DRAFT

SUSITNA HYDROELECTRIC PROJECT

FEDERAL ENERGY REGULATORY COMMISSION
PROJECT No. 7114

CULTURAL RESOURCES INVESTIGATIONS 1979-1985

VOLUME I
CHAPTERS 1-10
APPENDIX A

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CHAPTERS 1-10, APPENDIX A

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ABSTRACT

In conjunction with feasibility studies for the proposed Susitna Hydroelectric Project, a cultural resources program was undertaken from 1979-1985. The major goals of the program were: 1) to locate and document cultural resources, 2) address their significance, 3) assess the impact of the project on these resources, and 4) develop a mitigation plan to avoid or lessen adverse impact on the cultural resources. In the course of the survey, 248 historic/archeological sites were documented. Survey level testing involved recording the location, ecological setting, site description and size, and artifact inventory for each site. A program of grid shovel testing to aid in determining site size was undertaken at sites to be directly impacted by the proposed hydroelectric project. Systematic testing was employed to facilitate site interpretation by increasing the artifact sample and by recording both spatial and stratigraphic provenience for the recovered specimens.

The construction of a regional stratigraphic chronology was made possible by the presence of tephra units, designated as the Devil, Watana, and Oshetna tephras, and 42 radiocarbon dates. The Devil tephra dates from between 1400-1500 years B.P., the Watana between 1850-2700 B.P., and the Oshetna tephra from between ca. 5200-5900 B.P. Artifact and faunal analyses were conducted on all material collected during the cultural resources program. Lithic analysis focused on artifact and raw material type, while faunal analysis was concerned with animal exploitation and subsistence. The environmental settings of all sites were also analyzed in relation to nine major geographic features associated with them. Analysis of the distribution of cultural remains in association with radiocarbon determinations and regional stratigraphic soil/sediment units resulted in five major cultural historic intervals to be defined. They are: 1) Euro-American tradition (100 B.P. - present), 2) Athapaskan tradition (ca. 1500 B.P. - ca. 100 B.P.), 3) Late Denali complex (ca. 3500 B.P. - ca. 1500 B.P.), 4) Northern Archaic tradition (ca. 5200 B.P. - ca. 3500 B.P.), and 5) American Paleoarctic tradition (ca. 10,500 B.P. - ca. 5200 B.P.). The synthesis of these data is considered tentative due to the inherent limitations of analysis based solely on survey data.

EXECUTIVE SUMMARY

Research on the hydroelectric potential of the Middle Susitna River began in the late 1940's when four dam locations were identified by the Bureau of Reclamation. The Corps of Engineers conducted a number of feasibility and engineering studies in the subsequent years before the project was undertaken by the Alaska Power Authority in 1979.

The proposed development of the Susitna Hydroelectric Project consists of two major reservoirs and associated facilities and features. The Watana Dam will be an earthfill structure. Its reservoir will extend approximately 48 miles upstream with a surface area of approximately 38,000 acres. The Devil Canyon Dam will be a double-curved arch structure of concrete. The Devil Canyon Dam reservoir will extend for about 26 miles and have a surface area of approximately 7800 acres. The Watana Dam will be constructed first with the Devil Canyon Dam to be constructed later if demand warrants.

The proposed borrow areas associated with dam construction are locations where earth fill for dam construction will be obtained. There are 12 proposed borrow areas. Borrow areas B, J, and L are within the proposed Watana Dam reservoir. Borrow area D is located in the Watana construction area. Borrow areas E, G, and I are located within the proposed Devil Canyon Dam reservoir. The remaining areas (A, C, F, H, K) are located outside the impoundments.

The project area will be accessed by a road from the Denali Highway. A railroad tie to Gold Creek on the Alaska Railroad would be constructed to the Devil Canyon Dam site if that dam is constructed. Transmission lines would extend from the Watana Dam site, past the Devil Canyon Dam site, to the Railbelt Intertie at Gold Creek. Additional transmission lines for the project would extend from the Intertie between Willow and Anchorage, and between Healy and Fairbanks. A construction camp, village, and airstrip are planned for the Watana Dam site. The construction village would be moved to the Devil Canyon Dam site should that dam be constructed.

In conjunction with feasibility studies for the proposed hydroelectric project, a cultural resources program was initiated. The major goals of the program were: 1) to locate and document cultural resources, 2) address their significance, 3) assess the impact of the hydroelectric project on cultural resources, and 4) to develop a mitigation plan to avoid or lessen adverse impact of the proposed Susitna Hydroelectric Project on cultural resources.

Two study areas were defined for the cultural resources survey. The archeological study area consisted of impact areas associated with the proposed project facilities and features. Areas intensively surveyed for cultural resources include the proposed Watana and Devil Canyon reservoirs, Watana Dam construction area, portions of the Devil Canyon Dam construction area, borrow areas A through L, phase I recreation area D, geotechnical testing locales, and areas adjacent (within ½ mile) to direct impact areas that would be subject to indirect impact. Sites located by other project personnel were also recorded. The proposed access route, transmission routes, and the railroad were surveyed at the reconnaissance level as were recreation areas A, B, E, F, and portions of the Devil Canyon construction area. The geoarcheological study area included the area within 16 km on either side of the Susitna River from Portage Creek to the Maclaren River. Geoarcheology studies were conducted in conjunction with the cultural resources program to define and identify surficial geologic deposits, glacial events, and tephra deposits.

The development of a research design for the cultural resources survey took into consideration the lack of extant data regarding the history and prehistory of the area. The relative potential of the area for the resolution of specific types of anthropological problems was unknown upon initiation of the cultural resources survey. No fundamental research had been conducted in analogous areas of Alaska (dominated by a fast flowing, silt laden, unnavigable river lacking salmon runs and bordered by steep canyon walls) which could be extrapolated to the Middle Susitna River. Based upon the existing knowledge of site distributions and resource exploitation at the beginning of the project, few sites were expected to be located in the area. The need to develop a substantive regional data base was recognized in the development of the research design, and toward this end, baseline studies (literature review) on the geology, archeology, ethnohistory, and history were undertaken.

Initial archeological research in the project area was conducted in 1953 and only very limited field testing was undertaken prior to the cultural resources survey of the Susitna Hydroelectric Project. In addition to the Susitna River canyon area, the literature on the cultural resources of the Tanana River valley, Central Alaska Range, Denali Highway, Copper River valley, and Cook Inlet were reviewed. It was possible to develop a tentative cultural historical sequence for the Middle Susitna River at the commencement of the project, based on a literature review of the prehistory, ethnohistory and history of the surrounding regions. These data were used to construct a speculative cultural chronological framework.

The ethnohistory of the project area is concerned with the Western Ahtna and, to some extent, the Tanaina. A band of the Western Ahtna, the Mountain People, who intermarried with the Tanaina and occupied a portion of the Middle Susitna River valley, are reported to have died out in the influenza epidemic of 1918. Villages or established settlements have been documented on Valdez Creek, Lake Louise, Tyone Lake, Clarence Lake, and Stephan Lake. With the exception of Clarence Lake, all fall outside of the boundaries of the proposed Susitna Hydroelectric Project.

Euro-American exploration and use of the project area has been limited. Devil Canyon acted as an impediment to travel up the Susitna River to its headwaters. It was not until 1897 that the river was explored to its headwaters by gold prospectors, although there is a possibility that some exploration may have occurred earlier. Difficulties experienced on the trip and the lack of good gold prospects within the area of the proposed Susitna Hydroelectric Project resulted in subsequent gold prospecting and exploration to occur in other areas. The Middle Susitna

River was explored and mapped in 1914 by the U.S. Geological Survey. Predominant historic use of the region has been trapping, hunting, and recreational activities.

Following the literature review, implementation of the research design consisted of: 1) conducting survey to locate and document sites, 2) recording sites and testing sites to evaluate their significance, 3) assessing project impact of facilities and features, preconstruction studies, and dam operation on cultural resources, 4) formulating mitigation recommendations, and 5) curating collections and supporting documentation, and disseminating information. In evaluating site significance and formulating mitigation recommendations: 1) a cultural chronological framework was developed for the area, 2) research questions and important themes to address site significance were defined, and 3) sites were articulated to research questions and important themes.

Seven types of locales were identified which exhibited high potential for archeological site occurrence, preservation and discovery and upon which archeological survey was focused. These locales are overlooks, lake margins, stream and river margins, quarry sites, caves and rock shelters, natural topographic constrictions, and mineral licks. Four types of locales were defined which were considered to contain low/no potential for archeological site discovery. These were 1) steep slopes exceeding 15 degrees, 2) areas of standing water, 3) active gravel and sand bars within streams, and 4) active channels of rivers and streams. To facilitate the survey for cultural resources, the study area was divided into management units termed survey locales. Survey locales were specific geographic units or project features and facilities which were subject to intensive field survey.

For each survey locale, information was collected on the uniformity or variability of the surface morphology, areas which could be eliminated from survey, areas with high cultural resource potential both within and adjacent to the locale, and a map showing the path of the survey swathes. Testing in the survey locale consisted of shovel testing, a round test excavation generally not exceeding 50 cm in depth. Once a site was found, it was located on USGS maps and air photos. A site survey form was employed to collect information on site location, ecological setting, site description, surface and subsurface artifact inventory, site size, site disturbance, photographic record, and additional site specific information. A test pit, a ca. 40 x 40 cm square excavation, was excavated in order to obtain additional information on the soil/sediments at a site and the location of subsurface cultural material. A site tag with Alaska Heritage Resource Survey (AHRS) number, University of Alaska Museum, and date inscribed upon it was placed in the southwest corner of the first test pit. A profile of one wall was prepared for each test pit. Photographs were taken of the site and surrounding terrain. All artifacts were collected according to natural stratigraphic units or arbitrary 5 cm levels in the absence of natural stratigraphy.

A program of site size testing was undertaken at direct impact sites. This program consisted of a 4 m grid of shovel tests working into the periphery of the observed cultural remains. When exceptionally large sites were encountered, their size was determined by shovel testing along established grid lines beginning outside the anticipated distribution of material cultural remains and progressing toward the documented occurrences of material cultural remains. A second estimate of site size was based upon topography of the landform on which the site was located and functioned as a rough approximation of the possible maximum extent of the site. A site map showing surface artifacts, topographic features, and all tests was prepared for each site.

Systematically tested sites were mapped and gridded with transit and stadia rod. Horizontal and vertical controls were established. The unit of excavation was 1 x 1 m test squares. Cultural material was collected and bagged by stratigraphic units and quadrant within each test square. Soil/sediment samples were collected from each square. All artifacts and artifact concentrations were three-point provenienced in reference to the site controls. Plan maps were made of each artifact-bearing stratigraphic unit. Carbon samples were collected when available. Soil/sediment profiles were prepared for each wall of the test squares. All artifacts were accessioned and catalogued to the University of Alaska Museum, which is designated by state and federal regulatory agencies as the repository for all artifacts and supporting documentation from this study.

During the cultural resources survey, a total of 182 survey locales were examined. Examination of these locales as well as other areas associated with project facilities and features resulted in the location and documentation of 248 sites. An additional 22 sites located within the project area were documented in the AHRS files. A total of 73 sites were located within the Watana reservoir and 47 additional sites are located adjacent to it. Seven sites are present in the Devil Canyon reservoir with six sites located adjacent to it. No sites were recorded within features or facilities associated with the Watana construction area, but 10 sites occur adjacent to construction areas. No sites were discovered in the Devil Canyon Dam construction area. A total of 32 sites were located in the borrow areas (A through L) and an additional 15 sites were located adjacent to these areas. Seven sites were found while conducting geotechnical testing clearance work. No sites were found in association with survey of the five phase I recreation areas. No sites were documented directly on the centerline of the access routes during reconnaissance survey of these features. However, 24 sites are located adjacent to the access route. Eleven sites fall within access route borrow areas, while five are adjacent to these borrow areas. One site was located on the transmission routes while 20 sites are adjacent to them. No sites are known for the railroad route although one site is known to be adjacent to it. Thirty-five sites were also found in areas more than ½ mile from any project facility or feature. Sites in this category resulted from: 1) being located by other project personnel, 2) found in association with project facilities, features, or recreation areas that were subsequently modified, relocated, or deleted from project planning, 3) found during geoarcheology studies, 4) sites documented near the project area prior to this study, and 5) sites found by archeological personnel beyond ½ mile from project facilities or features.

Because of the relatively large number of sites found (248), and the level of documentation at each site, the resulting data base is substantial. As reflected in the site reports (Appendix D), data from some sites is the result of surface cultural material or artifacts recovered from a few shovel tests. The average area systematically tested at any one site sampled by this method was three square meters. While the bulk of these data provide important insights into the history and prehistory of the region, the inference which may be drawn from them must be understood within the context of survey level data.

Sixteen major stratigraphic units were recognized throughout the project area. In general, the stratigraphy consists of glacially scoured bedrock overlain by a discontinuous cover of weathered glacial sediments which is overlain by a series of volcanic tephra units interbedded with weathering units and buried soils. Three major soil/sediment units within this mantle have been designated by project-specific names. The units from oldest to youngest are the Oshetna, Watana, and Devil tephras, being named after major tributaries of the Susitna River. The presence of these tephra allowed the construction of a tephrochronology which in conjunction with radiocarbon determinations was used to date archeological sites. Eighty-three radiocarbon dates were run. They ranged from modern to mid-Wisconsin in age.

Three methods were employed in establishing a regional tephrochronology: 1) the stratigraphic integrity of the carbon samples was evaluated, 2) dates resulting from the analysis of bulk organics were eliminated, and 3) dates that could not be correlated with the tephra sequence were eliminated. Forty-two dates were considered applicable to dating the tephra. The Devil tephra dates from between ca. 1400 - 1500 years B.P., the Watana tephra between 1850 - 2700 B.P., and the Oshetna tephra from between ca. 5200 - 5900 B.P.

To test the validity of the terrestrial tephrochronology, a lacustrine sediment core from a pond in the Middle Susitna River valley was obtained. This core contains a postglacial sediment record extending back to approximately 10,800 - 11,500 years ago. Included in the stratigraphy of alternating bluish clays, organic silts, and rhythmically laminated units are six tephra layers, ranging from 0.2-4.0 cm in thickness. Radiocarbon dates indicate that the tephras were deposited sometime between 5200 and 2900 years ago, although the upper date is thought to be in error. The tephras can be correlated with the Oshetna, and probably the Watana and Devil tephras.

Artifact and faunal analyses were conducted on all material collected during the cultural resources program. The lithic analyses were carried out in two primary areas, the analysis of lithic artifact types and analysis of lithic raw material types; both for individual sites and within a regional stratigraphic context. Faunal analyses focused on animal resource exploitation. Faunal and lithic data were encoded into a computer coding system to allow for analyses of sites and the content and context of their assemblages.

Lithic analysis of the 137,835 specimens recovered includes a spatial and temporal study of lithic artifact types and lithic raw material types collected from the project area. Four major occupational episodes were identified within the project area based on lithic analysis. Each occupational episode is defined by changes in the frequency and diversity of artifact types. Locally available lithic raw materials are predominant on sites, but the nonlocal (exotic) lithic raw materials of obsidian and quartz also occur within the stratigraphic sequence. Both the temporal and spatial analysis suggests a great amount of variability in site types based on artifact type and raw material type differences.

The faunal assemblage is characterized by fragmentary remains which range from very small (5-10 mm) unidentifiable, calcined specimens to large unburned caribou and moose bone fragments. A total of 142,835 specimens were recovered from 78 sites in the project area. The great majority of the remains were burned or calcined, with the unburned portion of the assemblage almost entirely restricted to the upper organic units. Of the nine mammalian and one avian species identified, caribou is by far the best represented and constitutes 87% of the 1104 specimens identified to the species level. Stratigraphic distribution of caribou bones suggest that this resource has been a mainstay of subsistence, at least on a seasonal basis, for several millennia. The earliest evidence for tentatively identified caribou comes from TLM 030, and dates to possibly as early as ca. 5100 B.P. On the basis of faunal evidence, moose did not become an important game species until ca. 1400 years B.P. or later. Even after this date, caribou continued to be the major food resource. The other identified species (Dall sheep, canids, wolverine, ground squirrel, hare, vole, and ptarmigan) occurred in very low frequencies in the assemblage. Differential bone preservation between the organic units and the underlying tephra units was found to be an important biasing factor for potential cultural interpretations of bone processing and other site activities.

The environmental setting of historic and prehistoric sites discovered were analyzed in relation to nine major geographic features associated with them. Ninety percent of the sites occur in settings which suggest that the sites were used primarily for mammal hunting. Five major cultural historical intervals are defined based on the occurrence of material cultural remains associated with radiocarbon determinations and regional time stratigraphic soil/sediment units. These are: 1) Euro-American tradition - 100 B.P. - present, 2) Athapaskan tradition - ca. 1500 B.P. - ca. 100 B.P., 3) Late Denali complex ca. 3500 B.P. - ca. 1500 B.P., 4) Northern Archaic tradition ca. 5200 B.P. - ca. 3500 B.P., and 5) American Paleoarctic tradition - ca. 10,500 B.P. - 5200 B.P. Sites ascribed to each tradition/complex are presented in tables which incorporate the material cultural remains, faunal species present, the observed size, and environmental setting for each site. Cultural features associated with sites ascribed to each cultural historical period are enumerated. The synthesis of these data is considered tentative based on the inherent limitations imposed on this type of analysis based solely on survey data.

ACKNOWLEDGEMENTS

Few places in the United States provide the opportunity to conduct pioneering research. We are pleased to have worked in such an area and to have had the opportunity to contribute to Alaskan history and prehistory. Although pioneering work is exciting, inherent problems come with conducting field research in remote areas for which few data are available. Such a formidable task could not have been accomplished without the input, talents, cooperation, and dedication of many individuals. Their efforts facilitated execution of the program, and completion of fieldwork under what were frequently adverse and hazardous conditions. We would like to acknowledge those individuals who, in a variety of ways, helped bring this program to completion.

Geoarcheology studies including terrain unit mapping, tephra analysis and tephrochronology were facilitated by the work of Thomas Dilley, Thomas Gillispie, Jay Romick, and Robert Thorson. We would like to thank Tom Ager (U.S. Geological Survey) for examining lake core LIV-2 and for his valuable comments and insight. We would also like to acknowledge David Plaskett for aid in developing the initial research design and preparation of survey locale and site forms. Soil studies by Paul Buck assisted in regional site evaluation and Martie Hall provided valuable assistance in computer programming. Graphics are a critical part of any report, and between 1980 and 1985 hundreds of graphics were prepared. We acknowledge the excellent graphics work produced by Bernard Bensen, Robert Betts, Douglas Buteyn, Martha Johnson, James Jordan, Kenneth Pratt, and Dixon Sims. Site reports which appear in this report required the input of many individuals. We would like to thank the following people for their outstanding individual efforts - Joan Dale, Thomas Gillispie, Maureen King, and Nena Powell.

No field program could be conducted without the cooperation and dedication of many individuals. The individuals who participated in the five field seasons assisted greatly in the progress and enhanced the quality of the program. We greatfully acknowledge the following individuals: Cindy Amdur, Patricia Anderson, Lester Baxter, Bernard

Bensen, Robert Betts, Paul Buck, Virginia Butler, Martha Case, Fred Clark, Christopher Cojeen, Joan Dale, Dominique Desson, Thomas Dilley, Thomas Gillispie, Richard Glaser, Polly Haessig, Christine Hanson, Claudia Hemphill, Barbara Hildebrant, Anne Jensen, James Jordan, Jenny Jorgensen, Charles Hoffman, Elizabeth Horvath, William Johnson, Maureen King, James Kurtz, Stefanie Ludwig, Patricia McClenahan, James Marcotte, Herbert Maschner, Owen Mason, Howard Maxwell, Jeanne Nijhowne, Peter Phippen, Nena Powell, Bruce Ream, Allise Rhode, David Rhode, Nancy Saldi, Robert Sattler, Steven Shelley, Dixon Sims, Regen Vercruysse, Steve Winker, Allison Young, and Alan Ziff. Individuals who assisted in the laboratory portion of the project who were not also part of the field crews include: Steven Christy, Martha Johnson, Kenneth Pratt, and Eugene West. The excellent quality of the reports produced over the years is directly attributable to those who sat and typed: Shelly Carlson, Justice Higgens, Vickie Ivester, and Sharon Olive. Without their consistent high standards this report could not have been completed. Office staff provided a variety of assistance, and we wish to thank Miriam Banker, Shelly Carlson, and Sharon Olive. Their assistance with the administration and other aspects of the program is greatly appreciated.

We would like to acknowledge several individuals at the University of Alaska Museum who assisted in the project. Basil Hedrick, Ludwig Rowinski, and Hazel Daro who provided substantial administrative support. Alan Batten identified macrofossil floral remains recovered from some of the sites. Steven McDonald, Gary Selinger, and Hans-Peter Uerpmann aided in identification of faunal remains, and Barry McWayne provided excellent photographs of artifacts and maps.

The remoteness of the Middle Susitna River area mandated that personnel be moved by helicopter on a daily basis. We would like to thank both Air Logistics of Alaska, Inc., and ERA Helicopters for the safe and professional support. Without their experience and dedication to safety the program could not have been completed within the specified time frame.

For several field seasons the Watana base camp was home for archeological personnel. We would like to acknowledge the camp staff and especially Roy Goodman and Jack Matthewman for making camp life pleasant. We also acknowledge Granville Couey, Onnalie Logsden, and Vincent Volpes for their excellent job of coordinating our needs with the overall needs of the project and camp and for the excellent safety record. In a project of this size it is often necessary to transmit information collected by one study group to another. We would like to thank R & M Consultants, Inc., and Frank Moolin & Associates for providing data useful to the cultural resources program.

During the course of the project various federal and state agencies commented on the cultural resources program. We would like to thank Floyd Sharrock and Craig Davis (National Park Service), Beth Walton (Bureau of Land Management), Edward Slatter (Federal Energy Regulatory Commission), Douglas Reger (former State Archeologist), Robert Shaw (former SHPO), Ty Dilliplane (former SHPO), Judith Bittner (SHPO), and Timothy Smith (State Archeologist) for their valuable assistance and cooperation during the project. Their review and suggestions greatly facilitated the effectiveness of the cultural resources program. We would like to give a special note of thanks to Richard Fleming (Alaska Power Authority) for his excellent job of meshing science with the licensing requirements of the proposed Susitna Hydroelectric Project.

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1 - INTRODUCTION

1.1 - Program Purpose

The purpose of the cultural resources program was: 1) to locate and document cultural resources, 2) address their significance, 3) assess the impact of the hydroelectric project on cultural resources, and 4) to develop a mitigation plan to avoid or lessen adverse impact of the proposed Susitna Hydroelectric Project on cultural resources. This report covers item 1; reports representing the assessment by the University of Alaska Museum regarding items 2 through 4 are being produced independently.

1.2 - Proposed Development

In the proposed plan for full basin development, two major reservoirs will be formed (Chapter 2, Figure 2.1). The larger reservoir will extend 48 miles upstream of the Watana Dam site and will have an average width of about 1 mile and a maximum width of 5 miles. The Watana reservoir will have a surface area of 38,000 acres and a maximum depth of about 680 feet at normal operating level.

The Devil Canyon reservoir will be about 26 miles long and one-half mile wide at its widest point. The reservoir will have a surface area of 7800 acres and a maximum depth of about 550 feet at normal operating level.

Staged development is planned. The Watana Dam will be completed first. If energy demands warrant, the Devil Canyon Dam will be constructed later. If the Devil Canyon Dam is constructed, the Watana Dam Construction Camp will be moved to the Devil Canyon area to house construction personnel.

The Watana Dam will be an earthfill structure with a maximum height of 885 feet, a crest length of 4100 feet, and a total volume of about 62,000,000 cubic yards. During construction, the river will be diverted through two concrete-lined diversion tunnels in the north bank of the river. Upstream and downstream cofferdams will protect the dam construction area. The power intake includes an approach channel in rock on the north bank. A multilevel, reinforced concrete, gated intake structure capable of operating over a full 140-foot drawdown range will be constructed.

The Devil Canyon Dam will be a double-curved arch structure with a maximum height of about 645 feet and a crest elevation of 1463 feet asl. The crest will be a uniform 20-foot width and the maximum base width will be 90 feet. A rock-fill saddle dam on the south bank of the river will be constructed to a maximum height of about 245 feet above foundation level. The power intake on the north bank will include an approach channel in rock leading to a reinforced concrete gate structure which will accommodate a maximum drawdown of 55 feet. Flow construction will be diverted through a single concrete-lined pressure tunnel in the south bank. Cofferdams and the diversion tunnel are proposed to provide protection against floods during construction.

About 2½ years of average streamflow will be required to fill the Watana reservoir. Filling will commence after dam construction proceeds to a point at which impoundment and continued construction can take place concurrently. Postproject downstream flow will be lower in summer and higher in winter than current conditions. Downstream of the project, differences between pre and postproject flow conditions become less pronounced, as the entire upper basin contributes less than 20% of the total discharge into Cook Inlet.

The proposed access plan consists of a railroad from Gold Creek to Devil Canyon on the south side of the Susitna River and a road from the Denali Highway to the Devil Canyon Dam site, via the Watana Dam site, on the north side of the river.

The proposed transmission line route which will carry power from the Susitna project roughly parallels, but is not adjacent to, the access route of the railroad and road between Gold Creek and the Watana Dam site. At Gold Creek, it connects with the Railbelt Intertie. Between Willow and Anchorage, the route extends in a southerly direction to a point west of Anchorage, where undersea cables will cross Knik Arm. Between Willow and Healy, the route would utilize the transmission corridor previously selected by the Alaska Power Authority for the Railbelt Intertie.

Detailed information on proposed development is included in Chapter 2 of the draft Environmental Impact Statement for the Susitna Hydroelectric Project (Federal Energy Regulatory Commission 1984).

1.3 - Contents and Organization of Report

This report presents the results of studies conducted as part of the cultural resources program of the Susitna Hydroelectric Project. It incorporates and updates annual progress reports for 1980, 1981, 1982, and 1983. In addition, it includes results of work undertaken in 1984. Evaluation and interpretation of project data took place throughout the course of the project and this report supercedes data interpretations considered in earlier reports.

The report is organized into ten chapters followed by six appendicies. Chapter 2 presents the history of the cultural resources program. Information resulting from a literature review of archeological, ethnohistorical and historical data is presented in chapter 3. A review of information concerning the physical and environmental aspects of the Middle and Upper Susitna River area is presented in chapter 4. Chapter 5 presents the research design. Methods employed throughout the course of the program are discussed in Chapter 6. The areas examined for cultural resources and the sites found are discussed in chapter 7. Chapter 8 contains the results of analyses undertaken to assist in evaluating site significance, proposing mitigation measures, and developing a mitigation plan. An overview of the history and prehistory of the Middle and Upper Susitna River is presented as the final section of this chapter. The cultural resources program is evaluated in chapter 9 and an extensive bibliography is presented as chapter 10.

Appendix A is a glossary of terms as they apply to this report. Appendix B contains examples of project forms and field guides. Technical data concerning the tephra analysis is presented in Appendix C. Appendix D contains the individual site reports for the 270 sites which were documented. Appendix E contains site location and survey locale maps. Full-size USGS maps are also included depicting site locations, project features and facilities, areas eliminated from survey, survey areas, and survey locales. Specific site locational information is included in Appendix F. Due to the confidential nature of site location data, Appendices E and F are subject to limited distribution.

2 - CULTURAL RESOURCES PROGRAM

2.1 - Study Area Boundaries

In order to accommodate the interdisciplinary nature of the cultural resources program two study areas were defined: 1) cultural resources and 2) geoarcheological (Figure 2.1). The boundary for the cultural resources survey was developed to include impact areas associated with proposed project facilities and features. In the Middle Susitna River area this was broadly defined as the area within 3 km of the limits of the proposed reservoirs from immediately below the proposed Devil Canyon Dam site to the mouth of the Tyone River. Emphasis for survey, however, was placed on areas inclusive of and within one-half mile of project facilities and features, including linear features and recreation areas (Figures 2.1 and 2.2). Chapter 7 discusses the areas examined for cultural resources and sites found. Maps depicting areas surveyed and areas eliminated from survey are presented in Chapter 7 and Appendix E.

The study area for geoarcheological studies was limited to the Middle Susitna River area and included the area within 16 km on either side of the Susitna River from Portage Creek to the Maclaren River (Figure 2.1). The geoarcheology study area was defined to facilitate data collection in the Susitna River Canyon, the area between the canyon rim and the foothills of the Talkeetna Mountains and the Alaska Range, and the foothills themselves.

The study area for cultural resources was not static and was redefined in response to modifications in the engineering plan, changes in the location of borrow areas, linear features, and data provided by studies associated with other aspects of the project such as land use analysis and recreation planning. The broader 3 km cultural resources study area was defined to accommodate such changes.

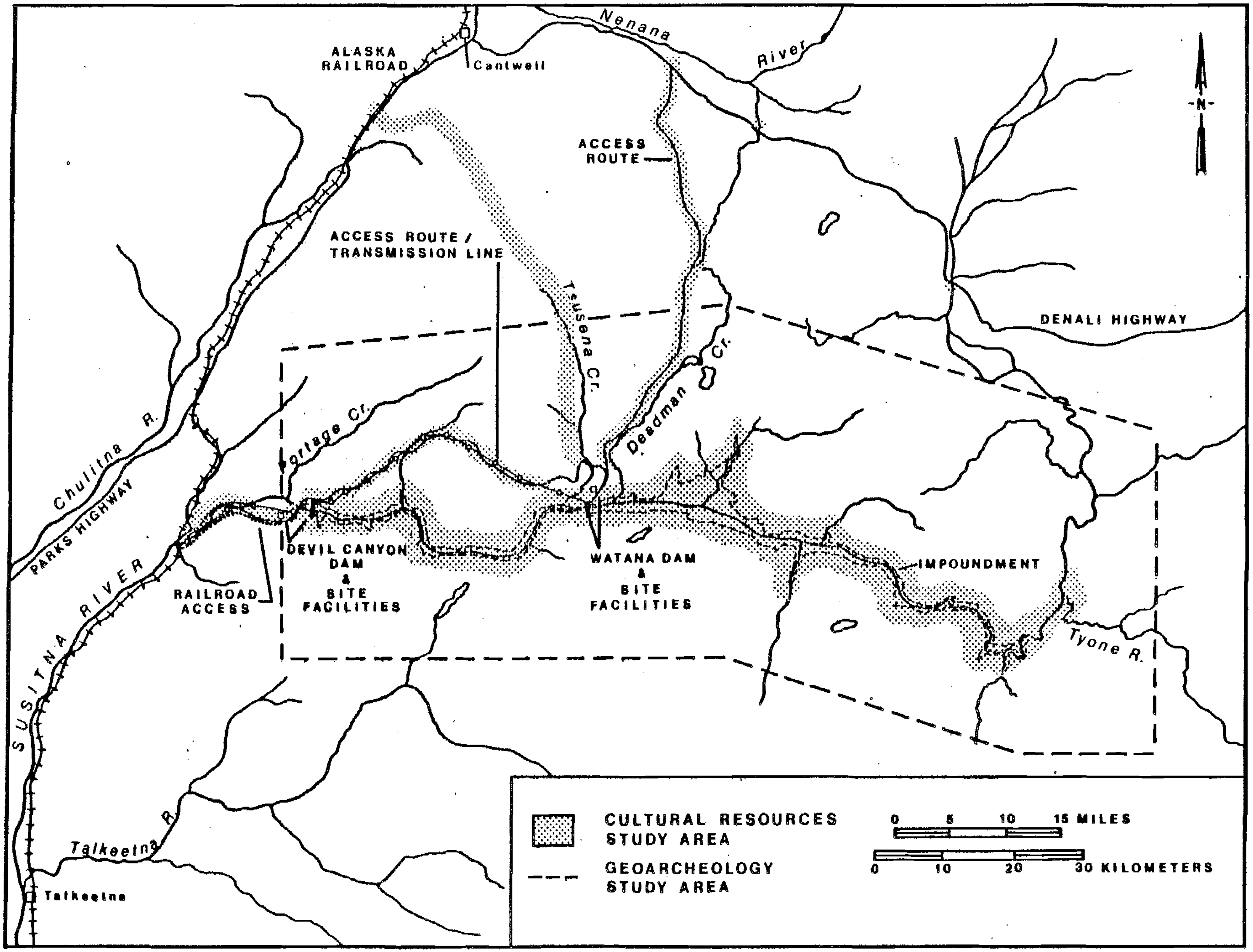


Figure 2.1. Study Area Boundaries in the Middle Susitna River Area

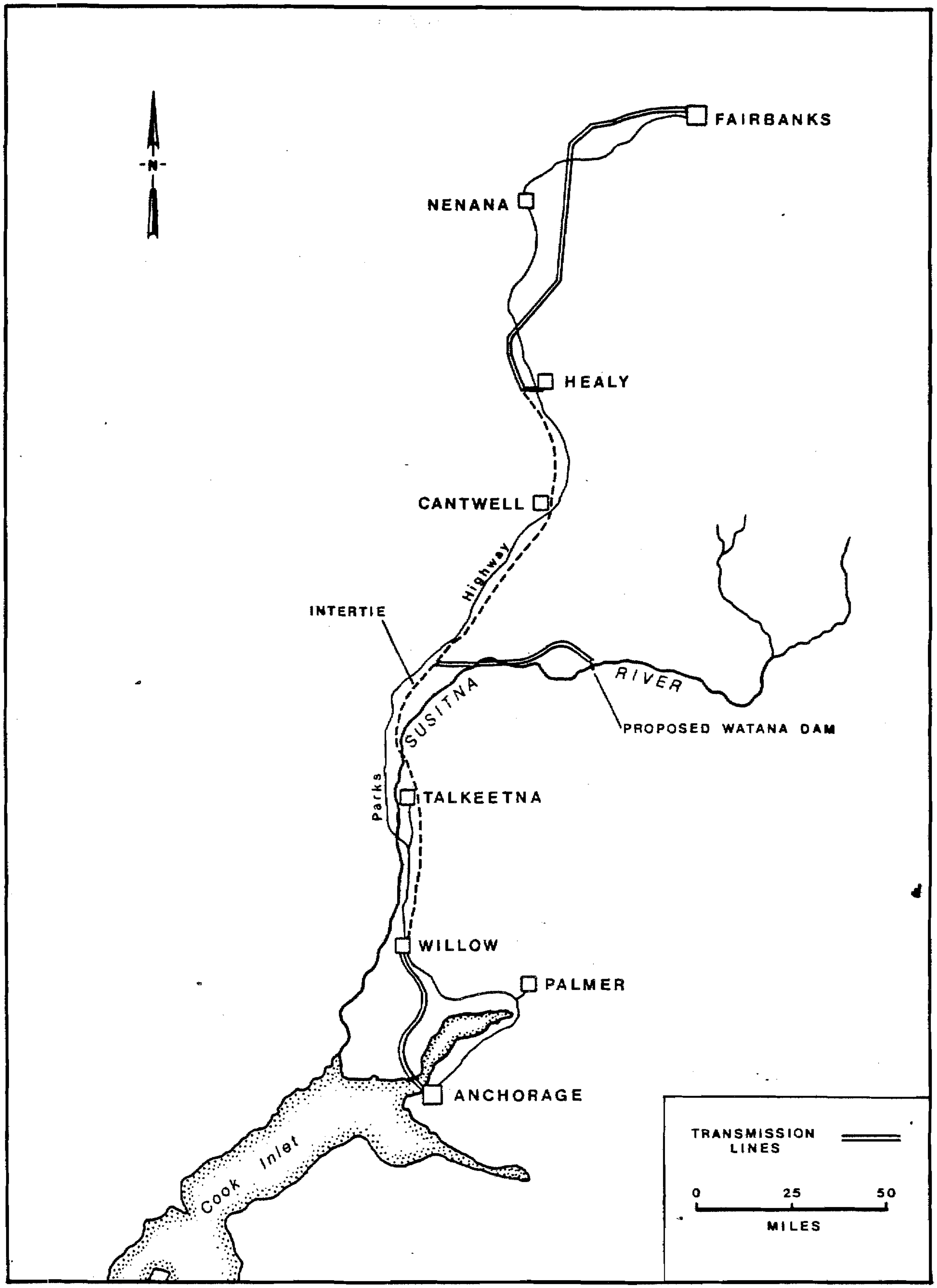


Figure 2.2. Study Area Boundaries Transmission Lines

2.2 - Program Objectives

In order to assist the Alaska Power Authority in complying with federal and state law and regulation concerning cultural resources associated with the Susitna Hydroelectric Project the following objectives were defined: 1) conduct survey to locate and document cultural resource sites, 2) collect and synthesize baseline data (literature review), 3) record sites and test sites to evaluate their significance, 4) assess project impact of facilities and features, preconstruction studies, and dam operation on cultural resources, 5) formulate mitigation recommendations, and 6) curate collections and supporting documentation, and disseminate information.

The following objectives were established to assist in evaluating site significance and formulating mitigation recommendations: 1) develop a fundamental cultural chronological framework for the area, 2) define research questions and important themes to address site significance, and 3) articulate research questions to sites which hold the potential to address important research questions and themes.

In order to assist in site interpretation, geoarcheology studies were conducted in conjunction with the cultural resources program to define and identify surficial geologic deposits, glacial events, and tephra deposits.

2.3 - Project History

(a) Program Development

The cultural resources program for the Susitna project began late in 1979 with a contract between the University of Alaska Museum and Terrestrial Environmental Specialist (TES). TES was a subcontractor to Acres American, Inc., which in turn was under contract to the Alaska Power Authority to investigate the feasibility of the proposed Susitna Hydroelectric Project. The original contract between the University Museum and TES was for a reconnaissance level survey of the impoundment area and associated ancillary facilities. A speculative cultural historical sequence was developed during the winter of 1979-80, using archeological data from known sites within and adjacent to the study area. The fundamental objective at this stage of research design development was to evaluate the validity of the postulated cultural historical sequence and to modify and/or redefine it through field research.

To accomplish this goal the project area was divided into eleven major geological/morphological units (later subdivided, modified, and termed "terrain units"). This initial geomorphic analysis was conducted under the direction of Dr. Robert M. Thorson, a quaternary surficial geologist and faculty member at the University of Alaska, Fairbanks, in conjunction with the Principal Investigator. This task was accomplished through airphoto analysis and interpretation and review of the geologic literature pertinent to the problem and study area. At that time it was anticipated that maximum limiting ages could be established for the surficial geologic deposits, thus providing broad temporal units within which to establish the chronological framework necessary to order the associated artifact assemblages through time. This was subsequently found to be impractical. As originally proposed, data resulting from on-the-ground examination and evaluation of the geological/morphological units in 1980 would be used to refine the definition and geographic distribution of the geological/morphological units. At that time it was anticipated that these units would be used to develop a stratified random archeological sampling program.

By the end of the 1980 field season, much fine tuning of the first phase of the research design had been accomplished (see chapter 5). The concept of stratified random sampling was abandoned in the 1981 season for the following reasons: 1) it would be difficult, if not impossible, to ascribe limiting ages to the specific surficial units because of the extremely complex sequence of deglaciation within the region and the difficulty of locating organics suitable for radiometric dating from contexts which would establish limiting ages for the units; 2) while the definitions of the units were generally useful in describing their overall characteristics, important environmental variables for site locations crosscut the units, thus rendering their distinction somewhat inappropriate as a primary device to establish sampling strata; 3) practical field experience gained during 1980 revealed the extreme difficulty of random sampling within the stratified terrain units due to technical and logistic limitations such as clearing numerous landing zones for helicopters; and 4) another major subcontractor, R&M Consultants, Inc., conducted a comprehensive program of terrain unit mapping for engineering purposes which exceeded the original effort in accuracy, scope, and detail.

Efforts were then focused on optimizing site discovery using site locational information from adjacent regions and important environmental information associated with the sites discovered within the project area. Specific subsurface deposits were identified which were tenatively recognized as volcanic ash (tephra). This discovery generated the possibility of establishing a regional chronologic and stratigraphic framework through tephrochronology.

A major revision of study objectives from reconnaissance level survey to intensive survey of direct impact areas accompanied an administrative shift from a subcontract with Terrestrial Environmental Specialists, Inc., to a direct contract with Acres American, Inc. At the request of the Alaska Power Authority, evaluations of the relative archeological sensitivity of linear features and phase I recreation areas continued. By the end of the 1982 field season, the major objective of the original research design had been accomplished: a fundamental stratigraphic framework and preliminary cultural historic sequence had been established. Throughout the development of the chronological framework, however, other research objectives were clearly recognized and being developed. These included changes in settlement and subsistence patterns, trade and diffusion, human response to environmental change including climate and tephra falls, and a variety of other problems.

During the 1983 field season, the Museum contracted with Harza-Ebasco, Inc.; the new prime contractor to the Alaska Power Authority. During the 1984 field season, the APA contracted with the Museum directly. The 1983 and 1984 field seasons were primarily directed toward completing the intensive survey of areas of proposed direct impact, systematically testing sites, and determining the size and elevation of sites in direct impact areas. Data resulting from these and other activities were analyzed with the objective of addressing the significance of specific sites, or collective groups of sites. These data were then analyzed and, in part, form the basis for formulating the Museum's mitigation recommendations for significant cultural resources which may be adversely effected by the proposed Susitna Hydroelectric Project.

(b) Fieldwork

Five field seasons were devoted to locating, documenting, and testing sites within the surveyable portions of the study area and areas associated with proposed features and facilities. Areas examined and sites found are discussed in chapter 7. The first field season (1980) consisted of a seven-person field crew working in the field for three months. During this field season 60 survey locales were examined and 37 sites were found. The 1981 field season was a larger effort with 18 people in the field for three months. Fifty-one survey locales were examined, 75 sites found, and 18 sites systematically tested. The 1982 field season was only two months long and consisted of a seven-person field crew. Fifteen survey locales were examined, 40 sites found, and 3 sites systematically tested. The 1983 field season was also two months long but consisted of a 24-person field crew. Thirty-eight survey locales were examined, 56 sites found, and 5 sites were systematically tested. The 1984, and final, field season consisted of 26 people in the field for three months. Eighteen survey locales were examined, 40 sites were found, and 37 sites received systematic testing. A total of 248 sites were located and documented during the five-year program and 182 survey locales were defined and examined. Twenty-two sites were documented in the files of the State of Alaska Office of History and Archaeology and bring the total number of sites to 270. Site reports for these sites are located in Appendix D.

(c) Permits

Fieldwork conducted between 1980 and 1983 on federal lands (BLM) was carried out under two Antiquities Permits (80AK-23, 81AK-209). Antiquities permit 81AK-209 was valid for the 1981, 1982, and 1983 field seasons. Fieldwork during the 1984 field season was conducted under Archaeological Resources Protection Act Permit number ARPA 84-AK-014. In addition to federal permits, State of Alaska permits were also obtained for fieldwork on state lands (80-1, 81-11, 82-4, 83-5). The 1983 state permit was extended for the 1984 field season. Fieldwork on lands selected by, or conveyed to, Alaska Natives was authorized under a Memorandum of Agreement between the Alaska Power Authority and the Cook Inlet Native Village Corporations and the Cook Inlet Region, Inc.

(d) Consultation and Review

The following federal and state agencies were consulted during the development and subsequent implementation of the cultural resources program: National Park Service, Bureau of Land Management, Federal Energy Regulatory Commission, and the State of Alaska Office of History and Archeology. Comments were solicited and received concerning the research design, methods, and proposed significance evaluation, impact and mitigation plan. Correspondance resulting from agency consulation is presented in the following section. Reports were prepared in consultation with the National Park Service and the Alaska State Historic Preservation Officer and Alaska State Archeologist. In addition to federal and state agencies, consultation with individuals knowledgable with the history, ethnohistory, and/or prehistory of the Middle and Upper Susitna River was also conducted.

As part of the APA's review process, cultural resources program discussion sections were incorporated into various workshops in 1982, 1983, and 1984. A separate workshop devoted to significant research questions that could be addressed by data collected as a result of this project was also held in 1984. During the course of the project Native concerns were addressed through the APA's Native Inspector, and Native leaders field inspected the cultural resource program in 1983. When appropriate, Native groups were contacted directly by Museum personnel concerning relevant cultural resource matters. The State Archeologist, State Historic Preservation Office, the APA's Native Inspector, a state legislative represenative, FERC represenative, and Native representatives visited the study area at various times during the course of the program and participated in on site inspection.

2.4 - Correspondence

STATE OF ALASKA

DEPARTMENT OF NATURAL RESOURCES

DIVISION OF PARKS

JAY S. HAMMOND, GOVERNOR

619 WAREHOUSE DR., SUITE 210
ANCHORAGE, ALASKA 99501

PHONE: 274-4676

December 15, 1982

File No. 1130-3

Mr. Al Carson
DPDP
Pouch 7-005
Anchorage, Alaska 99501

Dear Mr. Carson

Thank you for the review copy of the draft Exhibit E. We are pleased to comment on Chapter 4 - Report on Historic and Archaeological Resources.

The report is well done and addresses all the pertinent questions about mitigation. Table E.4.2 is particularly informative and is a good synthesis of the available information to date. We concur with the mitigation plan as it stands in this draft document. We would also like to add our recommendations to the proposed education program recommended on page E.4.114. We consider such a program to be a necessary part of any large construction project. It seemed to be quite effective during construction of the Alyeska Pipeline. If project personnel are adequately trained and sites are clearly marked, avoidance should be a viable mitigative measure in a fair number of the indirect and potential impact cases.

We look forward to continuing to work with all concerned parties on this project.

Sincerely,

Judith E. Marquez
Director

Tom Smith, DEPUTY
By: Ty L. Dilliplane
ACT: State Historic Preservation Officer

cc: Leila Wise, Division of Natural Resources Coordinator
Dr. Edward Slatter, FERC Archaeologist
Mr. Lou Wall, Advisory Council on Historic Preservation
Dr. E. James Dixon, Lead Archeologist, Susitna Hydro Project
Dr. Glenn Bacon, Lead Archeologist, Alaska Heritage Research Group

DR:ces

Task - 7.4

United States Department of the Interior

NATIONAL PARK SERVICE
Alaska Regional Office
540 West Fifth Avenue
Anchorage, Alaska 99501

IN REPLY REFER TO:

D18 (ARO-P)

03 DEC 1982

RECEIVED

DEC 7 1982

ALASKA POWER AUTHORITY

Mr. Eric Yould, Executive Director
Attention: Richard Fleming
Alaska Power Authority
344 W. 5th Avenue, Suite 501
Anchorage, Alaska 99501

Dear Mr. Yould:

I appreciate the opportunity to have participated in the recent Susitna Hydroelectric Project FERC License Application Exhibit E Presentation and Discussion and to discuss issues related to cultural resource management with Dr. Fleming, and Don Follows of Acres American, Inc., both of whom have done an outstanding job in my opinion.

The point that I made there, and wish to repeat here, is that the comments of the Advisory Council on Historic Preservation should be solicited without delay in the interest of expeditious development of a plan for future survey and inventory, and for mitigation of potential impact on sites already inventoried and evaluated. It is not necessary to wait until the inventory is complete to solicit Advisory Council comments since the Council can accommodate actions at this early stage. Council's comments now could negate the need for the compressed, one-year, program of mitigation that was proposed as a probable necessity if Council comments are delayed until the survey is completed. In my opinion more lead time is necessary for development and implementation of a mitigation plan for a project of this magnitude.

Again, I appreciate the hospitality of the Alaska Power Authority, and the opportunity to comment.

Sincerely,

Floyd W. Sharrock

Floyd W. Sharrock
Archeologist

cc:
Don Follows, Acres American, Inc.

United States Department of the Interior

NATIONAL PARK SERVICE
Alaska Regional Office
540 West Fifth Avenue
Anchorage, Alaska 99501

IN REPLY REFER TO:

L7621(ARO-PCR)

OCT 22 1982

Dr. E. James Dixon, Jr.
Curator of Archeology
University of Alaska Museum
University of Alaska
Fairbanks, Alaska 99701

Dear Dr. Dixon:

Our staff has examined the Susitna Hydroelectric Project cultural resources final report, in particular the identification and testing program elements of the research design, and find these and their field application to be very adequate methods and procedures for the discovery and evaluation of archeological and historical resources in the project area. Consultation between our staff archeologists and project personnel from the University of Alaska Museum and Acres American, as you well know, have occurred several times since the project's inception, and we have thus been kept abreast of most developments relating to cultural resources management matters. We hope that the level of identification, testing, and evaluation conducted to date continues as the project proceeds, to assure the highest levels of resource protection and compliance with Federal and State historic preservation law.

We look forward to evaluating your mitigation plan for cultural resources occurring in the project area.

Sincerely,

Regional Director
Alaska Region

cc:
Floyd Sharrock, Alaska Regional Office

STATE OF ALASKA

JAY S. HAMMOND, GOVERNOR

DEPARTMENT OF NATURAL RESOURCES

DIVISION OF PARKS

619 WAREHOUSE DR., SUITE 210
ANCHORAGE, ALASKA 99501

PHONE: 274-4676

October 15, 1982

Re: 1130-13

Mr. Eric P. Yould
Executive Director
Alaska Power Authority
334 W. 5th Avenue
Anchorage, Alaska 99501

Dear Mr. Yould:

Thank you for your letter of September 2 soliciting our recommendations on Susitna Hydro Project impacts and mitigation measures with respect to cultural resources.

First of all, we wish to commend archaeologists Dr. E. James Dixon of the University Museum and Mr. Glenn Bacon of the Alaska Heritage Research Group, Inc., for the excellent job they have been doing in locating cultural resources prior to ground disturbing activities.

Preconstruction survey is, of course, the first step in impact mitigation - the location and boundaries of cultural resource sites must be known. While this work is fairly far along, more needs to be done as plans become more concrete.

Secondly, these cultural resource sites must be evaluated in terms of eligibility for inclusion in the National Register of Historic Places. For evaluation, each site within the project area must be sufficiently investigated such that their boundaries, stratigraphy, relative age, cultural affiliation and potential to yield significant scientific information are known. Many of the currently known sites require further, more intensive, investigation for eligibility determinations to be made. Since so little is known about the prehistory of the area, each site discovered takes on added significance. In addition, groups of sites within a river drainage have been classic study areas throughout the history of anthropological archaeology. It would appear that a high percentage of the discovered sites may be eligible for the National Register.

Thirdly, each eligible site must be examined in terms of "Effect." Will the proposed action have "no effect," "no adverse effect," or an "adverse effect"? This would have to be done on a case by case basis. The criteria for determinations of effect may be found under Title 36, Code of Federal Regulations, Part 800.

Please note that every effort must be made to mitigate future "adverse effect" activities to National Register or eligible properties. In the few expected cases where very large, complex sites will be adversely effected, it may be more economical to build a barrier around the sites. In many cases, substantive investigation may be necessary. If so, this will usually mean relatively complete excavation of the site in order to recover as much scientific information as possible.

These recommendations are essentially those suggested by Dixon, et al, in the Cultural Resources Investigation Phase I Report (April 1982).

We are confident that impacts to significant cultural resources will be fully mitigated throughout the course of the Susitna Hydroelectric Project.

Sincerely,

Judith E. Marquez
Director

By: Ty L. Dilliplane
State Historic Preservation Officer

cc: Ms. Leila Wise, DNR, A-95 Coordinator
Dr. Edward Slatter, FERC Archaeologist
Mr. Lou Wall, Advisory Council on Historic Preservation
Dr. E. James Dixon, Lead Archaeologist, Susitna Hydro Project
Mr. Glenn Bacon, Lead Archaeologist, Alaska Heritage Research Group

TS:clk

STATE OF ALASKA

DEPARTMENT OF NATURAL RESOURCES

DIVISION OF PARKS

JAY S. HAMMOND, GOVERNOR

619 WAREHOUSE DR., SUITE 210
ANCHORAGE, ALASKA 99501

PHONE: 274-4676

October 1, 1982

Re: 1120-18-7

Mr. George Smith
UAF Museum, Archaeology Section
University of Alaska - Fairbanks
Fairbanks, Alaska 99701

Dear George:

We have reviewed your documentation on cultural resource investigations in areas to be affected by geotechnical testing and a proposed winter cat trail.

In view of the thoroughness of the work, we fully approve and concur with your recommendations in every case (winter cat trail, auger holes, hammer drill holes, and seismic lines).

We look forward to continued cooperation and consultation with the Museum on the Susitna Hydro Project cultural resource investigations.

Sincerely,

Judith E. Marquez
Director

By: Ty L. Dilliplane
State Historic Preservation Officer

DR:clk

0-J11LH

Alaska State Legislature

Senate

Office of the President

Official Business

Pouch V
State Capitol
Juneau, Alaska 99[illegible]

3 August 1982

Dr. E. James Dixon, Jr., Principal Investigator
Susitna Archaeological Project
The Univeristy of Alaska Museum
Fairbanks, Alaska 99701

Dear Jim:

Thank you and your excellent staff for making our tour of the Susitna Hydroelectric Project such an enjoyable and informative one.

It was very helpful for me to get a "hands on" or rather "feet on the ground" perspective in order to get a better idea of the nature of the research and the resources with which you are dealing. I feel quite secure in reporting to Senator Kerttula that good archaeological resource assessment is going on at Susitna.

The only regret that I have about our visit is that it didn't last long enough. So it goes. I look forward to the next time we can meet together.

Please thank for me your crew, Bob, Morine, Lisa and David. David Rhode was especially helpful in guiding us through the project area and to the Jay Creek site. I felt very good about the quality of those working for you in the short while I was around them. If the quality of one's staff is lacking somewhat, so can the research and results. I would not anticipate such with your personnel.

Again, thanks for a wonderful visit to the project area. Please let me know if this office can help you in any way.

Sincerely,

Richard

Richard J. Ramsey, Jr.
Assistant to Senator Kerttula

Meeting January 22, 1982, with State Historic Preservation Officer, Mr. Robert Shaw, and Acting State Archeologist, Mr. Ty Dilliplane.

Present at meeting:

E. James Dixon, Principal Investigator
George S. Smith, Project Supervisor
Robert Shaw, State Historic Preservation Officer (SHPO)
Ty Dilliplane, Acting State Archeologist
Robert Krogseng, T. E. S.
Jim Gill, Acres American

The purpose of the meeting was to discuss the general mitigation plan and approaches to mitigating adverse impact to cultural resources located and documented during the 1980 and 1981 field seasons. A brief description of the historical development of the project was presented and it was noted that the project is still in the planning, evaluation, and pre-license application, stage. Current engineering concepts and plans were presented by Mr. Gill and the possibility of clear-cutting the entire impoundment area was presented. All recognized that clear-cutting could have a major adverse effect on cultural resources which would require acceleration of mitigation plans, should this course of action be taken. Dr. Dixon presented the approach to impact and the general mitigation policy proposed and recommended for the project. In summary this includes three types of impact: 1) direct, 2) indirect, and 3) potential.

The general mitigation plan consists of the following recommendations:

All sites that will receive direct or indirect impact should be investigated, while those expected to be potentially impacted should be avoided and a preservation plan developed.

Both the State Archeologist and the SHPO felt that this was the appropriate way to handle cultural resources that would or could be impacted by the Susitna Hydroelectric Project. A question did arise, however, concerning the question of significance. Those sites that are on the National Register of Historic Places, or which are determined eligible for nomination to the National Register as defined by National Register critera, require mitigation. The SHPO's (Mr. Shaw's) primary concern was how we are evaluating significance. While systematic testing was employed to generate sufficient data on which to address site significance of 18 of the 115 sites, most sites have not been systematically tested. However, many of the sites can be dated using the three tephras identified and thus present a unique situation where sites not systematically tested can be related to those tested and significance on this broad scale addressed. These sites have yielded and will likely yield significant data concerning the history and prehistory of the Upper Susitna River Valley, which can be used to develop the first cultural chronology for this area of Alaska. However, site specific evaluations of significance must still await systematic testing. Systematic testing is also important for developing information on which to assess the appropriate mitigation measures and to estimate the cost of mitigation for each site.

Both the State Archeologist and the SHPO felt that dealing with significance in this manner was appropriate, given the data base to date. Mr. Dilliplane suggested that the entire region may be eligible for National Register nomination as an archeological district, based on the fact that it presents a unique opportunity to define regional prehistory.

The SHPO and the State Archeologist said that they would like to see the entire final report, including the impact and mitigation sections before they made a formal evaluation of the cultural resource program.

cc: Mr. Jim Gill, Acres American
Mr. Robert Shaw, Alaska State Historic Preservation Officer

STATE OF ALASKA

DEPARTMENT OF NATURAL RESOURCES

DIVISION OF PARKS

JAY S. HAMMOND, GOVERNOR

619 WAREHOUSE DR., SUITE 210
ANCHORAGE, ALASKA 99501

PHONE: 274-4676

December 4, 1981

Re: 1130-13

John D. Lawrence
Project Manager
Acres American, Inc.
The Liberty Bank Building, Main at Court
Buffalo, New York 14202

Dear Mr. Lawrence:

We have reviewed the 1980 reports by the University of Alaska Museum dealing with the cultural resources of the Susitna Hydroelectric project area. The report documents the survey activities conducted during 1980 which adequately accomplish the tasks outlined in the proposed work plan. The sampling plan designed on the basis of geomorphic features and known use areas seems to have surpassed our expectations of site incidence in the area. The report shows that the first level inventory was very competently conducted and recorded. The second year activities as outlined in the procedures manual was accomplished in the 1981 field season according to information gained through verbal communication with the principle archaeological investigators. We understand that the field research strategy was changed slightly from that expected due to information gained during 1980. These changes appear to have more directly addressed problems which surfaced during the course of analysis of the 1980 data. A final review of the 1981 results and reports will have to await receipt of that document.

We feel that the steps taken thus far in the cultural resource management of the project have been excellent and one of the few instances of adequate lead time. We would like to make the observation that the work thus far is only preliminary to the work yet needed for the Susitna Hydroelectric project. Reconnaissance and testing of yet to be examined areas should continue. The clearances of specific areas of disturbance provided as additional survey by the Museum should indicate the continued need for clearances of ancillary projects which could affect cultural resources. Also, a formal mitigation plan for those sites to be affected by the project must be formulated. Once definite decisions on the route of access to the project area from existing road systems are made, those access routes and material sites must be examined for conflicts and needs for mitigation. Issuance of a permit by the Federal Energy Regulatory Commission should and probably will include provisions specifying under federal law the need for such protection.

If you have any questions regarding our comments contained here, please call us. We look forward to receiving the report on 1981 field work.

Sincerely,

Chip Dennelein
Director

for Douglas Reger
By: Robert D. Shaw
State Historic Preservation Officer

cc: Dr. E. James Dixon
Curator of Archaeology
University of Alaska Museum
University of Alaska
Fairbanks, Alaska 99701

Eric Yould
Executive Director
Alaska Power Authority
333 W. 4th Avenue
Anchorage, Alaska 99501

DR:clk

3 - BASELINE DATA - ARCHEOLOGY, ETHNOHISTORY, and HISTORY

3.1 - Archeology

Prior to the current cultural resources survey the available data were inadequate to accurately define a cultural historical sequence for the project area. Consequently, it was necessary to draw on the data from adjacent areas to construct a speculative cultural chronological framework for the Middle Susitna River. The following literature review of regional prehistory is divided into geographical areas which are contained in, or contiguous to, the Susitna Hydroelectric Project boundaries and associated linear features. The following areas are considered: the Susitna River canyon area, Tanana River valley, Central Alaska Range, Denali Highway, Copper River valley, and Cook Inlet.

Many of the sites found within each geographical area lack diagnostic artifacts or have not been dated by absolute or relative dating methods. Additionally, some sites have only been reported in a cursory form because of very limited testing. Because of this, the current treatment is not encyclopedic, with emphasis being placed on sites which have been well documented and provide information which is applicable to the Susitna Project. Emphasis is on noncoastal regions because of their greater ecological similarity to the project area.

(a) Susitna River Canyon Area

Archeological investigation of the Upper Susitna River valley began over 27 years ago; however, research during the intervening years has been sporadic. In 1953 Ivar Skarland conducted an aerial reconnaissance of the region in preparation for a survey conducted by William Irving in that same year. This work was done under contract to the National Park Service. Irving's survey was designed to investigate impoundment areas of dams proposed for the Susitna River (Irving 1957:37). His efforts were focused in the area of a proposed Devil Canyon Dam, and near lakes Susitna, Louise, and Tyone. The lakes were investigated because the proposed Vee and Denali dams would inundate these areas (Irving 1957).

Eleven sites were found on the lakes and a twelfth site was discovered approximately three miles above the confluence of Tyone Creek with the Tyone River (Irving 1957). Five of the sites contained remains of semisubterranean houses which Irving thought resembled houses that Rainey (1939) had found along tributaries of the Upper Copper River. Both postcontact and early precontact sites were reported by Irving. A multicomponent site (site 9) was found north of the outlet of Lake Susitna and was reported to contain late prehistoric Athapaskan, Arctic Small Tool tradition, Northern Archaic tradition, and Denali complex components (Irving 1957).

Frederick Hadleigh West conducted a brief survey in the Stephan Lake area during the summer of 1971 and located five sites (West 1971). Survey for the proposed Denali State Park provided the reason for this survey. Consequently the report contains few data on the Stephan Lake sites. The Alaska Heritage Resource Survey (AHRS) files contain information which indicate a site on Stephan Lake found by West (TLM 007) is multicomponent and has been radiocarbon dated to 4000 B.C.

Bacon (1975a), utilized an aerial reconnaissance of the Middle Susitna River area to delineate several locales of high archeological potential along the Middle Susitna River utilizing an ecotone model to predict probable site locations. Most recently, Bacon (1978a, 1978b) conducted surveys near the Devil Canyon and the Watana dam sites. No sites were found at the proposed Devil Canyon Dam site but prehistoric sites were discovered in the vicinity of the Watana Dam site. The single component at site TLM 016 was radiocarbon dated to 3675 ± 160 years: 1725 B.C. (Bacon 1978a:24). Bacon (1978a:23) suggests occupation as early as 8,000 - 10,000 years ago at site TLM 015, based on an interpretation of the silt/loess unit above the artifacts.

(b) Tanana River Valley

Archeological survey and excavation have been conducted in many parts of the Tanana River valley, but for the most part survey has been concentrated in areas easily accessible by road. Aigner (1979) conducted a major archeological survey along the Northwest Alaskan Pipeline Company Natural Gas Pipeline Corridor between Prudhoe Bay and Delta Junction, Alaska. Sites from Denali through Athapaskan cultural traditions were found in this survey. Surveys conducted along the Alaska Highway include: Thurston's (1981) survey between mileposts 1256 and 1235, Fort Greely withdrawal lands off the Alaska Highway (Holmes 1979b), Shaw Creek Road Project (McKay 1981), Holmes and Dilliplane (1977), Johnson (1946), and the Trans Alaska Pipeline survey conducted by West and Workman (1970).

Other areas in the Tanana River valley have also been surveyed for archeological resources. Rosie Creek Road was surveyed by Andrews (1979). Holmes (1974a) conducted a survey in the Bonanza Creek area and Yarborough (1978) surveyed areas for the Chena River Lakes Project.

A more detailed examination of sites in the Tanana River valley follows with emphasis placed on well-documented sites which may provide insight into the culture history of the Susitna Hydroelectric Project area.

The Campus site is located on the Fairbanks campus of the University of Alaska. The first published report on the site was in 1935 by Nelson who reported that the Campus site showed clear archeological evidence of an early migration to America. Rainey (1939) summarized the 1930 excavations in an article, "Archeology in Central Alaska". The Campus site was excavated again in 1966, 1967, and 1971. Two unpublished papers resulted from the 1960's excavations (Hosley and Mauger 1967; Hosley 1968). The presence of microblade cores, microblades, burins, and notched points suggests the site contains Denali complex and Northern Archaic components. West (1981) has identified the site as one of four type sites of the Denali complex.

A restudy of the Campus site artifacts and contexts by Mobley (1984) suggests that the site is about 3000 years old and represents a single component. Radiocarbon and obsidian hydration dates of 2860 ± 180 years, 2725 ± 125 years, and 3500 ± 140 years support his contention. Additionally, Mobley's analysis of the vertical and horizontal distribution of lithic debris tends to support the single component interpretation.

The Donnelly Ridge site is located over 2600 feet asl in the northern foothills of the Alaska Range. The site is situated on one of the highest points in the area and provides an excellent view of the myriad lakes and ponds which surround it (West 1967:363). One thousand- twelve stone artifacts were recovered, of which 533 show various degrees of use (West 1967:365). Stone artifacts recovered include bifacial biconvex knives, endscrapers, large blades and blade-like flakes, prepared cores, core tablets, microblades, burins, burin spalls, and worked flakes (West 1967:365-366).

West interprets the site as a seasonal hunting camp used for a short period of time, possibly only one season (West 1967:27). The age of the site is uncertain although two radiocarbon dates 1830 ± 200 years: A.D. 120 (B-649) and 1790 ± 300 years: A.D. 160 (B-650) have been recorded. However, West (1967:32) feels that these actually date a later tundra fire and not the cultural material. Based on comparison of the Donnelly Ridge material with other Denali complex sites, West suggests an age of at least 10,000 B.C. The Minchumina site, the Village site at Healy Lake, and the Dixthada site have produced Denali complex artifacts with dates much more recent than West's projections (Cook 1969; Shinkwin 1975; Holmes 1984).

Healy Lake is located 60 km east of Donnelly Dome. Two major sites are recorded in this area, the Village and the Garden sites. Both have Athapaskan tradition artifacts from the upper three levels.
The Village site at Healy Lake has yielded evidence for human occupation of Interior Alaska by ca. 9000 B.C. (Cook 1969). Five components have been identified at the site. The upper level, just below the sod,

contained stemmed and notched points and microblades, a situation similar to the Minchumina site MMK 004 and suggestive of both the Northern Archaic tradition and the Denali complex. Below this level are two components similar to the Denali complex defined by West (1967). The lowest level named the Chindadn complex was characterized by triangular projectile points, tear drop-shaped knives, and an absence of microblades.

Holmes (1979b) discovered 62 archeological sites in the Fort Greely withdrawal lands. These sites were found on surface exposures and by subsurface testing. They range in size from single artifact sites to large multicomponent sites over 1,000 square meters in extent. Cultural components found in the Fort Greely lands include components from historic, Athapaskan, Northern Archaic, and Denali traditions. Two of the most significant sites are XMH 297 and XBD 110. Both sites are thought to be very old and represent the first occupations of the area. A radiocarbon date of 8555 ± 380 years: 6605 B.C. (GX-5998) was obtained for site XMH 297. This radiocarbon sample was taken from 10 cm above the culture bearing zone. Site XBD 110 is potentially very old as it is deeply buried in silt which covers a glacial moraine of Illinoian age.

A 1979 archeological survey of Ft. Wainwright Reservation in the Tanana River valley led to the discovery of 48 prehistoric and four historic sites (Dixon et al. 1980a). Sampling areas for this project, delineated by the research design, corresponded to most of the major elevations within the military reservation. Site locations included: lake shores (Blair Lakes), outlets of streams draining lakes, knolls near streams and rivers, and high bluffs and buttes. Several of the sites were more than 300 m above the Tanana River flats and provided excellent views of the surrounding area.

Three sites on the north shore of Blair Lake South were systematically tested: FAI 044, FAI 045, and FAI 048. Site FAI 044 contained historic, late prehistoric Athapaskan, Northern Archaic, and possible Denali components. Site FAI 045 contained the same recent historic component documented at FAI 044, and a possible Denali complex component. Samples for radiometric dating were not recovered but the Denali complex component was inferred from the recovery of microblades and microcores. Only one of four squares tested produced Denali complex material and two occupations are suggested. In addition to these sites, 10 Denali complex, 10 Northern Archaic, and 3 historic period sites on the military reservation could be assigned to a time period (Dixon et al. 1980a).

The Dixthada site on Fish Creek, locally called Mansfield Creek, near Mansfield Lake consists of 9 housepits, 1 associated midden, several storage pits, and 11 tent rings. The site was originally excavated by Rainey (1939:364-371) who interpreted the site as an Athapaskan settlement of the last few hundred years; although, based on presence of a microblade industry, he suggested a relationship with the Campus site. In 1953 Rainey amended his original evaluation of site age by assigning the microcores and microblades to an earlier component based on comparison with sites of known age (Rainey 1953). Additional excavations by Cook and McKennan in 1970 indicate that a yellow silty horizon located under the middens at Dixthada contained the core and microblade industry (Shinkwin 1975:149-150). These excavations supported the conclusion that the site was multicomponent, as suspected by Rainey.

Shinkwin (1975) studied materials from both components at Dixthada. The upper component, although mixed, contains an array of copper implements, bone and antler artifacts, bifacial knives, scrapers, whetstones, hammerstones, grinding stones, an adze, and two axes (Shinkwin 1975:151-152) and represents a late prehistoric/early historic Athapaskan group as suggested by Rainey (Shinkwin 1975:153). Shinkwin notes similarity of the upper level lithic and bone industries to the Klo-kut site in the Yukon Territory. The lower component at Dixthada contains a microcore and microblade industry dating 470 ± 60 B.C. The upper component is dated A.D. 1150 and A.D. 1550.

Several sites on the shores of Lake Minchumina in the western Tanana River valley document human occupation spanning approximately 2500 years

(Holmes 1976; Hosley 1967; C. West 1978). Holmes (1984:286) has divided the occupations at Lake Minchumina into five phases. From earliest to most recent these phases are Blueberry, Cranberry, Raspberry, Dogwood, and Spruce Gum. The three earliest phases are characterized as the Minchumina tradition, which is a local developmental sequence of the Northern Archaic tradition (Holmes 1984). He suggests these three phases form a cultural continuum linked by flake burins, microblade technology, projectile points, biface knifes, endscrapers, sidescrapers, and assorted pebble scrapers.

The Dogwood phase represents a Norton/Ipiutak presence at the site which may have replaced or displaced the local Raspberry phase group for a time (Holmes 1984:292). The final phase, Spruce Gum, is considered protohistoric Athapaskan. There is a widespread use of copper for tools and ornaments with a de-emphasis on lithic tools.

The oldest site known in this area is MMK 004 where a lower level was dated to ca. 600 B.C. and an upper level dated to ca. A.D. 1000 (Holmes 1976:2). The site is thought to represent a continuous sequence between these dates (Holmes 1976:2). Noteworthy is an apparent late persistence of microblade core and burin technology which dates to between A.D. 800 and A.D. 1000. Notched points were recovered in addition to microblades in Holmes' level one, but the exact association of these artifacts is not clear and late persistence of microcore technology and affiliations with the earlier Denali complex of Interior Alaska are unresolved questions. Until further research is conducted it may be prudent to consider that two traditions, i.e., Northern Archaic and Late Denali, may have coexisted during this time.

Holmes (1978) presents some comparative data on the assemblage from MMK 004. Point/knives from the lowest level resemble Choris points, and have been equated with the Norton period (Holmes 1976:5). A relationship between MMK 004 and forest-adapted Ipiutak/Norton cultures similar to those from Onion Portage and Hahanudan Lake has also been suggested (Holmes 1976:8; Dumond 1979:14).

The majority of obsidian from MMK 004 is from the Batza Tena source near the Koyukuk River to the north and indicated trade over considerable distance in Interior Alaska. The obsidian is also present at Gulkana in the Copper River valley and suggests widespread trade in that direction as well. Several other sites, the Birches site with a date of ca. A.D. 520 (C. West 1978), and MMK 012 dating to ca. A.D. 50 (Holmes 1976:8), demonstrate more recent occupations at Lake Minchumina.

(c) Central Alaska Range

Survey and excavation work in the central Alaska Range has been focused primarily along the Parks Highway and in Denali National Park. In 1964 Treganza conducted survey work in Denali National Park. Since that time Morgan (1965), Bowers (1977), and Davis (1979) have also surveyed within the park boundaries. Bacon, Holmes, and Mobley have surveyed along the transmission intertie between Anchorage and Fairbanks (1982a) and more extensively between Willow and Healy (1982b). A Healy to Fairbanks survey conducted along the transmission line was reported by Plaskett (1978). Plaskett (1976) has also conducted survey work in the Nenana River and Teklanika River valleys. The North Alaska Range Project was responsible for additional survey and excavation in the central Alaskan Range (see Hoeffecker 1978, 1979; Powers and Hoeffecker 1979).

Many of the sites discovered from these surveys only produced limited information about site content and extent. Other sites within this region are more fully documented and described below.

Two sites, Teklanika West and Teklanika East, were discovered in 1960 by members of the University of Alaska Geology field camp. Both sites are located in Denali National Park and were excavated by Frederick Hadleigh West in 1961. These sites are situated within a half mile of each other and contain physical settings similar to the Donnelly Ridge site (West 1967). Teklanika West occupies a knob overlooking the Teklanika River and is west-northwest of Teklanika East, which is on a nearby ridge. They produced sufficient cultural material to support the supposition that these were habitation sites (West 1965:5). It appears that they functioned as game lookouts and flaking stations, a point confirmed by Treganza (1964). Teklanika West and Teklanika East contained projectile points (mainly tips), leaf-shaped knives, endscrapers, sidescrapers, tabular blade cores, microblade cores (similar to Campus cores), microblades (prismatic blades), burins, scrapers or endblade tools, one polished adze blade (Teklanika East), and a pebble hammer (Teklanika East).

West interprets this material as coeval with Anangula (ca. 8500 B.C.), or slightly earlier than the Campus site (West 1981:73). He suggests that they date between 8000 and 10,000 B.C. However, microblade sites may extend into the Christian era from A.D. 500 - A.D. 1000 (Cook 1969; Holmes 1976) and the Teklanika sites could be quite recent in age, as suggested by the presence of a polished adze blade.

The Dry Creek site is located 10 miles north of Denali National Park. This site was first reported by Holmes in 1974 (Holmes 1974b). It is a multicomponent site representing exploitation of a shrub tundra environment prior to 9000 B.C. (Powers and Hamilton 1978:72; Powers et al. 1983). The oldest component at Dry Creek (component I) contains a biface and flake tool industry similar to the oldest component at the Moose Creek site (Hoeffecker 1982). Specimens of Ovis (sheep) and Cervus (elk) also occur in this component (Powers et al. 1983:211). A radiocarbon date of ca. 9100 B.C. was obtained from a paleosol stratigraphically above the cultural component (Thorson and Hamilton 1977:153). No microblades or microblade cores characteristic of the Denali complex as defined by West (1981) were associated with this component.

Component II at Dry Creek dates to ca. 8700 B.C. and contains a microblade core and microblade industry which is comparable to the Denali complex of Interior Alaska (West 1967, 1981) and the Akmak level at Onion Portage on the Kobuk River (Anderson 1968a). The similarity of these assemblages with the late Pleistocene Diuktai culture of northeastern Siberia has been noted by Powers and Hamilton (1978:76).

Component II also contains bones of *Bison priscus* (Steppe bison) as well as *Ovis* specimens (Powers et al. 1983:211).

The most recent component at Dry Creek, dating between 2600 and 1400 B.C., documents a notched projectile point horizon in Interior Alaska. The projectile points, endscraper forms, and time of occupation suggest of the Northern Archaic tradition. This and other notched point sites in Interior Alaska support Workman's (1978) hypothesis that Northern Archaic groups spread through the Yukon Territory and northward along the Brooks Range to the Onion Portage site by 4000 B.C. before spreading into southern Interior Alaska.

The Moose Creek site is located in the Nenana River valley on the north side of Moose Creek approximately 3 km east of the Nenana River. It is a multicomponent site with two occupations. The earliest component (I) dates between ca. 9730 and 6160 B.C. based on radiocarbon samples taken from soil organics (Hoeffecker 1982). The age of the later component (II) is unclear due to lack of absolute dates or diagnostic artifact types. Nine hundred ninety-two artifacts have been recovered from the site. Component I contained 983 artifacts while component II yielded only nine artifacts. Most of the artifacts excavated from the site were unretouched flakes, 973 from component I and seven from component II. Three bladelike flakes were found, two and one respectively from components I and II. Six bifaces and biface fragments were found in component I and a single biface was found in component II. No microblade cores or core tablets were found at Moose Creek although one of the bladelike flakes may represent microblade technology (Hoeffecker 1982:11).

Hoffecker indicates that component I at Moose Creek is similar to the early occupation at Dry Creek because of the presence of ovate bifaces and lanceolate projectile points at both sites. He also cites West's (1973) Tangle Lakes assemblage as containing an early premicroblade tradition (Amphitheater Mountain complex) which is similar to the bifacial technology found at Moose Creek.

The Carlo Creek site is located within a narrow constriction in the upper Nenana River valley just east of Denali National Park. The site contains two deeply buried cultural components both representing brief occupations by small groups of prehistoric hunters (Bowers 1980:1). The older of the two components (component I) dates to ca. 8500 B.C. based on radiocarbon analysis. Artifacts recovered from this component include percussion-flaked elongated bifaces, biface fragments, retouched flakes, several thousand waste flakes, and a possible bone awl (Bowers 1980:1). The more recent component (II) consists of 637 rhyolite biface reduction flakes and no diagnostic artifacts. Based on relative stratigraphy and radiocarbon dates, Bowers (1980:vi) estimates the age of component II to be between 5500 and 4000 B.C.

Granulometric analysis of component I sediment "indicates that human occupation occurred on a former sandbar/levee of the Nenana River, during a period of early postglacial downcutting and terrace formation" (Bowers 1980:16). Analysis of component I faunal remains suggests that this site may have been a fall/winter hunting camp. Component I may contain evidence of heat-treatment of lithic material to improve flaking (Bowers 1980:6).

Although component I tools are nondiagnostic and the sample size small, Bowers (1980) compared this material with assemblages from other sites. He suggests that component I at Carlo Creek may have some affinity with component II at the Dry Creek site (ca. 8600 B.C.) (Powers and Hamilton 1978:74), and the Denali Park Teklanika River sites (West 1965) on the basis of similar morphology of bifacial industries (Bowers 1980:14). General similarities were also noted with the "early horizon" at Healy Lake (Cook 1969), various Denali complex sites (West 1965, 1967) and possibly with the Akmak assemblage from Onion Portage (Anderson 1968a; Bowers 1980:14).

The Nenana River Gorge site is located at the northwest boundary of Denali National Park. The prehistoric component at the site represents a seasonal hunting campsite of Athapaskan Indians and has been radiocarbon dated to approximately A.D. 1600 (Plaskett 1977). It is not certain which Athapaskan subgroup occupied the site. Prehistoric archeological material found includes obsidian and pottery thought to have originated north of the Alaska Range and copper and chalcedony from south of the Alaska Range, suggesting that trade and communication among different Athapaskan groups occurred prehistorically.

(d) Copper River Valley

Archeological investigations in the Copper River valley began with Rainey's survey of the region in 1936 (Rainey 1939). Most recently a number of historic and prehistoric sites have been located and excavated (VanStone 1955; Shinkwin 1974, 1975, 1979; Workman 1976; Clark 1974; Arndt 1977). Workman (1976a:8) has synthesized the available data into a four period sequence for the area: historic (A.D. 1850 - present), protohistoric (A.D. 1770 - A.D. 1850), late prehistoric (A.D. 1000 - A.D. 1770), and early prehistoric (pre- A.D. 1000)

The following sites, some of which were previously discussed in this report, can be placed within Workman's (1977a) categories. Historic period: Taral (VanStone 1955), site on Taral Creek (VanStone 1955:121), Susitna sites 3A and 6C (Irving 1957:40), village near Batzulnetas (Rainey 1939:362). Protohistoric period: Dakah de'nin's village (Shinkwin 1974, 1979), VAL 146 (State of Alaska, Division of Parks), feature 77-3-4 at the GUL 077 site (Workman 1976a:26-28), Paxson Lake site (Workman 1976a:14), Gakona Airstrip site (Rainey 1939:350), Slana site (Rainey 1939:361). Late Prehistoric period: GUL 077 (Workman 1976), MS 23-0 (Clark 1974, 1976), Gulkanan River site (Rainey 1939:360), Susitna 3A (Irving 1957:41), Susitna 3B and 3C (Irving 1957:41), Susitna 3D (Irvine 1957:41-42), Susitna 6A (Irving 1957:42), Susitna 6B (Irving 1957:42), caches near Batzulnetas (Rainey 1939:361-362), Tangle Lakes caches (Workman 1976:28), Portage site upper component (Workman 1976:28). Early Prehistoric period: no sites representing this time period have been positively documented in the Copper River valley, although the Copper River basin would have been free of ice-dammed lakes and available for human occupation by ca. 9000 years ago (Workman 1976a:31). Workman (1976a:31) suggests that, when documented, the prehistory of the Copper River basin will probably span most of the Holocene. At present, however, there are only traces of occupations predating A.D. 1000 (Workman 1976:31).

Dakah de'nin's village is located on a bluff overlooking the Copper River just north of Fox Creek. A total of nine housepits and various cache pits were located and mapped. Shinkwin (1979:7) interprets the site as an Ahtna Athapaskan settlement. Shinkwin suggests that the site was a summer fishing settlement and probably a winter settlement as well. Two housepits (2 and 9) were completely excavated. The artifactual inventory from the site is varied and includes items made of copper, glass, stone, bone, iron, shell, and wood.

(e) Denali Highway

In 1958 Skarland and Keim (1958) conducted archeological survey in the Denali Highway area. Zinck and Zinck (1976) conducted additional work in the area around Tangle Lakes. The Tangle Lakes area was also surveyed by West (1981).

The Ratekin site, near the Denali Highway, is located about 75 miles west of Paxson Lake. Although few artifacts have been recovered in situ, several surface collections have been made. Based on the collections made by Skarland and Keim (1958), it is difficult to assess the significance of the site. Notched points suggestive of the Northern Archaic tradition are present. Based on the type of notching and comparison with the notched point sequence developed by Anderson (1968b), an age of ca. 2900 - 2600 B.C. seems a reasonable inference since side-notched, stemmed, and lanceolate point forms are present.

The site appears to consist of a number of flaking stations and Skarland and Keim (1958:80) suggest that it functioned as a kill site rather than a camp because of the large number of unbroken arrowheads which they think were lost during the hunt. They also suggest that caribou were funnelled through a narrow corridor near the site created by muskeg to the south and steep hills to the north. Photographs on file at the University of Alaska Museum show a low rock wall at or near the site which may have functioned as a hunting blind. Age of this structure and its association with the Ratekin site have not been determined.

The Tangle Lakes lie against and among the Amphitheater Mountains on the south side of the Alaska Range. A complex of lakes forms the headwaters of the Delta River. Lying to the west of the Tangle Lakes region, is the drainage of the Maclaren and Susitna rivers. The Tangle Lakes are ca. 80 km northeast of the Susitna River canyon area. Over 220 sites spanning the past 12,000 years have been documented in the Tangle Lakes area (West 1973). The sites represent several periods beginning in the early Holocene and continuing through the late Athapaskan period.

The earliest complex defined by West (1974:221-225) is the Amphitheater Mountain complex. This complex is characterized by crude bifaces and is suggested to be older than 10,000 years. Denali complex sites are located on or near old lake shorelines which are about 100 feet above present lake levels (West 1975:79). The Denali occupation at Tangle Lakes may have occurred as early as 10,000 B.C. but radiocarbon dates suggest a more recent date of 8200 B.C. with the occupation ending about ca. 6200 B.C. Denali hunters appear to have abandoned the area after that time. There is a hiatus in the Tangle Lakes archeological record until the appearance of the Northern Archaic tradition (West 1973). The Northern Archaic tradition was originally defined as a boreal forest adapted culture (Anderson 1968a); however, it may have thrived along the forest edge or even within the tundra forest ecotone (Hickey 1976). Appearance of the Northern Archaic peoples may be associated with a warming trend ca. 5000 years ago (Anderson 1968b) and raised tree line elevation (Hopkins 1967). Evidence exists for continued activity in the Tangle Lakes area up to the historic period (Mobley 1982:81).

The Landmark Gap Trail site is located ca. 15 kilometers north of the Denali Highway. It is situated on a low knoll only a few meters above the surrounding terrain. Environmentally and topographically the site is very similar to other sites found in the Tangle Lakes area recorded by West (1981). Surface artifacts exposed by off-road vehicle traffic as well as undisturbed subsurface artifacts (flakes) were collected from the site. The site was radiocarbon dated to ca. 2300 B.C. (Mobley 1982:81).

Mobley interprets the site as a specialized tool production station which emphasized the production of bifaces. No core and blade technology was found at the site. The morphological similarity between the site assemblage and others from the Tangle Lakes area call into question the validity of West's Amphitheater Mountain complex (Mobley 1982:96-100). Mobley suggests that this site and sites designated as Amphitheater Mountain complex are not pre-Denali in age, but simply reflect tool manufacturing and stone quarrying activities.

(f) Cook Inlet

The Cook Inlet area encompasses lands south of the Alaska Range to the Kenai Peninsula. Early survey work was conducted by Kent, Matthews, and West (1964) on the northeastern part of the Kenai Peninsula, and by Dumond and Mace (1968) on Knik Arm. Steele (1980) conducted an archeological reconnaissance of the Fort Richardson lands but found no prehistoric cultural resources. Bacon, Kari, and Cole (1982) surveyed in the Lower Susitna River valley and the Talkeetna area. Bacon, Kari, Cole, et al. (1982) produced a summary of cultural resources based on survey work in the "Beluga study area". The Natural Gas Pipeline from Anchorage to Beluga was surveyed by Lobdell in 1982 (Lobdell 1983).

Beluga Point is a multicomponent site composed of two localities on the northern shore of Turnagain Arm in Upper Cook Inlet. Beluga Point North contains three components. Component I includes a microblade and core industry associated with the Denali complex. Comparative data from Denali sites in Interior Alaska and the Alaska Peninsula suggest a tentative date between 4500 and 7000 B.C. for this component (Reger 1977). Component II contains stemmed points and points with tapering bases (Reger 1977). An estimated age is 1000 - 2000 B.C. based on typological comparisons (Reger 1977). Components IIIa and IIIb from Beluga Point North are similar to the third period of the Kachemak Bay Sequence as evidenced by ground slate points and stone ringed hearths filled with gravel (Reger 1977). A radiocarbon date for IIIa indicates an age of 790 ± 120 years: A.D. 960, while IIIb is estimated to be 1000 years older (Reger 1977).

Beluga Point South component I includes a few nondiagnostic specimens and dates to 4155 ± 160 years: 2205 B.C. Reger notes similarities between Beluga Point South component II and Norton collections from the Iyatayet site. Similarities include steeply retouched endscrapers, end blades, burinlike scrapers and ground slate points (Reger 1977).

The Long Lake site is located in the central Matansuka River valley in the southern Talkeetna Mountains. Diagnostic artifacts recovered from the site include core tablets, core fragments, blades, bifaces, scrapers, and retouched flakes (Bacon 1975b, 1978c). Bacon (1975b:4) suggests that the site represents a, "displacement of the Denali technology to the southern highlands of southern interior Alaska", a region which "represented a sort of tundra refugium that was pushed southward (but higher in elevation) by invading Taiga forests". He suggests a date of approximately 6600 years ago for the occupation of Long Lake site.

Little is known about the prehistory of Cook Inlet during the late Pleistocene, ca. 10,000 years ago. The Kachemak Bay sequence provides an organized data base which can be applied to this study. The Kachemak Bay tradition first appears in the second millenium B.C. and continues until just before historic contact. Kachemak settlements were usually along rugged coasts with deep water offshore and mountains inland (Reger 1977). Houses were semisubterranean and made of whalebone, stone, or wood. Economic exploitation concentrated on sea resources, although inland resources were also utilized.

Kachemak I is a poorly defined phase (Workman 1977b:35) and absence of reliable dates makes it difficult to place it in a specific time frame. However, relationships with Alaskan Peninsula material and the Takli Beach phase places it in the second millenium B.C. (Workman 1977b:35). Manifestations are known only on Yukon Island and are characterized by a predominance of flaked stone tools, grooved stone weights, and both toggle and dart harpoon heads.

Kachemak II dates from 400 B.C. to as late as A.D. 1200. Typically the assemblage contains large notched stones, grooved stone weights, primarily a flaked stone industry, houses of wood and whalebone, and the possible beginnings of grave goods (Workman 1977b:35).

A transitional phase called Kachemak Sub III (Workman 1977b:35) existed from approximately 400 B.C. to A.D. 0 and flaking was still the primary lithic technology. Stone saws appeared and there was a continuation of elaborate burial practices with the embellishments in later periods. This phase is known from Chugachik Island (SEL 033) and Yukon Island in Kachemak Bay.

Kachemak II began about A.D. 800 (Workman 1977b:35). Considering the climax of the tradition, this phase is characterized by an elaborate burial cult indicating dismemberment of the dead, a predominance of ground slate and a florescence of artists' skills. This phase is found at Cottonwood Creek and the Great Midden on Yukon Island.

The Kachemak sequence terminated in a poorly understood Kachemak IV phase during the second millenium A.D. and what is known comes from the upper level of the Great Midden on Yukon Island and the upper component at Cottonwood Creek (Workman 1977b:33). Some pottery and native copper has been recovered from Yukon Island, while from Cottonwood Creek (KEN 029) came triangular stemless slate endblades, an intricate bone knife handle, a barbed bone point, and evidence of cannibalism (Workman 1977b:33).

The Merrill site, KEN 029, near the Kenai River about 25 miles from the present river channel is on a former meander channel (Reger 1977). The lowest level dates to 2245 ± 115 years: 295 B.C. Reger (1977) notes similarities of adze blades, straight-based lanceolate points, and stemmed points to the Norton component at the Iyatayet site. Applicable to this study is the fact that the site conforms to locational data from other Norton period sites, i.e., riverine (Reger 1977). The riverine adaptation is suggested by evidence from fishing in nearly every Norton period site (Reger 1977).

3.2 - Ethnohistory

(a) Introduction

This chapter section presents the ethnohistoric documentation needed to aid in interpreting the function and patterning of Athapaskan tradition sites on the Middle and Upper Susitna River. Ethnohistory is generally understood to be the fusing of historical documentation, such as accounts of explorers, traders, and missionaries with ethnographic information of the same period to provide a more complete picture of a culture (Townsend 1970b:71), in this case the Western Ahtna. A history of contact between natives and whites during both the Russian and American periods is presented and is followed by an ethnohistoric account of the Western Ahtna. The final subsection summarizes shifting patterns of land use and settlement documented for the area during the century or more of transition between traditional and westernized ways of life, and brings these data to bear on the project area.

At the time of white contact, the Middle and Upper Susitna Basin was inhabited by the Western Ahtna, a subgroup of the 11 Athapaskan-speaking groups in Alaska. The Upper, Lower, and Central Ahtna were known to reside to the east along the Copper River and its tributaries. The northwestern portion of Ahtna territory is recognized as somewhat ethnographically ambiguous because this region was considered a hunting territory not only for the Ahtna, but also the neighboring Tanaina and Lower Tanana (de Laguna and McClellan 1981:641). A few Ahtna still resided on Valdez Creek, a tributary of the Upper Susitna River, until 1935, and one village located on Tyone Lake was occupied until at least the 1950's. Currently no Athapaskans inhabit the area.

Archeological work in Athna territority has been instrumental in providing a strong link between the ethnographically known Ahtna and prehistoric people inhabiting the area for at least 1000 years. Using the direct historic approach, which combines data on archeology, ethnography, history, and linguistics (Steward 1942:337), Workman (1977a) presents a strong case for extending into the past an Athna ethnic identity to protohistoric and prehistoric sites in the Copper River area. Through this approach, aspects of material culture preserved in the archeological record can be associated with similar artifacts and features documented ethnographically. By inference, it may be reasonable to assume a similar time depth for Ahtna occupation along the Middle and Upper Susitna River, but this has yet to be verified.

(b) Historic Contact

(i) Russian Period

The Ahtna and Tanaina were indirectly affected by Russian fur trading ventures for decades before direct contact with nonnatives was made. The influx of Russian trappers and traders began shortly after 1741 when Vitus Bering and his lieutenant, Alexi Chirikov, made the first known European landfalls in Alaska (Dumond 1977:16; Fall 1981:55). The traders and trappers traveled eastward along Alaska's southern coast from the Aleutians to the Alaska Peninsula in search of sea otter pelts. Russian items carried by intertribal trade networks, such as blue glass beads and iron knives, preceded the traders themselves as Captain James Cook made note of these goods in 1778 when first encountering inhabitants of the inlet (Cook Inlet) which was to later bear his name (Cook 1897:444; Fall 1981:59). Although Cook believed the natives to be Chugach Eskimo, it is more likely that they were actually Tanaina who had adopted much of the culture of their Eskimo neighbors (Bancroft 1886:207; de Laguna 1934:14-15).

Direct trade between the Russians and the Tanaina commenced a few years later in 1784, when Gregory Shelikov founded a permanent settlement at Three Saints Bay on Kodiak Island and soon tried to subjugate the Kenai Peninsula Tanaina. By 1786, Shelikov established the Alekandrovsky fort at English Bay on the Kenai Peninsula. It was probably the first post on the Alaskan mainland. The next year, the rival Lebedev-Lastochkin Company had set up a post, Georgievsk (Fort St. George) further up the inlet. By the time that the English Captain George Vancouver visited the area in 1794, several Russian posts, including one on the western side of Cook Inlet at Tyonek, had been established (Bancroft 1886:205, 338; Fall 1981:57-69; Simeone 1982:39-40).

The late 1780's and 1790's were marked by bitter hostilities between the Tanaina and the two rival Russian companies operating in Cook Inlet. By 1799, the rivalry ended when the Russian American Company, the successor to Shelikov's company, was granted a monopoly over trade in Russian North America by the tsar (Bancroft 1886:379ff). These two decades marked a shift in the economic and settlement systems of the Tanaina. As they began to be drawn more intensively into the fur trade as hunters and as middlemen between the Russians (and also the English) and peoples in Interior Alaska, modification of their traditional subsistence and residence patterns to accomodate such hunting and travel became necessary (Townsend 1970b). It has also been reported that numerous Tanaina villages were abandoned when the people moved inland to escape the Russians who forced them to work and robbed them of their furs (Simeone 1982:39).

As early as 1802, trade between the Kenai Peninsula Tanaina and the Copper River Ahtna was documented by Gavriil Davydov (1977), an employee of the Russian American Company who wintered on Kodiak Island in 1802-1803. As Davydov relates the story, the upper inlet Tanaina (referred to as Kinai) would travel up the Susitna (Sushitna) River in June to trap marmots and beaver....

> After a twelve-day journey they catch sight of the Sushitna bending to the right amongst the mountains. Where it flows out of the mountains they catch marmots. After 14 or 15 days' journeying they usually reach the mountains. Here the Kinai meet up with the inhabitants of the Copper River who have made the journey for the same reason. They trade with them and barter copper, iron wedges (which they use instead of axes), prepared elk skins and some other goods. It is well known that copper can be found in a raw state in the interior of America, but the iron wedges naturally have been passed from hand to hand and originated either in the United States or from Hudson's Bay. Assuming that the Kinai cover twenty-five versts every day, the distance from Kinai Bay (Cook Inlet) to this mountain range must be 375 versts (Daydov 1977:199).

By converting versts to miles (1 verst = .6629 miles), it can be estimated that the Tanainas journey covered approximately 250 miles and took them into the northern part of the Talkeetna Mountains. Certainly, the Ahtna of the Middle Susitna River basin must have been involved in trade which occurred so close to their own territory.

Another scene of trading activities was Prince William Sound. In this area, the role of middlemen between Russian and English traders and the Copper River Ahtna was assumed by the Chugach Eskimos. De Laguna (1934:118) documents that intertribal trade predated European contact as copper knives and blades, undoubtedly from the Copper River area, were found in prehistoric sites in Prince William Sound. Therefore, by the time that the Russian trading post was established at Nuchek in 1793 (Dall 1870:318), the native trade networks had been well established.

An inauspicious beginning to direct contact between Ahtna and Russian traders occurred in 1794, the year that Samoilov of the Lebedev - Lastochkin Company began inland exploration from Cook Inlet up the Matanuska River to Tazlina Lake (in Western Ahtna territory). Provocation of the natives presumably led to the torture and killing of Samoilov's entire party (Ketz 1983:9-10). Three other attempts to explore the Copper River country, one by Potochkin in 1798 and two by Bazhenov in 1803 and 1805, also met with failure (Davydov 1977:200; Ketz 1983:13-14). The first successful exploration of the Copper River was made in 1819 by Klimovskii of the Russian American Company (Dall 1870:331). The Klimovskii party visited the village of Taral and possibly the mouth of the Gulkana River. A trading outpost was supposedly built above the mouth of the Chitina River and was maintained for a number of years, though little is known of its operations (VanStone 1955:115). It is not certain that Klimovskii actually established this post, known as the Mednovskai Odinochka (Copper Fort), but apparently it was in existence by at least 1822 (Ketz 1983:25).

The name for the outpost, or odinochka, near Taral came from the Russian name, Mednovtsi, for the Copper River natives (VanStone 1955:115). The earliest historic accounts of these people were recorded prior to 1839, as by this date an ethnographic description of the "Mednovskiy" appears in a publication by Wrangell, chief manager of the Russian American Company (Wrangell 1970, translated by VanStone). Wrangell's information is based in part on Klimovskii's 1819 visit to Taral (de Laguna and McClellan 1981:651). Firsthand accounts of the Western Ahtna during the Russian period were limited to the records of Grigoriev, a Russian American Company agent who was well received on his reconnaissance to Tazlina Lake in 1843, and Serebrenikov, who repeated the investigation of Tazlina River and Lake in 1848 but was murdered by natives on his return voyage to Nuchek (Sherwood 1965:107; VanStone 1955:115-116).

Exploration of the Susitna River was not attempted until the summer of 1834 when Peter Malakov, also in the employ of the Russian American Company, dragged his "clumsy boat" up the river (Brooks 1911:24). His final destination on the Susitna River is not known. Brooks (1911:25) suggests that his journey did not take him above the mouth of the Indian River as the Susitna River is unnavigable above this point. Evidently the course of the Susitna River was still not well charted by western explorers in 1839 when a map of the southern coast of Alaska and adjacent inland areas was published by Wrangell (Figure 3.1). This map shows a trail crossing the Susitna River to two lakes. The native names of these lakes (Deadman and Butte lakes on U.S.G.S. maps) have been reversed, indicating the secondary nature of the map (J. Kari, personal communication). A Russian map of 1845, according to Brooks (1973:235), correctly delineates the course of the Susitna, Talkeetna, and Matanuska rivers. However, since Brooks did not provide a citation for this

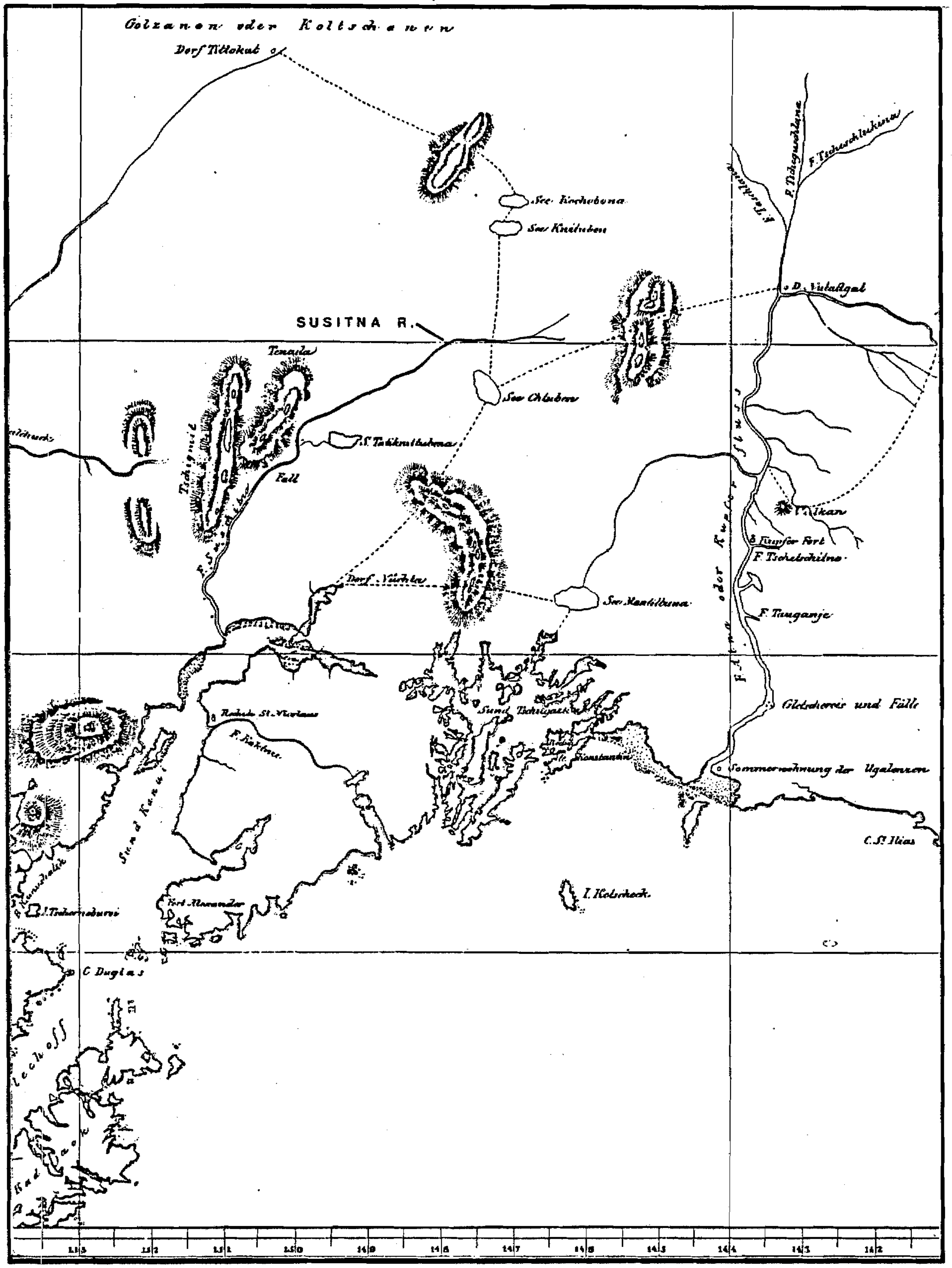


Figure 3.1. Wrangell's 1839 map showing the course of the Susitna River (after Wrangell 1839)

map and no copies of it have been located, we lack concrete evidence that the Russians actually explored the middle and upper reaches of the Susitna River.

Little historic documentation is available concerning the interactions between the Ahtna and the Russians during the waning decades of Russian control in Alaska. On the Copper River, trade came to an abrupt halt after the murder of Serebrenikov in 1848. The disastrous smallpox epidemic of 1836-40, which caused a great decline in the Tanaina population (Fall 1981:76), may have had the effect of drawing the Ahtna more directly into the Cook Inlet fur trade, rather than depending so heavily upon the Tanaina middlemen. Many Ahtna also died during this epidemic (Simeone 1982:53), although no precise estimates are available. Presumably, the Western Ahtna had established some trade relations with the Russians at Knik, an outpost on the Knik River, before the American period began in 1867.

(ii) American Period

The sale of Alaska to the United States in 1867 brought little immediate change to Ahtna traders. The Lower Ahtna continued to trade at Nuchek, and the Western Ahtna at the Knik outpost, which had been taken over by the newly formed Alaska Commerical Company (Fall 1981:85, 392; Reckord 1983b:55). Records of the Alaska Commercial Company indicate that trading expeditions up the Susitna River in search of furs often took place (Fall 1981:85). One such expedition was led by George Holt from Tyonek in November of 1881, but no further information about this journey was recorded (Alaska Commerical Company 1868-1911:B151/F1556). Holt also ventured up the Copper River as far as Taral in 1882 to check the possibility of establishing an inland post. He brought back such discouraging reports about the natives that the plans were dropped (Shinkwin 1979:31).

Increasing contact between the Copper River Ahtna and Americans began in 1884 with the voyage of a prospector, John Bremner, up the Copper River to Taral, where he spent the winter. Bremner's journal is valuable for recording some information about the seasonal movements and village life of the natives (VanStone 1955:118). A much more notable voyage was begun the following year by Lt. Henry Allen for the U.S. Cavalry (Allen 1887, 1900). Lt. Allen and his small party departed from Nuchek in the spring of 1885 and traveled up the Copper River to Taral. From here they continued upriver and passed over the Mentasta Mountains to the Tanana River which was also explored. Allen's narrative includes many references to the Ahtna and their villages encountered while on the Copper River, as well as an ethnographic description of the "Atnatana" (Copper River people) dwelling in the region.

In the years following Allen's extensive explorations in Alaska, three other expeditions would pass through Ahtna territory. The records kept during these journeys provide a glimpse of native life soon to be dramatically changed by prospectors lured into the country by the promise of gold. In 1891, Frederick Schwatka and C.W. Hayes of the U.S. Geological Survey crossed the treacherous Skolai Pass between the White and Chitina rivers and eventually reached Taral. Here they met Allen's Ahtna acquaintance, Nikolai, who accompanied them downriver to the coast (Sherwood 1965:143). The two other expeditions were sponsored by the army and both began in 1898 (Glenn and Abercrombie 1899). One was commanded by W.R. Abercrombie, charged with exploration from Valdez to the Copper River and tributaries of the Tanana. The other was led by Edwin F. Glenn and focused on Cook Inlet and the Lower Susitna and Matanuska rivers region, occupied in part by the Western Ahtna. Glenn and his lieutenants, H.G. Learnard and J.C. Castner, noted villages and recorded ethnographic vignettes of the Ahtna they encountered on their journeys (Glenn and Abercrombie 1899).

Reports of the Ahtna were to appear not only in explorers' journals, but also in the writings of early scientists. Dall (1877) briefly describes the "Ahtena" who were known to him principally by report, although he does make reference to a brief encounter with them in 1874. In addition, a population census of the Ahtna was presented by Petroff (1900) as part of his report on the population and resources of Alaska included in the Tenth Census of the United States. Petroff estimates the population of Cook Inlet and Copper River villages, all totaling not more than 450 individuals, but makes no mention of the Western Ahtna (Petroff 1900:89).

The gold rush era at the turn of the century brought a wave of prospectors into the Copper River valley, and marked the beginning of intensive American settlement in this region (Reckord 1983b:58-59). Prospectors had reached the upper portion of the Susitna River by 1897, and in 1903 gold was discovered in Valdez Creek (Moffit 1912:53). U.S. Geological Survey geologists followed close behind the prospectors. One of these geologists, Fred Moffit, sketched a map (Figure 3.2) of the entire length of the Susitna that included Ahtna trails and houses in one of his unpublished field notebooks in 1904 (Moffit 1904). Moffit received his information from "two men" (prospectors?) who had journeyed extensively on the frozen Susitna with a dog team the preceding winter (Moffit 1904). In later years, Moffit also briefly describes the small Ahtna population living in the vicinity of Valdez Creek (Moffit 1912:18). Another geologist, Theodore Chapin, mentions that Indian hunting and fishing camps and cabins existed along the Susitna River and around Tazlina Lake (Chapin 1918:20). The influenza epidemic of 1918 severely reduced the native population, and with the closing of the Valdez Creek mines in 1935, the remaining Ahtna relocated in Cantwell (de Laguna and McClellan 1981:643).

Ethnographers, linguists, and archeologists have contributed greatly to our knowledge of the Ahtna since the 1930's. An early ethnographic work describing the position of the Ahtna in relation to other northern Athapaskans was written by Osgood (1936). The culmination of ethnographic work dealing specifically with the Ahtna was prepared by de Laguna and McClellan (1981) for publication in the Subarctic volume of the Handbook of North American Indians. Linguistic research conducted by Kari (1977b) has provided evidence for linguistic diffusion and intermarriage between the Ahtna and Tanaina during historic times at the interface between the Lower and Middle Susitna River valleys. Kari's linguistic transcriptions (Kari 1983; Kari and Buck 1975; Pete 1975, 1980) have also been significant contributions to our knowledge,

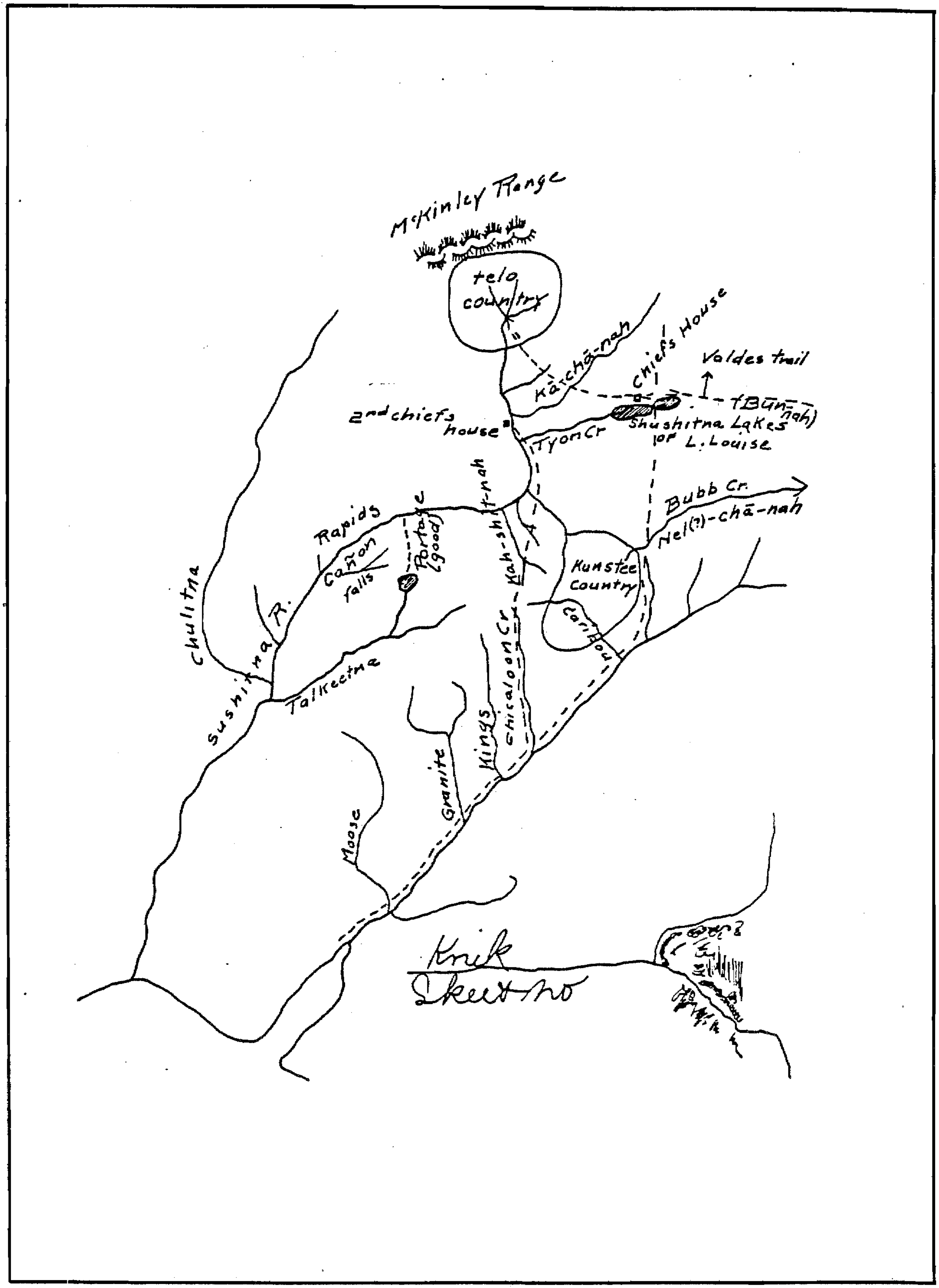


Figure 3.2. Moffit's 1904 sketch map of the Susitna River (after Moffit 1904)

particularly of the Western Ahtna. The task of extending an Ahtna ethnic identity back into protohistoric and prehistoric times has been undertaken by several archeologists, notably VanStone (1955), Irving (1953), Skarland (1953), Workman (1977a), and Shinkwin (1979).

(c) The Western Ahtna

Knowledge of the Ahtna is a composite picture based on observations of traders, explorers, and anthropologists over the span of a century and a half. This view of Ahtna culture during the 19th and 20th centuries cannot necessarily be projected very far back in time because many aspects of their technology, subsistence, settlement patterns, and political systems have changed since Euro-American contact (de Laguna and McClellan 1981:644). Most of the early records pertain specifically to the Copper River people, e.g., Wrangell (1970), Allen (1887), and passages in Abercrombie and Glenn (1899), although Lts. Learnard and Castner of the Glenn expedition do provide firsthand accounts of Western Ahtna life (Castner 1899; Learnard 1899). The following ethnographic summary pertains specifically to the Western Ahtna, but also includes data from the adjacent area (Copper River valley) in order to fill in the gaps of our knowledge of the Western Ahtna.

(i) Distribution

Ahtna is a relatively homogenous Athapaskan language comprised of four dialects (Kari and Buck 1975; Kari 1977b). Speakers of the Western Ahtna dialect are called Wca·y Wte·ne, or "jack-spruce people" (Kari and Buck 1975:57; de Laguna and McClellan 1981:662). The distribution of the Western Ahtna, depicted in Figure 3.3, is described by Kari as being

> primarily centered in the tundra country between Tazlina Lake in the Copper River drainage and Tyone Lake in the Upper Susitna River drainage. More recently, probably in historic times, the Ahtna expanded their territory northward to the Upper Susitna River...and westward down the Susitna River and into the drainage of the Talkeetna River (1977b:277).

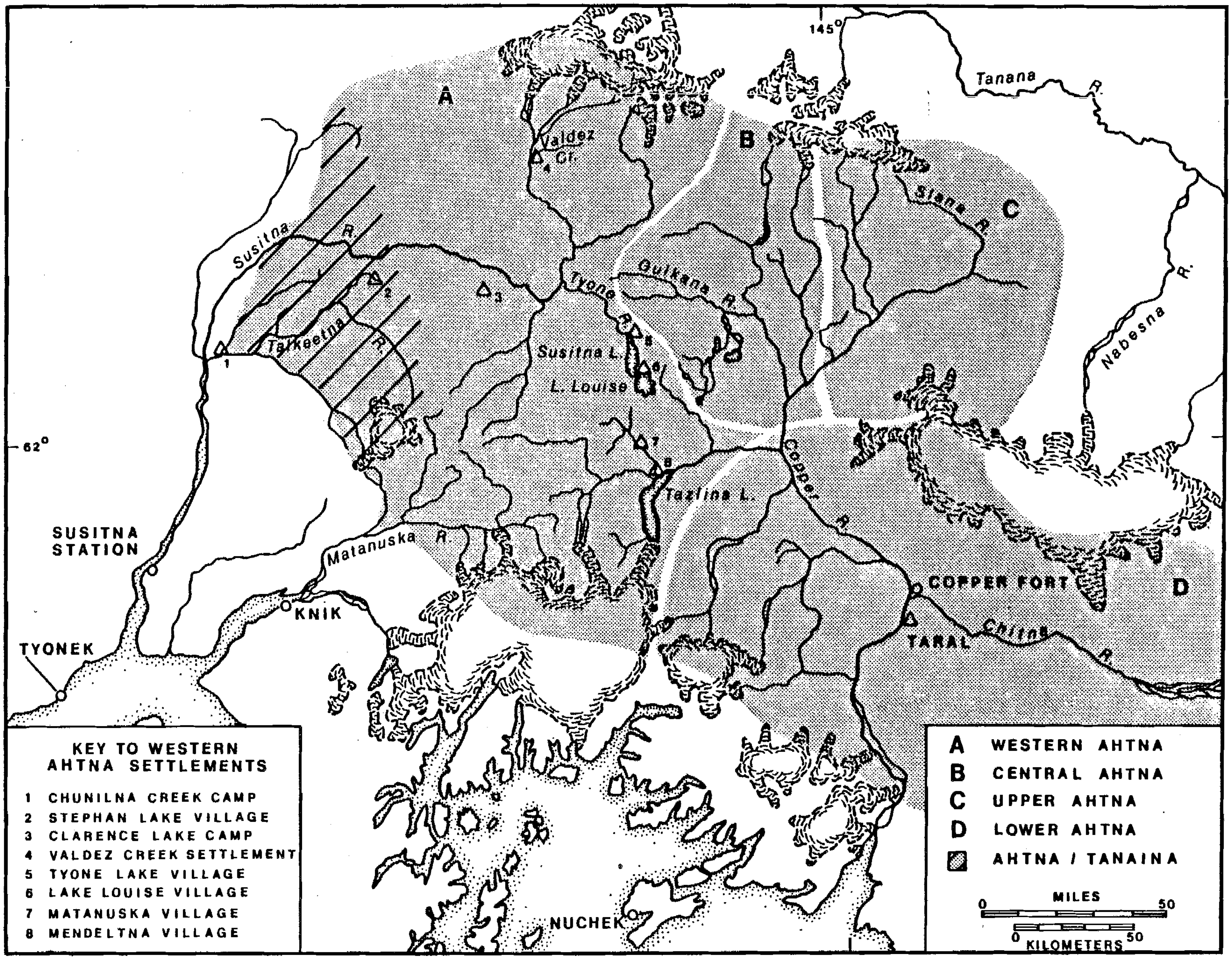


Figure 3.3. Distribution of Ahtna Dialects and Location of Western Ahtna Settlements During the 19th and Early 20th Centuries (based primarily on de Laguna and McClellan 1981)

Although the Russians recognized that two groups, the Lower and Upper Ahtna, resided on the Copper River, it was not until the end of the 19th century that Lt. Castner of the Glenn expedition differentiated the Western Ahtna from the Ahtna residing on the Copper River. Castner referred to them as the "Matanuskas" and described them as the "wildest, bravest, and least known of the Alaskan Indians" (Castner 1899:254).

One of the first archeologists to visit the Susitna River, William Irving, also remarked on the distinction between the Western Ahtna and the Copper River people. He states that

> a certain provincial feeling tends to segregate the more western members from those living on the large streams of the Copper River drainage. Very likely this is accentuated, in the case of the Lake Louise-Tyone River people, by their marginal position and somewhat different ecological situation. The importance of caribou and complete absence of salmon are the most notable causes of the difference (1953:5).

(ii) The Mountain People

Linguistically, the Western Ahtna dialect shares a number of traits with Upper Inlet Tanaina, reflecting the long-standing trade relationships between these two people (Kari 1977b). Linguistic research has shown that an Ahtna band with considerable Tanaina membership lived in the vicinity of Talkeetna at the turn of the century. These people, referred to as the Mountain People, have been described by Kari as:

> an Ahtna band that had no permanent village who migrated into the Talkeetna River drainage from the Upper Susitna River perhaps 150 years ago. This account is confirmed by Ahtnas and Tanainas who remember the personal names of the principal figures of the Mountain People. The Tanainas descended from this group say that their ancestors used to fish on the Talkeetna River at Chunilna Creek (near the town of Talkeetna), as far up the Talkeetna River as Stephan Lake, and on the Susitna River in the vicinity of Sunshine and Montana Creeks, and they hunted caribou in the mountain country along the Lower Talkeetna River and on Chulitna River at least as far north as Indian Creek (1977b:278).

The extent of their territory appears as cross-hatching on Figure 3.3.

A rare glimpse of the last of the Mountain People has been recorded as an oral history by James Kari of the Alaska Native Language Center. His Upper Inlet Tanaina informant, Shem Pete, relates the story of an Ahtna woman, Ch'anqet', of the Mountain People band, as a young girl up until her old age and death (Pete 1980). As the story goes, in young girlhood, probably in the early 1800's, Ch'anqet' hunted caribou at the lakes at the head of the Talkeetna River (Stephan Lake). Much later in life when she had become an old woman, the narrative tells of her annual subsistence cycle of fishing (with a fish fence) in Chunilna Creek and hunting caribou in the Talkeetna Mountains. It appears that caribou hunting took place in spring. With the help of her dogs packing the wind-dried caribou meat down the mountains, she would return to Chunilna Creek in the summer to trap salmon and smoke their meat for winter rations.

The importance of trading in the lives of the Mountain People is also recounted in the narrative. In the winter of 1902 or 1903, Ch'anqet' started on a journey with her children to Susitna Station for much-needed supplies, but had to be temporarily abandoned because of her age (nearly 100) and infirmity. Later rescued, Ch'anqet' and her sons spent the winter "out in the country". As Pete tells the story:

> Wherever they killed something was their village. The Mountain People was their name. They didn't stay in one place. Wherever they killed game they camped and when they ate up the whole moose again, at another place, wherever they killed something, they would go to camp (Pete 1980).

The narrative ends with Ch'anqet' being taken to Tyonek where she is finally baptized and dies. In the epilogue, the narrator states that Ch'anqet' and her six sons were the last of the Mountain People. The sons all died in Talkeetna in the flu epidemic of 1918.

(iii) Subsistence

The literature on Ahtna subsistence often presents conflicting information about the importance of fish versus big game in the diet.

For example, Wrangell (1970) maintained that spring and fall caribou hunts supplied the primary source of food, whereas Allen (1887:129) considered fish, and then rabbits, to be the most important dietary staples. Actually, both fishing and hunting figured significantly in subsistence activities, with the relative importance of each depending upon access to salmon streams and to big game, such as moose, caribou, and sheep. In general, the Copper River Ahtna were known to harvest large runs of salmon during the late spring and summer, while the Western Ahtna were more dependent on the hunting of big game, particularly caribou.

The dichotomy between the Copper River people and the more westerly group of Ahtna is not always a valid one, however, as even within the Western Ahtna territory, the availability of resources varied. As discussed above, Western Ahtna who aligned themselves with the Tanaina in the Talkeetna vicinity had access to salmon on the tributaries of the Talkeetna River, and as far north as Stephan Lake. Also, to the south of the Susitna River at Tazlina Lake, the people could harvest runs of salmon which had migrated to the lake via the Copper and Tazlina rivers. This activity is documented by Lt. Castner who observed the "Matanuskas" spearing humpback (chum?) salmon in the outlet stream of "Upper Lake Plaveznie" (Old Man Lake?) on August 5 in 1898 (Castner 1899:255). Although the Lake Louise-Tyone River Ahtna lacked access to salmon, they did fish for white fish, lake trout, and grayling (Irving 1953:2).

The annual cycle of the Western Ahtna living in the Lake Louise and Tyone River area was patterned by the distribution of seasonally available food resources. Ethnographic information about this cycle was obtained by William Irving from his Ahtna informant, Jimmy Second Chief, the source for the following discription:

> The annual cycle, as nearly as could be learned was divided into two major phases, distinguished on the basis of the feasibility of fishing. From mid-summer until January the principal activity was fishing, and the people lived in communities near places suitable for using V-and-basket traps. Caribou and moose were killed from time to time through most of the year, and were given particular attention in the late summer and fall when the bulls were fat and

> caribou skins most suitable for clothing. Fish, however, was the principal food item.....
>
> In the middle of the winter shallow places in the lake froze to the bottom so that fishing was no longer possible, or at any rate profitable, and usually stores of meat from the autumn hunt were exhausted. It was then necessary for the people to spread out and hunt moose, bear, and beaver. Whether the communities actually broke up or whether groups of hunters went off by themselves is not known, but it seems likely that the former was the rule. Moose and caribou fences, in conjunction with snares and the surround, were employed. This continued until break-up, after which the hunters would go to the hill country, often as far as the Talkeetna Mountains, to hunt caribou until midsummer when they returned for the fishing. Travel was generally on foot, infrequently by canoe (Irving 1953:4).

Another Western Ahtna informant, John Nicklie of Cantwell, stated that in addition to caribou, moose and sheep were hunted in the summer near the glaciers at the headwaters of the Susitna River (Skarland 1953:2). Other edible resources were grizzly and black bears, lynx, muskrats, beavers, rabbits, porcupines, and ground squirrels; birds, such as ducks, geese, grouse, and ptarmigan; and plants, such as blueberries, cranberries, edible roots, and herbs. Even during periods of starvation, the wolf, dog, and mink were not eaten (Castner 1899:254-255; Learnard 1899:159; Irving 1953:2-3; de Laguna and McClellen 1981:648).

Periods of starvation are known to have occurred when the caribou were not as plentiful as expected, and in the spring before the first salmon runs. According to Wrangell (1970:7), failure of the caribou herds caused 100 people to die of starvation in 1828. A lean period was observed by Allen (1887:68), when he visited the village of Batzulnetas in Upper Ahtna territory on June 3, 1885 before the first salmon appeared in the river. The Ahtna were acutely aware of the population cycles of animals, and were most severely affected when several species entered low population cycles at the same time (Reckord 1983b:36).

When fish or game was plentiful, it was air-dried and stored for later use. If large game was to be immediately consumed, the men would either stone-boil it in a spruce-bark basket or roast it on a spit within the stomach of a moose or caribou. Grease was also rendered from moose, caribou, and fish. Special rituals, observed when disposing of the bones of game animals and furbearers, involved burning the bones, which were never given to dogs (de Laguna and McClellan 1981:648-9).

Linguistic and ethnographic research among the Ahtna has been instrumental in identifying particular places, i.e., creeks, lakes, sites, where fish or game was taken or stored. Included in a list of Ahtna place names compiled by Kari and Buck (1983) is a section on the Susitna River. When translated, the Ahtna names for several places in the area can be identified as important in the subsistence cycle. Table 3.1 presents a list of these place names with their translated Ahtna equivalents.

(iv) Settlement Patterns

The Ahtna were a transhumant people whose settlements were either permanent winter villages or temporary hunting and fishing camps. These camps, according to Allen (1887:130) were "extemporized at any place where game may be found", or regularly occupied on a seasonal basis (de Laguna and McClellan 1981:644). Each Ahtna band had claim to a bounded territory which, in the Copper River area, was focused along the main river channel or its tributaries and extended into higher elevation terrain. The pattern varied in the Western Ahtna region, where "fishcamps, permanent winter villages, and hunting camps were situated within a very small area and represented the nucleus of a larger hunting territory" (Reckord 1983b:81). Local routes of caribou migration were included within the territory, the nucleus of which was often situated along a lakeshore.

Nineteenth and early twentieth century settlements in the Western Ahtna region can be attributed to two different bands. A band refers to the followers of a particular regional chief (de Laguna and McClellan 1981:644). The villages in the Tyone-Mendeltna band territory included two north of Tazlina Lake (one at the mouth of the Mendeltna River and the other further upriver, referred to as the "Matanuska village"), and two near the headwaters of the Tyone River, on Lake Louise and Tyone

Table 3.1. Place Names in the Susitna River Vicinity Associated with the Ahtna Subsistence Quest (after Kari and Buck 1983)

Place Name	Ahtna Equivalent
Valdez Creek	Abundant-game creek (C'ilaan Na')
Roosevelt Creek	Lake-trout-run creek (Bedlaex Na')
Lake south of creek entering Susitna below west fork	Salt lick lake (C'edenaa' Bene')
Hill west of the above lake	Sitting-for-game hill (C'edaay Tese')
Snodgrass Lake	Lake that we made (refers to place as a caribou hunting lake) (Ben'sdełtsiini Na')
Lake Creek (near Susitna Lodge)	Trout water lake (Tsabaey Tu' Na")
Lake west of Lake Creek	Dipnet hole (Ciisi K'ae Na')
Swampbuggy Lake	Caribou-migrate-through lake (Xanc'eltl'aes Bene')

Table 3.1. (Continued)

Place Name	Ahtna Equivalent
Tyone Creek	Trout creek (Tsegeli Na')
Lake east of Tyone River	Salmonberry lake (Nkaał Bene')
Two miles south of Tyone Lake village	Where animal trail crosses (Nac'iltenden)
Lake north of Susitna Lake	Beaver lodge (Tsa' Kaen')
Outlet of Little Lake Louise	We-gather-birch-sap creek (Skosi' Na')
Goose Creek*	Celery exists creek (Gguus Kulaen Na')
Jay Creek*	Food-is-stored-again creek (Nac'elcuut Na')
Watana Creek*	Sheep head river (Debetse' Na')
Outlet to Big Lake	Where-things-(meat)-are-brought down creek (Cetakolyaes Na')

Table 3.1. (Continued)

Place Name	Ahtna Equivalent
Mt. Watana	Sheep head (Debetse')
Talkeetna River	Food-is-stored river (I'delcuut Na')
Prairie Creek	Game-trail-goes-out creek (Titi'niłtaan Na')
Stephan Lake	Game-trail-goes-out lake (Titi'niłtaan Bene')

* Place names within the cultural resources study area

Lake (de Laguna and McClellan 1981:642). Another village (or camp) located on Clarence Lake (see Appendix D - TLM 100) may also possibly be attributable to this band. Two other settlements located in the vicinity of the Talkeetna River (one on Chunilna Creek and another at Stephan Lake) have been designated as belonging to Ahtna-Tanainas (Townsend 1981:625), and fall within the territory attributable to the Mountain People band. Valdez Creek was another area that attracted Ahtna settlement during the early decades of the twentieth century when mining activities were in operation. All of the settlements mentioned are plotted on Figure 3.3 and are discussed below.

The area surrounding the mouth of Mendeltna River was a focus of Western Ahtna village life, as this was one of the few places in their region with immediate access to salmon. Although only one village is plotted at this locale on Figure 3.3, at least three settlements existed in the close vicinity (Reckord 1983b:152-156). One of the settlements was first visited by Serebrenikov, the ill-fated Russian explorer who explored the area in 1848 and witnessed Ahtna spearing caribou in Tazlina Lake (Reckord 1983b:154). Two Indian families were reported to live at this settlement (Allen 1887:21; Orth 1967:952). The two villages at this locale were both decimated by disease early in the twentieth century (Reckord 1983b:155-156).

The "Matanuska Village", located near Old Man Lake, was visited by Lt. Castner on August 5, 1898. The people were fishing for salmon and preparing for an upcoming caribou hunt (Castner 1899:212). He estimated the population of this group to be 70 people (Castner 1899:254), while Abercrombie (1899:327-328) gave an estimated of 150 for all the "Taxlena Indians". The territory covered by the "Matanuskas" was quite extensive, bounded on the west by the Susitna River valley, on the north by the Tanana River, on the east by the Copper River, and on the south by the Chugach Mountains (Castner 1899:255). It is assumed that he referred to the valley of the Lower Susitna River, which would indicate that the Middle and Upper Susitna River valley was included in the territory of these people.

The villages on Lake Louise and Tyone Lake were first documented by Irving (1953) during an archeological reconnaissance of the area. His informant, Jimmy Second Chief, did not remember the occupants of the Lake Louise village, some buildings of which were still standing. The village site appeared to be occupied in prehistoric times up until sometime during the early contact period. The Tyone Lake village was still occupied by Second Chief and Johnny Tyone in 1953, and was described as "the traditional focal point of the now widely dispersed group which they (Second Chief and Tyone) represent" (1953:11).

One other settlement which may have been associated with the Tyone-Mendoltna band is located at Clarence Lake, south of the Susitna River between Kosina Creek and the Oshetna River. According to "local old-timers", caribou were killed while crossing the lake by the Tyone Ahtna (Dessauer and Harvey 1980:44). The use of this area has been confirmed archeologically by University of Alaska Museum personnel, who recorded and mapped 13 cultural depressions at TLM 100 on the outlet to Clarence Lake (see Appendix D - TLM 100).

Two settlements fall within the territory of the Mountain People Band. One of these is a camp on Chunilna Creek, close to its confluence with the Talkeetna River, encountered by Lt. Learnard on July 27, 1898. He referred to the camp as the "Midnooski" village of 3 men, 7 women, and 20 children (Learnard 1899:144, map). Kari (1977b:277) suggests that these people were hunting caribou at the time of Learnard's visit to their camp, but actually no mention of this is made by Learnard. It seems more likely that, as it was summer, they would have been involved in salmon fishing on the creek. The only other settlement in the Talkeetna River vicinity is Stephan Lake village (Townsend 1981:625).

With the discovery of gold in 1903, Valdez Creek was also to become the vicinity of a permanent settlement for the Ahtna. The residence of one Ahtna family on Valdez Creek was reported by Moffit in 1912 (1912:18), and by 1915, several native families lived permanently near the south bank of the creek (Reckord 1983b:175). Although Valdez Creek had traditionally been an area used seasonally by the Western Ahtna for hunting caribou and moose, for fishing, and for taking water-fowl (Reckord 1983b:171), the influx of miners who were willing to trade tea, sugar, flour, and other western goods attracted Ahtna from Gulkana and Copper Center as well (Dessauer and Harvey 1980:27, citing personal communication with Laurence Coffield). Ahtna were involved in mining, but continued to spend time in trapping and subsistence pursuits.

Several seasonally occupied hunting and fishing camps in Western Ahtna territory have been documented in the oral histories and interviews by Reckord (1983b). In the Upper Susitna and Tyone rivers area, some of the sites she recorded also appear in Table 3.1 as place names associated with the Ahtna subsistence quest. Valdez Creek ("abundant-game creek") is one of the locales formerly occupied by generations of Ahtna on a seasonal basis for hunting and fishing (Reckord 1983b:171). Reckord's informants spoke of Swampbuggy Lake ("caribou-migrate-through lake") as another long-used site where fishing for whitefish occurred in the summer, and where beavers were trapped and caribou hunted. Here the people would dry the whitefish and store them in above-ground caches for later use (Reckord 1983b:177). Caribou were also taken at Snodgrass Lake ("lake that we made", referring to the lake as a place to hunt caribou) by means of a long caribou fence that funneled the herd for miles across the tundra and opened onto the lake, where they were eventually speared (Reckord 1983b:179). Finally, Tyone Lookout or Tyone Fort, probably visited by Irving (1953) during archeological survey in the Tyone Lake vicinity, is reported to have been used as a caribou lookout in precontact times (Reckord 1983:180b).

Archeological survey has yet to confirm the presence of several of the sites documented by Reckord (1983b). One such site is the "Tyone River village", which has long been cited in the literature as lying at the mouth of the Tyone River and credited as being the "largest inland Athapaskan village prior to A.D. 1500" (Dessauer and Harvey 1980:12). Reference to the site first appeared in a publication by Moffit (1912), who recounted the travels of Peter Monahan and party in 1903. Moffit (1912:15) stated that "their first base camp was near the 'stick houses' at the mouth of Tyone Creek, from which they began their search for gold by prospecting the streams tributary to Susitna River below Tyone Creek". The context in which "Tyone Creek" is used seems to indicate that Moffit was actually referring to the Tyone River. The next recorded reconnaissance of this area was undertaken by the geologist Theodore Chapin in 1914. In his unpublished field notes, Chapin makes no mention of a site located at the mouth of Tyone River, although in his September 3rd entry he states, "three or four miles up the Tyone is an old Indian camp and on the Susitna a mile below the mouth of Tyone are cabins and caches of white" (Chapin 1914:70). Cross-checking the many references to "Tyone" in this field book indicates that he referred to both the Tyone River and Creek by the name of the latter. On September 3rd, he was actually surveying the Tyone River.

The mouth of the Tyone River was first field checked for the site by Ivar Skarland (1953), who was unsuccessful in his search and states, "the reference was erroneous and perhaps pertained to the Tyone River-Tyone Creek junction where an ancient village is located" (1953:5). Irving (1953:map) plots both the mouth of the river and creek as having sites despite the fact that neither locale was field verified. Intensive survey of the river mouth was made by University of Alaska Museum personnel in 1980 and 1981, but again no remains of a site were discovered. The fact that three attempts (two of which were conducted independently) failed to verify the existence of this large and relatively recent site demonstrates the difficulty in using ethnohistoric data to identify site locations. While ethnohistoric data provide valuable insights into general use of an area, it cannot be totally relied upon to accurately define site locations in the absence of field survey.

References to the "Tyone River Village" continue to appear in the literature, e.g., Dessauer and Harvey (1980:12), Kari and Buck (1983:12), and Reckord (1983b:179), despite the lack of field confirmation of its existence. Although it is possible that all vestiges of the site have been obliterated, a more likely explanation is that the exact location of a "village" on the Tyone has been misreported, perhaps in the original report of Moffit (1912), and subsequently perpetuated in the literature. Regardless of the exact location of a site or sites on the Tyone River and Tyone Creek, it is clear that the area was an important one in terms of Ahtna settlement.

The concept of territoriality, with regard to settlement and hunting rights, was firmly established in Ahtna ideology. A clear example of this is found in Lt. Castner's account of the reaction of his Indian guides when passing into the "hunting grounds" of the Tanana across the Alaska Range (Castner 1899:258). Interestingly, the "Matanuska" guide accompanying him did not display the same fear as the "Knik and Upper Copper River Indian". Skirmishes between Ahtna clans supposedly took place in the prime hunting grounds near Valdez Creek where Susitna Lodge is located today (Dessauer and Harvey 1980:14). Battles between the Western Ahtna and Tanana raiders from Nenana took place in the same general vicinity for four years until all the men of the Nenana party were killed (de Laguna and McClellan 1981:642).

(v) Structures

Structures differed between winter villages and temporary camps. The aboriginal winter house described by Jimmy Second Chief to William Irving was a:

> shallow semi-subterranean dwelling with a central fireplace, possibly a sweat lodge at the back, but without an entrance passage. The superstructure he showed to consist of light poles bent to form a dome, over which was piled moss and dirt (Irving 1957:46).

A similar structure was described by Allen (1887:130) as being in use by the Lower Ahtna at Taral. In plan view, the house was 18 ft. square, with walls nearly 4 ft. high and an interior shelf 4 or 5 ft. wide serving the purpose of a seat or bed, with the space underneath used for storage. The superstructure consisted of spruce poles and slabs and was covered with spruce bark and chinked with moss. The sleeping room or bath-house in the rear was 10 ft. square and 4 or 5 ft. high and nearly completely underground. During the 13 years that passed between the time that Allen described the house at Taral and Lt. Castner observed the winter houses at the "Matanuska village" (Castner 1899:255), the Ahtna had begun to construct log cabins for use in winter. Log cabins were occupied by inhabitants of Tyone Lake Village as late as 1953 (Irving 1953:10).

Other structures built at winter villages were underground pit caches, a variety of tree or platform caches and small huts used by menstruating women (de Laguna and McClellan 1981:645). Sometimes the caches were hidden quite far from the village in order to protect them from raiding Chugach Eskimos (Reckord 1983b:79).

Temporary structures at hunting camps were described by Allen (1887:130-31) as being built of poles and boughs of spruce or other wood, rectangular in plan view with a passage-way through the center and both ends left open. These traditional double lean-tos apparently also gave way to a more tentlike structure by 1898 when Castner encountered the "Matanuskas" living in small tents and summer shelters of bark, moose and caribou skins, and drill (Castner 1899:255). Ahtna informants confirm that the same type dwelling described by Castner, consisting of a one room "A"-frame structure made of connecting caribou skins and an adjacent sweathouse, were inhabited at Valdez Creek (Dessauer and Harvey 1980:14).

(vi) Subsistence Technology

The Ahtna tool assemblage was generally characteristic of that used by other northwestern Athapaskans. It differed, however, in the respect that native raw copper, found as nuggets in local streams, was frequently used to fashion a variety of implements, such as knives, daggers, spear heads, harpoon heads, arrow heads, etc. (de Laguna and McClellan 1981:645). Stone, bone, antler, and wood were other materials used in tool construction. Excellent inventories of these assemblages can be found in archeological reports of Workman (1977a) on a late prehistoric site, GUL 077, near Gulkana, and Shinkwin (1979) on a protohistoric site, Dakah de'nin's Village, on the Copper River.

The Athna used a variety of weapons (spears, bows and arrows, and later, shotguns) and devices (snares, deadfalls, pitfalls, caribou corrals, and fences) in the capture of game. Allen (1887:132) describes the procedures used for manufacturing bows and arrows of heat-treated birch wood. By 1885, the year of Allen's expedition, the bow and arrow was being superseded by "small-bore, double-barrel, muzzel-loading (sic) shotguns" (Allen 1887:132). Native copper bullets were thought by the Ahtna to be superior to those made of lead.

Caribou were captured in a number of ways, one of which involved spearing the animals from canoes as they crossed a lake. As mentioned above, this method of capture occurred at Snodgrass Lake. Caribou fences, mostly built above timberline, would sometimes be used to funnel the animals into the water or into narrow passes or box canyons (Reckord 1983b:32). A caribou fence site located on a hill northeast of the mouth of the Tyone River was reported by Reckord (1983, citing personal communication with J. Kari), but has not been field verified. Corrals with "V"-shaped entrances were also used during spring and fall migration for capturing caribou which would then be speared, shot with arrows, or entangled in snares (de Laguna and McClellan 1981:648). Wrangell (1970) describes the entrance to these corrals as being very wide, sometimes up to 10 versts, the equivalent of approximately 6½ miles. Both caribou and moose were caught in drag-pole snares, using long brush fences set with snares (de Laguna and McClellan 1981:648).

Various fishing implements and techniques were used depending on whether the fishing took place in clearwater streams, lakes, silt-laden waters such as the Copper River, or on the ice. Lt. Castner observed the "Matanuskas" using harpoons with barbed points while fishing for salmon in "Upper Lake Plaveznie" (Castner 1898:255), thought to be Old Man Lake. Funnel traps of spruce saplings were employed by the Western Ahtna when fishing for burbot (de Laguna and McClellan 1981:647). Hook and line fishing through the ice, and dipnet fishing in silty streams were other methods used by the Ahtna. In most places where dipnetting took place, the men had to make short fences to deflect the salmon to the ends of dipping platforms extending out into the water from shore (de Laguna and McClellan 1981:647).

(vii) Trade, Trails, and Transportation

Before the coming of the Russians, the Ahtna were involved in an "ancient and widespread trade network involving the Eskimo, other Athapaskans, the coastal Eyak and Tlingit, and probably the Chuckchi of Siberia" (de Laguna and McClellan 1981:650). This well-established intertribal trade fostered the spread of Euro-American goods long before actual contact was made between the Russians and inland Athapaskans. The Western Ahtna may well have been involved in the trade between the Kenai Peninsula Tanaina and Copper River people described by Davydov in 1802-03 (Davydov 1977:199). Direct trade between the Western Ahtna and the Russians was quite limited.

During the late nineteenth and early twentieth centuries, the Western Ahtna were traveling regularly to Knik Station on Cook Inlet and Susitna Station near the Susitna River mouth to trade with the Americans. Two of the trails leading down to Knik were pictured on the sketch map made by geologist Fred Moffit in 1904 (see Figure 3.2). The trail leading from the "2nd chief's" house is very similar to one described by John Nicklie for the annual winter trek to Knik Station (Skarland 1953:2). Another trail leading to Susitna Station, according to Nicklie, was by way of Stephan Lake, Prairie Creek, and down the Talkeetna River. The trade goods and camping equipment were carried on sleds pulled by men, as no dog teams were then in use. The return trip to the "Tyone camp" occurred late in winter (Skarland 1953:2).

Dog traction did not come into use by the Ahtna until 1899 (de Laguna and McClellan 1981:649), but dogs served as pack animals before this time. Allen highly praised the strength of the Ahtnas' dogs, and observed that "these dogs are never harnessed to the sleds, which the natives haul and push, but transport their burden directly on the back" (Allen 1887:133). During the winter, travel was assisted by snowshoes, and loads were carried on hand-drawn toboggons and sleds (de Laguna and

McClellan 1981:649). Summer travel was largely on foot, but skin boats, rafts, and one-man canoes for hunting swimming caribou were also used (Allen 1887:133; de Laguna and McClellan 1981:650).

(viii) Social Organization and Ritual

Social organization and ritual will only be discussed briefly because of the limited application of such data in interpreting the function or patterning of archeological sites. The reader is referred to the works of de Laguna and McClellan (1981) and Reckord (1983b) for a more thorough treatment of these aspects of Ahtna culture.

In terms of social organization, the Ahtna were divided into two exogamous moieties, the Sea Gull and the Raven moieties, each comprised of a number of matrilineal clans or descent groups. The clan was a semilocalized group, probably traceable to a particular area. Two of the clans with Western Ahtna membership were the "caribou people" and the "canyonberry people". The clan name associated with the Mountain People was "they came out of the water" (de Laguna and McClellan 1981:653-654). Marriages, some of which were arranged, took place between members of opposite moieties. Both Allen (1887:135) and Castner (1899:25) mentioned that despite the fact that women were in the minority, polygamy was sometimes practiced. The taking of two or more wives by wealthy men came into being sometime before the turn of the century (de Laguna and McClellan 1981:658).

Ranking was an important aspect of Ahtna social organization. Every major settlement had a chief or dene, who was more a leader of a community than of a descent group. The chief's power was primarily economic, and he was able to lead trading parties (de Laguna and McClellan 1981:656). Allen (1887:135) referred to the chiefs as "tyones", and likened them to haughty aristocrats. The immediate family of the chief was also entitled to special privileges and special personal possessions. Under the chief were shamans, freemen, servants, and finally captives and slaves (de Laguna and McClellan 1981:657).

The ceremonial life of the Ahtna centered around the potlatch, which was given in order to mourn and honor the dead, celebrate recovery from illness, or merely to honor a living person. Potlatches could last for one day to a week or two, but all required the presence of a guest from another settlement. The food and presents given to the guests also reflected honor upon the host of the potlatch. Rituals were observed throughout the life cycle of the individual, from birth to death. Rituals surrounding death involved removing the corpse through a smoke hole or window, but never the door, and then abandoning or burning the house with all its contents. The corpse traditionally was cremated until the mid-nineteenth century when the Russians introduced burial in plank-lined graves, marked by a cross and surrounded by a fence (de Laguna and McClellan 1981:659).

(d) Ethnohistoric Summary

The traditional culture of the Western Ahtna was probably first affected by the influx of Euro-Ameriean trade goods in the late decades of the eighteenth century. In exchange for furs, these goods were carried into Ahtna territory by native middlemen, such as the Tanaina, who traded directly with the Russians at posts on the Kenai Peninsula. Evidence that such trade occurred was documented by Davydov (1977), an employee of the Russian American Company. According to his description of trade between the Tanaina and the Copper River Ahtna in 1802-1803, the travel route taken by the Tanaina, up the Susitna River and into the mountains, indicates that trade took place in Western Ahtna territory.

Direct contact with the Russians in the 1790's and early 1800's consisted of brief encounters with traders attempting to reach the Copper River. The Russians made little effort to expand their fur trading enterprises deep in Ahtna territory, except on the Copper River, so the Western Ahtna maintained their independence and much of their traditional culture throughout the Russian period. During this time, however, the Ahtna developed increasing dependence on Euro-American trade goods. Regular direct contact with Europeans probably did not begin until late in the Russian period when the Western Ahtna began to trade at Knik Station on Cook Inlet.

After 1867 and the transfer of Alaska to the United States, the Western Ahtna were brought into contact with American traders of the Alaska Commercial Company at Knik Station and Susitna Station near the mouth of the river. The long-distance treks to these stations became incorporated into the Ahtna annual cycle, and settlement for at least part of the year was focused on the trading posts rather than winter villages. The travel routes of these annual winter treks were described by John Nicklie, who indicated that at other times of the year, traditional subsistence activities were still taking place (Skarland 1953). Technology was also changing in the last decades of the nineteenth century according to the reports of explorers Allen (1887) and Castner (1899). Shotguns began to replace bows and arrows, and log cabins were taking the place of traditional winter dwellings.

For the Western Ahtna, a major shift in settlement occurred shortly after the turn of the century, when gold was discovered at Valdez Creek. The Ahtna who were drawn here to work for the miners brought with them their families, and soon a permanent native settlement had been established. Previously the area had only been occupied seasonally for hunting caribou or fishing. The influenza epidemic of 1918 greatly affected the people, and the populations of at least two Western Ahtna villages were decimated (Reckord 1983b). The epidemic, according to oral history, also brought about the demise of the Mountain People (Pete 1980). Vestiges of traditional Ahtna life continued at Valdez Creek until the closing of the mines in 1935 and until at least the 1950's at Tyone Lake where two Western Ahtna men were residing at the time of Irving's (1953) archeological survey.

The ethnohistoric record provides strong evidence that the Middle and Upper Susitna River basin was traditionally inhabited by the Western Ahtna. Villages or established settlements have been documented on Valdez Creek, Lake Louise, Tyone Lake, Clarence Lake, and Stephan Lake, all of which fall outside the boundaries of the proposed Susitna

Hydroelectric Project. From these settlements, vast hunting territories extended northward across the Susitna River possibly as far as the Tanana River. Ahtna place name research conducted by Kari and Buck (1983) has provided information regarding potential locales for sites within this traditional hunting territory, part of which is encompassed by the project boundaries. Ethnohistoric references as to the location and/or nature of specific sites are not available. However, as a result of archeological survey of the project area, numerous Athapaskan tradition sites have been recorded and show great promise for increasing knowledge of this poorly understood period of rapid change in Ahtna culture.

3.3 - History

Most of the written history of the Middle Susitna River drainage is tied to the search for gold and for an all-American route to the Yukon gold fields. One measure of the Euro-American use and knowledge of the region is provided by maps. In the interval between Wrangell's 1839 map (Figure 3.1) and Johnston and Herning's 1899 "Latest Map of Knik, Sushitna Rivers & Tributaries" (Alaska Commercial Company n.d.) most of the major tributaries of the Susitna River had been identified but were still imprecisely located. On the 1899 map, the length of the river above Devil Canyon is contracted and the river is shown to headwater in a lake. The results of the 1898 military surveys for routes to the Tanana River drainages (Glenn and Abercrombe 1899) are crudely represented. Accurate mapping of the Middle Susitna River drainage was not completed until 1914 (Chapin 1915).

Difficult travel caused by Devil Canyon and the lack of productive gold deposits between Devil Canyon and the Tyone River have resulted in a sparse history of this portion of the Susitna River. Use of the project region since the turn of the century has been predominantly limited to hunting and trapping, with increased recreational use of the region since the 1950's.

The discovery of gold in Bear Creek and Palmer Creek created a stampede into the Turnagain Arm area in 1895 (Barry 1973:39). In 1897 gold was discovered along Willow Creek, a tributary of the Susitna River. The discovery of gold precipitated the first extensive explorations by Europeans into the Upper Susitna River area. In the summer of 1896 over 2,000 prospectors swarmed the shores of Cook Inlet and over 100 parties entered the Susitna River. Due to the treacherous river conditions in the upper reaches, only five parties attained any great distance up the river (Cole 1979:2).

In 1896 William Dickey and Allen Monks ascended the Susitna River as far as Devil Canyon. The river became unnavigable at this point and the banks were too steep to tow boats farther upstream. They were told by natives camped at the mouth of Portage Creek that there was a waterfall in the canyon, but a route existed which would allow them to portage around Devil Canyon. The portage route was too steep and difficult for them to follow and they returned down the Susitna River (New York Sun, 1/24/1879; Cole 1979:2-4).

In the spring of 1897 nine men (W.G. Jack, Captain Andrews, Chris Spellman, Billy Perry, Paul Buckley, Barney Clipsus, Ely Solum, Jim Johnson, and George Davis) decided to prospect along the Susitna River (Bayou 1946:12; Barry 1973:65). They became the first party to explore nearly the entire river. The party initially dog sledded up the Susitna River. Near Portage Creek they encountered a cabin with two starving prospectors. After supplying them with food they continued up the river. On the way they met several natives with their dog teams and enlisted their aid for transporting the starving prospectors to Susitna Station (Bayou 1946:12-13). They came to a deep canyon with what they presumed to be a frozen forty-foot waterfall just beyond Portage Creek. They avoided Devil Canyon by ascending Portage Creek, crossing a divide to Devil Creek, and descending the latter to the Susitna River. The portage of 25 miles lasted between April 20 and May 6. They named the creek "Devil's Creek" because they "had a devil of a time getting to the creek, and a devil of a time getting down on the creek" (Bayou 1946:13, 40). They arrived at the Susitna River on May 12 in time for breakup.

They built three boats and lined them up the river. They panned for gold as they went but found nothing until they reached what is known today as Valdez Creek. They named the creek "Swollen Creek" from the number of mosquito bites that they endured (Bayou 1946:41). They continued prospecting and crossed Broad Pass into the Tanana River drainage. Short of supplies, they returned down the Susitna River on July 29, again making the portage between Devil Creek and Portage Creek, building another boat and floating down the Lower Susitna River. A log of the trip maintained by W.G. Jack appears in Eldridge (1900:26-27). The party subsequently became involved with mining on Crow Creek, 15 miles northeast of Sunrise in the Turnagain Arm area, and did not return to the Upper Susitna River (Barry 1973:99-100). It was not until 1903 that the Monahan party from Valdez relocated the gold find and filed on the discovery.

At the same time that the above party was making their journey on the Upper Susitna River, W.A. Dickey apparently travelled up the Susitna River again as far as Devil Canyon. On a rock face near the mouth of Portage Creek the party made the following inscription: "M.E. Decker, L.F. Judson, W.A. Dickey, H.J. Kennaston, July 2, 1897". It is probably as a result of this second trip that Dickey collected information for his 1897 article in National Geographic Magazine (Dickey 1897). This article described the true nature of the rapids in Devil Canyon and laid to rest the notion of a waterfall.

The following year (1898), W.G. Jack guided George Eldridge of the USGS up the Susitna River, then up the Indian River and over to the Broad Pass country, and down the Nenana River. Their route avoided the Upper Susitna River area (Eldridge 1900). The purpose of their expedition was to locate a railroad or wagon route to the Tanana River drainage.

Sergeant William Yanert of Captain Glenn's expedition also attempted to travel up the Susitna River and cross into the Tanana drainage in 1898. The intended route up the Susitna River to its headwaters is depicted in Holeski and Holeski (1983:32). Blocked by Devil Canyon Yanert and his party headed up the Indian River to attain the Nenana River and Tanana

River but were forced to turn back due to lack of provisions and the lateness of the season. He was able to follow a well-worn footpath over the divide which was used by natives to reach the Tanana River drainage. Two Native frame structures were noticed north of the divide. A group of miners were observed at the mouth of Indian River (Yanert 1899:267-271).

In 1901, H. Jack Pamo and Al Campbell tried to make an overland trip from Fort Gibbon at the mouth of the Tanana River to Valdez. One month out from Fort Gibbon they ran out of food and giving up their plans to make for Valdez decided to cross from the Nenana River to the headwaters of the Susitna River. They descended the Susitna River and Campbell was left at an native hunting cabin some 50 miles above Devil Canyon when he could not continue. Pamo continued down the Susitna River for another two weeks before reaching a settlement at the mouth of the Talkeetna River. No attempt was made to return and rescue Campbell (Valdez News, 7/20/01; Cole 1979:607).

The difficult passage around Devil Canyon greatly reduced gold prospector traffic on the Upper Susitna River. It was not until 1903 that a more feasible route from the Copper River drainage was pioneered. In that year, Pete Monahan and three others from Valdez reached the Susitna River headwaters area. Their route took them over Valdez Glacier, down Klutina River, across Klutina Lake, along St. Anne River to St. Anne Lake, then over Tazlina Lake, Lake Louise, Susitna Lake, and Tyone Lake to Tyone River. They followed the Tyone River down the its junction with the Susitna River. At the confluence of the Tyone River with Susitna River they set up a base camp at a "stick house" native village which probably consisted of pole and bark dwellings similar to those on the Copper River described by Lieutenant Allen in this period (Dessauer and Harvey 1980:21). The miners prospected on the creeks south of the confluence, finding traces of gold in "Goose Creek" (Oshetna River (Moffit 1912:54)). In search of more productive deposits, they left the Tyone River area and proceeded up the Susitna River.

They prospected for gold along several creeks in the Upper Susitna River drainage and located gold-bearing gravels on August 15 on a small stream the Indians called "Galina" (anglicized version of Ahtna c'ilaanna', meaning "a place where game abounds" (Buck and Kari 1975)). In fifteen days they panned and sluiced 100 ounces of gold. They named the creek Valdez Creek in honor of their hometown (Moffit 1912).

The next year the discovery party and other miners returned to the creek and numerous claims were staked along this creek and its tributaries. At the end of the season, most of the miners left Valdez Creek and returned to Valdez by way of the Gulkana River. They were assisted by a native guide and followed an old native trail which stretched from Broad Pass to the Copper River. After that season, the difficult route over the Valdez Glacier was abandoned in favor of the Gulkana River trail (Moffit 1912:54). Another group of miners, E.L. Dickey and Jack Tansy, boated down the Susitna River from Valdez Creek to the mouth of the Tyone River. They followed the Tyone River to its headwaters at a glacier and then made a 3-mile portage to the Gulkana River. They then followed the Gulkana River to the Copper River (Alaska Prospector, 10/27/04; Cole 1979:12).

The Valdez Creek diggings in later years had as many as 150 men and continued to attract miners until the 1930's. Later routes to these gold fields roughly parallel the current Denali Highway from Cantwell in the west and Paxson in the east. The route from the west followed the West Fork of the Gulkana River from the Copper River to the Maclaren River, down the Maclaren River, and thence up the Susitna River (Cole 1979).

Other overland routes which bypassed Devil Canyon existed on the south side of the Susitna River. One route went up the Talkeetna River to Prairie Creek, past Stephan Lake to the Susitna River. Another route followed the Chickaloon or Talkeetna River and crossed low passes at the headwaters of Kosina Creek, descending the latter to the Susitna River (Chapin 1915:123, 1918:19; Cole 1979:5). The first topographic and geological surveys into the Upper Susitna River region between Devil

Canyon and the Oshetna River took place in 1914 (Chapin 1915:119). A geological map showing trails to the Valdez Creek area and the region to the southeast was prepared as a part of this expedition (Chapin 1918:Plate 2). None of the trails depicted enter the project area.

In 1907 the Alaska Commercial Company established a trading post at the mouth of Indian River. From the Indian River to Valdez Creek was a 90-mile long trail which took 11 days with horses. Both the trail and the trading post were abandoned after 1909 because the route was too time consuming and expensive (Cordova Daily Alaskan, 07/09/09:3; Moffit 1911a:116, 1911b:167; Cole 1979:11-12; Dessauer and Harvey 1980:24). In 1909 hope was still expressed for a wagon road between the head of navigation on the Susitna River and Valdez Creek (Priestley 1909:415).

Some published information exists on use of the area by prospectors and trappers between 1920's and the present (Vogel 1972, 1974; Walker 1979a, 1979b). Additional information on the history of the region was collected by Acres American, Inc. (1982a) as part of the land use studies for the Susitna Project. Individuals interviewed as part of the land use studies provide a cross section of use of the region for hunting, trapping, prospecting, and recreation (Acres American, Inc. 1982a: Table 2). It is known that Oscar Vogel, Elmer Simco, Joe Schneller, Adolph Wendeler, and Fred Smith worked the area during this time (Vogel 1972:11; Walker 1979b:37). Vogel maintained about ten main and line cabins in the upper Talkeetna and Susitna rivers. Vogel (1972:11; 1974:30) indicates that Elmer Simco trapped the Clarence Lake area and was his northern trapping neighbor. Mining was also practiced within the project area, particularly in the Jay Creek area. Cabins and other features related to the trapping and mining history of the region were recorded during the cultural resources survey and are described in Appendix D.

The Bureau of Reclamation first began exploring the Middle Susitna River for possible dam site locations in the late 1940's. In 1948, an aerial reconnaissance identified four possible dam locations. In 1950, the Bureau of Reclamation sent a five-man party in two aluminum boats down the Susitna River from Valdez Creek. The party swamped both of their boats just below Goose Creek. A helicopter was sent to look for the overdue party. While attempting to land next to one of the boats, the helicopter crashed (parts of a helicopter - probably this one - were found during the cultural resources survey). Another helicopter rescued all of the stranded men. The Bureau of Reclamation eventually identified three possible damsites in the Susitna River canyon: 17 miles below the mouth of the Tyone River at the Vee Damsite, the Watana Damsite north of Fog Lakes, and the Devil Canyon Damsite. Another damsite, the Denali Damsite, was proposed above the great bend in the Susitna River north of the Tyone River confluence (U.S. Congress House Document 197 1952; Naske and Hunt 1978; Cole 1979:16-18).

In 1955 the Corps of Engineers attempted to run a power boat up through Devil Canyon to study navigable watersheds in the Susitna River drainage. The vessel was wrecked and the eight-man crew rescued by Alaskan bush pilot Don Sheldon (Greiner 1974).

After the Corps of Engineers attempt to run Devil Canyon, additional attempts were made, usually without success. In 1972, the party of Walt Blackadar was the first to run sections of the canyon. Additional parties have since also been successful (Cole 1979:21-23). While conducting additional feasibility studies in 1978, the Corps of Engineers drilling sites became sites of refuge for the growing number of river users who encountered difficulty on the river. In the 1960's a boat house was built on the banks of the Susitna River by the owners of the Stephan Lake Lodge to facilitate the portage of recreational boaters between the Susitna River and Stephan Lake.

4 - BASELINE DATA - PHYSICAL and ENVIRONMENTAL SETTING

4.1 - Introduction

Baseline data on the physical and environmental setting of the Middle and Upper Susitna River basin are presented in this chapter. Each of the chapter sections is intended to provide a broad overview of the geological and biological aspects of this area, which to a great degree have conditioned the nature of its past human occupation. Beginning with a summary of the topography and bedrock geology, the discussion then turns to a description of Quaternary geology. This section focuses on glaciation, landforms, tephra falls, and soil development, all of which figure significantly in the description and interpretation of archeological sites. Past floral and faunal regimes are presented next in the paleoecology section, with a discussion of the present-day climate, and plant and animal communities completing the environmental description. The final section of the chapter provides a summary of the foregoing data, and helps set the stage for later analysis and synthesis of data on cultural resources.

4.2 - Topography

The Upper and Middle Susitna River basin, lying in the relatively low, northern portion of the Talkeetna Mountains, is bordered on the east by the broad Copper River basin, and on the west by the flat to gently rolling Cook Inlet-Susitna Lowland (Figure 4.1). To the north lies the mountainous arc of the Alaska Range. The Susitna Glacier on the southern slope of the range at 850 m asl (2800 feet) forms the headwaters of the Susitna River.

The Susitna River, the sixth largest in Alaska, drains an area more than 49,200 km^2 and flows 420 km before entering Cook Inlet northwest of Anchorage. The first 110 km of its course runs in a south-southwestern direction across a broad valley marked by kame and kettle and braided-channel topography. The Maclaren and Tyone rivers are two of its major tributaries along this stretch. Past the Tyone River, the

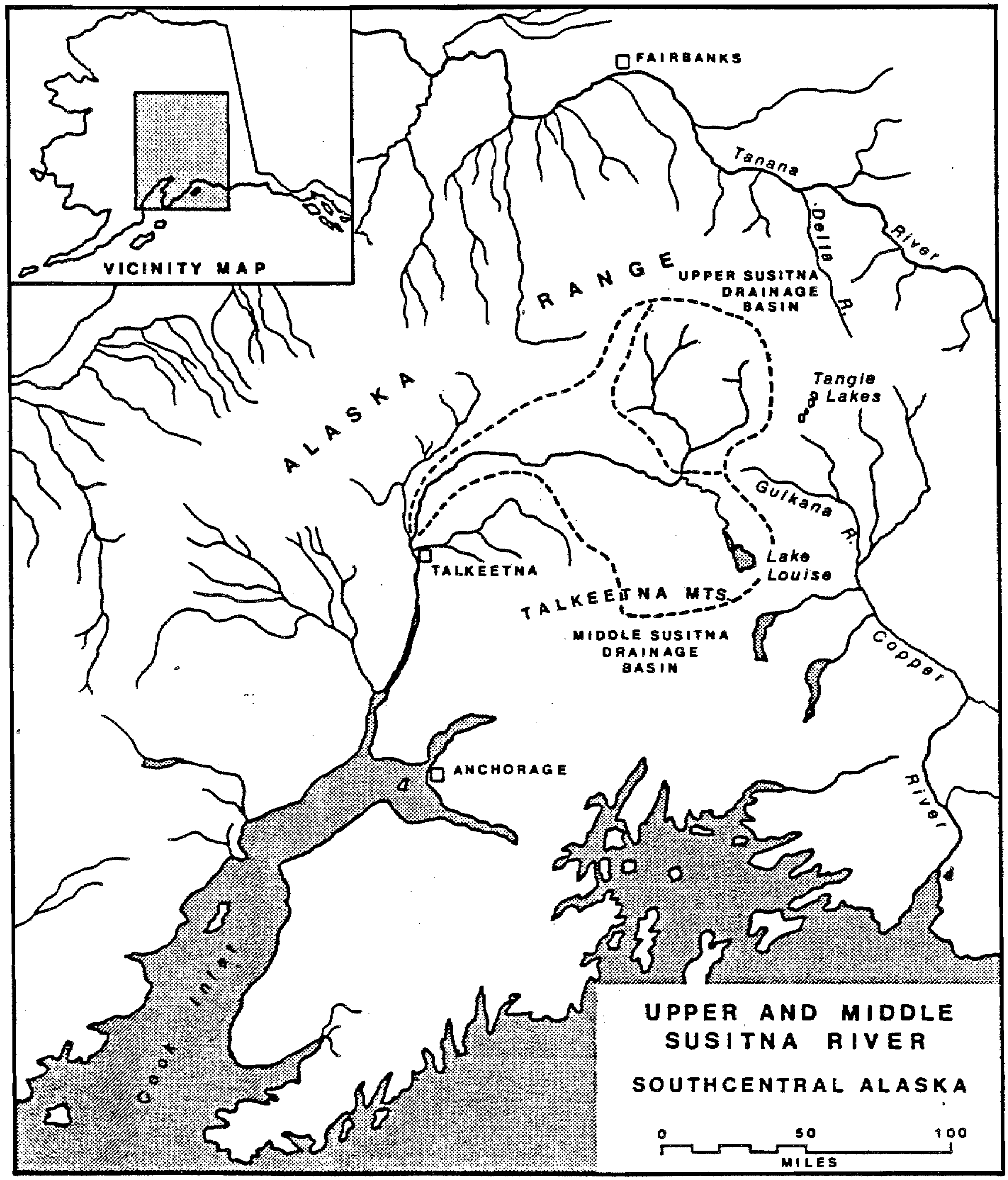


Figure 4.1. Middle and Upper Susitna River Basin, South-Central Alaska

Susitna River turns westward and begins its plunge between essentially continuous canyon walls for approximately 130 km. A very narrow, deep gorge, known as Devil Canyon, lies at the western end of the Middle Susitna River between Devil and Portage creeks. Other major drainages in the canyon are Jay, Watana, Deadman, and Tsusena creeks to the north, and Kosina and Fog creeks and the Oshetna River to the south (Figure 4.2). West of Portage Creek, the Susitna River resumes a southerly course for 180 km to tidewater.

Bordering the steep canyon walls of the Middle Susitna River is a broad glacial trough commonly mantled with hummocky moraines, ice-disintegration features, and glaciolacustrine and glaciofluvial plains. Largest among the lakes which are scattered across the plains are Butte Lake and Big Lake north of the Susitna River, and Stephan Lake, Fog Lakes, and Clarence Lake to the south. Stephan Lake is drained by Prairie Creek, a tributary of the Talkeetna River, which in turn is a tributary of the Lower Susitna River (Figure 4.2).

4.3 - Bedrock Geology

The early geologic history of the Susitna River canyon area is characterized by at least three major tectonic episodes, each separated by many millions of years. The first period of deformation occurred during the Jurassic, ca. 150 million years ago, with the intrusion of diorite and granite plutons which form a basolithic complex of the Talkeetna Mountains. A folding and faulting of the Talkeetna Mountains in the Late Cretaceous, 65-100 million years ago, marked the second tectonic event. Also at this time, a diorite pluton which comprises the bedrock of the Watana Dam site was intruded into the existing formations. A third period of uplift occurred in the Middle Tertiary approximately 40-20 million years ago. By the end of this period, the major topographic features of south-central Alaska had been established (Csejtey et al. 1978; Acres American, Inc. 1982b, 1983c).

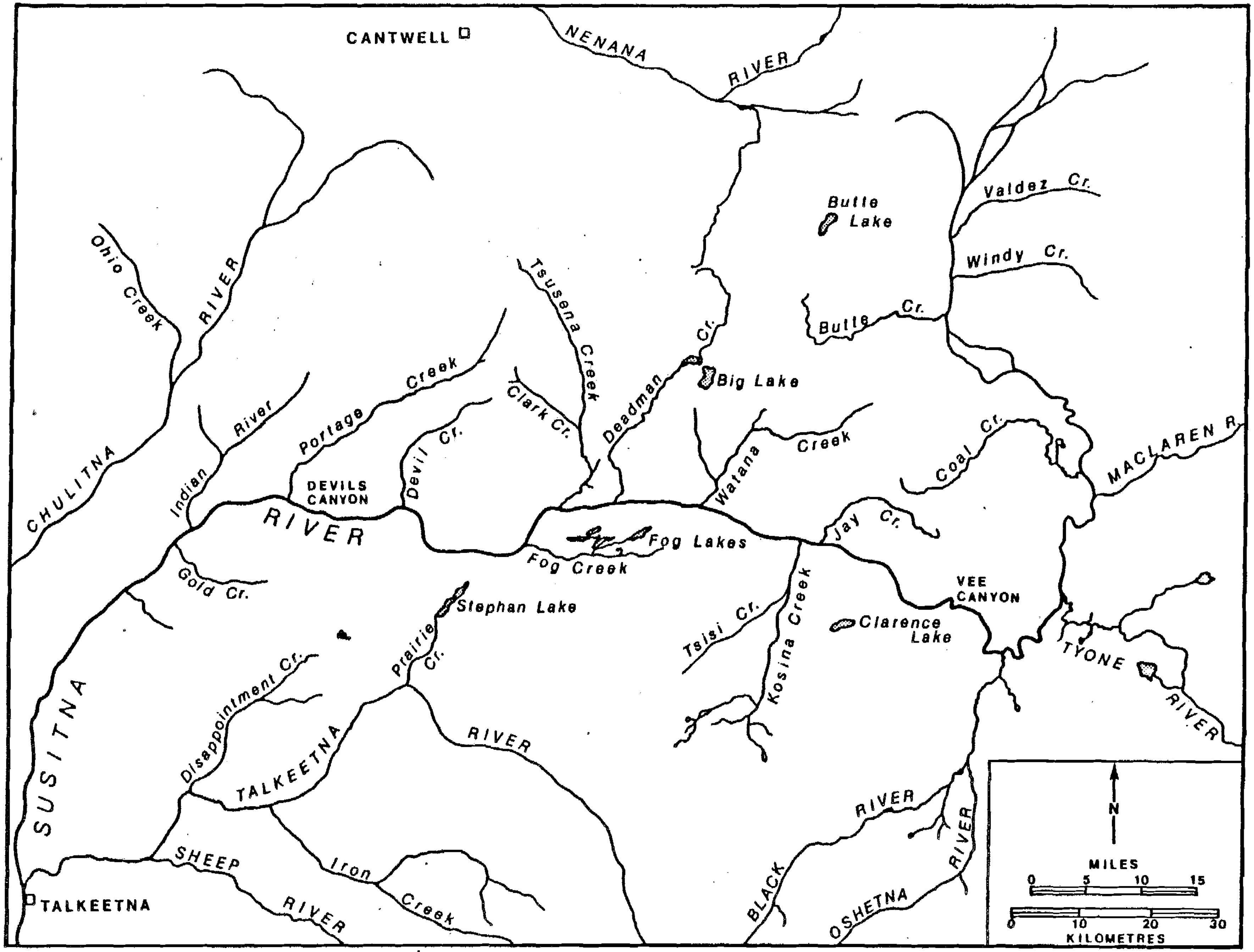


Figure 4.2. Susitna River Canyon and Surrounding Terrain

The ancestral Susitna River apparently followed a different course than it does at present as indicated by relict river channels buried under 100+ m of glacial deposits. One of these channels, found at Vee Canyon, has a bedrock floor cut below the floor of the present channel. The river's present course was probably determined in part by the rapid draining of proglacial lakes, and established sometime during the Wisconsinan glacial stage (R & M Consultants 1981).

4.4 - Quaternary Geology

(a) Glaciation

The past 1.8 million years, known geologically as the Quaternary period, has been witness to glacial processes which have shaped the present landscape of much of the northern part of the continent. Glaciation, commonly associated with the Pleistocene, actually began in high latitudes of both polar hemispheres before the end of the Miocene epoch, some 20 million years ago (Flint 1971:2-3). Along the Susitna River, the major extent of glacially altered land surface dates to the late Pleistocene, beginning approximately 120,000 years ago. More extensive Pleistocene glaciation completely covering the project area occurred prior to this time, but evidence for it has been obscured by erosion and more recent deposits.

During the late Pleistocene, almost all south-central Alaska was glaciated. South of the Alaska Range, glaciers coalesced into vast ice caps, intermontaine glaciers, and piedmont glaciers that constituted the northwestern part of the great Cordilleran ice sheet (Hamilton and Thorson 1983:38). The complex glacier system in the Susitna River canyon resulted from the coalescence of the valley glaciers (e.g., Kosina, Portage, and Watana creeks) in a piedmont glacier extending across the broad Susitna River valley floor. Sources for these glaciers existed in the Alaska Range and Talkeetna Mountains.

Glacial events during the late Pleistocene have been classified into the following four stages: 1) pre-Wisconsin (greater than 100,000 years B.P.), 2) Early Wisconsin (75,000 - 40,000 years B.P.), 3) Late Wisconsin (25,000 - 9000 years B.P.), and 4) Holocene (9000 - present). The 15,000-year hiatus between Early and Late Wisconsinan represents an interglacial period (Woodward-Clyde Consultants 1982, after Pewe 1975a). Multiple stades or advances have been recognized for the Late Wisconsinan period, with each successive readvance being less extensive than the preceding one. A chronology of these events in the study area has been developed by Woodward-Clyde Consultants (1982) and by Dixon, Smith, Betts, and Thorson (1982) based on relative age dating of glacial sediments. Techniques used to date the sediments involved determination of the weathering, elevation, morphology, etc. of glacial moraines coupled with radiocarbon dating of organic samples from the more recent exposures.

The earliest glaciated surfaces date to pre-Wisconsinan times and are evident at elevations higher than 1280 m asl (4200 feet) in the northern part of the Susitna River basin and to 945 m asl (3100 feet) in the southern part (Woodward-Clyde Consultants 1982:3-8). During Early Wisconsinan times (75,000 - 40,000 years B.P.), glaciation was less extensive than during the preceding stage, leaving large areas of the upland plateaus icefree. Evidence exists in the moraines of the Clear Valley area, south of the Susitna River in the vicinity of Stephan Lake and Fog Lakes, for the occurrence of several Early Wisconsinan stades or glacial readvances (Woodward-Clyde Consultants 1982:3-17).

The following chronology of Late Wisconsinan glaciation in the study area is based on the research of Robert Thorson, as reported in Dixon, Smith, Betts, and Thorson (1982), unless otherwise indicated. Figure 4.3 provides a timeline of the inferred glacial regimes.

During initial Late Wisconsinan glaciation, major ice masses began building up in three separate locations: the southern Alaska Range, and the northern and southern Talkeetna Mountains. The largest accumulation

TIME (years B.P.)	GLACIATION	CLIMATE	VEGETATION
100			
1000			
2000			
3000			
4000	Minor oscillations of valley glaciers during neoglcial	Neoglacial Interval (cooler)	Boreal Forest
5000			Decline in spruce(?)
6000	Susitna River valley ice free		Boreal Forest
7000			
8000		Hypsithermal Interval (warmer)	
9000	Deglaciation essentially complete		Invasion by spruce (Picea)
10,000			Shrub - tundra
11,000	Continued deglaciation of smaller valleys	Post-Wisconsinan warming trend	
12,000	Main valley and lowlands ice free		Tundra - steppe
13,000	Oscillatory glacial retraction and stagnation		
14,000	Ice-covered Susitna River valley		

Figure 4.3. Inferred Glacial, Climatological, and Vegetational Regimes in the Middle and Upper Susitna Basin

occurred along the southern flank of the Alaska Range and the Clearwater Mountains of the Alaska Range near the headwaters of the Susitna River. As ice built up vertically it advanced southward down the Upper Susitna and Maclaren river valleys, forming large lobes that extended up the valley of Coal Creek and in the Tyone River region. The lobe did not extend beyond the mouth of Tyone River until about 22,000 years B.P. During the southward advance of glaciers generated from the southern Alaska Range, ice also accumulated in the central Talkeetna Mountains in the headwater regions of Kosina and Tsisi creeks, and the Black and Oshetna rivers. Following initial valley glaciation of these regions a large ice cap, centered over the southern Talkeetna Mountains, was formed. Large lobes in the valleys mentioned earlier advanced northward toward the Susitna River canyon. A third accumulation locus was the northwestern portion of the Talkeetna Mountains north of Devil Canyon. Major valley glaciers in this area drained down the valleys of Deadman, Tsusena, and Portage creeks from a localized ice cap.

As ice from the southern Alaska Range built up above altitudes of about 914 m asl (3000 feet), it spilled through the structurally controlled valleys of Coal, Jay, and Butte creeks and then advanced southwest to the Susitna River canyon. The southernmost part of this ice mass built a large lobe near the Tyone River lowland which was deflected west-northwest down Susitna River canyon by lobes advancing northward down the Oshetna River valley. Ice derived from the northwest Talkeetna Mountains advanced southwest where it merged with northeast-flowing ice derived from the ice cap which existed near the present upper Talkeetna River valley. It also merged with north-flowing ice generated from the southern Talkeetna Mountains flowing down the valleys of Tsisi and Kosina creeks, and west-northwest-flowing ice extending down the Susitna River canyon from the Oshetna River and Tyone River lowland lobes. Thus, glacial drainage during the Late Wisconsinan glacial maximum was centripetal toward the Fog Creek and Watana Creek lowland. Ice did not cover this area until some time after 31,000 years B.P.

The distribution of moraines in this area indicates that following the glacial maximum the lobes withdrew at different rates. Glaciers advanced northeast across the Fog Creek and Watana Creek lowland to a terminal position near Big Lake after the south-flowing transection glaciers withdrew. Following withdrawal of this secondary lobe, west-flowing glaciers in the Susitna River canyon, fed largely by north flowing tributary glaciers, advanced to terminal positions near the mouth of Tsusena Creek. Valley glaciers draining Tsusena Creek also experienced readvance at this time.

Following these dynamically controlled readvances, glaciers may have disappeared rapidly over much of the region. After approximately 13,000 years B.P., individual valley glaciers were generally confined to these valleys and the piedmont glacier had retreated north of the Susitna River (Woodward-Clyde Consultants 1982:3-18). Prominent moraines of nearly identical surface morphology throughout the region indicate that two final readvances or still stands occurred. Prominent outer moraines from the older of these two readvances are recognized in: the small unnamed valleys south of Fog Lakes, near the confluence of Tsisi and Kosina creeks east of Watana Lake, in the Oshetna River valley west of Lone Butte, near the confluence of the Oshetna River with Susitna River, and in the valleys of Coal and Butte creeks.

Evidence for the younger readvance consists of a prominent moraine crossing the Susitna River valley floor near the Denali Highway, and similar moraines in many smaller valleys upstream from the most prominent moraines attributed to the early readvance. Deglaciation of the Tyone River lowland region, which was covered during the second-to-last readvance occurred prior to 11,500 years B.P. Large areas of stagnant ice were present in most of the broad lowland regions during deglaciation, which was essentially complete by 9000 years B.P. Neoglacial advances taking place during the Holocene were very small, not extending more than several kilometers beyond the present glacier margins.

The sequence of Pleistocene deposition varies across the study area due to the complex patterns of glacial advance, stagnation, and retreat; the formation and draining of proglacial lakes; and fluvial reworking of glacial sediments. In general, basal till, comprised of silt, sand, and gravel deposited during glacial advances, mantles older Pleistocene sediments in the area. Ablation till, glaciolacustrine and glaciofluvial sediments, and ice-contact, stratified drift overlie the basal till. The way in which the present-day terrain has been shaped by these depositional processes is discussed below.

(b) Landforms

Many of the depositional landforms in the Middle and Upper Susitna River basin date to the Late Wisconsinan. Because of the effectiveness of glacial erosion, transport, deposition, and the associated work of water and wind, the landforms provide a distinct signature of their origin long after the glacial ice has receded (Bloom 1978:386). Landforms vary depending upon mode of deposition. Moraines are formed, for example, by the accumulation of drift carried forward by direct glacial action; whereas kame terraces, kames, kettles, and eskers are classified as ice-disintegration (or ice-stagnation) features resulting from the deposition of drift in the channels and other openings between stagnant ice blocks in the terminal zone of a glacier (Flint 1971:207). Also shaping the landscape during deglaciation were fluvial and lacustrine deposition, represented by glacial outwash and fine to coarse-grained, bedded lacustrine sediments originating from the proglacial lakes that once existed.

Extensive glaciolacustrine plains, covering much of the Watana Creek and Stephan Lake lowland and extending eastward to the Copper River basin exist at present in the study area. These plains were formed by proglacial lake sedimentation sometimes reaching several meters in thickness. Glaciolacustrine conditions persisted into the Holocene in the Deadman Creek area where such deposits have been dated at 3450 ± 170 years B.P. (Woodward-Clyde Consultants 1982:3-15).

Distributed widely across the glaciolacustrine plains are ice-disintegration features, indicating that the ice stagnated over large areas during retreat. Eskers are common along the Susitna River between Devil and Fog creeks, as well as between the Oshetna and Tyone rivers. The gradient of eskers is commonly reverse relative to modern drainage indicating that glaciers controlled drainage during retreat (Dixon, Smith, Betts, and Thorson 1982:5-15). Hummocky, ice-distingration features mantle the basin between Tsusena and Deadman creeks, and well-exposed, ice-contact drift occurs near Watana Creek. Ice-disintegration features dating to the Early and Late Wisconsinan have also been mapped to the north of the Susitna River, in the Butte Lake vicinity, and to the south, in the Clear Valley area (Woodward-Clyde Consultants 1982).

Erosion, deposition, and periglacial action have modified glacial landforms since the Pleistocene. The glaciated floor of the Susitna River and its tributary streams have been incised, and low terraces above the modern flood plain, such as adjacent to Tsusena Creek, have been formed. Deposition of alluvial fan debris has further modified these terraces. Steep slopes, found typically along Devil Creek, have been altered by colluvial deposits and by the periglacial, mass wasting effect of solifluction (R & M Consultants 1981).

The term periglacial denotes intense frost action which produces permafrost, ice wedges, and cryoturbation, in addition to solifluction. The study area lies in a zone of discontinuous permafrost with few ice wedges (Pewe 1983:160), however, cryoturbation is common. Cryoturbation, which includes frost heaving, produces frost-stirred ground characterized by mixing and distortion of strata and soil horizons. Cryoturbation is the cause of the frequently involuted contacts between soil/sediment units at the archeological sites in the study area. The effects of this process can also be seen on the surface in the form of frost mounds or frost boils.

Mapping of landforms across the study area has been accomplished by R & M Consultants (1981) on the basis of aerial photo interpretation, corroborated by limited on-site surface investigation. Their basic mapping unit, designated as a terrain unit, crosscuts geological time periods and focuses on landforms expected to occur from the ground surface to a depth of about 25 ft. (8 m). The following fourteen individual terrain units were identified: bedrock, colluvial deposits, landslides, solifluction deposits, granular alluvial fans, floodplains, old terraces, ablation till, basal till, outwash, eskers, kames, lacustrine deposits, and organic deposits. Twelve terrain units representing two landforms complexly related and not divisible into a single unit, such as colluvium over bedrock, were also mapped.

(c) Tephra Falls

Central Alaska has had a long history of volcanic ash fall deposition recorded within its stratigraphy. The most recent of these tephra deposits were laid down during the Holocene, and have been identified throughout the study area. Widespread evidence for multiple tephra falls occurring during the millennia from possibly as early as 7000 years B.P. to roughly 1800 years B.P. has been documented by Dixon, Smith, Betts, and Thorson (1982); Dixon, Smith, King, and Romick (1982); Romick and Thorson (1983); Dixon, Smith, Andrefsky, Saleeby, Utermohle, and King (1984).

Evidence for Holocene tephra falls in the Susitna River canyon area has been found in lowland areas with gentle to moderate slopes where, on average, a 75 cm thick mantle of soil and sediment overlies the glacial drift (Dixon, Smith, Betts, and Thorson 1982:5-28; Romick and Thorson 1983:4). Three of the major soil/sediment units within this mantle have been designated by the names of the tephra they contain. From bottom to top, these units are the Oshetna, Watana, and Devil tephras, named after major tributaries of the Susitna River. A tephrochronology constructed on the basis of radiocarbon dates from many archeological sites, geological exposures, and lake core sediments is presented in chapter 8 of this document.

Although tephra is fairly ubiquitous in the lowlands of the project area, it has not been observed on steep slopes, windswept exposures or in locales above 1500 m in elevation (Dixon, Smith, Betts, and Thorson 1982:5-28). The stratigraphic units in which the tephras occur in the lowlands vary in thickness from 1-10 cm. Although it had been thought that each tephra unit represented a discrete volcanic event, recent lacustrine sediment analysis indicates that at least the Watana tephra is a complex tephra unit composed of ashfall from several, possibly closely spaced eruptions (Dilley 1984).

Petrographic analysis by Jay Romick (see Dixon, Smith, King, and Romick 1982) indicates a great deal of similarity in the mineral composition of the tephras. This can be explained, according to Romick and Thorson (1983:14-15), if the tephras were produced from consecutive eruptions over a short period of geologic time from a single vent. They believe the source to be the Hayes volcanic vent (Figure 4.4), about 200 km to the southwest of the Middle Susitna River, which is reported to have produced tephras containing the rare component of biotite - also present in the Susitna tephras.

Correlations between the Susitna suite of tephras and tephra from other central Alaskan locales and archeological sites dating to around 3500 - 4000 B.P. have not been positively made as yet. If such correlations can be made, such as with the Cantwell ash (Figure 4.4) discussed by Bowers (1979) and Bowers and Thorson (1981), and ash from the Tangle Lakes area to the east (Romick, personal communication), then a considerably more widespread distribution for these ashfalls would be evident. One estimate states that the most catastrophic volcanic eruption of the Hayes volcano would have spread ash over a 35,000 km^2 area (Riehle, in press) which would include the most western portion of the cultural resources study area.

(d) Soils

Soils in the study area have been classified into four orders: Spodosols, Inceptisols, Entisols, and Histosols (Winters 1984:E-11).

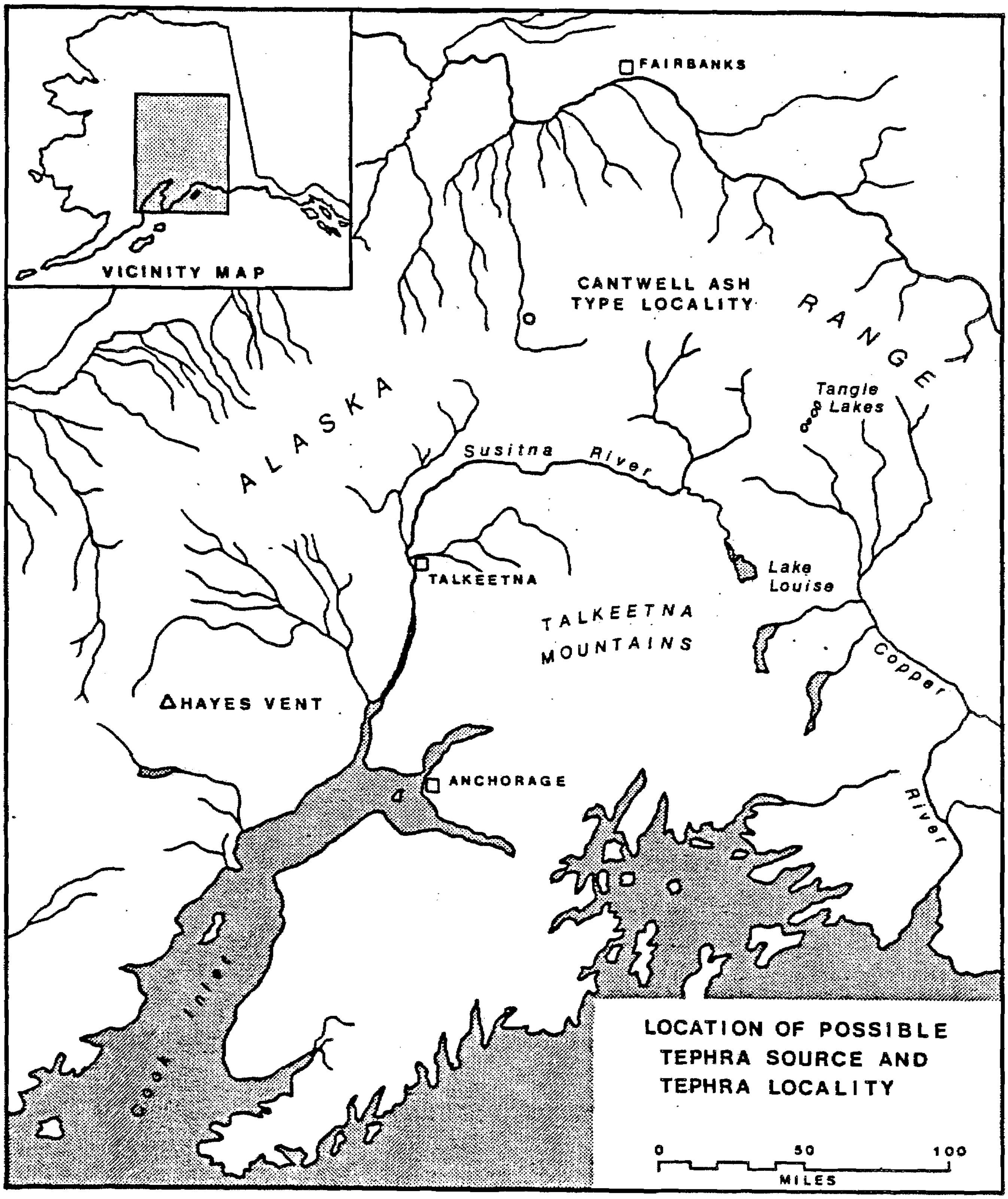


Figure 4.4. Location of Possible Middle Susitna River Tephra Source and the Cantwell Ash Type Locality

The most prominent are the well-drained Spodosols, represented by the suborder Cryorthods. In these soils iron, aluminum, and/or organic matter accumulate in a subsoil, or spodic, horizon. Generally in the study area, they form in a mantle of loess or volcanic ash over glacial drift or in loamy colluvial sediments.

Inceptisols are represented by four suborders: Cryandepts, Cryaquepts, Cryochrepts, and Cryumbrepts. Inceptisols are immature, horizonless soils, which in many cases are formed from volcanic ash (Buol et al. 1980:240). These soils are quite variable in the study area, ranging from well drained to saturated, and occurring in lowlands as well as on ridge tops and slopes. Cryofluvents and Cryorthents are the two types of Entisols found in the area. These loamy, recently formed soils are associated with well-drained, water-laid sediments and with broad terraces and moraines.

Histosols are organic soils which form under conditions of almost continuous water saturation, and are often associated with kettles, seepage sites, and depressions on glaciolacustrine plains (Buol et al. 1980:310-311). Two suborders, Borofibrists and Borohemists, are found in the study area.

Another type of soil generally far enough below the present land surface not to be affected by pedogenic processes is a buried soil, or paleosol. Paleosols are formed on ancient land surfaces and subsequently buried by younger deposits (Birkeland 1974:9). A widespread paleosol, documented in many archeological sites in the study area, occurs stratigraphiclly between the Watana and Oshetna tephra units. Another paleosol with a more localized distribution, has been found immediately below the Oshetna tephra. The chronological importance of these paleosols for dating archeological sites is discussed in chapter 8.

4.5 - Paleoecology

A post-Wisconsinan warming trend, beginning about 10,000 years ago, set the stage for floral and faunal colonization of the still glaciated portions of south-central Alaska. This warming trend peaked in a thermal maximum, termed the Hypsithermal interval, occurring between 7500 and 3500 years B.P., in some parts of Alaska (Pewe 1975a:113). The Hypsithermal may have actually begun as early as 8000 years B.P. in south-central Alaska, according to the botanical work of Heusser (1960). Following the Hypsithermal was a late Holocene climatic interval known as the Neoglacial, ranging from 3500 years B.P. to within the last two or three centuries (Flint 1971:524; Pewe 1975a:112; Ager and Sims 1981:85). Two relatively cool periods separated by at least a thousand year hiatus occurred during the Neoglacial. During this time, the cooler climate initiated glacial advances and a possible shift in botanical regimes. Inferred climatological and vegetational regimes for the Susitna River basin during the Holocene are presented in Table 4.3.

(a) Paleobotany

Paleobotanical evidence suggests that the vegetation of south-central Alaska changed dramatically during the Holocene when "successive invasions of trees transformed the treeless or nearly treeless landscape into a mosaic of forest, muskeg, tundra, and forest-tundra" (Ager 1983:139). At the present time, palynological analysis of lake cores taken by University of Alaska Museum personnel near Watana Creek is still in progress, so a local vegetational history cannot be presented. However, published data on sediment cores from the Alaska Range and the Tanana River valley provide a fair approximation of the vegetational succession in the Susitna River area. Published results of paleobotanical research in south-central Alaska localities are limited to the coastal forest zones, and are therefore not comparable to vegetation along the Susitna River.

Pollen evidence from lake cores in the Tanana River valley indicate that the full-glacial vegetation of Interior Alaska was treeless or nearly treeless and dominated by herbaceous plants and shrub willow, vegetation referred to as tundra-steppe or arctic-steppe. A climatic change to warmer, moister summers triggered a shift to shrub-tundra, characterized by dwarf birch (Betula), willow (Salix), Ericaceae (Labrador tea, cranberry, blueberry, etc.), and herbs at about 14,000 years B.P. This shrub-tundra vegetation was invaded by deciduous scrub-forest, including poplar (Populus), 3000 years later. Spruce (Picea), spreading southwestward from Canada via the Porcupine and Yukon rivers, entered the Tanana River valley by 9500 years B.P., the Alaska Range as early as 9100 years B.P., and the Kenai Peninsula by about 8000 years B.P. Alder (Alnus) expansion occurred at about 8400 years B.P., and by 6000 years ago the boreal forest had reached its present-day composition (Ager 1983:134).

The vegetational succession in the Alaska Range is similar to that of the Tanana River valley, although the shifts in vegetational regimes appear to occur somewhat later. For example, the invasion of Betula into the northern foothills occurred at about 13,000 years B.P., whereas in the Tanana River valley it occurred approximately one millennium earlier (Ager 1983:132).

One of the paleobotanical localities lying closest to the Upper Susitna River basin is Tangle Lakes at the headwaters of the Delta River in the Central Alaska Range. The pollen record indicates that the early postglacial vegetation (ca. 12,000 - 9500 years B.P.) in the area was herbaceous tundra with dwarf birch, a species which came to predominate at about 9500 years ago (Schweger 1981:99; Ager and Sims 1981:87). As in the Tanana River valley, poplar and later spruce, entered the area. Pollen and macrofossil evidence document the arrival of spruce by 9100 years B.P. in the Tangle Lakes area, although an earlier date of 9400 years B.P. for the spread of spruce forests has been reported by Connor (1983) for the Copper River basin. Sometime during the millennia which followed, spruce apparently died out or became scarce in the vicinity of Tangle Lakes. A resurgence of this species occurred approximately 3500 years B.P. a time period which coincides with the onset of the Neoglacial interval of cooler, moister climate (Ager and Sims 1981). It is not clear if this fluctuation in the Picea population was only limited to the Tangle Lakes area or had a more widespread occurrence.

(b) Paleontology

During Wisconsinan time, glacial barriers restricted the migration of the diverse Pleistocene mammalian fauna of unglaciated Alaska into the study area. Wooly mammoth (Mammuthus primigenius), steppe bison (Bison priscus), horse (Equus), and caribou (Rangifer tarandus) were among the megafaunal species included in this arctic-steppe biome (Matthews 1982:139). The only documented evidence in Alaska of Pleistocene megafauna south of the Alaska Range is that of a large proboscidean femur, probably that of a mammoth, found in situ in a bluff exposure near the confluence of the Susitna and Tyone rivers (Thorson et al. 1981). Dated at 29,450 ± 610 years B.P. (DIC-1819) on a sample of bone collagen, the mammoth is thought to have migrated southward through unglaciated passes of the Alaska Range during the Middle Wisconsin interstadial. The occurrence of the fossil is interpreted to represent a brief mammoth population expansion, followed by local extinction, rather than a widespread distribution of these mammals in south-central Alaska during the Middle Wisconsinan period (Thorson et al. 1981:415).

Large numbers of the megafaunal species became extinct or retracted their distribution around 14,000 - 10,000 years B.P. (Guthrie 1982:324). During this period, the long-standing dominance of arctic-steppe fauna by mammoth, horse, and bison was replaced by cervids, better adapted to the emerging vegetation zones and Holocene habitats (Guthrie 1982). As suitable habitat became available after the recession of glaciers south of the Alaska Range, surviving species began to colonize the area. Moose (Alces alces), caribou (Rangifer tarandus), and Dall sheep (Ovis dalli), are among the Pleistocene fauna that migrated southward with the waning of the glaciers.

4.6 - Climate

The present-day climate in Interior and the extreme northeastern part of south-central Alaska has been classified as Continental, one of four major climatic zones in Alaska (Selkregg 1974; Policastro 1984:G-3). Light precipitation and extreme temperature variations characterize this zone. Along the Middle and Upper Susitna River, the climate is similar to that of Interior Alaska, but with slightly milder temperatures and greater precipitation. Annual precipitation is between ca. 25-40 cm (10-15 in.), although it may exceed 50 cm (20+ in.) at higher elevations. Snow accumulation ranges from ca. 125-250 cm (50-95 in.) depending on altitude. Although temperature highs of 35°C (95°F) and lows of -50°C (-58°F) have been recorded, summers are mostly in the 16-21°C (60-69°F) range, and winter temperatures range from -12° to -34°C (10° to -30°F). At the western end of the Middle Susitna River, the climate grades into what is classified as the Transition zone of variable conditions between those of the Continental and Maritime zones. Terrain is also a major controlling factor for establishing local climatic conditions.

In order to monitor weather within the Susitna River study area, eight meteorological stations were installed in 1980. The most representative measurements were reported from the Watana station, located about 1.6 km north of the Susitna River, midway between Tsusena and Deadman creeks (Policastro 1984:G-3). In 1981, the maximum annual temperature of 22.7°C (73°F) was reached in June, and the minimum of -36.7°C (-34°F) was reached in December. Wind direction was predominately from the east-northeast and west-southwest, and ranged from 2.3-4.2 m/sec (ca. 5-9 miles per hour) (R & M Consultants 1984). Winds of greater velocity occur at higher elevations in the project area.

4.7 - Vegetation

Vegetation in the Middle and Upper Susitna River basin is part of the vast northern coniferous forest, or taiga, found in the subarctic regions. In Alaska, the taiga zone is usually delineated by the distribution of (Picea glauca), white spruce (Viereck 1975:1-5). Black spruce (Picea mariana), and hardwoods such as paper birch (Betula papyrifera), balsam poplar (Populus balsamifera), and quaking aspen (Populus tremuloides) are also associated with south-central Alaska forests. Shrubs and tundra species, such as sedges and members of the Ericaceae family (Labrador tea, blueberry, cranberry, etc.), add to the vegetational mosaic of the study area.

Mapping of major vegetation types throughout the study area has been undertaken by McKendrick et al. (1982). Their classification system is based upon one developed for the entire state by Viereck and Dyrness (1980). The system is hierarchical and involves organizing plant communities into broad classes based on similarity of composition by species. The communities are named for dominant species in principal layers (i.e., tree, shrub, herb) and listed under four major formations - forest, tundra, shrubland, and herbaceous vegetation (Viereck and Dyrness 1980:4-5). Table 4.1 presents the list and distribution of each of the vegetation types mapped in an area extending for 16 km on either side of the Susitna River from Gold Creek to the Maclaren River. Inventories of all plant species associated with each vegetation type can be found in McKendrick et al. (1982).

Ten forest types, differentiated by predominant species of tree (spruce, birch, poplar, aspen) and the extent of canopy cover (open, closed, or woodland), have been identified. In terms of shrubland, the vegetation types reflect the height of the shrubs (tall or low), the extent of the canopy cover, and the predominant species (willow, birch, and alder). Tundra vegetation is classified by presence of particular plant communities, as well as drainage of the underlying soil. Grasslands constitute the herbaceous vegetation found in the study area. The actual extent of each vegetation type by hectare and total area also appears in Table 4.1. Shrubland accounts for the greatest proportion of the total (ca. 38%), followed by forest vegetation (ca. 30%), tundra (ca. 25%), herbaceous vegetation (less than 1%). An additional ca. 6% of the area is unvegetated.

Table 4.1

Distribution of Vegetation Types in the Upper and Middle Susitna Basin (includes 16 km on either side of the Susitna River from Gold Creek to Maclaren River) (after McKendrick et al. 1982; Jastrow 1984)

Vegetation Type	Habitat	Hectares	% of total
Forest		142,306	30.75
Woodland black spruce	Poorly drained sites, sometimes underlain by permafrost on north-facing slopes; grades into boggy areas; average elevation of samples is 620 m.	62,993	13.62
Woodland white spruce	Warmer, well-drained sites	13, 291	2.87
Open black spruce	Poorly drained sites, sometimes underlain by permafrost	28,304	6.12
Open white spruce	Warmer, well-drained sites; on slopes or flatlands, or along rivers at an average elevation of 487 m.	10,460	2.26
Open birch	Steep, relatively dry, usually south-facing slopes	1,498	.32
Closed birch		2,324	.50

Table 4.1 (Continued)

Vegetation Type	Habitat	Hectares	% of total
Closed balsam poplar	Islands in the rivers or flat areas in the flood plain	571	.12
Closed aspen	Upper levels of dry, south-facing slopes	pockets too small to map	
Open mixed conifer-deciduous	Successional stage where white spruce is replacing deciduous forest; on slopes along river or on flood plain	9,639	2.08
Closed mixed conifer-deciduous		13,226	2.86
Shrubland		177,264	38.24
Open tall shrub	Usually in stringers through other vegetation types on slopes along rivers and creeks; in rings around mountains at certain elevations	15,524	3.36
Closed tall shrub		15,767	3.41
Birch shrub	See mixed low shrub	42,880	9.27
Willow shrub	See mixed low shrub-may occur in standing water	8,230	1.78

Table 4.1 (Continued)

Vegetation Type	Habitat	Hectares	% of total
Mixed low shrub	On relatively flat benches with soils that are frequently wet and gleyed, but without standing water; adjacent to treeline or within forests	94,863	20.52
Tundra		144,728	24.81
Wet sedge-grass	Wet, depressed areas with poor drainage	3,517	0.76
Mesic sedge-grass	Rolling uplands with well-drained soils	27,505	5.95
Sedge-shrub	Wet, depressed areas with poor drainage	20,073	4.34
Mat and cushion	Dry, windy ridges at high elevations (1013 m); shallow soils	63,633	13.76
Herbaceous Vegetation		1,097	.24
Herbaceous and grassland	Level to sloping terrain at low elevations along the river	1,097	.24
Disturbed and unvegetated		27,003	5.84
TOTAL AREA		462,398	99.98

The general distribution of vegetation types varies according to terrain, elevation, drainage, and the effects of natural disturbances such as fire and stream erosion and deposition. In the steep Susitna River canyon area between Portage Creek and the Oshetna River, the slopes are covered with conifer, deciduous, and mixed forests. Low shrub or woodland conifer communities occur on flat benches on the tops of banks, while tundra vegetation is found on the low mountains rising from these banks. To the southeast, in the extensive flats between the Susitna River and Lake Louise, low shrubland and woodland conifer stands occur and are often intermixed. To the northeast, in the vicinity of the Maclaren River, woodland and open spruce stands predominate (McKendrick et al. 1982:13).

4.8 - Fish and Wildlife

(a) Fish

The Susitna River drainage provides habitat for 19 species of fish (Table 4.2), classified in eight different families. The most well represented family is the Salmonidae which includes species of salmon, trout, whitefish, cisco, and grayling. Both anadromous and resident fish populations occur in the Susitna River and its tributaries. These two groups differ in terms of their life cycles - the former migrating from freshwater to the ocean and back again for spawning, while the latter remains in freshwater year-round. They also differ in terms of their distribution within the Susitna River drainage. With few exceptions, the anadromous fish are restricted to the waters downstream of Devil Canyon as the water velocity and high discharge of the canyon prevent further upstream movement (Acres American, Inc. 1983b:E-3-11). Resident species can be found throughout the drainage, with the exception of the rainbow trout, which also does not occur upstream of Devil Canyon.

The anadromous fish population is comprised primarily of five species of Pacific salmon, (Chinook, pink, sockeye, chum, and coho) each with a

Table 4.2

Fish and Mammalian Wildlife in the Susitna River Basin

Common Name	Scientific Name
Fish	
Anadromous species:	
Chinook (king) salmon	*Oncorhynchus tshawytscha*
Coho (silver) salmon	*Oncorhynchus kisutch*
Sockeye (red) salmon	*Oncorhynchus nerka*
Pink salmon	*Oncorhynchus gorbuscha*
Chum (dog) salmon	*Oncorhynchus keta*
Eulachon	*Thaleichthys pacificus*
Bering cisco	*Coregonus laurettae*
Dolly Varden[a]	*Salvelinus malma*
Humpback whitefish[a]	*Coregonus pidschian*
Arctic lamprey[a]	*Lampetra japonica*
Resident species:	
Arctic grayling	*Thymallus arcticus*
Rainbow trout[b]	*Salmo gairdneri*
Lake trout	*Salvelinus namaycush*
Burbot	*Lota lota*
Round whitefish	*Prosopium cylindraceum*
Threespine stickleback	*Gasterosteus aculeatus*
Longnose Sucker	*Catostomus catostomus*
Slimy sculpin	*Cotlus cognatus*
Northern pike	*Esox lucius*

Table 4.2. (Continued)

Common Name	Scientific Name
Mammals	
Nongame species and furbearers:	
Masked shrew	*Sorex cinereus*
Dusky shrew	*Sorex monticolus*
Arctic shrew	*Sorex arcticus*
Pygmy shrew	*Sorex hoyi*
Northern red-backed vole	*Clethrionomys rutilus*
Meadow vole	*Microtus pennsylvanicus*
Tundra vole	*Microtus oeconomus*
Brown lemming	*Lemmus sibiricus*
Northern bog lemming	*Synaptomys borealis*
Collared pika	*Ochotona collaris*
Snowshoe hare	*Lepus americanus*
Beaver	*Castor canadensis*
Muskrat	*Ondatra zibethicus*
Hoary marmot	*Marmota caligata*
Arctic ground squirrel	*Spermophilus (Citellus) parryi*
Red squirrel	*Tamiasciurus hudsonicus*
Porcupine	*Erethizon dorsatum*
Pine marten	*Martes americana*
River otter	*Enhydra lutra*
Least weasel	*Mustela nivalis*
Short-tailed weasel	*Mustela erminea*
Mink	*Mustela vison*
Red fox	*Vulpes vulpes*
Lynx	*Felis lynx*
Coyote	*Canis latrans*

Table 4.2. (Continued)

Common Name	Scientific Name
Big game species:	
Moose	*Alces alces*
Caribou	*Rangifer tarandus*
Dall sheep	*Ovis dalli*
Wolf	*Canis lupus*
Wolverine	*Gulo gulo*
Black bear	*Ursus americanus*
Brown bear	*Ursus arctos*

[a] Also may be considered resident species
[b] Not found above Devil Canyon

characteristic upstream migration period. Chinook enter the river first and arrive in the mainstem Susitna River between Talkeetna and Devil Canyon from mid-June through July. Pink salmon migration occurs from late July through August, while sockeye, chum, and coho move upstream between late July and September (FERC 1984:3-17). From the section of the river between Talkeetna and Devil Canyon, the fish migrate up tributaries such as the Talkeetna and Chulitna rivers where spawning takes place. Although salmon are restricted from the mainstem above Devil Canyon, Prairie Creek, a tributary of the Talkeetna River which drains Stephan Lake, provides an important salmon run immediately adjacent to the Middle Susitna River drainage.

The availability of anadromous species, particularly salmon, in early prehistoric time was not equivalent to what it is today. During the final phases of the Late Wisconsinan glaciation when vast quantities of water were locked in permanent ice sheets, the sea levels were as much as 100 m lower than at present. When the ice melted, the sea level rose once again. Steeper river gradients therefore existed during the last glacial advance, but as sea level rose, they gradually became more gentle, approaching present-day conditions by about 5000 years ago. It is the contention of Fladmark (1975) that salmon could not have attained full productivity prior to the stabilization of stream gradients at this time.

The dominant resident species upstream from Devil Canyon is the arctic grayling (Acres American, Inc. 1983b:E-3-11). It occurs in both lakes and streams. All the major tributaries of the Middle Susitna River support grayling populations, with the greatest density occurring in Tsusena Creek (Coutant and Van Winkle 1984:I-23). Lakes also provide habitat for lake trout and less commonly pike, while other resident fish, such as the burbot, round whitefish, longnose sucker, and slimy sculpin prefer the river drainages.

(b) Wildlife

(i) Birds

Birds are represented in the study area by a great many more species than mammalian forms of wildlife. Included within the 135 identified species are waterfowl, loons, and grebes; raptors and other large land birds such as ptarmigan, ravens, cranes; shorebirds and gulls; and a group of small birds comprised of woodpeckers and passerines. A complete inventory of these species, as well as their relative abundance and habitat preferences are presented by Kessel et al. (1982).

The most abundant of all species are the common redpoll, Lapland longspur, and three species of sparrow. While redpolls are habitat generalists, the other four abundant species occupy the extensive shrublands of the area. Other common residents of shrub thickets are willow and rock ptarmigan. In terms of density, the forest and woodland habitats actually support a greater biomass of birds than do shrub communities. A large variety of passerines and woodpeckers and the spruce grouse are found in such habitats. Golden eagles and marsh hawks are the most common of the raptors in the area. The former are known to breed on cliffs along the Middle Susitna River and its tributaries each year. Spotted sandpipers and mew gulls are also common summer breeders along the shorelines of creeks and rivers (Kessel et al. 1982). Wetlands of the area support waterbirds in summer and during spring and fall migrations. Relatively few breeding birds of all species inhabit the ponds and lakes in summer. The most numerous birds during migrations are scaup species, followed by mallards and American widgeons. Based on waterfowl counts in spring and fall, Kessel et al. (1982:51) have suggested that the Middle and Upper Susitna River basin is not on a major migration route for these birds. Kessel et al. (1982) also determined that certain waterbodies in the area were more important than others on a seasonal basis. Stephan and Murder lakes, lying just outside the Middle Susitna River basin, were found to be two of the most important lakes for waterfowl when all seasons were considered.

(ii) Nongame species and furbearers

The range of small nongame mammals and furbearers which inhabit the Middle and Upper Susitna River basin includes insectivores (shrews), rodents (microtine, squirrels, and larger rodents such as porcupine), lagomorphs (hares and pikas), and carnivores (mustelids, felids, and canids). The relative abundance and habitat preference for 16 species of small mammals have been presented by Kessel et al. (1982). They found that some of the small mammal species, such as the masked shrew and the red-backed vole, occupy a broad range of vegetation types, while others are more restricted. Marmots and pika are limited to the alpine zones, and red squirrels, porcupine, and hares occupy forested areas. The Upper and Middle Susitna River drainages were found to support a large and stable population of arctic ground squirrels, an ecologically important species which provides an abundant food resouce for mammalian and avian predators. A complete inventory of mammalian species is presented in Table 4.2.

Habitat use by the furbearers differs considerably by species. Beavers and muskrats both inhabit lakes and slow-flowing sections of major creeks, whereas pine martens are most numerous in coniferous and mixed forests and woodland habitats below 1000 m (3281 feet) in elevation. These three species are most important to trappers in the area.

Both otters and mink are common in the Middle Susitna River basin along the river and its major tributaries to 1220 m (3937 feet) and also along lakeshores. Primary habitat for red fox appears to be high elevation areas near or above timberline. Short-tailed weasels have been observed in a variety of habitats, while the presence of the least weasel has only been recorded on rare occasion. Lynx are uncommon along the Susitna River at present, but apparently were fairly numerous in the past. Coyotes are limited to the area downstream from Devil Creek (Acres American, Inc. 1983b:E-3-295 - E-3-365).

(iii) Big Game

Moose, caribou, Dall sheep, wolf, bear, and wolverine comprise the big game species inhabiting the Susitna River basin. Moose, caribou, and, to a lesser extent, Dall sheep, have been documented archeologically (present volume: chapter 8 and Appendix D) as being important subsistence resources for past inhabitants of the area, and therefore are discussed below in greater detail than the other forms of big game.

(1) Moose

Moose are widespread and numerous along the Middle and Upper Susitna River, with an estimated 11,000 or more individuals inhabiting 14,000 km^2 in the environs of the Middle and Upper Susitna River basin at present (Soholt 1984:K-5). A large moose population was known to exist in the area as far back as 1955 when the Alaska Department of Fish and Game began taking annual aerial censuses (Acres American, Inc. 1983b:E-3-311). Our knowledge of the abundance of moose during earlier times is still very sketchy, although the presence of moose bones in several archeological and one paleontological site (TLM 196) does provide some information on the time depth of moose occupation in the Susitna River region (see chapter 8 and Appendix D for further details). The fragmentary mandible of a Pleistocene moose found at TLM 196 on Goose Creek (Appendix D) attests to the presence of the species presumably shortly after deglaciation. Evidence for moose is not found again until relatively recent protohistoric/historic Athapaskan times. It has been documented that moose have expanded their range considerably since 1875 (Peterson 1955), which suggests that moose may have only recently reentered the area. However, it is also possible that continuous occupation at low population densities or earlier periodic range extensions into the area may have occurred. Lutz (1960) makes a strong case for moose being present on the Kenai Peninsula, to the south, for a long period of time despite the assertions that these animals migrated into the area during the 1800's. Support for his argument came from an archeological site on Yukon Island in Cook Inlet's Kachemak Bay which was excavated by de Laguna (1934). Her excavations revealed moose bones from several levels within the site. The original radiocarbon samples dating the site were discovered to be contaminated, but later cross-cultural dating of the earliest cultural component containing moose bones suggests a date of greater than 2000 years B.P. (de Laguna 1975). The early occurrence of moose bones at archeological sites dating from A.D. 1000 at Cape Krusenstern, in an arctic region where very recent migration supposedly occurred, has been noted by Hall (1973), and further supports the possibility of early periodic range extensions. It has been suggested by Kelsall (1972) that invasion of new ranges may be promoted by plant succession and new habitat availability following forest fires.

The annual cycle in the life history of moose involves seasonal movement from calving grounds in the spring to a more dispersed summer distribution, and then to congregation in the fall for breeding, followed by winter dispersal. Calving occurs at relatively low elevations (ca. 790 m or 2600 feet) from Devil Creek to the Oshetna River during May and June, with concentrations occurring along the major drainages of the basin. Summer habitats tend to lie at a somewhat higher elevation (ca. 850 m or 2750 feet). Breeding is concentrated in the uplands between Watana Creek and the Oshetna River, and to the west along Tsusena and Prairie creeks in September and October. Upland areas (850-900 m or 2800-2950 feet) continue to be utilized in the winter, according to studies undertaken in the area between 1977 and 1981. In earlier studies, the lowlands were also found to be occupied during the winter. The contrast may be due to the less severe winter and greater availability of browse in more recent years (Soholt 1984:K-6 - K-11).

On a year-round basis, spruce habitats are most important to moose for both food and cover. Upland shrub communities also provide habitat during the summer, fall, and throughout the winter if the winter is not severe. The most heavily used browse species are willow (three species), Sitka alder, and resin birch, although herbaceous plants and moss are also eaten in the summer (Ballard et al. 1982b; Acres American, Inc. 1983b; Soholt 1984).

The distance covered in seasonal movements varies considerably for various subpopulations of moose in the study area. Based on general patterns of movement and areas of concentration, 13 subpopulations of the species were identified (Ballard et al. 1982b:93). Each of the subpopulations was classified as sedentary or migratory. In the former group, summer and winter ranges were small and overlapping in area, while in the latter, the ranges were large and nonoverlapping. Migratory moose often move 16-93 km between seasonal home ranges. Movement for both sedentary and migratory groups involved seasonal changes in elevation and north-south travel along the tributaries (Ballard et al. 1982b:53, 56).

(2) Caribou

Paleontological evidence for caribou in Alaska dates to the height of the Late Wisconsin glaciation (Matthews 1982:14). As one of the successful species of Pleistocene fauna in North America, caribou have extended their range into previously glaciated areas, such as south-central Alaska. This area is now inhabited by several caribou herds, the largest of which, the Nelchina herd, ranges over about 50,000 km^2 (20,000 $mi.^2$) in and surrounding the Upper and Middle Susitna River basin (Skoog 1968; Davis 1978; Soholt 1984). The range of the Nelchina herd, illustrated in Figure 4.5, has remained essentially the same since 1948 when the Alaska Department of Fish and Game began studies of the herd. This range is considered to be the "center of habitation", encompassing the best habitat and serving as a focal point for dispersal, for caribou populations in south-central Alaska (Skoog 1968).

The use of the Nelchina range is closely tied to seasonal movements and population density of the herd. Historically, the Susitna River canyon uplands have been shown to provide important rangeland in all seasons (Skoog 1968). Although wintering and summering grounds may have changed over the course of the years, the herd has maintained remarkable

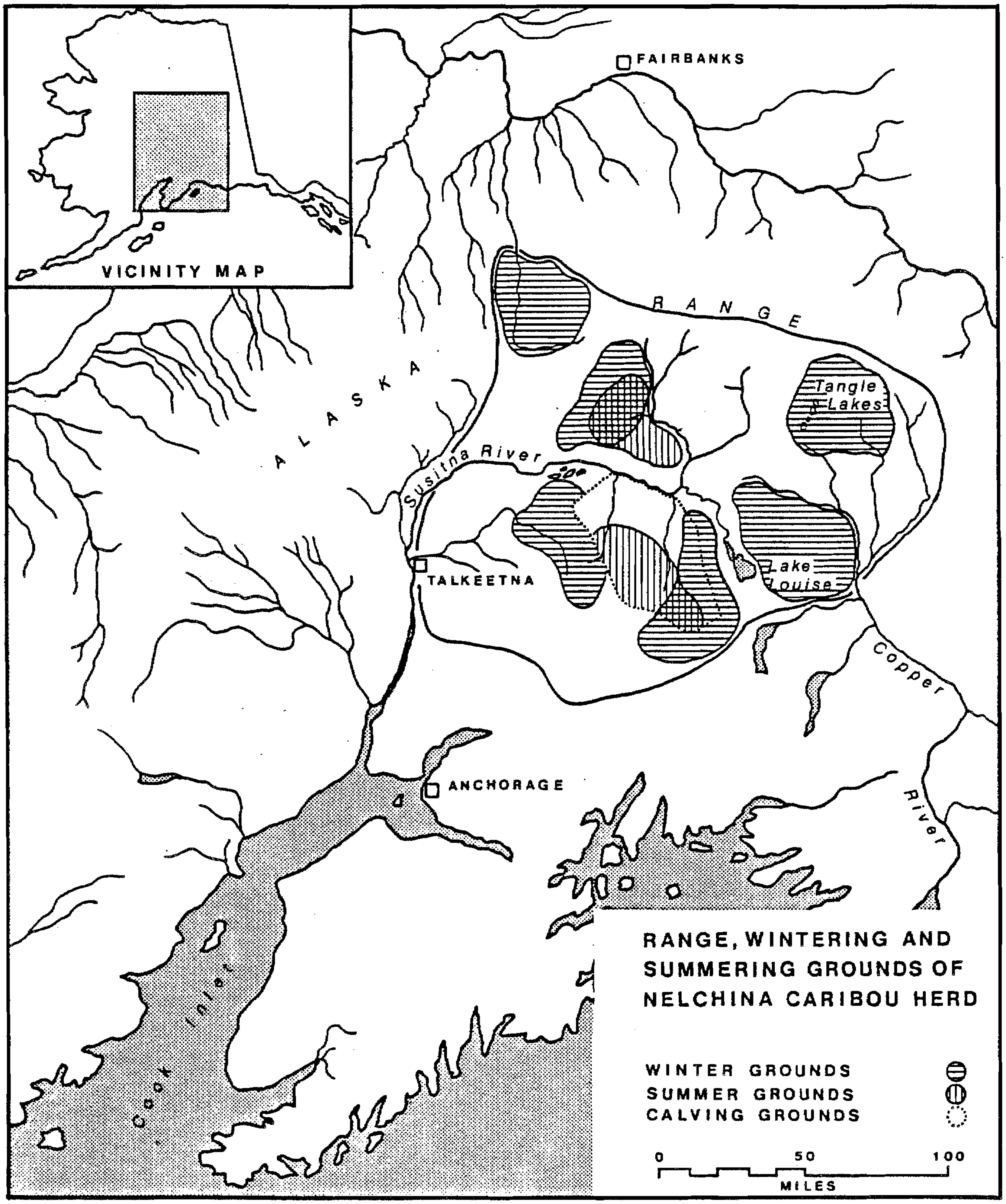


Figure 4.5. Range, Wintering and Summering Grounds of the Nelchina Herd (adapted from Skoog 1968)

fidelity to their traditional calving grounds south of the Susitna River in the vicinity of the Oshetna River and Kosina Creek (Skoog 1968:122, 440). The calving grounds are also frequently used as a summering area. Another area used during the summer is located on the north side of the Susitna River in the hilly treeless terrain around Deadman, Watana, and Jay creeks (Figure 4.5). During the summer, the female segment of the herd is relatively cohesive, while the males are more widely dispersed (Pitcher 1982:18).

Considerable movement and mingling of the sexes occur during the autumn rut. By the end of October, migration to the wintering grounds has begun. In contrast to the repeated use of the calving grounds, wintering areas have been more dispersed throughout the range. In recent years, the herd has wintered on the Lake Louise Flat and middle portions of the Gakona and Chistochina river drainages (Pitcher 1982:9). Various migration routes to and from the wintering grounds have been documented, and in general, the time, extent, and direction of these seasonal movements are characterized by their uncertainty (Skoog 1968: 119).

Vegetation types which provide primary habitat for the Nelchina herd are spruce forests, shrubland, and herbaceous vegetation (Acres American, Inc. 1983b:E-3-322). The use of different types of vegetation varies by season and by sex of the animal. In recent winters, the herd has occupied the spruce forests of Lake Louise Flat, with the male segment of the population tending to remain in the area after the females have departed for the calving grounds (Soholt 1984:K-13). The main winter forage for the animals is lichen, sedges, and small amounts of dwarf birch (Pegau and Hemming 1972:3). Despite their obvious preference for certain species of lichens, caribou can exist in areas where lichens are scarce (Skoog 1968:352). Except for Lake Louise Flat, the principal caribou habitat lies above timberline where heath vegetation (Ericaceae, sedges and lichens) is important forage. Willows and mosses are also constituents of the caribou diet (Murie 1935:37).

Historical records dating back to 1848 have been valuable in reconstructing the population fluctuations of the Nelchina herd for over a century. These records, compiled by R.O. Skoog (1968), indicate that in the last 100 years two population peaks occurred. The first took place in the mid-1800's and the second in the early 1960's, at which time the population increased to 71,000 animals. The major factors believed to control population levels are food availability and predation. Even though the range of the herd shrinks with decreasing population, movements of the Nelchina herd continue to focus on the traditional calving grounds regardless of the population status (Hemming 1975). At present, the herd numbers approximately 20,000 individuals, which represents a population doubling from the mid-1970's low of less than 10,000 (Soholt 1984:K-12).

(3) Dall Sheep

Dall sheep are another species of Pleistocene ungulate which successfully made the transition to a Holocene environment. During the Pleistocene, these animals were more widespread (Guthrie 1982:310, 314), but now are confined to alpine habitat and rarely extend below timberline. Along the Susitna River, they are found on steep, open terrain interspersed with rocky slopes, ridges, cliffs, and rugged canyons (Soholt 1984:K-16). The three general areas that sheep are known to inhabit are: 1) Portage/Tsusena Creek drainage, 2) Mount Watana, south of the Susitna River between Fog Lakes and Kosina Creek, and 3) Watana Hills, located between Watana and Jay creeks. The largest population, at times numbering over 200 animals, is found in the Watana Hills (Ballard et al. 1982:2, 5; Acres American, Inc. 1983b:E-3-326, 327).

Unlike the wide-ranging caribou, sheep are more or less sedentary and tend to cluster within familiar areas (Schweger et al. 1982:433). Patterns of movement and distribution of sheep within these areas can be affected by the presence of mineral licks, which are considered to be a critical habitat requirement for these animals (Heimer 1973). Several mineral licks are located in the Watana Hills, including an important one on lower Jay Creek. Use of mineral licks is most intensive in spring and summer when sodium levels in the diet may be low (Soholt 1984:K-17). As sheep cannot feed through deep snow, they usually inhabit windblown high-mountain ridges in winter (Guthrie 1982:314). The Watana Hills population also occupies south-facing slopes, which frequently have shallower snows than slopes with different aspects (Acres American, Inc. 1983b:E-3-327).

(4) Other Big Game Species

Brown bear, black bear, wolf, and wolverine comprise the other big game species not previously discussed. Each of these species is quite mobile and exhibits some form of seasonal movement in response to food availability. Brown bear, also known as grizzly bear, are abundant and occupy a variety of habitats in the Middle and Upper Susitna Basin. Home range for males has been estimated at 780 km^2, while females occupy a smaller range. In the spring, brown bears are often found in spruce habitats, while open tundra habitats are frequented in late spring and early fall. Late fall and winter hibernation takes place in dens on south-facing slopes usually above 1200 m (4000 feet) in elevation. Their traditional movements include dispersal to upland shrub habitat in late summer when berries (<u>Vaccinium</u> spp.) are ripe. Some brown bears also move to Prairie Creek or downstream along the Susitna River in July and August to take advantage of the salmon runs (Miller and McAllister 1982; Alaska Department of Fish and Game 1982; Acres American, Inc. 1983b; Soholt 1984).

In comparison to brown bears, black bears have a much less extensive home range in the Susitna River area, with males averaging 46 km^2. Their habitat is largely confined to the lowland spruce forest adjacent to the mainstem of the Susitna River. In late summer these bears may move to somewhat higher shrubland terrain to forage for ripening berries. They generally return to their spring and early summer home ranges in spruce forests to den in September. Denning occurs on steep south-facing slopes at an average elevation of about 600 m (2000 feet), which is considerably lower than brown bear dens. Both species of bear are omnivorous, although a smaller proportion of the black bear's diet is comprised of animal protein (Miller and McAllister 1982; Alaska Department of Fish and Game 1982; Acres American, Inc. 1983b; Soholt 1984).

More widely ranging than either the brown or black bear is the wolf, which occupies a variety of habitats along the Susitna River. The average pack home range is 1412 km^2. Each of the 13 known or suspected wolf packs, comprised of between 2 and 15 individuals, maintain an exclusive, nonoverlapping territory. Seasonal movement for these carnivores revolves around the distribution of prey, chiefly moose and caribou. In summer, the den and rendezvous site, which may be located in various habitats, is the focal point for activity. In general, lower elevations are frequented in winter more than in summer (Ballard et al. 1982a; Alaska Department of Fish and Game 1982; Acres American, Inc. 1983b; Soholt 1984).

The most elusive of the big game animals is the wolverine. It is a solitary animal which relies to a certain extent on scavenging. Like the other big game, it is highly mobile, with males extending on average over a 413 km^2 home range. Seasonal movement is affected by food supply. A pronounced movement toward upland shrub and tundra habitat has been noted in spring and fall, which may correlate with the emergence and hibernation of arctic ground squirrels, one of their prey species. In the winter, movement to the lower elevation spruce forest occurs. As a furbearer, wolverine are harvested annually by trappers (Gardner and Ballard 1982; Alaska Department of Fish and Game 1982; Acres American, Inc. 1983b; Soholt 1984).

4.9 - Summary

A broad overview of the physical and environmental factors conditioning human settlement along the Middle and Upper Susitna River basin has been presented in the preceding sections of this chapter. The intent of the discussion has been to provide a chronological perspective on the history of geological events which shaped the landscape long before the first people entered the area, and the subsequent environmental changes which undoubtedly affected many aspects of the early inhabitants' culture. The geological record indicates that by about 20 million years ago the major topographic features of the area, such as the Talkeetna Mts., had been established. Subsequent glaciation altered the landscape, with the most recent glacial events of Late Wisconsinan time still clearly evident in the lanforms present today. By 12,000 years B.P. the main valley and lowlands of the Susitna River were ice free, but deglaciation of the small valleys was not complete until approximately 9000 years ago. Until sometime between these two dates, the area was virtually inaccessible to human entry.

The rate to which floral and faunal colonization took place following glacial retreat also affected the time of entry. The earliest vegetational regimes in the area probably consisted of tundra-steppe species of herbaceous plants and occasional shrubs. Shrubs, such as birch and willow, gradually came to predominate, and by approximately 8000 - 9000 years ago, spruce had also colonized the area. Changes in plant communities not only provided habitat for more varied forms of wildlife, but also altered the desirability of certain locales for human occupation. For example, the vantage point afforded from sites used as lookouts for game may have become obscured with the invasion of spruce. Conversely, spruce and deciduous forest would have provided shelter and raw material sources not available when tundra and shrubland were the prevailing forms of vegetation.

The availability of animal resources also changed as a function of the changing environment. Although not documented archeologically, it is possible that species of extinct Pleistocene fauna contributed to the subsistence of the earliest inhabitants of the Middle and Upper Susitna River basin. The presence of one such species, the steppe bison (Bison priscus) has been identified from an early component at the Dry Creek site in the Central Alaska Range (see chapter 3). Big game species, such as the caribou, Dall sheep, and perhaps even moose are assumed to have been available throughout the millennia of human occupation of the area. Small game and birds would also have become possible constituents of the aboriginal diet once the appropriate habitats became established. Salmon, which is limited to the rivers and streams of the Lower Susitna River (but closely adjacent to the Middle Susitna River in locales such as Stephan Lake and Prairie Creek), may not have reached full productivity until sometime after 5000 years ago.

It seems very likely that the effects of the cooler climate during the Neoglacial interval and the emplacement of tephra falls over the landscape during the Holocene also had some effect on prehistoric populations inhabiting the area. These effects may have been subtle or short-term in nature, and thus more difficult to discern in the archeological record.

All information derived from archeological sites must be interpreted within the framework of the physical and environmental setting in existence at the time the site was occupied. Therefore, geological, paleontological, palynological, etc. data become crucial parts of the explanatory process in archeology. Intergration of data in such fields with artifactual analysis will be the basis of the ensuing discussion in chapter 8 of this volume.

5 - RESEARCH DESIGN

5.1 - Introduction

Goodyear, Raab, and Klinger (1978:161) define research design as:

> ... an explicit plan for solving a problem or set of problems. It is a plan that must contain theoretical goals in the form of a specific problem or hypothesis, relevant analytical variables, and specification of data that will allow empirical testing. To be complete, the design must lay out the methods and techniques for acquiring and analyzing the data, and predict the expected outcomes of the analysis.

The various elements which a research design should contain and the factors which it should consider, along with interrelated methodological and theoretical concerns are presented in various federal documents (36 C.F.R. 66; Advisory Council on Historic Preservation 1980; National Parks Service 1983; McGimsey and Davis 1977). Extensive discussion regarding research designs is also found in the professional literature (Binford 1964, 1968, 1977; Holton 1975; Plog 1974; Binford and Sabloff 1982; Butzer 1982; Dunnell 1982; Raab and Goodyear 1984; Salmon and Salmon 1979; Renfrew et al. 1982; and others). As discussed by Redman (1973:64), the approach to research design development in a region, such as the Middle Susitna River, where little data regarding the history and prehistory are available, must begin with general site survey and paleoenvironmental studies.

Unlike most regions of North America where cultural historical information is well documented and supported by chronologic, stratigraphic, and geographic patterns of artifact associations, the Susitna Project area was largely terra incognita prior to 1980. The relative potential of the area for the resolution of specific types of anthropological problems was unknown. Additionally, no fundamental research had been conducted in analogous areas (dominated by a fast-flowing, silt-laden, unnavigable river lacking salmon runs and bordered by steep canyon walls) which could be extrapolated to the Middle Susitna River. Based on the existing knowledge of site distributions and pre and postcontact resource exploitation, the opinion of many regional archeologists was that few sites were expected to be located in the area. By the end of the program, 248 previously unknown sites were discovered, thus suggesting that concepts regarding site distributions may require substantive rethinking.

In an important area specific paper, Davis (1984b) observes that Alaska lags far behind the continental United States in the development of its information base and research goals while reflecting contemporaneity in the development of archeological method and theory. This fundamental anachronism is the basis for considerable professional confusion and frustration in attempting to design and execute regional research programs. The development of any research design for Alaska must be fully cognizant of the incongruity between the comparatively underdeveloped regional data base and well-developed, contemporary method and theory at the national level. Most importantly, it must come to grips with this problem during research design formulation, and provide mechanisms by which the expanding data base may modify, and even redirect, research objectives if necessary. The need to develop a substantive regional data base was recognized in the development of the Susitna research design.

The necessity for feedback mechanisms in research design formulation is important in all scientific research, and particularly so for archeological surveys undertaken in regions for which little background data exists. This fundamental element in research design formulation is widely recognized (Redman 1973:62; McGimsey and Davis 1977:50; Shiffer and Gummerman 1977; and others). By incorporating feedback mechanisms into research designs, the gap between the rather under-developed regional data base and the comparatively well-developed body of method and theory can be progressively closed as research develops. In areas, such as the Middle Susitna River area, where basic cultural historical and fundamental geographic artifact associations were essentially unknown, it was not fruitful to formulate overly specific or focused hypotheses or problems during the initial stages of research design development. Instead it was more realistic to define general problem domains and formulate a research strategy and field procedures to ensure that data collected could be used to define more focused research questions and topical themes within the encompassing problem domains. Because of the sparse nature of the data directly available for the Susitna area and adjacent regions prior to field investigations, the Susitna cultural resources survey was designed as a progressive developmental process which was modified with feedback of new data in a rapidly expanding, multidisciplinary research environment. The role of feedback in the research design is illustrated in Figure 5.1.

Knowledge of the context of inquiry and historical development of the Susitna research design are important to understanding the research design itself. Because of their complexity and detail, specific aspects and facets of the research design are presented as separate chapters. This is necessary because lengthy technical presentations detract from the logical flow required to present the research design in a cohesive and synthetic fashion. Where appropriate, the reader is referred to these sections. While this segregation is necessary, separate sections of this report discussing areas surveyed, methods employed, literature reviewed, and background data presented are integral and important facets of the overall research design and should be recognized as such.

5.2 - Research Objectives

A primary, initial objective of the Susitna program was to test a fundamental hypothesis of an inferred cultural historical sequence for the area (Dixon et al. 1980a:29), while at the same time recording pertinent environmental information which would enable refinement of research questions within the context of larger problem domains. The initial stages of the program emphasized the testing of the hypothetical cultural chronologic framework for the area. It was realized that only through the accurate temporal and geographic ordering of past events could important anthropological issues such as shifts in settlement and subsistence patterns be addressed meaningfully. Thus the delineation of cultural chronology in an archeologically unknown area such as the Middle Susitna River should not be viewed as incompatible with other

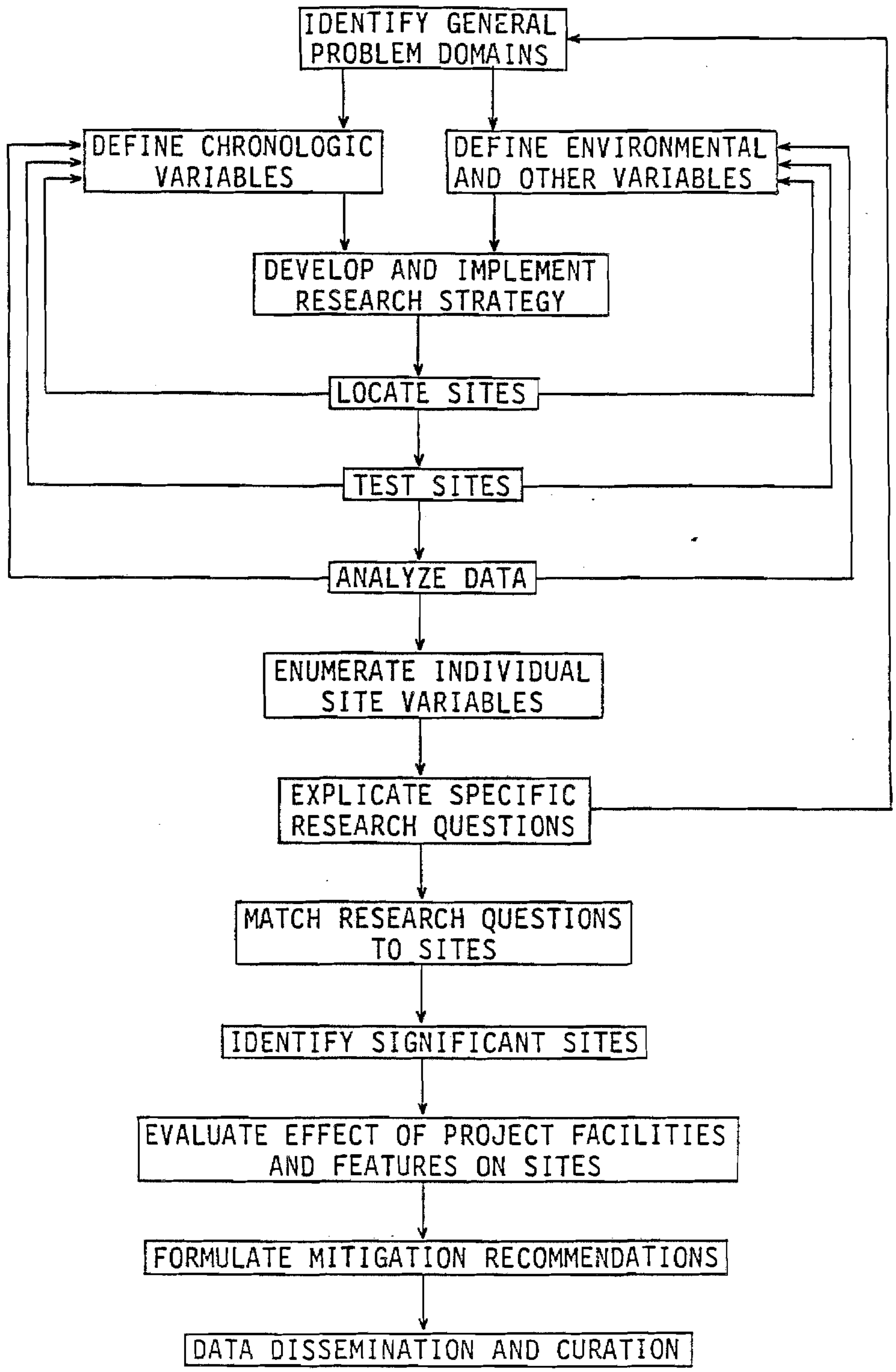


Figure 5.1. Research Design for the Susitna Hydroelectric Project Cultural Resources Program

archeological objectives. Rather, they were developed concurrently. Problem domains such as cultural ecology, cultural evolution, and settlement and subsistence analysis are fields of inquiry which are complementary to developing cultural chronology. However, the value of such research topics to anthropological inquiry is enhanced if they can be fixed in time.

The interdisciplinary blend primarily of anthropology and geology incorporated in the Susitna program established the temporal rigor essential for archeological interpretation and the realistic development of specific and substantive research questions. These questions provided the basis for more thorough development of the rich potential of the Susitna area to address important problem domains within the larger context of anthropological inquiry. Research questions also provided important criteria for determining which sites, or interrelated group of sites, represent significant cultural properties, thus facilitating the formulation of mitigation recommendations. An important objective in developing the cultural resources survey design was to interface management goals and research objectives.

The major objectives of the overall program were to: 1) establish a fundamental chronological framework for the area; 2) conduct intensive archeological survey of the areas of proposed direct impact combined with environmental and paleoenvironmental investigations; 3) develop research questions within the larger context of anthropological inquiry which the sites could address; 4) within the chronological framework, enumerate site variables necessary to address each research questions; 5) articulate the research questions to specific cultural resources; and 6) develop mitigation recommendations for the proposed hydroelectric project. To meet these objectives within the ever changing context of multidisciplinary research in the area, a research design was developed which would provide both flexibility and the ability to accomplish these objectives within the temporal, fiscal, and contractual constraints.

5.3 - Problem Domains

Five major problem domains of anthropological inquiry were defined which could be addressed within the scope of the Susitna cultural resources program. There were: 1) cultural chronology, 2) possible effects of tephra falls on prehistoric human ecology, 3) subsistence and settlement, 4) population dynamics, exchange, and diffusion, and 5) ethnography and history. Physical and environmental data were recorded from the discovered sites. Coupled with interpretation of cultural remains from the sites and information gathered from the available literature, these data were brought to bear on the specific problems outlined above. The establishment of a local chronological framework enabled comparison of this information through time, thus creating a data base amenable to advancing explanatory postulates. The theoretical basis for these initial assumptions in research design formulation rests within the vast body of data, methods, and theory within the subfields of anthropology, primarily culture history and cultural ecology.

5.4 - Chronological Variables

A speculative cultural historical sequence was developed during the winter of 1979-80, using archeological data from known sites within and adjacent to the study area. Chapter 3 presents information regarding these sites. The fundamental goal at this stage of research design development was to evaluate the validity of the postulated cultural historical sequence, and to modify and/or redefine it through field research.

To accomplish this goal the project area was divided into eleven major geological/morphological units (later subdivided, modified, and termed "terrain units"). This task was accomplished through airphoto analysis and interpretation and review of the geologic literature pertinent to the problem and study area. At that time it was anticipated that maximum limiting ages could be established for these surficial geologic deposits, thus providing broad temporal units within which to establish the chronological framework necessary to order the associated artifact assemblages through time. A similar approach had been successfully implemented for the Ft. Wainwright, Alaska, Cultural Resource Study (Dixon et al. 1980). As originally proposed, data resulting from on-the-ground examination and evaluation of the geological/morphological units in 1980 would be used to refine the definition and geographic distribution of the geological/morphological units. These units would then be used to develop a stratified random archeological sampling program.

For reasons discussed in the project history section (2.3) of this report, the concept of stratified random sampling was abandoned at the end of the 1980 field season, and the use of terrain unit maps produced for the Susitna Hydroelectric Project by R&M Consultants, Inc. (1981) was incorporated into the research design. By using these terrain unit maps, the archeological program would be consistent with other studies as well as engineering designations for the project. These terrain unit maps ultimately were used to provide a general characterization of the terrain in which sites were located. They served as a "*post facto*" basis for assessing the type of environment surveyed and the frequency of sites associated with the specific terrain units.

During the 1981 field season the existence of widespread tephra deposits throughout the study area was confirmed. At least three distinct tephra units were identified in a variety of terrestrial settings. Following the field season, radiometric determinations facilitated the development of a preliminary tephrochronology for the study area. The local tephrochronology provided the stratigraphic framework against which the postulated cultural historical sequence was tested and within which various sites were analyzed. The regional chronologic framework and cultural historic sequence resulting from tephrochronology and artifact analysis are presented in chapter 8, Analysis and Synthesis of Project Data.

5.5 - Environmental Variables

During the initial literature review, environmental settings in which archeological sites were known to occur in adjacent regions were identified. They include overlooks, lake margins, and stream and river margins. In addition to these three major types of site locales, the potential occurrence of quarry sites, caves, rockshelters, and topographic constrictions in the study area was also recognized. In 1982, mineral licks were recognized within the study area and added to the list of high potential locales for archeological site discovery. The seven types of site setting which were considered to have high archeological potential are listed below.

1) Overlooks: Locales of higher topographic relief than much of the surrounding terrain. They generally command a panoramic view of the surrounding area, and it is generally inferred that these types of natural settings served as hunting locales and/or possibly short-term camp sites.

2) Lake Margins: These are sites situated adjacent to lakes. It is generally inferred that such sites are frequently more permanent seasonal camps. Fishing, exploiting fresh water aquatic resources, and large mammal hunting are inferred to be the primary economic activities associated with these sites.

3) Stream and River Margins: Sites situated adjacent to streams and rivers vary from large, semipermanent, seasonal camps to what are probably brief, transient camps. Fishing, large mammal hunting, travel, and exploitation of fresh water aquatic resources are activities most probably associated with sites situated in these locales.

4) Quarry Sites: Natural exposures or secondary deposits of lithic raw material suitable for the manufacture of stone artifacts characterized these locales. The major activity associated with

these sites is the primary reduction of large blocks and cobbles of lithic raw material.

5) Caves and Rock Shelters: Natural cavities or overhangs in rock exposures large enough to afford shelter to one or more individuals are the attributes which characterize this type of locale.

6) Natural Topographic Constrictions: These locales are geomorphic settings which tend to concentrate and funnel large mammal movements within a restricted geographic area. Such locales served as hunting sites and possibly semipermanent seasonal camps.

7) Mineral Licks: Natural geologic exposures containing minerals, primarily sodium, which are consumed by large mammals characterize this type of locale. Areas adjacent to these locales served as hunting sites and short-term camp sites.

A variety of specific settings are subsumed under these broad environmental categories. However, there is little precise detail about environmental or paleoenvironmental settings of individual sites from adjacent regions described in the literature. Thus, a primary objective of the 1980 research strategy was to obtain more precise data relevant to prehistoric settlement patterns and the juxtaposition of individual sites in relation to the natural environment. It was anticipated that analysis of these data would increase predictability for locating archeological sites and permit detailed analysis of shifting subsistence patterns during various temporal intervals. Further, it was anticipated that these types of data might provide correlations between changing settlement patterns and environmental changes.

Fossil indications of environmental features, such as stream and lake terraces and relict stream channels, were incorporated in defining survey areas within the surficial units. It was recognized that such geomorphic and environmental features could occur together or in close proximity, thus further increasing the potential for former human occupation. Many sites in adjacent areas have been subject to reoccupation and share more than one of the defined physical, topographic, or environmental features. It was postulated that there may be a compounding effect in human utilization of a locale if more than one of these major variables occurred, thereby increasing the possibility of its use and subsequent reuse. Thus the initial literature review provided valuable insights to focus archeological survey within the defined geomorphological units, and to identify environmental and other variables important for site interpretation.

5.6 - Research Strategy

The development and implementation of the research strategy involved three stages: site location, site testing, and analysis of data from sites that were found. The methods and forms employed in collecting these data are described in chapter 6 and presented in Appendix B. Each of the stages in the research strategy is discussed below.

(a) Site Survey

In the development of a research design for an archeological survey in an area as large as the proposed Susitna Hydroelectric Project, it is not only important to recognize types of locales most likely to hold high potential for archeological site discovery, but also to legitimately eliminate others from the survey. Such areas may be identified by two criteria: 1) the extreme unlikelihood of specific types of environments to contain archeological sites based on objective physical criteria; and 2) the difficulty in testing specific types of environments, such as areas of standing water, based on the practical limitations of contemporary archeological survey techniques. Four types of locales were defined which were considered to contain low/no potential for archeological site discovery. These were: 1) steep slopes exceeding 15°, 2) areas of standing water such as lakes, bogs, and muskeg; 3) active gravel and sand bars within the river and its tributaries; and 4) the active channels of the Susitna River and its tributaries. These locations were not, however, arbitrarily eliminated from intensive archeological survey. For instance, during the 1980 field season, survey was conducted on gravel bars and islands in the Susitna River, bogs and muskeg areas in the uplands, and slopes exceeding 15° which contained exposed ground. Additionally, lake core samples were obtained to identify pollen and tephra profiles, and in no case was evidence of cultural resources found.

The entire "surveyable" portion of the proposed areas of direct impact was subject to survey. Within the limits of the survey procedures and methods described in chapter 6, all proposed areas of direct impact were surveyed exclusive of most areas defined as exhibiting low/no potential for archeological site discovery. Chapter 7, Areas Examined for Cultural Resources, precisely defines the direct impact areas surveyed. To facilitate the survey for cultural resources the study area was divided into management units termed survey locales. Survey locales are specific geographic units which were subject to intensive field survey. A total of 182 survey locales were examined. Maps of these survey locales are presented in Appendix E.

During 1980 and 1981 survey locales were usually defined based on the occurrence of one or more terrain features considered to exhibit high potential for the discovery of cultural resources. The number of survey locales was ultimately expanded to include the entire "surveyable" portion of the areas of proposed direct impact. As management units, survey locales were frequently defined on criteria other than their assessed potential to contain cultural resources. These factors were: 1) proximity to locations suitable for helicopter landing zones, and 2) spatial units which could be surveyed given the manpower levels at any given time. Several survey locales were subject to resurvey either in whole, or in part, if: 1) evaluation of the survey locale forms and field notes by project supervisors suggested the survey did not cover all high potential areas; 2) new data derived from site survey, testing, and/or analysis suggested increased coverage was necessary; 3) survey crews overlapped adjacent survey locales which had been surveyed during previous years; and 4) it was necessary, for survey crews to cut across previously surveyed areas in route to new survey locales or to landing zones. Within the survey locales most historic sites were located by visual reconnaissance and prehistoric sites were found by shovel testing or by examining natural exposures.

(b) Site Testing

The Susitna cultural resources program implemented two types of subsurface testing: 1) survey level testings, and 2) systematic testing. A detailed discussion of both testing phases is presented in Chapter 6.

(c) Artifact Description and Analysis

Artifact description and analysis was undertaken at two levels: 1) site specific, and 2) regional. Site specific description consisted of organizing, classifying, tabulating, and presenting recovered artifactual material from specific sites (see Chapter 6). These data were then synthesized with their associated contextual data and the environmental setting of the site. Regional analysis was focused on interpreting the data from all the sites within the project area in order to outline the regional history and prehistory, and ascertain which sites and/or groups of sites held the potential to address specific research problems and other concerns. Site specific description and regional analysis are presented in Appendix D and chapter 8, respectively.

Given the comparatively poor state of the data base for the region, and Alaska in general, it was imperative that precise and accurate descriptions be presented for each site tested. This was recognized as an important factor in research design development as new data, such as rapidly expanding knowledge in the realm of tephrochronology, necessitated reinterpretation of many sites. From a purely management perspective, comprehensive descriptions of sites and their associated contextual data are essential for continuity since future investigations may be performed by a different research team several years after the cultural resources survey. As research problems evolve and new data are presented, future researchers will require a substantive descriptive data base from which new research questions can be formulated and against which hypotheses may be tested (Lynott 1980). While interpretive reports address current research problems, descriptive site reports lend themselves to reinterpretation as new concepts emerge. A major contribution of the Susitna cultural resources program was the establishment of this type of data base at the survey level.

5.7 - Enumeration of Site Variables

Following description of the survey and site testing data, the array of variables (site setting and size, temporal context, and artifact assemblage) for the project area were enumerated. These variables were recorded on site data coding forms (Appendix B.4) and recorded for each site.

(a) Site Setting

Locational data compiled for each site include map coordinates, elevation, site size, terrain, vegetation, proximity to topographic features, and view. Map location was recorded by: 1) map quadrangle, e.g., Talkeetna Mountains; 2) the designation of the particular section of the quadrangle, e.g., D-5; 3) the township, range, section, and quarter section description; 4) the UTM coordinates to the nearest 50 m; and 5) the latitude and longitude coordinates to within 5 seconds. The elevation of the site was recorded according to the position of the site on USGS 1:63,360 series maps. Altimeter readings were recorded for direct impact sites.

Calculation of site size was based on the distribution of artifacts, features, and the results of grid shovel testing. An estimate of size was made only on the basis of artifact and feature distribution for sites which were not grid shovel tested. The testing procedures for site size determination are presented in Chapter 6 of this report.

Additional information relevant to the location of the site is provided by the terrain unit and vegetation regime within which a site is situated. Geologic terrain units used were defined by R & M Consultants, Inc. (1981) for the Susitna Hydroelectric Project. Descriptions of the vegetation regime at the site follow the designations on the vegetation maps prepared for the Susitna Hydroelectric Project by the Agricultural Experiment Station (1981), University of Alaska, Palmer. When these maps did not encompass areas where sites were located, the sites were assessed following the definitions of the terrain or vegetation units. Eighteen types of landforms (such as kames, eskers, and stream confluences) upon which sites were located were defined and the occurrence of sites in relation to these settings was recorded.

(b) Temporal Context

Sixteen stratigraphic regional units were identified in the project area. No individual tests or sites were found to contain all 16 stratigraphic units, however, several archeological sites exhibit at least ten. Within any given site or site locus, subunits can be arranged in stratigraphic order. The stratigraphic units are composed of the surface organics and associated pedogenic units, three tephra units, glacial drift, bedrock, and the intervening contacts. By regarding the contact units as separate stratigraphic units, it is possible to accurately define the intervals between deposition of soil/sediment units. The three tephra units were identified by local, project specific names. From the earliest to most recent they are: Oshetna, Watana, and Devil. The tephra units are identifiable in the field on the basis of color and texture.

Because it was not possible to date all strata at every site, an emphasis was placed upon the relative dating potential of the tephra units. The region-wide occurrence of the tephra deposits make them excellent temporal horizon markers. The association of stratigraphic horizons and stratigraphic units enables the construction of cultural components based upon the artifact assemblages of a number of sites sharing the same stratigraphic position.

Nine stratigraphic horizons frequently containing cultural remains were identified and correlated throughout the region. These zones consist of the upper level of organics, organic silts, and the contact between them, the surfaces of the three tephras, and the surface of the glacial drift or bedrock (chapter 8). In some cases paleosols were present between the tephra units. Dating these paleosols and cultural occupations associated with them assisted in establishing limiting dates for the tephra falls.

Chronological documentation of sites and components within the project area was based upon four methods: 1) the direct historic approach, 2) radiocarbon determinations, 3) relative stratigraphic placement, and 4) typological comparison of artifact assemblages with similar assemblages from dated sites, and specific artifact types such as trade beads which could reliably be used as temporal indicators. The nine stratigraphic horizons were dated within limits, although the time span represented by specific stratigraphic horizons varied from a few hundred years to as much as 7000 - 8000 years for stratigraphic horizon 9. Four major cultural traditions and one cultural complex, each characterized by a unique artifact assemblage have been documented within the study area and are discussed in section 8.6 of this report.

(c) Artifacts

An artifact is defined as any object for which one or more attributes could be ascribed to human activity. The definition is further expanded to include faunal and floral material brought onto the site, structures and features, and items modified from stone, bone, wood, or other raw material. The major categories of artifacts are 1) lithic remains which can be sorted according to material type and morphology, 2) faunal remains, 3) flora remains, 4) nonlithic artifacts (manufactured from bone, wood, glass, or metal), and 5) features.

Various types of lithic artifacts have been defined for the study area. These include: modified flakes, scrapers, blades, microblades, burins, burin spalls, bifaces, bifacial preforms, notched points, stemmed points, leaf-shaped points, lanceolate points, triangular points, microblade cores, microblade core tablets, blade cores, rejuvenation flakes, flake cores, hammerstones, abraders, and notched pebbles. The definition of each of the tool types may be found in Appendix A of this report. Information was recorded on the occurrence of the nontool categories: unmodified lithic flakes, thermally altered rock, ochre, cobbles, cobble fragments, and rock fragments (manuports).

Eight commonly occurring types of raw material used in the production of lithic artifacts have been identified in the study area. These raw materials are argillite, basalt, chalcedony, chert, obsidian, quartz, quartzite, and rhyolite. The distribution of tools by type and raw material was analyzed for the artifact assemblage of each component of a site or locus.

The occurrence of faunal remains was recorded for the variety of animals present in the Middle Susitna River valley. Fauna include the subsistence species (caribou, moose, and sheep), the furbearing species (wolf, wolverine, and hares), rodents, birds, and insects which may be incorporated into the site either intentionally or as a result of noncultural deposition. Subsistence and furbearing species are not mutually exclusive categories of fauna. The fur and flesh of all listed species presumably could have been used aboriginally. The research design placed special emphasis on caribou due to the apparent importance of this species in the subsistence regime. Specific skeletal elements of caribou and moose were recorded to elucidate patterns of subsistence activities.

Floral remains, such as seeds and macrofossils (charred or unburned), were recorded and collected when present at archeological sites. These specimens hold potential for research questions concerning subsistence or paleoenvironmental reconstructions. They can also be valuable for radiocarbon dating purposes.

Other artifacts made of bone/antler, metal, glass, and wood were recovered from the study area. Features which were recorded include cultural depressions, hearths, historic structures (such as cabins and caches), stone cairns, and hunting blinds.

5.8 - Research Questions

The identification of readily distinguishable regional tephra units in the Middle Susitna region provided a unique opportunity in Alaskan archeology to address research questions from a diachronic perspective. The occurrence of well-preserved organic remains in younger sites provided an excellent data base for addressing problems within the context of history and ethnography. Specific questions were formulated within the five major problem domains previously identified: 1) cultural chronology, 2) possible effects of tehpra falls on prehistoric human ecology, 3) subsistence and settlement, 4) population dynamics/exchange and diffusion, and 5) ethnography and history. Within each major problem area specific questions and pertinent topics were explicated in such a manner that they could be addressed by sites in the project area. The specific questions and topics are presented in detail, along with the specific sites which hold the potential to address these topics, in a separate report entitled "Site Significance: Framework for Evaluating Cultural Resources Associated with the Susitna Hydroelectric Project in Central Interior Alaska".

5.9 - Match Questions to Sites

The process of constructing a framework for matching specific sites, or groups of sites, within the Middle Susitna River area to research questions and other important topics was a complex task which involved three major steps: 1) identifying the variables present at the sites; 2) formulating specific research questions and identifying other topics of concern which the variables could realistically address; and 3) matching the specific sites, or group of sites, having the appropriate variables to specific questions and themes. To facilitate the correlation of site variables to research questions, a computer coding system (Appendix B.4 and chapter 6) was created (version 9 of the Statistical Package for the Social Sciences). The evaluation of specific sites, and groups of sites, is presented in a separate report entitled "Site Significance: Framework for Evaluating Cultural Resources Associated with the Susitna Hydroelectric Project in Central Interior Alaska".

5.10 - Identify Significant Sites

The federal mandate to manage and protect archeological and historical resources has historically divided cultural properties into two classes: those which are "significant" and those which are not (Tainter and Lucas 1983:707). The complexity of the concept of significance has been discussed and evaluated in a number of reports and articles (Anderson 1974; Scovill et al. 1972; House and Schiffer 1975; Moratto 1975; Glassow 1977; King et al. 1977; Raab and Klinger 1977; Schiffer and Gummerman 1977; Schiffer and House 1977; Moratto and Kelly 1978; Sharrock and Grayson 1979; Barnes et al. 1980; Tainter and Lucas 1983).

Effective evaluation of the concept of significance can be accomplished by dividing it into types.

> In principle, the process of assessing significance is relatively straightforward once there is agreement on the types of significance that needs to be considered. One first specifies explicit criteria for judging resources in relation to each type of significance. Then the fit between the criteria and the resources is evaluated. Finally, it may be desirable to arrive at an overall judgment based on a weighing of the types of significance that have been considered (Schiffer and Gumerman 1977:240).

Although several types of significance have been recognized in the literature, including historical, ethic, public, legal, and scientific significance (Schiffer and Gumerman 1977:244-245), two are considered most encompassing and integral to the research design. Legal and scientific concepts of significance provide two different but interrelated perspectives. The development of legal and scientific concepts of significance are presented in a separate report entitled: "Site Significance: Framework for Evaluating Cultural Resources Associated with the Susitna Hydroelectric Project in Central Interior Alaska".

The crucial element that defines significance for the vast majority of sites discovered during the Susitna cultural resources program is research potential. By evaluating the variables contained within specific sites, it was possible to identify the sites and/or groups of sites which hold the potential to address important archeological research problems, and themes and issues within the context of ethnography and history. Sites which demonstrated their potential to address these issues through objective analysis of their contents and contexts, coupled with the application of other source materials (chapters 3 and 4), were recognized as significant. Hence these sites potentially qualify for protection under both state and federal law. Within the context of the research design the concept of significance is the most important element in unifying management, academic, and humanistic concerns. A site was considered not significant if it did not exhibit the required variables, or suite of variables, necessary to address the topic. Specific sites were also evaluated as not significant if their integrity was destroyed as a result of erosion, cryoturbation, or adverse human impact.

5.11 - Evaluate Project's Effect on Sites and Formulate Mitigation Recommendations

The determination of impact was based on the location of sites in relation to project facilities and features, and their expected effect on the surrounding terrain and associated sites. Adverse impact of the Susitna Project on cultural resources was divided into 3 categories: 1) direct impact, 2) indirect impact, and 3) no-impact. Sites considered to fall under the direct impact category are located in proposed project areas, such as the proposed Devil Canyon and Watana dam sites, the Devil Canyon and Watana reservoirs, borrow areas, geotechnical testing sites, proposed construction camps, villages, and airstrips. Indirect impacted sites were defined as those sites which will be secondarily impacted by the proposed project, and which would not be impacted if the project were not undertaken. Indirect impact sites include those that may suffer erosion, such as sites on the shores of the proposed reservoirs (including the shoreline as it fluctuates during filling) or on tributaries of the Susitna (or other land features) that may be eroded due to altered drainage patterns. Increased access into what are today remote areas, as a result of construction and operation of the Susitna Project, was also considered indirect impact. Sites that will not be directly or indirectly impacted by the Susitna Project were classified as locales of no impact resulting from the proposed project.

Mitigation measures were recommended for significant sites subject to adverse impact by the proposed project. These measures included avoidance, preservation and/or data recovery. Mitigation recommendations considered groups and/or classes of sites (e.g. sites that represent various time periods or activities), and/or sites that are unique due to their location and/or artifact assemblage or other important attributes. Avoidance was the preferred recommendation whenever possible.

5.12 - Data Dissemination and Curation

The final report will be presented for review to State and Federal agencies having oversight responsibilities for the Susitna Project, and will be deposited in appropriate public repositories. Because of its massive size, publication of the report in its entirety is not feasible. One article "Interstadial Proboscidean from South-Central Alaska: Implications for Biogeography, Geology, and Archeology" (Thorson et al. 1981) resulting from the Susitna cultural resources program has already been published. Another publication "Cultural Chronology of Central Interior Alaska" (Dixon 1984) presents some of the Susitna data in a preliminary fashion as part of a larger regional paper. Future articles are planned which will present specific aspects of the Susitna data and will be submitted to appropriate professional journals for publication. Two master theses are currently in preparation which rely on data recovered during the course of the Susitna cultural resource program. One, by Thomas Dilley, presents the results of investigations and analysis of pedogensis and weathering of the Susitna valley tephra sequence. The other, by Thomas E. Gillispie, focuses on interpretation of the Northern Archaic tradition. They will be submitted through the University of Alaska, Fairbanks' programs of Geology and Geophysics, and Anthropology, respectively. Following faculty approval, these theses will be available through the University of Alaska, Fairbanks' Elmer E. Rasmuson Library.

The more than 285,000 specimens and their associated contextual data resulting from the program are housed in perpetuity at the University of Alaska Museum (chapter 6) where they are available for use by students, researchers, and resource managers. To a limited degree these data may also be used for exhibit and public education.

6 - METHODS

6.1 - Introduction

Although basic methods were consistent throughout the cultural resources program (1980-1985), methods were refined as necessary by the Museum. Methods described in this section reflect refinements that were implemented during the course of the project. Figure and Table designations prefixed by a letter indicate the appropriate appendix where this information is located, e.g., B.3.1 is located in Appendix B.

6.2 - General Procedures

Among the general quality control procedures in effect for the project were those concerned with data control, recording dates, and units of measurement. At the beginning of each field season, the names of project personnel and their unique initials were recorded. Dates were recorded in the format of month/day/year, whether spelled out or abbreviated. The units of measurements were normally metric. Exceptions were made for those measurements concerned with elevation above sea level or when working with historic structures or objects in which the colloquial units convey special significance (e.g., 2 x 4" lumber).

Organization of data recorded in the field was facilitated during the 1984 field season by the use of loose-leaf notebooks. Previous years used bound field notebooks. The management systems of indexing and pagination remained the same. Pages dealing with specific survey locales or sites were separated from individual loose-leaf notebooks and then reorganized into appropriate survey locale or site notebooks or file folders. This facilitated future research topically through the consolidation of information from several sources into a single location.

Each field notebook had three primary components: 1) a guidelines section (Appendix B.3) which detailed the format for data collection,

2) an index which listed the topic and page number of each notebook page completed, and 3) blank notebook pages stamped with a data management heading. The guidelines covered the content and format of data collected from survey of locales, survey testing, and systematic testing. The use of standardized format assured that all of the required information were recorded in the field, and that each individual's notes were of comparable completeness and quality.

The second component of the notebook was an index in which the individual kept a log of each page completed. An example of an index page appears in Figure B.3.1. The notebook pages were numbered consecutively as used and all pages had to be accounted for in the index.

The main body of the notebook was comprised of notebook pages, each stamped with the data management heading illustrated at the top of Figure B.3.1. In the blank space after the heading "Locale/Site" the data recorder entered the survey locale or AHRS site number which was the subject of the notes. The topic being discussed was entered on the second line. Topics could be narratives on specific subjects, plan views, artifact inventories, soil/sediment descriptions, etc. If the page discussed a test (shovel, grid, pit, or square), the designation of the test and the level concerned (if appropriate) were identified. The name of the individual, the date, and the individual's page number appear on the third line. Each new topic in the notes began on a separate page.

Upon the conclusion of work on a locale or site, the pertinent pages were removed from the notebooks and filed together. Table of contents for the collated pages and their source appear at the front of the collated notebook. After the pages had been collated for a specific survey locale or site, special page numbers were placed on the line in the upper right hand corner. This procedure facilitated file management when working with data from various sources with duplications or gaps in personal page numbers. Completeness of the documentation and its conformation with project procedures were documented by the signatures of the crew leader and field supervisor.

A quality control program was designed to provide control over the quality of all aspects of the monitoring program. Crew members were at the initial level of quality assurance in the data collection process. The crew member was responsible for following established guidelines for field procedures, report preparation, and collections management. The crew leader supervised the crew members, was responsible for assuring the quality of work by the crew, and for the orderly transmission of data and documentation into the quality assurance system. Field supervisors oversaw the work of their respective crews, documented compliance with procedures, and scheduled activities for the efficient attainment of project objectives. Field supervisors also coordinated logistics in the field and were in charge of the field program in the absence of the principal investigator and assistant principal investigator/project supervisor.

The principal investigator and assistant principal investigator/project supervisor guided the direction and progress of meeting project goals, and monitored quality assurance procedures of field supervisors, crew leaders, and crew members. The principal investigator and assistant principal investigator/project supervisor were responsible for the attainment of the project objectives.

Support personnel of secretaries, laboratory assistants, student assistants, and museum technicians were assigned tasks by research associates/field supervisors and higher levels of authority who were in turn responsible for quality assurance of the work performed at their request. The activities of the support personnel included administration, report preparation, expediting, and file and collections management. Secretaries recorded budget expenditures, processed purchase orders, maintained time sheets, and transcribed reports into final format. Museum technicians, in addition to other tasks to which they might be assigned, were responsible for the curation of project collections and graphics.

Individuals were introduced to and educated in the quality control program and the hierarchy of responsibilities at prefield orientation sessions, quality control meetings, and during the conduct of quality review. Copies of the Procedures/Quality Assurance Manual Cultural Resources Investigation Susitna Hydroelectric Project (Updated May 1984) were provided to crew members and were also available in each office or laboratory.

6.3 - Literature Review

During the initial phases of the project in the spring of 1980, a literature review pertaining to the archeology, ethnology, history, geology, paleontology, flora, and fauna of the study area and adjacent regions was undertaken. This review was integral to the preparation of the research design and original procedures manual. Since that time, review of the literature has been ongoing, and frequent additions and updates to the bibliography have been made. An effort has also been made to seek out primary sources of documentation, particularly pertaining to the ethnohistory of the area, as well as pertinent unpublished records, such as original USGS fieldbooks dating to the early 1900's.

The library, collections, and data files stored at the University of Alaska Museum and the Rasmussen Library on the University of Alaska campus have been used extensively throughout the literature review process. The archives at the Rasmussen Library and the Alaska Native Language Center at the University of Alaska have provided many valuable unpublished references. Additional sources of information include the AHRS (Alaska Heritage Resource Survey) files stored at the Office of History and Archaeology in Anchorage and maps published by USGS. Other researchers - archeologists, linguists, ethnographers, geologists, and wildlife biologists - have also been extremely helpful in providing information, including their own unpublished research. A compilation of all references reviewed and used in the preparation of this report is presented in the bibliography.

6.4 - Survey

The purpose of survey was to locate, identify, and inventory archeological and historical sites within the study area. Survey was aimed at identifying the type, size, and environmental associations of the site. Intensive archeological survey was conducted in the "surveyable" portions of areas to be directly impacted by the Susitna Hydroelectric Project (see sections 5.6 and 5.11). Intensive survey is a comprehensive field survey (McGimsey and Davis 1977) and "describes the distribution of properties in an area; determines the number, location, condition, and types of the properties; permits classification of the properties; and records their physical extent" (National Park Service 1983). In conducting intensive survey, the cultural resources program implemented two methods for locating sites: 1) visual surface investigation and 2) subsurface testing.

(a) Survey Locales

For logistical and management purposes, units of survey were delimited as survey locales or project defined areas such as proposed borrow sources, construction areas, airstrips, access routes, etc. Survey locales were management units in which field personnel concentrated their efforts for the finding of cultural resources. The use of survey locales ensured the examination of all surveyable portions of the study area. A master map showing survey locales to be tested was prepared each season to facilitate scheduling of survey activities. Survey locale maps were prepared prior to survey and the pertinent air photos and USGS quadrant maps identified. The localization of survey effort also facilitated transportation logistics.

(i) Survey Locale Form

Pertinent information on the survey locale was recorded on the survey locale form (Appendix B.1) and in field notebooks. Photographs were also taken to document each locale. The survey locale form was designed to record three types of data. First, a field description of the locale was obtained noting the uniformity or variability of surface morphology. Discrepancies between the definition of the units on the geological or terrain unit maps and field observations were identified. Second, areas within the survey locale which could be eliminated from the cultural resources survey were identified and objective criteria for these decisions recorded. And third, areas having high cultural resource potential in or adjacent to the locale were identified. The number of sites found during the survey and the amount of subsurface testing were recorded on the form.

The forms also had the vital function of facilitating the evaluation of survey coverage within the locale. Survey locale forms were evaluated with respect to coverage and recommendations of the field crew. Additional survey within or adjacent to a locale was undertaken if warranted.

Upon completion of a survey locale, crew members' notebook pages pertaining to the locale or site were assembled by the crew leader and placed in the appropriate notebook. A checklist for survey locale data sheets (Figure B.3.23) was filled out once all of the pages had been collected by entering the data recorder's initials and individual notebook page numbers in the right hand column of the checklist labeled "reference". Other information entered on the survey locale checklist were the AHRS numbers for sites located within the survey locale. It was also the responsibility of the individual entering data on the site checklist to check the location of the site plotted on the UTM master map and other required maps. When all information had been entered, the crew leader signed and dated the line labeled "Entered by". A final check was made by the field supervisor and/or project supervisor, who also signed and dated the checklist if all were in order. Items out of compliance were returned to the responsible party for correction in a timely manner.

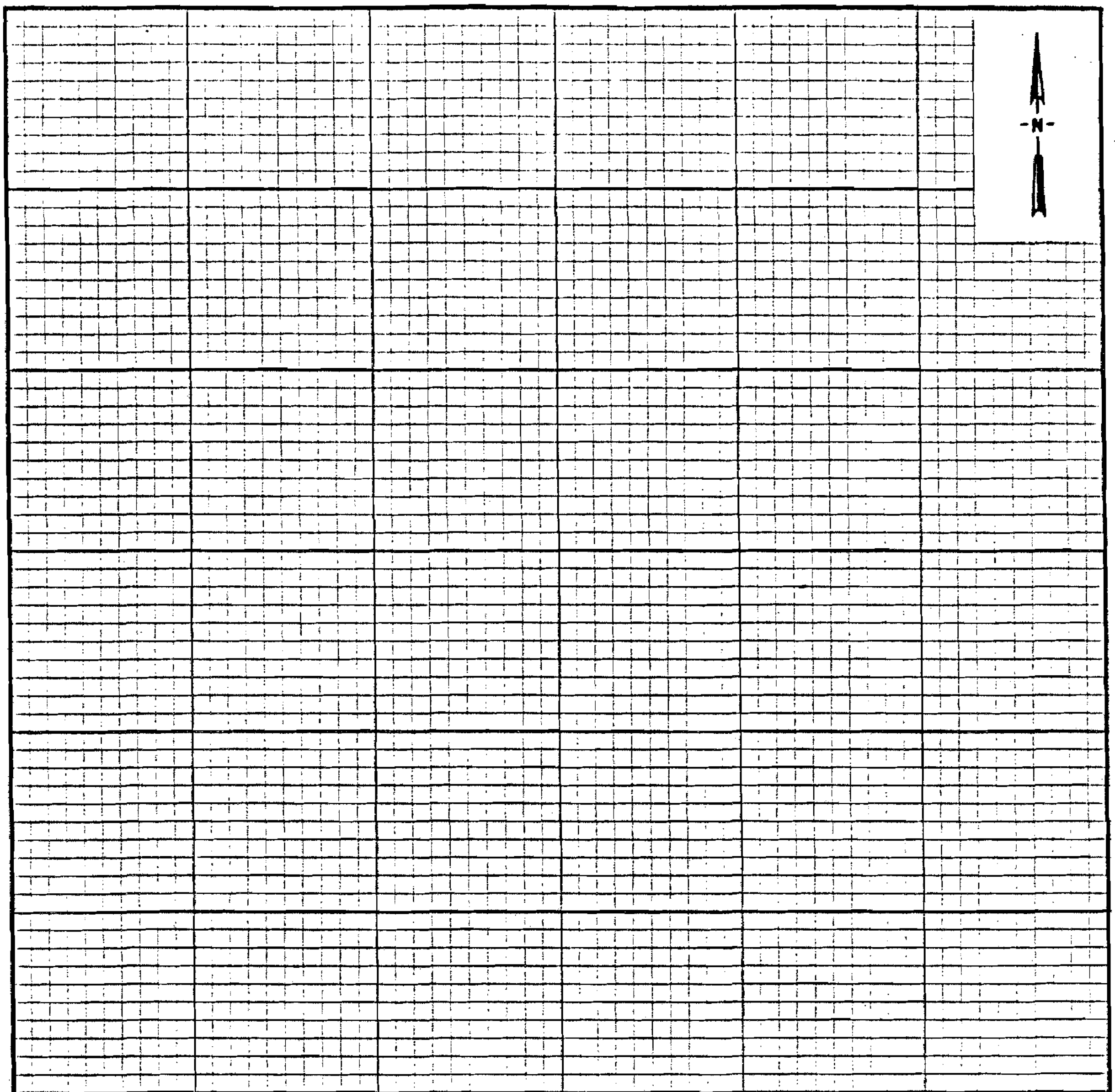
The design of the survey locale form and attachments was intended to facilitate the collection of comparable data from a variety of survey locales. The names and page numbers of all individuals involved in the survey appear on the form. The survey locale form with attached maps and notebook pages was reviewed by a field supervisor for completeness and accuracy. Notebook pages were placed in a survey locale notebook. The form and attached map were filed in folders. Notebook pages were filed in specially marked binders.

(ii) Survey Locale Map

An adjunct to the survey locale form is the survey locale map. The survey locale map shows the location of survey transects, the general location of subsurface testing, and the position of sites found. The map is usually an enlargement of part of a 1:63,360 scale USGS topographic map covering the immediate vicinity of the survey locale. The map may show additional detail not found on the USGS map such as minor streams, areas of standing water, and surface disturbances. The map shows all locations within the locale which were actually surveyed and, just as important, shows locations which were not surveyed. Figures 6.1 and 6.2 show the format for the survey locale map and the grid template for enlarging the region of the survey locale from USGS 1:63,360 scale maps. Figure B.3.6 shows the symbols used on the survey locale maps. Survey locale maps also provide a large scale map juxtaposing cultural resources with surrounding terrain features.

Sites located away from survey locales are presented on maps of a similar scale to the survey locale maps but are identified as site location maps.

Survey was not limited to the arbitrary boundaries of the survey locale. In the process of moving into or out of a survey locale, a field crew would continue testing and possibly locate cultural resources. For management purposes, sites are listed in association with the survey locale being tested at the time of site discovery even though the site may not fall within the predetermined boundaries of the survey locale. This procedure is appropriate as survey locales were not defined on the basis of terrain units.



Shovel Tests: ____

Surface Survey - - - - -

Subsurface Tests -.-.-.-

Helicopter Landing Zone LZ

Survey Locale ____ Boundary ----

METERS

Contour Interval: ____

Quadrangle: ____________

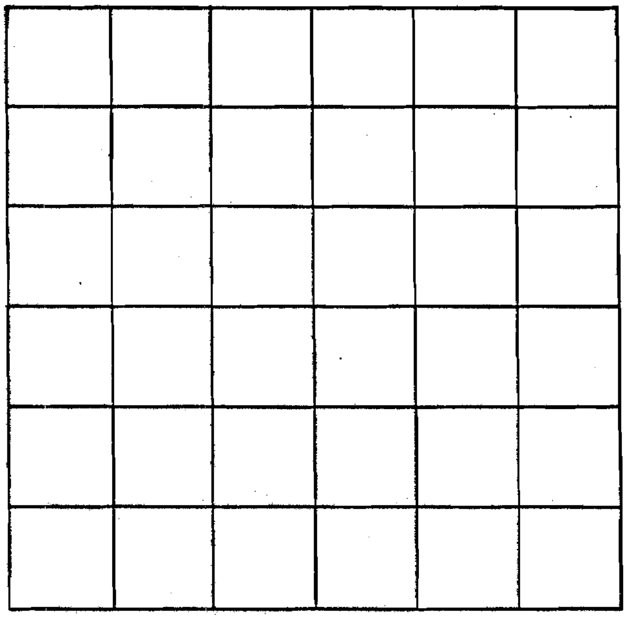
T.____., R.____., ___.M.

____________, Sec. ___

Figure 6.1. Survey Locale Map Format

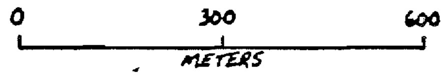
ENLARGEMENT GRIDS FOR 1" = 2000' R&M TERRAIN UNIT MAPS (1:24,000)

FOR 1" = 2000' MAPS



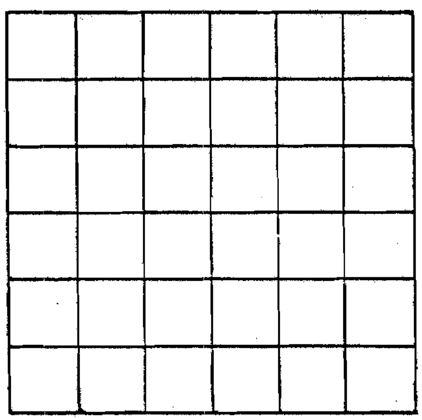
ONE SQUARE = 300 M

RESULTING SCALE ON ENLARGED MAP:



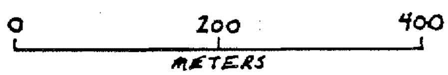
1 : 12,000

FOR 1" = 2000' MAPS



ONE SQUARE = 200 M

RESULTING SCALE ON ENLARGED MAP:



1 : 8,000

Figure 6.2. Grid template for Enlarging Survey Locale Map

(b) Testing

Surface examination was conducted in all surveyable areas including those which had exposed ground surface as a result of tree falls, rodent and bear disturbances, erosional areas, and fire-stripping. In places which had low surface visibility, subsurface testing using shovel tests was conducted. A shovel test is a "shovel-size" (No. 2 shovel) round (ca. 30 cm diameter) test excavation, usually not over 50 cm deep. As each shovel of soil was removed from the test, it was inspected for cultural material. The number, location, and depth of the shovel tests, and additional information concerning the presence of charcoal, volcanic ash, or distinctive soil characteristics were recorded in field notebooks. The number and location of the shovel tests were based upon the judgment of the field crew, although there was an intent to test all terrain features which may contain sites. The paths used by the field crew were determined by local topography and followed no predetermined constraints of direction, length, or width. The amount of testing which occurred within a survey area was limited by the amount of surveyable terrain, the density of surface vegetation, and time. The location of the survey routes followed by the field crew and the general location of subsurface testing were recorded on each survey locale map.

(c) Site Location

Once a site was found during survey its location was plotted on 1:24,000 scale air photos (when available) and on the appropriate USGS 1:63,360 scale topographic map. The template in Figure 6.3 was designed to facilitate the use of air photos and USGS maps. The template contains scales for both USGS 1:63,360 maps and 1:24,000 air photos, a hectares estimator, aliquot parts template, and guide for estimating UTM coordinates. The site location was then marked on both the air photo and the USGS map. A University of Alaska Museum accession number (if any artifacts were collected) and a State of Alaska Heritage Resource Survey (AHRS) number were assigned to the site. The location of the site was later transferred to a UTM-gridded USGS 1:63,360 quadrant map for determination of UTM coordinates, aliquot description, and latitude and longitude determinations. An aliquot template (Figure 6.3) and a latitude and longitude template (Figure 6.4) facilitated the description of site location. Given the scales on the templates, UTM coordinates are listed to the nearest 50 m and latitude/longitude to the nearest 5".

(d) Test Pit

An intensive surface survey of the vicinity of the site was conducted to obtain an initial idea of the size and nature of the site. All surface artifacts were flagged for subsequent mapping and possible collection. The excavation of at least one test pit was conducted at the site in order to obtain information on the soil/sediment stratigraphy and number of components present at the site. Test pits were generally 40 cm square, but could be expanded to determine the size of subsurface features. The first test pit excavated at the site was usually superimposed over the shovel test where the first subsurface artifactual materials were found or, for surface sites, adjacent to the surface scatter of artifacts in a location having soil deposition. All excavated tests were backfilled after the site was recorded.

(e) Site Tag

A site datum was established on the site which was usually located in the southwest corner of the first test pit excavated. A site datum was usually established on the highest part of the site if the site was composed of multiple surface scatters. The site datum consists of a large metal nail with an aluminum tag attached. Inscribed on the tag are: AHRS site number, University of Alaska Museum, and the date. This tag was usually buried in order to deter its removal by wildlife and help maintain the confidentiality of the site.

(f) Grid Shovel Testing

Sites in direct impact areas were grid shovel tested to assist in determining size, relative artifact density, and composition of artifactual materials. When grid shovel testing was conducted prior to

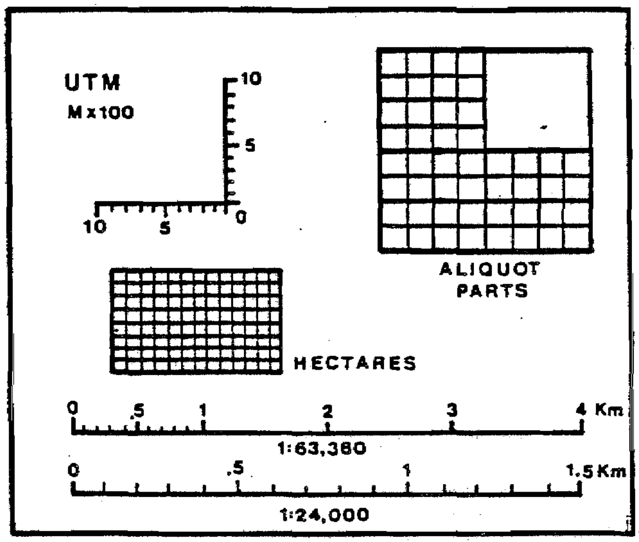


Figure 6.3. UTM and Aliquot Template

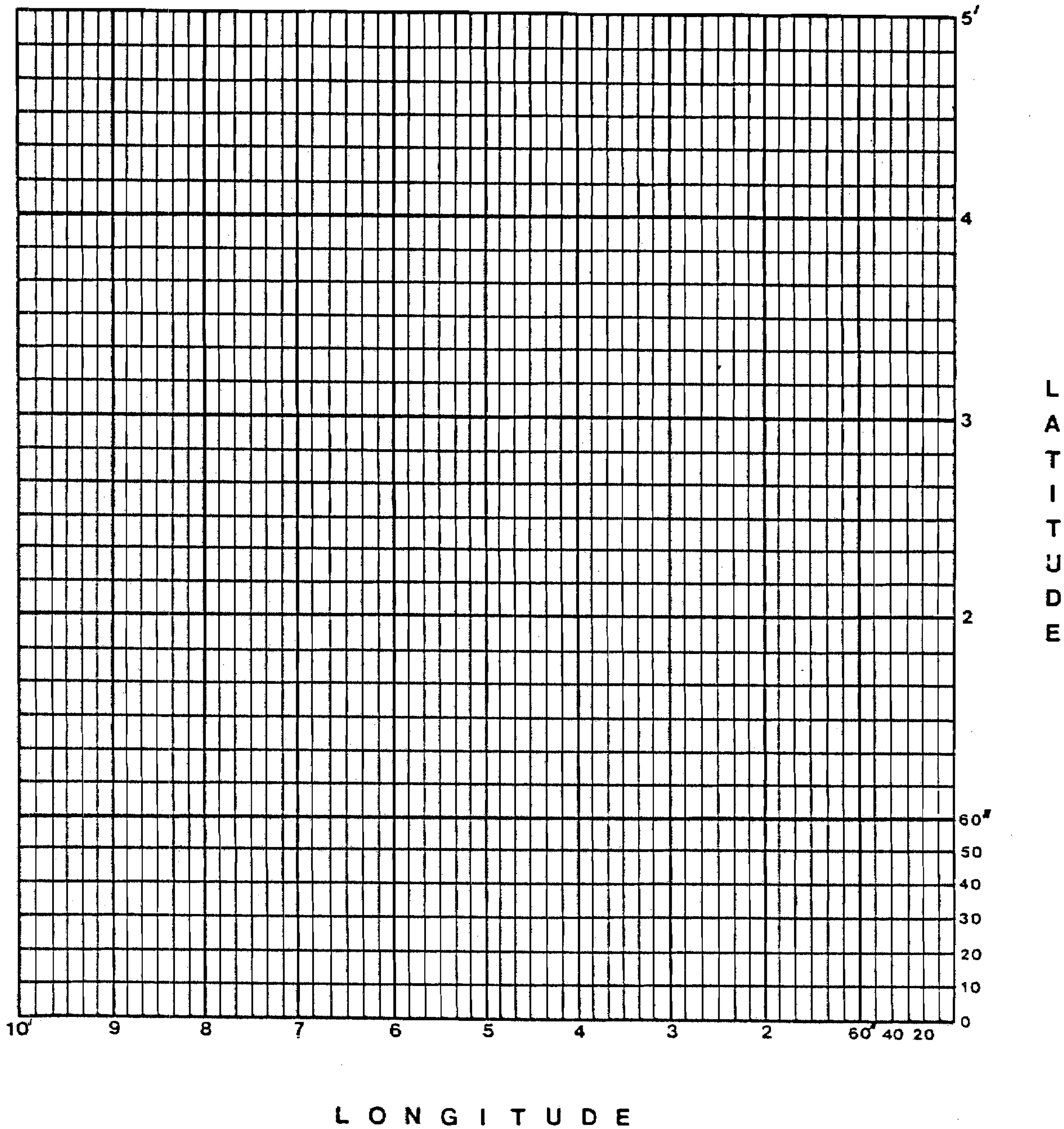


Figure 6.4. Template for Determining Latitude and Longitude

systematic testing, the resulting data was used to assist in determining test pit placement and the number and location of test squares. Grid shovel testing was only one of the ways in which site size was estimated. Two estimates of site size are presented in this report (Table D.2). Observed site size is the size of the site delimited by grid shovel testing and/or by the maximum extent of cultural remains. Estimated site size is based on the maximum extent of cultural remains in the absence of grid shovel testing.

Grid shovel testing began at the limit of artifacts located either on the surface or through subsurface testing. A grid system was then measured from that initial point, oriented in cardinal directions. Shovel tests were placed at four-meter intervals in each of these directions and at the corners to form an eight-meter square outline (Figure B.3.3). If cultural material was encountered in any of these shovel tests then the grid was extended in the direction of the find for an additional four meters. In directions where no artifactual material was found, the grid system was collapsed inward toward the initial cultural limits at a two-meter interval. As a result, grid shovel testing is sensitive to site size to an average one meter interval for a minimum site size of 4 square meters. Figure B.3.3 is an example of a shovel testing in which cultural material was only encountered in the initial shovel test. In this situation a total of 17 shovel tests were excavated to assist in determining the spatial extent of the site. Note that the shovel test with cultural material is enclosed by sterile shovel test on a two-meter grid interval.

Figure B.3.4 shows an example of grid shovel testing in which artifacts are encountered during expansion. This figure illustrates a series of site plots which indicate the sequence of shovel testing needed to encircle the identified cultural material.

Grid shovel testing was intended to be used with some amount of flexibility. The excavation of shovel tests on sites provides information on site size and artifact density but also adds to site disturbance. To address this problem, grid shovel testing may have started farther than four meters away from the initial productive shovel test or surface artifact. A site may have extensive surface scatters of artifacts which occur in discontinuous groups or clusters. Grid shovel testing in these cases began at the periphery of the surface scatters. Although a four-meter grid shovel testing interval was performed at the direct impact sites, the nature of some sites necessitated the use of a greater testing interval. All shovel tests were backfilled and vegetation replaced as much as possible.

(g) Site Map

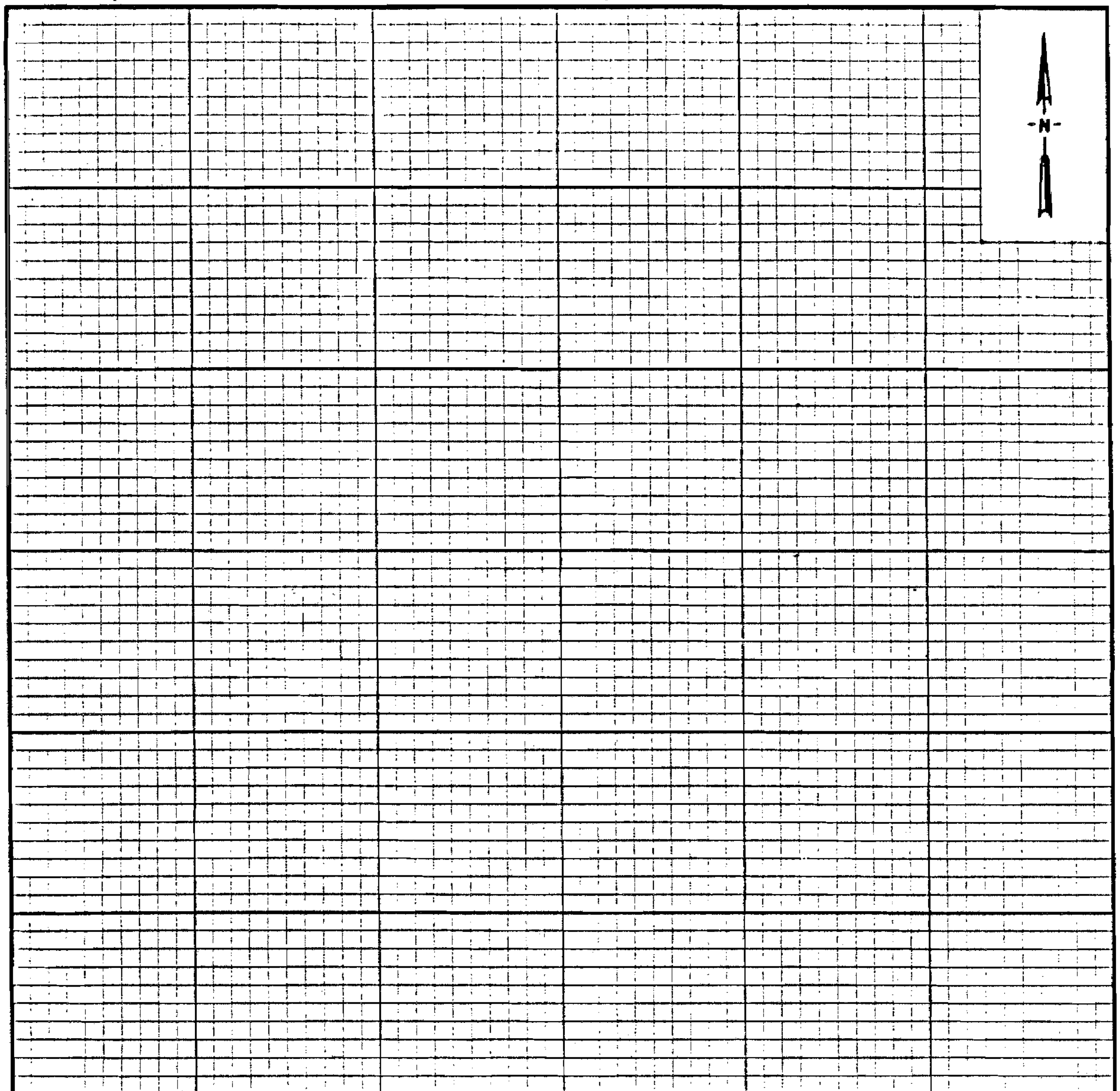
A site map was drawn for each site found during survey. This is a large scale, freehand map of the immediate site vicinity indicating surface contours, important vegetation features, and major surrounding topographic features. Included on this map are the location of shovel tests, test pits, site datum, and surface artifacts or clusters. The standard north arrow symbol appearing on the maps is oriented to true north. The format of the survey site maps appears in Figure 6.5 and symbols used on the site map appear in Figure B.3.6.

(h) Soil/Sediment Profile

A soil/sediment profile was required for each site whether or not subsurface cultural material was found. Bedrock exposures and historic sites were exceptions. A soil/sediment profile was drawn of at least one wall of each test pit excavated at the site. These profiles are not schematic but reflect soil/sediment units identified in the test. The provenience of artifacts, features, and presence of charcoal are identified on the profile. Figure B.3.5 shows the format for the profiles.

(i) Photography

A 35 mm camera loaded with black and white print film was used to take photographs of the site and surrounding terrain. The first frame taken at a site was a site identification exposure containing roll number,



Test Pit	□
Shovel Test	⊘
Grid Test: w/ Artifacts	●
Grid Test: Sterile	○
Site Datum	×

METERS

Contour Interval:___ m

Quadrangle:__________

T.___., R.___., ___.M.

__1/4 __1/4 __1/4, Sec.___

Figure 6.5. Format for Survey Site Map

AHRS site number, date, and survey crew. Each photograph taken at a site was recorded by roll, frame, direction of view, subject, and date. Figure B.3.22 shows the format for a photo log page in the field notebooks.

(j) Artifact Collection

All artifacts recovered from the test pit excavation were bagged by arbitrary 5 cm levels unless excavation could be made by stratigraphic units. Each artifact bag contained the following information: 1) AHRS site number; 2) University of Alaska Museum accession number; 3) test or feature number; 4) depth below ground surface and stratigraphic level, if appropriate; 5) number and description of specimen(s) in bag; 6) date excavated; and 7) name of excavator(s) (Figure 6.6). All individual bags from each test pit were place in a large bag marked with site number, location, test or feature number, date, and name of excavator(s). Individual test bags were then placed in a site bag with the site number and date marked on the outside. Paper coin envelopes and plastic ziploc bags were used for artifact collection. Radiocarbon samples were double-wrapped in aluminum foil and placed in ziploc bags labeled with the same information as the artifact bag.

(k) Site Survey Form

A site survey form was used to record sites found during survey in a consistent manner. Although the form is organized to retrieve a large quantity of data, information on the site was supplemented by records in field notebooks. The site survey form is presented in Appendix B.2. Major categories of site information recorded on the form include site location, ecological setting, site description, surface and subsurface artifact inventory, site size, site disturbance, photographic record, and additional site specific information. The names of crew members recording the site and relevant pages in their field notebooks were also recorded. The site form records site information collected as part of initial testing. Additional information collected as a result of

Project ______________________

Acc. no.: UA ______________________

AHRS no. ______________________

Survey Locale ______________________

Locus or Scatter ______________________

Surface ☐ Subsurface ☐

Test ______________________

______° ______ m from ______ Datum

Quad ______________________

N__________ E__________ D__________

Date ______________________

Excavator ______________________

Stratigraphic Unit ______________________

____

____

Contents ______________________

____

____

____

Figure 6.6. Artifact Collection Stamp

determination of site size or systematic testing is contained in field notebooks according to procedures discussed below.

After the site form and attachments were completed, the site form was signed by the crew leader and reviewed by a field supervisor who attested to the completeness of the document by signing in the designated location. The individual notebook pages were collected and organized with a checklist and table of contents according to the format in Figure B.3.24. The field supervisor checked the locational information of the site for accuracy.

(1) Artifact Accessioning and Cataloguing

The cataloguing of artifacts was conducted in the field or at the University of Alaska Museum. This process consisted of artifact cleaning, labeling, cataloguing, and storage. Artifacts were washed or gently cleaned with a fine brush to allow for identification of form and lithic raw material type and to allow for labeling.

Collected artifacts were accessioned to the University of Alaska Museum by a designation which identifies the repository, year of collection, and specimen or assemblage of specimens. Individual artifact catalogue numbers were applied following the accession designations to specimens with ink and covered with a clear fixative. The catalogue number and contextual data were then entered into the artifact catalogue. Additional information recorded for each site in the catalogue includes: date catalogued, names of excavators, name of cataloguer, and names of crew members. Each catalogue number was recorded in sequence. Next to the individual catalogue number, specimen description, provenience, excavator's initials, date excavated, and additional notes about the specimen were recorded. An example of a catalogue page for a survey site is shown in Figure 6.7. The artifact catalogue was checked and signed by the crew leader and field supervisor. Periodic checks were made by the project supervisor and principal investigator.

UA ACCESSION NUMBER UA83-415

AHRS SITE NUMBER TLM 311

SITE NAME NONE

CATALOGUED BY A. YOUNG

CATALOGUE DATE 7-22-83

EXCAVATOR(S) R.J. Dale, A. Young

CREW PERSONNEL Dale, Young, O. Mason

CHECKED BY RJD 8-3-83

GSU 9-30-83

GS 10/1/83

CATALOGUE #	SPECIMEN DESCRIPTION	PROVENIENCE	EXCAVATOR'S INITIALS	DATE	ADDITIONAL NOTES
UA83-415-1	1 QUARTZITE FLAKE	SURFACE T.P. 1	A.Y.	7-21-83	
UA83-415-2	1 BASALT FLAKE	T.P. 2 23 cmbs	RJD.	"	WATANA TEPHRA, IN ASSOCIATION W/ BONE FRAGS.
UA83-415-3	4 ARGILLITE FLAKES	T.P. 2 24 cmbs	"	"	WATANA TEPHRA
UA83-415-4	315 CALCINED BONE FRAGS.	T.P. 2 23 cmbs	"	"	WATANA TEPHRA
UA83-415-5	1 MODIFIED FLAKE, ARGILLITE	T.P. 2 30 cmbs	"	"	GRAY SANDY GRAVEL BELOW WATANA TEPHRA

Figure 6.7. Example of Artifact Catalogue for Survey Tested Sites

Artifacts were described in the catalogue ledger according to type and raw material. Twenty-four types of lithic artifacts were defined for the project and are listed in section 6.8 of this chapter. The definitions of lithic artifacts appear in Appendix A. Eight different rocks and minerals plus metal, wood, and glass were used to describe the raw material. A flow chart (Figure 6.8) was developed to aid in the identification of lithic raw materials.

Faunal material was sorted into unburned, burned, and calcined categories and recorded appropriately in the catalogue ledger. Within each category, bones were identified according to element. Most often, bone was present in only a fragmented state. Pieces which could possibly be identified according to species were noted in the catalogue for subsequent faunal identification. Bone was also examined during the cataloguing process for evidence of modification as a result of butchery or tool manufacture.

The cataloguing process involved organizing, cleaning, and consecutively numbering artifacts and samples following accessioning. A hierarchy of steps was used to facilitate the cataloguing process. These steps are outlined on Table 6.1, and the cataloguing format for systematically tested sites is illustrated in Figure 6.9. Individual catalogue numbers were assigned to four different categories of artifacts: 1) individual artifacts, 2) artifact clusters, 3) artifact lots, and 4) associated C-14 and soil samples. The category of individual artifacts includes those which have been three point provenienced, flakes from flake lots recognized in the lab as being modified or having other characteristics which warrant their separation, and bone fragments which were potentially identifiable. Artifact clusters which have been three point provenienced in the field and bagged separately were also given unique catalogue numbers. Collective lots such as flakes, thermally altered rock, and faunal remains collected by quadrants of the 1 m excavation units were given a single catalogue number.

Labeling individual artifacts (lithic, bone, or other) with the assigned catalogue number was done directly on the artifact with pen and ink

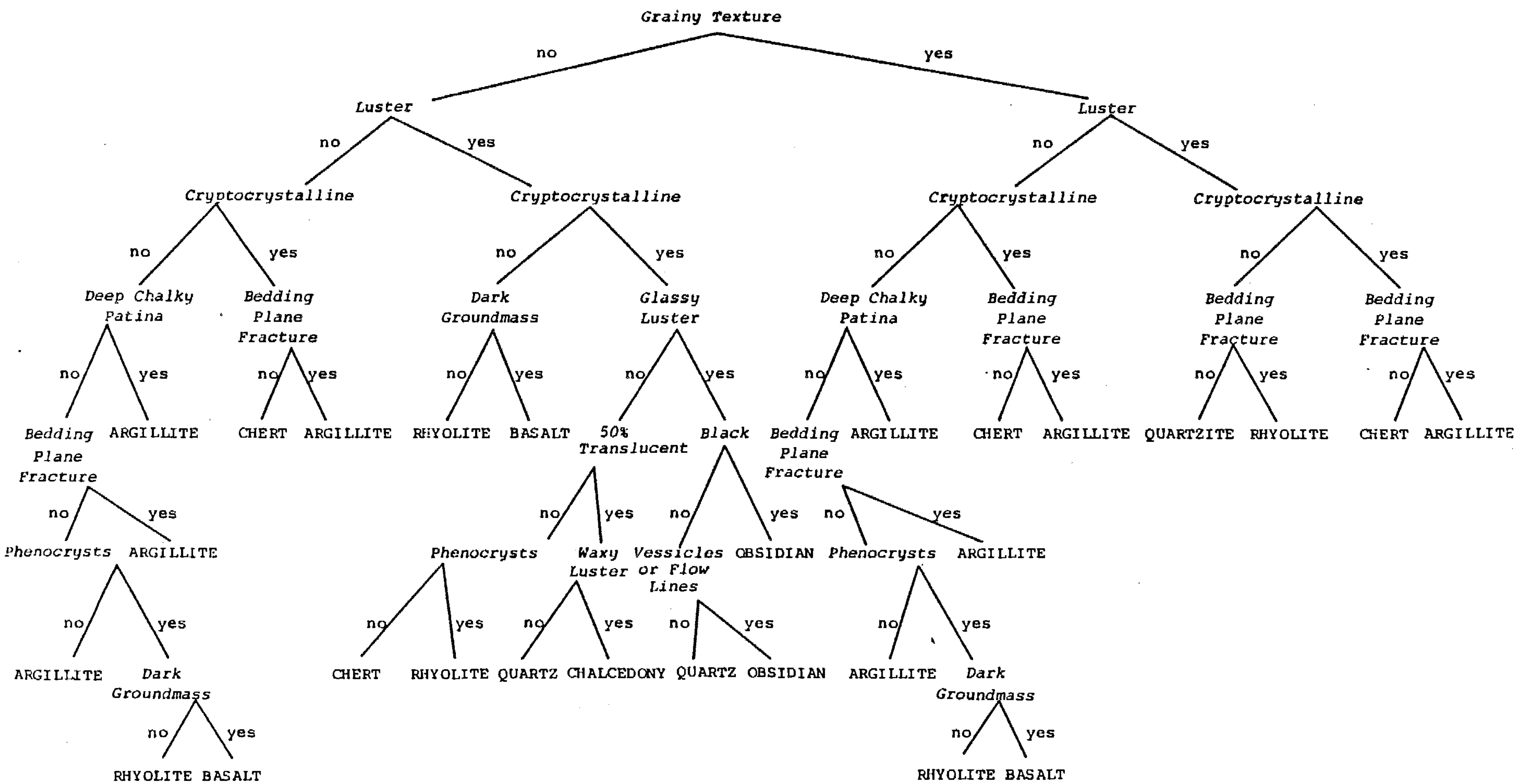


Figure 6.8. Rock Identification Flow Chart

Table 6.1. Steps in the Cataloguing Process

I. All artifacts are catalogued before C-14 and soil/sediment samples.

A. All artifacts from one square are catalogued prior to starting on the next. The order in which squares are catalogued depends on their grid coordinates, and usually proceeds from west to east or from south to north. For example, test square N99/E100 would be catalogued prior to square N99/E105.

B. All artifacts from a particular stratigraphic unit in a square, beginning from the top, are catalogued before proceeding on the next stratigraphic unit.

1. Diagnostic artifacts for each unit are catalogued first.

2. All three point provenienced artifacts or artifact clusters are catalogued next, beginning with the NW quad and proceeding as above.

3. Quadrant referenced items (without a three point provenience) are catalogued next, beginning with the NW quad and proceeding as above.

4. Artifacts associated with a particular feature or miscellaneous items such as thermally altered rock are catalogued after all four quads from the appropriate stratigraphic unit have been catalogued.

Table 6.1. (Continued)

II. Samples are catalogued after cataloguing all artifacts.

A. Radiocarbon samples are the first to be catalogued. Each sample is given an individual catalogue number in addition to the field number which has already been assigned. All the information recorded on the C-14 sample data sheets, plus the date of drying, the date sent to Beta Analytic (or other laboratory) for dating, and a space for the age of the sample in radiocarbon years, is included in the catalogue.

B. Soil and tephra samples are recorded in the catalogue by their field numbers only. These samples eventually may be incorporated into the collection of museum's tephrochronology lab, and therefore are not given individual catalogue numbers.

UA ACCESSION NUMBER UA83-415 | CATALOGUED BY A. YOUNG
AHRS SITE NUMBER TLM 311 | CATALOGUE DATE 7-22-83
SITE NAME NONE

EXCAVATOR(S) R.J. Dale, A. Young | CHECKED BY RJD 8-3-83
CREW PERSONNEL Dale, Young, O. Mason | GSU 9-30-83
GSS 10/1/83

CATALOGUE #	SPECIMEN DESCRIPTION	PROVENIENCE	EXCAVATOR'S INITIALS	DATE	ADDITIONAL NOTES
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UA83-415-4	315 CALCINED BONE FRAGS.	T.P. 2 23 cmbs	"	"	WATANA TEPHRA
UA83-415-5	1 MODIFIED FLAKE, ARGILLITE	T.P. 2 30 cmbs	"	"	GRAY SANDY GRAVEL BELOW WATANA TEPHRA

Figure 6.9. Example of Artifact Catalogue for Systematically Tested Sites

unless the artifact was too small to be numbered. The catalogue number was also printed on the coin envelope or bag. Collective lots of specimens, C-14 and soil samples were labeled on the container in which they were contained. Specimens were curated in the field to the best of available conditions in a nonpublic area.

In order to verify that correct accessioning procedures had been followed, both crew leaders and field supervisors signed the catalogue pages. Quality assurance of the cataloguing process included: verification of material and artifact types, checking counts, catalogue number on artifact, and the storage of samples. Subsequent changes in the catalogue book were accomplished by cross referencing the item being changed with the location of the correct information. The original entry remains in the catalogue although it is marked with an asterisk or similar distinguishing symbol. This process ensures that changes can be traced to an individual and time.

(m) Survey Site Report

Each site identified during survey is described in report form. This information is presented in Appendix D. Site reports contain the following information: site identification, site location, level of testing, artifact inventory, temporal context, site size, and site map. These reports are based upon information contained on the site forms and within field notebooks. The ecological setting of each site is presented and includes information on geography, geology, and vegetation, a presentation of how the site was initially located and subsequently tested, and an artifact inventory which identifies the number and types of artifacts.

The location of the site is referenced to the appropriate USGS 1:63,360 scale topographic map and the relevant survey locale or site location map. UTM coordinates, latitude and longitude designation, and aliquot description are also given. These data concerned with the exact location of the site have restricted access and are bound separately in Appendices E and F.

6.5 - Systematic Testing

Systematic testing consisted of controlled testing using 1 x 1 m test squares within an established grid system using vertical and horizontal controls. Systematic testing provided a larger excavation from which a more detailed appraisal of site components and stratigraphy could be developed and provided controlled data on such parameters as depth and number of cultural components, artifact density and diversity. Sites systematically tested were prioritized on the basis of direct or indirect impact status and their potential to answer specific research questions. The tasks involved in systematic testing included site mapping, test square location, excavation procedures, data recording, cataloguing, and site description.

(a) Site Mapping

Prior to systematic testing a mapping crew was dispatched to the site to stake a grid system on the ground. The stakes were marked with grid system coordinates to provide horizontal control for test square layout. Elevation readings at the grid coordinates aided in the preparation of a contour map for the sites, as well as providing vertical control for site excavation. Mapping was conducted with the aid of a 20" transit, stadia rod, metric tapes, wooden stakes, and flagging tape.

The initial step in laying out a grid system was to establish a grid datum. The grid datum was usually located at a different point than the initial site datum established during survey testing. This change was motivated both by constraints of surrounding topography and vegetation and by the potential for the original site datum to fall within an excavation square. The site grid datum was placed in a suitable location which provided an unobstructed view along the baselines with a minimum of setups. The site grid datum represented both the central point of the grid as well as a vertical reference point for the site.

Both north-south and east-west baselines extend through the grid datum. Baselines were oriented in relation to the landform upon which a site was situated or along true cardinal directions. When the terrain had an orientation that could not be accommodated by baselines in the cardinal directions, the baselines were rotated accordingly. The orientation of the grid was established with reference to true north with 27½ or 28 degrees east declination. Maps of systematically tested sites indicate grid north with respect to true and magnetic north. After the orientation of the grid was established, coordinates of the grid datum were assigned such that the site fell within the confines of the northeast quadrant of the grid. A designation of N100/E100 was commonly assigned to the grid datum to place the site within the northeast quadrant. The AHRS number, grid coordinate of the datum, and the orientation of grid north were attached to the datum stake.

Baselines along the N100 and E100 axes were marked at intervals by placing a wooden stake or metal spike at the required distance and pounding it into the ground until stable. All distances along the baselines were measured horizontally with metric tapes and were double-checked for accuracy. Plumb bobs were employed for accurate placement of each grid stake. The stake was marked at the exact intersection of distance and alignment. The grid coordinates were recorded on two sides of the stake unless loose soil or thick vegetation would obscure them, in which case the coordinates were marked upon the plastic flagging placed around the stake for easy visibility. Additional lines at right angles to the primary baselines were staked as needed to provide control for laying out excavation units. At the completion of site testing all flagging and spikes were removed from the site.

Vertical control for the grid was established with transit and stadia rod by taking elevations at the top and ground surface of each grid stake, as well as on the ground surface at unstaked grid coordinates. For convenience, the site vertical datum was arbitrarily set at 0.00 m at the top of the grid datum stake or the highest point at the site. The use of grid coordinates allowed quick determination of location for stadia rod placement, efficient mapping in the field, and accurate transfer of data points for drafting of the contour map. Additional elevation readings were taken at any topographic feature or break in slope. All recordings were recorded in field notebooks according to the format appearing in Figure B.3.7. Symbols used on the mapping notes appear in Figure B.3.8. An example of a completed mapping note page is shown in Figure B.3.9.

The elevation of the ground surface at each grid coordinate can be computed by subtracting (or in some cases adding) the stadia reading (in the "-" column) from the instrument height (HI) (see Figure B.3.9). The level data were reduced and checked for accuracy. Major discrepancies were field-checked. The elevations were then transferred to the appropriate point in the grid system as mapped on a sheet of graph paper. A mylar overlay was placed over the plotted matrix of points with their associated elevations, and contour lines drawn by interpolating the contour interval of either 0.5 m or 1 m from the elevation of adjacent grid coordinates. The location of test pits, shovel tests, and other relevant features were recorded in the field and transferred to the contour map. The map was field-checked before being finalized. Only previous test excavations which could be accurately relocated by the mapping crew appear on the systematic testing site maps. The location of test squares and additional shovel tests were mapped according to their grid coordinates.

(b) Test Squares

The location and number of 1 x 1 m test squares were determined using information from previous testing. If site size had not been determined during survey by grid shovel testing then this procedure was implemented prior to laying out the test squares during the final season of field work. Normally, test squares were laid out in an area of high artifact density as determined by survey testing and/or grid shovel testing. Commonly, three test squares were laid out in a checkerboard pattern. When appropriate, one or more of the test squares incorporated the survey test pits. Reexcavation of survey test pits aided the systematic testing crew in correlating previous stratigraphic interpretations with contemporary interpretations that have been refined through subsequent excavation and analysis. Additional squares were placed adjacent to the original test squares or outside the high density area as deemed appropriate.

In most cases, the test squares were laid out by the mapping crew using a transit, otherwise test squares were triangulated in from the preestablished site grid stakes. Each square is identified by the grid coordinates of its SW corner, e.g., N99/E00. A test square datum to aid in vertical control during excavation was also established in an area convenient to the square. The elevation of the test square datum was referenced to the elevation of the site datum. During excavation all depth measurements were taken from the square datum stake.

(c) Testing

It should be emphasized that systematic testing is a testing phase. Although the goal of systematic testing was controlled excavation, work proceeded rapidly. Excavation was done in natural stratigraphic units whenever possible. When the stratigraphy was not discernible, excavation was carried out in arbitrary 5 cm levels. Artifactual material from each quadrant of the square (NW, NE, SW, SE) was recorded separately. In most cases, excavation of a stratigraphic unit in all quadrants of the test square was completed before initiating excavation of the next stratigraphic unit. Test squares were excavated into glacial drift, to bedrock, or other strata indicating the limit of cultural material had been reached. This was usually reached at a depth of 50-75 cm below the surface. All soil/sediment from the test square was screened through a 1/4" and/or 1/8" mesh screen.

All cultural material, with the possible exception of thermally altered rock within a large feature, was collected and bagged by stratigraphic unit and quadrant within each test square. Diagnostic artifacts, large bone fragments, and isolated flakes were three point provenienced, using the system described below, and individually bagged within the quadrant bag for the stratigraphic unit. Lithic or bone clusters were also three point provenienced, collected, bagged as a unit, and then placed with the appropriate quadrant bag. Charcoal samples were three point provenienced, carefully collected by trowel, and wrapped in a double sheet of aluminum foil before being bagged in a ziploc bag. A radiocarbon field number was assigned to each of the radiocarbon samples and recorded according to the format in Figure B.3.16. Information required for the submittal of radiocarbon dating was collected according to the guidelines in Figure B.3.17. Each coin envelope or bag was stamped or marked with the information appearing in Figure 6.6. Small lithic debitage randomly scattered throughout the quadrant, collectable thermally altered rock, and other artifactual material recovered from the screen were bagged in the appropriate quadrant bag without being three point provenienced.

(d) Soil/Sediment Samples

Soil/sediment samples were collected from each square for reference purposes during excavation procedures. A sample representing each unit identified in the soil description and depicted on the profile was collected in 7 ml vials. The location of the samples was recorded on the pertinent wall profile. The vials were labeled with the site, square, and stratigraphic unit numbers. Field numbers were also assigned to these samples, e.g., SS 2 (soil/sediment sample 2). The format of recording soil/sediment samples is the same as that for radiocarbon samples illustrated in Figure B.3.16. When necessary, additional samples were collected from features or elsewhere in the test square to assist in assessing stratigraphy.

(e) Three-Point Provenience

In the three-point provenience system used, the following measurements were taken in centimeters and recorded on the coin envelope or bag in which the artifacts were placed:

N = distance form the <u>south</u> wall to center of artifact
E = distance from the <u>west</u> wall to center of artifact
D = depth of artifact - this measurement was taken at the lowest point of the artifact in the stratigraphic unit

As a helpful reminder, this information also appears in the notebook guidelines in Figure B.3.14.

(f) Field Notes

In addition to the provenience data recorded on all collection bags, pertinent data were also recorded in field notebooks, on profile drawings, and by photo-documentation of the site as it was being excavated. In order to ensure the quality and comparability of field notes taken during systematic testing, a set of guidelines which standardized the recording procedures was included in each field notebook (Appendix B.3). After being assigned a test square, the excavator was responsible for completing for each of the stratigraphic units excavated: 1) a horizontal plan map; 2) narratives discussing soil/sediment, general artifact distribution, features, etc.; 3) an artifact description; and 4) C-14 sample description. If necessary, the excavator also recorded comments about the sites as a whole, the environmental setting, possible interpretations of the data, etc. on narrative pages in the field notebook.

(g) Square Plan Maps

Beginning with the ground surface, the horizontal plan map includes the following information: 1) surface elevation in centimeters below square datum; 2) vegetation; 3) pertinent features within the test square, i.e., surface exposures, survey test pits, surface artifacts, etc. Plan maps were made according to the format illustrated in Figure B.3.11 for the top of each stratigraphic unit excavated using the standardized set of symbols illustrated in Figure B.3.12.

The purpose of these data recording sheets was to provide a concise, prose summary of the soil/sediments, artifact distribution, features, and possible disturbance noted in a particular stratigraphic unit after it had been excavated. Key words appear in the left hand column as in the example illustrated in Figure B.3.2.

(h) Artifact Summary

A more detailed description of individual artifacts with their exact provenience was recorded according to the format of Figure B.3.13. Guidelines for filling out each of the columns on the sheet are given in Figures B.3.14 and B.3.15. Reference to Figure 6.8 aided in determining rock and mineral types.

(i) Carbon Samples

When charcoal was encountered in the test square during excavation, a sample was collected, particularly when the sample was large enough for radiometric dating and was significant for dating archeological and/or geological levels. Samples were field wrapped in aluminum foil and later dried if necessary. A field number (CS - carbon sample) was assigned to each sample collected (e.g., TLM 016 CS 1), and a permanent accession number later was given to the sample in the lab. Pertinent information to record on the radiocarbon data sheet (Figure B.3.16) was outlined in Figure B.3.17.

(j) Site Data Recording

Field supervisors or crew leaders had the additional responsibility of recording data pertinent to the site as a whole, such as the excavator of each square and the elevation and location of each square's datum. A sketch map of the placement of the squares was also made. See Figure B.3.10 for the format used in recording these data. Keeping a record of the field numbers for both radiocarbon samples and soil/sediment samples was another responsibility of the field supervisor or crew leader.

(k) Soil/Sediment Profiles

Soil/sediment profiles were drawn for each wall of a test square according to the format in Figure 6.10 after excavation of the square was complete. Prior to drawing the profiles, the excavator, in consultation with the field supervisor or crew leader, defined the

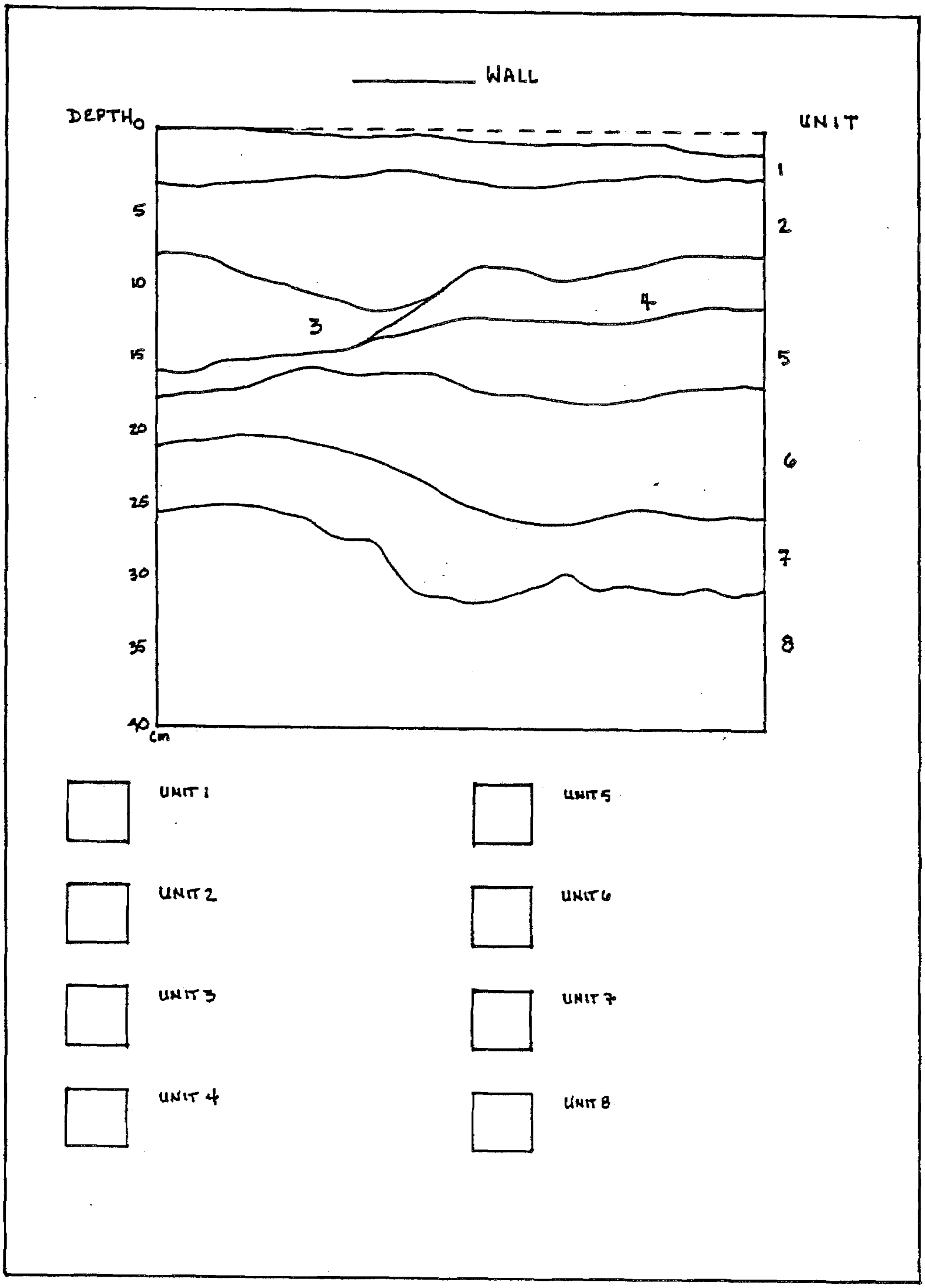

Figure 6.10. Wall Profile Format

stratigraphic units to be drawn, and assigned them a numerical designation. Subunits were given alphabetic designations. The provenience of artifacts, charcoal, soil/sediment samples, rodent burrows, etc. were also identified on the profile. Munsell charts were used to describe the color of stratigraphic units and were taken on dry soil/sediment samples unless otherwise indicated. Before the actual drawing began, horizontal and vertical baselines were established. The horizontal baseline was set either on the surface directly above the wall (usually at the same elevation as the square datum) or on the central portion of the wall. A vertical reference was set by suspending a plumb bob from the 50 cm mark (the midline) at the top of the wall to be drawn. Vertical reference lines were etched into the wall at the 25 cm and 75 cm marks, thus establishing five vertical references from corner to corner across the wall. Once these references had been established, the excavator measured the depth of each stratigraphic unit, in centimeters below the square datum, at the top of each unit at the five vertical reference marks. These data were then recorded on graph paper as dots marking the appropriate depths and the actual lines representing breaks between the strata drawn by using the dots as guides. On one 10 cm column of the profile, symbols representing the soil or sediment present were drawn in according to the key in Figure B.3.19. The excavator was also responsible for recording soil/sediment descriptions, referenced by stratigraphic unit number to the units depicted in the profile. The format used for recording this information is illustrated in Figure B.3.18, and the guide to aid in recording in Figures B.3.20 and B.3.21.

(1) Photography

Two 35 mm cameras, one loaded with color slide film and the other with black and white print film, plus a photo log book were standard equipment for the crew systematically testing a site. The procedures for identifying each roll of film when taking the first frame were described above in section 6.4 (i). The photos were recorded by roll number, frame, view, and description, and were taken of the following subjects in both black and white and color: 1) site area prior to excavation; 2) excavation in progress; 3) features, occupation surfaces, plan view of each stratigraphic unit before excavation; 4) test square profiles of each wall; and 5) airphotos of the site. When features, stratigraphic units, or profiles were being photographed, a chalkboard or signboard was set up to identify the subject. The chalkboard included the AHRS site number, square coordinates, subject (unit or feature number), and date.

Quality control procedures concerning photographs included checking for correct labeling and filing. A checkout system for film both ensured that unique roll numbers were assigned to the film and identified the individual responsible for completing the photograph entries.

(m) Site Data Compilation

The compilation of loose-leaf pages prepared in the process of systematic testing was aided through the use of three checklists. These checklists ensured that all of the appropriate information had been obtained and the pertinent pages had been collected. The checklists also served as guides for organizing the material within each site notebook.

The first checklist, illustrated in Figure B.3.25, identifies all of the general data recording sheets required for the site as a whole. After these sheets had been collected and placed in the site notebook, the initials and page numbers of the individual recording the information were entered on the index. To assure proper management of the data, the collator signed the "Entered by" line. The individuals conducting quality assurance signed the "Checked by" lines. In a similar fashion, the excavator's initials and page numbers were entered under the appropriate headings on the checklist for test square data sheets (Figure B.3.26). A checklist for profiles and soil descriptions (Figure B.3.27) was also prepared for each square.

After all of the data sheets had been collected and the initials and page numbers recorded, tables of contents similar to the checklists were prepared and consecutive site page numbers assigned. The notebooks were checked for accuracy and completeness by a field supervisor, who then signed and dated each checklist/table of contents when all was in order.

In the field, all files were kept in metal file cabinets. Files consisted of site forms, survey locale forms, and notebook pages with the pertinent attachments of maps, soil profiles, etc. When field data files had been checked by all appropriate personnel and were no longer needed in the field, they were shipped to the University of Alaska Museum in Fairbanks.

(n) Systematic Site Report

Each systematically tested site was described and evaluated. The narrative for each site description contains the following subheadings: testing, discussion, and evaluation. The number and placement of test squares were discussed under testing, while the major body of the narrative - description of stratigraphy, cultural components and associated artifacts, features, and dating - was incorporated into the discussion section. Determination of whether the site warrants additional testing and the significance of the site were included in the evaluation section. Site reports appear in Appendix D.

Figures and tables were prepared and presented with the site description. A site map and a composite profile are two figures which appear in the report for each of the systematically tested sites. Tables which appear in the report for each site are: soil/sediment description, artifact summary, artifact summary by stratigraphic unit, and faunal summary by stratigraphic unit.

6.6 - Altimeter Study

Altimeter readings were taken on sites in direct impact areas associated with the reservoirs in order to assist in evaluating the inundation sequence. Altimeter elevations for sites in other direct impact areas were also taken to assist in assessing impact. An American Paulin

System altimeter model M-1 with one-foot gradations was used. Altimeter elevations were taken during the 1984 field season.

(a) Vertical Control

Vertical control was established using the R & M third-order, class 1 horizontal cadastral control station 1204 at N1/16 S28/S27, T32N, R5E, Seward Meridian. This survey monument is located immediately southwest of the camp facilities at Watana. The monument, established in 1983, has a stated elevation of 2268.5 feet. The proximity of this control point to camp allowed periodic checks of the altimeter and the establishment of a temporary bench mark elevation of 2268 feet for Watana Camp.

(b) Elevation Correction

The altimeter was initially set to the elevation of the control point being used, either the survey monument or Watana Camp, prior to beginning the day's altimeter transect. Due to the influence of fluctuating atmospheric air pressure on the functioning of the altimeter, the time at which all measurements were taken was recorded. At the end of the transect of site elevation recording, the altimeter was checked back into the initial control point for the purpose of obtaining the apparent elevation. Due to atmospheric changes occurring in the course of the altimeter transect, the apparent and assumed elevations of the control point will differ producing the error of closure (E.O.C.).

Using a method of linear barometric change over time, the error of closure was distributed as a function of time across the intervening data points (Hodgson n.d.:25). This procedure results in the greater variation between recorded site elevation and adjusted site elevation as the altimeter survey progressed during the day. For example, with a positive E.O.C., the apparent control elevation exceeding the assumed control elevation, site elevations during the intervening period would be adjusted downward. Error of closures as great as 70 feet were obtained. Generally, the error of closures were approximately 20 feet. Due to the inherent biases of altimeter studies, the resulting site elevations should not be considered as absolute determinations. No temperature adjustments were made.

(c) Elevation Determination

Having calibrated the altimeter at the beginning of the site elevation survey, the altimeter was moved to the sites. At the site, the altimeter was allowed to equilibrate before recording the elevation. On the site, measurements were taken on the ground at the location of the central test pit or test square. Where the site datum of a systematically tested site was still present, the elevation of the datum was recorded. Duplicate measurements were taken until concordance occurred and the apparent site elevation was recorded. The elevation and time of the reading were recorded on the altimeter study data sheet (Figure 6.11). At the end of the transect period, the error of closure was determined and the necessary corrections implemented. When the E.O.C. was less than 5 feet, no correction was implemented. Conversion to meters was made using 0.3048 m per foot of elevation.

6.7 - Faunal Identification

After faunal material had been accessioned and catalogued, it was reexamined in the laboratory for identification purposes. Faunal identifications were made using the extensive comparative collections housed at the University of Alaska Museum. Whenever possible, bone specimens were identified as to skeletal element and species. Highly fragmented bone could generally be identified only to the size range of the animal. Counts were made of all bone fragments and the degree or absence of burning recorded. Other cultural modifications, such as butchering marks or possible tool manufacture, were also noted during the identification process. The results of faunal identification appear in the artifact summaries of each site in Appendix D.

Locale/ Site:

Test:

Topic: ALTIMETER SURVEY

Level:

Name: C. UTERMOHLE

Date: 8-6-84

Page: 181

ALTIMETER SET TO 2265' ON DESK @ 1:22 PM. PARTLY CLOUDY & WARM

TLM 178	1:50	1405' ≈ 1400'		
TLM 034	2:06	1458 ≈ 1451'		
TLM 030	2:32	1593' ≈ 1581'		N105 E105 OG
TLM 029	2:42	1535 ≈ 1521'		N100 E100 DATUM
TLM 027	2:55	1614' ≈ 1598'		N100 E100 DATUM
TLM 023	3:27	1475' ≈ 1454'		MIDDLE OF STRUCTURE
TLM 024	3:59	1595' ≈ 1568'		T.P. 1

ALTIMETER 2297' @ 4:30 PM DESK 2265'
EOC = +32 CORRECTED FOR PRESSURE CHANGE. CLEARING IN AFTERNOON

Figure 6.11. Example of Altimeter Study Data Sheet

6.8 - Site Data Coding

A computer coding system was created to facilitate analyses on the location of sites and the content and context of their assemblages. All sites visited as part of the cultural resources survey were coded. Sites along linear features which were not tested by the University of Alaska Museum were not included to obviate problems of data comparability. The purpose of coding the site data is to summarize data from the site survey forms, fieldnotes, and accession records.

The site data coding form appears in Appendix B.4. Data were coded onto eight card images for each stratigraphic unit producing artifactual material at a site. Most of the information for the coding process was drawn from the artifact and faunal summaries by stratigraphic unit in the systematic testing reports which appear in Appendix D. Excavation notes were reviewed to obtain comparable data from sites which were not subject to grid shovel or systematic testing. An emphasis was placed upon the analysis of archeological sites.

The first card image encompassed general information relating to the location of the site, its elevation and size, land ownership status, and amount of testing. Site location is designated by quad (e.g., Talkeetna Mts.), the letter and number of the relevant USGS map, and UTM coordinates. Sites were distinguished by their AHRS number and the designation of the relevant locus, if any. The highest level of testing (i.e., AHRS files, survey, grid shovel testing, systematic, and systematic and grid shovel testing) was recorded.

Environmental variables of elevation, terrain unit, landform, and vegetation were recorded. The elevation of the site was determined as a result of the altimeter study or estimated by the plotting of the site upon a USGS topographic map and estimating the elevation to the nearest half-contour interval. The method used in estimating elevation was coded. Data produced as a result of other tasks of the Susitna Hydroelectric Project were employed whenever possible. The 25 terrain units defined in air photo interpretation (R & M Consultants 1981) were used. Site locations were plotted on the terrain unit maps and the corresponding designation recorded. A similar procedure was used to assess the vegetation regime using the maps prepared by the University of Alaska Agricultural Experiment Station at Palmer (Agriculture Experiment Station et al. 1981). Landform was ascertained from information on site report forms. Water sources and mineral licks within one kilometer of the site were noted as present or absent.

The location of sites in relation to project facilities and features was coded. Project features include the dam construction areas, impoundments, borrow areas, linear features, geotechnical investigation areas, and recreation areas. Land ownership status is based upon maps in Vol. 4, Exhibit G by Acres American (1983a).

The amount of testing conducted in the vicinity of a site was summarized by the number and types of subsurface tests excavated. Artifact accession numbers and level of testing for each of the five years of fieldwork were also recorded.

Each data set is based upon cultural material from a given stratigraphic position. The first half of the second card image listed the stratigraphic units present in the test excavation and the boundaries of the stratigraphic unit containing cultural material. Sixteen possible stratigraphic units were coded plus two additional categories: 1) unknown surface - denoting surface finds which could not be referenced to regional stratigraphic units and 2) unknown subsurface - denoting the position of buried artifacts which could not be referenced to regional stratigraphic units. The stratigraphic units are described in chapter 8. The upper and lower stratigraphic limits of artifact distributions were defined either by soil/sediment unit contacts or by their occurrence within an individual stratigraphic unit(s). The contextual boundaries of artifact distributions were referenced to the individual stratigraphic units present at the site from which they were collected. Although systematic test units were excavated by natural stratigraphic units, shovel tests designed to ascertain the presence of or absence of cultural material frequently did not produce data amenable to ascribing artifactual material to specific stratigraphic units or contacts.

Bracketing radiocarbon dates were coded to establish the upper and lower age limits, and/or the dating of only given stratigraphic unit when the data were available. A unit date was any date falling within the upper and lower boundaries of the coded stratigraphic position. The date was recorded in years before present (B.P.) along with its standard deviation.

The coding of faunal remains uses summarized data and does not represent fully the detail of the faunal analyses conducted and summarized in chapter 8. Counts of bone and bone fragments were separated into groups of burned/calcined and unburned. The skeletal elements were divided into skull, axial, other identified elements, and unidentifiable elements of medium-large mammals of unidentified species. No breakdown by element was implemented for small-medium mammals or for mammals whose size range could not be determined. A special category was set up for the bones of nonmammals (e.g., birds).

Given the high frequency of caribou bones identified from sites and the prominence of caribou and moose in historic Athapaskan subsistence, special coding procedures were made for these two species. The distinction between burned/calcined and unburned was maintained. The skeleton was divided into five groups: skull and antler (includes teeth), ribs and vertebrae, shoulder and pelvic girdles, limbs, and extremities (carpals, tarsals, and phalanges). A distinction was made as to whether the identification of the elements was positive or tentative.

Because very few other mammal species were encountered during the cultural resources survey, only the number of mammal species and total number of bones were coded. Numbers in these columns alerted the faunal analyst to review the data for that level of the site and to add information from the detailed faunal reports to the computer summarized data as needed. The methods used in the faunal analysis are presented in section 6.10 and the results of the analyses in Chapter 8.

The presence of flora (e.g., seeds, macrofossils, or charcoal) in the stratigraphic unit is indicated and identified according to type. This piece of information is intended for determining the dating potential of a stratigraphic unit rather than for conducting a detailed botanic analysis.

Nonlithic artifacts are identified according to number and type (e.g., bone/antler, metal, glass, wood, and other). These variables are important for the identification of recent historic and prehistoric sites which have good preservation or items of Euro-American manufacture. Aboriginal use of native metals can also be identified with this data category.

The following cultural features were coded: depressions, hearths, historic structures (e.g., cabin, grave, mine, etc.), and stone features. Codes denote absence, possible presence, and presence.

Twenty four lithic and nonlithic artifact categories were defined and coded according to material type. The artifact categories are unmodified flakes, modified flakes, scrapers, blades, microblades, burins, burin spalls, bifaces, preforms, notched points, stemmed points, leaf-shaped points, lanceolate points, triangular points, microblade cores, microblade tablets, blade cores, rejuvenation flakes, flake cores, hammerstones, abraders, notched pebbles, thermally altered rocks, and cobbles and cobble fragments. The eight common lithic materials of argillite, basalt, chalcedony, chert, obsidian, quartz, quartzite, and rhyolite were used to code the majority of artifacts (see Figure 6.8 for the rock identification flow chart and Appendix A for rock and mineral definitions). The additional categories of igneous, metamorphic, and sedimentary were added to allow for coding of exotic material types or uncertainty in identification. Only artifacts greater than 1/8" were coded to eliminate biases introduced if fine screen samples from a few sites were included. Counts were made of thermally altered rock, ochre, and cobble and cobble fragments. The cobble and cobble fragments were identified according to material type when known. The methods of lithic analysis appear in section 6.9 and the results of analysis in Chapter 8.

All data were recorded using information appearing in Appendix D on site descriptions and Appendix F on site locations. The codings were entered onto 320 KB 5½" floppy disks using WORDSTAR under a CP/M-86 operating system. The use of a Fujitsu Micro 16s minicomputer facilitated data entry and editing. All codes were checked for accuracy after being entered into the computer. The data were then transferred to a Honeywell 6000 for processing. Analyses were conducted using version 9 of SPSS (Statistical Package for the Social Sciences) (Nie et al. 1975; Hull and Nie 1981).

6.9 - Lithic Analysis

The lithic analyses were carried out in two primary areas, the analysis of lithic artifact types and the analysis of lithic raw material types in both a site specific and stratigraphic perspectives.

A total of 24 lithic artifact types were defined in the project area. The variability of artifact types found on individual sites across the project area and within project-wide stratigraphic units was obtained through plotting artifact frequency, percentages, and density. Artifact distribution was analyzed by plotting the occurrence of these types within sites and within stratigraphic units.

Eight lithic raw material types were identified. The analysis of lithic raw material types focused on defining the variability of sites or site types within the project area. Percentages and counts of specimens of each lithic raw material were compiled to determine their distribution and relative abundance across time (stratigraphic units) and across space (sites). The lithic raw material distributions and frequencies were then compared against artifact type to identify any associations which may exist between raw material and artifact type.

6.10 - Faunal Analysis

The basic methodology of faunal analysis involved quantification of bone fragments recovered from all sites, identification of each bone or fragment as to skeletal element and species whenever possible, and examination of each specimen for evidence of cultural modification, such as burning, butchery marks, or tool manufacture. After the identification process was complete, tables were constructed to present data on the number of specimens for each identified faunal taxa by stratigraphic unit and by site. This information was analyzed with the objective of determining past subsistence patterns and the nature of changes which may have occurred in them over time. Bone processing activities were also considered during the analysis.

6.11 - Geoarcheology

(a) Literature Review

Geoarcheological studies were conducted in association with the cultural resources program to assist in providing data that could be used to located and evaluate site and regional stratigraphy. Prior to the 1980 field season all published geologic reports were collected and reviewed for information relevant to the project. Because specific glacial/climatic studies were not available for the immediate study area, literature for the adjacent regions was used. The review concentrated on those areas for which radiocarbon dates were available from meaningful stratigraphic contexts. Because of the relatively high quality of climatic sequences from the Glacier Bay-Boundary Ranges region, Southeast Alaska, and Brooks Range, these areas were also reviewed.

(b) Reconnaissance Airphoto Mapping

During May, 1980, a regional map of the Susitna Valley was prepared for a first-order interpretation of the geologic history and terrain units to be archeologically studied. The map extended to at least 10 km, and usually 15-20 km, from the Susitna River. Units defined completely from air photo interpretation using 1:20,000 false color infrared U-2 flight lines were subdivided on the basis of age and surface characteristics. The survey locale form was designed to provide ground truthing for the air photo interpretation. The development of terrain unit maps by R & M Consultants as part of subtask 5.02, photo interpretation, superseded efforts by the University of Alaska Museum in the mapping of terrain units.

(c) Field Study

Aerial reconnaissance of the Susitna River valley was done to evaluate the distribution and range of surface landforms and deposit. This reconnaissance was done in conjunction with project archeologists in order to obtain collective agreement on the basis for revised mapping, and to evaluate the reliability and accuracy of mapping done from air photos.

Twenty-five bluff exposures that might provide stratigraphic information needed to interpret and date the major valley-forming geologic processes were selected for study from along the Susitna River and its major tributaries between the Chulitna River and Tyone River. At each exposure the entire bluff face was examined and a selected stratigraphic section measured. The sediments were divided into significant natural units, and the character and height of each unit was described above "recent high water", which was used as the altitude datum. Study of each exposure resulted in a detailed sketch and description of units, including the character of the surface above the exposure. In addition to measuring and describing all units, as many as possible were sampled for various studies. Organic matter in key units was sampled whenever possible for radiocarbon dating. Organic horizons with well-preserved plant macrofossils were sampled for future paleobotanical analysis. Some sediment units were sampled to obtain a representative sample of the unit lithology. In addition, many exposures contained one or more volcanic ash layers, which were also sampled.

Landforms within the study area were examined. Major glacial moraines, deltas, lake plains, eskers, and terraces were described and their heights and gradient measured. Most examination was done from the air, but many glacial-geologic features were studied on the ground. Also the geomorphic character of each of the geological/morphological units (terrain units) within the impoundment were described.

Field data were organized, clarified, and tabulated. All short written descriptions were transferred to the 1:63,360 scale base maps. All stratigraphic diagrams and descriptions were redrawn and edited. All samples were double checked and curated, and a detailed master list was prepared. All photographs were labeled and keyed to geologic sites and exposures.

6.12 - Tephra Analysis

Samples of soil/sediment units were analyzed for tephra by the Alaska Tephrochronology Center in the University of Alaska Museum. Petrographic analyses were conducted to: 1) determine whether the tephra identified in the field were tephra, 2) characterize the mineralogy and glass shard morphology of the tephra, and 3) determine the number of tephra present. Details of tephra analysis are presented in Appendix C.

6.13 - Curation

The University of Alaska Museum is designated as the repository for all artifacts and supporting documentation from lands owned or controlled by the Department of the Interior. The University of Alaska Museum is also designated as the repository on the State of Alaska permit for artifacts and supporting documentation collected as a result of the program. All specimens and their associated contextual data resulting from the Susitna Hydroelectric cultural resources survey are housed at the University of Alaska Museum, 907 Yukon Drive, Fairbanks, Alaska 99701.

Following accessioning, cataloguing, analysis, and report preparation all artifacts and their associated contextual data were organized and incorporated into the archeological collection range and master assession files of the University of Alaska Museum. Following transport to the Museum the artifacts were either fumagated or frozen to eliminate the possibility of insect or parasitic infestation into the collection range or laboratories. Artifact assemblages were unpacked and incorporated into the collection range sequentially by accession sequence. Each accession is housed as a discrete assemblage within the collection range and individual catalogue entries were ordered sequentially within the accessioned assemblage. Assemblages are housed in drawers equipped with dividers within mobile "Space-Saver" compactor storage units. The collection range is a high security area with limited access, patrolled daily by University Safety and Security personnel. It is located within a three-tiered electronic security envelope during nonworking hours. Access during working hours requires curatorial authorization.

The original catalogue records were incorporated into the master catalogue for the University's archeological collections. An individual accession file corresponding to each assemblage housed in the collection range was established which contains the supporting documentation for each particular accession. In instances where the supporting documentation is not located in the accession file, it is cross referenced to the appropriate source of information, e.g. photo negative file, etc. A photocopy of the catalogue for each individual accession is contained within the file.

7 - AREAS EXAMINED FOR CULTURAL RESOURCES 1980-1984 AND SITES DOCUMENTED

7.1 - Introduction

Areas intensively surveyed for cultural resources include the proposed Watana and Devil Canyon reservoirs, Watana and Devil Canyon construction areas, borrow areas A through L, phase I recreation area D, geotechnical testing locales, and areas adjacent to direct impact areas that would be subject to indirect impact (i.e., areas within one-half mile of project facilities and features, section 7.10). Sites located by other project personnel were also recorded. The proposed access routes, transmission routes, the railroad, recreation areas A, B, E, and F, and the area proposed for the Devil Canyon construction camp were evaluated to determine their archeological sensitivity. Due to the preliminary nature of proposed access road borrow area selection, no survey was requested for these areas. However, a number of sites were located while evaluating archeological sensitivity along the access and transmission routes which cross-cut these proposed borrow sources.

The locations of survey locales, areas surveyed and areas eliminated from survey are shown in Figures 7.1 through 7.6. The location of project features that did not receive intensive survey, such as proposed access road borrow areas, are depicted in Appendix E. As a result of the study, 270 sites were located and documented. Site reports and the locations of sites found are located in Appendices D and F, respectively. Survey methods employed are presented in detail in chapter 6. The number of sites found in each area is listed in Tables 7.1 and 7.2. Full-size USGS 1:63,360 scale maps of Figures 7.1 through 7.6 are included in Appendix E.

7.2 - Proposed Watana Reservoir

The proposed Watana Dam is located approximately 2.5 miles (4 km) upstream from the Tsusena Creek confluence. The reservoir created by

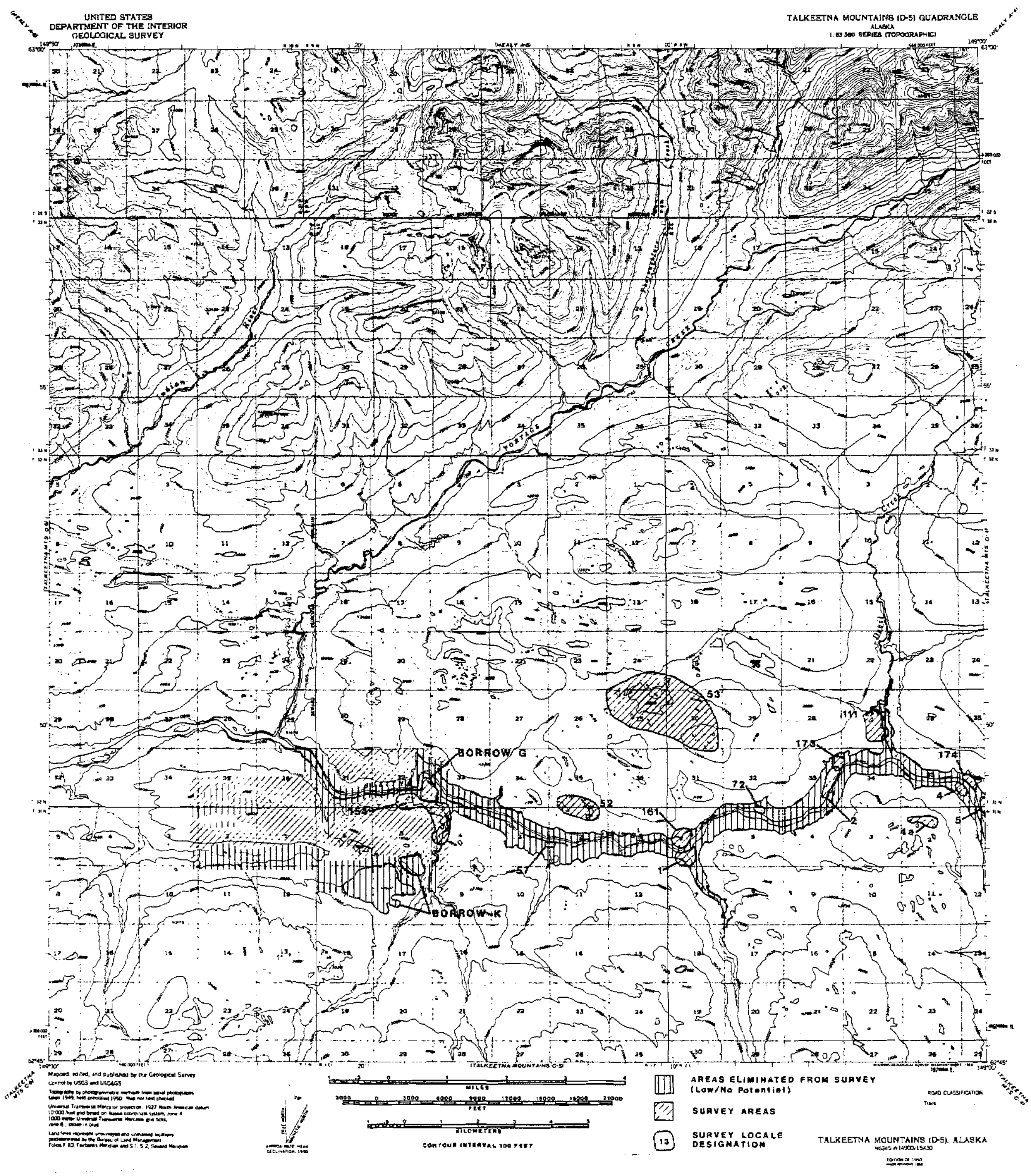

Figure 7.1. Location of Survey Locales, Areas Surveyed, and Areas Eliminated from Survey, Talkeetna Mts. D-5

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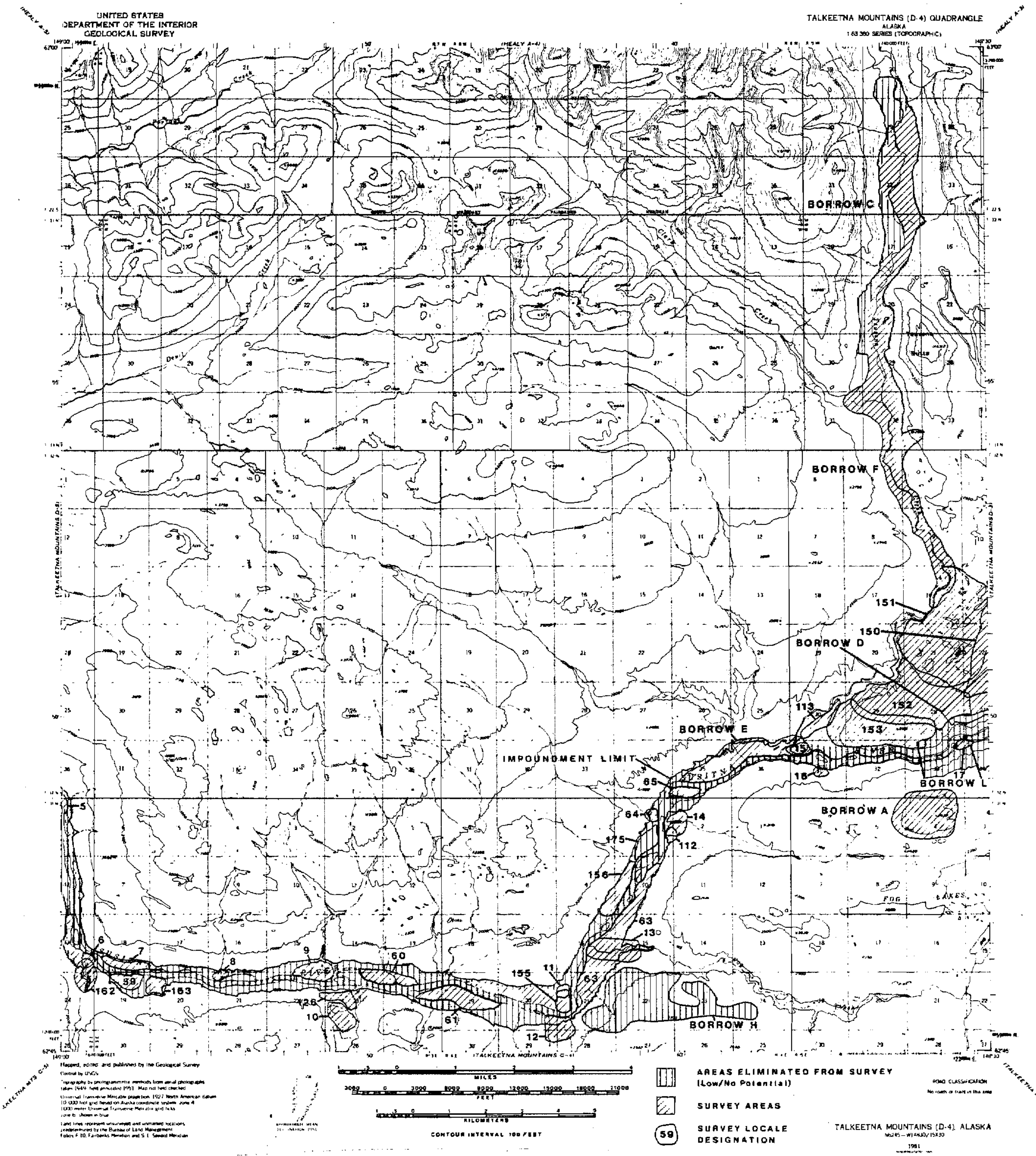

Figure 7.2. Location of Survey Locales, Areas Surveyed, and Areas Eliminated from Survey, Talkeetna Mts. D-4

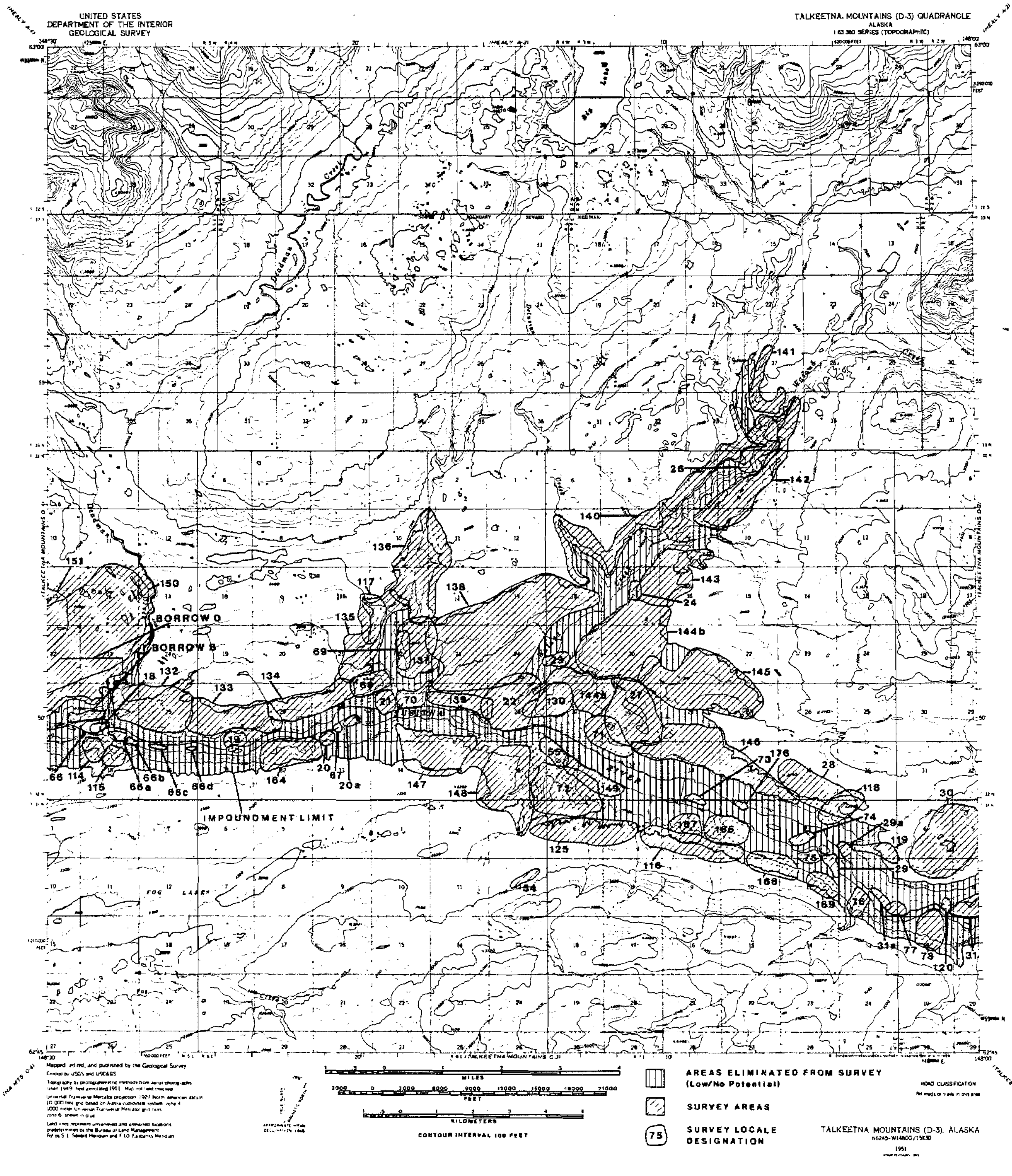

Figure 7.3. Location of Survey Locales, Areas Surveyed, and Areas Eliminated from Survey, Talkeetna Mts. D-3

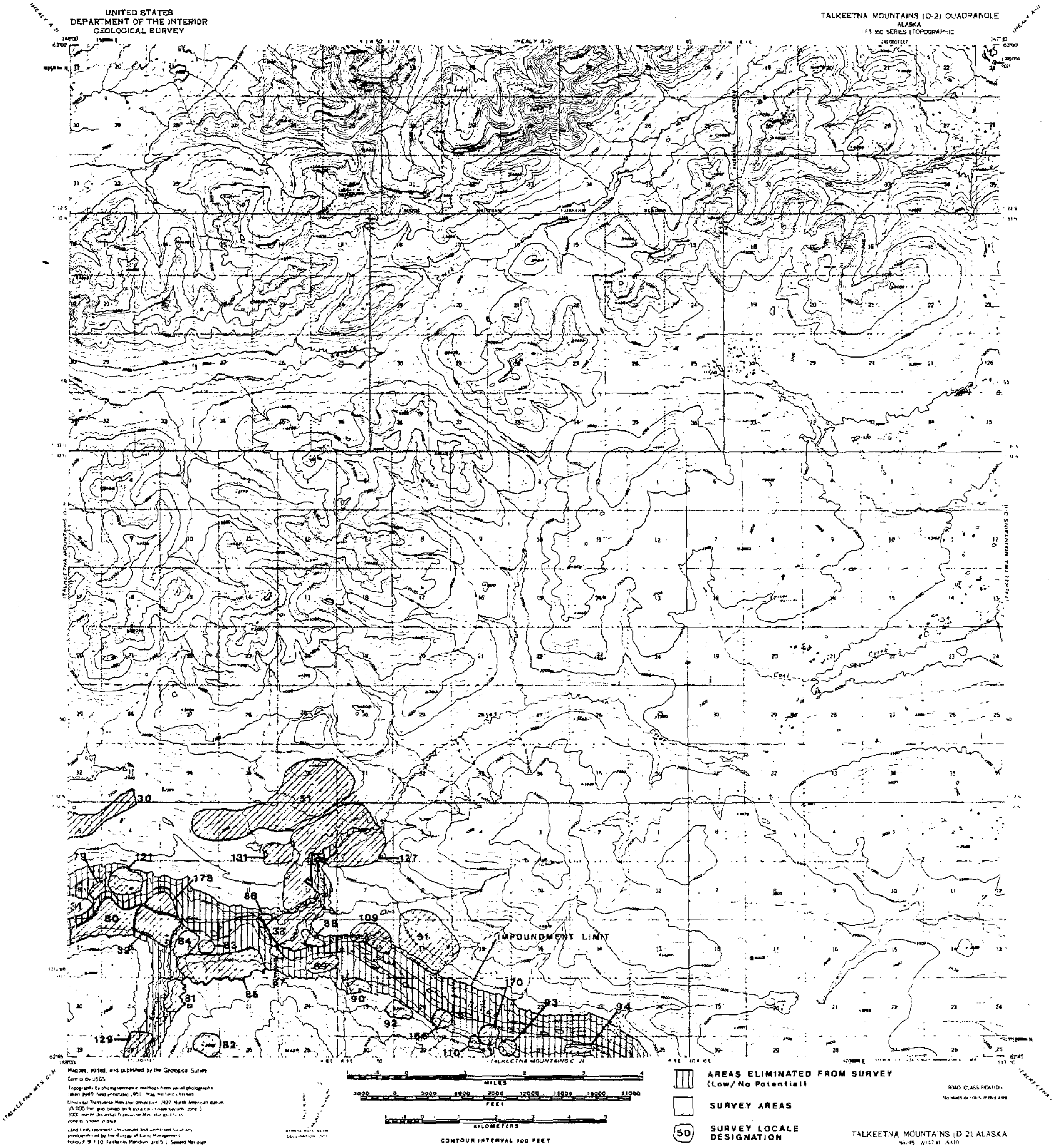

Figure 7.4. Location of Survey Locales, Areas Surveyed, and Areas Eliminated from Survey, Talkeetna Mts. D-2

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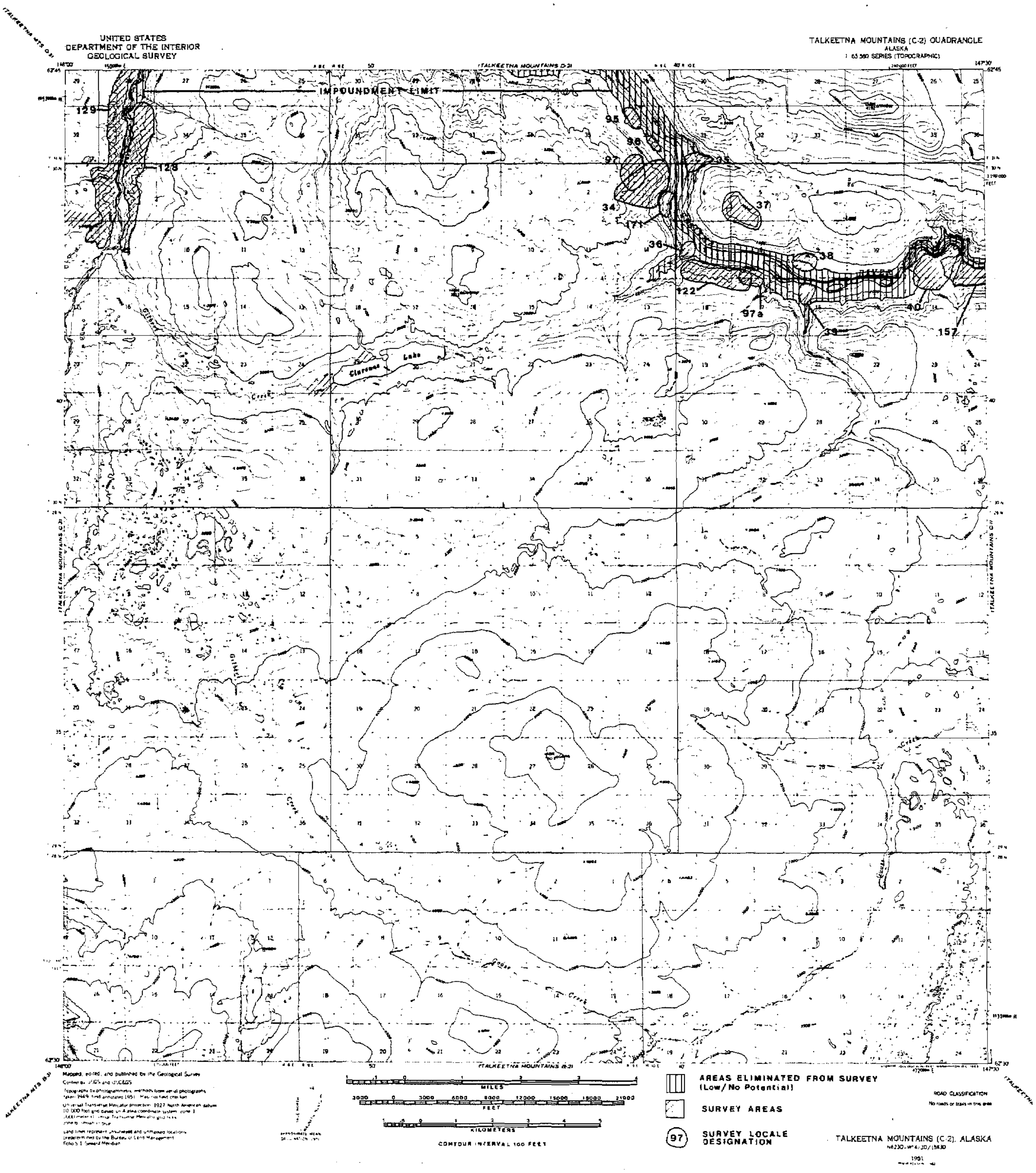

Figure 7.5. Location of Survey Locales, Areas Surveyed, and Areas Eliminated from Survey, Talkeetna Mts. C-2

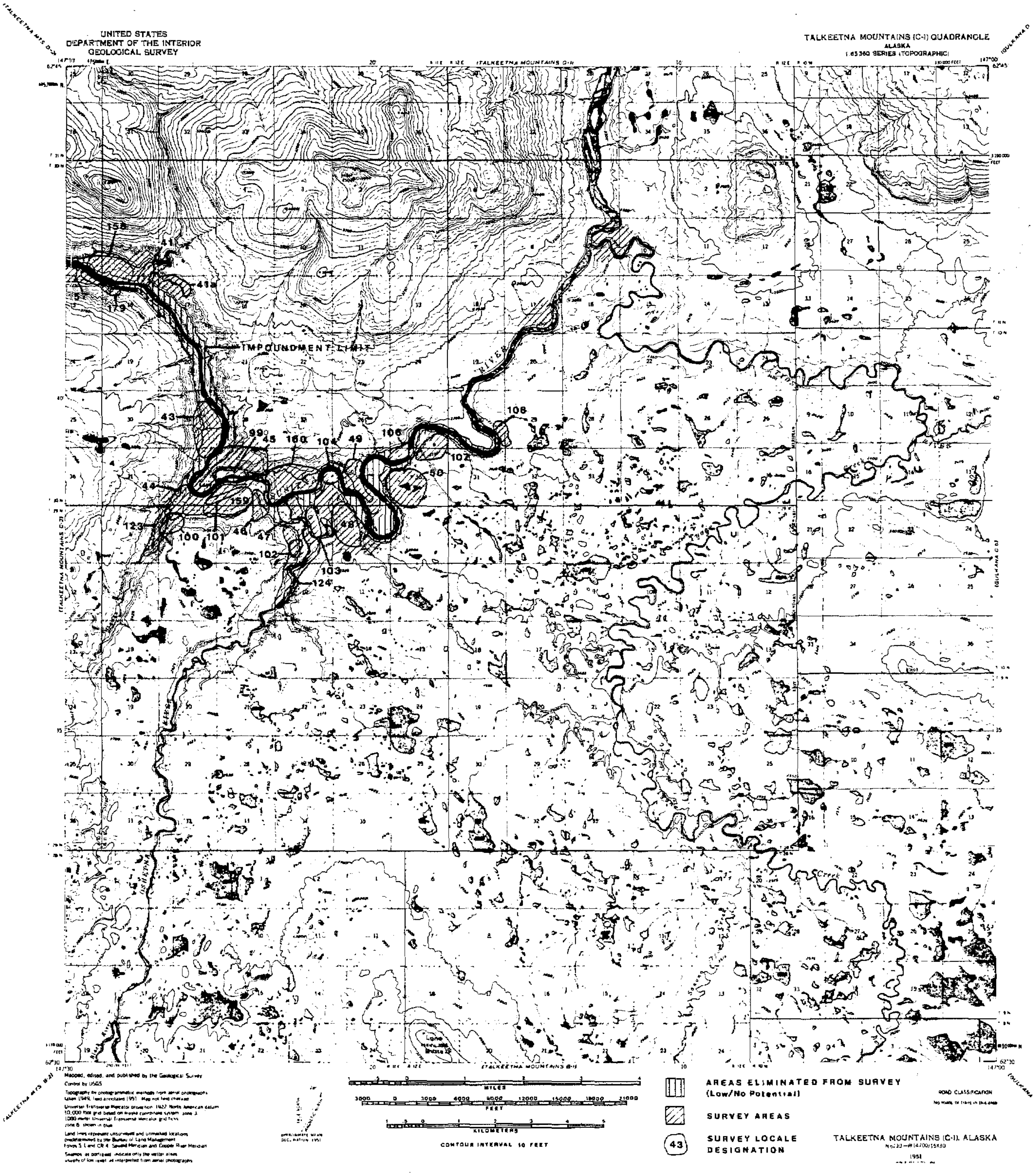

Figure 7.6. Location of Survey Locales, Areas Surveyed, and Areas Eliminated from Survey, Talkeetna Mts. C-1

the Watana Dam will be approximately 48 miles (77 km) long with a surface area of 38,000 acres (15,400 ha) and a maximum width of 5 miles (8 km). The surface water elevation of the reservoir will be 2,201 feet asl (671 m) maximum, 2,185 feet asl (666 m) normal, and 2,065 feet asl (629 m) minimum. Figures 7.2 through 7.6 show the location and extent of the Watana Dam reservoir. USGS maps found in Appendix E show the locations of cultural resources found in the Watana Dam reservoir area. Seventy-three sites are located within the Watana Reservoir and 47 additional sites are located adjacent (within one-half mile, section 7.10) to the reservoir (Tables 7.1 and 7.2).

7.3 - Proposed Devil Canyon Reservoir

The proposed Devil Canyon Dam is located 32 river miles (51 km) downstream from the Watana Dam. The reservoir formed by the Devil Canyon Dam will be approximately 26 miles (42 km) long with a surface area of 7,800 acres (3,200 ha) and a maximum width of one-half mile (805 m). The maximum water surface elevation of the reservoir will be 1,466 feet asl (446.8 m). The normal and minimum water surface elevation will be 1,455 feet asl (443.5 m), and 1,405 feet asl (428.2 m), respectively. Figures 7.1 and 7.2 depict the extent of the Devil Canyon Reservoir. The locations of cultural resources found in the reservoir area are presented in Appendix E. A total of seven sites are located within the Devil Canyon Reservoir. Another six sites are located adjacent to the reservoir (Tables 7.1 and 7.2).

7.4 - Proposed Watana Construction Area

With the exception of the Watana Dam the most significant facility in the Watana construction area (Figure E.2 and E.3, Appendix E) will be a combination camp and village. This proposed facility is a largely self-sufficient community anticipated to house 3,300 people during construction of the dam. Temporary and permanent airstrips (Figures E.2 and E.3, Appendix E) are also part of the facility. After construction most of the facility will be dismantled. Permanent facilities will include a town or small community for approximately 130 staff members and their families and a maintenance building for use during operation of the power plants. The location of cultural resources found in this construction area is found on USGS maps in Appendix E. No sites are presently recorded within facilities or features associated with the Watana construction area. However, ten sites are located adjacent to construction areas (Tables 7.1 and 7.2).

7.5 - Proposed Devil Canyon Construction Area

A proposed camp and construction village will be constructed and maintained at the Devil Canyon Dam site (Figure E.1, Appendix E). This camp will provide living facilities for approximately 1,800 people during the construction phase. Other facilities include contractors' work areas, site power, services, and communications. Following construction, operation and maintenance activities will be centered at the Watana Dam site, thus reducing the number of permanent facilities required at the Devil Canyon Dam site. No sites were discovered during intensive cultural resources survey of the Devil Canyon Dam site area or during reconnaissance level survey of the proposed construction camp area.

7.6 - Proposed Borrow Areas

The proposed borrow areas are locations where earth fill for dam construction will be obtained. There are 12 proposed borrow areas (designated A through L) within the project area. Borrow areas B, J, and L are located within the proposed Watana Dam reservoir. Borrow areas E, G, and I are located within the proposed Devil Canyon Dam reservoir. The six other proposed borrow areas are located outside proposed impoundment areas. Borrow areas C and F are situated along Tsusena Creek. Borrow area D is located in the Watana construction area. Borrow area H is located near Fog Creek outside of the impoundment zone. Borrow areas A and K are located just south of the Devil Canyon Dam site and Watana Dam site, respectively. The locations of proposed borrow areas are illustrated in Appendix E, Figures E.1 through E.3. Locations of cultural resources found in each of the borrow areas are noted on USGS maps found in Appendix E. Thirty-two sites are located in proposed borrow areas A-L. An additional 15 sites are located adjacent to these areas (Tables 7.1 and 7.2).

7.7 - Areas Associated with Geotechnical Testing

Areas associated with geotechnical testing include locations where auger holes, bore holes, hammer drill holes, test trenches, test pits, seismic lines, and temporary access trails were placed. Most of the geotechnical testing was conducted at the dam site locations and within the proposed impoundment areas. However, geotechnical testing was also done in borrow areas D, E, and G, the Stephan Lake area, the Butte Lake area, the Fog Lakes area, along the Black River moraine, and the Deadman Creek moraine. Geotechnical testing locales examined for cultural resources include 69 seismic lines, 73 bore/auger holes, 24 hammer drill holes, 16 test trenches, 45 test pits, and one temporary trail. Seven of these locations contained cultural resources. Site TLM 137 was found during cultural resources survey of seismic line 82-A, near the proposed Watana Dam site. The remaining sites were found during cultural resources surveys associated with bore and auger holes. Sites TLM 068 and TLM 070 were found during the cultural resources survey in the Stephan Lake area. Site TLM 082 was found during survey in the Black River area. Sites HEA 177, HEA 178, and HEA 179 were found while surveying in the Butte Lake area. All other geotechnical testing areas were either located in terrain which had low or no archeological potential, or were archeologically tested and found to have no archeological sites. The locations of cultural resources found in the geotechnical testing areas are noted on USGS maps found in Appendix E, and are identified in Tables 7.1 and 7.2.

7.8 - Proposed Phase One Recreation Areas

The recreation plan is to be implemented in phased intervals parallel with the phased development of the proposed Susitna project. Cultural resources survey was conducted for phase I areas of the recreation plan (A, B, D, E, F). Phase I of the recreation plan includes features in the following locations:

1) Brushkana Camp: 0.25 miles of road; 25 campsites; 3 single vault latrines; 1 bulletin board; 8 trash cans; and 1 water well (E).
2) Confluence of Tyone River with Susitna River: 1 shelter (D).
3) Confluence of Butte Creek with the Susitna River: 1 boat launch (Susitna Bridge) (B).
4) Middle Fork Chulitna River: 25 miles of primitive trail; trailhead; 2 overnight shelters; 6 parking spaces; trash cans; bulletin board; and signs (A).
5) Portal Entry: Explanatory entry sign and 2-3 car pullout (F).

The location of recreational areas are shown in Appendix E (Figures E.1, E.2, E.4, E.6, E.7, E.8, E.11, E.12, E.24, E.26, E.27, and E.28). The locations of cultural resources found in these areas are found on USGS maps in Appendix E. No sites were found in association with the above five areas. However, because of the juxtaposition of other recreation areas with existing project facilities and features, sites have been located that fall in or adjacent to recreation areas not specifically surveyed as part of this study. As a result, eight sites have been documented in association with recreation areas. Another 36 sites are located adjacent to recreation areas (Tables 7.1 and 7.2).

7.9 - Proposed Linear Features

The proposed linear features are comprised of three major components. These features include access roads and associated borrow areas connecting the Denali Highway to Watana Dam and continuing to Devil Canyon Dam and its associated borrow areas, a railroad between Devil Canyon Dam and Gold Creek, and three transmission lines: the first connecting Watana Dam and Devil Canyon Dam with the Intertie; the second connecting Willow and Anchorage; and the third connecting Healy and Fairbanks. The width of each of these linear features is 0.25 miles on each side of a mapped center line, resulting in an overall width of 0.5 miles.

The location of cultural resources found in each of these linear features is shown on USGS maps found in Appendix E. No sites are directly on the centerline of the access routes. However, 24 sites are located adjacent to the access routes. Eleven sites fall within access route borrow areas while five are adjacent to these borrow areas. One site is located on the transmission routes while 20 sites are adjacent to the transmission routes. No sites are known on the railroad but 1 is known to be adjacent to it (Tables 7.1 and 7.2).

7.10 - Areas Adjacent to Project Facilities and Features

Adjacent areas are defined as those areas directly adjoining and within one-half mile of the proposed Watana and Devil Canyon reservoirs and construction areas, borrow areas, access routes, access route borrow areas, recreation areas, railroad, and the transmission routes. Sites adjacent to these facilities or features are listed under the appropriate heading within this section. Adjacent sites are defined as those sites within one-half mile of any facility or feature. Adjacent sites are included in Tables 7.1 and 7.2.

7.11 - Cultural Resources Identified in Other Areas

Sites included in this category are more than one-half mile from any project facility or feature. Sites in this category were: 1) located by other project personnel, 2) found in association with project facilities, features, or recreation areas that have since been modified, relocated, or deleted, 3) found during geoarcheology studies (the geoarcheology study area was larger than the cultural resources study area, see chapter 2), 4) documented near the project area prior to the present study, and 5) found by archeological personnel but beyond one-half mile from project facilities or features. Thirty-five sites were found in "other areas". These sites are identified by the above five categories in Tables 7.1 and 7.2.

Because a site can be associated with more than one facility or feature, or be adjacent to more than one facility or feature, the total number of sites in and adjacent to project facilities and features totals more than the 270 sites documented in this report. Tables 7.1 and 7.2 indicate which sites are associated with more than one facility or feature.

Table 7.1.

Location of Sites in Relation to Project Facilities and Features

AHRS#[a]	Project Facility or Feature[b]	USGS Map[c] Quad	USGS Map[c] Figure
TLM 005 (H)	03	D-6	E.19
TLM 006 (H)	AJ(RR)	D-6	E.19
TLM 007 (P)	03	C-4	E.5
TLM 009 (P)	RA-D	C-1	E.8
TLM 015 (P)	AJ(AR)	D-4	E.2
TLM 016 (P)	AJ(WC-PAS)	D-3	E.3
	AJ(WC-WCC)		
	AJ(AR)		
TLM 017 (P)	AJ(WR)	D-4	E.2
TLM 018 (P)	AJ(WC-WD)	D-4	E.2
	AJ(T W-I)		
	AJ(AR)		
TLM 020 (H)	03	D-5	E.1
TLM 021 (P)	AJ(RA-K)	C-2	E.7
TLM 022 (P)	B-E	D-4	E.2
	AJ(DR)		
TLM 023 (H)	DR	D-4	E.2
	B-E		
TLM 024 (P)	AJ(DR)	D-4	E.2
	AJ(B-E)		
TLM 025 (P)	04	D-3	E.3
TLM 026 (P)	AJ(WR)	C-1	E.8
TLM 027 (P)	AJ(DR)	D-4	E.2
TLM 028 (P)	04	C-1	E.8
TLM 029 (P)	AJ(DR)	D-4	E.2

Table 7.1. (Continued)

AHRS#	Project Facility or Feature	USGS Map Quad	USGS Map Figure
TLM 030 (P)	AJ(DR)	D-4	E.2
	AJ(B-H)		
TLM 031 (P)	AJ(WR)	D-3	E.3
TLM 032 (P)	AJ(WR)	D-3	E.3
TLM 033 (P)	WR	D-3	E.3
TLM 034 (P)	DR	D-4	E.2
	B-I		
TLM 035 (P)	AJ(B-E)	D-4	E.2
TLM 036 (P)	02	D-2	E.4
TLM 037 (P)	02	D-3	E.3
TLM 038 (P)	AJ(WR)	D-3	E.3
TLM 039 (P)	WR	D-3	E.3
TLM 040 (P)	WR	D-3	E.3
TLM 041 (P)	AJ(B-H)	D-4	E.2
TLM 042 (P)	AJ(WR)	C-1	E.8
TLM 043 (P)	WR	D-3	E.3
	AJ(B-J)		
TLM 044 (P)	02	D-2	E.4
TLM 045 (P)	02	D-2	E.4
TLM 046 (P)	02	D-2	E.4
TLM 047 (P)	AJ(WR)	C-2	E.7
TLM 048 (P)	WR	D-3	E.3
TLM 049 (P)	AJ(WR)	C-1	E.8
Tlm 050 (P)	WR	D-3	E.3
TLM 051 (P)	AJ(B-F)	D-4	E.2
TLM 052 (P)	05	D-2	E.4
TLM 053 (P)	05	D-2	E.4

Table 7.1. (Continued)

AHRS#	Project Facility or Feature	USGS Map Quad	Figure
TLM 054 (P)	B-C RA-H	D-4	E.2
TLM 055 (P)	B-C AJ(RA-H)	D-4	E.2
TLM 056 (H)	B-C AJ(RA-H)	D-4	E.2
TLM 057 (P)	AJ(RA-L)	D-3	E.3
TLM 058 (P)	WR AJ(B-J)	D-3	E.3
TLM 059 (P)	WR	D-3	E.3
TLM 060 (P)	WR	D-3	E.3
TLM 061 (P)	WR	D-3	E.3
TLM 062 (P)	WR	D-3	E.3
TLM 063 (P)	WR AJ(B-J)	D-3	E.3
TLM 064 (P)	AJ(WR)	D-3	E.3
TLM 065 (P)	WR	D-2	E.4
TLM 066 (P)	04	D-3	E.3
TLM 067 (P)	04	B-1	E.10
TLM 068 (P)	GT	C-4	E.5
TLM 069 (P)	05	D-2	E.4
TLM 070 (P)	GT	C-4	E.5
TLM 071 (H)	01	C-2	E.7
TLM 072 (P)	WR	D-2	E.4
TLM 073 (P)	AJ(WR)	C-1	E.8
TLM 074 (P)	AJ(WR)	C-1	E.8
TLM 075 (P)	WR	D-2	E.4
TLM 076 (P)	AJ(WR)	C-1	E.8

Table 7.1. (Continued)

AHRS#	Project Facility or Feature	USGS Map Quad	Figure
TLM 077 (P)	WR	D-2	E.4
TLM 078 (P)	B-C	D-4	E.2
	RA-H		
TLM 079 (H)	WR	D-2	E.4
TLM 080 (H)	WR	D-3	E.3
	B-J		
TLM 081 (P)	B-C	D-4	E.2
	RA-H		
TLM 082 (P)	GT	B-2	E.9
TLM 083 (P)	RA-H	D-4	E.2
TLM 084 (P)	B-C	D-4	E.2
	AJ(RA-H)		
TLM 085 (P)	B-C	D-4	E.2
	AJ(RA-H)		
TLM 086 (P)	B-C	D-4	E.2
	AJ(RA-H)		
TLM 087 (P)	B-C	D-4	E.2
	AJ(RA-H)		
TLM 088 (P)	B-C	D-4	E.2
	RA-H		
TLM 089 (P)	AJ(RA-H)	D-4	E.2
	AJ(RA-I)		
TLM 090 (P)	AJ(RA-H)	D-4	E.2
TLM 091 (P)	AJ(RA-H)	D-4	E.2
TLM 092 (P)	05	D-4	E.2
TLM 093 (P)	05	D-4	E.2
TLM 094 (P)	B-C	D-4	E.2
	AJ(RA-H)		

Table 7.1. (Continued)

AHRS#	Project Facility or Feature	USGS Map Quad	Figure
TLM 095 (P)	B-C AJ(RA-H)	D-4	E.2
TLM 096 (P)	B-C	D-4	E.2
TLM 097 (P)	B-C AJ(RA-H)	D-4	E.2
TLM 098 (P)	AJ(AR) AJ(RA-L)	D-3	E.3
TLM 099 (P)	AJ(AR)	D-3	E.3
TLM 100 (P)	AJ(RA-J)	C-2	E.7
TLM 101 (P)	RA-Q	D-5	E.1
TLM 102 (P)	WR	D-3	E.3
TLM 103 (P)	AJ(RA-Q)	D-5	E.1
TLM 104 (P)	WR	D-3	E.3
TLM 105 (P)	AJ(RA-J)	C-2	E.7
TLM 106 (P)	ARB AJ(AR) AJ(T W-I)	D-4	E.2
TLM 107 (P)	ARB AJ(AR) AJ(T W-I)	D-4	E.2
TLM 108 (P)	ARB AJ(AR)	D-4	E.2
TLM 109 (P)	ARB AJ(AR)	D-4	E.2
TLM 110 (P)	ARB AJ(AR) AJ(T W-I)	D-4	E.2

Table 7.1. (Continued)

AHRS#	Project Facility or Feature	USGS Map Quad	Figure
TLM 111 (P)	ARB AJ(AR)	D-4	E.2
TLM 112 (P)	AJ(T W-I) AJ(AR)	D-4	E.2
TLM 113 (P)	ARB AJ(AR)	D-5	E.1
TLM 114 (P)	ARB AJ(AR)	D-5	E.1
TLM 115 (P)	WR	D-2	E.4
TLM 116 (P)	AJ(RA-I)	D-3	E.3
TLM 117 (P)	AJ(AR) AJ(RA-L)	D-3	E.3
TLM 118 (P)	AJ(DR)	D-5	E.1
TLM 119 (P)	WR	D-3	E.3
TLM 120 (P)	AJ(WR)	D-3	E.3
TLM 121 (P)	AJ(WR)	D-3	E.3
TLM 122 (P)	AJ(WR)	D-3	E.3
TLM 123 (P)	AJ(WR)	D-3	E.3
TLM 124 (P)	AJ(WR)	D-3	E.3
TLM 125 (P)	AJ(WR)	D-3	E.3
TLM 126 (P)	WR	D-3	E.3
TLM 127 (P)	AJ(WR)	D-3	E.3
TLM 128 (P)	AJ(WR)	D-2	E.4
TLM 129 (P)	AJ(WR)	D-3	E.3
TLM 130 (P)	AJ(WR)	D-3	E.3
TLM 131 (P)	AJ(WR)	D-3	E.3
TLM 132 (P)	AJ(WR)	D-3	E.3
TLM 133 (P)	AJ(WR)	D-3	E.3

Table 7.1. (Continued)

AHRS#	Project Facility or Feature	USGS Map Quad	Figure
TLM 134 (P)	AJ(WR)	D-2	E.4
TLM 135 (P)	AJ(WR)	D-2	E.4
TLM 136 (P)	AJ(WR)	D-2	E.4
TLM 137 (P)	GT AJ(W-I)	D-4	E.2
TLM 138 (P)	05	D-2	E.4
TLM 139 (P)	AJ(WR)	D-2	E.4
TLM 140 (P)	AJ(WR)	D-2	E.4
TLM 141 (P)	AJ(WR)	D-2	E.4
TLM 142 (P)	AJ(WR)	D-2	E.4
TLM 143 (P)	AJ(WR)	D-2	E.4
TLM 144 (P)	05	D-2	E.4
TLM 145 (P)	AJ(WR)	D-2	E.4
TLM 146 (P)	05	D-2	E.4
TLM 147 (P)	AJ(WR)	D-2	E.4
TLM 148 (P)	AJ(WR)	D-2	E.4
TLM 149 (P)	05	D-2	E.4
TLM 150 (P)	05	D-2	E.4
TLM 151 (P)	05	D-2	E.4
TLM 152 (P)	05	D-2	E.4
TLM 153 (P)	ARB AJ(AR)	D-3	E.3
TLM 154 (P)	05	D-2	E.4
TLM 155 (P)	AJ(AR)	D-3	E.3
TLM 159 (P)	AJ(WR)	D-3	E.3
TLM 160 (P)	AJ(WC-WCV) AJ(AR)	D-4	E.2
TLM 164 (P)	AJ(B-F)	D-4	E.2

Table 7.1. (Continued)

AHRS#	Project Facility or Feature	USGS Map	
		Quad	Figure
TLM 165 (P)	AJ(WR)	D-4	E.2
	AJ(T W-I)		
	AJ(WC-WD)		
TLM 166 (P)	AJ(WR)	D-4	E.2
	AJ(T W-I)		
	AJ(WC-WD)		
TLM 167 (P)	AJ(WR)	D-4	E.2
	AJ(WC-WD)		
TLM 168 (P)	AJ(AR)	D-3	E.3
TLM 169 (P)	WR	D-3	E.3
TLM 170 (P)	AJ(WR)	D-3	E.3
TLM 171 (P)	WR	D-3	E.3
TLM 172 (P)	AJ(WC-WCV)	D-4	E.2
TLM 173 (P)	WR	C-1	E.8
TLM 174 (P)	WR	D-3	E.3
TLM 175 (P)	WR	D-3	E.3
TLM 176 (P)	B-F	D-4	E.2
TLM 177 (P)	AJ(WR)	D-3	E.3
	AJ(B-J)		
TLM 178 (H)	DR	D-4	E.2
	B-I		
TLM 179 (P)	AJ(RA-K)	C-2	E.7
TLM 180 (P)	02	D-4	E.2
TLM 181 (P)	AJ(ARB)	D-3	E.3
TLM 182 (P)	WR		
	AJ(RA-J)	C-2	E.7
TLM 183 (P)	AJ(WR)	C-2	E.7

Table 7.1. (Continued)

AHRS#	Project Facility or Feature	USGS Map Quad	Figure
TLM 184 (P)	WR	D-3	E.3
TLM 185 (P)	AJ(WR)	C-1	E.8
TLM 186 (P)	AJ(RA-K)	C-2	E.7
TLM 187 (P)	AJ(RA-J)	C-2	E.7
TLM 188 (P)	B-F	D-4	E.2
TLM 189 (P)	AJ(WR)	C-1	E.8
TLM 190 (P)	AJ(WR)	C-1	E.8
TLM 191 (P)	AJ(ARB)	D-3	E.3
TLM 192 (P)	AJ(WC-WCV) AJ(AR)	D-4	E.2
TLM 193 (P)	AJ(ARB)	D-3	E.3
TLM 194 (P)	WR	D-2	E.4
TLM 195 (P)	AJ(WR)	D-3	E.3
TLM 196 (P)	WR	C-1	E.8
TLM 197 (P)	AJ(WC-PAS)	D-3	E.3
TLM 198 (P)	AJ(WR)	D-3	E.3
TLM 199 (P)	WR AJ(B-J)	D-3	E.3
TLM 200 (P)	WR AJ(B-J)	D-3	E.3
TLM 201 (P)	B-C AJ(RA-H)	D-4	E.2
TLM 202 (P)	B-F AJ(RA-H)	D-4	E.2
TLM 203 (P)	B-F AJ(RA-H)	D-4	E.2
TLM 204 (H)	WR	C-2	E.7
TLM 205 (P)	01	D-2	E.4

Table 7.1. (Continued)

AHRS#	Project Facility or Feature	USGS Map Quad	Figure
TLM 206 (P)	WR	C-1	E.8
TLM 207 (P)	AJ(WR)	C-1	E.8
TLM 208 (P)	AJ(RA-K)	C-3	E.6
TLM 209 (P)	B-F	D-4	E.2
	AJ(RA-H)		
TLM 210 (P)	B-F	D-4	E.2
	AJ(RA-H)		
TLM 211 (P)	B-C	D-4	E.2
	AJ(RA-H)		
TLM 212 (H)	B-F	D-4	E.2
TLM 213 (P)	B-C	D-4	E.2
	AJ(RA-H)		
TLM 214 (P)	B-F	D-4	E.2
	AJ(AR)		
TLM 215 (P)	WR	D-3	E.3
TLM 216 (P)	WR	D-3	E.3
TLM 217 (P)	WR	D-3	E.3
TLM 218 (P)	WR	D-3	E.3
TLM 219 (P)	AJ(WR)	D-3	E.3
TLM 220 (P)	WR	D-3	E.3
TLM 221 (P)	WR	D-3	E.3
TLM 222 (P)	WR	D-3	E.3
TLM 223 (P)	WR	D-3	E.3
TLM 224 (P)	WR	D-3	E.3
TLM 225 (P)	WR	D-3	E.3
TLM 226 (P)	WR	D-3	E.3
TLM 227 (P)	WR	D-3	E.3
TLM 228 (P)	WR	D-3	E.3

Table 7.1. (Continued)

AHRS#	Project Facility or Feature	USGS Map Quad	Figure
TLM 229 (P)	WR A(B-J)	D-3	E.3
TLM 230 (P)	WR A(B-J)	D-3	E.3
TLM 231 (P)	WR	D-3	E.3
TLM 232 (P)	WR	D-2	E.4
TLM 233 (P)	WR AJ(B-J)	D-3	E.3
TLM 234 (P)	WR	D-3	E.3
TLM 235 (P)	WR	D-3	E.3
TLM 236 (P)	WR	D-3	E.3
TLM 237 (P)	WR	D-3	E.3
TLM 238 (P)	WR	D-2	E.4
TLM 239 (P)	WR	D-2	E.4
TLM 240 (P)	WR	D-2	E.4
TLM 241 (P)	WR	D-2	E.4
TLM 242 (P)	WR	D-2	E.4
TLM 243 (P)	WR	D-3	E.3
TLM 244 (P)	WR	D-3	E.3
TLM 245 (P)	AJ(ARB) AJ(WR)	D-3	E.3
TLM 246 (P)	WR	D-2	E.4
TLM 247 (P)	WR	D-2	E.4
TLM 248 (H)	WR	D-2	E.4
TLM 249 (P)	WR	D-2	E.4
TLM 250 (P)	WR	D-2	E.4
TLM 251 (P)	WR	C-1	E.8
TLM 252 (P)	DR	D-4	E.2

Table 7.1. (Continued)

AHRS#	Project Facility or Feature	USGS Map Quad	USGS Map Figure
TLM 253 (P)	DR	D-4	E.2
TLM 256 (P)	WR	D-2	E.4
TLM 257 (P)	WR	D-3	E.3
TLM 258 (P)	DR B-E	D-4	E.2
TLM 259 (P)	DR B-I	D-4	E.2
HEA 007 (P)	AJ(T H-F)	D-5	E.37
HEA 012 (P)	AJ(T H-F)	D-5	E.37
HEA 033 (P)	AJ(T H-F)	D-5	E.37
HEA 035 (P)	AJ(T H-F)	D-5	E.37
HEA 038 (P)	AJ(T H-F)	D-5	E.37
HEA 081 (H)	AJ(T H-F)	D-4	E.38
HEA 091 (H)	T H-F	D-5	E.37
HEA 137 (P)	AJ(T H-F)	D-5	E.37
HEA 174 (P)	O2	A-3	E.11
HEA 175 (P)	O2	A-2	E.12
HEA 176 (P)	AJ(RA-L)	A-3	E.11
HEA 177 (P)	GT	A-2	E.12
HEA 178 (P)	GT	A-2	E.12
HEA 179 (P)	GT	A-2	E.12
HEA 180 (P)	AJ(AR)	A-3	E.11
HEA 181 (P)	ARB AJ(AR)	A-3	E.11
HEA 182 (P)	ARB AJ(AR)	A-3	E.11
HEA 183 (P)	AJ(RA-L)	A-3	E.11
HEA 184 (P)	AJ(RA-L)	A-3	E.11

Table 7.1. (Continued)

AHRS#	Project Facility or Feature	USGS Map Quad	USGS Map Figure
HEA 185 (P)	02	A-3	E.11
HEA 186 (P)	02	A-3	E.11
HEA 210 (P)	02	D-4	E.38
HEA 211 (P)	AJ(ARB)	A-3	E.11
FAI 070 (H)	AJ(T H-F)	A-5	E.36
FAI 089 (H)	AJ(T H-F)	A-5	E.36
FAI 090 (H)	AJ(T H-F)	A-5	E.36
FAI 169 (H)	AJ(T H-F)	A-5	E.36
FAI 213 (P)	02	A-5	E.36
FAI 214 (P)	02	A-5	E.36
TYO 014 (P)	AJ(T W-A)	D-1	E.42

[a, b] See Key to Tables on page following Table 7.2.

[c] The names for quad maps are not listed, however the first three letters of the site designation indicate the quad name. TLM sites are on the Talkeetna Mts. quad maps; HEA sites are on Healy quad maps; FAI sites are on Fairbanks quad maps; the TYO site is on a Tyonek quad map.

Table 7.2.

Sites by Project Facilities and Features

Facility or Feature[b]	Site(s)[a]	Total Number
Borrow Areas		
B - C	TLM 054, TLM 055, TLM 056, TLM 078, TLM 081, TLM 084, TLM 085, TLM 086, TIM 087, TLM 088, TLM 094, TLM 095, TLM 096, TLM 097, TLM 201, TLM 211, TLM 213	17
B - E	TLM 022, TLM 023, TLM 258	3
AJ (B-E)	TLM 024, TLM 035	2
B - F	TLM 176, TLM 188, TLM 202, TLM 203, TLM 209, TLM 210, TLM 212, TLM 214	8
AJ (B-F)	TLM 051, TLM 164	2
AJ (B-H)	TLM 030, TLM 041	2
B - I	TLM 034, TLM 178, TLM 259	3
B - J	TLM 080	1
AJ (B-J)	TLM 043, TLM 058, TLM 063, TLM 177, TLM 199, TLM 200, TLM 229, TLM 230, TLM 233	9

Table 7.2. (Continued)

Facility or Feature	Site(s)	Total Number
Transmission Lines		
T H - F	HEA 091	1
AJ (T H-F)	HEA 007, HEA 012, HEA 033, HEA 035, HEA 038, HEA 081, HEA 137	7
	FAI 070, FAI 089, FAI 090, FAI 169	4
AJ (T W-A)	TYO 014	1
AJ (T W-I)	TLM 018, TLM 106, TLM 107, TLM 110, TLM 112, TLM 137, TLM 165, TLM 166	8
Recreation Areas		
RA-D	TLM 009	1
RA-H	TLM 054, TLM 078, TLM 081, TLM 083, TLM 088	5
AJ (RA-H)	TLM 030, TLM 055, TLM 056, TLM 084, TLM 085, TLM 086, TLM 087, TLM 089, TLM 090, TLM 091, TLM 094, TLM 095, TLM 097, TLM 201, TLM 202, TLM 203, TLM 209, TLM 210, TLM 211, TLM 213	20

Table 7.2. (Continued)

Facility or Feature	Site(s)	Total Number
AJ (RA-I)	TLM 089, TLM 116	2
AJ (RA-J)	TLM 100, TLM 105, TLM 182, TLM 187	4
AJ (RA-K)	TLM 021, TLM 179, TLM 186, TLM 208	4
RA-L	HEA 176	1
AJ (RA-L)	TLM 057, TLM 098, TLM 117 HEA 183, HEA 184	5
RA-Q	TLM 101	1
AJ (RA-Q)	TLM 103	1
<u>Access Routes</u>		
AR	--	0
AJ (AR)	TLM 015, TLM 016, TLM 018, TLM 098, TLM 099, TLM 106, TLM 107, TLM 108, TLM 109, TLM 110, TLM 111, TLM 112, TLM 113, TLM 114, TLM 117, TLM 153, TLM 155, TLM 160, TLM 168, TLM 192, TLM 214	21
	HEA 180, HEA 181, HEA 182	3

Table 7.2. (Continued)

Facility or Feature	Site(s)	Total Number
AJ (RR)	TLM 006	1
ARB	TLM 106, TLM 107, TLM 108, TLM 109, TLM 110, TLM 111, TLM 113, TLM 114, TLM 153	9
	HEA 181, HEA 182	2
AJ (ARB)	TLM 181, TLM 191, TLM 193, TLM 245	4
	HEA 211	1
Geotechnical (GT)	TLM 068, TLM 070, TLM 082, TLM 137	4
	HEA 177, HEA 178, HEA 179	3
Watana Construction Area		
AJ (WC-PAS)	TLM 016, TLM 197	2
AJ (WC-WCC)	TLM 016	1
AJ (WC-WD)	TLM 018, TLM 165, TLM 166, TLM 167	4
AJ (WC-WCV)	TLM 160, TLM 172, TLM 192	3

Table 7.2. (Continued)

Facility or Feature	Site(s)	Total Number
Devil Reservoir (DR)	TLM 023, TLM 034, TLM 178, TLM 252, TLM 253, TLM 258, TLM 259	7
AJ (DR)	TLM 022, TLM 024, TLM 027, TLM 029, TLM 030, TLM 118	6
Watana Reservoir (WR)	TLM 033, TLM 039, TLM 040, TLM 043, TLM 048, TLM 050, TLM 058, TLM 059, TLM 060, TLM 061, TLM 062, TLM 063, TLM 065, TLM 072, TLM 075, TLM 077, TLM 079, TLM 080, TLM 102, TLM 104, TLM 115, TLM 119, TLM 126, TLM 169, TLM 171, TLM 173, TLM 174, TLM 175, TLM 181, TLM 184, TLM 194, TLM 196, TLM 199, TLM 200, TLM 204, TLM 206, TLM 215, TLM 216, TLM 217, TLM 218, TLM 220, TLM 221, TLM 222, TLM 223, TLM 224, TLM 225, TLM 226, TLM 227, TLM 228, TLM 229, TLM 230, TLM 231, TLM 232, TLM 233, TLM 234, TLM 235, TLM 236, TLM 237, TLM 238, TLM 239, TLM 240, TLM 241, TLM 242, TLM 243, TLM 244, TLM 246, TLM 247, TLM 248, TLM 249, TLM 250, TLM 251, TLM 256, TLM 257	73

Table 7.2. (Continued)

Facility or Feature	Site(s)	Total Number
AJ (WR)	TLM 017, TLM 026, TLM 031, TLM 032, TLM 038, TLM 042, TLM 047, TLM 049, TLM 064, TLM 073, TLM 074, TLM 076, TLM 120, TLM 121, TLM 122, TLM 123, TLM 124, TLM 125, TLM 127, TLM 128, TLM 129, TLM 130, TLM 131, TLM 132, TLM 133, TLM 134, TLM 135, TLM 136, TLM 139, TLM 140, TLM 141, TLM 142, TLM 143, TLM 145, TLM 147, TLM 148, TLM 159, TLM 165, TLM 166, TLM 167, TLM 170, TLM 177, TLM 183, TLM 185, TLM 189, TLM 190, TLM 195, TLM 198, TLM 207, TLM 219, TLM 245	51
Other (O)	TLM 005, TLM 007, TLM 020, TLM 025, TLM 028, TLM 036, TLM 037, TLM 044, TLM 045, TLM 046, TLM 052, TLM 053, TLM 066, TLM 067, TLM 069, TLM 071, TLM 092, TLM 093, TLM 138, TLM 144, TLM 146, TLM 149, TLM 150, TLM 151, TLM 152, TLM 154, TLM 180, TLM 205	28
	HEA 174, HEA 175, HEA 185, HEA 186, HEA 210	5
	FAI 213, FAI 214	2

Key to Tables 7.1 and 7.2

a	AHRS #	=	Alaska Heritage Resource Survey number (H) = Historic, (P) = Prehistoric
b	AJ	=	Adjacent to project facilities or features, i.e., within ½ mile
	AR	=	Access Route
	ARB	=	Access Route Borrow
	B	=	Borrow Area
	DR	=	Devil Canyon Reservoir
	GT	=	Geotechnical Area
	O	=	Site not within ½ mile of project facilities or feature
			01 = Site found by non-archeology personnel
			02 = Site found in association with a project feature, facility or recreation area that has since been modified, relocated or deleted
			03 = Site documented near the project area prior to the present study
			04 = Site found during geoarcheology studies
			05 = Site found by archeology personnel but not within ½ mile of project facilities or features
	RA	=	Recreation Area
	RR	=	Railroad

Key to Tables 7.1 and 7.2 (Continued)

- T = Transmission Route
  - H-F = Healy to Fairbanks
  - W-A = Willow to Anchorage
  - W-I = Watana Dam to Intertie
- WC = Watana Construction Area
  - PAS = Permanent Airstrip
  - WCC = Watana Construction Camp
  - WCV = Watana Construction Village
  - WD = Watana Dam
- WR = Watana Reservoir

If a site is located in association with more than one facility or feature, both are listed.

8 - ANALYSIS AND SYNTHESIS OF PROJECT DATA

8.1 - Introduction

Analytical techniques and methods included in this chapter were selected specifically to provide data which could be used to assist in evaluating sites, assessing site significance, and developing recommended mitigation measures and a mitigation plan. Emphasis, therefore, was placed on evaluating and synthesizing data on a project/regional wide level. Analysis in this chapter includes a section on geoarcheology (8.2), which introduces the regional stratigraphy and the associated radiocarbon dates, and sections on lithic (8.3) and faunal (8.4) assemblages, which were analyzed on the basis of this regional stratigraphy. Section 8.5 is an analysis of site setting. The final section of this chapter (8.6) is a synopsis of the regional history and prehistory of the Middle Susitna River area.

8.2 - Geoarcheology

(a) Terrestrial Stratigraphy

The numerous archeological test pits and excavation walls throughout the study area revealed a remarkably uniform regional stratigraphic sequence of sediments and soils. Sixteen major stratigraphic units have been recognized in the project area. Although no individual site contains all sixteen units, as many as ten have been recognized at some sites. Stratigraphic unit designations and stratigraphic horizons discussed in this section (Figure 8.1) do not necessarily correspond to soil units and stratigraphic horizons depicted in the text or on soil profiles in Appendix D. The stratigraphic units and horizons were defined based on field observation and laboratory analysis of data collected between 1980 and 1984. The stratigraphic units and associated radiometric dates provide the chronologic framework for synthesizing the regional prehistory of the Middle Susitna River valley.

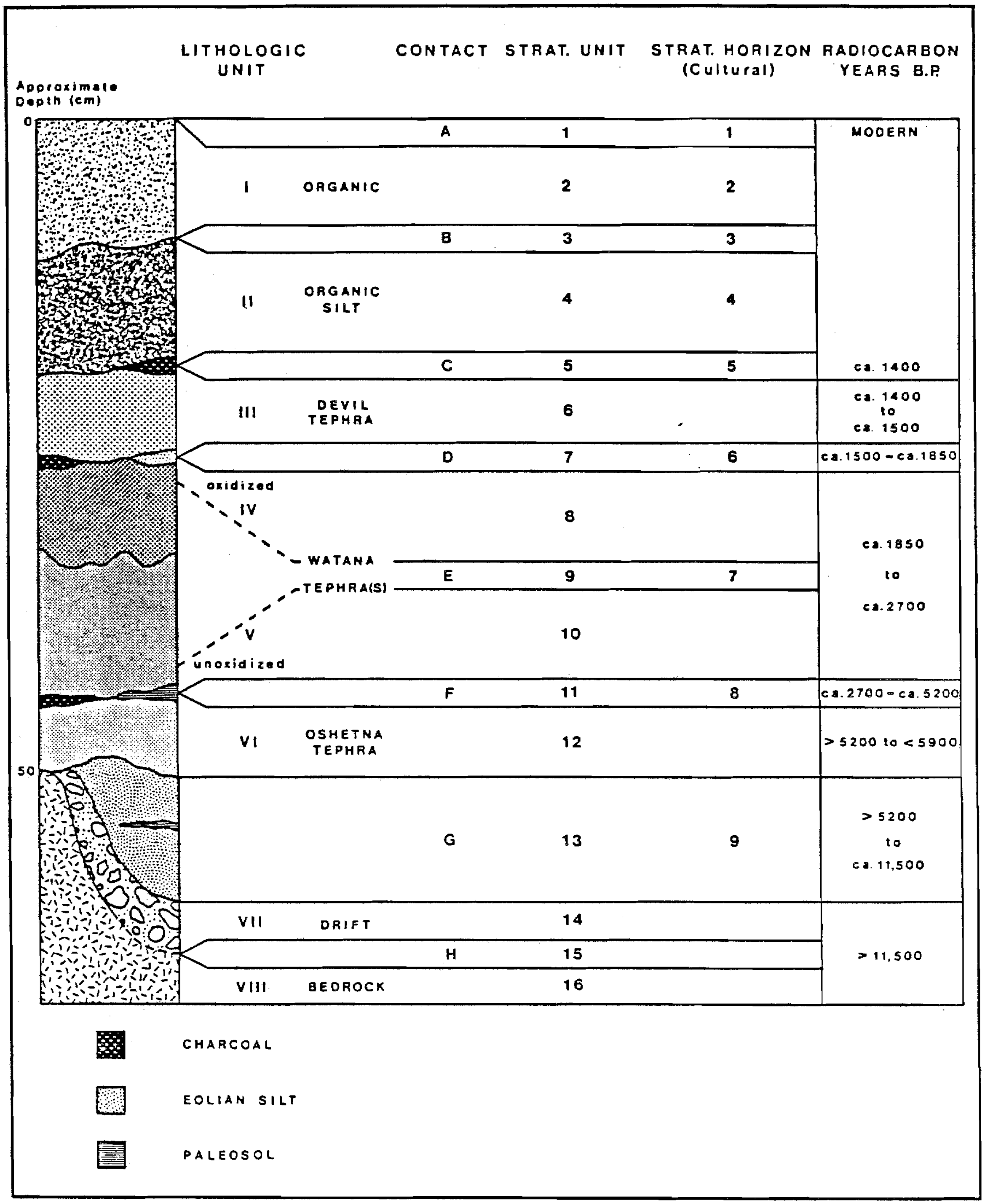

Figure 8.1. Generalized Terrestrial Stratigraphic Profile Middle Susitna River Area .

In general, the stratigraphy consists of glacially scoured bedrock overlain by a discontinuous cover of weathered glacial sediments, which are overlain by a series of volcanic tephra units interbedded with weathering units and buried soils. Tephras recognized in the Middle Susitna River area have been given project specific names, from the oldest to the youngest: Oshetna, Watana, and Devil. A surface organic mat overlies the older sediments. Nonvolcanic eolian sediments occur both as part of the tephra units and as separate subunits between tephra and organic units.

Three major types of stratigraphic units are identified: lithologic units, contact units (which commonly represent modification of lithologic units) and stratigraphic horizons; each contains one or more subunits. Each type of unit is discussed separately in the following subsections, and are presented in sequential order from oldest to youngest.

(i) Lithologic Units

The eight sediment units, designated by Roman numerals in Figure 8.1, represent different intervals of regional sediment deposition which span discrete time intervals that can be correlated throughout the project area.

(1) Unit VIII (Bedrock)

Bedrock varies in composition and is exposed at various locations throughout the project area. Some of the more common bedrock types are: argillite, graywacke, and basaltic and andesitic metavolcanogenic rocks.

(2) Unit VII (Drift)

Drift consists of glaciofluvial, glaciolacustrine, and undifferentiated glacial sediments which overlie the bedrock. Its thickness varies from a few centimeters to an unknown depth, but exceeds tens of meters at some exposures. At most sites the drift consists of cleanly washed sandy gravel and gravelly sand, which are commonly mixed with the overlying sediments near the contact.

(3) Unit VI (Oshetna Tephra)

The Oshetna tephra consists of a uniform layer of light brownish gray (2.5Y 6/2) sandy silt; typically, this layer was 3-5 cm thick, although maximum thicknesses of 8 cm were observed. Microscopic analysis indicates that the Oshetna tephra consists of transparent and translucent glass fragments which are the dominant grains, followed by green crystal fragments and opaque minerals. White glass is rare. The green crystals are generally short angular flakes without glass mantles. No significant variation in thickness could be related to latitude, longitude, or local setting. Oxidation or staining of this unit is generally absent. Technical data on tephra analysis are presented in Appendix C.

(4) Unit V (Unoxidized Watana Tephra)

This portion of the Watana tephra, brownish yellow (10YR 6/6) in color, contains almost no other eolian material. Thickness ranges from 1-10 cm, however, owing to the common gradational relation to overlying units, its thickness varies greatly from one locale to another. White glass shards are the most common grains, followed by transparent and translucent grains, green laths, and opaque minerals. The oxidized portion of the Watana tephra is mineralogically similar to the unoxidized portion.

(5) Unit IV (Oxidized Watana Tephra)

This portion of the Watana tephra is strongly oxidized and ranges in color from dark brown (7.5YR 4/6) to a reddish brown (2.5YR 3/4). Oxidation ranges from a pale brown stain to a durable cemented layer, but most commonly consists of small granular concretions in the sand size range. This unit is typically 5-10 cm thick and most commonly overlies Unit V; the relationship between units IV and V is gradational, based on texture and color. The oxidized portion of the Watana tephra represents a chemical process, and does not necessarily denote time stratigraphic boundaries between episodes of tephra deposition. Possible multiple episodes of deposition of the Watana tephra are discussed in section 8.3.a.ii.4.

(6) Unit III (Devil Tephra)

This unit consists of a pale brown (10YR 6/3) to pinkish white (7.5YR 8/2) volcanic ash which lies near the top of the stratigraphic column throughout the project area. It is typically 3-5 cm in thickness, but often reaches a thickness of 8 cm. The Devil tephra is primarily composed of white angular grains, followed in decreasing abundance by transparent and translucent grains, green laths, and opaque minerals. White glass commonly mantles the green laths.

(7) Unit II (Organic Silt)

This unit, relatively uniform in thickness (2-8 cm), consists of an organic sandy silt containing modern roots. The unit includes approximately equal amounts of fine windblown sandy silt and highly decomposed organic material. Delicate interbedding of mineral rich and organic rich layers in many areas indicates that Unit II can be considered a sediment unit separate from the overlying organic unit. Much of the organic component in this unit may have been illuviated into the unit from above, and thus can be considered an "A-horizon" in typical soil nomenclature. Although in part contemporaneous with the existing surface soil, the bulk of the mineral portion of the unit was apparently deposited under conditions different from those of the present.

(8) Unit I (Surface Organics)

Surface organics consist of a dense fibrous mat of roots and decayed vegetation that constitutes the present organic duff of the modern vegetation. Though typically thicker (ca. 20 cm) and denser in forested settings, it is remarkably similar to the surface organic layer under the modern shrub tundra.

(ii) Contact Units

The lithologic units described above represent major intervals of sediment deposition that can be recognized throughout the project area. The intervals between deposition of sediment units, which may span most of the time represented in the regional soil stratigraphy, can also be treated as separate stratigraphic units. Although contact units are defined by the contacts between sediment units, they are characterized largely by the soil-forming processes which acted to alter the sediment units. Eolian, organic, and stratigraphic horizon subunits occur at the contacts. Within any given site or site locus subunits can be arranged in stratigraphic order, but such correlations cannot be extended throughout the project area. For example, an eolian sand subunit between Lithologic Units VI and VII in one area may not correlate exactly with a similar deposit in the same stratigraphic position elsewhere. All that can be inferred in such cases is that both were deposited some time during the interval between deposition of Lithologic Units VI and VII. Contact units, designated by capital letters A-H, are described below in order of decreasing age.

(1) Unit H

Unit H represents the contact between the bedrock and the overlying drift. In all observed cases the bedrock was not appreciably weathered, suggesting that the interval separating the two lithologic units was relatively brief. In many cases, exposed bedrock shows evidence of glacial scour. Because most glacial drift was deposited during late Wisconsinan time (32,000 - 12,000 years B.P.), scouring probably occurred just prior to the deposition of the drift.

(2) Unit G

Unit G represents the contact between undifferentiated glacial drift and the lowest volcanic ash layer (Unit VI, Oshetna tephra). Weathering of the drift typically consists of shallow oxidation from the surface to a depth of 10-50 cm, depending on local conditions. Evidence for deflation, such as wind-polished stones and a cobble and pebble pavement, is present at a few localities, but eolian erosion at the contact has probably been negligible. At several localities evidence of cryoturbation was observed; this consisted of sorted zones of sand and gravel and cobbles with vertical orientation. Frost-cracked cobbles at the contact are uncommon.

The most common subunit at the contact is a discontinuous layer of eolian sand and/or silt, indicative of localized eolian erosion and deposition prior to deposition of Unit VI. In one site (TLM 065) several different silty and sandy subunits are present, indicating that an earlier interval of eolian (and possibly volcanic) activity may have occurred throughout the region, followed by an interval of erosion. Contact subunits and the upper part of the drift are commonly mixed with the lower portions of the Oshetna tephra, providing evidence that cryoturbation and/or downslope reworking postdated the first regionally recognizable tephra. Lacustrine sediments may also occur at this contact. A distinct paleosol has been identified within eolian silt deposits (loess) at this contact, and has been identified at one archeological site, TLM 128, as well as in a geological context (Tsusena Bluff).

(3) Unit F

Unit F consists of a recognized stratigraphic break between the lowermost Oshetna tephra (Unit VI) and the Watana tephra (Unit V). In many areas the contact can be recognized only on the basis of a color change downward in the tephra from brown to gray. Most commonly, however, a thin zone of charcoal flecks and clumps separates the two lithologic units, sometimes thickening into a discrete charcoal layer.

Occasionally a paleosol, represented as a thick zone of finely divided organic matter, is present. In several localities thin lenses of eolian sand (suggesting deflation) lie between the tephra.

The absence of pronounced weathering and resistant charcoal fragments along this contact suggests it is erosional. Thus, the time interval represented by Contact Unit F probably includes a period of sedimentation and weathering which is not represented in the regional stratigraphy, due to subsequent deposition.

(4) Unit E

Unit E is the most poorly represented of the contact units. In nearly all cases the Watana tephra can be observed as an upper intensely oxidized zone (Unit IV) that gradationally overlies an unoxidized or slightly oxidized tephra (Unit V). In at least six localities, however, there is good evidence for separating these tephra units into additional units; thus, Contact Unit E is well defined at only a few localities. Based on tephras identified in a lake core from the Watana Creek area, there is evidence to suggest that the Watana tephra, as seen in terrestrial settings, actually represents a tephra "package" which may result from two or more episodes of deposition. Contact Unit E can occur anywhere within this tephra unit (Figure 8.1).

The best evidence for Contact Unit E is thin organic layers, or paleosols, which clearly resulted from surface soil accumulation. They are commonly discontinuous and poorly developed. Additionally, distinct cultural components sometimes occur stratigraphically within the Watana tephra(s). Charcoal layers, possibly cultural in origin, are also found within the Watana tephra(s). A zone of coarse-medium sand, representing local eolian activity, also occurs within the Watana tephra(s). The poorly developed paleosols and the relatively low frequency of episodes of human occupation within this "zone" of contact(s) suggest that Unit E may represent a series of comparatively short temporal intervals.

(5) Unit D

Unit D is most commonly represented by a sharp color and textural contrast between the unweathered Devil tephra (Unit III) and the oxidized concretionary portion of the Watana tephra (Unit IV). In many respects this contact is similar in appearance to a leached zone (E-horizon) over a more oxidized lower layer (B-horizon). However, no independently verifiable evidence for leaching was observed in the upper soil layers within the study area. Furthermore, there appears to be no evidence for gradation above and below the Devil tephra (Unit III), which would be expected if the color horizons were geochemically controlled.

The best evidence for Contact Unit D is the occurrence of a charcoal layer with or without associated cultural material at this contact. In some cases, finely divided organic matter occurs at this contact, suggesting a poorly developed paleosol separating the Devil from the Watana tephra. Thin zones of eolian sand are sometimes present at the contact, but commonly the Devil tephra lies unconformably over cryoturbated Unit IV.

Owing to the extent of weathering of the upper portion of the Watana tephra, this contact appears to represent an interval of weathering, and more than one period of deposition or erosion. However, the strong oxidation of the upper Watana tephra may be controlled by its lithology; i.e., it may be exceptionally reactive (or weatherable) because of its chemical composition.

(6) Unit C

Unit C is exceptionally well defined. It is commonly represented by a dense black layer of discontinuous, finely divided organic material. Charcoal within this layer is common, but frequently the charcoal clasts have been reworked as clasts into the lowermost part of the organic silt (Unit II). Thus, the charcoal in Unit II is a contact phenomenon, even though it is included within a lithologic unit. Minor oxidation is commonly expressed as brownish-stained tephra and typically lies within 1-2 cm below the contact.

This contact probably represents the initial organic accumulation on a stable substratum immediately following the final episode of volcanic ash deposition in the study area. Prior to the slow deposition of eolian dust and the coeval accumulation of finely divided organic matter that characterizes Unit II, conditions were likely more stable. Limited erosion apparently occurred prior to the accumulation of Unit II. Unit C may also represent organics (Unit I) and/or organic silts (Unit II) that were buried by cultural deposition.

(7) Unit B

Unit B is commonly gradational, but represents a significant difference in the type of sedimentation that postdated the Devil tephra. The contact is expressed as the change from a mixed mineral and finely divided organic accumulation to one characterized by the accumulation of partly decomposed macroscopic organic matter. This contact could possibly be pedological, and may represent different processes in the O and A soil horizons. Units I (surface organic) and II (organic sandy silt) are separated because they are easily identifiable stratigraphic units in which cultural materials were found, and because there is evidence to suggest that some uniform change has occurred in the character of soil development within the last several hundred years. In many cases, surface organics appear to be accreting faster than organic decay can break them down. This may indicate that Contact Unit B is not an equilibrium pedologic feature. The interbedded mineral matter in Unit II and its absence in Unit I further support the separation of units on lithologic grounds. Clearly, both processes are occurring.

(8) Unit A

Unit A represents the present ground surface. It is designated as a stratigraphic unit because within the time frame of this study it can be considered as a discrete unit of time; i.e., it is younger than the surface organic accumulation.

(iii) Stratigraphic Units

The 16 stratigraphic units, designated by Arabic numbers 1-16, are comprised of both the lithologic and contact units described above. In order to conveniently describe both types within the same chronological framework, they have been combined into a series of stratigraphic units. Thus, it is possible to isolate and correlate 16 significant intervals of time throughout the project area. Stratigraphic unit 1, for example, is the equivalent of contact unit A, while stratigraphic unit 2 is the equivalent of lithologic unit I. Refer to Figure 8.1 for correlation of all units, and subsections (i) and (ii) for descriptions of the 16 units.

(iv) Stratigraphic Horizons (Cultural)

Nine discrete stratigraphic horizons can be identified (at the present time) from the regional archeological stratigraphy from which cultural remains have been recovered. These can all be correlated throughout the region. Each horizon can be dated within limits, and all but two correlate with the contact units in the regional stratigraphy (Figure 8.1). Stratigraphic horizons can be identified, and limiting dates can be established for each. However, cultural materials from the same stratigraphic horizon at different sites cannot be regarded as exactly equivalent in age. The volcanic ash and soil/sediment sequence provides the framework for identifying the stratigraphic horizons.

Stratigraphic horizons were assigned only where there was demonstrable evidence of human occupation that could be related to the regional stratigraphy. Artifacts were found in all of the units except bedrock, but only nine horizons can be firmly documented. Downslope reworking, cryoturbation, bioturbation, human alteration, and deflation all serve collectively to displace artifacts from their original stratigraphic contexts.

Evidence for human occupation is present in subunits associated with the contact units. Within any given site these subunits can be arranged in stratigraphic succession, but they cannot be correlated on a regional basis. It is probable that many more than nine cultural horizons exist. TLM 030 contains five horizons, one of which occurs in a subunit; no other site contains more than four regional stratigraphic horizons. The majority of sites located in the study area contain one or two regional stratigraphic horizons. Discussion of the age of the stratigraphic horizons is combined with a general stratigraphic chronology in the section 8.2f.

(b) Discussion of Tephras

From the above discussions it is apparent that individual volcanic ash layers and the unconformities/soil horizons between them form the basis for the archeological stratigraphy. Four key factors regarding the ash layers are: 1) geographic extent, 2) source, 3) postdepositional history, and 4) their age. The first four factors are discussed in this section.

The Middle Susitna River area exhibits variable relief in elevation, a factor which has affected the observed distribution of tephra deposits. Typically, tephra deposits are absent on slopes greater than 15 degrees, in windswept areas, and above 1500 m in elevation (Dixon, Smith, King, and Romick 1982; Romick and Thorson 1983). With the exception of windswept areas, this has little effect on the archeological application of tephrochronology in the Middle Susitna River area because no sites were found on slopes greater than 15 degrees or at elevations greater than 1500 m asl. Below hill crests the tephras thin or disappear and are extensively reworked by slope processes. Evidence of reworking is also common on the well-drained knolls and ridge crests where archeological test pits were frequently placed. While tephra may be eroded from ridge crests, it is unlikely that it is redeposited there. Tephras are well preserved in those sections of the project area that contain the majority of sites, although the best representation is found in the central and western portions of the area.

During the Holocene more than 70 different tephra falls have been identified in upper Cook Inlet and south-central Alaska (Riehle, in press). As discussed above, the tephras recognized in the Middle Susitna River area have been given the project-specific names of Devil, Watana, and Oshetna. Due to the level of data available, it is not known at this time whether these tephras correspond to previously recognized tephras in other regions of Alaska. Consequently, the local names ascribed to these units may require revision when such correlations can be made. Although the Devil and Watana tephras cannot be distinguished petrographically from one another, they can be distinguished petrographically from the Oshetna tephra. In the field, however, all three tephras can be distinguished from one another based on color, texture, and relative stratigraphic position, a situation which is similar to one documented by Dumond (1979) for tephras on the Alaska Peninsula.

The tephra units were tentatively identified in the field and corroborated as tephra by petrographic studies conducted by Jay Romick and Robert Thorson at the Tephrochronology Center at the University of Alaska Museum. All are amphibole-biotite bearing tephras and are probably derived from the same source, possibly the Hayes volcanic vent in the Tordillero Mountains southwest of the study area (Romick and Thorson 1983:15; Figure 4.4). Biotite is a rare component of tephras in Alaska, and the Hayes vent is the only one in the region known to have produced hornblende/biotite lavas.

In the study area, the tephra units with intervening paleosols and eolian fluvial units comprise the bulk of the preserved surficial geologic deposits. In most portions of the study area this stratigraphy is compressed into less than 50 cm. Although some pedogenic processes have taken place, the tephra units and their associated boundaries can be regarded as reliable time-stratigraphic markers.

Tephra descriptions and analysis were conducted by Jay Romick and Robert Thorson (Appendix C). Grain size analysis of the three tephras indicates that the Oshetna tephra is the coarsest and the Devil and

Watana tephras have comparable grain size distributions (Dixon, Smith, King, and Romick 1982; Romick and Thorson 1983); all three tephras are dominated by fine silt to clay size fractions. Under the binocular microscope the Devil and Watana tephras look very similar. All three tephras are predominately composed of subangular to subrounded white pumice shards (Romick and Thorson 1983). Transparent to translucent grains, many having cleavage surfaces, are the next most abundant grain types. Mafic minerals (hornblende, opaque minerals, and biotite) make up the remainder of the phases present. The Oshetna tephra can be distinguished from the other tephras by its lack of glass shards, its abundance of transparent and translucent grains, and the presence of hornblende lacking attached glass (Romick and Thorson 1983). The similarity of the Devil and Watana tephras and their dissimilarity with the Oshetna tephra were confirmed by point counts using Galehouse's (1969) method.

(c) Radiocarbon Dating

(i) Stratigraphic Position and Evaluation of Dates

Samples for radiocarbon dating were collected during the program's five field seasons (1980-1984) to date sites and site components, glacial events associated with the Wisconsinan Glaciation, and develop a regional tephrochronology based on the three tephras (Oshetna, Watana and Devil) identified in the study area. Eighty-three radiocarbon dates, two of which are linear accelerator dates, were run. They range from modern to the mid- Wisconsinan in age and are presented in Table 8.1. They are organized and presented as follows: 1) archeological dates not associated with tephra units, 2) dates associated with tephra units and derived from archeological, geological, and lacustrine contexts, and 3) glacial geology dates. Discussion of the relevance of these dates for the regional chronological framework is presented in subsections 8.2 d, e, and f.

The stratigraphic position and description of each sample is included in Table 8.1. For samples that date tephra units, an evaluation of the

Table 8.1.
Radiocarbon Dates: Stratigraphic Position, Sample Description, Relationship to Tephras, and Evaluation of Stratigraphic Position

Lab and UAM Number	Stratigraphic Position, Sample Description, and Evaluation of Stratigraphic Position	Site	Date Years B.P.
	ARCHEOLOGICAL DATES NOT ASSOCIATED WITH TEPHRAS (not applicable to tephrochronology)		
DIC-1879 UA80-69-1	Hearth feature in alluvial sediments. Charcoal, matrix.	TLM 022	Modern
Beta-10797 UA84-241-14 #2	Hearth feature in alluvial sediments. Charcoal, matrix.	TLM 249	Modern
Beta-10792 UA84-62-36	Thermally Altered Rock feature. Charcoal, matrix.	TLM 221	Modern
Beta-10795 UA84-99-13 #1	From cultural matrix below mixed sand and gravel backfill and above fluvial sand; surface organic overlies backfill. Charcoal.	TLM 242	Modern
Beta-10798 UA84-242-12 #1	Lens of cultural matrix in alluvial sediments. Charcoal.	TLM 250	370±80

Table 8.1. (Continued)

Lab and UAM Number	Stratigraphic Position, Sample Description, and Evaluation of Stratigraphic Position	Site	Date Years B.P.
DIC-2252 UA81-238-2	Hearth feature in alluvial sediments. Charcoal.	TLM 022	300±70
Beta-10796 UA84-217-38 #1	From oxidized sandy silt containing calcined bone. Cultural matrix underlies mottled fine sandy silt, tentatively identified as Devil tephra in field notes, but not in site report. That sediments may be alluvial is suggested by close proximity to Susitna River. Charred wood, matrix.	TLM 253	430±130
Beta-7292 UA83-122-6 Sample 1	Silt and clay, massive solifluction deposit. Decayed wood and peat.	TLM 196	2040±70
Beta-7293 UA83-122-6 Sample 2	Silt and clay, massive solifluction deposit. Decayed wood and peat.	TLM 196	2120±60

Table 8.1. (Continued)

Lab and UAM Number	Stratigraphic Position, Sample Description, and Evaluation of Stratigraphic Position	Site	Date Years B.P.
	DATES ASSOCIATED WITH TEPHRA (Archeological, Geological, Lacustrine)		
	ABOVE DEVIL TEPHRA		
DIC-2282 UA81-230-121	Fine sandy loam, below root mat and above Watana tephra. Charcoal. Reject for tephrochronology, provenience unclear (d).	TLM 042B	Modern
Beta-10793 UA84-63-6 #1a	Structural post associated with cultural fill below root mat; feature truncates Devil tephra. Charcoal. Accept for tephrochronology.	TLM 104	Modern
DIC-2244 UA81-243-3	Upper contact of Devil tephra; lower contact of organic silt. Charcoal. Accept for tephrochronology.	TLM 027	140±45
Beta-7684 UA83-130-4	From organic silt above Devil tephra and below organic mat. Charcoal, matrix. Accept for tephrochronology.	TLM 030	170±90

Table 8.1. (Continued)

Lab and UAM Number	Stratigraphic Position, Sample Description, and Evaluation of Stratigraphic Position	Site	Date Years B.P.
DIC-1905 UA80-157-3	Hearth feature at upper contact of Devil tephra; lower contact of root mat. Charcoal. Accept for tephrochronology.	TLM 050	280±110
DIC-1904 UA80-157-1	Hearth feature at upper contact of Devil tephra; lower contact of root mat. Charcoal. Reject for tephrochronology (g)	TLM 050	280±245
DIC-2253 UA81-205-14	Structural timber associated with peat and gravel fill; feature truncates Devil tephra. Charcoal. Accept for tephrochronology.	TLM 059	740±70
Beta-7692 UA83-110-945	Upper contact of Devil tephra; lower contact of organic silt. Charcoal. Accept for tephrochronology.	TLM 184	840±60
Beta-7693 UA83-110-949	Upper contact of Devil tephra; lower contact of organic silt. Charcoal. Accept for tephrochronology.	TLM 184	1060±70

Table 8.1. (Continued)

Lab and UAM Number	Stratigraphic Position, Sample Description, and Evaluation of Stratigraphic Position	Site	Date Years B.P.
DIC-1878 UA80-68-1a	Hearth associated with calcined bone. Charred wood, charcoal. Reject for tephrochronology, provenience unclear (a).	TLM 021	1060±100
Beta-7845 UA83-224-129	Upper contact of Devil tephra; lower contact of root mat. Charcoal. Accept for tephrochronology	TLM 097	1260±80
DIC-2245 UA81-252-51	Possible hearth feature at upper contact of Devil tephra; lower contact of root mat. Grades laterally to organic silt. Charcoal. Accept for tephrochronology.	TLM 097	1400±55
Beta-7846 UA83-227-25	From cultural overburden overlying Devil tephra and underlying gray sandy silt below root mat. Charcoal. Reject for tephrochronology, provenience unclear (a).	TLM 215	1580±110

Table 8.1. (Continued)

Lab and UAM Number	Stratigraphic Position, Sample Description, and Evaluation of Stratigraphic Position	Site	Date Years B.P.
DIC-2284 UA81-243-2	Upper contact of Devil tephra; lower contact of organic silt. Charcoal. Accept for tephrochronology.	TLM 027	1800±55
Beta-9899 UA84-59-354 #9	Below organic silt and above discontinuous Devil tephra. Charcoal. Reject for tephrochronology, provenience unclear (d).	TLM 217	2070±60
	IN DEVIL TEPHRA		
DIC-2246 UA81-208-7	In Devil tephra. Charcoal. Accept for tephrochronology.	TLM 062	1380±155
	BELOW DEVIL TEPHRA, WATANA TEPHRA NOT IDENTIFIED		
DIC-1877 UA80-77-1a	Below Devil tephra in mottled gritty silt; above possible Oshetna tephra. Charred peat. Reject for tephrochronology, provenience unclear (a).	TLM 030	2310±220

Table 8.1. (Continued)

Lab and UAM Number	Stratigraphic Position, Sample Description, and Evaluation of Stratigraphic Position	Site	Date Years B.P.
	ABOVE WATANA TEPHRA, DEVIL TEPHRA NOT IDENTIFIED		
DIC-1903 UA80-153-38a	Hearth feature below organic silt; above discontinuous possible Watana tephra. Charcoal. Reject for tephrochronology, provenience unclear (c).	TLM 046	2340±145
Beta-10780 LIV-2 #1	Above tephra A (uppermost preserved tephra band; Devil/Watana mineralogy) in pond core. Organic silt. Reject for tephrochronology, provenience unclear (d).	POND CORE	2940±110
	BELOW DEVIL TEPHRA, ABOVE WATANA TEPHRA		
Beta-10785 Sample #5	Peat between Devil and Watana tephras. Peat. Accept for tephrochronology.	BOG CORE	1240±60

Table 8.1. (Continued)

Lab and UAM Number	Stratigraphic Position, Sample Description, and Evaluation of Stratigraphic Position	Site	Date Years B.P.
Beta-10125 UA84-58-33	From silty cultural matrix underlying Devil tephra; truncates Watana and unidentified light gray tephra overlying Watana tephra. Charcoal. Accept for tephrochronology.	TLM 216	1530±80
Beta-9898 UA84-58-143 CS #3b	Same as Beta-10125 Accept for tephrochronology.	TLM 216	1670±50
Beta-10791 UA84-59-349 #4	From cultural matrix underlying discontinuous Devil tephra and truncating Watana tephra. Charcoal. Accept for tephrochronology.	TLM 217	1770±190
Beta-9892 UA84-58-143 CS #3a	Same as B10125. Accept for tephrochronology.	TLM 216	1880±50
	IN WATANA TEPHRA		
Beta-10784 PCV-1 #5	Tephra C. Dispersed charcoal. Reject for tephrochronology, provenience unclear (d).	POND CORE	835±180

Table 8.1. (Continued)

Lab and UAM Number	Stratigraphic Position, Sample Description, and Evaluation of Stratigraphic Position	Site	Date Years B.P.
Beta-7843 UA83-110-961	In upper extent of Watana tephra, associated with calcined bone concentration. Bulk organics. Reject for tephrochronology, (f).	TLM 184	1060±70
Beta-5363 UA82-70-158	In Watana tephra, associated with calcined bone concentration. Charcoal. Reject for tephrochronology, provenience unclear (b).	TLM 130	1420±70
Beta-7842 UA83-110-955	In oxidized Watana tephra, but sample taken only ca. 1 cm above Oshetna paleosol surface. Charcoal, matrix. Reject for tephrochronology, provenience unclear (e).	TLM 184	3920±100
Beta-10781 LIV-2 #2	Between tephras C and D (both of Devil/Watana mineralogy) in pond core. Organic silt. Reject for tephrochronology, provenience unclear (d).	POND CORE	5200±70

Table 8.1. (Continued)

Lab and UAM Number	Stratigraphic Position, Sample Description, and Evaluation of Stratigraphic Position	Site	Date Years B.P.
	BELOW WATANA TEPHRA, ABOVE OSHETNA TEPHRA		
Beta-7689 UA83-130-22	Charcoal concentration from lower extent of Watana tephra, possibly separated from underlying Oshetna tephra by a thin band of buff-colored Watana tephra matrix. Charcoal. Reject for tephrochronology, provenience unclear (a), (e), possible (b).	TLM 030	1730±120
Beta-7691 UA83-130-28	From cultural matrix below Watana tephra and above Oshetna tephra. Charcoal. Reject for tephrochronology, provenience unclear (e).	TLM 030	1870±120
Beta-7301 UA83-130-2	From upper extent of cultural matrix; below Watana tephra and above Oshetna tephra. Charcoal, matrix. Accept for tephrochronology.	TLM 030	2690±70

Table 8.1. (Continued)

Lab and UAM Number	Stratigraphic Position, Sample Description, and Evaluation of Stratigraphic Position	Site	Date Years B.P.
DIC-2285 UA81-250-5	Charcoal concentration; below Watana tephra and above Oshetna tephra. Charcoal, matrix. Accept for tephrochronology.	TLM 096	2750±215
Beta-7297 UA83-106-402	From paleosol below Watana tephra; above eolian deposit containing trace Oshetna component. Charcoal, matrix. Accept for tephrochronology.	TLM 180	2800±90
Beta-7688 UA83-130-14	Charcoal; below Watana tephra and above thin light brown matrix, texture different from Watana tephra; overlying occupational surface at upper extent of Oshetna tephra. Charcoal, matrix. Accept for tephrochronology.	TLM 030	3160±70
Beta-7685 UA83-130-6	Paleosol; below Watana tephra and above Oshetna tephra. Charcoal, charred peat, matrix. Accept for tephrochronology.	TLM 030	3180±170

Table 8.1. (Continued)

Lab and UAM Number	Stratigraphic Position, Sample Description, and Evaluation of Stratigraphic Position	Site	Date Years B.P.
DIC-2286 UA81-243-490	Paleosol; below Watana tephra and above Oshetna tephra. Charcoal. Accept for tephrochronology.	TLM 027	3210±80
DIC-1860 THORSON	Peat below Watana tephra; and above Oshetna tephra. Woody peat. Accept for tephrochronology.	TYONE BLUFF	3200±195
Beta-7299 UA83-132-128 #1b	Paleosol; below Watana tephra and above discontinuous Oshetna tephra. Charcoal, matrix. Accept for tephrochronology.	TLM 016	3220±90
Beta-7690 UA83-130-26	Paleosol; below Watana tephra and above thin silt unit overlying Oshetna tephra. Charcoal, matrix. Accept for tephrochronology.	TLM 030	3270±90

Table 8.1. (Continued)

Lab and UAM Number	Stratigraphic Position, Sample Description, and Evaluation of Stratigraphic Position	Site	Date Years B.P.
Beta-7699 TSUSENA BLUFF #1	Paleosol; at lower contact of Watana tephra and above eolian sand containing possible trace Oshetna tephra component. Two intervening units of eolian sand without tephra below the Watana tephra and above the Oshetna tephra. Charcoal, matrix. Accept for tephrochronology.	TSUSENA BLUFF	3270±110
Beta-7300 UA83-130-1	Paleosol; below Watana tephra and above Oshetna tephra. Charcoal, matrix. Accept for tephrochronology.	TLM 030	3290±60
Beta-7686 UA83-130-8	Paleosol; below Watana tephra and above Oshetna tephra. Charcoal, matrix. Accept for tephrochronology.	TLM 030	3290±130
Beta-10794 UA84-83-18 #1	Paleosol; below Watana tephra and above Oshetna tephra. Charcoal, matrix. Accept for tephrochronology.	TLM 169	3410±80

Table 8.1. (Continued)

Lab and UAM Number	Stratigraphic Position, Sample Description, and Evaluation of Stratigraphic Position	Site	Date Years B.P.
DIC-2283 UA81-252-427	Charcoal concentration; below Watana tephra and above Oshetna tephra. Charcoal. Accept for tephrochronology.	TLM 097	4020±65
Beta-9897 UA84-67-237 #6	Paleosol; below Watana tephra and above Oshetna tephra. Charcoal. Accept for tephrochronology.	TLM 207	4030±220
Beta-5364 UA82-83-1698	Below Watana tephra; upper contact of cultural matrix containing possible Oshetna tephra. Charcoal. Accept for tephrochronology.	TLM 143	4100±60
Beta-7697 UA83-216-11	Below Watana tephra; upper extent of cultural matrix containing possible Oshetna tephra. Charcoal, matrix. Accept for tephrochronology.	TLM 143	4250±110

Table 8.1. (Continued)

Lab and UAM Number	Stratigraphic Position, Sample Description, and Evaluation of Stratigraphic Position	Site	Date Years B.P.
Beta-7770 TSUSENA BLUFF #2	Paleosol; above eolian sand unit containing possible trace Oshetna tephra component and above eolian sand unit. Charcoal matrix. Accept for tephrochronology.	TSUSENA BLUFF	4250±90
Beta-7698 UA82-83-1701	Below Watana tephra; upper extent of cultural matrix containing possible Oshetna tephra. Charcoal, charred matrix. Accept for tephrochronology.	TLM 143	4440±120
Beta-7844 UA83-224-126	Paleosol; below Watana tephra and above Oshetna tephra. Bulk organics. Reject for tephrochronology (f).	TLM 097	4570±100
DIC-1880 UA80-77-2a	Paleosol; below Watana tephra and above silty sand; Oshetna tephra absent. Charcoal. Accept for tephrochronology.	TLM 030	4720±130

Table 8.1. (Continued)

Lab and UAM Number	Stratigraphic Position, Sample Description, and Evaluation of Stratigraphic Position	Site	Date Years B.P.
Beta-7298 UA83-132-128 1a	Paleosol; below Watana tephra and above discontinuous Oshetna tephra. Charcoal, matrix. Accept for tephrochronology.	TLM 016	4950±120
Beta-10782 LIV-2 #3	Below tephra E (Devil/Watana mineralogy) and above Oshetna tephra trace in pond core. Organic silt. Accept for tephrochronology.	POND CORE	5130±120
Beta-7302 UA83-130-3	Upper contact of Oshetna tephra; lower contact of paleosol. Charcoal. Accept for tephrochronology.	TLM 030	5130±140
Beta-7695 UA83-110-965	Paleosol; below Watana tephra and above Oshetna tephra. Charcoal, matrix. Reject for tephrochronology, provenience unclear (e).	TLM 184	5230±140
Beta-7694 UA83-110-962	Paleosol; below Watana tephra and above Oshetna tephra. Charcoal. Reject for tephrochronology, provenience unclear (e).	TLM 184	6490±370

Table 8.1. (Continued)

Lab and UAM Number	Stratigraphic Position, Sample Description, and Evaluation of Stratigraphic Position	Site	Date Years B.P.
	BELOW OSHETNA TEPHRA		
Beta-7848 UA83-230-130	Paleosol; in eolian deposit below Oshetna tephra and above drift. Bulk organics. Reject for tephrochronology (f).	TLM 128	1260±80
Beta-5362 UA82-68-319 UA82-68-320	Paleosol; in eolian deposit below Oshetna tephra and above drift. Charcoal. Reject for tephrochronology (h).	TLM 128	4580±780
Beta-7847 UA83-230-116	Paleosol; in eolian deposit below Oshetna tephra and above drift. Bulk organics. Reject for tephrochronology (f).	TLM 128	5780±100
Beta-10786 TSUSENA BLUFF	Paleosol, underlying eolian sand and above fine silt unit underlying Oshetna tephra. Charcoal. Accept for tephrochronology.	TSUSENA BLUFF	5900±135

Table 8.1. (Continued)

Lab and UAM Number	Stratigraphic Position, Sample Description, and Evaluation of Stratigraphic Position	Site	Date Years B.P.
Beta-7304 UA83-230-1 UA83-230-2 UA83-230-3 UA83-230-6 UA83-230-7 UA83-230-8 UA83-230-9 UA83-230-12	Paleosol; in eolian deposit below Oshetna tephra and above drift. Charcoal, matrix. Accept for tephrochronology.	TLM 128	6970±210
Beta-7306 UA83-230-4	Paleosol; in eolian deposit below Oshetna tephra and above drift. Charcoal, matrix. Accept for tephrochronology.	TLM 128	7240±110
Beta-10783 LIV-2 #4a	Below trace Oshetna tephra mineralogy; above gravelly clay (drift). Organic silt. Reject for tephrochronology, provenience unclear (d).	POND CORE	9140±100

Table 8.1. (Continued)

Lab and UAM Number	Stratigraphic Position, Sample Description, and Evaluation of Stratigraphic Position	Site	Date Years B.P.
	UNIDENTIFIED TEPHRA DATES		
DIC-2248 UA81-226-122	Possible contact between Watana and Oshetna tephras. Charcoal. Reject for tephrochronology, provenience unclear (d).	TLM 040	1260±105
	GLACIAL GEOLOGY DATES (not applicable to tephrochronology)		
DIC-2200	Granitic sand. Detrital wood fragments.	GRASS BLUFF	1030±60
DIC-1858	Unit containing organic material; overlying drift. Compressed wood.	EARTHFLOW BLUFF	2210±70
Beta-1821 8-9-80 #2	From peaty silt unit overlying cross-bedded sand; close minimum age for last glaciation. Peaty silt.	FROZEN CLAY BLUFF	11,535±140
DIC-1861	Lodgment till. Woody peat.	TYONE BLUFF	21,730±390

Table 8.1. (Continued)

Lab and UAM Number	Stratigraphic Position, Sample Description, and Evaluation of Stratigraphic Position	Site	Date Years B.P.
Beta-1822 8-9-80 #4	Recessional, ice-contact, stratified drift. Large wood fragment.	OSHETNA MOUTH BLUFF	24,900±325
Beta-1819 6-16-80 #8	Interstadial gravel deposition. Bone collagen.	TYONE BLUFF	29,450±610
DIC-1859	Oxidized sandy gravel underlying drift, maximum age for last glaciation. Large wood fragments.	EARTHFLOW BLUFF	30,700+260 -1230
DIC-1862	Fluvial reworking of basin-margin glaciolacustrine sediments. Detrital wood fragments.	TYONE BLUFF	31,070+860 -960
Beta-1820 8-9-80 #1b	Fluvial reworking of basin-margin glaciolacustrine sediments. Detrital wood fragments.	TYONE BLUFF	32,000±2735

Table 8.1. (Continued)

(a) Cultural deposit, or cultural overburden.

(b) Redeposited material on a solifluction slope.

(c) Sample from survey level test which cannot be rectified with systematic testing interpretation.

(d) Nature of soil/sediments difficult to rectify with tephra sequence.

(e) Cryoturbation or bioturbation.

(f) Bulk organics.

(g) Sample too small to give reliable date.

(h) Large standard deviation.

stratigraphic position (or sample quality, i.e., bulk sample or small sample) is also provided. Samples recovered from a clear stratigraphic context have been accepted for use in constructing a tephrochronology, while samples from an unclear context have been rejected for tephrochronological purposes. Criteria for rejecting a sample are the following: 1) it represents a cultural deposit or cultural overburden, 2) it has been redeposited on a solifluction slope, 3) it was recovered from a survey level test which could not be rectified with systematic testing interpretation, 4) the nature of the soil/sediment unit from which it was recovered was difficult to rectify with the tephra sequence, 5) it was recovered from a cryoturbated or bioturbated context, 6) the sample consists of bulk organics, 7) the sample is too small to give a reliable date, and 8) the sample produced a date with a large standard deviation. These evaluation criteria apply only to the tephrochronology, and therefore samples and their associated dates that were rejected for tephrochronological purposes, may still be valid for dating sites or components. Samples and dates not associated with the tephras were not applicable to tephrochronology and therefore were not evaluated in Table 8.1.

Samples were submitted to two radiocarbon laboratories for analysis -- Dicarb and Beta Analytic. The majority of the samples were processed by Beta Analytic and were processed as rush samples (seven days turnaround time). Both laboratories used the benzene method to measure radioactivity. This method eliminates the radon contamination known to produce erroneously young dates, and permits immediate measurement of the sample. The lengthy storage time required to dissipate radon when using conventional methods is consequently not necessary. The results are presented as uncorrected dates and are reported in radiocarbon years before A.D. 1950, using the Libby half-life of 5568 C-14 years. The quoted errors represent one standard deviation statistics (68% probability), based on the random nature of the radioactive disintegration process.

(ii) Possible Local Sources of Contamination

There are three project specific factors that could result in incorrect radiocarbon dates: 1) contamination resulting from reworked Tertiary age pollen, spores, and plant fragments, 2) small amounts of wind and water-transported lignitic material, and 3) contamination of samples associated with paleosols.

Several locations in the Middle Susitna River area, in particular Watana Creek, contain exposed coal deposits. Fine sediments resulting from the weathering and erosion of these deposits are subject to alluvial and eolian processes and redeposition by glacial events associated with the last glaciation. Lignite and tertiary plant fossils have been identified in a lake core from a small lake west of Watana Creek (Ager, personal communication 1985). Contamination by redeposited lignite and reworked Tertiary plant material can make radiocarbon dates older. Although this type of contamination was only recognized in the lake core it is possible that samples from terrestrial settings have been contaminated by similar materials. Inconsistent radiocarbon dates from archeological sites may result from finely pulverized lignitic material and/or by microscopic tertiary plant remains in varying concentrations (Ager, personal communication 1985).

Two regional paleosols have been identified in the Middle Susitna River area: one between the Watana and Oshetna tephras and another below the Oshetna tephra. Numerous samples were collected and dated from both (Table 8.1). Several problems associated with the radiocarbon-dating of paleosols (Yaalon 1971; Valentine and Dalrymple 1976; and others) have been identified. Valentine and Dalrymple (1976) indicate that dating of paleosols presents complex problems because a number of variables are interacting in a complex way over time. Although improper field or laboratory techniques can affect paleosol samples and the resulting dates, it is the natural processes occurring while the sample is still part of the paleosol that may lead to erroneous radiocarbon dates and perplexing interpretative problems. Natural contamination of a paleosol by other sources of carbon is a common problem. Contamination by modern organic carbon by roots, downward leaching of humus particulates, and organic-soil acids such as humic and fluvic acid can bias dates toward the recent end of the temporal spectrum (Scharpenseel 1971), while contamination by older carbon can skew dates toward the older end of the spectrum. The latter type of contamination can be especially troublesome in areas such as in the Susitna River valley where coal outcrops occur. Bowen (1978), however, feels that older carbon contamination is not a critical factor because relatively large percentages of old carbon are required to adversely affect the date. However, Geyh et al. (1971) state that soils developed on material containing older carbon, which accumulates in plants that eventually make up the radiocarbon samples, can give dates that are unreliable for dating the time of paleosol formation. Cultural activity such as disruption of soil horizons during occupation may result in mixing older and younger carbon.

Soil-forming processes and the type of material dated from paleosols can also be sources of error. The dating of humus from buried A horizons of paleosols is generally considered to be much less reliable than dating charcoal from the same horizon (Polach and Costin 1971; Goh and Pullar 1977). Humus is a mixture of biologically active carbon and inert carbon. Radiocarbon dates from humus reflect the residence time of the carbon mixture and not necessarily the age of the soil (Campbell et al. 1967; Geyh et al. 1983). While charcoal fragments are considered more reliable for dating, contamination by groundfluids can be a problem affecting smaller pieces more than larger pieces. The presence of extensive ground moisture may also transport carbon of different ages into various soil horizons. Ellis and Matthews (1984) show in a paleopodzol study that the carbon cycle in a podzol is a complex process involving eluviation and illuviation of carbon from the albic to the spodic horizon and that radiocarbon dates from a paleosol will reflect these processes which occur at varying rates under different climatic regimes.

Not only do the peculiarities of soil genesis create problems for radiocarbon dating of paleosols, but paleoenvironmental variables during paleosol formation can also affect dating. A period of forest fires can lead to an overrepresentation of the amount of charcoal, and a period of wetter climate may lead to faster rates of decomposition and leaching, thus creating a shorter residence time for carbon in the humus horizon which creates younger dates. The methods by which a paleosol becomes buried and the rate of deposition are also important variables affecting dating. Relatively slow burial by eolian processes may result in a different series of dates compared to rapid burial by tephra falls.

(d) Holocene Lacustrine Stratigraphy

A 254 cm lacustrine sediment core from a small pond in the middle Susitna River valley, west of Watana Creek, contains a postglacial sediment record extending back to approximately 10,800 - 11,500 years ago. Included in the stratigraphy of alternating bluish clays, organic silts, and rhythmically laminated units are six tephra layers. These tephras were deposited sometime between 5200 and 2900 years ago. The tephras show mineralogy similar to regional tephras described from terrestrial locales and correlate to the Oshetna and probably the Watana and Devil tephras. A peat bog core, obtained in the same area as the pond core resembles the on-land stratigraphy in thickness and age of sediments.

(i) Setting

The sample site, informally named Watana Triangle Pond, is located west of Watana Creek at Lat. 62°50'34" N., Long. 148°14'40" W., at an elevation of 530 m asl. The pond is situated on an intermontane plateau caused by extensive ice-sheet glaciation during the Pleistocene, and drains several square kilometers of small ponds and bogs developed on ice-stagnation terrain. Deglaciation is thought to have occurred between 12,000 and 11,500 years ago in the area. The pond, actually a small kettle lake about 110 x 170 m, has steep kames rising on the north and south sides; a small inlet stream (with a sandy bottom) flows in from the west. An outlet stream of similar dimensions flows out to the east through a steep canyon. Tertiary sediments, overlain by glacial drift, are exposed in the nearby Susitna River canyon, and coal outcrops occur within several kilometers of the pond on Watana Creek. The pond contains an extensive vegetational community. Vegetation in the surrounding area consists of spruce, aspen, birch, and a variety of small tundra and bog species.

(ii) Methods

Sediment cores were obtained using a standard 1½" Livingston piston corer in multiple 1 m drives. A continuous section of PVC pipe was used to obtain a continuous sediment core for comparison purposes, and to ensure the Livingston cores contained a complete sequence. Coring was confined to shallow, near-shore water due to logistic difficulties.

The laboratory analysis of these cores was performed at the University of Alaska Museum's Tephrochronology Center. This analysis consisted of extracting samples for radiocarbon dating and describing the stratigraphy, with special reference to the tephra units present. Tephra and other sedimentary units were sampled and prepared for mineralogic composition studies according to methods described by Steen-McInyre (1977).

(iii) Lacustrine Stratigraphy

The lacustrine sedimentary stratigraphy of Watana Triangle Pond is exemplified by the core LIV-2 (Figure 8.2), the evaluation of which forms the basis for this section. The core was taken in 15 cm of water about 3 m from shore. The total amount of sediments penetrated was approximately 431 cm, but due to compression the core length is only 254 cm. The core consists of 254 cm of clay, silt, sand, tephra, and organics. The bottom of the core is bluish gray, gravelly clay, thought to be glacial drift. The most significant sedimentary units in the core are bluish gray clays grading into silts, structureless organic silts, rhythmically laminated sections of blue clays and organic silts, six

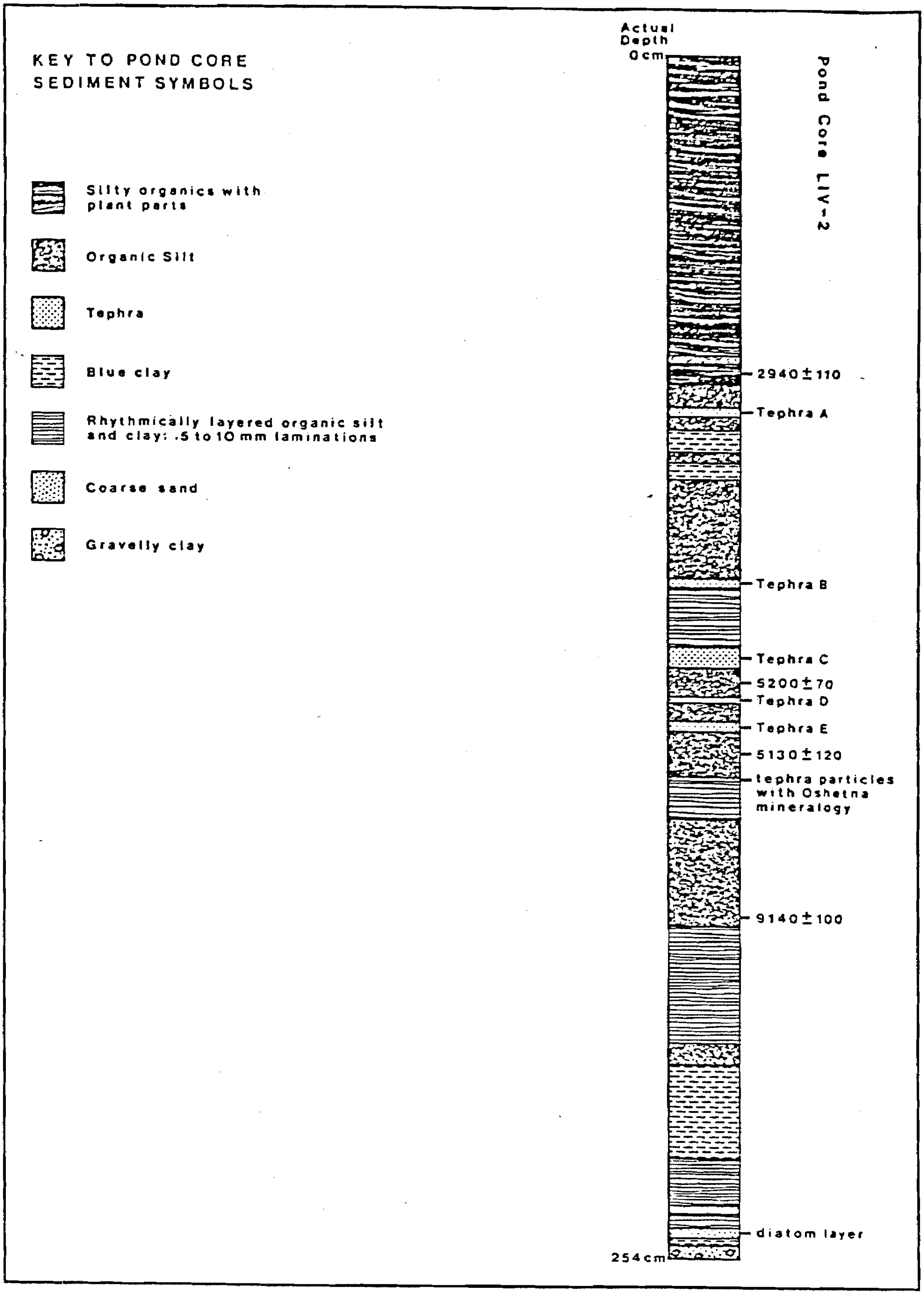

Figure 8.2. Lacustrine Core Stratigraphy

tephra units, and a thick section of structureless silty organics composing the upper 66 cm of the core.

Bracketing C-14 dates for the tephra units are available, allowing some correlation with the on-land tephra stratigraphy. Core samples yielded radiocarbon dates of 2940 ± 110 (66-71 cm), 5200 ± 70 (127-133 cm), 5130 ± 120 (138-144 cm), and 9140 ± 100 (174-181 cm). The conservative estimated age of the base of the core is 10,800 - 11,500 years old, based on sedimentation rates. This time span agrees favorably with the time of deglaciation in the area proposed by R.M. Thorson (Dixon, Smith, Betts, and Thorson 1982). This estimate, combined with the basal bluish gray, gravelly clay thought to represent glacial drift, indicates that the entire postglacial sequence was obtained in the core, although it is possible that unconformities may occur. Sedimentation rates in the pond appear to have been slower during the Hypsithermal when compared to events recorded in the terrestrial regional stratigraphy (Figure 8.1). This may be due to different vegetation cover and/or different rates or patterns of precipitation. Craig (1972) notes slower sedimentation rates for the Hypsithermal for lacustrine sediments from Minnesota.

The tephra stratigraphy recorded in the core consists of six individual tephra units ranging from 0.2-4.0 cm thick. The lowest tephra, a 0.2 cm thick unit, is below a 5200 year old date and is composed of quartz, feldspar, glass shards, a blue-green variety of hornblende, and orthopyroxene. Based on its stratigraphic position and mineralogy, this tephra has been correlated with the Oshetna tephra (Figure 8.2).

The upper five tephras in the core were deposited between 5200 and 2900 years ago and all exhibit a similar mineralogy of glass shards, glass-mantled brown-green hornblende, quartz, feldspar, and minor amounts of orthopyroxene and opaques. This mineralogy is identical to the Devil and Watana tephras found throughout the region, described in section 8.2a and Appendix C. The mineralogy and time of deposition of these tephras, suggest that they were derived from the Hayes volcanic vent which underwent several catastrophic eruptions about 3500 years ago (Riehle, in press).

The predominant sedimentary units of the core are bluish gray clays grading into silts, ranging up to 20 cm thick, and structureless organic silts, up to 25 cm thick. In four distinct sections of the core these units are tightly, rhythmically laminated with layers from 0.05-1.0 cm thick. The overall laminated units range from 7-26 cm in thickness and each is composed of several tens of laminations. These units have the appearance of varves, but they are not, because the laminated layers are not deposited as annual couplets.

Numerous workers (Lerman 1978; Reineck and Singh 1980; Hakanson and Jansson 1983) have discussed rhythmically laminated lacustrine sediments and their possible modes of origin, but most have dealt with classic glacial lake varves. Rhythmically laminated sediments, apart from classic varves, can be formed by turbidite flows (Sturm and Matter 1978), bacterial die-outs (Dickman 1979), and by lack of bioturbation (Ludlam 1976). In a core from the Tangle Lakes area, Alaska, Ager and Sims (1981) found 568 rhythmic laminae spanning 3000 radiocarbon years of deposition and ranging from 0.1-5.0 cm in thickness. Although these laminations may be due to turbidity currents, their origin is still unclear. Furthermore, the upper 1.5 m of their core, representing the last 2200 years, is structureless and not laminated, similar to the LIV-2 core.

Whatever their origin, the rhythmic laminations in the LIV-2 core can be related to sediment supply, water dynamics, and levels of vegetational productivity and bioturbation. A scenario can be postulated of unusual seasonal or periodic runoff, due to either large spring snow melts or floods, that delivered varying amounts of sediment into the pond over a period of several decades. In this scenario, and in the absence of bioturbating organisms, rhythmically laminated sediments would be produced. It is interesting to note that in the LIV-2 core and the Tangle Lakes core, rhythmically laminated sediments terminate about 2900 - 2200 years ago and structureless sediments continue being deposited up until the present day. A possible regional climatic factor, in the form of a bioturbation threshold, controlling sedimentary laminations may have been responsible for this change in the method of sedimentation.

(iv) Correlation With Regional Stratigraphy

The lacustrine stratigraphy from the LIV-2 pond core can be tentatively correlated to the terrestrial regional stratigraphy using both tephrochronology and radiocarbon chronology (Figure 8.2). Based on the estimated age of 10,800 - 11,500 B.P. and the stratigraphic location and sedimentary composition, the bluish gray gravelly clay may be reliably correlated to the regional glacial drift thought to be about 11,500 years old. The portion of the core between the 9100-year date (from the organic silt) and the Oshetna tephra also correlate well with the stratigraphy in the terrestrial setting (Figure 8.2).

Tephras A-E are difficult to correlate, because of their mineralogical similarity to the Devil and Watana tephras. Additionally, the radiocarbon sample, 2940 ± 110 (Beta-10780) is probably in error. If this date is correct, it would demonstrate that at least five distinct tephras, which have not been recognized in terrestrial settings, exist between the deposition of the Watana and Oshetna tephras. While this is remotely possible, it is extremely unlikely because evidence of these intervening tephras should have been preserved in some of the many terrestrial exposures subject to field investigation, particularly at Tsusena Bluff where this temporal interval is depositionally well represented and preserved. Consequently, it is probable that sample Beta-10780 is in error, although the reason for error has not been determined. It is possible that tephra C and B correlate to the Watana tephra, while tephra A from the core may be the Devil tephra. The lower and older tephras (D and E) may either be poorly represented or mixed with the Oshetna tephra in terrestrial settings, and consequently appear as a single unit identified by the distinctive Oshetna mineralogy. The extremely close limiting radiocarbon dates of 5200 ± 70 and 5130 ± 120 suggest this is possible.

The upper 66 cm of the core is extensively disturbed, structureless, and as a result cannot be correlated with the regional stratigraphy. Reworking of shallow, near-shore sediments into deeper water by seasonal water circulation is known to significantly affect the upper 6-12 mm in the littoral zone of lakes (Davis 1968, 1973). This process mixes sediments of different ages and destroys the stratigraphy of upper sediments. Nichols (1967) points out that shore ice can also mix and destroy sediments, especially in the shallow near-shore water of arctic and subarctic ponds; shore ice mixing can also result in anomalous C-14 dates. Finally, bioturbation can also significantly rework and destroy sediments.

(e) Tephrochronology

Three methods were employed to establish the regional tephrochronology: 1) the stratigraphic integrity of the carbon samples dated was evaluated, 2) dates resulting from the analysis of bulk organics were eliminated, and 3) dates that could not be correlated with the tephra sequence were not used. The latter category includes samples from sites in which tephra could not be identified and samples taken for geological purposes that were much older than the ca. 5900-year tephra sequence. While these samples were not applicable to the tephra sequence, they often provide reliable dates for other events.

Following stratigraphic evaluation of radiocarbon dates the accepted dates (Table 8.2) were examined statistically to establish the ages of tephra falls and organic paleosols. Figure 8.3 presents the accepted dates arranged by age, cumulative frequence, and stratigraphic position. Forty-two dates were considered applicable to dating the tephra sequence. Three dates are from below the Oshetna tephra, 23 fall at the contact between the Oshetna and Watana tephras, 5 are located at the contact between the Watana and Devil tephras, 1 sample was recovered within the Devil tephra, and 10 are from above the Devil tephra. The solid blocks in Figure 8.3 represent the mean age of each sample, while the thin lines with crossbars represent the 95% confidence interval for each date. In general, deposits below the Oshetna tephra are early Holocene in age, those of the contact between the Watana and Oshetna tephras are of middle Holocene age, and those above the Watana tephra are of late Holocene age.

Table 8.2

Radiocarbon Dates Accepted for Tephrochronology Analysis Based on the Evaluation of Samples

Lab Number	Site	Date
	ABOVE DEVIL TEPHRA	
Beta-10793	TLM 104	Modern
DIC-2244	TLM 027	140±45
Beta-7684	TLM 030	170±90
DIC-1905	TLM 050	280±60
DIC-2253	TLM 059	740±70
DIC-7692	TLM 184	840±60
DIC-7693	TLM 184	1060±70
DIC-7845	TLM 097	1260±80
DIC-2245	TLM 097	1400±55
DIC-2284	TLM 027	1800±55
	IN DEVIL TEPHRA	
DIC-2246	TLM 062	1380±155
	BELOW DEVIL TEPHRA, ABOVE WATANA TEPHRA	
Beta-10785	BOG CORE	1240±60
Beta-10125	TLM 216	1530±80*
Beta-9898	TLM 216	1670±50*
Beta-10791	TLM 217	1770±190
Beta-9892	TLM 216	1880±50*

* Same piece of wood

Table 8.2 (Continued)

Lab Number	Site	Date	
	BELOW WATANA TEPHRA ABOVE OSHETNA TEPHRA		
Beta-7301	TLM 030	2690±70	
DIC-2285	TLM 096	2750±215	
Beta-7297	TLM 180	2800±90	paleosol
Beta-7688	TLM 030	3160±70	
Beta-7685	TLM 030	3180±170	paleosol
DIC-2286	TLM 027	3210±80	paleosol
DIC-1860	TYONE BLUFF	3200±195	
Beta-7299	TLM 016	3220±90	paleosol
Beta-7690	TLM 030	3270±90	paleosol
Beta-7699	TSUSENA BLUFF 1	3270±110	paleosol
Beta-7300	TLM 030	3290±60	paleosol
Beta-7686	TLM 030	3290±130	paleosol
Beta-10794	TLM 169	3410±80	paleosol
DIC-2283	TLM 097	4020±65	
Beta-9897	TLM 207	4030±220	paleosol
Beta-5364	TLM 143	4100±60	
Beta-7697	TLM 143	4250±110	
Beta-7700	TSUSENA BLUFF 2	4250±90	paleosol
Beta-7698	TLM 143	4440±120	
DIC-1880	TLM 030	4720±130	paleosol
DIC-7298	TLM 016	4950±120	paleosol
Beta-10782	LIV-2 #3	5130-120	
Beta-7302	TLM 030	5130±140	paleosol

Table 8.2 (Continued)

Lab Number	Site	Date	
	BELOW OSHETNA TEPHRA		
Beta-10786	TSUSENA BLUFF 7	5900±135	paleosol
Beta-7304	TLM 128	6970±210	paleosol
Beta-7306	TLM 128	7240±110	paleosol

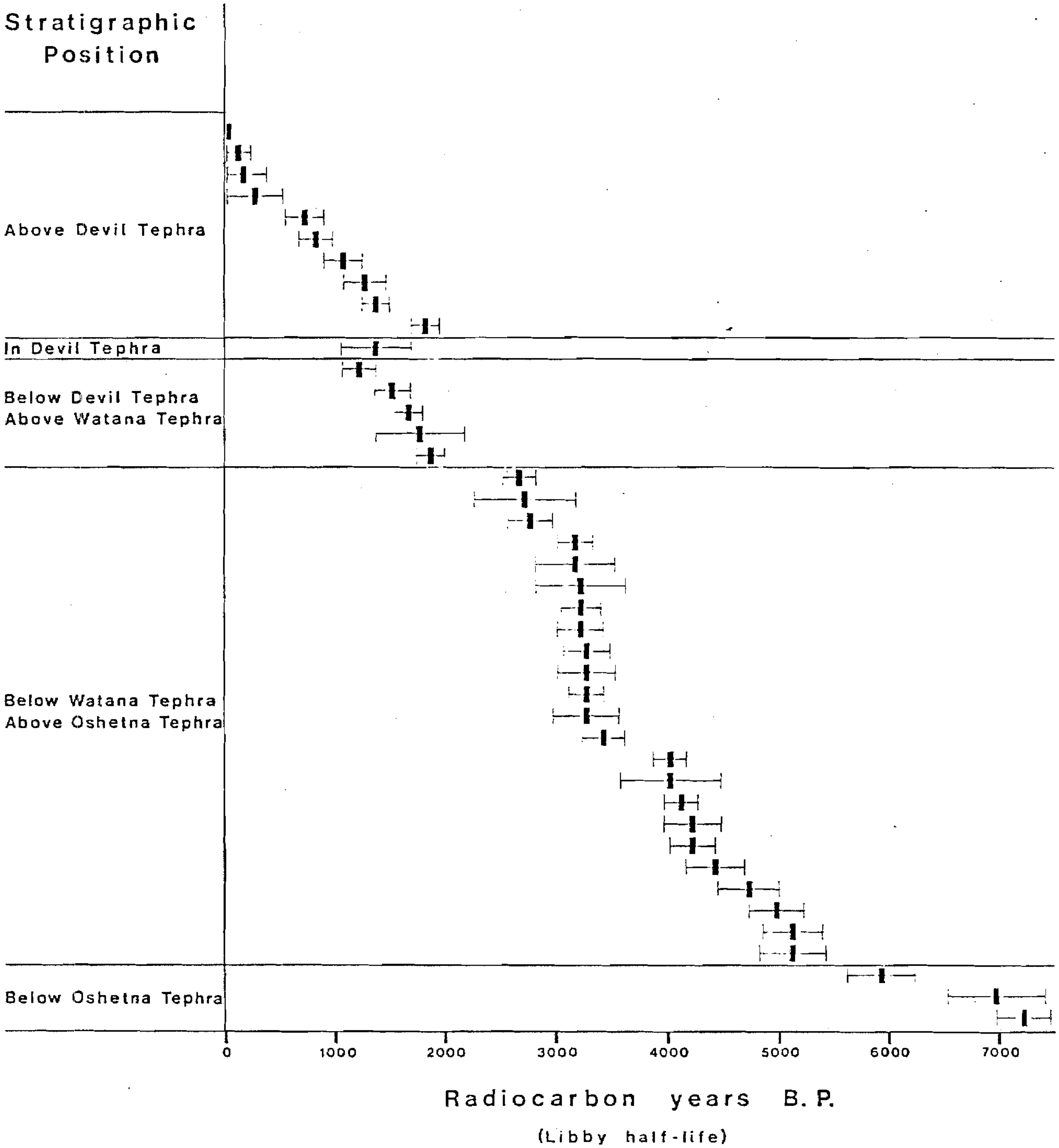

Figure 8.3. Accepted Tephrochronology Dates Arranged by Age and Stratigraphic Position

within the Devil tephra, and 10 are from above the Devil tephra. The solid blocks in Figure 8.3 represent the mean age of each sample, while the thin lines with crossbars represent the 95% confidence interval for each date. In general, deposits below the Oshetna tephra are early Holocene in age, those of the contact between the Watana and Oshetna tephras are of middle Holocene age, and those above the Watana tephra are of late Holocene age.

(i) Tephra Dating

Upper and lower limiting dates of the three major Susitna Project area tephras were established using date averaging techniques and tests for contemporaneity described by Long and Rippeteau (1974). The age of the Devil tephra is the most precisely known, because one dated sample is available from within the tephra itself, and seven dates are tightly clustered at the tephra's upper and lower boundaries.

The upper age boundary of the Devil tephra was established by taking the weighted average of the three dates whose means fall within the 95% confidence interval (C.I.) for the sample from the Devil tephra (DIC-2446). Sample DIC-2284 was added to these dates, and, although its date is anomalously old, it falls above the Devil tephra stratigraphically and could not be eliminated from the sample on the basis of the criteria outlined above. The upper limiting dates are:

DIC-7693	1060 ± 70 B.P.
DIC-7845	1260 ± 80 B.P.
DIC-2245	1400 ± 55 B.P.
DIC-2284	1800 ± 55 B.P.

The weighted average is: $\bar{X}_W$ = 1435±31 B.P.

Long and Rippeteau (1974:208) recommend using Chauvenet's rejection criteria to eliminate dates from the averaged series which have a probability of occurrence of less than 1/2n. Chauvenet's criteria are not applicable in this instance due to the small number of dates being averaged.

The lower limiting date for the Devil tephra is established using three dates within the 95% C.I. of DIC-2246. These are:

Beta-10785	1240 ± 60 B.P.
Beta-10125	1530 ± 80 B.P.
Beta-9898	1670 ± 50 B.P.

The weighted average of these dates is: $\bar{X}_w = 1514 \pm 37$

Again, due to the small number of dates, use of Chauvenet's criteria is not applicable.

A very precise age for the Devil tephra fall can be established from its upper and lower limiting ages, and the directly associated date. These values all fall within a 95% C.I.

	Date	95%. C.I.
Upper Limit	1435 ± 31 B.P.	1345-1496 B.P.
Associated Date	1380 ± 155 B.P.	1070-1690 B.P.
Lower Limit	1514 ± 37 B.P.	1440-1588 B.P.

Since these dates are tightly clustered, they can appropriately be averaged. As evidenced by the t-test for contemporaneity (Spaulding 1958), there is a 10% probability that the upper and lower limiting dates represent exactly the same "instant":

$$t = \frac{D}{\sqrt{\sigma_1^2 + \sigma_2^2}} = \frac{79}{\sqrt{37^2 + 31^2}} = 1.64,$$ probability of contemporaneity = 10% (p = .10)

The mean age estimate for the deposition of the Devil tephra is:

$\bar{X}_w$ = 1468 ± 24 B.P., 95% C.I. = 1420 - 1516 B.P.

Age estimates for the Watana and Oshetna tephras are less exact because no samples from these tephras have been dated. The upper and lower limiting dates for the Watana tephra are: Upper Limit Beta-9892 1880 ± 50 B.P., Lower Limit Beta-7301 2690 ± 70 B.P.

The t-test for contemporaneity indicates that the probability that these dates are coeval is very low: $t = 9.416$, probability of contemporaneity less than 1/10 of 1% ($p<.001$). Since there are no age - stratigraphic reversals or anomalous dates at either the upper or lower Watana boundary, the age of the tephra fall can be placed in the range: ca. 1850 - 2700 B.P.

The probable age range of the Oshetna tephra fall is established similarly to that of the Watana tephra. The upper and lower limiting dates for the Oshetna tephra are: Upper Limit Beta-10782 5130 ± 120 B.P., Lower Limit Beta-10786 5900 ± 135 B.P.

As for the Watana tephra, the t-test indicates that the probability that the upper and lower limiting ages on the Oshetna tephra are of the same age is very low: $t = 4.263$, probability of contemporaneity less than 1/10 of 1% ($p<.001$). Again, there are no stratigraphic reversals or anomalous dates, so the estimated age range for the Oshetna tephra fall can be placed at: ca. 5100 - 5900 B.P.

(ii) Paleosol Dating

Paleosol dates from between the Watana and Oshetna tephras and from units beneath the Oshetna tephra make up a population which can be separately analyzed. This group contains only those dates which are unequivocally correlated to the O horizons of the region-wide paleopodzols. There appear to be four subpopulations of paleosol dates.

Two age groups can be tentatively identified in the sub-Oshetna paleosol. These are:

Tsusena Bluff 7	Beta-10786	5900 ± 135 B.P.
TLM 128	Beta-7306	6970 ± 210 B.P.
	Beta-7306	7240 ± 110 B.P.

The probability for contemporaneity within the TLM 128 group is very high: t = 1.139, probability of contemporaneity greater than 80%, less than 90% ($.80 < p < .90$). The weighted mean of the TLM 128 dates is: $\bar{X}_x$ = 7186 ± 97 B.P.

The TLM 128 dates, and Tsusena Bluff 7 are definitely not coeval: t = 4.286, probability of contemporaneity less than 1/10 of 1% ($p < .001$) The paleosol dates immediately above and below the Oshetna tephra (Beta-7302 and Beta-10786) are widely separated in real age, as well as stratigraphically. There are two age groups within the Watana and Oshetna contact paleosol. These are designated:

Tsusena Bluff 1	2800 ± 90 - 3410 ± 80 B.P.
Tsusena Bluff 2	4030 ± 270 - 5130 ± 140 B.P.

The upper limiting date for Tsusena Bluff 2, and the lower limiting date for Tsusena Bluff 1 have only a small likelihood of being coeval: t = 2.629, probability of contemporaneity less than 1%, greater than 1/10 of 1% ($.01 < p < .001$). The Tsusena Bluff 1 group is very tightly clustered around a modal value of ca. 3280 B.P.

(iii) Discussion

The accepted dates (Table 8.2) are highly consistent, and reliably document the timing of the regional Holocene stratigraphy. The age of the Devil tephra event can be closely estimated. The radiocarbon ages of the Watana and Oshetna tephras can be assigned reliable ranges, but cannot be dated with great precision. Analysis of the paleosol dates indicates that there are discrete age groups within the O horizons of the Watana tephra and Oshetna tephra contact paleosol, and the sub-Oshetna paleosol. The age difference between the Tsusena Bluff 7 and TLM 128 paleosols may be due to local factors affecting eolian deposition (Dilley, personal communication 1985). The distinction between the Tsusena Bluff 1 and Tsusena Bluff 2 age groups of the Watana tephra and Oshetna tephra contact paleosol may be a result of Holocene climatic trends which affect vegetation cover and productivity. Hamilton (1977) has placed the initial Neoglacial expansion of alpine glaciers in Central Alaska at either 4500 or 3500 years B.P., based on a "sparse" radiocarbon record. The 4500-year glacial advance may be correlative to the brief hiatus in organic accumulation in the Watana tephra and Oshetna tephra contact paleosol. The dated tephra sequence can be used to establish bracketing dates for sites that fall in stratigraphic relationship to the tephra, in the absence of radiocarbon determinations for cultural remains.

(f) Regional Chronology

The evolution of the stratigraphic record presented in Figure 8.1 can be broken into four major intervals: (1) the time prior to the last glaciation, represented by Unit 15, (2) the time during the last glaciation, represented by Unit 14, (3) the time following deglaciation but prior to deposition of the first recognized tephra, represented by Unit 13, and (4) the time representing recurrent volcanic ash deposition and soil formation, represented by Units 1-12.

Interstadial dates below drift of the last glaciation range in age from 21,730 ± 390 years B.P. at Tyone Bluff to 32,000 ± 2735 years B.P. at Thaw Bluff. During this interval glaciers were restricted and human occupation of the study area and peripheral regions may have been possible. Although interstadial conditions may have prevailed for some time earlier, the maximum age for such conditions is not known. Certainly, human occupation could not have occurred during early Wisconsinan time because glaciation was very extensive at that time, virtually covering the entire study area.

During the 1980 field season a proboscidean fossil (likely mammoth) was found in situ in fluvial gravels at Tyone Bluff. The fossil, representing the shaft portion of a right femur, was identified by R. Dale Guthrie and George S. Smith of the University of Alaska, and is the first documented occurrence for any terrestrial Pleistocene mammals in southern Alaska. It yielded a radiocarbon date of 29,450 ± 610 C-14 years B.P., and clearly implies nonglacial conditions at that time (Thorson et al. 1981). This discovery indicates that the range of mammoth should be extended about 200 km south of its present limit. It also suggests that mountain passes in the Alaska Range may have been deglaciated, and that portions of southern Alaska may have been suitable for human habitation during mid-Wisconsinan time, although no sites have yet been found that represent this time period.

The last glaciation in the Susitna River canyon is bracketed by maximum age dates of 30,700 +260/-1230 years B.P. near Fog Lakes, 24,900 ± 390 years B.P. near Tyone Bluff, and by a minimum date of 11,535 ± 140 years B.P. near the Tyone Rivers. Based on these C-14 determinations, the last glaciation in the study area probably spanned the interval from about 25,000 years B.P. to about 12,000 years B.P. These data correlate with those from other regions which also document the age and duration of the mid-Wisconsinan interval. Owing to the extent of ice, human occupation was either impossible or severely restricted. Furthermore, in most areas, evidence for possible interstadial human occupation would have been destroyed by advancing late Wisconsinan ice. Final deglaciation of the Susitna River canyon area probably occurred about 12,000 - 13,000 years B.P., but large areas of unstable ground underlain by stagnant ice may have persisted for several thousand years following deglaciation. Melting ice may have partly influenced human occupation into Holocene time.

Dates are available for Unit 13, which represents the time interval between deglaciation and the first recognized tephra deposit. Two dates (6970 ± 210 B.P., 7240 ± 110 B.P.) are from a paleosol containing cultural material below the Oshetna tephra at site TLM 128. A third date (9140 ± 100 B.P.) is from the bottom portion of a lake core, from an area within the core interpreted as representing the early postglacial environment. Although Unit 13 may have been deposited in the late Pleistocene, it corresponds more closely with the early Holocene, and is characterized by weathering, erosion, and deposition of subunits. Sites found in this unit, including its subunits (such as the paleosol), represent the earliest documented human occupation of the Middle Susitna River area, some ca. 7000 - 8000 years ago. However, the age of sites in this unit may extend beyond the oldest radiocarbon dates associated with cultural material because several sites (TLM 027 and TLM 180) have cultural material resting directly on the glacial drift and covered by the Oshetna tephra. In this stratigraphic context, the artifacts from these sites are highly weathered, suggesting that they were exposed on the surface for a considerable amount of time. Considering the age span between the glacial drift and the lowest tephra (Oshetna), some of the artifactual material from this unit (Stratigraphic Horizon 9) may have been displaced from its original context by as much as ca. 6000 - 7000 years of exposure and/or erosion prior to deposition of the Oshetna tephra. This factor may account for the relatively low frequency of sites represented in Stratigraphic Horizon 9.

Deposition of the Devil/Watana/Oshetna tephra sequence probably occurred within the last ca. 5200 years. An evaluation of dates from between the Oshetna tephra (Unit 12) and the overlying lower subdivision of the Watana tephra (Unit 10) indicates that the Oshetna tephra was deposited sometime between 5100 - 5900 years B.P. However, the suite of minimum limiting dates above the Oshetna tephra suggests that the ash was deposited shortly before 5100 years B.P. The lack of weathering of the Oshetna tephra also supports a more recent temporal interpretation for deposition of the Oshetna tephra. Based on lower limiting dates for the Watana tephra and the prominent paleosol (unit 11) occurring between the Watana and Oshetna tephras, it appears that the Oshetna tephra was covered by vegetation for much of 2400-year interval prior to the Watana ash fall. Stratigraphic Horizon 8 falls within this temporal range.

Analysis of radiocarbon dates from the paleosol occurring between the Oshetna and Watana tephras indicates that there are two discrete age groups, suggesting two periods of paleosol formation. The first episode took place between 4030 and 5130 years B.P., and the second occurred between 2800 and 3410 years B.P. The distinction between these two date clusters may be due to Holocene climatic trends which affected vegetation cover and productivity. Hamilton (1977) has placed the initial Neoglacial expansion of the alpine glaciers in Central Alaska at either 4500 or 3500 years B.P. This glacial advance may be correlative to the brief hiatus in organic accumulation in the Watana tephra and Oshetna tephra contact paleosol.

An evaluation of radiocarbon dates from above, below, and within the Watana tephra (Units 8, 9, 10) indicates that deposition of the Watana tephra, and the intervening Contact Unit E, occurred sometime between 1850 and 2700 years B.P. Therefore, the Watana tephra may actually be a tephra sequence representing two or more depositional episodes. Stratigraphic Horizon 7 occurs in various places within this tephra unit, representing short time periods within the limiting dates for the Watana tephra. This may account for the relative scarcity of cultural material recovered from Stratigraphic Horizon 7 in the project area.

Stratigraphic Horizon 6 occurs above the Watana tephra, is not widespread, and probably dates to between 1500 and 1850 years B.P. The limited geographic distribution of Stratigraphic Horizon 6 and the close coincidence between its limiting dates are puzzling because evidence of weathering at this contact is clear.

Based on an evaluation of radiocarbon dates from above the Devil tephra it appears that Contact Unit C (Stratigraphic Horizon 5) represents an interval between 1400 and 140 years ago. These dates, when combined with those from Stratigraphic Horizon 6, reveal that the Devil tephra was deposited sometime between 1400 and 1500 years B.P.

An evaluation of radiocarbon dates from near the base of Unit 4 (organic sandy silt) indicates that it spans most of the last millennium. Owing to redeposition, contamination by modern roots, and an influx of modern humic material, it is doubtful that this layer could be more accurately dated using contemporary radiometric methods. Direct dating of cultural material within Stratigraphic Horizon 4 provides the most reliable means of dating human occupation during this interval.

No attempt was made to date the surface organic mat (Unit 2) because of its obviously young age. Stratigraphic Horizons 1-3 are very recent and can be differentiated in a relative stratigraphic sense only. Direct dating of cultural materials in this time range by the radiocarbon method would be difficult at best, because it falls within the younger limit of the method.

8.3 - Lithic Analysis

(a) Introduction

During the five field seasons of the Susitna Cultural Resources Program, over 150,000 lithic artifacts were recovered. This analysis deals with 137,885 of these specimens. Unmodified flakes less than 1/8" in diameter have been excluded from the analysis because collection strategies used to recover these flakes was employed at only a few systematically tested sites, and thus their inclusion would bias the analysis. The objectives of the analysis are to address temporal and spatial questions of archeological concern on a regional level, and in order to maximize the available lithic data, both survey level and systematically tested sites are included in the analysis. The lithic analysis section is organized into five major subsections. The first two, artifact types and lithic raw material type, present broad-scale data based on examination of the entire lithic assemblage. Lithic variability by site and lithic variability by stratigraphic position are discussed in the next two subsections, and are followed by a summary, which draws together conclusions from the previous subsections.

(b) Artifact Types

Recent archeological studies in lithic analysis have changed many of the assumptions about artifact function and morphological variability (Ahler 1971; Keeley 1974; Akoshima 1979; Odell and Odell-Vereeken 1980; Bienenfeld and Andrefsky 1984; Flenniken and Raymond 1984). For example, Ahler's study on the form and function of projectile points suggests that not all specimens classified as "projectile points" were used as projectiles (Ahler 1971). The ethnographic literature also demonstrates that traditionally used morphological tool types with functional names were not used to perform their ascribed functions (Heider 1967; Gould et al. 1971; Hayden 1977:179). Functional names applied to artifact types do not necessarily correlate with the function of artifacts (Keeley 1980; Meltzer 1981; Odell 1981).

To avoid the interpretive problem of artifact form and function, the classification scheme employed here is based on morphological characteristics and employs the traditional type names used to characterize archeological remains in the North American arctic and subarctic. Artifact types, as they are used in this analysis, are based on morphology and are not intended either implicitly or explicitly to imply function. The following 26 lithic artifact types have been identified in the lithic assemblage: unmodified flakes, modified flakes, scrapers, blades, microblades, burins, burin spalls, bifaces, preforms, notched points, stemmed points, leaf-shaped points, lanceolate points, triangular points, microblade cores, microblade tablets, blade cores, rejuvenation flakes, flake cores, hammerstones, abraders, tci thos, notched pebbles, thermally altered rocks, ochre, cobbles, and cobble fragments. Definitions for each of these types appear in the Glossary, Appendix A.

The number and percentage of each lithic artifact type found in the project area are listed on Table 8.3, along with the number of sites which contain each of these types. The most abundant artifact type is unmodified flakes, which comprise 95.75% of the entire lithic assemblage. They were recovered from 198 sites. Thermally altered rocks, ochre, cobbles, and cobble fragments account for an additional 3.34% of the assemblage. Flaked stone artifacts comprise less than 1% of the assemblage, and are best represented (in descending order of frequency) by microblades (.26%), modified flakes (.23%), bifaces (.11%) blades (.07%), and scrapers (.05%). The distribution of microblades, found at only eight sites, is much more restricted than that of modified flakes, which were found at 76 sites. Blades also had a somewhat restricted distribution (14 sites), while bifaces and scrapers, found at 49 and 28 sites respectively, appear to have been more widely distributed across the project area.

Of the five types of points identified (notched, lanceolate, stemmed, leaf-shaped, and triangular), notched points are the most abundant (43 specimens). These specimens, found at nine sites, have a more limited distribution than that of the lanceolate points (18 specimens).

Table 8.3.

Frequencies of Lithic Artifact Types

Type Name (Number)	Total Number of Artifacts	Percent of Totals	Number of Sites
Unmodified Flakes (1)	132,027	95.75	198
Modified Flakes (2)	326	0.23	76
Scrapers (3)	70	0.05	28
Blades (4)	98	0.07	14
Microblades (5)	364	0.26	8
Burins (6)	1	0.00	1
Burin Spalls (7)	5	0.01	5
Bifaces (8)	152	0.11	49
Preforms (9)	18	0.01	12
Notched Points (10)	43	0.03	9
Stemmed Points (11)	5	0.01	5
Leaf-shaped Points (12)	5	0.01	4
Lanceolate Points (13)	18	0.01	14
Triangular Points (14)	6	0.01	2
Microblade Cores (15)	2	0.00	2
Microblade Tablets (16)	2	0.00	1
Blade Cores (17)	3	0.01	1
Rejuvenation Flakes (18)	16	0.01	7
Flake Cores (19)	65	0.04	26
Hammerstones (20)	11	0.01	9
Abraders (21)	1	0.00	1
Tci Thos (22)	6	0.01	4
Notched Pebbles (23)	2	0.00	2
Thermally Altered Rocks (24)	2,988	2.16	31
Ochre (25)	1,488	1.07	10
Cobbles and Cobble Fragments (26)	163	0.11	35
Totals	137,885	99.98	

which were recovered from 14 sites in the area. Stemmed, leaf-shaped, and triangular points together account for an additional 16 specimens. Artifacts found in the lowest frequencies are blade cores (3), notched pebbles (2), microblade cores (2), microblade tablets (2), abraders (1), and burins (1).

(c) Lithic Raw Material Types

Lithic raw material identification is based upon two principal attributes of texture and composition which relate directly to the genesis of rock (see Greensmith 1951; Carozzi 1960; Kerr 1977; Ayers 1978). Texture refers to the particle size of a rock and composition refers to the mineral content of the rock (Hamblin and Howard 1971). Both are derived from processes of rock formation. Rock formation processes are continuously ongoing and are not necessarily discrete from one another. This continuous formation process is illustrated by the three broad rock families: 1) sedimentary, 2) igneous, and 3) metamorphic.

Rock types which were used to manufacture artifacts found within the project area exhibit characteristics which render them suitable for chipping and flaking. In most cases, they exhibit the qualities of elasticity, homogeneity, isomorphism, and are siliceous (Crabtree 1972:5). These qualities allow the worker to fracture the rock in any direction desired in order to shape the piece into a preconceived form. Rocks with inclusions, cracks, flaws, or bedding planes cause hinge and step fractures (Tixier 1974; Bradley 1975).

Coarse-grained rocks tend to crumble when force is applied. Rocks which have the desired qualities important for artifact manufacture are found in all three of the broad families. Because of similarities in these qualities and the similar formation processes which produce these qualities, it is sometimes difficult to type rock specimens into one category or another. For instance, the argillites and cherts found in the project area can be morphologically similar because both are formed in the same manner, but differ in the amount of silica present. Also, when in artifact form, the rock may undergo weathering which can mask its composition. To determine composition in the field or laboratory specimens were examined at fresh unweathered breaks when possible.

Nine rock categories are defined for this project: argillite, basalt, chalcedony, chert, obsidian, quartz, quartzite, rhyolite, and an "other" category. Identification was based on a flow chart of lithic properties, illustrated in Figure 6.8. These categories were kept narrow enough to reduce the amount of overlap between groups, while at the same time providing internal cohesion. Each was identified based on characteristics which could be observed in the field. These characteristics include: texture, color, luster, patina, bedding planes, flowlines, and phenocrysts (Appendix A). The "other" category represents a group of lithics which is not entirely suitable for chipped stone artifact production. Most of the specimens assigned to the "other" category are composed of granite, greenstones, and diorite. The artifact types manufactured from this category include hammerstones, abraders, tci thos, notched pebbles, thermally altered rock, and cobble fragments.

Each of the lithic raw material types is listed on Table 8.4, which gives the frequency, percentage, and number of sites at which the lithic material is found. The most abundant lithic raw material found in the project area is basalt, representing 60.64% of the total lithic assemblage. The second most abundant material is argillite (28.31%), which together with basalt account for 88.95% of all lithics. In decreasing order of frequency, the other types of lithic raw materials are chert, "other", rhyolite, chalcedony, quartzite, obsidian, and quartz.

The two lithic raw material types which show the lowest frequencies of occurrence are quartz (.06%) and obsidian (.27%). These two lithic raw material types are also found at the fewest number of sites, 13 and 26, respectively. Natural sources of quartz and obsidian have not been identified in the project area, and they are therefore considered to be exotic. All of the other categories of lithic raw material types have

Table 8.4.

Frequency of Lithic Raw Material Types

Lithic Type	Total Number of Artifacts	Percent of Totals	Number of Sites
Argillite	39,044	28.31	121
Basalt	83,624	60.64	150
Chalcedony	531	0.38	47
Chert	6,502	4.71	131
Obsidian	379	0.27	26
Quartz	90	0.06	13
Quartzite	515	0.37	41
Rhyolite	2,620	1.90	45
Other	4,580	3.32	53
Total	137,885	99.96	

been found in primary deposits or secondary deposits of glacial drift and fluvial sediments. Sites which contain quartz and obsidian may represent an influx of nonlocal populations or local populations which had access to areas and resources outside of the immediate project area, but these hypotheses are yet to be tested.

The frequency and percentage of lithic artifact types listed by raw material of manufacture appear in Table 8.5. When compared to the percentages in Table 8.4, an interesting pattern emerges. Percentages for the unmodified flakes closely approximate those in Table 8.4, as might be expected given the fact that these flakes comprise the vast majority of all lithic specimens. However, if only the flaked stone tools are considered, i.e., artifact types 2 - 19, the frequency and percentage for some material types is quite different. The combined tool count indicates that chert (536 specimens in artifact types 2 - 19) is the best-represented lithic material, contributing 44.70% to the total tool inventory. However, chert represents only 4.71% of the entire assemblage including unmodified flakes. Basalt and argillite are each represented by 264 specimens, or 22.02% of the total tool assemblage. The percentage of obsidian tools (5.59%) is greater than would be expected on the basis of the contribution that obsidian made to the total lithic inventory, i.e. .27%. The percentages of tools manufactured from chalcedony, quartz, quartzite, and rhyolite are all quite low (2% or less), which corresponds to their low frequencies in the total lithic assemblage.

The comparison of these percentages indicate that the ratio of unmodified flakes to tools is greater for basalt and argillite than it is for chert and obsidian. Preference for chert and obsidian in the manufacture of certain tools, and limited availability of these two raw material types are both possible explanations for this observed pattern. Chert appears to be the preferred material for production of scrapers (48.57%) and microblades (97.25%), while obsidian is the preferred type for blade production (48.98%). If these particular tools in finished form were transported as people moved from site to site in their subsistence pursuits, evidence of all stages of lithic reduction,

Table 8.5.

Lithic Artifact Type by Lithic Raw Material Type

Artifact Type	Argillite (1)	Basalt (2)	Chalcedony (3)	Chert (4)	Obsidian (5)	Quartz (6)	Quartzite (7)	Rhyolite (8)	Other (9)	Totals
Unmodified	38777	83323	511	5932	311	86	494	2593	-	132027
Flakes-1	29.37	63.11	0.39	4.49	0.24	0.07	0.37	1.96	-	100.00
Modified	124	109	3	59	6	1	16	8	-	326
Flakes-2	38.04	33.44	0.92	18.10	1.84	0.31	4.91	2.45	-	100.00
Scrapers-3	10	17	-	34	6	1	-	2	-	70
	14.29	24.29	-	48.57	8.57	1.43	-	2.86	-	100.00
Blades-4	21	10	3	16	48	-	-	-	-	98
	21.43	10.20	3.06	16.33	48.98	-	-	-	-	100.00
Microblades-5	4	-	5	354	1	-	-	-	-	364
	1.10	-	1.37	97.25	0.27	-	-	-	-	100.00
Burins-6	-	-	-	1	-	-	-	-	-	1
	-	-	-	100.00	-	-	-	-	-	100.00
Burin Spalls-7	1	-	1	3	-	-	-	-	-	5
	20.00	-	20.00	60.00	-	-	-	-	-	100.00
Bifaces-8	52	56	4	27	2	2	2	7	-	152
	34.21	36.84	2.63	17.76	1.32	1.32	1.32	4.61	-	100.00
Preforms-9	4	5	2	5	-	-	1	1	-	18
	22.22	27.78	11.11	27.78	-	-	5.56	5.56	-	100.00
Notched	10	26	-	5	-	-	-	2	-	43
Points-10	23.26	60.47	-	11.63	-	-	-	4.65	-	100.00
Stemmed	2	2	-	1	-	-	-	-	-	5
Points-11	40.00	40.00	-	20.00	-	-	-	-	-	100.00
Leaf-shaped	-	1	-	3	1	-	-	-	-	5
Points-12	-	20.00	-	60.00	20.00	-	-	-	-	100.00
Lanceolate	3	6	-	5	-	-	1	3	-	18
Points-13	16.67	33.33	-	27.78	-	-	5.56	16.67	-	100.00
Triangular	4	2	-	-	-	-	-	-	-	6
Points-14	66.67	33.33	-	-	-	-	-	-	-	100.00
Microblade	1	-	-	1	-	-	-	-	-	2
Cores-15	50.00	-	-	50.00	-	-	-	-	-	100.00
Microblade	1	-	-	1	-	-	-	-	-	2
Tablets-16	50.00	-	-	50.00	-	-	-	-	-	100.00
Blade	3	-	-	-	-	-	-	-	-	3
Cores-17	100.00	-	-	-	-	-	-	-	-	100.00

Table 8.5. (Continued)

Artifact Type	Argillite (1)	Basalt (2)	Chalcedony (3)	Chert (4)	Obsidian (5)	Quartz (6)	Quartzite (7)	Rhyolite (8)	Other (9)	Totals
Rejuvenation	6	3	-	7	-	-	-	-	-	16
Flakes-18	37.50	18.75	-	43.75	-	-	-	-	-	100.00
Flake	18	27	1	14	3	-	-	2	-	65
Cores-19	27.69	41.54	1.54	21.54	4.62	-	-	3.08	-	100.00
Hammerstones-20	-	-	-	-	-	-	-	-	11	11
	-	-	-	-	-	-	-	-	100.00	100.00
Abraders-21	-	-	-	-	-	-	-	-	1	1
	-	-	-	-	-	-	-	-	100.00	100.00
Tci Thos-22	-	-	-	-	-	-	-	-	6	6
	-	-	-	-	-	-	-	-	100.00	100.00
Notched	-	-	-	-	-	-	-	-	2	2
Pebbles-23	-	-	-	-	-	-	-	-	100.00	100.00
Thermally	-	-	-	-	-	-	-	-	2988	2988
Altered Rocks-24	-	-	-	-	-	-	-	-	100.00	100.00
Ochre-25	-	-	-	-	-	-	-	-	1488	1488
	-	-	-	-	-	-	-	-	100.00	100.00
Cobbles-26	3	37	1	34	1	-	1	2	84	163
	1.84	22.70	0.61	20.86	0.61	-	0.61	1.23	51.53	100.00
TOTALS	39044	83624	531	6502	379	90	515	2620	4580	137885

specifically in terms of unmodified waste flakes, would not be expected in great abundance in the archeological record. On the other hand, basalt and argillite tools may not have been as frequently transported due to the ready availability of sources of these raw materials in the project area. If tools were newly manufactured wherever natural sources of basalt and argillite occurred locally, the proportion of waste flakes to finished tools for these materials would be high relative to the rarer materials of chert and obsidian.

(d) Lithic Variability By Site

This section describes and characterizes the variability of lithic artifact types and raw material types found in the project area. The unit of analysis is the site. The objective of this section is to provide the range of lithic artifact spatial distribution and frequency.

(i) Frequency of Artifact Type by Site

Lithics were recovered from 223 sites in the project area. The total number and percentage of specimens listed by artifact type appear in Table 8.6. Uncollected specimens are not included in this inventory. Three salient points regarding lithic abundance, diversity, and distribution made in the table are the following: 1) only a few sites have yielded the bulk of all lithics, 2) the sites with the largest sample sizes also tend to have the greatest diversity in artifact types, and 3) some artifact types cluster at particular sites. Figures 8.4 and 8.5 aid in illustrating the first and second of these points.

As evident in Table 8.6, TLM 030, with 65,525 lithic specimens, and TLM 143, with 29,616 specimens far surpass all other sites in terms of artifact abundance. At only 7 sites, i.e., TLM 030, TLM 143, TLM 217, TLM 018, TLM 184, and TLM 097, does the total inventory exceed 2,000 specimens. Lithics at these 7 sites account for 85.36% of the entire inventory. In Figure 8.4 an attempt is made to illustrate this trend in lithic distribution across the project area. The horizontal axis represents the number of artifact found on the site by ordinal classes,

Table 8.6.

Frequency of Lithic Artifact Types Per Site

AHRS Number	Unmodified Flakes (1)	Modified Flakes (2)	Scrapers (3)	Blades (4)	Micro-blades (5)	Burins (6)	Burin Spalls (7)	Bifaces (8)	Preforms (9)	Notched Points (10)	Stemmed Points (11)	Leaf-shaped Points (12)	Lanceolate Points (13)	Triangular Points (14)	Micro-blade Cores (15)	Micro-blade Tablets (16)	Blade Cores (17)	Rejuve-nation Flakes (18)	Flake Cores (19)	Hammer-stones (20)	Abraders (21)	Tci Thos (22)	Notched Pebbles (23)	Thermally Altered Rocks (24)	Ochre (25)	Cobbles (26)	Totals
TLM 016	155 0.12	2 0.61	1 1.43	-	-	-	-	2 1.32	-	-	-	-	-	-	-	-	-	-	5 7.69	-	-	-	1 50.00	-	-	3 1.80	169
TLM 017	894 0.68	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	894
TLM 018	3609 2.73	12 3.68	-	1 1.02	-	-	1 20.00	3 1.97	-	-	-	-	-	1 16.67	-	-	-	-	4 6.15	-	-	1 16.67	-	-	-	1 0.58	3633
TLM 021	854 0.65	8 2.45	-	-	-	-	-	1 0.66	1 5.56	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	864
TLM 022	1 0.00	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	55 1.84	-	9 5.50	65
TLM 024	4 0.00	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	4
TLM 025	15 0.01	1 0.31	-	-	2 0.56	-	-	1 0.66	-	-	-	-	-	-	1 50.00	2 100.00	-	-	-	1 9.09	-	-	-	-	1 0.07	-	24
TLM 026	3 0.00	-	1 1.43	-	-	-	-	1 0.66	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2 1.16	7
TLM 027	561 0.42	18 5.52	-	13 13.27	-	-	-	2 1.32	-	-	-	-	-	-	-	-	-	2 12.50	5 7.69	-	-	-	-	-	-	2 1.16	603
TLM 028	2 0.00	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2
TLM 029	761 0.58	-	1 1.43	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3 0.20	1 0.58	766
TLM 030	62492 47.33	31 9.51	11 15.71	3 3.06	-	-	-	41 26.97	1 5.56	23 53.44	1 20.00	-	1 5.56	-	-	-	-	3 18.75	7 10.77	3 27.27	-	-	-	1442 48.26	1391 93.54	75 43.35	65525
TLM 031	-	-	1 1.43	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1 0.58	2
TLM 032	6 0.00	1 0.31	2 2.86	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1 1.54	1 9.09	-	-	-	-	-	5 2.89	16
TLM 033	-	1 0.31	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1
TLM 034	18 0.01	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	18
TLM 035	2 0.00	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1 0.58	3
TLM 036	1 0.00	-	1 1.43	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2

Table 8.6. (Continued)

AHRS Number	Unmodified Flakes (1)	Modified Flakes (2)	Scrapers (3)	Blades (4)	Micro-blades (5)	Burins (6)	Burin Spalls (7)	Bifaces (8)	Preforms (9)	Notched Points (10)	Stemmed Points (11)	Leaf-shaped Points (12)	Lanceolate Points (13)	Triangular Points (14)	Micro-blade Cores (15)	Micro-blade Tablets (16)	Blade Cores (17)	Rejuve-nation Flakes (18)	Flake Cores (19)	Hammer-stones (20)	Abraders (21)	Tci Thos (22)	Notched Pebbles (23)	Thermally Altered Rocks (24)	Ochre (25)	Cobbles (26)	Totals
TLM 037	4 0.00	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	4
TLM 038	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	9 0.30	-	-	9
TLM 039	222 0.17	-	-	-	3 0.82	-	1 20.00	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1 0.03	1 0.07	-	288
TLM 040	611 0.46	1 0.31	3 4.29	55 56.12	-	-	-	-	-	-	-	-	1 5.56	-	-	-	-	-	4 6.15	1 9.09	-	-	-	1 0.03	1 0.07	1 0.58	679
TLM 041	1 0.00	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1
TLM 042	604 0.46	15 4.60	1 1.43	-	-	-	-	3 1.97	-	1 2.33	1 20.00	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	625
TLM 043	19 0.01	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	19 0.64	-	1 0.58	39
TLM 044	37 0.03	1 0.31	-	-	-	-	-	2 1.32	-	-	-	1 20.00	-	-	-	-	-	-	-	-	-	-	-	-	-	-	41
TLM 045	93 0.07	2 0.61	-	-	-	-	-	-	-	-	-	-	1 5.56	-	-	-	-	-	-	-	-	-	-	16 0.54	-	-	112
TLM 046	358 0.27	4 1.23	1 1.43	-	-	-	-	-	-	-	-	-	3 16.67	-	-	-	-	-	-	-	-	-	-	-	-	-	366
TLM 047	95 0.07	1 0.31	-	-	1 0.27	-	-	1 0.66	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	98
TLM 048	18 0.01	1 0.31	-	-	1 0.27	-	-	1 0.66	-	-	-	-	-	-	-	-	-	-	1 1.54	-	-	-	-	316 10.58	-	-	338
TLM 049	1 0.00	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1
TLM 050	11 0.01	1 0.31	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	147 4.92	-	-	159
TLM 051	4 0.00	1 0.31	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	5
TLM 052	42 0.03	-	-	-	-	-	-	1 0.66	1 5.56	-	-	-	1 5.56	-	-	-	-	-	-	-	-	-	-	-	-	1 0.58	46
TLM 053	3 0.00	4 1.23	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	7
TLM 054	2 0.00	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2

Table 8.6. (Continued)

AMS Number	Unmodified Flakes (1)	Modified Flakes (2)	Scrapers (3)	Blades (4)	Micro-blades (5)	Burins (6)	Burin Spalls (7)	Bifaces (8)	Preforms (9)	Notched Points (10)	Stemmed Points (11)	Leaf-shaped Points (12)	Lanceolate Points (13)	Triangular Points (14)	Micro-blade Cores (15)	Micro-blade Tablets (16)	Blade Cores (17)	Rejuve-nation Flakes (18)	Flake Cores (19)	Hammer-stones (20)	Abraders (21)	Tci Thos (22)	Notched Pebbles (23)	Thermally Altered Rocks (24)	Ochre (25)	Cobbles (26)	Totals
TLM 055	7 0.01	-	1 1.43	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	5 0.17	-	-	13
TLM 057	12 0.01	3 0.92	-	-	1 0.27	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	16
TLM 058	3 0.00	1 0.31	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	4
TLM 059	1 0.00	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	6 0.20	-	-	7
TLM 060	428 0.32	6 1.84	-	-	-	-	-	1 0.66	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	435
TLM 061	47 0.04	-	-	-	-	-	-	1 0.66	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	15 0.50	3 0.20	-	66
TLM 062	207 0.16	2 0.61	2 2.86	-	-	-	-	1 0.66	-	-	-	-	-	-	-	-	-	-	1 1.54	-	-	-	-	-	-	-	213
TLM 063	5 0.00	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	5
TLM 064	626 0.47	1 0.31	-	-	-	-	-	1 0.66	-	-	-	-	1 5.56	-	-	-	-	-	-	-	-	-	-	-	-	-	629
TLM 065	2 0.00	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	7 0.23	-	-	9
TLM 066	-	-	-	2 2.04	-	-	-	-	-	-	-	2 40.00	1 5.56	-	-	-	-	-	-	-	-	-	-	-	-	-	5
TLM 067	39 0.03	1 0.31	-	-	-	-	-	1 0.66	3 16.67	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2 1.16	46
TLM 068	2 0.00	3 0.92	1 1.43	-	-	-	-	-	-	-	-	1 20.00	-	-	-	-	-	-	-	-	-	-	-	-	-	-	7
TLM 069	1972 1.49	10 3.07	2 2.86	1 1.02	-	-	-	6 5.26	3 16.67	-	-	-	-	-	-	-	-	-	1 1.54	-	-	-	-	-	-	1 0.58	1994
TLM 070	5 0.00	-	1 1.43	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	6
TLM 073	49 0.04	-	-	-	-	-	-	1 0.66	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	50
TLM 074	1 0.00	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1
TLM 075	3 0.00	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1 6.25	-	-	-	-	-	-	-	-	4

Table 8.6. (Continued)

AHRS Number	Unmodified Flakes (1)	Modified Flakes (2)	Scrapers (3)	Blades (4)	Micro-blades (5)	Burins (6)	Burin Spalls (7)	Bifaces (8)	Preforms (9)	Notched Points (10)	Stemmed Points (11)	Leaf-shaped Points (12)	Lanceolate Points (13)	Triangular Points (14)	Micro-blade Cores (15)	Micro-blade Tablets (16)	Blade Cores (17)	Rejuve-nation Flakes (18)	Flake Cores (19)	Hammer-stones (20)	Abraders (21)	Tci Thos (22)	Notched Pebbles (23)	Thermally Altered Rocks (24)	Ochre (25)	Cobbles (26)	Totals
TLM 076	6 0.00	1 0.31	-	-	-	-	-	1 0.66	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	7 0.23	-	-	15
TLM 077	8 0.01	-	-	-	-	-	-	1 0.66	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	9
TLM 078	23 0.02	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	23
TLM C81	31 0.02	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	31
TLM C82	6 0.00	1 0.31	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	7
TLM C83	-	1 0.31	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1
TLM 084	183 0.14	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	183
TLM 085	69 0.05	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	69
TLM 086	1 0.00	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1
TLM 087	13 0.01	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	13
TLM 088	22 0.02	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	22
TLM 089	666 0.50	-	-	-	-	-	-	1 0.66	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	667
TLM 090	5 0.00	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	5
TLM 091	10 0.01	-	-	-	-	-	-	-	-	-	-	-	1 5.56	-	-	-	-	-	-	-	-	-	-	-	-	-	11
TLM 092	3 0.00	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3
TLM 093	103 0.08	1 0.31	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	104
TLM 094	28 0.02	-	-	-	-	-	-	2 1.32	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	30
TLM 095	72 0.05	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	72

Table 8.6. (Continued)

AHRS Number	Unmodified Flakes (1)	Modified Flakes (2)	Scrapers (3)	Blades (4)	Micro-blades (5)	Burins (6)	Burin Spalls (7)	Bifaces (8)	Preforms (9)	Notched Points (10)	Stemmed Points (11)	Leaf-shaped Points (12)	Lanceolate Points (13)	Triangular Points (14)	Micro-blade Cores (15)	Micro-blade Tablets (16)	Blade Cores (17)	Rejuve-nation Flakes (18)	Flake Cores (19)	Hammer-stones (20)	Abraders (21)	Tci Thos (22)	Notched Pebbles (23)	Thermally Altered Rocks (24)	Ochre (25)	Cobbles (26)	Totals
TLM 096	3 0.00	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3
TLM 097	2227 1.69	7 2.15	4 5.71	-	-	-	-	-	1 5.56	2 4.65	-	-	-	-	-	-	-	-	3 4.62	-	-	-	-	163 5.46	1 0.07	-	2408
TLM 098	2 0.00	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2
TLM 099	15 0.01	1 0.31	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	16
TLM 101	1 0.00	1 0.31	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2
TLM 102	6 0.00	2 0.61	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	8
TLM 103	6 0.00	-	-	-	-	-	-	1 0.66	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	7
TLM 105	61 0.05	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	61
TLM 106	-	-	-	-	-	-	-	1 0.66	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1
TLM 107	21 0.02	2 0.61	-	-	-	-	-	2 1.32	-	-	-	-	1 5.56	-	-	-	-	-	-	-	-	-	-	-	-	-	26
TLM 108	16 0.01	2 0.61	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	18
TLM 109	4 0.00	1 0.31	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	5
TLM 110	61 0.05	-	-	-	-	-	-	2 1.32	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	63
TLM 113	1 0.00	1 0.31	-	-	-	-	-	1 0.66	-	-	1 20.00	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	4
TLM 114	14 0.01	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	14
TLM 115	-	-	-	-	-	-	-	-	-	-	-	-	1 5.56	-	-	-	-	-	-	-	-	-	-	-	-	-	1
TLM 117	4 0.00	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	4
TLM 118	31 0.02	-	-	-	-	-	-	1 0.66	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	7 0.23	-	-	39

Table 8.6. (Continued)

AHRS Number	Unmodified Flakes (1)	Modified Flakes (2)	Scrapers (3)	Blades (4)	Micro-blades (5)	Burins (6)	Burin Spalls (7)	Bifaces (8)	Preforms (9)	Notched Points (10)	Stemmed Points (11)	Leaf-shaped Points (12)	Lanceolate Points (13)	Triangular Points (14)	Micro-blade Cores (15)	Micro-blade Tablets (16)	Blade Cores (17)	Rejuve-nation Flakes (18)	Flake Cores (19)	Hammer-stones (20)	Abraders (21)	Tci Thos (22)	Notched Pebbles (23)	Thermally Altered Rocks (24)	Ochre (25)	Cobbles (26)	Totals
TLM 119	20 0.02	2 0.61	-	-	-	-	-	1 0.66	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	23
TLM 120	23 0.02	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	23
TLM 121	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	8 0.27	-	-	8
TLM 122	1 0.00	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1
TLM 124	-	1 0.31	-	-	-	-	-	-	-	-	-	1 20.00	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2
TLM 125	3 0.00	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3
TLM 126	142 0.11	8 2.45	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	150
TLM 127	8 0.01	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	8
TLM 128	7849 5.94	18 5.52	3 4.29	1 1.02	-	-	-	10 6.58	3 16.67	-	-	-	-	5 83.33	-	-	-	-	2 3.08	-	-	-	-	-	-	-	7891
TLM 129	38 0.03	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	38
TLM 130	141 0.11	1 0.31	1 1.43	-	-	-	1 20.00	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	144
TLM 131	1 0.00	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1
TLM 132	1 0.00	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1
TLM 133	-	-	-	-	-	-	-	1 0.66	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1
TLM 134	-	3 0.92	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1 0.58	4
TLM 135	8 0.01	-	-	-	-	-	-	-	-	1 2.33	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	9
TLM 136	52 0.04	-	1 1.43	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	53
TLM 137	2 0.00	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2

Table 8.6. (Continued)

AHRS Number	Unmodified Flakes (1)	Modified Flakes (2)	Scrapers (3)	Blades (4)	Micro-blades (5)	Burins (6)	Burin Spalls (7)	Bifaces (8)	Preforms (9)	Notched Points (10)	Stemmed Points (11)	Leaf-shaped Points (12)	Lanceolate Points (13)	Triangular Points (14)	Micro-blade Cores (15)	Micro-blade Tablets (16)	Blade Cores (17)	Rejuve-nation Flakes (18)	Flake Cores (19)	Hammer-stones (20)	Abraders (21)	Tci Thos (22)	Notched Pebbles (23)	Thermally Altered Rocks (24)	Ochre (25)	Cobbles (26)	Totals
TLM 138	1 0.00	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1
TLM 139	93 0.07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	93
TLM 140	16 0.01	1 0.31	-	-	-	-	-	1 0.66	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	18
TLM 141	53 0.04	-	-	-	-	-	-	1 0.66	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	54
TLM 142	5 0.00	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	10 0.33	-	-	15
TLM 143	29060 22.01	54 16.56	11 15.71	-	-	-	-	20 13.16	-	12 27.91	-	-	-	-	-	-	-	-	1 1.54	-	1 100.00	-	-	375 12.55	78 5.25	4 2.31	29616
TLM 144	13 0.01	-	-	-	-	-	-	-	-	1 2.33	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	14
TLM 145	109 0.08	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	109
TLM 146	1 0.00	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1
TLM 147	-	1 0.31	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1
TLM 148	31 0.02	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	31
TLM 149	2 0.00	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2
TLM 150	8 0.01	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	8
TLM 151	13 0.01	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	13
TLM 152	1 0.00	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1
TLM 153	31 0.02	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	31
TLM 154	136 0.10	-	-	-	-	-	-	-	-	-	-	-	1 6.66	-	-	-	-	-	-	-	-	-	-	-	-	-	137
TLM 155	3 0.00	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3

Table 8.6. (Continued)

AHRS Number	Unmodified Flakes (1)	Modified Flakes (2)	Scrapers (3)	Blades (4)	Micro-blades (5)	Burins (6)	Burin Spalls (7)	Bifaces (8)	Preforms (9)	Notched Points (10)	Stemmed Points (11)	Leaf-shaped Points (12)	Lanceolate Points (13)	Triangular Points (14)	Micro-blade Cores (15)	Micro-blade Tablets (16)	Blade Cores (17)	Rejuve-nation Flakes (18)	Flake Cores (19)	Hammer-stones (20)	Abraders (21)	Tci Thos (22)	Notched Pebbles (23)	Thermally Altered Rocks (24)	Ochre (25)	Cobbles (26)	Totals
TLM 159	354 0.27	1 0.31	-	-	1 0.27	-	-	3 1.97	-	-	-	-	-	-	-	-	-	-	1 1.54	-	-	-	-	-	-	3 1.73	363
TLM 160	3 0.00	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3
TLM 164	3 0.00	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3
TLM 165	698 0.53	1 0.31	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1 1.54	-	-	-	-	-	-	-	700
TLM 166	13 0.01	1 0.31	-	-	-	-	-	-	1 5.56	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	15
TLM 167	-	1 0.31	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1
TLM 168	-	1 0.31	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1
TLM 169	68 0.05	-	2 2.86	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	70
TLM 170	25 0.02	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2 3.08	-	-	-	-	-	-	-	27
TLM 171	14 0.01	-	-	-	1 0.27	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	15
TLM 172	5 0.00	1 0.31	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	6
TLM 173	37 0.03	2 0.61	-	1 1.02	-	-	-	1 0.66	-	-	-	-	-	-	-	-	-	-	-	1 9.09	-	-	-	-	-	-	42
TLM 174	22 0.02	-	-	-	-	-	-	1 0.66	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	23
TLM 175	59 0.04	-	-	-	-	-	-	1 0.66	-	-	-	-	1 5.56	-	-	-	-	-	1 1.54	-	-	-	-	22 0.74	-	-	84
TLM 176	2 0.00	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2
TLM 179	2 0.00	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2
TLM 180	1377 1.04	9 2.76	-	9 9.18	-	-	-	-	-	-	-	-	-	-	-	-	3 100.00	3 18.75	-	-	-	-	-	-	-	-	1401
TLM 181	1 0.00	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1

Table 8.6. (Continued)

AHRS Number	Unmodified Flakes (1)	Modified Flakes (2)	Scrapers (3)	Blades (4)	Micro-blades (5)	Burins (6)	Burin Spalls (7)	Bifaces (8)	Preforms (9)	Notched Points (10)	Stemmed Points (11)	Leaf-shaped Points (12)	Lanceolate Points (13)	Triangular Points (14)	Micro-blade Cores (15)	Micro-blade Tablets (16)	Blade Cores (17)	Rejuve-nation Flakes (18)	Flake Cores (19)	Hammer-stones (20)	Abraders (21)	Tci Thos (22)	Notched Pebbles (23)	Thermally Altered Rocks (24)	Ochre (25)	Cobbles (26)	Totals
TLM 182	4 0.00	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	4
TLM 183	4 0.00	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	4
TLM 184	3115 2.36	15 4.60	4 5.71	2 2.04	-	-	-	4 2.63	1 5.56	1 2.33	-	-	-	-	-	-	-	2 12.50	2 3.08	1 9.09	-	-	-	3 0.10	7 0.47	-	3157
TLM 185	6 0.00	-	-	-	-	-	-	-	-	-	1 20.00	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	7
TLM 186	4 0.00	-	-	-	-	-	-	1 0.66	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	5
TLM 187	9 0.01	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	9
TLM 188	2 0.00	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2
TLM 189	8 0.01	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	8
TLM 190	11 0.01	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	11
TLM 191	1 0.00	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1
TLM 192	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1 0.58	1
TLM 193	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2 1.16	2
TLM 194	18 0.01	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	18
TLM 195	3 0.00	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3
TLM 197	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1 1.54	-	-	-	-	-	-	-	1
TLM 198	-	1 0.31	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1
TLM 199	579 0.44	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	579
TLM 200	1 0.00	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1

Table 8.6. (Continued)

AHRS Number	Unmodified Flakes (1)	Modified Flakes (2)	Scrapers (3)	Blades (4)	Micro-blades (5)	Burins (6)	Burin Spalls (7)	Bifaces (8)	Preforms (9)	Notched Points (10)	Stemmed Points (11)	Leaf-shaped Points (12)	Lanceolate Points (13)	Triangular Points (14)	Micro-blade Cores (15)	Micro-blade Tablets (16)	Blade Cores (17)	Rejuve-nation Flakes (18)	Flake Cores (19)	Hammer-stones (20)	Abraders (21)	Tci Thos (22)	Notched Pebbles (23)	Thermally Altered Rocks (24)	Ochre (25)	Cobbles (26)	Totals
TLM 201	207 0.16	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	207
TLM 202	1 0.00	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1
TLM 203	53 0.04	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	53
TLM 205	-	-	1 1.43	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1
TLM 206	224 0.17	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	224
TLM 207	689 0.52	-	1 1.43	-	354 97.25	-	-	-	-	-	-	-	-	-	1 50.00	-	-	4 25.00	-	-	-	-	-	-	-	24 13.87	1073
TLM 208	16 0.01	2 0.61	6 8.57	-	-	-	-	3 1.97	1 5.56	-	-	-	1 5.56	-	-	-	-	-	2 3.08	-	-	-	-	-	-	-	31
TLM 209	297 0.22	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	297
TLM 210	2 0.00	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2
TLM 211	22 0.02	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	22
TLM 213	1 0.00	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1
TLM 214	74 0.06	2 0.61	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	76
TLM 215	56 0.04	1 0.31	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	57
TLM 216	552 0.42	2 0.61	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1 0.58	555
TLM 217	5455 4.13	3 0.92	-	-	-	-	-	4 2.63	1 5.56	-	-	-	3 16.67	-	-	-	-	-	-	-	-	-	-	-	-	-	5466
TLM 218	1 0.00	-	-	-	-	-	-	1 0.66	-	-	-	-	-	-	-	-	-	-	2 3.08	-	-	-	-	-	-	-	4
TLM 219	1 0.00	-	1 1.43	-	-	1 100.00	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3
TLM 220	131 0.10	2 0.61	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3 16.67	-	1 0.03	-	1 0.58	136

Table 8.6. (Continued)

AHRS Number	Unmodified Flakes (1)	Modified Flakes (2)	Scrapers (3)	Blades (4)	Micro-blades (5)	Burins (6)	Burin Spalls (7)	Bifaces (8)	Preforms (9)	Notched Points (10)	Stemmed Points (11)	Leaf-shaped Points (12)	Lanceolate Points (13)	Triangular Points (14)	Micro-blade Cores (15)	Micro-blade Tablets (16)	Blade Cores (17)	Rejuvenation Flakes (18)	Flake Cores (19)	Hammer-stones (20)	Abraders (21)	Tci Thos (22)	Notched Pebbles (23)	Thermally Altered Rocks (24)	Ochre (25)	Cobbles (26)	Totals
TLM 221	1 0.00	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	216 7.23	-	-	217
TLM 222	1 0.00	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	44 1.47	-	1 0.58	46
TLM 223	32 0.02	-	-	-	-	-	-	1 0.68	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	33
TLM 224	2 0.00	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2
TLM 225	66 0.05	1 0.31	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2 0.13	-	69
TLM 226	22 0.02	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1 16.67	-	-	-	-	23
TLM 228	3 0.00	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3
TLM 229	120 0.09	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1 0.58	121
TLM 230	85 0.06	10 3.07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1 6.25	1 1.54	1 9.09	-	-	1 50.00	-	-	1 0.58	100
TLM 231	1 0.00	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1 0.58	2
TLM 232	7 0.01	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1 9.09	-	3 50.00	-	-	-	1 0.58	12
TLM 234	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	11 0.37	-	-	11
TLM 235	180 0.14	-	-	-	-	-	-	1 0.66	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	5 0.17	-	2 1.16	188
TLM 236	33 0.02	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	33
TLM 237	1 0.00	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1
TLM 238	12 0.01	2 0.61	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	14
TLM 241	32 0.02	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	32
TLM 242	3 0.00	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3

Table 8.6. (Continued)

AHRS Number	Unmodified Flakes (1)	Modified Flakes (2)	Scrapers (3)	Blades (4)	Micro-blades (5)	Burins (6)	Burin Spalls (7)	Bifaces (8)	Preforms (9)	Notched Points (10)	Stemmed Points (11)	Leaf-shaped Points (12)	Lanceolate Points (13)	Triangular Points (14)	Micro-blade Cores (15)	Micro-blade Tablets (16)	Blade. Cores (17)	Rejuve-nation Flakes (18)	Flake Cores (19)	Hammer-stones (20)	Abraders (21)	Tci Thos (22)	Notched Pebbles (23)	Thermally Altered Rocks (24)	Ochre (25)	Cobbles (26)	Totals
TLM 243	1 0.00	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1
TLM 245	4 0.00	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	4
TLM 246	11 0.01	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	11
TLM 247	8 0.01	1 0.31	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1 9.09	-	-	-	4 0.13	-	1 0.58	15
TLM 249	-	1 0.31	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	49 1.64	-	-	50
TLM 250	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1 0.03	-	-	1
TLM 251	94 0.07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1 0.58	95
TLM 252	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2 1.16	2
TLM 253	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	22 0.74	-	-	22
TLM 259	15 0.01	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	9 13.85	-	-	-	-	-	-	7 4.05	31
HEA 174	7 0.01	4 1.23	4 5.71	1 1.02	-	-	-	-	1 5.56	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	17
HEA 175	396 0.30	4 1.23	-	5 5.10	-	-	-	6 3.95	-	1 2.33	1 20.00	-	-	-	-	-	-	-	4 6.15	-	-	-	-	-	-	1 0.58	418
HEA 176	17 0.01	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1 0.03	-	-	18
HEA 177	49 0.04	-	-	-	-	-	1 20.00	-	-	-	-	-	-	-	-	-	-	-	2 3.03	-	-	-	-	-	-	1 0.58	53
HEA 178	38 0.03	1 0.31	-	1 1.02	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1 1.54	-	-	-	-	-	-	-	41
HEA 179	1 0.00	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1
HEA 180	22 0.02	8 2.45	-	3 3.06	-	-	1 20.00	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	34
HEA 181	9 0.01	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	9

Table 8.6. (Continued)

AHRS Number	Unmodified Flakes (1)	Modified Flakes (2)	Scrapers (3)	Blades (4)	Micro-blades (5)	Burins (6)	Burin Spalls (7)	Bifaces (8)	Preforms (9)	Notched Points (10)	Stemmed Points (11)	Leaf-shaped Points (12)	Lanceolate Points (13)	Triangular Points (14)	Micro-blade Cores (15)	Micro-blade Tablets (16)	Blade Cores (17)	Rejuvenation Flakes (18)	Flake Cores (19)	Hammer-stones (20)	Abraders (21)	Tci Thos (22)	Notched Pebbles (23)	Thermally Altered Rocks (24)	Ochre (25)	Cobbles (26)	Totals
HEA 182	2 0.00	-	-	-	-	-	-	1 0.68	-	1 2.33	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	4
HEA 183	1 0.00	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1
HEA 184	-	2 0.61	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2
HEA 185	5 0.00	1 0.31	1 1.43	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1 1.54	-	-	-	-	-	-	-	8
HEA 186	10 0.01	3 0.92	-	-	-	-	-	4 2.63	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	17
HEA 210	1 0.00	1 0.31	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2
HEA 211	6 0.00	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	6

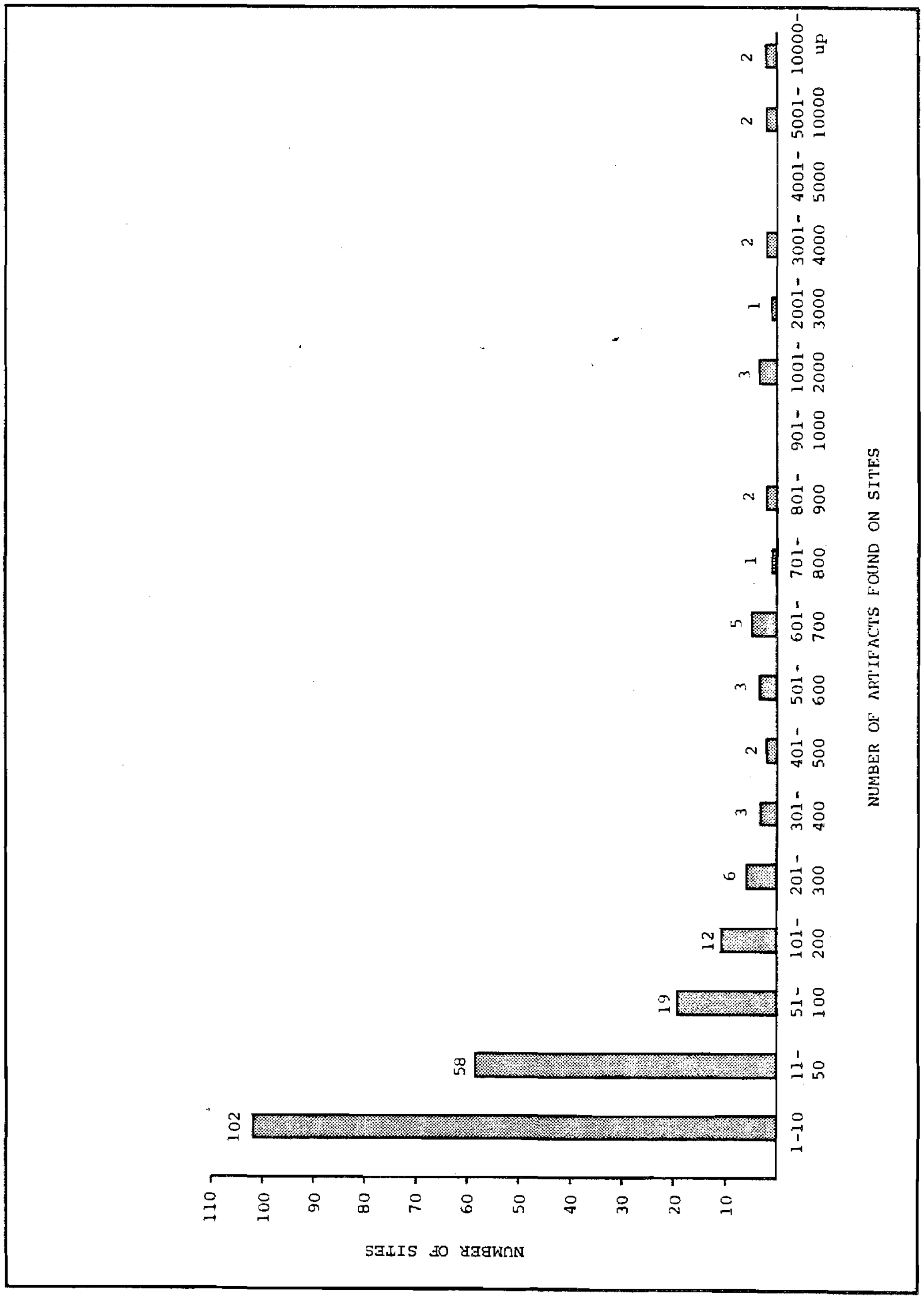

Figure 8.4. Number of Sites by Number of Artifacts Recovered From Individual Sites

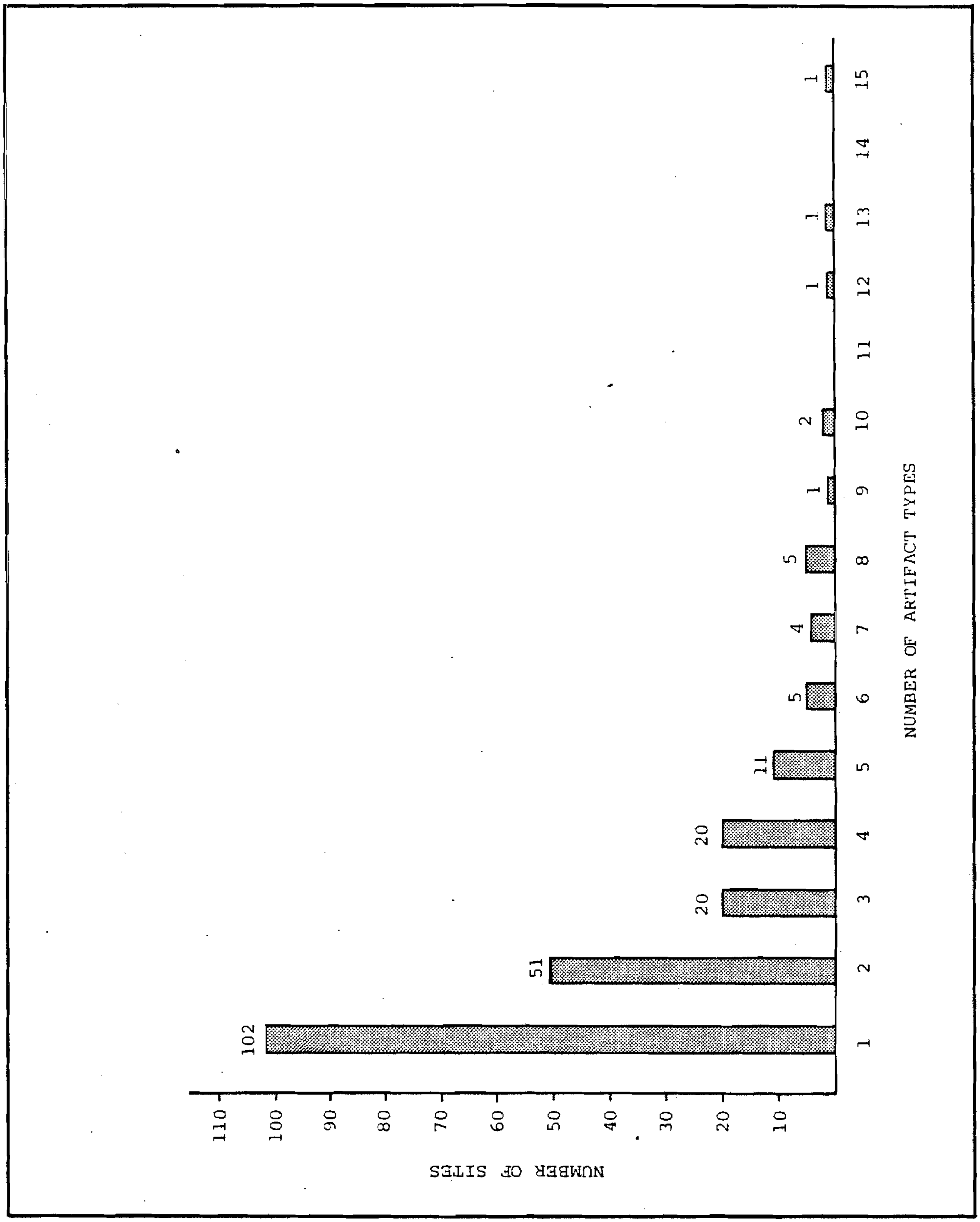

Figure 8.5. Number of Sites by Number of Artifact Types Found on Individual Sites

ranging from 1-10 through over 10,000 artifacts. As illustrated in the figure, 102 of the sites (45.74%) produced only 1-10 artifacts, while only 2 (TLM 030 and TLM 143) produced over 10,000. By combining the first three ordinal classes, it is apparent that the majority of the sites, 179 or 80.27%, yielded 100 or fewer artifacts.

Table 8.6 also presents data which indicates that sites with large samples have correspondingly high degrees of artifact variability. Six of the sites with assemblages exceeding 2,000 specimens (TLM 030, TLM 143, TLM 128, TLM 018, TLM 184, and TLM 097) have each produced eight or more different artifact types. This trend is to be expected as an increase in assemblage size is likely to be accompanied by an increase in the diversity of artifact types. A different pattern is found at a few sites, i.e., TLM 025 and TLM 208 which have a good deal of artifact variability (seven or eight different types) despite small sample sizes. At the opposite end of the spectrum are the majority of sites with small assemblages and few artifact types. Of the 179 sites with 100 artifacts or less, 95 produced only one artifact type, and 43 produced only two types. This point is best illustrated by comparing the bar graph curves in Figure 8.4 and 8.5. The latter illustrates the range in number of sites by number of artifact types. Similar curves showing a progressive decrease in number of sites as individual site assemblages become larger and as they become more diverse is apparent in comparison of the figures.

Clustering of certain artifact types is also apparent in the data presented in Table 8.6. The highest occurrence of blades was found at TLM 040 (55 specimens or 56.12% of the total), while the vast majority of microblades were recovered from TLM 207 (354 specimens or 97.25% of the total). Blade cores (3) were found exclusively at TLM 180, and triangular points were found in greatest abundance at TLM 128 (5 specimens or 83.33% of the total). Included in the extensive collection from TLM 030 were the majority of notched points (53.44%) and ochre (93.54%), and close to half of the unmodified flakes (47.33%) and thermally altered rock (48.26%) in the project area.

(ii) Artifact Density by Site

An important factor to consider in attempting to find patterns in the lithic data presented above involves intensity of site testing. Sites that were survey level tested are included with systematically tested sites in the data set, and thus the frequency of artifacts recovered may be biased because of these different testing levels. In other words, sites which produced large assemblages may have been subjected to more intensive testing than those which produced small assemblages. Computing artifact densities, or frequencies of artifacts per unit of excavated area, is one method of assessing different testing levels. In Table 8.7 the density figure for each site was derived by dividing the total number of artifacts recovered from the site by the total area (in m^2) that was excavated. Only sites with subsurface lithic material are included in this table. For the 153 sites that received survey level testing, the mean area of excavation is equivalent to 1.76 m^2 and the artifact density to 73.59 artifacts per m^2. The remaining 62 sites that were systematically tested (indicated by asterisks on Table 8.7) have a mean excavation area of 7.10 m^2 and a mean artifact density of 158.32. These figures indicate that by increasing the area of excavation the artifact density of the site may also be increased.

Testing intensity is not, however, the only factor responsible for creating the differences in observed densities recorded on Table 8.7. Density is also related to prehistoric occupation and/or use of a site. Certain sites exhibit high artifact densities regardless of level or intensity of testing, and in these cases the densities probably do reflect a greater occupation or use of the site in prehistoric times. This point is illustrated in Table 8.8 which compares the amount of area excavated and artifact density at 13 sites with densities greater than 300 artifacts per m^2. The sites are arranged in order of total excavated area, ranging from .16 - 29.24 m^2. At these sites, seven of which were systematically tested and six survey level tested, artifact density appears to be unrelated to the amount of excavated area at the site.

Table 8.7.

Area Excavated and Artifact Density per Square Meter by Site

AHRS Number	Survey Shovel Tests (.07m²)	Test Pits (.16m²)	Grid Shovel Tests (.07m²)	Test Squares (1.0m²)	Excavated Area in Square Meters	Artifact Density Per Square Meter
TLM 016*	4	5	44	4	8.16	20.71
TLM 017*	8	1	16	1	2.84	314.79
TLM 018*	0	0	70	3	7.90	459.87
TLM 021	0	6	0	0	0.96	900.00
TLM 022*	9	1	17	5	6.98	9.32
TLM 024	3	2	13	0	1.44	2.77
TLM 025	0	3	0	0	0.48	50.00
TLM 026	92	3	34	0	9.30	0.76
TLM 027*	0	3	40	3	6.28	96.01
TLM 028	1	3	0	0	0.55	4.41
TLM 029*	0	4	34	1	4.02	190.56
TLM 030*	4	8	224	12	29.24	2240.94
TLM 031	1	2	0	0	0.39	5.13
TLM 032	0	1	0	0	0.16	100.00
TLM 033*	5	3	16	6	7.95	0.13
TLM 034*	0	1	17	1	2.35	7.66
TLM 035	0	3	0	0	0.48	6.25
TLM 036	0	1	0	0	0.16	12.50
TLM 037	0	1	0	0	0.16	25.00
TLM 038*	4	2	0	5	5.60	1.61
TLM 039*	0	3	64	3	7.96	28.66
TLM 040*	11	2	122	6	15.63	43.44
TLM 041	0	2	0	0	0.32	3.13

Table 8.7. (Continued)

AHRS Number	Survey Shovel Tests (.07m²)	Test Pits (.16m²)	Grid Shovel Tests (.07m²)	Test Squares (1.0m²)	Excavated Area in Square Meters	Artifact Density Per Square Meter
TLM 042*	4	5	36	11	14.60	46.98
TLM 043*	11	3	27	6	9.14	4.27
TLM 044	0	1	0	0	0.16	256.25
TLM 045	0	1	0	0	0.16	700.00
TLM 046*	0	3	0	5	5.48	66.78
TLM 047	0	2	0	0	0.32	306.25
TLM 048*	3	2	29	5	7.56	44.70
TLM 049	0	4	0	0	0.64	1.56
TLM 050*	5	3	20	6	8.23	19.31
TLM 051	0	5	0	0	0.80	6.25
TLM 052	0	1	0	0	0.16	275.00
TLM 053	0	1	0	0	0.16	37.50
TLM 054	0	2	16	0	1.44	1.39
TLM 055*	8	1	16	1	2.84	4.58
TLM 057	5	1	0	0	0.51	31.37
TLM 058*	6	2	26	1	3.56	1.12
TLM 059*	0	3	24	3	5.16	1.35
TLM 060*	8	3	70	1	6.94	62.68
TLM 061*	8	1	29	1	3.75	17.61
TLM 062*	6	2	80	6	12.34	17.26
TLM 063*	13	2	23	1	3.84	1.30
TLM 064*	3	2	27	1	3.42	112.70
TLM 065*	7	2	282	4	24.55	0.15
TLM 066	1	1	0	0	0.23	21.74
TLM 067	0	2	0	0	0.32	143.76

Table 8.7. (Continued)

AHRS Number	Survey Shovel Tests (.07m²)	Test Pits (.16m²)	Grid Shovel Tests (.07m²)	Test Squares (1.0m²)	Excavated Area in Square Meters	Artifact Density Per Square Meter
TLM 068	0	1	0	0	0.16	43.75
TLM 069*	2	3	0	6	6.62	301.81
TLM 070	0	1	0	0	0.16	37.50
TLM 073*	10	2	16	1	3.14	15.92
TLM 074	7	2	0	0	0.81	1.23
TLM 075	7	2	32	0	3.05	1.37
TLM 076	0	4	0	0	0.64	18.75
TLM 077*	5	1	46	1	4.73	1.90
TLM 078	0	2	41	0	3.19	7.21
TLM 081	0	1	17	0	1.35	22.96
TLM 082	0	2	0	0	0.32	21.86
TLM 083	1	1	16	0	1.35	0.74
TLM 084	4	2	27	0	2.49	73.49
TLM 085	2	2	16	0	1.58	43.67
TLM 086	1	1	11	0	1.00	1.00
TLM 087	0	2	40	0	3.12	4.17
TLM 088	0	2	15	0	1.37	16.06
TLM 089	0	1	0	0	0.16	4168.75
TLM 090	7	1	0	0	0.65	7.69
TLM 091	0	1	0	0	0.16	62.50
TLM 092	0	1	0	0	0.16	18.75
TLM 093	8	1	0	0	0.72	144.44
TLM 094	0	1	21	0	1.63	18.41
TLM 095	8	2	32	0	3.12	23.53
TLM 096	62	0	160	0	15.54	0.19

Table 8.7. (Continued)

AHRS Number	Survey Shovel Tests (.07m²)	Test Pits (.16m²)	Grid Shovel Tests (.07m²)	Test Squares (1.0m²)	Excavated Area in Square Meters	Artifact Density Per Square Meter
TLM 097*	10	2	108	8	16.58	145.23
TLM 098	0	1	0	0	0.16	12.50
TLM 099	0	2	0	0	0.32	50.00
TLM 101	0	1	20	0	1.56	1.28
TLM 102*	1	1	16	1	2.35	3.41
TLM 103	0	1	21	0	1.63	4.29
TLM 105	1	1	0	0	0.23	265.21
TLM 106	0	1	16	0	1.28	0.78
TLM 107	0	1	52	0	3.80	6.84
TLM 108	0	1	80	0	5.76	3.12
TLM 109	2	1	37	0	2.89	1.73
TLM 110	0	1	50	0	3.66	17.21
TLM 113	0	1	16	0	1.28	3.13
TLM 114	3	1	34	0	2.75	5.09
TLM 115*	5	1	24	1	3.19	0.31
TLM 117	0	1	0	0	0.16	25.00
TLM 118	9	1	0	0	0.79	49.37
TLM 119*	0	2	57	1	5.31	4.32
TLM 120	6	1	0	0	0.58	39.66
TLM 121	2	1	0	0	0.30	26.67
TLM 122	7	1	0	0	0.65	1.54
TLM 124	16	1	0	0	1.28	1.56
TLM 125	7	1	0	0	0.65	4.62
TLM 126*	0	1	28	1	3.12	48.08
TLM 127	10	1	0	0	0.86	9.30

Table 8.7. (Continued)

AHRS Number	Survey Shovel Tests ($.07m^2$)	Test Pits ($.16m^2$)	Grid Shovel Tests ($.07m^2$)	Test Squares ($1.0m^2$)	Excavated Area in Square Meters	Artifact Density Per Square Meter
TLM 128*	5	1	0	8	8.51	927.29
TLM 129	27	1	0	0	2.05	11.18
TLM 130*	1	1	0	4	4.23	34.50
TLM 131	0	1	0	0	0.16	6.25
TLM 132	13	0	0	0	0.91	1.10
TLM 133	12	1	0	0	1.00	1.00
TLM 134	7	1	0	0	0.65	6.15
TLM 135	5	1	0	0	0.51	17.65
TLM 136	0	1	0	0	0.16	331.25
TLM 137	10	1	15	0	1.91	1.05
TLM 138	5	1	0	0	0.51	1.96
TLM 139	0	1	0	0	0.16	581.25
TLM 140	8	1	0	0	0.72	25.00
TLM 141	7	1	0	0	0.65	83.08
TLM 142	5	1	0	0	0.51	29.41
TLM 143*	0	1	142	5	15.10	1961.32
TLM 144	5	1	0	0	0.51	27.45
TLM 145	3	1	0	0	0.37	294.60
TLM 146	6	1	0	0	0.58	1.72
TLM 147	4	1	0	0	0.44	2.27
TLM 148	7	1	0	0	0.65	47.69
TLM 149	3	1	0	0	0.37	5.41
TLM 150	8	1	0	0	0.72	11.11
TLM 151	0	1	0	0	0.16	81.25
TLM 152	5	1	0	0	0.51	1.96

Table 8.7. (Continued)

AHRS Number	Survey Shovel Tests (.07m²)	Test Pits (.16m²)	Grid Shovel Tests (.07m²)	Test Squares (1.0m²)	Excavated Area in Square Meters	Artifact Density Per Square Meter
TLM 153	5	2	27	0	2.56	12.11
TLM 154	6	1	0	0	0.58	236.20
TLM 155	6	1	0	0	0.58	5.17
TLM 159*	4	1	0	1	1.44	252.08
TLM 160	6	1	0	0	0.58	5.17
TLM 164	5	1	0	0	0.51	5.88
TLM 165	6	1	30	0	2.68	261.19
TLM 166	8	1	47	0	4.01	3.74
TLM 167	16	1	13	0	2.19	0.46
TLM 168	8	1	0	0	0.72	1.39
TLM 169*	8	1	52	1	5.36	13.07
TLM 170	10	1	0	0	0.86	31.40
TLM 171*	10	1	16	1	2.98	5.04
TLM 172	10	1	15	0	1.91	3.14
TLM 173*	9	3	98	1	8.97	3.27
TLM 174*	8	1	16	1	2.84	8.09
TLM 175*	4	1	25	3	5.19	16.17
TLM 176	8	1	16	0	1.84	1.09
TLM 179	4	1	0	0	0.44	4.55
TLM 180*	9	1	0	5	5.79	241.97
TLM 181	6	1	0	0	0.58	1.72
TLM 182*	19	2	24	1	4.33	0.92
TLM 184*	7	4	90	13	20.43	154.52
TLM 185	14	2	0	0	1.30	5.87
TLM 186	4	1	0	0	0.44	11.36

Table 8.7. (Continued)

AHRS Number	Survey Shovel Tests (.07m²)	Test Pits (.16m²)	Grid Shovel Tests (.07m²)	Test Squares (1.0m²)	Excavated Area in Square Meters	Artifact Density Per Square Meter
TLM 187	14	1	0	0	1.14	7.90
TLM 188	6	1	13	0	1.49	1.34
TLM 189	8	2	0	0	0.88	9.10
TLM 190	1	1	0	0	0.23	47.82
TLM 191	8	1	0	0	0.72	1.39
TLM 192	6	1	0	0	0.58	1.72
TLM 193	9	1	0	0	0.79	2.53
TLM 194*	23	1	16	1	3.89	4.63
TLM 195	8	1	0	0	0.72	4.17
TLM 197	10	1	0	0	0.86	1.16
TLM 198	6	1	0	0	0.58	1.72
TLM 199*	7	1	27	1	3.54	163.55
TLM 200*	15	1	16	1	3.33	0.30
TLM 201	4	2	27	0	2.49	83.12
TLM 202	9	1	16	0	1.91	0.52
TLM 203	5	2	48	0	4.03	13.15
TLM 205	8	1	0	0	0.72	1.39
TLM 206*	10	1	16	1	2.98	75.18
TLM 207*	5	2	20	2	4.07	263.41
TLM 209	5	1	32	0	2.75	108.00
TLM 210	9	1	16	0	1.91	1.04
TLM 211	8	1	16	0	1.84	11.96
TLM 213	8	1	16	0	1.84	0.54
TLM 214	0	1	31	0	2.33	35.77
TLM 215*	25	0	4	4	6.03	9.47

Table 8.7. (Continued)

AHRS Number	Survey Shovel Tests (.07m²)	Test Pits (.16m²)	Grid Shovel Tests (.07m²)	Test Squares (1.0m²)	Excavated Area in Square Meters	Artifact Density Per Square Meter
TLM 216*	0	1	25	3	4.91	113.04
TLM 217*	0	1	30	3	5.26	1039.15
TLM 218	21	2	0	0	1.79	2.32
TLM 219	5	1	0	0	0.51	5.88
TLM 220*	0	0	78	3	8.46	16.07
TLM 221*	0	1	56	1	5.08	42.72
TLM 222	4	2	334	0	23.98	1.31
TLM 223	13	1	41	0	3.94	8.37
TLM 224	13	1	25	0	2.82	0.70
TLM 225*	8	1	35	1	4.17	16.55
TLM 226*	61	2	217	3	22.78	0.73
TLM 228	0	1	16	0	1.28	2.34
TLM 229*	2	1	41	1	4.17	29.02
TLM 230*	1	1	73	1	6.34	15.78
TLM 231	0	1	34	0	2.54	0.79
TLM 232	9	0	252	0	18.27	0.66
TLM 234	2	1	132	0	9.54	1.23
TLM 235	25	3	90	0	8.53	22.69
TLM 236	13	1	44	0	4.15	7.95
TLM 237	5	1	16	0	1.63	0.61
TLM 239	2	1	23	0	1.91	7.33
TLM 241	1	1	16	0	1.35	23.70
TLM 242	3	1	57	0	4.36	0.69
TLM 243	0	1	16	0	1.28	0.78
TLM 245	2	1	0	0	0.30	13.34

Table 8.7. (Continued)

AHRS Number	Survey Shovel Tests (.07m²)	Test Pits (.16m²)	Grid Shovel Tests (.07m²)	Test Squares (1.0m²)	Excavated Area in Square Meters	Artifact Density Per Square Meter
TLM 246	0	1	16	0	1.28	8.59
TLM 247	0	1	144	0	10.24	1.22
TLM 249	0	2	50	0	3.82	10.04
TLM 251*	0	0	31	1	3.17	29.97
TLM 252	0	1	14	0	1.14	1.75
TLM 253	0	1	13	0	1.07	20.56
TLM 259	2	0	0	0	0.14	221.42
HEA 174	0	1	0	0	0.16	106.25
HEA 175*	6	2	0	5	5.74	42.57
HEA 176	0	1	0	0	0.16	93.75
HEA 177	0	1	0	0	0.16	25.00
HEA 178	0	1	0	0	0.16	206.25
HEA 180	0	1	0	0	0.16	212.50
HEA 181	3	1	35	0	2.82	3.19
HEA 182	0	1	16	0	1.28	3.13
HEA 186	0	1	0	0	0.16	106.25
HEA 211	8	1	16	0	1.84	3.26

* Systematically tested sites.

Table 8.8.

Comparison of Area Excavated and Artifact Density at Sites with Densities Greater than 300 Artifacts per m²

Site	Total Area Excavated	Total Number of Artifacts	Density of Artifacts per Square Meter
TLM 089	.16	667	4168.75
TLM 045	.16	112	700.00
TLM 139	.16	93	581.25
TLM 136	.16	53	331.85
TLM 047	.32	98	306.25
TLM 021	.96	864	900.00
TLM 017*	2.84	894	315.79
TLM 217*	5.26	5466	1039.50
TLM 069*	6.62	1998	301.81
TLM 018*	7.90	3,633	459.87
TLM 128*	8.51	7,891	927.29
TLM 143*	15.10	29,616	1961.32
TLM 030*	29.24	65,525	2240.94

* Systematically tested sites.

The number of sites in several artifact density classes is presented in Figure 8.6. At the high end of the spectrum are the sites listed in Table 8.8 with artifact densities greater than 300. However, the majority of sites, 168 or 78.14%, have observed densities of less than 50 artifacts per m^2. The curve in Figure 8.6, showing a decrease in number of sites as artifact density increases, is comparable to those previously discussed for Figures 8.4 and 8.5, which indicate a similar decrease in number of sites as sample size and artifact variability increase.

(iii) Frequency of Raw Material Type by Site

The total number of lithic material types found at each site is listed in Table 8.9 by count and percentage. The percentages represent the proportion of artifacts manufactured from the total population of artifacts of each material type. For example, TLM 016 contains 0.02% of the argillite specimens found in the project area. The percentage that each material type contributed to the entire assemblage and the number of sites at which each is represented are listed at the end of Table 8.9. As previously discussed, basalt is the most frequent and widespread of the material types, found at 150 sites in the project area. Basalt is by far the best represented material at TLM 030, where it dominates the extensive lithic assemblage (56,655 of the 65,525 artifacts are basalt). Basalt and argillite are roughly equal in importance at TLM 143, which has the second largest site assemblage, while argillite predominates at TLM 128 (6989 of the 7891 artifacts are argillite).

In proportion to its rather small contribution to the entire assemblage, chert (4.71%) is quite widely distributed, being found at 131 sites. Three of the sites which have yielded almost half (49.66%) of the chert specimens are TLM 030, TLM 184, and TLM 207. At TLM 207, 350 of the chert artifacts are microblades. This large sample of chert microblades at one site is a biasing factor in the apparent preference for chert in flaked stone tool production. However, even if these 350 specimens are removed from the sample, chert still contributes 21.97% of the total

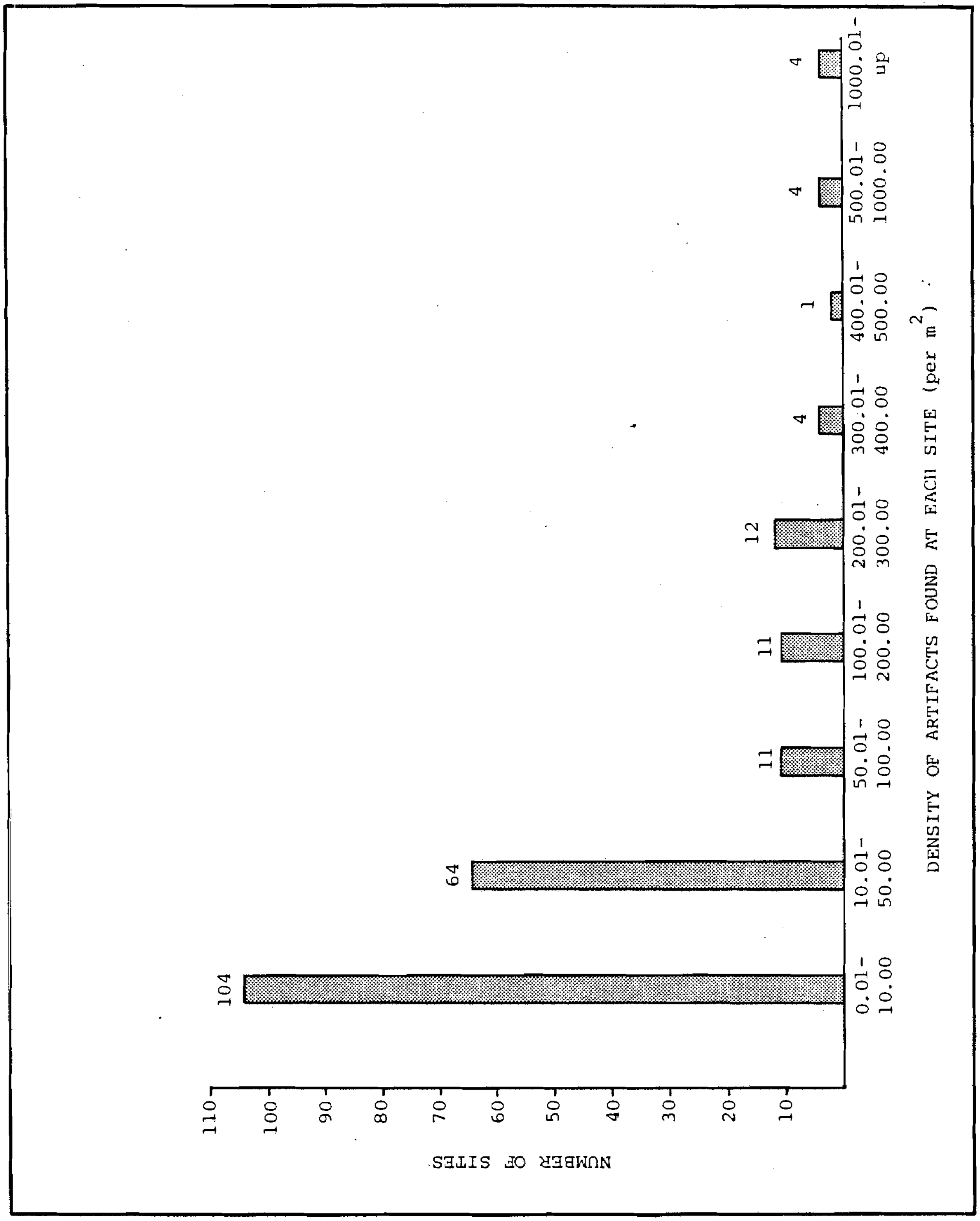

Figure 8.6. Number of Sites by Artifact Density Classes Per Individual Sites

Table 8.9.

Lithic Raw material Type by Site

AHRS Number	Argillite (1)	Basalt (2)	Chalcedony (3)	Chert (4)	Obsidian (5)	Quartz (6)	Quartzite (7)	Rhyolite (8)	Other (9)	Totals
TLM 016	8 0.02	151 0.18	4 0.75	2 0.03	-	-	-	-	4 0.08	169
TLM 017	-	894 1.07	-	-	-	-	-	-	-	894
TLM 018	2263 5.79	1187 1.42	2 0.38	79 1.22	6 1.58	-	1 0.19	94 3.59	1 0.02	3633
TLM 021	823 2.11	4 0.00	-	35 0.54	-	-	2 0.39	-	-	864
TLM 022	-	-	-	-	-	1 1.11	-	-	64 1.39	65
TLM 024	-	4 0.00	-	-	-	-	-	-	-	4
TLM 025	8 0.02	6 0.01	1 0.19	5 0.08	2 0.53	-	-	-	2 0.04	24
TLM 026	1 0.00	1 0.00	-	3 0.05	-	-	-	-	2 0.04	7
TLM 027	333 0.85	217 0.26	17 3.20	32 0.49	1 0.26	-	-	1 0.04	2 0.04	603
TLM 028	1 0.00	1 0.00	-	-	-	-	-	-	-	2
TLM 029	-	750 0.90	-	12 0.18	-	-	1 0.19	-	3 0.07	766
TLM 030	4357 11.16	56655 67.75	262 49.34	905 13.92	39 10.29	3 3.33	52 10.10	377 14.39	2875 62.77	65525
TLM 031	-	-	-	2 0.03	-	-	-	-	-	2
TLM 032	5 0.01	2 0.00	1 0.19	2 0.03	-	-	-	-	6 0.13	16
TLM 033	-	-	-	1 0.02	-	-	-	-	-	1
TLM 034	18 0.05	-	-	-	-	-	-	-	-	18
TLM 035	1 0.00	2 0.00	-	-	-	-	-	-	-	3

Table 8.9.

Lithic Raw material Type by Site

AHRS Number	Argillite (1)	Basalt (2)	Chalcedony (3)	Chert (4)	Obsidian (5)	Quartz (6)	Quartzite (7)	Rhyolite (8)	Other (9)	Totals
TLM 016	8 0.02	151 0.18	4 0.75	2 0.03	-	-	-	-	4 0.08	169
TLM 017	-	894 1.07	-	-	-	-	-	-	-	894
TLM 018	2263 5.79	1187 1.42	2 0.38	79 1.22	6 1.58	-	1 0.19	94 3.59	1 0.02	3633
TLM 021	823 2.11	4 0.00	-	35 0.54	-	-	2 0.39	-	-	864
TLM 022	-	-	-	-	-	1 1.11	-	-	64 1.39	65
TLM 024	-	4 0.00	-	-	-	-	-	-	-	4
TLM 025	8 0.02	6 0.01	1 0.19	5 0.08	2 0.53	-	-	-	2 0.04	24
TLM 026	1 0.00	1 0.00	-	3 0.05	-	-	-	-	2 0.04	7
TLM 027	333 0.85	217 0.26	17 3.20	32 0.49	1 0.26	-	-	1 0.04	2 0.04	603
TLM 028	1 0.00	1 0.00	-	-	-	-	-	-	-	2
TLM 029	-	750 0.90	-	12 0.18	-	-	1 0.19	-	3 0.07	766
TLM 030	4357 11.16	56655 67.75	262 49.34	905 13.92	39 10.29	3 3.33	52 10.10	377 14.39	2875 62.77	65525
TLM 031	-	-	-	2 0.03	-	-	-	-	-	2
TLM 032	5 0.01	2 0.00	1 0.19	2 0.03	-	-	-	-	6 0.13	16
TLM 033	-	-	-	1 0.02	-	-	-	-	-	1
TLM 034	18 0.05	-	-	-	-	-	-	-	-	18
TLM 035	1 0.00	2 0.00	-	-	-	-	-	-	-	3

Table 8.9. (Continued)

AHRS Number	Argillite (1)	Basalt (2)	Chalcedony (3)	Chert (4)	Obsidian (5)	Quartz (6)	Quartzite (7)	Rhyolite (8)	Other (9)	Totals
TLM 036	1 0.00	-	-	1 0.02	-	-	-	-	-	2
TLM 037	-	1 0.00	-	3 0.05	-	-	-	-	-	4
TLM 038	-	-	-	-	-	-	-	-	9 0.20	9
TLM 039	116 0.30	19 0.02	-	78 1.20	1 0.26	1 1.11	8 1.55	3 0.11	2 0.04	228
TLM 040	429 1.10	51 0.06	5 0.94	33 0.51	130 34.30	-	-	27 1.03	4 0.09	679
TLM 041	1 0.00	-	-	-	-	-	-	-	-	1
TLM 042	558 1.43	55 0.07	-	5 0.08	3 0.79	-	1 0.19	3 0.11	-	625
TLM 043	-	-	-	20 0.31	-	-	-	-	19 0.42	39
TLM 044	5 0.01	25 0.03	1 0.19	7 0.11	1 0.26	1 1.11	-	1 0.04	-	41
TLM 045	6 0.02	47 0.06	2 0.38	30 0.46	1 0.26	-	6 1.17	4 0.15	16 0.35	112
TLM 046	25 0.06	91 0.11	4 0.75	34 0.52	4 1.06	-	108 20.97	100 3.82	-	366
TLM 047	96 0.25	1 0.00	-	1 0.02	-	-	-	-	-	98
TLM 048	9 0.02	1 0.00	-	9 0.14	-	-	-	3 0.11	316 6.90	338
TLM 049	-	1 0.00	-	-	-	-	-	-	-	1
TLM 050	-	1 0.00	2 0.38	9 0.14	-	-	-	-	147 3.21	159
TLM 051	5 0.01	-	-	-	-	-	-	-	-	5
TLM 052	8 0.02	36 0.04	1 0.19	1 0.02	-	-	-	-	-	46
TLM 053	-	1 0.00	-	2 0.03	-	-	3 0.58	1 0.04	-	7

Table 8.9. (Continued)

AHRS Number	Argillite (1)	Basalt (2)	Chalcedony (3)	Chert (4)	Obsidian (5)	Quartz (6)	Quartzite (7)	Rhyolite (8)	Other (9)	Totals
TLM 054	-	-	2 0.38	-	-	-	-	-	-	2
TLM 055	4 0.01	-	-	3 0.05	-	-	-	1 0.04	5 0.11	13
TLM 057	-	11 0.01	1 0.19	3 0.05	-	-	-	1 0.04	-	16
TLM 058	-	-	-	3 0.05	-	-	1 0.19	-	-	4
TLM 059	-	1 0.00	-	-	-	-	-	-	6 0.13	7
TLM 060	11 0.03	-	-	372 5.72	-	-	42 8.16	10 0.38	-	435
TLM 061	22 0.06	18 0.02	-	8 0.12	-	-	-	-	18 0.39	66
TLM 062	-	181 0.22	-	9 0.14	-	-	18 3.50	5 0.19	-	213
TLM 063	-	4 0.00	-	-	-	-	-	1 0.04	-	5
TLM 064	2 0.01	626 0.75	1 0.19	-	-	-	-	-	-	629
TLM 065	-	-	1 0.19	1 0.02	-	-	-	-	7 0.15	9
TLM 066	-	2 0.00	-	3 0.05	-	-	-	-	-	5
TLM 067	1 0.00	33 0.04	4 0.75	4 0.06	-	1 1.11	-	2 0.08	1 0.02	46
TLM 068	3 0.01	3 0.00	-	1 0.02	-	-	-	-	-	7
TLM 069	148 0.38	1204 1.44	7 1.32	457 7.03	40 10.55	-	15 2.91	126 4.81	1 0.02	1998
TLM 070	4 0.01	2 0.00	-	-	-	-	-	-	-	6
TLM 073	3 0.01	12 0.01	-	3 0.05	-	-	10 1.94	22 0.84	-	50
TLM 074	-	-	1 0.19	-	-	-	-	-	-	1

Table 8.9. (Continued)

AHRS Number	Argillite (1)	Basalt (2)	Chalcedony (3)	Chert (4)	Obsidian (5)	Quartz (6)	Quartzite (7)	Rhyolite (8)	Other (9)	Totals
TLM 075	2 0.01	1 0.00	-	1 0.02	-	-	-	-	-	4
TLM 076	-	4 0.00	1 0.19	1 0.02	1 0.26	-	1 0.19	-	7 0.15	15
TLM 077	7 0.02	2 0.00	-	-	-	-	-	-	-	9
TLM 078	2 0.01	15 0.02	-	3 0.05	-	-	3 0.58	-	-	23
TLM 081	31 0.08	-	-	-	-	-	-	-	-	31
TLM 082	5 0.01	-	-	2 0.03	-	-	-	-	-	7
TLM 083	-	-	1 0.19	-	-	-	-	-	-	1
TLM 084	-	183 0.22	-	-	-	-	-	-	-	183
TLM 085	-	-	-	69 1.06	-	-	-	-	-	69
TLM 086	-	-	-	1 0.02	-	-	-	-	-	1
TLM 087	-	13 0.02	-	-	-	-	-	-	-	13
TLM 088	-	22 0.03	-	-	-	-	-	-	-	22
TLM 089	522 1.34	134 0.16	1 0.19	5 0.08	-	-	-	5 0.19	-	667
TLM 090	-	5 0.01	-	-	-	-	-	-	-	5
TLM 091	-	11 0.01	-	-	-	-	-	-	-	11
TLM 092	-	3 0.00	-	-	-	-	-	-	-	3
TLM 093	9 0.02	92 0.11	-	3 0.05	-	-	-	-	-	104
TLM 094	7 0.02	8 0.01	4 0.75	10 0.15	-	-	1 0.19	-	-	30

Table 8.9. (Continued)

AHRS Number	Argillite (1)	Basalt (2)	Chalcedony (3)	Chert (4)	Obsidian (5)	Quartz (6)	Quartzite (7)	Rhyolite (8)	Other (9)	Totals
TLM 095	-	67 0.08	-	5 0.08	-	-	-	-	-	72
TLM 096	3 0.01	-	-	-	-	-	-	-	-	3
TLM 097	222 0.57	1960 2.34	5 0.94	51 0.78	1 0.26	-	-	5 0.19	164 3.58	2408
TLM 098	2 0.01	-	-	-	-	-	-	-	-	2
TLM 099	15 0.04	1 0.00	-	-	-	-	-	-	-	16
TLM 101	1 0.00	1 0.00	-	-	-	-	-	-	-	2
TLM 102	-	5 0.01	-	3 0.05	-	-	-	-	-	8
TLM 103	-	6 0.01	-	1 0.02	-	-	-	-	-	7
TLM 105	39 0.10	13 0.02	1 0.19	8 0.12	-	-	-	-	-	61
TLM 106	-	-	-	1 0.02	-	-	-	-	-	1
TLM 107	22 0.06	3 0.00	-	1 0.02	-	-	-	-	-	26
TLM 108	-	16 0.02	-	2 0.03	-	-	-	-	-	18
TLM 109	-	-	-	5 0.08	-	-	-	-	-	5
TLM 110	4 0.01	47 0.06	1 0.19	10 0.15	-	-	-	1 0.04	-	63
TLM 113	2 0.01	1 0.00	-	-	-	-	-	1 0.04	-	4
TLM 114	-	-	-	-	-	-	14 2.72	-	-	14
TLM 115	-	1 0.00	-	-	-	-	-	-	-	1
TLM 117	-	2 0.00	-	2 0.03	-	-	-	-	-	4

Table 8.9. (Continued)

AHRS Number	Argillite (1)	Basalt (2)	Chalcedony (3)	Chert (4)	Obsidian (5)	Quartz (6)	Quartzite (7)	Rhyolite (8)	Other (9)	Totals
TLM 118	1 0.00	-	-	30 0.46	-	-	-	1 0.04	7 0.15	39
TLM 119	1 0.00	11 0.01	4 0.75	7 0.11	-	-	-	-	-	23
TLM 120	-	23 0.03	-	-	-	-	-	-	-	23
TLM 121	-	-	-	-	-	-	-	-	8 0.17	8
TLM 122	-	1 0.00	-	-	-	-	-	-	-	1
TLM 124	-	1 0.00	-	1 0.02	-	-	-	-	-	2
TLM 125	-	3 0.00	-	-	-	-	-	-	-	3
TLM 126	102 0.26	8 0.01	-	1 0.02	-	-	35 6.80	4 0.15	-	150
TLM 127	-	7 0.01	-	1 0.02	-	-	-	-	-	8
TLM 128	6989 17.90	438 0.52	30 5.65	428 6.58	1 0.26	-	5 0.97	-	-	7891
TLM 129	-	38 0.05	-	-	-	-	-	-	-	38
TLM 130	37 0.09	57 0.07	5 0.94	45 0.69	-	-	-	-	-	144
TLM 131	-	-	-	1 0.02	-	-	-	-	-	1
TLM 132	-	-	-	1 0.02	-	-	-	-	-	1
TLM 133	-	-	-	1 0.02	-	-	-	-	-	1
TLM 134	3 0.01	-	-	-	-	-	-	-	1 0.02	4
TLM 135	-	9 0.01	-	-	-	-	-	-	-	9
TLM 136	20 0.05	21 0.03	-	12 0.18	-	-	-	-	-	53

Table 8.9. (Continued)

AHRS Number	Argillite (1)	Basalt (2)	Chalcedony (3)	Chert (4)	Obsidian (5)	Quartz (6)	Quartzite (7)	Rhyolite (8)	Other (9)	Totals
TLM 137	-	1 0.00	-	1 0.02	-	-	-	-	-	2
TLM 138	-	1 0.00	-	-	-	-	-	-	-	1
TLM 139	60 0.15	15 0.02	-	18 0.28	-	-	-	-	-	93
TLM 140	13 0.03	3 0.00	-	2 0.03	-	-	-	-	-	18
TLM 141	35 0.09	19 0.02	-	-	-	-	-	-	-	54
TLM 142	-	1 0.00	3 0.56	1 0.02	-	-	-	-	10 0.22	15
TLM 143	14418 36.92	14208 16.99	39 7.34	402 6.18	58 15.30	3 3.33	3 0.58	28 1.07	457 9.98	29616
TLM 144	5 0.01	7 0.01	-	2 0.03	-	-	-	-	-	14
TLM 145	69 0.18	23 0.03	-	17 0.26	-	-	-	-	-	109
TLM 146	-	1 0.00	-	-	-	-	-	-	-	1
TLM 147	1 0.00	-	-	-	-	-	-	-	-	1
TLM 148	31 0.08	-	-	-	-	-	-	-	-	31
TLM 149	2 0.01	-	-	-	-	-	-	-	-	2
TLM 150	-	8 0.01	-	-	-	-	-	-	-	8
TLM 151	1 0.00	8 0.01	2 0.38	2 0.03	-	-	-	-	-	13
TLM 152	-	-	-	1 0.02	-	-	-	-	-	1
TLM 153	1 0.00	8 0.01	-	-	-	-	22 4.27	-	-	31
TLM 154	124 0.32	-	-	-	-	-	13 2.52	-	-	137

Table 8.9. (Continued)

AHRS Number	Argillite (1)	Basalt (2)	Chalcedony (3)	Chert (4)	Obsidian (5)	Quartz (6)	Quartzite (7)	Rhyolite (8)	Other (9)	Totals
TLM 155	2 0.01	-	-	-	-	-	-	1 0.04	-	3
TLM 159	119 0.30	4 0.00	-	125 1.92	-	-	47 9.13	65 2.48	3 0.07	363
TLM 160	2 0.01	1 0.00	-	-	-	-	-	-	-	3
TLM 164	3 0.01	-	-	-	-	-	-	-	-	3
TLM 165	-	700 0.84	-	-	-	-	-	-	-	700
TLM 166	11 0.03	4 0.00	-	-	-	-	-	-	-	15
TLM 167	-	-	-	-	-	-	1 0.19	-	-	1
TLM 168	-	-	-	1 0.02	-	-	-	-	-	1
TLM 169	38 0.10	1 0.00	1 0.19	28 0.43	2 0.53	-	-	-	-	70
TLM 170	15 0.04	4 0.00	-	1 0.02	-	-	1 0.19	6 0.23	-	27
TLM 171	-	-	5 0.94	9 0.14	1 0.26	-	-	-	-	15
TLM 172	6 0.02	-	-	-	-	-	-	-	-	6
TLM 173	1 0.00	3 0.00	-	34 0.52	-	-	-	3 0.11	1 0.02	42
TLM 174	20 0.05	-	2 0.38	1 0.02	-	-	-	-	-	23
TLM 175	36 0.09	11 0.01	-	3 0.05	-	-	1 0.19	11 0.42	22 0.48	84
TLM 176	-	2 0.00	-	-	-	-	-	-	-	2
TLM 179	-	1 0.00	-	1 0.02	-	-	-	-	-	2
TLM 180	1361 3.48	28 0.03	-	10 0.15	1 0.26	1 0.19	-	-	-	1401

Table 8.9. (Continued)

AHRS Number	Argillite (1)	Basalt (2)	Chalcedony (3)	Chert (4)	Obsidian (5)	Quartz (6)	Quartzite (7)	Rhyolite (8)	Other (9)	Totals
TLM 181	1 0.00	-	-	-	-	-	-	-	-	1
TLM 182	-	-	-	4 0.06	-	-	-	-	-	4
TLM 183	-	3 0.00	-	-	1 0.26	-	-	-	-	4
TLM 184	1504 3.85	137 0.16	40 7.53	1389 21.37	64 16.89	-	6 1.17	6 0.23	11 0.24	3157
TLM 185	-	4 0.00	-	3 0.05	-	-	-	-	-	7
TLM 186	-	3 0.00	-	-	2 0.53	-	-	-	-	5
TLM 187	7 0.02	1 0.00	1 0.19	-	-	-	-	-	-	9
TLM 188	2 0.01	-	-	-	-	-	-	-	-	2
TLM 189	-	7 0.01	-	1 0.02	-	-	-	-	-	8
TLM 190	5 0.01	6 0.01	-	-	-	-	-	-	-	11
TLM 191	1 0.00	-	-	-	-	-	-	-	-	1
TLM 192	1 0.00	-	-	-	-	-	-	-	-	1
TLM 193	-	-	-	2 0.03	-	-	-	-	-	2
TLM 194	7 0.02	11 0.01	-	-	-	-	-	-	-	18
TLM 195	-	2 0.00	-	1 0.02	-	-	-	-	-	3
TLM 197	-	-	-	1 0.02	-	-	-	-	-	1
TLM 198	1 0.00	-	-	-	-	-	-	-	-	1
TLM 199	3 0.01	576 0.69	-	-	-	-	-	-	-	579

Table 8.9. (Continued)

AHRS Number	Argillite (1)	Basalt (2)	Chalcedony (3)	Chert (4)	Obsidian (5)	Quartz (6)	Quartzite (7)	Rhyolite (8)	Other (9)	Totals
TLM 200	-	1 0.00	-	-	-	-	-	-	-	1
TLM 201	-	205 0.25	-	1 0.02	-	-	1 0.19	-	-	207
TLM 202	-	1 0.00	-	-	-	-	-	-	-	1
TLM 203	2 0.01	19 0.02	-	32 0.49	-	-	-	-	-	53
TLM 205	-	1 0.00	-	-	-	-	-	-	-	1
TLM 206	-	-	-	4 0.06	-	-	-	220 8.40	-	224
TLM 207	69 0.18	44 0.05	25 4.71	935 14.37	-	-	-	-	-	1073
TLM 208	3 0.01	12 0.01	-	8 0.12	4 1.06	1 1.11	1 0.19	2 0.08	-	31
TLM 209	8 0.02	288 0.34	-	1 0.02	-	-	-	-	-	297
TLM 210	-	2 0.00	-	-	-	-	-	-	-	2
TLM 211	18 0.05	-	4 0.75	-	-	-	-	-	-	22
TLM 213	-	1 0.00	-	-	-	-	-	-	-	1
TLM 214	5 0.01	68 0.08	-	3 0.05	-	-	-	-	-	76
TLM 215	6 0.02	50 0.06	1 0.19	-	-	-	-	-	-	57
TLM 216	501 1.28	18 0.02	1 0.19	17 0.26	-	-	2 0.39	15 0.57	1 0.02	555
TLM 217	2736 7.01	1135 1.36	-	150 2.31	-	-	2 0.39	1443 55.08	-	5466
TLM 218	2 0.01	-	-	2 0.03	-	-	-	-	-	4
TLM 219	1 0.00	-	-	2 0.03	-	-	-	-	-	3

Table 8.9. (Continued)

AHRS Number	Argillite (1)	Basalt (2)	Chalcedony (3)	Chert (4)	Obsidian (5)	Quartz (6)	Quartzite (7)	Rhyolite (8)	Other (9)	Totals
TLM 220	3 0.01	37 0.04	-	11 0.17	3 0.79	75 83.33	1 0.19	3 0.11	3 0.07	136
TLM 221	-	1 0.00	-	-	-	-	-	-	216 4.72	217
TLM 222	-	-	-	1 0.02	-	-	-	-	45 0.98	46
TLM 223	-	-	-	29 0.45	-	-	-	4 0.15	-	33
TLM 224	-	-	-	1 0.02	-	-	-	1 0.04	-	2
TLM 225	17 0.04	2 0.00	-	38 0.58	10 2.64	-	-	-	2 0.04	69
TLM 226	13 0.03	8 0.01	-	1 0.02	-	-	-	-	1 0.02	23
TLM 228	1 0.00	2 0.00	-	-	-	-	-	-	-	3
TLM 229	16 0.04	104 0.12	-	-	-	-	-	-	1 0.02	121
TLM 230	1 0.00	19 0.02	-	74 1.14	-	-	3 0.58	-	3 0.07	100
TLM 231	-	-	-	1 0.02	-	-	-	-	1 0.02	2
TLM 232	-	3 0.00	-	3 0.05	-	1 1.11	-	-	5 0.11	12
TLM 234	-	-	-	-	-	-	-	-	11 0.24	11
TLM 235	152 0.39	11 0.01	-	-	-	-	18 3.50	-	7 0.15	188
TLM 236	28 0.07	5 0.01	-	-	-	-	-	-	-	33
TLM 237	-	-	-	1 0.02	-	-	-	-	-	1
TLM 239	-	13 0.02	-	-	1 0.26	-	-	-	-	14
TLM 241	-	30 0.04	-	2 0.03	-	-	-	-	-	32

Table 8.9. (Continued)

AHRS Number	Argillite (1)	Basalt (2)	Chalcedony (3)	Chert (4)	Obsidian (5)	Quartz (6)	Quartzite (7)	Rhyolite (8)	Other (9)	Totals
TLM 242	-	-	-	1 0.02	-	-	2 0.39	-	-	3
TLM 243	-	-	-	-	-	-	-	1 0.04	-	1
TLM 245	4 0.01	-	-	-	-	-	-	-	-	4
TLM 246	11 0.03	-	-	-	-	-	-	-	-	11
TLM 247	1 0.00	5 0.01	-	3 0.05	-	-	-	-	6 0.13	15
TLM 249	-	-	-	-	-	-	1 0.19	-	49 1.07	50
TLM 250	-	-	-	-	-	-	-	-	1 0.02	1
TLM 251	7 0.02	73 0.09	2 0.38	12 0.18	-	-	-	-	1 0.02	95
TLM 252	-	-	-	-	-	-	-	-	2 0.04	2
TLM 253	-	-	-	-	-	-	-	-	22 0.48	22
TLM 259	9 0.02	19 0.02	-	1 0.02	-	-	-	2 0.08	-	31
HEA 174	3 0.01	4 0.00	1 0.19	7 0.11	-	1 1.11	1 0.19	-	-	17
HEA 175	176 0.45	68 0.08	25 4.71	106 1.63	1 0.26	-	34 6.60	7 0.27	1 0.02	418
HEA 176	3 0.01	4 0.00	1 0.19	9 0.14	-	-	-	-	1 0.02	18
HEA 177	-	1 0.00	-	52 0.80	-	-	-	-	-	53
HEA 178	10 0.03	5 0.01	-	1 0.02	-	-	25 4.85	-	-	41
HEA 179	-	1 0.00	-	-	-	-	-	-	-	1
HEA 180	6 0.02	2 0.00	5 0.94	19 0.29	-	1 1.11	-	1 0.04	-	34

Table 8.9. (Continued)

AHRS Number	Argillite (1)	Basalt (2)	Chalcedony (3)	Chert (4)	Obsidian (5)	Quartz (6)	Quartzite (7)	Rhyolite (8)	Other (9)	Totals
HEA 181	-	8 0.01	-	1 0.02	-	-	-	-	-	9
HEA 182	-	2 0.00	-	-	-	1 1.11	-	1 1.04	-	4
HEA 183	-	-	-	1 0.02	-	-	-	-	-	1
HEA 184	2 0.01	-	-	-	-	-	-	-	-	2
HEA 185	-	4 0.00	-	4 0.06	-	-	-	-	-	8
HEA 186	1 0.00	2 0.00	-	12 0.18	-	-	2 0.39	-	-	17
HEA 210	-	-	1 0.19	-	-	-	-	1 0.04	-	2
HEA 211	-	-	-	6 0.09	-	-	-	-	-	6
	39,044	83,624	531	6,502	379	90	515	2,620	4,580	137,885
Contributing to entire assemblage	28.31%	69.64%	.38%	4.71%	.27%	.06%	.37%	1.90%	3.32%	99.96%
Number of sites where present	121	150	47	131	26	13	41	45	53	

inventory of flaked stone tools. This percentage is high considering that chert represents only 4.71% of the total lithic sample.

The category of "other" is found most frequently at sites with thermally altered rock and ochre, particularly at TLM 030. A high percentage of chalcedony (49.34%) is also found at TLM 030, but the large sample size at this site is undoubtedly a factor in this apparent clustering. Large sample size may also be a partial explanation for the clustering of rhyolite (55.08%) found at TLM 217. However, the high frequency of quartz (83.33%) at TLM 220 cannot be explained by sample size. Cultural selection or preference for quartz and for a variety of other lithic material is evident at this site comprised of only 136 artifacts.

Quartzite and obsidian are represented at 41 and 26 sites, respectively. A relatively high proportion of quartzite (20.97%) is found only at one site, TLM 046. Although slightly over half the obsidian was recovered from sites with large assemblages (TLM 030, TLM 069, TLM 143, and TLM 184 account for 53.03% of the obsidian) it also occurs at several sites with small assemblages, such as TLM 025, TLM 076, TLM 171, TLM 183, and TLM 239. The only real clustering of obsidian was found at TLM 040, where 130 obsidian specimens represent 34.30% of the total for this material type (46 of these obsidian artifacts at TLM 040 are blades). Sampling bias and cultural selection both seem to be factors in the distribution of obsidian throughout the project area.

Another measure of the variability among sites is the range in lithic raw material they contain. Data taken from Table 8.9 was used to construct the bar graph in Figure 8.7, which illustrates the number of sites containing different numbers of lithic material types. The majority of sites, 130 or 58.39%, were found to contain only one or two lithic material types. This apparent lack of diversity is due in part to the small sample sizes of these sites, 94 of which produced 10 or fewer artifacts. On the other end of the spectrum are seven sites with a great deal of material diversity, i.e., eight or nine different material types. Sample size is also probably a factor in the variability found at these sites; only two of the seven sites yielded

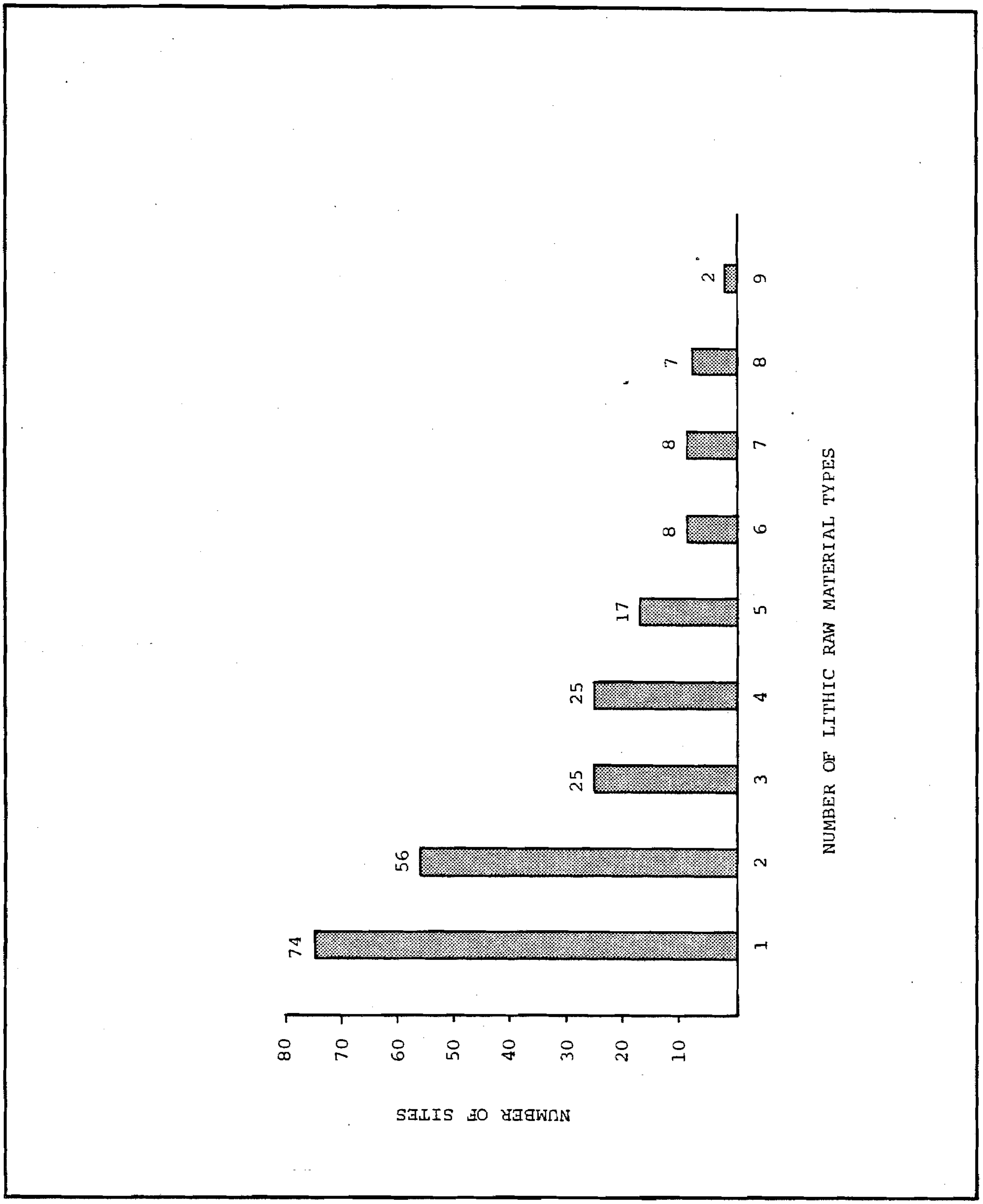

Figure 8.7. Number of Sites by Number of Lithic Raw Material Found on Individual Sites

fewer than 400 artifacts. The remaining 83 sites which fall between the two extremes (represented by 3 - 7 material types) have greatly divergent sample sizes, ranging from an assemblage of 4 specimens (TLM 075, TLM 113, and HEA 182) to an assemblage of 7891 (TLM 128). The diversity exhibited at many of the small assemblage sites is probably attributable to cultural selection, preference in stone tool manufacture, or multiple occupations of the site.

(e) Lithic Variability by Stratigraphic Position

Lithic artifacts were recovered from all stratigraphic units, with the exception of bedrock, which have been described in section 8.2, a. The distribution of artifact types and lithic raw material types are discussed in this section by individual unit or by groupings of stratigraphic units. Theses larger classificatory units were necessary for stratigraphic analysis because both bioturbation and cryoturbation frequently result in some vertical displacement of artifacts associated with the same component. Subsumed within some groups of stratigraphic units are minor subunits which do not occur throughout the project area. The unit numbers which are given in the text correspond to the regional stratigraphic unit numbers which appear in Figure 8.1. An additional category, identified as "other", includes specimens from unknown proveniences.

(i) Artifact Types by Stratigraphic Position

Lithic artifact types are listed by stratigraphic unit in Table 8.10. This table provides the absolute number of each artifact type for each stratigraphic unit and the percentage of each artifact type from the total number of specimens of that artifact type. For instance, 3657 unmodified flakes are found in stratigraphic unit 1 (surface). They represent 2.77% of the total number of unmodified flakes from the project area. The totals for each of the stratigraphic units represent total numbers of artifacts found in that stratigraphic position and the percentage of the total number of lithic artifacts found in the project area.

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Table 8.10.

Lithic Artifact Type by Stratigraphic Position

Strati-graphic Position (Unit)	Unmod-ified Flakes (1)	Modi-fied Flakes (2)	Scrapers (3)	Blades (4)	Micro-blades (5)	Burins (6)	Burin Spalls (7)	Bi-faces (8)	Pre-forms (9)	Notched Points (10)	Stemmed Points (11)	Leaf-shaped Points (12)	Lance-olate Points (13)
Surface (1)	3657	36	9	7	-	1	2	21	2	2	2	-	4
	2.77	11.04	12.86	7.14	-	100.00	40.00	13.82	11.11	4.65	40.00	-	22.22
Current	258	1	-	1	-	-	-	-	-	1	-	-	-
Organics (2)	0.20	0.31	-	1.02	-	-	-	-	-	2.33	-	-	-
Organic Silt	2330	7	4	-	2	-	-	3	-	1	-	-	1
Current (4)	1.76	2.15	5.71	-	0.55	-	-	1.97	-	2.33	-	-	5.56
Eolian	2116	1	-	-	-	-	-	-	-	-	-	-	-
Sand (5)	1.80	0.92	-	-	-	-	-	-	-	-	-	-	-
Buried	-	-	-	-	-	-	-	-	-	-	-	-	-
Organics (5)	-	-	-	-	-	-	-	-	-	-	-	-	-
Organic Silt	-	-	-	-	-	-	-	-	-	-	-	-	-
Buried (5)	-	-	-	-	-	-	-	-	-	-	-	-	-
Devil (6)	6683	24	5	2	13	-	-	9	1	-	-	-	2
	5.06	7.36	7.14	2.04	3.57	-	-	5.92	5.56	-	-	-	11.11
Eolian	981	2	-	-	-	-	-	2	-	-	-	-	-
Sand (7)	0.74	0.61	-	-	-	-	-	1.32	-	-	-	-	-
Ox.	3877	16	2	5	-	-	-	6	1	-	-	-	-
Watana (8)	2.94	4.91	2.86	5.10	-	-	-	3.95	5.56	-	-	-	-
Unox.	895	5	1	1	4	-	-	3	-	-	-	-	-
Watana (10)	0.68	1.53	1.43	1.02	1.10	-	-	1.97	-	-	-	-	-
Paleosol (11)	24001	48	11	-	28	-	-	17	-	9	-	-	-
	18.18	14.72	15.71	-	7.69	-	-	11.18	-	20.93	-	-	-
Oshetna (12)	50074	36	15	36	250	-	1	41	1	23	1	-	2
	37.93	11.04	21.43	36.73	68.68	-	20.00	26.97	5.56	53.49	20.00	-	11.11
Eolian	14662	8	1	10	-	-	-	3	-	1	-	-	1
Sand (13)	11.11	2.45	1.43	10.20	-	-	-	1.97	-	2.33	-	-	5.56
Paleosol/	3766	8	1	-	-	-	-	5	3	-	-	-	-
Other (13)	2.85	2.45	1.43	-	-	-	-	3.29	16.67	-	-	-	-
Eolian	608	1	-	-	-	-	-	-	-	-	-	-	-
Sand (13)	0.46	0.31	-	-	-	-	-	-	-	-	-	-	-
Drift (14)	2607	16	-	6	50	-	-	2	1	-	-	-	-
	1.97	4.91	-	6.12	13.74	-	-	1.38	5.56	-	-	-	-

Triangular Points (14)	Microblade Cores (15)	Microblade Tablet (16)	Blade Cores (17)	Rejuvenation Flakes (18)	Flake Cores (19)	Hammerstones (20)	Abraders (21)	Tci Thos (22)	Notched Pebbles (23)	Thermally Altered Rock (24)	Ochre (25)	Cobble Fragments (26)	Total Count Percent
1	-	-	-	-	14	1	-	2	-	6	-	12	3779
16.67	-	-	-	-	21.54	9.09	-	33.33	-	0.20	-	7.36	2.74%
-	-	-	-	-	-	-	-	-	-	5	-	2	268
-	-	-	-	-	-	-	-	-	-	0.17	-	1.22	0.19%
-	-	-	-	-	-	-	-	3	-	394	2	4	2751
-	-	-	-	-	-	-	-	50.00	-	13.19	0.13	2.45	1.99%
-	-	-	-	-	1	2	-	1	-	437	-	-	2558
-	-	-	-	-	1.54	18.18	-	16.67	-	14.63	-	-	1.86%
-	-	-	-	-	-	-	-	-	-	7	-	-	7
-	-	-	-	-	-	-	-	-	-	0.23	-	-	0.01%
-	-	-	-	-	-	-	-	-	-	7	-	-	7
-	-	-	-	-	-	-	-	-	-	0.23	-	-	0.01%
-	-	-	-	3	4	-	-	-	-	25	20	4	6795
-	-	-	-	18.75	6.15	-	-	-	-	0.84	1.34	2.45	4.92%
-	-	-	-	-	-	-	-	-	-	-	-	-	985
-	-	-	-	-	-	-	-	-	-	-	-	-	0.71%
-	-	-	-	-	-	-	-	-	1	50	5	4	3971
-	-	-	-	-	-	-	-	-	50.00	1.67	0.34	2.45	2.88%
-	-	-	-	-	-	1	-	-	-	-	1	2	913
-	-	-	-	-	-	9.09	-	-	-	-	0.07	1.23	0.66%
-	-	-	-	-	6	-	1	-	1	361	73	2	24558
-	-	-	-	-	9.23	-	100.00	-	50.00	12.08	4.91	1.22	17.81%
-	1	-	-	7	12	1	-	-	-	1200	1173	87	52962
-	50.00	-	-	43.75	18.46	9.09	-	-	-	40.16	78.90	53.37	38.41%
-	-	-	-	-	3	1	-	-	-	235	199	6	15130
-	-	-	-	-	4.62	9.09	-	-	-	7.86	13.37	3.68	10.97%
2	-	-	-	-	2	-	-	-	-	-	-	-	3787
33.33	-	-	-	-	3.08	-	-	-	-	-	-	-	2.75%
2	-	-	-	-	-	-	-	-	-	-	-	-	611
33.33	-	-	-	-	-	-	-	-	-	-	-	-	0.44%
-	-	-	3	2	1	1	-	-	-	7	1	6	2703
-	-	-	100.00	12.50	1.54	9.09	-	-	-	0.23	0.07	3.68	1.96%

Table 8.10. (Continued)

Strati-graphic Position	Unmod-ified Flakes (1)	Modi-fied Flakes (2)	Scrapers (3)	Blades (4)	Micro-blades (5)	Burins (6)	Burin Spalls (7)	Bi-faces (8)	Pre-forms (9)	Notched Points (10)	Stemmed Points (11)	Leaf-shaped Points (12)	Lance-olate Points (13)
Devil and	201	1	-	-	-	-	-	-	-	-	-	-	-
Above (2-6)	0.15	0.31	-	-	-	-	-	-	-	-	-	-	-
Pre-Watana/	75	-	-	-	-	-	-	2	-	-	-	-	-
Post Oshetna (11)	0.06	-	-	-	-	-	-	1.32	-	-	-	-	-
Pre-	3328	5	-	1	-	-	-	1	-	-	-	-	-
Oshetna (13-14)	2.52	1.53	-	1.02	-	-	-	0.66	-	-	-	-	-
Watana or	970	5	1	4	-	-	1	-	-	-	-	-	-
Younger (2-10)	0.73	1.53	1.43	4.08	-	-	20.00	-	-	-	-	-	-
Oshetna or	381	4	-	-	2	-	-	1	1	-	-	-	-
Younger (2-12)	0.29	1.23	-	-	0.55	-	-	0.66	5.56	-	-	-	-
Other	10557	102	20	25	15	-	1	36	8	6	2	5	7
	8.00	31.29	28.57	25.51	4.12	-	20.00	23.68	44.44	13.95	40.00	100.00	38.89

Triangular Points (14)	Microblade Cores (15)	Microblade Tablet (16)	Blade Cores (17)	Rejuvenation Flakes (18)	Flake Cores (19)	Hammerstones (20)	Abraders (21)	Tci Thos (22)	Notched Pebbles (23)	Thermally Altered Rock (24)	Ochre (25)	Cobble Fragments (26)	Total Count Percent
-	-	-	-	-	-	-	-	-	-	78	-	-	280
-	-	-	-	-	-	-	-	-	-	2.61	-	-	0.20%
-	-	-	-	-	-	-	-	-	-	3	-	-	80
-	-	-	-	-	-	-	-	-	-	0.10	-	-	2.42%
1	-	-	-	-	-	-	-	-	-	-	-	-	3336
16.67	-	-	-	-	-	-	-	-	-	-	-	-	2.42%
-	-	-	-	-	-	-	-	-	-	-	-	-	981
-	-	-	-	-	-	-	-	-	-	-	-	-	0.71%
-	-	-	-	-	2	-	-	-	-	-	-	-	391
-	-	-	-	-	3.08	-	-	-	-	-	-	-	0.28%
-	1	2	-	3	18	4	-	-	-	169	13	28	11,022
-	50.00	100.00	-	18.75	27.69	36.36	-	-	-	5.66	0.87	17.18	8.00%

Stratigraphic unit 1 represents artifacts which were recovered from the ground surface. A total of 3779 (2.74%) lithic specimens were found in this stratigraphic unit. It contains high relative percentages of lanceolate points (22.22%), stemmed points (40.00%), tci thos (33.33%), and burin spalls (40.00%). Of a total of 18 lanceolate points found in the project area, four were collected on the ground surface and five could not be assigned to a stratigraphic position. When those five points are removed from the sample, lanceolate points found on the ground surface represent 30.77% of the total population of lanceolate points. Of the 13 lanceolate points with known provenience, nine (69.23%) are found within or stratigraphically above the Devil tephra (unit 6). Lanceolate points appear to be associated with the upper stratigraphic units in general and with the surface unit in particular. Although the sample size is low for stemmed points (n=5) and tci thos (n=6), these also tend to be associated with the upper strata (units 1-5). The single burin found in the project area was recovered from the ground surface.

Between stratigraphic unit 1 (surface) and stratigraphic unit 6 (Devil tephra) are five strata which represent various organic and sand/silt units. Together these strata contain 4.91% of the lithic artifacts found in the project area. Three of these strata - current organics (unit 2), buried organics (unit 5), buried/organic silt (unit 5) - contain less than half of 1% of total lithic artifacts. All the tci thos not found on the ground surface (4 out of 6) occur within these strata. Thermally altered rocks, represented by 831 (27.73%) specimens, also tend to occur in high relative frequency in these strata. An additional 78 (2.61%) specimens of thermally altered rock are found in the Devil tephra and above stratum. Two hammerstones, representing 18.18% of the total for this artifact type, were also recovered from the upper strata (units 1-5).

The Devil tephra (stratigraphic unit 6) contains 6795 (4.92%) lithic artifacts. Most of these lithic artifacts are composed of unmodified flakes, but three rejuvenation flakes are found in this stratum and three additional rejuvenation flakes are found in the general stratigraphic position Devil tephra and above. Together, this represents 37.5% of the rejuvenation flakes found in the project area. Below the Devil tephra is an eolian sand (unit 7) which contains 985 (0.71%) lithic artifacts. At 0.71% of the total lithic artifacts, this stratum is poorly represented in the regional stratigraphy and virtually sterile.

The Watana tephra has been separated in the field into two units, oxidized (unit 8) and unoxidized (unit 10). Lithic artifacts found in these strata represent 4177 and 913 specimens, respectively. No diagnostic artifacts have been found in high relative proportions in either of these strata. The lower of the two strata (unoxidized Watana) only contains 0.66% of the total lithic artifacts. This unit could possibly be interpreted as a sterile zone which contains a low density of artifacts resulting from soil mixing processes from above or below.

Stratigraphic unit 11 (Watana/Oshetna paleosol) contains 24,562 (17.81%) lithic artifacts. It contains the second highest frequency of lithic material in the project area. The majority of artifacts from this unit were recovered from TLM 143 (see Appendix D). Table 8.10 provides a complete listing of artifacts found, and depicts the relatively high occurrence of notched points (20.93%) recovered from this unit. One of the two notched pebbles recovered from the project area is also found in this stratum.

The Oshetna tephra (unit 12), lying just below the Watana/Oshetna paleosol, contains 52,962 (38.41%) lithic artifacts. This is by far the highest frequency of artifacts found in any of the stratigraphic units. The greatest contributor to the total artifact count from the Oshetna tephra is TLM 030. The following artifact types show their highest frequencies in this stratum: scrapers (21.43%), blades (36.73%), microblades (68.68%), bifaces (26.97%), notched points (53.49%), rejuvenation flakes (43.75%), thermally altered rock (40.16%), ochre (78.90%), and cobble fragments (53.37%). Tci thos, triangular points, and leaf-shaped points were not recovered from this unit and stemmed and lanceolate points occur in low frequency. The great variability of the

Oshetna tephra in terms of artifact type is partially a function of the large lithic sample recovered from this unit.

Stratigraphic units below the Oshetna tephra (unit 12) and above the drift (unit 14) contain 19,528 (13.76%) lithic artifacts. The general stratigraphic position pre-Oshetna contains 83.33% of all the triangular points found in the project area, all from TLM 128. The three preforms recovered from stratigraphic unit 13 (below the Oshetna tephra) at this site are probably preforms for triangular points (see Appendix D). The differences in assemblages between the Watana/Oshetna paleosol (11), the Oshetna tephra (12), and the pre-Oshetna/post-drift (13) units suggest a change in prehistoric economy or change in prehistoric people. For instance, both blades and microblades achieve their highest frequencies in the Oshetna tephra unit. A marked decrease in both these artifact types is evident in the underlying and overlying strata.

Stratigraphic unit 14 (drift) contains 2703 lithic artifacts. The most significant artifact type found in this unit is blade cores (100%). The high relative occurrence of this artifact type documents an early blade industry in the project area. Six blades and 50 microblades also occurred in the drift.

(ii) Lithic Material Type by Stratigraphic Position

The number of specimens and percentage of each lithic raw material type found in each stratigraphic position are listed in Table 8.11. The percentages in the total column represent the fraction of all artifacts from the project area found in given stratigraphic units. As evident in the table, each raw material type, with the exception of quartz, is represented virtually throughout the stratigraphic sequence from the drift (unit 14) to the ground surface. Quartz, however, does not occur below the Oshetna tephra. Basalt and argillite are the two most most common material types in almost all strata, as might be expected on the basis of their overall prevalence in the lithic assemblage. Argillite occurs in highest relative frequency in the paleosol (unit 13) below the Oshetna tephra (91.60%) and the eolian sand underlying the paleosol

Table 8.11.

Lithic Raw Material Type by Stratigraphic Position

Stratigraphic Position	Argillite (1)	Basalt (2)	Chalcedony (3)	Chert (4)	Obsidian (5)	Quartz (6)	Quartzite (7)	Rhyolite (8)	Other (9)	Totals
Surface	2264	1140	17	157	3	2	81	103	12	3779
	59.91	30.17	.45	4.15	.08	.05	2.14	2.73	.32	2.74
Current	55	161	-	42	1	2	-	1	6	268
Organics	20.52	60.07	-	15.67	.37	.75	-	.37	2.24	0.19
Organic Silt	796	902	22	285	12	72	39	221	402	2751
Current	28.93	32.79	.80	10.36	.44	2.62	1.42	8.03	14.61	2.00
Eolian Sand	1117	456	1	37	2	2	2	501	440	2558
	43.67	17.83	.04	1.45	.08	.08	.08	19.59	17.20	1.86
Buried	-	-	-	-	-	-	-	-	7	7
Organics	-	-	-	-	-	-	-	-	100.0	0.01
Organic Silt	-	-	-	-	-	-	-	-	17	17
Buried	-	-	-	-	-	-	-	-	100.0	0.01
Devil	1955	3264	37	815	45	-	36	594	49	6795
	28.77	48.04	.54	11.99	.66	-	.53	8.74	.72	4.93
Eolian Sand	632	168	1	35	-	-	2	147	-	985
	64.16	17.06	.10	3.55	-	-	.20	14.92	-	0.71
Ox.	1211	1986	19	575	27	1	14	78	60	3971
Watana	30.50	50.01	.48	14.48	.68	.03	.35	1.96	1.51	2.88
Unox.	153	376	10	354	10	-	4	3	3	913
Watana	16.76	41.18	1.10	38.77	1.10	-	.44	.33	.33	0.66
Paleosol	10896	12502	40	589	43	2	32	18	436	24558
	44.37	50.91	1.63	2.40	.18	.01	.13	.07	1.78	17.81
Oshetna	4323	43605	255	1738	108	4	95	421	2413	52962
	8.16	82.33	.48	3.28	.20	.01	.18	.79	4.56	38.41
Eolian Sand	1438	13042	37	119	20	-	5	32	437	15130
	9.50	86.20	.24	.79	.13	-	.03	.21	2.89	10.97
Paleosol/	3469	269	28	21	-	-	-	-	-	3787
Other	91.60	7.10	.74	.55	-	-	-	-	-	2.75
Eolian Sand	569	9	-	33	-	-	-	-	-	611
	93.12	1.47	-	5.40	-	-	-	-	-	0.44
Drift	924	1435	3	213	13	-	48	57	10	2703
	34.18	53.09	.11	7.88	.48	-	1.78	2.11	.37	1.96

Table 8.11. (Continued)

Stratigraphic Position	Argillite (1)	Basalt (2)	Chalcedony (3)	Chert (4)	Obsidian (5)	Quartz (6)	Quartzite (7)	Rhyolite (8)	Other (9)	Totals
Devil and	149	39	1	-	-	-	12	1	78	280
Above	53.21	13.93	.36	-	-	-	4.29	.36	27.86	0.20
Pre-Watana/	-	30	-	29	-	-	6	12	3	80
Post Oshetna	-	37.50	-	36.25	-	-	7.50	15.00	3.75	0.06
Pre-Oshetna	2851	141	1	342	1	-	-	-	-	3336
	85.46	4.23	.03	10.25	.03	-	-	-	-	2.42
Watana or	274	557	6	105	11	-	7	21	-	981
Younger	27.93	56.78	.61	10.70	1.12	-	.71	2.14	-	0.71
Oshetna or	44	202	-	24	1	-	25	95	-	391
Younger	11.25	51.66	-	6.14	.26	-	6.39	24.30	-	0.28
Other	5924	3340	53	989	82	5	107	315	207	11022
	53.75	30.30	.48	8.97	.74	.04	.97	2.86	1.88	7.99
Total Counts	39044	83624	531	6502	379	90	515	2620	4580	137885

(93.12%). This distribution is mostly a factor of the large argillite assemblage from these two units at TLM 128. Basalt is predominant in the Oshetna tephra (unit 12)(82.33%) and the eolian sand (unit 13) underlying this tephra (86.20%). Most of the basalt in these units was recovered from TLM 030.

Raw materials other than argillite and basalt occur mostly in low frequencies throughout the strata, although some clustering of these less common materials is apparent. Chalcedony appears to be fairly evenly distributed throughout the strata, with highest relative percentage found in unit 11, the Watana/Oshetna paleosol (1.63%). High frequencies of chert are found in the upper organic units (15.67% in the current organics and 10.36% in the current organic silt), and in the units from the Devil tephra through the unoxidized Watana tephra (units 6-10). Chert contributes 38.77% to the lithic sample from the unoxidized Watana; the relative percentages of chert decrease below this unit. Quartzite, on the other hand, is found in its highest relative frequencies in the drift (1.78%) and on the ground surface (2.14%). Rhyolite is also most common in the lower strata (24.30% in stratigraphic position of Oshetna or younger), and in the eolian sand just above the Devil tephra (19.59%). All the rhyolite in this eolian sand unit was recovered from TLM 217. The lithic category of "other", i.e., thermally altered rock, is found predominantly in the stratigraphic units above the Devil tephra.

Both "exotic" material types, i.e., obsidian and quartz, occur in low frequencies throughout the stratigraphic sequence. In terms of absolute frequencies, obsidian is most common in the Oshetna tephra, but this is undoubtedly a function of the large lithic sample recovered from this unit. The highest relative frequencies of obsidian are found in the unoxidized Watana tephra (1.10%), oxidized Watana tephra (.68%) and Devil tephra (.66%). Quartz is absent below the Oshetna tephra. It occurs in very low frequencies, except in the organic silt (unit 4) at TLM 220, where the majority of quartz (67 of the 90 specimens) were recovered.

(f) Summary

The preceding lithic analysis has presented the ranges of spatial and temporal variability in artifact types and lithic raw material types recovered from sites in the project area. In general, it was found that the majority of sites are characterized by small lithic assemblages, and correspondingly exhibit little diversity in artifact and raw material types. Sites with larger sample sizes, i.e., over 100 artifacts, generally tended to show a greater variability of artifact and raw material types. The observed artifact density is partially a result of testing intensity, and is also greatly dependent on the level of prehistoric use and/or occupation of a site. Very high artifact density, i.e., greater than 300 artifacts per m^2 was found to occur at both survey level and systematically tested sites.

The most abundant lithic raw material types found in the project area are locally available basalt and argillite. Obsidian and quartz are not known locally and occur in low frequencies in most strata. High relative frequencies of obsidian occur between the Devil and unoxidized Watana tephra. Quartz is absent below the Oshetna tephra and occurs most commonly in the organic silt unit at only one site. Chalcedony, quartzite, and rhyolite also occur in low frequencies in most of the stratigraphic units. Although the overall frequency of chert is fairly low in the entire assemblage, it is quite widely distributed and apparently a preferred material type for flaked stone tool production, particularly microblades.

Stratigraphic analysis of lithic artifacts has resulted in the identification of four major occupational episodes within the project area. These episodes are:

1) The depositional period from the time of glacial retreat up to but not including the Oshetna tephra (unit 12) represents the earliest occupational episode. This has been identified on the basis of high frequencies of triangular points and core and blade technology.

2) The depositional period beginning at the time of the Oshetna tephra fall up to but not including the Watana tephra fall represents an occupational episode with the greatest number of lithic artifacts. This period contains high frequencies of notched points and microblades.

3) The depositional period beginning at the time of the Watana tephra fall up to and including the Devil tephra (unit 6) represents the third occupational episode. This period is characterized by high relative frequencies of obsidian.

4) The depositional period beginning after the Devil tephra fall up to the current organic mat represents the final prehistoric occupational episode. This period is characterized by the diagnostic artifact types of tci thos and lanceolate points, and high frequencies of thermally altered rock.

8.4 - Faunal Analysis

(a) Introduction

The preservation of faunal remains at archeological sites provides an added dimension to site analysis and interpretation not possible with lithics alone. Questions concerning subsistence, such as what animal species were exploited and how they were processed, are profitably addressed in analyzing the bones and bone fragments comprising a faunal assemblage. Faunal data, when integrated with information on other site variables such as presence of features, lithics, and environmental factors, are also valuable indicators of the nature and seasonality of past human settlement at a site. The objectives of the present analysis are to determine: 1) the species of animals which contributed to the diet and economy of past inhabitants of the Middle Susitna Valley, 2) whether a change in faunal utilization occurred over time, and 3) the different game (i.e., bone, meat, hide, sinew) processing activities that occurred and how they may reflect the nature of site occupation.

The methodology of faunal analysis involved quantification of bone fragments recovered from all sites, identification of each bone or fragment as to skeletal element and species whenever possible, and examination of each specimen for evidence of cultural modification, such as burning, butchery marks, or tool manufacture. Bones were initially quantified by count, i.e., number of specimens per taxon, with the minimum number of individuals (MNI) being determined after the identification process was complete. For the analysis, some taxa were subsumed under broader taxonomic categories. For example, all specimens attributed to cervids (moose <u>or</u> caribou) or artiodactyls (moose, caribou, <u>or</u> sheep) and not identifiable to the species level were categorized as medium-large mammal. Identification was facilitated through the use of comparative skeletal collections housed at the University of Alaska Museum.

The presence and degree of burning, i.e., lightly burned, heavily burned (charred), or calcined, was noted, as were the presence and anatomical location of any marks resulting from butchery or carnivore gnawing. To facilitate analysis, all degrees of burning (lightly burned through calcined) were categorized as "burned". Most of the bone thought to represent either a tool, tool fragment, or debitage from tool manufacture was examined by Dr. Hans-Peter Uerpmann for positive identification of any of these cultural modifications.

The biases which can affect the results of a faunal analysis should be mentioned before proceeding. One important fact which may be overlooked is that an entire zooarcheological assemblage represents only a portion of the bone deposited when a site was occupied. The major factors responsible for transforming the original deposit into the archeological assemblage are differential preservation, sampling method, and recovery. Differential preservation of bone is the result of soil conditions (particularly soil acidity), weathering of exposed bone, removal or scattering by carnivores, the use of bone as raw material, differences in cooking or disposal practices, and differences in the density and resistance to decay of the skeletal elements. Archeological field methods of sampling and recovery are also potential sources of bias in the data. A faunal assemblage most useful for interpretive purposes can only be recovered by testing various activity areas within a site. During survey level testing, it is unlikely that an entirely representative sample was collected. A thorough treatment of the potential factors that can bias a faunal assemblage, particularly with respect to Alaskan sites, is presented by G.S. Smith (1979).

(b) Stratigraphic Position and Spatial Distribution

The faunal assemblage is characterized by fragmentary bone which varies from very small (5-10 mm) calcined specimens to large unburned caribou and moose bone fragments. A total of 142,835 specimens were recovered from 78 sites in the project area. Due to the highly fragmentary nature of the assemblage, the vast majority of the bones were only attributable to the broad category of "medium-large mammal". However, nine mammalian and one avian species were identified and are represented by 1104 of the specimens. Caribou (Rangifer tarandus) is the best represented, constituting 87% of the identified portion of the assemblage.

The stratigraphic distribution of burned and unburned bones from all sites is presented in Table 8.12. Below the surface, bone occurred in stratigraphic units 2-14, ranging from the organic unit through the drift. At sites where the faunal remains could not definitely be attributed to a single stratigraphic unit, they were assigned to a combined unit grouped by relative stratigraphic position, such as Devil tephra and above, Oshetna tephra and above, etc. One category is titled "other" and contains bone from unknown or unclear stratigraphic proveniences. Although bones occurred throughout the stratigraphic sequence, the highest percentages (in terms of total specimen count) were recovered from the paleosol between the Watana and Oshetna tephras (21.20%), the organic silt (13.47%), the oxidized (or unknown) Watana tephra (13.46%), and the unoxidized Watana tephra (10.97%). The "other" category accounts for 15.71% of the total bone count of 142,835 specimens.

A great contrast between the preservation of burned and unburned bone is evident in Table 8.12. Burned bone comprised 96.34% of the faunal assemblage and was distributed virtually throughout all strata, whereas unburned bone was recovered primarily from the organic silt. Eighty-four percent of all unburned bone was found in this stratum. Less than 1% of all unburned bone occurred below the Devil tephra. One factor in the differential preservation relates to the fact that bone which has been intensely burned to the point of calcination is more resistant to chemical decomposition than unburned bone (H.-P. Uerpmann, personal communication 1984). Acidic soils, such as found at sites along the Susitna River (Buck 1983), are particularly damaging to bone (Chaplin 1971:16, Gordon and Buikstra 1981; Butzer 1982:196; White and Hannus 1983). Thus, it appears that unburned bone, originally deposited in the unoxidized Watana or below, eventually decomposed, leaving no trace in the archeological record.

Table 8.12. Number of Burned and Unburned Bone Specimens by Stratigraphic Position

Stratigraphic Position	Strat. Unit	Burned (%)	Unburned (%)	Total (%)
Surface	1	644 (00.47)	85 (01.63)	729 (00.51)
Organics	2	118 (00.09)	31 (0.59]	149 (0.10)
Organic silt	4	14,850 (10.79)	4,388 (84.01)	19,238 (13.47)
Eolian sand	5	4,950 (03.60)	294 (5.63)	5,244 (3.67)
Buried organics	5	8 (0.01)	0	8 (0.01)
Buried organic silt	5	0	36 (0.69)	36 (0.03)
Devil tephra	6	1,822 (1.32)	8 (0.15)	1,830 (1.28)
Eolian sand	7	2,117 (1.54)	2 (0.04)	2,119 (1.48)
Watana tephra (oxidized or unknown)	8	19,193 (13.95)	27 (0.52)	19,220 (13.46)
Watana tephra (unoxidized)	10	15,665 (11.38)	0	15,665 (10.97)
Paleosol	11	30,280 (22.00)	0	30,280 (21.20)

Table 8.12. (Continued)

Stratigraphic Position	Strat. Unit	Burned (%)	Unburned (%)	Total (%)
Oshetna tephra	12	9,813 (7.13)	0	9,813 (6.87)
Eolian sand	13	1,261 (0.92)	0	1,261 (0.88)
Drift	14	710 (0.52)	0	710 (0.50)
Devil tephra and above	2-6	575 (0.42)	165 (3.16)	740 (0.52)
Pre-Watana tephra through Oshetna tephra	11-12	56 (0.04)	0	56 (0.04)
Watana tephra and above	2-10	1,401 (01.02)	1 (0.02)	1,402 (0.98)
Oshetna tephra and above	2-12	11,891 (8.64)	0	11,891 (8.32)
Other (surface or subsurface unknown)		22,258 (16.17)	186 (3.56)	22,444 (15.71)
Total		137,612 (100.1)	5223 (100.0)	142,835 (100.0)

The paleosol between the Watana and Oshetna tephras yielded the most specimens of burned bone (30,280), 99.40% of which were recovered from TLM 143. Overlying the Watana/Oshetna paleosol, the unoxidized and oxidized Watana tephra units also yielded an abundance of burned bone (15,665 and 19,193 specimens, respectively), with 64.64% of the combined sum recovered from TLM 184. The only other site to have a great deal of bone present in the oxidized Watana tephra was TLM 229 (3125 specimens). Although almost half of all the burned bone was recovered from the Watana tephra units and the underlying paleosol, only three sites (TLM 143, TLM 184, and TLM 229) contributed significantly to the total.

The stratigraphic unit with the best bone preservation was the organic silt, which produced a relatively high percentage of the burned bone (10.79%) and the great majority of all unburned bone (84.01%). At many sites, such as TLM 065, TLM 220, TLM 222, TLM 231, etc., both burned and unburned bone were recovered from this unit. Also, as might be expected, the total number of specimens identified to species (503 of the 1104 specimens or 45.56%) was greater in the organic silt than in any other stratigraphic unit. Burned, unburned, and identifiable bone were also recovered in the eolian sand, found at sites such as TLM 048, TLM 059, and TLM 220, underlying the organic silt. The recency of deposition of both the organic silt and eolian sand (younger than ca. 1400 years B.P.) accounts for this good state of bone preservation.

Table 8.13. presents a list of faunal taxa by stratigraphic position for all sites. The ten species which have been identified are the following: 1) caribou (Rangifer tarandus), 2) moose (Alces alces), 3) sheep (Ovis dalli), 4) wolf (Canis lupus), 5) dog or coyote (Canis familiaris or Canis latrans), 6) wolverine (Gulo gulo), 7) ground squirrel (Spermophilus parryi), 8) snowshoe hare (Lepus americanus), 9) vole (Microtus sp.), and 10) ptarmigan (Lagopus sp.). Other specimens only identified by class, i.e., mammals or birds, also appear in the table, and are broken down by size-range (medium-large and small-medium mammals). By far the best represented category is that of medium-large mammals, which contribute 87.52% to the total assemblage.

Table 8.13. Number of Specimens by Faunal Taxa and Stratigraphic Position

Stratigraphic Position	Strat. Unit	CR[a]	MS	SH	CN	WV	GS	HA	VL	PT	M-L	S-M	MA	B	Total
Surface	1	47	9								671		2		729
Organics	2	15	1							1	132				149
Organic silt	4	482	16		2		3				17,764	14	957		19,238
Eolian sand	5	104									5,132	1	6	1	5,244
Buried organics	5										8				8
Buried organic silt	5	16									20				36
Devil tephra	6	11								1	1,787		31		1,830
Eolian sand	7	9									2,106		4		2,119
Watana tephra (oxidized or unknown)	8	92			1				2		18,549	26	549	1	19,220
Watana tephra (unoxidized)	10	58									15,373	105	129		15,665
Paleosol	11	2									30,247	12	19		30,280
Oshetna tephra	12										8,798	1,014	9,813		
Eolian sand	13	1									1,258	1	1		1,261
Drift	14	6									700		4		710
Devil and above	2-6	3	10				1				725		1		740
Pre-Watana thru Oshetna	11-12										48		8		56
Watana tephra and above	2-10	13									1,326		63		1,402
Oshetna tephra and above	2-12	4									592	18	11,277		11,891
Other		99	18	9		64	2	1		1	19,779	24		2	22,444
Total		962	54	9	3	64	6	1	2	3	125,013	204	16,510	4	142,835

[a] Codes for faunal taxa are as follows:

CR -	caribou (Rangifer tarandus)
MS -	moose (Alces alces)
SH -	sheep (Ovis dalli)
CN -	canid (Canis sp.)
WV -	wolverine (Gulo gulo)
GS -	ground squirrel (Spermophilus parryi)
HA -	hare (Lepus americanus)
VL -	vole (Microtus sp.)
PT -	ptarmigan (Lagopus sp.)
M-L -	meidum-large mammal
S-M -	small-medium mammal
MA -	mammal
B -	bird

The mammal category contributes another 11.56%. All other categories combined account for less than 1% of the faunal remains.

Caribou bones are predominant among the identified specimens representing 87.13% of the total. They are distributed throughout the stratigraphic sequence, from the surface down to the drift, and were recovered from 46 sites (Table 8.14). If bone from the remaining 32 sites had been identifiable, it is likely that most of them would also have produced evidence of caribou. The earliest evidence comes from the Fog Creek site, TLM 030, at which one calcined phalanx fragment, tentatively identified as caribou, was recovered from the contact between the Oshetna tephra and a fine silt (stratigraphic position of eolian sand). Associated with the phalanx fragment was a very fragmentary burned molar, attributed to an artiodactyl, and also probably representative of caribou. The four radiocarbon dates from the paleosol above the Oshetna tephra at TLM 030 range from 3920 ± 130 through 5130 ± 140 years B.P. (Table 8.1). Thus, the occurrence of a probable caribou bone and tooth below the Oshetna tephra at the site indicates that caribou were hunted possibly as early as ca. 5100 years B.P. in the Susitna River valley.

Other early evidence for caribou hunting occurs at TLM 143. Two calcined molar fragments, tentatively identified as caribou, were situated within a culturally altered Oshetna tephra (stratigraphic position defined as paleosol above Oshetna tephra) which formed the matrix of two features comprised of ca. 30,000 calcined bone fragments. A calcined phalanx fragment of a probable caribou was also recovered at the base of this unit. Three radiocarbon samples taken from the upper contact of this cultural matrix produced dates of 4100 ± 60, 4250 ± 110, and 4440 ± 120 years B.P. (Table 8.1), indicating a pre-4000 year old date for the faunal remains. The six calcined caribou bone fragments (vertebral and metapodial) from the drift of TLM 069 also may fall within this time range as the site report (Appendix D) states that cultural material on the surface of the drift represents a lag deposit lowered from the Watana/Oshetna tephra contact. However, the true stratigraphic provenience for these bones is still not clear.

Table 8.14. Number of Specimens of Identified Faunal Taxa by Site

Site (AHRS #)	CR[a,b]	MS	SH	CN	WV	GS	HA	VL	PT	M-L	S-M	MA	B	Total
TLM 016	2								3	337		39		381
TLM 018	1													1
TLM 021										6		2		8
TLM 022	6	13				1				692				712
TLM 026										134				134
TLM 029										2				2
TLM 030	1									9,349	3	1,000		10,353
TLM 038	12							2		440		950		1,404
TLM 040										28				28
TLM 042										6		22		28
TLM 043	24									11,210				11,234
TLM 044										19		55		74
TLM 045	2					2				264		102		370
TLM 046	1									654	11,105			11,760
TLM 048	21									1,400				1,421
TLM 049							1							1
TLM 050	3									449	1	45	1	499
TLM 054										1				1
TLM 055												4		4
TLM 059	49*									1,489		2		1,540
TLM 060										1				1
TLM 061	3									553				556

Table 8.14. (Continued)

Site (AHRS #)	CR[a,b]	MS	SH	CN	WV	GS	HA	VL	PT	M-L	S-M	MA	B	Total
TLM 062	7									1,953		172		2,132
TLM 063	3									752				755
TLM 065	172*									1,064	2	15		1,253
TLM 069	7									2,009	3	1,411	1	3,431
TLM 072		1												1
TLM 076												2		2
TLM 077	4									21				25
TLM 089	6									3,095	4	800	1	3,906
TLM 097	16									449		10		475
TLM 104										8				8
TLM 121										23				23
TLM 123	1									1				2
TLM 130	12									1,236		110		1,358
TLM 136	1									69				70
TLM 139										76				76
TLM 142	9									184				193
TLM 143	5									32,315	30	2		32,352
TLM 144										1				1
TLM 145										93				93
TLM 149	3									568	20	390		981
TLM 150												5		5
TLM 151										511		20		531

Table 8.14. (Continued)

Site (AHRS #)	CR[a,b]	MS	SH	CN	WV	GS	HA	VL	PT	M-L	S-M	MA	B	Total
TLM 169												8		8
TLM 173										55				55
TLM 178					64									64
TLM 184	105*									26,666	10	27		26,808
TLM 187												1		1
TLM 196**		5												5
TLM 207										1				1
TLM 215	4									739		3		746
TLM 216	1									1,084		3		1,088
TLM 217	12									2,269		7		2,288
TLM 220	47*			1						1,414	1	33	1	1,497
TLM 221	17									803		5		825
TLM 222	190*									1,997		21		2,208
TLM 223										69		8		77
TLM 225										626	98	42		766
TLM 226	18									176				194
TLM 227	3									191		42		236
TLM 229	12									3,551	2	28		3,593
TLM 231	2									3,098				3,100
TLM 232	40	6								70				116
TLM 234	70*	1		2		3				109	2			187

Table 8.14. (Continued)

Site (AHRS #)	CR[a,b]	MS	SH	CN	WV	GS	HA	VL	PT	M-L	S-M	MA	B	Total
TLM 239										3				3
TLM 240	5	10								199	10	2		226
TLM 242	10									535				545
TLM 246										5				5
TLM 247	4	1								3		1		9
TLM 249	7									42				49
TLM 250		1	9							26				36
TLM 251										85	1			86
TLM 252	4	16								1,589	6	1		1,616
TLM 253	36									8,099	10	13		8,158
TLM 256	3									46	1			50
HEA 175	1											2		3
HEA 211										1				1
Total	962	54	9	3	64	6	1	2	3	125,013	204	16,510	4	142,835

[a] Codes for faunal taxa are as follows:

CR -	caribou (_Rangifer tarandus_)
MS -	moose (_Alces alces_)
SH -	sheep (_Ovis dalli_)
CN -	canid (_Canis_ sp.)
WV -	wolverine (_Gulo gulo_)
GS -	ground squirrel (_Spermophilus parryi_)
HA -	hare (_Lepus americanus_)
VL -	vole (_Microtus_ sp.)
PT -	ptarmigan (_Lagopus_ sp.)
M-L -	medium-large mammal
S-M -	small-medium mammal
MA -	mammal
B -	bird

[b] The MNI for each species at each site is 1, except for sites with caribou specimens followed by an asterisk (*). The MNI for caribou at these sites is as follows: TLM 059 = 2, TLM 065 = 8, TLM 184 = 3, TLM 220 = 2, TLM 222 = 3, and TLM 234 = 2.

** Paleontological site

Identifiable caribou bone fragments become more frequent above the paleosol separating the Watana and Oshetna tephras. Fifty-eight calcined fragments, primarily from TLM 184, were recovered from the unoxidized Watana and 92 fragments were recovered from the oxidized Watana tephra at several sites, including TLM 038, TLM 142, TLM 184, TLM 220, TLM 229, etc. The greatest frequency of caribou bones, however, was situated in the stratigraphic units above the Devil tephra, and account for 69% of all identified caribou bone specimens. Less than 20% of these bones above the Devil tephra were burned. Again, differential preservation appears to be responsible for the greater frequency of identified specimens from the upper stratigraphic units.

After caribou, moose is the second-best represented species, found at nine sites in the project area (Table 8.14). One of the sites, TLM 196, is a paleontological site where five mandibular fragments of what is probably a Late Pleistocene moose were recovered in a redeposited context (see TLM 196 in Appendix D). With the exception of these non-archeological specimens, none of the moose fragments occurred in an unambiguous stratigraphic context below the organic silt. Although it is possible that moose bones found at TLM 022 and TLM 252 and attributed to the "Devil and above" and "other" categories, respectively, may represent earlier evidence for the animal, it appears that moose did not become an important subsistence resource in the Susitna River valley until sometime after 1400 years B.P. (lower limiting date of the organic silt). If moose did inhabit the area at an earlier date (see section 4.8, b, iii for discussion), preservation factors and sampling error could account for the absence of their remains. The date of 370 ± 80 years B.P., obtained from a charcoal sample at TLM 250 (Table 8.1) where an unburned long bone shaft fragment of a probable moose was recovered, does not chronologically bracket moose exploitation in the area because of the uncertain association between the bone and the rest of the faunal material and charcoal at the site.

All other identified species occurred in very low frequencies and were often recovered from unclear stratigraphic contexts (stratigraphic position defined as "other"). In addition to caribou and moose, species categorized as "other" included Dall sheep, wolverine, ground squirrel, snowshoe hare, and ptarmigan. The nine calcined Dall sheep specimens (all extremity fragments) were found at TLM 250 and radiocarbon dated at 370 ± 80 years B.P. (Table 8.1). All the wolverine specimens (64 various unburned skeletal elements from a burial of the animal) came from TLM 178, and were associated with an historic cabin, which indicates the recency of the interment. The unburned specimens of ground squirrel (TLM 045), snowshoe hare (TLM 049), and ptarmigan (TLM 016), also categorized as "other", appear to be intrusive to the sites at which they were found. Two vole cranial specimens found within the oxidized Watana tephra at TLM 038 are also considered to be intrusive because they were the only unburned fragments within a stratigraphic unit primarily containing calcined bone.

Three canid bone fragments were identified by H.P. Uerpmann, who based his determination of species for these specimens on both size and morphology. One calcined fragment, tentatively identified as a wolf phalanx, occurred in the oxidized Watana tephra in association with caribou bone fragments at TLM 220. The only other evidence for canids was found at TLM 234, where two unburned radius and tibia fragments, representing either dog or coyote, occurred in the organic silt. Also found in the same stratigraphic postion at TLM 234 were three unburned fragments attributable to ground squirrel. The best evidence for ground squirrel being utilized as a food resource occurred at TLM 022, where a calcined mandible of this rodent was found within a hearth feature in association with moose and caribou bones. Completing the faunal inventory are four unidentified bird bone fragments, two of which may actually represent the fragmentary remains of small mammals. All are calcined and their association with other calcined bone fragments suggests that the birds were being utilized as food.

Quantifying faunal remains on the basis of number of identified specimens, as discussed above, is one method of assessing the relative importance of various species at archeological sites. Another method involves determining the MNI per species, and is generally based upon counts of the most numerous skeletal elements and determination of the minimum number of individuals from which they were derived. Other factors such as skeletal age (adult vs. immature) and wear patterns on the teeth are also considered. The method of aggregating specimens, i.e., by stratigraphic unit, by cultural component, or by complete site, can greatly affect the MNI count. The problems associated with establishing the proper unit of aggregation have been discussed in depth by Grayson (1973, 1979). For sites in the project area, many of which have been disturbed by cryoturbation and the resultant stratigraphic displacement of cultural remains, the unit of specimen aggregation has been the cultural component. With the exception of caribou, the MNI for all species at all site components has been determined to be 1. As examples, only one individual Dall sheep is represented at the TLM 250 cultural component, and only one individual moose per site is represented at TLM 022, TLM 072, TLM 032, etc. (all of which are single component sites). The low MNI is a function of the scarcity of identified specimens for these species, and possibly reflects the small sample size of material recovered archeologically.

Of the 46 sites with identified caribou bones, six were determined to have an MNI of greater than 1 (see Table 8.14). Two of the sites, TLM 059 and TLM 234, had single components and an MNI of 2, while the third single component site, TLM 065, preserved evidence for at least eight individual caribou. The MNI determination at TLM 065 was based on the stage of dental eruption and wear patterns on the numerous teeth recovered from the site. The remaining three sites all contained caribou bones within two separate cultural components. An MNI of 1 was evident for each component at TLM 220 while both TLM 184 and TLM 222 had a total MNI of 3. At TLM 222, the distinction between two of the individuals was made on the basis of skeletal age, i.e., the bones of an adult and a fetal caribou were both present.

(c) Bone Processing

Evidence for various types of bone processing can often be found by analyzing the condition and context of bone debris discarded at archeological sites. The most apparent type of processing is burning which results in a loss of much of the organic matter in the bone and a change in its physical properties. The difference between a heavily burned (charred) or calcined (chalky, white appearance) bone and one that is unburned is quite obvious. Other types of processing, such as dismembering and butchering a carcass, can also leave traces on the bone itself which are easily detectable unless the bone has been subsequently finely fragmented or burned. The modification of bone into tools is often more difficult to discern and can be confused with natural modification as a result of carnivore fracturing or rodent gnawing or postdepositional trampling (see Dixon 1984b; Lyman 1984). Finally, the context of the bone fragments, such as in a hearth or cache pit, and the presence or absence of particular skeletal components (e.g., skull, limbs, extremities) are other useful indicators of bone processing activities at a site.

Virtually all sites with bone preservation contained small burned or calcined fragments. This was even true for sites such as TLM 065, TLM 220, or TLM 234, where unburned bone was predominant. Simply roasting or boiling the meat and attached bone of a game animal produces brittle and perhaps porous bone (Chaplin 1971:15), but not the finely fragmented, charred or calcined fragments which were recovered. Processing activities which could account for this condition are disposal of bone refuse in hearths and use of bone as fuel. Ethnographic examples exist for both of these activities. The Ahtna were known to burn the bones of meat animals, such as caribou, sheep, and moose as a ritual observance (de Laguna and McClellan 1981:648), and the Nunamiut Eskimos have been documented to use caribou bone as fuel at sites which are at elevations above willow line (Binford 1978:292, 350, 411). The Nunamiut also pile and burn bone debris at processing sites located adjacent to areas where meat is to be cached, in order to prevent flies from infesting it (Binford 1978:461). The archeological evidence in all these cases is calcined bone fragments.

The production of bone grease by boiling cracked bone in water and skimming the fat from the top was a widespread practice among many groups of native Americans (Jenness 1922; Leechman 1951; Vehik 1977;

Bonnichsen 1973; Binford 1978). The archeological evidence for this activity would either be "many small pieces of unburned animal bone" (Vehik 1977:172) or "a large pile of pulverized bone approaching the appearance of bone meal" (Binford 1978:159). Certainly, the fragments used in bone grease manufacture could later have been discarded into the fire, and subsequently have become calcined. Although this type of activity could be inferred to explain the presence of some of the more finely fragmented specimens at Susitna River sites, it is equally likely that they are the result of bone disposal after meat processing and caching, ritual disposal of game animal bones, or simply the use of bones as fuel. On the whole, the type of activity which produced the burned or calcined fragments must be inferred on a case by case basis and cannot be generalized for all the sites in the project area. The same is true for small unburned fragments, which could represent activities such as bone grease manufacture, marrow extraction, or tool manufacture, depending on the characteristics of the fragments and their context within the site.

The possibilities for analysis are greater when identifiable elements are preserved at a site. Tabulation of the presence or absence of various skeletal components of game species, such as caribou and moose, is useful for interpreting the types of bone processing activities which took place, i.e., dismemberment and butchery, bone grease manufacture, marrow extraction, etc. For example, the skeletal components found at kill sites might include bulky, low meat-yield elements, such as the skull, atlas and axis vertebrae, and lower limb bones that were not transported to another site for further processing, caching, or consumption. Abandonment of such bones at moose kill sites has been documented for Athapaskan groups, including the Chippewyans of northern Canada (Jarvenpa and Brumbach 1983) and the Koyukon of Interior Alaska (Nelson 1973).

Ethnographic analogy can be used as a model for determining the steps in disarticulating a carcass and the sets of anatomical parts which are consumed at the site or transported to another site for further processing. Ethnographic examples of caribou or moose butchery have been presented by McKennan (1965:29) for the Chandalar Kutchin, Nelson et al. (1982:31) for the Koyukon, Hadleigh-West (cited by Yesner 1980:20-21) for the Netsi Kutchin, and Binford (1978) for the Nunamiut Eskimo. Ethnoarcheological models should not be relied upon exclusively, however, as many variables, such as the size of the animal, season, kill location, and personal preference, probably affected the method of butchery (Frison 1982:159). With respect to Koyukon moose kills, Nelson et al. (1982:30) have suggested that field butchery of a moose varies according to the sex and size of the animal, the distance it must be carried, and the need for the hide. Even though different types of bone processing will result in the representation of different skeletal elements at a site, the biasing factors mentioned in the introduction are important to bear in mind before attempting to discern cultural patterns.

The number of identified caribou specimens grouped by skeletal component, i.e., skull and antler, axial, shoulder and pelvis, limbs, and extremities, are listed by stratigraphic unit in Table 8.15. The number of specimens in each component represent bone fragments, not individual bones. The total number of bones in each skeletal component differs, with the axial skeleton (ribs, sternum, and vertebrae) and extremities (carpals, tarsals, metapodials, sesamoids, and phalanges) being comprised of more bones than are found in any of the other categories. Even with this in mind, the percentage of extremity fragments, 52.91% of the total number of identified specimens, is greater than would be expected on an anatomical basis. This apparent over-representation is believed to be a function of preservation and identifiability of extremities rather than evidence for bone processing. The preservation factor is particularly obvious when comparing the ratio of extremity specimens to the total number of identified specimens in the stratigraphic units with good bone preservation (above the Devil tephra) to those with poor preservation (Devil tephra and below). Excluding the combined or unknown stratigraphic proveniences, the ratios are 298 extremities to 664 total specimens from above the Devil tephra, and 143 extremities to 179 total specimens from the Devil tephra to the drift. In other words, in the upper stratigraphic units there is a much

Table 8.15. Number of Caribou Specimens per Skeletal Component by Stratigraphic Unit

Stratigraphic Position (Unit)	Skull and Antler	Axial	Shoulder and Pelvis	Limbs	Extrem-ities	Total
Surface (1)	3	9	2	19	14	47
Organics (2)	0	1	2	5	7	15
Organic Silt (4)	90	57	22	110	203	482
Eolian Silt (5)	1	14	4	14	71	104
Buried Organic Silt (5)	10	0	2	1	3	16
Subtotal:						
Above Devil tephra	104	81	32	149	298	664
(Percentage)	(15.66)	(12.20)	(4.82)	(22.44)	(44.88)	(100.00)

Table 8.15. (Continued)

Stratigraphic Position (Unit)	Skull and Antler	Axial	Shoulder and Pelvis	Limbs	Extrem-ities	Total
Devil tephra (6)	3	0	0	1	7	11
Eolian Silt (7)	1	0	0	1	7	9
Oxidized Watana tephra (8)	10	5	0	5	72	92
Unoxidized Watana tephra (10)	1	2	0	0	55	58
Palesol (11)	2	0	0	0	0	2
Eolian Silt (13)	0	0	0	0	1	1
Drift (14)	0	5	0	0	1	6
Subtotal:						
Devil tephra through drift	17	12	0	7	143	179
(Percentages)	(9.50)	(6.70)	(0.00)	(3.91)	(79.89)	(100.00)

Table 8.15. (Continued)

Stratigraphic Position (Unit)	Skull and Antler	Axial	Shoulder and Pelvis	Limbs	Extrem- ities	Total
Devil and Above (2-6)	0	1	0	1	1	3
Watana and Above (2-10)	6	0	0	0	7	13
Oshetna and Above (2-12)	2	1	0	0	1	4
Other	5	9	4	22	59	99
Column Total (Percentages)	134 (13.93)	104 (10.81)	36 (3.74)	179 (18.61)	509 (52.91)	962 (100.00)

greater likelihood of recovering the full range of bones actually deposited by past occupants of a site, and therefore cultural interpretations of bone processing should be limited to sites that have remains in the organic units, above the Devil tephra. Bone scattering and gnawing by carnivores, such as documented at TLM 222, is a further biasing factor to consider.

An interesting pattern emerges when the number of caribou specimens above the Devil tephra are tabulated by skeletal component (see Table 8.15) and compared to percentages of these same components in a complete caribou skeleton. In a complete skeleton the approximate percentages of the various components are as follows: skull and antler (17%), axial (37%), shoulder and pelvis (2%), limbs (7%), and extremities (38%). It should be stressed that these percentages are not entirely comparable to those in the archeological assemblage, which is comprised of fragments, not complete bones. However, the percentage of limb fragments in the archeological assemblage (22.44%) is much greater than would be expected on an anatomical basis, while the percentage of axial fragments (12.20%) is much lower. One explanation for these discrepancies is differential processing and transport of axial skeletal elements and limb bones. While heavy limb bones may have been filleted and discarded at the site, rib slabs may have been carried away, thus resulting in their under-representation in the assemblage. Another explanation for the discrepancy in the percentages of the axial component is that ribs are difficult to positively identify as to species, and caribou ribs may have been classified only as medium-large mammals. In such a case, the low frequency of ribs would be an artifact of analysis and not an artifact of butchery practices. Site by site analysis is necessary to verify either of these tentative explanations.

Butchering involves a sequence of steps, all of which leave characteristic traces on the bone. These steps include skinning, dismemberment, filleting, and marrow extraction. Dismemberment may result in cut marks on the articular surfaces of bones, while filleting is most recognizable by the longitudinally oriented cut marks on anterior and posterior bone surfaces (Binford 1981:128-129). Butchery marks appeared on bone fragments from 19 sites in the project area. Each of the specimens is listed in Table 8.16. Many of the cut marks appeared on unidentified, calcined fragments, so interpretation of the significance of the marks is limited. Three identified moose bone fragments, an axis, a vertebral facet, and a mandible, had evidence of butchery. Marks on both vertebral elements can probably be attributed to dismemberment of the carcass, according to the inventory of butchery marks compiled by Binford (1981:136-142). The carving marks (several non-parallel striations) on the mandibular condyle may either be associated with dismemberment or filleting.

Evidence for butchery marks on caribou bones was found on nine specimens from eight different sites (see Table 8.16). A metal tool cut mark was observed on an antler fragment from TLM 220. Metal tools leave clean cuts, distinguished by an overlapping small shelf of bone (or antler) that remains on the specimen. The cut marks on the three innominate fragments may have resulted from either dismemberment or filleting, while the location of the marks on the distal condyles of the metapodial fragment indicate dismemberment (Binford 1981:136-142). Cut marks on the three phalangeal fragments may represent skinning, as Binford (1981:126) has suggested that great pains were taken by Eskimos when skinning the feet of animals if the skins were to be used for making certain articles of clothing, such as mukluks and socks. The types of butchery suggested above are only tentative interpretations based on limited survey data. The pattern of butchering an animal cannot be based on a few isolated specimens, and must be determined on a site by site, rather than on inter-site bases.

The final category of bone processing to be mentioned is bone tool manufacture. Only six sites produced evidence for bone tools, tool fragments, or debitage from tool manufacture. Occupation at these sites (TLM 022, TLM 065, TLM 220, TLM 222, TLM 232, And TLM 252) was associated with the uppermost stratigraphic units. The specimens from these sites are described in Table 8.17. Fragments identifiable as distinct tools include a beamer fragment manufactured from a caribou metapodial, a unilaterally barbed point base, and an awl. The other

Table 8.16. Faunal Specimens with Butchery Marks

AHRS Number	Accession Number	Description	Comments
TLM 022	UA84-122-2	Vertebral facet epiphysis, unburned, probably moose (_Alces alces_)	cut marks
		Long bone fragment, unburned large mammal	cut mark
TLM 030	UA83-130-2678	Unidentifiable fragment, calcined, medium-large mammal	cut mark
TLM 043	UA81-221-65	Medial phalanx fragment, unburned, caribou (_Rangifer tarandus_)	cut marks
TLM 050	UA80-157-7	Proximal fragment proximal phalanx, calcined, caribou (_Rangifer tarandus_)	cut mark
TLM 059	UA81-205-15	Unidentifiable fragment, calcined, medium-large mammal	possible cut mark
	UA81-205-32	Long bone fragment, burned, medium-large mammal	cut marks

Table 8.16. (Continued)

AHRS Number	Accession Number	Description	Comments
TLM 062	UA81-208-95	Unidentifiable fragment, calcined, medium-large mammal	possible cut marks
TLM 065	UA84-238-18	Right metapodial (hindlimb) distal end, unburned, caribou (*Rangifer tarandus*)	cut marks
TLM 069	UA83-131-59	Unidentifiable fragment, calcined, medium-large mammal	cut marks
TLM 089	UA81-247-75	Unidentifiable fragment, calcined, medium-large mammal	cut mark
TLM 097	UA83-224-89	Left innominate (ischium) fragment, unburned, caribou (*Rangifer tarandus*)	cut marks
TLM 184	UA83-110-702	Unidentifiable fragment, calcined, medium-large mammal	possible cut marks
TLM 215	UA83-227-12	Long bone fragment, calcined, medium-large mammal	cut marks

Table 8.16. (Continued)

AHRS Number	Accession Number	Description	Comments
TLM 220	UA84-60-148	Antler fragment, unburned, caribou (Rangifer tarandus)	metal tool cut marks
	UA84-60-165	Long bone fragment, unburned, medium-large mammal	possible opposing cut marks
	UA84-60-169	Lumbar vertebra, weathered, caribou (Rangifer tarandus)	deep "impact mark"
TLM 222	UA84-69-50	Unidentifiable fragment, calcined, medium-large mammal	possible cut marks
	UA84-69-190	Innominate fragment, unburned, caribou (Rangifer tarandus)	cut marks
	UA84-69-238	Thoracic vertebra spinous process, unburned, large mammal	possible cut mark
TLM 232	UA84-84-11	Left innominate fragment, unburned, caribou (Rangifer tarandus)	cut marks
TLM 242	UA84-99-7	Proximal phalanx distal end, calcined, caribou (Rangifer tarandus)	cut marks

Table 8.16. (Continued)

AHRS Number	Accession Number	Description	Comments
TLM 247	UA84-133-17	Axis, immature, moose (Alces alces)	possible cut mark
TLM 252	UA84-142-1	Right mandible fragment, (coronoid process and condyle), unburned, moose (Alces alces)	pronounced cut marks
	UA84-142-6	Long bone fragment, calcined, medium-large mammal	polished
	UA84-142-22	Unidentifiable fragment, heavily burned, large mammal	polished
TLM 253	UA84-217-22	Long bone fragment, calcined, medium-large mammal	cut marks

Table 8.17. Bone Tools, Tool Fragments, and Debitage from Tool Manufacture

AHRS Number	Accession Number	Description	Comments
TLM 022	UA84-122-2	Unidentifiable fragment with striations, unburned, probably moose (_Alces alces_)	possible tool fragment
TLM 065	UA84-238-65	Left metapodial shaft fragment, unburned, caribou (_Rangifer tarandus_)	possible tool
TLM 220	UA84-60-28 and UA84-60-75 (articulate)	Right metapodial (hindlimb) fragments, unburned, caribou (_Rangifer tarandus_)	beamer fragments
	UA84-60-76	Left metapodial shaft fragment, unburned, caribou (_Rangifer tarandus_)	bone debitage
	UA84-60-139	2 bone fragments, unburned, large mammal	bone point fragments
	UA84-60-148	Antler fragment, unburned, caribou (_Rangifer tarandus_)	antler debitage
TLM 222	UA84069-193	Antler fragment, with lateral incisions, calcined, medium-large mammal	tool

Table 8.17. (Continued)

AHRS Number	Accession Number	Description	Comments
TLM 232	UA84-84-7	Right radius fragment, longitudinally split, unburned, caribou (Rangifer tarandus)	culturally split
	UA84-84-16	Longbone fragment, calcined, medium-large mammal	tool
	UA84-84-32 and UA84-84-33 (articulate)	Longbone fragments, unburned, medium-large mammal	awl
	UA84-84-39	Proximal shaft of radius, unburned, caribou (Rangifer tarandus)	possible tool
TLM 252	UA84-142-33	4 cylindrical bone fragments, calcined, medium-large mammal	tool fragments

specimens described as tools or possible tools had only slight evidence of modification and could not be characterized by tool type. The longitudinally split caribou radius fragment may be classified as a bone core, such as the type described by Le Blanc (1984:307), and used as a blank in tool manufacture. Although all the bone cores Le Blanc described were made from caribou metapodials, he does not rule out the possibility of other skeletal elements serving the same purpose (Le Blanc 1984:314). Bone and antler debitage, presumably the by-product of tool manufacture, were represented by two specimens within the assemblage.

(d) Summary

The preceding faunal analysis addresses some very general questions about the nature of faunal utilization on a regional level, and documents the preservation biases inherent in the assemblage. One of the originally stated objectives was to enumerate the species of animals which contributed to the diet and economy of past residents of the area. Certainly, the bulk of the evidence suggests that caribou has been a mainstay of subsistence, at least on a seasonal basis, for several millennia. The earliest remains were found at the Fog Creek site, (TLM 030). A calcined phalanx fragment and molar fragment found at the site and, tentatively identified as caribou, are possibly as old as 5100 years B.P. TLM 143 also produced burned molar fragments and a phalanx fragment of a probable caribou in a stratigraphic unit deposited prior to 4000 years B.P. The evidence for caribou hunting continued upward throughout the stratigraphic sequence, with little indication that other animals played a major role in subsistence until sometime after ca. 1400 years B.P.

On the basis of faunal evidence, moose did not become an important game species until ca. 1400 years B.P. or later. The paleontological specimens of moose at TLM 196 indicate that these large artiodactyls may have been present during the Late Pleistocene, but whether they existed in the Susitna Valley in small numbers or were absent in the area during most of the Holocene is a question that is yet to be resolved. Caribou continued to be the major food resource, even after moose began to be exploited, as documented by the co-occurrence of caribou bones at six of the eight archeological sites where moose bones were recovered. Dall sheep co-occurred with moose at TLM 250, the only site that produced evidence for sheep as a subsistence resource. Dall sheep were known to be frequently hunted by the Ahtna in mountainous habitat adjacent to the Susitna River. The scarcity of their remains may be a function of the relatively low elevation of the sites recorded during the archeological survey, although sheep are known to descend from the mountains into the project area to use mineral licks.

Three of the other species identified during analysis, snowshoe hare, ptarmigan, and vole, were concluded to be intrusive, primarily because the fragments of these species were unburned and apparently not associated with the cultural remains at the sites where they were excavated. Ground squirrel also appears to be intrusive at one and possibly two sites, but evidence at TLM 022 suggests that these rodents could have been utilized for food. Very scarce evidence (four bone fragments) also exists for the taking of birds as subsistence items. The economic importance of fur-bearers during the historic trapping era is borne out by the partial wolverine skeleton interred adjacent to an historic cabin at TLM 178. Three fragmentary remains of canids, one phalanx of a probable wolf and the unburned limb bones of a dog or coyote, complete the inventory of faunal species.

Evidence for caribou and moose butchery, possibly including skinning, carcass dismemberment, and filleting, as well as evidence for bone tool manufacture, was found at a few sites with occupations in the upper (organic) stratigraphic units. Evidence for other types of bone processing, such as bone grease manufacture and marrow extraction, was found to be ambiguous. Another finding was that a preservation bias in favor of extremity elements in the lower stratigraphic units affected the relative frequencies of identified caribou specimens, thus skewing possible interpretations of bone processing based on the presence or absence of particular skeletal components. Although a range of bone processing activities has been suggested for the region, further study of each site is necessary before these interpretations are made.

8.5 - Site Setting Analysis

The analysis of the environmental setting of sites is a complex task which involves not only identification of meaningful criteria for site setting classification, but also determination of how each site fits into the classification framework. For example, numerous sites occur adjacent to the confluences of clear water tributaries and the Susitna River, yet they are situated on different types of landforms which range from flood plain deposits to glacial kames. It is important to remember that geomorphic terminology is based largely on an understanding of the formation process attributed to various topographic features. These classificatory units were not employed by early inhabitants of the region and probably held little significance to them in selecting specific sites. The common characteristic which is important for human use and which is shared by these types of landforms is that they are comparatively flat, well-drained surfaces. The most meaningful criteria for classification of site setting are those which directly relate to the potential of an area for human ocupation, i.e., access to water, a good vantage point, access to game, etc.

The presence or absence of major environmental features was recorded for each site by project personnel through the course of the field research. These data, coupled with map and air photo interpretation, were used in the construction of an environmentally relevant site classification. Nine types of settings were defined in which sites occur throughout the project area: 1) overlooks, 2) lake margins, 3) stream margins, 4) river margins, 5) confluence of a stream with a river, 6) confluence of a stream with a stream, 7) natural topographic constrictions, 8) mineral licks, and 9) quarries. Caves and rockshelters were included in the research design as likely to yield archeological sites, but the one rockshelter located within the project area proved to be culturally sterile.

While most of the settings are self explanatory, some require elaboration. Overlooks are physical settings with higher topographic relief than much of the surrounding terrain and command good views of the adjacent area. Streams are defined as the clear water tributaries to the two major silt-laden rivers (the Susitna and Oshetna) within the project area. Natural topographic constrictions are locations where steep-walled mountains or buttes converge and funnel large mammal movements between them. Mineral licks are natural geologic exposures containing minerals, primarily sodium, which are desired and consumed by large mammals.

The setting of each site is listed in Table 8.18 according to the nine variables defined above. Proximity of a site to a given variable is generally less than 1 km. Overlooks are found to be the preferred site setting, with 88.44% of all sites falling within this category. However, the nine types of settings are not mutually exclusive and 70.30% of the sites occur in settings which exhibit two or more of the defined variables. When taking into consideration the co-occurrence of site variables, five major types of setting are apparent: 1) overlooks associated with a body of water, 2) overlooks not associated with another variable, 3) mineral licks (also associated with overlooks or overlooks and a body of water), 4) natural topographic constrictions (also associated with overlooks or overlooks and a body of water), and 5) nonoverlooks associated with bodies of water. Theses five setting types encompass all sites within the project area with the exception of one quarry site adjacent to the Susitna River. The number and frequency of sites occurring in these settings are listed below.

Setting	N	Percent of Total Sites
Overlooks with water	123	46.9
Overlooks	58	22.1
Mineral licks	22	8.4
Natural Topographic Constriction	33	12.6
Nonoverlooks with water	26	9.9

Table 8.18.

Sites Classified by Environmental Setting

Site Number	Over-look	Lake Margin	Stream Margin	River Margin	Stream/ River Conflu-ence	Stream/ Stream Conflu-ence	Natural Topo-graphic Constric-tion	Mineral Lick	Quarry
TLM 016	X	X							
TLM 017	X								
TLM 018	X								
TLM 020					X				
TLM 021A	X					X			
TLM 021B	X					X			
TLM 021C	X					X			
TLM 022					X				
TLM 023					X				
TLM 024	X		X						
TLM 025	X								
TLM 026	X			X					
TLM 027	X				X				
TLM 028	X			X					
TLM 029	X				X				
TLM 030	X				X				
TLM 031	X								
TLM 032	X	X							
TLM 033	X				X				
TLM 034	X	X							
TLM 035	X		X						
TLM 036	X								
TLM 037	X								
TLM 038	X		X						
TLM 039	X	X							
TLM 040	X			X					
TLM 041	X								
TLM 042	X			X					
TLM 043					X				
TLM 044	X								
TLM 045A	X								
TLM 045B	X								
TLM 046	X								
TLM 047	X	X							
TLM 048	X	X							
TLM 049	X			X					
TLM 050					X				
TLM 051	X	X							
TLM 052A	X								
TLM 052B	X								
TLM 053	X								
TLM 054	X					X			
TLM 055	X					X	X		
TLM 056			X				X		
TLM 057	X	X							
TLM 058	X				X				
TLM 059	X								

Table 8.18. (Continued)

Site Number	Over-look	Lake Margin	Stream Margin	River Margin	Stream/ River Conflu-ence	Stream/ Stream Conflu-ence	Natural Topo-graphic Constric-tion	Mineral Lick	Quarry
TLM 060	X	X							
TLM 061	X					X			
TLM 062	X			X					
TLM 063	X			X					
TLM 064A	X								
TLM 064B	X								
TLM 065A	X		X						
TLM 065B	X		X						
TLM 065C	X		X						
TLM 066	X								
TLM 067	X								
TLM 068	X								
TLM 069	X	X							
TLM 070	X								
TLM 071						X			
TLM 072				X					
TLM 073					X				
TLM 074	X			X					
TLM 075A	X								
TLM 075B	X								
TLM 076	X	X			X				
TLM 077	X		X						
TLM 078	X		X				X		
TLM 079					X				
TLM 080					X				
TLM 081	X		X				X		
TLM 082	X								
TLM 083	X		X				X		
TLM 084	X		X				X		
TLM 085	X		X				X		
TLM 086	X					X	X		
TLM 087	X		X				X		
TLM 088	X		X				X		
TLM 089	X						X		
TLM 090	X						X		
TLM 091	X						X		
TLM 092	X	X					X		
TLM 093	X	X					X		
TLM 094	X		X				X		
TLM 095	X		X				X		
TLM 096	X		X				X		
TLM 097	X					X	X		
TLM 098	X		X				X		
TLM 099	X		X				X		
TLM 100A	X	X							
TLM 100B	X	X							
TLM 101	X					X			
TLM 102	X			X					
TLM 103	X			X					

Table 8.18. (Continued)

Site Number	Over-look	Lake Margin	Stream Margin	River Margin	Stream/ River Conflu-ence	Stream/ Stream Conflu-ence	Natural Topo-graphic Constric-tion	Mineral Lick	Quarry
TLM 104	X	X							
TLM 105	X	X	X						
TLM 106	X		X						
TLM 107	X		X						
TLM 108	X					X			
TLM 109	X	X							
TLM 110	X	X							
TLM 111	X	X							
TLM 112	X		X						
TLM 113	X		X						
TLM 114	X					X			
TLM 115	X								
TLM 116	X								
TLM 117	X		X				X		
TLM 118	X	X							
TLM 119	X		X						
TLM 120	X								
TLM 121	X								
TLM 122	X								
TLM 123	X								
TLM 124	X								
TLM 125	X								
TLM 126	X								
TLM 127	X		X						
TLM 128	X							X	
TLM 129A	X								
TLM 129B	X								
TLM 130	X								
TLM 131	X								
TLM 132	X								
TLM 133	X								
TLM 134	X		X					X	
TLM 135	X		X					X	
TLM 136	X		X					X	
TLM 137	X								
TLM 138	X							X	
TLM 139	X		X					X	
TLM 140	X		X					X	
TLM 141	X							X	
TLM 142	X							X	
TLM 143	X		X					X	
TLM 144	X		X					X	
TLM 145	X		X					X	
TLM 146	X							X	
TLM 147	X							X	
TLM 148	X		X					X	
TLM 149	X							X	
TLM 150	X							X	
TLM 151	X							X	

Table 8.18. (Continued)

Site Number	Over-look	Lake Margin	Stream Margin	River Margin	Stream/River Conflu-ence	Stream/Stream Conflu-ence	Natural Topo-graphic Constric-tion	Mineral Lick	Quarry
TLM 152	X	X							
TLM 153	X		X						
TLM 154	X	X							
TLM 155	X						X		
TLM 159	X					X			
TLM 160	X	X							
TLM 164	X	X	X						
TLM 165	X								
TLM 166	X								
TLM 167	X								
TLM 168	X						X		
TLM 169	X		X						
TLM 170	X		X						
TLM 171	X	X							
TLM 172	X	X							
TLM 173A	X			X					
TLM 173B	X			X					
TLM 173C	X			X					
TLM 174	X	X							
TLM 175	X	X	X						
TLM 176	X					X	X		
TLM 177	X								
TLM 178				X					
TLM 179	X					X			
TLM 180	X		X						
TLM 181	X		X						
TLM 182	X		X						
TLM 183	X								
TLM 184	X								
TLM 185	X			X					
TLM 186	X					X			
TLM 187	X					X			
TLM 188	X	X							
TLM 189	X			X					
TLM 190	X			X					
TLM 191	X	X	X						
TLM 192	X								
TLM 193	X	X	X						
TLM 194	X			X					
TLM 195	X	X	X						
TLM 197	X	X							
TLM 198	X		X						
TLM 199	X				X				
TLM 200	X				X				
TLM 201	X		X						
TLM 202	X					X	X		
TLM 203	X					X	X		
TLM 204	X								
TLM 205	X		X					X	

Table 8.18. (Continued)

Site Number	Over-look	Lake Margin	Stream Margin	River Margin	Stream/River Conflu-ence	Stream/Stream Conflu-ence	Natural Topo-graphic Constric-tion	Mineral Lick	Quarry
TLM 206	X			X					
TLM 207					X				
TLM 208	X	X							
TLM 209	X		X				X		
TLM 210	X		X				X		
TLM 211	X		X				X		
TLM 212			X						
TLM 213	X		X				X		
TLM 214A	X		X				X		
TLM 214B	X		X				X		
TLM 215	X								
TLM 216	X	X							
TLM 217	X		X						
TLM 218	X					X			
TLM 219	X		X						
TLM 220	X								
TLM 221	X								
TLM 222	X		X						
TLM 223	X		X						
TLM 224	X								
TLM 225	X								
TLM 226	X		X						
TLM 227	X								
TLM 228	X	X	X						
TLM 229	X								
TLM 230	X				X				
TLM 231	X		X						
TLM 232					X				
TLM 233					X				
TLM 234	X								
TLM 235	X		X						
TLM 236	X					X			
TLM 237	X		X						
TLM 238	X		X						
TLM 239	X				X				
TLM 240					X				
TLM 241	X			X					
TLM 242	X		X						
TLM 243	X		X						
TLM 244	X								
TLM 245	X		X						
TLM 246	X				X				
TLM 247	X				X				
TLM 248			X						
TLM 249					X				
TLM 250					X				
TLM 251				X					
TLM 252				X					
TLM 253				X					

Table 8.18. (Continued)

Site Number	Over-look	Lake Margin	Stream Margin	River Margin	Stream/ River Conflu-ence	Stream/ Stream Conflu-ence	Natural Topo-graphic Constric-tion	Mineral Lick	Quarry
TLM 256				X					
TLM 257					X				
TLM 258					X				
TLM 259				X					X
HEA 174	X	X							
HEA 175	X	X	X						
HEA 176	X	X	X						
HEA 177	X								
HEA 178	X	X							
HEA 179	X	X							
HEA 180	X		X						
HEA 181	X	X	X						
HEA 182	X					X			
HEA 183	X	X						X	
HEA 184	X	X						X	
HEA 185	X	X	X					X	
HEA 186	X		X						
HEA 210	X		X						
HEA 211	X					X			
TOTAL	235	46	79	26	28	23	33	22	1

Overlooks are excellent locales from which to hunt large mammals. From such elevated settings hunters can ascertain the presence of large mammals within the area, monitor their movements, and formulate intercept routes. The fact that the majority of sites within the project area occur in overlook settings indicates the importance of large mammal hunting in prehistoric subsistence strategies throughout the project area. The most favored types of locales (46.9%) for human occupation and use are overlooks which are associated with a body of water. Such settings were probably favored because of the combined potential to exploit freshwater aquatic resources with large mammal hunting at a single locale. Additionally, they provide sources of fresh water for utilitarian purposes.

Mineral licks and natural topographic constrictions are appropriate features to use in predicting the presence of large mammals within a restricted geographic area. The importance of such settings in terms of resource exploitation within the project area is documented by the fact that 21% of the recorded sites occur in association with one or another of these features. If hunting is the primary subsistence activity associated with natural topographic constrictions, mineral licks, and overlooks, then the overwhelming importance of this activity throughout the project area is apparent. Ninety percent of the sites discovered occur in these types of settings. This inference is supported by the fact that virtually all preserved faunal remains associated with cultural occupations at sites occuring within these settings are those of medium to large mammals, although preservation bias favoring skeletal elements of medium to large mammals may contribute to this apparent association.

8.6 - Synopsis of Regional History and Prehistory

(a) Introduction

The majority of sites discovered within the project area are single component sites and exhibit only one recorded interval of human occupation. This fact necessitates that inferences regarding local settlement patterns, population density, resource exploitation, and changes in material culture be drawn from a series of widely scattered sites and site components. To accomplish these tasks each site and site component within the project area was identified temporally and classified, when possible, within one of the five recognized cultural historical periods: 1) Euro-American tradition, 2) Athapaskan tradition, 3) Late Denali complex, 4) Northern Archaic tradition, and 5) American Paleoarctic tradition. Tables for each cultural historical period were compiled. Those presented for the four earliest periods list each site, its setting, observed site size, faunal species present, and associated material cultural remains. The presentation of these tables and the discussion of each cultural historical period is preceded by a brief discussion of how the terms "tradition" and "complex" are employed in this analysis and the limitations of the data from which the tables were compiled. Ambiguous cases in which a particular site or site component could not be ascribed to a specific cultural historical interval based on radiocarbon determinations or their relationship to the regional time stratigraphic units were omitted from the tables.

The term "tradition" as used in this analysis follows Willey and Phillips (1958:37) who define the concept of an archeological tradition as "a (primarily) temporal continuity represented by persistent configurations in technologies or other systems of related forms". More specifically, the regional application of the term follows Anderson (1968a:31), who uses "tradition" to describe "a continuity of cultural traits that persist over a considerable length of time and often occupy a broad geographical area". Anderson further subdivides the concept to include, and subsume, cultural complexes which are spatially and temporally more restricted. The term "tradition" is used in this analysis to delineate configurations of associated cultural traits which persist over a broad geographical area, while the term "complex" connotes similar technological cohesiveness but is more restricted chronologically and regionally. As employed in this analysis, the term "complex" corresponds more closely to the concept of "phase" as advanced by Willey and Phillips (1958:22-24). Dumond (1982:39) notes that the beginning and end of a tradition are marked "by a pervasive, systematic change in material culture, and second by a change in economic indicators". Within the project area the preservation of faunal remains is poor below the organic units, thus creating difficulties in identifying important changes in economic indicators. However, one method by which such shifts in economic indicators may be discerned in either the presence or absence of identifiable faunal remains is an analysis of the environmental setting, size, and artifact assemblages of the discovered sites.

In many cases it is impossible to attribute specific components to specific cultural historic periods in the absence of radiocarbon determinations and where regional time-stratigraphic horizon markers are absent, poorly represented, or discontinuous. Additionally, at two multicomponent sites (TLM 030 and TLM 143) it was only possible to define site size for the largest component. Only the observed site size was used for the largest component in the following analysis, because of an inability to accurately define the spatial limits of the smaller components. The reader is therefore cautioned that these inferences are drawn from survey data, which in many cases is derived only from shovel tests or from a single 1 x 1 m test square. Survey data only provide a small window into the past. Future excavation of the sites under consideration may expand the range of material culture within specific temporal intervals and more accurately define, or redefine, the age and nature of the components present.

(b) Euro-American Tradition: ca. A.D. 1900 - present

The ten sites ascribed to the Euro-American tradition occur in the project area on the modern ground surface. They were identified by the presence of cabins, either standing or collapsed, and are characterized by artifacts of Euro-American manufacture. Two exceptions are a possible grave (TLM 248) attributed to an early miner and a rock inscription (TLM 020). Because of the surface context of the remaining eight sites, their size could be accurately estimated by surficial observation of artifact distributions without subsurface testing. Table 8.19 lists the sites ascribed to the Euro-American tradition, their observed site size, and their environmental setting. The Euro-American tradition can be temporally bracketed within the study area from historical sources (chapter 3) to between ca. 1900 A.D. and the present.

With one exception, these sites do not occur on overlooks. With the exception of the Corps of Engineers camp (TLM 204) associated with the development of the area's hydroelectric potential, all these sites occur in low-topographic settings which reflect the major economic activities of trapping and placer mining in the area during the Euro-American period. It is inferred that this shift in settlement pattern reflects a persuasive shift in the economic activities within the project area shortly after the replacement of resident Athapaskan populations by Euro-Americans. The environmental setting of sites dating to this period is markedly different than earlier times when large mammal hunting appears to be the most important economic focus within the region. These low-topographic settings were probably favored because: 1) of proximity to the resources being exploited - placer gold and fur bearers, 2) to facilitate travel along frozen waterways during winter, and 3) of adequate supplies of wood for heat. The mean site size of sites ascribed to the Euro-American tradition, exclusive of the Corps of Engineers camp and the rock inscription, is 460 square meters. Settlements are restricted to single cabins and associated outbuildings.

Table 8.19 European-American Tradition Sites

AHRS-No.	Site Size (m²)	Setting
TLM 020	1	Stream/river confluence
TLM 023	90	Stream/river confluence
TLM 056	225	Stream margin; NTC*
TLM 071	960	Stream/stream confluence
TLM 079	2100	Stream/river confluence
TLM 080	36	Stream/river confluence
TLM 178	150	River margin
TLM 204	4900	Overlook
TLM 212	96	Stream margin
TLM 248	25	Stream margin

* NTC = Natural Topographic Constriction

(c) Athapaskan Tradition: ca. 1500 B.P. - ca. 100 B.P.

The Middle Susitna drainage was occupied by Western Ahtna Athapaskans (chapter 3) at the time of contact with Euro-Americans. Through implementation of the direct historic approach (Wedel 1938; Steward 1942; Workman 1977a), it is possible to trace through time Athapaskan occupation of the project area. Sites dating to this interval occur within and above the Devil tephra (stratigraphic horizons 2, 3, 4, and 5). The lower limiting radiocarbon date for stratigraphic horizon 5 is ca. 1400 years B.P. (Table 8.1). In the absence of this regional time-stratigraphic marker, sites can be ascribed to this tradition based on radiocarbon determinations. It is further possible to separate sites within this tradition into two phases based on the presence of trade goods of Euro-American manufacture, which probably began to enter the area through indirect trade by at least A.D. 1750. Thus a late phase may be identified which can be dated between ca. 50 - 200 B.P. where trade goods are present.

In addition to Euro-American trade goods which characterize the later phase of the tradition, the material cultural assemblage is characterized by the following artifact types: 1) tci thos, 2) high frequencies of thermally altered rock, 3) flake cores, 4) bifaces, 5) scrapers, 6) modified and unmodified flakes, 7) artifacts manufactured from native copper, 8) conical-based bone projectile points, 9) bone fleshers, 10) straight-based lanceolate points 11) hammerstones, 12) cobble fragments, and 13) a single preform and a rejuvenation flake. A variety of features have been recognized at sites ascribed to the Athapaskan tradition. These include: 1) hearths, 2) small circular depressions - probably cache pits, 3) rectangular depressions - probably small house pits, 4) large circular depressions - probably house pits, and 5) a single human coffin burial ascribed to the late phase of the tradition.

During the Athapaskan tradition red ochre was used, probably as a pigment to decorate material cultural items and/or as body paint. The high frequencies of thermally altered rock common in many of the sites may suggest stone boiling for the preparation of food, a technique commonly employed by Native North Americans in the absence of ceramic cooking vessels. It may also indicate the frequent use of steam baths by fire heating rocks and sprinkling water on them after transporting them into a sweat lodge.

Table 8.20 lists the sites and site loci ascribed to the Athapaskan tradition and presents the observed site size, environmental setting, faunal species, and lithic artifact types which occur at each site. Moose have only been identified at sites ascribed to the Athapaskan tradition and this may suggest that only relatively recently was this species an important subsistence resource. Eight sites contain moose remains, and six of these are located in low-topographic settings while the other two occur on overlooks. Seven of the eight sites occur adjacent to streams or rivers, thus suggesting that during Athapaskan tradition times moose were primarily hunted in low-topographic settings adjacent to rivers and streams. Due to the large size of these animals,

Table 8.20

Sites Ascribed to the Athapaskan Tradition

Site Number	Over-look	Lake Margin	Stream Margin	River Margin	Stream/River Conflu-ence	Stream/Stream Conflu-ence	Natural Topo-graphic Constric-tion	Mineral Lick	Quarry	Faunal Species	Observed Site Size (m²)	Lithic Artifacts
TLM 018	X										171	UF,MF
TLM 021B	X					X					25	--
TLM 022					X					CR,MS,GS	57	UF,TAR,CO
TLM 026	X			X							75	UF
TLM 027	X				X						105	UF
TLM 030	X				X						--	UF,MF,SC,BI,O
TLM 039	X	X									75	UF
TLM 040	X			X							--	UF,TAR
TLM 043					X					CR	--	UF,TAR,CO
TLM 048	X	X								CR	50	UF,MF,FC,TAR
TLM 050					X					CR	51	UF,MF,TAR
TLM 052A	X										--	UF
TLM 054	X					X					4	UF
TLM 055	X					X	X				8	UF,SC,TAR
TLM 058	X				X						4	UF,MF
TLM 059	X									CR	41	UF,TAR
TLM 061	X					X					21	UF
TLM 062	X			X						CR	384	UF,MF,SC,BI,FC
TLM 064B	X										9	UF,BI,LP
TLM 065	X		X							CR	552	UF,TAR
TLM 069	X	X									225	UF
TLM 072				X						MS	28	--
TLM 075A	X										4	UF,RF
TLM 077	X		X							CR	46	--
TLM 078	X		X				X				39	UF
TLM 084	X		X				X				12	UF
TLM 087	X		X				X				28	UF
TLM 088	X		X				X				4	--
TLM 089	X						X			CR	375	UF
TLM 093	X	X					X				30	UF,MF
TLM 094	X		X				X				20	UF,BI
TLM 096	X		X				X				410	UF
TLM 097	X						X			CR	185	UF,MF,SC,FC,TAR
TLM 100	X	X									4280	--
TLM 102	X			X							8	UF,MF
TLM 104	X	X									24	--
TLM 105	X	X	X								150	UF
TLM 111	X	X									4	--
TLM 123	X									CR	75	--
TLM 127	X		X								4	UF
TLM 128	X							X			600	UF,MF,BI
TLM 129A	X										150	UF
TLM 129B	X										4	UF
TLM 130	X										12	UF
TLM 139	X		X					X			4	UF
TLM 140	X		X					X			800	UF,MF,BI

Table 8.20 (Continued)

Site Number	Over-look	Lake Margin	Stream Margin	River Margin	Stream/ River Conflu-ence	Stream/ Stream Conflu-ence	Natural Topo-graphic Constric-tion	Mineral Lick	Quarry	Faunal Species	Observed Site Size (m²)	Lithic Artifacts
TLM 141	X							X			25	UF,BI
TLM 143	X		X					X			844	UF,TAR,CO
TLM 148	X		X					X			4	UF
TLM 150	X							X			4	UF
TLM 151	X							X			4	UF
TLM 153	X		X								16	--
TLM 154	X	X									400	UF
TLM 165	X										16	UF,MF,FC
TLM 171	X	X									--	UF
TLM 173B	X			X							28	--
TLM 175	X	X	X								34	UF,TAR
TLM 184	X									CR	93	UF
TLM 186	X					X					35	UF,BI
TLM 187	X					X					16	UF
TLM 188	X	X									4	UF
TLM 189	X			X							300	UF
TLM 199	X				X						46	UF
TLM 201	X		X								43	UF
TLM 203	X					X	X				40	UF
TLM 206	X			X							15	UF
TLM 207					X						35	UF
TLM 209	X			X			X				24	UF
TLM 210	X			X			X				8	UF
TLM 211	X			X			X				4	UF
TLM 214B	X		X				X				12	UF
TLM 215	X									CR	52	UF,MF
TLM 217	X		X								22	UF,MF,BI,LP
TLM 220	X									CR	145	UF,MF,T,TAR
TLM 221	X									CR	28	UF,TAR
TLM 222A	X		X							CR	87	TAR
TLM 222B	X		X							CR	531	TAR,CO
TLM 222D	X		X								36	UF
TLM 222E	X		X								4	--
TLM 223	X		X								40	UF
TLM 224	X										16	UF
TLM 225	X										31	UF
TLM 226A	X		X								58	UF
TLM 226B	X		X							CR	32	UF,T
TLM 226D	X		X							CR	16	--
TLM 226E	X		X							CR	32	--
TLM 227	X										4	--
TLM 230	X				X						66	0
TLM 231	X		X							CR	19	UF,CO
TLM 232A					X					CR,MS	439	T,H
TLM 232B					X						33	UF,T,CO
TLM 233					X						4	--
TLM 234A	X									CR,MS,GS	104	TAR
TLM 234B	X									CR,CN	56	TAR

Table 8.20 (Continued)

Site Number	Over-look	Lake Margin	Stream Margin	River Margin	Stream/ River Conflu-ence	Stream/ Stream Conflu-ence	Natural Topo-graphic Constric-tion	Mineral Lick	Quarry	Faunal Species	Observed Site Size (m²)	Lithic Artifacts
TLM 235C	X		X								33	UF,BI
TLM 236	X					X					30	UF
TLM 237	X		X								4	UF
TLM 238	X		X								26	--
TLM 240					X					CR,MS	314	--
TLM 242	X		X							CR	49	UF
TLM 244	X										4	--
TLM 246	X				X						4	UF
TLM 247A	X				X					MS	232	UF,TAR
TLM 247B	X				X					CR	344	UF,MF,H,TAR
TLM 247C	X				X						16	--
TLM 249A					X					CR	20	MF,TAR
TLM 249B										CR	4	TAR
TLM 250					X					MS,SH	4	TAR
TLM 252				X						CR,MS	25	H,CO
TLM 253				X						CR	4	TAR
TLM 256				X						CR	6	--
TLM 257					X						4	--
TLM 258					X						12	--
TLM 259				X					X		123	UF,FC,CO

Key for Table 8.20

Key to Artifact Type Abbreviations

1.	unmodified flakes	UF
2.	modified flakes	MF
3.	scrapers	SC
4.	blades	B
5.	microblades	MB
6.	burins	BU
7.	burin spalls	BUS
8.	bifaces	BI
9.	preforms	PR
10.	notched points	NP
11.	leaf shaped points	SP
13.	lanceolate points	LP
14.	triangular points	TP
15.	microblade cores	MC
16.	microblade tablet	MT
17.	blade core	BC
18.	rejuvenation flakes	RF
19.	flake cores	FC
20	hammerstones	H
21.	abraders	A
22.	tci thos	T
23.	notched pebbles	NPE
24.	thermally altered rock	TAR
25.	ochre	O
26.	cobble fragments	CO

Key to Faunal Abbreviations

1.	caribou	CR
2.	moose	MS
3.	Dall sheep	SH
4.	ground squirrel	GS
5.	canid	CN
6.	medium-large mammal	M-L
7.	mammal	MA

it is not likely that they were transported far, if at all, from the kill sites as unprocessed carcasses.

Twenty-six sites contain caribou bones. Based on the available data this species appears to represent the most important subsistence resource during the Athapaskan tradition. Eighty-eight (72.13%) of the 122 sites and site loci ascribed to the Athapaskan tradition occur on overlooks. Together with sites situated in low-topographic settings containing moose remains, these sites demonstrate an important shift in economic activities between the Athapaskan and Euro-American traditions. The mean site size for sites ascribed to the Athapaskan tradition is 58.9 square meters for sites subject to grid shovel testing, approximately 13% of the size of the sites ascribed to the Euro-American tradition.

(d) Late Denali Complex: ca. 3500 B.P. - ca. 1500 B.P.

Site ascribed to the Late Denali complex are listed in Table 8.21 along with their environmental setting, material cultural remains, observed site size, and identified faunal species. The Late Denali complex is the most difficult cultural historical period to define within the study area. This is because cultural components occur on a number of poorly defined contacts from the contact between the Devil and Watana tephras, throughout the Watana tephra, to the prominent regional paleosol(s) at the contact between the Watana and Oshetna (stratigraphic horizons 6, 7, and 8). Additionally, the size of the sites during the Late Denali complex is small, with a mean site size of 36.8 square meters, the smallest of all the defined cultural historic periods.

No organic tools were recovered from any of the Late Denali sites, and while bone preservation is generally poor, some faunal identifications were possible. Caribou were identified at twelve sites ascribed to the Late Denali complex, and calcined wolf bone was identified at one site. Caribou were taken at mineral licks and natural topographic constrictions. All sites, with the exception of locus C at TLM 226, are located on overlooks. The majority of these overlook sites (83.78%) are

Table 8.21. Sites Ascribed to the Late Denali Complex

Site Number	OV	LM	SM	RM	SR	SS	NTC	ML	Q	Faunal Species	Observed Site Size * (m²)	Artifact Types
TLM 027	x				x						105	UF, MF, B, CO
034	x	x									6	UF
038	x		x							CR	62.5	TAR
039	x	x									75	UF, O
040	x			x							144	UF, B
063	x			x						CR	15	UF
074	x			x							10	UF
077	x		x								46	UF, BI
078	x		x				x				39	
097	x				x		x				185	UF, SC, TAR
130	x									CR	12	UF, MF, BUS
136	x		x				x			CR	6	UF
142	x							x		CR	4	UF, TAR
143	x		x					x		M-L		UF, MF, BI
149	x							x		CR	4	UF
159	x					x					16	FC, CO, UF, MF, MB, BI
164	x	x	x								4	UF
169	x		x							MA	45	UF
171	x	x									9	UF
173B	x		x							M-L	28	UF
181	x		x								4	UF

Table 8.21. (Continued)

Site Number	OV	LM	SM	RM	SR	SS	NTC	ML	Q	Species	Observed Faunal Size * (m²)	Site Artifact Types
TLM 184	x									CR	93	UF, MF, SC, B, BI, PR, RF, FC, A, O
190	x			x							12	UF
202	x					x	x				4	UF
213	x		x				x				4	UF
216	x	x								CR	27	UF, MF, CO
217	x		x							CR	22	UF
218B	x					x					4	BI
220	x									CR, CN	145	UF, MF
222C	x		x							M-L	4	
225	x									M-L	31	UF
226A	x		x							M-L	58	UF, MF
226C		x		x						M-L	16	
228	x	x	x								4	UF
229	x									CR	24	UF, CO
230	x				x						66	UF, MF, NPE, CO
246	x				x					M-L	4	
HEA 181	x	x	x									UF

* Observed site size based on grid shovel test expansion. n = 22
x = 36.8

Key for Tables 8.21, 8.22, and 8.23

Key to Artifact Type Abbreviations

1.	unmodified flakes	UF
2.	modified flakes	MF
3.	scrapers	SC
4.	blades	B
5.	microblades	MB
6.	burins	BU
7.	burin spalls	BUS
8.	bifaces	BI
9.	preforms	PR
10.	notched points	NP
11.	leaf shaped points	SP
13.	lanceolate points	LP
14.	triangular points	TP
15.	microblade cores	MC
16.	microblade tablet	MT
17.	blade core	BC
18.	rejuvenation flakes	RF
19.	flake cores	FC
20	hammerstones	H
21.	abraders	A
22.	tci thos	T
23.	notched pebbles	NPE
24.	thermally altered rock	TAR
25.	ochre	O
26.	cobble fragments	CO

Key to Faunal Abbreviations

1.	caribou	CR
2.	moose	MS
3.	Dall sheep	SH
4.	ground squirrel	GS
5.	canid	CN
6.	medium-large mammal	M-L
7.	mammal	MA

Key to Site Setting Abbreviations

1.	overlook	OV
2.	lake margin	LM
3.	stream margin	SM
4.	river margin	RM
5.	stream/river confluence	SR
6.	stream/stream confluence	SS
7.	natural topo-graphic con-strictions	NTC
8.	mineral lick	ML
9.	quarry	Q

also associated with bodies of water. The material cultural inventory for sites ascribed to the Late Denali complex include: 1) unmodified and modified flakes, 2) scrapers, 3) blades and microblades, 4) burin spalls, 5) bifaces, 6) preforms, 7) rejuvenation flakes, 8) flake cores, 9) hammerstones, 10) low frequencies of thermally altered rock, 11) ochre, and 12) cobble fragments. Probably the most significant difference in material cultural traits between the Late Denali complex and the subsequent Athapaskan tradition is the presence of core, blade, and burin technology in the former and the absence in the latter.

(e) Northern Archaic Tradition: ca. 5200 B.P. - ca. 3500 B.P.

Sites ascribed to the Northern Archaic tradition are listed in Table 8.22 along with their environmental setting, material cultural remains, observed site size, and identified faunal species. Sites ascribed to the Northern Archaic tradition occur at the contact between the Watana and Oshetna tephras. The mean site size (727.4 square meters) for sites which can be firmly ascribed to this tradition is the largest of all the defined cultural historical periods. The fact that faunal remains are only preserved in a calcined state in Northern Archaic tradition sites makes this an impressive statistic, because differential preservation tends to increase observed site size for the more recent sites. For example the size of the more recent Athapaskan tradition sites was commonly defined by the distribution of unburned faunal remains in the absence of nonorganic material cultural remains. At the present stage of analysis, the assertion that Northern Archaic sites are exceptionally large is made cautiously due to the small sample of these sites (n=6) and large size variance within the sample.

Material cultural remains associated with the Northern Archaic tradition are: 1) unmodified and modified flakes, 2) scrapers, 3) bifaces, 4) preforms, 5) notched projectile points, 6) rejuvenation flakes, 7) hammerstones, 8) abraders, 9) thermally altered rock, 10) cobble fragments, and 11) flake cores, and a single stemmed lanceolate point. Red ochre was used, probably to decorate items of material culture and/or as body paint. The margins of a feature consisting of large

Table 8.22. Sites Ascribed to the Northern Archaic Tradition

Site Number	OV	LM	SM	RM	SR	SS	NTC	ML	Q	Species	Observed Faunal Size * (m^2)	Site Artifact Types
			Site Setting									
TLM 017	x										6	UF
029	x				x					M-L	31	UF, SC, O, CO
030	x				x					CR	2571	RF, FC, H, TAR, O, CO, UF, MF, SC, BI, PR, NP, SP, LAP
097	x					x	x				185	UF, MF, SC, NP, FC
143	x		x					x		CR	844	UF, MF, SC, BI, NP, FC, A, TAR, O
144*	x		x									UF

* Observed site size based on grid shovel test expansion. n = 5
x = 727.4

Key for Tables 8.21, 8.22, and 8.23

Key to Artifact Type Abbreviations

1.	unmodified flakes	UF
2.	modified flakes	MF
3.	scrapers	SC
4.	blades	B
5.	microblades	MB
6.	burins	BU
7.	burin spalls	BUS
8.	bifaces	BI
9.	preforms	PR
10.	notched points	NP
11.	leaf shaped points	SP
13.	lanceolate points	LP
14.	triangular points	TP
15.	microblade cores	MC
16.	microblade tablet	MT
17.	blade core	BC
18.	rejuvenation flakes	RF
19.	flake cores	FC
20	hammerstones	H
21.	abraders	A
22.	tci thos	T
23.	notched pebbles	NPE
24.	thermally altered rock	TAR
25.	ochre	O
26.	cobble fragments	CO

Key to Faunal Abbreviations

1.	caribou	CR
2.	moose	MS
3.	Dall sheep	SH
4.	ground squirrel	GS
5.	canid	CN
6.	medium-large mammal	M-L
7.	mammal	MA

Key to Site Setting Abbreviations

1.	overlook	OV
2.	lake margin	LM
3.	stream margin	SM
4.	river margin	RM
5.	stream/river confluence	SR
6.	stream/stream confluence	SS
7.	natural topo-graphic con-strictions	NTC
8.	mineral lick	ML
9.	quarry	Q

cobbles spaced several meters apart was observed at the level of the paleosol at the contact between the Watana and Oshetna tephras at TLM 184, and this feature may date to the Northern Archaic tradition. Hearths were the only other feature noted at sites ascribed to this tradition. Sheep and caribou were probably hunted.

All sites firmly ascribed to the Northern Archaic tradition occur on overlooks and suggest the importance of land mammal hunting during this time. One site (TLM 143) is located adjacent to a mineral lick and, although sheep have not been identified in the assemblage, tentatively identified caribou remains do occur. The largest site, TLM 030, occurs on a terrace near the confluence of a clear water tributary with the Susitna River, and its large size as defined by grid shovel testing suggests that it may have functioned as a major camp during this interval. Although this large site tends to skew the computed mean site size for the Northern Archaic tradition, two of the other sites are also large. If site size reflects population density, the project area may have been most densely populated during Northern Archaic times.

(f) American Paleoarctic Tradition: ca. 5200 B.P. - ca. 10,500 B.P.

Sites ascribed to the American Paleoarctic tradition all occur below the Oshetna tephra. Only one site (TLM 128) ascribed to this tradition has been dated by radiometric methods, but based on stratigraphic position the remaining sites can be bracketed between the time of deglaciation (ca. 11,500 B.P.) and prior to the deposition of the Oshetna tephra (ca. 5200 B.P.). They all occur within regional stratigraphic horizon 9. The sites ascribed to the American Paleoarctic tradition are listed in Table 8.23 along with their environmental setting, observed site size, associated faunal remains and artifact types present.

Material cultural remains associated with the American Paleoarctic tradition sites include: 1) modified and unmodified flakes, 2) scrapers, 3) blades, 4) microblades, 5) burin spalls, 6) bifaces, 7) preforms, 8) triangular points, 9) microblade cores, 10) blade cores, 11) rejuvenation flakes, 12) flake cores, and 13) cobble fragments.

Table 8.23. Sites Ascribed to the American Paleoarctic Tradition

Site Number	Site Setting: OV	LM	SM	RM	SR	SS	NTC	ML	Q	Species	Observed Faunal Size * (m^2)	Site Artifact Types
TLM 027	x				x						105	UF, MF, B, BI, RF, FC, CO
039	x	x									75	UF, MB, BUS
040	x			x						M-L	144	UF, SC, B, FC, O, CO
061	x					x				M-L	21	UF, BI
128	x							x				UF, MF, SC, B, BI, PR, TP, FC
180	x		x									UF, MF, B, BC, RF
207	x				x					M-L	35	UF, SC, MB, MC, RF, CO

* Observed site size based on grid shovel test expansion. n = 5
x = 76

Key for Tables 8.21, 8.22, and 8.23

Key to Artifact Type Abbreviations

1.	unmodified flakes	UF
2.	modified flakes	MF
3.	scrapers	SC
4.	blades	B
5.	microblades	MB
6.	burins	BU
7.	burin spalls	BUS
8.	bifaces	BI
9.	preforms	PR
10.	notched points	NP
11.	leaf shaped points	SP
13.	lanceolate points	LP
14.	triangular points	TP
15.	microblade cores	MC
16.	microblade tablet	MT
17.	blade core	BC
18.	rejuvenation flakes	RF
19.	flake cores	FC
20	hammerstones	H
21.	abraders	A
22.	tci thos	T
23.	notched pebbles	NPE
24.	thermally altered rock	TAR
25.	ochre	O
26.	cobble fragments	CO

Key to Faunal Abbreviations

1.	caribou	CR
2.	moose	MS
3.	Dall sheep	SH
4.	ground squirrel	GS
5.	canid	CN
6.	medium-large mammal	M-L
7.	mammal	MA

Key to Site Setting Abbreviations

1.	overlook	OV
2.	lake margin	LM
3.	stream margin	SM
4.	river margin	RM
5.	stream/river confluence	SR
6.	stream/stream confluence	SS
7.	natural topo-graphic con-strictions	NTC
8.	mineral lick	ML
9.	quarry	Q

Red ochre was recovered from one site (TLM 040) and probably used to decorate items of material culture and/or as body paint. Faunal remains from American Paleoarctic tradition sites are rare, and could only be identified as the remains of medium to large mammals.

The mean observed site size for the sites ascribed to the American Paleoarctic tradition is 76 square meters. Based on the admittedly limited sample, sites ascribed to this tradition are larger than those ascribed to either the Late Denali complex or the Athapaskan tradition, but smaller than those attributed to the Northern Archaic tradition. All sites ascribed to the American Paleoarctic tradition occur on overlooks and this coupled with the presence of faunal fragments attributed to medium to large mammals suggests the importance of land mammal hunting during American Paleoarctic times. At one site (TLM 128) mammals were probably hunted along an approach to a mineral lick. The remaining four sites which can be placed confidently within this tradition all occur adjacent to bodies of water, which may suggest that exploitation of fresh water aquatic resources were important economic activities.

There is a marked and significant difference in both site size and lithic technology between sites ascribed to the American Paleoarctic tradition and those ascribed to the subsequent Northern Archaic tradition. American Paleoarctic tradition sites are smaller and exhibit a pronounced burin, blade/microblade technology. It is impossible to determine when the earliest evidence of the American Paleoarctic tradition occurs within the study area, and hence a speculative bracketing date of 10,600 B.P. is derived by extrapolating limiting radiometric dates from sites located in the Tanana and Nenana river valleys to the north and the Tangle Lakes to the east. Human occupation of the study area could possibly have begun shortly following deglaciation ca. 11,500 B.P. However the earliest dated occupation found in the study area is ca. 7000 B.P.

(g) Comment

Although the sparse nature of survey data does permit limited analysis, the organizational framework established by the regional stratigraphy and classification of sites by tradition and complex remains tentative. Gillispie (1985) has recently proposed a three period sequence to classify the occurrence of notched point assemblages in noncoastal settings. The earliest phase is postulated to occur between 7500 and 5500 years ago and to be characterized by the association of notched points and microblades. The second occurs between 6700 and 4000 years ago and is typified by notched points in the absence of microblades. The third is believed to have occurred between 2550 and 750 years ago and is characterized by the association of notched points and microblades.

Within the project area no evidence has been found to support the proposed earliest phase. However immediately north of the study area at Butte Lake, Betts (personal communication 1985) discovered notched points in association with microblades and burins during late summer of 1984. One radiocarbon determination of 5030 ± 200 years: 3080 B.C. (BETA 10751) is available from a hearth apparently directly associated with the points and microblades. A second determination of 6390 ± 580 years: 4440 B.C. (BETA 10750) was obtained from what is probably the same stratigraphic position but not in direct association with the microblade and notched point assemblage. Both radiocarbon dates were derived below a tephra unit which probably correlates to the Watana tephra in the project area. Unfortunately, the Oshetna tephra appears to be absent in the Butte Lake stratigraphy.

The above data suggest that the survey data from the project area may be misleading when employed in synthetic analysis. For example, if microblades were discovered below the Oshetna tephra and notched points were "fortuitously" not located in the unit sample, the resultant assemblage would be attributed to the American Paleoarctic tradition. Such difficult problems result from analysis of a data base derived solely from survey and very limited testing. Additionally, artifactual remains ascribed to the Late Denali complex are few in number and the sites are very small. Perhaps the only tentative postulate which can be drawn from the very limited data is that some microblades occur late in the regional stratigraphy. It is possible that the beginning of the Late Denali complex may correlate with Holocene climatic trends. Hamilton (1977) has placed the initial Neoglacial expansion of alpine glaciers in Central Alaska at either 4500 or 3500 B.P. based on the "sparse" radiocarbon record. The Neoglacial advance may be correlated to the brief hiatus in organic accumulation in the paleosol between Watana and Oshetna tephras throughout the project area. This interpretation is supported by the two prominent clusters of radiocarbon determinations derived from this paleosol (Figure 8.3). The Late Denali complex is poorly understood and defined, and what role, if any, it played in the development of the subsequent Athapaskan tradition is unknown.

The limited survey sample resulted in only providing sufficient carbon to date one site occurring below the Oshetna tephra. Hence, the beginning of human occupation of the project area remains unclear. While the survey data permit temporal ordering of sites throughout the project area based on radiocarbon determinations and relative position within the regional stratigrapy, these data are extremely limited in defining the range of material cultural associated with each stratigraphic horizon. These data provide only a small window into the prehistoric past and raise many questions which cannot be addressed in the absence of more comprehensive field research.

9 - SURVEY EVALUATION

9.1 - Introduction

The effectiveness of a cultural resource program can be evaluated by relating results to project objectives and discussing the reliability of the data collected (McGimsey and Davis 1977). The purpose of this evaluation is to document site discovery, coverage and intensity of the survey, and address the quality of the data base.

9.2 - Research Design - Survey

The major emphasis of the cultural resources survey was to focus efforts toward site discovery by concentrating survey in areas that had the potential for site occurrence, preservation, and discovery, while eliminating areas from survey which exhibited low/no potential for site occurrence or discovery (chapter 5). Five field seasons were devoted to survey, with field seasons length varying from two to three months and crew size varying from seven to 26 people (chapter 2). Personnel levels were reduced after each field season to levels necessary to produce the annual report.

(a) Personnel

The quality of the research design alone does not determine its effectiveness; the qualifications of personnel involved in its implementation ultimately lead to its success or failure. Both the principal investigator (PI) and project supervisor (PS) had extensive field experience, and had published several articles on Alaskan archeology prior to undertaking the Susitna Project. To ensure adequate implementation of the research design and program methods, all other project personnel were hired on the basis of level of training and archeological experience. Field and laboratory supervisors, crew leaders, and crew members all had educational backgrounds in anthropology and prior field experience, often in supervisory roles.

(b) Locating Sites - Surface Survey and Subsurface Testing

(i) Site Discovery

Areas of proposed impact were examined (chapter 7) during the course of the five field seasons of cultural resources investigation. As a result of these investigations 248 previously unrecorded cultural resource sites were located and documented, 240 of which were prehistoric and eight of which were historic. One hundred twenty-nine of the prehistoric sites (54%) were located by the presence of cultural material on the surface. The remaining 111 prehistoric sites (46%) were located through subsurface testing in the absence of surface indicators. The percentage of sites found through subsurface testing is higher than a similar survey in Alaska's Tanana Valley, i.e., 36% (Dixon et al. 1980a). No other figures concerning the percentage of sites found by subsurface testing as opposed to surface survey are reported from Alaska.

The high percentage of sites found during subsurface testing can be directly correlated to the high archeological potential of areas selected for survey and the large number of shovel tests excavated (minimum number - 28,028). In the early field seasons (1980, 1981) the easily visible surface sites were more often located than subsurface sites. In later years (1982-1984) the number of sites located through subsurface testing increased. This increase, however, may be due to increased familiarity with the area by project personnel as the program progressed. The effort placed on subsurface testing and the sites found is particularly important to the project because buried sites more frequently contain in situ assemblages that provide data which can be used to address research questions and assess site significance.

The percentage of sites found by shovel testing indicates that this was an effective method to employ in this area of Alaska. The ages of sites found range through the Holocene up to and including the recent historic past. This demonstrates that the research design and methods employed were able to locate sites throughout the entire temporal continuum within the project area.

(ii) Coverage and Intensity

The research design explicated methods by which areas exhibiting the potential for site occurrence and/or discovery were defined. Criteria were also defined for identifying areas exhibiting low/no potential for site occurrence and/or discovery (chapter 5). As a result, it was possible to eliminate portions of the study areas from direct field investigation. Forty-two percentage of the area within the proposed Watana reservoir, 62% of the area within the proposed Devil Canyon reservoir, 13% of the proposed Watana construction area, 40% of the proposed Devil Canyon construction area, and 46% of proposed borrow areas (A, C, F, H, K) outside the proposed reservoirs were eliminated from field survey. The areas remaining after low/no potential areas were eliminated contained potential for site discovery and were the focus of survey and evaluation by field personnel.

During the five field seasons of the cultural resources survey approximately 215 person-months were devoted to fieldwork including survey, systematic testing, and field laboratory activities. In addition to survey, site reports were also drafted in the field. Of the time spent in the field approximately 118 person-months were devoted to survey and 97 person-months to systematic testing. Approximately 25% of the field time for each of these activities was allocated to laboratory procedures and draft report preparation. As a result 88.5 person-months (2301 person-days) were devoted to survey and 73 person-months (1898 person-days) to systematic testing. During survey 28,028 shovel tests were recorded to have been excavated in an effort to locate sites. This should be considered a minimum number and does not include shovel tests excavated to assist in determining site size.

The cultural resources program exclusive of laboratory and draft report preparation, resulted in a coverage intensity of approximately 44 person-days per square mile. This estimate is inclusive of travel-time and down-time due to bad weather and/or helicopter logistics. Based on estimates for intensive surveys ranging from 10-60 person-days per square mile (Dancey 1974; Fehon and Viscito 1974; Lipe 1974; Martin and Plog 1973; Redman 1974; Wait 1976: in Schiffer and Gummerman 1977:186), the area covered, and the intensity of the survey for the Susitna Project is consistent with area per person-day coverage of other intensive surveys. Due to the ruggedness and remoteness of the area and difficult helicopter logistics, it is expected that the person-days per square mile would be biased towards the higher end of this range in an area such as the Middle Susitna River region.

9.3 - Field Program Data

Because of the relatively large number of sites found (248) and the level of documentation at each site, the resulting data base is substantial. As reflected in the site reports (Appendix D), data from some sites are the result of surface cultural material or artifacts recovered from a few shovel tests. The average area systematically tested at any one site sampled by this method was three square meters. While the bulk of these data provide important insights into the history and prehistory of the region, the inferences which may be drawn from them must be understood within the context of a data base derived solely from survey data and not from extensive excavation.

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APPENDIX A - GLOSSARY

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Abrader:	A coarse grain stone used for grinding and sanding.
Accession:	An accession number includes all the specimens (objects, artifacts, etc.) received from one source at one time. In the accessioning process, each transaction by which specimens are acquired is registered in a central book or despository.
Adjacent sites:	Sites within one-half mile of Susitna Hydroelectric Project facilities or features.
AHRS:	Alaska Heritage Resource Survey.
Aliquot description:	The township, range, meridian, section, and quater section which identified the location of a property.
Alluvium:	A general term for all detrital deposits resulting from the operations of running water.
Anadromous:	Species of fish which ascend rivers from the sea for breeding.
APA:	Alaska Power Authority.
Aphanitic:	Refers to the texture of fine-grained igneous rocks in which individual crystals are too small to be detected without the aid of magnification.

Argillite: A sedimentary rock that is much harder and more dense than shale, which it resembles in origin, minerals, and general appearence. Its cement is generally silica. Although some argillites grade into slates and other shaly quartzites, they preserve varves, ripplemarks, mud cracks, and other sedimentary rock structures.

asl: Above sea level.

Astragalus: A tarsal bone in the hindlimb.

Artiodactyl: A member of the order Artiodactyla, including moose, caribou, and sheep.

Basal till: Till carried at or deposited from the under surface of a glacier.

Basalt: An igneous rock which is characteristically black, dense, and massive. Individual crystals cannot be seen with the naked eye unless in phenocryst form. Phenocrysts are commonly pyroxene and olivine.

Biface: A stone artifact bearing flake scars on both faces.

Blade: Specialized flake with parallel or subparallel lateral edges; the length being equal to, or greater than the width. Cross sections are plano-convex, triangulate, subtriangulate, rectangular, or trapezoidal. Some have more than two dorsal crests or ridges.

Blade core: A nucleus or mass of lithic material shaped to allow the removal of a blade. Piece of isotrophic material bearing negative flake scars resulting from the removal of blades.

B.P.: C-14 years before 1950.

Bulbar Scar: The negative scar found on a core or core tool that results from the bulb of force - either percussion or pressure. It is a mirror surface or mold of the cone part resulting from flake detachment. See negative bulb of force.

Burned, heavily burned: Characteristic of bone exposed to fire; burned bone is somewhat darkened, while heavily burned bone is charred.

Burin: An implement manufactured from a flake, blade, or other implement by using the burin technique to remove the edges parallel to their long axis and/or transversely or obliquely. The resulting facet, or flake scar, generally forms a right angle on one or both margins.

Burin spall: A specialized flake removed from a burin, which is generally rectangular or triangular in transverse section.

Calcaneus: A tarsal bone in the hindlimb.

Calcined: Describes a bone fragment which has been intensely burned and is characterized by a white, chalky appearance.

Catalogue: The catalogue is comprised of individual entries, normally one for each specimen (artifacts, samples, etc.) acquired through an accession.

Cervid: A member of the family Cervidae, including moose and caribou.

Chalcedony: A form of quartz that has a waxy luster; it is never crystalline but forms layers, stalactites, or grapelike masses.

Chert: A compact rock which consists chiefly or wholly of silica, although calcite and dolomite may be present in a small amount. The siliceous portion may consist of chalcedony alone or of a mixture of quartz and chalcedony, the grain cannot be seen without high magnification. It is brittle and breaks conchoidally with a waxy or dull glasslike luster.

Cluster: A number of things of the same sort gathered or grouped together; i.e. lithic artifact cluster. See scatter.

cmbs: Centimeters below the surface.

Colluvium: A general term applied to loose and incoherent deposits, usually at the foot of a slope or cliff and brought there chiefly by gravity.

Complex: Configurations of associated cultural traits which are restricted chronologically and regionally. Complex closely corresponds to the concept of "phase" as advanced by Willey and Phillips (1958:22-24).

Component: The physical manifestation of a given archeological site which indicates a period of occupation.

Cortex flake: A flake removed in lithic raw material reduction which retains part of the outer surface or rind of the original unmodified piece.

Cryoturbation: Frost action including frost heaving.

Cryptocrystalline: The texture of a rock or mineral consisting of crystals that are too small to be recognized and easily distinguished under the light microscope.

Crystalline: Of or pertaining to the nature of a crystal, having regular molecular structure. Contrasted with amorphous.

Cultural resources: Districts, sites, structures, and objects and evidence of some importance to a culture, a subculture, or a community for scientific, traditional, religious, and other reasons (McGimsey and Davis 1977).

Cuneiform: Name given to a carpal and three tarsal bones.

Curation: Storage, preservation, and care of accessions and their associated contextual data.

Direct impact The immediate affect of ground disturbing activities associated with preconstruction, construction, and operation of a project (McGimsey and Davis 1977).

Distal: Farthest from the center or the point of attachment or origin.

Dorsal: Outer surface. Keeled part of a blade or flake. For instance, the dorsal side of a blade is the face of the cone prior to detachment.

Epiphysis: A bone extremity which has not yet ossified to the shaft or main body of the bone, and indicates that the individual is skeletally immature.

Esker: Serpentine ridges of gravel and sand. These are often associated with kames, and are taken to mark channels in the decaying ice sheet, through which streams washed much of the finer drift, leaving the coarser gravel between the ice walls.

Estimated site size: An estimate of site size based upon the size of the terrain feature on which the site is located.

Exhausted flake core: An amorphous core without definite form, having the platform area exhausted. Bears scars denoting the removal of flakes or blades.

Exposure: The condition or fact of being exposed to view, either naturally or artificially; that part of a rock, formation, or surface which is so exposed; an outcrop.

FERC: Federal Energy Regulatory Commission.

Feature: Cultural and "nonportable" physical manifestations such as hearths, storage pits, etc.

Fine screen samples: Samples sieved through less than 1/8 inch mesh for the purpose of separating small lithic detritis or botanical specimens from soil/sediment.

Flake: A fragment of rock culturally removed from a parent rock by percussion or pressure flaking. The remains of lithic tool manufacturing or repair, usually characterized by a bulb of percussion, a striking platform, and radiating ripples or force lines from the point of impact or pressure on the ventral surface.

Flake core: A nucleus of stone bearing the scars from the removal of flakes either in a random or regular pattern.

Flat bones: Ribs, scapulae, innominates, and some cranial bones.

Glaciofluvial: Pertains to streams flowing from glaciers or to the deposits made by such streams.

Glacio-lacustrine: Pertains to lakes formed by glaciers.

Granite: Light-colored, coarse-grained igneous rock.

Grid shovel testing: A method employing a grid of shovel tests to define the boundary of a site and the distribution of cultural material within it.

Groundmass: The fine-grained matrix of a rock which may contain larger inclusions such as phenocrysts.

Grus: An accumulation of angular, coarse-grained fragments resulting from the granular disintergration of crystalline rocks (expecially granite) generally in an arid or semi arid region.

Hammerstone: A natural rounded, largely unmodified pebble used as an unhafted hammer. Usually contains some evidence of a battered surface from percussion flaking.

Histosol: In soil classification, an order characterized by more than half organic matter in its upper 80 cm or organic matter filling interstices.

Holocene: That period of time since the Wisconsinan glaciation.

Horizon: In soil science, a natural development zone in a soil profile.

Hypsithermal: Postglacial warm interval.

Inceptisols: Soils on new volcanic deposits, or soils of recently deglaciated areas, or other soils that are so young they have only a slight horizon development.

Indirect impact: Adverse effects that are secondary but clearly brought about by the project and which would not occur if the project were not undertaken (McGimsey and Davis 1977).

Innominate bone: Either of the two large, irregular bones that, together with the sacrum and coccyx, make up the pelvis. It is formed of three bones, the ilium, ischium, and pubis, which become fused in the adult.

Isotrophic: Having the same properties in all directions.

Kame: A conical hill or short irregular ridge of gravel or sand deposited in contact with glacier ice.

Kame terrace: A terracelike body of stratified drift deposited between a glacier and an adjacent valley wall.

Kettle: A depression in drift, made by the wasting away of a detached mass of glacier ice that had been either wholly or partly buried in drift.

Krotovina: A fossil rodent burrow

Lanceolate point: A biface which contains a squared finished haft and no shoulders.

Leaf-shaped point: A biface which contains a finished, contracting base haft element, with no shoulders.

Level: The vertical subdivision of an excavation unit, generally a naturally deposited stratigraphic unit.

Locus: One of two or more concentrations of cultural material within a site which are spatially discrete from each other.

Long bones: Limb bones including the femur, tibia, humerus, radius, and ulna.

Lunate: A carpal bone of the forelimb.

Luster: Refers to the appearance of light reflected from the surface of a rock or mineral.

Magnum: A carpal bone of the forelimb.

Medium to large mammal: Mammals ranging in size from a medium sized dog to a moose.

Metapodial: A general term for both the metacarpals and metatarsals of artiodactyls.

Microblade: A diminutive blade generally made by pressure technique. See blade.

Microblade core: A nucleus of lithic material formed into a desired shape for the removal of microblades. Bears flake scars resulting frrom the removal of microblades.

Microblade core tablet: A flake used to rejuvenate the platform surface of a microblade core. A flake resulting from the removal of an exhausted or ruined microblade core platform. Identified by flake scars resulting from microblade removal along its margins.

Mitigation: The alleviation of adverse impact by avoidance through project redesign or project relocation, by protection, or by adequate scientific study of cultural resources (McGimsey and Davis 1977).

MNI: Minimum number of individuals, which refers to the number of individuals which are necessary to account for all the skeletal elements (specimens) of a particular species found in the site.

Modified flake: A flake which has been altered in morphological form from its original shape either from use or from intentional retouch or both.

Moraine: An accumulation of drift having initial constructional topography, built within a glaciated region chiefly by the direct action of glacier ice.

Naviculo-cuboid: A tarsal bone of the hindlimb.

Negative bulb of force: A mirror surface of the cone part always on the objective piece and not on the flake or blade. See bulbar scar.

No impact: When preconstruction, construction, and operation of a project does not result in direct or indirect impact to cultural resources.

Notched pebble:	Commonly a water-rounded rock which contains two opposing chipped notches.
Obsidian:	Volcanic glass.
Observed site size:	The size of a site based upon grid shovel testing or the extent of observed cultural material.
Ochre:	Iron oxide or hematite. Commonly reddish brown to yellow in color.
Outwash:	Drift deposited by meltwater streams beyond active glacier ice.
Paleosol:	A buried soil.
Palynology:	The study of pollen and other spores and their dispersal.
Pedogenesis:	Soil formation.
Permafrost:	Permanently frozen ground (subsoil).
Phenocryst:	A distinctive crystal formed during the slower cooling period in igneous rocks.
Pleistocene:	The earlier of the two epochs comprising the Quaternary Period.
Preform:	Preform is an unfinished, unused form of proposed artifact. It is larger than, and without the refinement of, the completed tool. It has no means of hafting and is generally manufactured by direct percussion.

Proglacial lake: Lake occupying a basin in front of a glacier generally in direct contact with the ice.

Proximal: Situated nearest the center of the body or nearest the point of attachment of a muscle, limb, etc.

Quartz: A mineral, silicon dioxide, which occurs in hexagonal prismatic crystals and/or in cryptocrystalline forms. It ranges from colorless to black and exhibits a vitreous or glassy luster.

Quartzite: A nonfoliated metamorphic rock composed principally of quartz. In some deposits quartz is the only mineral present. Individual grains are deformed, interlocked, and are fused together so the rock breaks across the grains. Pure quartzite is derived from quartz sandstone, but may contain as much as 40% other minerals.

Rejuvenation flake: A flake removed to renovate, renew, restore, recreate, or reestablish a flaking platform.

Retouch: The occurrence of small flake scars along the edge of a lithic artifact.

Rhyolite: The microcrystalline extrusive equivalent of a granite formed at or near the earth's surface. It is characteristically white, gray, or pink and nearly always contains a few phenocrysts of feldspar or quartzite (2-10%).

Scaphoid: A carpal bone of the forelimb.

Scraper: Most frequently refers to flaked stone artifacts with one or more steep, unifacially retouched edges presumably used in scraping, scouring, or planing.

Scatter: A concentration or cluster of cultural material at a site or within a locus. See cluster.

Sesamoid: A small, rounded ossification found in tendons; in caribou and moose they normally occur in the extremities.

Shatter: Small amorphous pieces of lithic debris generated in reduction or tool manufacture, generally as a result of percussion.

Shovel test: A subsurface testing method using a #2 shovel. For this project, shovel tests were excavated to at least 50 cm when possible.

Site: A locus of past human behavior.

Site datum: A datum established during survey testing. Normally located in the southwest corner of the first test pit or at the point of highest relief if numerous lithic scatters are present.

Site grid datum: A datum established for systematic sites. May not be at the same location as the site datum from survey testing. Establishes horizontal and vertical control for the site.

Solifluction: The process of slow flowage from higher to lower ground of masses of waste saturated with water.

Spodosols: Humid forest soils, mostly under conifers, with an ashy gray, leached A horizon and an iron and organic rich B horizon; comparable to gray forest podsols.

Stemmed point: A biface which contains a finished haft element characterized by distinctive shoulders and a contracting base.

Survey locale: An area selected for management purposes within which surface survey and subsurface testing were conducted.

Systematic Testing: A testing phase with the goal of controlled excavation. Units of excavation were 1 x 1 m test squares. Excavation was conducted with vertical and horizontal controls.

Tci tho: Large tabular slab or boulder spall flake tool.

Tenacity: Refers to the resistence of a rock or mineral to breakage.

Tephra: A collective term for all clastic volcanic materials which during an eruption are ejected from a crater or from some other type of vent and transported through the air; includes volcanic dust, ash, cinders, lapilli, scoria, pumice, bombs, and blocks.

Tephrochronology: A chronology based on the dating of volcanic ash layers.

Terrain unit: Area of ground considered as to its extent and natural features in relation to its use for a particular operation.

Tertiary: The older of the two geologic periods comprising the Cenozoic Era.

TES: Terrestrial Environmental Specialists.

Test pit: A small excavation conducted with trowel. In some cases shovel tests were enlarged into test pits when cultural material was encountered.

Test square: A testing unit of 1 x 1 m used during systematic testing.

Test square datum: A datum adjacent to a test square which has been referenced to the site grid datum and from which all cultural materials were referenced for depth.

Texture: Refers to the size, shape, and boundary relations between adjacent minerals in a rock mass.

Thermally altered rock: Rock which has been split, cracked, and/or damaged by heating and/or cooling.

Till: Nonsorted, nonstratified sediment carried or deposited by a glacier.

TLM ###: Alaska Heritage Resource Survey site number. The first three letters reflect the USGS quadrangle in which the site is located; in this case TLM refers to Talkeetna Mts. The following number represents the specific site.

Tradition: Configurations of associated cultural traits which persist over a long temporal interval and over a broad geographic area.

Triangular point: A biface which contains a finished haft element where the base is the widest point and the sides progressively contract to the tip.

Unciform: A carpal bone of the forelimb.

Unmodified flake: Any piece of stone removed from a larger mass by the application of force, either intentionally or accidentally, and not altered after removal. A portion of isotrophic material having a platform and bulb of force at the proximal end.

USGS: United States Geological Survey.

UTM: Universal Transverse Mercator. A type of map projection dividing the surface of the earth into 60 zones of 6-degree intervals in longitude between 80 degrees south and 84 degrees north.

Verst: A former Russian unit of linear measurement, equal to ca. 3,500 feet.