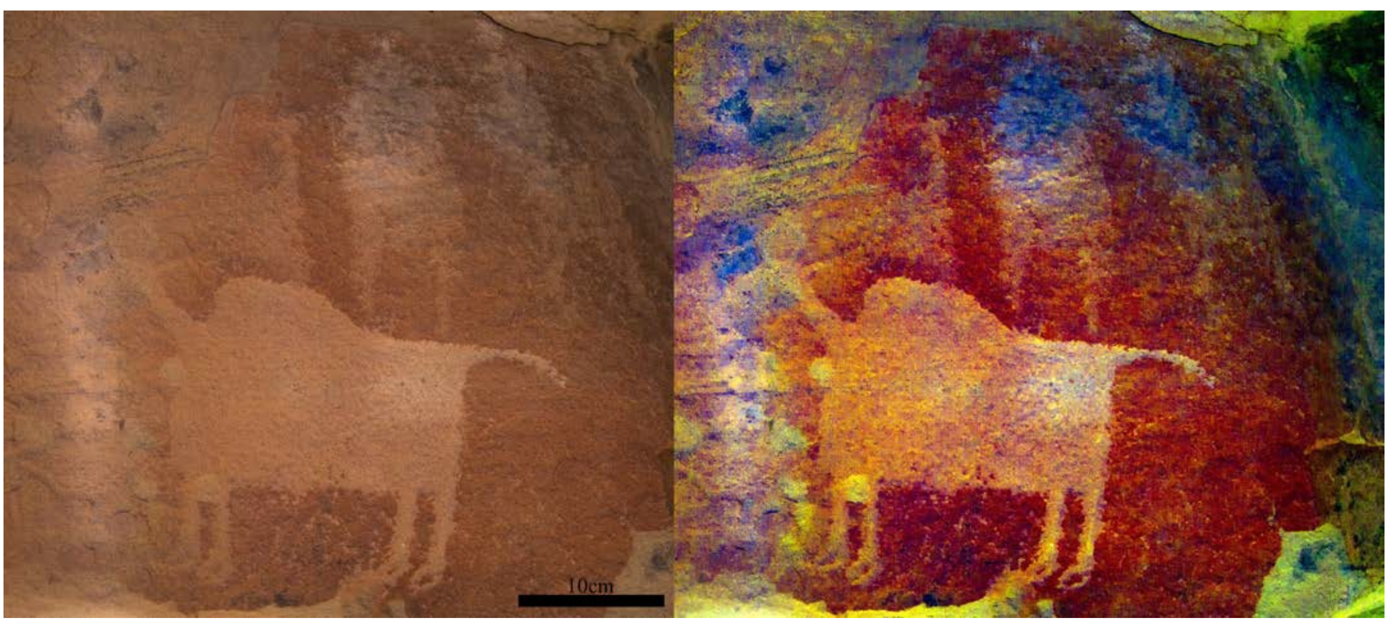

Plate 11.5. Rock art panel of 5GF303 showing a bison with an atlatl arrow upright in its hump and directed toward the heart/lung area and two human figures.

The rock art of site 5RB687 is intriguing in several aspects when examined in relation to the imaginary landscape represented on the sandstone medium and the site's surrounding, physical landscape. A section of the overall panel displays two apparent female anthropomorphs – with "squash blossom" hair styles – portrayed on either side of a bison head-like or skull-like image (Plate 11.5). The bison head originates in a crack, a symbolization of the bison spirit's emergence from earth. Above the skull motif is a representation of a human neck and head with a horned headdress. Together this figure is possibly representative of the spirit of the bison being brought into that of a shaman with the assistance of the two females. The rock art panel is situated in an overhang overlooking a small, (box-end) side-canyon of Douglas Creek where a bison corral kill site could have been located.

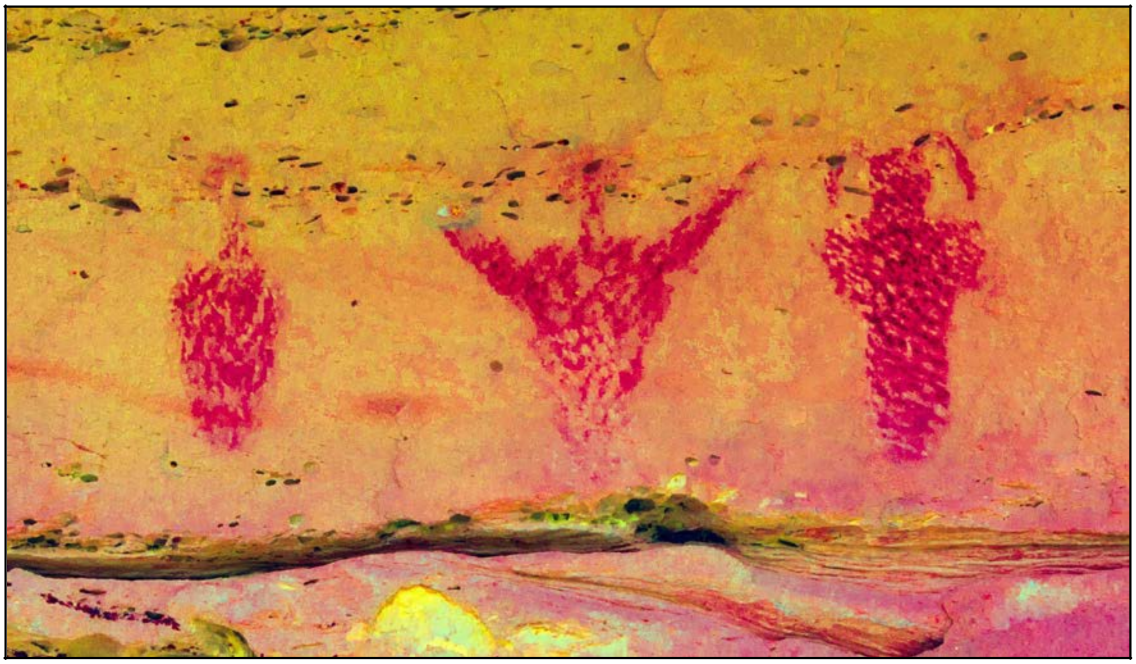

Plate 11.6. An enhanced photo of a portion of the rock art panel in 5RB687. Two apparent female images (with squash blossom-like style hair) flank a large bison head figure (representing the spirit of the bison) that is interpreted as "emerging" from a crack in the earth, and apparently filling the shaman represented with a horned headdress.

Site 5MN1034, located at the east end of Paradox Valley along one of the major prehistoric/historic trails of the region, contains important bison hunter rock art within a complex of panels and habitation areas. Two of the features of the site include a "sleeping bison" boulder covered with rock art (with a kill line through the hump), and a panel on a large boulder displaying deeply pecked bison hoof prints (Plates 11.6, 11.7 and 11.8). Both are forms of rock art classified as Hoofprint Tradition by Keyser and Klassen (2001:177-179). Those authors cite ethnographic evidence of this Tradition having themes related to fertility, fecundity, and the sacred relationship between women and bison (ibid.:177). The regional distributions of these sites includes southern Saskatchewan and Alberta provinces, eastern Montana, western North Dakota, cental and western South Dakota, Wyoming northeast and west-central, and northwest Colorado, which includes areas most often designated as having Avonlea cultural sites. Their illustration of the continental distribution of this Tradition extends into the Eastern Woodlands area (which would explain the presence of Woodland type [cordmarked] ceramics in the Besant and Avonlea sites), and the whole of western Colorado (Keyser and Klassen 2001:176; Map 11.1 Hoofprint Tradition Rock Art).

Plate 11.7. Site 5MN1034 located in Paradox Valley, includes a "sleeping bison" rock covered with rock art.

Plate 11.8. Large boulder within site 5MN1034 that contains deeply pecked bison tracks.

Plate 11.9. Bison tracks on boulder located near the "sleeping bison" within site 5MN1034. Notably, these tracks display dewclaws, which are identified as bison type by Keyser and Klassen (2001:177,179: Figs. 11.1 and 11.3).

11.3 Subsistence Data

The two prehistoric sites occur on the south-facing sides of low ridges vegetated with pinyon/juniper forest, which is surrounded by either brush or bordered by sagebrush/ grasslands. The pollen or macrobotanical samples obtained from the features provided appreciable information on the subsistence of the site's occupants. The results are comparable to archaeological evidence from Protohistoric/Historic Era sites throughout the Basin/Plateau. The plants represented in the record roughly match known uses of plants exploited by the Utes as listed by Lewis (1994:28-29):

> "Ute women gathered and utilized many edible seeds, plants, and roots in their physical environment. Pine nuts were a staple, parched in baskets with hot coals and stored whole or as ground meal for winter use. The women mixed the meal with water to form small meal balls or boiled it into mush. Women gathered wheat grass (Agropyron), bentgrass (Agrostis), bluegrass (Poa), needle grass (Stipa), and June grass (Koeleria), and seeds from lamb's-quarter (Chenopodium), sunflowers, and amaranth, among others, which they stored whole or parched and ground into flour. The people ate raspberries, strawberries, gooseberries, serviceberries, currants, buffalo berries, rose and juniper berries in season or dried and cached them in baskets underground. Chokecherries (Prunus), molded and dried into round cakes for winter use, were a particularly important fruit resource. Women gathered numerous roots, including yampa (Perideridia), camas (Camassia), sego lily (Calochortus), tule, valerian, and yucca, as well as seasonal greens and thistles, cactus leaves and fruit, and some acorns. Women also collected and processed vegetal fibers for baskets, cordage, and clothing. Ute men gathered native tobacco (Nicotiana) and numerous other plants valued for their medicinal or ceremonial power."

That the Utes were exploiting these plant resources in this portion of the Northern Colorado Plateau is attested to by the 4 September 1776 record of the Dominguez-Escalante Expedition. While traveling near the present day town of Plateau City located on Plateau Creek (south of the Sunnyside area, about 2.0 miles west of Collbran), the group:

> "...passed through a section of piñon growth, and came upon a sagebrush stretch where three Yuta women with a child were preparing the small fruits they had picked for their sustenance in the arroyos and rivulets hereabouts. We went over to talk to them, and right away they offered us their fruits, which were chokecherry, gooseberry, lemita, and some of this year's piñon nuts."

11.4 Summary and Conclusions

The importance of the finds at these two sites cannot be overstated. The mitigation of the two sites has accumulated and presented information that can be used to identify cultural components of single open camp sites occupied during the period of AD 200-500 in western Colorado.

The evidence of a small conical wood-pole structure dating 1700 years old is the oldest recorded (artist conception of structural framework, Plate 11.9). As well, the identifiable features within the structure including moccasin tracks, a seating position and possible impressions of persons sleeping have never been documented in structures of this type. The temporally diagnostic projectile points, artifact assemblage, and radiocarbon dates represent direct evidence of the presence of a Besant-Avonlea bison-hunting tradition in Northwest Colorado.

Interpreting the pattern of settlement/subsistence of a particular group is dependent on accurate documentation of artifact assemblages and radiocarbon dating. This project has demonstrated that radiocarbon (AMS) samples can be obtained from surface exposures and produce reliable dates from small pieces of carbon. The turn-around times and the costs for dating such samples have been greatly reduced. Considering the limited impact to sites and the considerable research value in obtaining and processing the carbon, the preservation of this data should be paramount in inventory procedures as well as for testing and excavation. Radiocarbon dating of the camps is the only way to accurately determine the distribution of various cultural groups' activities and thus glean some idea of their purpose.

Plate 11.10. Artist conception of small conical wood structure at 5RB8902.

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APPENDIX A: TREATMENT PLAN

Data Recovery Treatment Plan:
Data Retrieval from Sites 5RB4558 and 5RB8902
For the Proposed Strawberry Creek and Grand Hogback Land Sale in Garfield and Rio Blanco Counties, Colorado

Prepared for:
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January 31, 2020

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DATA RECOVERY PLAN FOR THE NRHP-ELIGIBLE SITES WITHIN THE STRAWBERRY CREEK AREA

INTRODUCTION

The Bureau of Land Management – White River Field Office (WRFO) intends to sell six parcels of public land identified for disposal in the 1997 White River Resource Management Plan (RMP). In consultation with the Colorado State Historic Preservation Officer (SHPO), the WRFO determined that the sale of six parcels in the field office Strawberry Creek and Grand Hogback areas is an undertaking with the potential to affect historic properties, pursuant to Section 106 of the National Historic Preservation Act (NHPA) and the State Protocol Agreement between the Colorado State Director of the BLM and the Colorado SHPO. The Area of Potential Effect (APE) comprises a combined area measuring approximately 400-acres on lands administered by the WRFO that are slated for disposal (Appendix A: Parcels 1-2, A-D).

All BLM parcels proposed to be sold were surveyed for cultural resources in 2018 (OAHP Report #MC.LM.R802). Two of the sites located during this inventory, 5RB.4558 and 5RB.8902, have been determined eligible for the National Register of Historic Places (NRHP; Appendix B). Accordingly, the purpose of this data recovery treatment plan is to outline the proposed archaeological investigations required to mitigate the adverse effects of the land sale to both sites as per Section X.H.2 of the State Protocol Agreement. Such work will be undertaken to meet the requirements of the Federal Land Policy and Management Act of 1976, the National Historic Preservation Act (as amended in 1992), and the National Environmental Policy Act (NEPA) of 1969.

The WRFO submitted consultation letters to the Ute Indian Tribe of the Uintah & Ouray Reservation, Southern Ute Indian Tribe, the Ute Mountain Ute Tribe, the Eastern Shoshone Tribe, the Pueblo of Jemez, and the Hopi Tribe on June 26, 2018 and November 19, 2018. Ongoing consultation on the BLM's mitigation strategies for both open camps was specifically requested by the Ute Indian Tribe of the Uintah & Ouray Reservation, Southern Ute Indian Tribe, the Ute Mountain Ute Tribe, and the Hopi Tribe. Additional comments provided by the Southern Ute Indian Tribe and Ute Mountain Ute Tribe were incorporated into the following research design, which the WRFO developed concurrently with the overarching data recovery plan. This document is intended to provide guidance on research objectives and data recovery procedures, while allowing for some flexibility in the work to be completed by the contracted archaeologist under a BLM-issued ARPA permit. This data recovery plan shall be included as an attachment to that permit.

RESEARCH DESIGN

The data recovery plan will be jointly applied with this research design to outline the process dictating the collection and interpretation of significant archaeological data at sites 5RB.4558 and 5RB.8902. Ethnobotanical data derived from the thermal features will be an emphasis of the research; in that, the pollen and macrobotanical sampling will be a focus of the data recovery to determine what plants grew in the area when the site was occupied, and what was processed as a food resource. As per the data recovery plan, both sites have a single hearth feature that will be fully excavated. All uncovered artifacts, a sample of dateable materials, and bulk soil samples for yielding potential ethnobotanical data will be collected for analysis. In addition, all diagnostic artifacts identified on the surface of both sites will also be collected and curated. As requested by the Southern Ute Indian Tribe, a broad prehistoric context will be researched and developed to identify whether the material culture at either site is associated with the Ute occupation of the study area. This research would complement the Ute Mountain Ute's request to research the relationship between the Fremont and Ute cultural periods in the study area.

This research emphasis will be broken down into two steps: (1) *archaeological and environmental data recovery and description*, and (2) *the synthesis and interpretation of the recovered archaeological materials.* Both are outlined in detail below. As per the first step, excavation data form the base from which temporal information is obtained, whether from C-14 samples, artifact seriation, and/or cross-dating. Additionally, paleo-environmental data are derived from the excavation of pollen, macrofloral, and faunal remains and are compared with the present-day environment. Under the second step, the data recovered during the archaeological excavation is synthesized to understand the relationship between paleoenvironment and prehistoric land use, site function, and technology. Here, the cultural affiliation of the site occupants is determined and tied in to regional land use studies. If data provides for such detail, the contracted archaeologists will also examine contextual considerations, such as the identification of spatial and temporal variability and functions of various artifact and feature classes.

(1) Archaeological and Environmental Data Recovery and Description

Thermal Features

The function and age of excavated thermal features will be investigated through multiple lines of evidence. Recent analyses of thermal features on the northern Colorado Plateau and in the Southern Rocky Mountains have shown that considerable variation exists in thermal feature form and function through time, reflecting varying intensity of processing labor (Greubel et al. 2003; Hauck et al. 1997; Pugh and Johnson 2000; Reed and Metcalf 1999; Reed et al. 2001; Stiger 2008). Large fire-cracked rock (FCR) features, thought to represent roasting pits or ovens, for example, are most common after 3000 B.P., whereas small, simple hearths extend throughout prehistory. Similar trends may be evident at the sites in and around the Strawberry Creek and Grand Hogback Land Sale. Pit feature variation can be better understood if concerted efforts are made to determine feature function. Although experimental data have shown that many of the rock-filled features were well suited for roasting foods that require long cooking times at moderate temperatures (e.g., tubers, such as sego lilies and biscuit root, or meat), the types of foods cooked in these features is seldom determined (Smith and Martin 1999; Smith et al. 2001; Wandsnider 1997). To determine the foods baked or roasted in FCR features, soil and rock constituents from selected features can be submitted for protein residue analysis and recovery of macrofloral remains, pollen, and starch crystals.

A prerequisite for investigating synchronic and diachronic variation in thermal feature form and function is careful and uniform documentation of features in the field. In the past, variable excavation and documentation methodologies have resulted in data that are difficult to compare. To achieve comparability, recent projects have employed simple measures of feature variability consisting of volume, total quantity of FCR by weight, and presence or absence of rock or slab linings, to generate 12 basic feature types (Greubel et al. 2003; Reed et al. 2001). The patterned distributions of feature types across time and space can be interpreted within the context of site function, associated artifact assemblages, botanical and faunal contents, and a variety of environmental variables. Such an approach can reveal insights into feature function, as well as contribute to a greater understanding of prehistoric settlement and subsistence strategies.

FCR is one source of data that has probably received insufficient attention in the region. The potential of this class of cultural materials for yielding insights into the thermal properties of roasting pits has not been fully explored. Typically, FCR is weighed or counted, sometimes both. Less commonly, it may be quantified by size class and material type. Sometimes, FCR samples are collected for protein residue studies. The goal for documenting burned rock from thermal features is to both maximize the information content of this class of cultural material, as well as establish uniform methods for collecting the data. The precise methodological approach will be defined in the pending data recovery reports to be prepared by the contracted archaeologist.

Lithic Technology Reduction Strategies

Lithic tools and debitage will also be analyzed to provide insight into the nature and range of prehistoric activities occurring within the immediate vicinity of the hearth features. Formal and expedient flaked stone tools will be measured, described, and classified according to a set of criteria that encompasses morphology, function, and use wear, with bifaces placed into stages (e.g., Callahan 1979; Sullivan and Rozen 1985). In a general sense, the goal of the lithic tool analysis will be to define assemblages of functional tool types that will serve as the basis for inferences about site function, economy, subsistence, and tool-making behaviors (Andrefsky 1998:189). Other uses of lithic tool data include the refinement of projectile point chronologies, typically through the recovery of diagnostic point types from well-dated contexts. Debitage analysis will focus on delineating lithic reduction strategies for discrete activity areas, occupations, components, sites, or time periods. Lithic reduction sequences will be defined according to the results of previous replication studies conducted by a number of researchers (Ahler 1986; Flenniken 1981, 1984, 1989; Flenniken et al. 2001; Pecora 1990; Reed et al. 1996; Yerkes and Kardulias 1993:94-97). Diachronic changes in reduction strategies can be addressed by comparing the synchronically defined reduction regimes.

Lithic Source Studies

The procurement of raw lithic material for tool making was undoubtedly an important aspect of prehistoric flaked stone technology, comprising the first stage of a potentially lengthy and complex reduction continuum. An understanding of the distributions, morphologies, quality, and other aspects of siliceous raw material sources within a study region can, therefore, yield valuable insights into the organization and techniques of prehistoric lithic procurement, early stage reduction practices, and even tool forms. With knowledge of regional lithic sources it may eventually become possible to reconstruct patterns of lithic material transport across landscapes. If such studies are successful, they hold the potential for contributing to larger research concerns such as exchange, embedded versus logistical procurement, and even the delineation of group territories in prehistory.

Because of the importance of research issues connected to prehistoric lithic raw material procurement, investigations at 5RB.4558 and 5RB.8902 should include the regional distributions, availability, and nature of siliceous tool stones. Archaeologists working in the region have noted the frequent occurrences of several unique types of cryptocrystalline silicate (CCS) and quartzite lithic materials and have developed a certain degree of facility in identifying them based on macroscopic characteristics (Miller 1991, 2010; Redman and Chandler 2004). The known material types include Bridger chert, pumpkin chert, and Uinta quartzite (c.f., Miller 1991, 2010). The proposed study is, admittedly, problematic because the geologic formations that yield flakeable tool stone are widespread and it is possible that there are numerous sources for each material type (Redman and Chandler 2004).

Complicating the picture is the possibility that secondary, alluvial sources of siliceous cobbles may exist in the region.

Despite the obstacles, a study of lithic sources near the Strawberry Creek project area will likely yield useful information, if the goals remain modest. The study will focus on the frequencies, size, and amount of cortex of debitage made of identifiable lithic materials. The debitage data variables will be correlated with distance from the nearest known sources of the materials. It is hoped that the results will yield information about prehistoric lithic raw material procurement and the organization of technology. The expected pattern, given a simple model of direct procurement embedded within seasonal transhumance, is that debitage will be more numerous, larger, and retain more cortex at sites that are nearer the source and will be less numerous, smaller, and retain less cortex with increasing distance from the source. If the data deviate from the expected pattern, then the model may be incorrect and other models that better explain the distribution of the data can be examined.

In addition to the proposed lithic source studies, detailed analysis will be conducted on obsidian artifacts collected during data recovery efforts. Obsidian artifacts of sufficient size for study will be submitted for trace-element analysis to identify geologic source. Obsidian recovered from sites in northwest Colorado has been analyzed and found to originate primarily from Wyoming, Utah, and Idaho quarries. Complementing ongoing obsidian analysis study initiated by the WRFO, sourcing data will be correlated with each site’s period(s) of occupation to examine prehistoric exchange patterns through time.

Ground Stone Trends

Ground stone artifacts recovered during the data recovery will be subjected to analytical and interpretive procedures similar to those applied to flaked stone tools. Characteristics of grinding implements, such as material type, morphology, size, grinding surface area, and use wear patterns, will be examined with the goal of determining function and the nature of the processed materials. The contexts of ground stone tools will be carefully analyzed in an attempt to define tool kits, taking into consideration relationships with thermal features and/or domestic work areas. Tool function and assemblage composition will, in turn, permit inferences about food-processing technologies, subsistence, and economic strategies. Ground stone technologies can also be related to mobility practices, particularly in degree of intensity of manufacture and use (Adams 1999; Nelson and Lippmeier 1993).

Traditional analysis of ground stone artifacts includes measurement of length, width, thickness, and use area, and the characterization of manufacture, shape, form, and use surfaces. The analysis of ground stone artifacts otherwise will be based largely on the work of Adams (1997, 1999, 2002), who has integrated experimental and ethnographic information with technological data to gain insight into prehistoric subsistence practices. Microscopic analysis of manos will be undertaken in order to determine if they were used in vegetal or hide processing. Pollen washes will be taken from the working surfaces of buried manos and metates to gain insight into the types of plants processed. A sample of ground stone artifacts will also be subjected to protein residue analysis to identify the potential types of processed animal resources.

Ceramics

Although no ceramic artifacts were observed during recording any of the recordings of sites

5RB.4558 and 5RB.8902, the presence of ceramics at either site is possible. Both sites are within the geographic ranges of several ceramic manufacturing cultures. Should ceramics be identified at these sites, analysis of three different aspects of ceramic production (materials, manufacturing technology, and decoration) will be examined. Dating the appearance of different pottery styles is also an important research objective (Reed and Metcalf 1999). This is best accomplished by thermoluminescence dating of ceramic sherds, a method that avoids the "old wood problem" associated with many radiocarbon and dendrochronological dates. Such studies may affirm artifacts commonly used as diagnostics of Ute or Shoshone culture in the region, such as Uncompahgre Brownware, Intermountain Ware, and Desert Side Notched points, and the temporal range of use. Ceramic artifacts can also provide information on what they were used for through materials analysis of residues and can also provide chronological information through the radiocarbon dating of these residues.

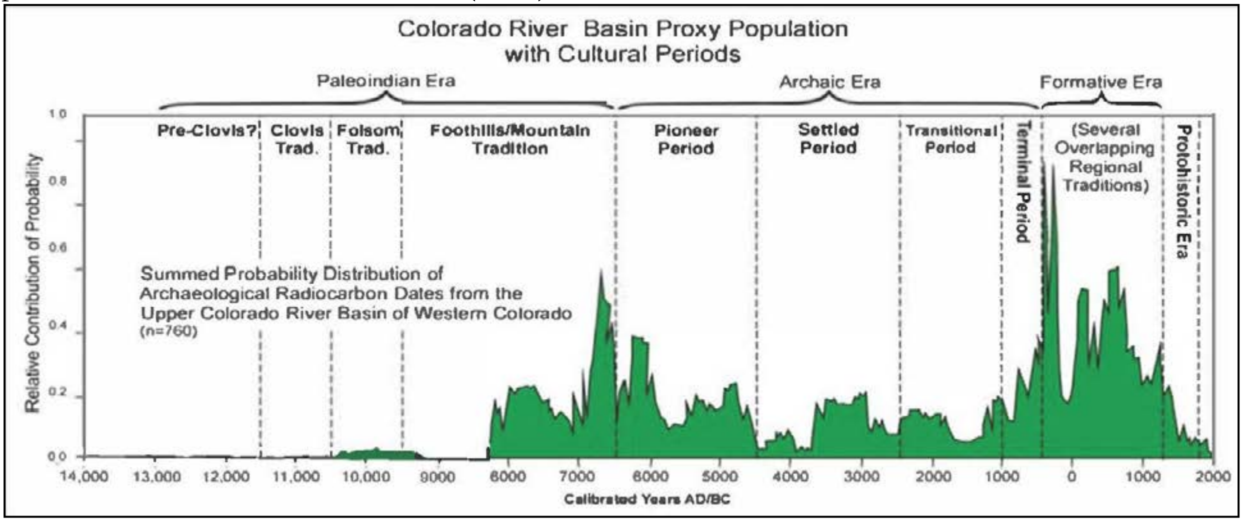
(2) Synthesis and Interpretation of the Recovered Archaeological Materials

Research Domain 1: Paleoenvironment

If culture is adaptive, then changes in the technological aspects of culture that interact with the environment should accompany significant changes in climate. Population size also influences culture, since population size and density has a direct association with the carrying capacity of any particular environment within the limits established by the technological, social, and ideological interaction any culture has with the environment. Although it has been demonstrated that extended periods of drought influenced prehistoric cultural adaptations, it is periods of high variability in climate that apparently have a greater coincidence with episodes of rapid cultural change. Recent models developed to explain changing patterns of subsistence, settlement patterns and sociopolitical organization observed in the archaeological record for western Colorado have cited changing environment and increasing population as the major drivers of cultural change in the region. The shift from a more generalized forager subsistence pattern based on a high degree of residential mobility and relatively low population density to one relying on more intensive procurement and processing of critical resources has been explained as a response to a combination of changing environment coupled with increasing population pressure (Gilmore 2008). The initial shift from a less intensive subsistence pattern to an economy increasingly reliant on more intensive procurement and processing of lower yield resources accompanied by increased elaboration of social systems is hypothesized to have begun in the Terminal Archaic Period ca. 2500 B.P. and continued through the transition between the Archaic and Formative eras, as reflected in proxy population represented by summed probability distributions of radiocarbon dates in Reed and Metcalf (1999). Understanding the paleoenvironmental context in which these changes occurred would be vital to the interpretations of why these changes occurred at this time.

Luckily, there are records of paleoclimate relevant to western Colorado and the surrounding region that provide sufficient resolution for examining high frequency—high amplitude climate variability. Hopefully, paleoenvironmental information will be available within the site itself. Although terrestrial deposits are not usually amenable to preserving high-resolution continuous records of paleoenvironment in the way that lake or wetland sediments often do, under certain conditions they can provide a snapshot of conditions during longer periods of time or at the time of a specific depositional event. The sediments on site will be examined to determine if any information can be derived from the morphological characteristics, post depositional changes, or microfossil content that may pertain to paleoenvironmental changes relevant to the occupation of the site. The interpretation of any acquired paleoenvironmental data would rely on existing regional frameworks.

Figure 1. Proxy prehistoric population of the Upper Colorado River basin and cultural periods. Data from Reed and Metcalf (1999).



An attempt to discern cultural affiliation at 5RB4558 and 5RB8902 will be accomplished by reviewing the appropriate literature to develop a culture context in tandem with cross-dating diagnostic materials with radiocarbon and/or dendrochronological dates procured from these sites. Data recovery at these sites will also be applied towards regional studies in settlement and subsistence patterns. For instance, in western Colorado, excavated Ute sites evidence much less reliance on plant foods than their Fremont-era foraging predecessors, and more intensive procurement of deer (Reed et al. 2001). The initial shift from a less intensive subsistence pattern to an economy increasingly reliant on more intensive procurement and processing of lower yield resources accompanied by increased elaboration of social systems is hypothesized to have begun in the Terminal Archaic Period ca. 2500 B.P. and continued through the transition between the Archaic and Fremont eras, as reflected in proxy population represented by summed probability distributions of radiocarbon dates in Reed and Metcalf (1999). Understanding the paleoenvironmental context in which these changes occurred would be vital to the interpretations of why these changes occurred at this time. The interpretation of any acquired paleoenvironmental data would rely on existing regional frameworks; it is plausible that similar patterns are evident in the study area, because the population decline that followed the Fremont period appears to have been region wide.

Research Domain 2: Site Function

Settlement and subsistence strategies are concepts that are mutually inclusive. Settlement strategy is largely constrained and conditioned by the availability (seasonality and patchiness) of food resources, while subsistence strategy is conditioned by the types of resources in a given environment. Consumers mitigate the relative availability of resources by structuring their method of procurement in a way that best fits the relative abundance of primary resources. Optimal foraging theory evaluates return rate (in calories) against energy expended to find, procure, transport, and process a given resource (Kelly 1995; Smith and Winterhalder 1992). Settlement and subsistence data at 5RB.4558 and 5RB.8902 is not expected to be sufficiently robust to address large-scale models such as optimal foraging. Rather, data in the form of the hearth features and lithic technology will be used to address regional settlement models and to address more modest research domains such as settlement type and subsistence base. Macrobotanical remains from feature fill could provide information not only on subsistence practices but also on the seasonal use of sites. Population movements were often in response to what resources (both plant and animal) were available at certain times of the year.

Hunter-gatherer mobility has been traditionally organized along a continuum that places sedentary groups (collector strategy) on one end of the spectrum and highly mobile hunter-gatherers (forager strategy) on the other. It is important to recognize that all indigenous groups practiced some level of residential mobility (i.e., periodic movement of the entire group to a new location), whether undertaken frequently, seasonally, yearly, or even at the decadal scale. As conceptualized by Binford (1980), a collector strategy is equated with low residential mobility wherein resources are collected by specialized task groups (logistically organized hunters and gatherers) and brought back to a permanent residence for consumption; in other words, resources are moved to consumers. Conversely, a forager strategy involves relatively frequent (however defined) residential moves so that the consumers are moved in relation to the resources. Understanding this model is to appreciate where across the continuum a particular group occupies in terms of mobility. For example, hunter-gatherers of the Great Basin have been conceptualized as occupying the extreme end of the foraging side of the continuum (Jennings 1978; Steward 1938), perpetually in motion to bring consumers to the resources in an environment where resources are spread unevenly (patchy) across the landscape.

On the extreme collector side of the continuum is the Pueblo IV period of the Southwest and the Late Prehistoric, littoral-based Northwest culture areas. Abundant resources such as maize horticulture and marine resources, respectively, tether these groups to a relatively permanent residential village; these villages may not change location for a generation or more. It is easy to place these examples at the ends of the continuum, but it becomes more problematic for those groups who do not fit so neatly within the continuum. There also may be disparity between how ethnographers conceptualize the forager-collector continuum and that recognized by archaeologists from the material culture record. Local perspective becomes significant when defining what constitutes mobility and whether this correlates to foragers or collectors. Resource availability and paleoenvironmental conditions will condition the perspective and provide the parameters from which to generate expectations from the archaeological record.

Research Domain 3: Technology

Given the ambiguity of the available data, and the poor preservation of organic materials in open sites, stone tool technology offers a viable research avenue to evaluate diachronic changes in settlement and subsistence practices. Semi to permanent residences should exhibit an informal stone tool technology (provided raw material is readily available) with fewer bifaces and other formed tools and a higher frequency of modified and utilized flakes (cf. Parry and Kelly 1987); on the other hand, mobile foragers tended to produce a more formalized tool kit to maximize dependability and reliability with a proven form (such as the versatility of bifaces), and practice conservation through rejuvenation. Temporary campsites occupied by logistically organized collectors will exhibit a more mixed stone tool technology, with both local and non-local raw material and both formal and expedient tools provided that local raw material is abundant and easily accessible. Metcalf and Reed (2011:134) report three main lithic raw material types occurred in sites in their project areas and are considered local to the region of Colorado overlapping with the project area. These included: “Bridger” or “Banta Ridge” chert found in the Bridger Formation, with major outcrops in the Sand Wash Basin as well as in sources in northeastern Utah and southern Wyoming; “pumpkin” chert derived from the Morgan and Madison Formations, with major outcrops on Cross and Juniper Mountains; and, a quartzite from the Uinta Mountain Group, a formation also with outcrops on Cross and Juniper Mountains. Notably, the Bridger chert exhibited its highest occurrence in the Early Archaic and Late Prehistoric occupations.

Expedient or informal technology (e.g., modified flakes) and curative (formal) technologies (e.g., bifaces) reflect the amount of effort invested in a stone tool. According to widely accepted theory (i.e., Hayden et al. 1996; Kuhn 1986, 1989; Odell 1996; Torrence 1989), stone tool technology reflects relative mobility by evaluating the investment of time and effort into tool design, incorporating such concepts as reliability, maintainability, flexibility, versatility, and portability. Expedient technology tends to be utilized when raw material is readily available (Andrefsky 1994; Bamforth 1986; Parry and Kelly 1987) and conservation is not required because the activity is scheduled and predictable. Non-standardized forms such as modified flakes, for example, are not flexible (ability to be changed into a different form easily) or reliable (not overdesigned or of good craftsmanship).

Curated technologies such as bifaces require a period of 'gearing up' in anticipation of activities that are unpredictable (requiring highly versatile and flexible technology), when the availability of new raw material is uncertain and transport cost (i.e., weight) is an additional consideration. According to Parry and Kelly (1987), an expedient technology correlates well with more sedentary societies whose technological requirements are generally not specialized, access to raw material is consistent, and transport costs are not a factor. Bifaces are particularly specialized, for example, in that they retain cutting edge through retouch, are versatile as cores for producing expedient flakes for additional cutting implements, and as blanks (flexibility) for producing new formal tools (Kelly 1988). When considered as cores (Kelly 1988), bifaces provide additional versatility for their ease of transport and low weight to utility aspect.

Other formal tools, such as end scrapers, drills, and projectile points, are more informative for inferring the range of activities performed on a site such as hide working, wood working, and hunting. Cores can be broadly categorized similar to bifaces in that cores can reflect the availability of raw material, general mobility and range, and the distribution of task-specific localities across the landscape. Specialized cores will exhibit unidirectional flaking patterns while multi-directional patterns reflect an ad hoc approach to core reduction, perhaps indicating the relative abundance of raw material. Examining use wear and secondary retouch can provide information (by referencing experimental work, e.g., Keeley 1980 and Odell 1996) related to the type of activity (i.e., cutting, scraping), the material against which the tool was used (i.e., wood, bone, vegetal), and diachronic changes in tool use (recycling).

At the assemblage level, flake analysis provides a complementary data set for the interpretation of raw material procurement strategies and the organization of stone tool technology. Debitage assemblages are typically dichotomized between core reduction and stone tool manufacture, each identified by a specific frequency of flake morphology correlates. On a general level, core reduction is identified with a high frequency of relatively large, complete, and cortical flakes; an emphasis towards biface production or formalized stone tool manufacture is identified in assemblages with flakes that are relatively small and exhibit non-cortical complex exterior surfaces and complex platform characteristics. Late stage stone tool manufacture and edge rejuvenation is further identified by flakes with extremely complex exterior surfaces (i.e., the relative number of flake scars), pronounced curvature, and platforms that exhibit multiple facets, are ground, and often are lipped.

This is an overly simplistic description of the continuum between core reduction and final stone tool production, but the characteristics representative of the two lithic strategies have been replicated repeatedly during experimental studies (Hall and Larson 2004). Expectations for lithic assemblages and site function fall under the following:

- Collector—Residential Site: A mix of both local (e.g., pumpkin chert) and non-local raw material should be present; predominantly late stage flaking debris from rejuvenation of formal tools and an expedient strategy evident within the local chert assemblage consisting of predominantly middle stage flaking debris. High rate of tool discard and manufacturing failures expected. Ground stone used to exhaustion and recycled.
- Collector—Logistical Site: Debitage assemblage should be dominated by late stage biface manufacture and rejuvenation; few reworked and discarded formal tools. Ground stone should be rare to nonexistent and if present should represent more expedient forms (hand stones and milling slabs). Gathered resources will be transported and not processed.
- Forager—Residential Site: High frequency of formal, standardized and reliable forms; exhausted bifaces common; discarded tools used to exhaustion; non-local lithic material should constitute a higher percentage of the assemblage with less frequency of local material; and late stage and edge rejuvenation flakes should dominate the assemblage. Ground stone should be common (representing immediate consumption) and not used to exhaustion—complete ground stone tools should be common unless they've been recycled as fire-cracked rock. Repeated use of the site should result in highly fragmentary fire-cracked rock due to being recycled.
- Given the discussion above on evaluating settlement and subsistence strategies, the following generalized research questions are suggested:
    - Site chronology: Are there multiple components represented at both sites?
    - Site seasonality: is it possible to determine what time of year the site was occupied, and is it possible to determine what resources were gathered during particular seasons?
    - Site function: is it a logistical, specialized task location, or a residential base?
    - Is there evidence of the specialized tool kits associated with logistical sites, or is there a wide range of activities and technologies represented, indicating a residential base?
    - What does the biface technology tell us about mobility in relation to the forager/collector continuum?

DATA RECOVERY PLAN

The two NRHP-eligible sites documented during this project are prehistoric open camps with hearth features. This site type requires little to no site testing compared to a typical phased testing approach because these sites contain cultural features that can serve as the foci for data recovery investigations. Following site management discussions with the Southern Ute Indian Tribe on August 7, 2019, the Ute Mountain Ute on October 2, 2019, and the Ute Indian Tribe on January 20, 2020, the known hearth features at 5RB4558 and 5RB8902 will be fully excavated to identify the extent of subsurface cultural deposits. Both sites will also be subject to narrowly-spaced pedestrian transects to identify diagnostic flaked and ground stone tools or previously unknown features. If applicable, newly identified and/or possible features will be shovel tested to determine the presence of subsurface artifacts and deposits. Artifacts subject to collection and curation include all diagnostic flaked and ground stone artifacts identified on the surface, and all artifacts unearthed during data recovery. If data recovery and/or testing determines that a site does not contain significant cultural deposits, then the site eligibility will be reevaluated, and consensus determinations of eligibility obtained.

The mitigation approach for this site category is described below. The plan is specific enough to establish the parameters for data recovery at each site, but are not intended to be a rigid prescription for the activities that should be carried out at each site. Although the plan is moderately detailed, much is left to the judgment of the archaeologists who will conduct the work. In that sense, these plans should be regarded as guidelines, with the specific measures to be tailored to either site and ultimately determined in the field.

Prehistoric Open Camps with Cultural Features

Both sites, summarized in Table 1, comprise prehistoric lithic scatters, with cultural features represented by discrete concentrations of charcoal-stained soil, fire-cracked rock (FCR), or both. Both of these sites appear to have the potential for buried cultural deposits as suggested by their presence of hearth features, though their respective depositions settings indicate shallow and deflated soils are likely to be encountered during data recovery. Unlike prehistoric sites that lack visible cultural features, data recovery at sites with features can proceed with little or no testing, although it is recommended that data recovery work begin with intensive transecting (e.g., transect interval of 2 or 3 m) of the site surface to identify lithic tools or temporally diagnostic artifacts, FCR, or charcoal stains denoting the possible presence of previously-undetected cultural features, and artifact concentrations. Although the site surfaces were examined during the inventory, more intensive examination can sometimes yield additional information that was missed during the survey work.

Table 1. Prehistoric Open Camps with Cultural Features in the Proposed Sale of 6 Parcels in the Strawberry Creek and Grand Hogback Project Area.

Site Number	Temporal/Cultural Affiliation	Site Description
5RB4558	Unknown prehistoric	Light scatter of lithic debris, a ground stone mano, a thumb scraper, a scraper fragment and a possible hearth feature
5RB8902	Unknown prehistoric	Sparse scatter of lithic tools, flakes, ground stone and heat-fractured cobbles comprising three loci that may represent separate camping areas. A small hearth feature is evident among one concentration of heat-fractured cobbles.

Lithic tools and temporally diagnostic artifacts found on the surface should be mapped and collected. If few lithics are subsequently recovered from excavation units, it may also be necessary to collect a substantial sample of lithic debitage from the site surface, to be analyzed in the laboratory for the purpose of characterizing lithic-reduction strategies. However, if substantial debitage is recovered from site excavations, it should not be necessary to surface-collect debitage. In any case, both sites exhibited minimal debitage in surface contexts.

Data recovery will focus on exposed cultural features. A site grid oriented to true north will be established using a total station or optical transit and all units be tied into the grid. At least one corner of the grid will be mapped using a Global Positioning System (GPS) unit capable of submeter accuracy. Vertical control will be maintained by means of a laser level or a physical datum such as a rebar with an attached datum line. Excavation will proceed by 10-cm levels or by natural or cultural strata, if identifiable. A minimum of a 2-x-2-m block (excavated by l-m^2 units) will be laid out and excavated in a controlled fashion over each cultural feature. A block of this size is recommended instead of a single 1-x-1-m unit because it will allow an assessment of the possible presence of associated artifacts or occupation zones close to each feature, whereas a single 1-x-1-m unit will, in many cases, not be large enough to capture materials or identify associated occupation surfaces. Because the goal will be data recovery rather than merely feature salvage, this approach will be superior in terms of yielding interpretable data.

All features will be excavated in their entirety: they will first be exposed and mapped in plan view, then bisected and profiled, and then the other half excavated, with photographs taken at each stage of excavation. At a minimum, samples of radiocarbon dating will be collected from each feature and submitted to a radiometric data facility. Samples of fill for flotation and recovery of macrobotanical remains should also be systematically collected from all excavated thermal features and considered as potential sources for radiocarbon samples. If few or no artifacts are recovered from areas adjoining the feature, or if no occupation zone is discerned, excavation can be terminated after the feature and its associated 2-x-2-m block have been fully excavated. If associated artifacts are found, or a discrete, well-defined occupation surface or zone is detected, the 2-x-2-m block should be expanded to capture as much of the associated component as possible, up to a maximum of a 5-x-5-m block per feature. If multiple features are identified upon revisiting the site for data recovery, only the two most promising feature areas will be expanded beyond the initial 2-x-2-m block into, potentially, a maximum of a 5-x-5-m block. Thus, the total minimum amount of data recovery excavation at either site would potentially be 4 m^2 per cultural feature. The fill from all units should be screened through ¼-inch (in.) mesh, except for uncollected cultural feature fill, which should be screened through ⅛-in. mesh. All excavations will be carefully backfilled after data recovery has been completed.

Extensive testing should not normally be necessary at sites with cultural features. However, should some reason for testing become apparent during work at these sites, it should proceed according to the general schemes described below.

Testing can involve a variety of methods, including manual augering, use of a motorized auger, shovel testing, shovel trenching, backhoe trenching, and geophysical survey. Three of these methods- motorized augering, backhoe trenching, and geophysical survey-are ill-suited for sites with shallow, rocky sediments that characterize most of the area around the Strawberry Creek project sites. Therefore, these methods are not recommended for either of the Strawberry Creek sites and will not be discussed further. The most effective methods for testing such sites include manual augering (using a 10-cm-wide bucket auger), shovel testing, and shovel trenching. Manual augering is effective for assessing soil depth and the presence or absence of buried cultural features, stained occupation surfaces, or charcoal-rich horizons. Augering is not as effective at detecting buried components that consist mainly of artifacts, because the auger's narrow bucket does not sample a sufficiently large volume of sediment. To identify the presence of subsurface artifacts, shovel testing is more effective. Although more labor intensive, shovel testing results in the sampling of a much greater volume of sediment within each test, resulting in efficient detection of buried artifacts as well as cultural features, horizons, and subsurface soil staining. Shovel trenching is even more labor intensive than shovel testing and is mainly useful for finding cultural features. The principle is the same as for backhoe trenching but on a much smaller scale; intensive, small parallel trenches excavated across areas suspected to contain cultural features have a high likelihood of finding such features if they exist. A major disadvantage of shovel trenching is that it can destroy or otherwise impact the occupation surface or zone associated with the features that one is attempting to locate. For that reason, it is not recommended except in cases where the component has already been well investigated and the goal is simply to find additional features for sampling purposes. Ultimately, the decision to use one or more of these testing methods should depend on a variety of factors including site size, the nature of the sediments, and the distributions of cultural materials on the site. A typical testing scheme that might employ augering and/or shovel testing is described below.

After close-interval pedestrian transecting of the entire site area to locate artifacts and identify the best areas to begin the investigation, testing can begin with either a series of manual auger probes or shovel tests spaced in rows at regular intervals (e.g., 2-5 m). The probes or tests might first be spaced 5 m apart. If positive results are not obtained using 5 m intervals, then additional, more closely spaced tests can be excavated. Multiple parallel rows will ultimately result in a grid pattern of test holes across the tested site area. Since the primary goal of data recovery is to locate and recover cultural features, augering will be an effective method of detecting buried soil staining or charcoal associated with such features, especially if large areas must be tested. Positive auger probes can be further investigated with either additional auger probes radiating outward from the positive probe at closer intervals (e.g., 0.5-1 m), or 30-cm-wide shovel tests arrayed in the same pattern to delineate the extent of the subsurface staining or charcoal or to find its source. Alternatively, shovel tests alone might be used if the area to be tested is of a more manageable size. Both methods have their advantages and drawbacks, and the decision to use one or the other might be reserved until more is known about each site following additional surface examination.

Focused testing provides an alternative approach to the site-wide systematic testing described above. This approach centers on the idea that cultural features and activity areas on prehistoric sites tend to be in close proximity to domestic items such as ground stone or pottery. Therefore, initial test excavations-consisting of auger probes, shovel tests, or even individual 1-m^2 units could focus on areas where ground stone implements or potsherds are present. This approach presumes that these surface artifacts have not moved substantially since the prehistoric occupation. If clear indications are seen that the artifacts have been post-occupationally transported and secondarily deposited, this approach has little merit. This approach could easily be combined with site-wide systematic testing to ensure the site is properly evaluated during data recovery. The presence of FCR, as on site 5RB8902, can also guide the placement of excavation units, because the FCR may give away the presence of nearby features.

If testing as described above reveals no evidence that substantial buried cultural deposits are present on the site, work may be terminated following consultation with the BLM. If auger probing or shovel testing reveals the presence of buried cultural materials, data recovery in the form of single or contiguous 1-m^2 units excavated in a controlled fashion can commence in the area where buried artifacts, soil staining, or charcoal was found. A site grid as should first be established prior to commencing excavation per the procedures described above (e.g., excavating 10-cm levels or by natural or cultural strata, if identifiable). When seeking to identify the nature of the subsurface deposits, it is recommended that excavation begin with individual 1-m^2 units, expanding them into blocks if intact cultural deposits are encountered and continued excavation is justified. A maximum of 25 m^2 of excavation per site, preferably in the form of a 5-x-5-m block, is recommended. A block of this size is essentially the minimum area in which meaningful spatial patterning can be discerned. However, a block this size is only justified if each expansion unit continues to yield important data in the form of artifacts or cultural features. If not, a smaller excavation area, such as a 2-x-2-m or 3-x-3-m block, may prove to be sufficient to mitigate the site. The fill from all units should be screened through ¼-in mesh, except for uncollected cultural feature fill, which should be screened through ⅛-in. mesh. All excavations will be carefully backfilled after data recovery has been completed. Encountered cultural features should be excavated in their entirety as discussed above.

REPORTING

Within 90 days following data recovery, the contracted archaeologist will prepare and submit a draft archaeological data recovery report to the WRFO, which shall account for site evaluations. An extension request of this deliverable date will be considered by the WRFO and, if granted, will not exceed 180 days following the completion of fieldwork. As with all other reports, this document will meet the Secretary of Interior's Standards, as well as the Colorado OAHP Report Guidelines, the BLM Handbook, and the *2020 Procedures and Reporting Standards for Cultural Resource Consultants Conducting Projects under a CRUP Permit for the Colorado Northwest District, Bureau of Land Management*. The BLM will review the draft report for completeness and for appropriate incorporation of review comments prior to its acceptance. At a minimum, copies of the report will be made available to the SHPO and the BLM.

ARTIFACT CURATION

A curation agreement is necessary for the issuance of excavation permits from the BLM and OAHP. The permitted archaeologist will be responsible for acquiring a curation agreement with the Museum of Western Colorado, a certified federal repository, for all materials excavated from federally-administered land during data recovery. The curation fee will be determined after the number of artifacts requiring curation is determined following the conclusion of the data recovery.

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Appendix A: Map of 6 Parcels Proposed for Sale in the Strawberry Creek and Grand Hogback Area

Figure 1. Overview Map of Proposed Land Sale.

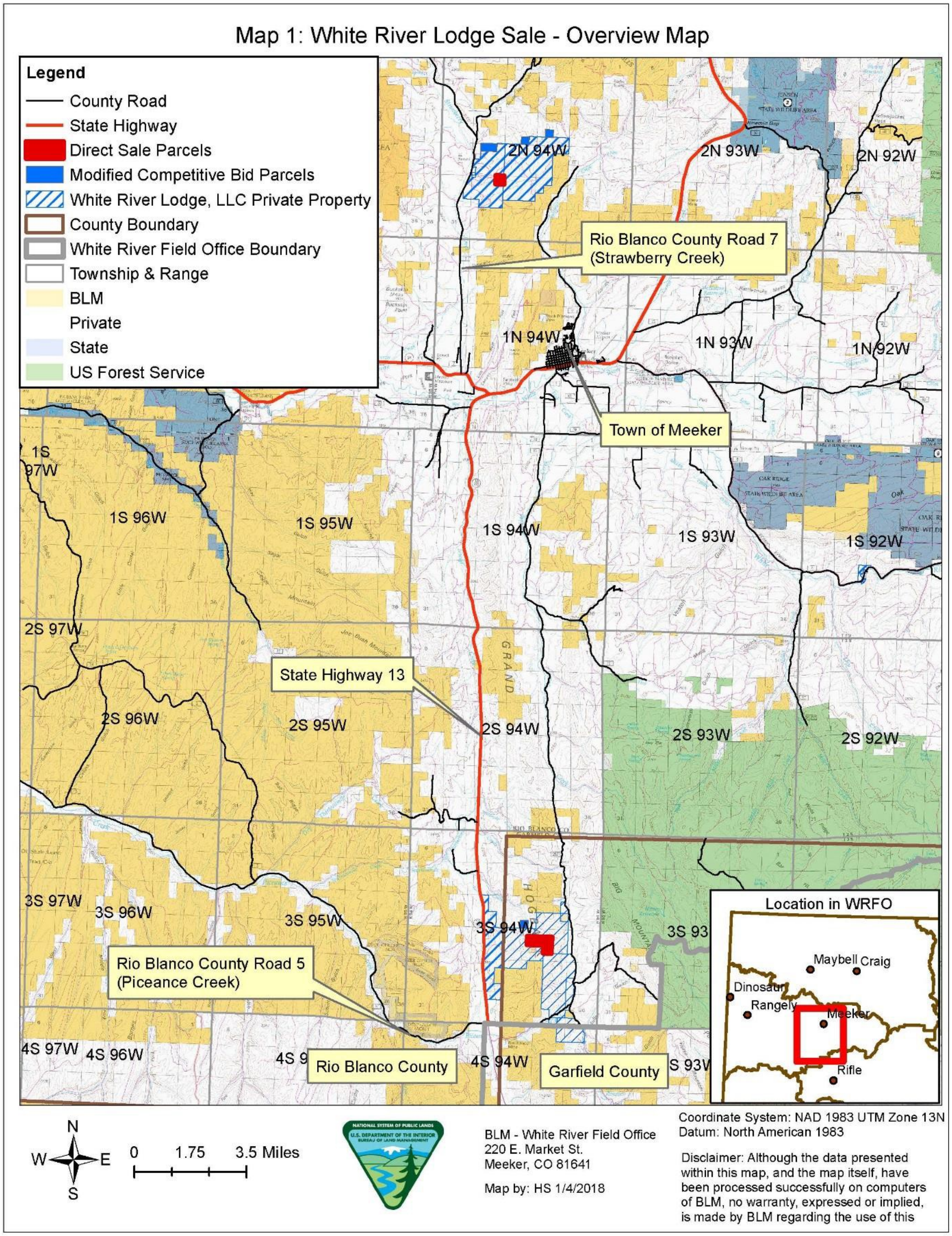


Figure 2. Map of the Strawberry Creek Parcels.

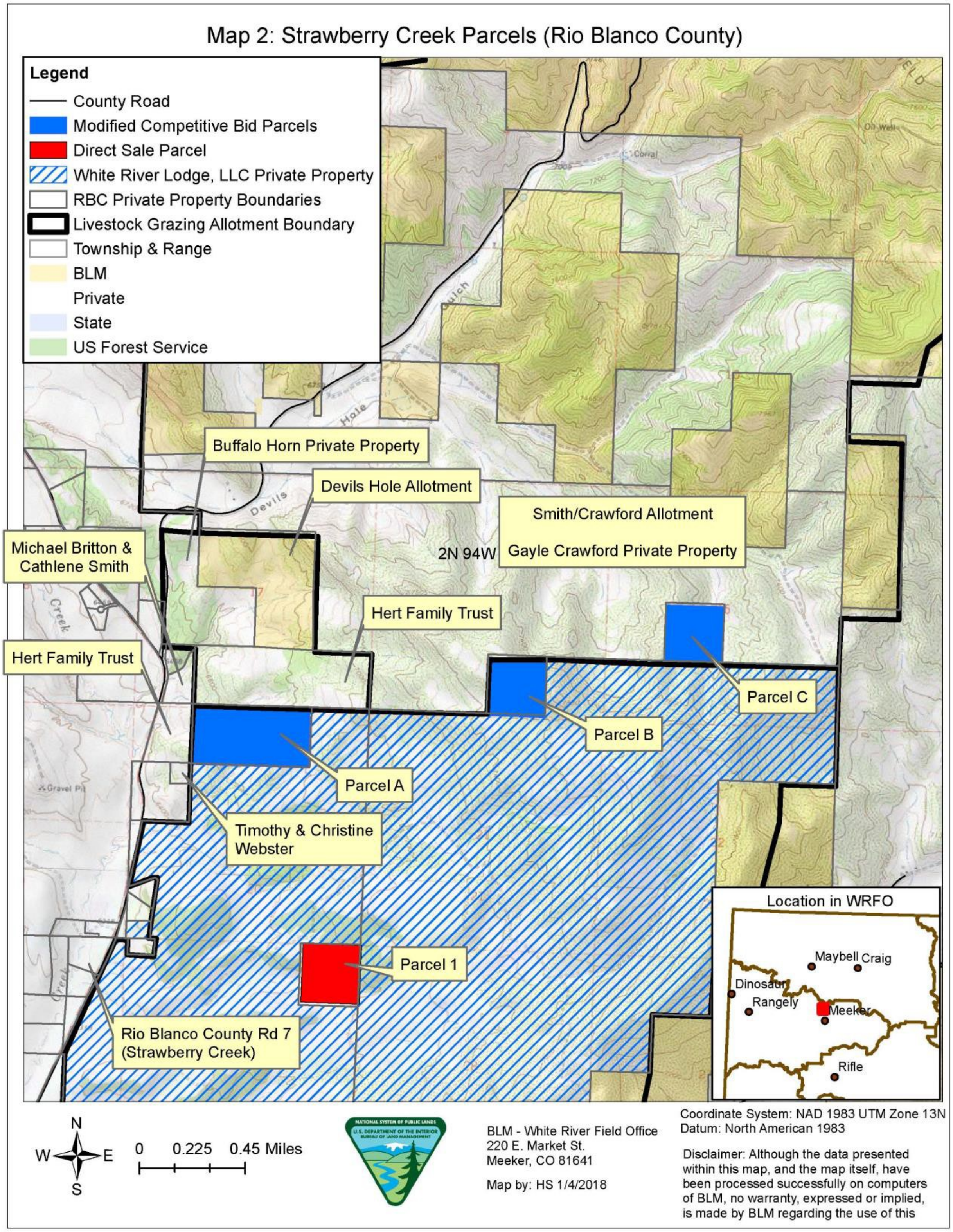
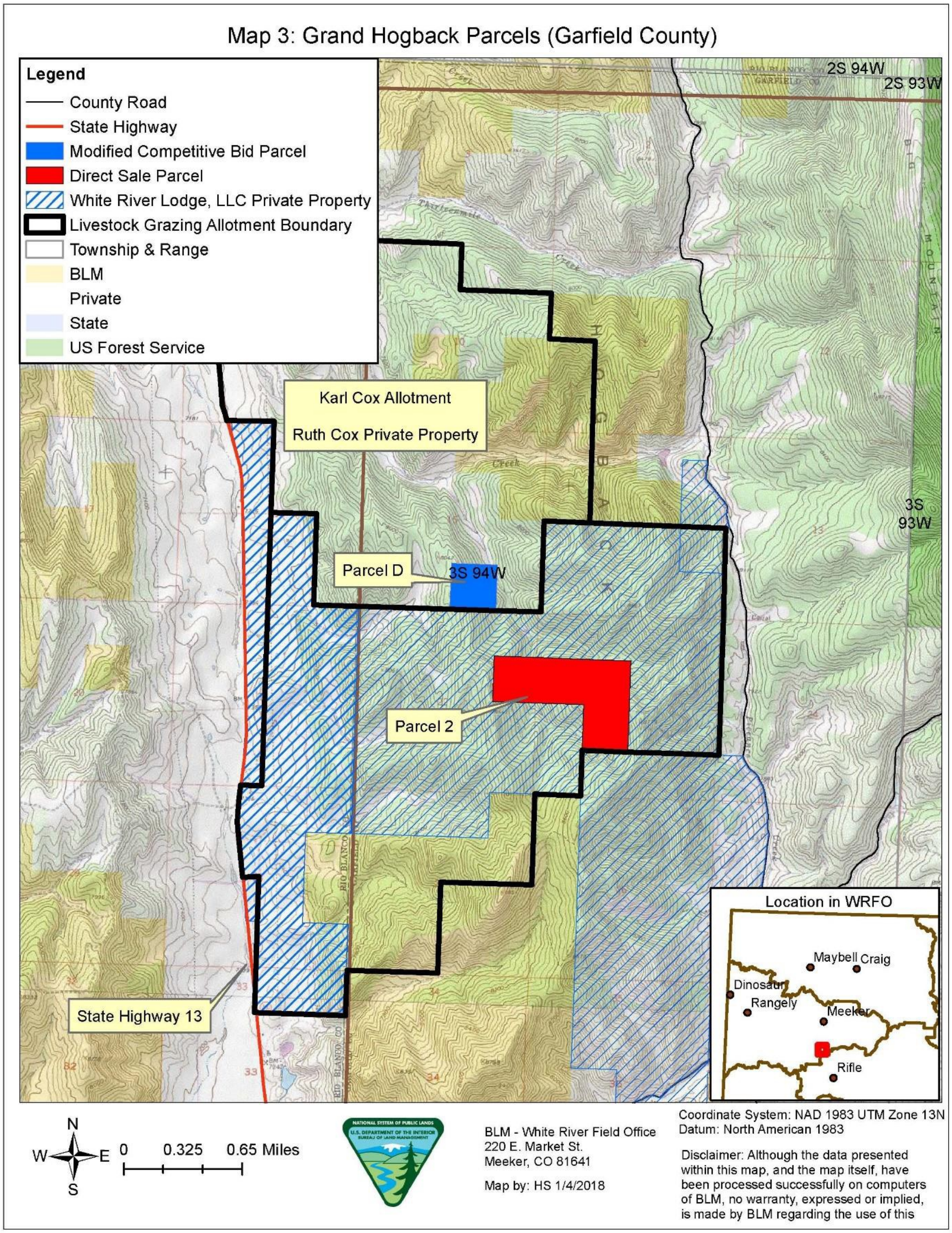


Figure 3. Map of the Grand Hogback Parcels.



Appendix B: Eligible Sites Table

Appendix B
Strawberry Creek Area with Eligible Sites

Site Number	**Location**	**Temporal/ Cultural Affiliation**	**Site Type**	**Site Description**	**NRHP Evaluation**
5RB4558		Unknown prehistoric	Open camp	Light scatter of lithic debris, a ground stone mano, a thumb scraper, a scraper fragment and a possible hearth feature.	Eligible
5RB8902		Unknown prehistoric	Open camp	Three loci that apparently represent separate camping areas potentially by the same cultural group during the same time period. Characteristics of the loci include comparable ground stone types, clusters of heat-fractured cobbles with one suggesting a small hearth feature, and a low density of lithic tools and flakes.	Field Eligible

Appendix C: Human Remains Discovery Plan

HUMAN REMAINS DISCOVERY PLAN

If Native American human remains and associated NAGPRA cultural items are discovered on federal lands the discovery shall be treated in accordance with the provisions of NAGPRA and its implementing regulations at 43 CFR 10. If other human remains are discovered on federal land, the discovery shall be treated under 36 CFR 800. The following procedures will otherwise be followed upon the discovery of human remains and associated cultural items.

Coordination and Notification

Upon a discovery believed to contain human remains, work will immediately be halted in the vicinity of the discovery and the BLM-WRFO Authorized Officer shall be notified immediately by telephone. The Authorized Officer will ensure coordination with law enforcement personnel; the Authorized Officer will notify the County Sheriff, who will contact the County Coroner. If law enforcement and the County Coroner determine that the remains are not modern or do not reflect a crime scene and/or if they otherwise relinquish their jurisdiction over the remains, the BLM will assume responsibility for the human remains. If jurisdiction is assumed by the BLM, the BLM will record, evaluate, and treat the remains.

BLM will ensure that a determination is made if the human remains are Native American. If the human remains are Native American, the BLM Authorizing Officer has three working days to notify by telephone or in person, with written confirmation, the Indian tribes identified through regulation 43 CFR 10(d)(1)(iii). This notification shall include pertinent information as to the nature of the human remains, an estimated number of individuals present, their estimated ages, (i.e., adult, juvenile, infant), and their estimated sex (if possible to determine) as well as their condition and the circumstances of their discovery. BLM will select the appropriate mitigation option within 10 working days of the discovery based on the input received.

Steps to Protect

If human remains are discovered, BLM shall take steps to ensure that no additional disturbance shall take place and all work within 100 feet of the discovery will cease immediately. The 100-foot radius shall be secured and all personnel and equipment shall be excluded from the area to the extent practicable until a determination is made regarding the next action. Undisturbed human remains will be left in place. Steps will be taken to stabilize the human remains, if necessary. It may be necessary to provide 24-hour, on-site security for discoveries of human remains as determined by the BLM in consultation with Tribes and SHPO. All human remains and associated NAGPRA cultural items shall be treated with dignity and respect.

Identification

With the assistance of the County Sheriff, the County Coroner, and, if necessary, a forensic anthropologist, an archaeologist will assess the exposed bones (without further disturbance) to determine whether they are human and, if so, whether the remains are Native American. All human remains and associated NAGPRA cultural items will be protected from further damage until treatment is completed.

For any discoveries of non-Native American human remains and associated cultural items, BLM will attempt to locate claimants or next-of-kin and transfer custody to them. The BLM will consider unclaimed human remains and associated items for reburial or as federally owned and administered archaeological collections under 36 CFR 79.

Recording and Treatment

An archaeologist will record the location of the discovery with a GPS instrument and will immediately evaluate the integrity of the human remains and any associated cultural items, staining, or features. Pertinent information as to the nature and extent of human remains identified, an estimated number of individuals present, their estimated ages, i.e., adult, juvenile, infant), and their estimated sex (if possible to determine) as well as their condition and the circumstances of their discovery.

In consultation with the appropriate culturally affiliated tribe(s), BLM will develop a Plan of Action for the treatment of Native American human remains and associated cultural items in accordance with 43 CFR 10.5.

Resumption of Activity

Pursuant to 43 CFR 10.4(d)(2), the data recovery activity that resulted in the inadvertent discovery may resume in 30 calendar days beginning with the BLM certification of initial notification. All reasonable measures will be taken to resolve any issues regarding affiliation and disposition of discovered human remains within this 30-day period. The measures to protect the human remains and any associated cultural items and artifacts will remain in effect until the BLM-WRFO Authorized Officer (for discoveries on BLM land) authorize resumption of activity in the buffer zone. The activity may also resume, if otherwise lawful, at any time that a written, binding agreement is executed between BLM and the affiliated Indian tribe(s) that adopt a plan for the treatment of the human remains and/or NAGPRA objects following 43 CFR 10.3(b)(1). The BLM-WRFO Authorizing Officer will authorize the resumption of activity when the treatment of the human remains and associated cultural items are completed.

APPENDIX B: PHOTO GALLERY

PHOTOGRAPHS OF EXCAVATION PROGRESSION
FLOOR OF SMALL CONICAL LODGE 5RB8902 FEATURE 3

Photo 188, north
Surface clearing and exposure of ashstain

Photo 190, north
Grid extablishment and identification of Feat.2 hearth

Photo 192, north
Feature 2 exposed

Photo 195, south
Feature 2, hearth

Photo 234, West. Floor features are observable: hearth south of yellow tape; moccasin tracks at end of tape (north and south); seating area at 0mN -1mW (just north of pin).

Photo 210, North. Floor features are observable. Notable are tracks west of pin "walking" to south. Several tracks visible just north of tape, near center pin.

Photo 212, North.

Photo 214, North.

Photo 222, North.

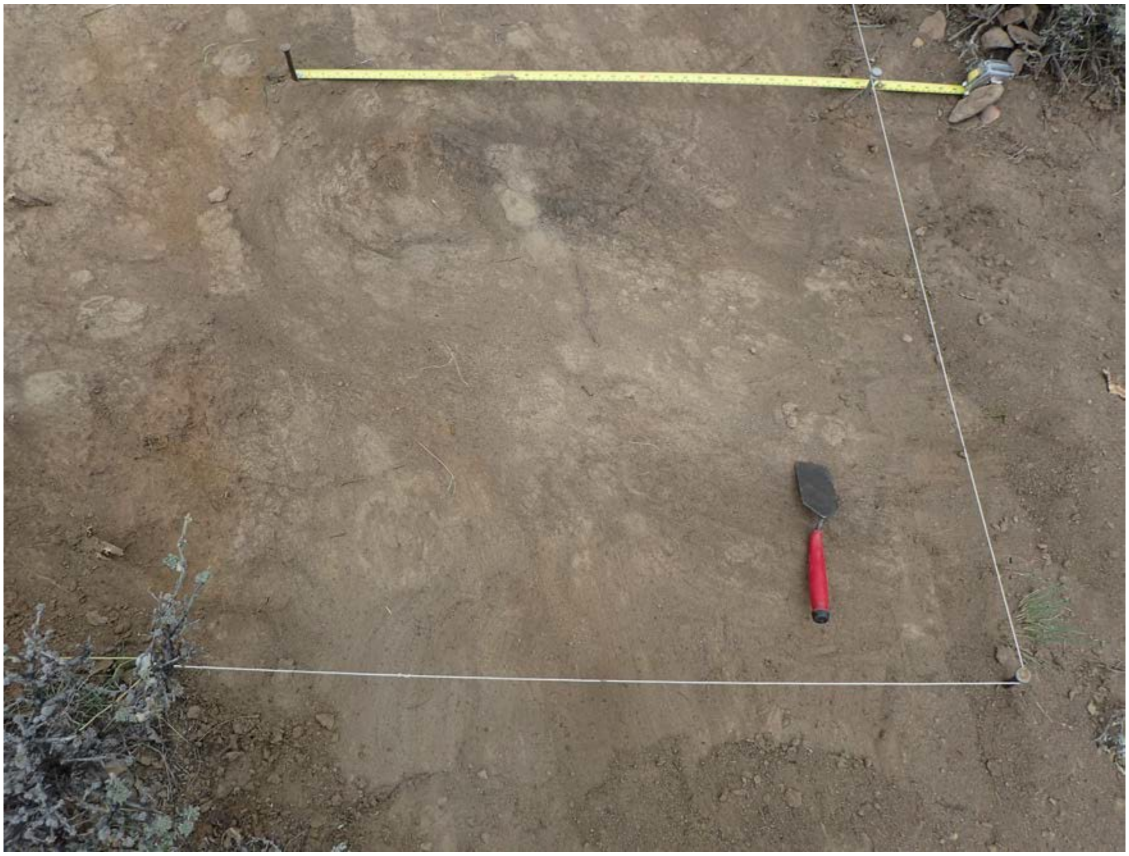


Photo 236,
North.

Photo 238, South.

Photo GP 14, down.

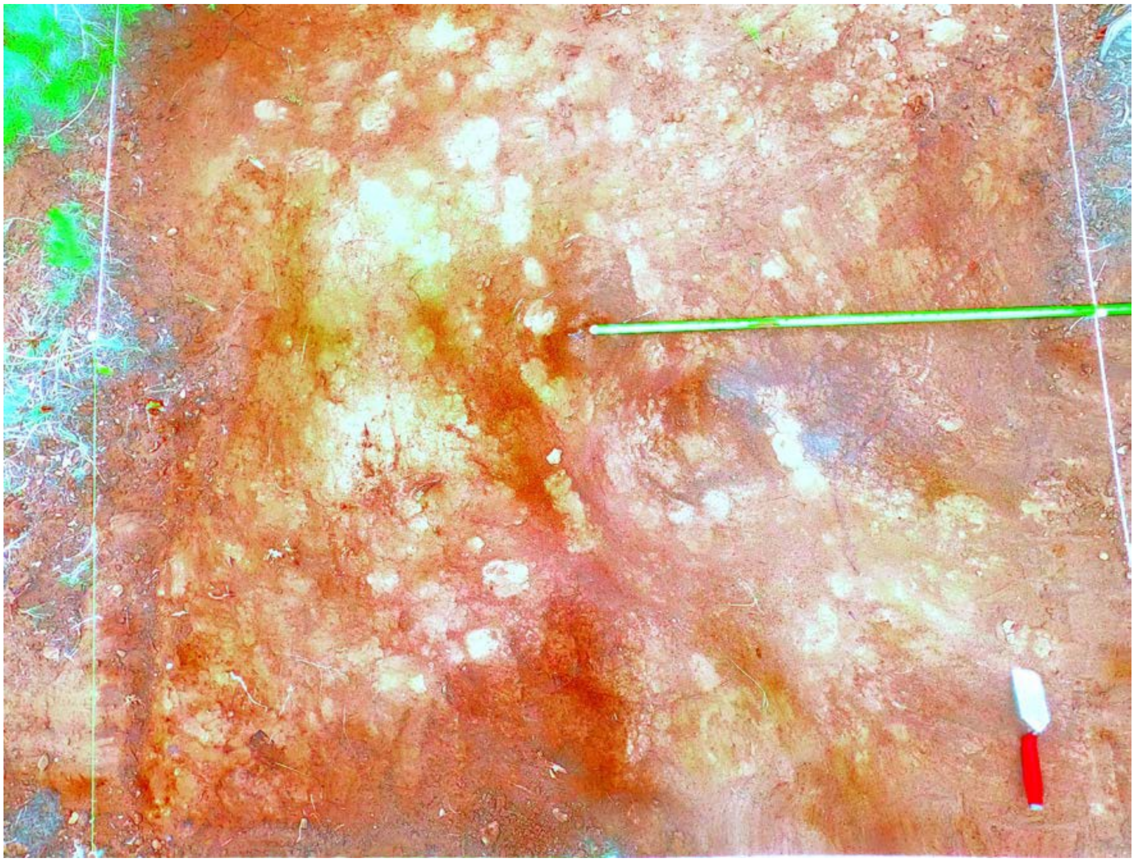
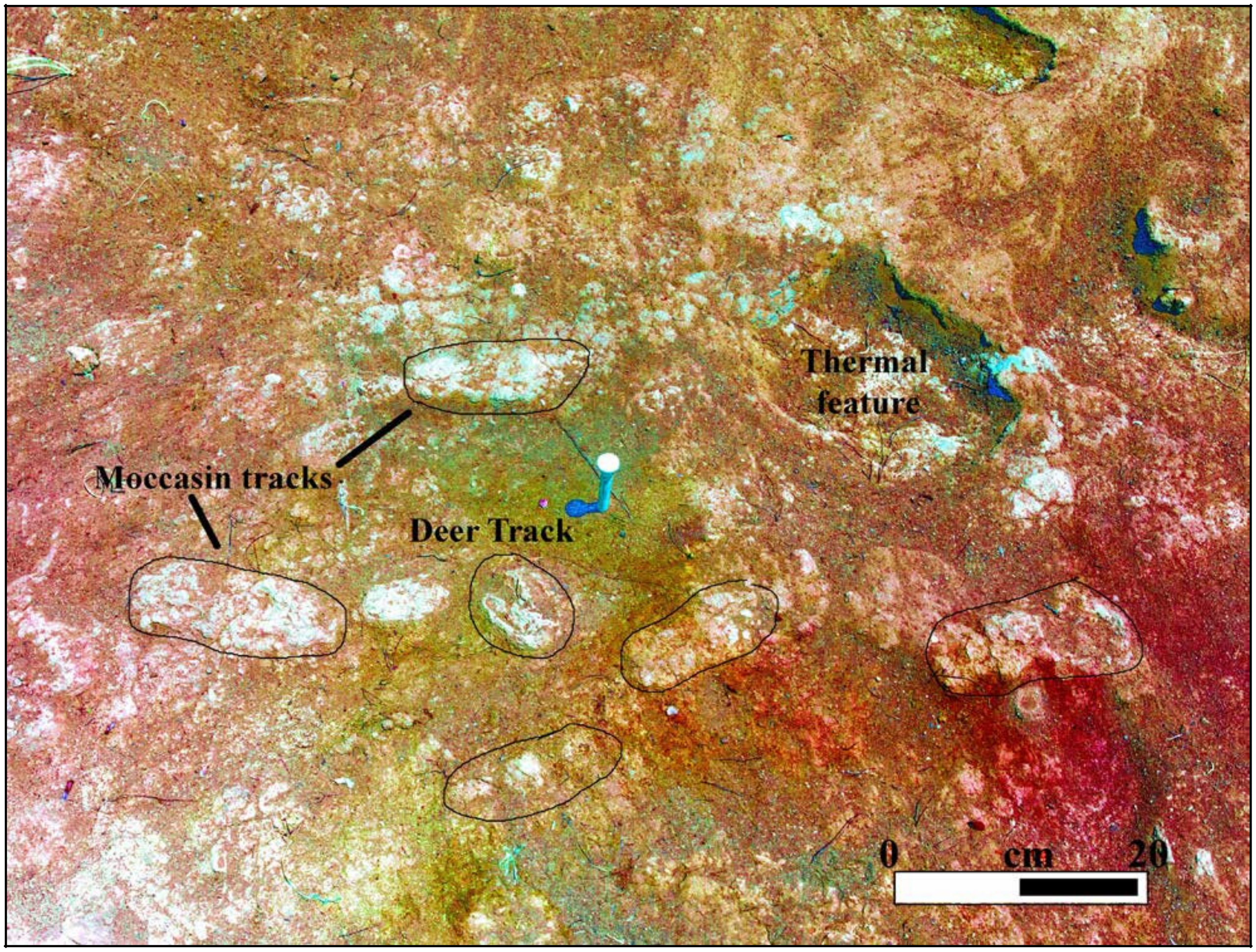


Photo GP14 enhanced

Photo GP20, down, center pin with cleared thermal feature below and to right of pin. Moccasin tracks below pin, left of center. Deer track upper left of pin.

Outlined moccasin tracks (ovals), a deer track (small circle), and thermal feature (large circle).



Outlined moccasin tracks (ovals), a deer track (small circle), and thermal feature (large circle).

PHOTOGRAPHS OF POST DISTRIBUTION AND IMPRESSIONS
SMALL CONICAL LODGE, 5RB8902 FEATURE 3

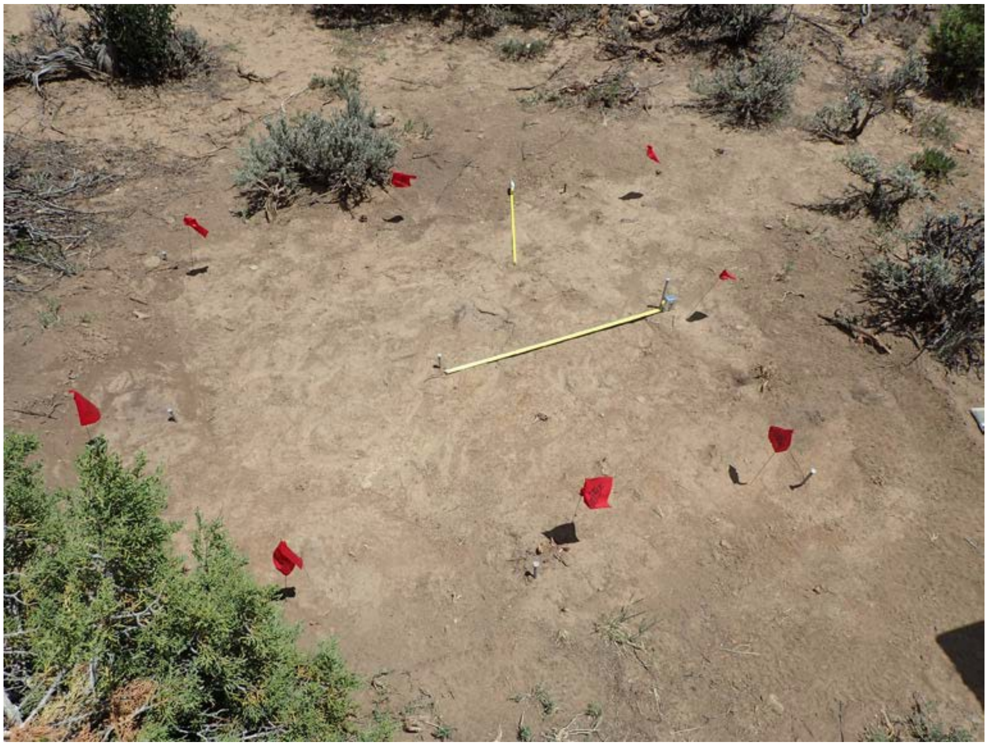


Photo 553. Distribution of post impressions Feat. 3. Overview 1. Flags are offset from impressions. View is southeast as indicated by far scale. One-meter scale points north along UTM gridline.

Photo 551. Distribution of post impressions Feat. 3. Overview 2. Flags are offset from impressions. View is southeast as indicated by far scale. One-meter scale points north along UTM gridline.

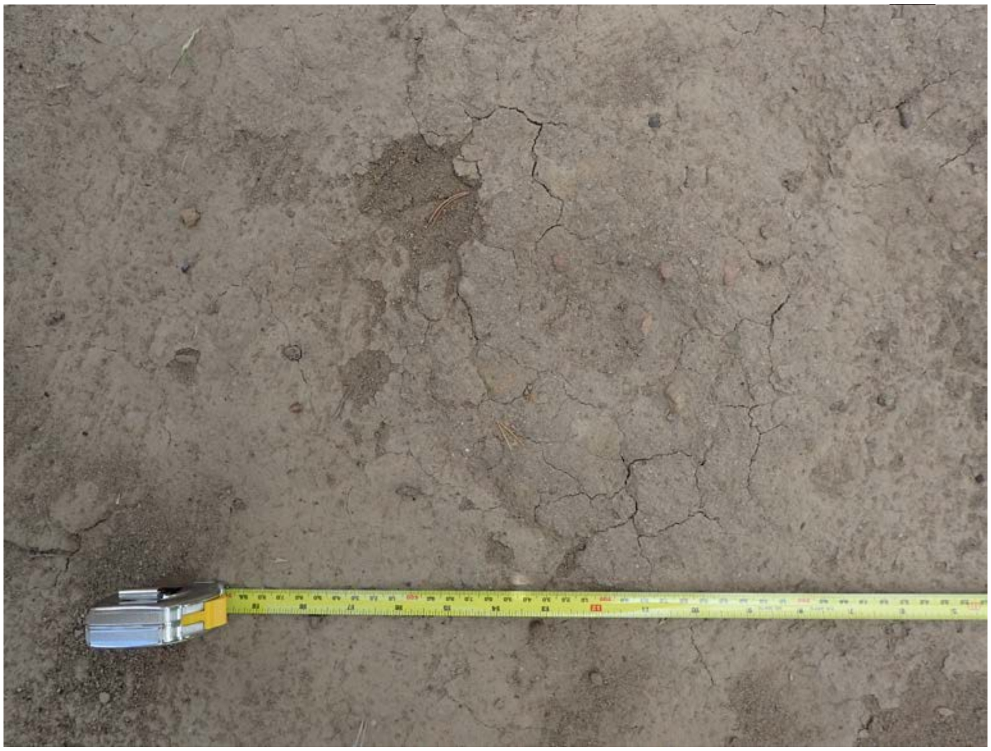


Photo 541. Post impression Feat. 3.#1. Southeast post, door-post south side. Scale points north.

Photo 543. Post impression Feat. 3.#2. East-center post, door-post north side. Scale points north.

Photo 544. Post impression Feat. 3.#3. Northeast post. Scale points north. (Photo #P6130544; 6/13/2020)

Photo 546. Post impression Feat. 3.#4. North-center post. Scale points north.

Photo 547. Post impression Feat. 3.#5. Northwest post. Scale points north.

Photo 548. Post impression Feat. 3.#6. West-center post. Scale points north.

Photo 549. Post impression Feat. 3.#7. Southwest post. Scale points north.

Photo 550. Post impression Feat. 3.#8. South-center post. Scale points north.

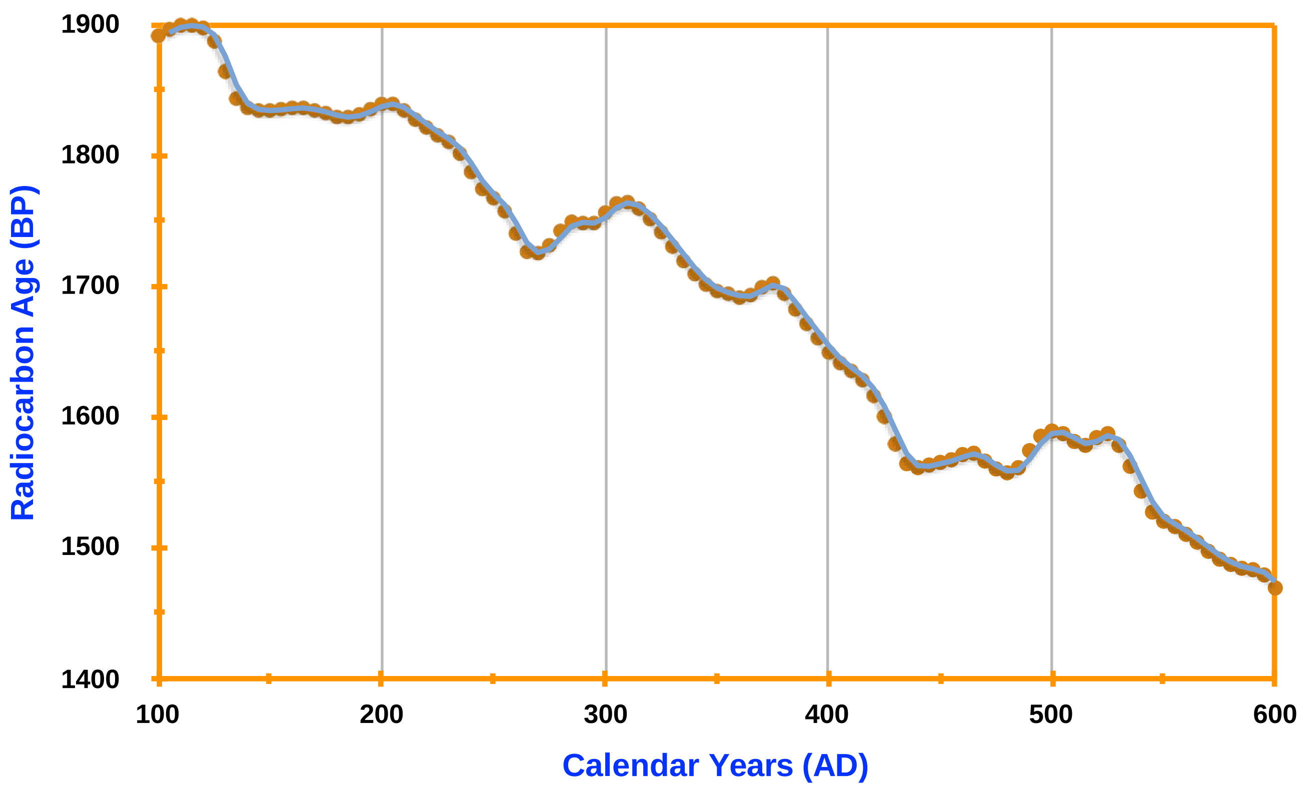
APPENDIX C: RADIOCARBON

International Chemical Analysis Inc.
10585 NW 53rd ST.
Sunrise, FL 33351

Sample Report

Submitter Name: Carl Conner
Company Name: Dominguez Archaeological Research Group, Inc
Address: P.O Box 3543, Grand Junction, CO 81502

Date Received	June 18, 2018	Material Type	Charcoal
Date Reported	July 18, 2018	Pre-treatment	AAA
ICA ID	18C/0628	Conventional Age	**1720 +/- 30 BP**
Submitter ID	WRL S4.F1	Calibrated Aged	**Cal 240 - 400 AD**



International Chemical Analysis Inc.
10585 NW 53rd ST.
Sunrise, FL 33351

QC Report

Submitter Name: Carl Conner
Company Name: Dominguez Archaeological Research Group, Inc
Address: P.O Box 3543, Grand Junction, CO 81502

Date Submitted	June 18, 2018	**Date Reported**	July 18, 2018
QC 1 Sample ID	**IAEA C7**	**QC 2 Sample ID**	**NIST OXII**
QC Expected Value	49.53 +/- 0.70 pMC	**QC Expected Value**	134.09 +/- 0.70 pMC
QC Measured Value	50.70 +/- 0.20 pMC	**QC Measured Value**	134.06 +/- 0.20 pMC
Pass?	**YES**	**Pass?**	**YES**

- pMC = Percent Modern Carbon.
- IAEA = International Atomic Energy Agency.

- Calibrated ages are attained using INTCAL13: **IntCal13 and Marine13 Radiocarbon Age Calibration Curves 0–50,000 Years cal BP.** *Paula J Reimer, Edouard Bard, Alex Bayliss, J Warren Beck, Paul G Blackwell, Christopher Bronk Ramsey, Caitlin E Buck, Hai Cheng, R Lawrence Edwards, Michael Friedrich, Pieter M Grootes, Thomas P Guilderson, Haflidi Haflidason, Irka Hajdas, Christine Hatté, Timothy J Heaton, Dirk L Hoffmann, Alan G Hogg, Konrad A Hughen, K Felix Kaiser, Bernd Kromer, Sturt W Manning, Mu Niu, Ron W Reimer, David A Richards, E Marian Scott, John R Southon, Richard A Staff, Christian S M Turney, Johannes van der Plich*t. **Radiocarbon 55(4), Pages 1869-1887**.
- Unless otherwise stated, 2 sigma calibration (95% probability) is used.
- Conventional ages are given in BP (BP=Before Present, 1950 AD), and have been corrected for fractionation using the delta C13.

International Chemical Analysis Inc.
10585 NW 53rd ST.
Sunrise, FL 33351

Sample Report

Submitter Name: Carl Conner
Company Name: Grand River Institute
Address: P.O Box 3543, Grand Junction, CO 81502
Date Received: May 09, 2020
Date Reported: May 28, 2020

ICA ID	Submitter ID	Material Type	Pretreatment	Conventional Age	Calibrated Age
20C/0574	5RB4558 Feat. 1	Charcoal	AAA	1750 +/- 30 BP	Cal 220 - 390 AD
20C/0575	5RB8902 Feat. 2	Charcoal	AAA	1730 +/- 30 BP	Cal 240 - 390 AD

\

International Chemical Analysis Inc.
10585 NW 53rd ST.
Sunrise, FL 33351

QC Report

Submitter Name: Carl Conner
Company Name: Grand River Institute
Address: P.O Box 3543, Grand Junction, CO 81502

Date Submitted	May 09, 2020	**Date Reported**	May 28, 2020
QC 1 Sample ID	**IAEA C7**	**QC 2 Sample ID**	**NIST OXII**
QC Expected Value	49.53 +/- 0.70 pMC	**QC Expected Value**	134.09 +/- 0.70 pMC
QC Measured Value	49.78 +/- 0.20 pMC	**QC Measured Value**	134.07 +/- 0.20 pMC
Pass?	**YES**	**Pass?**	**YES**

- pMC = Percent Modern Carbon.
- IAEA = International Atomic Energy Agency.

- Calibrated ages are attained using INTCAL13: **IntCal13 and Marine13 Radiocarbon Age Calibration Curves 0–50,000 Years cal BP.** *Paula J Reimer, Edouard Bard, Alex Bayliss, J Warren Beck, Paul G Blackwell, Christopher Bronk Ramsey, Caitlin E Buck, Hai Cheng, R Lawrence Edwards, Michael Friedrich, Pieter M Grootes, Thomas P Guilderson, Haflidi Haflidason, Irka Hajdas, Christine Hatté, Timothy J Heaton, Dirk L Hoffmann, Alan G Hogg, Konrad A Hughen, K Felix Kaiser, Bernd Kromer, Sturt W Manning, Mu Niu, Ron W Reimer, David A Richards, E Marian Scott, John R Southon, Richard A Staff, Christian S M Turney, Johannes van der Plicht*. **Radiocarbon 55(4), Pages 1869-1887**.
- Unless otherwise stated, 2 sigma calibration (95% probability) is used.
- Conventional ages are given in BP (BP=Before Present, 1950 AD), and have been corrected for fractionation using the delta C13.

Appendix D: Pollen and Residue Report

POLLEN AND ORGANIC RESIDUE (FTIR) ANALYSIS OF SAMPLES FROM SITES 5RB4558 AND 5RB8902, RIO BLANCO COUNTY, COLORADO

By

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With assistance from
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PaleoResearch Institute Technical Report 2020-026

Prepared for

Grand River Institute
Grand Junction, Colorado

July 2020

INTRODUCTION

Sites 5RB4558 and 5RB8902 are both open campsites located approximately a mile apart on the south side of a ridge that slopes gently to the west. Radiocarbon ages were returned as 1750 ± 30 BP for Feature 1, 5RB4558 and 1730 ± 30 BP for Feature 2, 5RB8902. Feature fill samples were collected from one feature at each site and submitted for pollen analysis. In addition, fire-cracked rock from Feature 1 at 5RB4558 was submitted for organic residue analysis to identify a signature that might identify cooking foods.

METHODS

Pollen

Sediments often present unique challenges for pollen preservation and recovery, meaning that larger samples are required for land sediments than for pollen recovery from lake sediments or peat bogs. A chemical extraction technique based on flotation is the standard preparation technique used in this laboratory for recovering pollen grains from sediments. This particular process was developed for extracting pollen from soils where the ratio of pollen to inorganic material is relatively low. It is important to recognize that it is not the repetition of specific and individual steps in the laboratory, but rather mastery of the concepts of extraction and how the desired result is best achieved, given different sediment matrices, that results in successful recovery of pollen for analysis.

Hydrochloric acid (10%) was used to remove calcium carbonates present in the sediment samples, after which, they were screened through 250-micron mesh. Multiple water rinses were utilized until neutral employ Stoke's Law for settling time. A small quantity of sodium hexametaphosphate was used to suspend clay-sized particles prior to additional rinsing using Stoke's Law. This process was repeated with ethylenediaminetetraacetic acid (EDTA), which removes clay, soluble organics, and iron. Finally, the samples were freeze-dried under vacuum.

Once dry, the samples were mixed with sodium polytungstate (SPT), at a density of 1.8 g/ml, and centrifuged to separate the organic material including pollen and starch, which floats, from the inorganic remains and silica, which do not float. The light fraction was recovered and the process was repeated, as many times as necessary. This pollen-rich organic fraction was rinsed, then all samples received a short (25 minute) treatment in hot hydrofluoric acid to remove remaining inorganic particles. The samples were acetylated twice for 10 minutes each time to remove extraneous organic matter. The samples were rinsed with RODI water to neutral. Following this, a few drops of potassium hydroxide (KOH) were added to each sample, which was then stained lightly with safranin. Due to the presence of large quantities of minute organic debris, the samples were centrifuged at high speeds for short intervals to remove this debris for better viewing.

A light microscope was used to count pollen at a magnification of 500x. Pollen preservation in these samples varied from good to poor. An extensive comparative reference housed at PaleoResearch Institute aided pollen identification to the family, genus, and species level, where possible.

Pollen aggregates were recorded during pollen identification. Aggregates are clumps of a single type of pollen and may be interpreted to represent either pollen dispersal over short distances or the introduction of portions of the plant represented into an archaeological setting. The aggregates were included in the pollen counts as single grains, as is customary. An "A" next to the pollen frequency on the percentage pollen diagram notes the presence of aggregates. The percentage pollen diagram was produced using Tilia Version 2.1.1. Total pollen concentrations were calculated in Tilia using the quantity of sample processed in cubic centimeters (cc), the quantity of exotics (spores) added to the sample, the quantity of exotics counted, and the total pollen counted and expressed as pollen per cc of sediment.

The microscopic charcoal frequency registers the relationship between pollen and charcoal. The total number of microscopic charcoal fragments was divided by the pollen sum, resulting in a charcoal frequency that reflects the quantity of microscopic charcoal fragments observed, normalized per 100 pollen grains.

Pollen analysis also included observing and recording starch granules and, if they were present, their assignment to general categories. We did not, however, search for starches outside the pollen count. An additional search for starches is performed only when starch analysis is part of the suite of analyses performed. Starch granules are a plant's mechanism for storing carbohydrates. Starches are found in numerous seeds, as well as in starchy roots and tubers. The primary categories of starches include the following: with or without visible hila, hilum centric or eccentric, hila patterns (dot, cracked, elongated), and shape of starch (angular, spherical, etc.), others are more common and tend to occur in many different types of plants.

FTIR (Fourier Transform Infrared Spectroscopy)

A mixture of chloroform and methanol (CHM) was used as the solvent to remove lipids and other organic substances that had soaked into the fire-cracked rocks. The was broken, then placed in a glass container with CHM solvent, covered, and allowed to sit for several hours, after which the solvent was poured into a small aluminum evaporation dish, where the solution was allowed to evaporate leaving organic residues behind. To evaporate the entire quantity of CHM, the aluminum dishes are filled repeatedly until all the solution has been evaporated. The aluminum dishes were tilted during evaporation to separate the lighter fraction (lighter molecular weight compounds) from the heavier fraction (heavier molecular weight compounds), leaving the residue of absorbed chemicals in the aluminum dish after the solvent has evaporated. Then the aluminum dish containing the residue was placed residue side down on the FTIR ATR diamond crystal, and the spectra were collected along the upper, middle, and lower bands of residue in each dish. These spectra were merged, creating a single spectrum for analysis.

FTIR is performed using a Bruker Alpha optical bench FTIR with an ATR (attenuated total reflection) accessory and a diamond crystal. The aluminum dish containing the sample residue was placed residue side down approximately on the diamond crystal in the path of a specially encoded infrared beam that passes through the crystal, producing a signal called an "interferogram". The interferogram contains information about the frequencies of infrared light that are absorbed and the strength of the absorptions, reflecting the sample's chemical make-up. A computer reads the interferogram, uses Fourier transformation to decode the intensity information for each frequency (wave numbers), then presents the data as a spectrum. Lighter and heavier fractions are designated upper (lighter fraction) and lower (heavier fraction), respectively, in the subsequent analysis. These data were saved in an Excel file, then processed using a template to sort the peak numbers by organic compounds (fats/lipids, proteins, carbohydrates, and other) for interpretation and discussion.

FOURIER TRANSFORM INFRARED SPECTROSCOPY (FTIR) REVIEW

Infrared spectroscopy (IR) is a technical method that measures the atomic molecules' vibrations. It is currently one of the more powerful methods used in organic and analytical chemistry for identification of organic compounds. The infrared spectrum is produced by passing infrared radiation through a sample, whether the sample is from a liquid, paste, powder, film, gas or surface. Measurement of this spectrum is an indication of the fraction of the incident radiation that is absorbed at a particular energy level (Stuart 2004). The spectrum provides information on infrared radiation absorption and the structure of the organic molecules. Analysis of specific regions and peaks in the infrared spectrum enables identification of organic compounds, including both plant and animal fats/lipids, plant waxes, esters, proteins, and carbohydrates.

The Fourier Transform Infrared Spectrometer collects raw data, then, using Fourier transformations, creates the output that we see as a spectrum. Advantages of using this technique over others include the simultaneous measurement of all wavelengths and a relatively high signal-to-noise ratio with a short measurement time. Since molecular structures absorb vibrational frequencies (i.e., wavelengths) of infrared radiation, we can use the bands of absorbency to identify organic compound compositions.

The spectrum is divided into two groups, the functional and the fingerprint regions. These groups are characterized by the effect of infrared radiation on the respective group's molecules. The functional group region is between 4000 and c. 1500 wave numbers (cm^{-1}), and the fingerprint region is below 1500 cm^{-1}. The molecular bonds display vibrations that we can interpret as characteristic of fats, lipids, waxes, lignins, proteins, amino acids, carbohydrates, and polysaccharides. The portion of the infrared spectrum most useful for this research and in the identification of organic compounds (e.g., carbohydrates, lipids, proteins) is termed the mid-infrared, between 4000 and 400 cm^{-1} (Isaksson 1999:36-39). Recorded wavelengths of the electromagnetic spectra are what we compare to reference collections housed in the PaleoResearch Institute (hereafter PRI) library. That is, we compare the results from the sample with the reference collection aiming to identify the closest match. For example, lipids, fats, and plant waxes are indicated identifiable between 3000 and 2800 cm^{-1}. This portion of the spectrum can be suggestive of the presence of animal fats, plant oils, oily nuts (e.g., hickory, walnut, or acorn), or plant waxes. Additional peaks representing fats/lipids and allied substances, including esters, are noted in the fingerprint portion of the spectrum.

Samples from archaeological contexts are difficult to analyze because they often contain complex compound mixtures, whether from multiple uses or burial in contexts such as trash mounds. For instance, groundstone tools and ceramic cooking vessels are often multipurpose artifacts used to process (e.g. crush, grind, cook) a variety of foodstuffs, ingredients, and/or medicines. Multipurpose artifacts can yield a spectrum of overlapping absorption bands with few distinctive characteristics.

FTIR has shown itself to be a useful technique for examining organic compounds recovered from fire-cracked rock (FCR) because so few other techniques can be used. Organic compounds often are deposited on rocks during cooking. Fats, lipids, waxes, and other organic molecules may be deposited onto rock surfaces as a result of (a) dropping, (b) oozing from foods being cooked or baked in a pit, or © seepage out of or spill over from cooking vessels. Re-use of rocks is possible, in which case the organics recovered from the FCR might represent multiple cooking episodes. The PRI extraction method gently removes these organic molecules from the groundstone, ceramics, and/or rocks so they can be measured with FTIR and subsequently identified. Organic molecules also can be extracted from sediments, then measured, and identified. This is useful in the identification of dark horizons to determine whether they result from the decay of organic matter, whether plant or animal, or are dark because they contain ash. Below is a discussion of the common organic compounds that can be identified in archaeological samples using FTIR.

DISCUSSION

Sites 5RB4558 and 5RB8902 are located near an unnamed intermittent drainage that flows into Strawberry Creek, another intermittent drainage that flows west into Sulphur Creek. Sulphur creek is the closest permanent water source. Local vegetation includes a sparse pinyon juniper forest, mountain mahogany, and an understory of short bunch grasses. A moccasin print was observed at one of these sites. Nearly identical radiocarbon dates were obtained for Feature 1 at 5RM4558 (1750 ± 30 BP) and Feature 2 at 5RB8902 (1730 ± 30 BP). Both pollen and organic residue (FTIR) analyses were conducted on Feature 1, 5RB4558, while only pollen analysis was requested for Feature 2 at 5RB8902 (Table 1).

The pollen record is dominated by Pinus pollen (Figure 1, Table 2), representing pine trees, in both samples. Sample 1, representing Feature 1 at 5R4558, also contained a large quantity of Juniperus pollen, suggesting a local vegetation community of mixed pinyon pine and juniper. Sample 2, collected in Feature 2 at 5RB8902, exhibited significantly less Juniperus pollen, suggesting a change in local vegetation across the landscape. Both samples revealed small quantities of Abies pollen, representing long distance wind transport of fir pollen from a mountainous community at higher elevation. Only Sample 1 yielded Ulmus pollen, reflecting local growth of elm trees, probably in a drainage.

The non-arboreal portion of the pollen record is dominated by Artemisia pollen in Sample 2, collected in Feature 2 at 5RB8902. This indicates sagebrush as a dominant member of the local vegetation and appears to define the primary difference in local vegetation between the occupation or use of these two features. Feature 1 was situated in an area where local vegetation included a larger population of juniper and limited amount of sagebrush, perhaps creating a more closed canopy along with the pine. In contrast, Feature 2 lies in an area that appears to have been more open where local vegetation was dominated by sparsely spaced pine trees with a large amount of sagebrush growing in the open areas.

Both samples exhibited small to moderately small quantities of Amaranthaceae, Low-spine Asteraceae, High-spine Asteraceae, Cercocarpus, Ephedra nevadensis-type, Poaceae, and Sarcobatus pollen representing plants in the goosefoot family, ragweed or cocklebur and similar plants, plants in the sunflower family that likely included rabbitbrush and/or snakeweed, mountain mahogany, ephedra, grasses, and greasewood. Only Feature 1 yielded small quantities of Liguliflorae, Petalostemon, Agropyron, and Typha angustifolia-type pollen representing plants in the chicory tribe of the sunflower family, prairie clover, western wheatgrass, and cattail. The moderate quantity of Poaceae pollen observed in both samples indicates that grasses grew in abundance across the landscape. Fern spores were observed in both samples, suggesting local presence of at least a few ferns, probably growing in a drainage. Sample 2, collected in Feature 2, displayed a chain of well-silicified stomata guard cells that survived HF digestion. Stomata are common on the surface of plant leaves and are part of the respiratory system.

Microscopic charcoal was much more abundant in Feature 1 than in Feature 2. Total pollen concentration also was greater in Feature 1, where it was calculated as nearly 16,000 pollen per cubic centimeter (cc) of sediment. Feature 2, on contrast, displayed a total pollen concentration of only slightly more than 5,800 pollen/cc of sediment. Feature 2 also yielded centric starch grains, suggesting processing starch food. This morphology of starch is very generic, occurring not only in grass seeds, but also some other seeds and some roots/tubers.

FTIR analysis yielded low amplitude peaks typical of proteins and amino acids (Table 3). Although the highest amplitude peak, at 999 wave numbers (cm-1) is typical of cellulose, it is also part of the complex of numbers for four amino acids. A low amplitude peak suggesting the presence of softwood lignin could indicate use of pine or juniper as fuel in this feature. Given the high amplitude of this peak and the relatively low amplitude of peaks also typical of amino acid, this peak is interpreted to represent cellulose (plant matter), with the possibility that several amino acids contributed to this particular peak. Very low amplitude peaks are noted in the ranges of fats/lipids and saturated esters, but the “rule of three” is never satisfied for esters. This rule states, briefly, that for the peaks to be interpreted as representing saturated (or aromatic) esters, peaks must be observed in three specific ranges. This is not the case in these samples. The FTIR signature for this rock is interpreted as containing cellulose from deteriorating plant matter and a variety of amino acids suggesting cooking lean meat.

SUMMARY AND CONCLUSIONS

Pollen analysis of two samples, representing Features 1 and 2 at sites 5RB4558 and 5RB892, respectively, suggests these two features were situated in slightly different vegetation zones. Local vegetation appears substantially different during use of these two features, with juniper being more common on the landscape near Feature 1 and sagebrush being more common near Feature 2. Starches recovered in the Feature 2 sample suggest processing seeds or roots/tubers. The FTIR signature suggests cooking lean meat in Feature 1.

TABLE 1
PROVENIENCE OF POLLEN SAMPLES FROM SITES 5RB4558 AND 5RB8902,
RIO BLANCO COUNTY, COLORADO

Site No.	Sample No.	Feature	Provenience/Description	Analysis
5RB4558	1	1	Feature fill	Pollen
5RB4558	Rock	1	Feature Rock	FTIR
5RB8902	2	2	Feature fill	Pollen

FTIR = Fourier Transform Infrared Spectroscopy

TABLE 2
POLLEN TYPES OBSERVED IN SAMPLES FROM 5RB4558 AND 5RB8902

Scientific Name	Common Name
ARBOREAL POLLEN:	
Juniperus	Juniper
Pinaceae:	Pine family
Abies	Fir
Pinus	Pine
Ulmus	Elm
NON-ARBOREAL POLLEN:	
Amaranthaceae	Amaranth family (now includes Chenopodiaceae, these two families were combined based on genetic testing and the pollen category “Cheno-ams”)
Asteraceae:	Sunflower family
Artemisia	Sagebrush
Low-spine	Includes ragweed, cocklebur, sumpweed
High-spine	Includes aster, rabbitbrush, snakeweed, sunflower, etc.
Liguliflorae	Chicory tribe, includes dandelion and chicory
Cercocarpus	Mountain mahogany
Ephedra nevadensis-type (includes E. clokeyi, E. coryi, E. funera, E. viridis, E. californica, E. nevadensis, and E. aspera)	Ephedra, jointfir, Mormon tea
Petalostemon	Prairie clover
Poaceae:	Grass family
Agropyron	Wheatgrass
Sarcobatus	Greasewood
Typha angustifolia-type	Narrowleaf cattail
STARCHES:	
Centric starch	Typical of starches produced by grass seeds, other seeds, and some roots/tubers (usually the developing starch grains)

TABLE 2 (Continued)

Scientific Name	Common Name
SPORES:	
Monolete smooth	Fern
Trilete smooth	Fern
OTHER:	
Stomata guard cells	Cells surrounding the stomata (opening) in a plant leaf
Microscopic charcoal	Microscopic charcoal fragments
Total pollen concentration	Quantity of pollen per cubic centimeter (cc) of sediment

TABLE 3
PROVENIENCE DATA FOR SAMPLES FROM SITES 5RB4558 and 5RB8902,
RIO BLANCO COUNTY, COLORADO

		Sample
Peak Range	Represents	5RB4558, F. 1
Fats/Lipids/Waxes:		
3000-2800	Aldehydes: fats, oils, lipids, waxes	2920, 2898
2959, 2938, 2936, 2934, 2931, 2930, 2926, 2924, 2922	CH2 Asymmetric stretch	2920
	Saturated Esters:	
1210-1160 (Rule of Three)	Saturated esters	1164
1100-1030 (Rule of Three)	Saturated esters	1093
1094	Saturated ester O-C-C	1093
	Aromatic Esters:	
699-697	Aromatic ring bend	692
692	Aromatic ring bend (phenyl ether)	692
Proteins:		
1700-1500; 1500-1400; 1490-1350	Protein, incl. 1650 protein	1629, 1559, 1516, 1437, 1418
	Amino Acids:	
3077, 2985, 2917, 2858, 2729, 2599, 2520, 2122, 1619, 1586, 1526, 1451, 1408, 1353, 1306, 1237, 1148, 1114, 1026, 1014, 918, 850, 768, 643, 543, 495, 407	DL-Alpha-Alanine_CB	2920, 913, 772, 646
3294, 3149, 3067, 2992, 2951, 2868, 2732, 1674, 1654, 1635, 1571, 1515, 1464, 1407, 1356, 1325, 1289, 1266, 1216, 11175, 1134, 1097, 1046, 1023, 995, 969, 950, 925, 896, 848, 792, 747, 725, 696, 666, 606, 570, 546, 522, 449, 438	AL-Arginine Hydrochloride_CB	1516, 1093, 999, 794, 692, 605, 524
3439, 3377, 3100, 2923, 2743, 2645, 2526, 1679, 1633, 1575, 1520, 1426, 1397, 1358, 1303, 1234, 1148, 1101, 1073, 1004, 910, 887, 834, 801, 665, 634, 597, 577, 557, 505, 416	L-Asparagine Monohydrate_CB	2920, 1629, 1516, 999, 913
3131, 3003, 2895, 1897, 1685, 1612, 1546, 1493, 1451, 1416, 1396, 1375, 1342, 1307, 1287, 1210, 1139, 1114, 1068, 985, 915, 893, 852, 790, 763, 692,639, 578, 522, 473	DL-Aspartic Acid_CB	2898, 1418, 913, 794, 692, 524

TABLE 3 (Continued)

		Sample
Peak Range	Represents	5RB4558, F. 1
2967, 2915, 2581, 1655, 1620, 1576, 1481, 1400, 1379, 1335, 1295, 1192, 1122, 1087, 1039, 961, 871, 844, 774, 673, 613, 538, 498, 451	L-Cystine_CB	2920, 772
1560	Glutamate (amino acid) CO2- asymmetric stretching	1559
1415	Glutamate (amino acid) CO2- symmetric stretching	1418
3032, 3013, 2955, 2739, 2643, 2070, 2020, 1963, 1834, 1637, 1613, 1506, 1434, 1418, 1409, 1349, 1308, 1254, 1228, 1211, 1150, 1123, 1073, 1051, 967, 945, 912, 865, 805, 759, 711, 702, 671, 536, 502, 456, 413	L-Glutamic Acid_CB	1437, 1418, 913
3152, 3007, 2823, 2700, 2600, 2515, 2114, 1580, 1498, 1443, 1407, 1330, 1131, 1109, 1032, 908, 891, 694, 605, 498, 425, 406	Glycine_CB	913, 692, 605
3405, 3157, 3105, 3074, 2993, 2936, 2711, 2612, 2003, 1630, 1604, 1577, 1530, 1494, 1449, 1429, 1414, 1334, 1309, 1285, 1261, 1205, 1186, 1167, 1142, 1123, 1064, 977, 958, 916, 866, 833, 819, 805, 696, 648, 628, 526	L-Histidine Hydrochloride_CB	1629, 1418, 1164, 913, 692, 646, 625, 524
3120, 2960, 2929, 2876, 2127, 1592, 1495, 1461, 1414, 1379, 1362, 1349, 1327, 1310, 1260, 1184, 1132, 1076, 1040, 995, 962, 925, 891, 874, 827, 809, 797, 773, 693, 683, 540, 487, 450	DL-Isoleucine_CB	1418, 999, 794, 772, 692
3080, 2952, 2932, 2866, 2717, 2513, 2437, 2151, 1615, 1584, 1508, 1469, 1442, 1413, 1387, 1370, 1359, 1339, 1311, 1294, 1235, 1179, 1173, 1139, 1084, 1036, 997, 942, 924, 848, 832, 773, 717, 683, 536, 438	DL-Leucine_CB	1437, 1418, 999, 772
1640-1610, 1550-1485,	Lysine (amino acid) NH3+ bending	1629, 1516
1160, 1100	Lysine (amino acid) NH3+ rocking	1164
2868, 2640, 2088, 1623, 1598, 1497, 1464, 1418, 1358, 1350, 1339, 1320, 1286, 1265, 1241, 1224, 1190, 1157, 1143, 1127, 1101, 1049, 1030, 1009, 984, 957, 935	L-Lysine Hydrochloride_CB	1418

TABLE 3 (Continued)

		Sample
Peak Range	Represents	5RB4558, F. 1
3031, 3005, 2947, 2717, 2546, 2452, 2162, 1618, 1584, 1494, 1457, 1443, 1410, 1340, 1309, 1295, 1209, 1153, 1073, 1035, 985, 947, 912, 850, 774, 744, 696, 678, 605, 521, 473	DL-Phenylalanine_CB	913, 772, 692, 605, 524
3043, 3007, 2981, 2954, 2774, 2372, 1609, 1550, 1474, 1448, 1375, 1318, 1288, 1254, 1168, 1085, 1033, 982, 947, 913, 881, 847, 787, 640, 572, 506, 450	L-Proline_CB	1164, 913
3432, 2995, 2946, 2903, 2723, 2600, 1586, 1497, 1467, 1409, 1380, 1339, 1302, 1218, 1124, 1084, 1010, 967, 917, 852, 803, 729, 608, 520, 438	DL-Serine_CB	2898, 913, 605, 524
3023, 2974, 2872, 2040, 1623, 1453, 1414, 1344, 1319, 1287, 1249, 1180, 1107, 1090, 1041, 930, 872, 834, 757, 697, 676, 620, 559, 498, 440, 420	DL-Threonine_CB	1418, 1093, 692, 625
3400, 3007, 2071, 1656, 1579, 1455, 1407, 1351, 1338, 1315, 1278, 1250, 1228, 1155, 1142, 1117, 1097, 1076, 1052, 1022, 1006, 985, 919, 857, 849, 802, 767, 740, 682, 655, 624, 580, 549, 526, 494, 455, 423	L-Tryptophan_CB	1093, 772, 625, 524
3198, 3041, 2929, 2876, 2815, 2736, 2692, 2646, 2596, 2067, 1902, 1606, 1583, 1510, 1451, 1435, 1416, 1361, 1329, 1266, 1242, 1213, 1198, 1175, 1154 1112, 1099, 1042, 1015, 984, 939, 896, 877, 840, 793, 739, 713, 648, 574, 527, 493, 474, 432	DL-Tyrosine_CB	1437, 1418, 794, 646, 524
3115, 2975, 2961, 2881, 2700, 2524, 2407, 2239, 2179, 2154, 2135, 1593, 1495, 1472, 1413, 1391, 1357, 1323, 1269, 1179, 1132, 1105, 1064, 1034, 949, 925, 890, 819, 776, 685, 535, 474, 425	DL-Valine_CB	1418, 772
Carbohydrates:		
1170-1150, 1162, 1120, 1059, 1050, 1046, 1033, 1030 1016, 1010, 1009, 1006, 930	Cellulose	1164
1028-1000	Cellulose Carbohydrates	999
796	Deteriorated cellulose	794
Above 1510	Lignins, softwood, Aromatic skeletal bands	1516
915, 840	a-D-glucose	913

TABLE 3 (Continued)

		Sample
Peak Range	Represents	5RB4558, F. 1
915, 900	ß-D-glucose	913
916, 908	ß-D-cellulose	913
910, 869, 850	ß-D-sucrose	913
1680-1600, 1260, 1152, 1144, 1100, 1082, 1051, 1047, 1022, 1017, 972, 955, 953, 891, 857, 835, 834	Pectin	1629
	Polysaccharides:	
1141, 1097, 1039, 918, 895, 807	Arabinan	1093, 913
916	Arabinogalactan (Type II), Glucan	913
1161, 1151	Arabinoglucuronoxylan + Galactoglucomannan	1164
1049	Arabinogalactorhamnoglycan	913
1092, 1064, 941, 814	Glucomannan	1093
1122, 1043, 989, 951, 916, 902, 846, 823	Rhamnogalacturonan	913
Other:		
1095	Saturated ether C-O stretch	1093

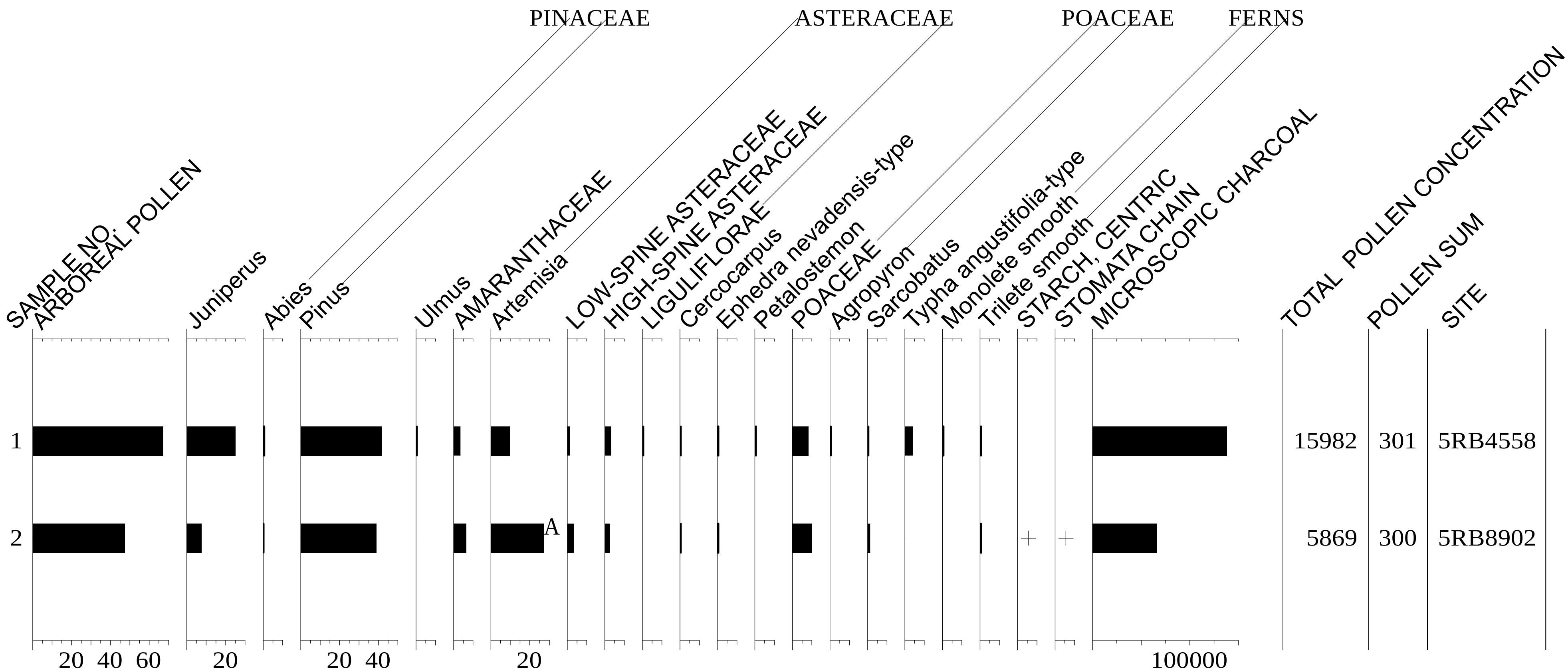

FIGURE 1. POLLEN AND STARCH DIAGRAM FOR 5RB4558 AND 5RB8902.

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Appendix E: List of Collected Artifacts and OAHP Forms
(BLM and OAHP only)

Table of Collected Artifacts

Specimen No.	Description	UTM Zone 13, NAD 83	
		Easting	Northing
5RB4558.s1	Projectile point, corner-notch/concave base, tip and one tang missing, white chert (3.8+ x 1.7 x 0.4cm)	247196mE	4446913mN
5RB4558.s2	Projectile point, corner-notch/concave base, tip missing, salmon chert (2.0+ x 1.9 x 0.2cm)	247207mE	4446920mN
5RB4558.s3	Biface, white chert with heavy patination (4.4 x 3.3 x 1.0cm)	247213mE	4446924mN
5RB4558.s4	Biface, tip missing, white/salmon chert, (9 x 4.5 x 1.1cm)	247232mE	4446890mN
5RB4558.s5	Biface fragment, gray chert (4.9+ x 3.6 x 0.8cm)	247201mE	4446942mN
5RB4558.s6	Backed blade with perforator, chert (7.5 x 3.2 x 1.8cm)	247419mE	4446965mN
5RB4558.s7	Uniface knife base, white chert, large secondary flake (4.4 x 3.2 x 0.8)	247400mE	4446935mN
5RB4558.s8	End scraper, gray quartzite (4.9 x 3.8 x 1.1cm)	247202mE	4446941mN
5RB4558.s9	Backed knife edge, petrified wood (5.9 x 5.5 x 2.0cm)	247390mE	4446941mN
5RB4558.s10	Flake, interior, pumpkin chert, extra large (4.0 x 2.9 x 0.9cm)	247197mE	4446943mN
5RB4558.s11	Perforator, tan claystone (3 x 2 x 1.3cm)	247197mE	4446944mN
5RB4558.s12	Flake, utilized, inteior, pumpkin chert, (2.4 x 2.0 x 0.2cm)	247219mE	4446931mN
5RB4558.s13	Mano, bifacial, ground, shaped and pecked, quartzitic (9.1 x 8 x 3.7cm)	247253mE	4446900mN
5RB4558.s14	Metate, bifacial, portable, sandstone (2 pieces: 11 x 7.0 x 3.0cm and 11.0 x 8.0 x 3.0)	247217mE	4446932mN
5RB4558.s15	Groundstone fragment, (comal?), sandstone (10.4 x 4.8 x 1.8cm)	247200mE	4446937mN
5RB4558.s16	Metate fragment, bifacial, portable, sandstone (10.4 x 6.0 x 2.8cm)	247390mE	4446941mN

5RB4558: Excavation Unit Collection from 2 x2m grid (Datum SE corner Unit 1, E1: 13; 247337mE; 4446904mN, NAD83)

Provenience	Exc. No.	Type	Size (cm)	Material
Excavation units 0-5cm screen	E1.1	Possible scraper, or util. as spokeshave, primary flake from cobble	4.7 x 3.9 x 1.4	chert, red
	E4.1	Primary flake from cobble with perforator tip	3.8 x 2.9 x 0.8	chert, red

Table of Collected Artifacts from Excavated Contexts at 5RB8902

5RB8902: Excavation Unit Collection from 2 x2m grid (Datum SE corner Unit 1, E1: 13; 247996.5mE; 4445263.15mN, NAD83)

Provenience	Exc. No.	Type	Size (cm)	Material
Unit 1 (E1) (SE 1x1m) Surface to clay layer (~5cm)	E1.1	Scraper, utilized primary flake from cobble	5.0 x 4.3 x 1.5	rhyolite, maroon
	E1.2	Flake, primary	medium	chert, tan
	E1.2	Flake, interior	medium	chert, grey
	E1.2	Thinning flake, interior	medium	chalcedony (moss agate)
	E1.2	Flake, interior	micro	chert, grey
	E1.2	Flake, interior	micro	chert, light grey
	E1.2	Flake, interior	micro	chert, dark grey
	E1.2	Flake, interior	micro	chert, black
	E1.2	Flake, primary	micro	jasper, maroon
Unit 2 (E2) (NE 1x1m) Surface to clay layer (~5cm)	E2.1	Scraper - knife edge, util. pri. flake from cobble	4.3 x 2.6 x 1.9	jasper, maroon
	E2.1	Flake, interior	micro	chalcedony (moss agate)
	E2.1	Chunk	small	chert, white
Unit 3 (E3) (NW 1x1m) Surface to clay layer (~5cm)	E3.1	Flake, primary	medium	claystone, tan
	E3.1	Flake, interior	micro	chert, dark brown, (algalitic)
	E3.1	Flake, interior	medium	chert, orange
	E3.1	Flake, primary	micro	chert, red
Unit 4 (E4) (SW 1x1m) Surface to clay layer (~5cm)	E4.1	Perforator-scraper, woodworking tool, utilized secondary flake from cobble	3.3 x 2.6 x 1.5	chert, grey
	E4.2	Chisel-end scraper on chunk	5.0 x 3.3 x 1.9	chert, red/grey
	E4.3	Crescent knife edge on chunk	5.0 x 2.4 x 2.2	chert, red/grey
	E4.4	Biface thinning flake	small	chert, white
	E4.4	Flake, primary	micro	jasper, maroon
	E4.4	Flake, primary	medium	chert, grey (mottled)
	E4.4	Flake, secondary	medium	chert, dark grey
	E4.4	Flake, interior	medium	chert, white

*micro (<11mm), small (<18mm), medium (< 25mm), large (<50mm)

Table of Surface Collected Artifacts 5RB8902

Specimen No.	Description	UTM Zone 13, NAD 83	
		Easting	Northing
5RB8902.s1	Biface - drill (hafted), white chert (4 x 2.3 x 0.4cm)	247956mE	4445246mN
5RB8902.s2	Utilized flake (fragment), rhyolite, grey (5 x 3.5 x 1.2cm)	247995mE	4445263mN
5RB8902.s3	Perforator, orange chert (3.5 x 2.5 x 0.8cm)	247991mE	4445264mN