Attachment M

Amendment 2 to the
Jonah Programmatic Agreement

AMENDMENT 2
TO THE PROGRAMMATIC AGREEMENT AMONG THE BUREAU OF LAND MANAGEMENT, THE WYOMING STATE HISTORIC PRESERVATION OFFICER, JONAH ENERGY LLC, LINN ENERGY HOLDINGS, LLC, AND ENTERPRISE JONAH ENERGY GATHERING COMPANY LLC, REGARDING THE JONAH GAS FIELD PROGRAMMATIC AGREEMENT AND OWNERSHIP CHANGE OF LEASE AND RIGHT-OF-WAY HOLDER,WITHIN THE JONAH GAS FIELD, SUBLETTE COUNTY, WYOMING

WHEREAS, the Bureau of Land Management (BLM), Wyoming State Historic Preservation Officer (Wyoming SHPO), Encana Oil and Gas, U.S.A, Linn Energy Holdings, LLC, (Linn), and Enterprise Jonah Gas Gathering Company LLC (Enterprise) implemented a Programmatic Agreement (PA) executed on 06/26/07, to mitigate adverse effects to Criterion D Historic Properties within the Jonah Gas Field; and

WHEREAS, Jonah Energy LLC has assumed ownership of leaseholds formally held by Encana, as of 05/12/14; and

WHEREAS, the State Protocol Part V.F.ii.a recognizes three types of signatories to this agreement: **Signatories**, **Invited Signatories** and **Concurring Parties,** which are referred to collectively as **the Parties**. Signatories and Invited Signatories may include any party who assumes responsibilities under this agreement. Concurring Parties have a demonstrated interest in the undertaking or its effects on historic properties, but do not assume responsibilities under the agreement. Concurring Parties may participate in development of the document and may concur with this agreement. The refusal of any Invited Signatory or Concurring Party to sign does not invalidate the PA. Concurring Parties cannot amend or terminate this agreement; and

WHEREAS, the BLM, Wyoming SHPO, Jonah Energy LLC, Linn and Enterprise have specific responsibilities under this PA Amendment, and the BLM has invited these parties to participate in consultation as Invited Signatories to this amendment and all parties have accepted; and

WHEREAS, the Eastern Shoshone Tribe has requested to participate in consultation regarding the Jonah Gas Field PA, and the BLM has invited the Eastern Shoshone Tribe to participate as a Concurring Party to this PA Amendment, and they have accepted; and

WHEREAS, the BLM, Wyoming SHPO, Jonah Energy LLC, Linn and Enterprise have agreed that a PA Amendment should be executed to acknowledge this sale of lease holds and name change of right-of-way Holder; and

NOW, THEREFORE, the BLM, Wyoming SHPO, Jonah Energy LLC, Linn, and Enterprise agree that the PA shall be amended as follows:

I. **Ownership of Leaseholds** has been transferred from Encana to Jonah Energy LLC as of 05/12/14 and all prior agreements pertaining to the original PA transfer to Jonah Energy LLC.

II. **Same Terms and Conditions.** With the exception of items explicitly delineated in this PA Amendment, all terms and conditions of the original PA shall remain unchanged and in full force and effect.

III. **Sunset Terms.** The terms of the PA shall extend for two (2) years from the date of this PA Amendment in order to fulfill all requirements.

IV. **General Provisions**

A. **Entirety of Agreement.** This PA Amendment, consisting of four (4) pages, the original PA consisting of seven (7) pages, and PA Amendment 1, consisting of five (5) pages, represents the entire and integrated agreement between the Parties and supersedes all prior negotiations, representations and agreements, whether written or oral, regarding compliance with Section 106 of the National Historic Preservation Act.

B. **Prior Approval.** This PA Amendment shall not be binding upon any party unless this PA Amendment has been reduced to writing before performance begins as described under the terms of this PA Amendment, and unless the PA Amendment is approved as to form by the Wyoming Attorney General or his representative.

C. **Severability.** Should any portion of this PA Amendment be judicially determined to be illegal or unenforceable, the remainder of the PA Amendment shall continue in full force and effect, and any party may renegotiate the terms affected by the severance.

D. **Sovereign Immunity**. The State of Wyoming, the Wyoming SHPO and the Tribes do not waive their sovereign or governmental immunity by entering into this PA Amendment and each fully retains all immunities and defenses provided by law with respect to any action based on or occurring as a result of the PA Amendment.

E. **Indemnification.** Each Party to this PA Amendment shall assume the risk of any liability arising from its own conduct. Each Party agrees they are not obligated to insure, defend or indemnify the other Signatories to this PA Amendment.

Signatures In witness whereof, the parties to this PA Amendment through their duly authorized representatives have executed this PA Amendment on the days and dates set out below, and certify that they have read, understood, and agreed to the terms and conditions of this PA Amendment as set forth herein.

The effective date of this PA Amendment is the date of the last signature affixed to these pages.

Signatories:

Bureau of Land Management, Pinedale Field Office

3-25-15

Shane DeForest, Field Manager — Date

Bureau of Land Management, Wyoming State Office

Acting

5-11-15

Buddy Green, Deputy State Director, Resources Policy and Management — Date

Wyoming State Historic Preservation Officer

Mary Hopkins

6/1/15

Mary Hopkins, SHPO — Date

Invited Signatories:

Jonah Energy LLC

4/7/2015

Craig Managh, President and COO — Date

Enterprise Jonah Gas Gathering Company LLC

Michael A. Todd, Senior Land Manager — Date

Linn Energy Holdings, LLC

Debra J. Gordon, Regulatory Manager — 4/9/2015 Date

Concurring Parties:

Eastern Shoshone Tribe

Darwin St. Clair, Jr., Chairman — 4/30/15 Date

Wyoming Attorney General's Office Approval as to Form

S. Jane Caton, Senior Assistant Attorney General — 5-14-15 Date

APPENDIX A

CULTURAL RESOURCES MANAGEMENT PLAN
for the
Jonah Gas Field, Sublette County, Wyoming

15, JUNE 2007

Theoretical Perspective. A useful approach to structuring data recovery derives from assumptions inherent in evolutionary ecology (Bettinger 1991). Human behaviors are viewed as being adaptive in the sense that the long term success of a group depends upon knowledge and adaptive behaviors being passed from one generation to the next. In order to focus on archaeological evidence for these behaviors, models based on hunter-gatherer mobility (Binford 1980) and on food (energy) costs are used. Sometimes termed middle range research, these approaches form a bridge between broad theory and the archaeological record. Binford's (1980) observations showing that hunter-gatherers organize along a continuum of strategies between two extremes, foraging and collecting, have laid the groundwork for much debate in archaeology (Gould 1980; Hodder 1986), but have also stimulated a very useful way to view the archaeological record (Binford 1983; Price and Brown 1985; Kelly 1983; 1995; Watson 1986). The forager-collector model and others of a similar nature (e.g. Bettinger and Baumhoff 1982) provide the archaeologist with a powerful set of tools for interpreting archaeological remains.

The archaeological record is viewed as being reflective of sets of behaviors used by prehistoric people in their daily lives. Evidence of these behaviors includes tools and facilities, the nature and distribution of refuse produced by tool manufacture and use, and the overall patterning of these remains both within individual sites and over the landscape. Care must be used in interpreting the meaning of the patterning of remains in order to account for various natural and cultural distortions that may have affected this record during the elapsed period of time since the prehistoric activity occurred (e.g., Schiffer 1987). Nevertheless, utilizing this perspective in interpreting the archaeological record provides a useful structure for the organization of data.

In addition to organizational and mobility models, approaches that measure energy costs have demonstrated their utility in the study of subsistence. Derived from optimal foraging theory, these models are used to assess the practicality of hypothesized subsistence strategies. When evidence of resource use in the archaeological record is encountered, archaeologists construct simple models of resource use. These models can then be tested and refined through the use of ideas drawn from diet breadth and other optimal foraging-based models. By assessing things like potential caloric yields and estimating time and transport costs, one can test the practicality of these resource-use models. Often, an assumption concerning the use of a certain resource or food will prove to be flawed once a practical measure of its utility is applied.

Data recovery will be conducted within the general framework of the above ideas, bearing in mind that many of the identified data gaps for research questions addressed below are simple and do not directly depend on any particular theoretical perspective. The approach is appropriate for the region because its focus is on hunter-gatherer organization, and because there are definable expectations for prehistoric behavior that can be measured in the archaeological record. In addition to more general concerns of chronology and subsistence, sites can be evaluated in terms of how well the data contained within them addresses the organizational model itself. Since the objective is to understand the entire cultural system, sites of every type and in every setting are worthy of some attention or study, though that may not always be possible within the constraints of one project. This is not expected to be possible on this project. Investigations must assess the significance of all available classes of sites--from nondescript lithic scatters to substantial residential and structural sites, burials and ceremonial sites in terms of what they can contribute to the understanding of hunter-gatherer lifeways.

As stated in the National Register criteria, the integrity of sites is the single most important factor in evaluations of significance. Under the hunter-gatherer organizational approach, any site meeting minimum

standards of integrity is worthy of study. If a site retains integrity, has sufficient material culture content to provide an estimate of site function, and has potential for approximating its age or ages, it is important to the research design. During survey and testing, this approach guides site evaluations. During data recovery, it will help to identify the most appropriate research questions for each site and will guide decisions concerning the size and placement of excavation blocks, aid in prioritizing work within and between sites, and will help determine when data recovery goals have been met.

Research Topics

Research topics, and corresponding data sources that can be expected during further investigations for this project, are outlined below. The topics run the gamut from being very general to quite site-specific, but all in the end will contribute data to understanding the overall prehistoric lifeway. The nature of some research domains requires considerable inter-site or regional comparison and synthesis which may not be fully realized within the framework and practical limits of any one project, including this one. The importance of recovered data that speaks to these topics is not diminished by this; the data still become an essential part of the growing body of baseline information which may be of utility in other research efforts that have the advantage of a larger or broader point of view.

Time-Space Systematics. This broad topic integrates with all other research domains by providing an integrative framework for looking at things like variability, continuity and changes either across space or time. Though several chronological sequences might be appropriate for Jonah (e.g. Frison 1991; Metcalf 1987) in a very general way, the primary goals of chronology building for this project will be to establish the temporal sequences for specific traits or complexes of traits that occur together in the study area. The focus will be on looking at how such things as fire pit technology, shelter, tool kits, and use of plant and animal foods vary through time and to relate patterning seen in these to the regional picture.

One such regional integrative proposal is presented by McNees in the cultural background study for the Express Pipeline Project (McNees 1999). He has revised a concept used by George Frison and colleagues in their overview of adaptations Northern Plains prehistory (Frison et al. 1996). In this study, McNees discusses adaptation types as being a sort of integrative concept that can be applied to ecologically cohesive environments covering long periods of time. Within an adaptation type, there may be continuity in subsistence and settlement, while there is variability in other aspects of material culture. Within each adaptive type there might be a chronological sequence and the development of cultural complexes which are composed of suites of co-occurring traits (McNees 1999). The adaptation types include the Northwestern Plains Pleistocene-Holocene Transition, Northwestern Plains Grassland, Big Horn Basin Foothill-Mountain, Western Wyoming Interior Basin, and Northwestern Plains Equestrian adaptation types. As the names of these adaptation types imply, ecological characteristics, most prominently the distribution and seasonality of plant and animal resources are central to definition of the adaptive type. Adaptation types do not have temporal or geographic boundaries. The geographic limitations of an adaptive type are dependent upon the functional distributions of the resources key to the adaptation type. These boundaries change as climates change, or as is the case for the Pleistocene-Holocene Transition, the ecological characteristics might disappear altogether (McNees 1999 3-2 - 3-88). Given the characteristics of the Jonah study area, the Western Wyoming Interior Basin Adaptation Type (McNees 1999:3-62) is the most relevant, but all five adaptive types could have functioned in the study area given the right climatic conditions.

McNees' ideas are introduced here because they represents a major effort to move beyond simple reference to established chronologies that may or may not fit ones study area very well. And given the known patterning of ages and pit features in the Jonah, aspects of the Western Wyoming Interior Basin type appear to be particularly relevant. Nevertheless, this is only one idea about how to approach the broad topic of chronology, and certainly not the only valid one.

General goals of chronology building for the Jonah project are: a) to obtain samples of artifact assemblages, projectile points, and ceramics where present, which can be directly related to >>>samples>>>??? taken for radiocarbon dating; b) to use resulting intrasite chronologies as a basis for including the dimension of time in intra- and intersite comparisons in subsistence, settlement, technology, and other related topics; and c) to examine the relationships between the depositional model and chronology as derived from the archaeological record to better understand both, especially in settings where absolute chronological control is not available. Thus, two important research questions are proposed.

First, is the San Arcacio cultural bearing sediment a sediment that was deposited in antiquity (Archaic Period) that is now being deflated or is it an intact paleosol that retains the cultural materials? The newer Wyoming Basin chronologies do not seem to fit Jonah (or the Upper Green River Basin) very well. Some aspects seem to fit the Plains chronologies better (Vlcek 1995). Can this chronology be refined better for this region or Jonah specific to start with? The problems seem to be prominent during Early Archaic period (Wyoming Basin model). We also have a lack of dated occupations in the late Archaic period. Does this support the postulated "little altithermal" period and general lack of occupational evidence in the Wyoming Basin during this time period or is this an artifact of the harsh environment that was not conducive for site preservation from this period?

The 316 radiocarbon ages from 122+ sites in the Jonah area provide a solid background place for chronology building, but the nature of this date sample is not yet clear, as discussed above. An exact number of components represented in the 316 dates are difficult to determine since multiple dates derive from several individual site components. Still, there are some aspects of the known dates that suggest research questions. First is to better determine the nature of the radiocarbon sample relative to stratigraphic and spatial occurrences of features. Most of the features are shallowly buried within the same soil unit and in some cases have little vertical difference. A related question is, are there any significant slices of time where sediments are missing from the depositional record? By better characterizing the nature of the Jonah sample, we may gain a better understanding of what the apparent patterning in date frequencies really means in terms of past occupations. Was the area abandoned during certain time periods, or is the record simply missing because of erosion?

Currently the Paleo-Indian period is poorly documented in the Jonah record. Numerous surface finds of Folsom, Eden, Scottsbluff and other temporal artifacts exist from the surface and six radiocarbon dates exceeding 8500 years BP have been collected. However, with the exception of site 48SU6181, a site with a radiocarbon date of 8850±60 and an Eden point, none of the surface finds have known buried deposits and none of the remaining dates sites have associated artifact assemblages (further work at this site will occur under the programmatic agreement). So any intact remains from this time period would be highly significant. Because of the paucity of remains from this period, it is very difficult to develop specific research questions at this time. These remains are generally located near the Sand Draw drainage valley and general questions related to topographic setting, stratigraphy, artifact assemblages and resource use are primary. What was the paleoenvironment actually like? The presence of Birch as a fuel source in the features indicates a wetter clime. Patterning of early sites along Sand Draw may indicate that the

draw was perennial instead of seasonal. Also, it has been postulated that the area north of the playa in Section 32 may have been a large pond at the end of the Pleistocene, is there data support this?

The Jonah field has produced a number of Scottsbluff, Eden and other Paleo-Indian temporally diagnostic artifacts. Where are these occupations? Are they preserved in the soils we have? Most of these specimens are manufactured from stone types that are local and not exotic or imported into the area. Does this represent a more local population instead of more traditionally accepted versions of Paleo-Indian people engaging in more traditional statewide or larger regional rounds or wanderings for subsistence?

The Early Archaic is the best represented time period or cluster of data in Jonah. This Time period has a large range, encompassing the years 3600 through 8500 years BP. Jonah is rich with radiocarbon dated sites from this period, with 234 or 74% of our dates from this period. The nature of Early Archaic occupation in the region is becoming better known, and additional sites from this time period are expected to occur in the study area. Current evidence from the region suggests that a distinctive complex of traits are in place by about 6,000 BP which researchers have variously called the Green River or Opal Phase (see Thompson and Pastor 1995:20), and which McNees suggests might more accurately be called a ■complex• (McNees 1999 3-64). Characteristic traits include emphasis on pit feature use including cylindrical basins, use of basin houses, frequent reoccupation of the same sites, and use of bone ornaments including bone tubes and discs. Projectile points are variable but tend toward being medium-sized side notched forms. This phase lasts until about 3600 BP in southwestern Wyoming. What were the food sources in Jonah during this period?

Generally in the region, prior to about 6000 BP there is little data, but Metcalf (1987) proposed a Great Divide phase to account for sporadic pre-6000 BP dates associated with pit features and lacking any evidence for Paleo-Indian affiliations. Thompson and Pastor (1995:28) move the beginning date for this period back to about 8500 BP based on a combination of archaeological and paleoenvironmental data. This corresponds well with the record from northwestern Colorado where Reed and Metcalf (1999) use a similar age to mark the onset of the Archaic Era, and also separate the Early Archaic into two periods, a Pioneer Period and a Settled Period.

Jonah has numerous dates and site data dating between 8500 BP and 6000 BP. Ninety-seven or 31% of the recovered dates from Jonah fall into this poorly documented time period. Some of the major traits that coalesce into the Green River Complex by about 6000 BP are present at earlier dates, including house structures, pit features and a lone burial at 7300 BP. It seems likely at this juncture that the deteriorating climatic conditions of the middle Holocene forced changes in many aspects of cultural systems, and that the Green River Complex in western Wyoming, and the Settled Period in northwestern Colorado are reflections of stability after a period of wild change. With such a large body of data from this time period, Jonah provides an excellent area to try and address some of these changes. It may be that this area also had a more stable environment then most of the basin areas during this change and this may be the reason for such a large percentage of use during this period.

Because of their larger numbers in Jonah, an intact site with a pre-6000 BP age would almost automatically a candidate for preservation or applied research because such sites represent an excellent chance to look at aspects of technology and subsistence that are not well understood. Traits similar to those found later are expected, but differences reflective of evolving adaptations are also expected.

In the Jonah, radiocarbon ages are reduced in number prior to 4000 BP, but there is a still a significant cluster of ages between 3000 - 4000 BP (49 or 15.5%). A major concentration of dates occurs between 3200 BP and 4000 BP during what is traditionally called Middle Plains Archaic. The Jonah dates are derived from pit features, including basin houses, which are similar in most aspects to the definition of the Green River Complex. Initial evidence points to a broader spectrum of adaptation techniques, where processing of plant foods was as important as game hunting. Existing evidence suggests a stronger reliance on small game as opposed to larger ungulates. The artifact assemblage is ripe with temporal projectile point types, but there is little similar subsistence evidence for the presence of the McKean Complex, which is traditionally associated with the Middle Plains Archaic. This complex is characterized as having a subsistence emphasis that leans toward big game hunting which to date is not supported in the Jonah (Vlcek 1997b). Clearly, there is a need to better understand the technology and subsistence during this time period in order to understand how the area was used during this time.

Dates drop off in frequency between about 1800 BP and 3100 BP, or throughout the Late Archaic, though there are twenty-six dates spread through this interval. This is a period in general that seems to be less understood than the times immediately before and after. Again, is this due to "little altithermal" environmental conditions and/or preservation? Are basin environments being used less frequently during this period, are proper aged sediments missing, or is the prehistoric use more transitory or less visible? These are clearly questions that need ADDRESSED …attention in the Jonah as well as in the larger region.

The early Late Prehistoric from about 1800 BP to about 900 BP is not abundantly represented in the Jonah, but is well represented elsewhere in the region (twenty dates or 6.5%). This period corresponds to the Uinta Phase as proposed by Metcalf (1987) and McNees has suggested, like for the Green River Complex, that it be viewed as the Uinta Complex. The traits that define the Uinta Complex are essentially the same as for the Green River complex, except that Rose Spring arrow points and occasionally ceramics are present, and sites appear to be more numerous or at least better preserved. McNees sees the Uinta Complex as a second strong expression of the Wyoming Basin Interior adaptation type, viewing the similarity between the two periods as similar adaptations to similar conditions (McNees 1999:3-65). This view of similar adaptive patterns appears to have some validity, as regards the use of pit features and basin houses, however no basin houses of this age are present within the Jonah. There are also marked differences which need to be explored, including use of smaller structures during the Uinta Phase, and perhaps a heavier reliance on seeds.

There are no dates from the later Late Prehistoric, between 400 and 900 BP. In the region, small corner-notched points are replaced by small side and tri-notched projectile points, plain gray ceramics are replaced by Intermountain Ware. There are far fewer radiocarbon dated sites than previously, there is less use of pit features, and basin houses disappear from the record. This is certainly a period of cultural change. There is an apparent increase in carrying capacities attributed to the Little Ice Age, bison hunting fluoresced on the Northwestern Plains (Reher and Frison 1980) and various researchers have suggested that a more mobile, less processing-oriented lifeway occurred.

An expansion of Numic speaking peoples out of the Great Basin has been proposed for this time period (see Madsen and Rhode 1994). This expansion included the Eastern Shoshone, the main ethnographically known group to use the area. Whatever the nature of the occupations, or the mechanisms of change, there are significant data gaps within this time period, and almost any information would be of importance. ….The Site 48SU4000 district contains the greatest known concentration of ceramic sites in southwestern Wyoming. As well, many of these sites have

associated intact cultural components. Thus, research questions directed at answering ceramic technologies through time can be answered by investigation of sites in the district. For example, what is the antiquity of the intermountain wares within Site 48SU4000? Will additional investigations in the district recover the Grayware common in the regions to the west. An unusual small, serrated-edged, ceramic beaker specimen was recovered at 48SU3986 (Wolf Tooth, Miner 2007), the only known specimen of this type in Wyoming, just south of the Jonah boundaries. Wolf Tooth dated to 1100 BP, Will additional investigations document this ceramic technology in Jonah?

Finally, the Protohistoric/historic era is poorly known, with only one site assigned to it from the Jonah (280±40 BP). But the study area is with the known use area of the Eastern Shoshone and others, and both pre-reservation and post-reservation era sites could be present, though there is, as yet, no artifactual evidence from the project area to indicate the presence of such sites. The 48SU4000 district, currently insufficiently archaeologically explored has numerous Late Prehistoric temporal projectile points and may be an area that could provide an area of serious investigation for this period. If found, These types of sites could provide a source of data about understanding the transition between the prehistoric and historic eras. They would be especially significant in this region because of the early contacts with American traders and trappers.

Lithic Technology and Source Area Analysis. The study of lithic materials is nearly ubiquitous to any data recovery program because lithic materials are common to most prehistoric site types. Detailed study of lithic assemblages will be used to address a variety of topics including: a) interpreting site function; b) chronology building; c) describing prehistoric technology; d) making intra- and intersite comparisons; and e) tracing movements of lithic raw material types (and thus, indirectly, people or contacts with people) from source areas to destination use areas.

Current data suggest that the presence and use of chipped stone tools is poorly understood in Jonah. This is reflected by relatively low densities of chipped stone debitage found during excavations and relatively few formal tool types in excavated assemblages. This contrasts with evidence from other areas in the region and surface assemblages in found in Jonah, where manufacture and use of formal tool kits is prevalent in assemblages. This may be a site type bias due the fact the most of the excavations that have occurred in Jonah have involved housepit sites. It will be important to see if this apparent aspect of Jonah assemblages holds true after more work is reported, but in any event, characterizing the nature of chipped stone use in the Jonah will be important for what it will reveal about the relationship between technology and subsistence. It is not the intent of this research design to dictate what approach to functional analysis must be used, but Binford's (1979) division of assemblages into functional categories is one approach that has been used successfully in the region (e.g. Stiger 1998). In this approach, stone tools, in addition to being functionally described, are classified into personal gear (knives, projectile points, formal scrapers), site furniture (ground stone, choppers, hammer stones, and core tools), and expedient tools (flake tools with little modification). Differences in the make-up of site assemblages then provide information on the range of activities represented. An emphasis on personal gear, for example, would be indicative or greater mobility and emphasis on hunting, while an emphasis on site furniture might correlate with a processing-intensive adaptation.

The size of the lithic procurement system can be approximated by the range of raw materials represented in the assemblage. Obsidian, where present, is one of the best indicators of this, and obsidian should be analyzed for source whenever possible. Other materials are not as useful, mainly because they can seldom be traced to source, but the material types can be inferred to likely sources based on known outcrops and geologic maps. However, materials types common to the Jonah (i.e., alkali creek/wilkens peak, quartzite and oolitic chert and obsidian) will need to also be documented. Some information on lithic raw material distributions can be found in Miller (1991),

Clayton (1999), and Batterman and Martin (1999).

Site Function. Site function includes the range of activities carried out at a site during any one occupation. Establishing site function is basic to larger scale studies of settlement and subsistence patterns and to application of hunter-gatherer organization to site data. This topic can be pursued through functional analysis of lithic assemblages, and through analysis of features such as hearths and middens. Flotation of feature matrix and faunal analysis will contribute to this as well. A primary goal of data recovery will be to delineate the range of activities represented in each identified site occupation to facilitate other lines of inquiry. Site types presently known in Jonah are short term open camp sites, lithic reduction sites, lithic procurement areas, very small, single hearth sites, housepits, rock shelters, stone circles, larger multiple occupation sites and any occasional human interment. To date no rock alignments, hunting structures or formal architectural sites are known in Jonah. These types of sites would be significant if found.

Subsistence and Settlement. These topics are related to site function in that data on subsistence are often used in addressing site function. Reconstruction of subsistence strategies through recovery of floral and faunal food remains, as well as through data gathered from technological and functional analysis, will be attempted. Topics addressed will include: a) species identification; b) study of extractive technology; c) seasonality; d) site catchment analysis; e) settlement analysis; and f) synchronic and diachronic comparisons. Specific questions include how evolutionary ecology models (Bettinger 1991) and Binford's (1980) model of hunter/gatherer organizational systems can be applied to settlement and subsistence evidence from sites in the project area.

A brief summary of the subsistence evidence for the Jonah was presented above. Preservation of both plant and animal remains appears to be fair. Basic to the study of subsistence, is of course, recovery of direct evidence of the foods that were utilized, and the interpretation of how these foods were obtained. There are some baseline subsistence data from previous work in the Jonah area, but the data are difficult to interpret. Recovery and identification of animal foods is generally the most reliable, but thus far in the Jonah, (the recovered arch fauna is small game…..archaeological fauna have been small, somewhat diverse, and have not indicated big game hunting as a primary focus. A real need in the Jonah is to better characterize the range of species utilized and to understand the context of their use. Was hunting a focus at all, or simply the result of chance encounter? Are the housepits related to long-term use or multiple short-term use?

By the same token, were the bulk collection and/or processing of plant foods important in the Jonah? Jonah has numerous pit features and one would assume they are for plant food use. Both flotation and pollen studies have attempted to address this, and these analyses have not help suggest economic use of plant foods. To date, pollen is not preserved in the shallow archaeological record and the main product from flotation studies is the presence of cactus, which may be processed as a food item or used in association with other food preparation practices. There is a need to set some expectations for the analysis of floral remains in activity areas and pit features. Is the collection of plants a major focus of subsistence during any period of use in Jonah? If Sand Draw was more of a perennial stream, what plant food sources would have been collected, such as willow or cattail? Since little groundstone is being identified in Jonah sites and if plants were being collected, how or were these materials being processed or were they simply just collected for transport (i.e. tubers).

Jonah is rich in sites that date between 4000-7000 years BP and the site areas are more expansive than the Late Prehistoric areas. Is there a real difference in the site patterns or is this related to San Arcacio soil preservation.

Where different resources being utilized during the different periods?

Pit Features. Because pit features are so common in the archaeological record, and because such features were the focal point of much prehistoric behavior, considerable archaeological attention has focused upon pit features in recent years. In addition to description of feature morphology and chronology (McKibbin et al. 1988), feature contents have been analyzed with various techniques (e.g. Cummings et al. 1996), the ethnographic context of pit feature use has been explored (Francis 2000; Wandsnider 1997; 1999; Smith and McNees 1999), and several experiments have been conducted to explore the functional characteristics of various feature types (Stiger 1998; Jensen et al. 1999; Smith et al. 2000). Within the Jonah, pit features appear to be ubiquitous and to occur both as isolated features and as parts of structured activity areas. Most have been found during construction; few are visible on the surface or in cut banks. A large number of these features have been excavated, dated, and sampled for macrobotanical and pollen remains. What has been lacking is systematic analysis of the cultural context of the use of these features. Future research on pit features in the Jonah needs to occur with research goals as discussed below.

Physical Characteristics of Pit Features. Pit features occur in a range of sizes and shapes and with a wide variety of contents and linings, and there is evident variability in labor investment and intended function …is evident… Most pit features in the region are presumed to be hearth features, but secondary or other uses including storage and burials are known as well. Although most basic feature types are in evidence by the end of the Early Archaic time period (ca. 6000 BP), recent syntheses suggest that there is variability through time in the nature and intensity of pit feature use, and this variability is reflected in several ways, including variability in size, form, content, and construction. Measuring this variability has been hampered by inconsistencies in description and reporting, but a good deal of data are present with which to address this variability.

Important physical characteristics of pit features include the basic metrics of size and shape, nature of pit lining, if any, nature and content of pit fill, oxidation of surrounding soil or feature rocks and other indications of heat intensity such as calcinations of lining rocks or fusing of clayey soils, and presence or absence of any associated clean-outs or dumps. Simple graphing of these characteristics against time will provide a lot of insight into changing prehistoric use patterns.

Standard measurements of all features should include, diameter or long and short axis and depth so that feature type and volume is clear. Representative profiles should be standard. Feature volume should be calculated using the appropriate formula for the feature•s shape.

Feature lining is an important variable. Most features are unlined, but some are either slab or rock lined, and this lining may or may not include the bottom of the feature. Specialized functions have been attributed to slab lined features, including storage, specialized roasting (Smith and McNees 1999), better heat control (Stiger 1998), and maintainability. Beyond this generalization, little has been done to explore variability in lined versus unlined features, yet there is considerable variability in the sizes and depths of slab and rock lined features and in the number and size of lining rocks used. A number of questions can be posed about the function of lined versus unlined features. For example, do lined features occur in contexts that suggest either more complex processing or longer term occupation than for unlined features? Are lined features a reflection of specific foods or classes of foods, are they used when storage will be important as a subsequent use, do they reflect long-term or repeated use of the same camp site, are they used when management of thermal output is important, or are they simply a reflection of availability of suitable materials? The McKean cultural complex is known or recognized to heavily use slab-lined

roasting pits. While Jonah appears to have a large number of sites that date to and has produced hundreds of temporal diagnostic projectile points similar or typically associated with the McKean complex, why are slab-lined features and the previously mentioned reliance of big game hunting so rare in Jonah?

Heating or cooking rocks are often associated with feature use, either as boiling stones, roasting stones, or for simple heat retention. Burned and fire-cracked rocks are often found concentrated at the base of features (rock-filled hearths), or are found in other contexts like scattered through feature fill, or in concentrations or scatters adjacent to or near pit features or feature clusters. Clearly, rocks are heated in some features and removed hot for use in other features, or in baskets, pots, or hide lined pits. In other contexts, the hot rocks are left in place to provide long-term residual heat. Hot rocks were also important for sweat lodges. The differing, yet similar functions of cooking rocks will create variability in the way they occur archaeologically, since some are left in place, some are removed and used in other ways, and all will be removed or dumped as site space is maintained or re-used. A clearer understanding of the role of heating rocks as tools, and of their subsequent patterns of re-use or occurrence as refuse is an avenue of research that has been underutilized to date.

Researchers in the Jonah should be cognizant of current research going on in the region focusing on the ethnographic, experimental, and archaeological aspects of pit feature use and the use of hot rocks in food processing and cooking. Summaries of ethnographic context can be found in the work of Wandsnider (1997; 1999) and Thoms (1989), experimental work on pit feature construction and function includes work by Smith et al. (2000), Jensen et al. (1999), and Stiger (1998), among others.

Perhaps one of the most recent data sets for pit feature use for the Jonah study area may be contained in the synthetic volume for the Express Pipeline Project which is located in the Big Horn and Wind River Basins (Martin and Smith 1999). This volume contains basic data on 139 cultural features of various types including from 127 pit or hearth type features (McClelland 1999:2-17). This, along with a number of other contract reports (including Trappers Point, Miller et al 1999), forms a large comparative sample for feature types, contents, metrics and ages. Are there clear changes in patterns of pit feature use in the Jonah as well as regionally? Continuing studies of features as described above could provide this needed resolution.

Pit Hearth Morphology and Food Characteristics. Wandsnider's paper on the heat treatment requirements of various food types is an important contribution to pit feature research because it lays out some basic processing requirements for certain food classes, and forms a starting point for linking feature form and size to the specific class of food resources being processed (Wandsnider 1997). In addition it is a good source of ethnographic information on cooking and pit feature use. A basic knowledge about the processing requirements of potential foods, as well as some information on the heat generating and retention characteristics of various feature types is important for inferring feature function and suggesting food types that were prepared in the features. As an example, Craig Smith and colleagues conclude that prickly pear, a potential food, was used in Late Prehistoric deep cylindrical pits as a buffer between the heat source and some other food, most likely sego lily bulbs (Smith et al. 1999:3-59). This inference is based on the idea that oven roasting is not necessary to make prickly pear digestible, and that known ethnographic references to prickly pear processing describe brief roasting over open coals for spine removal. The key point here is that knowing the functional limitations of various feature types will provide clues to the kinds of foods that could be effectively processed.

Wandsnider suggests that the simple presence of pit hearths is a powerful indicator of subsistence, since they were designed to process a specific range of foods and products (Wandsnider 1999:22). The pit hearths she refers to are deep basins with a rock cooking element. Such hearths have good long term (ca. 12 hr) heat retention characteristics (see also Smith et al. 2000). This is important for processing foods that have their fructans in the form of inulin, since they are essentially indigestible in raw form and require long baking to become edible for humans (Wandsnider 1997). A number of roots and bulbs fit this category including Camus (Alston 1989), sego lily, biscuit root, and others. Wandsnider's research indicates that pit roasting was also frequently used for moist roasting of higher fat meats, especially where there is connective tissue to be broken down, or when large portions are involved.

The empirical and ethnographic data base is not complete and there are some unresolved areas were information seemingly conflicts, but there are some basic pit feature characteristics that would seem to be useful as a basis for inferring use and predicting subsistence practices. Since formal, deep pit features appear to be specialized for moist baking, the processing of one or two food classes can be fairly reliably inferred, fatty or large quantities of meat, and non-seedy plant parts, mainly roots. Roasting of animals tends to leave an archaeologically visible fauna and thus, should be present in assemblages if meat roasting was a feature function. Roasting of soft plant tissues, with a few exceptions, appears to have left almost no evidence at all. Thus, in the face of negative evidence for target species, one generally concludes that bulb, roots, or tubers were being processed. Today Biscuit Root grows through out the Jonah and Anticline area and is dominate in the early spring. Wandsnider (1997) suggests that lipids might be detected as a residue on cooking rocks, but we are not aware that such has yet been attempted. It is time that methods for detecting trace elements of residues are applied to hearth content analysis.

Along these same lines, the use of hot rocks in cooking can be examined. Evidence indicates that rocks were used in cooking in two main ways, as a heating element within pit features, and as a heat transfer mechanism for stone boiling. Prehistoric use of rocks for cooking has left a highly visible archaeological legacy where concentrations and scatters of fire-cracked rock form one of the main classes of observed materials. Like with pit features, there is only a modest amount of ethnographic and especially experimental data published about fire-cracked rock in archaeological contexts, but there is quite a bit of unpublished (and in press) work currently being done. A recent example comes from the Dugway Proving Ground in Utah where a series of replicative experiments were done in order to understand the distributions of fire-cracked rock in a Middle Archaic sand dune site (Simms et al.1999). The researches specifically wanted to use FCR as a means of estimating the intensity of activity at the site. Their experiments were aimed at gauging the amount of time, effort, and resources that went into the production of a FCR concentration of a certain size (Jensen et al. 1999:51). In a series of 10 experiments starting with 10 rocks each, rocks were repeatedly used to boil set quantities of water. They found that as rocks fragment to a size of 2-3 cm and about 110 g in size they fall below a threshold of usefulness, with this typically occurring within 5 use cycles. The 100 rocks in the initial experiment were reduced to 610 pieces over approximately 8 hours of boiling time. They thus calculate that the 1000+ pieces of FCR from the Playa Dune Site indicates some 13 hrs of boiling time (Jensen et al. 1999:61). This information can then be related back to other archaeological characteristics of the site in order to make inferences about the number of people and duration of use of the site.

This, and other experiments with FCR (Black and Hester 1998) suggest that FCR and the rock elements of pit features in general, has been an underutilized avenue of analysis in the region to date, since at a minimum, these materials can be used to infer cooking method and the amount of cooking that occurred. Of course there are a number of variables that cannot be extrapolated in these experiments (composition, size, and availability of

available rocks, for example) but specific experiments with both baking and boiling using local rocks of the same material found archaeologically is suggested by the Playa Dune experiments …. Describe…...

In terms of archaeological data collection, it becomes important to keep a record of FCR attributes as well as to determine what sort of sample of FCR should be kept for potential analysis. At this time, counts and total weight of FCR from features must be recorded, as well as details about degree of breakage and typical rock or rock-fragment sizes. A few pieces of FCR from intact features and from clear primary discard features should be bagged for possible residue analysis. There does not seem to be a justification for collection and curation of all FCR however.

From the above, it is clear that the various aspects of heating and cooking features are a significant potential data source in the Jonah. Elements of chronology, subsistence, and group structure can be pursued through analysis of feature contents, morphology, and association with other features and activity areas. In fact it might be more accurate to say that intact hearth-centered activity areas are the basic unit of analysis. Depending upon what elements are present in a given hearth-centered area, one can pursue various research topics that are interrelated with the major themes described herein.

Pit Features and Pollen, Flotation, and Starches. It has been standard practice in Wyoming archaeology to sample feature fill for flotation analysis, though there is have been some inconsistencies in the amount of fill that has been saved and subjected to analysis. Some researchers advocate floating 100% of feature fill (which has been the case for most of the excavated features in Jonah); many do not consider such a large sample to be necessary, and some believe it to be an unnecessary waste of money. Still, there is little debate that flotation analysis should be pursued, but recent studies indicate that more care is needed in the interpretation of the results (Bach 1997). For the Jonah, a basic sample of 10 liters (five gallons) per feature is recommended as a compromise sample size. This is far greater than the 2 liter sample favored by some analysts, yet is often far less than the 100% advocated by Guernsey (1993) and practiced in most Jonah research.

Pollen analysis of activity areas and feature fill in the Jonah has also been pursued, with entirely negative results. Most Jonah sites and soils are too shallow and the constant wet/dry cycles have not permitted pollen and/or starch granules to be preserved>>>>>. Some attempts will still be made in Jonah, depending on depth and soils present. But there has not been enough consideration given to how these pollens or starches were introduced into the feature contexts, and there is no baseline about whether pollen would even be present given known ethnographic uses of plants. Before the presence or absence of pollen in feature fills will have any analytical meaning, a baseline understanding of what pollens should or should not be present is needed. We need to know in what circumstances pollen should be expected to occur when plants are processed. Without this understanding, we are left with a species list of dubious meaning, but of high cost. Pollen sampling should be pursued during excavations, but no analysis should occur until a better baseline for analysis is established. Work relating to further attempts to produce a pollen baseline in the playa regions in and around Jonah is envisioned for the 2007 field season.

Basin House Structures. Many Archaic house depressions have been excavated in the Rocky Mountain region over the last decade including an impressive number from northern Colorado and from the Wyoming Basin (Jones 1986; Horn et al. 1987; Metcalf and Black 1991; Pool 1997; Rood and McDonald 1999). Some of the better reported Wyoming Basin housepit sites include Split Rock Ranch (Eakin 1987), Maxon Ranch (Harrell and McKern 1986), Sweetwater Creek (Newberry and Harrison 1986), and Sinclair (Smith and Reust 1992). The

Express Pipeline in northwestern and central Wyoming also excavated eight housepits on five sites (Martin and Smith 1999). Jonah itself has produced twelve housepits on four sites (McKern and Current 2001; McKern and Current 2002; McKern and Current 2004 and Nelson and Smith 2006). Data on many of these structural sites have been summarized in an in-depth analysis of regional architecture in a Master's thesis by Lane Shields (1998) and in a *Plains Anthropologist* article by Mary Lou Larson (1997).

Based on a sample of excavated structures from 98 sites in a four-state region, including the Bairoil project, most of the Wyoming housepit sites and five of the Uinta Basin Lateral sites, as well as several farther south, Shields (1998:63) lists the following characteristics:

> Basin houses are defined by a number of characteristics including irregular perimeters; variety in outline including oval, elliptical, circular, and subrectangular forms; shallow basins or depressions, sometimes irregular across the house; low walls with shallow and sometimes changing slopes; often lack of wall definition along part of the house arc; undulating floors that often slope with the paleoslope direction; internal features including a number along house perimeters that often contribute to the irregular outline; infrequent evidence of postholes; and adjacent or nearby external features.

Shields also defines the "basin house core area" as being essentially the same as the physiographic Wyoming Basin, and defines this as an area of occupation by a cultural group (Shields 1998:65).

Alternatively, a review of house depressions excavated in the Rocky Mountain area prompted the following list by Larson (1997:353:369):

- an average of one to two structures per site;
- a range in diameter from two to six meters;
- a range in depth from 15 to 125 cm;
- typically occur on or very near permanent water sources and zones of edible plant foods (specifically grass seeds and forbs);
- typically occur in sagebrush or saltbush communities;
- most date between 4500 and 6000 years ago;
- animal bone is highly fragmented, with remains indicative of a broad-based subsistence strategy not limited to a single size class or type of animal;
- there may be a connection between the presence of ground stone, charred seeds, and the number of features.

Thompson and Pastor (1995:94) have also reviewed house pit data, in terms of size, and that data is reproduced here with the addition of data from some additional structures. This table does not include Medicine House (McGuire *et al.* 1984) or Yarmony House (Metcalf and Black 1991), because both of these structures were large, formal pit structures retaining many internal characteristics that the remaining house depressions do not.

There appears to be some variability in house size, within time periods. diameters of Early Archaic structures range from about 3 m to over 6 m. But there also seems to be almost a dichotomy in structure sizes

between Archaic era basin houses, and Late Prehistoric structures. Late prehistoric structures, in fact, seldom approach being 3 m in maximum dimension, and based on their small size, have variously been interpreted as windbreaks, wikiups, and prepared occupation surfaces.

Larson (1997:361-362) discusses in some detail the connection between the presence of ground stone, charred seeds, and the number of features in various house pits throughout the Wyoming Basin, specifically as it relates to season of occupation. While there is not much conclusive data pointing to specific seasons during which these house pits were used, Larson (1997:362), citing Eckerle and Hoby (1996), suggests that the house pits may have been used during milder weather for resource procurement, and then again during winter months as caches for stored resources. This may have been as a response to patchier environmental conditions during the middle Holocene, when settlement may have been more ▪place• oriented--repeated visits to the same locale would have resulted in the investment in more permanent housing, more elaborate site furniture, and more stable features. The food cache represents a concrete attempt to conquer temporal incongruity in a seasonably variable ecosystem (Thomas 1985:30). Such a strategy would have allowed more equitable temporal phasing of key resources through the storage of seasonally available foodstuffs. Food would have been intensively harvested, and stored in bulk. Typically, food caches usually contain only a single kind of seasonally available resource, and are generally constructed near the locus of procurement (Thomas 1985:30).

There are several implications and problems or questions for the Jonah study area that are derived from the above. If one follows up on the inference that house pit use, as well as use of pits for storage or caches, are indicative of a ▪place• oriented settlement system, it follows that the people are targeting key resources that can be economically pursued within a small area surrounding the ▪place•. This implies some degree of sedentism in the settlement system, and together with other inferences derived from the nature of pit feature use, suggests bulk processing and storage of relatively low-ranked plant resources. In essence, this is an off shoot or variety of a central place foraging model (e.g. Zenah 2000), and it is one that can be tested against other archaeological evidence. Metcalf and Black (1991; 1997) discuss various lines of evidence that indicate either winter occupation or long-term occupation. They suggest that winter sedentism, because it represents an occupation of at least several months, will also be characterized by the features of long-term occupation. Attributes of winter occupation include positive evidence like fetal elements of large game animals, and inferential things like the presence of well-constructed shelters with interior hearths, presence of storage features, and site placement in a setting with adequate solar gain, and minimal cold air drainage or inversion potential. The presence of storable plant food residues and a highly processed fauna are characteristics that can be supportive of, but not conclusive of winter occupation. Of equal importance in interpreting winter occupation is evidence to support long-term occupation. These characteristics include a highly diverse tool-kit reflective of the varied tasks that occur in domestic sites, often including bone as well as chipped and ground stone tools, beads, pendants and other personal ornaments and non-utilitarian items, and the accumulation of refuse as sheet or actual middens. There are any numbers of studies that show that site space is maintained when the duration of occupation is more than a few days, and evidence of this site maintenance is imperative if one is to infer long-term occupation (e.g. Binford 1987).

Thus far, all of the structures excavated in the Jonah are Early Archaic in age. Jonah houses generally date between 4000 and 7300 years BP, however a posthole from 48SU4479 dates to 8210±50 BP. All Jonah basin houses are similar in construction and assemblage characteristics to other known Archaic houses, however most have post hole preservation with a larger variance with regard to diameter and number of internal features, but few associated artifacts and no associated sheet midden. By way of contrast, at least seven small late prehistoric basin

houses, and house-like depressions have been excavated, including the Sand Draw Dump (Walker 1999) and several from the Beaver Creek Pipeline (Goss 1999a; Goss 1999b; Goss and McKay 1999). The late houses tend to be small and to have a good deal of their interior space taken up by pit features (similar to Jonah houses). They seem to conform to the general pattern that is emerging from the region (e.g. Buffalo Hump, Nova, 48SW5655), but a good deal remains to be learned about this structure or feature type. It will remain important to excavate such sites and to learn more about the overall context of use of the structures. Important questions include architectural details; patterning relative to artifacts, other features, and middens; ages; seasons of use; and a good comparison with ethnographically known house types. Also needed are serious efforts to investigate the contemporaneous of pit house occupations. Do the pit houses in Jonah represent many short term occupations or do sites like 48SU4479, J. David Love, represent something akin to a village?

Paleoclimate, Paleoenvironment, and Sedimentation Models. Reconstruction of past climates and environments is important to understanding many other aspects of the prehistoric occupation. Such reconstruction can be pursued through palynological, geomorphological, faunal, and soil sedimentation analyses. On this project, the opportunities for addressing these issues will come from exposure of sediment profiles that can provide pollen data (through sampling of a pollen column), sedimentological and depositional information (through soils and sediment analysis), and most critically, chronological control (through recovery of datable cultural materials). The implications of recovery of this type of information carry through the other research topics identified for this project, but also will add to a regional data base that becomes of increasing utility as new evidence is accumulated.

The work reported for by Eckerle and Taddie (1997) provides a good starting point for investigation of the depositional sequences in the Jonah. A terrace sequence for the area has been proposed, and the presence of two paleosols, one of which may serve as a marker horizon, has also been described. The nature and ages of the sediment sequence will be integrated with pre-construction testing and with any data recovery excavations.

Eckerle (1997) has completed a preliminary soils sensitivity map. This coupled with the Burma Road Soils map will be used in a GIS base which will continue to be updated and tested as more data are gathered. Thing envisioned to be updated include tested sites, discovery sites, dated sites, locations of pollen samples, etc. Specifically, the San Arcacio soils will be more accurately mapped with survey grade GPS. Discovered sites will be upgraded onto maps and diachronic settlement studies will be continued.

Intersite and Intrasite Patterning. Patterning of the cultural remains within and between site components will be used as a basis for addressing such topics as: a) group size and structure; b) prehistoric organization and use of space (Kent 1987); and c) other aspects of hunter-gatherer theory such as prehistoric landscape use (Binford 1980, 1982; Winterhalder and Smith 1981) and transport costs.

Data Sources and Needs

Based on the results of survey and limited testing, the following data sources are expected to be present in data recovery sites.

Data Source	Type of Analysis
Lithic Assemblages	Technological
	Functional
	Source Area
	Typological
	Chronological
	Inter- and Intrasite Patterning
	Diversity Indices
	Activity Area Analysis
Features	Chronology
	Form & Function
	Prehistoric Diet
	Activity Area Analysis
Faunal Assemblages	Procurement
	Species Identification
	Seasonality
	Prehistoric Diet
	Butchering/Processing
	Activity Area Analysis
Floral*	Macrobotanical (flotation)
	Palynological
	Prehistoric Diet
	Activity Area Analysis
	Paleoenvironment
Soils	Sand Sheet Geomorphology
	Alluvial Stratigraphy
	Paleoenvironment
	Site Formation Processes
	Chronology
	Preservation
Radiocarbon	Chronology

Data Recovery Needs:

To date in Jonah large scale mitigations has been nearly exclusively performed on housepit sites. What is needed is similar excavation space on a sample of the open camps and rock sheltered areas for purposes of comparison. Are some of the research interests discussed above noted in the base camps such as presence of formal tools, a broader faunal assemblage or time specific feature types?

We propose to recover data from sites in the near future. We have identified an open camp dating to Eden times, Site 48SU6181 which dated to 8850±60 year BP. This site is a fine candidate for answering some of our Paleo-Indian subsistence questions. It also may provide some paleoenvironmental information.

There is a large sand dune site located on the western edge of Yellow Point Ridge that dates to a poorly understood period of the archaic (48SU2615). This site seems to demonstrate and preserve a settlement pattern different than is typical for Yellow Point Ridge and would also be an excellent candidate for data recovery efforts.

Site 48SU2220 is a lithic reduction site under the North Jonah Road. A revisit to this site could shed light on local lithic procurement and reduction practices. Other questions that could be answered by a revisit to this site include topics related to site burial as a possible preservation or management technique.

Sites on western shore of the Section 32 playa would be great places for additional data recovery efforts. Backhoe testing and pollen cores conducted in an effort to glean information about the paleoenvironment for the region will be very beneficial.

Site 48SU5593 in the Cabrito Unit is a ca. 7200 year BP site that will compare interestingly to 48SU4479, the J. David Love Site (our bench mark and possible housepit village) in Section 28 along Sand Draw.

Interpretation of radiocarbon dates in our housepit sites, especially at J. David Love, continue to be problematic. Our radiocarbon dates at J. David Love for example show 1800 year variables in the same house structure and present problems in chronology. Where these houses reused? Is this a product of preservation? Is there post occupation contamination?

Data Recovery Excavation

Data recovery will involve excavation of blocks of one square meter excavation units. This research design identifies the activity area as the critical cultural unit and the focus of data recovery. Activity areas are best explored in block excavations of sufficient extent to recover a reasonable sample of materials so that activities can be identified, and the distribution of artifacts and, by inference, individual activities, can be understood within the context of the larger activity area. These block excavations are estimated to be from about 20 sq m in size to over 100 sq m depending on the nature and extent of the cultural materials. It appears likely, from information already gathered at the project area, that excavation blocks will probably tend toward the smaller end of this postulated range, but there may be several block excavation areas per site instead of one large block.

The plan anticipates that for small, spatially limited sites that do not meet the criteria as a significant Jonah site, as defined above and not considered for larger data recovery excavations (i.e. housepits, etc.), the immediate excavation of small blocks to be a useful tool for sites that contain some, but limited, information. These small blocks will be subject to standard professional excavation techniques that are summarized below. Larger or Jonah significant sites will have an individual data recovery plan developed and approved by the BLM and SHPO prior to any excavation efforts.

Data recovery excavations will be conducted within a grid system established at each site. Excavation will proceed as 1 sq m excavation units, each designated by a grid coordinate. Excavation will proceed in 10 cm levels, which, like those in the test pits, will be oriented either with the ground surface or will be horizontal, depending on the nature of the sediment units that make up the site matrix. Excavation levels will follow natural or cultural levels where possible, but this is not expected to be viable on most sites. Excavation in thinner 5 cm levels will be considered only where this allows resolution of separate cultural levels that would otherwise be blurred by 10 cm excavation levels.

All excavated matrix will be screened through eighth or quarter-inch mesh hardware cloth, with the exception of samples noted below. Vertical control will be maintained from a site-wide vertical datum, which will be used to correct local datum's to the same ■zero• elevation. A constant volume (5 liters) sample of fill from each excavation level will be saved for fine screening (sixteenth-inch) to recover artifacts that would otherwise escape detection through quarter-inch mesh. These samples will be dry screened on-site if possible, but may be water-screened at a suitable location at the project area, or returned to the lab for screening. All materials that do not pass through the fine screen will be sorted in the lab regardless of the method or location of screening.

All artifacts will be collected and provenienced to the site, excavation unit, and level. Chipped stone debitage and bone debris will be bagged separately by provenience and catalogued. Tools will be bagged and catalogued individually. If tools are found in situ, they will be point-plotted. No specific effort will be made to point plot all tools or other classes of artifacts unless some unique characteristic of the assemblage indicates that such detail will be informative.

Features are anticipated to consist of hearths, other basin features, structures, rock alignments, burials, and burned rock clusters or middens. These will be treated by first exposing their lateral extent, then mapping and photographing the feature. For basin features, fill will be removed from half of the basin. Feature fill will be screened through eighth-inch mesh and a five liter constant volume sample will be recovered for flotation analysis. Samples, such as flotation, pollen, charcoal, and bulk soil for radiocarbon will be taken. Once half the basin has been emptied, the feature will be profiled and photographed. If the profile reveals cultural or natural strata within the feature fill, they will be followed in the excavation of the second half. Otherwise, excavation will proceed in the same fashion. Samples will not be duplicated unless the original samples are found to be inadequate. A final map and photographs will be taken when excavation is complete. If pollen samples are recovered from the feature, control samples will be taken from the occupation surface nearby. Structures will not be treated significantly differently, except to segregate inside and outside proveniences, and to separately excavate the floor contact zone. Collection of flotation, pollen and radiocarbon samples will be considered if appropriate. Burned rock features will be exposed, mapped and photographed. To the extent that a sediment matrix from among the rocks can be segregated, it will be treated as a separate provenience, and sampled accordingly.

The lateral extent of excavations will terminate when activity areas have been adequately sampled and further excavation is likely to yield only meager scientific utility or information, redundant information, or there is no indication of additional significant information in unexcavated contexts. The depth of excavation will be limited by the depth of cultural materials, although excavation of one or several units into sediments underlying the cultural level(s) will be considered if there is important sediment or geoarchaeological information to be recovered.

All artifacts recovered during excavation will be bagged, labeled, and entered onto a catalogue in the field. Ground stone artifacts will collected and packaged in anticipation of pollen and starch analysis. Chipped stone tools, and possibly certain ground stone implements, will be packaged in anticipation of possible blood residue analysis. All samples recovered during excavation will be appropriately bagged or packaged, labeled, and entered onto a sample log in the field.

Record keeping will include level notes kept by the excavators, daily notes at each site kept by the site's crew chief, and daily project notes kept by the project manager. Features will be individually recorded on feature forms. Scaled maps and profiles will be made where appropriate and photographs will be taken as work progresses, focusing on specific findings and on the excavations in general. All sites that undergo data recovery excavation will be instrument mapped by total station, survey grade gps or other professional methods able to record and reproduce data to the sub-centimeter level.

Artifact and Sample Analysis

All collected cultural materials will undergo analysis. The goals of all analysis are to derive as much information as possible about the activities that produced the artifact assemblage, to place artifacts that typically provide some chronological information in context with other datable materials, to describe the technology of the artifact manufacturing process, and to examine raw materials for use of exotic material types. Chipped stone debitage, chipped stone tools, and ground stone tools will be analyzed. Ceramics, historic artifacts, and bone will be analyzed by other specialists. When CAR conducts data recovery excavations, radiocarbon samples will be processed by Beta Analytic of Coral Gables, Florida. Flotation, pollen and starch analyses will be conducted by High Plain Macrobotanical Studies, Casper, Wyoming or PaleoResearch Laboratories, Golden, Colorado. Geoarchaeological investigations will be done by Michael McFaul of LaRamie Soils Services of Laramie, Wyoming or Bill Eckerle of Salt Lake City, UT. If other firms conduct data recovery excavations they will use firms acceptable to the BLM and SHPO.

Chipped Stone Debitage. Chipped stone debitage analysis will focus on reduction stage and technology. Cortical analysis is not expected to be productive since many clasts of raw material lack an identifiable cortex. Instead, analysis will focus on size grading and flake morphology, providing information on the point at which the flake was removed from the reduction sequence.

Chipped Stone Tools. Chipped stone tools will be analyzed for morphology, production technology and edge characteristics. Tool shape, degree of patterning, nature of edge modification, edge angle, edge shape, evidence of retouch or reuse, heat alteration, general morpho-functional category, production technology (biface, uniface, flake tool), and style (if applicable) will all be recorded, as will size and completeness. Some artifacts or specimens will be subject to blood residue analysis.

Ground Stone Tools. Ground stone tools will first be classified into grinding stones or metates, hand stones or manos, and other grinding implements. Each will be described and measured. Shape, size and nature of use surfaces will be recorded, including noting such attributes as grinding, pecking, beveling, striations, and shaping. If found in sheltered or protected areas or if the grinding surface is face down, specimens will be immediately wrapped in foil for a pollen wash.

Other Stone Tools. Other non-chipped stone tools will be described and classified as appropriate. At this time, hammer stones, polishing stones and edge-ground cobbles are the only artifacts in this category expected on the project area.

Ceramics. Ceramics have been located at six sites or locales in the 48SU4000 site district and may turn up elsewhere in Jonah. Block surveys have not found additional ceramics and it is thought that they are unlikely to be found during these investigations. If they are encountered, they will be analyzed for type or style and area of origin with special attention paid to local versus exotic wares. Description will include the nature of the paste, temper and surface treatment. Ceramic artifacts will be examined for residues that might be indicative of function or use, and will be considered for residue analysis if appropriate.

Bone or antler tools are rare, but have been found in Jonah. An antler tool was recovered from 48SU4479, the J. David Love Site and may be located during future excavations. Depending on the type and condition of future recovered tools, differing analyses will be discussed and conducted.

Faunal Materials. Bone analysis will focus on identification of species, minimum number of individuals, and evidence of butchering or other processing. This will include classification into size categories to the greatest degree of precision possible where taxonomic identification is not possible.

Unanticipated Historic Properties

The treatment plan described above should minimize the chance of unanticipated discoveries and how they will be handled. Nevertheless, should any unanticipated historic properties be discovered during construction that cannot be dealt with as detailed in the Jonah CRMP in balance with our understanding of the resources in the area and the research design, small data recovery efforts for sites not germane to research design will be conducted in consultation with the BLM and SHPO.

Discovery of Human Remains

Discovery of human remains at any time during the course of this project shall result in the immediate cessation of all activities in that area. BLM policy is to immediately notify Sublette County Coroners office and Sublette County Sheriff's office. The discovery of human remains is considered as an unattended death and must be treated as a potential crime scene under State of Wyoming law. Subsequent to notification above, should the remains be deemed to be Native American, procedures in compliance with NAGPRA will be followed. Any operator will insure that those remains are respectfully protected from further disturbance or additional damage as the result of their exposure.

Remote Sensing

Remote sensing related to the detection and identification of buried cultural sites is a desirable and applicable effort. Past magnetometer efforts in Jonah have produced limited success (Current 1997). However due to the constantly changing and emerging environment and technologies related to these types of endeavors, the door is always open in Jonah to try additional remote sensing operations to define and develop their role as a useful detection and management tool in relation to cultural resources. Some types of remote sensing that could be tried, but are not

limited to, include magnetometers, gradiometers, conductivity meters, resistance meters, low level aerial reconnaissance, infrared photography, etc.

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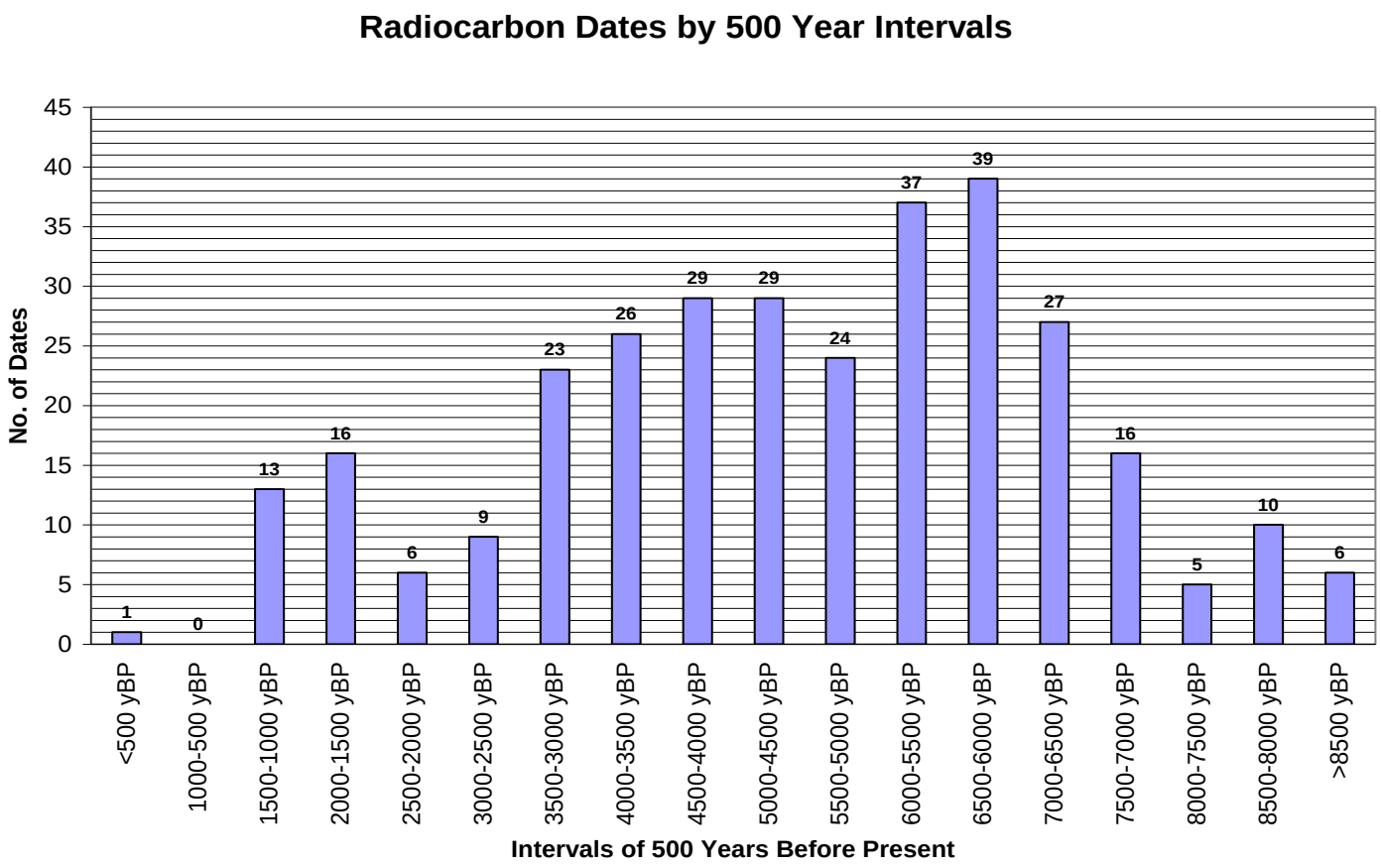
Radiocarbon Dates by 500 Year Intervals
No. of Dates
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5
10
15
20
25
30
35
40
45
1
0
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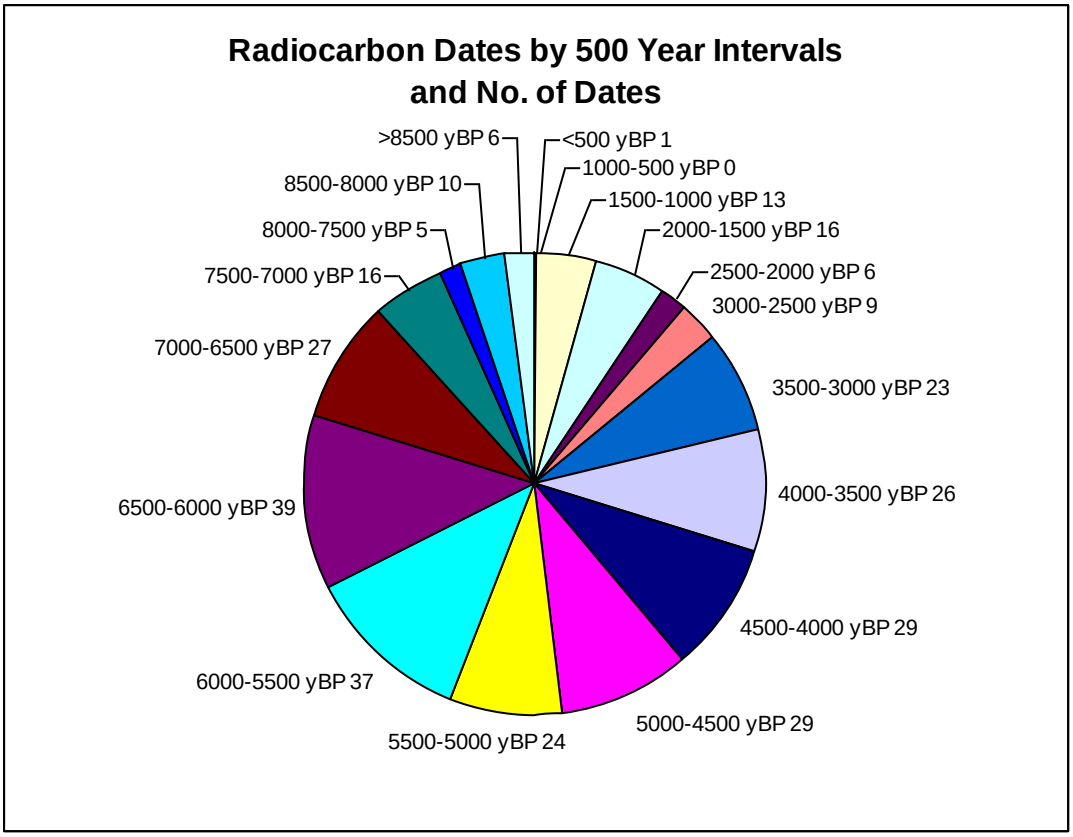
16
6
9
23
26
29
29
24
37
39
27
16
5
10
6
<500 yBP
1000-500 yBP
1500-1000 yBP
2000-1500 yBP
2500-2000 yBP
3000-2500 yBP
3500-3000 yBP
4000-3500 yBP
4500-4000 yBP
5000-4500 yBP
5500-5000 yBP
6000-5500 yBP
6500-6000 yBP
7000-6500 yBP
7500-7000 yBP
8000-7500 yBP
8500-8000 yBP
>8500 yBP
Intervals of 500 Years Before Present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1500-1000 yBP 13
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2000-1500 yBP 16
7500-7000 yBP 16
2500-2000 yBP 6
3000-2500 yBP 9
7000-6500 yBP 27
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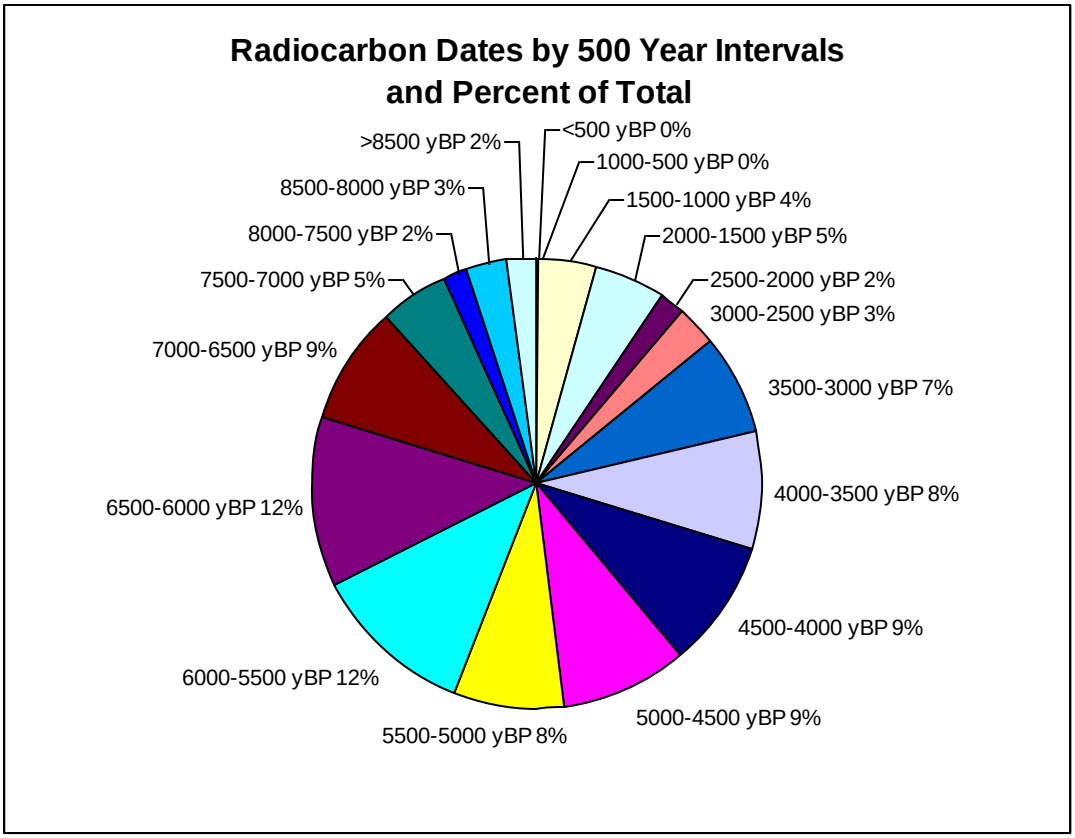
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1000-500 yBP 0%
8500-8000 yBP 3%
1500-1000 yBP 4%
8000-7500 yBP 2%
2000-1500 yBP 5%
7500-7000 yBP 5%
2500-2000 yBP 2%
3000-2500 yBP 3%
7000-6500 yBP 9%
3500-3000 yBP 7%
6500-6000 yBP 12%
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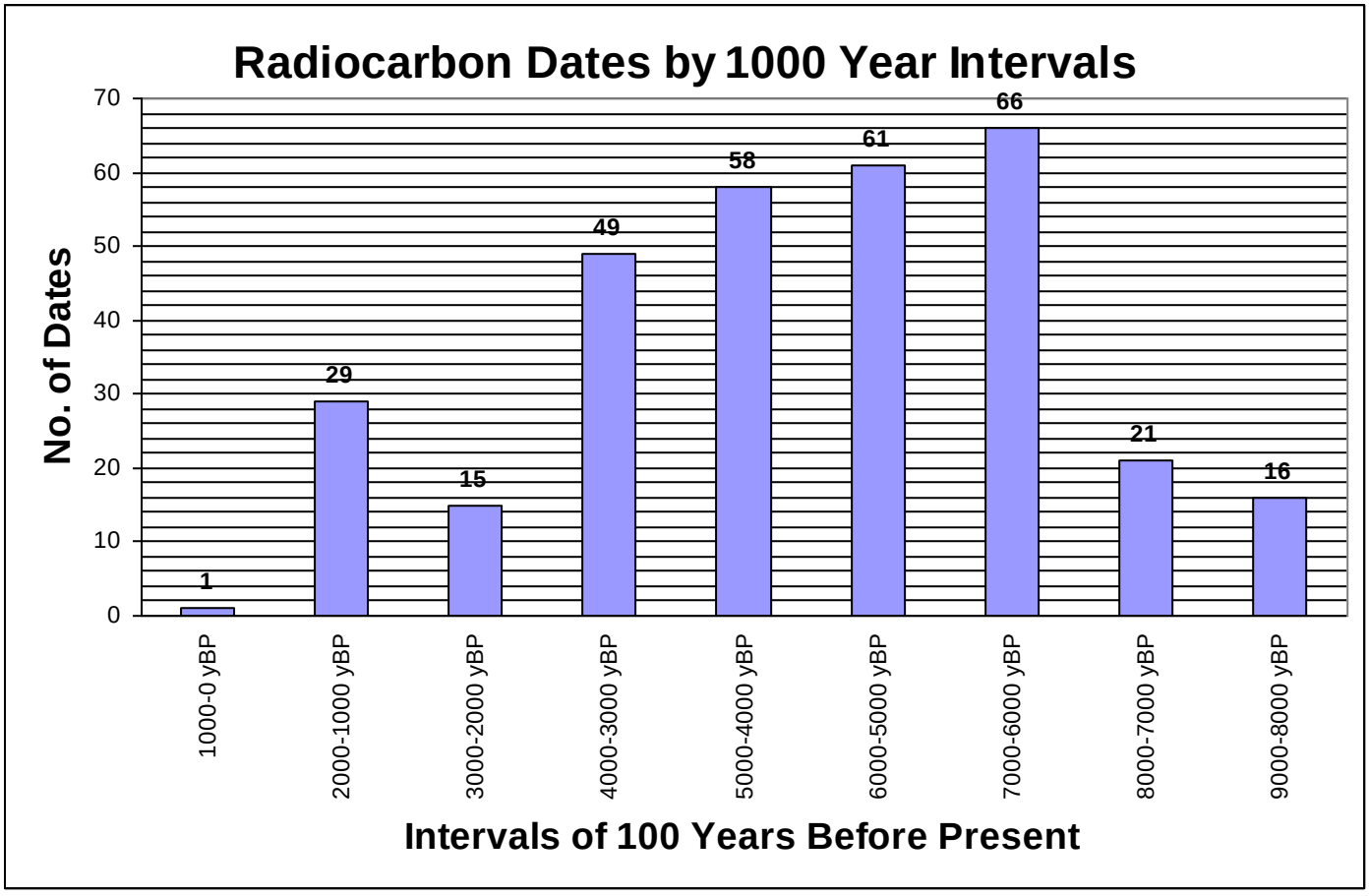
6000-5500 yBP 12%
5000-4500 yBP 9%
5500-5000 yBP 8%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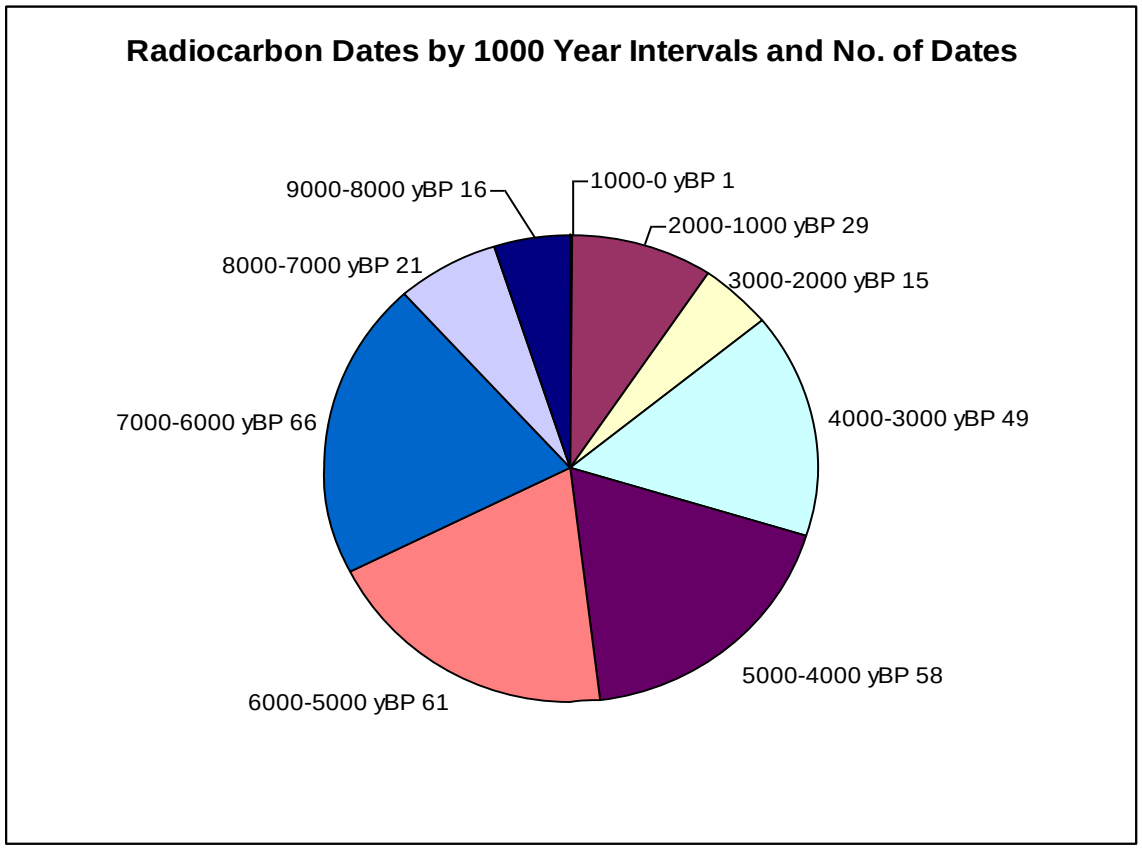
No. of Dates
70
60
50
40
30
20
10
0
1
29
15
49
58
61
66
21
16
1000-0 yBP
2000-1000 yBP
3000-2000 yBP
4000-3000 yBP
5000-4000 yBP
6000-5000 yBP
7000-6000 yBP
8000-7000 yBP
9000-8000 yBP
Intervals of 100 Years Before Present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1000-0 yBP 1
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3000-2000 yBP 15
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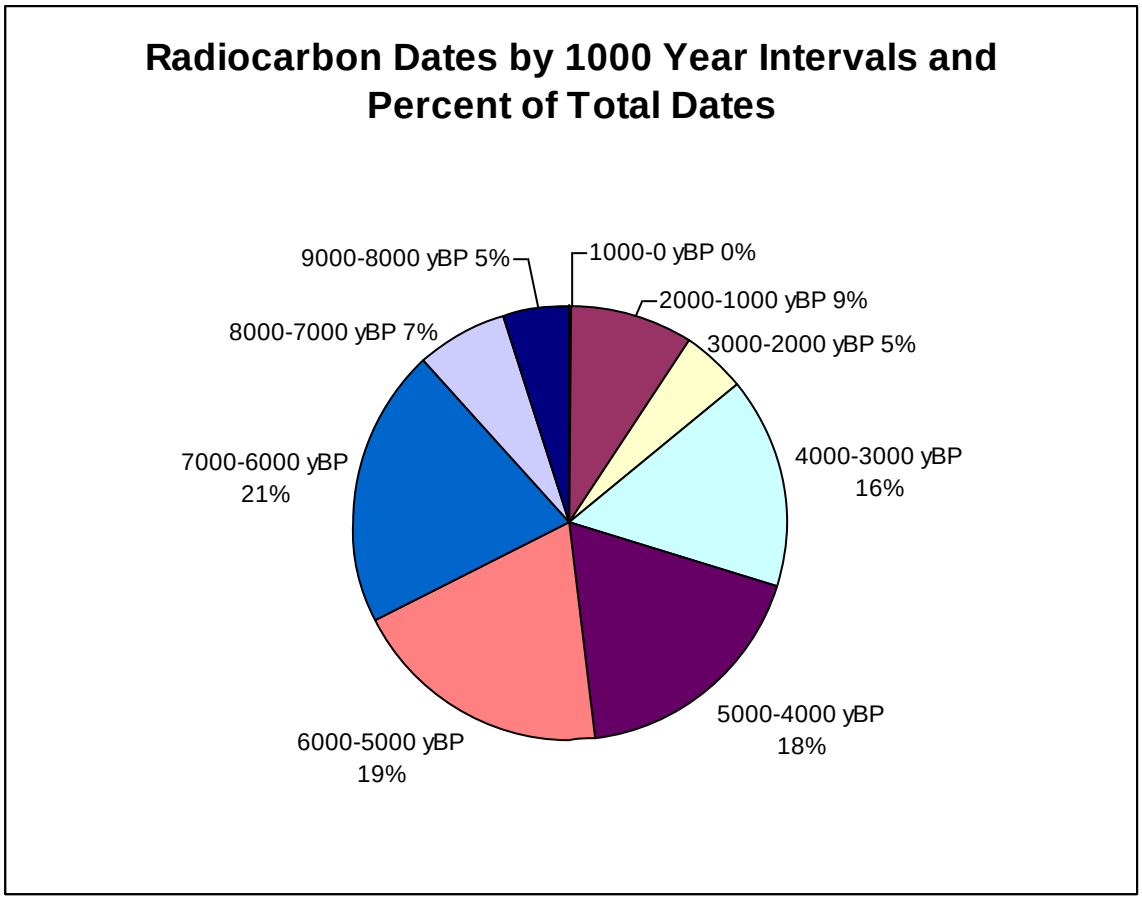
4000-3000 yBP 49
5000-4000 yBP 58
6000-5000 yBP 61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2000-1000 yBP 9%
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7000-6000 yBP 21%
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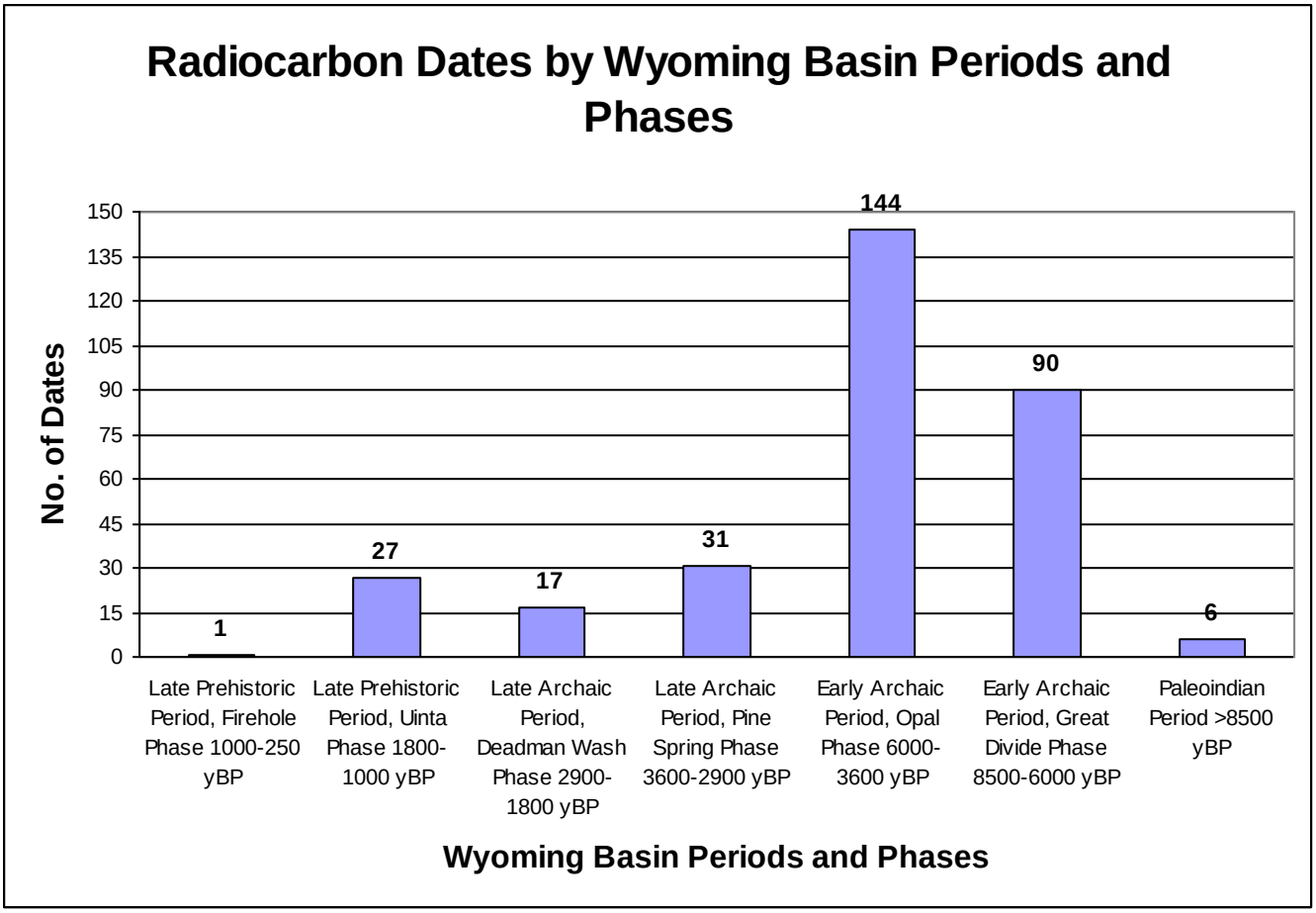
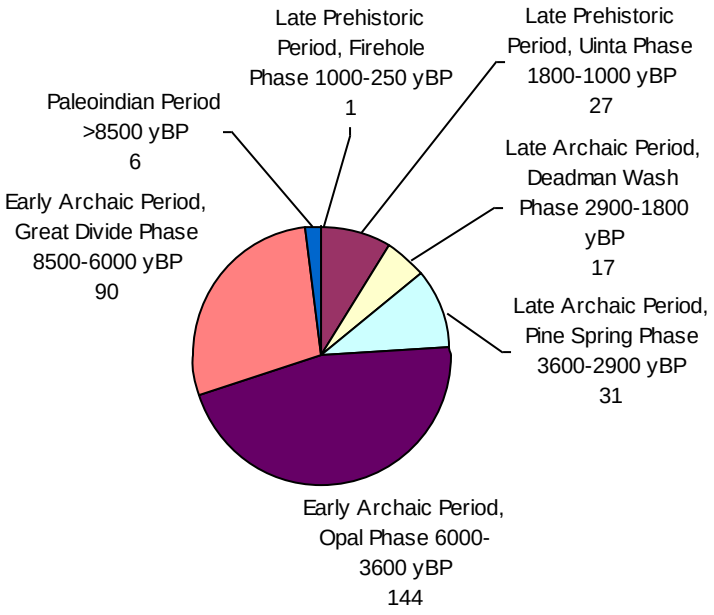
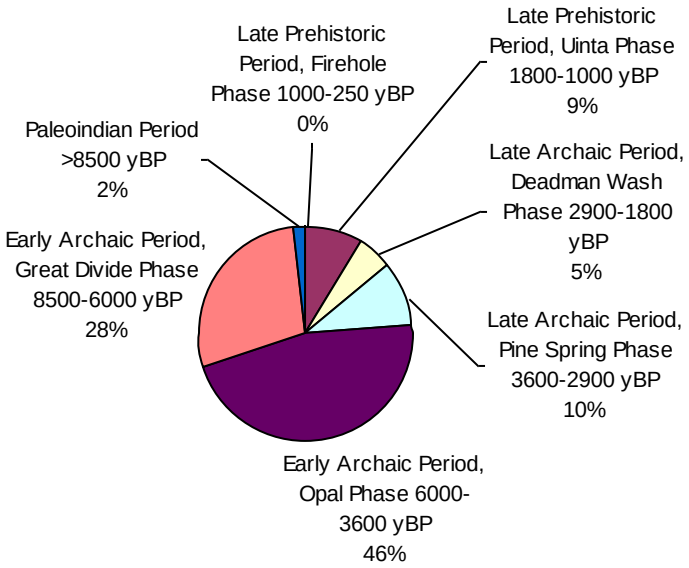
5000-4000 yBP 18%
6000-5000 yBP 19%

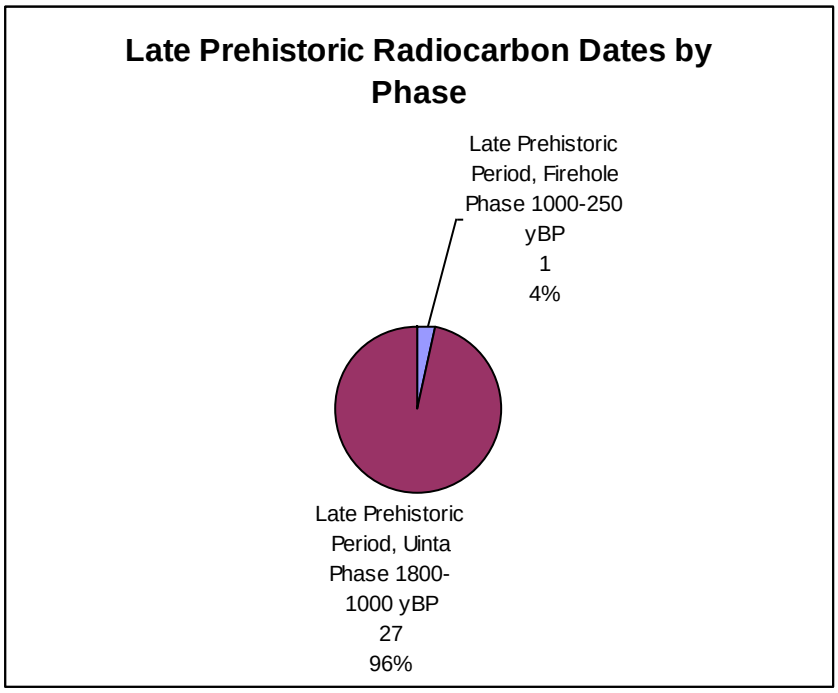

Radiocarbon Dates by Wyoming Basin Periods and Phases
No. of Dates
150
135
120
105
90
75
60
45
30
15
0
1
27
17
31
144
90
6
Late Prehistoric Period, Firehole Phase 1000-250 yBP
Late Prehistoric Period, Uinta Phase 1800-1000 yBP
Late Archaic Period, Deadman Wash Phase 2900-1800 yBP
Late Archaic Period, Pine Spring Phase 3600-2900 yBP
Early Archaic Period, Opal Phase 6000-3600 yBP
Early Archaic Period, Great Divide Phase 8500-6000 yBP
Paleoindian Period >8500 yBP
Wyoming Basin Periods and Phases

Radiocarbon Dates by Wyoming Basin Periods and Phases and No. of Dates



Radiocarbon Dates by Wyoming Basin Periods and Phases and Percent of Total Dates




Late Prehistoric Radiocarbon Dates by Phase
Late Prehistoric Period, Firehole Phase 1000-250 yBP
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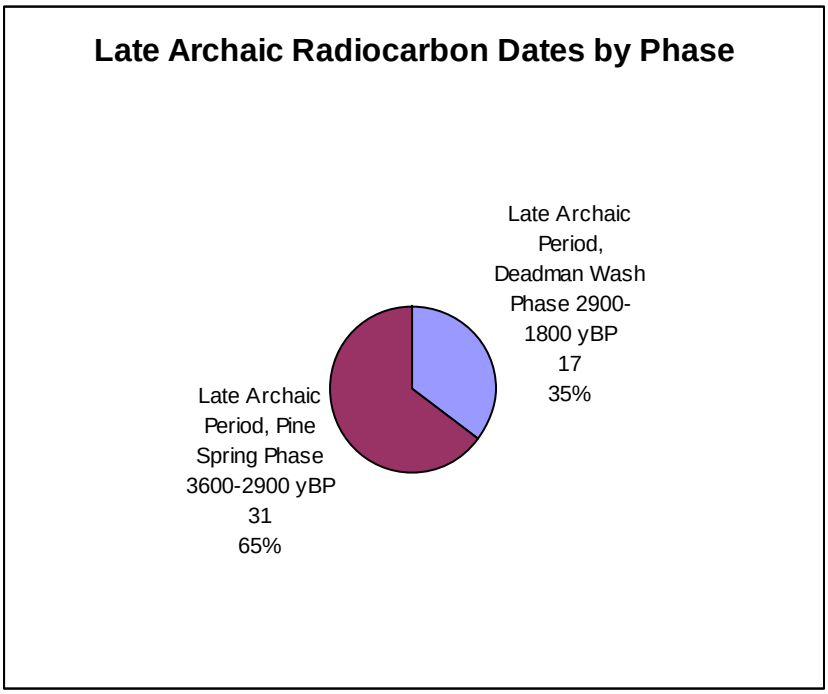
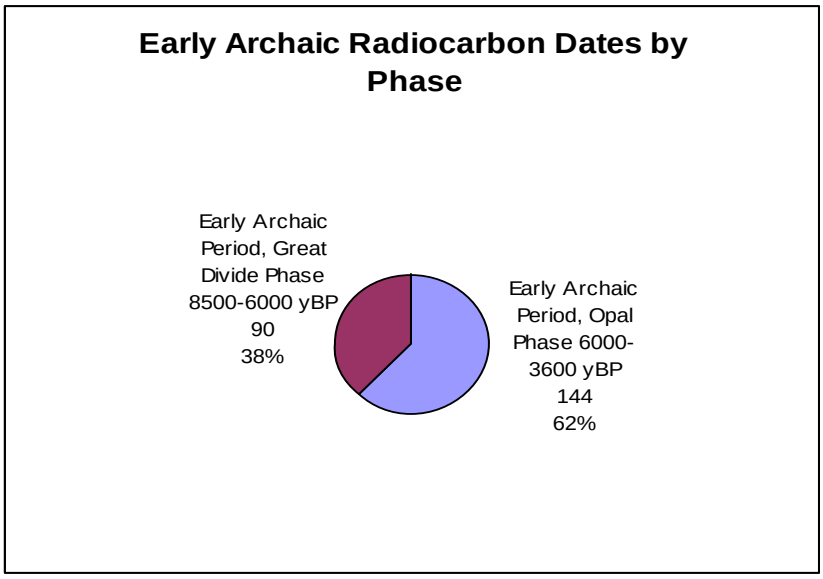
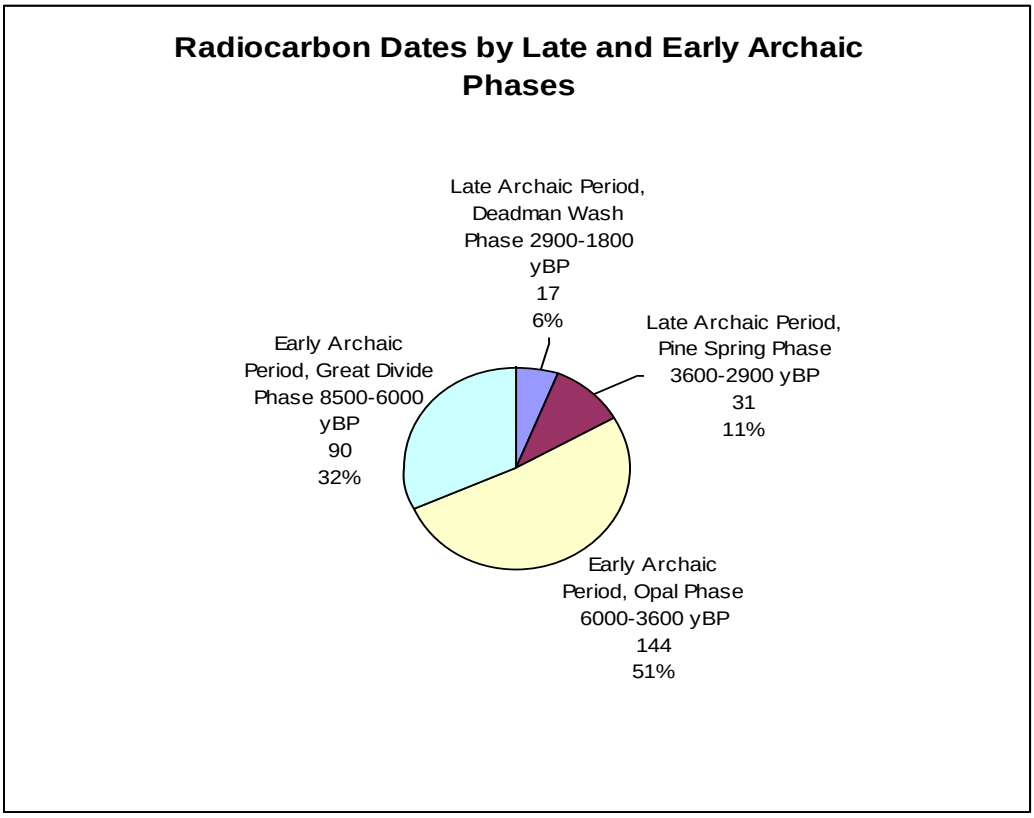
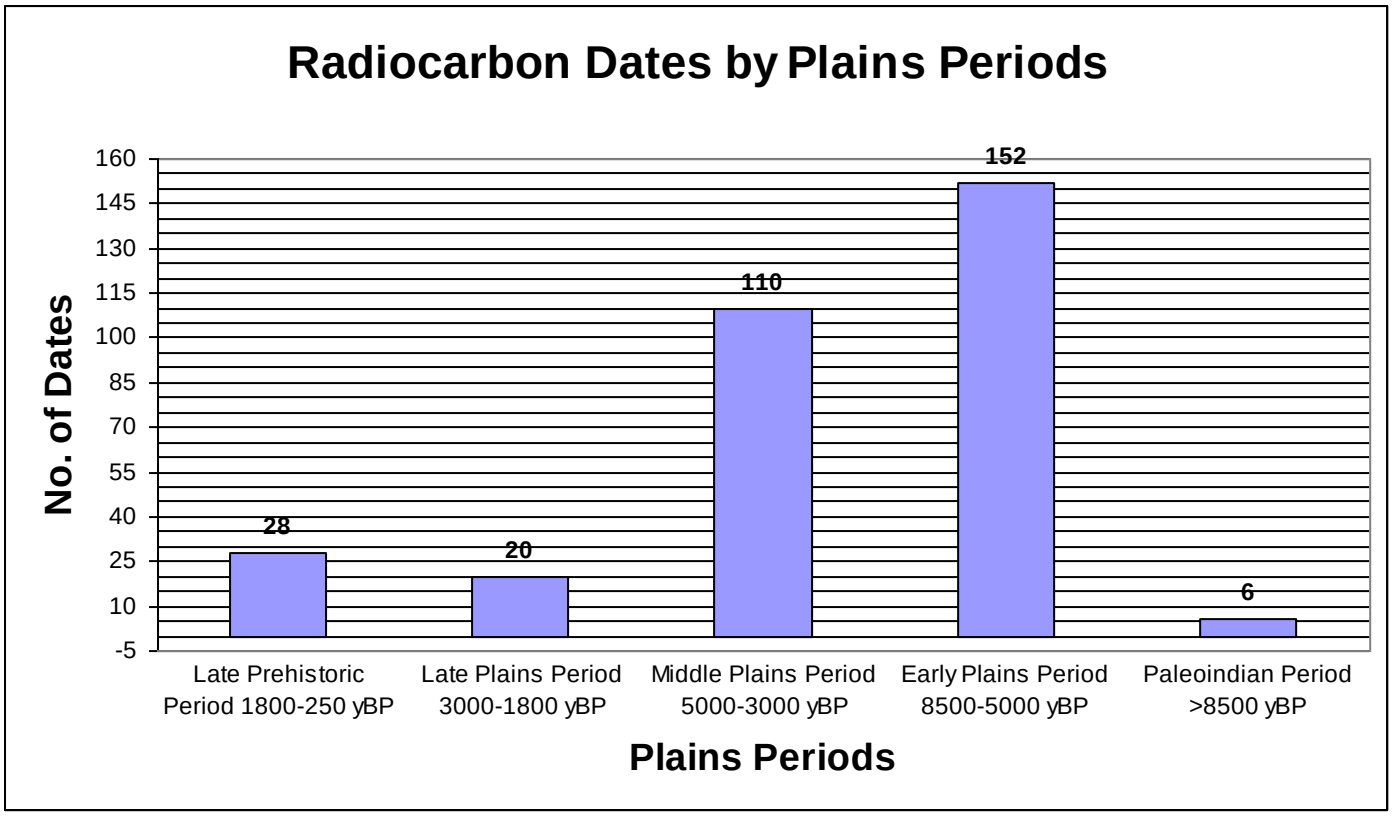
4%
Late Prehistoric Period, Uinta Phase 1800-1000 yBP
27
96%

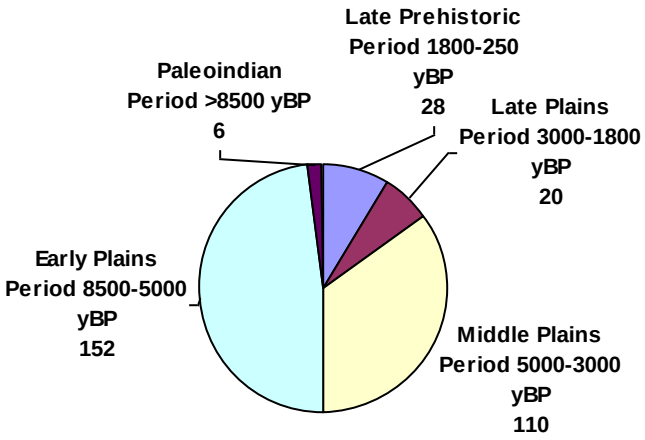

Late Archaic Radiocarbon Dates by Phase
Late Archaic Period, Deadman Wash Phase 2900-1800 yBP
17
35%
Late Archaic Period, Pine Spring Phase 3600-2900 yBP
31
65%


Early Archaic Radiocarbon Dates by Phase
Early Archaic Period, Great Divide Phase 8500-6000 yBP
90
38%
Early Archaic Period, Opal Phase 6000-3600 yBP
144
62%

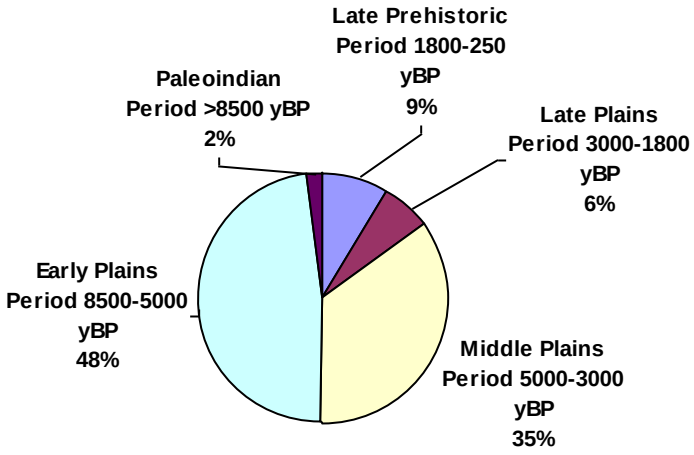

Radiocarbon Dates by Late and Early Archaic Phases
Late Archaic Period, Deadman Wash Phase 2900-1800 yBP
17
6%
Late Archaic Period, Pine Spring Phase 3600-2900 yBP
31
11%
Early Archaic Period, Great Divide Phase 8500-6000 yBP
90
32%
Early Archaic Period, Opal Phase 6000-3600 yBP
144
51%


Radiocarbon Dates by Plains Periods
No. of Dates
160
145
130
115
100
85
70
55
40
25
10
-5
28
20
110
152
6
Late Prehistoric Period 1800-250 yBP
Late Plains Period 3000-1800 yBP
Middle Plains Period 5000-3000 yBP
Early Plains Period 8500-5000 yBP
Paleoindian Period >8500 yBP
Plains Periods

Radiocarbon Dates by Plains Periods and No. of Dates



Radiocarbon Dates by Plains Periods and Percent of Total Dates



APPENDIX B

CULTURAL RESOURCES MANAGEMENT PLAN
for the

Jonah Gas Field, Sublette County, Wyoming

June 18, 2007

I. Purpose and Scope

The purpose of the management plan is twofold: 1) to outline a set of standardized procedures, methods and documentation requirements for archeological investigations in the Jonah Gas Field; and 2) to provide a uniform and holistic system for mitigating adverse effects to archaeological resources and guide research efforts within the Jonah Gas Field for the projected 10 year period during which the Jonah Natural Gas Development Project will be implemented. All activities conducted under this plan are restricted to the geographical boundaries of the Jonah Gas Field as defined in the Expanded Jonah In-Fill EIS document, U. S. Department of Interior, Bureau of Land Management (Bureau), 2006.

Ultimately, it is expected that implementation of this plan will result in streamlined processing of permits and will lead to enhanced contributions to cultural context development in Southwest Wyoming. The plan will streamline procedures under current operation in the following ways: although the cost of identification and evaluation efforts may remain similar to present, the cost of mitigating adverse effects on a project-specific, site-specific basis will be reduced. More importantly, the risk of encountering those situations will become negligible under the proposed program, because the proportion of National Register eligible properties in the Jonah Gas Field will be reduced. Therefore, unpredictable situations in which eligible properties require mitigation due to adverse effects of individual undertakings will be reduced to a minimum and managed programmatically. The conditions of the standard discovery plan also provide for proceeding expeditiously with undertakings that encounter previously undetected National Register properties during implementation. The approach expressed in this plan will allow Jonah Operators to implement expanded gas development with more predictable, stable costs of funding archeological investigations. The terms of the plan are intended to benefit the archeological community by providing an environment in which better science and research can be accomplished and by outlining standards specific to the Jonah Gas Field for documenting, evaluating and studying archeological properties.

II. Implementation

A. Programmatic Agreement

The terms of this management plan will be implemented per the Jonah Gas Field Programmatic

Agreement.

B. Research Design

The Jonah field in southern Sublette County has produced a remarkable suite of Archaic period archaeological sites radiocarbon dated to the third through the seventh millennia BP. Frequently, these sites are found in buried context, lacking surficial indications. The early ages of these sites, coupled with their abundance, provides the researcher with an ideal Archaic Laboratory to study post-Pleistocene occupation of and adaptation to a seemingly arid portion of the upper Green River Basin. Preliminary spatial patterning of dated sites suggests that there is a correlation between soil types and Early Archaic Period occupations. An Archeological Research Design (RD) which outlines the research objectives that structure the procedures of this plan has been developed by the Bureau, SHPO and Current Archaeological Resources (CAR). The RD identifies research issues and questions specific to the archeological resources in the Jonah Gas Field, and outlines test implications and data needs to address the research questions. The formal Research Design for the Jonah Field is attached to the Jonah Field Programmatic Agreement (PA) as Appendix A. .

III. Cultural Resource Management

Management of cultural resources in the Jonah Gas Field will be conducted via two main efforts: the routine Section 106 undertakings and permitting on the one hand and by conducting research excavations directed to answer questions posed in the RD. All sites in the Jonah Gas Field are to be evaluated with two standards, National Park Service cultural resources National Register of Historic Places (NRHP) evaluation criteria (36 CFR part 60) and the Jonah Field specific criteria set forth in the RD. Only those sites that meet RD criteria will be proposed for excavations or other data retrieval as part of the RD effort under this CRMP. The use of Mat Pads has been proposed as part of the Jonah Field development scheme. Mat Pad concerns and cultural resource management are developed below.

A. Routine Section 106 undertakings and permitting:

Projects managed by this CRMP include all undertakings proposed by the signatories to the PA. Other undertakings within the Jonah Gas Field initiated by other operators, applicants or land users will be managed in accordance with the Wyoming Protocol (ratified April. 2006) or other authorities.

Procedures

B. Determination of BLM responsibility over the undertaking and Inventory Standards:

The extent of the Bureau's responsibility to take into consideration the effects on historic properties of federal undertakings will be implemented as follows: For undertakings, the Bureau will consider the effects on historic properties for the entire APE, regardless of land ownership.

The determining factor for BLM's responsibility for complying with Section 106 will reside with BLM's undertaking permitting authority, i.e., whether a federal permit (e.g., APD, Sundry Notice or R/W) is required.

C. Definition of Area of Potential Effects

The area of potential effects (APE) for this project is recognized to encompass the Jonah Infill Natural Gas EIS boundary, and has been divided into four Cultural Resource Management Areas (CMAs), CMAs 1 through 4, as based upon site density and sensitivity (as depicted within Appendix A of the PA). (For a more complete discussion of the cultural resources within the Jonah field, the reader is referred to the pertinent cultural resources sections of existing Jonah field EIS documents, the Jonah In-Fill EA or the cultural resources synthesis in the Pinedale RMP revision. These documents are on file at BLM Pinedale). Intensity of cultural resource management varies between each CMA as described below. Within this document, the term ***undertaking*** will refer to all individual actions and their accompanying effects.

CMA-1 Includes the Sand Draw San-Arcacio soils Archaeological District. CMA-1 is an area of complex archaeology, many buried sites and intensive archaeological concerns. CMA-1 contains the bulk of San Arcacio sediments, described as ancient alluvial fan and terrace deposits in the Jonah basin. These sediments contain the majority of extensive archaeological discoveries from within the Jonah Field, including the 48SU4479 J. David Love site, 48SU2094 and 48SU2324 with their respective 6,000 to 7,000 year old house pits and other Early Archaic occupations. Other major sites along Sand Draw include 48SU1779, 48SU3043 with prehistoric ceramics and the extensive 48SU1751 site. Perhaps one hundred prehistoric sites are recorded along Sand Draw. CMA-1 also contains the Section 32 playa, one of the most predominant topographic features in the Jonah field. This playa has produced Folsom cultural material and a large National Register Eligible eolian site complex recorded as 48SU3086, SU3087 and SU3088. 48SU3049 on the northeast rim of the playa and along Sand Draw contains extensive Archaic buried cultural materials and is a significant historic property. Topographically, CMA-1 is quite level to gently undulating and contains a semi-prominent sandstone ridge trending southwest to northeast along the western flank of Sand Draw in Sec. 22. Where sandstone outcrops within CMA-1, surficial archaeological material is found. Sec. 28 and to a lesser extent, Secs. 22 and 27 have proven to contain abundant and extensive buried cultural materials inhibiting industrial development. The boundary of CMA-1 was established by jointly using the Burma Road Soils Survey maps and the corpus of NRHP-Eligible archaeological sites from project base maps.

CMA-2 consists of Yellow Point Ridge and the colluvial flanks of this ridge, the Cabrito Unit to the southeast with its isolated buttes and broken upland terrain, the headwaters of Jonah Gulch, the headwaters of East Buckhorn Draw to the southwest and the headwaters of Bull Draw. As these place names suggest, CMA-2 is an upland area containing quartzite cobble armored ridge and mesa tops with their characteristic thin soils, poor buried site potential and abundant surficial bedrock outcrops. CMA-2 is noted for containing surficial Eocene petrified wood. This rock, coupled with abundant surficial quartzite cobble served as lithic source material for the

prehistoric inhabitants of the region. Partly because of this, early on in archaeological investigations in the Jonah area, the Yellow Point Archaeological Landscape (48SU1334) was identified. Rock Alignments are occasionally but infrequently located along the northern edge of Yellow Point Ridge and a few stone circle sites, a hunting blind and other small cairns and other alignments are known. No rock drive lines have yet to be recorded in CMA-2. Soils are generally thin on the ridgetops and colluvial elsewhere. Some eolian deposits are identified, however, and these eolian soils can and do contain National Register-Eligible prehistoric occupations such as at 48SU2615 where construction encountered extensive buried Archaic and Late Prehistoric buried materials. Similarly, 48SU1328 is a Yellow Point Ridge dunal site containing buried cultural materials and is considered to be National Register Eligible. CMA-2 also contains the main production pipeline corridor running along the Luman Road ultimately to Opal. This large, multi-pipeline corridor has been extensively surveyed with many archaeological open trench examinations performed, almost always completely negative. Generally, CMA-2 is an area containing poor buried site potential, low significant site density, diminished archaeological resources concerns with less constraints upon development. Soils are largely residual and the colluvium generally has not produced buried cultural material. Sites in CMA-2 are frequently surficial and not eligible. The Dry Lakes Playas are within CMA-2 and its archaeological research potential will need to be evaluated.

CMA-3 is an expansive area encompassing the nonsensitive San Arcacio soil portions of the Jonah basin, the western Corona Unit by the Burma Road, the northern Jonah field headwaters of Alkali Creek and the eastern end of the Jonah Field. This area includes the northern Stud Horse Butte Unit and the eastern portions of the Cabrito Unit. Soils in this area contain known colluvial-clay flats that are not particularly archaeologically sensitive. Additionally, areas of residual soils are known and overall site density is less than CMA-1. San Arcacio soils are known for CMA-3 but are localized. Several smaller Playas are known on the western edge of CMA-3 and past inventory has identified several Scottsbluff-aged sites in this area. Overall, CMA-3 is a catch-all management area containing both areas of poor buried site potential but also National Register eligible sites as well. Section 9 in the northern Jonah field has produced several discoveries, both while constructing individual well pads and access roads, but also in Jonah North pipelines. Open trench examinations of these Anticline-derived pipelines and limited well pad/access road construction has resulted in identification of a fairly unique feature type. Section 9 contains discoveries of several large, deep basin features over one meter in depth and over 80 cm in width. Middle Archaic C-14 age estimates are known. Overall, permitting individual actions over the past 10 years has not proven overly difficult, but clearly, case-by-case evaluations of specific project areas is needed to adequately manage cultural resources in CMA-3.

CMA-4 is a smaller area in the eastern Jonah uplands containing the 48SU4000 Archaeological District. Subject to intensive and extensive inventory and evaluation in 1999/2000, the 48SU4000 Archaeological District is a 600+ acre zone of highly visible and damageable National Register-Eligible archaeological sites associated with a series of large, prominent sandstone outcrops. Surficial cultural material within the rock outcrop areas is both abundant and highly

visible and the area is known as a favorite illegal artifact collecting area by local residents. To this day, screens from illegal excavations are found within the district, and numerous "collectors' piles" are found throughout CMA-4. This situation was noted in the first EIS prepared for the Jonah Field and carried forward in subsequent NEPA efforts. Folsom material is known from 48SU3875, the Rabbit Ear Rock Site. 48SU3875 also contains an intact rock sheltered cavern with buried cultural materials. Other prominent sites in CMA-4 include the Raven's Nest Site encompassing the 48SU3871, SU3872 and SU3873 site complex, with a noteworthy large prehistoric ceramic component. An impressive quantity of archaeological materials is recorded at 48SU2194, SU2508, SU3865. This site complex includes well preserved stone circles, intact rock sheltered areas, a looted rock shelter and prominent sandstone outcrops. A large (300 acres plus) National Register eligible quarry site is recorded at 48SU2892 in the southwestern district area. 48SU2892 is undergoing re-recordation and its site boundary will change in the near future. Because individual site boundaries within the 48SU4000 archaeological district are frequently arbitrarily drawn and abut one another, early on in Jonah Field cultural resource management, the district approach was applied to this area. CMA is managed in accordance with a previously established "Section 13" management plan. In particular, the highly visible and fragile nature of the rock sheltered areas make the district very prone to looting if access into the area is facilitated by energy development road construction.

D. Determination of Information Needs:

The signatories to the PA have committed to inventorying their respective leaseholds in block fashion. All Class III inventory will be completed by 2008. As part of this agreement, all sites in the Jonah Gas Field are to be evaluated with two standards, National Park Service cultural resources National Register of Historic Places (NRHP) evaluation criteria (36 CFR part 60) and the Jonah Field specific criteria set forth in the RD. Sites previously determined eligible or unevaluated will also be evaluated pursuant to the criteria developed in the RD.

For actions that have no potential to affect historic properties because of their nature (cf. CMA-2 and portions of CMA-3), the Bureau's cultural resource specialist will conduct a data review to determine if cultural properties are known to exist in the undertaking area. If no historic properties are recorded in this area, the cultural resource specialist will document this determination in the case file and CRMTracker and proceed with the undertaking. Commonly, numerous undertaking may be batched in CRMTracker. Specific projects or activities that are likely to occur commonly as a result of the Jonah Field that have no potential to affect historic properties because of their nature include those listed below, some of which **may** have the potential to affect historic properties and traditional cultural properties, as determined by the Bureau's professional cultural resource specialist

1. Issuing leases, easements, right-of-way and permits which do not authorize or promote surface disturbance.

2. Issuing rights-of-way for existing developments or renewal of existing rights-of-way

except where operations, maintenance, or abandonment activities might result in new surface disturbance.

3. Installing signs and markers adjacent to existing roads and outside known sites, and placing recreational, special designation or information signs, or visitor registers, unless within known cultural sites.

4. Cadastral survey.

5. Water lines, frac lines or other facilities laid on the surface or parallel to existing, previously authorized roads or other Rights-of-Way which require no excavation or other surface disturbance.

E. If the undertaking is previously disturbed to such an extent that there is a negligible probability of intact historic properties to be present, the Bureau's cultural resource specialist will conduct a data review to determine if cultural properties are known to exist in the APE. If no historic properties are recorded in the APE, the cultural resource specialist will document this determination via CRMTracker and proceed with the action.

F. If the undertaking is previously examined by an adequate Class III inventory that was reviewed and accepted by the Bureau and SHPO, no additional Class III inventory will be required and the Bureau will proceed as described below, after conducting a data review.

1. If no historic properties or only previously reported isolated finds and archeological landscape sites are identified in the construction area, the Bureau will document this finding in the case file and via CRMTracker, and proceed with the undertaking. If unevaluated resources are identified in the construction area, fieldwork will be required to evaluate the sites, followed by the appropriate level of SHPO consultation.

2. If historic properties (i.e. National Register properties eligible under criterion d) are identified in the construction area, fieldwork will be required to evaluate the property using the criteria specific to the Jonah Gas Field and assess the effects of the undertaking on the properties, followed by SHPO consultation.

3. For areas containing sensitive soils (CAM-1 and parts of CMA-3), additional identification efforts may be required. These efforts may include subsurface evaluation, such as subsurface evaluation, backhoe testing, remote sensing or construction monitoring. Sites identified by these methods will be evaluated for significance. All mechanical testing will be preapproved by the Bureau and the Bureau will notify SHPO of these activities.

4. If none of the above situations apply to the undertaking, a Class III inventory will be required and the Bureau will proceed with completion of the inventory. Upon completion of a field inventory and the Bureau's acceptance of the report, the Bureau will proceed in

accordance with the Wyoming Statewide Protocol, depending on the results of the inventory.

G. Determinations of Effect and Standard Treatments

1. If historic properties that possess qualities which would make them eligible for inclusion in the NRHP under National Register Criterion D and the criteria specific to the Jonah Gas Field Research Design are identified in the APE, sufficient specific data relevant to the Jonah Field criteria must be collected and documented in accordance with standards and methods described in the RD. Should any other historic properties be found, the Bureau will comply with the following terms. Otherwise, the Bureau will consult with the SHPO according to the Wyoming Protocol.

a. If the undertaking is redesigned to avoid effects on historic properties by at least 100 feet, the Bureau may proceed with the action. If physical barriers are installed that prohibit all effects to the properties, regardless of the avoidance distance obtained, the Bureau may proceed with the undertaking and implement the standard Discovery Plan.

b. If the undertaking cannot be satisfactorily redesigned to avoid effects on a historic property, it will not be authorized until such a time that the Bureau has consulted with the SHPO to make a formal determination of the property's National Register eligibility under the criteria specific to the Jonah Gas Field Research Design. In such cases, the Bureau will require site-specific treatment in the form of data recovery to mitigate the adverse effects on the properties, pursuant to the Jonah PA/Research Design. Site-specific treatment plans for adversely affected historic properties will be reviewed by BLM, the SHPO and any identified interested parties to reach agreement on the terms of the site-specific treatment plans prior to their approval and implementation. Historic Properties that do not meet the RD criteria for significance will be managed with the standardized Data Recovery/Discovery Plan as included in Appx. A. SHPO involvement in implementation of this effort will be as a Notify and Proceed action.

2. If historic properties evaluated NRHP-eligible under National Register criteria A, B or C are identified in the APE, they will be treated in accordance with existing guidance and pursuant to the Wyoming Protocol. If deemed necessary by the signatories, a standardized program for treatment of adverse effects on these properties may be developed by the Bureau and SHPO during the initial one-year term of pilot implementation of this Agreement. This programmatic treatment plan will be developed within one year of ratification of this Agreement and implemented upon acceptance. It is recognized, however, that very few historic properties evaluated NRHP-eligible under

National Register criteria A, B or C are known to exist in the Jonah Gas Field.

H. Research Effort

Once the PA is executed, the Jonah Gas Field archaeological research effort will be initiated. Sites slated for RD excavations will be addressed via site-specific Data Recovery Plans, to be reviewed by BLM PFO, SHPO and any identified interested parties. It is projected that two to three larger RD excavation efforts will be initiated within 12 months of ratification of the PA and completion of the Research Design. Larger excavation efforts are preliminarily defined as those excavations in excess of 150 square meters. It is also realized that in 2007, initial startup of this effort may be slow due to the time spent upon preparation of the PA, RD and this CRMP. After five years of implementation, the Bureau, the SHPO and the Operators will evaluate the adequacy and completeness of the research effort (see the PA for specific language) to determine if more or less fieldwork is needed. If it is determined that past fieldwork is adequate, work on the Jonah Gas Field synthesis will commence.

1. Data Recovery Programs and Research Projects

As a means of programmatically mitigating adverse effects on archeological properties due to expanded development in the Jonah Gas Field, the Operators agree to establish and fund an excavation space "Bank" (defined as 500 square meters of excavation space per year) established to support data recovery programs on selected historic properties and other studies that contribute to the goals of the research design.

Annually, the affected consulting archaeologists may propose mitigative excavations or other research to be supported out of the excavation bank. Research proposals will follow the goals of the research design and will be focused on selected historic properties that will contribute maximum information pertinent to specific research questions through data recovery programs, or on collection of ancillary data relevant to broader research domains such as paleoenvironmental or geoarcheological studies in the immediate area. Initially in the first year, the excavation bank may be used in support of additional studies (e.g., limited testing and analyses of radiocarbon, pollen, macrofloral, sediment, ceramic and obsidian samples) that will contribute more specific information about the historic properties in the Jonah Area. Each year, during non construction times (cf. the winter months) the BLM , SHPO and the affected Operators will evaluate all submitted research proposals. The research programs selected by BLM, SHPO and the affected Operators will be implemented in the following field season. The Bureau will authorize the projects to be permitted, conduct any additional consultation as needed and provide for quality control and compliance with the specific terms of each research proposal. When requested, peer review of final reports or any other aspect of approved research programs may occur.

Each research proposal will outline specific methods, following the guidelines in this plan, by which specific sites and/or research domains will be investigated. Specific research objectives based upon the RD will be stated. Specific time frames must be outlined in each research proposal, identifying the schedules and time lines for the duration of the program, through

submission of final reports. Each proposed research program will be required to provide specific measures to ensure public participation and education during implementation of the project. The Bureau will be responsible for Native American consultation over each approved research proposal.

Research proposals and reports of completed research programs will follow existing standards for methods of implementation and documentation. Each research program will be required to produce a technical report of the results of the investigation, as well as a basic summary of the project that may be published for distribution to local libraries, schools, museums and interested organizations for public education. Reports of research programs will be submitted initially as draft documents to the Bureau. The Bureau will provide comments to the author(s) of the reports for revision and production of final reports, of which four copies of the technical reports will be provided to the Bureau. Bound copies of the final technical reports will be distributed as follows: two for the Bureau's files, one for the SHPO and one for the client. Electronic copies of all final technical reports (on CD or other acceptable media) will also be required. The means of production of the popular publications will be developed by the Bureau in consultation with interested parties.

The overall data recovery program will be required to incorporate a plan for public participation and education during the implementation of the project. Public participation will include tours of the project and the use of volunteers from local communities to contribute to the research effort, as well as presentations to professional organizations, and local schools and interest groups, Jonah Operators and Native Americans, upon request. The Bureau and the SHPO will assist the project proponent in publicizing the project.

Ultimately, all research efforts conducted under this plan will be required to contribute to the development a cultural context for the Jonah Field. The Bureau, the SHPO, the Wyoming Association of Professional Archaeologists and other historic preservation groups will be invited to incorporate the Jonah Gas Field research projects into the various cultural contexts currently being generated in this area.

I. Standard Construction Monitoring Methods

The primary purpose of a standard discovery plan for archeological monitoring of construction in the Jonah Gas Field will be to seek and recover evidence of National Register qualities specific to the Jonah Gas Field Research Design criteria outlined in Appendix A. Construction monitors will be conducted by several methods, such as: inspection of open trenches to view profiles of Holocene and Pleistocene deposits, conducted primarily during construction of pipelines where the pipeline trench is inspected. When construction monitoring is the chosen option in cases where these deposits are proposed for removal due to grading of well pads and rights-of-way, backhoe trenches may be excavated in the construction area in advance of construction to provide similar profiles and produce information compatible with that documented from pipeline trenches. One advantage of construction monitoring as an exploratory method lies in its ability to provide archeologists with more complete views of subsurface deposits than limited testing can

grant. Another advantage is the limitation of surface disturbance to only that which occurs due to project construction, which will also limit costs of construction and testing to that which is actually productive for the recovery of relevant data. Two types of archaeological construction monitoring are in use-normal construction monitoring and "Slow Monitors". Normal monitoring occurs when archaeologists are present during initial surface disturbance and the heavy equipment in use is determined by the Operators and their contractors. "Slow Monitoring" occurs in sensitive soil areas such as in CMA-1 soils, when only one piece of heavy equipment is used for initial site preparation. The standard discovery plan that will be implemented on appropriate undertakings in the Jonah Gas Field is detailed in Appendix A, the Research Design.

J. Mat Pad Methodology: The use of "Mat Pads" in lieu of traditional well location construction has been proposed. Rather than stripping topsoil and constructing traditional well pads, mat pad construction uses a track hoe propelled "grapple" to load and set 8 x 12 ft. oak mats (basically oak pallets) across a reduced size well location. All production facilities are located off the mat pads on larger, nearby "mother pads", and access is via a temporary oak mat road surface (akin to the Eastern "Plank Roads" of the eighteenth century). Direct surface disturbance is limited to a multi-pipeline R/W containing a production pipeline trench in which one to three pipelines are placed, and the well head itself. A pit liner is placed above the mats, directly below the drilling platform to catch spills. Weight of the drilling platform has been estimated at 2,000,000 pounds ($\pm$20%), including the drilling derrick substructure, and also including the drilling mud stacks, pipe stacks, equipment and ancillary facilities tied to drilling Jonah wells. Shim mat pad proposals include use of fill material on top of the oak mats for leveling purposes on locations where slope so dictates. Weight estimates, potential contaminants or other disturbances associated with hauling in tons of fill and use on hybrid mats are issues we are only beginning to evaluate. One key requirement of mat pad use is the commitment in perpetuity, to use oak mats for all reentry, redrill and recompletion activities, thus, life-of-well field tracking of mat pads is required in order to obtain the reduced surface disturbance claims in using mat pads.

The use of oak mats in the Jonah Gas Field is recognized to have reclamation and other surface preserving benefits. It has been proposed to use mat pads as a mitigative treatment to preserve surficial and near surface cultural deposits in a pristine, nondisturbed state. There is no available literature to support the claim that mat pads have No Effect to significant Jonah Gas Field archaeological deposits. Thus, an important element of this CRMP is to establish a program of evaluation and monitoring of matted well locations to establish some base line data on the effectiveness of placing oak mats below the drilling platform and any observed effects to the archaeological resource. The use of mat pads to preserve archaeological sites intact, or as a mitigation tool for mitigative potential adverse effects to significant, near surface historic properties in CMA-1 (The Sand Draw Archaeological District) will be an important element of this CRMP. Monitoring mat pad effectiveness is recognized to require both short and long term elements and basically becomes an ongoing, life-of-project evaluation. If generalizations about the effectiveness of mat pad use in archaeology are to be made, then the Jonah effort must employ state-of-the-art technology. Pinedale BLM, the operators and the affected subcontractors

will need to develop the needed technology and evaluation tools to support this effort. The mat pad project breaks new ground in this historic preservation program and there is no comparable data from which to draw.

The mat pad program is considered experimental. Cultural resource concerns relating to this proposal include both the direct and indirect effects created by implementation of the project. Artifact displacement, soil compaction, soil chemistry change, artifact breakage, the effects of vibration from drilling and completion activities, and the removal of archaeological deposits from scientific study are all agents considered to potentially effect the cultural resources in the project APEs. As a preliminary step in experimenting with mat pads, BLM in Pinedale initiated a small scale experiment utilizing pseudo-artifacts of bone, stone, ceramic and other material placed in near surface sediments. These pseudo-artifacts also included articulated antelope skeletal material, partially fractured crockery and point plotted stone items the size of archaeological lithic tools. The purpose of this effort is to determine if horizontal displacement, crushing, disarticulation of skeletal materials or other disturbance to near surface pseudo-artifacts occurs. Very preliminary analysis of the pseudo-experiment suggests that buried crockery may have been broken or cracked. Experimental lithics, bone and other ceramic appear to have been unaffected. Use of a GPS unit for measuring vertical or horizontal displacement of the pseudo-artifacts was of insufficient accuracy to measure displacement. A survey grade GPS, transit or total station must be used in future experiments in order to establish vertical and horizontal controls prior to mat placement and subsequent to mat pad drilling and completion.

Industry's funded mat pad soils compaction study demonstrated soil compaction on sediments from 6 to 12 inches BGS. In the Sand Draw Archaeological district (CMA-1), this equates to the San Arcacio soils considered of highest archaeological sensitivity. While some reviewers of the soil compaction study feel that the compaction is of insignificant levels, the overall Jonah Field effort provides for an ideal laboratory for evaluating the effects of soil compaction upon the near-surface significant archaeological deposits. We propose to continue the soil compaction studies in Jonah in the following manners:

1. Continue the experimental archaeological studies in CMA-1 for those mat pads proposed by industry. A 20% sample is considered statistically comparable, so as mat pad proposals come forward, we will continue our experiments and evaluate results ongoing. Individual mat pad evaluation reports will be prepared by the Operators' cultural resources permittees. The Annual Report shall serve as the vehicle for presenting a synthesis of ongoing mat pad experimentation and analysis of results obtained.

2. Utilize non RD historic properties as actual tests of compaction and other effects.

3. Post-mat pad drilling activities will be evaluated for obvious or measurable compaction or other ancillary or indirect effects as mats are utilized in CMA-1. These effects include, but are not limited to, spills of materials that can contaminate archaeologically sensitive materials, off-site disturbance such as soil disturbance outside defined project areas, nonadherance to stipulations attached to project authorizations and emergency situations

(blow outs, equipment failure presenting threat to human health).

No additional mat pads are to be installed within CMA-1, (The Sand Draw Archaeological District) on RD-Eligible Historic Properties before the experiment is completed, analyzed, documented and reported upon.

Mat Pad Standard Stipulations:

That the buried pipelines be subject to archaeological monitoring and inspection during construction. All located cultural materials will be evaluated for National Register purposes and recommendations for further mitigation will be made, based upon the results of the evaluation

- Soil samples for chemical analysis, Ph, and compaction studies will be conducted prior to and subsequent to Mat Pad Placement.

- Assessment of the archaeological experiments will occur subsequent to mat pad drilling and prior to completion of the location. Fracing of the wells will take place prior to the archaeological assessment.

All NRHP-Eligible RD sites located on well locations, access roads or pipeline R/Ws will be either avoided by all activities or subject to the appropriate mitigative treatments. Mitigation will be decided upon in consultation among BLM, SHPO and the applicant. Subsequent to placement of Mat Pads within CMA-1 (The Sand Draw Archaeological District) or in other locales where archaeologically sensitive soils are present, the continuing evaluation and monitoring plan detailed above will be implemented.

K. Documentation

Unless otherwise noted above, all project documentation will meet the Secretary of Interior's and the State of Wyoming's standards for archaeological documentation