A COST SURFACE ANALYSIS OF OBSIDIAN USE IN THE WYOMING BASIN, USA

by

David C. Harvey

A Thesis

Submitted in Partial Fulfillment of the

Requirements for the Degree of

Master of Science

Major: Earth Sciences

The University of Memphis

May 2012

ACKNOWLEDGEMENTS

Many individuals contributed countless amounts of time, patience, and understanding while helping guide me through this process. First and foremost, the members of my committee, Drs. Judson Finley, Andrew Mickelson, and George Swihart were always willing to take time from their schedules and offer assistance when I encountered unforeseen issues. Steve Sutter, Ross Hilman, and the staff of the Wyoming Cultural Records Office earned my gratitude with their support and enthusiasm during initial data collection. Without their efforts this project would be a shadow of what it turned into. Bill Current, Dave Crowley, Craig Lee, Mike Metcalf, Karen Reed, Summer Moore, and Jana Pastor enthusiastically shared provenance reports and data allowing this project to grow more than I ever imagined. To anyone I may have forgotten know that while your name does not appear here this project would not have been possible without your help. As always, all errors and omissions are solely my responsibility.

ABSTRACT

Harvey, David C. M.S. The University of Memphis. May 2012. A Cost Surface Analysis of Obsidian Use in the Wyoming Basin, USA. Major Professor: Judson B. Finley:

A trans-Holocene time averaged synthesis of obsidian use in the Wyoming Basin is presented through the analysis of published and unpublished obsidian source provenance reports. A caloric based cost surface model is used to evaluate whether or not ecological factors contributed to the low regional abundance of Yellowstone Plateau obsidian. The results of the cost surface analysis indicate that modeled caloric costs for the use of four key sources varies little across the region and rather than environmental variables, social factors likely structured the regional obsidian record. Least cost paths generated from the cost surface models were compared to regional ethnographic and ethnohistoric records with the aim of comparing the seemingly stable trans-Holocene settlement and land-use patterns with historically documented ethnographic ranges. The regional obsidian record supports a stable, long-term subsistence strategy centered on the Wyoming Range and encompassing the Wyoming Basin and eastern Snake River Plain.

TABLE OF CONTENTS

Page

List of Tables vi

List of Figures vii

Introduction 1
    Environmental Setting and Regional Obsidian Sources 4
    Previous Research and Regional Provenance Analysis 7

Methods 9
    The Obsidian Dataset 9
    Cost Surface Models and Least Cost Path Analysis 10
        The Spatial Caloric Model 11
        Model Assumptions and Considerations 14
        Model Construction 16
        Model Output 17

Results 22
    The Obsidian Dataset 22
    Spatial Analysis 27
        The Spatial Caloric Model 27
        The Least Cost Paths 31

Discussion 34
    Yellowstone Plateau Obsidian and Long-Term Settlement Stability 34
    The Regional Ethnographic Record 36

Conclusions 38

References Cited 41

Appendix A: Individual Artifact Data and Attributes 51

Appendix B: Minimum Round Trip Caloric Costs (kCal) Extracted from SCM Analysis 75

LIST OF TABLES

Table Page

1. Obsidian sources by source area 7

2. Caloric costs per kilometer at various gradients calculated for the spatial caloric model (modified from Brannan 1992) 13

3. Minimum caloric costs and round trip travel days extracted from SCM output 19

4. Overview of Wyoming Basin obsidian dataset by source 24

5. Overview of Wyoming Basin obsidian dataset by source area 24

6. Data extracted from SCM analysis for northern, southern, and eastern portions of study area (kCal) 30

LIST OF FIGURES

Figure Page

1. Overview of study area including obsidian sources (red) and archaeological sites (grey) included in analysis 5

2. Final cost surface with classified values, obsidian sources, and sites 18

3. SCM model radiating from Bear Gulch 19

4. SCM model radiating from Malad 20

5. SCM model radiating from Teton Pass 21

6. SCM model radiating from Obsidian Cliff 22

7. Percentage of obsidian artifacts by source 25

8. Percentage of obsidian artifacts by source area 26

9. Percentage of obsidian artifacts by chronological association 28

10. Percentage of obsidian artifacts by artifact type 29

11. Least cost paths from one site in northern (48SU4118, red), southern (48LN3552, blue), and eastern (48SW6324, black) portion of study area to each of the four analyzed sources 32

INTRODUCTION

The recent energy boom in southwestern Wyoming has generated archaeological data representing at least 9,500 years of occupation firmly placing the region among the most extensively documented North American hunter-gatherer landscapes (Byers et al. 2005). Data from mitigation efforts provide a rare opportunity to produce regional archaeological syntheses; however, much of these data remain buried in unpublished reports awaiting compilation into coherent evaluations of local and regional archaeological histories. For examples, the Wyoming Basin archaeofauna dataset (Broughton et al. 2008; Byers et al. 2005; Byers and Smith 2007) provides a comprehensive trans-Holocene consideration of environmental change, faunal community structure, and human foraging efficiency based on 88,000 specimens recovered from 144 dated components during contract data recovery efforts. In a similar fashion, this study synthesizes regional obsidian use based on geochemical source data generated from both previously published reports and unpublished contract data.

Frison and colleagues (1968) ushered in the era of archaeological obsidian archaeometry in the Central Rocky Mountains and northwestern High Plains with their pioneering use of neutron activation analysis (NAA) to analyze artifacts from several northwestern Wyoming sites. The study identified the presence of a then unidentified obsidian source with a Na-Mn elemental ratio approximating 90, which gave the source its first name as the Field Museum Yellowstone 90 (F.M.Y. 90) source group (Frison et al. 1968; Griffin et al. 1969). Later work identified the Camas-Dry Creek area in Idaho's Centennial Mountains as the source location of what is now formally known as Bear Gulch obsidian (Hughes and Nelson 1987; Wright and Chaya 1985; Wright et al. 1990).

Since that time obsidian studies have continued to develop both methodologically and theoretically becoming a mainstay of modern archaeological research throughout the world (Eerkens et al. 2008; Glascock 2002; Hughes 1998; Hughes and Smith 1993; Shackley 1998). Regional obsidian studies often focus on the Yellowstone Plateau, its numerous well-documented sources, and their role in prehistoric economies (Bohn 2007; Cannon 1993; Cannon and Hughes 1993; Davis 1972; Davis et al. 1995; Griffin et al. 1969; Iddings 1888; Kunselman 1994; Kunselman and Husted 1996; Molyneaux 2002; Park 2010). However, recent studies (Scheiber and Finley 2011; Smith 1999; Thompson et al. 1997) question the importance of Yellowstone obsidian outside the Yellowstone Plateau and demonstrate that a unique opportunity exists to evaluate prehistoric settlement, mobility, and land use patterns within a broader regional context using geochemical source data.

Environmentally, the Wyoming Basin can be seen as a transition zone between the Great Plains to the east and the Great Basin to the west, but it can also be seen as a cultural transition zone as well, particularly following the assumed Numic expansion sometime around A.D. 1500 (Lubinski 2000; Shimkin 1986). Archaeological evidence demonstrates that the Wyoming Basin has been utilized and inhabited for at least the past 10,000 years, primarily by highly mobile hunting and foraging groups (Kornfeld et al. 2010; Larson 1997; Smith 1999; Smith 2003; Smith 2011; Smith and McNees 1999). With this tradition of highly mobile hunter-gatherers one interesting fact emerging from previous studies is the overall lack of Yellowstone Plateau obsidian in southwestern Wyoming, a point contrary to expectations given its proximity and assumed importance in native settlement patterns. In light of this fact, I was particularly interested in determining if Yellowstone obsidian was truly as rare in the region as those previous studies indicated. To address this question, I compiled what is currently the largest dataset of sourced obsidian artifacts recovered from southwestern Wyoming to reevaluate previously recognized patterns in the regional obsidian record. If Yellowstone obsidian is in fact uncommon then what sources did prehistoric inhabitants most frequently rely on? With the knowledge of which obsidian sources were commonly used I consider what variables, cultural or natural, structured obsidian procurement and use in the Wyoming Basin?

The recent advances in spatial techniques, particularly those available with the aid of Geographic Information Systems (GIS) allow for the evaluation of obsidian use as an economic endeavor operating within the theoretical framework of human behavioral ecology using an energetic cost-benefit framework for raw material procurement (Beck et al. 2002; Jones et al. 2003; Roth 2000; Zeanah 2000). Simply ascribing a definition to GIS can be rather difficult, but at the basic level GIS is a computer based tool with five aspects highly applicable to archaeological research: data acquisition, spatial data management, database management, data visualization, and spatial analysis (Connolly and Lake 2006). I use the spatial caloric model (SCM, Mickelson 2003), a cost surface model ideal for analyzing large geographic areas and datasets, to illuminate the potential ecological factors that structured obsidian distributions in the Wyoming Basin. The SCM calculates conservative caloric costs associated with round trip forays alleviating the need to model both outbound and inbound costs separately. Additionally, the SCM can be used to perform source to site analysis, greatly reducing the number of models needed to analyze datasets containing a large number of sites. Least cost paths generated from the

SCM calculations can be compared to generalized trails and reconstructed seasonal rounds of the Wind River Shoshone (Shimkin 1947), the historic inhabitants of the study area, to understand the relationships between ethnographic and average trans-Holocene patterns. Because of contract research designs and data reporting standards the dataset lacks a distinct chronological component; hence, the models are considered to be a time-averaging analysis of regional obsidian procurement under optimal conditions. Because procurement and exchange are difficult to disentangle in material assemblages, we assume procurement was direct via either logistical forays or embedded strategies associated with annual subsistence rounds (Binford 1979, 1980). It is believed this analysis provides the best opportunity to evaluate and interpret the potential cultural and ecological factors that influenced the patterning of obsidian in the southwestern Wyoming material record.

Environmental Setting and Regional Obsidian Sources

The study area is situated in the Central Rocky Mountains and encompasses three smaller physiographic provinces: the Yellowstone Plateau, the eastern Snake River Plain, and the Wyoming Basin (Figure 1). The Central Rocky Mountain physiographic province is characterized by a series of north-south trending uplifts and intermontane basins associated primarily with the Laramide orogeny (Reheis et al. 1991). The Wyoming Basin is a generally homogenous environment consisting of several distinct structural and depositional sub-basins with minor uplifts that is a prime example of the Central Rocky Mountain landscape (Thelin and Pike 1991). Covering an area of approximately 16,000 km^2 with elevations ranging from 1,800 to 2,400 m asl, the Wyoming Basin is predominantly situated in southwestern Wyoming but extends into

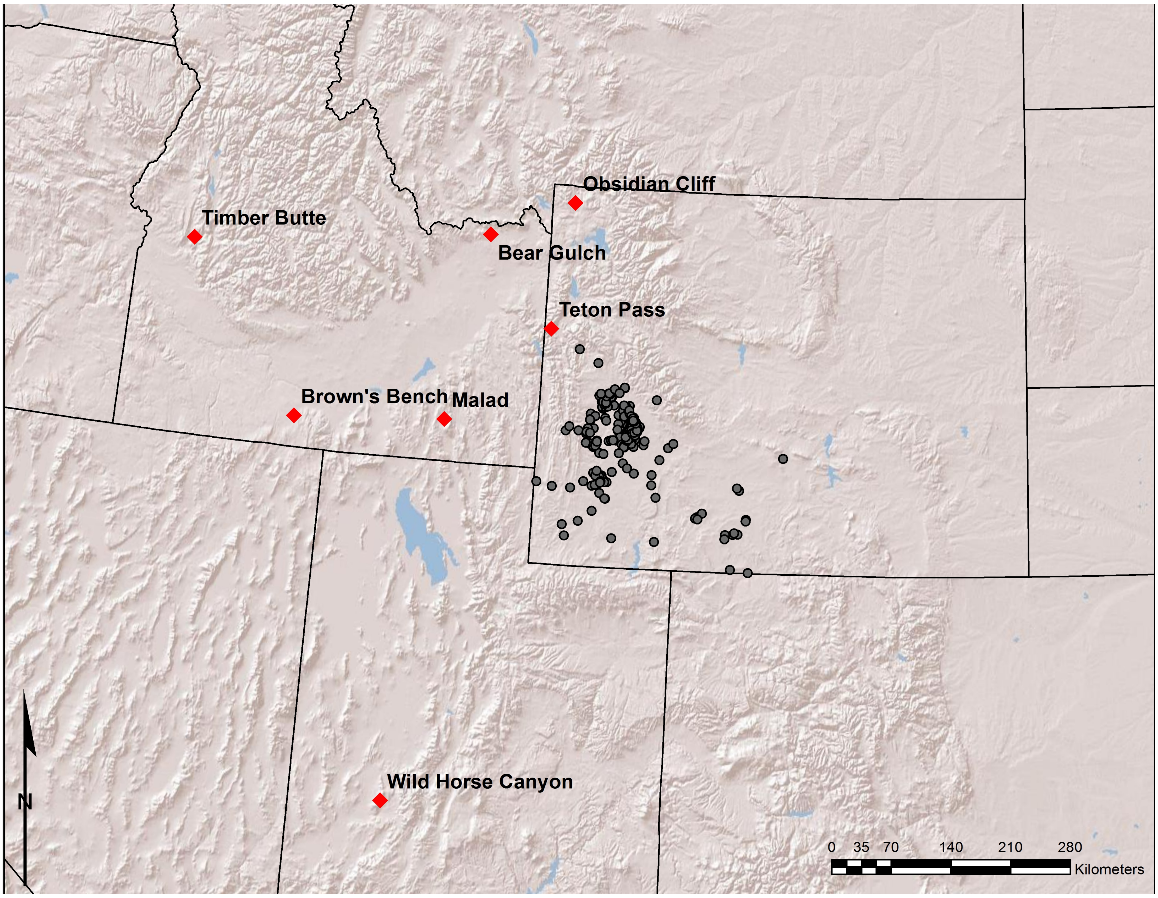

Figure 1. Overview of study area including obsidian sources (red) and archaeological sites (grey) included in analysis

northwestern Colorado and northeastern Utah (Byers et al. 2005). The Green River is the principle stream draining the area forming the Upper Green River Basin as one of the main subsections of the Wyoming Basin. All sites analyzed in this study are located within the Wyoming Basin in general with most occurring in the Upper Green River Basin, which is the scene of the most intensive energy extraction. Some sites lie to the southeast in the vicinity of the Rock Springs Uplift and Great Divide Basin.

Though thirteen geochemically distinct obsidian sources occur in the dataset, including sources in western Idaho and central Utah, sources relevant to the study are restricted to the eastern Snake River Plain and Yellowstone Plateau (Figure 1, Table 1). The eastern Snake River Plain is a volcanic province characterized by a base of rhyolitic rocks overlain with basaltic lava flows (Malde 1991). Holmer (1997) reported that some 30 obsidian sources circumscribe the periphery of the Plain, including the Malad and Bear Gulch sources, which factor significantly in the study. The same hot spot magmatism that shaped the Snake River Plain currently lies beneath the Yellowstone Plateau as the North American continental plate continues to migrate westward. Quaternary volcanism has produced a rich obsidian environment in and around the Yellowstone Caldera (Davis et al. 1995; Pierce et al. 1976). Though all obsidian sources in the dataset could represent participation in regional exchange systems, a few stand out as probable markers of exchange. These include the few artifacts sourced to the Mineral Mountains of central Utah and Browns Bench and Timber Butte on the periphery of the western Snake River Plain, Idaho. Additionally, several obsidian sources are located in close geographic proximity to each other. For ease of discussion, geographic locales with multiple obsidian sources are referred to as sources areas (Table 1). These include the Jackson Hole source area (Teton Pass variety 1, Teton Pass variety 2, Phillips Pass, West Gros Ventre Butte, and Engineer's Quarry), the Yellowstone Plateau sources area (Obsidian Cliff and Huckleberry Ridge Tuff), and the northeastern Idaho source area (Bear Gulch and Packsaddle Creek). Any reference to the eastern Snake River Plain sources includes Bear Gulch, Malad, and Packsaddle Creek.

Table 1. Obsidian sources by source area

Source Area	Obsidian Source	Alternative Source Names
Eastern Idaho	Malad	Wright Creek
Northeastern Idaho	Bear Gulch	Camas-Dry Creek, F.M.Y. 90 Group, Warm Creek
	Packsaddle Creek	n/a
Jackson Hole, Wyoming	Teton Pass variety 1	Fish Creek variety 1
	Teton Pass variety 2	Crescent H, Fish Creek variety 2
	Phillips Pass	Green River Pebble
	Engineer’s Quarry	n/a
	West Gros Ventre Butte	n/a
Yellowstone Plateau, Wyoming	Obsidian Cliff	F.M.Y. 150 Group
	Huckleberry Ridge Tuff	n/a
Central Utah	Wild Horse Canyon	Mineral Mountains
Western Idaho	Browns Bench	Brown’s Bench, Mahogany Butte
	Timber Butte	Squaw Butte, Webb Creek

Previous Research and Regional Provenance Analysis

While the numerous Yellowstone Plateau obsidian sources are well documented and served important regional functions, previous research has shown that the majority of obsidian artifacts recovered in southwestern Wyoming originated from Malad and the Jackson Hole sources (Scheiber and Finley 2011; Smith 1999; Thompson et al. 1997). Thompson et al. (1997) provided the first published report of obsidian utilization in the Wyoming Basin with a diachronic analysis of 135 sourced artifacts, which included 38 artifacts from dated excavation components and 97 diagnostic surface finds. Though there was insufficient data to evaluate the Paleoindian and Historic periods, data from Archaic and Late Prehistoric samples provided the first indication that Malad played an important role as a primary regional obsidian source. Thompson et al. (1997) reported similar proportions of Jackson Hole and Malad obsidian among their Archaic samples and noted that Malad obsidian increased sharply among the Late Prehistoric samples. Ultimately, Thompson et al. (1997) concluded that the prehistoric inhabitants of the Wyoming Basin likely procured obsidian through a regional commodity exchange system and opportunistically from secondary deposits in the Upper Green River Basin, not directly as part of a recurring subsistence round.

The second major study (Smith 1999) analyzed obsidian artifacts from 18 sites across Wyoming and northern Colorado, seven of which lie within the Wyoming Basin study area. Smith (1999) reported similar proportions of Malad and Jackson Hole sources when compared to the results of the Thompson et al. (1997) study, further demonstrating that the obsidian record of southwestern Wyoming is dominated primarily by Malad and Jackson Hole obsidian. Smith (1999) observed two sites in the study area where obsidian comprised a large portion of the overall lithic assemblage and posited that the size of the obsidian assemblage and the reduction stages present evidenced direct procurement of obsidian from the eastern Snake River Plain. He concluded that these instances likely represent a subsistence pattern that focused on the upper Snake River Plain where obsidian was procured directly during the course of a regular subsistence round (Smith 1999).

More recently, Scheiber and Finley (2011) presented a regional synthesis of obsidian data to examine diachronic obsidian source variation with the explicit aim of evaluating the formation of ethnographic territories and contact period resource use. Incorporating data from both Thompson et al. (1997) and Smith (1999) in addition to data from unpublished reports, they increased the dataset of sourced artifacts in southwestern

Wyoming to 364 (Scheiber and Finley 2011). Malad and Jackson Hole sources occurred in similar proportions to previous research with an overall minimal amount of Yellowstone Plateau obsidian. With the consistent reports of Malad and Jackson Hole area sources accounting for the majority of artifacts in southwestern Wyoming, I questioned whether increasing the sample size would continue to yield similar proportions of significant obsidian sources, particularly the seemingly absent Yellowstone Plateau sources.

METHODS

The Obsidian Dataset

The first goal of this study was to expand the Wyoming Basin obsidian dataset beyond the 364 artifacts reported by Scheiber and Finley (2011). Data collection methods followed those established by Scheiber and Finley (2011) emphasizing cultural, temporal, and diagnostic features of each artifact in order to maximize the potential for extrapolating meaningful results. Major recorded attributes include obsidian source and artifact type, style, and chronologic period. In addition to individual artifact attributes, the site of artifact origin and associated spatial data were collected in order to implement spatial analyses. Individual artifact data are located in Appendix A, but per the Wyoming State Historic Preservation Office's (SHPO) data use agreement, spatial data are not divulged. Data were collected from published studies, unpublished contract reports, and contractor submitted sourcing reports on file at the Wyoming Cultural Records Office (WYCRO) in Laramie. In addition to data collected from WYCRO, a data request was sent to the Wyoming Association of Professional Archaeologists (WAPA) listserv that resulted in further expansion of the dataset. In instances where no artifact information could be discerned based on reported data, artifact type and style were coded as ‘unknown’. Additionally, if non-diagnostic artifacts were analyzed from multicomponent sites, chronological association was coded as ‘unknown’. Unfortunately, as will be seen in the results, unknown artifact attributes and chronological associations were encountered more frequently than anticipated.

Primary or central site coordinates were collected in Universal Transverse Mercator (UTM) format. All sites were reported using either the North American Datum 1927 (NAD27) or North American Datum 1983 (NAD83), and though the vast majority of the study area lies within UTM Zone 12N a small portion in the east crosses into UTM Zone 13N. Obsidian source locations were obtained from the Northwest Research Obsidian Laboratory (2011) Source Catalog, which is accessible to the public online.

Cost Surface Models and Least Cost Path Analysis

Spatial analysis techniques are becoming increasingly common in archaeological research due in part for their potential to illuminate aspects of prehistoric mobility, settlement, and resource exploitation in modeled environments. Cost surface models incorporate multiple variables that cannot be accounted for in traditional Euclidian distance models (i.e., “as the crow flies”). When used in conjunction with provenance studies, these techniques provide powerful tools that can model prehistoric human behavior and shed light on aspects of archaeological formation processes that would otherwise be unavailable (Taliaferro et al. 2010; Wood and Wood 2006).

Cost surface and least cost path analyses rely on constructing an isotropic or anisotropic model (Connolly and Lake 2006; Wheatley and Gillings 2002). Isotropic models calculate the cost of movement across a modeled environment but do not differentiate between potential variations in costs associated with the direction of travel through the environment. Anisotropic models account for both cost of movement and direction of travel (Connolly and Lake 2006; Wheatley and Gillings 2002). For example, an isotropic model would employ an algorithm that assumes the cost of traversing a 10% gradient would be equal regardless of whether it is being traversed up or down hill. Alternatively, an anisotropic model employs an algorithm that assumes traversing the 10% gradient downhill results in less resistance and therefore accrues less cost than an uphill traverse. Whether an isotropic or anisotropic model is generated it is important to define the appropriate currency for calculating associated costs. Both time (Connolly and Lake 2006; Taliaferro et al. 2010; Wheatley and Gillings 2002) and energy (Connolly and Lake 2006; Wheatley and Gillings 2002; Wood and Wood 2006) are common currencies used to define cost surfaces and calculate least cost paths in archaeological research.

The Spatial Caloric Model. For this study I employ the spatial caloric model (SCM, Mickelson 2003), a caloric-based cost surface model, with the assumption that caloric expenditure is a greater economic motivator given the potential extreme topographic relief encountered throughout the study area, as well as the relatively large distances between obsidian sources and site concentrations. The SCM is based in optimal foraging theory and particularly central place foraging where time and caloric costs are central variables in decision trees (Kelly 2007). The SCM integrates the work of several researchers (Brannan 1992; Jones and Madsen 1989; Machovina 1996) into a coherent application of central place foraging and human pedestrian models for use in conjunction with the environmental analysis capabilities of GIS (Mickelson 2003).

The SCM models a round trip foray with a fixed point of departure and return in which an agent traverses a cost surface defined in kCal estimated from gradient changes. The model is simplified by assuming that the agent travels the same path outbound and inbound. While this may not be the case in reality, it allows the user to calculate approximate caloric costs for round trip forays while allowing for the definition of different travel paths later in the GIS environment, alleviating the need to model both to and from trips separately. Assuming that the agent traverses the same path to and from the resource, calculating a round trip foray becomes a function of simply adding the uphill and downhill gradient costs for each cell:

$$T_r = (C_u + C_d) \tag{1}$$

where T_r is the round trip caloric cost, C_u is the cost to traverse a cell uphill, and C_d is the cost to traverse a cell downhill. This simple form approximates the costs of a round trip foray for an agent carrying the same load both ways. However, since GIS software cannot account for negative slope values, I calculated the mean cost of corresponding positive and negative slope values presented by Brannan (1992) to accommodate the round trip calculation (Table 2).

Table 2. Caloric Costs per kilometer at various gradients calculated for the spatial caloric model (modified from Brannan 1992)

Percent grade	One way foray kCal/km	Increase in kCal/km with 10 kg load increase	Total round trip kCal/km
0	50.6	4.0	105.2
5	57.6	5.1	120.3
10	75.9	7.4	159.2
15	89.9	10.3	190.1
20	114.7	15.2	244.6
25	136.0	20.4	292.4
30	156.2	26.2	338.6
35	179.0	32.7	390.7
35+	206.8	40.8	454.4

Brannan (1992) estimates caloric costs associated with traversing different gradients and the increase in caloric costs associated with carrying a 10 kg load at different gradients (Table 2), which can be used to modify equation one (1) to account for a one-way 10 kg load increase associated with acquiring a resource as follows:

$$T_r = [(C_u + C_d) + (L_u \bullet C_u + L_d \bullet C_d)/2] \tag{2}$$

where L_u is the percent increase of C_u incurred carrying a 10 kg load and L_d is the percent increase of C_d incurred carrying a 10 kg load. The product of equation two (2) is used to assign cells a value that incorporates the combined costs of a two-way traverse plus the increased costs of carrying an additional 10 kg on one of the two traverses.

Terrain coefficients are commonly used to account for variations in vegetation and other ecological factors that could affect costs across a modeled environment (Connolly and Lake 2006; Wheatley and Gillings 2002). The final product of the model incorporates a terrain coefficient, if applicable, and the specific frequency of each value:

$$fnT_r = \sum_{i=1}^{n} (b[(C_u + C_d)] + [L_u \bullet C_u + L_d \bullet C_d / 2]f \qquad (3)$$

where *f* is the frequency of each specific value and *b* is the terrain coefficient. Equation three (3) approximates the total cost of a round trip foray from a known point of departure and back along the same route with a one-way load increase of 10 kg and a constant walking speed of 3 km/hr.

Model Assumptions and Considerations. Even the most complex model cannot account for all variables that could potentially affect the desired modeled behavior. I begin with a number of initial assumptions that serve to guide this study's model construction and interpretation. First, I assume direct procurement from each of the primary source groups, a notion that directly opposes Thompson et al.'s (1997) conclusion that obsidian was procured through participation in regional exchange systems but has precedence based on the results of Smith's (1999) analysis. Conversely, obsidian from sources outside the eastern Snake River Plain and Yellowstone Plateau (i.e., Browns Bench, Timber Butter, and Wild Horse Canyon) occur infrequently in the dataset, and I assume these to have entered the study area via active exchange networks; obsidian from these sources are excluded from the spatial analysis. Likewise, reliable spatial data for the Packsaddle Creek source in eastern Idaho could not be obtained and this source with its small number of artifacts (n=4) was excluded from the spatial analysis. However, Packsaddle Creek's geographic proximity to Bear Gulch would indicate that the caloric costs associated with directly procuring it would be less than, but similar to those of Bear Gulch.

Spatial analyses focus on Malad, Bear Gulch, and the Jackson Hole sources, which comprise the majority of the dataset, as well as Obsidian Cliff on the Yellowstone Plateau, the source that guided the initial study questions (Figure 1). While the Malad and Bear Gulch sources represent single or spatially restricted outcrops, the Jackson Hole sources (Teton Pass varieties 1 & 2, Phillips Pass, Engineer's Quarry, and West Gros Ventre Butte) are geochemically distinct sources located within a relatively close geographic proximity. Based on their proximity I assume that the cost surface models and least cost paths will not vary significantly throughout this source group. Thus, all spatial analyses for the Jackson Hole sources were generated from the Teton Pass variety 1 locale. An additional consideration lies in the fact that Phillips Pass obsidian, which is located near Teton Pass but is geochemically distinct, occurs in a secondary context in Quaternary alluvial deposits within the upper terraces of the Green River. Artifacts from the region demonstrating this geochemical signature are often referred to as Green River Pebble obsidian (Huebner 2000; Hughes 2006; Smith 1999; Thompson et al. 1997). Because Green River Pebble obsidian and Phillips Pass are geochemically indistinguishable I assume that all obsidian with this particular signature originates from the primary source in the Jackson Hole area. Survey results indicate that these secondary cobbles rarely exceed 4 cm in maximum dimension bringing into question their usefulness for the production of formal tools (Huebner 2000; Thompson et al. 1997).

Model Construction. The cost surface from which the models were generated was constructed in ArcMap® 9.3 with National Elevation Dataset (NED) raster datasets obtained via the Natural Resource Conservation Service's (NRCS, 2011) online Geospatial Data Gateway. I chose NED data with a 30 m-grid cell size, the coarsest available from the NRCS, to facilitate faster computational calculations across the large analyzed surface area. The NED data, a series of individual raster datasets covering the entirety of the study area, were first transformed into a continuous seamless surface using the 'Mosaic to New Raster' Spatial Analyst tool. This tool converts numerous raster datasets into a single raster by codifying the natural edges of each dataset input originally and seamlessly stitching them together. The model is simplified to account strictly for caloric costs based on topographic relief calculated from the difference in slope from one cell to the next. Slope changes throughout the unified raster were calculated in terms of percent change from cell to cell for consistency with assigning gradients caloric costs (Brannan 1992; Mickelson 2003). ArcMap® performs a neighborhood analysis of a 3-x-3 cell matrix assigning the central cell of each matrix a mean slope value calculated from slope changes between it and each adjacent cell. This results in some discrepancies between real-world terrain gradients and the calculated gradient since each cell is assigned a mean value. However, the data resolution results in a negligible caloric cost difference between the calculated slope and the physical reality of the terrain accrued over a 30 m cell. The model excludes terrain coefficients and impeding factors such as water barriers or harsh terrain, which affect caloric expenditure but are more relevant to models evaluating travel time or areas smaller than those incorporated in this study.

The cells of the percent slope surface were reclassified to caloric cost values based on the values reported by Brannan (1992). Since terrain gradient is the only variable used to calculate caloric costs, models were generated with a constant terrain coefficient of 1.0. This final transformation resulted in a cost surface where each 30 m cell was assigned a caloric cost value required to traverse it (Figure 2). The cost surface was then used to model the round trip caloric costs of traversing the study area from each of the four obsidian sources under consideration. I chose to use a baseline daily caloric requirement of 2,500 kCal, roughly the mean of numerous dietary studies (Lee 1968; Rappaport 1984; Smith 1991; World Health Organization 1985). This baseline requirement can be used to turn the model output of minimum kCal cost into temporal measurements of travel time. Typically archaeologists are concerned with site-to-source analysis, but by simulating the models radiating from sources across the entirety of the study area I was able to produce just four models instead of the several hundred required to analyze individual sites in the study.

Model Output. The four cost surface models (Figures 3 through 6) resemble bullseye patterns radiating from each of the four obsidian sources with each zone of the bullseye representing a caloric cost continuum. The zonal statistics package in GIS software allows for easy data extraction from each model. In this case, I extracted the minimum caloric cost required for a round trip foray from each obsidian source to all 318 sites included in the spatial analyses (Appendix B). In addition to the models and extracted data, least cost paths were calculated from each source to three sites throughout

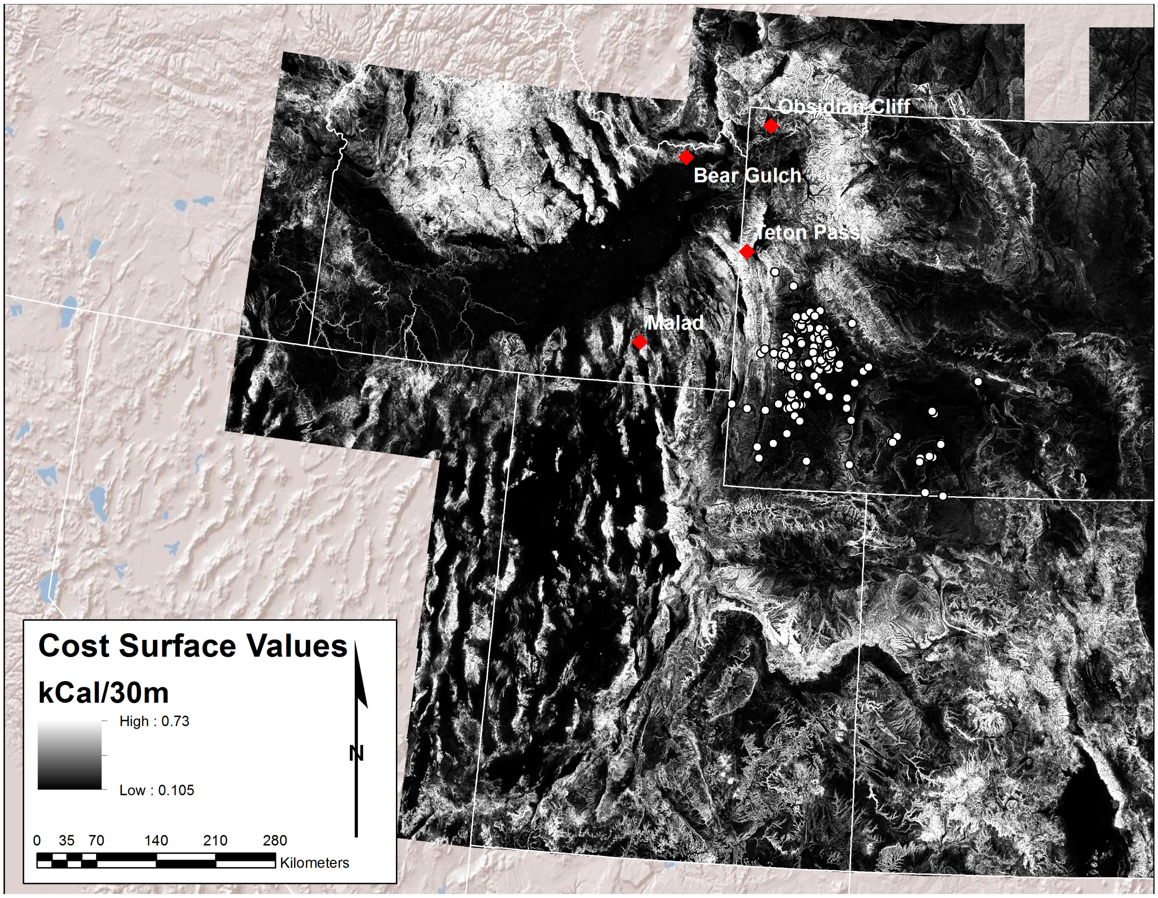

Figure 2. Final cost surface with classified values, obsidian sources, and sites

the study area (Table 3). I arbitrarily segregated the study area into a northern, southern, and eastern designation and selected one site from each segregated portion for least cost path analysis assuming the site to be representative of the larger sample. Descriptive statistics of the obsidian record of southwestern Wyoming are presented below alongside the data extracted from the cost surface models and narrative descriptions of the least cost paths.

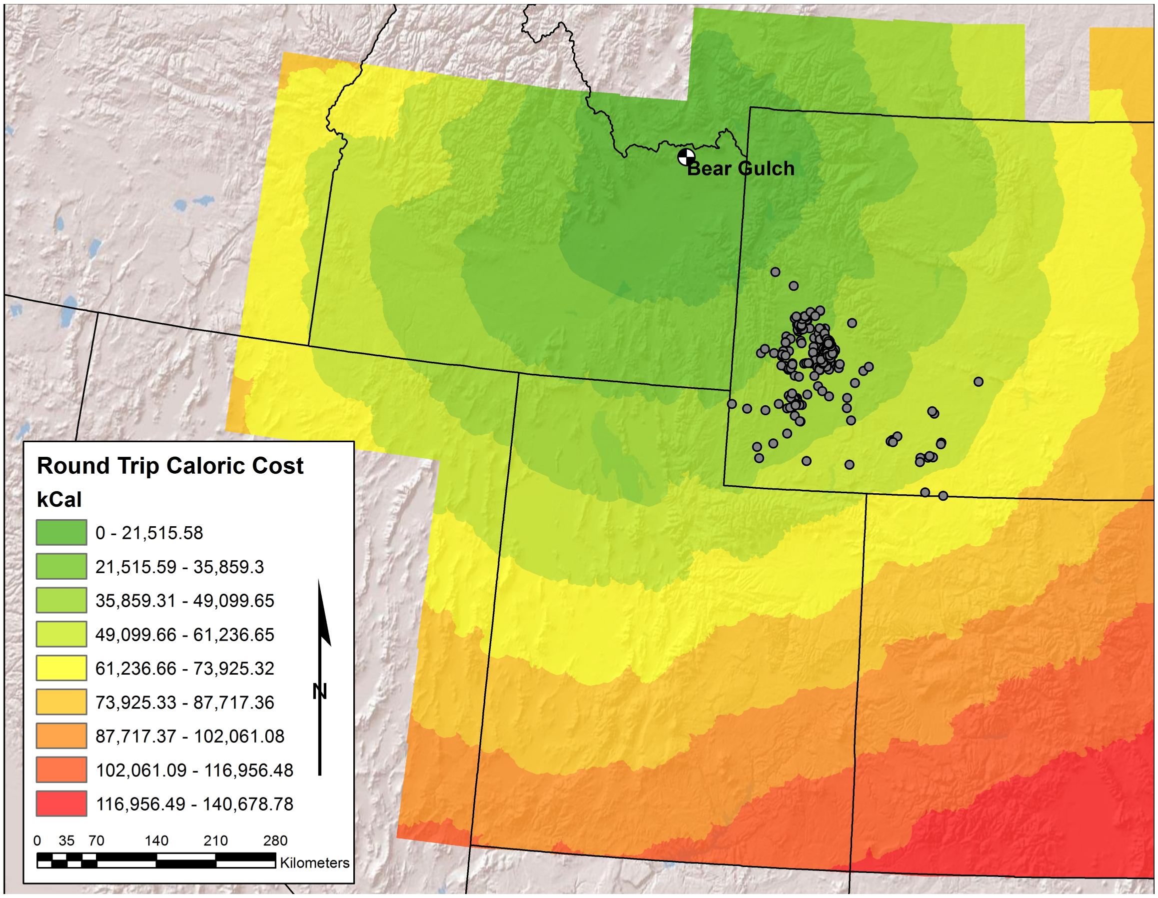

Figure 3. SCM model radiating from Bear Gulch

Table 3. Minimum caloric costs and round trip travel days of data extracted from SCM output

	48SU4118	48LN3552	48SW6324	All Sites
Malad				
kCal	34,100	31,264	46,503	35,273
Round Trip Days	13.6	12.5	18.6	14.1
Bear Gulch				
kCal	36,925	43,691	53,997	39,361
Round Trip Days	14.8	17.4	21.6	15.7
Teton Pass				
kCal	20,447	28,362	37,522	23,269
Round Trip Days	8.2	15.0	15.0	9.3
Obsidian Cliff				
kCal	36,767	45,273	43,241	39,648
Round Trip Days	14.7	18.1	17.3	15.9

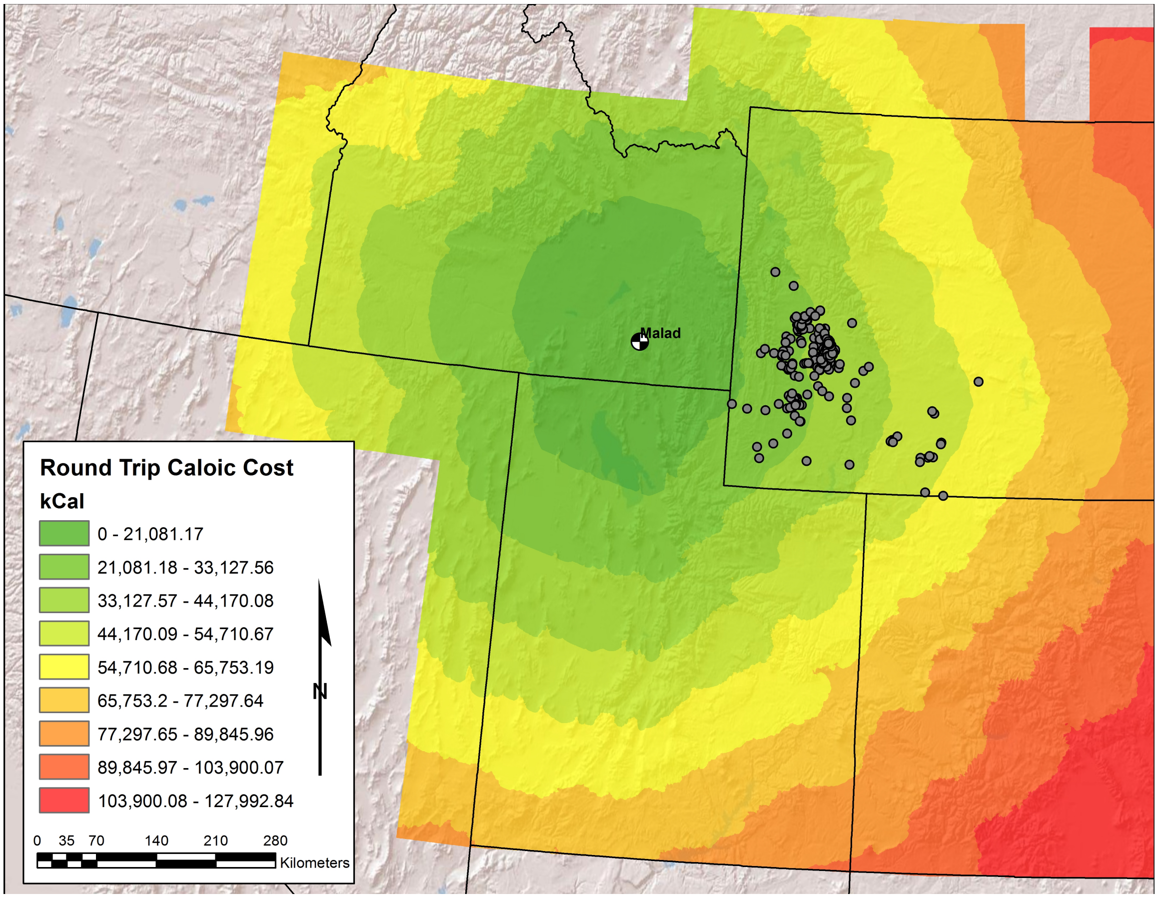

Figure 4. SCM model radiating from Malad

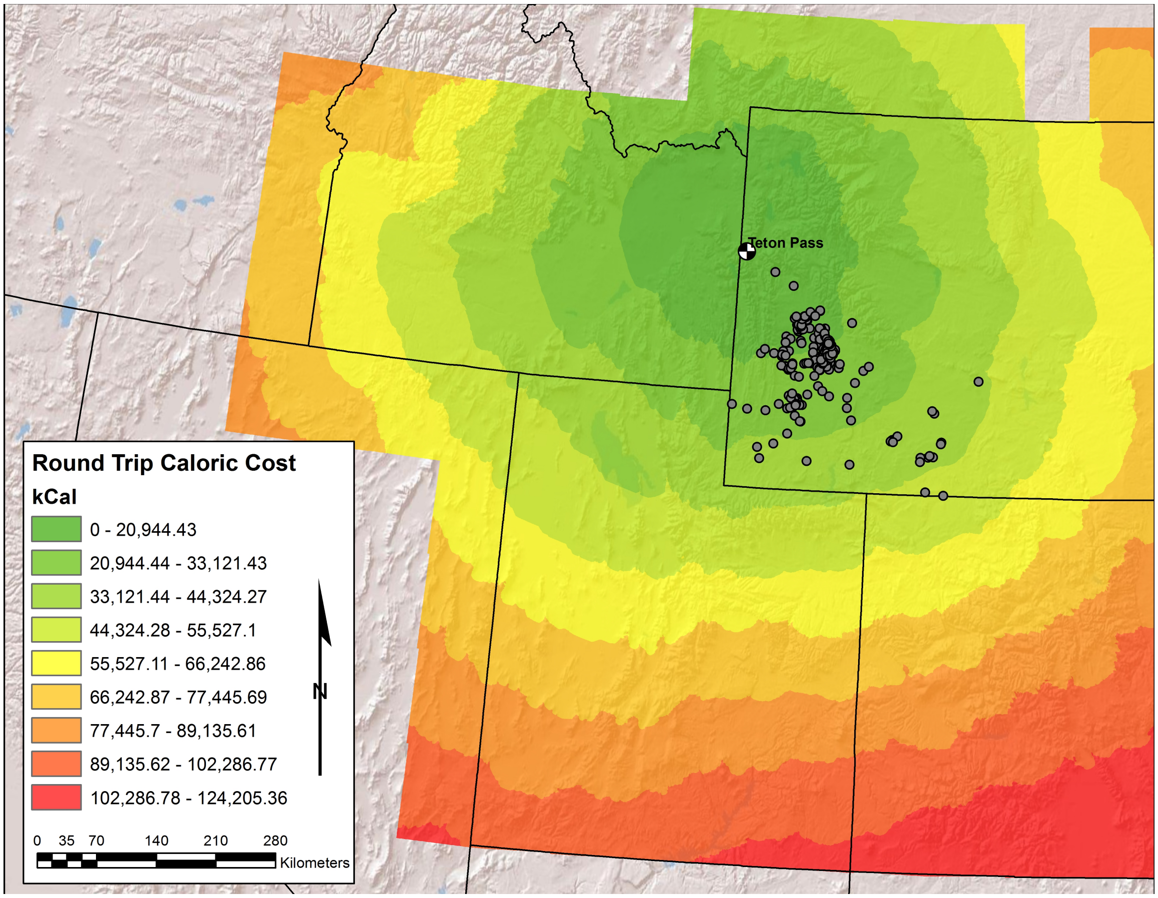

Figure 5. SCM model radiating from Teton Pass

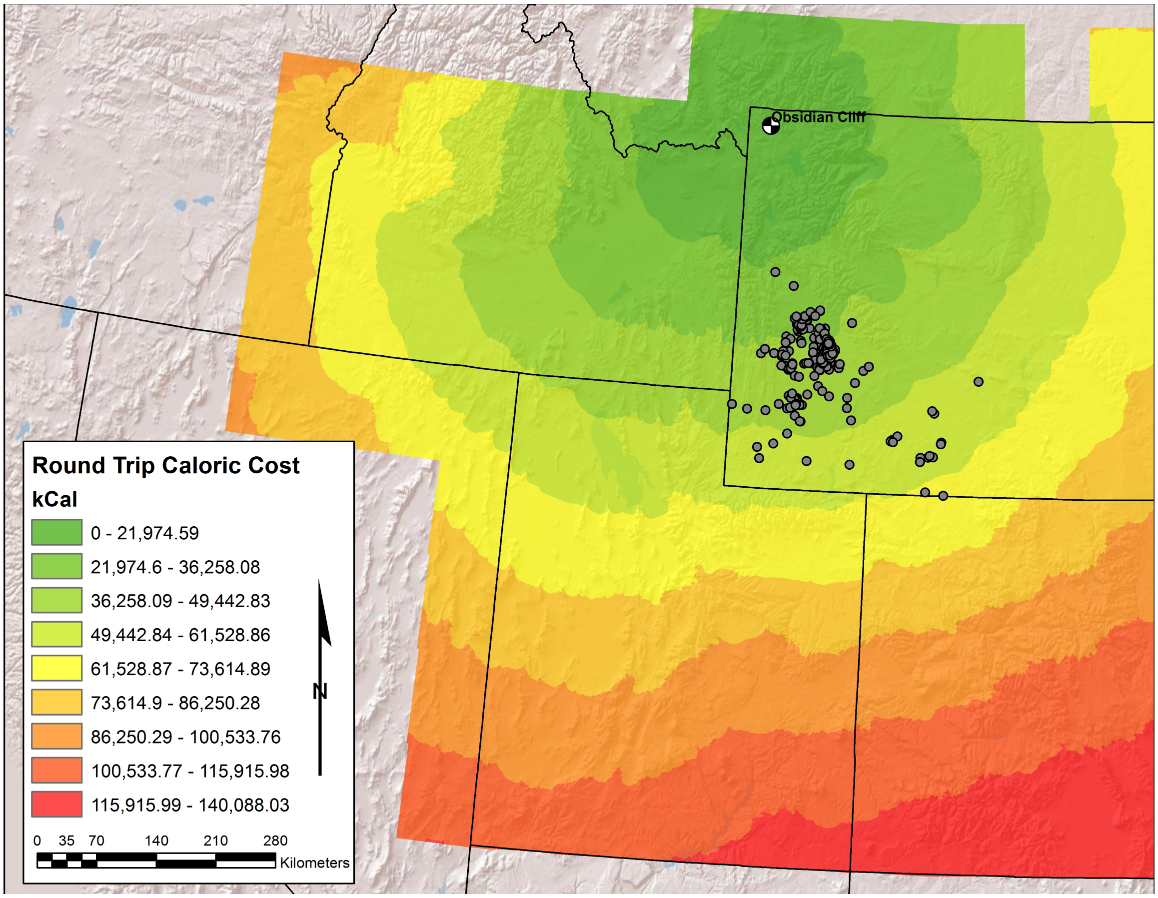

Figure 6. SCM model radiating from Obsidian Cliff

RESULTS

The Obsidian Dataset

The dataset consists of 864 sourced artifacts recovered from 337 sites and isolated finds throughout Lincoln, Sublette, Sweetwater, and Uinta counties, Wyoming. Site data for samples from the Thompson et al. (1997) study were not published, and though I know their samples include artifacts from at least 19 sites I was unable to rectify published artifact data with site data obtained from the study's second author (Jana Pastor, personal communication 2010). Artifact data from the Thompson et al. (1997)

study is included here, but site data is excluded from the spatial analysis bringing the total number of sites included in that part of the study to 318. Sourced artifacts range from 1-61 per site with a mean of 2.5 sourced artifacts per site (Tables 4 and 5). It is important to note that 97.9% (n=320) of all sites in the dataset have 10 or fewer sourced artifacts. In fact, the majority of sites in the dataset (68.2%, n=230) are represented by only a single sourced artifact. Of the 864 artifacts, 828 (95.8%) were confidently assigned to one of 13 geochemically distinct regional obsidian sources. The remaining 36 (4.2%) artifacts were not assigned to a documented source and were coded as ‘unknown’. A number of laboratory reports indicated that samples submitted for provenance analysis were not obsidian; these artifacts were omitted from the dataset.

Of the 13 distinct obsidian sources, Malad is the most frequently represented accounting for 39.6% (n=342) of the total sourced sample (Figure 7). Artifacts from the Jackson Hole sources represent an additional 39.5% (n=341) and include 286 artifacts from Teton Pass variety 1 and Phillips Pass, 47 from Teton Pass variety 2, 6 from West Gros Ventre Butte, and 2 from Engineer’s Quarry respectively (Figure 8). It must be noted that I coded analyzed samples assigned to the Phillips Pass/Green River Pebble obsidian source as originating from Teton Pass variety 1. While these two sources are geochemically distinct confusion arose during data collection as an alternative name for Teton Pass variety 1 indicated a potential correlation between the two sources. Thus, I coded them as originating from the same source. The Bear Gulch source, which is commonly reported in eastern Idaho, northwestern Wyoming, and southwestern Montana, is the third most common individual source behind Malad and Teton Pass variety 1 accounting for 10.5% (n=91) of the total sample. Central to this study and in keeping

Table 4. Overview of Wyoming Basin obsidian dataset by source

Obsidian Source	Frequency	Percent
Malad	342	39.6
Bear Gulch	91	10.5
Packsaddle Creek	4	0.5
Teton Pass variety 1	286	33.1
Teton Pass variety 2	47	5.4
Engineer’s Quarry	2	0.2
West Gros Ventre Butte	6	0.7
Obsidian Cliff	30	3.5
Huckleberry Ridge Tuff	1	0.1
Wild Horse Canyon	13	1.5
Browns Bench	5	0.6
Timber Butte	1	0.1
Unknown	36	4.2
Total	864	100

Table 5. Overview of Wyoming Basin obsidian dataset by source area

Source Area	Frequency	Percent
Southeastern Idaho	342	39.6
Eastern Idaho	95	11.0
Jackson Hole, Wyoming	341	39.5
Yellowstone Plateau, Wyoming	31	3.6
Central Utah	13	1.5
Western Idaho	6	0.7
Unknown	36	4.2
Total	864	100

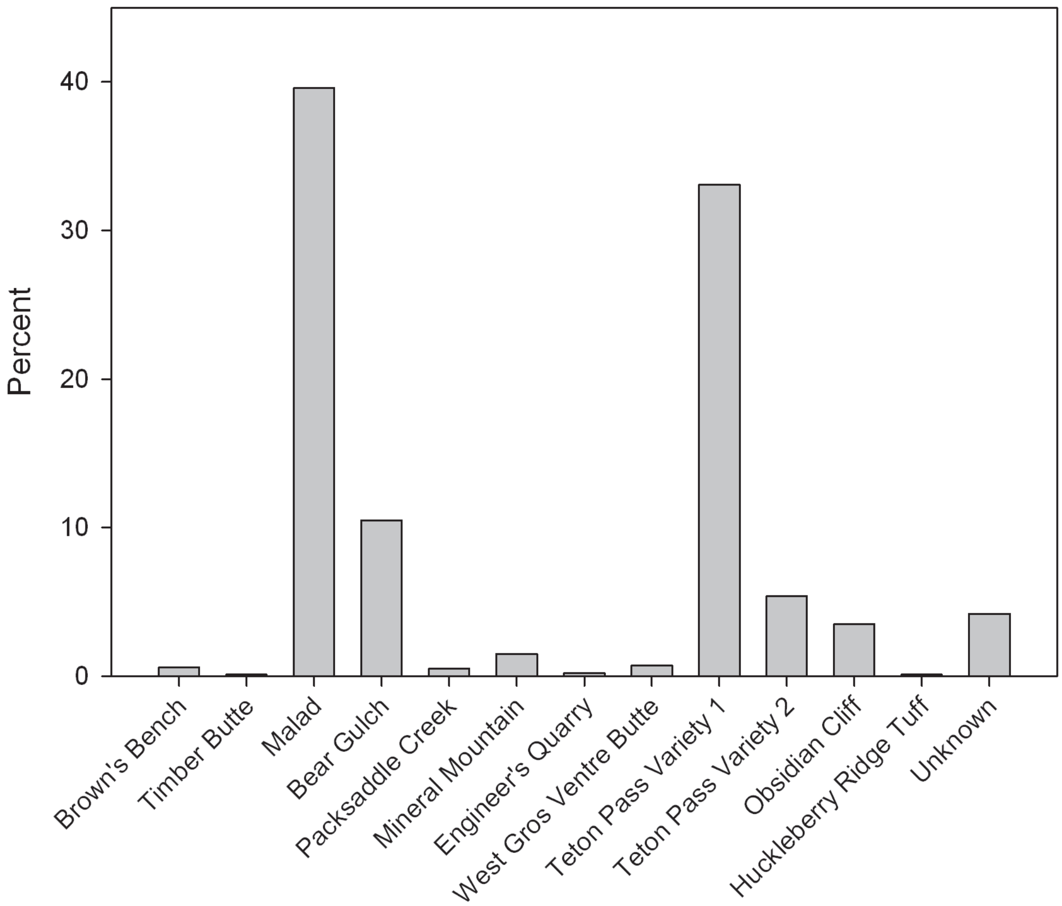

Figure 7. Percentage of obsidian artifacts by source

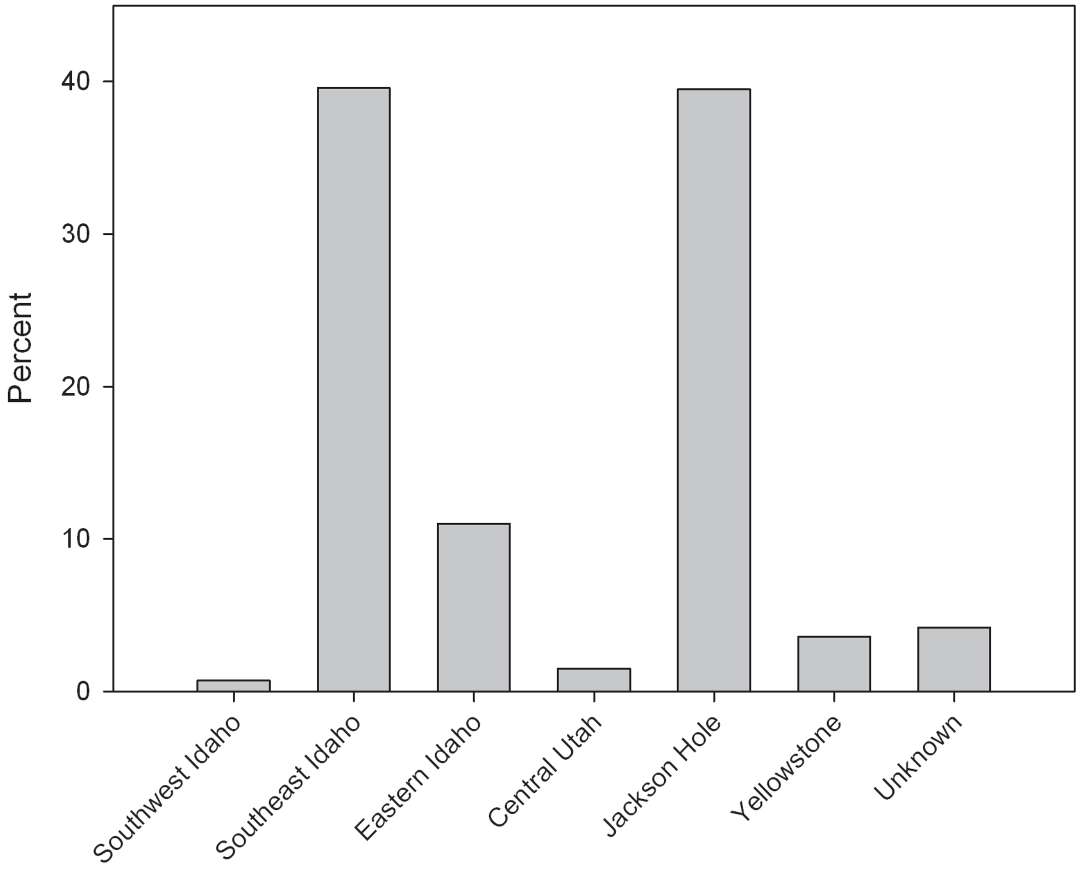

Figure 8. Percentage of obsidian artifacts by source area

with previous trends (Scheiber and Finley 2011; Smith 1999; Thompson et al. 1997), Yellowstone Plateau obsidian is rare in the dataset accounting for a mere 3.6% (n=31) of the sample with 30 artifacts originating from Obsidian Cliff and one from the Huckleberry Ridge Tuff. Additional sources are present in small quantities. Among these artifacts 13 were sourced to the Mineral Mountains of south-central Utah, four to Packsaddle Creek in eastern Idaho near the Wyoming border, five to Browns Bench, and one to Timber Butte in western Idaho.

One of the planned study goals was a diachronic analysis of the expanded dataset in order to compare to those presented in previous studies. However, the dataset has a distinct lack of chronological control with 432, or exactly 50%, of sampled artifacts having no known chronological association based on reported data (Figure 9). The Archaic period is represented by 181 artifacts and can be confidently divided into samples from the Early Archaic (n=46), Middle Archaic (n=31), Late Archaic (n=61), and general or unknown Archaic (n=43). The Late Prehistoric is represented by 170 artifacts, followed by the Historic period with 46 artifacts, and the Paleoindian representing only four artifacts.

One reason so many artifacts were not assigned to a time period can be seen in the artifact types often selected for provenance analysis (Figure 10). Projectile points, which frequently can be assigned to a general time period based on regional typologies, account for 250 artifacts. Non-diagnostic flakes are the second most frequently analyzed artifact type, represented by 210 artifacts. Other sourced artifact types include 14 unspecified tools, 34 bifaces, and 3 cores. The remaining 353 artifacts in the dataset could not be assigned an artifact type based on reported data. I believe it is probable that if artifact data were discernable for these remaining artifacts that flakes would be the most frequently analyzed artifact type in the dataset, a problem arising from contract research designs, sampling strategies, and reporting inconsistencies.

Spatial Analysis

The Spatial Caloric Model. While the results of the spatial analyses primarily inform my discussion and conclusions, some general results are presented here. The results (Table 6) derived from the SCM include data from 318 sites (Appendix B). The

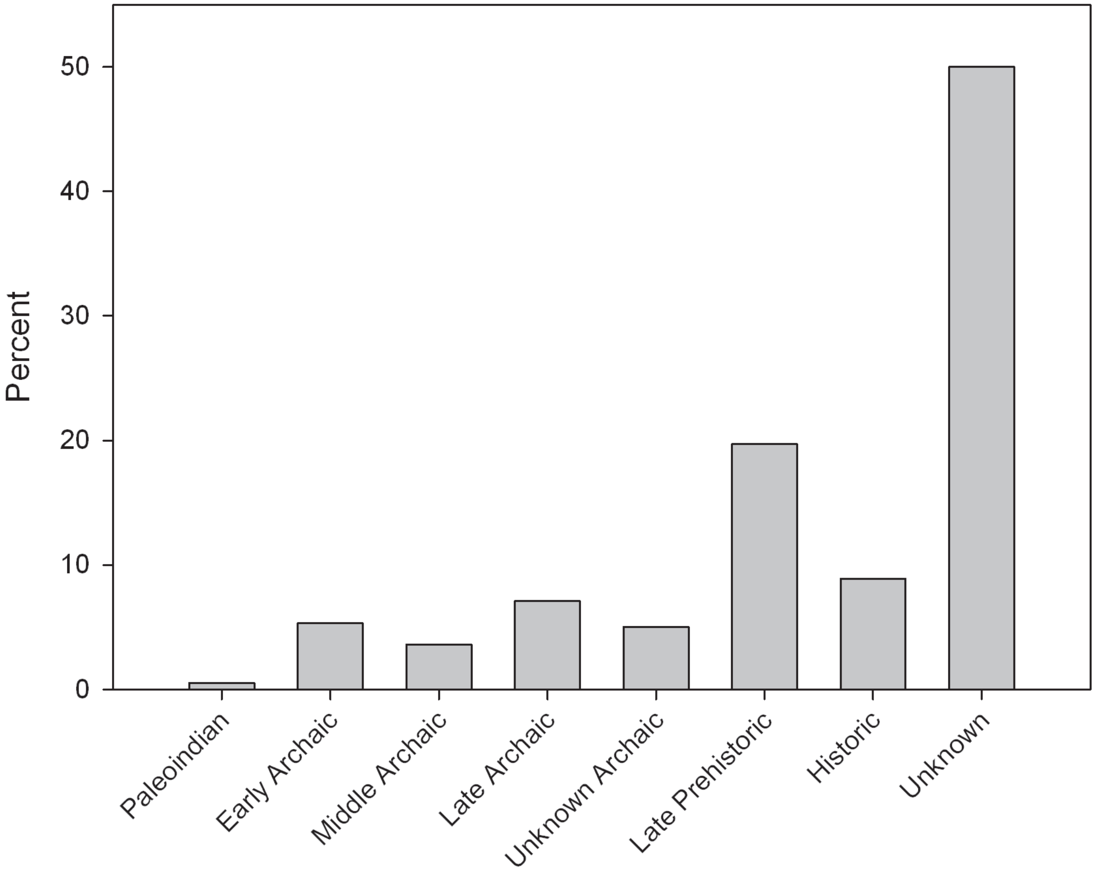

Figure 9. Percentage of obsidian artifacts by chronological association

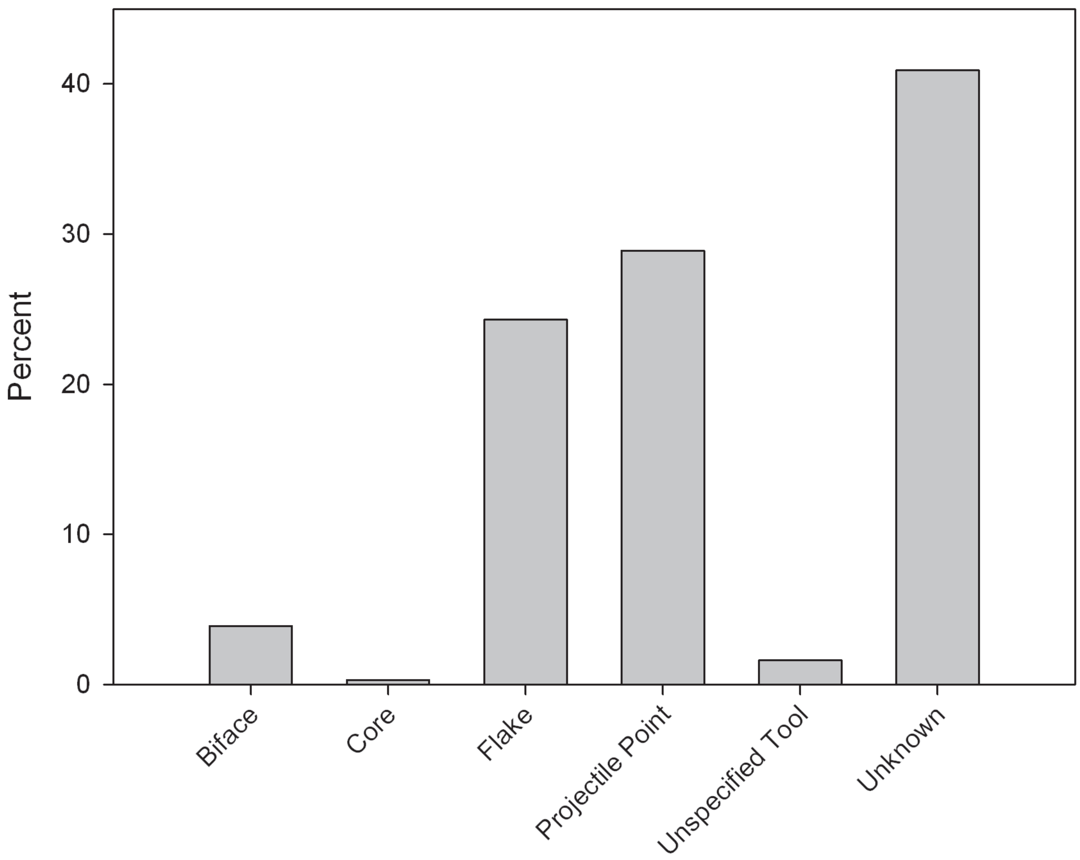

Figure 10. Percentage of obsidian artifacts by artifact type

study area was arbitrarily segregated into a northern, southern, and eastern portion based on clustering of sites (Table 6). The majority of sites (n=256) lie in the northern portion of the Upper Green River Basin. Not surprisingly given its proximity to Jackson Hole, those sources are the least costly for the northern portion of the study area with a mean caloric expenditure of 21,104 kCal accrued during a round trip foray. Mean caloric expenditure from Malad is 34,438 kCal, followed by Bear Gulch at 37,392 kCal, and

Table 6. Data extracted from SCM analysis for northern, southern, and eastern portions of study area (kCal)

Source	**Northern** (n=256)	**Southern** (n=44)	**Eastern** (n=18)	**Total** (n=318)
Malad				
Min	25,727	20,835	45,913	20,835
Max	41,655	45,155	56,916	56,916
Mean	34,881	31,586	50,634	35,272
Jackson Hole				
Min	7,523	24,165	37,522	7,523
Max	26,712	39,202	48,612	48,612
Mean	21,104	29,018	41,059	23,268
Yellowstone				
Min	24,854	40,794	53,420	24,854
Max	42,606	55,302	64,511	64,511
Mean	37,438	45,951	56,701	39,648
Bear Gulch				
Min	24,001	37,124	53,996	24,001
Max	43,189	55,072	65,087	65,087
Mean	37,392	43,829	57,497	39,361

Obsidian Cliff at 37,438 kCal. Forty-four sites lie in the southern portion of the Upper Green River Basin where the Jackson Hole sources continue to represent the most efficient exploitable sources with a mean caloric expenditure of 29,019 kCal. In the southern portion of the study area Malad is nearly as efficient as the Jackson Hole sources averaging 31,588 kCal for a round trip foray. Bear Gulch (43,829 kCal) and Obsidian Cliff (45,952 kCal) are much less efficient as they lie further north in relation to this portion of the study area. Only 17 sites are in the eastern Wyoming Basin study area where the Jackson Hole sources still represent the least costly exploitable sources with a mean expenditure of 41,059 kCal. Malad remains the second most efficient source with a mean caloric expenditure of 50,653 kCal, followed by Obsidian Cliff (56,701 kCal) and

Bear Gulch (57,497 kCal). These results are not surprising given the geographic locations of both the sites and obsidian sources being analyzed. The products of the SCM analysis can be divided by 2,500 kCal, the baseline daily caloric requirement to convert the values into round trip travel days associated with these forays (Tables 3 and 6).

The Least Cost Paths. The least cost paths generated from the SCM (Figure 11) provide another opportunity to examine regional obsidian use in conjunction with the ethnographic record (Shimkin 1947). Narrative descriptions of the least cost paths provide an understanding of potential routes through the landscape and their relationship to other documented regional travel corridors including ethnographic and emigrant trails, wildlife migration corridors, and modern transportation routes. It must be noted that excluding terrain coefficients and impedance factors from the SCM analysis means that some paths cross bodies of water, such as Jackson Lake. While this would slightly affect the estimated caloric costs, I believe the general course of the paths generated would not vary based on these occasional observed discrepancies.

The least cost paths to Malad follow two general routes. The path from 48SW6324 in the eastern portion of the study area and 48LN3552 in the southern portion of the study area follow the same route after converging in the southern portion of the Upper Green River Basin. The path follows the general course of Black Butte Creek and enters the southern extent of the Wyoming Range northeast of the community of Kemmerer. After exiting the Wyoming Range the path crosses the Pomeroy and Dempsey Basins and Sublette Flats before passing north of Bear Lake and following Paris Creek through the Bear River Range. The path then continues north/northwest skirting north of the Oxford Mountains before following Wright Creek north of Elkhorn Mountain to the obsidian source.

Figure 11. Least cost paths from one site in northern (48SU4118, red), southern (48LN3552, blue), and eastern (48SW6324, black) portion of study area to each of the four analyzed sources

The path from 48SU4118 in the northern portion of the study area follows South Piney Creek west across the Upper Green River Basin before entering the central portion of the Wyoming Range following LaBarge Creek. The path continues west and south following several smaller drainages through the mountains along a path similar to Bill Sublette's cutoff of the Emigrant Trail (Sunder 1959). The path crosses the Nounan Valley before following the Bear River south of Soda Springs, Idaho across the northern portion of the Bear River Range into Gem Valley. The path follows the Portneuf River through the Portneuf Range passing into Marsh Valley north of Elkhorn Mountain picking up Wright Creek to the source.

The least cost paths from all three sites to Teton Pass follow various drainages through the Upper Green River Basin before converging just south of the Gros Ventre Range. The paths enter the southern portion of the Gros Ventre Range through the Hoback Basin following the Hoback River. The paths continue northwest picking up the Snake River north into the southern extent of Jackson Hole before crossing Teton Pass and arriving at the obsidian source. The paths from 48SU4118 and 48SW6324 to the Bear Gulch source follow the same route to Teton Pass before continuing north along Coal Creek to the Teton Basin. From the Teton Basin the path enters the Snake River Plain continuing north/northwest to the Camas Meadows area and picking up Camas Creek into the Centennial Mountains and the Bear Gulch source.

From 48LN3552 in the southern portion of the study area the path to Bear Gulch trends north/northwest across the Upper Green River Basin entering the Wyoming Range along LaBarge Creek. The path follows the same route from 48SU4118 to Malad following the general trend of the Emigrant Trail. The path then continues north/northwest eventually picking up the Salt River north through Star Valley. The path then follows the Snake River onto the Snake River Plain south of the community of Rexberg, Idaho continuing north across the Plain. The path enters the Camas Meadows area picking up the course of Camas Creek into the Centennial Mountains before arriving at the Bear Gulch source.

The least cost paths to Obsidian Cliff follow various drainages through the Upper Green River Basin before converging south of the Wind River Range. The path crosses the northern extent of the Wind River Range via Union Pass and then follows the Gros Ventre River along the eastern edge of the Gros Ventre Range passing through the northern extent of Jackson Hole to the west of Jackson Lake. The path continues onto the Yellowstone Plateau passing west of Yellowstone Lake and eventually to Obsidian Cliff.

DISCUSSION

Yellowstone Plateau Obsidian and Long-Term Settlement Stability

It is immediately apparent that Yellowstone Plateau obsidian is, in fact, rare in the Wyoming Basin. Yellowstone obsidian accounts for a mere 31 (3.6%) artifacts of the total sourced sample, which is sharply contrasted by the 778 (90.1%) artifacts originating from the Jackson Hole and eastern Snake River Plain sources. These results are not unexpected given the indications of previous studies (Scheiber and Finley 2011; Smith 1999; Thompson et al. 1997); however, the extreme rarity with which Yellowstone Plateau obsidian is observed in the region warrants further consideration.

In general, the obsidian record of southwestern Wyoming shows a strong correlation between the Wyoming Basin and the Jackson Hole area and eastern Snake River Plain. More importantly, the seemingly homogenous composition of the obsidian record, namely that fact that 90% of the sample is restricted to three source areas, suggests that regional settlement and mobility patterns and resource use has remained relatively stable over the course of millennia. Thompson et al. (1997) demonstrated that there is variation in regional obsidian use between the Archaic and Late Prehistoric noting that Malad became more frequently utilized during the Late Prehistoric. This variation seems to further strengthen the argument for stable long-term landscape and resource use between the Wyoming Basin and eastern Snake River Plain.

The SCM shows that energetically speaking the Jackson Hole sources are the least costly exploitable obsidian sources available in southwestern Wyoming. This is expected given the fact that these sources are immediately north of the study area and the proportions with which they are represented in the dataset. The SCM also shows that Malad is consistently the second most efficient exploitable source throughout the study area. This becomes particularly pronounced in the southern portion of the study area where energetically speaking the SCM shows a difference of only 2,500 kCal, representing a single travel day difference between the Jackson Hole sources and Malad. However, in the northern and eastern portions of the study area the energetic differences between directly procuring Malad and Yellowstone Plateau obsidian greatly decreases with maximum differences of approximately 6,000 kCal or an approximate increase of two travel days, one day each way.

Similarly, given the argument for direct procurement of Bear Gulch obsidian presented by Smith (1999) one would expect that directly procuring Bear Gulch obsidian would be more energetically efficient than Yellowstone Plateau obsidian. Contrary to these expectations, the SCM analysis shows that throughout the entire study area the energetic costs associated with procuring Bear Gulch and Yellowstone obsidian are basically equal. In fact, over the entire study area, the energetic difference between Malad and the eastern Idaho and Yellowstone Plateau sources is less than one travel day both ways. Given the implications of the SCM it appears that factors influencing access to Yellowstone Plateau obsidian by Wyoming Basin inhabitants are primarily social and not environmental. Given this, I compare the ethnographic record of the area with the results of the spatial analysis to see if historic documentation supports the regional material record.

The Regional Ethnographic Record

The Wyoming Basin obsidian dataset, SCM, and least cost pathways illustrate a clear mismatch between the regional ethnographic and archaeological records. Ethnographer Demitri Shimkin (1947) noted that among the Wind River Shoshone obsidian was, according to his informants, the most important exploited mineral resource. While the ethnohistoric importance of obsidian is documented here, it was likely less important throughout prehistory compared to other more regionally abundant, high-quality raw material sources (Miller 2010). Based on his time with the Wind River Shoshone Shimkin (1947) documented at least two instances of obsidian procurement. Considering the "Utilization of natural areas" obsidian is labeled as an Upper Green River Basin resource (Shimkin 1947:Map 9) that could represent either procurement and utilization of Jackson Hole or Green River Pebble obsidian sources, although the latter is unlikely given the low abundance and small clast sizes. Obsidian procurement is also mentioned in the context of a westward movement along a route to spring rendezvous activity (Shimkin 1947). In this context it is noted that obsidian is procured from "volcanic cliffs" (Shimkin 1947:279) and though the generalized description of the seasonal movement does not mention specific geographic localities it seems probable that this refers to Obsidian Cliff. The regional obsidian record simply does not support the significant direct exploitation of Yellowstone obsidian by Wyoming Basin inhabitants at any time throughout the Holocene.

The second mismatch lies in comparing the regional obsidian record and least cost paths to Shimkin's (1947) ethnographic mobility ranges. While Shimkin's (1947) informants clearly possessed an intimate understanding of western Wyoming, including the Yellowstone Plateau, the obsidian record supports limited utilization of or interaction between northwestern Wyoming and the Wyoming Basin at best. While the ethnohistoric record (Stamm 1999) supports Shimkin's (1941) claims that the Wind River Shoshone directly exploited a large geographic extent reaching as far east as the Powder River Basin and Black Hills including the Yellowstone Plateau and Absaroka Range, the obsidian record and terrain analysis supports a long-term stable settlement pattern oriented to the west centering around the Wyoming Range and encompassing the Wyoming Basin, Jackson Hole, and eastern Snake River Plain. Shimkin's (1947) reconstruction may be more relevant to a post-contact, post-horse Shoshone settlement pattern than the juxtaposed precontact, prehorse pattern that would be in keeping with Shoshone salt procurement near Soda Springs, Idaho (Shimkin 1947).

The lack of chronological control and homogenous nature of the Wyoming Basin obsidian dataset strongly supports a long-term stable land use pattern in the region akin to Binford's (1980) foraging system. Binford (1980) contrasts foraging and collecting subsistence strategies in which foragers "map-on" to resources through a periodic relocation of residential bases along a series of resource patches during seasonal or resource dependent movements. The lines of evidence from the obsidian dataset, SCM, and least cost paths support a west- and northwest-oriented settlement pattern that was likely stable for millennia during which obsidian was directly procured from Jackson Hole and eastern Snake River Plain sources during regular residential base relocations.

CONCLUSIONS

Obsidian provenance studies continue to generate new and nuanced interpretations of regional settlement strategies, resource use, and social interaction (Jones et al. 2003; Scheiber and Finley 2011; Taliaferro et al. 2010; Wood and Wood 2006). When used in conjunction with new developments in spatial analysis techniques, previously reported patterns can be reevaluated using the environmental and ecological capabilities of GIS software. I compiled what is currently the largest dataset of sourced obsidian artifacts from southwestern Wyoming with the aim of evaluating the role Yellowstone Plateau obsidian played in regional settlement strategies and subsistence economies. Contrary to expectations, Malad obsidian is the most common regional obsidian source utilized while Yellowstone obsidian is so infrequent it likely entered the area via an exchange network or rare visits to the source. The results of the dataset and spatial analyses show relatively minimal energetic cost differences between Malad, Yellowstone Plateau, and Bear Gulch sources suggesting that access to regional obsidian sources was likely the product of social factors rather than environmental ones. The regional obsidian record supports a long-term, stable subsistence strategy focusing on the Wyoming Basin and eastern Snake River Plain. Diachronic changes in obsidian could not be evaluated due to the lack of chronological control inherent in the contract-generated data that accounts for a significant portion of the dataset. Additionally, the reconstructed ethnographic subsistence round and trails (Shimkin 1947) for the region are not supported by the obsidian record, calling into question its applicability to the prehistoric record.

I believe future research into the obsidian record of eastern Idaho will further substantiate the conclusions of this study and provide additional evidence of regional interactions. Generating comprehensive datasets from multiple sources is a challenge, but has merit for addressing regional questions as in this and other studies (Broughton et al. 2008; Byers et al. 2005; Byers and Smith 2007). In order to unlock the full potential of the multitudes of data buried in contract reports and site forms associated with mitigation efforts several changes in reporting procedures from laboratory analysts to contract reports must be made. Laboratory analysts conducting provenance analysis on obsidian artifacts must standardize names assigned to well-documented obsidian sources. Only confusion arises from referring to a single, geochemically discreet source by multiple names. Additionally, contract researchers must accurately report all data associated with analytical studies performed beyond field analysis of artifacts and other data collected during data collection and mitigation efforts. Contract researchers must better define and implement research and sampling strategies when conducting geochemical analyses as well. The data generated through their efforts often represents the largest cross section of regional data available, particularly in areas of intensive development, as was the case here. While contract and academic research designs and goals can vary greatly, it is important that contractors realize the data they generate during projects becomes part of the public record and can be used for studies they may not have envisioned.

REFERENCES CITED

Beck, Charlotte, Amanda K. Taylor, George T. Jones, Cynthia M. Fadem, Caitlyn R. Cook, Sara A. Millward

2002 Rocks Are Heavy: Transport Costs and Paleoarchaic Quarry Behavior in the Great Basin. *Journal of Anthropological Archaeology* 21:481-507.

Binford, Lewis R.

1979 Organization and Formation Processes: Looking at Curated Technologies. *Journal of Archaeological Research* 35:25-273.

Binford, Lewis R.

1980 Willow Smoke and Dogs' Tails: Hunter-Gatherer Settlement Systems and Archaeological Site Formation. *American Antiquity* 45:4-20.

Bohn, Allison D.

2007 Scattered Glass: Obsidian Artifact Provenance Patterns In Northwestern Wyoming. Unpublished Master's Thesis, Department of Anthropology, Colorado State University, Fort Collins.

Brannan, James A.

1992 On Modeling Resource Transport Costs: Suggested Refinements. *Current Anthropology* 33:56-60.

Broughton, Jack M, David A. Byers, Reid A. Bryson, William Eckerle, David B. Madsen

2008 Did Climatic Seasonality Control Late Quaternary Artiodactyl Densities in Western North America? *Quaternary Science Reviews* 27:1916-1937.

Byers, David A., Craig S. Smith, Jack M. Broughton

2005 Holocene Artiodactyl Population Histories and Large Game Hunting in the

Wyoming Basin, USA. *Journal of Archaeological Science* 32:125-142.

Byers, David A. and Craig S. Smith

2007 Ecosystem Controls and the Archaeofaunal Record: An Example from the Wyoming Basin, USA. *The Holocene* 17:1171-1183.

Cannon, Kenneth P.

1993 Paleoindian Use of Obsidian in the Greater Yellowstone Area: New Evidence of the Mobility of Early Yellowstone People. *Yellowstone Science* 1:6-9.

Cannon, Kenneth P. and Richard E. Hughes

1993 Obsidian Source Characterization of Paleoindian Projectile Points from Yellowstone National Park, Wyoming. *Current Research in the Pleistocene* 10:54-56.

Connolly, James and Mark Lake

2006 *Geographical Information Systems in Archaeology.* Cambridge University Press, Cambridge.

Davis, Leslie B.

1972 The Prehistoric Use of Obsidian in the Northwestern Plains. Unpublished Ph.D. Dissertation, Department of Archaeology, University of Calgary, Calgary, Alberta.

Davis, Leslie B., Stephen A. Aaberg, James G. Schmitt, Ann M. Johnson

1995 The Obsidian Cliff Plateau Prehistoric Lithic Source, Yellowstone National Park, Wyoming. Selections from the Division of Cultural Resources, Rocky Mountain Region. National Park Service 6, Denver, Colorado.

Eerkens, Jelmer W., Amy M. Spurling, Michelle A. Gras

2008 Measuring Prehistoric Mobility Strategies based on Obsidian Geochemical and Technological Signatures in the Owens Valley, California. *Journal of Archaeological Science* 35:668-680.

Frison, George C., Gary A. Wright, James B. Griffin, Adon A. Gordus

1968 Neutron Activation Analysis of Obsidian: An Example of its Relevance to Northwestern Plains Archaeology. *Plains Anthropologist* 13:209-217.

Glascock, Michael D.

2002 *Geochemical Evidence for Long-Distance Exchange.* Bergin and Garvey, Westport, Connecticut.

Griffin, James B., Adon A. Gordus, Gary A. Wright

1969 Identification of the Sources of Hopewellian Obsidian in the Middle West. *American Antiquity* 34:1-14.

Holmer, Richard N.

1997 Volcanic Glass Utilization in Eastern Idaho. *Tebiwa* 26:186-204.

Huebner, Thomas A.

2000 Green River Pebble Obsidian Distribution and Locations in the Green River Gravel Terraces, Southwestern Wyoming. Manuscript on file, Department of Geology and Geophysics, University of Wyoming, Laramie, Wyoming.

Hughes, Richard E.

1998 On Reliability, Validity, and Scale in Obsidian Sourcing Research. In *Unit Issues in Archaeology: Measuring Time, Space, and Material,* edited by A.F. Ramenofsky and A. Steffen, pp. 103-114. University of Utah Press, Salt Lake City.

Hughes, Richard E.

2006 *Geochemical Research Laboratory Letter Report 2006-87.* Geochemical Research Laboratory. Submitted to SWCA Environmental Consultants. Copies available from the Wyoming Cultural Records Office, Laramie.

Hughes, Richard E. and Fred W. Nelson, Jr.

1987 New Findings on Obsidian Source Utilization in Iowa. *Plains Anthropologist* 32:313-316.

Hughes, Richard E. and Robert L. Smith

1993 Archaeology, Geology, and Geochemistry in Obsidian Provenance Studies. In *Effects of Scale on Archaeological and Geoscientific Perspectives,* edited by J.K. Stein and A.R. Linse, pp. 79-91. Geological Society of America Special Paper 283, Boulder.

Iddings, Joseph P.

1888 Obsidian Cliff, Yellowstone National Park. *U.S. Geological Survey 7th Annual Report 1885-86* 3:249-295.

Jones, Kevin T. and David B. Madsen

1989 Calculating the Cost of Resource Transportation: A Great Basin Example. *Current Anthropology* 30:529-534.

Jones, George T., Charlotte Beck, Eric E. Jones, and Richard E. Hughes

2003 Lithic Source Use and Paleoarchaic Foraging Territories in the Great Basin. *American Antiquity* 68:5-38.

Kelly, Robert L.

2007 *The Foraging Spectrum: Diversity in Hunter-Gatherer Lifeways.* Eliot Werner Publications, Clinton Corners.

Kornfeld, Marcel, George C. Frison, and Mary Lou Larson

2010 *Prehistoric Hunter-Gatherers of the High Plains and Rockies: Third Edition.* Left Coast Press, Walnut Creek.

Kunselman, Raymond

1994 Prehistoric Obsidian Utilization in the Central Rocky Mountains: The Lookingbill Site 48FR308. *The Wyoming Archaeologist* 38:1-17.

Kunselman, Raymond and Wilfred M. Husted

1996 Prehistoric Obsidian Utilization in the Beartooth Mountains of Montana and Wyoming. *The Wyoming Archaeologist* 40:27-34.

Larson, Mary Lou

1997 Housepits and Mobile Hunter-Gatherers: A Consideration of the Wyoming Evidence. *Plains Anthropologist* 42:353-369.

Lee, Richard B.

1968 What Hunters Do for a Living or How to Make Out on Scarce Resources. In *Man the Hunter,* edited by R.B. Lee and I. Devore, pp. 30-48. Aldine Press, Chicago.

Lubinski, Patrick M.

2000 Of Bison and Lesser Mammals: Prehistoric Hunting Patterns in the Wyoming Basin. In *Intermountain Archaeology,* edited by D.B. Madsen and M.D. Metcalf, pp. 176-188. University of Utah Press, Salt Lake City.

Machovina, B.J.

1996 Modeling of Pedestrian Mobility Across a Natural Landscape Using Geographical Information System. Unpublished Master's Thesis, Geography Department, Ohio State University, Columbus.

Malde, Harold E.

1991 Quaternary Geology and Structural History of the Snake River Plain, Idaho and Oregon. In *Quaternary Nonglacial Geology: Conterminous U.S.,* edited by R.B. Morrison, pp. 251-281. The Geological Society of America, Boulder.

Mickelson, Andrew M.

2003 A GIS-Based Optimal Foraging Model of Human Walking and Load Transport. Manuscript of File, Department of Earth Sciences, University of Memphis, Memphis, Tennessee.

Miller, James C.

2010 Lithic Resources. In *Prehistoric Hunter-Gatherers of the High Plains and Rockies Third Edition,* edited by M. Kornfeld, G.C. Frison, and M.L. Larson, pp. 553-598. Left Coast Press, Walnut Creek.

Molyneaux, Brian L.

2002 Exploring the Landscapes of Long-Distance Exchange: Evidence from Obsidian Cliffs and Devils Tower, Wyoming. In *Geochemical Evidence for Long-Distance Exchange,* edited by M.D. Glascock, pp. 133-152. Bergin and Garvey, Westport, Connecticut.

Natural Resources Conservation Service

2011 USDA NRCS Geospatial Data Gateway. Electronic document, http://datagateway.nrcs.usda.gov/, accessed February 29, 2012.

Northwest Obsidian Research Studies Laboratory

2011 Obsidian Source Locations and Tools. Electronic document, http://www.obsidianlab.com/gis_sources.html#distance, accessed February 29, 2012.

Park, Robin J.

2010 A Culture of Convenience? Obsidian Source Selection in Yellowstone National Park. Unpublished Master's Thesis, Department of Archaeology and Anthropology, University of Saskatchewan, Saskatoon.

Pierce, Kenneth L., J.D. Obradovich, I. Friedman

1976 Obsidian Hydration Dating and Correlation of Bull Lake and Pinedale Glaciations Near West Yellowstone, Montana. *Geological Society of America Bulletin* 87:703-710.

Rappaport, Roy A.

1984 *Pigs for the Ancestors: Ritual in the Ecology of a New Guinea People.* Yale University Press, New Haven.

Reheis, Marith C., Robert C. Palmquist, Sherry S. Agard, Cheryl Jaworowski, Brainerd Mears, Jr., Richard F. Madole, Alan R. Nelson, Gerald D. Osborn

1991 Quaternary History of some Southern and Central Rocky Mountain Basins. In *Quaternary Nonglacial Geology: Conterminous U.S.,* edited by R.B. Morrison, pp. 407-440. The Geological Society of America, Boulder.

Roth, Barbara J.

2000 Obsidian Source Characterization and Hunter-gatherer Mobility: An Example from the Tucson Basin. *Journal of Archaeological Science* 27:305-314.

Scheiber, Laura L. and Judson Byrd Finley

2011 Obsidian Source Use in the Greater Yellowstone Area, Wyoming Basin, and Central Rocky Mountains. *American Antiquity* 76:372-394.

Shackley, M. Steven (editor)

1998 *Archaeological Obsidian Studies: Method and Theory*. Plenum Press, New York.

Shimkin, Demitri B.

1947 Wind River Shoshone Ethnogeography. *Anthropological Records of the University of California* 5:245-288. Berkeley, California.

Shimkin, Demitri B.

1986 Eastern Shoshone. In *The Handbook of North American Indians, Volume 11: Great Basin,* edited by W.L. D'Azevedo and W.C. Sturtevant, pp. 308-335. Smithsonian Institution, Washington.

Smith, Craig S.

1999 Obsidian Use in Wyoming and the Concept of Curation. *Plains Anthropologist* 44:271-291.

Smith, Craig S.

2003 Hunter-Gatherer Mobility, Storage, and Houses in a Marginal Environment: An Example from the mid-Holocene of Wyoming. *Journal of Anthropological Archaeology* 22:162-189.

Smith, Craig S.

2011 Persistent Land Use Patterns and the mid-Holocene Housepits of Wyoming. *Journal of Field Archaeology* 36:298-311.

Smith, Craig S. and Lance M. McNees

1999 Facilities and Hunter-Gatherer Long-Term Land Use Patterns: An Example from Southwest Wyoming. *American Antiquity* 64:117-136.

Smith, Eric Alden

1991 *Inujjuamiut Foraging Strategies: Evolutionary Ecology of an Arctic Hunting Economy.* Aldine de Gruyter, New York.

Stamm IV, Henry E.

1999 *People of the Wind River: The Eastern Shoshones 1825-1900.* University of Oklahoma Press, Norman.

Sunder, John E.

1959 *Bill Sublette, Mountain Man.* University of Oklahoma Press, Norman.

Taliaferro, Matthew S., Bernard A. Schriever, M. Steven Shackley

2010 Obsidian Procurement, Least Cost Path Analysis, and Social Interaction in the Mimbres area of Southwestern New Mexico. *Journal of Archaeological Science* 37:536-548.

Thelin, Gail P. and Richard J. Pike

1991 Landforms of the Conterminous United States- A Digital Shaded-Relief Portrayal. U.S. Geological Survey, Supplement to Map 1-2206.

Thompson, Kevin W., Jana V. Pastor, Steven D. Creasman

1997 Wyoming Basin-Yellowstone Plateau Interaction: A Study of Obsidian Artifacts from Southwest Wyoming. *Tebiwa* 26:241-254.

Wheatley, David and Mark Gillings

2002 *Spatial Technology and Archaeology: The Archaeological Applications of GIS*. Taylor & Francis, New York.

Wood, Brian M. and Zoë J. Wood

2006 Energetically Optimal Travel Across Terrain: Visualizations and a New Metric of Geographic Distance with Archaeological Applications. *Proceedings of the SPIE Electronic Imaging* 6060.

World Health Organization

1985 Energy and Protein Requirements. *Technical Reports Series 724.* World Health Organization, Geneva.

Wright, Gary A. and Henry J. Chaya

1985 Obsidian Source Analysis in Northwestern Wyoming: Problems and Prospects. *Plains Anthropologist* 30:237-242.

Wright, Gary A., Henry Chaya, James McDonald

1990 The Location of the Field Museum Yellowstone (F.M.Y., 90) Group Obsidian Source. *Plains Anthropologist* 35:71-74.

Zeanah, David W.

2000 Transport Costs, Central-Place Foraging, and Hunter-Gatherer Alpine Land-Use Strategies. In *Intermountain*, edited by D.B. Madsen and M.D. Metcalf, pp. 1-14. University of Utah Press, Salt Lake City.

Appendix A

Individual Artifact Data and Attributes

Coding Guide

Artifact Type

Projectile Point	PP
Flake	FL
Biface	BF
Unspecified Tool	TO
Core	CR
Unknown/Unspecified	UNK

Artifact Style

Stemmed Paleoindian	SPI	Northern Side Notch	NSN
Late Prehistoric Side Notch	LPS	Cottonwood Triangular	COT
Late Prehistoric Corner Notch	LPC	Avonlea	AVO
Elko Series	ELK	Pelican Lake	PLA
Tri-Notch	TRN	Besant	BES
Mckean Middle Archaic	MMA	Unknown/Unspecified	UNK
Desert Side Notch	DSN		

Age

Paleoindian	PI
Early Archaic	EA
Middle Archaic	MA
Late Archaic	LA
Unspecified Archaic	UA
Late Prehistoric	LP
Historic	HI
Unknown	UNK

Site	Source	Artifact Type	Artifact Style	Age	Reference
48SU4099	Malad	FL	UNK	UNK	Hughes 2002
48SU4118	Teton Pass	BF	UNK	UNK	Hughes 2002
48SU4157	Malad	FL	UNK	UNK	Hughes 2002
48SU4162	Teton Pass	FL	UNK	UNK	Hughes 2002
48SU4220	Crescent H	PP	LPC	LP	Hughes 2002
48SU4225	Teton Pass	BF	UNK	UNK	Hughes 2002
48SU4251	Bear Gulch	FL	UNK	UNK	Hughes 2002
48SU4254	Teton Pass	BF	UNK	UNK	Hughes 2002
48SU4284	Obsidian Cliff	FL	UNK	UNK	Hughes 2002
48SU4291	Teton Pass	FL	UNK	UNK	Hughes 2002
48SU4293	Malad	FL	UNK	UNK	Hughes 2002

48SU4293	Bear Gulch	FL	UNK	UNK	Hughes 2002
48SU4293	Bear Gulch	FL	UNK	UNK	Hughes 2002
48UT2365	Malad	FL	UNK	UNK	Hughes 2002
48UT2371	Phillips Pass	FL	UNK	UNK	Hughes 2002
48SW13805	Wild Horse Canyon	FL	UNK	UNK	Hughes 2002
48SW13803	Malad	FL	UNK	UNK	Hughes 2002
48SW13809	Malad	FL	UNK	UNK	Hughes 2002
48SW13935	Obsidian Cliff	FL	UNK	UNK	Hughes 2002
48SW13942	Malad	FL	UNK	UNK	Hughes 2002
48LN2025	Phillips Pass	UNK	UNK	UNK	Hughes 2003
48LN2025	Phillips Pass	UNK	UNK	UNK	Hughes 2003
48LN2025	Phillips Pass	UNK	UNK	UNK	Hughes 2003
48LN2255	Phillips Pass	UNK	UNK	UNK	Hughes 2003
48LN2255	Obsidian Cliff	UNK	UNK	UNK	Hughes 2003
48LN2255	Malad	UNK	UNK	UNK	Hughes 2003
48LN3826	Phillips Pass	FL	UNK	UNK	Hughes 2003
48LN3826	Phillips Pass	FL	UNK	UNK	Hughes 2003
48LN3879	Teton Pass	FL	UNK	UNK	Hughes 2003
48LN3879	Teton Pass	FL	UNK	UNK	Hughes 2003
48LN3881	Malad	FL	UNK	UNK	Hughes 2003
48LN3881	Malad	FL	UNK	UNK	Hughes 2003
48LN3883	Malad	PP	UNK	LP	Hughes 2003
48SU1303	Obsidian Cliff	FL	UNK	UNK	Hughes 2003
48SU1303	Teton Pass	FL	UNK	UNK	Hughes 2003
48SU1303	Teton Pass	FL	UNK	UNK	Hughes 2003
48SU1303	Teton Pass	FL	UNK	UNK	Hughes 2003
48SU3583	Teton Pass	FL	UNK	UNK	Hughes 2003
48SU3583	Teton Pass	FL	UNK	UNK	Hughes 2003
48SU3583	Teton Pass	FL	UNK	UNK	Hughes 2003
48SU3678	Malad	CR	UNK	UNK	Hughes 2003
48SU3875	Crescent H	FL	UNK	UNK	Hughes 2003
48SU3875	Malad	FL	UNK	UNK	Hughes 2003
48SU3875	Wild Horse Canyon	PP	UNK	UNK	Hughes 2003
48SU3875	Crescent H	PP	UNK	UNK	Hughes 2003
48SU3893	Crescent H	FL	UNK	UNK	Hughes 2003
48SU3900	Malad	BF	UNK	UNK	Hughes 2003
48SU3900	Malad	FL	UNK	UNK	Hughes 2003
48SU3900	Phillips Pass	FL	UNK	UNK	Hughes 2003
48SU3900	Phillips Pass	FL	UNK	UNK	Hughes 2003
48SU4460	Malad	UNK	UNK	UNK	Hughes 2003
48SU4460	Phillips Pass	UNK	UNK	UNK	Hughes 2003
48SU4460	Phillips Pass	UNK	UNK	UNK	Hughes 2003
48SU4465	Malad	UNK	UNK	UNK	Hughes 2003
48SU4473	Obsidian Cliff	PP	UNK	LA	Hughes 2003
48SU4494	Crescent H	PP	UNK	UNK	Hughes 2003
48SU4507	Teton Pass	UNK	UNK	UNK	Hughes 2003
48SU4507	Teton Pass	UNK	UNK	UNK	Hughes 2003

48SU4515	Obsidian Cliff	FL	UNK	UNK	Hughes 2003
48SU4541	Teton Pass	UNK	UNK	UNK	Hughes 2003
48SU4541	Teton Pass	UNK	UNK	UNK	Hughes 2003
48SU4541	Malad	UNK	UNK	UNK	Hughes 2003
48SU4541	Crescent H	UNK	UNK	UNK	Hughes 2003
48SU4541	Malad	UNK	UNK	UNK	Hughes 2003
48SU4541	Teton Pass	UNK	UNK	UNK	Hughes 2003
48SU4545	Bear Gulch	UNK	UNK	UNK	Hughes 2003
48SU4547	Gros Ventre Butte	UNK	UNK	UNK	Hughes 2003
48SU4547	Gros Ventre Butte	UNK	UNK	UNK	Hughes 2003
48SU4666	Teton Pass	UNK	UNK	UNK	Hughes 2003
48SU4668	Crescent H	UNK	UNK	UNK	Hughes 2003
48SU4668	Crescent H	UNK	UNK	UNK	Hughes 2003
48SW7580	Bear Gulch	FL	UNK	UNK	Hughes 2003
48SW13894	Malad	FL	UNK	UNK	Hughes 2003
48SW13894	Malad	FL	UNK	UNK	Hughes 2003
48LN754	Malad	FL	UNK	UNK	Hughes 2005
48LN755	Malad	UNK	UNK	UNK	Hughes 2005
48LN755	Phillips Pass	UNK	UNK	UNK	Hughes 2005
48LN1296	Phillips Pass	UNK	UNK	UNK	Hughes 2005
48LN1296	Phillips Pass	UNK	UNK	UNK	Hughes 2005
48LN1296	Phillips Pass	UNK	UNK	UNK	Hughes 2005
48LN1296	Phillips Pass	UNK	UNK	UNK	Hughes 2005
48LN1296	Phillips Pass	UNK	UNK	UNK	Hughes 2005
48LN1296	Crescent H	UNK	UNK	UNK	Hughes 2005
48LN1296	Malad	UNK	UNK	UNK	Hughes 2005
48LN2222	Crescent H	UNK	UNK	UNK	Hughes 2005
48LN2222	Malad	UNK	UNK	UNK	Hughes 2005
48LN2222	Phillips Pass	UNK	UNK	UNK	Hughes 2005
48LN2261	Gros Ventre Butt	BF	UNK	UNK	Hughes 2005
48LN2598	Phillips Pass	FL	UNK	UNK	Hughes 2005
48LN2614	Bear Gulch	BF	UNK	UNK	Hughes 2005
48LN3552	Phillips Pass	FL	UNK	UNK	Hughes 2005
48LN4036	Phillips Pass	FL	UNK	UNK	Hughes 2005
48LN4123	Malad	FL	UNK	UA	Hughes 2005
48LN4138	Teton Pass	PP	ELK	UA	Hughes 2005
48SU261	Teton Pass	UNK	UNK	UNK	Hughes 2005
48SU873	Malad	UNK	UNK	UNK	Hughes 2005
48SU873	Malad	UNK	UNK	UNK	Hughes 2005
48SU1106	Bear Gulch	UNK	UNK	UNK	Hughes 2005
48SU1106	Teton Pass	UNK	UNK	UNK	Hughes 2005
48SU1106	Teton Pass	UNK	UNK	UNK	Hughes 2005
48SU1303	Obsidian Cliff	UNK	UNK	UNK	Hughes 2005
48SU1303	Teton Pass	UNK	UNK	UNK	Hughes 2005
48SU1303	Teton Pass	UNK	UNK	UNK	Hughes 2005
48SU1303	Teton Pass	UNK	UNK	UNK	Hughes 2005
48SU1386	Malad	UNK	UNK	UNK	Hughes 2005

48SU1386	Malad	UNK	UNK	UNK	Hughes 2005
48SU1386	Malad	UNK	UNK	UNK	Hughes 2005
48SU1386	Malad	UNK	UNK	UNK	Hughes 2005
48SU1386	Bear Gulch	UNK	UNK	UNK	Hughes 2005
48SU1500	Malad	FL	UNK	UA	Hughes 2005
48SU2094	Phillips Pass	UNK	UNK	UNK	Hughes 2005
48SU3511	Malad	TO	UNK	UNK	Hughes 2005
48SU3678	Malad	CR	UNK	UNK	Hughes 2005
48SU3978	Phillips Pass	UNK	UNK	UNK	Hughes 2005
48SU3986	Bear Gulch	UNK	UNK	UNK	Hughes 2005
48SU4465	Malad	UNK	UNK	UNK	Hughes 2005
48SU4668	Crescent H	UNK	UNK	UNK	Hughes 2005
48SU4668	Crescent H	UNK	UNK	UNK	Hughes 2005
48SU4773	Teton Pass	BF	UNK	UNK	Hughes 2005
48SU4893	Phillips Pass	FL	UNK	UNK	Hughes 2005
48SU4894	Phillips Pass	FL	UNK	UNK	Hughes 2005
48SU5006	Obsidian Cliff	FL	UNK	UNK	Hughes 2005
48SU5068	Timber Butte	UNK	UNK	UNK	Hughes 2005
48SU5068	Bear Gulch	UNK	UNK	UNK	Hughes 2005
48SU5102	Malad	UNK	UNK	UNK	Hughes 2005
48SU5105	Obsidian Cliff	UNK	UNK	UNK	Hughes 2005
48SU5154	Malad	UNK	UNK	UNK	Hughes 2005
48SU5175	Malad	FL	UNK	UNK	Hughes 2005
48SU5189	Malad	FL	UNK	UNK	Hughes 2005
48SU5189	Bear Gulch	FL	UNK	UNK	Hughes 2005
48SU5190	Crescent H	FL	UNK	UNK	Hughes 2005
48SU5249	Crescent H	UNK	UNK	UNK	Hughes 2005
48SU5301	Teton Pass	UNK	UNK	UNK	Hughes 2005
48SU5301	Teton Pass	UNK	UNK	UNK	Hughes 2005
48SU5301	Bear Gulch	UNK	UNK	UNK	Hughes 2005
48SU5302	Huckleberry Ridge Tuff	FL	UNK	UNK	Hughes 2005
48SU5304	Malad	UNK	UNK	UNK	Hughes 2005
48SU5340	Bear Gulch	UNK	UNK	UNK	Hughes 2005
48SU5373	Malad	UNK	UNK	UNK	Hughes 2005
48SU5380	Phillips Pass	FL	UNK	UNK	Hughes 2005
48SU5384	Bear Gulch	PP	LPC	LP	Hughes 2005
48SU5384	Malad	PP	LPC	LP	Hughes 2005
48SW11504	Malad	FL	UNK	UNK	Hughes 2005
48SW14033	Phillips Pass	FL	UNK	UNK	Hughes 2005
48SW14888	Phillips Pass	UNK	UNK	UNK	Hughes 2005
48SW14888	Phillips Pass	UNK	UNK	UNK	Hughes 2005
48SW15220	Teton Pass	PP	LPC	LP	Hughes 2005
48SW15359	Phillips Pass	BF	UNK	UNK	Hughes 2005
48SW15650	Phillips Pass	FL	UNK	UNK	Hughes 2005
48LN4313	Crescent H	BF	UNK	UNK	Hughes 2007
48SU1301	Obsidian Cliff	UNK	UNK	UNK	Hughes 2007

48SU1301	Malad	UNK	UNK	UNK	Hughes 2007
48SU1562	Malad	FL	UNK	UNK	Hughes 2007
48SU2189	Phillips Pass	FL	UNK	UNK	Hughes 2007
48SU2191	Malad	BF	UNK	UNK	Hughes 2007
48SU2230	Phillips Pass	UNK	UNK	UNK	Hughes 2007
48SU2230	Malad	UNK	UNK	UNK	Hughes 2007
48SU2230	Brown's Bench, ID	UNK	UNK	UNK	Hughes 2007
48SU2230	Phillips Pass	UNK	UNK	UNK	Hughes 2007
48SU2230	Brown's Bench, ID	UNK	UNK	UNK	Hughes 2007
48SU2230	Phillips Pass	UNK	UNK	UNK	Hughes 2007
48SU2249	Teton Pass	UNK	UNK	UNK	Hughes 2007
48SU2249	Teton Pass	UNK	UNK	UNK	Hughes 2007
48SU2617	Teton Pass	UNK	UNK	UNK	Hughes 2007
48SU2617	Teton Pass	UNK	UNK	UNK	Hughes 2007
48SU2617	Teton Pass	UNK	UNK	UNK	Hughes 2007
48SU2617	Teton Pass	UNK	UNK	UNK	Hughes 2007
48SU2617	Teton Pass	UNK	UNK	UNK	Hughes 2007
48SU2617	Teton Pass	UNK	UNK	UNK	Hughes 2007
48SU2617	Teton Pass	UNK	UNK	UNK	Hughes 2007
48SU2617	Teton Pass	UNK	UNK	UNK	Hughes 2007
48SU2617	Teton Pass	UNK	UNK	UNK	Hughes 2007
48SU2618	Malad	PP	UNK	LA	Hughes 2007
48SU3417	Malad	UNK	UNK	UNK	Hughes 2007
48SU3522	Malad	UNK	UNK	UNK	Hughes 2007
48SU4398	Malad	BF	UNK	UNK	Hughes 2007
48SU5880	Malad	UNK	UNK	UNK	Hughes 2007
48SU5966	Obsidian Cliff	FL	UNK	UNK	Hughes 2007
48SU6009	Malad	UNK	UNK	UNK	Hughes 2007
48SU6009	Malad	UNK	UNK	UNK	Hughes 2007
48SU6030	Malad	BF	UNK	UNK	Hughes 2007
48SU6030	Malad	FL	UNK	UNK	Hughes 2007
48SU6031	Malad	FL	UNK	UNK	Hughes 2007
48SU6039	Malad	FL	UNK	UNK	Hughes 2007
48SU6045	Malad	FL	UNK	UNK	Hughes 2007
48SU6047	Teton Pass	UNK	UNK	UNK	Hughes 2007
48SU6232	Teton Pass	UNK	UNK	UNK	Hughes 2007
48SU6232	Crescent H	UNK	UNK	UNK	Hughes 2007
48SU6232	Crescent H	UNK	UNK	UNK	Hughes 2007
48SU6232	Teton Pass	UNK	UNK	UNK	Hughes 2007
48SU6246	Malad	UNK	UNK	UNK	Hughes 2007
48SU6247	Malad	UNK	UNK	UNK	Hughes 2007
48SU6254	Obsidian Cliff	PP	UNK	UNK	Hughes 2007
48SU6300	Obsidian Cliff	UNK	UNK	UNK	Hughes 2007
48SU6324	Phillips Pass	FL	UNK	UNK	Hughes 2007
48SU6324	Phillips Pass	FL	UNK	UNK	Hughes 2007
01-CAR-062-IF.1	Teton Pass	PP	TRN	LP	Hughes 2003
02-CAR-035-IF.2	Malad	PP	UNK	UNK	Hughes 2003

01-CAR-165-IF.5	Obsidian Cliff	PP	LPS	LP	Hughes 2005
03-CAR-014-IF.1	Teton Pass	FL	UNK	UNK	Hughes 2005
03-CAR-042-IF.1	Teton Pass	FL	UNK	UA	Hughes 2005
04-CAR-113-IF.1	Bear Gulch	BF	UNK	UNK	Hughes 2005
04-CAR-139-IF.1	Malad	PP	LPC	LP	Hughes 2005
04-CAR-193-IF.1	Teton Pass	PP	UNK	UNK	Hughes 2005
04-CAR-273-IF.2	Teton Pass	BF	UNK	UNK	Hughes 2005
05-CAR-394-IF.1	Malad	FL	UNK	UA	Hughes 2007
06-CAR-129-IR.3	Teton Pass	BF	UNK	UNK	Hughes 2007
06-CAR-131-IR.12	Malad	BF	UNK	UNK	Hughes 2007
06-CAR-164-IR.1	Crescent H	PP	LPS	LP	Hughes 2007
06-CAR-189-IR.6	Obsidian Cliff	PP	UNK	UNK	Hughes 2007
SU-28-109-35-IF.3	Malad	BF	UNK	UNK	Hughes 2002
48LN2097	Phillips Pass	FL	UNK	UNK	Hughes 2001
48LN2097	Phillips Pass	FL	UNK	UNK	Hughes 2001
48LN3552	Phillips Pass	FL	UNK	UNK	Hughes 2001
48SU1156	Malad	UNK	UNK	UNK	Hughes 2001
48SU2194	Teton Pass	FL	UNK	UNK	Hughes 2001
48SU2205	Malad	FL	UNK	UNK	Hughes 2001
48SU2205	Malad	FL	UNK	UNK	Hughes 2001
48SU2205	Malad	BF	UNK	UNK	Hughes 2001
48SU2205	Malad	TO	UNK	UNK	Hughes 2001
48SU2205	Bear Gulch	PP	UNK	UNK	Hughes 2001
48SU2205	Wild Horse Canyon	FL	UNK	UNK	Hughes 2001
48SU2273	Phillips Pass	FL	UNK	UNK	Hughes 2001
48SU2273	Malad	FL	UNK	UNK	Hughes 2001
48SU2324	Phillips Pass	FL	UNK	UNK	Hughes 2001
48SU2510	Malad	FL	UNK	UNK	Hughes 2001
48SU2527	Malad	PP	UNK	UNK	Hughes 2001
48SU2528	Malad	PP	UNK	UNK	Hughes 2001
48SU2615	Teton Pass	PP	MMA	MA	Hughes 2001
48SU3043	Teton Pass	PP	LPS	LP	Hughes 2001
48SU3044	Malad	PP	UNK	UNK	Hughes 2001
48SU3044	Malad	BF	UNK	UNK	Hughes 2001
48SU3044	Malad	FL	UNK	UNK	Hughes 2001
48SU3048	Teton Pass	BF	UNK	UNK	Hughes 2001
48SU3056	Malad	FL	UNK	UNK	Hughes 2001
48SU3056	Malad	FL	UNK	UNK	Hughes 2001
48SU3083	Teton Pass	BF	UNK	UNK	Hughes 2001
48SU3083	Teton Pass	PP	LPC	LP	Hughes 2001
48SU3083	Teton Pass	PP	LPC	LP	Hughes 2001
48SU3511	Malad	CR	UNK	UNK	Hughes 2001
48SU3526	Phillips Pass	BF	UNK	UNK	Hughes 2001
48SU3552	Malad	FL	UNK	UNK	Hughes 2001
48SU3552	Malad	FL	UNK	UNK	Hughes 2001

48SU3552	Malad	FL	UNK	UNK	Hughes 2001
48SU3552	Malad	FL	UNK	UNK	Hughes 2001
48SU3752	Malad	PP	ELK	MA	Hughes 2001
48SU3782	Malad	PP	UNK	UNK	Hughes 2001
48SU3869	Unknown	FL	UNK	UNK	Hughes 2001
48SU3869	Malad	FL	UNK	UNK	Hughes 2001
48SU3869	Malad	FL	UNK	UNK	Hughes 2001
48SU3870	Teton Pass	BF	UNK	UNK	Hughes 2001
48SU3871	Crescent H	BF	UNK	UNK	Hughes 2001
48SU3871	Teton Pass	FL	UNK	UNK	Hughes 2001
48SU3871	Malad	FL	UNK	UNK	Hughes 2001
48SU3872	Obsidian Cliff	FL	UNK	UNK	Hughes 2001
48SU3872	Malad	FL	UNK	UNK	Hughes 2001
48SU3875	Malad	FL	UNK	UNK	Hughes 2001
48SU3875	Wild Horse Canyon	PP	UNK	UNK	Hughes 2001
48SU3875	Crescent H	FL	UNK	UNK	Hughes 2001
48SU3878	Teton Pass	FL	UNK	UNK	Hughes 2001
48SU3879	Malad	FL	UNK	UNK	Hughes 2001
48SU3880	Wild Horse Canyon	FL	UNK	UNK	Hughes 2001
48SU3880	Wild Horse Canyon	FL	UNK	UNK	Hughes 2001
48SU3880	Wild Horse Canyon	TO	UNK	UNK	Hughes 2001
48SU3880	Malad	FL	UNK	UNK	Hughes 2001
48SU3881	Malad	PP	MMA	MA	Hughes 2001
48SU3882	Bear Gulch	TO	UNK	UNK	Hughes 2001
48SU3882	Teton Pass	FL	UNK	UNK	Hughes 2001
48SU3884	Packsaddle Creek	FL	UNK	UNK	Hughes 2001
48SU3884	Packsaddle Creek	FL	UNK	UNK	Hughes 2001
48SU3884	Malad	FL	UNK	UNK	Hughes 2001
48SU3884	Malad	FL	UNK	UNK	Hughes 2001
48SU3885	Malad	FL	UNK	UNK	Hughes 2001
48SU3885	Malad	FL	UNK	UNK	Hughes 2001
48SU687	Teton Pass	BF	UNK	UNK	Hughes 2001
48SW11504	Malad	FL	UNK	UNK	Hughes 2001
48SW7580	Bear Gulch	FL	UNK	UNK	Hughes 2001
48UT1	Malad	PP	UNK	UNK	Hughes 2001
01-CAR-001-IF.1	Brown's Bench, ID	PP	DSN	LP	Hughes 2001
48SU6653	Malad	FL	UNK	UNK	Hughes 2009
48SU6653	Malad	FL	UNK	UNK	Hughes 2009
48SU6655	Phillips Pass	BF	UNK	UNK	Hughes 2009
48SU6657	Phillips Pass	FL	UNK	UNK	Hughes 2009
48SU6657	Teton Pass	PP	UNK	UNK	Hughes 2009
48SU6677	Phillips Pass	FL	UNK	UNK	Hughes 2009
48SU6677	Phillips Pass	FL	UNK	UNK	Hughes 2009
48SU6677	Phillips Pass	FL	UNK	UNK	Hughes 2009
48LN338	Teton Pass	FL	UNK	UNK	Hughes 2008
48LN338	Crescent H	FL	UNK	UNK	Hughes 2008
48LN4161	Malad	PP	UNK	UNK	Hughes 2008

48LN4161	Malad	FL	UNK	UNK	Hughes 2008
48LN4161	Malad	FL	UNK	UNK	Hughes 2008
48LN4344	Teton Pass	FL	UNK	UNK	Hughes 2008
48LN4349	Phillips Pass	FL	UNK	UNK	Hughes 2008
48SU2617	Malad	UNK	UNK	UNK	Hughes 2008
48SU2617	Malad	UNK	UNK	UNK	Hughes 2008
48SU2617	Teton Pass	UNK	UNK	UNK	Hughes 2008
48SU3511	Malad	FL	UNK	UNK	Hughes 2008
58SU5415	Bear Gulch	UNK	UNK	UNK	Hughes 2008
48SU5643	Malad	PP	DSN	LP	Hughes 2008
48SU5643	Malad	PP	DSN	LP	Hughes 2008
48SU5643	Malad	FL	UNK	UNK	Hughes 2008
48SU5643	Malad	FL	UNK	UNK	Hughes 2008
48SU5643	Malad	FL	UNK	UNK	Hughes 2008
48SU5643	Malad	FL	UNK	UNK	Hughes 2008
48SU5643	Malad	FL	UNK	UNK	Hughes 2008
48SU5643	Malad	FL	UNK	UNK	Hughes 2008
48SU5644	Malad	FL	UNK	UNK	Hughes 2008
48SU5645	Malad	FL	UNK	UA	Hughes 2008
48SU6780	Teton Pass	PP	MMA	MA	Hughes 2010
48SU6782	Malad	FL	UNK	UNK	Hughes 2010
48SU6782	Malad	FL	UNK	UNK	Hughes 2010
48SU6782	Malad	FL	UNK	UNK	Hughes 2010
48LN4535	Phillips Pass	TO	UNK	UNK	Hughes 2010
08-CAR-298-IR.3	Bear Gulch	FL	UNK	UNK	Hughes 2010
08-CAR-023-IR.1	Malad	FL	UNK	UNK	Hughes 2009
08-CAR-089-IR.1	Teton Pass	FL	UNK	UNK	Hughes 2009
05-CAR-28-IR.4	Malad	FL	UNK	UNK	Hughes 2008
05-CAR-28-IR.18	Bear Gulch	FL	UNK	UNK	Hughes 2008
05-CAR-28-IR.7	Teton Pass	BF	UNK	UNK	Hughes 2008
05-CAR-62-IR.1	Teton Pass	FL	UNK	UNK	Hughes 2008
05-CAR-102-IF.1	Bear Gulch	PP	COT	LP	Hughes 2008
05-CAR-112-IR.1	Malad	FL	UNK	UNK	Hughes 2008
05-CAR-189-IR.1	Malad	PP	LPC	LP	Hughes 2008
05-CAR-190-IR.2	Teton Pass	PP	LPS	LP	Hughes 2008
05-CAR-221-IR.5	Malad	FL	UNK	UNK	Hughes 2008
07-CAR-58-IR.2	Teton Pass	BF	UNK	UNK	Hughes 2008
07-CAR-189-IR.1	Bear Gulch	PP	UNK	UNK	Hughes 2008
07-CAR-230-IR.1	Malad	PP	LPC	LP	Hughes 2008
07-CAR-230a-IR.1	Malad	PP	UNK	UA	Hughes 2008
48LN3519	Teton Pass	FL	UNK	UNK	Hughes 2006
48SW16561	Phillips Pass	FL	UNK	UNK	Hughes 2006
48SW061021	Malad	FL	UNK	UA	Hughes 2006
48SU4733	Malad	PP	AVO	LP	Hughes 2003b
48SU4742	Obsidian Cliff	FL	UNK	MA	Hughes 2003b
48SU4752	Crescent H	FL	UNK	LA	Hughes 2003b

48SU4752	Malad	FL	UNK	LA	Hughes 2003b
48SU4783	Phillips Pass	FL	UNK	UNK	Hughes 2003b
48SU4792	Malad	FL	UNK	UNK	Hughes 2003b
48SU4798	Malad	PP	LPS	LP	Hughes 2003b
48SU4822	Bear Gulch	PP	UNK	UNK	Hughes 2003b
48SU4833	Bear Gulch	BF	UNK	UNK	Hughes 2003b
48SU4839	Teton Pass	FL	UNK	UNK	Hughes 2003b
48SU4869	Bear Gulch	FL	UNK	UNK	Hughes 2003b
48SU4872	Teton Pass	FL	UNK	UNK	Hughes 2003b
48SU4872	Malad	FL	UNK	UNK	Hughes 2003b
48SU582	Teton Pass	PP	LPC	LP	Hughes 2003b
48SU4560	Bear Gulch	TO	UNK	UNK	Hughes 2003b
48SU4561	Malad	PP	TRN	LP	Hughes 2003b
48SU4561	Malad	PP	TRN	LP	Hughes 2003b
48SU4561	Malad	PP	TRN	LP	Hughes 2003b
48SU4561	Malad	PP	TRN	LP	Hughes 2003b
48SU4561	Malad	PP	UNK	LP	Hughes 2003b
48SU4563	Phillips Pass	PP	UNK	LA	Hughes 2003b
48SU4568	Packsaddle Creek	TO	UNK	UNK	Hughes 2003b
48SU4569	Malad	PP	UNK	UNK	Hughes 2003b
48SU4570	Phillips Pass	PP	LPS	LP	Hughes 2003b
48SU4575	Phillips Pass	FL	UNK	UNK	Hughes 2003b
48SU4576	Wild Horse Canyon	FL	UNK	UNK	Hughes 2003b
48SU4577	Phillips Pass	PP	LPC	LP	Hughes 2003b
48SU4577	Phillips Pass	FL	UNK	LP	Hughes 2003b
48SU4584	Bear Gulch	FL	UNK	UNK	Hughes 2003b
48SU4586	Teton Pass	TO	UNK	UNK	Hughes 2003b
48SU4587	Bear Gulch	PP	LPC	LP	Hughes 2003b
48SU4591	Bear Gulch	FL	UNK	UNK	Hughes 2003b
48SU4595	Malad	FL	UNK	LA	Hughes 2003b
48SU4596	Bear Gulch	BF	UNK	LP	Hughes 2003b
48SU4598	Bear Gulch	BF	UNK	UNK	Hughes 2003b
48SU4601	Phillips Pass	PP	LPC	LP	Hughes 2003b
48SU4604	Malad	PP	UNK	UNK	Hughes 2003b
48SU4611	Malad	FL	UNK	LP	Hughes 2003b
48SU4627	Malad	FL	UNK	LP	Hughes 2003b
48SU4649	Malad	PP	PLA	LA	Hughes 2003b
48SU4649	Packsaddle Creek	FL	UNK	LA	Hughes 2003b
48SW14365	Bear Gulch	FL	UNK	UNK	Hughes 2003b
48LN2439	Malad	PP	LPS	LP	Schoen 1993
48LN2439	Malad	PP	LPC	LP	Schoen 1993
48LN3142	Malad	PP	BES	LA	Schoen 1993
48SU1041	Malad	FL	UNK	LP	Schoen 1993
48SU1041	Brown's Bench, ID	PP	LPS	LP	Schoen 1993
48SU1041	Teton Pass	FL	UNK	LP	Schoen 1993
48SU1041	Teton Pass	PP	LPS	LP	Schoen 1993
48SU1041	Teton Pass	FL	UNK	LP	Schoen 1993

48SU1041	Malad	FL	UNK	LP	Schoen 1993
48SU1041	Unknown	FL	UNK	LP	Schoen 1993
48SU1041	Bear Gulch	FL	UNK	LP	Schoen 1993
48SU1041	Unknown	PP	LPS	LP	Schoen 1993
48SU1041	Malad	FL	UNK	LP	Schoen 1993
48SU1041	Unknown	FL	UNK	LP	Schoen 1993
48SU1041	Green River Pebble	FL	UNK	UNK	Schoen 1993
48SU1041	Unknown	FL	UNK	UNK	Schoen 1993
48SU1041	Teton Pass	PP	UNK	UNK	Schoen 1993
48SU1041	Green River Pebble	FL	UNK	UNK	Schoen 1993
48SU1041	Unknown	FL	UNK	UNK	Schoen 1993
48SU1041	Teton Pass	FL	UNK	UNK	Schoen 1993
48SU1041	Unknown	FL	UNK	UNK	Schoen 1993
48SU1042	Teton Pass	PP	NSN	EA	Schoen 1993
48SU1042	Teton Pass	PP	PLA	LA	Schoen 1993
48SU1042	Malad	PP	UNK	LP	Schoen 1993
48SU1790	Teton Pass	PP	UNK	UNK	Schoen 1993
48SU2085	Teton Pass	FL	UNK	UNK	Schoen 1993
48SU2085	Bear Gulch	FL	UNK	UNK	Schoen 1993
48SU2085	Teton Pass	FL	UNK	UNK	Schoen 1993
48SW8828	Teton Pass	PP	LPC	LP	Lee 2009
48SW15758	Malad	PP	DSN	LP	Lee 2009
48SW15758	Malad	PP	COT	LP	Lee 2009
48SW15758	Malad	PP	LPC	LP	Lee 2009
48SW15758	Malad	PP	LPC	LP	Lee 2009
48SW15758	Malad	FL	UNK	LP	Lee 2009
48LN2555	Malad	UNK	UNK	MA	Smith 1999
48LN2555	Malad	UNK	UNK	MA	Smith 1999
48LN2555	Malad	UNK	UNK	MA	Smith 1999
48LN2555	Malad	UNK	UNK	MA	Smith 1999
48LN2555	Malad	UNK	UNK	MA	Smith 1999
48LN2555	Malad	UNK	UNK	MA	Smith 1999
48LN2555	Malad	UNK	UNK	MA	Smith 1999
48LN2555	Malad	UNK	UNK	MA	Smith 1999
48LN2555	Malad	UNK	UNK	MA	Smith 1999
48LN2555	Malad	UNK	UNK	MA	Smith 1999
48LN2555	Malad	UNK	UNK	MA	Smith 1999
48LN2555	Malad	UNK	UNK	MA	Smith 1999
48LN2555	Malad	UNK	UNK	MA	Smith 1999
48LN2555	Malad	UNK	UNK	MA	Smith 1999
48LN2555	Malad	UNK	UNK	MA	Smith 1999
48LN2555	Malad	UNK	UNK	MA	Smith 1999
48LN2555	Malad	UNK	UNK	MA	Smith 1999
48LN2555	Malad	UNK	UNK	MA	Smith 1999
48LN2555	Malad	UNK	UNK	LA	Smith 1999
48LN2555	Malad	UNK	UNK	LA	Smith 1999
48LN2555	Malad	UNK	UNK	LA	Smith 1999

48LN2555	Malad	UNK	UNK	LA	Smith 1999
48LN2555	Malad	UNK	UNK	LA	Smith 1999
48LN2555	Malad	UNK	UNK	LA	Smith 1999
48LN2555	Malad	UNK	UNK	LA	Smith 1999
48LN2555	Malad	UNK	UNK	LA	Smith 1999
48LN2555	Malad	UNK	UNK	LA	Smith 1999
48LN2555	Malad	UNK	UNK	LA	Smith 1999
48LN2555	Malad	UNK	UNK	LA	Smith 1999
48LN2555	Malad	UNK	UNK	LA	Smith 1999
48LN2555	Malad	UNK	UNK	LA	Smith 1999
48LN2555	Malad	UNK	UNK	LA	Smith 1999
48LN2555	Malad	UNK	UNK	LA	Smith 1999
48LN2555	Malad	UNK	UNK	LA	Smith 1999
48LN2555	Malad	UNK	UNK	LA	Smith 1999
48LN2555	Malad	UNK	UNK	LA	Smith 1999
48LN2555	Malad	UNK	UNK	LA	Smith 1999
48LN2555	Malad	UNK	UNK	LP	Smith 1999
48LN2555	Malad	UNK	UNK	LP	Smith 1999
48LN2555	Malad	UNK	UNK	LP	Smith 1999
48LN2555	Malad	UNK	UNK	LP	Smith 1999
48LN2555	Malad	UNK	UNK	LP	Smith 1999
48LN2555	Malad	UNK	UNK	LP	Smith 1999
48LN2555	Malad	UNK	UNK	LP	Smith 1999
48LN2555	Malad	UNK	UNK	LP	Smith 1999
48LN2555	Malad	UNK	UNK	LP	Smith 1999
48LN2555	Malad	UNK	UNK	LP	Smith 1999
48LN3117	Bear Gulch	UNK	UNK	LA	Smith 1999
48LN3117	Bear Gulch	UNK	UNK	LA	Smith 1999
48LN3117	Bear Gulch	UNK	UNK	LA	Smith 1999
48LN3117	Bear Gulch	UNK	UNK	LA	Smith 1999
48LN3117	Bear Gulch	UNK	UNK	LA	Smith 1999
48LN3117	Bear Gulch	UNK	UNK	LA	Smith 1999
48LN3117	Bear Gulch	UNK	UNK	LA	Smith 1999
48LN3117	Bear Gulch	UNK	UNK	LA	Smith 1999
48LN3117	Bear Gulch	UNK	UNK	LA	Smith 1999
48LN3117	Bear Gulch	UNK	UNK	LA	Smith 1999
48LN3117	Bear Gulch	UNK	UNK	LA	Smith 1999
48LN3117	Bear Gulch	UNK	UNK	LA	Smith 1999
48LN3117	Bear Gulch	UNK	UNK	LP	Smith 1999
48LN3117	Bear Gulch	UNK	UNK	LP	Smith 1999
48LN3117	Bear Gulch	UNK	UNK	LP	Smith 1999
48LN3117	Bear Gulch	UNK	UNK	LP	Smith 1999
48LN3117	Bear Gulch	UNK	UNK	LP	Smith 1999
48LN3117	Bear Gulch	UNK	UNK	LP	Smith 1999
48LN3117	Bear Gulch	UNK	UNK	LP	Smith 1999
48LN3117	Bear Gulch	UNK	UNK	LP	Smith 1999
48LN3117	Bear Gulch	UNK	UNK	LP	Smith 1999

48LN3117	Bear Gulch	UNK	UNK	LP	Smith 1999
48LN3117	Bear Gulch	UNK	UNK	LP	Smith 1999
48LN3117	Bear Gulch	UNK	UNK	HI	Smith 1999
48LN3117	Bear Gulch	UNK	UNK	HI	Smith 1999
48LN3117	Bear Gulch	UNK	UNK	HI	Smith 1999
48LN3117	Bear Gulch	UNK	UNK	HI	Smith 1999
48LN3117	Bear Gulch	UNK	UNK	HI	Smith 1999
48LN3117	Bear Gulch	UNK	UNK	UNK	Smith 1999
48LN3117	Bear Gulch	UNK	UNK	UNK	Smith 1999
48LN3117	Bear Gulch	UNK	UNK	UNK	Smith 1999
48LN3117	Malad	UNK	UNK	LP	Smith 1999
48LN3117	Malad	UNK	UNK	LP	Smith 1999
48LN3117	Unknown	UNK	UNK	LA	Smith 1999
48LN3117	Unknown	UNK	UNK	LA	Smith 1999
48LN3117	Unknown	UNK	UNK	LA	Smith 1999
48LN3117	Unknown	UNK	UNK	LA	Smith 1999
48LN3117	Unknown	UNK	UNK	LA	Smith 1999
48LN3117	Unknown	UNK	UNK	LA	Smith 1999
48LN3117	Unknown	UNK	UNK	LA	Smith 1999
48LN3117	Unknown	UNK	UNK	LA	Smith 1999
48LN3117	Unknown	UNK	UNK	LP	Smith 1999
48LN3117	Unknown	UNK	UNK	LP	Smith 1999
48LN3117	Unknown	UNK	UNK	LP	Smith 1999
48LN3117	Unknown	UNK	UNK	LP	Smith 1999
48LN3117	Unknown	UNK	UNK	UNK	Smith 1999
48SU1006	Bear Gulch	PP	UNK	EA	Clayton and Kunselman 2002
48SU1006	Bear Gulch	PP	UNK	EA	Clayton and Kunselman 2002
48SU1006	Bear Gulch	PP	UNK	EA	Clayton and Kunselman 2002
48SU1006	Bear Gulch	PP	UNK	EA	Clayton and Kunselman 2002
48SU1006	Gros Ventre Butte	OT	UNK	EA	Clayton and Kunselman 2002
48SU1006	Gros Ventre Butte	FK	UNK	EA	Clayton and Kunselman 2002
48SU1006	Malad	PP	UNK	EA	Clayton and Kunselman 2002
48SU1006	Malad	PP	UNK	EA	Clayton and Kunselman 2002
48SU1006	Obsidian Cliff	PP	UNK	EA	Clayton and Kunselman 2002
48SU1006	Obsidian Cliff	FK	UNK	EA	Clayton and Kunselman 2002
48SU1006	Teton Pass 1	PP	UNK	EA	Clayton and Kunselman 2002
48SU1006	Teton Pass 1	PP	UNK	EA	Clayton and Kunselman 2002
48SU1006	Teton Pass 1	PP	UNK	EA	Clayton and Kunselman 2002
48SU1006	Teton Pass 1	PP	UNK	EA	Clayton and Kunselman 2002
48SU1006	Teton Pass 1	PP	UNK	EA	Clayton and Kunselman 2002
48SU1006	Teton Pass 1	PP	UNK	EA	Clayton and Kunselman 2002
48SU1006	Teton Pass 1	PP	UNK	EA	Clayton and Kunselman 2002
48SU1006	Teton Pass 1	PP	UNK	EA	Clayton and Kunselman 2002
48SU1006	Teton Pass 1	PP	UNK	EA	Clayton and Kunselman 2002
48SU1006	Teton Pass 1	PP	UNK	EA	Clayton and Kunselman 2002
48SU1006	Teton Pass 1	PP	UNK	EA	Clayton and Kunselman 2002
48SU1006	Teton Pass 1	PP	UNK	EA	Clayton and Kunselman 2002

48SU1006	Teton Pass 1	PP	UNK	EA	Clayton and Kunselman 2002
48SU1006	Teton Pass 1	PP	UNK	EA	Clayton and Kunselman 2002
48SU1006	Teton Pass 1	PP	UNK	EA	Clayton and Kunselman 2002
48SU1006	Teton Pass 1	PP	UNK	EA	Clayton and Kunselman 2002
48SU1006	Teton Pass 1	PP	UNK	EA	Clayton and Kunselman 2002
48SU1006	Teton Pass 1	PP	UNK	EA	Clayton and Kunselman 2002
48SU1006	Teton Pass 1	OT	UNK	EA	Clayton and Kunselman 2002
48SU1006	Teton Pass 1	OT	UNK	EA	Clayton and Kunselman 2002
48SU1006	Teton Pass 1	OT	UNK	EA	Clayton and Kunselman 2002
48SU1006	Teton Pass 1	OT	UNK	EA	Clayton and Kunselman 2002
48SU1006	Teton Pass 1	FK	UNK	EA	Clayton and Kunselman 2002
48SU1006	Teton Pass 1	FK	UNK	EA	Clayton and Kunselman 2002
48SU1006	Teton Pass 1	FK	UNK	EA	Clayton and Kunselman 2002
48SU1006	Teton Pass 2	PP	UNK	EA	Clayton and Kunselman 2002
48SU1006	Teton Pass 2	PP	UNK	EA	Clayton and Kunselman 2002
48SU1006	Teton Pass 2	PP	UNK	EA	Clayton and Kunselman 2002
48SU1006	Teton Pass 2	OT	UNK	EA	Clayton and Kunselman 2002
48SU1006	Teton Pass 2	FK	UNK	EA	Clayton and Kunselman 2002
48SU1006	Teton Pass 2	FK	UNK	EA	Clayton and Kunselman 2002
48SU1006	Teton Pass 2	FK	UNK	EA	Clayton and Kunselman 2002
48SU1006	Teton Pass 2	FK	UNK	EA	Clayton and Kunselman 2002
48SU1006	Teton Pass 2	FK	UNK	EA	Clayton and Kunselman 2002
48SU1006	Teton Pass 2	FK	UNK	EA	Clayton and Kunselman 2002
48SW211	Mineral Mountain	UNK	UNK	MA	Smith 1999
48SW211	Mineral Mountain	UNK	UNK	MA	Smith 1999
48SW211	Teton Pass 1	UNK	UNK	LP	Smith 1999
48SW211	Unknown	UNK	UNK	LA	Smith 1999
48SW212	Bear Gulch	UNK	UNK	MA	Smith 1999
48SW212	Bear Gulch	UNK	UNK	MA	Smith 1999
48SW212	Bear Gulch	UNK	UNK	MA	Smith 1999
48SW212	Bear Gulch	UNK	UNK	MA	Smith 1999
48SW212	Obsidian Cliff	UNK	UNK	MA	Smith 1999
48SW270	Malad	UNK	UNK	LP	Smith 1999
48SW304	Browns Bench	PP	TRN	HI	Weathermon 1996
48SW304	Malad	PP	TRN	HI	Weathermon 1996
48SW304	Malad	PP	TRN	HI	Weathermon 1996
48SW304	Malad	PP	TRN	HI	Weathermon 1996
48SW304	Malad	PP	TRN	HI	Weathermon 1996
48SW304	Malad	PP	TRN	HI	Weathermon 1996
48SW304	Malad	PP	TRN	HI	Weathermon 1996
48SW304	Malad	PP	TRN	HI	Weathermon 1996
48SW304	Malad	PP	TRN	HI	Weathermon 1996
48SW304	Malad	PP	TRN	HI	Weathermon 1996
48SW304	Malad	PP	TRN	HI	Weathermon 1996
48SW304	Malad	PP	TRN	HI	Weathermon 1996
48SW304	Malad	PP	TRN	HI	Weathermon 1996
48SW304	Malad	PP	TRN	HI	Weathermon 1996

48SW304	Malad	PP	TRN	HI	Weathermon 1996
48SW304	Malad	PP	TRN	HI	Weathermon 1996
48SW304	Malad	PP	TRN	HI	Weathermon 1996
48SW304	Malad	PP	TRN	HI	Weathermon 1996
48SW304	Malad	PP	TRN	HI	Weathermon 1996
48SW304	Malad	PP	TRN	HI	Weathermon 1996
48SW304	Malad	PP	TRN	HI	Weathermon 1996
48SW304	Malad	PP	TRN	HI	Weathermon 1996
48SW304	Malad	PP	TRN	HI	Weathermon 1996
48SW304	Malad	PP	TRN	HI	Weathermon 1996
48SW304	Malad	PP	TRN	HI	Weathermon 1996
48SW304	Malad	PP	TRN	HI	Weathermon 1996
48SW304	Malad	PP	TRN	HI	Weathermon 1996
48SW304	Malad	PP	TRN	HI	Weathermon 1996
48SW304	Malad	PP	TRN	HI	Weathermon 1996
48SW304	Malad	PP	TRN	HI	Weathermon 1996
48SW304	Malad	PP	TRN	HI	Weathermon 1996
48SW304	Malad	PP	TRN	HI	Weathermon 1996
48SW304	Malad	PP	TRN	HI	Weathermon 1996
48SW304	Malad	PP	TRN	HI	Weathermon 1996
48SW304	Malad	PP	TRN	HI	Weathermon 1996
48SW304	Malad	PP	TRN	HI	Weathermon 1996
48SW304	Malad	PP	TRN	HI	Weathermon 1996
48SW304	Malad	PP	TRN	HI	Weathermon 1996
48SW304	Malad	PP	TRN	HI	Weathermon 1996
48SW304	Malad	PP	TRN	HI	Weathermon 1996
48SW304	Malad	PP	TRN	HI	Weathermon 1996
48SW304	Malad	PP	TRN	HI	Weathermon 1996
48SW304	Malad	PP	TRN	HI	Weathermon 1996
48SW304	Malad	PP	TRN	HI	Weathermon 1996
48SW304	Malad	PP	TRN	HI	Weathermon 1996
48SW304	Malad	PP	TRN	HI	Weathermon 1996
48SW304	Malad	PP	TRN	HI	Weathermon 1996
48SW304	Malad	PP	TRN	HI	Weathermon 1996
48SW304	Malad	PP	TRN	HI	Weathermon 1996
48SW304	Malad	PP	TRN	HI	Weathermon 1996
48SW304	Malad	PP	TRN	HI	Weathermon 1996
48SW304	Malad	PP	TRN	HI	Weathermon 1996
48SW304	Teton Pass 1	PP	TRN	HI	Weathermon 1996
48SW304	Teton Pass 1	PP	TRN	HI	Weathermon 1996
48SW304	Teton Pass 1	PP	TRN	HI	Weathermon 1996
48SW304	Teton Pass 1	PP	TRN	HI	Weathermon 1996
48SW304	Teton Pass 1	PP	TRN	HI	Weathermon 1996
48SW304	Teton Pass 1	PP	TRN	HI	Weathermon 1996
48SW304	Teton Pass 1	PP	TRN	HI	Weathermon 1996
48SW304	Teton Pass 1	PP	TRN	HI	Weathermon 1996
48SW304	Teton Pass 2	PP	TRN	HI	Weathermon 1996

48SW6324	Bear Gulch	UNK	UNK	LP	Smith 1999
48SW6324	Green River Pebble	UNK	UNK	LA	Smith 1999
48SW6324	Green River Pebble	UNK	UNK	LP	Smith 1999
48SW6324	Teton Pass 1	UNK	UNK	LP	Smith 1999
48SW6324	Teton Pass 1	UNK	UNK	LP	Smith 1999
48SW6324	Teton Pass 1	UNK	UNK	LP	Smith 1999
48SW6324	Teton Pass 1	UNK	UNK	LP	Smith 1999
48SW6324	Teton Pass 1	UNK	UNK	LP	Smith 1999
48SW6324	Teton Pass 1	UNK	UNK	LP	Smith 1999
48SW6324	Teton Pass 1	UNK	UNK	LP	Smith 1999
48SW6324	Teton Pass 1	UNK	UNK	HI	Smith 1999
48SW6324	Teton Pass 1	UNK	UNK	HI	Smith 1999
48SW6324	Teton Pass 1	UNK	UNK	HI	Smith 1999
48SW6324	Teton Pass 1	UNK	UNK	HI	Smith 1999
48SW6324	Teton Pass 1	UNK	UNK	HI	Smith 1999
48SW6324	Unknown	UNK	UNK	LP	Smith 1999
48SW7991	Green River Pebble	UNK	UNK	LA	Smith 1999
48SW7991	Green River Pebble	UNK	UNK	LA	Smith 1999
48SW7991	Green River Pebble	UNK	UNK	LA	Smith 1999
48SW7991	Green River Pebble	UNK	UNK	LA	Smith 1999
48SW7991	Teton Pass 1	UNK	UNK	LA	Smith 1999
48SW7991	Teton Pass 1	UNK	UNK	LA	Smith 1999
48SW998	Malad	UNK	UNK	LP	Smith 1999
48SW998	Malad	UNK	UNK	LP	Smith 1999
48SW998	Malad	UNK	UNK	LP	Smith 1999
48SU5875	Obsidian Cliff	BF	UNK	UNK	Hughes 2008
48SU5875	Malad	BF	UNK	UNK	Hughes 2008
48SU5877	Phillips Pass	FL	UNK	UA	Hughes 2008
48SU5879	Malad	PP	ELK	LA	Hughes 2008
48SU5981	Malad	PP	UNK	LA	Hughes 2008
48SU6057	Malad	UNK	UNK	UNK	Hughes 2008
48SU6066	Phillips Pass	FL	UNK	UNK	Hughes 2008
48SU6087	Obsidian Cliff	UNK	UNK	UNK	Hughes 2008
48SU6114	Obsidian Cliff	UNK	UNK	UNK	Hughes 2008
48SU6117	Bear Gulch	UNK	UNK	UNK	Hughes 2008
48SU6130	Crescent H	UNK	UNK	UNK	Hughes 2008
48SU6224	Teton Pass	PP	UNK	MA	Hughes 2008
48SU6226	Malad	PP	UNK	LA	Hughes 2008
48SU6251	Teton Pass	UNK	UNK	UNK	Hughes 2008
48SU6281	Crescent H	FL	UNK	UNK	Hughes 2008
48SU6308	Phillips Pass	PP	LPC	LP	Hughes 2008
48SU6317	Teton Pass	UNK	UNK	UNK	Hughes 2008
48SU6319	Malad	PP	UNK	LP	Hughes 2008
48SU6326	Malad	UNK	UNK	UNK	Hughes 2008
48SU6354	Malad	FL	UNK	UNK	Hughes 2008
48SU6381	Malad	FL	UNK	UNK	Hughes 2008
48SU6381	Malad	FL	UNK	UNK	Hughes 2008

48SU6391	Teton Pass	FL	UNK	UNK	Hughes 2008
48SU6445	Malad	UNK	UNK	UNK	Hughes 2008
48SU6561	Malad	FL	UNK	UNK	Hughes 2008
48SU6596	Malad	UNK	UNK	UNK	Hughes 2008
48SU6599	Phillips Pass	UNK	UNK	UNK	Hughes 2008
48SW14289	Malad	FL	UNK	UNK	Hughes 2008
48SW15925	Teton Pass	FL	UNK	UNK	Hughes 2008
48SW16319	Malad	FL	UNK	UNK	Hughes 2008
48SW16822	Malad	UNK	UNK	UNK	Hughes 2008
48SU1686	Phillips Pass	UNK	UNK	UNK	Hughes 2010
48SU1691	Phillips Pass	UNK	UNK	UNK	Hughes 2010
48SU1701	Phillips Pass	UNK	UNK	UNK	Hughes 2010
48SU4000	Teton Pass	UNK	UNK	UNK	Hughes 2010
48SU6540	Crescent H	UNK	UNK	UNK	Hughes 2010
48SU6747	Crescent H	UNK	UNK	UNK	Hughes 2010
48SU6800	Malad	UNK	UNK	UNK	Hughes 2010
48SU6948	Phillips Pass	UNK	UNK	UNK	Hughes 2010
48SU6948	Phillips Pass	UNK	UNK	UNK	Hughes 2010
48SU6948	Phillips Pass	UNK	UNK	UNK	Hughes 2010
48SU6948	Phillips Pass	UNK	UNK	UNK	Hughes 2010
48SU6948	Phillips Pass	UNK	UNK	UNK	Hughes 2010
48SU6948	Phillips Pass	UNK	UNK	UNK	Hughes 2010
48SU6948	Phillips Pass	UNK	UNK	UNK	Hughes 2010
48SU1524	Phillips Pass	UNK	UNK	UNK	Hughes 2010
48SU1524	Malad	UNK	UNK	UNK	Hughes 2010
48SU1525	Phillips Pass	UNK	UNK	UNK	Hughes 2010
48SU1525	Phillips Pass	UNK	UNK	UNK	Hughes 2010
48SU1527	Phillips Pass	UNK	UNK	UNK	Hughes 2010
48SU1527	Phillips Pass	UNK	UNK	UNK	Hughes 2010
48SU1527	Phillips Pass	UNK	UNK	UNK	Hughes 2010
48SU1527	Phillips Pass	UNK	UNK	UNK	Hughes 2010
48SU1527	Phillips Pass	UNK	UNK	UNK	Hughes 2010
48SU1527	Phillips Pass	UNK	UNK	UNK	Hughes 2010
48SU1527	Phillips Pass	UNK	UNK	UNK	Hughes 2010
48SU1527	Phillips Pass	UNK	UNK	UNK	Hughes 2010
48SU1527	Phillips Pass	UNK	UNK	UNK	Hughes 2010
48SU1527	Phillips Pass	UNK	UNK	UNK	Hughes 2010
48SU1527	Phillips Pass	UNK	UNK	UNK	Hughes 2010
48SU1661	Phillips Pass	UNK	UNK	UNK	Hughes 2010
48SU6957	Crescent H	UNK	UNK	UNK	Hughes 2010
48SU6958	Phillips Pass	UNK	UNK	UNK	Hughes 2010
48SU6958	Phillips Pass	UNK	UNK	UNK	Hughes 2010
48SU6679	Phillips Pass	UNK	UNK	UNK	Hughes 2009
48SU6726	Malad	UNK	UNK	UNK	Hughes 2009
48SU6726	Malad	UNK	UNK	UNK	Hughes 2009
48SU6726	Malad	UNK	UNK	UNK	Hughes 2009
48SU6726	Malad	UNK	UNK	UNK	Hughes 2009

48SU6726	Malad	UNK	UNK	UNK	Hughes 2009
48LN2245	Phillips Pass	UNK	UNK	UNK	Hughes 2010
48LN2245	Phillips Pass	UNK	UNK	UNK	Hughes 2010
48SU2184	Malad	UNK	UNK	UNK	Hughes 2010
48SU2233	Phillips Pass	UNK	UNK	UNK	Hughes 2010
48SU2235	Phillips Pass	UNK	UNK	UNK	Hughes 2010
48SU2239	Phillips Pass	UNK	UNK	UNK	Hughes 2010
48SU3455	Teton Pass	UNK	UNK	UNK	Hughes 2010
48SU3799	Teton Pass	UNK	UNK	UNK	Hughes 2010
48SU3948	Malad	UNK	UNK	UNK	Hughes 2010
48SU5415	Bear Gulch	UNK	UNK	UNK	Hughes 2010
48SU5652	Malad	UNK	UNK	UNK	Hughes 2010
48SU4938	Obsidian Cliff	UNK	UNK	UNK	Hughes 2010
48SU3975	Crescent H	UNK	UNK	UNK	Hughes 2010
48SU3975	Teton Pass	UNK	UNK	UNK	Hughes 2010
48SU3975	Teton Pass	UNK	UNK	UNK	Hughes 2010
48SU3975	Crescent H	UNK	UNK	UNK	Hughes 2010
48SU5656	Teton Pass	FK	UNK	UNK	Hughes 2010
48SU5672	Malad	PP	SPI	PI	Hughes 2010
48SU5692	Crescent H	BF	UNK	UNK	Hughes 2010
48SU5670	Malad	PP	LPS	LP	Hughes 2010
48SU5695	Malad	FK	UNK	UNK	Hughes 2010
48SU5696	Bear Gulch	FK	UNK	UNK	Hughes 2010
48SU5696	Bear Gulch	FK	UNK	UNK	Hughes 2010
48SU5707	Obsidian Cliff	UNK	UNK	UNK	Hughes 2010
48SU5722	Malad	UNK	UNK	UNK	Hughes 2010
48SU5723	Malad	UNK	UNK	UNK	Hughes 2010
48SU5723	Crescent H	UNK	UNK	UNK	Hughes 2010
48SU5775	Bear Gulch	UNK	UNK	UNK	Hughes 2010
48SU5783	Malad	UNK	UNK	UNK	Hughes 2010
48SU5783	Malad	UNK	UNK	UNK	Hughes 2010
48SU5783	Malad	UNK	UNK	UNK	Hughes 2010
48SU5804	Teton Pass	FK	UNK	UNK	Hughes 2010
48SU5866	Teton Pass	FK	UNK	UNK	Hughes 2010
48SU5869	Malad	PP	LPC	LP	Hughes 2008
48SU4320	Malad	UNK	UNK	UNK	Hughes 2001
48SU4460	Malad	UNK	UNK	UNK	Hughes 2003
48SU4460	Phillips Pass	UNK	UNK	UNK	Hughes 2003
48SU4460	Phillips Pass	UNK	UNK	UNK	Hughes 2003
	Teton Pass 1	UNK	UNK	LP	Thompson et al. 1997
	Engineer's Quarry	UNK	UNK	LP	Thompson et al. 1997
	Engineer's Quarry	UNK	UNK	LP	Thompson et al. 1997
	Bear Gulch	UNK	UNK	LP	Thompson et al. 1997
	Bear Gulch	UNK	UNK	HI	Thompson et al. 1997
	Bear Gulch	UNK	UNK	HI	Thompson et al. 1997
	Malad	UNK	UNK	PI	Thompson et al. 1997
	Malad	UNK	UNK	LP	Thompson et al. 1997

	Malad	UNK	UNK	LP	Thompson et al. 1997
	Malad	UNK	UNK	LP	Thompson et al. 1997
	Malad	UNK	UNK	LP	Thompson et al. 1997
	Malad	UNK	UNK	LP	Thompson et al. 1997
	Malad	UNK	UNK	LP	Thompson et al. 1997
	Malad	UNK	UNK	LP	Thompson et al. 1997
	Malad	UNK	UNK	LP	Thompson et al. 1997
	Malad	UNK	UNK	LP	Thompson et al. 1997
	Malad	UNK	UNK	LP	Thompson et al. 1997
	Malad	UNK	UNK	LP	Thompson et al. 1997
	Malad	UNK	UNK	LP	Thompson et al. 1997
	Wild Horse Canyon	UNK	UNK	LP	Thompson et al. 1997
	Wild Horse Canyon	UNK	UNK	LP	Thompson et al. 1997
	Green River Pebble	UNK	UNK	LA	Thompson et al. 1997
	Green River Pebble	UNK	UNK	LP	Thompson et al. 1997
	Green River Pebble	UNK	UNK	LP	Thompson et al. 1997
	Green River Pebble	UNK	UNK	LP	Thompson et al. 1997
	Green River Pebble	UNK	UNK	LP	Thompson et al. 1997
	Green River Pebble	UNK	UNK	LP	Thompson et al. 1997
	Green River Pebble	UNK	UNK	LP	Thompson et al. 1997
	Green River Pebble	UNK	UNK	LP	Thompson et al. 1997
	Green River Pebble	UNK	UNK	LP	Thompson et al. 1997
	Green River Pebble	UNK	UNK	LP	Thompson et al. 1997
	Green River Pebble	UNK	UNK	LP	Thompson et al. 1997
	Green River Pebble	UNK	UNK	LP	Thompson et al. 1997
	Unknown	UNK	UNK	LP	Thompson et al. 1997
	Unknown	UNK	UNK	HI	Thompson et al. 1997
	Obsidian Cliff	PP	UNK	PI	Thompson et al. 1997
	Obsidian Cliff	PP	UNK	UA	Thompson et al. 1997
	Obsidian Cliff	PP	UNK	LP	Thompson et al. 1997
	Obsidian Cliff	PP	UNK	LP	Thompson et al. 1997
	Obsidian Cliff	PP	UNK	LP	Thompson et al. 1997
	Teton Pass 1	PP	UNK	UA	Thompson et al. 1997
	Teton Pass 1	PP	UNK	UA	Thompson et al. 1997
	Teton Pass 2	PP	UNK	UA	Thompson et al. 1997
	Teton Pass 2	PP	UNK	UA	Thompson et al. 1997
	Teton Pass 2	PP	UNK	UA	Thompson et al. 1997
	Teton Pass 2	PP	UNK	UA	Thompson et al. 1997
	Teton Pass 2	PP	UNK	LP	Thompson et al. 1997
	Teton Pass 1	PP	UNK	UA	Thompson et al. 1997
	Teton Pass 1	PP	UNK	UA	Thompson et al. 1997
	Teton Pass 1	PP	UNK	LP	Thompson et al. 1997
	Teton Pass 1	PP	UNK	LP	Thompson et al. 1997
	Teton Pass 1	PP	UNK	PI	Thompson et al. 1997
	Teton Pass 1	PP	UNK	UA	Thompson et al. 1997
	Teton Pass 1	PP	UNK	UA	Thompson et al. 1997
	Teton Pass 1	PP	UNK	UA	Thompson et al. 1997

	Teton Pass 1	PP	UNK	UA	Thompson et al. 1997
	Teton Pass 1	PP	UNK	UA	Thompson et al. 1997
	Teton Pass 1	PP	UNK	LP	Thompson et al. 1997
	Teton Pass 1	PP	UNK	LP	Thompson et al. 1997
	Teton Pass 1	PP	UNK	LP	Thompson et al. 1997
	Teton Pass 1	PP	UNK	LP	Thompson et al. 1997
	Gros Ventre Butte	PP	UNK	UA	Thompson et al. 1997
	Bear Gulch	PP	UNK	UA	Thompson et al. 1997
	Bear Gulch	PP	UNK	UA	Thompson et al. 1997
	Bear Gulch	PP	UNK	UA	Thompson et al. 1997
	Bear Gulch	PP	UNK	UA	Thompson et al. 1997
	Bear Gulch	PP	UNK	LP	Thompson et al. 1997
	Bear Gulch	PP	UNK	LP	Thompson et al. 1997
	Bear Gulch	PP	UNK	LP	Thompson et al. 1997
	Bear Gulch	PP	UNK	LP	Thompson et al. 1997
	Malad	PP	UNK	UA	Thompson et al. 1997
	Malad	PP	UNK	UA	Thompson et al. 1997
	Malad	PP	UNK	UA	Thompson et al. 1997
	Malad	PP	UNK	UA	Thompson et al. 1997
	Malad	PP	UNK	UA	Thompson et al. 1997
	Malad	PP	UNK	UA	Thompson et al. 1997
	Malad	PP	UNK	LP	Thompson et al. 1997
	Malad	PP	UNK	LP	Thompson et al. 1997
	Malad	PP	UNK	LP	Thompson et al. 1997
	Malad	PP	UNK	LP	Thompson et al. 1997
	Malad	PP	UNK	LP	Thompson et al. 1997
	Malad	PP	UNK	LP	Thompson et al. 1997
	Malad	PP	UNK	LP	Thompson et al. 1997
	Malad	PP	UNK	LP	Thompson et al. 1997
	Malad	PP	UNK	LP	Thompson et al. 1997
	Malad	PP	UNK	LP	Thompson et al. 1997
	Malad	PP	UNK	LP	Thompson et al. 1997
	Malad	PP	UNK	LP	Thompson et al. 1997
	Malad	PP	UNK	LP	Thompson et al. 1997
	Malad	PP	UNK	LP	Thompson et al. 1997
	Malad	PP	UNK	LP	Thompson et al. 1997
	Malad	PP	UNK	LP	Thompson et al. 1997
	Malad	PP	UNK	LP	Thompson et al. 1997
	Malad	PP	UNK	LP	Thompson et al. 1997
	Wild Horse Canyon	PP	UNK	UA	Thompson et al. 1997
	Green River Pebble	PP	UNK	UA	Thompson et al. 1997
	Green River Pebble	PP	UNK	UA	Thompson et al. 1997
	Green River Pebble	PP	UNK	UA	Thompson et al. 1997
	Unknown	PP	UNK	UA	Thompson et al. 1997
	Unknown	PP	UNK	UA	Thompson et al. 1997
	Unknown	PP	UNK	UA	Thompson et al. 1997
	Unknown	PP	UNK	UA	Thompson et al. 1997

	Unknown	PP	UNK	UA	Thompson et al. 1997
	Unknown	PP	UNK	LP	Thompson et al. 1997
	Unknown	PP	UNK	LP	Thompson et al. 1997
	Unknown	PP	UNK	LP	Thompson et al. 1997
	Unknown	PP	UNK	LP	Thompson et al. 1997
	Unknown	PP	UNK	LP	Thompson et al. 1997
	Unknown	PP	UNK	LP	Thompson et al. 1997
	Unknown	PP	UNK	LP	Thompson et al. 1997
	Malad	UNK	UNK	HI	Thompson et al. 1997
	Malad	UNK	UNK	HI	Thompson et al. 1997
	Malad	UNK	UNK	HI	Thompson et al. 1997

REFERENCES CITED

Clayton, Carmen, and Raymond Kunselman

2002 Obsidian Source Utilization at the Trappers Point Antelope Kill Site 48SU1006. *Wyoming Archaeologist* 46:83-91.

Moore, Summer and Craig Lee

2009 Aboriginal Trade. In *Synthesis of Archaeological Data Compiled for the Piceance Basin Expansion, Rockies Express Pipeline, and Uinta Basin Lateral Projects Moffat and Rio Blanco Counties Colorado, and Sweetwater County, Wyoming,* edited by A.D. Reed and M.D. Metcalf, pp. 329-413. Copies available from Alpine Archaeological Consultants, Inc., Montrose, CO.

Hughes, Richard E.

2001 *Geochemical Research Laboratory Letter Report.* Geochemical Research Laboratory. Submitted to Current Archaeological Research. Copies Available from the Wyoming Cultural Records Office, Laramie.

Hughes, Richard E.

2002 *Geochemical Research Laboratory Letter Report.* Geochemical Research Laboratory. Submitted to Current Archaeological Research. Copies available from the Wyoming Cultural Records Office, Laramie.

Hughes, Richard E.

2003 *Geochemical Research Laboratory Letter Report 2002-115.* Geochemical Research Laboratory. Submitted to Current Archaeological Research. Copies available from the Wyoming Cultural Records Office, Laramie.

Hughes, Richard E.

2003b *X-ray Fluorescence Analysis of 44 Artifacts from Three Projects in Wyoming.* Geochemical Research Laboratory. Submitted to Kail Consulting, Ltd. Copies available from the Wyoming Cultural Records Office, Laramie.

Hughes, Richard E.

2005 *Geochemical Research Laboratory Letter Report 2005-32.* Geochemical Research Laboratory. Submitted to Current Archaeological Research. Copies available from the Wyoming Cultural Records Office, Laramie.

Hughes, Richard E.

2006 *Geochemical Research Laboratory Letter Report 2006-87.* Geochemical Research Laboratory. Submitted to SWCA Environmental Consultants. Copies available from SWCA Environmental Consultants, Broomfield, CO.

Hughes, Richard E.

2007 *Geochemical Research Laboratory Letter Report 2007-30.* Geochemical Research Laboratory. Submitted to Current Archaeological Research. Copies available from the Wyoming Cultural Records Office, Laramie.

Hughes, Richard E.

2008 *Geochemical Research Laboratory Letter Report 2008-79.* Geochemical Research Laboratory. Submitted to Current Archaeological Research. Copies available from the Wyoming Cultural Records Office, Laramie.

Hughes, Richard E.

2009 *Geochemical Research Laboratory Letter Report 2009-85*. Geochemical Research Laboratory. Submitted to Current Archaeological Research. Copies available from the Wyoming Cultural Records Office.

Hughes, Richard E.

2010 *Geochemical Research Laboratory Letter Report 2010-45*. Geochemical Research Laboratory. Submitted to Current Archaeological Research. Copies available from the Wyoming Cultural Records Office, Laramie.

Schoen, Jamie

1993 A Report on Obsidian X-Ray Florescence, and Sourced Obsidian Artifacts from Western Wyoming. Manuscript on file, Bridger-Teton National Forest, Jackson Hole, WY.

Smith, Craig S.

1999 Obsidian Use in Wyoming and the Concept of Curation. *Plains Anthropologist* 44:271-291.

Thompson, Kevin W., Jana V. Pastor, Steven D. Creasman

1997 Wyoming Basin-Yellowstone Plateau Interaction: A Study of Obsidian Artifacts from Southwest Wyoming. *Tebiwa* 26:241-254.

Weathermon, Rick L.

1996 Projectile Point Analysis of the Eden-Farson Site Assemblage: Aspects of Social Structure Among a Late Prehistoric Numic Group. Unpublished M.A. Thesis, Department of Anthropology, University of Wyoming, Laramie.

Appendix B

Minimum Round Trip Caloric Costs (kCal) to all Sites in Study Area Extracted from SCM Analysis

SITE	Bear Gulch	Malad	Obsidian Cliff	Teton Pass
48SW15758	65087.2	56916.3	64511.1	48612.8
48SW998	58242.7	56073.5	54019.1	42392.2
48SU4099	37069.9	34500.3	36896.7	20591.9
48SU4118	36925.1	34100.9	36767.4	20447.5
48SU4157	35624.6	33927.3	35451.5	19146.9
48SU4162	34260.5	33094.3	34094.4	17782.0
48SU4220	33143.9	32585.9	33145.4	16665.2
48SU4225	33049.4	32574.3	33183.1	16570.8
48SU4251	32557.6	32616.6	32833.9	16078.9
48SU4254	32575.8	33194.5	32106.3	16097.2
48SU4284	35081.6	32069.4	36188.5	19201.5
48SU4291	33257.2	31357.6	34110.6	16778.6
48SU4293	32292.7	30697.5	33146.2	15814.2
48UT2365	46128.3	30452.1	51580.0	34270.6
48UT2371	47505.5	31043.3	54317.3	36558.1
48SW13805	59076.7	51976.2	58494.3	42601.9
48SW13803	59263.9	52598.2	58681.5	42789.1
48SW13809	58850.9	52051.8	58268.4	42376.1
48SW13935	58675.9	50875.5	58093.5	42201.1
48SW13942	58959.1	51101.6	58383.0	42484.7
48LN2025	42670.4	30730.9	44414.4	27341.0
48LN2255	42661.0	30819.1	44405.0	27331.8
48LN3826	38535.4	30860.6	40420.1	23329.0
48LN3879	42714.1	30765.2	44458.2	27384.7
48LN3881	42749.3	30755.3	44493.3	27419.9
48LN3883	38620.2	30631.9	40648.8	23557.7
48SU1303	38183.8	36298.7	37689.8	21706.3
48SU3583	38682.5	35824.0	38509.3	22205.2
48SU3678	36180.9	31099.3	38566.2	21233.5
48SU3875	38488.5	36589.5	37945.3	22011.1
48SU3893	38758.9	36538.7	38373.9	22281.9
48SU3900	38755.8	36500.4	38374.3	22278.7
48SU4460	37361.4	36107.1	36791.0	20883.9
48SU4465	36931.1	35692.1	36391.8	20453.6
48SU4473	35901.2	35019.2	35576.0	19423.3
48SU4494	35843.4	35012.0	35506.3	19365.6
48SU4507	38714.6	37237.9	38136.1	22236.8
48SU4515	34091.2	32152.0	34640.4	17612.5
48SU4541	32696.4	31862.3	33235.4	16217.8
48SU4545	32833.3	31742.9	33378.8	16354.6
48SU4547	32730.0	31816.5	33275.5	16251.4
48SU4666	38203.5	36276.7	37739.0	21726.6
48SU4668	38178.9	36306.5	37684.8	21701.4
48SW7580	41913.7	30042.3	43550.1	26768.8
48SW13894	63550.3	54192.3	62974.3	47076.0
48LN754	43288.3	31075.5	44986.6	27959.1
48LN755	43276.3	31078.5	44970.9	27947.1
48LN1296	43559.9	30407.8	45405.2	28331.9
48LN2222	43236.1	31053.9	44927.8	27906.9

48LN2261	43270.1	31079.3	44954.2	27940.9
48LN2598	42804.1	30511.3	44558.2	27484.9
48LN2614	43694.1	30433.2	45533.6	28460.3
48LN3552	43691.3	31264.2	45273.3	28362.3
48LN4036	45029.3	30919.8	46821.5	29748.1
48LN4123	43729.4	29644.0	46083.0	29009.9
48LN4138	43690.0	30076.8	45764.3	28691.3
48SU261	36815.9	35644.1	36272.6	20338.4
48SU873	36417.7	30469.6	39165.5	21832.8
48SU1106	34409.9	30349.4	36686.2	19353.8
48SU1386	38087.8	31026.6	40472.5	23139.7
48SU1500	38129.0	30964.1	40513.8	23180.9
48SU2094	38177.7	35884.0	37931.1	21700.4
48SU3511	38906.9	36504.2	38546.3	22429.8
48SU3978	38526.5	36236.2	38188.4	22049.4
48SU3986	39157.2	36174.6	38918.8	22680.1
48SU4773	35801.4	31317.0	37876.8	20544.1
48SU4893	37686.5	34550.9	37528.8	21208.8
48SU4894	37558.8	34447.2	37401.1	21081.1
48SU5006	39030.1	36909.7	38529.0	22553.3
48SU5068	38564.1	37206.5	37985.5	22086.3
48SU5102	32815.1	33685.3	32304.3	16336.5
48SU5105	32856.2	33693.9	32345.4	16377.6
48SU5154	41138.3	37631.4	40701.1	24661.9
48SU5175	40731.6	36346.5	40479.1	24254.6
48SU5189	35604.8	30690.0	38211.1	20878.7
48SU5190	35569.6	30737.4	38179.3	20847.0
48SU5249	42519.3	28449.4	46003.2	28929.6
48SU5301	34040.1	31497.5	35002.4	17780.2
48SU5302	33919.6	31498.9	34795.4	17471.6
48SU5304	33894.6	31475.7	34795.3	17463.2
48SU5340	38055.6	30303.9	40529.8	23197.0
48SU5373	38759.7	35360.0	38602.0	22282.3
48SU5380	34506.1	30445.5	36707.3	19374.9
48SU5384	35267.6	35398.2	34691.4	18789.4
48SW11504	57577.9	52501.4	56987.0	41103.2
48SW14033	43785.1	31495.0	45219.0	28456.2
48SW14888	48480.3	38895.3	48104.4	32005.3
48SW15220	54490.3	49848.8	53899.5	38015.6
48SW15359	42385.5	34019.6	42556.7	26236.2
48SW15650	43794.8	31593.1	45228.8	28466.0
48LN4313	41989.0	29596.7	44250.6	27176.5
48SU1301	38042.1	36356.8	37510.7	21564.7
48SU1562	38903.3	36264.9	38651.8	22426.1
48SU2189	38755.7	36070.9	38582.5	22278.4
48SU2191	38723.9	35943.6	38550.8	22246.6
48SU2230	38208.4	36153.4	37797.1	21731.4
48SU2249	38026.6	36239.0	37538.2	21549.2
48SU2617	38746.2	35779.1	38573.0	22268.8
48SU2618	38858.2	35732.4	38685.1	22380.8

48SU3417	36977.6	35823.0	36408.0	20500.1
48SU3522	38738.1	35996.6	38565.0	22260.8
48SU4398	38369.1	36226.7	37975.6	21892.1
48SU5880	37153.5	35970.0	36589.1	20676.0
48SU5966	38720.8	36107.6	38547.7	22243.6
48SU6009	39383.7	35652.0	39210.5	22906.3
48SU6030	38716.5	36445.6	38347.7	22239.3
48SU6031	38735.4	36454.0	38365.7	22258.3
48SU6039	38557.9	35931.5	38384.7	22080.6
48SU6045	38328.9	35727.3	38155.8	21851.5
48SU6047	38407.9	35832.4	38234.8	21930.6
48SU6232	38772.6	36903.8	38208.1	22295.4
48SU6246	39060.6	37072.5	38497.5	22583.4
48SU6247	39114.0	37110.4	38550.8	22636.7
48SU6254	38364.3	36147.5	38017.5	21887.2
48SU6300	38025.6	36273.8	37518.6	21548.1
48SU6324	38606.0	36402.1	38219.2	22128.9
01-CAR-062-IF.1	35163.8	34854.0	34728.2	18685.7
02-CAR-035-IF.2	35928.1	35094.8	35558.4	19450.3
01-CAR-165-IF.5	38821.1	36899.0	38256.5	22343.8
03-CAR-014-IF.1	35821.1	28886.9	39303.1	21752.2
03-CAR-042-IF.1	38838.9	36782.6	38308.4	22362.2
04-CAR-113-IF.1	43278.3	34308.7	43302.1	26982.0
04-CAR-139-IF.1	36272.0	30529.6	38967.4	21635.0
04-CAR-193-IF.1	40286.9	35113.4	40163.4	23843.6
04-CAR-273-IF.2	33621.9	30080.4	35619.3	18287.0
05-CAR-394-IF.1	54137.4	49519.9	53546.6	37662.7
06-CAR-129-IR.3	38319.9	35797.8	38146.8	21842.6
06-CAR-131-IR.12	38588.6	36434.7	38163.7	22111.7
06-CAR-164-IR.1	36958.9	35848.2	36380.4	20481.0
06-CAR-189-IR.6	43164.2	40700.9	42581.8	26688.0
SU-28-109-35-IF.3	39427.6	35567.8	39254.5	22950.2
48LN2097	42425.6	29990.9	44496.2	27423.0
48SU1156	43188.6	41654.8	42606.1	26712.4
48SU2205	38510.5	36610.9	37973.7	22033.2
48SU2273	39029.6	35546.5	38856.4	22552.2
48SU2324	38460.7	36028.2	38219.3	21983.4
48SU2510	38359.4	36618.1	37797.9	21882.1
48SU2527	38557.3	36613.9	38022.2	22079.9
48SU2528	38514.2	36582.2	37980.2	22036.8
48SU2615	38580.8	35869.5	38407.6	22103.5
48SU3043	38431.7	36236.8	38058.6	21954.6
48SU3044	38413.9	36229.6	38036.8	21936.8
48SU3048	38806.2	36169.3	38592.6	22329.0
48SU3056	38715.0	36313.4	38414.9	22237.9
48SU3083	38858.3	34068.8	38988.9	22668.6
48SU3526	38824.4	36629.2	38400.2	22347.4
48SU3552	38687.3	36294.1	38374.7	22210.2
48SU3752	35297.5	34801.5	34990.4	18819.5
48SU3782	34405.8	30345.2	36658.3	19325.9

48SU3869	38365.4	36523.6	37820.4	21888.0
48SU3870	38394.1	36527.3	37857.3	21916.8
48SU3871	38435.7	36549.3	37898.7	21958.3
48SU3872	38454.8	36584.8	37906.6	21977.5
48SU3878	38517.3	36622.9	37964.3	22039.9
48SU3879	38541.2	36622.1	38004.6	22063.8
48SU3880	38456.5	36519.7	37926.5	21979.1
48SU3881	38454.7	36507.2	37931.0	21977.3
48SU3882	38443.7	36490.6	37920.2	21966.2
48SU3884	36248.9	31123.0	38633.6	21300.9
48SU3885	36256.1	31119.3	38641.4	21308.7
48SU687	34146.0	30768.9	35969.0	18636.8
48UT1	45652.9	29341.9	52508.2	34749.1
01-CAR-001-IF.1	38021.4	31712.7	39655.4	22507.8
48SU6653	36220.9	34712.5	36047.8	19743.3
48SU6655	37911.7	36010.3	37492.0	21434.7
48SU6657	37956.8	36040.5	37536.8	21479.8
48SU6677	39891.1	36729.1	39560.3	23414.2
48LN338	39689.0	31119.7	41238.9	24165.0
48LN4161	43398.2	30851.4	45142.3	28068.8
48LN4344	38464.2	30777.7	40516.8	23407.9
48LN4349	40372.3	31791.5	41366.1	24694.2
48SU5643	38842.8	36631.2	38446.6	22365.8
48SU5644	38841.5	36643.3	38441.7	22364.5
48SU5645	38937.2	36763.8	38479.3	22460.3
48SU6780	35394.4	34501.7	35198.7	18916.5
48SU6782	37570.1	36318.6	36991.6	21092.1
48LN4535	43585.8	30749.5	45329.9	28256.5
08-CAR-298-IR.3	37607.5	36342.5	37029.0	21129.5
08-CAR-023-IR.1	38266.6	36175.7	37860.0	21789.6
08-CAR-089-IR.1	27690.4	32025.9	28544.0	11212.0
05-CAR-28-IR.4	38992.5	36687.6	38615.1	22515.5
05-CAR-28-IR.18	38939.9	36499.0	38631.2	22462.8
05-CAR-28-IR.7	38786.8	36350.8	38519.8	22309.7
05-CAR-62-IR.1	38542.1	36388.3	38126.3	22065.1
05-CAR-102-IF.1	44278.5	35161.1	44120.8	27801.4
05-CAR-112-IR.1	34422.4	30353.4	36714.0	19381.6
05-CAR-189-IR.1	36013.6	35257.8	35581.4	19535.9
05-CAR-190-IR.2	36003.2	35263.7	35548.6	19525.3
05-CAR-221-IR.5	37499.0	36336.5	36920.4	21021.1
07-CAR-58-IR.2	37108.8	36150.4	36530.3	20631.0
07-CAR-189-IR.1	34889.0	34569.9	34521.5	18410.9
07-CAR-230-IR.1	39025.4	36002.2	38852.2	22548.1
07-CAR-230a-IR.1	38989.2	36015.9	38816.0	22511.9
48LN3519	45738.3	30736.8	49542.1	32468.3
48SW16561	45963.4	31917.5	47485.9	30634.1
48SW061021	45922.8	31794.2	47467.9	30593.5
48SU4733	34078.4	31978.4	34665.3	17600.1
48SU4742	34061.7	32291.5	34605.9	17583.0
48SU4752	33701.2	31805.9	34302.4	17222.5

48SU4783	33333.1	31584.7	34044.6	16854.5
48SU4792	33598.5	32114.6	34157.4	17119.9
48SU4798	33425.8	31941.4	33984.7	16947.2
48SU4822	32630.3	31909.2	33106.1	16151.7
48SU4833	32296.4	32363.3	32581.5	15817.8
48SU4839	32336.4	32403.3	32610.8	15857.8
48SU4869	32115.5	31109.5	32876.5	15637.0
48SU4872	32080.5	31037.3	32844.7	15601.9
48SU582	39594.8	35702.7	39421.7	23117.5
48SU4560	39889.8	36629.5	39562.2	23412.8
48SU4561	39317.6	36398.0	39054.8	22840.5
48SU4563	39854.7	36638.9	39526.5	23377.8
48SU4568	39505.9	35214.4	39348.2	23028.6
48SU4569	39381.7	35092.2	39224.0	22904.3
48SU4570	39974.9	35753.3	39801.7	23497.6
48SU4575	39751.3	36115.6	39516.2	23274.2
48SU4576	39692.7	36051.7	39465.8	23215.6
48SU4577	39798.9	36193.3	39550.9	23321.7
48SU4584	39901.6	36109.3	39669.9	23424.5
48SU4586	40202.9	36025.5	39985.7	23725.8
48SU4587	39497.2	34945.7	39352.3	23032.5
48SU4591	39708.2	35308.6	39550.5	23231.0
48SU4595	39321.4	35854.7	39148.2	22844.2
48SU4596	39389.0	36000.9	39178.6	22911.8
48SU4598	39407.3	36060.4	39179.0	22930.1
48SU4601	39197.1	35047.3	39039.4	22719.6
48SU4604	38754.0	34714.7	38596.3	22276.4
48SU4611	39752.8	34747.3	39646.2	23326.3
48SU4627	40013.4	35034.8	39889.9	23570.2
48SU4649	40242.2	35014.8	40119.8	23800.1
48SW14365	40619.2	34090.5	40794.9	24474.3
48LN2439	34152.2	25727.1	38068.9	20517.7
48LN3142	33326.1	26715.2	36808.1	19257.1
48SU1041	33192.4	34355.4	32352.4	16713.7
48SU1042	33201.2	34364.1	32361.1	16722.5
48SU1790	24001.2	28514.2	24854.9	7523.0
48SU2085	39293.7	40112.1	38655.8	22815.4
48SW8828	57738.1	52661.6	57147.3	41263.4
48LN2555	39531.8	23581.2	46682.5	28358.2
48LN3117	37124.8	20835.0	44908.9	26587.5
48SU1006	32267.7	32972.9	31834.7	15789.1
48SW211	54317.1	46075.8	53741.1	37842.8
48SW212	54359.3	45998.2	53783.3	37885.0
48SW270	54551.5	45913.5	53975.5	38077.2
48SW304	45260.3	37615.6	44883.2	28785.1
48SW6324	53996.5	46503.1	53420.5	37522.2
48SW7991	54570.7	46302.4	53994.6	38096.3
48SU5875	37379.3	36197.8	36800.8	20901.4
48SU5877	37437.1	36273.9	36858.5	20959.1
48SU5879	37392.9	36183.3	36814.4	20914.9

48SU5981	39581.6	35532.5	39408.5	23104.1
48SU6057	37955.9	35770.7	37731.1	21478.6
48SU6066	39486.0	35675.0	39312.8	23008.7
48SU6087	39062.1	36897.0	38589.4	22585.3
48SU6114	38576.1	36903.4	37997.6	22098.2
48SU6117	38613.0	36912.7	38034.5	22135.1
48SU6130	38738.7	36995.1	38160.2	22260.8
48SU6224	37078.8	36128.9	36500.3	20601.0
48SU6226	36428.7	35267.7	36020.4	19951.0
48SU6251	38167.5	36295.7	37673.5	21690.0
48SU6281	38439.9	36050.3	38191.6	21962.7
48SU6308	36880.8	35991.5	36302.2	20402.9
48SU6317	36559.2	35311.2	36167.7	20081.7
48SU6319	37755.5	36593.2	37177.0	21277.8
48SU6326	38625.0	36693.2	38082.4	22147.6
48SU6354	38459.5	31265.7	40041.3	22954.7
48SU6381	37390.7	36222.2	36812.1	20912.7
48SU6391	36905.0	35548.2	36442.6	20427.6
48SU6445	37694.8	35544.3	37521.6	21217.4
48SU6561	40760.7	37928.1	40182.2	24283.0
48SU6596	37903.2	35856.6	37591.9	21426.0
48SU6599	37938.0	35914.0	37601.2	21460.9
48SW14289	50711.3	35640.9	53001.7	36566.1
48SW15925	46557.7	37623.2	46181.8	30082.8
48SW16319	43966.4	38983.9	43389.7	27490.9
48SW16822	55072.9	41154.8	55302.2	39202.9
48SU1686	38673.5	31104.4	40259.6	23174.0
48SU1691	38390.4	31355.5	39954.8	22876.9
48SU1701	38662.9	31024.4	40336.8	23245.6
48SU4000	38390.9	36546.8	37844.3	21913.6
48SU6540	36235.4	34749.0	36062.3	19757.8
48SU6747	36253.1	35437.2	35744.7	19775.4
48SU6800	33061.2	33938.5	32543.9	16582.5
48SU6948	38454.9	33218.5	39455.9	22692.6
48SU1524	38687.2	33739.7	39037.5	22717.1
48SU1525	38654.8	33719.4	39044.8	22724.4
48SU1527	38501.0	33537.1	39140.5	22738.7
48SU1661	38131.6	31565.4	39728.5	22618.1
48SU6957	38704.3	33815.1	38985.3	22664.9
48SU6958	38678.3	33746.3	39027.6	22707.2
48SU6679	38040.6	35999.2	37668.2	21563.4
48SU6726	39029.3	35479.6	38856.2	22551.7
48LN2245	40750.7	26402.4	46875.0	29261.8
48SU2184	38075.9	35811.6	37847.6	21598.6
48SU2233	37972.1	35998.5	37579.1	21495.0
48SU2235	38787.8	36514.1	38410.4	22310.7
48SU2239	37947.1	35954.6	37573.4	21470.0
48SU3455	37942.2	35962.3	37562.2	21465.2
48SU3799	38737.6	36766.7	38188.1	22260.2
48SU3948	38115.8	36240.7	37633.7	21638.2

48SU5415	35878.9	35348.4	35302.7	19400.7
48SU5652	38847.8	36526.4	38480.3	22370.6
48SU4938	38122.6	36114.0	37711.3	21645.6
48SU3975	38422.8	36163.5	38088.0	21945.6
48SU5656	38859.0	36441.5	38543.5	22381.9
48SU5672	39327.1	36755.9	38962.9	22850.1
48SU5692	38929.9	36913.9	38380.0	22452.6
48SU5670	39367.9	36852.9	38990.4	22890.8
48SU5695	38974.2	36738.1	38571.8	22497.2
48SU5696	38924.0	36943.0	38360.0	22446.7
48SU5707	37442.7	36098.0	36878.5	20965.1
48SU5722	37242.9	35883.3	36705.8	20765.2
48SU5723	37270.0	35934.5	36731.6	20792.5
48SU5775	36642.5	35656.9	36071.6	20165.0
48SU5783	37887.7	36578.5	37309.1	21409.8
48SU5804	37056.4	35935.4	36477.9	20578.5
48SU5866	37529.2	36330.5	36950.7	21051.3
48SU5869	37484.8	36332.0	36906.3	21006.9
48SU4320	35458.7	32329.8	36544.9	19598.5
	Mean Cost	Mean Cost	Mean Cost	Mean Cost
	39361.0	35272.9	39648.2	23268.9
	Minimum Cost (48SU1790)	Minimum Cost (48LN3117)	Minimum Cost (48SU1790)	Minimum Cost (48SU1790)
	24001.2	20835.0	24854.9	7523.0
	Maximum Cost (48SW15758)	Maximum Cost (48SW15758)	Maximum Cost (48SW15758)	Maximum Cost (48SW15758)
	65087.2	56916.3	64511.1	48612.8