ABSTRACT

Title of Thesis:	LIV-00456: LITHIC PROCUREMENT AND LAND USE STRATEGIES WITHIN THE VICINITY OF THE LIVENGOOD DOME CHERT FORMATION IN THE YUKON-TANANA UPLANDS, ALASKA
	Master of Professional Studies Degree, Cultural and Heritage Resource Management, 2025
Thesis Directed By:	Dr. Matthew Palus, Department of Anthropology

LIV-00456 is a pre-contact archaeological site identified during the proposed realignment of the Dalton Highway in central interior Alaska. This site is located on the Livengood Dome Chert Formation among many co-related sites situated in a landscape within the Yukon-Tanana Uplands, where primary lithic raw materials are easily accessed in an elevated feature that would have provided good viewsheds of the Tanana-Yukon lowlands. The diverse data presented in this thesis offer insight into the following questions: What was the function of LIV-00456 through time? And how does the site fit into ancient regional landscape use patterns? Indicating that LIV-00456 was integrated into a comprehensive network of ancient land utilization, which prioritized lithic raw material procurement and hunting activities, this pattern exemplifies logistical short-term occupation with instances of reoccupation extending over several thousand years. The geoarchaeological data, which included environmental magnetic susceptibility (EMS) and sediment acidity (pH)/conductivity, along with the lithic data, support the site's temporal association with the middle to late Holocene, in association with the Northern Archaic and Dené traditions.

LIV-00456: LITHIC PROCUREMENT AND LAND USE STRATEGIES WITHIN THE VICINITY OF LIVENGOOD DOME CHERT FORMATION IN THE YUKON-TANANA UPLANDS, ALASKA

by

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Thesis submitted to the Faculty of the Graduate School of the
University of Maryland, College Park, in partial fulfillment
of the requirements for the degree of
Master of Professional Studies,
Cultural and Heritage
Resource Management
2025

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Acknowledgments

This thesis was produced as a result of my enrollment in the Master of Professional Studies, Cultural Heritage Resource Management program. Thanks to all the fabulous staff, and specifically Dr. Matt Palus, for his generous guidance and support throughout this process. The background research, survey, and excavations were conducted in 2024 through Northern Land Use Research Alaska, LLC (NLURA) and the author of this thesis, Lori Hansen, who has accumulated over 12 years of experience in Cultural Resource Management (CRM) at NLURA. Lindsay Simmons and Rob Bowman of Northern Land Use Research Alaska, LLC (NLURA), played pivotal roles in facilitating the opportunity for the author to serve as co-field director and to utilize the data collected and analyzed from the Phase III Data Recovery of LIV-00456, Dalton Highway MP 0-9 Reconstruction Project, Alaska (Federal/DOT & PF). Holly McKinney at the State of Alaska Department of Transportation & Public Facilities (DOT&PF) was instrumental in providing permission to use the site data from the project, and her unwavering personal support. To the LIV-00456 NLURA project team: Rob Bowman, Kate Yeske, Tom Allen, Cory Coulman, and Mindy Grunin, for their dedication in rallying under challenging conditions and offering extensive support— the author is deeply grateful. Again, to Rob Bowman for providing geoarchaeological testing and analysis and educating me on the process and results. Tom Allen and Mindy Grunin for their work on the lithic analysis. Many thanks to everyone at the Fairbanks and Anchorage NLURA offices for their support and encouragement; it was truly appreciated. Respect and admiration are extended to all my predecessors who paved the way in Alaskan archaeology and CRM; substantial progress has been made, yet much remains to

be discovered. In conclusion, I would like to extend a special shout-out to Nukluk, whose presence always brought joy, especially at the site, even when she was demanding treats. She passed away last December, and the office just isn't the same without her. Rest in peace, my furry friend.

Nukluk snuggled down at LIV-00456 2024.

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Chapter 1.   Introduction

1.1 Site Overview

LIV-00456 is located between MP 0-9 on the Dalton Highway, approximately 85 mi. (136.80 km) northwest of Fairbanks. Within this area, LIV-00456 lies within the boundaries of a material source positioned near MP 6 on the Dalton Highway. The site lies approximately 0.18 mi. (0.29 km) west of Lost Creek, a small tributary of the Tolovana River, 1 mi. (1.6 km) south of the Trans-Alaska Pipeline System (TAPS) corridor, and 7.1 mi. (11.42 km) northwest of Livengood. Figure 1 is an aerial map showing the location of LIV-00456.

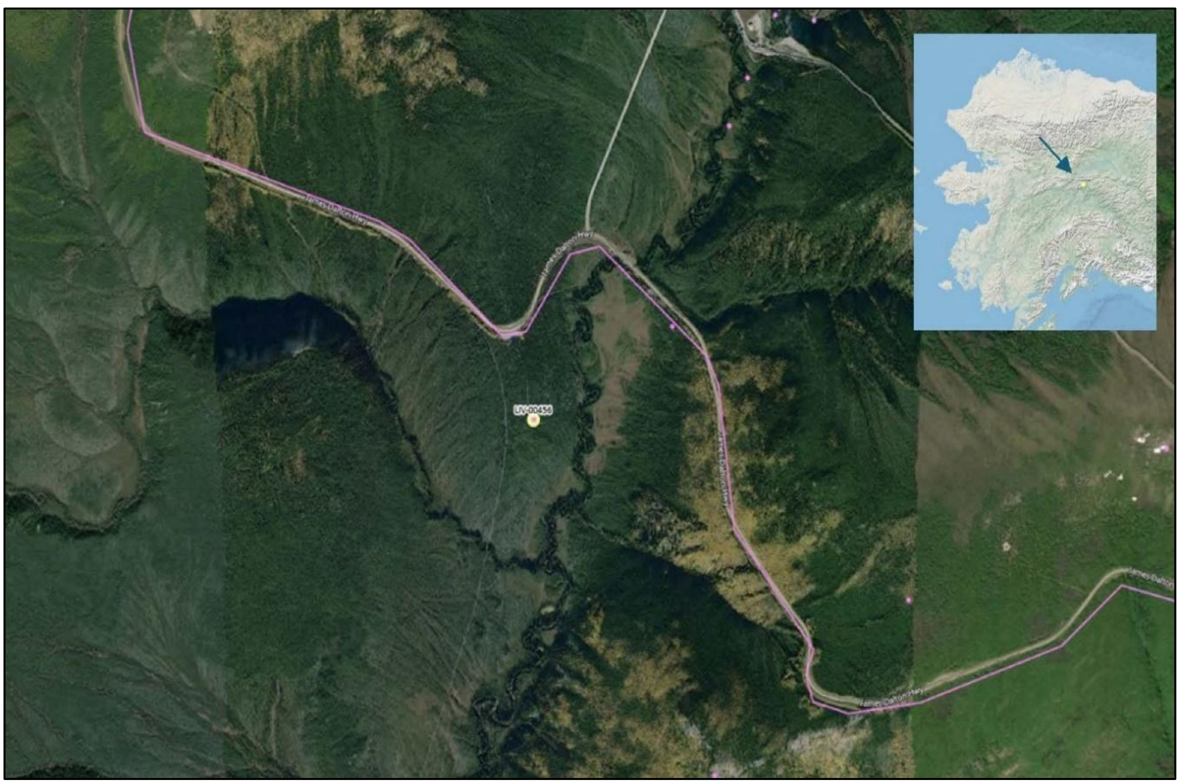

Figure 1. Aerial view of the location of LIV-00456 (Map Google Earth Pro by author).

The investigation of LIV-00456 included a review of previous reports and available background research, a Phase III data recovery of the site, and a synthesis of 97 other known pre-contact sites known sites within the vicinity of Livengood Dome Chert

Formation, which encompassed an area of approximately 190.6 square miles (mi.). The Phase III Data Recovery Plan was undertaken in accordance with the proposed Alaska Department of Transportation and Public Facilities realignment of a portion of the Dalton Highway. The research and archaeological methods used in this investigation provided the data to answer the following questions: What was the function of LIV-00456 through time? And how does the site fit into ancient regional landscape use patterns?

On August 18, 2024, the field crew of six archaeologists mobilized to LIV-00456, located at approximately milepost 6 of the Dalton Highway, where we set up camp at the nearby material site. After arriving at the location, the crew walked the existing four-wheeler trail to conduct a preliminary assessment of the site's condition. Figure 2, below shows the four-wheeler trail, which bisects the site.

Figure 2. South view on four-wheeler trail (courtesy of NLURA).

A total of 80 TPs were laid out, and 72 were excavated to delineate the site boundaries; two excavation units were dug, and geoarchaeological analyses were done. The survey revealed two loci at the site and one cultural zone, yielding 296 specimens across the site. The specimens include nine soil samples, 279 pieces of debitage, and eight tools, which include two scrapers, four informal flake tools, one core fragment, and one hammerstone. Cumulatively, with the previously collected assemblages, 2,057 specimens were recovered. The LIV-00456 assemblage consists entirely of lithic artifacts, as no faunal or other organic datable material was recovered at the site.

The geoarchaeological analyses consisted of collecting magnetic susceptibility (EMS) measurements within positive test units, and acidity analysis (pH)/ sediment conductivity was conducted on soil samples collected from both excavation units (EU1 and EU2), one in each locus. In archaeological settings, magnetic susceptibility measures and quantifies the degree of human input into magnetic minerals, which are affected by exposure to extreme heat, such as hearths. The EMS results appear to support multiple occupations throughout time. The acidity (pH)/sediment conductivity analyses in combination have the potential to provide information regarding the degree of human land use, as well as the density of vegetation coverage during occupations. The results suggest occupation of the site began with the Northern Archaic tradition and potentially extended into the Dené tradition.

LIV-00456 is one of numerous sites in proximity to the Livengood Dome Chert Formation that share commonalities. It appears the area may have been accessed by logistical foray or specialized task groups entering the area to procure raw materials for lithic production and short-term hunting lookout camps. Unfortunately, despite the many known sites in the region, not much is known about raw lithic procurement and quarry sites or their distribution.

1.2 Thesis Outline

The structured theories and regional background research in Chapters 2 and 3 provide the foundation from which interpretations are made. Chapter 4 lays out the methodology applied while investigating the site. Chapters 5 and 6 present the data collected during the data recovery process and interpretations of the results. Conclusions and additional remarks concerning the site and its function as a procurement location linked to the Livengood Dome Chert Formation vicinity sites are provided in Chapter 7.

Chapter 2. Technological Organization and Logistical Mobility

This chapter examines the background and context for understanding how LIV-00456 fits as a short-term, task-specific site and is reflective of land-use patterns found within the Livengood Dome Chert Formation in the Yukon-Tanana Uplands of central interior Alaska. Since debitage is the most abundant cultural material recovered from the site, the technological organization of the material is important in understanding and interpreting the makeup of the assemblage. Additionally, in pre-contact Alaska, we do know that most cultural traditions practiced a logistical mobility pattern using some form of caching resources primarily as, in Binford's term, a type of collector, as discussed further on in this chapter.

2.1 Technological Organization

A review of available data and literature on technological organization and lithic procurement theory provides a framework for understanding the role LIV-00456 played within the larger procurement area in the region. When defining site type and function, lithic assemblage analyses serve as the primary data source for determining the duration of occupation, while the length of occupation in an environmental setting clearly influences the archaeological remains at the site (Bicho and Cascalheira 2018:2-3).

Lithic artifacts constitute the most frequently recovered artifact type at archaeological sites and are subjected to analysis concerning typologies, functions, and technological attributes. Numerous analytical approaches are employed to gain a deeper understanding of lithic artifact procurement, production, maintenance, and discard. The aspects of lithic artifact variability are encompassed within the concept of lithic technological organization, which pertains to the manner in which tool makers and users structure their lives and activities concerning lithic technology (Andrefsky 2009:66).

The life history of stone tools partly relates to the concept of reduction sequences, which is shown in how tools change during their procurement, production, and use, including the properties of the raw materials, the intended task, and the activities involved (Andrefsky 2009:67). Advocates of the *chaîne opératoire* concept assert that it encompasses a considerably broader spectrum of processes than the term reduction sequences, spanning from raw material procurement through manufacturing, utilization, and eventual disposal (Andrefsky 2009:68). The primary distinction lies in its acknowledgment of culturally distinct patterns associated with these stages (Andrefski 2008: 68). The lithic material most abundantly collected and recorded across sites is debitage, and this was the case at LIV-00456.

Debitage is defined as the sequential removal of detached pieces of stone material left behind in the process of tool production. The analysis of debitage is of significant importance primarily because assemblages often lack lithic tools for analysis, whereas most contain only the remnants of production and maintenance. Inferences can be derived from an assemblage of debitage specimens by categorizing them into typologies that associate individual specimens with particular technologies, such as bifacial trimming, end-scraper resharpening, projectile point notching, and bipolar reduction, thereby providing information on site formation (Andrefsky 2009:80).

When categorized by relevant technological features, debitage can offer insights into site functions; however, challenges emerge when multiple activities occurred or when the site was used for brief periods over extended durations. Additionally, tools are often produced or retouched at one site and subsequently transported to another site for different uses and disposal, thereby complicating the characterization of lithic technology across the landscape (Andrefsky 2009:80). The distribution and availability of lithic raw materials are undeniably crucial in stipulating how humans produced and modified stone tools and moved them within the environment. Lithic raw materials can often be sourced, providing robust information about the circulation of lithic resources across the landscape, which is crucial for gaining insight into the relationship between lithic technology, human mobility, and land-use patterns (Andrefsky 2009:75).

2.2 Logistical Mobility

Mobility and technological organization have been examined in relation to groups that relied on some form of residential mobility, often in response to seasonal or resource exploitation patterns. Binford (1980) Identified two categories of mobility patterns: collectors and foragers. The different strategies are characterized according to the following parameters: foragers exploited the resources within the immediate area around their settlement residence, usually daily until depletion, then moved to another suitable location (Binford 1980; Shott 1986:27). They typically do not store or cache resources. Collectors, on the other hand, are characterized by the need to store or cache food for significant portions of the year, especially in northern regions, and their use of organized, specialized logistical procurement groups (Binford 1980; Shott 1986:27).

Although many agree that Binford’s model is a useful framework for structuring archaeological data there has been criticism that the model oversimplifies these groups into a dichotomy when it is possible most groups probably employed a combination of the two systems or used other innovative solutions (Odell 2001:62). In his journal article

“Hunter-Gatherer Mobility Strategies,” Kelly (1983) proposed a cross-cultural study suggesting that examining mobility strategies requires a multi-dimensional approach that considers both environmental and cultural systems, rather than focusing solely on types of environmental characteristics. Furthermore, it is suggested that mobility strategies may vary from year to year (Odell 2001:62-63). When examining logistic mobility, excursions from the primary residence may consist of brief day trips or, as observed among collectors, task-specific expeditions of extended duration (Kelly 1983:278).

Task groups would depart from the primary residential location and establish logistical camps to carry out various procurement activities. The types of logistical camps included field camps, lookout stations, hunting camps, caches, quarries, and workshop sites. These specialized task groups were generally small, skilled labor groups with specializations in procurement strategies, resulting in functionally specific sites generated according to the properties of the logistical organization, also reflecting the targeted resource (Binford 1980:10). These activities have direct site implications, for example resources that were field processed to facilitate ease of transport back to main camps generating varying amounts of debris. Site complexity arises when a logistical camp location was used for combined functions, resulting in greater inter-site variability reflected in the archaeological record (Binford 1980:10). Additionally, specialized or geographically fixed resources, such as lithic procurement and quarry sites, are reused as logistical groups intermittently returned, leading to a buildup of debris.

2.3 Technological Organization and Lithic Procurement

Binford (1979) proposed that the procurement of raw lithic materials was conducted through two methods, which he designated as embedded or direct procurement strategies. He asserted that procurement was an embedded process, as materials were generally obtained incidentally while groups were performing other subsistence tasks, rarely sought out exclusively or directly (Binford 1979:259). Other research tends to disagree, suggesting that raw lithic materials are important for determining tool and core technological strategies (Andrefsky 2009:75-76). Additionally, Bamforth, citing Gould's research observing the aborigines of the Western Desert of Australia, noted that:

> By far the greatest amount of time and effort in the stone tool-making process occurred during quarrying and transport. Not only did this behavior involve visits to specific localities where stone could be quarried and collected, but it also included transport of the stone back to camp for further shaping and use. These visits were often planned ahead of time, since quarries seldom occur in close proximity to waterholes where aborigines camp in the normal course of their hunting and gathering routine. Special efforts were made by aborigines to visit quarry localities, but only when the lithic raw material had something special about it. White chert was always collected in this manner, from localities known to lie within a day's walk of a habitation base camp. Individual men or small groups of men made such trips whenever their supplies of this type of raw material ran low (Bamforth 2006: 520).

He further proposes that human groups most likely employed a combination of acquisition strategies, such as participating in long-distance hunting excursions and integrating various subsistence activities (Bamforth 2006:521). Additionally, raw lithic material procurement should be regarded as an equally vital subsistence resource (Bamforth 2006:522). Unfortunately, while doing this research, it appears as Gramly (1980:824, 832) indicated, there have been very limited longitudinal studies conducted concerning raw lithic material sources, ignoring their special character and valuable source of regional information. In Alaska, only approximately 5% of the state's archaeological sites are known, and most of the known sites have not undergone any significant research.

The following chapter provides an overview of the environmental, cultural, and historic background of the region.

Chapter 3. Environmental Setting, Cultural and Historic Background

This chapter provides an introduction and overview of the Interior regions, environmental setting, regional cultural background, and history of LIV-000456.

3.1 Environmental Setting

Alaska is divided into various regions based on the agency defining the regional boundaries. For this thesis, an Alaska regional-specific map is presented of the geographically separated regions, which are generally categorized as the Northern, Interior, Western, Southcentral, Southwest, and Southeast. Archaeologically, some of these regions are further divided into subregions; for example, the Northern is divided into the North Slope and the Brooks Range. These maps and definitions vary somewhat depending on agency or research outlook.

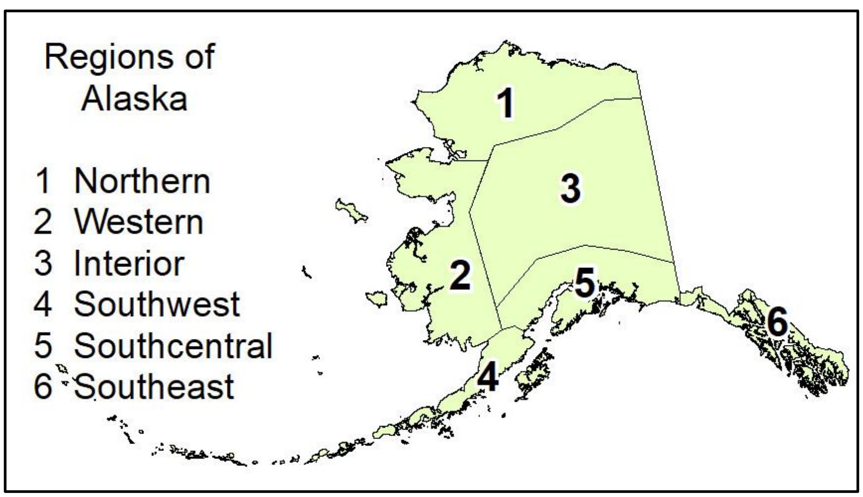

Figure 3. Map of regional divisions (USGS).

The Interior region encompasses approximately 175,000 square miles, is bordered to the south by the Alaska Range and the Brooks Range to the north, and is further divided into five regions: northern, central, western, eastern, and southern interior. LIV-00456 is located in the central Interior in a physiographic region identified as the Yukon-

Tanana Uplands. As a region, it encompasses approximately 175,000 square miles; for indication of the scale, it is comparable in size to the combined area of Indiana, New York, Pennsylvania, and Ohio.

The site is located within the physiographic region (Wahrhaftig 1965:24) identified as the Yukon-Tanana Uplands. The Yukon-Tanana Uplands (Figure 4) are characterized by high-rounded ridges above the adjacent valley floors. The area is within the Yukon drainage basin, with streams flowing south to the Tanana River and north to the Yukon River. The lakes present in the valleys and passes are mainly thaw lakes. Glaciers are not present in the region, and the permafrost is discontinuous. Ice wedges and pingos appear on the lower slopes and valley bottoms. A belt of limestone bedrock runs through the northern section of the region, with the remainder of the bedrock consisting primarily of schist and gneiss with minor granitic intrusions (Wahrhaftig 1965).

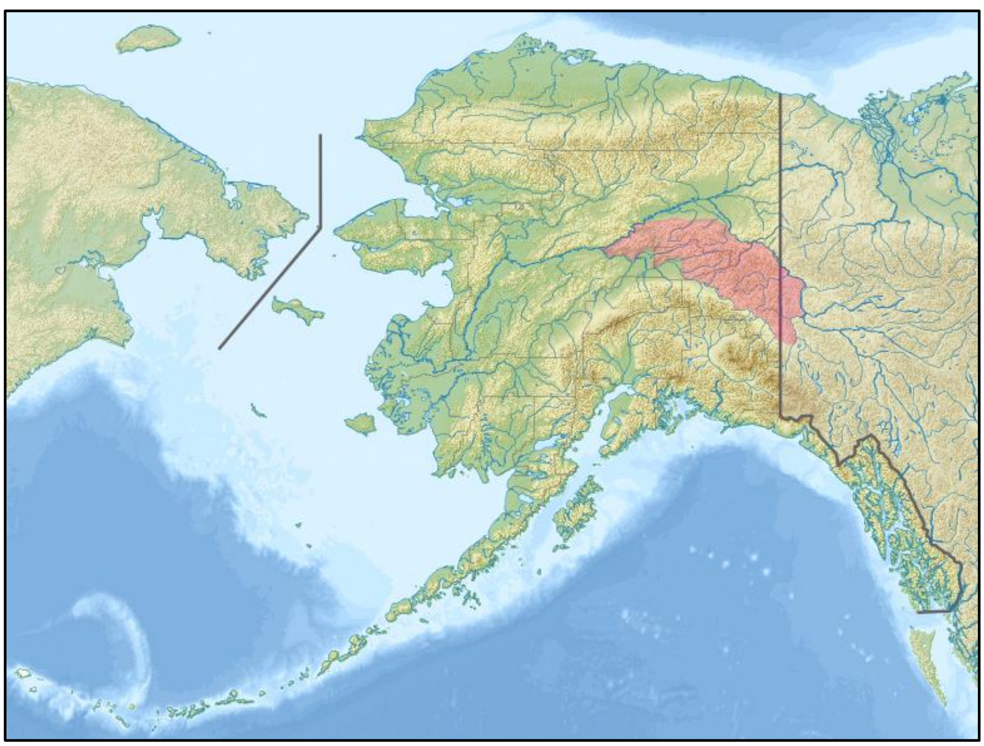

Figure 4. Location of Tanana-Yukon uplands (see pink-Wikipeda).

The vegetation in the Yukon-Tanana Uplands consists of a spruce-hardwood forest, featuring white spruce, birch, and aspen, primarily in well-drained areas of the valley bottoms. Black spruce is typically found in poorly drained areas and on north-facing slopes. In well-drained areas, the underbrush comprises primarily mosses and grasses, whereas in wet areas, it includes tussocks and sphagnum moss. Alpine tundra dominates regions above the tree line (Selkregg 1974).

The Yukon-Tanana Uplands are home to a variety of animal species, including moose, black and brown bears, and wolves (Betts 1997:7-8). Additionally, the area is inhabited by a variety of small mammals, furbearers, waterfowl, willow grouse, and several genera of fish, notably including salmon. Caribou utilized this region in the early twentieth century and may be in the process of returning to the area. (Betts 1997:11).

3.2 Cultural Traditions and Historic Themes

Archaeological research in Interior Alaska suggests that humans have inhabited the Tanana River Basin, a major tributary of the Yukon River, for over 14,000 calendar years (approximately 12,000 radiocarbon years), making the interior of Alaska a significant region with some of the earliest dated sites in the Americas. These cultural tradition designations were derived based on diagnostic traits attributed to taxonomic categories developed through several systems of culture-historic reconstructions, and the validity may be argued (Aigner and Gannon 1981a:24).

The prehistory of Interior Alaska is often divided into four broad archaeological cultural traditions, which will be briefly presented here, followed by a more focused discussion of the Northern Archaic and Dené traditions associated with LIV-00456.

- ***The Eastern Beringian tradition*** dates from 14,000 to 12,000 BP. This tradition is represented by lithic technology, including burin and microblade tools, an atlatl throwing spear system, and a subsistence strategy based on various large and small mammals, waterfowl, fish, and other animals that inhabited the late Pleistocene steppe-tundra environment (Bowman et al. 2022:8).
- ***The American Paleoarctic tradition***, which spans from 12,000 to 7,000 BP, is characterized by lithic assemblages that include microblades, bifacial points, lanceolate projectile points, large bifacial cores and tools, burins fashioned from flakes, endscrapers, macroblades, osseous and flaked spear tips, as well as the atlatl spear-throwing system. Furthermore, minor technical differences exist in manufacturing techniques, artifact styles, and the proportions of tool types, which set it apart from earlier site traditions (Bowman et al. 2022:9-10).
- ***The Northern Archaic tradition***, dating from 6,000 to 2,000 BP, will be discussed in the following "Northern Archaic Tradition" subsection below.
- ***Dené tradition***, from 2,000 BP to circa AD 1880, to be discussed in the following "Dené Tradition" subsection below.
- **The American Period**: From 1867 to 1899 CE marked a significant era of American geological and geographical expeditions and exploration in Alaska's interior and waterways, including the Tanana River. For instance, in 1885, Lieutenant Henry Allen mapped the Tanana River. Then, between 1899 and 1955 CE, a period known as the Extraction Economy emerged. Whereas, we have the representative gold rushes, which saw an influx of gold miners and the establishment of the associated infrastructure and communities.

- **Commercial Corridor** 1969 and the present, developed through the construction of the Dalton Highway and the Trans Alaska Pipeline System (TAPS) project. This resulted in an increase in ground transportation along the Dalton Highway, which is a 415-mile-long road extending from the terminus of the Elliot Highway north of Livengood to Deadhorse and the Prudhoe Bay oil field.

3.3 Northern Archaic Tradition (6,000-2,000 BP)

Presently, between 7,800 and 6,200 BP, few identified archaeological sites exist in Interior Alaska. There are numerous factors limiting archaeological knowledge of Alaska's interior. For example, many landforms in the subarctic exhibit site formation and disturbance processes that appear to affect the spatial and temporal distribution of components, and little is known about subsistence patterns, tool use, lithic procurement, settlement patterns, or population factors (Potter 2008:95). Additionally, many assemblages lack detailed faunal analyses or datable materials.

The term "Northern Archaic tradition" was initially proposed in the 1960s to describe assemblages containing notched and lanceolate points associated with the middle Holocene excavated at the Onion Portage site (Esdale and Rasic 2008:1) The term was adopted as more sites were researched and today represents assemblages in the Interior that date between approximately 6,500 and 3,000 BP. Northern Archaic tradition sites primarily occur in interior boreal forests and upland northern tundra settings, with sites located near modern caribou migration routes (Gillispie 2018:15). It has been suggested that the transition from American Paleoarctic technological organization and subsistence strategy to Northern Archaic technological organization and subsistence strategy may relate ecological shifts with the growth of spruce, specifically black spruce, and increased wetland presence as being primary factors for the shift (Hansen et al. 2025:9; Keeney and Bowman 2018:5). In this portion of the Interior, there is an apparent gap of dated sites, especially those that have been radiocarbon dated between 7,800 and 6,200 cal BP. This gap has led to questions regarding the designations of archaeological traditions and how technological differences may be related to environmental factors, whether through technological diffusion, continuity, or a combination of both (Proue and Higgs 2010:7-8).

The Northern Archaic tradition lithic technology is characterized by the presence of side-notched points, the utilization of microblade and core technologies, burin technologies, lanceolate bifaces, and other point forms. Many assemblages contain a significant number of hide-scraping tools, such as endscrapers (Bowman et al. 2022:10). Obsidian from distant sources is also commonly utilized to manufacture tools. Approximately a third of Northern Archaic sites contain microblade and burin technology (Esdale 2008). Beyond the specific side-notched points, many tools are typologically similar to earlier Paleoarctic technology.

3.4 Dené Tradition (2,000 BP-circa AD 1880)

Approximately 2,000 years ago, the late Holocene environmental conditions, although similar to present-day conditions, were slightly cooler than the Holocene average, marking the transition from the Northern Archaic tradition to the Dené tradition, previously referred to as the Athabascan tradition. Currently, sites in Interior Alaska south of the Brooks Range dating to at least 2,000 years ago and up to 1880 AD[1] (late Holocene) are generally attributed to the Dené tradition (Bowman et al. 2022:10). There

[1] Anno Domini, in this context the date in the Gregorian Calendar

have been few Dené tradition sites excavated in Interior Alaska. Early pre-contact Dené sites are characterized by subsurface house pits and cache features associated with various flaked and ground stone, bone, wood, bark, and antler artifacts (Langdon 1993:106; Proue and Higgs 2010:8).

Faunal materials discovered at Dené tradition sites included a diverse range of Interior wildlife. At the Dixthada site, Rainey (1939) identified moose, caribou, beaver, hare, small rodents, fish, avian faunal materials, and freshwater mussel shells.

Additionally, the relatively recent introduction of Euro-Americans into Interior Alaska provides some of the most recent dates for proto-historic sites, which include the Dené Tradition Late Period (1740-1867 CE), characterized by an artifact assemblage dominated by Dené-made materials and trade items, such as iron obtained through trade with other Native groups, alongside a small amount of non-Native goods like beads (Hansen et al. 2025:10; Proue and Higgs 2010:8-9).

3.5 LIV-00456 Site Research History

The first systematic cultural resource surveys occurred in the vicinity of LIV-00456, which was in preparation for the construction of the Trans-Alaska Pipeline System (TAPS) in the 1970s and in 1981, with a proposed natural gas pipeline project. At that time, several cultural resource surveys were undertaken along the haul road (Dalton Highway) and the proposed corridor, resulting in various reports between 1970 and 1981. Several surveys have been conducted since the 1970s, most associated with projects and proposed projects, and have resulted in many reports; unfortunately, not all are available for review (Hansen and Allen 2025; Hansen et al. 2025:13).

LIV-00456 was identified in 2008 by archaeologists from the Office of History and Archaeology during a cultural resource reconnaissance for a Department of Transportation and Public Facilities (DOT&PF) material source for a highway reconstruction project (Thompson and Schneider 2008:1). The site was initially discovered on the exposed surface of a pre-existing four-wheeler trail where two concentrations of surface lithics debitage were observed and recorded. This initiated the researchers to excavate nine test pits near the surface concentrations, two of which were positive for further cultural materials. According to Thompson and Schneider (2008:14), the crew collected a total of 72 pieces of debitage and one microblade fragment, and all were recovered from the subsurface between 5 and 15 centimeters below the surface (cmbs).

The lithic materials collected from the site in 2008 were analyzed. Based on the obsidian microblade fragment recovered level, an initial interpretation was made that placed the projected cultural period of the site between the American Paleoarctic tradition (10,000 to 7,000 BP) and the Northern Archaic tradition (6,000 to 2,000 BP) (Thompson and Schneider 2008:15). These conclusions were based on the idea that microblades constitute a chronological type and on the belief that the technology used to create microblades evolved over time, allowing archaeologists to use them as a chronological marker (Dixon 1985:61). Although these theories are currently being reanalyzed (Anderson 2008:170; Esdale 2008:3, 6), (Thompson and Schneider 2008:15) asserted that the microblade provided the most robust temporally diagnostic data for associating the site within a cultural context. In their report, Thompson and Schneider (2008) briefly discussed the lithic raw materials recovered from LIV-00465, which included Livengood chert and obsidian debitage obtained from various local and non-local sources. They concluded that these materials were significant as they provided insights into the trade networks and resource utilization of LIV-00456.

The results of the 2008 testing efforts established the preliminary site boundaries, which initially encompassed an area measuring 100 x 250 ft. (30 x 76 m), approximately 0.6 ac. (Thompson and Schneider 2008). Based on this analysis and the data collected, Thompson and Schneider (2008:15) recommended that LIV-00456 be eligible for listing on the National Register of Historic Places (NRHP) under criterion D.

In 2014, the OHA archaeologist Thompson took a crew to revisit LIV-00456 to conduct a site condition assessment (Thompson 2014:31-33). The site assessment indicated minimal disturbance had occurred since it was recorded in 2008. However, during the investigation, an additional 20 fragments of lithic debitage, including fine-grained basalt and banded chert, were found on the exposed surface of an existing four-wheeler trail outside the established 2008 preliminary site boundary (Thompson and Schneider 2008:14). Near the surface scatters, Thompson excavated five additional shovel tests, and one test unit was positive for cultural material, from which they collected two small retouch flakes and one microblade (2014:32). The expanded site boundaries encompassed an area measuring 1.08 acres in size, incorporating the 2014 investigation findings (Thompson:31).

In 2016, OHA conducted data recovery at LIV-00456. During their fieldwork, 1,761 artifacts were collected from the site (Hansen et al. 2025:15). Very little information exists regarding this field effort, as it did not lead to a technical report or any updates to the AHRS site card.

3.6 Livengood Dome Chert Formation and Archaeological Sites in the Vicinity of LIV-00456

The Livengood Dome Chert formation is a massive, variegated chert formation of Ordovician age located primarily within the Yukon Basin of Alaska, and the Yukon, with outcroppings found along Livengood Dome and Livengood Creek (Twelker et al. 2016:22). The chert colors display various colors and hues of gray, including bluish gray, white, orange, red, tan, greenish blue, and black. Some display banding and a range of textures. Evidence indicates that this area was significant for the acquisition of raw materials appropriate for tool technologies.

In addressing the inquiry regarding the relationship of LIV-00456 to other sites within the region, I began by refining the scope and proximity of the sites under examination through an extensive search of the Alaska Heritage Resources Survey (AHRS) database. I subsequently delineated a study area encompassing a portion of the Livengood Dome Chert formation and the sites situated on or adjacent to the dome formation, see Figure 5.

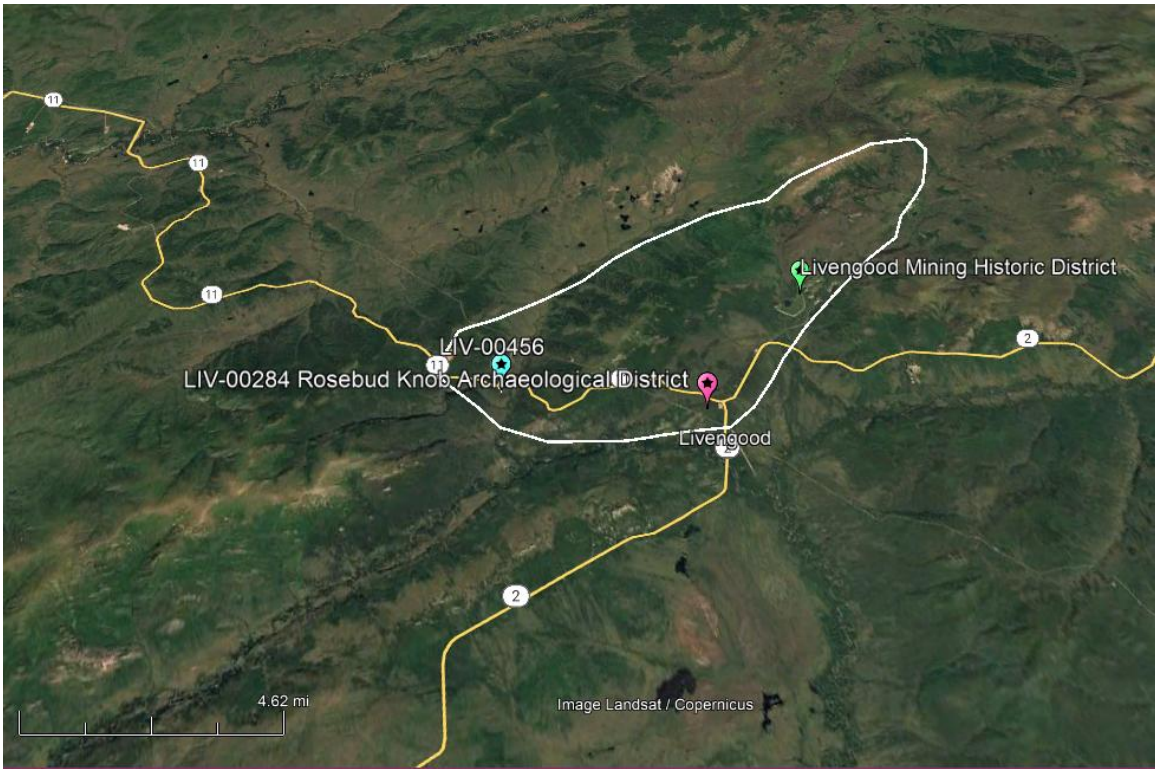

Figure 5. Map of Study Area (L. Hansen, Google Earth Pro).

They encompassed an area of approximately 190.6 km² (73.58 mi²), comprising a total of 98 recorded sites, including the Rosebud Knob Archaeological District, and intersecting with the Livengood Mining Historical District. Of those, 46 sites are located directly on the Livengood Dome Chert formation, including LIV-00456. Additionally, 34 sites are located within the Rosebud Knob Archaeological District, 13 sites are found within the Livengood Mining Historic District, and three sites are situated between the two districts. The initial pre-contact sites were discovered in the Livengood Dome Chert Formation in 1962, followed by a 1964 survey that identified many more sites. Subsequently, numerous additional sites have been discovered, primarily as a result of compliance archaeology conducted from the 1970s to the present. There are 97 known pre-contact sites within the vicinity of LIV-00456, and one resource, Rosebud Knob Archaeological District (LIV-00284), as indicated above, consists of 34 sites encompassing nearly two square miles. Given that Rosebud Knob contains numerous sites, some very large, and the presence of several outcrops of usable chert, it is possible that many more sites may remain undiscovered, as well as non-correlated with existing AHRS #s. The protocols in place to deal with archaeological sites may be limited, and this area is of utility in providing an example of a 'landscape of resource utilization' rather than discrete sites. This area was a heavily used lithic quarrying locality composed of several discrete episodes not necessarily equivalent to AHRS #s (Aigner and Gannon 1981b:27 see map) of multiple technological complexes. Although there are numerous sites, little research or analysis has been conducted within this region to date.

The author conducted an examination of the broader landscape while exploring the perspective of landscape use and how resource utilization is reflected within the study area. Furthermore, expanding the perspective to consider potential locations where the inhabitants utilizing this landscape may have established settlements or maintained long-term seasonal camps. Additionally, consideration was given to the surrounding topography and the numerous creeks and river systems that traverse the region. Since there is a lack of recorded pre-contact settlement sites in the region, and the sites in the area appear to reflect short-term task-specific sites, looking to ethnographic accounts of land use may provide clues as to where seasonal habitation sites may be located.

For example, the Koyukon Dené occupied several confluences on the Koyukuk River. The Koyukuk displays similar physiographic characteristics and is approximately 113 miles to the closest point northwest of the Livengood area sites. During the summer, the Koyukon Dené camped near confluences of small streams and major rivers (Andrews 1977, Clark 1974: 3, 5).

The Livengood Dome Chert Formation sites are located within an environment of similar characteristics, near the confluence of three major river systems: the Tolovana, of which the west fork is approximately 1.8 miles south; the Yukon, approximately 30 miles west; and the Tanana, approximately 41.6 miles to the southwest. All are situated within the lowlands. This geographic setting would have provided access to a variety of resources. Furthermore, Tolovana Hot Springs is situated within 16 miles, and three contemporary villages are located within 40 miles: Minto, approximately 30 miles to the south; Rampart, around 39 miles to the west; and Stevens Village, roughly 34 miles to the north. While these distances are measured in a straight line and the terrain likely posed seasonal challenges, rivers and streams functioned as vital corridors for travel and resource acquisition.

All three of these villages are a part of the Tanana Chiefs Conference, an Alaskan Native organization representing the Dené groups in the Interior. These groups are the direct ancestors of what is referred to as the Dené Tradition, defined as spanning 2000 BP- circa AD 1880. According to the Tanana Chiefs website, the village of Minto was relocated in 1969 due to repeated flooding and erosion, indicating that the current location had been historically used during the fall and winter as a seasonal camp (TCC 2025). Looking toward these settlements may give insights into where ancient seasonal settlements of the people using the landscape of the Livengood Dome Chert Formation may occur.

The next chapter presents the methodology used in collecting the data.

Chapter 4. Methodology

4.1 Pre-field Methods

The archaeological data recovery project was overseen by the author in the capacity of field director as part of the program's internship at their place of employment. A pre-field analysis of all accessible data for LIV-00456 was conducted to develop an initial site mitigation work plan. As part of the pre-field work for the project, a review of previous reports from the relevant area was requested from the Office of History and Archaeology (OHA), including the 2008 and 2014 field data.

The information analyzed included the 2008 and 2014 survey reports and all available 2016 field data from the State of Alaska Office of History and Archaeology (OHA) data recovery project. According to the 2014 geographical information system (GIS) data, the preliminary site boundary recorded in GIS did not encompass many of the recorded site features, and it appears that there are two distinct loci approximately 133 meters (m) apart. It can be inferred that the discovery of locus 2, which was not mentioned in the 2008 and 2014 reports, resulted from the 2016 data recovery project. Additionally, the 2016 data recovery effort did not revise the site boundaries. Thus, it was determined that the old site boundaries were not very useful in delineating the extent of the site. It was determined that the most effective approach for delineating and mitigating the site was to establish the presence and extent of the two loci (Hansen et al. 2025: 17).

This led to the establishment of two loci centroids positioned around the two identified loci areas. These centroids were plotted in GIS utilizing the test pit, artifact, and locational data obtained from the published reports of 2008 and 2014, along with interpretations of the 2014 and 2016 GIS data points, various field notes, and documented artifact recovery locations represented within the artifact catalog. A geodatabase was created using the approximate location of the two centroids, providing a basis for the 2024 data recovery field collection strategy.

4.2 Field Methods

Excavations were conducted using shovels and trowels, with all excavated sediments passed through a 1/8” mesh sieve. The excavation levels were to follow distinguishable natural and cultural stratigraphic levels. When such levels could not be discerned, arbitrary excavation levels of 5 cm were used. All test and excavation units were backfilled.

A master datum for the site was established, and the utilization of a total station to create an accurate georeferenced map indicating the following: old and new test units, excavation units, isolated artifacts (if any), features, the site boundary, site contours, and the landform in and around the site. Additionally, artifact and feature locations were mapped both vertically and horizontally with the total station. Any features or significant clusters of cultural materials were subject to sketch plans along with the total station data.

A standard set of data was gathered for each test or excavation unit, regardless of artifact recovery. This included information on stratigraphy, soil type, Munsell color descriptions, and a stratigraphic profile of at least one side wall of the unit. The use of standardized forms to document test and excavation units, including level, feature, profile, sample, and field specimen forms. Additional observations were recorded in field notebooks.

Photographs of at least the north wall of every test pit (if positive, all four walls) and any samples (e.g., charcoal or tephra samples) or *in situ* artifacts collected from them were taken. Photographs of any features in situ were to be taken to document significant finds and the landform. Photographs of features or artifacts included a photo scale. Photographs were listed on a photo log. The photo log documented the direction or location of the shot, date, photographer, total station location, GPS location (if applicable), and subject of the photograph.

When encountered, faunal and other cultural materials were collected and bagged by excavation level (either natural or arbitrary). Provenience data was recorded on the plastic artifact storage bags in the field and on both the level and field specimen forms. An inventory of collected materials was completed for each test unit, excavation unit, or isolated find.

4.3 Geospatial Methods

During the mitigation, a Leica TS-06 total station and a stadia rod were used to record three-point location information within and around the site. A primary datum, three control points (CPs), and nineteen sub-datums were established for the site. The total station was utilized to generate an accurate, georeferenced map that delineated the location of both the old and new TPs, excavation units (EUs), isolated artifacts, features, site boundaries, site contours, and the surrounding landform. Moreover, the total station facilitated the mapping of artifact locations in both vertical (depth) and horizontal dimensions. In addition to the data obtained from the total station, sketch maps were prepared to illustrate any significant assemblages of archaeological materials uncovered during the survey. The measurements acquired from the total station were precise to within 0.001 cm. Furthermore, a Samsung Galaxy Tab (model S4 and/or S6 Lite), connected to a Stonex S580 GNSS receiver, was employed to document geospatial data in ArcGIS Field Maps pertaining to main and sub-datums, TPs, and EUs.

4.4 Site Boundary Delineation Methods

In accordance with the Project Data Recovery Plan, the crew delineated the site boundaries by excavating a series of 50 x 50-cm test pits (TPs). Based on prior investigations, these TPs were excavated across and beyond the extent of the two loci centroids established in 2024. Excavation was performed in cardinal directions at 10-meter (30-foot) intervals, with two consecutive negative TPs in each cardinal direction indicating the boundary for cultural material. As initially indicated, an arbitrary 10-meter (30-foot) grid, oriented to true north, was employed to facilitate TP placement across the site, particularly in areas where vegetation, slope, or significant disturbance hindered excavation at the prescribed intervals. In locations where safety was a concern, particularly in areas with steep slopes, TP locations were either adjusted to be as close to 10 meters (30 feet) as possible or left unexcavated. Once the delineation commenced, the crew ascertained that the site boundary was considerably more extensive than initially anticipated, necessitating consultation with the Statewide Cultural Resource Management (CRM). Following discussions on August 23, 2024, the Data Recovery Plan was modified based on crew observations from the field, leading to an agreement culminating in the expansion of the site delineation through radial TPs at 20-meter (65-foot) intervals (Hansen et al. 2025: 18). Furthermore, it was stipulated that one 1 x 1-meter excavation unit (EU) would be established in each locus. Due to scheduling and budgetary constraints, it was recognized that the expansion of the 1 x 1-meter EUs into 2 x 2-meter block excavations was impracticable. The revised strategy was implemented in the field to ensure the site delineation was completed within the established fieldwork timeline.

Shovels and trowels were employed for the excavation of test pits, and sediment was systematically screened through a one-eighth-inch screen utilizing small shaker screens. TPs were excavated to a primary 100% concentration of alluvial gravels. The TP grid was extended in all cardinal directions until cultural artifacts were absent in two consecutive TPs. Boundaries of the site were established by the occurrence of double negative TPs or by the landform's edges, marked by slopes exceeding 20 degrees.

At each positive TP, data collected included soil type, Munsell color descriptions, and illustrations of stratigraphic profiles from four sidewalls. This information was recorded on standardized profile forms, sample forms, and field specimen (FS) forms, as well as in field notebooks. Digital photographs were taken of all four walls of every positive unit and a plan view of the floor of the unit, of any features, artifacts, or samples obtained from them, including a photo scale, using a Ricoh WG-6 digital camera. One wall and a plan overview of each negative TP were photographed and recorded. All photographs were organized in a photo log that recorded details such as direction, location, date, photographer, total station location, GPS coordinates, and subject.

4.5 Excavation Methods

The mitigation plan encompassed the expansion of the 2008 positive EUs (test units 1 and 2) and the placement of additional units in proximity to surface finds identified along the four-wheeler trail during the 2014 condition assessment. Based on the 2016 mitigation findings, these stipulations were modified to allow the selection of any 2024 positive TPs for expansion into 1 x 1-meter EUs at locations likely to provide cultural information relevant to the research questions (Hansen et al. 2025: 18)

Trowels were used to remove sediment in EUs at arbitrary 10-cm levels (levels are labeled based on their range in depth below surface, i.e., Level 20-25 cmbs[2]) and in 50 x 50-cm quadrants (quads) for each 1 x 1-m EU (EUs were assigned numbers based on order of excavation). In instances where the level beneath the cultural zone (CZ) was clearly negative, shovel skimming was utilized until cultural materials were again encountered, then trowels were reintroduced. All sediments underwent screening through a 1/8-inch screen hardware cloth using portable screens.

Stratigraphic layers were analyzed according to the standards established by the United States Department of Agriculture and Natural Resources Conservation Service, as provided in their thirteenth edition of Keys to Soil Taxonomy, published in 2022 (USDA Soil Survey 2022). Sediment sampling was conducted on one wall at each EU for sediment analysis.

4.6 Artifact Collection Methods

All surface and subsurface artifacts encountered at the LIV-00456 site during the evaluation for site boundary delineation, excavation, and data recovery were meticulously collected, bagged, labeled, and documented. Cultural materials retrieved from test pits (TPs) and excavation units (EUs) were systematically collected and bagged by stratigraphic level. Three-point provenience for all artifacts found in situ was recorded with the total station. Cultural material, such as flakes or faunal material within a 5-cm

[2] Levels are assigned depths based on depth below surface (cmbs) or depth below datum (BD), depending on location recording method and the data being recorded.

radius, was defined and collected as a concentration, and their provenience was recorded together as a lot. Sediment was systematically screened by level and quadrants, and all artifacts discovered within each screen were documented correspondingly by level and quadrant. Provenience data was recorded on plastic artifact storage bags in the field, level, and field specimen forms. An inventory of collected materials was completed for each TP, EU, and isolated surface find.

All artifacts, faunal remains, field notes, forms, and related materials recovered during excavations on land owned or controlled by the State of Alaska remain the property of the State of Alaska. All artifacts, faunal remains, field notes, field forms, and related materials will be accessioned by the University of Alaska Museum of the North (UAMN) in accordance with the current DOT&PF curation agreement.

4.7 Sampling Methods

Sediment samples were identified, collected, bagged, labeled, and recorded during the processes of testing and excavation. In instances where such materials were encountered, bulk samples were to be collected for any features identified during testing and excavation. All samples were obtained in situ; samples were not obtained from screens. Photographs of samples from unit walls were taken prior to their collection. In cases where encountered, charcoal samples were to be collected for the purposes of radiocarbon dating, and sediment samples were collected for geomorphic analysis.

Environmental magnetic susceptibility (EMS) measurements were collected to acquire information regarding thermoremanent magnetization at the site. These measurements were obtained utilizing a Bartington MS2 unit equipped with an MS2K probe attachment. Samples were extracted from the north wall at 2 cm intervals of each positive TP and EU at the site (Bowman et al. 2022:32; Hansen et al. 2025:20).

4.8 Environmental Magnetic Susceptibility (EMS)

In archaeological studies, magnetic susceptibility measurements evaluate and measure human contributions to the magnetic properties found in sediments or soils at a site (Dalan 2006; Tite and Mullin 1971). Magnetic particles at archaeological sites mainly comprise hematite and maghemite, formed when natural iron deposits in sediments undergo elevated temperatures from hearth features (Keeney and Bowman 2018:6; Rapp and Hill 2006:114). These signals are distinguishable from forest fire events due to their lack of uniformity across the landscape, although they may be present in areas of the site extending beyond the spatial confines of individual hearth features due to various factors (Bowman et al. 2022:32).

EMS utilizes a field sensor to gather data, in contrast to conventional magnetic susceptibility analysis, which is usually performed in a laboratory on dried sediment samples collected from the field, contained in small plastic cubic boxes. Consequently, the data gathered through the Electromagnetic Survey (EMS) not only represents the comprehensive magnetic values found at the site but also considers the contemporary moisture content present at any specified location (Bowman et al. 2022:32; Hansen et al. 2025:20). In the field, data for the EMS was collected using a Bartington MS2E field meter alongside an MS3 meter and a Trimble Nomad field computer. The MS3 meter was also used in the laboratory with an MS2B unit to gather values from the traditional magnetic susceptibility samples (Bowman et al. 2022:32-33; Hansen et al. 2025:20).

Bartsoft software was used to process all data. EMS data is shown at one frequency. Laboratory magnetic susceptibility samples were measured at two frequencies (high and low) to calculate frequency dependence. Previous analyses indicate that both frequencies and calculations of percent dependence may yield insights into cultural behavior at various sites, with frequency dependence demonstrating the highest degree of correlation with cultural alterations in the landscape (Bowman et al. 2022:33).

Magnetic susceptibility measurements were collected side by side in vertical columns within EUs and positive TPs. EMS data was collected using a field meter to ensure that the environmentally affected magnetic susceptibility data would be representative across the site.

4.9 Acidity Analysis (pH)/Sediment Conductivity

Under specific conditions, pH analysis can assist in the reconstruction of paleoenvironmental factors, including humidity or aridity, the types of vegetation that existed on a given landform in the past, and the density of forested areas (Rapp and Hill 2006; Zinko et al. 2006). The pH has been observed to demonstrate a slightly more alkaline state when anthropogenic inputs on-site contain substantial amounts of degraded faunal material (Rapp and Hill 2006).

Sediment conductivity serves as an indicator for assessing anthropogenic inputs and variations in paleoenvironmental conditions. Generally, anthropogenic inputs are associated with a reduction in sediment conductivity due to the introduction of non-conductive elements, a trend also observed with the development of soils (Bowman 2017:54). In contrast, conductivity has been observed to increase in areas characterized by minimal to no anthropogenic influence, where primarily mineralized sediments are present, coupled with limited soil development (Bowman 2017:54). The integration of these measurements holds significant potential for illuminating the intensity of human land use at the site throughout various periods of occupation, as well as the extent of vegetative coverage during these times and consequently inform assessments of site function in both synchronic and diachronic contexts (Bowman 2017:54).

A specific sequence of steps must be followed to determine the pH and conductivity of sediment samples. Since both tests utilize the same device (the Oakton Acorn series pH 6), it is vital to maintain consistency in preparation and equipment for accurate sampling and analysis (Bowman 2017:54). This process involves standardizing measurements of sediment mixed into a slurry for data gathering, using calibration fluids for pH and conductivity to set baseline instrument settings, and taking measurements at consistent intervals (Bowman 2017:54-56; Bowman et al. 2022:33). Sediment column samples were collected from the two EUs at LIV-00456 for pH analysis and conductivity analysis.

4.10 Lithic Analysis Methods

The lithic analysis was undertaken in a Laboratory setting. Although the 2008 and 2014 assemblages were unavailable, the 2016 and 2024 assemblages were coded and statistically analyzed (the author did not participate in the analysis) using standard laboratory methods. These methods included the collection of metric data, examining attributes, identifying and grouping material types and artifact types, and then assigning technological types based on the collected data. Subsequent to data collection, statistical analyses were conducted to characterize the assemblages and examine correlations and associations between the various attributes (Hansen et al. 2025:21). Ultimately, these analyses were performed to assist with site interpretation and address the research questions for the project. A pXRF geochemical analysis[3] was also performed on obsidian samples in order to trace the geographical source.

Both assemblages were analyzed. The 2016 collection consisted of 1,714 samples, and consequently, without adequate provenience data, the statistical analysis was treated as a separate sample. The core interpretations of the lithic assemblage were based on the 2024 samples we collected. Thus, the 2016 collection provided additional interpretive discernment (Hansen et al. 2025:21-22).

According to Andrefsky's "*Lithics: Macroscopic Approaches to Analysis*" (2005) lithic technological types are classified into three broad categories: formal technologies, informal technologies, and debitage. Formal technologies are characterized by an extensive variety of tools that have been subjected to the process of intentional manufacturing and show evidence of secondary modification through a specialized technique (Andrefsky 2005:256; Odell 2004:4). For example, formal technological tool forms include complete or partially complete bifaces, prepared blades and microblade cores, and processed tools with a sustained history of use, such as diagnostic bifaces and side and end scrapers (Hansen et al. 2025:21). Informal technologies refer to casually made tool forms made with only minimal manufacturing design, also called expedient tools quickly fashioned for immediate use such as flake tools which may indicate signs of intentional retouch and/or reveal some wear patterns (Andrefsky 2005:255, 256). These informal technologies include flake tools, core tools (i.e. tested cobbles, flake cores), boulder spall scrapers, burins, gravers, cobble tools, and hammerstones (Hansen et al.

[3] Testing was conducted by the University of Alaska Museum of the North (UAMN).

2025: 21). Finally, debitage is defined as the debris or detached fragments that constitute the discarded by-products of the stone tool manufacturing or reduction process (Andrefsky 2005:254). Typological forms of debitage include primary, secondary, and tertiary flakes, bifacial thinning and notching flakes, retouch and retouch scraper flakes, bipolar flakes, pressure flakes, burin spalls, nodule and core trimming elements, and angular shatter (Andrefsky 2001:6-7; Hansen et al. 2025:21).

In the next chapter, the results will be presented.

Chapter 5. Results

5.1 General Survey Results and Observations

This chapter presents the survey results and analysis of the collected data, which includes the placement of 80 test pits (TPs) for site delineation. Out of these, 72 TPs were excavated, with 16 yielding positive results and 56 yielding negative results. Two loci were documented, and one cultural zone was identified. All collected assemblages consisted exclusively of lithic materials.

The site is situated on a terrace that predominantly extends in a north-south orientation, featuring a well-established four-wheeler trail that traverses the crest of the terrace, bisecting the site. The terrace is encircled by steep slopes on its eastern, western, and southern perimeters, and it features a spruce forest intermingled with birch and aspen. The understory consists of mosses, lichens, Labrador tea, cranberries, and blueberries (Hansen et al. 2025:29).

While conducting our initial assessment of the site in order to locate the old test units, we began identifying surface lithics eroding out of the trail (Figure 6 and Figure 7). Consequently, we flagged the surface finds to be recorded later, as we had yet to establish the site datum and the total station. Eventually, we began to identify what we discerned to be the old test units from 2016 and realized little to no delineation had occurred at the site. Furthermore, our investigation revealed that the 2016 study had positioned most of their test units within the disturbed context, either directly on or overlapping the four-wheeler trail. We set a site datum the next day and configured the total station for accurate data collection.

Figure 6. Surface finds on the four-wheeler trail (courtesy of NLURA).

Figure 7. Flagged surface scatter (courtesy of NLURA).

The first task was to delineate the site boundaries, which initially began at an arbitrary 10 m (30 ft) TP placement within a grid around Locus 1. This locus had been established to contain cultural materials identified by past investigations in 2008, 2014, and 2016 and was reinforced with the newly located surface finds (Hansen et al. 2025: 34).

Once delineation had commenced, the crew realized that the site was significantly larger than initially reported or projected. Our initial delineation plan, which involved 10-meter intervals, resulted in more positive units than anticipated. Due to time constraints, an adjusted delineation plan was devised. The new plan increased TP placement at 20-m intervals. With the new plan, the crew split into two groups and continued to delineate both loci. Simultaneously, as delineation continued, a location was selected from the positive TPs in each locus to expand into a 1 x 1-m excavation unit (EU).

5.2 Delineation

Ultimately, the delineation of LIV-00456 resulted in the placement of 80 TPs, 72 of which were fully excavated, while eight locations were not tested due to either steep slopes or significant disturbance from activity on the four-wheeler trail. The finalized site boundary was established based on the occurrence of double negative TPs positioned in approximately cardinal directions, where the terrain and vegetation permitted (Hansen 2025: 36). Consequently, two cultural loci [4]and one cultural zone[5] were identified. The LIV-00456 site was observed to encompass an area of approximately 2.7 acres along the

[4] The horizontal distribution of a specific point in space; a discrete excavated unit or concentration of site elements: loci (plural)

[5]. The term' cultural zone' refers to the vertical distribution of a specific area within a site that exhibits a unique set of artifacts, features, and/or environmental characteristics indicating human activity or cultural modification associated with a stratigraphic layer or level.

top of the terrace, where the four-wheeler trail appeared to bisect at the approximate center. This was indicated by the numerous artifacts recovered on the four-wheeler trail's surface as well as the position of positive TPs in relation to the trail, further supported by the volume of artifacts recovered from this area in the 2016 data recovery project. See Figure 8 delineation map, black squares are positive test units, and the red triangle represents the site datum, and the red lines signify the two loci.

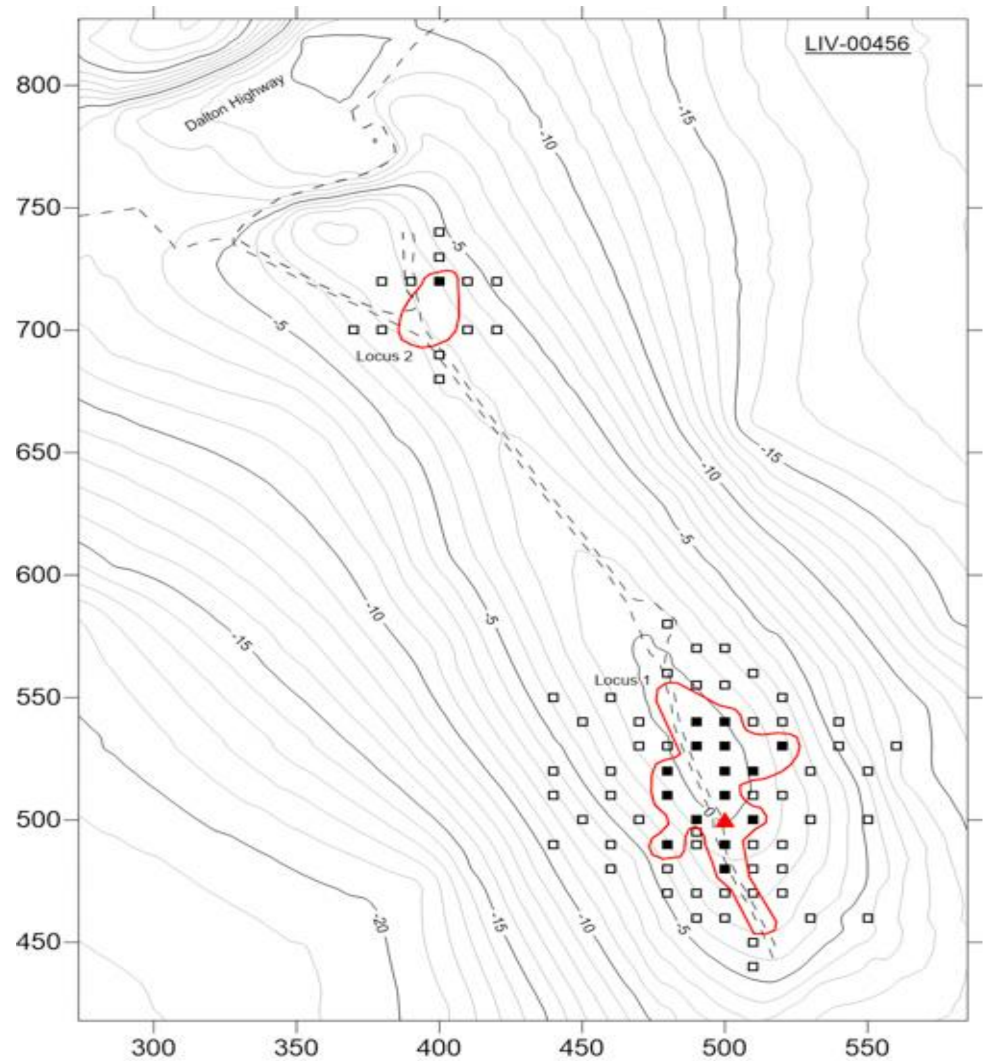

Figure 8. Delineation map (courtesy of NLURA).

5.3 Locus 1

Locus 1 encompassed most of the site's parameters, comprising 67 of the placed TPs and the location of the eight unexcavated units. Fifteen TPs were positive for subsurface cultural materials, while 44 TPs were negative, and 302 artifacts were collected within this locus. One of the two excavation units (EU) at the site was expanded in Locus 1. After the crew deliberated on which positive TP would be most suitable for expansion, TP-03 was chosen based on its location relative to the 2016 excavation units and the type of material collected from the unit. Based on a preliminary examination of the recovered materials, which consisted of 30 small tertiary lithic fragments produced primarily from obsidian and, to a slightly lesser degree, chert. Considering the size and extent of reduction, the crew concluded that TP-03 could plausibly have been situated in close proximity to a hearth feature. This conclusion is based on the Binford (1978) drop/toss model, which posits that artifacts, including materials of small splinter or shatter size, are often "dropped" within 1 m of a hearth or designated sitting areas utilized as workspaces, whereas larger, less useful fragments may be "tossed" beyond the 1 m threshold (Hansen et al 2025: 41). Therefore, the decision was made to expand TP-03 in hopes that we may uncover features that would help identify site chronology and possibly activity areas. Artifact locations were documented through three-point provenience upon discovery in situ, while those found in the screen were noted and placed into level screen bags. See Figure 9 below EU1.

Figure 9. Excavation unit 1 (courtesy of NLURA).

Five stratigraphic layers were identified, and all the layers exhibit margin distinctions consistent with advanced cryoturbation, causing irregular and broken horizons. Hence, any exact vertical or horizontal positioning of artifacts recovered within the EU may not have been located within their original context (Bowers et al. 1983). As shown in Figure 10 of stratigraphic details, there is evidence indicating that the stratigraphic layers range in transitions from wavy and clear to discontinuous and diffuse. One cultural zone was discerned to be present in three of the arbitrary levels between 0 and 30 cmbs based on the lack of clear stratigraphy.

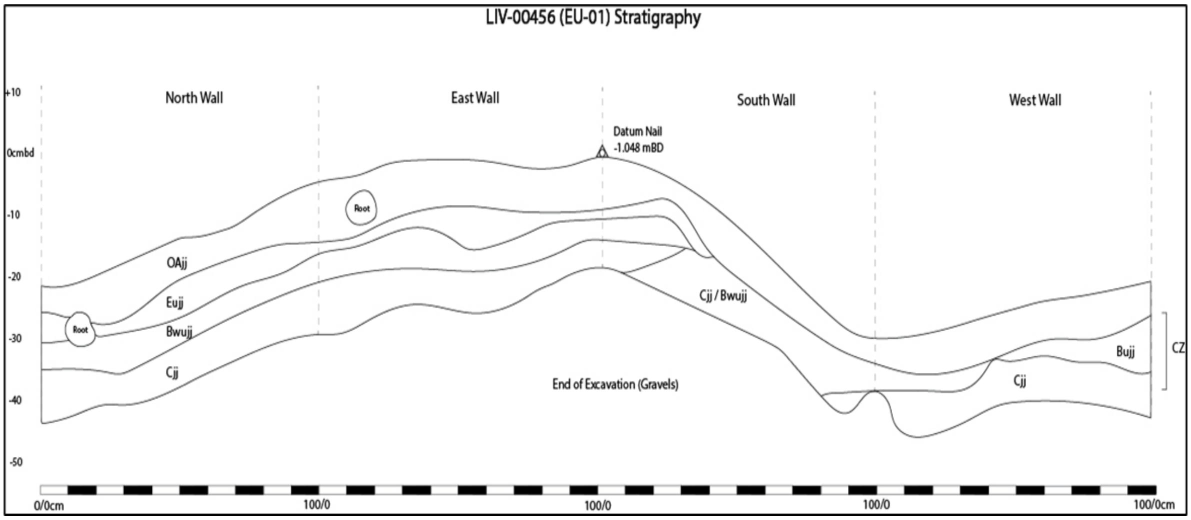

Figure 10. Stratigraphy profile for excavation unit 1 (courtesy of NLURA).

This cultural zone yielded 84 lithic artifacts, primarily retrieved from the screen. The percentages of unit assemblage concentrations are as follows: 38% from level I (0-10 cmbs), 61% from level II (10-20 cmbs), and 1% from level III (20-30 cmbs), with no cultural materials found between 30 cmbs and the termination depth of 48 cmbs. See Table 1.

Table 1. Stratigraphic layer descriptions (NLURA).

This table Stratigraphic Layer	Depth (cmbs)	Horizon	Description	Cultural Zone/Artifacts
I	0-37	OAjj	Black (5YR 2.5/1) root mat with silt, clear wavy boundary	Absent
II	9-30	Eujj	Dark Gray (2.5YR 4/1) silt with heavy rootlet content, clear wavy boundary	Present
III	11-36	Bwujj	Weak Red (10YR 4/2) silt with fine gravels. Discontinuous to wavy, diffuse boundary	Present
IV	14-47	Cjj	Brown (10YR 4/3) silt with gravels, clear wavy boundary	Present
V	16-39	Cjj/Bwujj	Highly mottled/mixed; discontinuous to wavy, diffuse boundary (2.5YR 4/1) (10YR 4/2) (10YR 4/3) silt	Present

Table Notes:
cmbs = centimeters below ground surface
N/A = not applicable

5.4 Locus 2

I would like to note here that Locus 2 was not present in the 2008 or 2014 reports; GIS points appear in that location in the 2016 data recovery project's GIS data, and from the limited data we received, it was initially unclear what was recovered from this location as it was not indicated what these GIS point referred to. While conducting the background analysis, I surmised that the collected cultural material may have been located on the surface, but the 2016 crew recorded fourteen GIS points in and around the area, including four labeled as waypoints, including shovel test pits, EUs, and other various designations, indicating there must have been positive results within this area. Thus, the 2024 data recovery crew was initiated to expand the original site boundaries and create Locus 2.

Figure 11. Wall profile of EU2 (courtesy of NLURA).

There were 13 TPs excavated in locus 2; of those, only one was positive for cultural material. The positive TP (TP-101) contained a lithic flake tool, and no other cultural material was found in locus 2; thus, this became the location of EU2, of which ultimately no other artifacts were recovered. One cultural zone and four stratigraphic layers were present in EU2 (Figure 11. Wall profile of EU2 (courtesy of NLURA). Layer I (0-9), which closely corresponds to the arbitrary Level I (0-10), was where the lithic flake tool was recovered. Refer to Table 2 and Figure 12 for detailed stratigraphic information.

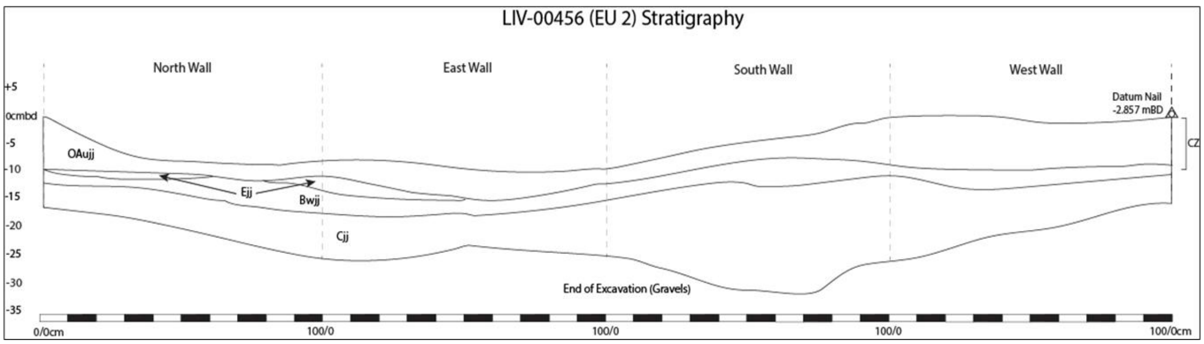

Figure 12. Stratigraphic profile of EU2 (courtesy of NLURA).

Table 2. Stratigraphic layer descriptions (NLURA).

Stratigraphic Layer	Depth (cmbs)	Horizon	Description	Cultural Zone/Artifacts
I	0-9	OAujj	Black (10YR 4/1) root mat, clear wavy boundary, loosely compacted	Present
II	10-15	Ejj	Dark Gray (2.5YR 4/1) silt with heavy rootlets, irregular wavy boundary, loosely compacted	Absent
III	13-17	Bwjj	Reddish-Brown (5YR 5/3) silt with minor rootlets and fine gravel, diffuse wavy boundary, moderate compaction	Absent
IV	12-33	Cjj	Brown (10YR 4/3) silt with fine to medium gravels, clear wavy boundary, highly compacted	Absent
N/A		R	Bedrock	Absent

Table Notes:
cmbs = centimeters below ground surface
N/A = not applicable

5.5 The Cultural Zone

A cultural zone is defined as the vertical extent to which cultural material was present within stratigraphic layers or distinct levels within an archaeological site. A single cultural zone is observed across the site between 0-30 cmbs and present in all stratigraphic layers in EU1. The location of the single flake tool recovered in EU2 correlates with the cultural zone identified in Locus 1 and EU1 based on the depth of the recovered artifact, which ranges between 0-10 cmbs. The evidence of cryoturbation is evident across the site within both loci, further supporting the notion that the exact vertical and horizontal positioning of artifacts collected across the site represents their original context (Hansen et al. 2025: 50). The entire assemblage of cultural material recovered from the cultural zone is composed entirely of lithics.

5.6 LIV-00456 Lithic Assemblages

The total lithic assemblage sample comprises 2,069 lithic artifacts, of which 98.5% is constituted by debitage, resulting in a total of 2,038 debitage fragments, 26 flake tools, including two bifaces, and three core or core fragments (Hansen et al. 2025: 51). Initially, the assemblages were analyzed by year of collection, whereas the 2008 and 2014 assemblages were not available for analysis. The data was analyzed separately for the 2016 and 2024 assemblages due to provenience issues with the 2016 data.

5.7 Lithic Debitage

5.7.1. 2016 Debitage Metric and Attribute Analysis

The debitage contained 20 different identified technological flake types with the most common being the non-diagnostic flakes characterized as flakes without an identifiable platform representing 63.4% (n=1,104) of the assemblage (Hansen et al. 2024: 51). Flakes that are characterized as non-diagnostic contain limited interpretive value due to the idea that these flakes may be produced at any point in the reduction process by cultural means or could be a result of post depositional non cultural processes (Rasic 2008: 358, Hansen et al. 2024: 51). The assemblage contained primarily the following two technological flake types: bifacial thinning flakes (n=178, 10.2%) and pressure flakes (n=173, 9.9%) the remaining 5% represent various flake types (Hansen et al. 2025: 51).

We note that notching flakes accounted for 1% (n=3) of the 2024 sample and 4.3% (n=75) of the 2016 assemblage (Figure 13 and Figure 14).

Figure 13. Notching flakes from the 2016 assemblage (courtesy of NLURA).

Figure 14. Notching flakes from the 2024 assemblage (courtesy of NLURA).

The material types present in the 2016 sample of artifacts (Figure 15) indicated six distinct raw materials. Chalcedony appears to be the dominant material, accounting for 714 artifacts, followed by chert with 622 items, 374 items made of obsidian, basaltic materials are present in 17 items, quartzite in 13 items, and one artifact in the sample assemblage is sandstone, which is not represented in Figure 15 or Table 2 (Hansen 2024: 53).

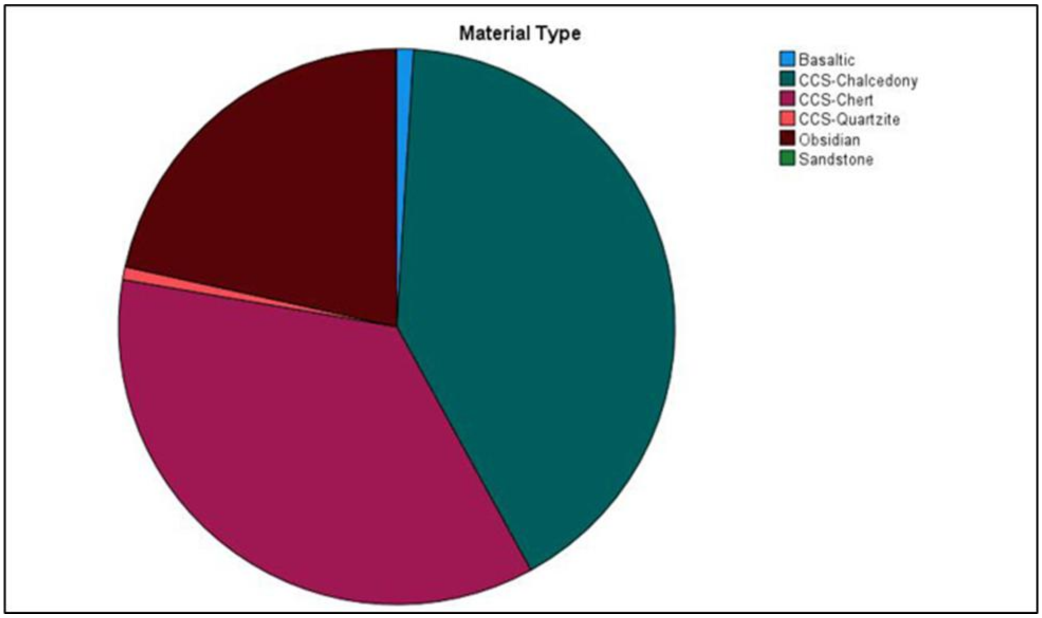

Figure 15. Collected debitage material type percentages (courtesy of NLURA).

The total mass percentage (Table 3) of raw material of the collected debitage attributed to chert constitutes 64.98% of the overall mass. In contrast, while chalcedony is identified as the most abundant material type recovered, accounting for 714 samples, its total mass accounts for merely 24.1%. By count, obsidian was the third most recovered material type, accounting for a mass percentage of 4% and a sample size of 249. Other materials present in the assemblage in very limited quantities are basaltic, with 17 samples and a mass percentage at 6.15%, and quartzite, with 13 specimens and a mass percentage of 0.89%.

Table 3. 2016 Assemblage mass percentage (graphic courtesy NLURA 2016).

Material Type	Case Count (n)	Case %	Summed Mass (g)	Mass percent of total summed mass
Chert	590	37.27	541.62	64.89
Chalcedony	714	45.10	200.78	24.05
Obsidian	249	15.73	33.45	4.01
Basaltic	17	1.07	51.32	6.15
Quartzite	13	0.83	7.51	0.89
Total	1583	100	834.68	100

Table Notes:
Sandstone was also identified in the sample but excluded because the sandstone sample is unlikely to be archaeological
Samples with a mass less than 0.01g were excluded
n = sample number
% = percent
g = grams

When comparing the technological flake types by material in the 2016 assemblage, which contains very few decortication flakes, the Chi-Square analysis (Table 4) indicates that alternate flakes and edge preparation flakes (Figure 16) are statistically more likely to be made of chert, while late-stage bifacial thinning flakes and pressure flakes are significantly more likely to be obsidian (Hansen et al. 2025:54). According to Hansen et al. (2025:56-57) the predominant material type in terms of mass percentage within the assemblage is chert; however, it does not have the highest sample count, with 590 specimens recorded.

Table 4. Chi-square test comparing technological flake type and material type 2016 (graphic courtesy NLURA).

Test Type	Test Statistic	Sample Size (n)	Degrees of Freedom	Alpha Level[1]	P[2]	Reject Null Hypothesis[3]
Chi-Square	χ^2=264.652	1714	90	0.05	<0.00	Yes

Table Notes:
[1]Standard Alpha value for anthropological statistical hypothesis testing, indicates that there is < 5% of wrongly rejecting the null hypothesis through chance alone.
[2]Significance value compared to Alpha, values below 0.05 are considered significant and reject null.
[3]Null hypothesis is that there is no statistically significant difference between observed and expected technological flake type and material type occurrence, rejection of the null indicates that there is a statistically significant difference.

Figure 16. Edge preparation flakes from the 2016 assemblage (courtesy of NLURA).

A Shapiro-Wilk normality test (Table 5) was conducted on the metric variables—maximum length, thickness, and weight—to ascertain whether the sample data originated from a normal distribution. According to the results, the p-value for all variables is p = 0.00, indicating that the 2016 lithic assemblage was not normally distributed. Therefore, other parametric tests (e.g., ANOVA) were considered not useful. (Hansen et al., 2025: 57-58).

Table 5. 2016 Results of Shapiro-Wilk tests of normality for max. size, max. thickness, and weight (courtesy of NLURA).

Variable	Normality test	Test Statistic	DF	Alpha[1]	P[2]	Not Normally Distributed?[3]
Max. Length	Shapiro-Wilk	0.879	1476	0.05	<0.00	Yes
Max. Thickness	Shapiro-Wilk	0.822	1476		<0.00	Yes
Weight	Shapiro-Wilk	0.360	1476		<0.00	Yes

Table Notes:
[1]Standard Alpha value for anthropological statistical hypothesis testing indicates that there is < 5% of wrongly rejecting the null hypothesis through chance alone.
[2]Significance value compared to Alpha, values below 0.05 are considered significant and reject null.
[3]Normality testing has a standard null hypothesis of normally distributed data, significant results in this context indicate the data set in question is not normally distributed
DF = Degree of Freedom
Max. = Maximum

Alternatively, the Kruskal-Wallis non-parametric test was used to assess the statistical significance of the metric variables (maximum length, thickness, and weight) in relation to the material types, aiming to determine whether the differences in the data sets are genuinely significant or merely a random occurrence. The results of the statistical testing on the 2016 assemblage indicated the variation shown in the metric variables can be attributed to differences in raw material type, suggesting differences in technological organization patterns (Table 6) (Hansen et al. 2025:58). Evident differences were observed between chert and obsidian with respect to thickness and weight. Chert materials are comparatively heavier and tend to be thicker. Furthermore, the maximum length of obsidian flakes differed from that of all other material types. Interestingly, the statistical analysis revealed that chalcedony exhibits similarities in maximum length that were closer to obsidian than to chert, although it remains distinctly different from both (Hansen et al. 2025:58).

Table 6. 2016 Kruskal-Wallis test of metric variables as grouped by material type (courtesy of NLURA).

Variable	Valid Sample	Test	Test Statistic	DF	Alpha[1]	P[2]	Reject Null?[3]
Max. Length	1741	Kruskal-Wallis	297.941	5		<0.00	Yes
Max. Thickness	1741	Kruskal-Wallis	614.072	5	0.05	<0.00	Yes
Weight	1476	Kruskal-Wallis	337.204	5		<0.00	Yes

Table Notes:
[1]Standard Alpha value for anthropological statistical hypothesis testing indicates that there is < 5% of wrongly rejecting the null hypothesis through chance alone.
[2]Significance value compared to Alpha, values below 0.05 are considered significant and reject null.
[3]Null hypothesis is that there is no statistically significant difference between median values of the metric variables when organized by material type. Rejection of the null indicates that there is a statistically significant difference.
DF = Degree of Freedom

5.7.2. 2024 Debitage Metric and Attribute Analysis

The 2024 collected debitage sample has 15 different technological flake types, the most common being non-diagnostic flakes, accounting for 41.9% (n=124) (which have limited interpretive value), including the following diagnostic flake types: alternate flakes (n=40, 13.5%), interior flakes (n=23, 7.8%), pressure flakes (n=19, 6.4%), late stage bifacial thinning flakes (n=16, 5.4%), decortication flakes (n=15, 5.1%), and notching flakes (n=3, 1%) with the remaining 5% made up of various technological flake types (Hansen et al. 2025:51).

The raw material types present in the debitage collected include chert, making up 210 items (70.9%), obsidian, accounting for 61 items (20.6%), and chalcedony, representing 16 items (5.4%). Additionally, there are eight basaltic materials (2.7%) and one granitic material (0.3%) present (Hansen et al. 2025:53). The mass percentage of raw materials within the assemblage reflects the raw material counts, with chert constituting the most significant percentage of total mass at 95.66%, obsidian accounting for 3.42%, and chalcedony (0.27%) and the basaltic materials (0.65%) each making up less than 1% (Hansen et al. 2025: 57). See Figure 17 and Table 7.

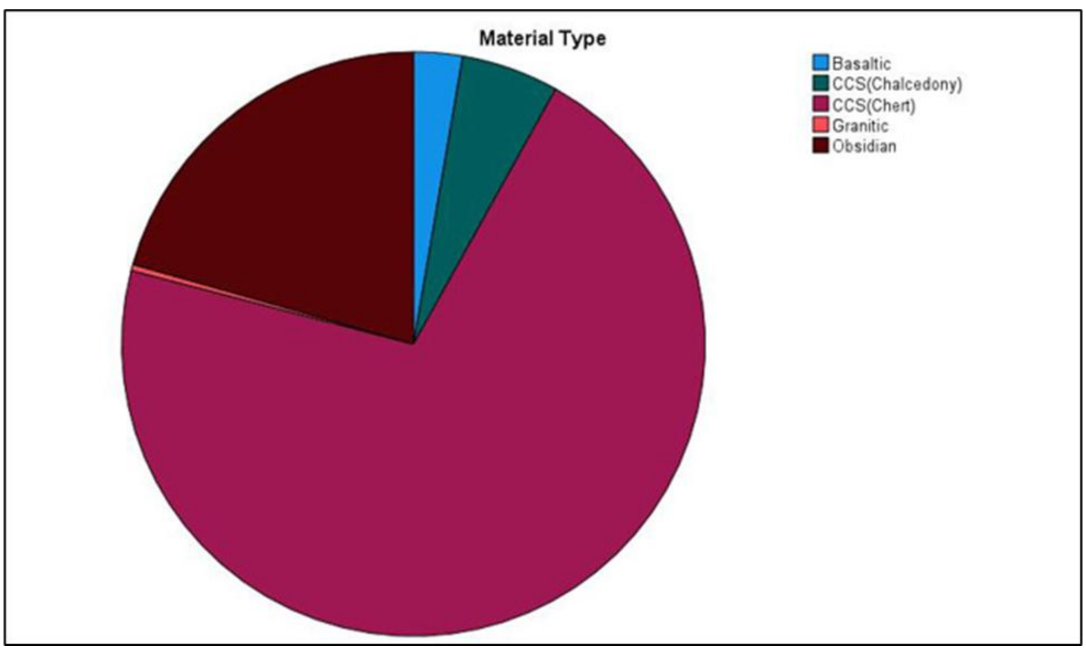

Figure 17. 2024 Collected debitage material type percentages (courtesy of NLURA).

Table 7. 2024 Assemblage mass percentage (courtesy of NLURA)

Material Type	Case Count (n)	Case %	Summed Mass (g)	Mass percent of total summed mass
Chert	210	71.19	213.71	95.66
Chalcedony	16	5.42	0.61	0.27
Obsidian	61	20.68	7.65	3.42
Basaltic	8	2.71	1.43	0.65
Total	295	100	223.4	100
Table Notes:				

Granitic material was also identified in the sample but excluded because the sample is unlikely to be archaeological

While most nominal variables for the assemblage produced statistically insignificant results when applying the Chi-square test, a significant statistical relationship emerged when comparing technological flake types to material types, indicating that chert comprises the majority of decortication, alternate, and interior flakes (Hansen et al. 2025:55).

Table 8. 2024 Chi-squared test comparing technological flake type and material type (courtesy of NLURA).

Test Type	**Test Statistic**	**Sample Size (n)**	**Degrees of Freedom**	**Alpha Level[1]**	**P[2]**	**Reject Null Hypothesis[3]**
Chi- Square	χ^2=105.072	296	56	0.05	<0.00	Yes

Table Notes:
[1]Standard Alpha value for anthropological statistical hypothesis testing, indicates that there is < 5% of wrongly rejecting the null hypothesis through chance alone.
[2]Significance value compared to Alpha, values below 0.05 are considered significant and reject null.
[3]Null hypothesis is that there is no statistically significant difference between observed and expected technological flake type and material type occurrence, rejection of the null indicates that there is a statistically significant difference.

Additionally, obsidian is more commonly found in pressure flakes and bifacial shaping flakes, which are frequently produced during late-stage tool production and tool maintenance (Hansen et al. 2025:55). Whereas decortication, alternate, and interior flakes serve as indicators of early-stage lithic reduction activities, as evidenced by the statistical analysis of the metric data, which reveals that the chert in the assemblage corresponds with the larger fragments typically associated with early-stage lithic production. Figure 18 provides an example of early-stage flakes.

Figure 18. Early-stage flakes from the 2024 assemblage (courtesy of NLURA).

When examining the metric variable data—maximum length, thickness, and weight—using the Shapiro-Wilk normality test, the 2024 lithic assemblages, similar to the 2016 assemblage, showed a p-value of p = 0.00 for all variables, indicating that both assemblages were not normally distributed (Table 9) (Hansen et al. 2025:57-58).

Table 9. 2024 Results of Shapiro-Wilk tests of normality for max size, max. thickness, and weight (courtesy of NLURA).

Variable	Normality test	Test Statistic	DF	Alpha[1]	P[2]	Not Normally Distributed?[3]
Max. Length	Shapiro-Wilk	0.750	290	0.05	<0.00	Yes
Max. Thickness	Shapiro-Wilk	0.734	290		<0.00	Yes
Weight	Shapiro-Wilk	0.241	290		<0.00	Yes

Table Notes:
[1]Standard Alpha value for anthropological statistical hypothesis testing indicates that there is < 5% of wrongly rejecting the null hypothesis through chance alone.
[2]Significance value compared to Alpha, values below 0.05 are considered significant and reject null.
[3]Normality testing has a standard null hypothesis of normally distributed data, significant results in this context indicate the data set in question is not normally distributed
DF = Degree of Freedom
Max. = Maximum

As with the 2016 debitage assemblage, the Kruskal-Wallis non-parametric test was used to test the metric variables statistically for any possible correlation between the variables (max length, thickness, and weight) and material type. The results for the 2024 collected debitage assemblage (Table 10) indicate statistically significant comparisons between the treatment of obsidian and chert when examining material and maximum length. Evident differences were observed between chert and obsidian with respect to thickness and weight.

Table 10. Kruskal-Wallis test of metric variables as grouped by material type (courtesy of NLURA).

Variable	Valid Sample	Test	Test Statistic	DF	Alpha[1]	P[2]	Reject Null?[3]
Max. Length	293	Kruskal-Wallis	65.88	4	0.05	<0.00	Yes
Max. Thickness	293	Kruskal-Wallis	29.949	4		<0.00	Yes
Weight	290	Kruskal-Wallis	41.161	4		<0.00	Yes

Table Notes:
[1]Standard Alpha value for anthropological statistical hypothesis testing indicates that there is < 5% of wrongly rejecting the null hypothesis through chance alone.
[2]Significance value compared to Alpha, values below 0.05 are considered significant and reject null.
[3]Null hypothesis is that there is no statistically significant difference between median values of the metric variables when organized by material type. Rejection of the null indicates that there is a statistically significant difference.
DF = Degree of Freedom

Chert materials are comparatively heavier and tend to be thicker. Additionally, maximum thickness reveals differences between chert and obsidian as well as chert and chalcedony. Furthermore, the weight of material type indicates significant differences between chert and obsidian, chert and chalcedony, and chalcedony and obsidian (Hansen et al. 2025:59).

5.8 Lithic Tools

5.8.1. 2016 Tool Assemblage

Again, the analyses were initially divided by the year of collection. The 2016 investigation gathered a total of 20 flake tools, two biface fragments, and one core fragment. As mentioned earlier, due to the difficulty in interpreting the 2016 spatial data, no statistical hypothesis testing was performed on the 2016 tool assemblage (Hansen et al. 2025: 59).

Among the flake tools present in the assemblage, four are identified as obsidian burins (Figure 19). The inferred function of a burin is to serve as a grooving or engraving tool utilized on organic materials such as wood, bone, or antler. As no faunal or other organic materials were recovered at the site, it is therefore plausible that these burins were not used as designated and may instead be the product of post-depositional processes or an incidental flake design (Bowman et al. 2022:161; Hansen et al. 2025:59). There are 14 informal flake tools present: eight made of chalcedony, four chert, and two of obsidian, along with two scrapers, one of obsidian and one of chert.

The two biface fragments are comprised of chalcedony and are missing the distal bases, thus contain no clear diagnostic features, but given the presence of cortex, their relative thickness, and minimal presence of pressure flaking and edge retouch, the conclusion is that they may represent bifacial blanks (Hansen et al. 2025:59). Also present is a chert core fragment from a percussion or free-handed flake core that ultimately shows little to no sign of patterned flake removal (Hansen et al. 2025:59).

Table 11 presents the 2016 tool assemblage, while the figures 20-22 present representative assemblage samples: Figure 20 examples of informal tools, Figure 21 scrapers, and Figure 22 cores and biface fragments from the 2016 assemblage.

Table 11. 2016 Collected tool assemblage (courtesy of NLURA).

Tool Type	Sample Size (n)	Percent of Tool Sample
Biface Fragment	2	8.69%
Burin[2]	4	17.39%
Core Fragment[1]	1	4.36%
Informal Flake tool	14	60.87%
Scraper	2	8.69%
Total	23	100%

Table Notes:
[1]Cores are not usually grouped with tools but with a sample of one it is included here for reporting.
[2]Possible misidentification, see corresponding text description.

Figure 19. Obsidian burins from the 2016 assemblage (courtesy of NLURA).

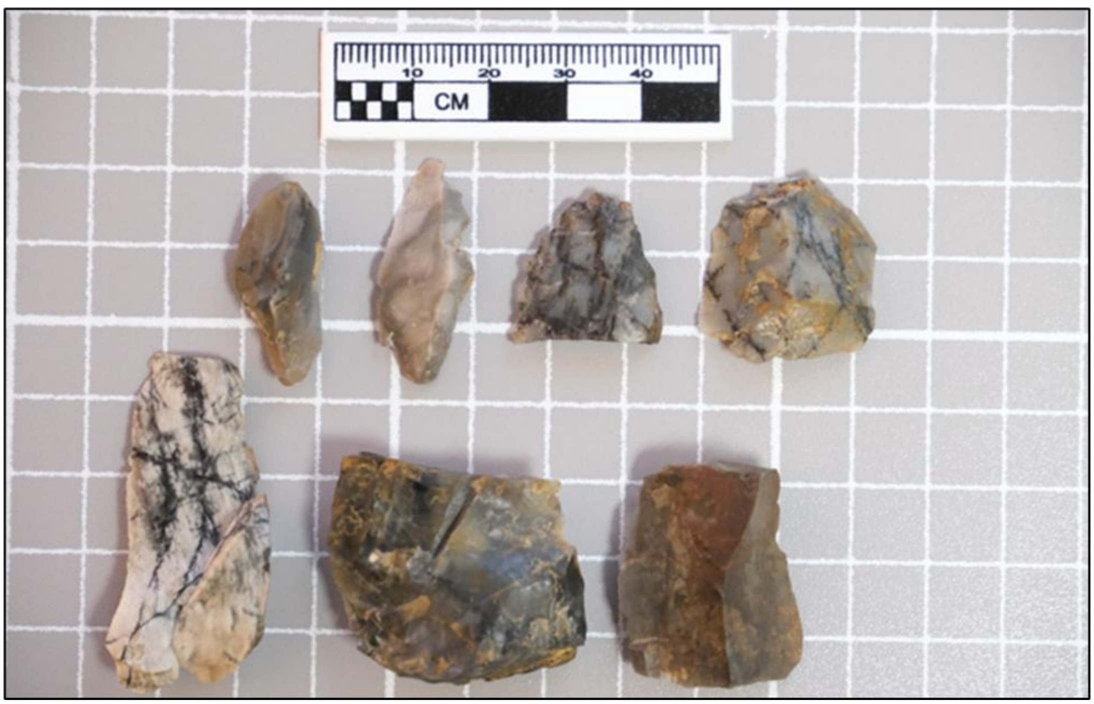

Figure 20. Informal flake tools from the 2016 assemblage (courtesy of NLURA).

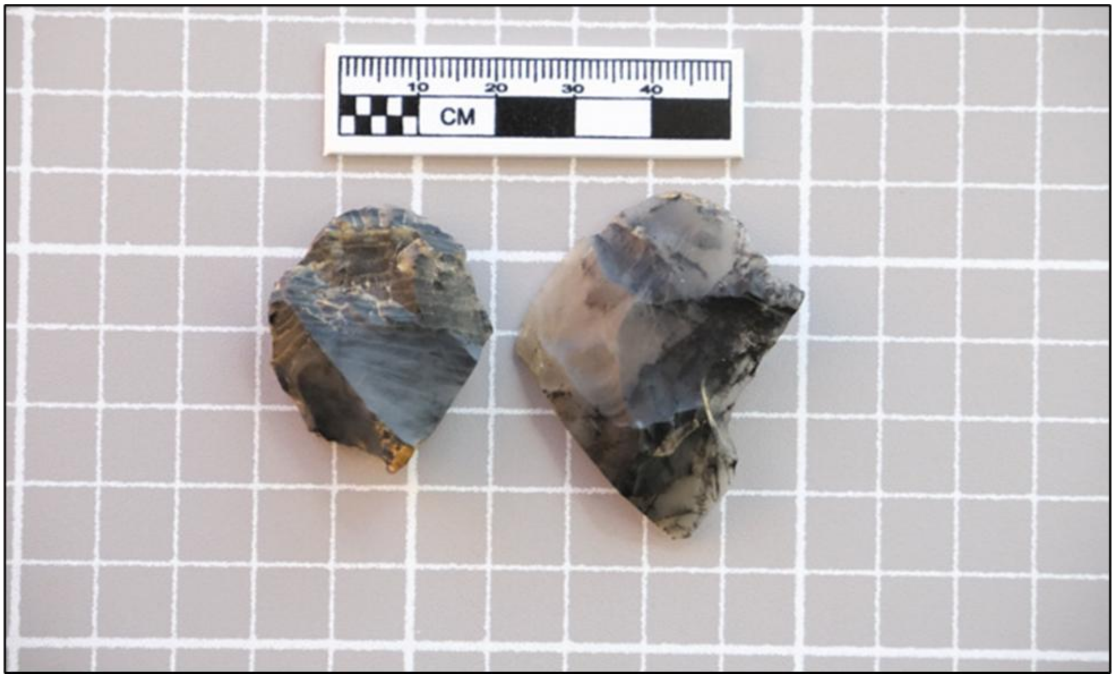

Figure 21. Scrapers from the 2016 assemblage (courtesy of NLURA).

Figure 22. Core fragment (top) and biface fragments (bottom) from the 2016 assemblage (courtesy of NLURA).

5.8.2. 2024 Tool Assemblage

During the 2024 data recovery, the crew recovered a total of eight tools: four informal flake tools (Figure 23), two scrapers (Figure 24), one core fragment (Figure 25), and a hammerstone (Figure 26), none of which are diagnostic and, therefore, are not assigned to a temporal period or cultural tradition (Hansen et al. 2025:63).

The tool assemblage consists of one obsidian end scraper and one small chert side scraper. All four informal flake tools are composed of chert; one exhibits retouching along one margin and, on both faces, with limited retouch on one surface, categorizing it with the flake tools rather than the more formal tool technology (Hansen et al. 2025:63). One chert core fragment has been identified as possibly originating from an unshaped percussion or free-handed flake core. Additionally, a sandstone hammerstone that is relatively teardrop-shaped and exhibits substantial wear on its broad margin. Considering the softness of sandstone, which would fragment easily if used as a percussor for lithic reduction, its presence suggests it may have had some other unidentified use (Hansen et al. 2025:63).

Figure 23. Informal flake tools from the 2024 assemblage (courtesy of NLURA).

Figure 24. Scrapers from the 2024 assemblage, FS22 (left) and FS36 (right) (courtesy of NLURA).

Figure 25. Freehand core from the 2024 assemblage (courtesy of NLURA).

Figure 26. Sandstone hammerstone from the 2024 assemblage (courtesy of NLURA).

5.9 Environmental Magnetic Susceptibility (EMS)

The analysis of EMS value distribution across the site revealed significant peaks at three key depths: 0-5 cmbs, 6-10 cmbs, and 14-20 cmbs, while some TPs exhibited a mix or variation of these peaks, depending on their location within the site and the specific depth of each TP (Hansen et al. 2025:71). Figure 27 illustrates the vertical representation of EMS value spikes at four locations in Locus 1, along with data from Locus 2, which shows a comparable vertical pattern (Hansen et al. 2025:71-72).

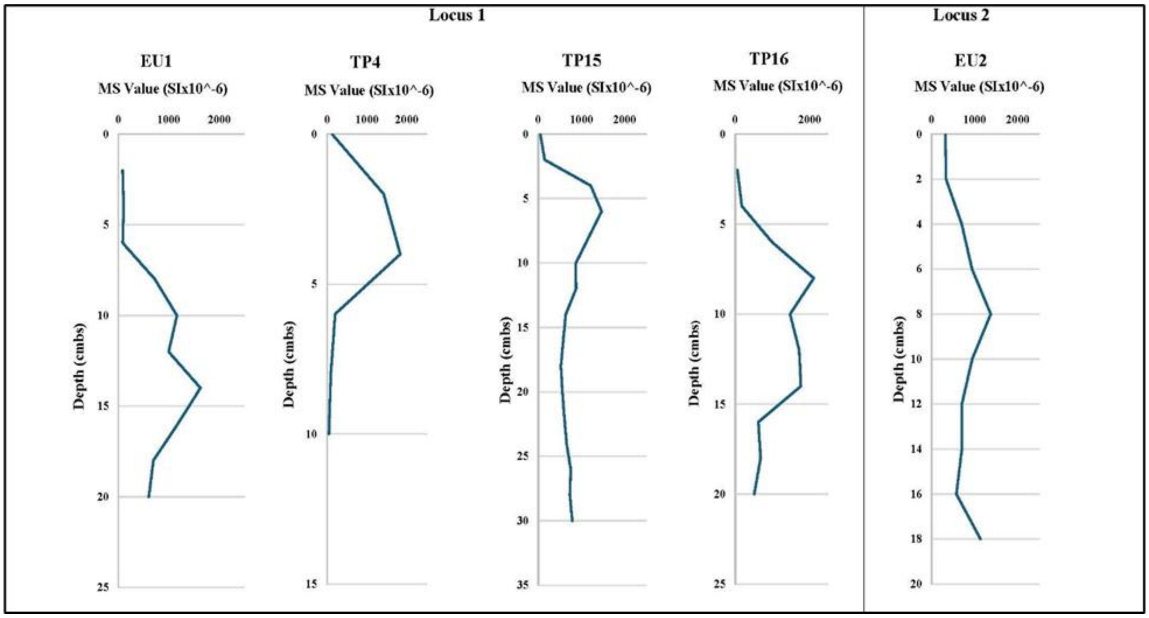

Figure 27. Left shows EMS spike values in Locus 1. Far right indicates EMS value in Locus 2 (courtesy of NLURA).

The EMS values were mapped in plan-view for Locus 1 because it contained multiple positive test units, whereas Locus 2, which had only one positive TP, was excluded from the plan-view mapping of EMS values (Hansen et al. 2025:71). The total EMS values for the thermoremanent proxy are presented in Figure 28 as a cumulative plan-view map, indicating that the concentration of thermoremanent values increased with depth, thus decreasing over time (Hansen et al. 2025:72-73).

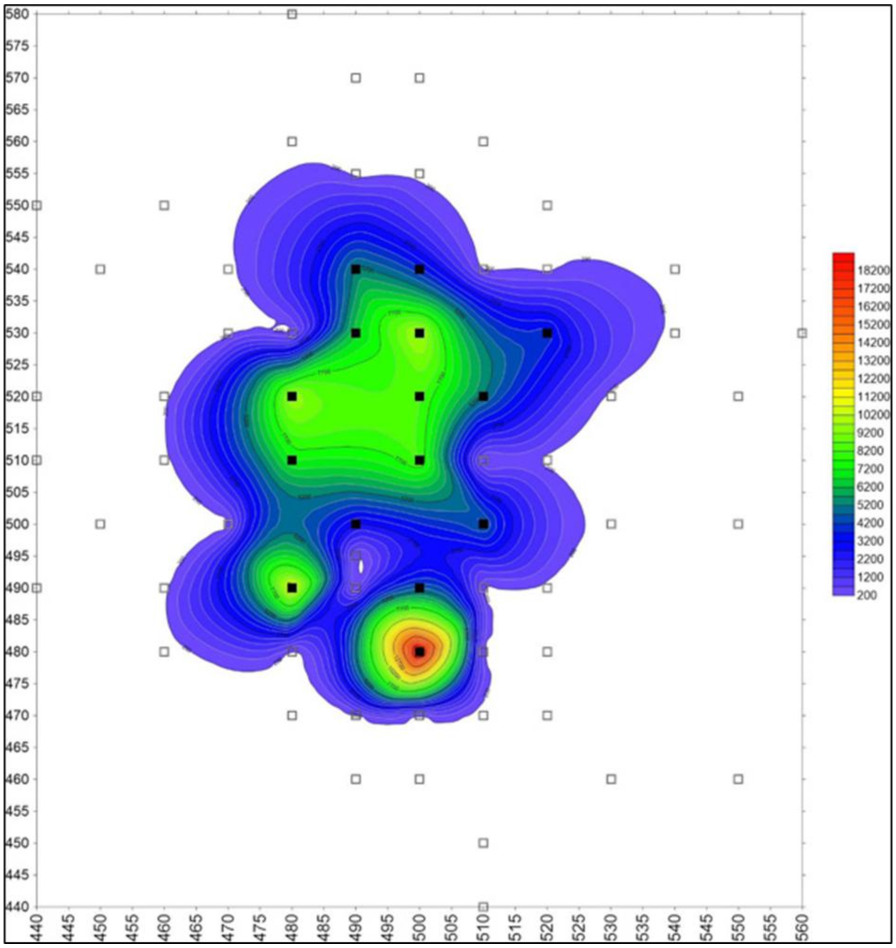

Figure 28. Locus 1 cumulative EMS value map (SI x10^-6) (courtesy of NLURA).

Figure 29 illustrates the increased values found throughout much of Locus 1 at depths of 14-20 cmbs, with the highest values concentrated around TPs at TP-3/EU1 (N510E480) and TP-2 (N520E500), while also being somewhat isolated at N480E500, TP 49 (Hansen et al. 2025:74).

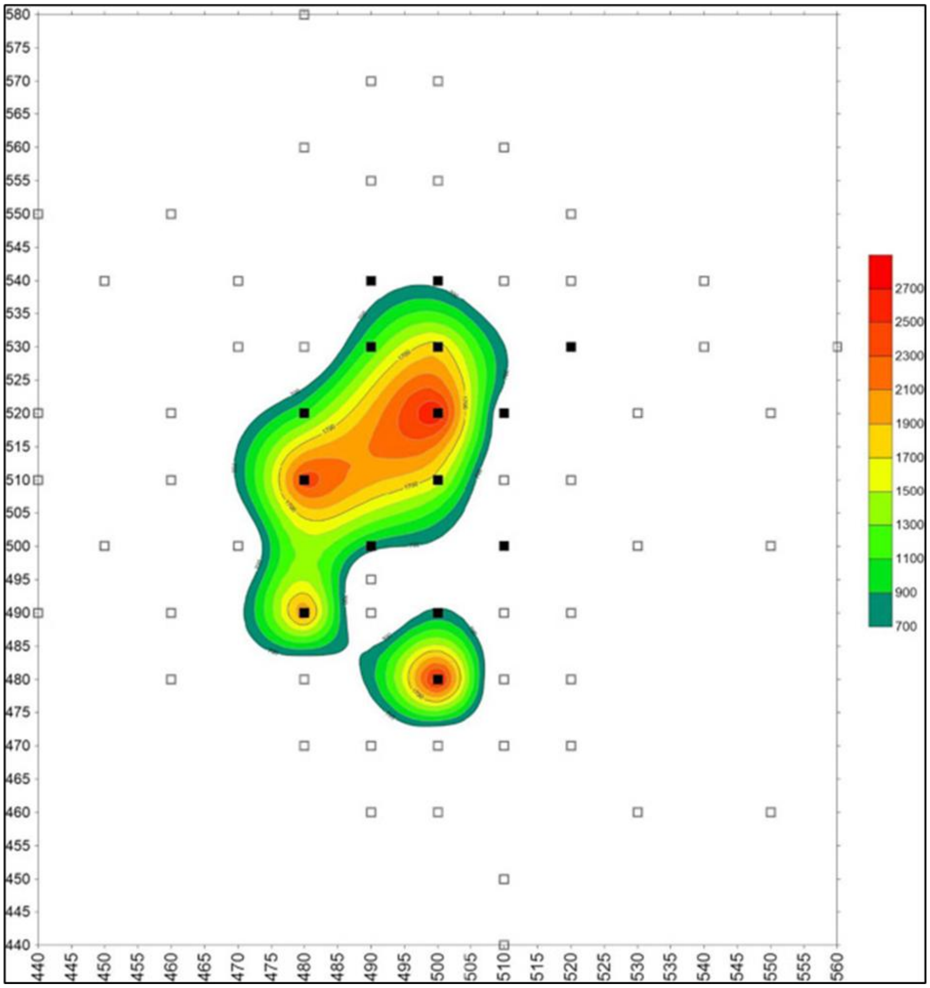

Figure 29. EMS concentrations between 14-20 cmbs (SI x10^-6) (courtesy of NLURA).

Simultaneously, TP-10 (N510E500), TP-16 (N530E500), and TP-13 (N520E510) exhibit elevated EMS values, indicated at 6-10 cmbs, as illustrated in Figure 30. Furthermore, the 0-5 cmbs data reveal two distinct isolated spikes at TP-19 (N540E490) and TP-4 (N540E490), as presented in Figure 31.

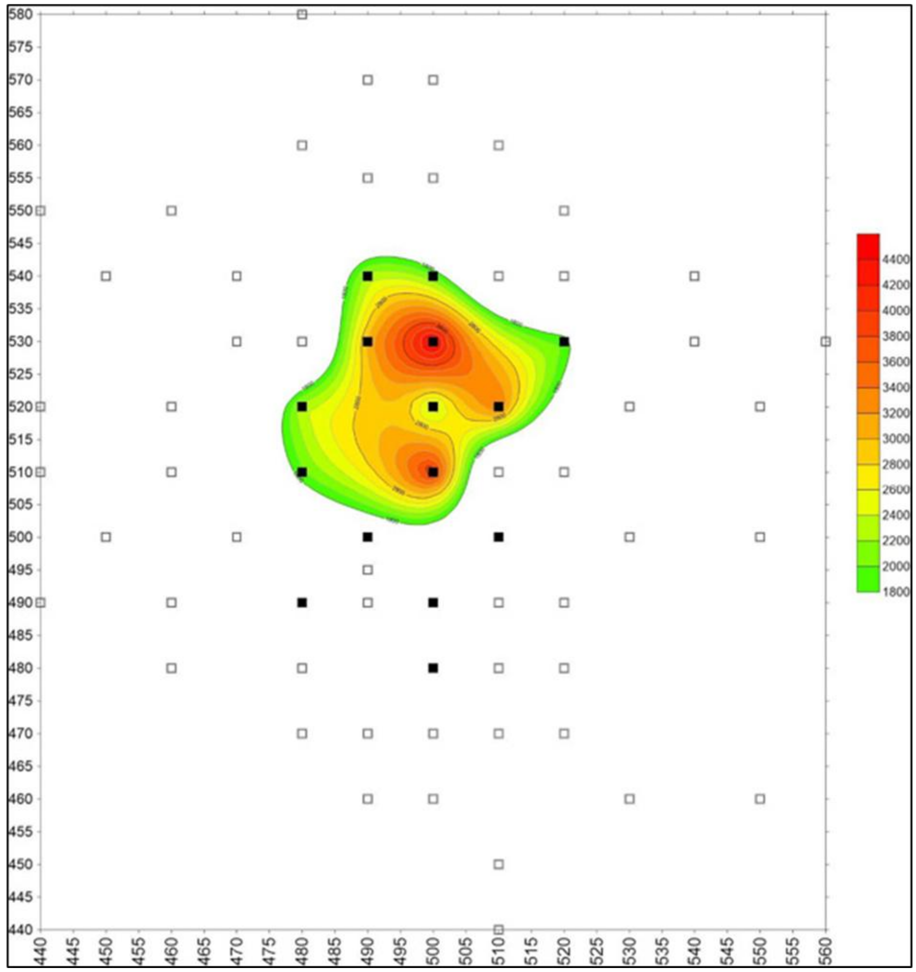

Figure 30. EMS concentrations between 6-10 cmbs (SI x10^-6) (courtesy of NLURA).

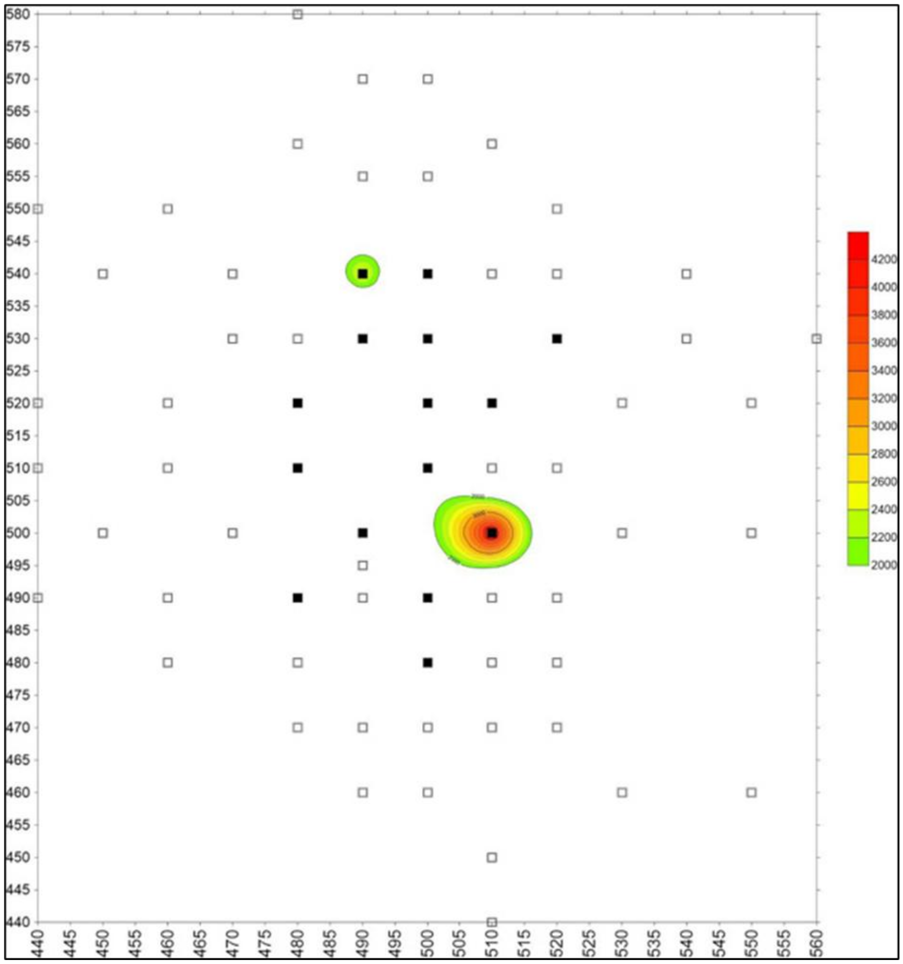

Figure 31. EMS concentrations between 0-5 cmbs (SI x10^-6) (courtesy of NLURA).

Site-level comparisons based on the EMS data indicate that the interval between 14-20 cmbs offers the broadest range of values within Locus 1, whereas the interval between 6-10 cmbs shows values concentrated in the northern portion of the locus, and 0-5 cmbs is narrowed to two distinct isolated spikes (Hansen et al. 2025:76). Ultimately, the EMS data indicate significant correlations between the features present in the EUs and the positive test units across the site. A series of distinct spikes may offer potential evidence supporting the notion that multiple occupations could be associated with the cultural assemblage, and despite the limited data available for Locus 2, similar spikes were observed at 8 cmbs and 18 cmbs, corresponding with the two earlier occupations at the site (Hansen et al. 2025:76-77).

5.10 Sediment Acidity (pH)/Conductivity

Representative samples were obtained from each locus to conduct acidity and conductivity testing, thereby examining the potential differences between the two locations. Five samples were collected from each stratigraphic level at Locus 1 in EU1, and at Locus 2, four stratigraphic samples were collected from EU2 (see Chapter 5, 5.3 and 5.4).

In Locus 1, the pH of the soil indicates that the modern forest soil is the exclusive soil type present at the site or may also imply that the acidity of the modern forest soil has permeated and superseded the acidity characteristics of the underlying layers (Hansen et al. 2025: 77). The stable acidity observed between 12-30 cmbs indicates the thorough movement of water filtering through the soil column (Hansen et al. 2025:77).

According to Hansen et al. (2025:77)

> The soil conductivity demonstrates that the earliest deposition on the site started during a period of relative aridity followed by some enhancement. A later increase in aridity is present at about 18 cmbs and intensifies between 12 and 5 cmbs. This increase in aridity may correlate with the appearance of the modern black spruce forestation, showing a rapid shift in pH from a baser system to the beginning of a more localized forested ecosystem. This signature may also have been affected by the presence of mammals introduced either naturally or anthropogenically. The cultural occupation indicated in this unit occurred contemporaneously with the change between the upper increase in aridity and the high upper intensified signal. This pattern indicates that the occupation of the site probably occurred during the beginning of the colonization of the black spruce and potentially extended through forestation into the completion of the modern forest system.

By comparison, the amelioration patterns at Locus 2 in EU2 do not present similarly, as the results indicate aridity moving more linearly and gradually into forestation, possibly due to its elevation and position on the landform (Hansen et al. 2025:77).

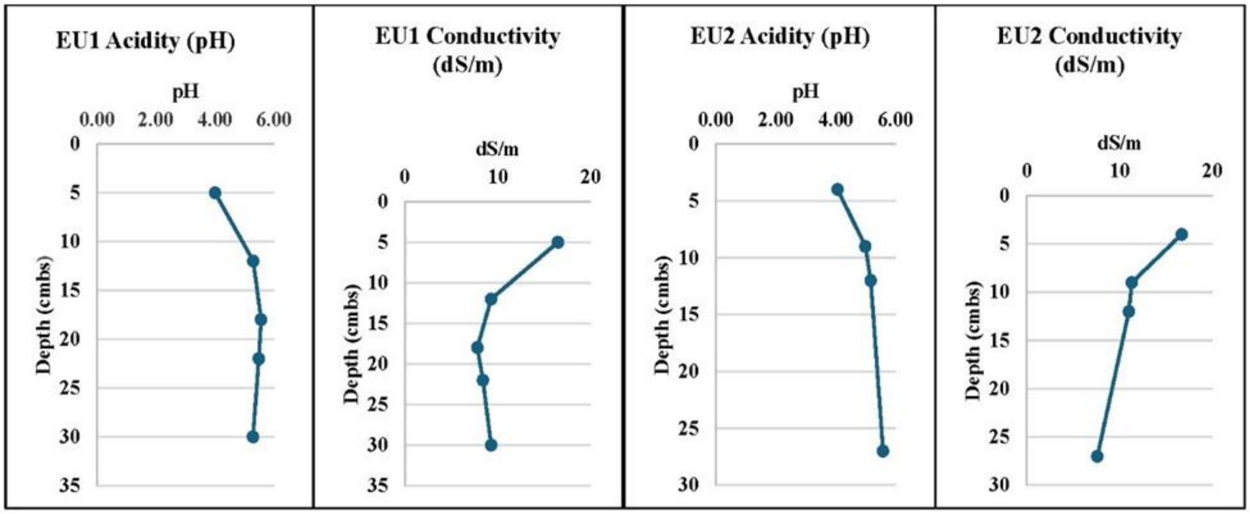

Figure 32. Left pH values for Excavation Unit 1 by depth. Right pH values for Excavation Unit 2 by depth (courtesy of NLURA).

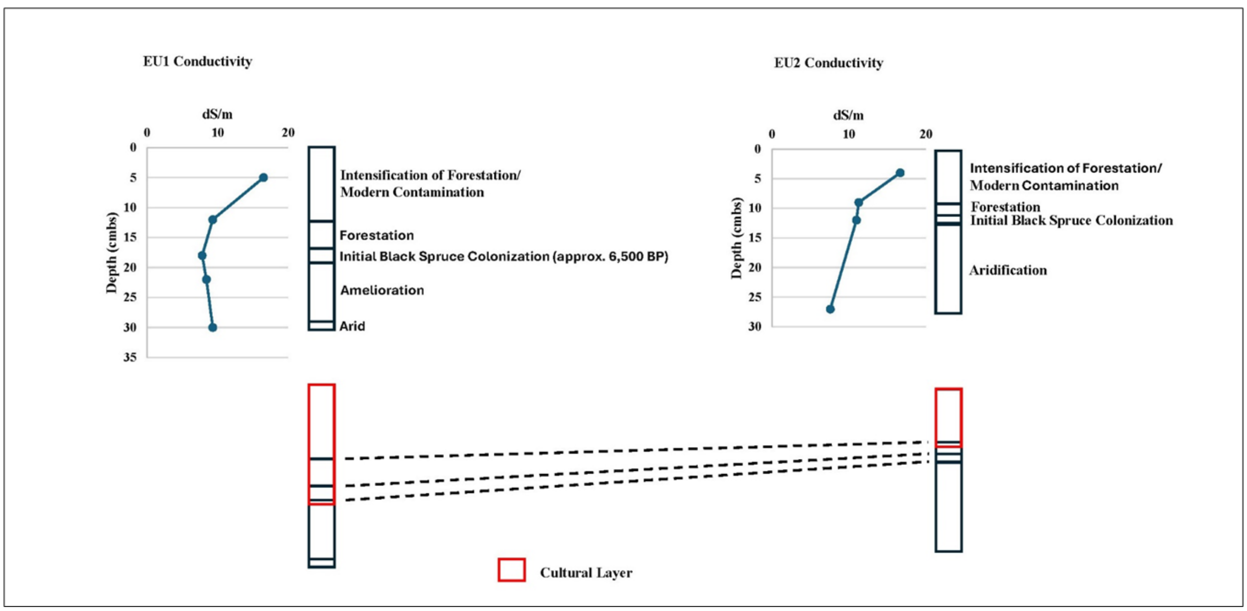

Figure 33. Salinity patterns for Excavation Unit 1 and Excavation Unit 2 and corresponding cultural layer (courtesy of NLURA).

5.11 Alaska Heritage Resources Survey Inventory Review

While reviewing the site cards on the Alaska Heritage Resources Survey (AHRS) database and affiliated reports of the 98 sites in my study area, approximately 11% indicate that the collected assemblages contain "tools" which could possibly be associated with a typological cultural affiliation, but it appears no analysis has been carried out or reported. Approximately 13% did not specifically state whether they contained tools of any sort, and of those, four sites' assemblages are missing. I did not conduct a review of the museum collections, although the Holloway et al (2018) "Mitigation Report for the Trans-Alaska Pipeline Archaeological Project (1969-1977) does include artifact collections information, and approximately 30 of the sites have collections data included. Only two sites, or 3%, indicate that the assemblages contain datable material such as faunal bone or charcoal. One site, LIV-00539, located on a prominent knob situated within the Livengood Mining Historic District, contained charcoal collected from a possible hearth area and associated with lithic debitage. The sample was submitted to Beta Analytic Inc. for radiocarbon dating, and the results indicated the sample dated to cal BP 310 to 0 cal BP (1640-1950 cal AD/CE).

The sites within the district are primarily situated on small knolls, and the assemblages include flakes, cores, preforms, and occasional tools, the debitage present is suggestive of early-stage reduction indicating quarrying activities, and except for a few sites, the deposits are shallow, unstratified, and are shown to be affected by some degree of erosion and cryoturbation and, similar to LIV-00456, lacked datable carbon material (Thompson 2014). Rosebud Knob Archaeological District is reported to contain components representing the Northern Archaic, Denali Complex, and Tuktu-Palisades periods and possible late Pre-contact Dené use, but presently, the archaeological evidence is unclear (Aigner and Gannon 1981b; Derry 1976).

The following chapter provides a synthesis of the resulting compiled data from Chapter 5.

Chapter 6. Site Interpretation

6.1 Introduction

Based on the previous research accessed and site investigations conducted in 2008, 2014, and 2016, as well as the 2024 data recovery at LIV-00456, the site consists of two distinct loci covering an area of approximately 2.7 acres along a terrace crest within a boreal forest overlooking Lost Creek (Hansen et al. 2025:79). The site is bisected by an established four-wheeler trail, which has caused disturbance in what data suggests is the centerline of the site.

Considering the previous cultural material gathered from the site, along with the cultural material recovered from test units and surface scatters during the 2024 delineation, all the cultural material consists entirely of lithics. Unfortunately, no datable material was recovered at the site. Most of the 2024 assemblage was recovered within Locus 1, with the cultural materials recovered from excavation unit 1 (EU1) found in all stratigraphic layers. Whereas Locus 2 consisted of one flake tool recovered during the delineation process. Post-depositional disturbances recorded at the site in EU1 precluded any correlation on a layer-by-level stratigraphic basis.

The post-depositional factors observed at the site encompass instances of cryoturbation, evidence of previous forest fires, and disturbances caused by human activity. Ultimately, neither excavation unit possessed stratigraphy that could offer any definitive indications pertaining to the time periods of occupation(s); furthermore, while the stratigraphy exhibited evidence of post-depositional disturbances, the main drawback lies in the absence of datable materials, such as faunal remains or charcoal for radiocarbon analysis, from the site.

Despite the lack of datable materials and post-depositional disturbances that obscure potential occupation timelines, the analytical results from the geoarchaeological data and lithic assemblage offer significant insights into the possible duration of occupation, site function, and land-use strategies employed by past individuals.

6.1.1. Lithic Analysis

Only one cultural zone, designated CZ1, was observed at LIV-00456. Locus 1 displayed a consistent pattern in the treatment of lithic materials, although no distinct activity areas were identified. The statistical analysis of the lithic debitage assemblage collected indicates that LIV-00456 was predominantly utilized for the procurement of raw materials, primarily chert, as well as for the early-stage processing of these materials. The site's location on a lower-lying ridge of a prominent geological feature, the Livengood Dome Chert Formation, signifies its association with a well-documented lithic material source. This location aligns with numerous other sites in the vicinity.

The lithic debitage data indicate that the site was task-specific within a logistical mobility strategy system accessed by smaller logistical or specialized task groups, which utilized the area for short-term but repeated procurement activities over long periods, resulting in a significant accumulation of waste (Lanoë et al. 2018:4). The fact that LIV-00456 is located atop a significant raw material source suggests that the site likely experienced several brief occupational periods. Consequently, in conjunction with post-depositional disturbances, the interpretation of the site's spatial patterning becomes notably more complex, akin to an open-air site, which infrequently retains preserved faunal material or hearth features that assist in interpreting the site's structure (Clark 2017:1, 18). The data available does not indicate any primary butchering or large-scale consumption of ungulates at the site. Thus, the low level of site complexity, as indicated by the composition and spatial distribution of the assemblages, appears to represent palimpsests of several occupations, which makes it difficult to determine the duration and extent of these occupations (Lanoë et al. 2018:4-5).

The obsidian debitage, a non-local material (Batza Tena), suggests that the site was used for the finishing or rejuvenation of late-stage, nearly complete, or fully complete tools (Hansen et al. 2025:79). The chalcedony, another non-local material, based on both the metric and statistical attribute results, was treated more similarly to obsidian than chert (Hansen et al. 2025:79). It seems to have been brought to the site in a previously worked form or toolkit, but the debitage does not fully correspond with either of the other material types.

Another distinct difference is the amount of chalcedony sample proportions collected between the 2016 and 2024 field efforts, with significantly more appearing in the 2016 lithic assemblage. This may be the result of sampling error or bias, but it is difficult to determine due to incomplete provenience data for the 2016 recovered assemblage. It appears that most of the assemblage was recovered from units placed on or in close proximity to the four-wheeler trail, which corresponds with what appears to be the center of the site. Consequently, without more accurate data, not much can be said beyond speculation.

Despite the limitations, the debitage at LIV-00456 does provide some clear patterns between the chert and obsidian. The chert debitage recovered from the site indicates that its use is consistent with accessing local materials for lithic procurement and initial reduction activities. Whereas the obsidian and chalcedony use are both consistent with tool maintenance and repair, although chalcedony to a lesser degree, and both are non-local materials, possibly suggesting that the chalcedony may be acquired in closer proximity to the area than the obsidian (Hansen et al. 2025:79).

Although limited, the analysis of site activities based on the tool assemblages collected in 2016 and 2024 generally corresponds with the interpretations of the debitage, which strongly indicates that the site was utilized for the procurement and reduction of locally available chert. Furthermore, there is evidence that supports the refinement, rejuvenation, and disposal of exhausted lithic implements crafted from non-local materials, such as obsidian and chalcedony. The sandstone hammerstone serves as an isolated artifact, suggesting the possibility of other activities occurring at the site. However, in the absence of the recovery of additional cultural features or faunal remains, this evidence remains speculative.

Regarding the potential classification of the lithic assemblage within a specific temporal period or cultural tradition, the presence of notching flakes associated with side-notched points—a typological hallmark of the Northern Archaic tradition (6,000-2,000 BP)—suggests a mid-Holocene occupation at LIV-00456 (Hansen et al. 2025:80). However, due to the absence of diagnostic tool types or radiometric dates, the technological correlation deduced by the presence of the notching flakes in the assemblage, a definitive association with the Northern Archaic cannot be fully verified.

6.1.2. Geoarchaeological Analysis

The elevated values of magnetic susceptibility (EMS) and thermoremanent signatures are likely associated with the presence of isolated thermal features, such as hearth features (Hansen et al. 2025:80). Consequently, a direct correlation exists between these values and the cultural materials retrieved from the positive TPs across Locus 1 and the entirety of the site, which may be linked to specific cultural patterns. These values suggest that the site has likely been employed for various occupations throughout time. The data indicates that the mapped concentration of EMS values may signify distinct occupational periods within the general cultural zone (CZ) of Locus 1, correlating depth with the respective occupation periods, specifically Occupation 1 occurring at 14-20 centimeters below surface (cmbs), Occupation 2 at 6-10 cmbs, and Occupation 3 at 0-5 cmbs. The observed patterns further suggest a potential deintensification of land use linked to the diverse occupation periods throughout Locus 1. Occupation 1 appears to have predominantly utilized much of the locus, while Occupation 2 is concentrated in the northern section of the locus. Additionally, Occupation 3 is indicated in two small, isolated areas: one situated in the northern portion and the other located in the more southern section of the locus. In examining Locus 2, increased values were observed at 8 cmbs and 18 cmbs, which may coincide with occupations 2 and 1, but due to the limited cultural material recovered within this locus, it may be speculated that it represents a smaller occupational footprint.

At LIV-00456, numerous factors associated with ecological change and human-environmental interaction are signified by the paleoenvironmental proxy data. The sediment acidity (pH)/conductivity data reveal the likelihood that the landform where LIV-00456 inhabits remained unvegetated or perhaps contained sparse patches of vegetation until the colonization of the modern boreal forest ecosystem. The implications of this data suggest that during its initial occupation (Occupation 1), LIV-00456 would most probably have provided an unobstructed viewshed of the surrounding landscape.

Therefore, indicating occupation in this area of the site initially began approximately 6,500 BP, further suggesting the other occupation periods may have occurred throughout the transition away from the use of lithic technologies, which would correlate with the apparent ecological trends described by palynologists for the uplands of Interior Alaska (Hansen et al. 2025: 80). This occupation data coincides with two designated cultural periods: the Northern Archaic tradition (6,000-2,000 BP) and the Dené tradition (2,000 BP-AD 1880). Although it was determined that there was only a single CZ present at the site, which may be inferred to mean a single occupation, the presence of cultural materials excavated from all levels, along with the EMS results from several positive TPs in Locus 1, provide high-resolution data allowing for the CZ to be separated into three distinct site occupations.

6.1.3. Landscape Use, Procurement, and Occupation Patterns

LIV-00456 is not unique when compared to other pre-contact sites found within its proximity. As stated in Chapter 3, a study area[6] was selected for review to compare land use strategies within this section of the Livengood Dome Chert formation and those known sites located on or near its borders. The sites cover an area of approximately 190.6 km^2 (73.58 mi^2) with a total of 98 recorded locations. Of these, 46 sites are situated on Livengood Dome, 34 are located in the Rosebud Knob Archaeological District, 13 are in the Livengood Mining Historic District, and three are situated between the two districts.

In 1964, Kegler led a crew to the Livengood area to determine the extent of the archaeological sites, where they found twenty-one sites which were described as manufacturing sites (Kegler 1964:1). As was observed then these sites are located within a landscape exhibiting distinctive characteristics, where elevated features contain outcroppings and blowouts of raw materials that also provide viewsheds.

Despite the scarcity of research and comprehensive analysis regarding the proximity sites of LIV-00456 and the Livengood Dome Chert Formation, it has been noted and documented that there exists a prevalence of sites characterized by substantial quantities of debitage, accompanied by a limited presence of formal tools, and a nearly complete absence of recovered datable material. These sites are all situated in areas of the landscape where primary and/or secondary raw materials for lithic production are abundant and readily accessible. For example, sites within this area include the Lost Creek Overlook site, also described as a “small look-out quarry campsite,” and another site known as Kenworthy Quarry, characterized as a quarry site, lithic workshop, and possibly a short-term encampment/bivouac or spike camp (Office of Archaeology and Historic Preservation Alaska 2025).

Based on the available information, examining these sites collectively suggests that the area may have been accessed by logistical foray or task groups, which primarily utilized the landscape to acquire raw materials for lithic production and as suitable short-term hunting lookout stations. These specialized task groups may have employed these logistical strategies, thus using the landscape in a low-intensity and long-term reoccupation pattern, resulting in an organizational mix and variability that may yield some confusing archaeological assemblages (Binford 1980; Wilson and Rasic 2008:143).

6.2 Conclusion

Regarding LIV-00456, despite the presence of logistical use strategy patterns across the site, no evidence was recovered that would narrow down distinct task or activity areas within the site. Despite the lack of diagnostic lithic artifacts recovered from the site, the presence of notching flakes is suggestive of a mid-Holocene occupation, along with the paleoenvironmental proxy data, further indicating the area was used during the mid-to-late Holocene in association with the Northern Archaic and Dené traditions (Bowman et al. 2022:153; Hansen et al. 2025:83). Overall, LIV-00456 conforms to the broader patterns of land use strategies that are evident in the abundance of sites within the study area. Along with procurement activities, the presence of Batza Tena obsidian at LIV-00456 is evidence that the individuals accessing the area participated in trade and brought non-local materials to the site. In addition to LIV-00456, six other sites within the study area noted the presence of obsidian in the assemblages, and one of these sites reported that the obsidian was sourced from Batza Tena.

Chapter 7. Conclusion

To answer the initial research questions: What was the function of LIV-00456 through time? And how does the site fit into ancient regional landscape use patterns? In order to address these questions and understand how LIV-00456 relates to other sites in the Livengood Dome Chert Formation study area, a comparison was made with subsequent conclusions regarding site function, site utilization over time, and regional cultural history derived from a comprehensive analysis of all available data collected from LIV-00456. This data was obtained through background research on previous investigations, the newly implemented Phase III data recovery plan in 2024, and site card reviews of recognized pre-contact sites within the study area, which encompasses the Livengood Dome Chert Formation.

When addressing the question of the site’s function based on a comprehensive analysis of the artifact assemblages, the conclusions indicate that none of the lithic artifacts collected are diagnostic of the site's function. However, the statistical analysis suggests that LIV-00456 primarily functioned as a site for lithic procurement and initial processing activities, primarily of chert. Amongst the chert material, there is minimal evidence of early stages of tool reduction. The use of chert as the main material procured and processed aligns with other sites in the Livengood Dome Chert Formation area.

This appears to fit the general pattern observed across the sites examined within the Livengood Dome Chert Formation and the broader region. LIV-00456, which is situated directly on the Livengood Dome Chert Formation and within the approximately 190.6 km^2 (73.58 mi^2) study area of related sites, all appear to be co-located in portions of the landscape where primary lithic raw materials are easily accessed in an elevated feature that provides suitable viewsheds optimal for hunting lookouts and stations used to access faunal resources throughout the area. At LIV-00456, the presence of a sandstone tool, possibly used as a hammerstone, suggests potential use for the processing of organic materials. Although the data is limited for many of the surrounding sites within the examined area, all the preliminary reports indicate a similar lithic pattern as well as a lack of recovered datable materials.

Additionally, a significant amount of non-local materials was collected at LIV-00456, including obsidian and chalcedony in the form of debitage, which is indicative of final tool processing and rejuvenation. Other Livengood Dome Chert Formation sites have also reported the presence of obsidian. The presence of Batza Tena obsidian indicates that the Livengood sites were part of an extensive procurement network that facilitated the movement of obsidian through trade and travel systems, given that the Batza Tena obsidian source is situated over 100 mi. (160 km) west-northwest of the site.

Regrettably, at LIV-00456, no evidence of features indicative of a long-term camp was identified; however, the absence of such evidence does not necessarily preclude its existence. Moreover, the current data does not identify specific seasonal signals at the site; instead, they suggest a complex history of occupations spanning several thousand years. This encompasses the entire scope of the site, as it is not confined to a single specific area but rather spans across two loci covering 2.7 acres of the landform.

The temporal context regarding whether the two loci were inhabited contemporaneously remains uncertain, primarily due to the absence of datable materials. Unfortunately, direct stratigraphic correlations across the site are not feasible due to disturbances caused by cryoturbation, erosion, and human activity. The EMS data suggest a minimum of three occupation periods, with the most extensive and intensive correlating with the earliest occupation. Soil conductivity (pH) indicates that utilization commenced approximately 6,500 BP, aligning with the Northern Archaic tradition and further implying that usage extended into the Dené tradition. The lithic data support the geoarchaeological data, indicating the site has been temporally tied to the middle to late Holocene in association with both the Northern Archaic and Dené traditions.

In conclusion, collectively, the correlation between LIV-00456 and the remaining 97 sites within the Livengood Dome Chert Formation study area mainly indicates that the sites are located on small knolls. These sites feature assemblages that are predominantly composed of flakes, with some cores, preforms, and occasional tools. The debitage observed suggests early-stage reduction activities, indicative of quarrying. Aside from a few sites, the deposits are shallow, unstratified, and exhibit signs of erosion and cryoturbation, with a notable absence of datable carbon material. Overall, the data suggest that a comprehensive network of ancient land use, primarily focused on activities associated with lithic raw material acquisition and hunting, was extensively distributed across the region. The current data suggest that these sites functioned as task-oriented short-term logistical occupation locations, further implying the possibility of intermittent reoccupation over thousands of years during the Middle to Late Holocene, in association with the Northern Archaic and Dené traditions.

7.1 Additional Comments

To date, little has been published regarding the cultural chronology of the greater Livengood to Yukon River area, and as a result, researchers have had to rely on the surrounding regions to determine how this landscape was used from the early to late

Holocene. The initial pre-contact sites were discovered in the Livengood Dome Chert Formation in 1962, followed by a 1964 survey that identified many more sites. Subsequently, numerous additional sites have been discovered, largely as a result of compliance archaeology conducted from the 1970s to the present. The consequence is that archaeology is undertaken frequently with insufficient time, budget, and personnel, and compliance research rarely continues beyond the initial site identification (Phase I). As a result, site evaluation and delineation (Phase II) and excavation/mitigation (Phase III) are most often conducted before planned site destruction, as salvage archaeology and, unfortunately, academic archaeologists have shown an apparent lack of interest in the region over the past several decades (Hansen and Allen 2025). Although numerous sites exist, little research or analysis has been conducted in this region to date.

In general, because the discovery of most sites is reliant on compliance archaeology, access to the data is important in order to help generate further research potential. This project started out as collecting data at the site level, but nothing exists in isolation. LIV-00456 is part of a broader landscape, which, despite limited research attention, appears to have been intensely used for many millennia. The question remains as to where these people were coming from. Where are the seasonal settlements? Close, or were they traveling a significant distance to access the area? The extensive utilization of the region surrounding the Livengood Dome Chert Formation underscores its significance as a source of raw materials. It appears that no research is currently being undertaken in archaeology, tracing, and sourcing chert artifacts, as is being done extensively with obsidian. Tracking the movement of Livengood chert across the landscape would be of significant interest, as it could offer further insights into ancient travel and trade networks.

Numerous sites in the vicinity are subject to ongoing risks, including the continued construction of the Dalton Highway, small-scale mining activities, public ATV and other recreational trail usage, and erosion. The author's hope is that the sites near the Livengood Dome Chert Formation will garner the interest of researchers interested in landscape use prior to their potential disappearance, as indicated by LIV-00456. The site is scheduled for destruction in the near future as the area is to become a material site to support the realignment of the Dalton Highway.

Appendix A

Metric and Attribute Debitage and Lithic Tools Analysis Methods

Metric and Attribute Debitage Analysis Methods

All the debitage recovered from LIV-00456 was analyzed. The research team used an individual flake analysis approach for the highest level of precision possible. Individual flake analysis is particularly useful in contexts where multiple technological organizational strategies are represented within a single assemblage or component. The attributes selected for the analysis are presented in **Error! Reference source not found.**. These attributes were selected due to a high degree of correspondence to technological organization (Andrefsky 2005; Prentiss 2001; Rasic 2008). Attributes such as size class, cortex presence and percentage, and completeness of flake measurements relate directly to the reduction techniques, while additional characteristics (i.e., weight, thickness, raw material type, raw material color, platform type, dorsal scars, and termination type) may be used to infer or characterize debitage typologies and estimate the stage and type of tool production (Beck et al. 2002; Prentiss 2001; Rasic 2008; Sullivan and Rozen 1985). The collected attributes may be used to create informed flake typologies to provide insight into technological strategies and site function (Andrefsky 2001, 2005; Rasic 2008). Below are the debitage attributes recorded during artifact analysis.

Debitage Attribute
Technology Flake Type (Andrefsky 2005; Rasic 2008)
Material Type
GSA Color Code
Color Name

Debitage Attribute
Completeness (Prentiss 2001)
Cortex Presence and Percentage
Dorsal Scar Count
Platform Type
Bulb Salience
Eraillure Scar Presence
Termination Type
Maximum Size Dimension
Maximum Thickness
Weight

Maximum size and thickness of each flake were measured in millimeters (mm) using Mitutoyo CD-6” ASX calipers, and weight was measured in grams (g) on a Reshy electronic scale. Other attributes were measured following methods outlined by Prentiss (2001), Andrefsky (2001, 2005), and Rasic (2008). Material types were broken down categorically. Cryptocrystalline Silicate (CCS) material was recorded first as CCS, followed by its subcategory (in this case either chert or chalcedony).

The variables and attributes described above were used to estimate the measure of material type mass percentages to explore differing treatment of local versus non-local material by comparing material counts, material percentages, the sum of mass per material, and the percentage of total assemblage mass for each material. We expect local materials to be both a greater number and a greater total mass than non-local materials. In cases where material type case percentages and material type mass percentages do not correspond, material type mass percentages are more informative (Little 2013).

The standard statistical practice in debitage studies is to use Analysis of Variance (ANOVA) when data is 1) ratio level (such as maximum length, maximum thickness, and weight) and 2) normally distributed (the attribute values cluster continuously and symmetrically around the sample mean equal to the sample median and sample mode)(Young 1965). The ANOVA procedure is less prone to Type I and Type II[7] errors and is preferred when testing normally distributed data. However, data sets that are not normally distributed cannot be evaluated using ANOVA without risk of producing both Type I and Type II errors.

If the data is ratio level and not normally distributed ("non-parametric") is considered best practice to use either Mann-Whitney U tests if the examined variables are being compared between two independent categories/groups (i.e. "pairwise" or "two way") or Kruskal-Wallis tests when the examined variables are being compared among more than two categories/groupings.

Ratio level data, such as maximum size, was evaluated first for normality using the Shapiro-Wilk test. The data was tested for normality to determine which hypothesis tests would be the least likely to produce invalid results. Therefore, data with statistically significant non-normal distributions were evaluated with the Mann-Whitney U-test or Kruskal-Wallis test depending on sample characteristics (Kent State University 2019). Both tests utilize median values to minimize the bias introduced by outliers (Kent State University 2019).

NLURA lab personnel concluded that the non-parametric Kruskal-Wallis test was most appropriate for metric variables following data normality testing. While the same statistical analysis procedures were used for metric data on both the 2016 and 2024 samples, the samples were tested separately due to the absence of available provenience information for the 2016 sample. The Kruskal-Wallis tests applied to the 2016 data

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[7] Type I errors refer to the action of mistakenly rejecting a null hypothesis that is truly null. Type II errors refer to the action of not rejecting a null hypothesis that should be rejected.

examined maximum length, maximum thickness, and weight, grouped by material type. The Kruskal-Wallis tests applied to the 2024 data examined maximum length, maximum thickness, and weight, grouped by material type.

Nominal and ordinal level data, such as technological type, material type, and Geological Society of America (GSA) color code, were analyzed using the chi-square statistical procedures, which evaluate what would be expected in even unstructured environments and the actual observed data (Kent State University 2019).

While the same statistical analysis procedures for attribute data were applied to both the 2016 and 2024 samples, the samples were tested separately due to the absence of available provenience information for the 2016 sample. The chi-square tests used on the 2016 collection attribute data compared material type and technological flake type. The chi-square tests used on the 2024 attribute data also compared material type and technological flake type.

Lithic Tools Analysis Methods

Metrics used to record lithic tools differed from those collected on debitage. The attributes measured and collected during lithic analysis of the tools were chosen to assist in understanding the activities, spatial organization, and role of the site in a broader regional context (Bowman et al. 2022). The lithic tool assemblage was divided into three categories: flake tools, bifaces, and cores. Attributes recorded for each category are presented in table form, see the following examples below.

Flake Tool Attributes
Artifact Type
Material Type
Color
GSA Color
Tool Condition

Flake Tool Attributes
Cortex Presence and Percentage
Maximum Size
Maximum Thickness
Weight
Angle of Utilized Edge
Length of Utilized Edge
Fracture
Facial Modification
Margin Modification
Flaking Continuity
Flaking Regularity

Bifacial Tool Attributes
Artifact Type
Material Type
Color
GSA Color
Tool Condition
Cortex Presence and Percentage
Maximum Length
Maximum Width
Maximum Thickness
Weight
Outline Shape
Length of Utilized Edge
Base Width
Thickness at Base
Base Form
Base Modification
Fracture
Secondary Modification
Description

Core Attributes
Artifact Type
Material Type
Color
GSA Color

Core Attributes
Tool Condition
Cortex Presence and Percentage
Maximum Length
Maximum Width
Maximum Thickness
Weight
Core Shape
Number of Flake Scars
Direction of Removals
Number of Platforms
Description

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