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Rock Imagery: A Cultural Landscape Analysis in the Yakima Uplands

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ROCK IMAGERY: A CULTURAL LANDSCAPE ANALYSIS
IN THE YAKIMA UPLANDS

A Thesis
Presented to
The Graduate Faculty
Central Washington University

In Partial Fulfillment
of the Requirements for the Degree
Master of Science
Cultural and Environmental Resource Management

by
Jessica Eliana Delgado-Morris
December 2019

CENTRAL WASHINGTON UNIVERSITY
Graduate Studies

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Dr. Sterling Quinn

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Dean of Graduate Studies
ABSTRACT

ROCK IMAGERY: A CULTURAL LANDSCAPE ANALYSIS

IN THE YAKIMA UPLANDS

by

Jessica Eliana Delgado-Morris

December 2019

This thesis evaluates the history of rock imagery documentation and the ways it can be improved moving forward. This study also explores the potentials of using viewshed analysis to examine the cultural landscape. The documentation and locational analysis support recommendations for future study and protection of rock image sites.

There are currently twelve known rock imagery sites at the Joint Base Lewis-McChord - Yakima Training Center (YTC). Most of these sites have not been assessed for changes in integrity or damages in over twenty years. Prior documentation efforts have produced site forms with varying degrees of accuracy and completeness. During the documentation effort for this research, eleven of the twelve rock imagery sites were re-documented using a standardized methodology to ensure that all eleven sites were documented to the same level of completeness; including scaled field drawings, digital photographs, and digitally enhanced images of the pictographs and petroglyphs. Thus, providing YTC cultural resource managers a standard baseline with which to assess these sites later on.
The cultural landscape surrounding the rock imagery was examined using a viewshed analysis to make a connection between patterns in the landscape and the rock imagery itself. Seven of the twelve sites have a direct line of sight with special horizon events, with a potential eighth; indicating that horizon events may be a contributing factor to rock imagery placement. Viewshed analysis did not seem to be as useful for establishing associations between rock image sites and other factors, such as potential root soils.
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I would like to thank Randy Korgel, Cultural Resource Program Manager at the Yakima Training Center, for his enthusiasm for my research and support throughout the process. Bethany Mills, Whitetail Archaeologist, contractor stationed at the Yakima Training Center, was my field partner and moral support throughout this entire project. Without her help, this project would not be where it is today.

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For access to the information in Appendixes C and D, please contact the U.S. Army, Yakima Training Center.
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CHAPTER I

INTRODUCTION

This study focuses on the rock imagery at the Joint Base Lewis McChord - Yakima Training Center (JBLM-YTC), referred to as the YTC. The training area spans the Central Interior and Middle Columbia River of the Columbia Plateau. The rock imagery of this area, including a dozen sites, represents an invaluable record of Native American cultural expression and deserves study and protection. The importance of these heritage resources has led to the documentation and study of their place in the cultural landscape.

Archaeologists and heritage resource managers now understand the importance of complete documentation of cultural resources as well as placing rock imagery within the context of a cultural landscape. Rock imagery includes petroglyphs and pictographs. These images have been created on fine-grained rock, by either rubbing or pecking with a hand-held rock of harder material, or by rubbing brightly colored pigments onto the rock face (Boreson 1998, Keyser 1992, Oregon Archaeological Society 2008). Documentation includes providing sufficient information to re-locate rock imagery using scaled drawings and photographs, including digital enhancement. A cultural landscape approach to analyzing rock imagery requires a spatial analysis of the locations, or elements of the images within the landscape. Spatial analysis includes comparison of locations of images by types of landform, viewsheds, and other archaeological sites and resource areas. The
interpretation of the meaning of rock images are important to some communities, academics, and managers. Although some social contexts for rock images are known, this study does not include interpretation of the meaning of rock images and is restricted to spatial analysis of rock imagery sites.

*Landscape Archaeology*

Landscape archaeology provides the model for this research. This model directs the researcher to understand the relationship between people and their interactions and connections with the physical environment in which they live, not simply where they live (David and Thomas 2008; see also Basso 1996 for this theme). In this context, the cultures of the Central Interior and the Middle Columbia River are actively using resources in a manner which requires fundamental knowledge of the land to continually support the people as well as the landscape that provides these perennial resources (Anschuetz et al. 2001, Loubser 2006).

Understanding how past cultures interacted with the landscape requires an understanding of the landscape’s geographical and natural features, available routes, and an understanding of how the landscape influenced the seasonal rounds of its original inhabitants. Landscape, in this sense, and for the purposes of this research, is used to represent the ecological and socially constructed habitat from which a population actively sustains itself (Hassan 2004, Wilkinson 2004). This viability emerges, to some extent, from changes in subsistence and settlement practices through time, both in seasonal
variability and long-term variability with changing climatic and environmental conditions (Hassan 2004, Wilkinson 2004).

I have used a geographically based approach in the form of a viewshed analysis to study the landscape while also concentrating on the available ethnographic information of the cultures of the modern-day Wanapum and Yakama Tribes. The focus of the viewshed analysis is to analyze whether certain geographical patterns emerge frequently on the landscape from the viewpoint of the rock imagery locale. By focusing on the landscape aspect of archaeology, I attempt to reconcile the arbitrary boundaries (Fuller 2011, Harding 2000, Loubser 2006) that North American archaeologists assign to individual “archaeological sites” as we encounter them, leaving out less tangible sources of evidence that connect each locale to its surroundings. Additionally, I have fully documented eleven of the twelve sites at the YTC to include scaled-drawings and digitally enhanced photographs. By providing a standard form of documentation for these sites, I have provided cultural resource managers on the YTC a baseline with which to assess changes to the rock imagery.

Research Questions

This paper will explore three facets of rock imagery and its documentation in order to answer the following questions.
1. *In what ways could rock imagery documentation be standardized and improved, using non-invasive techniques, to ensure completeness and accuracy of results?*

2. *As part of the documentation process, in what ways does processing photographs through digital enhancement programs, such as DStretch, add value to the documentation and management of pictographs and petroglyphs?*

3. *How can viewshed analysis be used for identifying horizon events; corridors for water, people, and animals; or views to resources like roots or hunting grounds?*

As it stands, there is no standardization in rock imagery documentation throughout the United States. The state of Washington, for example, has no designated form to document the specifics that rock imagery requires. Throughout this paper, I will outline some ways to improve rock imagery documentation to promote preservation and improved records management. Records management consists of a detailed record of the images using scaled drawings and proper photography of the sites. In this analysis, I will describe how digital enhancement software, like DStretch, can benefit the documentation process specifically for rock imagery. Furthermore, as an added method to my research design, I conducted a visibility analysis, in the form of a viewshed, to identify the cultural landscape from the point of view of the rock imagery. This viewshed includes cultural
artifacts, topographic landforms, predicted rootcrop soils (Cauffman 2014), and potential passageways for people, animals and water.

This research can be divided into two ideas: the first based on field documentation and the second, based on discerning and working within a cultural landscape. The following outlines the format for this paper: The study area, including the associated ethno-historic cultural landscape follows this section of Chapter I. Chapter II contains a literature review of the history of rock imagery. Next, Chapter III outlines the methodology for each of the two ideas described above. Chapter IV describes the results for the field documentation portion of the study for each site, whereas Chapter V details the viewshed results for each site. Chapter VI concludes the paper with a discussion, a review of potential for future research, and general management recommendations. Appendixes A and B, included at the end, contain examples of the site forms used for this study as well as additional tables with counts specific to the viewshed analysis. Two additional appendixes, C and D, include the completed site forms for this research as well as additional DStretch images. For access to the information located in Appendixes C and D, please contact cultural resource managers at the YTC.
Throughout rock imagery research, it remains unclear why certain locations were chosen over other potentially equally suitable locations in the immediate vicinity. People of the Central Columbia Plateau regarded the landscape and all that it provides as central to their system of beliefs, and continue to do so today (Hunn 1990, Layman 2002, Relander 1986). The life-sustaining resources encountered seasonally were each celebrated by thanksgiving feasts, called, First Feasts, and Waashat dances (Hunn 1990, Relander 1986), where First Feasts still continue today. Thus, it is not unthinkable that special markings on a permanent surface of the landscape would revolve around various aspects of these life-sustaining properties (Robinson 2010).
The re-documentation efforts for this research have helped to update rock imagery site forms for sites that have not been visited for many years; some for over twenty years. Without the effort of specialized research into these sites, the large numbers of sites inside of federally managed lands can sometimes be overlooked for other sites in more pressing danger. Additionally, to begin addressing the question of importance of rock imagery placement, this study includes a visibility analysis to digitally assess the extent of the viewshed from a specific site location.

This study will add to the body of research on rock imagery in the Central Interior and Mid-Columbia River areas. The relationship between the permanent impressions that rock imagery has left on the land and the larger cultural landscape may help amend the way modern archaeologists record cultural “sites” and the way in which cultural sites should be represented. There has been a long-standing debate regarding the merit of assigning arbitrary site boundaries around cultural remains and generating interpretations from these arbitrary boundaries (Fuller 2011, Harding 2000, Tainter 2004). This study will attempt to reconcile the multitude of arbitrary sites within the viewshed of the rock imagery with the landscape on which they reside. This study is not focused on the interpretation of the images, rather the association between rock imagery and the landscape.

*Study Area*

The YTC, a United States Army Base, is located in Central Washington State and encompasses the hills on either side of the border between Kittitas County and Yakima
County. It is bordered by the Columbia River to the east, Interstate Freeway 82 to the west, Schnebly Coulee and Interstate Freeway 90 to the north, and Rattlesnake Hills to the south with the Yakima Ridge running along the southern boundary. This particular study area was chosen as an arbitrary boundary due to the accessibility of the rock imagery sites with permission from the military base. While rock imagery is plentiful throughout the larger Yakima uplands, land management and ownership, as well as the collaboration between the YTC and Central Washington University (CWU), allowed me to conduct a thorough investigation of the rock imagery sites within this particular study area.

The YTC lies on the west-central boundary of the Columbia Plateau, constructed of the Miocene Columbia River Basalt Group (CRBG) and within the Yakima Fold Belt (YBF) of the CRBG (Keyser 1992, Reidel, et al. 1989, WADNR 2018). The Columbia River Basalts were formed through sheets of lava flows formed primarily during the Tertiary period (Easterbrook and Rahm 1970:106 in Morgan 2001). Imperfections in these basalt flows display themselves in the form of lava tubes, talus slopes, cliff faces, colonnades, and entablatures (Morgan 2001, WADNR 2018). The slender, curved colonnade columns located throughout the rolling hills of the YTC, as well as along the Columbia River, form the canvas for the majority of the rock imagery of the area.

The study area is set on the leeward site of the Cascade Range. In contrast to the wet and humid climate west of the Cascades, the Central Basin only receives approximately 7-15 inches of precipitation per year (Hunn 1990, Keyser 1992, WRCC
The YTC sits on the western side of the basin between the Cascade Range and the Rocky Mountain Range. The decline in elevation causes the warmer air to become drier as it descends into the basin creating conditions suitable mainly for large swaths of shrub steppe habitat. From the east, the basin is protected by the Rocky Mountains from the harsher winters typical of the central U.S. (Hunn 1990, Keyser 1992, WRCC 2016). Snow is likely to a depth range of 10-35 inches, usually starting December and remains on the ground between a few days to a couple of months (WRCC 2016).

The landscape typology of the area ranges from east-west trending rolling hills to relatively flat landscapes in the valleys between the hills. The YTC occupies the upper terraces of ridges without extending north into the main valleys of Ellensburg or south to the Yakima Valley. The Columbia River portion of the study area lies at the southern end of the spill-over floods from the Quincy Basin region which overtook the Frenchman Hills and spilled into the Lower Columbia Valley and the northernmost end of the Pasco Basin (Bjornstad 2006). Sentinel Gap was created during one of the last ice age floods cutting a channel through the Saddle Mountains near the west end (Bjornstad 2006). The geology of the gap itself is made up of the Ellensburg Formation formed by volcanic layers (Bjornstad 2006, Waitt 1977). The Sentinel Gap, which borders the northeastern portion of the study area, is visible from many of the rock imagery sites on the Columbia River (Figure 1).

The Columbia River is the second largest river in volume in North America draining approximately 259,000 square miles (Western Regional Climate Center 2016).
Before contact, the Columbia River was a free-flowing river with many dangerous rapids and waterfalls (Hunn 1990, Journals of the Lewis and Clark Expedition 1805, Relander 1986). The Columbia River has been the major focus of much rock imagery research (Greengo 1982; Keyser 1992; Kreiger 1928; Layman 2002, 2017). On the western boundary of the YTC, the Yakima River irrigates the more arid lands of the Kittitas and Yakima Valleys via diversion of its tributaries (Calkins 1905). Several smaller streams and tributaries cut through the valleys or feed directly into these two larger rivers (Meinig 1968, Smith 1910). Most of the surface water in the region is derived from snowmelt from the nearest ranges: The North Cascades, the Coast Range, and the Rocky Mountains (Chatters and Pokotylo 1998). Both the Columbia and the Yakima Rivers have been dammed to generate hydroelectric power, to irrigate agricultural lands, and to prevent major flooding events that were common pre-damming. The reservoirs and the rise in water level has resulted in the inundation and/or damage to many rock imagery sites (Layman 2002, McClure Jr. 1978).

The Wanapum Tribe are associated with the Mid-Columbia River people that inhabited the areas between Celilo Falls in Oregon and Priest Rapids in Washington (Hunn 1990, Relander 1986). While the Wanapum signed no treaty, they are designated as part of the Confederated Tribes and Bands of the Yakama Nation (Confederated Tribes and Bands of the Yakama Nation 2010) who traditionally occupied the Central Interior to the west along the Yakima River and portions of the Columbia River (Schuster 1998). However, both bands practiced a semi-sedentary lifestyle and made seasonal rounds to

Cultural Landscape

The landscape of the Middle Columbia River consisted of a culturally rich area in which people subsisted on seasonally anadromous fish populations as well as mammals including deer and rabbits (Ames, et al. 1998, Chatters and Pokotylo 1998, Hackenberger 2009, Miller 1998, Schuster 1998). As the spring root gathering season began, many roots could be ready to harvest at one time in different areas. The cultural knowledge of the area allowed women to gather at specific areas where the roots would be ready to harvest and continue to move throughout the landscape in the coming weeks for each root as it reached its peak harvesting time (Hunn 1990, Hunn and French 1998, Miller 1998, Schuster 1998). While the roots were provided by the earth, the careful act of choosing specific roots to gather helped to partially domesticate roots. This allowed the ground to provide the people with root crops on a timely schedule that population could rely on (Hunn and French 1998, Miller 1998, Schuster 1998). The spring also marked the beginning of the fishing season; however, the largest quantities of salmon ran through the summer (Schuster 1998). This task, performed mostly by men, required standing on the edges of rapids or on a protruding rock at the bottom of large waterfalls (Hunn 1990, Hunn and French 1998). Groups and individuals tended to return to their own fishing spots regularly and regularly built planks on the rocks to provide better support (Hunn and French 1998). Again, as the earth provided the supply of fatty foods, groups would,
in turn, pay the mother back with a celebration of thanksgiving after the first root-gathering and salmon fishing: the First Foods feast (Hunn 1990, Hunn and French 1998, Miller 1998, Relander 1986, Schuster 1998). The root-gathering season meant that women would spend days at a time away from their primary villages, camp at location, while the roots dried, before transporting them back to the primary village (Hunn 1990). Each root gathering cycle involved the same process. The roots would have to be dried before transporting because dried roots are far less cumbersome, and weighed far less, than fresh roots (Hunn 1990:136). The spring and summer fishing season also meant that temporary houses were built along the riverbanks. Houses were built with salmon drying in mind and retained the down-wind section specifically for drying salmon (Hunn and French 1998, Schuster 1998). However, most evidence of temporary residences during fishing season has been wiped away or inundated with the expansion of the hydroelectric dams. The fall hunting season required people travel distances to find and hunt large game. Accounts from the Wanapum indicate that there was a special hunting shaman that would aid in locating game (Hunn 1990). These shamans would sometimes be involved in creating the rock imagery as a way to channel the spirits to provide game for the hunt (Hunn 1990, Keyser 1992, Relander 1986, Whitley 1994). Because this rock imagery also remained secret, it is difficult to decipher which rock imagery was intended for these purposes. However, hunting usually required groups to travel long distances and could occur anywhere between the low-land hills to the Cascade Mountains.
All of this area was considered part of the cultural landscape. The winter was a time for celebrations and entertaining groups from other regions (Schuster 1998). According to Schuster (1998), this may have been used as a way to maintain trade relations as well as keep spirits up during the cold and gloomy season that seasonally covers the Columbia Plateau. The continuous trade and travel that occurred between polities also required traveling long distances. Until the mid-1700s, this extensive traveling would historically have happened without the use of the horse (Hunn 1990). However, the introduction of the horse, while making travel much faster, also lessened the contemplation that occurs when traveling slowly through a known landscape.

Land-Use Overview

Table 1. Ethnohistoric timeline for the Middle Columbia River Area.

<table>
<thead>
<tr>
<th>Phase/ Period</th>
<th>Years B.P.</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Paleoindian/ Clovis</td>
<td>~12,000 – 10,500</td>
<td>Primarily high-mobility, hunter-gatherer bands. Economy consists of a broad, seasonally-based diet. Low artifact densities.</td>
</tr>
<tr>
<td>Windust Phase</td>
<td>10,500 – 8200</td>
<td>Become forager-collector bands with small seasonally-based settlements. Exploitation of a wide variety of resources.</td>
</tr>
<tr>
<td>Vantage/ Cascade</td>
<td>8200 – 5200</td>
<td>Salmon and fishing becomes an increasingly important part of subsistence pattern. Archaeological assemblages contain fishing tackle collections including small to large eyed needles, weighted nets, and bolas.</td>
</tr>
<tr>
<td>Frenchman Springs</td>
<td>5200 – 2800</td>
<td>First evidence of rock imagery in the Pacific Northwest. Introduction of semi-subterranean pit-houses. Berries and tuberous plants such as camas, biscuitroot and balsam root were also exploited.</td>
</tr>
<tr>
<td>Cayuse Phase</td>
<td>2800 – 250</td>
<td>Winter longhouses and summer mat houses are used in well-organized seasonal rounds. Travel between lowlands and the highlands becomes part of seasonal round. Evidence of permanent human occupations. Evidence of food storage.</td>
</tr>
<tr>
<td>Ethnohistoric Period</td>
<td>250 – present</td>
<td>First introduction to Euro-Americans. Disease, trade, and colonialism brought cultural change and population collapse to cultures of the Columbia Plateau.</td>
</tr>
</tbody>
</table>


**Pre-Contact**

The land that the YTC is settled on prehistorically belonged to the people of the modern-day Confederated Tribes and Bands of the Yakama Nation. The land itself was crossed by people of several cultural groups who now identify with modern-day tribes.
including the Wanapum, the Colville, and the Warm Springs, among others (Schuster 1998).

The people of the Middle Columbia River relied heavily on the fishing for subsistence, primarily salmon (Chatters and Pokotylo 1998, Hewes 1998, Krieger 1928, Miller 1998, Layman 2002). Peak fishing season was May through August with large quantities of sizeable salmon. Still, fish of less diverse species and of smaller size could be caught through November (Miller 1998). The Frenchman Springs phase provides the first evidence of rock imagery in the Columbia Plateau. The earliest reliably known rock imagery sites in the Pacific Northwest (PNW) are the Bernard Creek Rockshelter in Hells Canyon and a petroglyph partially buried by volcanic ash located in southcentral Oregon (Keyser 1992). However, there continues to be a data gap regarding the earliest known rock imagery in the state of Washington.

The villages along the Columbia River were described as sparse and scattered in early reports by travelers during the first contacts at the beginning of the Ethnohistoric Period (Krieger 1928, Meinig 1968). During the summer months, mat houses were erected near fishing spots and doubled as drying areas for fish (Miller 1998). During the winter, those who returned from fall hunting, lived in the communal longhouse near the river; others chose to stay in the hills tending to trap lines (Grabert 1968, Miller 1998, Schuster 1998). Archaeological investigations, supported by ethnographic accounts, conclude that the semi-subterranean pit house was the primary type of habitation structure along the Middle Columbia River until the arrival of European colonizers,
where semi-subterranean pit houses were then replaced by mat long houses (Chatters and Pokotylo 1998, Miller 1998, Schuster 1998).

During the Cayuse phase, between ca. 2500 and 500 B.P., fluctuations in temperature and precipitation amounts created various shifts in the expansion and decline of forests (Chatters and Pokotylo 1998). With this, the Columbia River underwent frequent flooding events, rapidly changing the floodplain formation (Chatters and Pokotylo 1998). The Cayuse phase shows evidence of permanent human occupation along every major and minor river valley as well as the expansion toward higher upland areas and more arid climates (Andrefsky 2004). Evidence of food storage appears in association with the expansion of pithouse villages (Andrefsky 2004, Chatters and Pokotylo 1998). By A.D 500, longhouses are introduced and were at times erected over former pithouses (Ames, et al. 1998, Schuster 1998). A proliferation in net weights, including variation in size and shape, is heavily evidenced in tool assemblages (Ames, et al. 1998).


Historic
By 1855, with the influx of settlers, the Confederated Tribes and Bands of the Yakama Nation was established (Schuster 1998). This was a turbulent time for the tribes. With the Gold Rush pushing settlers north and the Yakama Wars in progress, the Nation ceded large portions of their land to the US Government under the Treaty of 1855 (Schuster 1998). Some of that ceded land eventually became the Yakima Training Center.

By the time of European contact, societies had become egalitarian in structure, functioning under a politically autonomous structure (Schuster 1998, Chatters and Pokotylo 1998). Epidemics transmitted through trade routes devastated the populations of those living in the Columbia Plateau before the arrival of permanent settlers (Miller 1998, Schuster 1988). The mid-nineteenth century was a turbulent time for the people living along the Columbia River, as well as throughout the Columbia Basin. The forced cessation of land by the treaties of 1855 partially caused by the pressures of the gold rush, and partially for the proposed railway system, created warfare among the newly established tribes (Miller 1998, Schuster 1998). The struggles continued well into the twentieth century with the erection of hydroelectric dams along the major rivers, taking away fishing rights and traditions (Schuster 1998, Layman 2002, Relander 1986).

Military Land Use

The YTC is part of a joint base effort with JBLM in Tacoma to provide open space for soldiers of various military sectors to train (Prengaman 2015, US Army Bases 2018, WSDE 2018). At 660 square miles and with 327,231 acres of land (Washington State Department of Ecology (WSDE) 2018, US Army Bases 2018), the YTC is the
largest contiguous swath of shrub steppe habitat in the state of Washington that remains uninterrupted by agriculture (Audubon 2018, Keany 1996). The base, while normally very empty, has held training exercises for as many as 26,000 soldiers at one time (US Army Bases 2018). While the YTC is bordered by bustling towns, the remoteness of the base's character comes from the overall size and the limited number of soldiers stationed year-round (Prengaman 2015). The YTC continues to host military training exercises for soldiers from around the world (US Army bases 2018). The YTC maintains a fire crew that aids in fire management outside the base in Yakima and Selah, offers employment opportunities for civilians from Yakima, Selah, and Ellensburg. Throughout the year, YTC opens its doors to civilians for recreational activities including archery, hunting, horseback riding, hiking and mountain biking (Morey 2008, Prengaman 2015, US Army Bases 2018).

The base originated in 1941 out of anticipation of the oncoming World War II (US Army Bases 2018) with 64,752 hectares (approximately 160,000 acres) of land leased from local landowners (Morey 2008, US Army Bases 2018). The property was returned to those local landowners in 1946, and in 1951 the Department of Defense (DOD) purchased 105,706 hectares of land that came to be known as the Yakima Firing Center until 1990 (US Army Bases 2018). Since acquiring the land for the Yakima Firing Center, the YTC expanded once more in 1990 while hosting the 19th infantry division of the Fort Lewis Army base in Tacoma (Fort Lewis Directorate of Public Works 2010, US Army Bases 2018).
The size of the base, and the remoteness that size creates, makes it ideal for the testing of new weapons, one of the base's primary objectives (Prengaman 2015). The base’s road system is made up of a 1,635-mile network and the restricted airspace reaches up to 55,000 ft. (Denny Miller Associates, Hyjek & Fix, Inc., Gordon Thomas Honeywell 2012, Fort Lewis Directorate of Public Works 2010). Training areas on base include 327,000 acres of training space, 22,000 acres of which are designated “Impact Area,” with elevation ranging between 400 ft. and 4216 ft. (at the summit of Cairn Hope Peak).

The YTC maintains 20 training areas, 26 established ranges, and 212 artillery firing points (Denny Miller Associates, Hyjek & Fix, Inc., Gordon Thomas Honeywell 2012, Fort Lewis Directorate of Public Works 2010).

YTC environmental and cultural resource managers use seibert stakes to delineate restricted boundaries for soldiers. These stakes are not particularly associated with any single restriction – environmental or cultural – in efforts to maintain ambiguity between them. Seibert stakes are distinctly marked to stand out against the shrub steppe background and to facilitate a soldier’s awareness of the appropriate side to be facing (Personal Communication, Mills 2018). When a soldier sees the colored stripes on one side of the stake, it means he or she is on the correct side. However, if they find themselves looking at the side marked with black tape, they have crossed into the restricted zone and risk penalties.

Community Integration
Over 600 documented plant species thrive in the shrub-steppe habitat of the YTC (Hackenberger 2009). The military’s expansion in Central Washington has allowed for the preservation of the largest contiguous shrub-steppe habitat reservation that remains uninterrupted by agriculture (Audubon 2018, Keany 1996). Small perennial streams run through the base and flow into the two larger rivers forming the base’s geographic boundaries; the Yakima River on the west and the Columbia River on the east.

In addition to the biological resources the base maintains, the YTC also takes care to manage over 2,000 cultural resource sites found within the base, following the guidelines of the National Historic Preservation Act (NHPA) (Keany 1996). The base maintains a Cultural Resources Program Manager employed on staff and contracts several other cultural resource managers to survey, manage and protect resources of historic and pre-historic significance. This involves diverting training exercises and infrastructure development away from culturally sensitive areas, maintaining a record of the cultural resources documented on the base, and constant monitoring of protected sites for damages and potential hazards. In 2010, during an assessment for structural realignments on the YTC, the number of archaeological sites eligible for listing in the National Register of Historic Places (NRHP) totaled 140 (Fort Lewis Directorate of Public Works 2010), and with further upgrades, that number continues to rise. Prehistoric sites on base represent at least 10,000 years of land-use history and include lithic scatters, long-term habitation sites, seasonal habitation sites, and rock imagery sites (Fort Lewis Directorate of Public Works 2010). Historic period sites are generally domestic, or
habitation sites, but also include historic mining, railroad, and ranching structures, all
dating to the Homestead era (Fort Lewis Directorate of Public Works 2010). In addition
to observable archaeological remains, certain landscapes and traditional resources are
also considered culturally sensitive. The YTC maintains an open access agreement with
the Yakama Nation and the Wanapum for access to locations such as root gathering areas
and Traditional Cultural Places (TCP) for the purposes of plant and root gathering,
ceremonial practices, and tribal hunting (Fort Lewis Directorate of Public Works 2010).
Hunting is available to tribal members year-round. The base maintains policies that
specifically address the safety of tribal members while inside the boundary (Fort Lewis
Directorate of Public Works 2010).

Recreationists also have access to certain portions of the base. After a background
check, visitors are free to enter the boundary of the military base to participate in
activities that include hiking, horseback riding, mountain biking, hunting, and bird
watching (US Army Bases 2018). As there are 158 native bird species documented on the
base, the YTC is listed on the Audubon Society's webpage as an important bird-watching
area (Audubon 2018). Seasonal permits are available for game hunting; however, the
Greater Sage Grouse is off limits. Fishing is also available for youth, fourteen and under,
at the small, half-acre fishing pond (WDFW 2018).

Archaeological Context

The YTC was part of the traditional landscape for the Wanapum and Yakama
indigenous groups before European contact. These groups were semi-sedentary with

To understand how the landscape was used prehistorically, I must first consider the definition of the landscape as it will be used in this study. The landscape of the Middle Columbia River was a culturally rich area in which people subsisted on seasonally anadromous fish populations as well as mammals including deer and rabbits (Ames, et al. 1998, Chatters and Pokotylo 1998, Hackenberger 2009, Miller 1998, Schuster 1998). The spring marked the root digging season for which gatherings took place into the summer to stockpile before the summer fishing season and the fall hunting
season (Hunn and French 1998, Miller 1998, Schuster 1998). Communities developed as politically autonomous contiguous groups frequently involved in external relations for trade, inter-group marriage, and social activities (Hunn and French 1998, Schuster 1998). Sedentism was semi-permanent in many locations of the Middle Columbia River and involved seasonal rounds from the river to the uplands, and further into neighboring territories with the introduction of the horse (Campbell 1990, Hunn and French 1998, Miller 1998, Schuster 1998). The increasingly sedentary patterns were made possible by the storage of dried foods and their delayed consumption; the technologies developed from local availability of plant species and raw materials, including storage, structures, and trade items; and long-distance trade facilitated by the horse (Hunn and French 1998, Miller 1998, Schuster 1998). This combination of variables that includes the way in which people and the land influence each other forms the basis that enables us to study the placement of rock imagery within the landscape.

Rock imagery sites have been recorded in the interior regions of the YTC, but many have not been revisited or re-assessed since the 1990s making this an under researched area. Additionally, rock imagery has been documented using inconsistent techniques and levels of precision due to a lack of standardization in the practice of rock imagery documentation. In this paper, I make a call to standardize techniques for rock imagery documentation to allow for better preservation. This involves creating a standardized form to consistently document aspects of rock imagery that deserve
attention, taking photographs at each site visit, and drawing rock imagery to scale. This will be elaborated upon in Section 3 of this paper.

Several historic homestead sites and pre-contact sites are visible on the surface throughout the YTC and have been recorded and revisited by several agencies over the decades that the YTC has been operational for research and development purposes. Since 2004, Randy Korgel has been the Cultural Resources Manager at the YTC and has worked closely with Steven Hackenberger, professor at CWU, to conserve and protect several archaeological sites on the base by providing research opportunities to several agencies as well as graduate students at CWU.

During this research effort, all twelve known rock imagery sites were revisited, including those along the Columbia River. One new site, later found to be originally observed in 2009, was documented and is currently awaiting designation of an official Smithsonian archaeological site trinomial. A second visit to the site revealed a site datum from Central Washington Archaeological Survey (CWAS) with the temporary site number P2-BLS-PS500. At all sites, the rock images were re-documented with updated site forms, the images were drawn to scale with a 1 x 1-meter string grid, the sites were tagged using a global positioning system (GPS) with Trimble and Garmin units, and detailed photographs were taken at each site location. Full methods and procedures will be explained in detail in Section 3 of this paper.
The lack of development on base, over 660 square miles (Washington State Department of Ecology 2018, US Army Bases 2018), provides an excellent opportunity to assess the open landscape from a first-person perspective in addition to digital analysis. Additionally, the various techniques used to document these images has allowed me to assess those that have served better for preservation purposes and those which may have done more harm than good. An analysis of the landscape, the re-documentation of each site, and the investigation of this cultural tradition will provide us with a clearer understanding of the way the landscape was used before European contact in the Mid-Columbia River area of the Columbia Plateau.
CHAPTER II
LITERATURE REVIEW AND BACKGROUND

*Rock Imagery and Landscape*

Recent hypotheses, regarding the role rock imagery played within pre-contact societies, include rock imagery as a precursor to the development of writing (Lambert 2014), rock imagery as markers along trade routes indicating inter-tribal social interactions and territorial claim (Dematte 2004), and rock imagery as a symbol of power within the most “intimate confines of the most important economic places in the landscape” (Robinson 2010:792). With each new hypothesis, the research methodology has developed to include a relevant cultural ideology (development of writing based on the social interactions and trade relations with neighboring groups (Lambert 2014)), or a geospatial component (positioning of rock imagery panels to indicate territory and delineate trade route patterns (Dematte 2004)), or both (the relationship between how individuals perform daily activities in the visual presence of rock imagery panels based on specific locations on the physical landscape (Robinson 2010)). Additionally, other researchers around the world, with examples from Sweden (Ling 2008), Morocco (Bokbot and Galán 2010), Sonora (Bech 2015), and Mongolia (Dematte 2004) have found that looking at the geophysical terrain surrounding the rock imagery panels provides the very information needed to construct the cultural landscape. However, this construct may not reflect the Native American ideologies of the cultural landscape we are attempting to identify and instead only reflect a European ideological perspective.
For the purposes of this research, a rock imagery panel refers to the compilation of images on a single, definable, wall or boulder which distinctly separates it from other sections containing figures. This can be a large crack that separates multiple images from each other, or a change in the angle of the rock face. One panel can contain just one single figure or be made of multiple figures. This landscape archaeology approach to inspecting rock imagery places rock imagery within the cultural place of the landscape rather than an isolated space severed of meaningful connections to its surrounding territory (Aston and Rowley 1974). This space includes not only the visual aspects of the landscape, but also the utility of the landscape, the way in which people used the land for food, to travel on and to live within. Thus, finding the relationship that links rock imagery sites to the surrounding landscape and inferring mobility patterns is a chance to analyze, and perhaps begin to interpret, the cultural landscape of the Middle Columbia River area.

Some geospatial approaches are proving difficult, however, in providing a contextual link to the cultural landscape (Bokbot and Galán 2010, Llobera 2001, Robinson 2010). Geophysical studies, using remote sensing for “archaeo-geophysical” surveys” (Kvamme 2003:435), attempt to locate the cultural landscape within an extensive coverage area; however, these potentially miss the larger, cultural, picture when focusing solely on physical, locatable attributes. The larger picture, in this case, meaning how the landscape was used in relation to these physical attributes and the changing relationships between the people and the land (Hassan 2004). Nevertheless, these approaches have yielded results in the form of geospatial data that will be valuable in
future interpretations of the landscape. The approach used for this analysis uses a mix of geospatial techniques involving a digital viewshed analysis taken from Digital Elevation Models (DEM) freely available online as well as LiDAR imagery provided by the YTC’s Cultural Resources department. From this digital viewshed, I can compile and confirm the “taskscape” (Robinson 2010), or resource landscape, as it was seen during my own exposure to it during fieldwork. This information, compiled with a critical literature review about the landscape, how it was used and the way in which traveling occurred throughout it will provide a clearer picture of the cultural aspect of the rock imagery. Ethnographic accounts currently detail the ritualistic aspect of rock imagery throughout the mid-Columbia River area. This might lead some to conclude that rock imagery would be in private areas away from the public view. However, this is not always the case. The mid-Columbia River people, as with many other Native American cultures, consider many aspects of their culture to be sacred and secret in many regards and are not at liberty to reveal pieces of their culture with outsiders (Brandt 1980, Colwell 2015, Fuller 2011, Harding 2000). Based on ethnographic accounts, this is also true of the vision quest rituals performed by adolescents during puberty rights (Cline et al. 1938, Malouf and White 1953 in Keyser 1992). The vision quest is meant to reveal a young adult’s spirit animal, which many believe lead to the drawings of animals on the rock wall (Keyser 1992, Relander 1986). After the vision quest was performed, the vision quester was not to reveal his spirit animal and risk abandonment by the spirit animal (Hunn 1990:238). For all rock imagery to contain such personal meaning would imply that most, if not all rock
imagery would be produced in remote areas, away from village locations, and far from those that might accidentally come across it during daily activities. Further, it would suggest that single panels, or figures, would be located in isolation from others. However, during the course of this analysis, much of the rock imagery was in places easily accessible from other imagery panels or within view of river-scapes. Some of the panels observed during this investigation were indeed isolated panels located with no other figures near them. However, this was not true of the majority of the panels. This would suggest either communal drawing or re-visitation to familiar locations by a number of individuals or the same individual on multiple occasions.

The cultural landscape cannot be viewed as a synchronic picture devoid of human occupancy. The cultural landscape is the heavily, continuously used topography in which individuals move, live, thrive, and subsist (Robinson 2010). The land is well known and well-traveled because vast swaths of land was their home. While certain areas may have been avoided due to tales of evil spirits (Relander 1986), the vast majority of the land was used throughout the course of one individual's lifetime. Based on Hunn (1990), the cultural landscape can be interpreted as a utilitarian landscape, or a resource landscape, that was incorporated into the everyday practices and beliefs that kept the physical landscape productive, but undamaged by heavy development. The people of the mid-Columbia River area understood that the land provided all the necessary resources, but in order to maintain the land, one must not damage the land that provides these resources (Hunn 1990, Relander 1986). Llobera (2001) argued that viewshed analyses to evaluate
the cultural landscape lack the inclusion of artifact assemblages, thus precluding the ability to re-create a culturally inhabited landscape. The viewshed analysis for this project incorporates, not only landforms and topographic features, but also the artefactual remains throughout the landscape.

Based on the literature by Robinson (2006, 2010), I have chosen to explore the viewshed analysis of the landscape to look for prevalent patterns associated with rock imagery. Robinson (2010) used viewshed analysis to explore the relationship between rock imagery locations and bedrock mortars (BRM) at nearby seed and nut processing stations utilized by the Chumash during the summer and fall seasons in the Southern California Coastal region. While the YTC does not necessarily have the same characteristics that appealed to Robinson (2010), the purpose of my study was also to analyze the correlation between rock imagery and life-sustaining resources.

Cumulative viewshed analysis saw a rise in popularity around the mid-1990s. Wheatley (1995) used this technique to extrapolate the line of sight between long barrows, or chambered tombs, at two Neolithic sites (Stonehenge and Avebury regions) with mixed results. Wheatley (1999) and Llobera (2001) both agree that while viewshed analysis can be a powerful tool in an archaeological setting, its use in a landscape analysis without a cultural context can lead to an oversimplified topographic analysis. In attempts to remedy this issue, this analysis includes outside archaeological sites, predicted root crop zones, and water corridors that all contribute to the cultural landscape. Thirty years since the rise in popularity in viewshed analysis, three-dimensional (3D)
analyses for rock imagery are beginning to take hold (di Maida 2016, Landeschi 2018, Mark 2017, Sanz 2014). As this technique gains popularity, researchers may encounter the same cultural context limitations with 3D studies that limited viewshed analyses. However, the limiting factor for 3D analysis remains the need for large amounts of disk space and computer processing power (Sanz 2014).

Rock Imagery and Archaeology

There has been a long history of studies of rock imagery on the Columbia Plateau. Early investigators include Elizabeth Barrow, Beth and Ray Hill, Harold Cundy, Columbia River Archaeological Society, Thomas Cain, John Campbell, David Cole, Mark Hanse and James Haseltine. McClure (1978) reviews some of this history as part of his inventory of sites with rock imagery. Most early studies of rock imagery have included interpretation of the images, which has led to generalized western assumptions without regard to affiliated cultures (see Boreson 1998, Keyser and Hillis 1994, Keyser 1992, Layman 2002). More recently James Keyser (1992, 2006, 2016), and William Layman (2002, 2017, 2018) have provided cultural, historical, and anthropological reviews of rock imagery of the Columbia Plateau.

Within the context of archaeology, rock imagery long has fallen into its own conceptually abstract dimension. Images painted on rocks do not provide us a physical artifact to hold and therefore cannot be attributed a physical dimension within the cultural sphere. Over the years, researchers have attempted to identify the images; interpreting and assigning them names that we, as western researchers, are familiar with (Keyser
1992, Hill and Hill 1974, Lundy 1969, McClure 1978). While the fascination with rock imagery lies within the colored pigments and elaborate designs, it is best to keep in mind that not all rock imagery is created in such a way. This begs the question of functionality. Mid-Columbia River groups do not practice “art” in the way we are familiar with (Hunn 1990), nor do they see rock imagery as simple depictions of art. While many non-researchers see Native American artifacts and rock imagery as “folk art,” indigenous groups recognize it as a part of a rich culture heritage. The western perception of rock imagery has long influenced the way in which rock imagery is analyzed. From the realm of Art History, we study motifs, patterns, temporal continuity, and subject matter. As a westernized researcher, I may not be able to pull myself out of this way of thinking. However, placing the research emphasis on a spatial sphere rather than artistic significance contributes to non-interpretive research results.

As researchers, we are still attempting to hypothesize various reasons for the creation of such imagery. Investigations of archaeological sites yield chronological data for the dating of various artifacts located within the soil stratigraphy. Dating rock imagery can become somewhat difficult, further obscuring its place in the archaeological record. There are several ways of dating rock imagery: 1) pigment position analysis—in southern Africa researchers have applied a chronological approach to studying the stratigraphy of superimposed (images laid over one another at different points in time) pigments in pictographs (Layman 2002; Loubser 1993, 1997; Anderson 1996; Mguni 1997; Russell 1997, 2000; Pearce 2002; Swart 2004; in Russell 2012). 2) Dating the
repatination (buildup of basalt tarnish) between superimposed figures to place a chronological division between the figures (Boreson 1998, Keyser 1992). While this technique can provide a relative chronology between figures on an individual rock, repatination by itself cannot provide an absolute age identification for petroglyphs due to the variability in which repatination occurs in different geographic locations (i.e., humidity, sun exposure) (Boreson 1998, Keyser 1992). 3) Dating artifacts around rock imagery panels, or sediments which have buried rock imagery panels (Boreson 1998, Keyser 1992, Randolph and Dahlstrom 1977). Attempting to date rock imagery based solely on surrounding artifacts can only provide relative chronologies but lacks concrete temporal linkage (Boreson 1998, Keyser 1992). This method can be useful for creating a relative chronological association (Boreson 1998, Keyser 1992, Randolph and Dahlstrom 1977), but is not as useful for asserting an absolute chronology.

In some cases, multiple modern-day tribes claim ownership of the regions where rock imagery is present (Oregon Archaeological Society 2008). In those cases, stylistic interpretations become useful in establishing thematic associations with cultural associations (see Keyser 1992, Layman 2002, Hill and Hill 1974, Oregon Archaeological Society 2008, Whitley 1987). Investigations of stylistic patterns allow for a bridge in communication between researchers and descendants of indigenous communities to converse about patterns commonly observed in regions of study (Fuller 2011, Keyser et al. 2006, Lahelma 2012, Pearce 2012). This communication has allowed those seeking to study rock imagery a venue for which to place it within the appropriate cultural landscape

As research on this topic moves toward geospatial modeling, it is important not to lose sight of the cultural aspect we are attempting to identify. Nevertheless, in depth distributional analyses to analyze relationships between the physical sites visible to us is a step forward to placing rock imagery within the cultural landscape (Arsenault 2004a, 2004b; Bahn 2006; Keyser 1982; Keyser and Whitley 2006; Fuller 2011; Johnson 2012; Whitley 1987). Moving forward, understanding how locations tie into indigenous oral traditions potentially place greater weight on the depictions of each panel (Arsenault 2004, Lahelma 2012, Pearce 2012, Vazquez 2010, Whitley 1987).

The distinction between private rock imagery and public rock imagery (see Arsenault 2004, Barjamovic et al. 2017, Oregon Archaeological Society 2008, Robinson 2010, Whitley 1987) is finding its place within a geospatial context. How rock imagery panels are seen, by whom they are seen, and from and where is a question regarding the positioning of rock imagery panels, largely from a European perspective (Arsenault 2004, Bahn 2006, Fuller 2011, Oregon Archaeological Society 2008, Robinson 2010, Vazquez 2010). This theoretical perspective analyzes the way in which rock imagery panel locations vary within the same context. Private rock imagery sits in sheltered locations, are smaller in size and are sheltered from public view (Arsenault 2004, Bradley 2006 Oregon Archaeological Society 2008, Robinson 2010). They are meant to be observed only at certain angles and/or by certain people (Bahn 2006, Bradley 2006, Oregon
Archaeological Society 2008). Public rock imagery is that which sits on boulders, or large rock faces, in unobstructed view to the public (Bahn 2006, Bradley 2006, Oregon Archaeological Society 2008). A geospatial analysis of the placement of panels, including viewsheds, may help construct where some panels may represent images for public display versus those discreetly displayed.

Other approaches to the study of rock imagery involves the search for interpretations (Clark 1953) or the search for meaning within a cluster of images (Keyser 1992). Most rock imagery is associated with hunting magic (Keyser and Whitley 2016, Whitley 1987), shamanism (Arsenault 2006, Boreson 1998, Keyser and Whitley 2016), and legends relating to specific locations (Bahn 2006, Clark 1953, Keyser 1992, Layman 2002, Keyser and Whitley 2016). Shamanistic “vision quests” (Keyser 1992, Keyser and Whitley 2016) have been the longest standing explanation of the images left on the land. However, some disagree with these types of interpretations (Bahn 2006) and others feel that the lack of artefactual evidence (aside from the rock images themselves) combined with the lack of ethnography has created a detachment between the research subject (rock imagery) and researchers, which in turn has led to patsy interpretations of magical origins (Bahn 2006, Vazquez 2010). In response to earlier published work claiming interpretations of magic (Bahn 2006), more researchers are taking an ethnographic approach to incorporate traditional knowledge passed down to descendants (Basso 1996, Boreson 1998, Keyser 1992, Keyser et al. 2006, Lahelma 2012, Pearce 2012).
Rock imagery has been associated with canyons, permanent and ephemeral water sources, and grand panoramic overlooks. Examples of this can be found in Nevada in sites such as Grapevine Canyon, Cottonwood Cove, and Boyscout Canyon in Lake Mead National Recreation Area (NPS 2016) and on the western most edge of Wheeler Peak in Great Basin National Park. In the State of Washington, one of the most heavily researched areas is the Columbia River where no shortage of rock imagery lines the canyon walls and where substantially more currently lies under the water surface due to the implementation of hydroelectric dams (Layman 2002). The physical associations mentioned above are some of the most widely recognized patterns when researchers begin to study rock imagery. However, when studying rock imagery along a river corridor, it becomes apparent that these patterns cannot be generically applied to all rock imagery research. While at times prominently displayed, such as She Who Watches, rock imagery is also found in isolated areas away from what we would consider grandiose vistas (Whitley 2005). However, even these areas will usually have been associated with water in the past. Among these structures that researchers understand of rock imagery, the creation of rock imagery coincides with ceremonial rituals such as puberty rites and hunting magic (Keyser 1992, Keyser and Whitley 2016).

Rock Imagery Preservation

Archaeology as a research field continues to evolve. With it, the idea of preservation has evolved into research through non-invasive techniques. Rock imagery documentation, in the same way, has undergone many evolutions since its beginning. The
recording of rock imagery has evolved from recording rock imagery through invasive techniques such as rubbings and silastic casting (Hartmann and Stephenson 1980, Hill and Hill 1974, Loendorf and Lawrence-Smith 2015), to analyzing the differences in styles by geographic area by which to determine cultural attributes, to using spatial techniques to analyze variables in the landscape, and finally to using improved technology to record rock imagery using non-invasive techniques. This evolution in recording styles trumpets the influence of progress; however, change for the sake of change may ignore key components necessary to fully evaluate rock imagery sites. Early research, when rock imagery research was a burgeoning field, did not necessarily provide detailed explanations of their methodology. Initially for this analysis I hoped to find works by early researchers using rubbings as a technique to record rock imagery. While there are books published with several of the copied images (Hill and Hill 1974, Keyser and Hillis 1994, Loring and Loring 1982), I was unable to find books with detailed descriptions of the methodology used during these documentations.

Petroglyph rubbings refers to a method in which researchers would apply a thin sheet of parchment over a petroglyph and use chalk or pencil to copy, or transfer, the image over onto the sheet of parchment. This technique potentially provided a fairly accurate representation of the petroglyph, however, not only was this method space-consuming – as it provided a full-scale transfer – but it was also damaging to the rock imagery. This rubbing technique wore down petroglyphs as well as the rock surrounding the petroglyph. Nevertheless, this technique was used to document rock imagery to be
lost under the raising water of the Columbia River reservoir upon implementation of the Priest Rapids dam, completed in 1959 (Layman 2002). A similar technique in scale, rock imagery traced on clear acetate plastic film produced full-size replications of the images (Barrow 1957). While tracings were less invasive than rubbings, both techniques involved scrubbing the surface of the rock with a bristle brush, using soap and water, to remove dirt and lichen from the rock imagery (Barrow 1957, Greengo 1982).

Another technique, used commonly in the 1970s and 1980s, was silastic casting. This involved taking a silastic latex solution, applying it over the petroglyph, and then peeling off a molded replica of the petroglyph once dry (Hartmann and Stephenson 1980, Loendorf and Lawrence-Smith 2015). However, this technique also had issues concerning preservation. In order to get an accurate replica of the petroglyph, like preparation for tracings and rubbings, the petroglyphs also needed to be scrubbed to remove all lichen encroachment and any other impurities that would affect the cast (Hartmann and Stephenson 1980, Loendorf and Lawrence-Smith 2015). Additionally, peeling the silastic cast risked damaging fragile portions of the rock already in danger of spalling, or removing any evidence of pigment associated with the petroglyph.

Over time, freehand drawings became more common, but many lacked a sense of scale. Nevertheless, this was a step toward less invasive recording techniques. The advent of digital photography has been incredibly helpful for rock imagery documentation. Digital photography allows the researcher to take vastly more photographs, with less storage space, than with traditional film photography. Increasingly, digital photographic
storage capacity has increased to the point that researchers can seemingly take an infinite number of photographs in the field (Di Maida 2016, Sanz 2014). While photographic documentation alone can still lack small details not easily captured with a lens, paired with other documentation methods, such as digital enhancement software, photography is a very helpful resource for documenting rock imagery in a non-invasive manner. Photography has also been useful in demonstrating deterioration of rock imagery through time. More recently, scaled drawings have become more commonplace, but even these techniques differ. For example, using two measuring tapes in an “x, y” formation and sketching on graph paper, or using string grids, of soft or rigid borders. More common, however, is the non-scaled field sketch of the imagery for posterity. The most recent additions to the suite of rock imagery documentation techniques is the use of 3D Imaging to record rock imagery with highly detailed precision (Di Maida 2016, Landeschi 2018, Mark 2017).

With so many techniques available, there is still a lack of proper rock imagery documentation to this day. Archaeological site forms include questions regarding the condition of the site and specific elements of the site. For example, whether the site is historic or prehistoric, whether there is sub-surface component, etc. However, some site forms, including Washington State’s, does not include any information regarding rock imagery, despite the amount of rock imagery observed throughout the state. This lack of standardization in documentation techniques allows for gaps in the site record and the archaeological record itself. Researchers continue to visit rock imagery sites without
drawing or photographing rock imagery panels. While not all drawings and photographs provide a clear representation of each figure, descriptions of rock imagery figures alone cannot provide details regarding decay, or other changes to the condition of the panel. At this point, all states containing rock imagery should include a section, or an attachment with a standard set of questions regarding the condition and composition of rock imagery panels to their site forms. As site photographs are standard in completing documentation, scaled drawings of the rock imagery must also be standard for rock imagery sites.

Researchers are seeing the value in using alternative techniques for documenting projects that are otherwise difficult through conventional field methods. Skala (2013) used digital enhancement techniques in DStretch to document the pictographs in the central coast of British Columbia. Much of the rock imagery was extremely faded or inaccessible requiring photographs from a distance. The use of DStretch allowed Skala (2013) to enhance photographs to the point of recognition. Di Maida (2016) performed a 3D analysis of cave rock imagery off the coast of Sicily that was otherwise a project too large to document in detail by hand. Jennings et al. (2014) used high-precision GPS to document the landscape of areas with a high concentration of rock imagery in Saudi Arabia. The crew recorded rock imagery panels to a 5mm accuracy along the face of escarpments overlooking a desiccated river system (Jennings et al. 2014).
CHAPTER III

METHODS AND PROJECT OBJECTIVES

Documentation efforts for this project began in the summer of 2018 with the help of the Central Washington University Archaeological Field School led by Steve Hackenberger. In order to help with my research interests, the field school was split and rotated between two groups during their time on the YTC; one group to assist the rock imagery project, and the other to learn general field archaeology techniques. Additionally, the field school assisted with surveys to relocate previously documented rock imagery and to find any previously unknown rock imagery. The groups were shuffled around to provide everyone an opportunity to work with all activities and in turn give them a sense of the many aspects of archaeological work. During the rock imagery project, field school students learned about rock imagery, its various forms, and they learned and applied non-invasive documentation techniques.

In addition to assistance by the CWU archeology field school, Bethany Mills, a sub-contractor with Stell Environmental (later Whitetail Environmental), stationed at the YTC, assisted through the entire rock imagery re-documentation project and throughout the course of this thesis, as a whole. Working under the Cultural Resources Program Manager, Randy Korgel, who has spent much of his archaeological career studying rock imagery (personal communication 2018), Mills assisted with visiting each documented rock imagery site within YTC boundaries. We relocated and redocumented sites not
visited in several years, while also correcting three files incorrectly labeled in the database records and correcting spatial coordinates for two.

Most sites were accessible by vehicle or by hiking. However, some sites along the Columbia River, were more efficient to reach by boat. For these sites, the Grant County Public Utility District (GCPUD) provided a boat with which to access the sites. Chris Kaiser, GCPUD ranger and his crew, took us to each site located along the Columbia River. Due to a small draw-down of the river, low water levels caused engine problems for two of the six days reserved for our project during the summer 2018 field season. This caused a delay in re-documenting two rock imagery sites lower on the Columbia River until the 2019 field season.

Figure 2. Project area including rock imagery Sites.
Field Documentation Component

As this paper is composed of two distinct sections - the first outlining the re-documentation efforts of the rock imagery on the YTC, and the second analyzing the cultural landscape of the YTC – the methods for each will remain separate to correspond accordingly. The first four sub-sections of field documentation methods focus on the archaeological aspect of the documentation process. The first and second sub-sections will be an overview of the methods used to document the rock imagery on the YTC and the rationale behind these methods. The third section will go over the use of digital enhancement techniques on photographs. The final portion of the methods section will go over the methodology used in geographic information systems (GIS) to conduct the digital viewshed analysis of the areas surrounding each rock imagery site.

Guidelines for Documenting Rock Imagery

The inspiration for this project emerged from a few years of working on rock imagery projects in Nevada and California. The states of California, Nevada, Idaho, Utah, and Wyoming use the Inter-Mountain Antiquities Computer System (IMACS) form to document archaeological sites (University of Utah 1992). IMACS Attachments Forms, such as the Rock Art Attachment Form for rock imagery sites, are used to document more specialized archaeological sites. Because the state of Washington uses no such documentation to distinguish between types of archaeological sites, the IMACS Rock Art Attachment Form was used in combination with the Washington state archaeological site
form during this documentation effort to gather a standardized set of information.

Throughout the course of this study, a concerning lack of standardization in rock imagery documentation was observed. While much of archaeological documentation has been held to strict protocols for a number of decades, rock imagery lingers in a domain which continually faces challenges in documentation procedures – some to the detriment of the rock imagery itself, as noted in the literature review. The primary concern is that a lack of standardization in documentation can negatively impact the archaeological record as in cases where inadvertent destruction of the imagery occurs due to poor documentation techniques.

Through previous experience in documenting rock imagery it became clear that without clear documentation - including drawings to scale, clear photographs, and descriptions of the images themselves - rock imagery becomes difficult to relocate. In many cases, when UTM coordinates are incorrect or lost, pedestrian survey and photographic documentation are the only method of relocating previously documented rock imagery panels. In addition to using the IMACS Rock Art Attachment Form, the techniques standardized by the Nevada Rock Art Foundation (NRAF) (2016) were employed (See Appendix A). The NRAF is a non-profit volunteer rock imagery stewardship organization that has partnered with and helped federal land managers keep watch over archaeological sites and report observed damages (NRAF 2016). As part of their efforts, the group has standardized a drawing grid, including a drawing key, for use in the field. Additionally, the NRAF created a standardized sheet for counting and
tracking panels in sites where there are dozens (if not hundreds) of rock imagery panels. The NRAF (2016) has allowed me to use these keys and grids for rock imagery documentation outside of Nevada. I have used these forms for this research in the state of Washington to provide consistency to field documentation and to add information beyond what is traditionally documented of rock imagery on the YTC.

In addition to consistency in drawing and documentation of rock imagery, a standardization in photographs was enforced as much as possible. One overview shot of the site, one overview shot of each petroglyph panel that included the full panel, and several detail shots of each panel with individual figures.

**Documenting the Rock Imagery**

Using the Washington State archaeological site forms, Mills and I relocated each rock imagery site for re-documentation. Many of the site forms contained incomplete information and lacked photographs, making relocation difficult. Others had complete information, but UTM coordinates were in NAD27 and required conversion to NAD83 to relocate. We conducted a small pedestrian survey around each site in search of additional panels. In the instances we observed previously undocumented rock imagery, a GPS point was taken with a Garmin GPS to keep track of its location, and we documented the new panel as a new addition to the site.

To document the rock imagery sites, Mills and I followed a standard set of procedures. Upon relocating the site, we took updated GPS points, relocated each panel
listed on the site form, surveyed for additional panels not previously documented, photographed the site and each of its panels, used a flexible string grid to draw each panel to scale, and fully documented the site. A flexible string grid is a 1x1-meter gridded unit divided into 10 cm² units constructed without a rigid border used for rock imagery documentation purposes. For an example of how this grid was used, see Appendix A. The grids were constructed to match the dimensions of the paper grid, called a field drawing grid, provided by the NRAF. The lack of a rigid border allows the grid to be draped over uneven surfaces or to be hung vertically on sheer basalt rock faces – places where rock imagery is most commonly observed. Painter’s tape provides the best hold on rock surfaces without leaving residue and without damaging the rock surface. Using the string grid as a guide, the panel is then sketched to scale onto the field drawing grid. Each panel is measured and documented using the IMACS Rock Art Attachment form.

To facilitate documentation and relocation, each panel in a rock imagery site is numbered individually. In certain instances, we found it necessary to renumber panels listed in the original documentation: 45KT208, 45KT338 and 45KT345. Panels marked “not relocated” at site 45KT208 during the 1996 site assessment were not assigned panel numbers on the site form. During the 2018 field season, those panels were relocated and assigned panel numbers. 45KT338 included a description of two potential panels as “possibly not existent” and contained no drawings or photographs (Klug 1997). Mills and I were unable to relocate these panels and, therefore, removed their numbers from this site form update. Additionally, one numbered panel in the site documentation was
discovered to actually belong to site 45KT208 and documentation was mistakenly placed with 45KT338’s.

Photographing rock imagery is extremely dependent on lighting. To remove glare in the field, a car window shade was used as a shading element. However, some petroglyphs were simply too faint to be captured on camera. Where possible, a digitally enhanced image using DStretch was included as a supplement to pictograph photographs that were otherwise difficult to discern. The DStretch process is discussed in detail below.

*Photographic DStretch Component*

A photo enhancement program tailored to enhance rock imagery, primarily the pigment in pictographs was developed by John Harman (Harman 2008) as a Plugin to Image J, a photo processing software. DStretch, or decorrelation stretch, “diagonalizes the covariance matrix of the colors [where] the contrast for each color is stretched to equalize the color variances [and] the colors are uncorrelated [to] fill the colorspace” (Harman 2008). According to Harman (2008), decorrelation stretch was developed at the National Aeronautics and Space Administration’s Jet Propulsion Laboratory to “enhance multispectral images” from remote sensing operations. The DStretch plugin has been adapted to automatically apply transformation matrices in several “colors spaces,” or filters.
DStretch contains several colorspace filters that enhance colors in a variety of spectrums. Different filters bring to light different areas of pictograph panels that are otherwise invisible in the original photograph and to the naked eye. For the purposes of this research, I tested the program on petroglyphs in attempts to highlight any previously unseen pigment. In the case of site 45KT0338, using DStretch uncovered that panels 2 and 3 were in fact a combination of petroglyph and pictograph where no pigment was detected during previous documentations. However, because DStretch optimizes colorspace, it is only useful for enhancing pigment in pictographs. Scratches and abrasions in petroglyphs do not interact with the color matrices to make them visible.

Researchers, including Skala (2013) have used DStretch to gather more information of the pictographs in the central coast of British Columbia than is readily available in the field. Photography alone is unable to capture most pigment in pictographs. DStretch enhanced images makes it possible to provide a heightened representation of pictographs and include those images in the site form update. This will aid in site relocation during future site evaluations.

GIS Analytical Component

Technical advances have been made in the recording of images including the utilization of light detection and ranging (LiDAR), 3D imaging, and GIS (Bokbot and Galán 2010, Di Maida 2016, Kvamme 2003, Mark 2017, Ripin 2017, Robinson 2010).
The visibility analysis component of this research is meant to provide a digital representation of the landscape from the viewpoint of the person creating the rock imagery. A GIS can analyze a DEM to create a viewshed, in other words, the extent that can be seen from a particular point on the landscape. It can be used to identify any geographic and cultural features that are encompassed within the extent of that view. This technique is frequently used by city planners when assessing the visual impact of placing intrusive items on the landscape, such as cell phone towers. I have adapted this technique to gain a historical perspective of the landscape from the rock imagery site locale itself. The YTC presented a particularly good location for this analysis because of its lack of infrastructure. Although LiDAR imagery avoids the detection of surface interferences such as trees and buildings – the open landscape of the YTC modeled the viewshed from each location without the sole reliance on digital models. However, this is not meant to be an exhaustive account of the rock imagery sites on the base. This documentation effort only focused on the sites previously recorded on the YTC.

To begin this analysis, a GPS point was taken at each rock imagery site on the YTC using a Trimble or Garmin unit projected in WGS 1984, UTM zone 10 (Table 2). As most rock imagery panels are located on the sheer face of basalt rock walls, GPS units lost accuracy in the field and could have a margin of error of up to 10-meters. However, because this analysis required precise locations of each rock imagery site (e.g. points are to be on the correct terrace to represent the true location of each rock imagery site), GPS points were verified in GIS. GPS points with imprecise UTM coordinates were edited
using DEM, LiDAR data, and Google Earth maps. To correct UTM coordinates, a hillshade layer was created from 1-meter LiDAR data, provided by the YTC’s Cultural Resources Department, and was used alongside Google Earth maps to visually inspect the accuracy of each point. Aside from the interference from natural features, DEM and LiDAR data specifically penetrate human-built environments such as tactical training facilities inside the military base and were therefore preferred over other formats. As a stipulation of using the YTC LiDAR, tactical military training facilities were not to be disclosed. Additionally, DEM and LiDAR formats disregard trees, allowing for a true representation of the viewshed along the Columbia River from site P2-BLS-PS500. See Results section below for an explanation of this site.

Table 2. Steps to processing spatial information for visibility analysis.

<table>
<thead>
<tr>
<th>Process</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 GPS Points</td>
<td>• All gathered in WGS 1984, UTM Zone 10</td>
</tr>
<tr>
<td>2 Verify coordinates</td>
<td>• Verified and corrected using Google Earth and GIS using LiDAR, DEM, and 3D Scene.</td>
</tr>
<tr>
<td>3 Visibility tests</td>
<td>• Pre-analysis tests run using 10 and 30-meter resolution DEM</td>
</tr>
<tr>
<td>4 Mosaic 1-meter LiDAR tiles</td>
<td>• Based on test results from 10 and 30-meter DEM viewsheds</td>
</tr>
<tr>
<td>5 Visibility analysis</td>
<td>• Parameters set based on Observers</td>
</tr>
<tr>
<td>6 Important information within viewsheds</td>
<td>• Apply outside archaeological sites using DAHP data.</td>
</tr>
<tr>
<td>7 Hydrology layers</td>
<td>• Original Columbia River boundary created from georeferenced GLO map</td>
</tr>
<tr>
<td>8 Root crop layers</td>
<td>• Streams and Creeks layers added from county websites.</td>
</tr>
<tr>
<td></td>
<td>• Added from Cauffman’s (2010) data.</td>
</tr>
</tbody>
</table>
All analysis was performed using ArcGIS Pro 2.0. All viewsheds were projected from the rock imagery site points using the Visibility tool. In addition to the 1-meter LiDAR data, USGS DEM data were also downloaded in 10-meter and 30-meter resolutions to perform several levels of analysis. The 10-meter resolution files were downloaded from the University of Washington’s Earth and Space Sciences GIS open access portal (University of Washington 2010) to incorporate the areas of Kittitas, Yakima and Grant counties that make up the YTC. These 10-meter resolution tiles were stitched together into a mosaic to perform a broad-scale visibility analysis for prominent nearby geographic features. To run a visibility analysis from one rock imagery site at a time, each site datum was assigned a visibility input from which the viewshed would project. From this input, landforms, hydrologic features, predicted root crop areas, and archaeological sites visible from each rock imagery site would become evident. Further, a single visibility analysis of all site datums was run to determine how many rock imagery sites were in line of sight of one another.

Next, a 30-meter DEM of Washington State was used to analyze prominent landforms on still a broader scale. This was done in order to verify whether any prominent landforms in the distance fall inside the viewshed of rock imagery sites which may not have been captured using the limited data downloaded for 10-meter resolution. As 10-meter resolution DEMs were downloaded to only encompass the areas of Yakima, Kittitas, and Grant counties that make up the YTC, the 30-meter resolution DEM was used to gauge whether the viewshed extent projected beyond the 10-meter DEM
boundary. In order to determine which mountain peaks and ranges could be seen from each site, a point was placed at the highest elevation of a mountain peak or range which might be significant, and a visibility analysis was performed to verify which landforms were visible from each rock imagery site. Significance, in terms of this analysis, was determined in two ways; geographic landforms currently known to be TCPs such as Mount Baldy and Push-Tay, and by prominence of nearby mountain ranges. The prominence of mountain ranges, while not necessarily a true indication of significance, was used in this analysis due to a lack of TCP awareness outside of tribal communities.

To inspect the surrounding landscape for each rock imagery site at a small-scale, 1-meter resolution LiDAR was used next to perform a visibility analysis. While 1-meter resolution LiDAR was provided for the entire YTC, the processing power required to mosaic all 81 tiles into a single raster was beyond the capabilities of the computer running the analysis. To compensate for this, 1-meter LiDAR tiles were mosaicked together based on the viewsheds projected using the 10-meter DEM. If the viewshed proved to be different and extended beyond what the 10-meter resolution suggested, additional tiles were added to compensate.

A visibility analysis was performed to assess if any rock imagery sites were visible from mountain peaks. The visibility analyses performed from each rock imagery site were also provided with a 1.5-meter surface offset to account for the height of the person creating the rock imagery – or viewing the scene from the rock imagery – and a value of zero for the observer offset to ensure all observations within the viewshed were
of the ground level. Curvature of the earth corrections were applied with a default value of 0.13-meters. All output coordinate systems were projected in WGS 1984, UTM zone 10 North.

*Important Features Inside Viewsheds*

Archaeological sites are an important factor in the visibility analysis and were therefore included wherever the viewshed extended. Archaeological sites located inside the projected viewshed were then clipped from the Washington Information System for Architectural and Archaeological Records Database’s (WISAARD) topographic map and the archeological polygons geodatabase. From here, the archaeological site polygons were laid over the viewshed raster to visually demonstrate which sites were included in the viewshed of each rock imagery site. For an example of the overlaid sites within the viewshed, see Section 5 for viewshed analysis results.

As hydrology on the landscape is also an important factor in this analysis, a hydrology layer was downloaded from the USGS online National Map containing all stream beds within the YTC. Furthermore, the current shoreline for the Columbia River does not represent the shoreline originally present at the time the rock imagery was created, but reflects the reservoirs created by the hydrologic dams. Therefore, the original shoreline boundary needed to be created in GIS. In order to convey the rock imagery’s distance from the original shoreline, historic plat survey GLO (General Land Office) maps were downloaded from the BLM website as jpeg raster files for the area between
Wanapum Dam and Priest Rapids Dam. These were then georeferenced so that the historical outline of the river could be traced.

All analysis to this point had been processed using a 2-dimensional (2-D) map. Using ArcGIS Pro, the map was converted into an interactive 3-dimensional (3-D) map which allowed for improved verification of the placement of each site datum. Further, the collected layers for archaeological sites, streambeds and topographic landmarks provided an interactive representation of the results of the viewsheds. Elevation for the 3-D map was set from the 1-meter resolution LiDAR, and elevation for the layers was set to “relative to the ground” with a vertical exaggeration of 2 meters to project each feature above the viewshed.
CHAPTER IV

RESULTS: FIELD DOCUMENTATION AND DSTRETCH

Field Documentation

The project involved documenting twelve sites at the YTC. However, documenting those twelve sites was challenging due to the logistics involved in coordination, thus eleven of the twelve sites was completed. Accessibility, scheduling, and timing for each site interfered with completing this project. Accessing the rock imagery sites, like with most archaeological sites, required a vehicle that could travel on unkempt dirt roads. Prior to scheduling a field day, access to the site area needed to be cleared through Range Operations to ensure that training schedules did not interfere with our access. My schedule and Mills’ did not always line up. Mills’ job on the base limited her availability to select days of the week to assist this project. Finally, each site took a minimum of two days to complete with the exception of 45KT347 and 45YA13 (David’s Site). Accessing each site took a few hours’ travel each way, leaving approximately four hours for field documentation per day, give or take an hour. However, the amount of time spent documenting these sites has created a standardized recorded baseline that future researchers can use to assess the sites.

Listed below are the findings for each site.
The site is located on a sheer-faced basalt outcrop with two terraces suitable for walking approximately 10 meters north of Lnuma Creek. A total of thirteen panels were located at the site divided between the two terraces. The upper terrace contains panels 1 through 3 and 11 through 13. Panels 4 through 10 are located on the lower terrace. This site contains a combination of pictographs and petroglyphs. During the summer of 2018, the CWU archaeological field school crew learned techniques for sketching rock imagery at this site and assisted with sketching panels 1 and 3. This site has been heavily impacted by graffiti. Siebert stakes are in place to protect the site. However, the site is very visible and easily accessible to any bored troops awaiting orders. Between the field school visit in the summer of 2018 and a site visit in the spring of 2019, a substantial amount of new graffiti was observed and photographed on the site. Motifs, or common elements, observed at this site include rayed circles, rays inside circles, rayed arcs, anthropomorphic figures, animal figures, and abstract figures of different shapes.

Panel 1 (P1) is a red pictograph of an outlined rayed circle (Figure 3). A large circular spall has damaged the center-right of the pictograph. Upon closer inspection, there is additional pigment above the main pictograph. There is also graffiti below the pictograph in the form of an “X” inside a box that is not directly impacting the pictograph.
Figure 3. Panel 1 at 45KT208.

P2 is a very lightly abraded rayed circle. This figure most closely resembles a sun. The figure rests on a separate rock in the same rock face just east of P1, but faces the same southeasterly direction. P3 is a heavily abraded, prominently visible double rayed arc on a south-oriented face. This panel sits just east of P1 and 2. The upper arc consists of eleven rays and the lower arc consists of ten. The arcs are rounded to form half circles, on inset within and below the other. A crack runs diagonally through the petroglyph on the right side. Small fragments of spall are affecting the panel, but it is unclear whether that is a change from previous documentations. Lichen has not yet reached the panel itself, but is encroaching.

P4 sits on the lower terrace, approximately 10 meters west of the wall containing Panels 5 through 10 and approximately 1 meter east of P13. P4 consists of a rayed arc, of six or seven rays, over a single thick line running down the center. The rayed arc is a similar shape to the smaller arc of P3 and encircles a portion of the line. The panel has
been heavily affected by cracks and spalling and is very lightly scratched, making it difficult to see. Graffiti sits directly over the petroglyph.

Panels 5 through 10 all sit on one face on the lower tier. P5 is shaped resembling a five-pronged fork, with four or five lines standing straight over a single horizontal line, which sits on top of a single vertical line in the center. The panel is highly repatinated and is difficult to see. P5 is the furthest to the west on the wall. P6 is a lightly abraded petroglyph consisting of a rayed arc with potentially twelve rays over a single line. The arc is more open than that of P3 and P4. P7 forms a shape similar to P6 but is thinner and more highly repatinated. Spalling is encroaching and may soon affect the petroglyph. P8 is a rayed circle with approximately thirteen visible rays and red pigment where abraded rays are no longer visible. The figure is being affected by a mineral stain and a crack that is spalling outward from the center. Both damages occur on the right side of the figure. P9 is an inverse rayed circle consisting of thirteen or fourteen abraded rays protruding inward from an abraded circle. P10 is also a rayed arc over a single line. The rayed arc consists of approximately eight abraded lines with remnants of red pigment between a couple of the rays. The panel is being affected by the same mineral stain that affects P8.

P11 rests on a boulder to the west of, and behind P1. This figure consists of a red and white rayed arc with approximately eight rays visible. Mineral staining and lichen are beginning to affect the panel. This panel, and the others following, were not relocated during the 1996 assessment and are therefore being assigned panel designations during this assessment.
P12 is potentially modern, but was included due to uncertainty. This panel is a rayed arc with six or seven rays. Between the summer and fall visits in 2018, new graffiti emerged adjacent to the panel making its legitimacy more difficult to determine.

P13 sits approximately one meter west of P4 on a separate boulder face. This panel was not relocated during the 1996 assessment due to its extremely faint visibility. The site was visited approximately four times between the spring of 2018 and summer of 2019 before this panel was observed while drawing P4. The angle of the sun and the observer’s position make a great impact on the visibility of this panel. This panel consists of a rayed arc with twelve visible rays. The figure is being affected by cracks and lichen growth.

Many of the panels at this site contain silastic casting residue. Hartmann and Stephenson’s (1980) report states that they replicated a panel at this site, but makes no mention of which panel or whether they tested multiple. However, during this investigation, we observed silastic casting residue at all but panels 2 and 12.

Additionally, upon investigation for further information in WISAARD, we observed that 45KT208 is plotted in the wrong location. Currently, the site is displayed as east of 45KT347 near a modern military dirt road in a location devoid of rock outcrops. The actual location of the site is west of 45KT347, just above and north of Lmuma Creek. I recommend that updated coordinates be submitted to DAHP in order to correct the site’s location within WISAARD.
45KT338

The site is located on a basalt bedrock outcrop on the southern bank of Lmuma Creek (formerly Squaw Creek). The rock imagery is located in a concave portion of the rock face overlooking Lmuma Creek (Figure 4). A bulldozer cut is located downhill of the rock imagery, approximately 25 meters northwest, near the bank of the creek. The house-pits and talus pit documented during previous site visits were not observed during this visit and should be relocated during a subsequent assessment. However, several lithics were observed on the surface as well as in the subsurface of the dozer cut. The rebar datum was also relocated on the mound as well.

![Figure 4. Rock Imagery at site 45KT338.](image)

The site is a multicomponent site with historic and pre-contact elements. During previous site updates, the rest of site, including artifacts have been well documented. Because the focus of this study was to redocument rock imagery, it was not necessary to perform a site assessment for the rest of the site. Several rock imagery panels have been re-numbered to correct naming conventions used in previous recordings described by
Klug (1997) as being possibly faulty and requiring further inspection. However, the panels requiring further inspection were not photographed and were therefore not relocated. Lmuma Creek was visited several times during the 2018 season from Spring to Fall and water was present in the creek at all times.

The rock imagery on site consists of three panels: one pictograph and two petroglyphs with pigment. The rock imagery was covered in silastic casting during the 1979 field-testing (Hartmann and Stephenson 1980). Panel 1 (P1) was approximately 99% covered in silastic casting residue; P2 and P3 were less currently affected, but remains of silastic casting are evident along the edges of the rock, especially the top and bottom. P1 is a sun-shaped figure made with red pigment. The rays alternate in color; however, it is difficult to tell whether the alternating rays are a white pigment or whether they are abraded due to the silastic residue. It may be possible that the alternating rays were abraded before white pigment was applied. A chip in the silastic residue on P1 reveals the brightness of the red pigment underneath.

P2 is nestled further back in the cove of the wall between P1 and P3 (Figure 4). This panel consists of a scratched petroglyph consisting of four short scratched lines connecting to one long scratched line. When processing the image through DStretch, it became apparent that P2 also contained pigment and was in fact an alternating red and white scratched rayed arc (Figure 5). It is unknown whether the panel is heavily weathered or whether the pigment was removed during the removal of the silastic casting. However, given the panel’s sheltered location it is less likely that the panel was so
severely weathered. P3 is also a scratched petroglyph consisting of eight lines. It may be possible that this panel also contained pigment in the past, however, the presence of pigment is not as readily detectable as in P2.

This site was also discovered to be plotted in the incorrect location in WISAARD. The current coordinates display the site at the top of the hill south of the modern military dirt road. The actual location of the site is at the bottom of the cliff face near the stream. It is recommended that the coordinates be corrected with DAHP to update WISAARD.
The site consists of two petroglyph panels located 145m away from each other on two basalt outcrops. Locus 1, Panel 1 (L1, P1) is located on a basalt outcropping 145m east of L2, P1. This site was re-numbered to correct confusion in the original numbering system. L2, P1 was originally designed as L2, P2, but was changed to reflect a single panel in Locus 2. The basalt outcroppings are located on the hill approximately 100m north of Lmuma Creek.

L1, P1 depicts a double-rayed arc. The arc is slanted in a diagonal position along the top left edge of the rock. There is significant fading in the upper right section of the image. The image is scratched/pecked into the furthest western edge of the basalt face of the wall. In the sun, the brightly-lit landscape in the background created a high contrast that made it difficult to photograph the panel alone.

L2, P1 depicts three figures in line immediately adjacent to each other (Figure 6). The furthest left figure depicts a possible anthropomorphic figure. Within the circle are further markings, almost akin to eyes on a face. The center figure resembles an arrow or another anthropomorphic figure. The third figure resembles a sun or circle with rays.
These figures are located on two different basalt outcroppings on a hillside. A flaked stone chopper was observed across the creek (A1) and ammunition shell scatter was observed at the top of the hill approximately 20 meters above and north of the basalt outcrop at L2. The shell scatter was piled in one spot and more than likely came from a stationary rifle.

*45KT347*

This site lies approximately 100 meters east of 45KT208. The petroglyphs rests on a much smaller outcrop than KT208 and KT338. The site comprises two petroglyphs, one in the shape of the letter “m” with an incomplete right side, and the other a straight line with slightly curved lines emerging from either side of the line. The second figure is extremely difficult to distinguish and only becomes visible after observing the larger figure to the left for a period of time. This figure was deemed modern, potentially graffiti, by Boreson in 1997. A recommendation that the Yakama be consulted regarding this location to verify was included in the notes, but there is no information whether this ever
occurred. Upon further inspection, this figure looks newer than other petroglyphs, but cannot be considered graffiti at the moment. The panel itself is being affected by lichen and cracks. Because the panel is so faint, there is less chance that it will be impacted by graffiti.

The site itself rests on a vertical basalt face. The boulders in this outcrop are smaller than the others located within Lmuma Creek. The walk from 45KT208 involved simply walking up Lmuma Creek for approximately 260 meters.

*45KT723*

The petroglyph panel is located on a singular boulder in the middle of a scree field. Unlike other rock imagery within the YTC, this is the only panel that lies on an individual boulder, facing upward, with no other rock imagery nearby (Figure 7). The panel consists of two sets of hatch marks, or tally marks (Keyser 1992) – the top row containing 17 hatch marks in a line and the bottom row 18 marks. The hatch marks are fairly evenly spaced forming almost an inverted arc. In 2013 Yakama Nation Cultural Resources Program documented the single petroglyph, a cairn, and thirteen CCS flakes. Lichen growth is encroaching on the hatch marks but has not fully obscured them. The primary purpose of the 2018 site visit was to re-document the petroglyph. The other cultural material was not assessed since a full documentation had been conducted in 2013.
The petroglyphs at this site are part of a much larger, very extensive site comprised of several thousand lithics. The site is listed as eligible for the National Register of Historic Places (NRHP) and was a large base camp measuring approximately 700-meters, north-south, by 200-meters, east-west (Arthur 2001, Earth Imaging Associates 2002, Landreau 1996) P1 was the only rock imagery documented at the site, and was only documented during the last site assessment. During the 2018 field season, Mills and I observed three additional petroglyph panels, all within the boundaries of the site.

Petroglyph P1 sits on a basalt terrace approximately 1 meter from the present-day Columbia River edge. The petroglyph panel comprises two horizontal lines of dots of uneven sizes with two vertical lines emerging from the bottom row between dots 2 & 3 and dots 3 & 4 (Figure 8). P2 sits on another basalt terrace approximately 45 meters south of P1 along the water line. This panel is comprised of multiple figures, some of which
have been covered by a white spray-painted arrow on the upper center of the rock (Figure 9). This panel and panel 4 were initially observed at the end of the day during our September 2018 visit to the site, and we could not document the panel. On our return in November 2018, the water level was too high, and we were not able to stand in a position to draw the panel; however, photographs were taken from the upper edge of the terrace. Without further inspection, it is unclear whether there is additional graffiti among the petroglyphs. P3 rests on the ledge directly above P2. This panel consists of small abrasions on horizontal basalt boulders without a clear indication of figures. This panel is distributed between two separate boulders.

Figure 8. Panel 1 at 45KT1160. Orientation is WNW.
Figure 9. Panel 2 at 45KT1160 with graffiti. Orientation is North.

P4 was observed during our September visit. A GPS point was taken, but we were unable to relocate this panel during our November visit. It is possible that the high-water line affected this panel’s visibility. Measurements were only taken for panels 1 and 3 at the time of documentation. Measurements for panels 2 and 4 must be taken during the next visit.

45YA047

The site is located on a small basalt outcrop about 30 m north of Selah Creek. The outcrop is 50 m long and 3 m high. It sits on a northeast-southwest trending finger with drainage into Selah Creek. This site consists of numerous petroglyphs and one pictograph in four panels. The design elements include lines, rays, arcs, dots, and circles. Graffiti is also impacting the site. A modern “LAX” is pecked onto a boulder near P1 as well as scratched graffiti on P2. Bullet holes are evident throughout the site.

P1 is located on an east-facing basalt cliff-face. P1 is a petroglyph with five figures comprised of rayed-arcs with dots and lines connecting multiple elements and arrow-like
figures (Figure 10). This panel has been abraded and pecked, is deeply incised, and is in
good condition, considering its exposure to the elements. Compared to the stone
surrounding it, there is very low re-patination. Upon further inspection of the photographs,
the background may have been prepared or abraded to surround, or halo, the panels. This
panel may have been subject to bullets, indicated by holes along the top of the panel. P2 is
composed of six or seven partially interconnected figures. It sits approximately 1.5 meters
north of P1 on a fully vertical, east-facing, basalt face. The figures have been abraded and
pecked with various cracks running directly through the panel. This panel is also being
affected by possible bullet holes, scratched graffiti, and some lichen encroachment from
the top-left corner of the panel. Figures in the panel include rayed circles with dots and
abstract shapes.

Figure 10. Panel 1 at 45YA47. Orientation is West.

P3 sits at ground level on the south-facing side of the rock outcrop. The bottom
right of the panel has been heavily affected by spalling. This panel was originally
designated as an isolate in previous documentations of the site. However due to its
proximity and the discovery of another new panel, this has been designated P3. This panel is made up of a rayed arc and stacked arcs connected by one or more, faintly visible, vertical line(s). A second, very faint figure is visible above and to the right of the larger figure on the ground line. Cracks are also impacting the panel. A fourth panel was observed approximately 2 meters east-northeast and down from P2 and was designated as P4. This panel is located on a boulder that sits closer to the ground than P1 and P2. It comprises seven pecked dots on the center of the boulder and an X-like abraded figure with red pigment. Spalling is affecting the bottom portion of the panel where the red pigment is located. A large crack runs through the center of the panel, but is not affecting the figures. Isolate 2 described and drawn by Klug (1997) was not observed during this assessment. Another visit, during a different time of year, may change lighting enough to make the panel visible.

45YA099

This site also sits along the Columbia River and contains ten panels. The site sits on a north-facing bedrock rock-shelter with three openings. Historically, this site was located approximate 350 meters from the original Columbia River shoreline; today it is located 80 meters from the shore. The site is a mixture of pictograph and petroglyph panels distributed across 14.2 meters of the cliff face between the first and third rock shelters. All nine previously recorded panels were observed and one additional tenth pictograph panel.
Panel 1 (P1) is a polychrome pictograph composed of white and red pigment (Figure 11). The single figure panel is in the shape of an arc (in white) with interchanging red and white rays. The two adjacent top center rays are both white. P2 is a monochrome red pictograph composed of two distinct figures. The higher figure comprises a circle with attached rays. The second figure is a set of lines resembling nine rays with no arc. However, the furthest-most right two rays are attached to, what may have once been, the edge of an arc. Two cracks run through the panel, affecting primarily the rays, with a third crack affecting the tip of the arc to the right. The panel sits directly over P3 with a large crack creating a clear delineator between the two panels. P3 is an extremely faded red pictograph. The shape, with the naked eye, most closely resembles the letter “I” with dots on either side. This figure seems to be connected to what may be a rayed arc tilted left. This portion of the panel is almost imperceptible and has been drawn with cautionary lightness. A large crack runs horizontally through the center of the panel. This panel sits directly below P2. P4 is a brown, single-figure, pictograph that rests on the underside of a small overhang on the top edge of rock-shelter entrance 3. The brown panel may originally have been white pigment that has since turned to brown (see P5). It comprises a singular figure in the shape of a half-sun with faintly visible dots dotting the end of the top four rays and potentially over the last ray on the right (extremely faded). The half circle, forming the body of the sun shape, is fully filled in. P5 rests above and to the right on a vertical face.
P5 is a single-figure, polychrome pictograph comprising of a double-arsed ray with alternating colors. This panel is heavily affected by a mineral stain running down the center right of the figure. The left half of the figure is very faded. The lower arc is made of red pigment. The upper arc, made of white pigment on the right, contains a mixture of white and brown tones in the center, and is brown on the left. It is possible that the white pigment has turned brown since the creation of the panel. The rays alternate between red and white pigment on the right, red and a mixture of white and brown in the center right, red and brown on the center left, and very faded tones of red and brown on the far left. Some of the rays appear to have dotted ends. Some spalling affects the upper right rays. Panel 4 is located below and to the left east on the underside of a small overhang.

P6 contains two monochrome figures in red paint (Figure 12). One figure comprises a single dot approximately six centimeters left of a six-pointed figure. The six-pointed figure has three upward-pointed fingers and three down-pointed fingers. Note the faintness of the pigment in Figure 12. Many pictographs become difficult to photograph
as pigment fades. Using DStretch on this photograph to enhance the pigment improve the quality of the site form for future research and relocation. The DStretch portion of this section below will further discuss results with picture juxtapositions.

![Figure 12. Panel 6 at 45YA99. Orientation is NW.](image)

P7 is a monochrome figure, possibly consisting of a rayed arc, and an abraded figure sitting just below the pictograph. The rayed arc is most clearly defined on the right side with portions of the center partly visible, and virtually nothing visible on the left-hand side. The right-hand side is composed of two arcs approximately ten centimeters apart with four rays connecting the arcs. The center is potentially remnants of the same figure style with mostly rays remaining. A long crack runs along the left side of the figure and contains what may be remnants of red pigment dots along the crack. The crack and some spalling presently affect the panel. One abraded figure is located below the red pictograph. No clear shape can be determined of the figure; however, the abrasion does look intentional.
P8 contains a series of abraded and solid pecked dots forming two concentric arcs with one additional dot possibly forming the beginning of a lower, third, arc. The top arc contains thirteen abraded dots, the lower contains ten dots, and a singular dot on the left side forms what could be part of the lowest, third, arc. Two small cracks run through the panel vertically but do not affect the figure. However, a large spall is evident to the top left of the panel and may affect the figure in the future. P9 is formed by a series of abraded dots forming one circle containing 14 dots. A second series of dots is located on the bottom left, adjacent to the center circle containing 8 dots. The center circle is not fully “closed” and retains a gap on the bottom right. The overall effect of the figure is of a spiral of dots. The panel has potentially been affected by mineral staining on the right side.

P10 is a newly observed panel documented during the 2018 field season. A red monochrome figure composed of a diagonal line approximately 5cm in length and a ninety-degree angle backwards “L” shape.

45YA307

This petroglyph site sits high on a basalt outcrop. The panels are accessible by walking up a steep scree embankment at a slope between 50 and 60 degrees. The three panels form a line from left to right. The figures are made up of rayed arcs, circles, dots and lines.

The site sits on a small, narrow basalt embankment that sits on the side of a northeast-facing hillside. To reach this embankment, some scurrying is required, and
once at the panels, the bench is only half a meter wide in certain places. This site is located approximately 40 meters from the current Columbia River reservoir line and approximately 290 meters from the Columbia River's original water line. The three panels sit on three separate rocks on the cliff face. Overall, the cliff embankment was only 6 meters across.

P1 consists of a faint scratched glyph that may have been completed on multiple visits. The panel is a double rayed arc, with the upper arc only partially visible on the left. Eleven rays sit on the lower arc and bisect part of the upper arc. Scratch marks, that may or may not be associated with the petroglyph, are located directly below the arc. Two lines of dots trail down from each end of the arc. The dots on the right side, containing eight dots, are more visible than the dots on the left side, which contains four dots. P2 is a rayed circle with dots on the ends of each ray and one large dot in the center of the circle. The panel is heavily incised with a high percentage of repatination. The surface for the panel may have been prepared with red pigment that is now extremely faded. Eighteen rays surround the circle and each ray is dotted at the end. A relatively large crack runs horizontally through the center of the panel with a chip in the center of the center dot. A second crack runs vertically through the rays on the right side. A large mineral stain runs down approximately 10cm left of the panel. Klug (1998) describes P3 as “two concentric arcs joined by radiating lines…with later additions.” Six abraded rays connect the arcs on the left side and an additional 2 and a half rays are visible to the right of a large mineral stain – however, this portion looks different and may have been added at a later visit (Figure
13). The outer arc is extended to form a full circle, but is a different color and composition, with less repatination, than the rest of the panel, suggesting this too was a later addition. The mineral stain does not appear to have grown since Klug’s 1998 sketch.

Figure 13. Panel 3 at 45YA307. Orientation is West.

45YA308

Due to time and scheduling constraints, this site was not fully re-documented. This site, along with David’s Site, was visited briefly during the summer of 2019 for a post-fire survey that occurred within the project boundary, near the site. This site, and several others, were assessed to be in good condition and untouched by the fire. However, the length of the trip and the need to evaluate multiple sites in a single trip impeded the possibility of a full re-documentation.

David’s Site

Currently, the Smithsonian trinomial for this site is unknown. However, after some research, it is possible that this site is 45YA13. This site was originally documented
in 1958 by the Anthropology class directed by Dr. Greengo at the University of Washington (Greengo 1958). In 1998, Linda Klug fully documented the site under the site name “David’s Site” without a Smithsonian number and listed that no previous investigations were known for this site (Klug 1998). The site has been referred to as David’s Site ever since. However, after researching the site documents for 45YA13 and affiliated report (Stallard 1958), the description of the site and its contents matches the current figures in the rock imagery. WISAARD currently projects this site under the Columbia River. However, it may be that the portion of the site containing the documented housepits is inundated while the rock imagery remains on the surface.

David’s Site is composed of two loci. The first located closest to the river, at the mouth of the Sourdough Canyon and contains two rock imagery panels. The second is located approximately 30 meters west into the canyon and contains four panels. Locus 1 contains a combination of abraded petroglyphs and red pigment pictographs. Locus 2 fully comprises red pigment pictographs. One petrified wood lithic tool was observed near L2, P1.

L1, P1 is comprised of abraded petroglyphs and red pigment. This panel contains four figures with additional dots of red pigment trailing down diagonally to the left of the four figures. A large spall is affecting the panel and several mineral stains are encroaching on the figures.
L1, P2 is composed entirely of red pigment and contains three figures that may have once been a single connected anthropomorphic figure. This panel is also being affected by mineral stains and spalling.

L2, P1 and L2, P2 are also composed entirely of red pigment. L2, P1 contains three figures that are potentially being obscured by brown lichen. Two horizontal red lines, below the lichen, are separated by a horizontal crack. L2, P2 spans over a meter across containing several small figures. A cluster of small figures lies on the left edge of the rock and are separated by a crack that runs from left to right. The figure on the lower right is affected by a bullet hole. Another large crack runs from the top down which separates the cluster of figures from a single small circle with three rays. A final figure, a single diagonal red line, is located approximately 45cm east of the rayed circle figure but was included in this panel for the sake of time and efficiency.

L2, P3 is composed of nine clusters of red pigment figures. The cluster in the center is being affected by a bullet hole. The bottom and left of the rock are being affected by spalling. The figures seem disjointed and are being affected by cracks throughout the rock. L2, P4 sits to the right of L2, P3 and is composed of a single vertical red line with a large mineral stain that resembles abrasions. A potential cupule is located above the stain, approximately 20cm above the red line.

P2-BLS-PS500

The site is a pre-contact petroglyph with a possible multicomponent and two potentially modern pecked panels. Panels 1, 3, 4, and 5 are grouped in one location with
P2 located away from the rest at approximately 36 meters west. Panel number designations correspond to the order in which they were observed. No artifacts were observed in association with this site. However, one rock pile (Feature 1) was observed at the site. There are two rock shelters (RS1, RS2) located with the cluster of petroglyphs (P1, P3-5). RS1 has its opening low to the ground. P4 is located approximately 3 meters north of the opening to RS1. Feature 1 (F1), is located immediately in front of this opening. It is unclear whether F1 is a rock wall or rock pile due to the amount of vegetation growth over and around. Feature 2 (F2) is a natural semi-circular rock wall formation that has been built up with more rocks. The additional rocks stacked on top are potentially modern, as the lichen growth does not reflect a homogenous growth pattern. F2 extends from the edge of RS1 to the edge of P4. RS2 is located on the northern-most edge of the site approximately 3 meters east-northeast of P1. Panels 1, 4 and 5 are pre-contact petroglyphs. These are primarily clustered in the southwest corner of the site. P2 is potentially modern and created with a metal object. The pecking scars on the basalt face look more recent, are deeper and contain what may be metallic remains. P3 may also be modern for the same reasons (Figure 14).
P1 (a-e) has many distinct figures. Each figure in this panel was designated a letter by the CWU fieldschool crew to facilitate duties in documentation. This is a pre-contact panel, abraded, and possibly pecked, composed of five figures (a-e). P1 “a” and “b,” furthest to the left, are anthropomorphic figures. P1a is an anthropomorphic figure with what could be a headdress.

P3 (a-b) is a potentially modern, pecked, petroglyph composed of two distinct figures. P3a is a sun-shaped figure with additional pecking to the right with no definitive form. The sun-shaped figure is composed of a hollow circular shape with ten rays emitting from the circle. P3b is an anthropomorphic figure, also with additional pecking to the right. The anthropomorphic figure has what could be described as additional headwear, as it extends up and flares out on both sides. Both panels look to be of recent age and contain no re-patination.

P4 is an indistinguishable pecked figure. It more closely resembles a line potentially flanked by additional pecking. This panel sits approximately 35cm above P5 on the same
rock face. P5 is another indistinguishable pecked figure. This panel rests approximately 35cm below P4 on the same rock face.

**Discussion: Site Documentation**

Re-documentation of each site is a time-consuming process. For contractors under the constraints of project deadlines, full documentation of a site, including complete field drawings, photographs and panel descriptions can hardly be included in a budget. Equally, without focused research from sources such as academia, intensive documentation of these sites every ten years can rarely be justified. However, complete documentation of rock imagery sites, like any other site, is necessary at least once. Subsequent assessments of the site can then be made with a certain level of confidence regarding significant changes.

Further, documenting the imagery in multiple forms helps ensure that small details of the rock imagery are captured that may otherwise be missed. Details captured in a scaled drawing are potentially missed in photographs. Significantly faded pictographs can be digitally revitalized using DStretch for a more complete picture of the site.

Most sites were easily accessible. In fact, a surprising detail that arose while conducting field investigations was that sites still retained readily accessible trails leading up to them. The most accessibility between rock imagery sites was granted on Lmuma Creek, where the greatest number of sites in the study area are clustered in one canyon. It
did become clear, however, that rock imagery sites were likely created by younger individuals capable of walking gradients.

While most sites only required a minor incline to reach, two sites varied from this trend: 45KT723 and 45YA307. 45KT723 was not created on the wall of a basalt cliff face. Rather, this petroglyph was created on a single upward-facing boulder in the middle of a scree slope (Figure 6). The walk from Johnson Creek to this petroglyph is approximately 100 meters with an elevation gain of 120 feet. Rock cairns and lithic flakes are associated with this site, but the petroglyph is unique in its placement from all the others. The image of tally marks, while not unheard of on the Columbia Plateau (Keyser 1992), is the only one documented within the boundaries of the base. Access to the site is open with no obstacles, nevertheless, the remoteness of the site may imply that re-visititation was limited and was not meant for frequent use.

45YA307’s distance to the river has not changed since its original mapping in 1890s. However, the historic Hanford Branch—Pacific Railroad Grade was constructed approximately 35 meters in front of the petroglyph site, cutting short the talus slope leading to the water. Today, this has become part of the Palouse to Cascades State Park Trail, as well as a road used by environmental and cultural monitors at the YTC. While currently access is steep, the road cut into the talus slope may have impacted access to the site. Still, the standing ledge at the site is narrow making movement between the three petroglyphs difficult.
Association with water continues to be a common factor in rock imagery site placement. The association between water and rock imagery should appear obvious along the Columbia River, however, all of the five sites currently closest to the water line were originally set further back, away from the river. While these sites may not originally have been on the shoreline of the Columbia River, the sites within the study area continually appear near drainages and canyons that drain into the Columbia River.

Additionally, P2-BLS-PS500 is located a considerable distance from the Columbia River – at over a kilometer – and from surrounding drainages. The site is set at an elevation too high to be considered directly associated with water. Nevertheless, P2-BLS-PS500 has one of the widest viewsheds, encompassing most of the river and its many tributaries, within the project area. The rock pile features, and the site’s distance from other resources and sites, implies there may be a special significance for this site and could warrant further research. That is, however, outside the scope of this study.

*DSstretch*

DSstretch proved helpful to improve the photographs at certain sites. DStretch can help enhance pigment in photographs for use in the site form. DStretch can also help bring to light pigment that went previously unnoticed (Figure 5). Several filter settings come pre-programed into DStretch to make it easier to use. Several manual adjustments are available to enhance or retract from certain features. For more advanced users, filters can be created and saved from scratch. For this project, I used the available pre-programmed filters, but adjusted the intensity with which they were applied. Figure 15
below, for example, has been adjusted to an LRD colorspace with an intensity scale of 20. The adjustments represent the enhancement of certain pigments with the suppression of white and black hues (Harman 2008).

Below are some examples of rock imagery panels processed through DStretch (Figures 15 and 16).

Figure 15. Panel 1 at 45KT208 processed through DStretch (LRD, scale 20). Enhanced image shows additional pigment above main figure.
Discussion: DStretch as a Documentation Aid

Pictographs can be difficult to distinguish in photography (Figure 12). The time of year and amount of sunlight can also affect the way that pictographs are seen and drawn. DStretch has been a useful tool in accentuating details that may no longer be visible with the naked eye or that are not reproduced through photography. For example, site 45YA99 contains a large pictograph that is barely perceptible in the field, and even less so in the
photograph to be included in the site form. Figures 17 and 18 below highlight the benefits of using DStretch for relocation and analytical purposes.

Figure 17. Comparison of Photo 281. Panels 2 and 3 at 45YA99. Top: Original unaltered image. Bottom: Image processed through DStretch (YRD, scale 12.5).
Additionally, and more importantly, DStretch can also be a useful way to unveil hidden elements that have not been documented in the past or to determine if a panel has been damaged between site assessments. Referring to a previous example in Section 4 of this paper (Figure 5), site 45KT338 contained pigment that could not be seen with the naked eye and had not previously been documented.
While DStretch has become a key instrument in documenting pictographs, it is not always useful for accentuating petroglyphs in the same way (Figure 19). The color-fill matrix cannot distinguish the subtle differences between lightly abraded rock and the naturally weathered rock. In other cases, it is difficult to distinguish between rock that has natural coloration and petroglyphs that have a combination of pigment and abraded elements (Figure 20). Nevertheless, DStretch can be useful when applied to petroglyphs that are heavily abraded to verify certain elements that may be difficult to distinguish in the field (Figure 21). Regardless, scaled drawings in the field are crucial for the preservation of all rock imagery. Presently, DStretch is the most cost-effective, non-invasive, rock imagery research technology available. Until a similar substitute is available for petroglyphs, scaled drawings will continue to be necessary.
Figure 19. Comparison of Photo 323, Panel 6 at 45KT208. Top: Original unaltered image. Bottom: Image processed through DStretch (RGB0, scale 15).
Figure 20. Comparison of Photo 247. Panel 2 at 45YA307. Top: Original unaltered image. Bottom: Image processed through DStretch (LAB, scale 15).
CHAPTER V

GIS – VIEWSHED ANALYSIS

Results of Viewshed Analysis

For the purposes of performing a viewshed analysis, it is important that the viewsheds were illustrated accurately to demonstrate a historical view of the landscape. A few key points needed to be addressed to accomplish this. The GPS point needed to be in precisely the right location to derive the appropriate viewshed. The one-meter LiDAR data used to get such a precise representation of the viewshed from that GPS point required a lot of time and computer processing power. Lastly, the cultural data to be incorporated into the viewshed analysis is difficult to get with a very limited number of individuals having permission to download the locational geodatabase from WISAARD. This geodatabase encompasses the entirety of Washington State and must be downloaded as a whole. The large amount of information contained in that dataset requires a huge amount of data storage. The latest download the university received was too large and could not maintain the appropriate feature classes for all sites. Therefore, sites projected as a single point in WISAARD, were unable to maintain correct spatial reference and instead projected as large circles after the data transfer (Figure 21). The results from eleven of the twelve sites produced viewsheds accurately illustrating what was seen in the field. One site proved particularly difficult due to issues discussed in the results section below. Overall, the visibility analysis was successful and produced useful viewsheds reflecting personal field experience and panoramic photographs taken in the field.
Tables of the archaeological site encompassed within the viewshed were compiled using the data from the WISAARD database. Please see Appendix B for this information.

This section will describe, in further detail, findings by site location.

45KT208

The viewshed for this site extends to encompass site 45KT338, meaning they are in line of sight of one another (Figure 22). The viewshed for this site also includes Mount Baldy on the east bank of the Yakima River, which is a TCP. Although the walls of the basalt outcrop face south, the brightest, most visible images sit on the middle terrace where the viewshed extends primarily southwest, up the canyon, toward Mount Baldy. Among the sites in Lmuma Creek, this site has the widest extending viewshed. The second set of petroglyphs sit on the lowest terrace. The viewshed extending from this is far smaller and narrower and faces directly south (Figure 23). This site sits in the northwest side of an abrupt S-shape curve in the stream. The viewshed for 45KT208 encompasses twenty-nine pre-contact archaeological sites.
Figure 22. Viewshed from 45KT208. Note the uniform circular shape of many sites with incorrect spatial reference.
45KT338

The viewshed for this site extends toward site 45KT208, meaning they are in line of sight of one another. This site looks north with a very limited view, but also looks northeast toward an unnamed peak further in the distance whose highest point 2912ft (Figure 24). This peak sits between the North Fork Lmuma Creek and the northern split of the main Lmuma Creek. The ridge trends in a crescent shape unlike the rest of the ridges in the surrounding landscape. The site itself sits on the southwest side of an abrupt S-shape curve in the stream. The viewshed for 45KT338 encompasses three pre-contact archaeological sites, as well as the housepits and artifacts that are associated with the same site.
The viewshed for this site also extends to Mount Baldy on the east bank of the Yakima River (Figure 25). The designation for this site contains two basalt outcrops sitting across a north/south trending canyon from each other. The outcrops sit near each other. Locus 1, east of the canyon, looks east, down the canyon toward site 45KT338, but the viewshed does not encompass the site. However, Locus 2 has a much wider viewshed extent – west, east and south. Locus 2 sits in a position to see the east side of the north-south trending canyon on the other side of the creek. This location may be advantageous...
for watching game animals walk toward Lmuma Creek through the canyon. Locus 1 can see the west side of the north-south trending canyon across the creek. The viewshed for 45KT345 encompasses four pre-contact archaeological sites.

![Figure 25. Viewshed from 45KT345, Loci 1 and 2.](image)

45KT347

As stated in the introduction of this section, conducting the visibility analysis for site 45KT347 was the most difficult of the sites within the study area. Three methods were used to take GPS coordinates for this petroglyph: the Avenza cellphone application, a Garmin, and a survey-grade Trimble GPS unit. All three units placed the GPS coordinates a minimum of 30 meters away, each in a different location. Google Earth and ArcGIS have been used during the course of this analysis to verify and correct slight
inaccuracies in UTM coordinates taken in the field with success. However, the
topography at this site does not contain obvious markers in the terrain nor steep
embankments that are easily identifiable from a Google Earth image except a large
cement block visible on the aerial and located less than 10-meters from the site. The
coordinates were placed at an approximated location based on the closest visible markers
on the aerial. Therefore, the viewshed projecting from this rock imagery, at best, only
approximates the true viewshed. Using the panoramic photograph taken in the field, I can
verify the accuracy of the represented viewshed. After several attempts to reposition the
site point in ArcGIS, the viewshed continues to be inaccurate. Thus, a detailed
description is unwarranted, as it does not represent an accurate representation.

Figure 24, below, is a 3-D model of the viewshed from 45KT347. While the
landmarks appear to be in the correct locations in the image of the map, those landmarks
are not on the correct topographic location. Whereas 45KT347 is actually located a few
meters above the creek bed, the current map positions the site at level or below the creek
bed with an obstruction to the southeast. A small landmark that is not included in the
viewshed, but could be seen from the site, is the cluster of trees at the creek bend (circled
in Figure 26). The most notable indication that the viewshed is incorrect is the gap in
view of the hillside across the creek. Note in Figure 27 that the entire hillside across the
creek is visible.
Figure 26. Digital viewshed from 45KT347, inconsistent with panoramic photo and first-hand experience. Cluster of trees circled.

Figure 27. Panoramic from 45KT347. Note height of site compared to creek bed and to elevation of site in figure above. Cluster of trees in the distance circled.

45KT723

The viewshed for this site extends to parts of the Boylston Mountains (Figure 27). This site is the only rock imagery documented in the YTC that is not on the wall of a basalt outcrop but sits on a solitary rock. Similarly, this is one of only two sites where the rock imagery sits horizontally and faces upward. This site has the widest viewshed of all.
inland rock imagery sites. While the position of the site allows for a view of the entire hillside across the stream, it misses almost every canyon across the stream except for the one directly across from the site. This site sits higher, in a much further removed location from suitable basalt outcrops than other panels. Sixty-two pre-contact archaeological site are encompassed within the viewshed for 45KT723.

Figure 28. Viewshed from 45KT723.
45KT1160

The viewshed for this site extends toward the newly documented site, P2-BLS-PS500, meaning they are in line of sight of one another. 45KT1160 does not sit as high off the ground as other sites; however, the viewshed extends far up and down the Columbia River (Figure 28). The viewshed encompasses Sentinel Gap, the Sentinel Mountains and Umtanum Ridge. The four rock imagery panels at this site are part of a much larger archaeological site, which may have also been part of a large base camp (Arthur 2001, Earth Imaging Associates 2002, Landreau 1996). 45KT1160 sits near site 45KT001 and 45KT044. All three sites may have been part of one base camp site that has been arbitrarily assigned multiple archaeological designations. The panels on 45KT1160 sit on south side of a wide curve in the Columbia River. The viewshed for 45KT1160 encompasses 292 pre-contact archaeological sites, eight of which are within 2 kilometers and on the same side of the river.
45YA047

This site sits at the confluence of Selah Creek and an ephemeral stream from the canyon north of the panel (Figure 29). Of the four panels at this site, those facing west – from which the visibility analysis was performed – sit on a higher rock and can mostly see the confluence of the streams and the canyon walls to the south. The panel facing south sits directly on the ground. The site rests on the northwest side of an abrupt S-shape curve in the stream. The site sits low inside the canyon of Selah Creek and has a very
limited viewshed. Push-Tay, a TCP, sits just south of the canyon, but from the location of the rock imagery site, Push-Tay cannot be seen. The viewshed for 45YA047 encompasses four pre-contact archaeological sites.

Figure 31. Viewshed from 45YA0047.

45YA099

The viewshed for this site extends primarily north and east (Figure 30). This site was placed on a basalt rock wall that clashes with the landscape as it stands alone and distinctly faces northeast. Therefore, the viewshed extends up the river toward Sentinel Gap and the Sentinel Mountains. An ephemeral stream runs directly north of the site and flows into the Columbia River. The viewshed for 45YA099 encompasses 645 pre-contact...
archaeological sites, three of which are within 2 kilometers and on the same side of the river.

![Map showing archaeological sites and viewshed](image)

Figure 32. Viewshed from 45YA0099.

### 45YA307

Being on the Columbia River, this site also projects a wide viewshed (Figure 31). The viewshed for this site is comparable to the viewshed projected by 45KT1160. However, compared to the other rock imagery sites, this one was one of the more difficult one to reach. The viewshed for 45KT307 encompasses sites 45KT1160 and the Temp 1
site. Sentinel Gap and the Sentinel Mountains can also be seen from this location. The viewshed for 45YA0307 encompasses 699 pre-contact archaeological sites, seven of which are within 2 kilometers and on the same side of the river.

![Figure 33. Viewshed from 45YA307.](image)

**Temp 1/ P2-BLS-PS500**

The viewshed for P2-BLS-PS500 encompasses all sites downstream along the Columbia River within the project boundaries (Figure 32). This site looks toward the highest point of the Saddle Mountains, Sentinel Gap and encompasses a large portion of
the Rattlesnake Hills beyond Priest Rapids. P2-BLS-PS500 sits high above a major curve of the Columbia River. As this site overlooks Auvil Orchards, the current in-field viewshed is blocked by a stand of trees planted by the orchard owners as a wind-block. However, the digital visibility model allows for a true representation of the original viewshed from the site. The viewshed for P2-BLS-PS500 encompasses 455 pre-contact archaeological sites, sixteen of which are within 2 kilometers and on the same side of the river.

Figure 34. Viewshed from P2-BLS-PS500.
45YA308

While 45YA308 sits along the Columbia River, the viewshed for this site does not reflect the same landscape of the other sites on the river (Figure 33). Rather, it resembles the viewsheds of the sites within the canyons further inland, on the other side of the base. The viewshed cast from this site is much narrower and primarily orients east across the river and west up the canyon. The site sits at the end of Cow Canyon 155 meters from the current water line, but almost 300 meters from the original water line. While the cliff face itself faces south, the view south is obstructed by the opposing canyon wall. Unlike the other sites on the Columbia River within the project area, this site does not look north toward Sentinel Gap. However, like the sites within the canyons of Lmuma and Selah creeks, the site sits on a major curve within the canyon. According to the GLO maps, the site sits on the last major curve in the stream before it spills into the Columbia River. The viewshed for 45KT308 encompasses nine pre-contact archaeological sites.
David’s Site

This site, and 45YA308 to the north, share many similarities. This site sits at the end of Sourdough Canyon 145 meters from the current water line, 225 meters from the original water line. This site also rests on the east side, north of the last major bend in the creek before letting out onto the Columbia, according to the GLO map. Rather than looking north toward Sentinel Gap, the viewshed orients toward Umtanum Ridge. The site itself is placed on tall south-facing basalt bluffs at the foot of a creek turned into a flood plain. A major difference in the placement of this site in comparison to others is that it does not sit at a large bend in the river; however, the viewshed does extend directly toward the bend in the river.
David’s Site sits just south of site 45YA006; a habitation site containing nine housepits. 45YA006 sits on top of the bluffs and extends north. While this habitation site is not encompassed in the viewshed emanated from David’s Site, the site’s presence may have had some influence on the creation of David’s Site. Because we cannot be certain of the temporal association, we cannot make the determination that the two sites are directly associated. Sites 45YA005 and 997 are both captured within the viewshed generated from David’s Site. Both are lithic sites with 45YA005 also containing tools, bone, charcoal and trade beads (Campbell 1950). The viewshed for this site encompasses 456 pre-contact sites, three of which are near the site.

Figure 36. Viewshed from David's Site/45YA0013.
The resulting viewsheds do not provide any strong evidence that imagery sites were purposefully placed within sight of each other. However, in a few cases, some sites do fit this parameter, including sites 45KT208 to 45KT338 and 45KT1160 to 45YA307. Based on the visual representation of all rock imagery sites on the map, it is evident that each is located near a source of water, regardless of permanence. The sites located inland, namely the sites within the canyons of Selah Creek and Lmuma Creeks sit to one side of S-shaped curves in the streams. These sites sit fairly low to the ground within the canyons, preventing the viewshed from extending to major geographic provinces; however, this is not true of all sites. Sites in canyons sit fairly low on the rock outcrops even when there are suitable and accessible rocks higher up. While not every site’s viewshed reached the top of prominent mountains, some do see prominent mountain ranges. Overall, the sites along the Columbia River have much wider viewsheds than those which sit inside of canyons.

GIS – Root Soils Locations

The location of rock imagery sites within the project area have consistently included some amount of elevation gain. Walking up a talus slope or hopping between rocks is not uncommon to reach rock imagery sites. This would suggest that the images were created by younger individuals rather than the elderly. Based on the data gathered by Gideon Cauffman (2010), communal root gatherings take place in areas more easily accessible as women of all ages participate. For his thesis, Cauffman (2010) gathered raw data on soils that meet the criteria for the growth of traditional cultural root crops to
create a root crop area predictive model. During interviews with elders from the Yakama Nation, Cauffman realized that root gathering areas must be easily accessible on soft slopes, and today, preferably near roads (Cauffman 2010). It stands to reason, that this same logic applied when root gathering was practiced before the introduction of restrictive boundaries throughout the study area. Because the YTC has had access restrictions since its inception in 1941 (US Army Bases 2018), knowledge of many traditional root gathering areas has been lost (Cauffman 2010). With Cauffman’s permission, I have applied his predictive soils model to this viewshed analysis for further investigation.

Based on the predictive model, results of rock imagery association to predicted root crop soils are listed below in table format (Table 3) and in maps (Figures 25 – 30).

<table>
<thead>
<tr>
<th>Area</th>
<th>Site Number</th>
<th>Type of root</th>
<th>Distance of site from root area in meters</th>
<th>Position from viewshed</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lmuma Creek (Figure 25)</td>
<td>45KT208</td>
<td>Bitterroot</td>
<td>220</td>
<td>Inside viewshed</td>
</tr>
<tr>
<td></td>
<td>45KT338</td>
<td>Bitterroot</td>
<td>20</td>
<td>Viewshed faces away</td>
</tr>
<tr>
<td></td>
<td>45KT345 L1</td>
<td>Lomatium</td>
<td>50</td>
<td>Small, west portion</td>
</tr>
<tr>
<td></td>
<td>45KT345 L2</td>
<td>Lomatium</td>
<td>5</td>
<td>Inside viewshed</td>
</tr>
<tr>
<td></td>
<td>45KT347</td>
<td>Lomatium</td>
<td>165</td>
<td>N/A</td>
</tr>
<tr>
<td>Johnson Creek (Figure 26)</td>
<td>45KT723</td>
<td>Bitterroot Lomatium</td>
<td>320&lt;br&gt;86</td>
<td>Inside viewshed</td>
</tr>
<tr>
<td>Site Name</td>
<td>Code</td>
<td>Species</td>
<td>Viewshed</td>
<td>Notes</td>
</tr>
<tr>
<td>-------------------------------</td>
<td>----------</td>
<td>-------------</td>
<td>----------</td>
<td>---------------------------------</td>
</tr>
<tr>
<td>Selah Creek (Figure 27)</td>
<td>45YA47</td>
<td>Lomatium</td>
<td>0</td>
<td>Site sits within</td>
</tr>
<tr>
<td>Columbia River (Figures 28-30)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>P2-BLS-PS500</td>
<td></td>
<td>Lomatium</td>
<td>175</td>
<td>Inside viewshed</td>
</tr>
<tr>
<td>45KT1160</td>
<td></td>
<td>Lomatium</td>
<td>400</td>
<td>Inside viewshed</td>
</tr>
<tr>
<td>45YA99</td>
<td></td>
<td>Lomatium</td>
<td>80</td>
<td>Viewshed faces away</td>
</tr>
<tr>
<td>45YA307</td>
<td></td>
<td>Lomatium</td>
<td>90</td>
<td>Viewshed faces away</td>
</tr>
<tr>
<td>45YA308</td>
<td></td>
<td>Bitterroot, Lomatium</td>
<td>BR: 580 LM: 330</td>
<td>Viewshed faces away</td>
</tr>
<tr>
<td>David’s Site</td>
<td></td>
<td>Lomatium</td>
<td>200</td>
<td>Viewshed faces away</td>
</tr>
</tbody>
</table>

Figure 37. Predicted Root Crop areas on Lmuma Creek with sites and Viewsheds.
Figure 38. Predicted Root Crop areas on Johnson Creek with 45KT723 and Viewshed.

Figure 39. Predicted Root Crop areas on Selah Creek with 45YA47 Viewshed.
Figure 40. Predicted Root Crop areas on the Columbia River with viewsheds for P2-BLS-PS500 (top) and 45KT1160 (lower).

Figure 41. Predicted Root Crop areas on the Columbia River with viewsheds for 45YA99 (top) and 45YA307 (lower).
Based on Cauffman’s (2010) data, rock imagery sites within the study area are likely not directly associated with the predicted root crop soils, nor are they associated with the known root gathering areas utilized today. It appears that any loose association between rock imagery and lomatium arises from lomatium’s association with water. Lomatium is predicted in areas closest to sources of water, in much the same way as rock imagery.

**Discussion: Viewshed Analysis**

The viewshed, in accordance with the field visits, indicate that water was the primary common element among the rock imagery sites. Based on the viewshed, it seems that intra-site visibility was not a primary focus. However, a strong association with S-
shaped curves in the nearest stream at the location of the rock imagery site has continuously emerged, but it is unclear whether that association is intentional. The viewsheds emanating from rock imagery sites within canyons primarily encompass the landscape inside the canyon, rather than the area up and over toward grand panoramas. However, even within the canyon of Lmuma Creek, two sites do have a view of a TCP. The majority of viewsheds from rock imagery sites along the Columbia River look northeast toward Sentinel Gap, a known special marker in the landscape. Based on the evidence provided by the viewsheds, corridors for game hunting, and views to root crop resources cannot be confirmed to be a primary focus for choosing locations to establish a rock imagery site. However, there is a possibility that horizon events may be a contributing factor.

In addition to the various archaeological sites that rock imagery viewsheds encompass, the sites outside of the viewshed are part of the same cultural landscape. Using the North American tradition of establishing terminal site boundaries creates a detachment between sites and the culture area of which they are a part. In this way, only unassociated patches remain of a utilized cultural landscape. The cultural landscape of the YTC is one which has been traveled frequently. Recognizing the interconnectedness between currently detached archaeological sites may be helpful in establishing eligible districts in areas with current minimal protections.

Why certain rock formations were chosen over others remains unclear. While some associations between rock imagery and landscape have been established, at this
point, I can only generate a list of contributing factors. The placement of rock imagery may be as simple as ease of access, or as complicated as the azimuth of celestial alignments. Contributing elements to rock imagery inside the canyons in the study area could include ease of access, proximity to water, placement near a sharp s-shaped curve, and a suitable drawing surface. Elements of those on the Columbia River include proximity to a water source other than the river and a bend in the river. 45KT723 is an outlier in this as well. It sits above the canyon overlooking several hills, it is far from the three nearby potential water sources, and it is set on a single upright boulder rather than the nearby columnar basalt formations that are typical of rock imagery sites.

Although listing contributing factors for typical rock imagery locations is an oversimplification that may exclude real-world influences during the creation of rock imagery, it can be a useful tool when surveys include time constraints. No one single blanket definition can be put forth of exact locations to encounter rock imagery. Each culture’s perspective of the landscape will alter rationale for placing rock imagery in certain locations. Further, it is useful to question some of these guidelines as it may be obscuring the discovery, and subsequent protection, of rock imagery in overlooked areas. Nevertheless, even an oversimplified list of characteristics can be useful when time constraints affect the ability to survey the entire landscape.
CHAPTER VI

CONCLUSIONS, FUTURE RESEARCH, AND RECOMMENDATIONS

Conclusions

This research has been done in part to demonstrate the connection between people and the landscape in which they lived. A main goal of this study was to find associations that link the way in which people thrived in a minimally engineered, yet heavily utilized resource landscape. Additionally, as resource managers, we need to make standardization in documenting rock imagery a priority in order to help preserve its historical context.

Finally, to address the three initial questions posed for this paper.

In what ways could rock imagery documentation be standardized and improved, using non-invasive techniques, to ensure completeness and accuracy of results?

The field of archaeology still lacks practical standardized methods for rock imagery documentation. This lack of standardization is creating an inventory of rock imagery sites with incomplete and inaccurate information. While researchers have moved away from potentially harmful practices that involve directly manipulating the imagery, drawings to scale are not a standard practice and photographs are still not taken on every occasion. Rock imagery documentation can and should be standardized to a certain degree. It is not necessary to draw rock imagery to scale on every visit; however, it is important to photograph the panels that are observed on every occasion. While a detailed explanation of every panel is useful for identifying characteristics, identifying rock
imagery is a visual experience that is difficult to visualize without photographic evidence. Additionally, a standard checklist for rock imagery assessment is useful for identifying changes during subsequent visits.

As researchers, we are attempting to replicate the images as we currently see them; however, the exact contents of the imagery will remain unknown to us. While standardizing rock imagery documentation should be a priority, we should not rely on a sole method. A combination of methods that involves a standardized checklist to assess changes in the rock imagery, drawing the imagery to scale, and photographing the imagery would help minimize a researcher’s personal infusion and bias. However, standardization does not mean impeding progress in research technologies. Optional additions such as DStretch or 3D imaging are useful to researchers as long as it does not cause unintentional damage to the rock imagery.

Field documentation was important for this research largely because the majority of sites have lacked updates for over twenty years. It was also important to show how documentation techniques have changed. As part of this re-documentation effort, it was my goal, in partnership with the YTC, to provide an assessment of the condition of the rock imagery on base and be able to provide any recommendations for additional protection, if needed. While archaeology, as a field, has standardized documentation guidelines for many site types, rock imagery documentation lacks that same standardization. With the completion of this research, YTC cultural resource managers will have a permanent baseline by which to assess these sites. Additionally, revisiting
each site confirmed that rock imagery sites within the study area continue to be easily accessible. While today remote areas are accessed by vehicle, the terrain throughout the study area is not impassable and the sites themselves can be reached with little physical demand.

As part of the documentation process, in what ways does processing photographs through digital enhancement programs, such as DStretch, add value to the documentation and management of pictographs and petroglyphs?

DStretch, while not a new technology, is emerging as a mainstream research tool for rock imagery. Several CRM companies have seen the benefits in utilizing DStretch to enhance pictographs for use in their research and site forms. At the YTC alone, many of the pictographs have faded to the point that they are difficult to discern in photographs. Digital enhancement through DStretch has allowed the pictograph to stand out in photographs. Adding a digitally enhanced photograph to the site form can add essential information to relocate a pictograph panel. This has made tracking and assessing the state of pictographs easier and more accurate.

How can viewshed analysis be used for identifying horizon events; corridors for water, people, and animals; or views to resources like roots or hunting grounds?

Performing a visibility analysis from rock imagery sites at the YTC was an experimental attempt to connect the significance of permanent markings on the landscape to the cultural landscape that surrounds it. This cultural landscape has been created by the
people, which inhabited and utilized the area. While the viewsheds only captured horizon events in approximately sixty percent of the sites in the study area and did not capture resources in the manner which was expected, this analysis did bring to light interesting geographic features surrounding the imagery and could prove useful for future research. This viewshed analysis was conducted primarily to make a case for the protection of cumulative cultural landscapes. The images rendered from this research demonstrates the interconnected nature of the geographic and cultural features of the cultural landscape. These visuals may in turn provide landowners or leadership with a visual to understand cultural resource protection arguments.

However, the viewshed analysis within the study area showed its limitations both within the canyons and on the Columbia River. Within the canyons, the digital viewshed was limited due to the functionality of the visibility tool itself. The purpose of the tool is to assess line of sight from a specified location. However, this may not reflect the interpretation of the cultural landscape that a culture which values a resource landscape maintains. For example, at site 45YA47, the line of sight does not reach Push-Tay, just over the opposite side of the canyon. However, regardless of whether Push-Tay was encompassed within the viewshed, the resource landscape in which individuals utilized the cultural place may have been enough to provide a constant reminder of Push-Tay's location on the landscape. The location of this rock imagery is the only available suitable rock face within this spot of the canyon, and the viewshed of the site faces the direction of Push-Tay. Conversely, along Lmuma Creek, suitable rock faces are plentiful, but some
are steeper and less accessible than others. Located within this canyon, the viewshed from sites 45KT208 and 45KT345 was wide enough to encompass Mount Baldy. These sites were also easily accessible, and they were near to the water.

On the Columbia River, the viewshed encompasses a much wider view where five of the six sites on the Columbia River, within the study area, have a view toward special horizon events, Sentinel Gap and Umtanum Ridge. Yet, archaeological sites located at a great distance from the imagery on the Columbia River are encompassed within the viewshed. These further sites may not hold special significance or association with the rock imagery site, regardless of their inclusion within the viewshed. Perhaps a spatial analysis that determines sites within a closer range, rather than line of sight, would produce results more fitted to the resource landscape surrounding the imagery. A buffer analysis, another tool used in ArcGIS, would allow for spatial measurement based on distance parameters from the rock imagery site.

Additionally, in areas where the viewsheds have the widest panoramic extents, the viewshed from the rock imagery site tends to face away from predicted root crop areas. In canyon areas, the viewsheds do not necessarily encompass predicted root crop areas, with the exception of 45YA47. However, the sites within canyons are generally in closer proximity to root crop areas than those on the Columbia River.

What continued to be evident, in the field, was the bypassing of other potentially suitable rock for creating rock imagery. Viewshed analysis is not suitable for determining rock imagery placement based on rock or landform type. However, it was a way to
manageably highlight the availability of nearby cultural resources, which can then be analyzed using a different analysis method.

While experimental in nature, this analysis has eliminated certain questions about patterns in the landscape and associations with rock imagery. This viewshed analysis highlights cultural sites that can be seen from the location of the rock imagery site. However, this research cannot verify that the viewshed is the driving force behind rock imagery placement within the study area, only that the potential exists. With this information, it is possible for future researchers to conduct similar studies to verify whether other rock imagery sites within the Central Columbia River area exhibit the same qualities laid out in this study. It is also possible for others to analyze other aspects on the landscape that were not used in this study. Overall, visual representations such as the ones laid out in this thesis can aid cultural resource managers in bolstering cultural resource protection arguments.

Limitations

With the conclusion of this research, certain challenges have become apparent. During the fieldwork process, the combination of travel time and the need for a proper vehicle created short field days. Due to short field days and the number of panels at rock imagery sites, most sites required multiple days to complete. This was an added complication due to the coordination efforts necessary to work with a team and access the study areas. The low accuracy of the GPS units in the field was another hurdle that could be corrected, to a certain extent, within GIS. However, because the data was corrected
using aerial photography, corrections are ultimately not guaranteed accurate and a margin of error will continue to exist. The biggest challenge during the data analysis portion occurred when correcting coordinates for site 45KT347. This ultimately resulted to be an error with the LiDAR data as well as the GPS data. The coordinates for this site were erroneous, even when using three types of GPS units, and the LiDAR contains incorrect elevations. This leads me to conclude that something within the vicinity of the site distorts geo-locational equipment. Part of discerning the cultural landscape included applying the cultural sites located within the viewshed. However, due to the issues discussed in Section 5, Results of Viewshed Analysis (Figure 21), the cultural sites added were not a true representation of the actual sites located on the landscape.

When conducting the viewshed analysis of the predicted root crop areas, it became apparent that a buffer analysis might have been more productive than a viewshed analysis for discerning the cultural landscape. Initially, the idea that rock imagery was directed outward toward a landscape meant that would incorporate places of special significance and artefactual remains. However, these parameters are not necessarily within view, but may still be located nearby. Lastly, while adding cultural artifacts to the viewshed analysis adds certain value, it does not indicate that all the cultural artifacts are temporally associated.

*Future Research*

Overall, we have learned that something other than the viewshed may be the driving force behind rock imagery placement. While this research cannot solidly provide
proof that the viewshed contributes to placement within the Central Columbia River area, future spatial research of the area’s rock imagery can still be expanded upon. Future researchers may be able to apply the same criteria to other rock imagery sites in the Central Columbia River area to determine whether other sites have a view toward special horizon events.

A complete survey of the steeper terrain at the YTC should be conducted to ensure that no rock imagery is neglected and potentially endangered. Small munitions testing is regularly conducted against mountainsides to reduce the risk of rogue fire. Without a complete survey of previously avoided steep terrain, it is possible that unknown rock imagery will be damaged during weapons testing in non-environmentally regulated areas.

Site 45YA308 requires an updated site evaluation as well as a full documentation. The last site assessment was conducted in 1996. The site assessment conducted during the summer of 2019 was a brief damage assessment with photographs.

New rock imagery was observed at 45KT1160, but we were unable to draw Panel 2 to scale during the fall 2018 field visit, nor relocate a newly observed panel from the summer 2018 field visit due to the high waterline. These panels should be documented as part of the site, as they are currently inside the site boundary.
Recommendations

As stated in Section 3, documentation procedures for rock imagery must be standardized, as they are for other site types. In reality, the world of Cultural Resource Management (CRM) archaeology does not allow for new scaled drawings during every assessment. However, rock imagery must be drawn to scale at least once to maintain a baseline for damage assessment. Photographs will remain the preferred method for assessing archaeological sites, but photographs are a supplement to any site form, not a standalone method. While scaled drawings may appear tedious and time consuming to the unaccustomed rock imagery researcher, the process becomes customary over time, the same way, for example, documenting a historic cabin becomes customary. Additionally, scaled drawings on letter-size paper ensure that the field drawings can be included with the site forms or reports. Unlike the full-size replications of rock imagery traced on clear acetate plastic film (Barrow 1957), scaled field drawings are a portable and useful tool for relocation.

As part of future research to complete documentation of the rock imagery at 45KT1160, vandalism should be monitored due to the exposed nature of this site to recreationists.

Over time, researchers have come to realize that physically touching the rock imagery can have deleterious effects (Loendorf and Lawrence-Smith 2015). From the literature, it seems it is becoming common practice to avoid making direct contact with the imagery (site 3D scans, aerials, and photography). However, this point has rarely
been explicitly stated (Comer 2013). Too much physical contact can wear away the stone and the imagery. As a rule, it is up to researchers to refrain from making direct contact with the imagery and to instruct students and peers to adhere to the same.

Further, the rock imagery sites within the study area are protected through location information restrictions and the use of Seibert stakes. Regardless of these protections, rock imagery sites inside the study area continue to be vandalized. The rock imagery at 45KT1160 sits on the Columbia River, in view of recreationists with a keen eye. This area of the river does not warn of military property boundaries. 45KT208 is protected by Seibert stakes from both the north and southern road entrances. Still, this site was further vandalized during the course of our investigations. The site sits on the border of two training areas, both of which receive frequent training activity.

Recommendations to help prevent vandalism at 45KT1160 include placing signs at strategic locations along the shore of the Columbia River to deter recreationists from approaching the boundary. Recommendations for protection of 45KT208 include diverting staging areas further from sensitive rock imagery locations to prevent soldiers from wandering into these areas during down time. Seibert stakes are currently placed in strategic locations for this site. Nevertheless, the site is prominent and visible from the creek bed, where soldiers might wander. Wildlife cameras placed to monitor the site is another recommendation that may help stop the current vandalism (Mills, Personal Communication 2019).
Currently, archaeological sites on the YTC can be listed as Eligible for inclusion into the National Register of Historic Places (NRHP), but sites cannot be included in the listing (Valencia-Gica 2013). Nevertheless, the CRM program on base ensures that all eligible archaeological sites are provided the same protections that listed sites are provided. Presently, the preferred method for documenting and tracking archaeological sites requires a terminal site boundary. Site boundaries makes maintaining site records and tracking sites easier, especially for infrastructure development purposes. Because of the YTC’s function, infrastructure development is not frequent. Therefore, this provides a prime testing area to implement the Landscape Archaeological model to identify strengths and weaknesses in the protection of cultural resources. Under the current model, flake scatters, or culturally modified stone remnants, do not constitute as eligible for the NRHP. Implementing the landscape archaeology model can aid in connecting discrete sites into a whole, which may provide a pattern to facilitate regeneration of native plant habitats and species – a goal of cultural and environmental resource managers at YTC (Personal Communication 2019).

While the NRHP’s guidelines specify that sites are to be visited at least every ten years, external factors, such as wildfires, can, and do, influence how cultural resource managers allocate field visits. Through this report, I have identified sites that are in danger of further damage through vandalism or extreme weathering. I recommend that rock imagery sites with special mention in this report be monitored more frequently to assess further damage. Further, I recommend that rock imagery sites at the YTC be
assessed at a minimum of every ten years. Because nine of the eleven rock imagery sites
are clustered within Lmuma Creek or along the Columbia River, groups of rock imagery
sites can be quickly assessed for major changes in a single field day.
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University of Washington

US Army Bases

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Vazquez, Cesar Vazquez

Waitt, Jr. Richard B.

Wanapum

Washington Department of Fish and Wildlife

Washington State Department of Ecology
Washington State Department of Natural Resources (WADNR)

Western Regional Climate Center

Western Regional Climate Center

Wheatley, David

Whitley, David S.


Wilkinson, Tony J.
APPENDIX A

Extension of Documentation Tools and Examples

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**IMACS ROCK ART ATTACHMENT**

1. Number of panels at this site:
2. This form is for panel number:
3. Panel is situated on:
   - [ ] Bedrock (A)
   - [ ] Boulder (B)
   - [ ] Cave Interior (C)
   - [ ] Cliff Face (D)
   - [ ] Portable-Small Stones (E)
   - [ ] Rockshelter Interior (F)
   - [ ] Structure (G)
   - [ ] Other (H)

Additional Information:

4. Worked Surface is:
   - [ ] Vertical ±10° (A)
   - [ ] Horizontal ±15° (B)
   - [ ] Slanting (B)
   - [ ] Overhead (D)

Additional Information:

5. Type of Rock:
   - [ ] Basalt (A)
   - [ ] Limestone (C)
   - [ ] Tuff (E)
   - [ ] Unknown (Z)
   - [ ] Granite (B)
   - [ ] Sandstone (D)
   - [ ] Other (X)

Additional Information:

6. Background:
   - [ ] Natural (A)
   - [ ] Patinated (C)
   - [ ] Smoke Blackened (E)
   - [ ] Painted (B)
   - [ ] Plastered (D)
   - [ ] Other (X)

Additional Information:

7. Categories and Techniques:
   - [ ] Petroglyphs
     - [ ] Abraded (A)
     - [ ] Incised (C)
     - [ ] Solid pecked (E)
     - [ ] Stipple pecked (F)
     - [ ] Cupule (B)
     - [ ] Scratched (D)
     - [ ] Stipple (L)
   - [ ] Pictographs
     - [ ] Monochrome (G)
     - [ ] Outlined (I)
     - [ ] Solid (J)
   - [ ] Polychrome (H)

Additional Information:

8. Petroglyph regeneration:
   - [ ] None - 0 to 5% (A)
   - [ ] Light - 5 to 30% (B)
   - [ ] Medium - 30 to 60% (C)
   - [ ] Dark - 60 to 95% (D)
   - [ ] Total - 95 to 100% (E)
   - [ ] Varies across panel (F)

Additional Information:

9. Number of figures:
   - [ ] 1 to 10 (A)
   - [ ] 11 to 20 (B)
   - [ ] 21 to 30 (C)
   - [ ] 31 to 40 (D)
   - [ ] 41 to 50 (E)
   - [ ] 51 to 60 (F)
   - [ ] 61 to 70 (G)
   - [ ] 71 to 80 (H)
   - [ ] 81 to 90 (I)
   - [ ] 91 to 100 (J)
   - [ ] greater than 100 (K)

10. Rock art figures superimposed:
    - [ ] Describe:
**IMACS ROCK ART ATTACHMENT**

11. Incorporation of natural features in design or figures:
   Describe:

12. Surface preparation prior to rock art application:
   Describe:

13. Prehistoric figure modification:
   [ ] Covering with pigment or paint (A)
   [ ] Reworking/Additions (D)
   [ ] Covering with plaster or mud (B)
   [ ] None (N)
   [ ] Obliteration - part of total (C)
   [ ] Other (X)
   Describe:

14. Panel aspect: degrees
   [ ] Multi-directional. Indicate general direction:

15. Panel dimensions (meters):
   x Area Sq. Meters

16. Height of highest rock art figure above present soil line (meters):

17. Height of lowest rock art figure above present soil line (meters):

18. Natural destructive agents, % of rock art panel affected: (Use multiples of 10%)
   [ ] % Bird/insect nest (A)
   [ ] % Surface spall (F)
   [ ] % Exposure- wind/rain (B)
   [ ] % Vegetation abutment (G)
   [ ] % Lichen growth (C)
   [ ] % Water run off (H)
   [ ] % Mineral deposits (D)
   [ ] % Mud deposits (E)
   [ ] % Other (X)

Additional information:

19. Other destructive agents, % of rock art panel affected: (Use multiples of 10%)
   [ ] % Alteration/defacing (A)
   [ ] % Obliteration (I)
   [ ] % Bullet holes (B)
   [ ] % Paint (J)
   [ ] % Chalking (C)
   [ ] % Removal-attempted (K)
   [ ] % Construction activities (D)
   [ ] % Removal-completed (L)
   [ ] % Graffiti (E)
   [ ] % Smoke backburning (M)
   [ ] % Latex mold residue (F)
   [ ] % None (N)
   [ ] % Livestock (G)
   [ ] % Other (X)

Additional information:

If warranted, provide a field sketch of the panel. Note manufacturing techniques, impacting agents, superimposed figures, colors (using Munsell color chart if possible), or any other applicable comments.

Attachment:

---

Figure A1. Example of IMACS Rock Art Attachment form used to document rock imagery, front (top) and back (bottom).
Figure A2. Example of field sketch template.
Figure A3. Example of inking template for finalized site form. Inkings completed with archival pens.
Figure A4. Example of field string grid in use. J. Morris sketching rock imagery panel to scale. Painter’s tape placed with care to avoid the imagery.
APPENDIX B

Counts of Cultural Sites Inside Viewsheds

Viewshed tables were compiled using the data from the WISAARD database. The sites counted within the viewshed contain only pre-contact sites. All counts are based on the comments section of the database. In circumstances where the site contains multiple cultural elements, the feature was chosen over the artifacts listed. Where rock imagery sites have an extensive viewshed, a selection of the sites within a 2-kilometer radius are included as well. For those on the Columbia River, only the sites on the west side of the river are included in the 2-kilometer radius. Sites may not include several inundated sites.

Table A1. List of pre-contact site types encompassed within 45KT208 Viewshed.

<table>
<thead>
<tr>
<th>Site Type</th>
<th>Count</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pre-contact lithic scatter including biface fragments</td>
<td>10</td>
</tr>
<tr>
<td>Pre-contact lithic scatter with projectile point</td>
<td>2</td>
</tr>
<tr>
<td>Chipping station</td>
<td>5</td>
</tr>
<tr>
<td>Isolate – Projectile point or projectile point fragment</td>
<td>4</td>
</tr>
<tr>
<td>Isolate – Biface, biface fragment, flake, or core</td>
<td>8</td>
</tr>
<tr>
<td>Pre-contact camp</td>
<td>-</td>
</tr>
<tr>
<td>House pits</td>
<td>-</td>
</tr>
<tr>
<td>Total</td>
<td>29</td>
</tr>
</tbody>
</table>

Table A2. List of pre-contact site types encompassed within 45KT338 Viewshed.

<table>
<thead>
<tr>
<th>Site Type</th>
<th>Count</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pre-contact lithic scatter including biface fragments</td>
<td>2</td>
</tr>
<tr>
<td>Pre-contact lithic scatter with projectile point</td>
<td>1</td>
</tr>
<tr>
<td>Chipping station</td>
<td>-</td>
</tr>
<tr>
<td>Isolate – Projectile point or projectile point fragment</td>
<td>-</td>
</tr>
<tr>
<td>Isolate – Biface, biface fragment, flake, or core</td>
<td>-</td>
</tr>
<tr>
<td>Pre-contact camp</td>
<td>-</td>
</tr>
<tr>
<td>House pits</td>
<td>1</td>
</tr>
<tr>
<td>Total</td>
<td>4</td>
</tr>
</tbody>
</table>
Table A3. List of pre-contact site types encompassed within 45KT345 Viewshed.

<table>
<thead>
<tr>
<th>Site Type</th>
<th>Count</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pre-contact lithic scatter including biface fragments</td>
<td>1</td>
</tr>
<tr>
<td>Pre-contact lithic scatter with projectile point</td>
<td>-</td>
</tr>
<tr>
<td>Chipping station</td>
<td>1</td>
</tr>
<tr>
<td>Isolate – Projectile point or projectile point fragment</td>
<td>-</td>
</tr>
<tr>
<td>Isolate – Biface, biface fragment, flake, or core</td>
<td>-</td>
</tr>
<tr>
<td>Pre-contact camp</td>
<td>1</td>
</tr>
<tr>
<td>House pits</td>
<td>1</td>
</tr>
<tr>
<td>Total</td>
<td>4</td>
</tr>
</tbody>
</table>

Table A4. List of pre-contact site types encompassed within 45KT723 Viewshed.

<table>
<thead>
<tr>
<th>Site Type</th>
<th>Count</th>
<th>Within 2km</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pre-contact lithic scatter including biface fragments</td>
<td>43</td>
<td>11</td>
</tr>
<tr>
<td>Pre-contact lithic scatter with projectile point</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Chipping station/Lithic procurement</td>
<td>14</td>
<td>5</td>
</tr>
<tr>
<td>Isolate – Projectile point or point fragment</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>Isolate – Biface, biface fragment, flake, or core</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>Pre-contact camp</td>
<td>-</td>
<td>1</td>
</tr>
<tr>
<td>Rock cairn</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>Talus pits</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Total</td>
<td>62</td>
<td>21</td>
</tr>
</tbody>
</table>
Table A5. List of pre-contact site types encompassed within 45KT1160 Viewshed.

<table>
<thead>
<tr>
<th>Site Type</th>
<th>Count</th>
<th>2km, west side of river</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pre-contact lithic scatter including biface fragments</td>
<td>111</td>
<td>-</td>
</tr>
<tr>
<td>Pre-contact lithic scatter with projectile point</td>
<td>3</td>
<td>-</td>
</tr>
<tr>
<td>Chipping station/ Procurement site</td>
<td>3</td>
<td>-</td>
</tr>
<tr>
<td>Isolate – Projectile point, fragment, or shell bead</td>
<td>22</td>
<td>-</td>
</tr>
<tr>
<td>Isolate – Biface, biface fragment, flake, or core</td>
<td>98</td>
<td>-</td>
</tr>
<tr>
<td>Pre-contact camp</td>
<td>14</td>
<td>5</td>
</tr>
<tr>
<td>House pits</td>
<td>4.5</td>
<td>-</td>
</tr>
<tr>
<td>Rock cairn</td>
<td>10</td>
<td>1</td>
</tr>
<tr>
<td>Talus pits</td>
<td>13</td>
<td>-</td>
</tr>
<tr>
<td>Rock alignments</td>
<td>9</td>
<td>1</td>
</tr>
<tr>
<td>Rock imagery</td>
<td>2.5</td>
<td>-</td>
</tr>
<tr>
<td>Rock mound</td>
<td>1</td>
<td>-</td>
</tr>
<tr>
<td>Rock shelter</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Total</td>
<td>292</td>
<td>8</td>
</tr>
</tbody>
</table>

Table A6. List of pre-contact site types encompassed within 45YA0047 Viewshed.

<table>
<thead>
<tr>
<th>Site Type</th>
<th>Count</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pre-contact lithic scatter including biface fragments</td>
<td>1</td>
</tr>
<tr>
<td>Pre-contact lithic scatter with projectile point</td>
<td>-</td>
</tr>
<tr>
<td>Chipping station/ Procurement site</td>
<td>-</td>
</tr>
<tr>
<td>Isolate – Projectile point, projectile point fragment, or shell bead</td>
<td>-</td>
</tr>
<tr>
<td>Isolate – Biface, biface fragment, flake, or core</td>
<td>-</td>
</tr>
<tr>
<td>Pre-contact camp</td>
<td>-</td>
</tr>
<tr>
<td>House pits</td>
<td>1</td>
</tr>
<tr>
<td>Talus pits</td>
<td>1</td>
</tr>
<tr>
<td>Rock imagery</td>
<td>1</td>
</tr>
<tr>
<td>Total</td>
<td>4</td>
</tr>
</tbody>
</table>
Table A7. List of pre-contact site types encompassed within 45YA0099 Viewshed.

<table>
<thead>
<tr>
<th>Site Type</th>
<th>Count</th>
<th>2km, west side of river</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pre-contact lithic scatter including biface fragments</td>
<td>277</td>
<td>-</td>
</tr>
<tr>
<td>Pre-contact lithic scatter with projectile point</td>
<td>20</td>
<td>1</td>
</tr>
<tr>
<td>Chipping station/ Procurement site</td>
<td>11</td>
<td>-</td>
</tr>
<tr>
<td>Isolate – Projectile point, fragment, or shell bead</td>
<td>34</td>
<td>-</td>
</tr>
<tr>
<td>Isolate – Biface, biface fragment, flake, or core</td>
<td>216</td>
<td>-</td>
</tr>
<tr>
<td>Pre-contact camp</td>
<td>25</td>
<td>-</td>
</tr>
<tr>
<td>House pits</td>
<td>1</td>
<td>-</td>
</tr>
<tr>
<td>Rock cairn</td>
<td>20</td>
<td>-</td>
</tr>
<tr>
<td>Talus pits</td>
<td>20</td>
<td>2</td>
</tr>
<tr>
<td>Rock alignments</td>
<td>12</td>
<td>-</td>
</tr>
<tr>
<td>Rock imagery</td>
<td>2</td>
<td>-</td>
</tr>
<tr>
<td>Rock shelter</td>
<td>4</td>
<td>-</td>
</tr>
<tr>
<td>Habitation Site</td>
<td>3</td>
<td>-</td>
</tr>
<tr>
<td>Total</td>
<td>645</td>
<td>3</td>
</tr>
</tbody>
</table>
Table A8. List of pre-contact site types encompassed within 45YA307 Viewshed.

<table>
<thead>
<tr>
<th>Site Type</th>
<th>Count</th>
<th>2km, west side of river</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pre-contact lithic scatter including biface fragments</td>
<td>302</td>
<td>-</td>
</tr>
<tr>
<td>Pre-contact lithic scatter with projectile point</td>
<td>22</td>
<td>1</td>
</tr>
<tr>
<td>Chipping station/ Procurement site</td>
<td>11</td>
<td>-</td>
</tr>
<tr>
<td>Isolate – Projectile point, fragment, or shell bead</td>
<td>39</td>
<td>-</td>
</tr>
<tr>
<td>Isolate – Biface, biface fragment, flake, or core</td>
<td>224</td>
<td>-</td>
</tr>
<tr>
<td>Pre-contact camp</td>
<td>28</td>
<td>2</td>
</tr>
<tr>
<td>House pits</td>
<td>1</td>
<td>-</td>
</tr>
<tr>
<td>Rock cairn</td>
<td>23</td>
<td>-</td>
</tr>
<tr>
<td>Talus pits</td>
<td>23</td>
<td>2</td>
</tr>
<tr>
<td>Rock alignments</td>
<td>15</td>
<td>-</td>
</tr>
<tr>
<td>Rock imagery</td>
<td>4</td>
<td>2</td>
</tr>
<tr>
<td>Rock shelter</td>
<td>5</td>
<td>-</td>
</tr>
<tr>
<td>Habitation Site</td>
<td>2</td>
<td>-</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>699</strong></td>
<td><strong>7</strong></td>
</tr>
</tbody>
</table>
Table A9. List of pre-contact site types encompassed within P2-BLS-PS500 Viewshed.

<table>
<thead>
<tr>
<th>Site Type</th>
<th>Count</th>
<th>2km, west side of river</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pre-contact lithic scatter including biface fragments</td>
<td>159</td>
<td>8</td>
</tr>
<tr>
<td>Pre-contact lithic scatter with projectile point/trade bead</td>
<td>23</td>
<td>-</td>
</tr>
<tr>
<td>Chipping station/ Procurement site</td>
<td>4</td>
<td>-</td>
</tr>
<tr>
<td>Isolate – Projectile point, fragment, or shell bead</td>
<td>29</td>
<td>-</td>
</tr>
<tr>
<td>Isolate – Biface, biface fragment, flake, or core</td>
<td>126</td>
<td>-</td>
</tr>
<tr>
<td>Pre-contact camp</td>
<td>29</td>
<td>-</td>
</tr>
<tr>
<td>House pits</td>
<td>4</td>
<td>-</td>
</tr>
<tr>
<td>Rock cairn</td>
<td>27</td>
<td>2</td>
</tr>
<tr>
<td>Talus pits</td>
<td>29</td>
<td>4</td>
</tr>
<tr>
<td>Rock alignments</td>
<td>13</td>
<td>1</td>
</tr>
<tr>
<td>Rock imagery</td>
<td>4</td>
<td>-</td>
</tr>
<tr>
<td>Rock shelter</td>
<td>5</td>
<td>1</td>
</tr>
<tr>
<td>Habitation Site</td>
<td>3</td>
<td>-</td>
</tr>
<tr>
<td>Total</td>
<td>455</td>
<td>16</td>
</tr>
</tbody>
</table>

Table A10. List of pre-contact site types encompassed within 45KT308 Viewshed.

<table>
<thead>
<tr>
<th>Site Type</th>
<th>Count</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pre-contact lithic scatter including biface fragments</td>
<td>3</td>
</tr>
<tr>
<td>Pre-contact lithic scatter with projectile point</td>
<td>1</td>
</tr>
<tr>
<td>Chipping station</td>
<td>0</td>
</tr>
<tr>
<td>Isolate – Projectile point or projectile point fragment</td>
<td>0</td>
</tr>
<tr>
<td>Isolate – Biface, biface fragment, flake, or core</td>
<td>1</td>
</tr>
<tr>
<td>Pre-contact camp</td>
<td>4</td>
</tr>
<tr>
<td>Total</td>
<td>9</td>
</tr>
</tbody>
</table>
Table A11. List of pre-contact site types encompassed within David’s Site Viewshed.

<table>
<thead>
<tr>
<th>Site Type</th>
<th>Count</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pre-contact lithic scatter including biface fragments</td>
<td>9</td>
</tr>
<tr>
<td>Pre-contact lithic scatter with projectile point/ trade bead</td>
<td>1</td>
</tr>
<tr>
<td>Chipping station</td>
<td>1</td>
</tr>
<tr>
<td>Isolate – Projectile point or projectile point fragment</td>
<td>-</td>
</tr>
<tr>
<td>Isolate – Biface, biface fragment, flake, or core</td>
<td>6</td>
</tr>
<tr>
<td>Pre-contact camp</td>
<td>-</td>
</tr>
<tr>
<td>House pits</td>
<td>1</td>
</tr>
<tr>
<td>Rock cairn</td>
<td>2</td>
</tr>
<tr>
<td>Total</td>
<td>20</td>
</tr>
</tbody>
</table>