The Knife River Study Unit

Michael L. Gregg and Amy C. Bleier
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The Knife River Study Unit (KRSU) has the greatest density of prehistoric sites in the state because the primary source area for Knife River flint (KRF) is here. Settlements with activity areas partially or entirely devoted to the procurement and initial processing of KRF abound in the area. Additionally, the Knife River basin was used heavily for hunting and gathering wild plant foods and other materials by large populations of Plains Village peoples whose residential bases were concentrated along the Missouri River immediately to the east. Also, paralleling other southwestern North Dakota drainages, most of the KRSU has been free of glacial ice and open for exploitation throughout all of prehistory. It has surely witnessed at least intermittent human occupation since people first came to the Northern Plains, and reports of Clovis point surface finds seem to affirm that.

Description of the Knife River Study Unit

The KRSU covers 2,445 mi². Maps are presented in Figures 3.1 and 3.1A followed by a complete listing of townships included within the Study Unit (SU) (Table 3.1). The use of straight township lines rather than the meandering drainage divide lines results in the exclusion and inclusion of several sites situated on the Knife-Missouri, Knife-Little Missouri, and Knife-Heart divides. For example, Boeckel-Renner (32ME799) on the Knife-Missouri divide (Artz 1989b) is within the KRSU while 32DU99 on the Knife River side of the Knife-Little Missouri divide (Meier 1983b) is assigned to the Little Missouri River SU. Portions of Billings, Dunn, Mercer, Morton, Oliver, and Stark counties are within the KRSU.

Physiography

The terrain is flat or gently rolling prairie with occasional buttes in the headwaters areas, and it is roughly broken near the drainages. The elevation varies from about 2,600 feet at the headwaters to about 1,660 feet at the confluence with the Missouri River near Stanton, North Dakota. The eastern portion of the unit is discontinuously covered with a mantle of Pleistocene glacial till and outwash sediments (Bluemle 1977b). Broadly cut late Pleistocene glacial meltwater channels run here and there mainly across northern portions of the basin (cf. Bluemle 1977b; Clayton 1980). In the western portions of the unit, outside of valleys filled with Holocene alluvium, surfaces are weathered bedrock of several formations. Sentinel Butte Formation silt, sand, clay, sandstone, lignite, baked clay, and limestone predominate (ibid.). There are also some remnants of White River Group and Golden Valley Formation siltstones, claystones, sands, and other Eocene and Oligocene lacustrine and alluvial sediments. Few of the sandstone formations are sufficiently massive and stable to have been used for rock shelter settlements or art panels. However, rock art can be expected on durable stone exposures such as at the Voegele Petroglyph site (32ME113) where there were deeply grooved linear and hand

Figure 3.1: Map of the Knife River Study Unit.

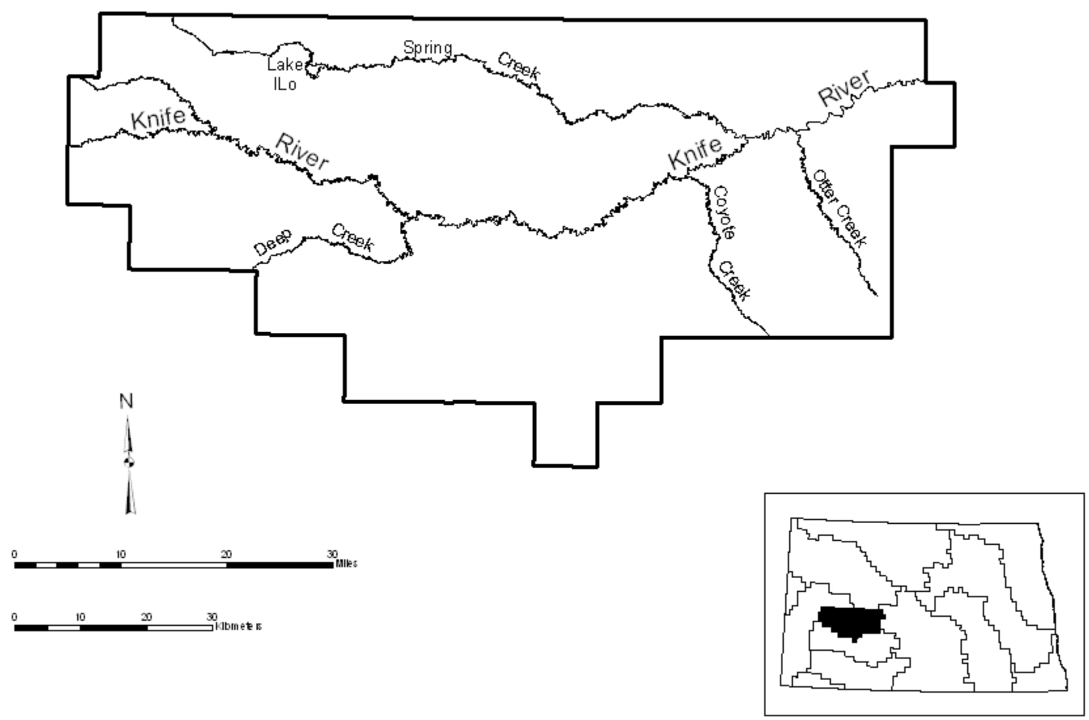

Figure 3.1A: Shaded Relief Map of the Knife River Study Unit.

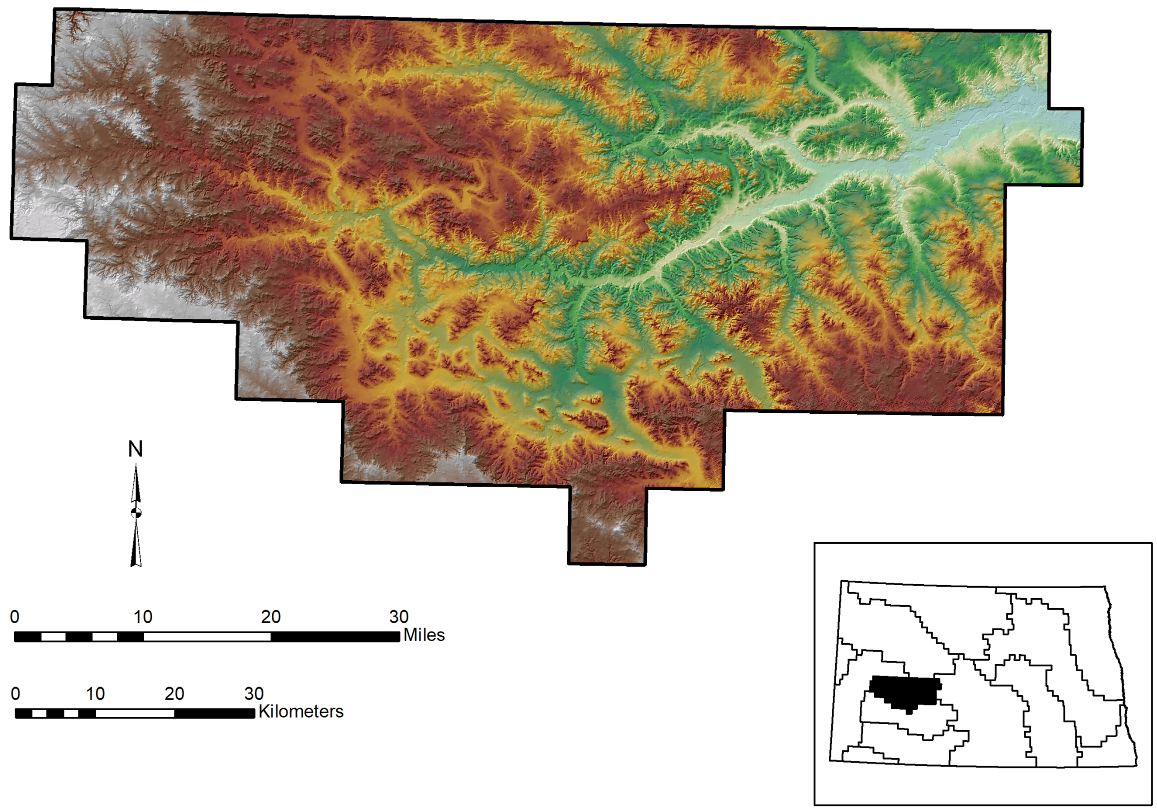

Table 3.1: Townships in the Knife River Study Unit.

TOWNSHIP	RANGE
139	91
140	90
140	91
140	92
140	93
140	94
141	86
141	87
141	88
141	89
141	90
141	91
141	92
141	93
141	94
141	95
142	86
142	87
142	88
142	89
142	90
142	91
142	92
142	93
142	94
142	95
142	96
142	97
143	86
143	87
143	88
143	89
143	90
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143	92
143	93
143	94
143	95
143	96
143	97
143	98
144	85
144	86
144	87
144	88

TOWNSHIP	RANGE
144	89
144	90
144	91
144	92
144	93
144	94
144	95
144	96
144	97
144	98
145	85
145	86
145	87
145	88
145	89
145	90
145	91
145	92
145	93
145	94
145	95
145	96
145	97

motifs on a sandstone boulder atop a knoll (NDCRS form on file at SHSND).

Drainage

The Knife River valley is about 90 miles long with a drop of about 13.5 feet per mile in the first 33 miles and 3.8 feet per mile for the next 57 miles with an overall average drop of about 10.4 feet per mile. The main tributary of the Knife River is Spring Creek with a drainage area of about 570 miles. Spring Creek's headwaters are in the Killdeer Mountains at an elevation of about 3,300 feet. This stream drops about 25 feet per mile in the first 14 miles, and between the towns of Killdeer and Beulah it drops an average of about 6.75 feet per mile (NDSPB 1937). The KRF primary source area, where an excellent quality brown, translucent, crypto-crystalline silica was collected and surface mined from early in North Dakota prehistory, is centered along this stream. Another tributary of the Knife River is the Little Knife River which drains an area of about 275 miles.

Climate

The annual precipitation is about 15 inches, most of it falling as rain between May and September. The ground is often snow-covered from mid-November to mid-April. Stream flows are greatest during the spring thaw. Most streams usually dry up in the summer. Springs flow from veins of lignite and Fort Union Formation sandstone strata in places (NDSPB 1937).

Landforms and Soils

Natural Resources Conservation Service (NRCS) official soil survey resources are available online (NRCS 2021 a, b).

- Electronic Field Office Technical Guide: https://efotg.sc.egov.usda.gov/#/
- Web Soil Survey: https://websoilsurvey.sc.egov.usda.gov/App/HomePage.htm

To know where to expect archaeological sites, it is important to understand early Holocene landforms, especially in stream valleys within this SU. Alluvial geomorphology has been an important research concern of test excavation projects in the KRF quarry area since the 1980s (see Root et al. 1986:486-503 for a summary). In several tested locales, KRF quarry pits were encountered in the lower levels of the excavations in places where such pits were imperceptible from the surface. These Paleo-Indian- and Early Archaic-age surface mining pits had been filled in and completely leveled over by mid-Holocene and late-Holocene aeolian and alluvial sedimentation (cf. ibid.:409).

Flora and Fauna

Chokecherry *(Prunus virginiana),* juneberry *(Amelanchier alnifolia),* buffaloberry *(Shepherdia argentea),* and several kinds of currents and gooseberries *(Ribes* sp.) are fruit bearing shrubs found in this area. Cottonwoods *(Populus deltoides),* box elder *(Acer negundo),* green ash *(Fraxinus pennsylvanica),* quaking aspen *(Populus tremuloides),* Rocky Mountain red cedar *(Juniperus scopulorum),* burr oak *(Quercus macrocarpa),* and a small variety of paper birch *(Betula papyrifera)* are the major types of trees. Indian breadroot, an important native food, is common on the prairie.

Local faunal resources during prehistoric times regularly included bison, elk, mule deer, white-tailed deer, antelope, foxes, badgers, coyotes, raccoons, rabbits, skunks, and occasionally included moose, grizzly bear, wolves, and beavers (Bailey 1926). The most numerous fish in the Knife River and Spring Creek today are suckers, catfish, perch, walleyed pike, and northern pike. Large northern pike run up Spring Creek into the KRF primary source area to spawn after the spring thaw when water levels rise.

Other Natural Resource Potential

The most prominent natural resource here, and perhaps in all of North Dakota, is Knife River flint. While this flint has been known for over 12,000 years and was the resource for which KRF was named, the article in *Plains Anthropologist* by Clayton, Bickley, and Stone in 1970 marked the beginning of serious, academic attention to KRF. As with many of the most prominent aspects of North Dakota archaeology, threats of destruction provided the impetus for intensive archaeological investigations here when the quarry heartland was targeted for strip mining and construction of a lignite gasification complex with associated roads, powerlines, water pipelines, gas pipelines, and other ancillary developments (cf. Greiser and Greiser 1981; Loendorf et al. 1976, 1984). In the early 1980s, the Bureau of Land Management (BLM; controlling the mineral rights throughout much of the KRF quarry area) and the North Dakota State Historic Preservation Office (ND SHPO) took active roles in promoting and financially supporting archaeological site inventories and site significance evaluation projects. That support resulted in a series of detailed investigations into KRF as a natural resource and KRF procurement/workshop sites as cultural resources reported by Ahler (1986), Ahler and Christensen (1983), Artz and Ahler (1989), Kay and Van Nest (1984), Root et al. (1985, 1986), Root and Van Nest (1985), William (1988), and others.

With this flurry of work in the 1980s, KRF itself become central to a variety of research concerns. The following research questions were enumerated by Loendorf et al. (1984:15-18) in *North Dakota History*:

> <u>Geologic Context of Natural KRF.</u> What is the natural geologic context of KRF in surface and subsurface deposits in the primary source area? Did the geologic context of deposition of KRF affect its intensity of use, and which of the various types of natural occurrence of KRF were most or least intensively used in the past? Much needs to be learned in order to understand prehistoric preferences for one source location over another.

Quantity of Flint Removed from the Area. What quantity of KRF has been removed from the ground and processed in individual and cumulative quarrying operations in the KRF primary source area? The answer to this question, together with information about site chronology and settlement patterns, will allow assessment of the overall significance of KRF as a lithic resource and the total human effort expenditure devoted through the ages to its extraction and distribution.

Age of the Quarries. For how long have the subsurface quarries in the KRF primary source area been used? When was the first major episode of quarrying conducted in the source area, and by whom? The maximum age of the quarries remains a mystery which can only be solved by analyses of artifacts and other materials recovered from well-controlled and dated subsurface archeological contexts.

Temporal Change in Intensity of KRF Use. How has the general level of intensity of exploitation of KRF changed through time, particularly that taken from subsurface quarries? Were there major periods of time when quarrying activities were most intensive and extensive, and other periods when little use of subsurface KRF occurred? If fluctuations in the intensity of use of KRF did occur, did they correlate with regional or continent-wide cultural developments?

Quarrying Techniques and Effort Expenditures. What kinds of excavation techniques were used to prospect for and extract KRF from subsurface deposits? What kinds of digging tools were used, and what kinds of labor expenditures were involved in various geologic contexts? Did quarrying techniques change with time? Did KRF become measurably scarcer with time, and did later groups expend greater energy in its extraction than earlier groups?

Climatic Change and Quarrying of KRF. It is widely assumed that the KRF primary source area was subjected to a general rise in mean annual temperature and possibly a decrease in mean annual precipitation during the mid-postglacial period. Did this climatic change actually occur in the KRF primary source area? Was the change severe enough to affect surface vegetation cover, surface erosion patterns, natural exposure of KRF cobbles, and related quarrying and settlement patterns? Holocene climatic change has not been demonstrated for the primary source area, and speculations about its occurrence are based on general concepts of geomorphology integrated with climatic change models developed from data far outside the area.

Flintknapping Technologies Used with KRF. What flintknapping technologies and reduction sequences were used with KRF by the prehistoric inhabitants of the area? Once KRF cobbles were taken from the ground, what testing procedures and flaking procedures were used to produce usable artifacts? The key to answering this series of questions lies in the innovative application of new forms of technological analysis to both cores and flaking debris obtained from controlled excavations at sites within the KRF primary source area.

Lithic Reduction Technologies and Settlement Systems in the Source Area. Where were KRF flintknapping operations implemented with reference to different sorts of settlements? How did these activities integrate and correlate with other activities not specifically aimed at use of KRF (e.g., hunting, subsistence pursuits, etc.)? In other words, what is the function or range of functions for the individual component and sites in the primary source area, and how are the sites associated with a single group of people or a single time period functionally integrated with each other to form a settlement system? The key to studying these questions is accurate and objective functional classification of individual archeological components and sites in the primary source area.

Settlement System and Resource Distribution Links with Outside Areas. On a given time level, how did the settlement systems within the KRF primary source area integrate with settlement systems for the same or contemporaneous cultural groups outside the source area? Was the use of the KRF source area controlled, and was the control from the outside or by groups residing directly within the area? How was KRF distributed to its intermediate and maximal geographic limits throughout the North American continent?

Chronological Change in KRF Flintknapping Technologies and Related Settlement Systems. Did the flaking operations performed with KRF and the intended lithic end products change through time? Can such change or lack of change be explained with reference to regional or continent-wide cultural evolution, continent-wide technological innovations (such as the introduction of the bow and arrow or horticulture), or the diffusion of major religious/ceremonial complexes?

Refer to Ahler (1986:16-23), Hiemstra (2010) Kay and Van Nest (1984:201-227), Root et al. (1986:565-617) for extensive summary treatments of research topics and cultural resource management considerations regarding KRF and archaeological sites in the KRF primary source area. Many of the concerns treated by those authors have broader applications which can be extended beyond the primary source area.

The KRSU truly is rich in lithic raw materials. In addition to KRF, other stones include porcellanite, various forms of petrified wood, and coarse porous quartzite. Also, "a silcrete indistinguishable from the coarser varieties of Tongue River silicified sediment (TRSS) is found in the Taylor Bed, in the Bear Den Member of the Golden Valley Formation (Ahler and Christensen 1983; Clayton 1980; Wehrfritz 1978)" (Artz et al. 1987:2.6).

In 2021 the South Dakota State Historical Society published *Tool Stone Found at South Dakota Archaeological Sites* edited by Renee M. Boen. The document contains information, photographs, and maps on raw stone materials found at archaeological sites in South Dakota and will be a valuable reference for archaeologists in North Dakota as well. Craig Johnson's *Chipped Stone Technological Organization: Central Place Foraging and Exchange on the Northern Great Plains* (2019) is likewise a valuable resource regarding lithics resources and provides important research questions for future studies.

Overview of Previous Archaeological Work

The abundance of work in the KRSU is primarily the result of implementation of the federally mandated Section 106 process in areas of energy development and transportation networks coupled with high site densities in areas where KRF naturally occurs.

As of 31 December 2020, there were 2,079 archaeological sites, and 1,231 archaeological isolated finds and site leads in the state site data for this SU. With an area of 2,445 mi², this unit has the highest archaeological resource density with one archaeological site per 1.2 mi². The density is one archaeological resource per 0.7 mi² when all sites, site leads, and isolated finds are included. This is a result of the unit's relatively small size coupled with the extensive areas that have been intensively inventoried for energy development and transportation projects.

Table 3.2 presents a cross tabulation of data for recorded sites by the landforms upon which the sites are situated. A reader gets two immediate impressions of the data from the site files: (1) several gross patterns of recorded site characteristics are apparent, and (2) **there is missing and bare-minimum data indicating the need for site recorders to accurately enter data on page 1 of the NDCRS form for archaeology**.

Table 3.2: Feature Type by Landform of Archaeological Sites in the Knife River Study Unit, 31 December 2020.

SU 3	Cairn	CMS	Eagle	Village	Earth	Grave	Hearth	Jump	Mound	ORF	Pit	Quarry	Art	Circle	Trail	Misc.	TOTAL
Alluvial fan		5															**5**
Beach/River bank		13					2										**15**
Beachline (glacial)		1															**1**
Butte	1	8								1	2	2		2			**16**
Canyon		1										1					**2**
Draw	4	61				1	2	1		3	4	2		4		1	**83**
Floodplain		85					1			1	1	5		4			**97**
Hill/Knoll/ Bluff	138	727	1		1	8	11		4	40	13	61	1	158		8	**1171**
Other	1	40					1					2		4			**48**
Ridge	172	304				4	8		2	53	21	24		237	1	1	**827**
Saddle	9	20					1			3				13			**46**
Spur	17	30								5	1			24			**77**
Swale	1	11				1			1	1				1			**16**
Terrace	14	237					3			4	1	8		10		1	**278**
Upland plain	27	208			1	1			1	10	1	7	1	37	1	2	**297**
Valley wall foot slope	1	41		1	1	1	1	1	1	2	2	7		3		2	**64**
TOTAL	**385**	**1,792**	**1**	**1**	**3**	**16**	**30**	**2**	**9**	**123**	**46**	**119**	**2**	**497**	**2**	**15**	**3,043**

CMS=Cultural Material Scatter; Eagle=Eagle Trapping Pit; Village=Earthlodge Village; Earth=Earthwork; ORF=Other Rock Feature; Art=Rock Art; Circle=Stone Circle; Misc.=Miscellaneous

Table 3.3: Cultural/Temporal Affiliation of Archaeological Resources in the Knife River Study Unit, 31 December 2020.

Paleo-Indian	
Unspecified	18
Clovis	2
Folsom	1
Agate Basin	1
Plano (Cody)	8
Total	**30**
Archaic	
Unspecified	48
Early Large Side-Notched	6
Oxbow	8
McKean/Duncan/Hanna	52
Yonkee	2
Pelican Lake	53
Total	**169**
Woodland	
Unspecified	11
Early Woodland	1
Sonota/Besant	63
Avonlea	10
Middle Woodland	2
Late Woodland	1
Total	**88**
Late Prehistoric	
Unspecified	99
Plains Village	20
Plains Equestrian	7
Total	**126**
TOTAL	**413**

Regarding gross patterns of site characteristics, (1) most recorded sites are on elevated landforms such as hills, ridges, and upland plains where archaeological deposits are most readily detected because of erosion and deflation; (2) the numbers of sites along river banks and on floodplains are surely underrepresented due to burial of such site deposits by alluvial sedimentation; and (3) the solid representation of stone circle, cairn, and other stone features is evidence that some portion of the SU remains in relatively undisturbed condition.

Concerning missing and bare-minimum data, cultural/temporal affiliations surely are not recorded in as detailed a manner as they could be. Many more Paleo-Indian (Paleo) complexes are represented in the sample of recorded cultural resources than are indicated by the site database (Table 3.3). Folsom, Plano (in the form of Scottsbluff, Eden, and Alberta), and Frederick and Pryor Stemmed are certainly represented in the KRF quarry area (cf. Ahler and Christensen 1983:Figure 38; Root et al. 1986:428). Multiple Folsom sites are recorded in the Lake Ilo National Wildlife Refuge. Plains Village components should be much better represented than they are. There may be hesitancy to code sites with Plains side-notched points as Plains Village if readily identifiable Plains Village pottery sherds are not observed.

Inventory Projects

Several large project areas within the KRSU have been intensively surveyed. They are (1) locations of energy development, (2) transportation networks, (3) rural water infrastructure, and (4) the Lake Ilo National Wildlife Refuge. Table 3.4 provides a summary of reported Section 106 undertakings or state-level projects requiring pedestrian inventory in the KRSU.

Table 3.4: The percentage of the projects by type and the percentage of the total acres intensively surveyed in the Knife River Study Unit, 31 December 2020.

Type	Projects 13 September 2007 - 5 August 2015	Acres Surveyed 13 September 2007 - 5 August 2015	Projects 5 August 2015 - 31 December 2020	Acres Surveyed 5 August 2015 - 31 December 2020
Land use*	34%	6%	35%	8%
Transportation**	24%	30%	42%	34%
Mining	4%	24%	1%	20%
Oil and Gas	14%	19%	8%	15%
Electricity	15%	19%	7%	21%
Telecom	9%	2%	7%	1%
* Includes rural water and federal land use projects ** Includes road and airport projects				

Early intensive surveys and re-surveys took place in the 1970s and 1980s in the KRF primary source area. This work was prompted by plans of a private developer to create a lignite strip mine and a lignite-to-methanol conversion plant in the very heart of the KRF quarry area. Reviewing the results of the series of surveys in the KRF primary source area is like reviewing refinements in site survey methodology during those two decades. The initial survey recorded a seemingly large number of sites: 144 sites in 13,200 ha (Loendorf et al. 1976). The next survey identified more sites (49 in 4,000 ha) and a struggle began with the problems of defining and identifying site boundaries in this area of sprawling, complex sites and intensive prehistoric land use (cf. Greiser and Greiser 1981; Root et al. 1986:505-512). Site boundary considerations have since become much more precise. Surface and subsurface artifact distributions could be viewed as nearly continuous throughout much of the KRF primary source area (cf. Steinacher 1982). Table 3.5 lists reports and other publications relevant to the study of KRF and the KRF primary source area reprinted from Artz and Ahler (1989:17-19).

In 2006, the North Dakota Department of Transportation (NDDOT) sponsored a the KRF primary source area project, centered on ND Highway 200. The initial report was titled *KRF Predictive Model: Resource Distribution and Land Use through Time in Dunn and Mercer Counties, North Dakota* (Metcalf et al. 2009). This report was never finalized, but a draft copy is on file at ND SHPO. In 2012, the NDDOT began planning road improvement projects along Highway 200 through a portion of the KRF quarry district with the goal of expanding research in the area and updating the KRF Predictive Model. The annotated bibliography, published in the 2008 edition of the State Plan, has been updated (Table 3.6).

Table 3.5: Summary of Reports and Publications Relevant to the Study of Knife River Flint and the *Primary Source Area* through the Year 1989 (Artz and Ahler 1989:Table 2).

Reference	Major Contribution
Wilson 1908-1918 (Weitzner 1979:240)	* discussion of Hidatsa use of the KRF quarries
Crawford 1936	* the first published description of the KRF quarries
Bowers 1965:120, 166	* discussion of Hidatsa use of the KRF quarries * Hidatsa arrowpoint making with KRF
Clayton et al. 1970	* accurate documentation of major KRF quarry areas * description of typical quarry pits and sites * detailed description of geologic origin of KRF
Loendorf et al. 1976	* survey of 13,200 ha in KRF primary source area, 144 sites discovered * backhoe trenching of two KRF quarries
Greiser and Greiser 1981	* sample survey of 4000 ha in KRF primary source area, 49 sites recorded * modeling of site distributions in KRF quarry area
Stanfill et al. 1983	* probing and sampling at 32 sites in the study area
Steinacher 1982	* survey within the Lynch KRF historical district, site boundary definition
Ahler and Christiansen 1983	* first controlled excavation in a KRF quarry and workshop, reported herein * analytic procedures for KRF quarry area samples, reported herein
Ahler 1983	* heat treatment in KRF, feasibility and detection
Kay and Van Nest 1984	* test excavation at four nonquarry sites in the primary source area * documents buried deposits in varied contexts * documents Paleoindian through Late Prehistoric in situ deposits
Loendorf et al. 1984	* documents the significance and content of the Lynch Knife River Flint Quarry National Historic District * distribution of KRF beyond the primary source area * discounts other major sources reported for KRF
Root and Ahler 1984	* documents first in situ Paleoindian projectile discovery in ND, in the primary source area
Ahler and Van Nest 1985	* documents chronological change in KRF reduction strategies in the primary source area
Root and Van Nest 1985	* test excavation at 10 quarry and nonquarry sites * documents Paleoindian through late occupation at several sites * Holocene sedimentary record documented at several sites
Root et al. 1985	* documents Paleoindian through Late Prehistoric workshop activity and changing depositional conditions
Root and Ahler 1985	* Holocene environmental change and changing reduction strategies in the primary source area
Clark 1985	* documents private projectile point collections in the study area * patination/age relationships in KRF * changing intensity of use of the primary source area

Reference	Major Contribution
Van Nest 1985b	* patination in KRF artifacts
Lehmer 1954	* KRF occurrence in Plains Village tradition sites in South Dakota
Johnson and Roper 1974	* KRF occurrence through time in Eastern Montana
Neuman 1975	* documents significance of KRF in Woodland Sonota complex
Leaf 1976	* KRF occurrence at sites on the Sakakawea Reservoir
Ahler 1977b	* documents significance of KRF in certain Plains Village tradition sites in South Dakota
Syms 1977	* documents significance of KRF in Sonota and other sites in Manitoba
Leaf 1979	* bipolar reduction strategies applied to KRF
Braun et al. 1982	* documents occurrence of KRF in Middle Woodland sites in the Midwest
Frison and Stanford 1982	* KRF in Folsom and Agate Basin components * distinction between KRF and South Dakota stones
Root 1983 (ed.)	* KRF workshop activities at a site just south of the primary source area
Clark 1984	* KRF exchange and movement into the Woodland period Midwest
C. Johnson 1984	* KRF occurrence in Plains Village tradition sites in South Dakota
Keuhn 1984	* KRF workshop activities at an Early Archaic site near the Killdeer Mountains
Artz 1985b	* KRF procurement and reduction north of the Killdeer Mountains, outside the primary source area

Table 3.6: Annotated Bibliography from *KRF Predictive Model: Resource Distribution and Use through Time in Dunn and Mercer Counties, North Dakota*. Courtesy of Metcalf Archaeological Consultants, Inc., Bismarck, North Dakota. (MS# is the manuscript on file at the ND SHPO).

Author	Year	Reference
Artz, J.	1986	*Southwest Pipeline Archeology: Testing and Evaluation of 15 Sites in Mercer and Dunn Counties, North Dakota*. Department of Anthropology, University of North Dakota, Grand Forks. Submitted to the North Dakota State Water Commission, Bismarck. The University of North Dakota conducted archaeological investigations at 15 sites Mercer and Dunn Counties for the North Dakota State Water Commission's construction of the Southwest Pipeline. One site in Mercer County, 32ME796 and six sites in Dunn County, 32DU194, 32DU198, 32DU199, 32DU307, 32DU308, and 32DU319 are located in the Primary Source Area. Artz noted several patterns in the quantity and quality of natural KRF. The highest densities are within quarry sites than in non-quarry contexts. He also indicates that sites in overbank alluvial settings tend to have the lowest densities of knappable KRF pebbles and cobble-sized gravels.
Artz, J. and S. Ahler	1989	*Further Evaluation of the Alkali Creek Archeological Site, 32DU336-SEE, Dunn County, North Dakota*. Prepared by Department of Anthropology, University of North Dakota, Grand Forks, for North Dakota State Office, Soil Conservation Service, USDA, Bismarck, North Dakota. Manuscript on file at the State Historic Preservation Office, MS#4799. The authors summarize the 1988 reevaluation of the Alkali Creek site for inclusion in the National Register of Historic Places. This reevaluation was conducted during the early phases of Halliday Flood Prevention project. The site was originally evaluated as not eligible based on the testing that occurred in 1986-1987; however, additional evidence revealed during construction indicated that the site contained stratified cultural deposits. Their results revealed two occupations focused on the procurement of Knife River flint from the Pleistocene age gravels, the first predating ca. 9000-8000 RCYBP, and the most recent after ca. 4000-3000 RCYBP.
Artz, J., Root, and M. Gregg (editors)	1983	*Archeological Investigations at 32DU37 and 32DU273: Two Sites Near the Killdeer Mountains in Dunn County, North Dakota*. Department of Anthropology, University of North Dakota, Grand Forks. Submitted to the Northern Border Pipeline Company, Omaha, Nebraska. Archaeological investigations were conducted at sites 32DU37 and 32DU273, located outside the Primary Source Area, to mitigate adverse effects from construction of the Northern Border Pipeline. Both sites are adjacent to the Killdeer Mountains and show evidence of Knife River flint (KRF) procurement and reduction. Based on the mitigation results, site 32DU37 is inferred to have multiple occupations spanning from the Middle Plains Archaic to post-Archaic period, all representing field camps that focused on resource exploitation of the Killdeer Mountains and KRF processing and biface production. The low density of faunal remains suggested limited food processing and preparation. Site 32DU273, Big Gulch-Chase site, is described as a Middle Plains Archaic campsite and KRF workshop. As the authors note, the presence of a workshop is particularly important since the site lies outside the Primary Source Area.
Clausen, E.	2011	*Knife River Drainage Basin Landform Origins, Western North Dakota, USA*. Electronic document, https://geomorphologyresearch.com/2011/12/24/knife-river-drainage-basin-landform-origins-western-north-dakota-usa/, accessed September 2, 2021. Clausen reconstructs the geomorphic history of the Knife River flint drainage basin using topographic maps. These maps indicate large-scale flood events across the entire basin which led to rapid erosion of the basin bedrock layers. Clausen indicates the stripping of rock layers was due to northwest to southeast oriented floods that led to the Killdeer Mountains as an isolated landform standing in eroded low plains.
Clayton, L., W. Bickley, Jr. and W. Stone	1970	Knife River Flint. *Plains Anthropologist* 15(20):282-290. Clayton et al. identify the original source location and different sedimentary deposits that contain Knife River flint. They indicate that the source of the KRF is inferred to be in the HS bed of the Golden Valley Formation. This hypothesis is based on evidence recorded on the hill slopes of the Killdeer mountains that revealed the presence of KRF cobbles. They contend that KRF also occurs in secondary deposition of Pleistocene age comprised of alluvial, residual lag

Author	Year	Reference
		gravel, and slope-wash deposits.
Crawford, L.	1936	Flint Quarries on Knife River. *The Minnesota Archaeologist* 2(4):1-4. The first publication on the Knife River flint quarries.
Hiemstra, D.	2006	*Highway 200: A Class III Cultural Resource Inventory in Dunn and Mercer Counties, North Dakota*. Prepared by Metcalf Archaeological Consultants, Inc., Bismarck for North Dakota Department of Transportation, Bismarck. Manuscript on file at the State Historical Preservation Office, MS#9913. An intensive cultural resource inventory inside the Knife River Flint Primary Source Area was conducted for the North Dakota Department of Transportation to document the cultural resource distribution and better facilitate future road projects. The inventory paralleled Highway 200 between the towns of Zap and Killdeer, North Dakota, in Dunn and Mercer counties. A total of 34.5 miles were surveyed in the fall of 2005 and spring of 2006. Recorded were 15 prehistoric sites, one historic site, four prehistoric site leads, and seven prehistoric isolated finds. Hiemstra also updated 24 sites during the inventory.
Hiemstra, D.	2010	The Lynch Knife River Flint Quarry National Historic Landmark nomination form. Submitted by Metcalf Archaeological Consultants, Inc., Bismarck, North Dakota. Submitted to the National Park Service, Lincoln, Nebraska.
Loendorf, L., S. Ahler, and D. Davidson	1984	The Proposed National Register District in the Knife River Flint Quarries in Dunn County, North Dakota. *North Dakota History* 51(4):4-20. A summary of the first organized inventory that took place in 1975 when Department of Anthropology, University of North Dakota, Grand Forks conducted an archaeological pedestrian survey of an area that the Natural Gas Pipeline Company of America proposed for a coal gasification complex and associated lignite deposits. The focus of the inventory was 33,000 acres south of Spring Creek, and a reconnaissance of an adjacent 80,000 acres tract that included areas north of Spring Creek and the Lynch Quarry Site. The result was a better understanding of the nature, distribution, and densities of the quarry pits and archaeological material, but the data were not sufficient to place the sites in any archaeological context.
Luedtke, B.	1992	*An Archaeologist's Guide to Chert and Flint*. University of California Press, Los Angeles. Luedtke discusses the lithology characteristics of KRF, observing that the structure of the flint is homogeneous or finely laminated. Its color is typically very dark brown, 10YR2/2 or 3/2; the texture is fine; the luster is medium; and the translucency is 5 to 11 mm. Impurities consist mostly of organic carbon and, in some cases, visible plant remains.
Murphy, E.	2001	*Geology of Dunn County, North Dakota*. Bulletin 68, Part I. North Dakota Geological Survey, Bismarck. Murphy provides a synthesis of the subsurface and surface lithostratigraphic record in Dunn County. He identifies the different topographic locations and describes the lithologies of the various geologic formations present in Dunn County. The purpose of this study is to interpret the geologic history, construct a geologic map that illustrates the geochronology and lithologies of the rock units, to locate and define the county's aquifers and natural resources.
Murphy, E.	2003	*Surface Geology, Killdeer 100K Sheet, North Dakota*. North Dakota Geological Society. 100K series geologic map covering the east-central portion of Dunn County and west portion of Mercer County from Township T. 144 N. to T. 146N, and Range R. 97W to R. 89W. The map illustrates the surface geology, including rock units from the Tertiary and Quaternary periods. Prominent geologic units include Pleistocene and Holocene age deposits with high potential to yield buried cultural material.
Murphy, E.	2004	*Surface Geology, Dodge Quadrangle, North Dakota*. North Dakota Geological Society. 24K series geologic map covering portions of Dunn County along the Highway 200 corridor and surrounding the town of Dodge from Township T. 144 N. to T. 145N, and Range R. 91W to R. 90W. The map illustrates the surface geology, including rock units from the Tertiary and Quaternary periods. Prominent geologic units include Pleistocene and Holocene age deposits with high potential to yield buried cultural material.
Murphy, E.	2004	*Surface Geology, Dunn Center Quadrangle, North Dakota*. North Dakota Geological Society. 24K series geologic map covering portions of Dunn County along the Highway 200 corridor and west of Dunn Center from Township T. 144 N. to T. 145N, and Range R. 94W to R. 93W.

Author	Year	Reference
		The map illustrates the surface geology, including rock units from the Tertiary and Quaternary periods. Prominent geologic units include Pleistocene and Holocene age deposits with high potential to yield buried cultural material.
Murphy, E.	2004	*Surface Geology, Golden Valley Quadrangle, North Dakota*. North Dakota Geological Society. 24K series geologic map covering portions of Dunn County along the Highway 200 corridor and surrounding the town of Halliday from Township T. 144 N. to T. 145N, and Range R. 90W to R. 89W. The map illustrates the surface geology, including rock units from the Tertiary and Quaternary periods. Prominent geologic units include Pleistocene and Holocene age deposits with high potential to yield buried cultural material.
Murphy, E.	2004	*Surface Geology, Halliday Quadrangle, North Dakota*. North Dakota Geological Society. 24k series geologic map covering portions of Dunn County along the Highway 200 corridor and surrounding the town of Halliday from Township T. 144 N. to T. 145N, and Range R. 92W to R. 91W. The map illustrates the surface geology, including rock units from the Tertiary and Quaternary periods. Prominent geologic units include Pleistocene and Holocene age deposits with high potential to yield buried cultural material.
Murphy, E.	2004	*Surface Geology, Lake Ilo Quadrangle, North Dakota*. North Dakota Geological Society. 24K series geologic map covering portions of Dunn County along the Highway 200 corridor and surrounding Lake Ilo from Township T. 144 N. to T. 145N, and Range R. 95W to R. 94W. The map illustrates the surface geology, including rock units from the Tertiary and Quaternary periods. Prominent geologic units include Pleistocene and Holocene age deposits with high potential to yield buried cultural material.
Murphy, E.	2004	*Surface Geology, Werner Quadrangle, North Dakota*. North Dakota Geological Society. 24K series geologic map covering portions of Dunn County along the Highway 200 corridor and surrounding the town of Werner from Township T. 144 N. to T. 145N, and Range R. 93W to R. 92W. The map illustrates the surface geology, including rock units from the Tertiary and Quaternary periods. Prominent geologic units include Pleistocene and Holocene age deposits with high potential to yield buried cultural material.
Murphy, E.	2014	Knife River Flint and Other Siliceous Rocks in Western North Dakota. Electronic Document, https://www.dmr.nd.gov/ndgs/documents/newsletter/2014Winter/Winter2014KnifeRiverFlint.pdf, accessed September 2, 2021. *Geo News*, January 2014. Murphy discusses the five major geologic beds that contain silica-rich rocks in western North Dakota, including the HS bed defined by Clayton et al. (1970) as the primary source for Knife River flint. The stratigraphic location, geochronology, and lithology characteristics are described, including a brief narrative of the uses for the rocks, prehistorically and historically.
Olson, B.	1992	*The White Owl Site (32DU621): A Late Prehistoric-Protohistoric Campsite and Knife River Flint Procurement Locality on the Fort Berthold Indian Reservation, Dunn County, North Dakota*. Prepared by Powers Elevation Company, Inc., Aurora Colorado. Prepared for the North Dakota Department of Transportation, Bismarck. In 1991, archaeologists from Powers Elevation Company, Inc. investigated the White Owl Site, 32DU621, on the Ft. Berthold Reservation, Dunn County. The White Owl Site is one of several sites outside the Knife River flint (KRF) Primary Source Area in rolling grasslands north of the Little Missouri River and that are associated with natural outcrops of KRF. More specifically, the site is situated on the T2 terrace overlooking Moccasin Creek to the east. Olson named this area the Moccasin Creek KRF Source Area. Olson defined the White Owl Site as a procurement area with an associated camp area composed of stone circles. A date of 60 ± radiocarbon years before present was from stained soil obtained from a hearth in one of the stone circles. This date was rejected as too young. The second date of 190 ± 70 radiocarbon was from charcoal found in another stone circle.
Root, M.	1999	*Field and Laboratory Methods and Techniques the Lake Ilo Archaeological Project*. Center for Northwest Anthropology, Department of Anthropology, Washington State University, Pullman, Washington. Submitted to the University of North Dakota, Grand Forks, and the U.S. Fish and Wildlife Service, Denver, Colorado. Chapter 1 discusses the field techniques used during the 1992-1994 excavations at 12 sites during the Lake Ilo Archaeological project. Field methods included topographic mapping,

Author	Year	Reference
		intensive surface artifact collection, backhoe trenching, probability site sampling using 1-x-1 meter excavation units and blocks, stratigraphic profiling and description, and environmental sampling for radiocarbon dating, flotation, pollen and phytolith analyses. In Chapter 2, laboratory techniques are summarized beginning with size grading and sorting and finishing with descriptions of the artifact types encountered during excavation. Stone tool and core analysis are discussed in Chapter 3. The authors summarize the descriptive category codes and definitions of stone tool and cores, including technological, morphology, functional, and raw material. Also discussed are the stages of biface tool production, patination intensity classes, and definitions. Chapter 4 summarizes analysis of flaking debris, including the technological classification of flakes, flake fragments, and shatter. Chapter 5 describes the techniques for studying vertebrate faunal remains with the goal of identifying the types of animals present during occupation, subsistence patterns, and paleoenvironmental reconstruction. Soil and sediment laboratory methods are summarized in Chapter 6. This chapter outlines the procedures for proper care and treatment of samples for particle-size analysis.
Root, M.	2000	*The Archaeology of the Bobtail Wolf Site: Folsom Occupation of the Knife River Flint Quarry Area, North Dakota*, Washington State University Press, Pullman. Root presents a summary of the excavations conducted at the Bobtail Wolf site, a Folsom age Knife River flint (KRF) workshop and campsite located inside the (KRF) Primary Source Area. The site represents one of the largest Folsom age assemblages recorded on the Northern Plains. The site offers clues into Paleoindian stone tool procurement, manufacture, and group mobility at the end of the Pleistocene.
Root, M. and S. Ahler	1984	Early Man at the Knife River Flint Quarries. *North Dakota History* 51(4):54. The authors summarize archaeological investigations at the Benz site, 32DU452. The site contains a late Paleoindian occupation as evident by the recovery of Scottsbluff and Alberta projectile points buried in the Leonard Paleosol. The points are associated with radiocarbon dates between 8000 to 9300 RCYBP.
Williams, J., J. Zabel, J. Glennon, S. Ahler, and M. Thompson	2000	*Site 32DU954G: An Early Plains Archaic Workshop in the Lake Ilo National Wildlife Refuge, Dunn County, North Dakota*. Bilby Research Center. Northern Arizona University. Flagstaff. The authors discuss the data recovery conducted at a portion of site 32DU954 (32DU954G) located on the floodplain of Spring Creek, west of Murphy Creek. The site is a campsite and lithic workshop dated to the Late Plains Archaic based on radiocarbon dates obtained from faunal collagen (5190 +/- RCYBP) and projectile points. A late Paleoindian Angostura projectile point was documented; however, the authors indicate that it was recycled by later occupants.

In a rapid series of responses to threats of destruction to potentially vast tracts within the KRF quarry heartland, sufficient site inventory work and test excavations were conducted to compile a National Register of Historic Places (NRHP) nomination entitled the Lynch Knife River Flint Quarries National Register District (see Loendorf et al. 1984 for a review of events leading to the nomination and a description of the District). The Lynch Quarry site (32DU526) is the KRF quarry type-site (Clayton et al. 1970). Site surveys and test excavations in the KRF primary source area continue to refine understandings of this very important cultural resource base.

In 1988, a survey and evaluation project were conducted to the south of the Lynch District. The project was designed to collect specific sets of data to enable more precise site characterizations. The specific sets of data included (1) artifact density data from auger holes and point-quarter survey, (2) stratigraphic data from auger holes, (3) technomorphological content data for chipped stone tools from surface collections and auger samples, (4) temporal data from patination studies, (5) diagnostic artifact temporal data, (6) identification of non-KRF exotics, and (7) observations on surface features. These data, along with other information routinely collected by inventory projects, were utilized in attempts to (1) develop and apply a consistent definition for the concept of "a site," (2) develop and apply methods for determining site boundaries so that the site boundary concept has management utility, and (3) develop and apply methods for evaluating NRHP eligibility in the absence of data from test excavation (William 1988). This survey work was performed at a rate of about 30 acres per person-day.

Inconsistent definitions of what a site is in the KRF area have resulted in fewer sites being recorded than indicated by the distribution of surface artifacts (William 1988:289). Surveyors have been overwhelmed by extensive scatters of KRF chips and have subjectively elevated the threshold of the flaking debris density required to classify light-density artifact scatters as sites rather than isolated finds. However, in a 1988 BLM-SHPO-sponsored survey, it was found that it is undesirable to adhere rigidly to a single site definition. It was determined that site definitions *should* vary between localities with different sorts of archaeological deposits. In areas with continuous occurrences of artifacts, sites were delimited by concentrations. In areas with very few background artifacts or poor visibility, a low number of artifacts such as 5 per 2,500 m^2 sometimes were considered sufficient to define a site (William 1988:293). It was concluded that the combination of auger probing, and surface reconnaissance leads to a more reliable estimation of site boundaries than the use of either method alone (ibid.:294).

National Register of Historic Places evaluations were attempted by calculating "research value rankings" for each site. The scorings involved (1) number of artifact classes present, (2) features present, (3) site disturbance, (4) number of cultural components, (5) site size, (6) surface visibility, (7) presence of exotic artifacts, (8) soil depth, (9) site function, (10) presence of paleosols, and (11) surface artifact density (William 1988:294). In William's assessment, in many cases, sites can be evaluated as eligible for NRHP listing without need for data from test excavations.

Energy Development and Expansion

Coteau Mining

This surveyed area is land mined by the Coteau Properties Company (Coteau) north of Spring Creek, in the northeastern portion of the KRSU. The area consists of tens of thousands of acres. Initial surveys were conducted by Woolworth Research Associates (1974) and Margaret Taylor working for the BLM. In 1977, survey by Dill and Ludwickson covered 27,721 acres and identified 149 sites, not all of them prehistoric (Dill 1978). Additional surveys in 1979 and 1981 covered several thousand acres and recorded more sites. With this work, isolated finds began to be recorded. In 1983, 23,555 acres were intensively inventoried with surveyors walking at 35-meter intervals (North American Consultants 1984). Stone circle and stone feature sites were the principal archaeological sites recorded in native prairie. The number of stone circles per site ranged from 1 to 85. Some 817 stone circle features were identified on 72 stone circle sites (ibid.: Table A-1). Cultural material scatters dominated the inventory in tilled areas. Inventories for Coteau continue as the mining operations expand (Boughton 2005; Boughton et al. 1994, 2000; Moloney 2020; Strait et al. 2003).

Boughton et al. (2000) report on a 22,820-acre Class III inventory conducted for Coteau's expansion area north of Beulah. The project area includes the KRSU (West Permit Area and Permit Area D Extension) and a smaller portion in the Garrison Study Unit (Permit Area H Extension). Two hundred and thirty-one prehistoric sites were recorded. Within the largest expansion block (West Permit Area), 157 of the 204 prehistoric sites are stone circle sites. Other types include 28 rock feature sites (cairns, alignments, and a petroglyph) and 17 lithic scatters. In this block alone, more than 1,400 stone circles, 400 cairns, and 16 rock alignments were observed (ibid.:9.1).

Boughton et al. (2000) provide an analysis of site patterning in the project area. Investigators offer several salient issues regarding stone feature site placement, including (1) distance from natural resources, (2) feature size as it relates to topography, elevation, and site size, and (3) special purposes. Some general trends described in the report are: (1) larger stone circle sites, and larger rings within sites, are located nearer drainages; (2) the frequency and density of stone feature sites, and rings within sites, are preferentially placed north and east of drainages; 3) larger stone circles are more often placed in less rugged, higher elevations; (4) most stone circles are single course; (5) when both stone circles and cairns are present at a site, there is a greater quantity of cairns; and (6) rock alignments generally are observed in less rugged areas, often in the vicinity of stone circles (Boughton et al. 2000:9.1-9.17).

During the field season of 2002, 6,510 acres were inventoried for Coteau at the Freedom Mine northeast of Beulah (Strait et al. 2003). Thirty prehistoric sites and four multi-component sites were recorded, including stone circles (n=22) and lithic scatters (n=8) (ibid.:8.1). In 2007, 27 stone circle (n=23) and cairn (n=4) sites were recorded during a survey of 1,280 acres (Thomas 2008).

Coyote Creek Mining

Intensive inventory and testing occurred in an 8,939-acre tract of the Coyote Creek mining area in 2012-2013 (Kuntz, et al. 2013). In 2012, shovel probes and formal test units were excavated at 23 lithic scatters and 37 stone feature sites (95 circles, 32 cairns, and 6 other stone features) (ibid.:7.1). Forty-two of the sites were tested, totaling 125.84 square meters excavated. Excavation uncovered four subsurface features (two hearths and two lithic concentrations) and chipped stone flaking debris, tools, pottery, and faunal bone fragments. Investigators noted an "unusually high" density of lithic artifacts, particularly KRF (ibid.). They theorize this is due to exposures of KRF nodules near the Coyote Creek.

Follow-up evaluative investigations were conducted during 2013-2015 (Kuntz and Peterson 2013; Peterson et al. 2016). At seven of the sites (32ME2455, 32ME2456, 32ME2457, 32ME2461, 32ME2463, 32ME2465, 32ME2487) geophysics were used along with traditional testing methods (Kuntz and Peterson 2013). The purpose of the magnetic field gradient survey was to identify subsurface features such as hearths. Ultimately, the geophysics proved unsuitable for the area. Subsequent testing revealed that all the anomalies were false positives due to the presence of igneous boulders (ibid.). Shovel test probes and formal test units, totaling 47.4 square meters, yielded chipped stone flaking debris, tools, pottery, and faunal bone fragments.

Optically stimulated luminescence has been employed to date stone features. Mahan (2006:1) explains, "Optically stimulated luminescence (OSL) is one of a class of measurements known as stimulated phenomena. Such phenomena may be stimulated thermally or optically…OSL has become popular procedure for the determination of environmental radiation doses absorbed by archaeological and geological materials in an attempt to date these materials." Ethnoscience utilized OSL to analyze features at 32ME2453 and 32ME2473, however, the resulting dates differed significantly from the radiocarbon dates of the same features (Peterson et al. 2016). Of site 32ME2453, investigators write, "Although OSL provides accurate dates in other environments, we feel that the radiocarbon date (BC 363-342) is likely more accurate. The OSL date could mark a later occupation (perhaps associated with Feature 2 or 3) in which ring rocks were lifted and potentially moved" (ibid:6-83.)

Pipelines

Survey of the Northern Border Pipeline right-of-way covered a ca. 50-mile transect across the KRSU from the Killdeer Mountains to Hebron; about 80 sites were recorded (Root, Kordecki, Billeck et al. 1983; Root, Kordecki, and Meier 1983). Temporally diagnostic artifacts indicated components ranging from Early Archaic to Plains Village in age. Sites were found mostly on the crests and upper slopes of hills and ridges with lower frequencies in stream valleys. This is the expected surface site distribution: discoveries are most common in areas where Holocene-age sediments are thinnest. Most of the sites were hypothesized to represent short-term occupations such as field camps, stations, and locations (Root, Kordecki, and Meier 1983:893). However, functional classification of sites was rendered difficult because most of them appeared to represent "palimpsest deposits which accumulated through successive occupations" (ibid.:898). Site densities were especially high in the rolling uplands west of the KRF quarries and near the Knife River. Densities were low to the south of the Knife River. High site densities were hypothesized to be attributable to settings with high plant and animal resource potential. The area of low site density, south of the Knife River, was viewed as having had lower natural resource density and diversity (e.g., plants, animals, water, KRF, and timber) (ibid.). Overall, site densities and surface artifact densities were greater in the Knife River basin portion of the Northern Border transect than in other portions of the pipeline route across North Dakota. These high densities probably are attributable primarily to the heavy use of the KRF primary source area for lithic raw material procurement.

As a direct result of the oil and gas boom of the 2010s, several large pipelines crossing multiple counties (and SU) in North Dakota necessitated pedestrian inventories of linear project corridors. Four of these are 1) Bridger (2,471 acres), 2) BakkenLink (6,167 acres), 3) Dakota Access (7,128 acres), and 4) BOE II (1,424 acres) (Dodson et al. 2016; France and Reinhart 2010; Kulevsky 2010, 2012; Kulevsky and Stine 2012; Lange Mueller et al. 2015; von Wedell and Hull 2017). Nearly all the sites recorded in the KRSU for these projects are lithic scatters, except for two Mercer County sites which include cairns, stone circles, and other stone features.

Southwest Pipeline

Survey of the Southwest Pipeline right-of-way yielded inventory information for transects totaling ca. 75 miles in length within the Knife River basin, and 57 sites and 30 isolated finds were recorded (Artz et al. 1987:Table 9.2). As with the Northern Border Pipeline survey, this was the highest site density of all drainage basins transected by the Southwest Pipeline, greater than in the Southern Missouri, Cannonball, Heart, Cedar, Grand, or Little Missouri basins (ibid.). Within the Knife River basin site density was highest in the Spring Creek drainage. Two particularly dense concentrations were identified near Golden Valley and Dodge along Spring Creek where greater topographic diversity and water availability translate to plant and animal resource diversity further attracting prehistoric settlement by people who were already drawn by KRF availability. Sites were also clustered near the Knife River-Spring Creek divide (ibid.:9.9). As with the Northern Border transect, site densities were higher north of the Knife River than to the south.

Lake Ilo

In 1989, archaeologists conducted a Class III inventory at the Lake Ilo National Wildlife Refuge in Dunn County. A total of 1,360 acres, in areas with low water levels, were surveyed using pedestrian transects spaced no further than 10 m apart. Fifteen prehistoric sites were recorded. Diagnostic artifacts collected from the sites ranged in age from Paleo through Late Prehistoric. The sites were evaluated as “probably significant” and “potentially significant” (Borchert et al. 1990). Six sites were evaluated as probably significant meaning that they contain datable materials, intact cultural deposits, and an abundance of artifacts (ibid.:E-117). The other sites were evaluated as potentially significant. That is, investigators were less sure about the potential to find datable materials, intact deposits, and/or answers to research questions at the sites (ibid.). Test excavations were recommended at both types of sites.

As part of background studies for large-scale inventory projects, researchers should attempt to make use of Landsat imagery of groundcover available for North Dakota (cf. Reid and Johnson 1978) supplemented by aerial photographic coverage (cf. USDA 1937). LIDAR coverage should be reviewed. Recent digital imagery is available from several internet sources including the North Dakota GIS Hub (2021), https://www.gis.nd.gov/.

In general, site avoidance, rather than formal testing and/or mitigation, has been the choice of applicants. The result is initial documentation of many new sites but relatively few evaluative investigations, and therefore little new knowledge about the prehistory of North Dakota.

Formal Test Excavation Projects

This SU has the highest ratio of testing projects to inventory projects in the state. This high rate of testing is due principally to several very big, high-impact developments where site evaluative investigations have been carried out. Swenson et al. (2016) discuss this situation on a state-wide level. Table 3.7 lists reported test excavation projects.

In dealing with shallow stone circle sites, however, high artifact densities often translate directly into positive significance evaluations. For example, the first mitigating excavation of a Coteau Properties’ archaeological resource was at 32ME166, a site with 11 stone circles, five stone features, two cairns, and one small depression (Kuehn 1984). Artifacts were found in 42%

Table 3.7: Formal Testing Projects in the Knife River Study Unit, 31 December 2020.

Year	First Author	Second Author	Title	Sites Tested	MS #
1978	O'Brien, L.		Test Excavation of the Ted Reich Farm Site - 32ME157	32ME157	301
1980	Tate, M.		Beulah Bridge Replacement Addendum Report, Mercer Co., ND	No SITS number	1868
1980	Good, K.	J. Logan	Test Excavation of Two Archeological Sites (32ME217 & 32ME218) within Section K, Indian Head Mine, North American Coal Company, Mercer Co., ND	32ME218	2530
1980	Rippeteau, B.		Addendum for the CRS2913(52) Road Improvement Testing of Archaeological Sites 4-8, Mercer Co., ND	32ME457 to 459, 32ME461	2297
1981	Roberson, W.	C. Parish	Northern Border Pipeline, ND: Historic Sites Testing & Evaluation, Morton, Dunn, McKenzie & Williams Counties	32DU93	2566
1982	Ahler, S.		Progress Report Concerning Archeological Investigations at the Cross Ranch & in the Knife River Flint Quarry Area, Dunn & Oliver Counties, ND	32DU508	2750
1983	Ahler, S.	R. Christensen	A Pilot Study of Knife River Flint Procurement & Reduction at Site 32DU508, a Quarry & Workshop Location in Dunn Co., ND	32DU508	2658
1983	Kjos, J	M. Schreiner	Recording & Evaluation of Site 32ME681 & Evaluation of Site 32ME135, Indian Head Mine NE Mine Area B, Mercer Co., ND	32ME681	3115
1983	Stanfill, A.	H. Plochman	Dunn-Nakota Methanol Project, Dunn Co., ND, Test Excavation & Evaluation of Selected Archaeological Sites, Vol. I	32DU106 to 109, 32DU425, 32DU431, 32DU433 to 436, 32DU438, 32DU440, 32DU450, 32DU454 to 457, 32DU467, 32DU518	3173
1983	Deaver, K.	K. Schweigert	Archaeological & Historical Evaluation Project for Proposed Permit Area D Coteau Properties Freedom Mine Area 2, Mercer Co., ND	32ME556, 32ME559 to 560, 32ME562 to 563, 32ME566 to 568	3225
1983	Root, M.	M. Gregg	Archeology of the Northern Border Pipeline, ND: Vol. 3, Test Excavations, McIntosh, Emmons, Morton, Stark, Mercer, Dunn, McKenzie, & Williams Counties, ND	32DU41, 32DU64, 32DU67 to 69, 32DU71, 32DU81 to 82, 32DU92, 32DU94, 32DU105, 32DU290, 32DU583, 32ME385, 32MO235 to 236, 32SK6	3456
1984	Historical Research Associates		Phase II Detailed Mitigation Plan for Significant Cultural Resources Sites Located Within Glenharold Mine Area I, Mercer Co., ND	32ME644	3255

Year	First Author	Second Author	Title	Sites Tested	MS #
1984	Kay, M.	J. Van Nest	Archeological Investigations in the Knife River Flint Primary Source Area, Dunn Co., ND: 1983-1984 Program	32DU159, 32DU429, 32DU438, 32DU452	3411
1984	Kuehn, D.		Preliminary Report on the Archeological & Historical Investigation Along the Voight Bay Road, Dunn Co., ND	32DU190	3415
1984	Kuehn, D.	J. Hodny	National Register Evaluations of 12 Archaeological Sites & 8 Historical Sites in the Coteau Mine Areas D and J, Mercer Co., ND	32ME166, 32ME252, 32ME691, 32ME694, 32ME709	3548
1984	Borchert, J.		Archaeological Investigations for the Basin Electric AVS to Charlie Creek 345 kV Transmission Line, Dunn Co., ND	32DU144, 32DU147, 32DU237, 32ME782	3551
1984	Kuehn, D.		Archaeological Testing at 32ME166	32ME166	3561
1984	Greiser, T.	S. Greiser	Report of Findings Resulting from Phase I Mitigation of Adverse Impacts to Cultural Resource Sites in Mine Area I of the Glenharold Mine, Mercer Co., ND, 2 Vols.	32ME117, 32ME627 to 628, 32ME630 to 632, 32ME635 to 637, 32ME642 to 645, 32ME648, 32ME651 to 652, 32ME655, 32ME659 to 661, 32ME670, 32ME674 to 675, 32ME677	3834
1985	Artz, J.		Boeckel-Renner (32ME799): A Mound Complex and Stone Circle Site in Mercer Co., ND (Paper Presented at the 43rd Plain Conference, October 23-26, 1985, Iowa City, IA)	32ME799	3891
1985	Root, M.	J. Van Nest	Archeological Investigations in the Knife River Flint Primary Source Area, Dunn Co., ND: 1984-1985 Site Testing Program	32DU124, 32DU181 to 182, 32DU184, 32DU193, 32DU490, 32DU512, 32DU518, 32DU520	3552
1985	Root, M.	S. Ahler	Archeological Investigations in the Knife River Flint Primary Source Area, Dunn Co., ND: The Benz Site, 32DU452 (Contribution No. 225)	32DU452	3733
1985	Kuehn, D.		A Report on Archaeological Evaluative Testing at Sites 32ME427 & 32ME438, Knife River Coal Mine, Mercer Co., ND	32ME427, 32ME438	3860
1986	Artz, J.	K. Schweigert	Southwest Pipeline Archeology: Testing & Evaluation of 15 Sites in Mercer & Dunn Counties, ND (Segments A, B-1, & B-2), Contribution No. 229	32ME182, 32ME796, 32ME799	3898
1986	Kuehn, D.		A Report on Significance Testing at Sites 32ME679 & 32ME680, Coteau Permit Area G, Mercer Co., ND	32ME679 to 680	4063
1986	Christensen, R.	D. Kuehn	An Evaluation of Archaeological Sites 32ME819 & 32ME834 on the Knife River Coal Company "S-S Tract" & Site 32ME825	32ME819, 32ME834	4093
1986	Kuehn, D.	L. Perry	Archaeological & Historical Investigations Along the Voigt Bay Road, Dunn Co., ND.	32DU190, 32DU205	4151
1986	Christensen, R.	D. Kuehn	Archaeological Testing at Five Sites Along the Golden Valley	32ME827 to 830	4156

Year	First Author	Second Author	Title	Sites Tested	MS #
			South Road Improvement, Mercer Co., ND		
1986	Root, M.	S. Ahler	Archeological Investigations in the Knife River Flint Primary Source Area, Dunn Co., ND: 1982-1986 Program.	32DU121, 32DU184 to 185, 32DU224, 32DU452, 32DU461	4273
1987	Borchert, J.		Final Report on Additional Test Excavations at 32ME199, Mercer Co., ND	32ME199	4255
1987	Shaw, T.	D. Kuehn	Final Report on the Archaeological Testing Carried Out on the Golden Valley Road South Improvement Project, Mercer Co., ND	32ME842 to 843, 32ME845 to 846	4256
1987	Artz, J.	L. Loendorf	Southwest Pipeline Archeology: Further Investigations at the Goodman Creek (32ME796) & Boeckel-Renner (32ME799) Sites, Mercer Co., ND	32ME799	4270
1987	Noisat, B.	J. Campbell	Cultural Resources Evaluation of Sites 32DU336 & 32DU337: Completion of the Historic Properties Survey for the RC & D Flood Prevention Project, Halliday, Dunn Co., ND	32DU336 to 337	4288
1988	Borchert, J.		32ME1014 to 32ME1016 Evaluative Testing	32ME1014, 32ME1016	4609
1988	Haury, C.	P. Picha	Evaluation of Four Cultural Resources on the Southwest Pipeline, Dunn, Mercer, and Stark Co., ND	32ME851	4711
1988	Bergstrom, M.	K. Deaver	Mitigation of Site 32ME163, Mercer Co., ND	32ME163	4712
1988	Deaver, K.	J. Brownell	Site Mapping, Testing and Evaluation in Area F, Coteau Freedom Mine, Mercer Co., ND	32ME167, 32ME169	4713
1989	Ahler, S.	J. Artz	Non-Technical Summary Report on Further Evaluation of the Alkali Creek Archeological Site, 32DU336-SEE, Dunn Co., ND	32DU336	4708
1989	Artz, J.	S. Ahler	Further Evaluation of the Alkali Creek Archeological Site, 32DU336-SEE, Dunn Co., ND	32DU336	4799
1989	Persinger, R.	J. Whitehurst	Test Excavations at 11 Sites for the Proposed Mercer County Road #13 Improvement Project Draft Final Report	32ME454, 32ME1032 to 1033, 32ME1035 to 1037, 32ME1040 to 1041, 32ME1044, 32ME1048 to 1049	4719
1989	Artz, J.	E. Hayden	Southwest Pipeline Archeology: The 1987 Survey & Test Excavation Programs at Prehistoric Sites in Mercer & Dunn Counties, ND (Segment A and B2)	32DU200, 32DU319 to 320, 32ME792 32ME847	5097
1989	Burbidge, G.	J. Borchert	Final Report Evaluation of Eight Sites Dunn Co., Road Dunn Co., ND	32DU910, 32DU913 to 918	4882
1989	Peterson, L.	J. Brownell	Archaeological & Historical Investigations of Sites within the Coteau Freedom Mines Areas, Mercer Co., ND (Life-of-Mine Area)	32ME175	4914

Year	First Author	Second Author	Title	Sites Tested	MS #
1990	Peterson, L.		Testing Conducted within the Southern Extreme of Site 32DU908	32DU908	5044
1990	Borchert, J.		Preliminary Report Evaluative Testing at 32ME835	32ME835	5294
1991	Newberry, G.	B. Olson	Western Area Power Administration Charlie Creek-Belfield Transmission Line Project: Results of Limited Testing at Four Prehistoric Sites in Billings and McKenzie Counties, ND	32BI746 to 747	5161
1991	Larson, T.	J. Miller	A Report of Archaeological Investigations at 32ME1267 & 32ME1269, Mercer Co., ND	32ME1267, 32ME1269	5515
1991	Späth, C.		32ME1049: Archaeological Data Recovery T142N, R89W Sections 23 & 24, Mercer Co., ND	32ME1049	5597
1991	Aaberg, S.	K. Deaver	Preliminary Report Dakota Star Reserve Archaeological Site Testing Project, Mercer Co., ND	32ME1087, 32ME1089, 32ME1213	5682
1991	Pool, K.		Dunn Co., Road Improvement: Results of Subsurface Testing at 32DU985 & Treatment Plan	32DU985	5796
1991	Späth, C.	R. Christensen	32ME254, Evaluation and Intensive Testing	32ME254	5798
1991	Späth, C.		The Bees Nest Ring Site (32ME175): Inventory of 80 Acres T145N R88W Section 2 Mercer Co., & Documentation & Limited Testing of 32ME175	32ME175	5799
1991	Aaberg, S.	K. Deaver	Testing & Evaluation of Nine Prehistoric Sites in Permit D Area, Coteau East Mine, Mercer Co., ND	32ME1087, 32ME1089, 32ME1213 to 1214, 32ME1234, 32ME1243, 32ME1245 to 1246	5932
1992	Borchert, J.	L. Blikre	Final Report of Evaluative Testing at 32DU1032 (UW#1477)	32DU1032	5711
1992	William, J.	S. Ahler	Phase II Cultural Resource Investigations Associated with Proposed Dam Safety Modifications at Lake Ilo National Wildlife Refuge, Dunn Co., ND Parts 1, 2	32DU953 to 955, 32DU958 to 959, 32DU964 to 970, 32DU972	5702
1992	McKibbin, A.		Interim Report of Findings During Data Recovery at 32ME1089, Mercer Co., ND	32ME1089	5788
1992	Stine, E.	A. McKibbin	Coteau Freedom Mine Testing & Evaluation of Nine Sites in Mercer Co., ND	32ME1075 to 1076, 32ME1085, 32ME1257	6007
1993	Cochran, S.		Dunn County Road Improvement: Results of Subsurface Testing at 32DU924, 32DU1069, 32DU1070, 32DU1071, & 32DU1073	32DU924, 32DU1069 to 1071, 32DU1073	5985
1994	Kulevsky, A.		Phase II Testing & Evaluation of Site 32ME1328 in Mercer Co., ND	32ME1328	6321
1994	Boughton, J.	L. Peterson	Testing & Evaluation of Prehistoric Sites within the North Mine Extension Area, Mercer Co., ND	32ME158, 32ME776	6347

Year	First Author	Second Author	Title	Sites Tested	MS #
1995	Klinner, D.		Results of the Evaluative Testing at Site 32DU1096 & Portions of Sites 32DU1097 & 32DU1098, Dunn Co., ND (UW#1696)	32DU1096 to 1098	6444
1996	Porter, D.	D. Klinner	Evaluative Testing at Portions of Sites 32DU1100 and 32DU1113, Dunn Co., ND	32DU1100, 32DU1113	6824
1998	Christensen, R.		Otter Creek Archaeology: Testing of 32OL336 and 32OL337, Oliver Co, ND	32OL336 to 337	7154
1999	Olson, B.	G. Newberry	Final Report of Evaluative Testing of Sites Impacted by the Dakota Gasification Company CO_2 Pipeline: Mercer, Dunn, McKenzie, and Williams Counties, ND	32DU1167, 32DU1180	7299
2000	Morrison, J.		Limited Testing of 32DU1028 Along Highway #8: Dunn Co., ND	32DU1028	7412
2001	Boughton, J.	B. Fandrich	Coteau Properties Company: Testing & Criterion D Evaluation of Prehistoric Sites Located in Permit Extension Areas D & H & the West Permit Area, Mercer Co., ND	32ME102, 32ME106 to 109, 32ME112, 32ME144 to 147, 32ME149 to 156, 32ME167 to 168, 32ME170 to 171, 32ME181, 32ME183 to 188, 32ME190 to 192, 32ME204 to 207, 32ME209, 32ME211 to 212, 32ME214, 32ME225 to 228, 32ME230 to 233, 32ME238, 32ME241 to 242, 32ME244 to 245, 32ME247, 32ME250 to 251, 32ME285, 32ME697 to 698, 32ME701, 32ME703, 32ME705, 32ME745, 32ME747, 32ME749, 32ME753 to 757, 32ME766, 32ME770, 32ME1309, 32ME1311, 32ME1317 to 1318, 32ME1320, 32ME1322 to 1323, 32ME1465 to 1466, 32ME1468 to 1469, 32ME1471 to 1485, 32ME1487 to 1488, 32ME1491 to 1493, 32ME1495 to 1501, 32ME1504 to 1507, 32ME1510, 32ME1513 to 1517, 32ME1519 to 1521, 32ME1524, 32ME1526, 32ME1529 to 1531, 32ME1533 to 1534, 32ME1536 to 1537, 32ME1539 to 1540, 32ME1542, 32ME1544 to 1545, 32ME1548, 32ME1551 to 1554, 32ME1556 to 1558, 32ME1560 to 1563, 32ME1565, 32ME1570 to 1575, 32ME1577 to 1580, 32ME1584, 32ME1586, 32ME1588 to 1589, 32ME1599	8531
2002	Wermers, G.		Evaluative Testing of the Southern Portion of Site 32DU319, Dunn Co., ND	32DU319	8171

Year	First Author	Second Author	Title	Sites Tested	MS #
2003	Strait, J.	L. Peterson	Coteau Properties Company: Testing and NRHP Evaluation of Properties Located in the Mine Area 2 North, Mercer Co., ND	32ME566 to 567, 32ME2203	8748
2004	Wermers, G.		Evaluative Testing at Sites 32ME427, 32ME2180, & 32ME2181, Mercer Co., ND	32ME427, 32ME2180 to 2181	9144
2005	Hiemstra, D.		Hazen Flint Quarry: Results from Evaluative Testing at 32ME365 Mercer Co., ND	32ME365	9101
2007	Toom, D.	C. Kordecki	Site 32DU1301 Archeological Test Excavations on the Upper Knife River, Dunn Co., ND	32DU1301	9989
2007	Jackson, M.	C. Kordecki	Dakota Westmoreland Corporation Beulah Mine Expansion: 2005 Evaluative Testing of Eleven Archeological Sites in Mercer Co., ND	32ME437, 32ME443 to 445, 32ME447, 32ME2225, 32ME2229, 32ME2231 to 2234	10733
2009	Jackson, M.	D. Toom	Dakota Westmoreland Corporation West Beulah Mine Expansion: 2007 Expanded Test Excavations at Site 32ME2229, Mercer County, ND	32ME2229	13994
2010	Klinner, D.	J. Harty	Evaluative Testing and Monitoring of a Portion of Site 32ME2275: A Knife River Flint Quarry Site in Mercer Co., ND	32ME2275	11414
2011	Banks, K.		Final Report: Evaluation of 32SK1020 & 32OL427, in Stark & Oliver Counties, ND	32SK1020	11556
2012	Harty, J.		Evaluative Testing at 32DU1254: North Dakota Highway 22, Dunn County, ND	32DU1254	13284
2012	Toom, D.	M. Jackson	Dakota Westmoreland Corporation West Beulah Mine Expansion: 2012 Evaluative Testing of Five Archeological Sites, Mercer County, ND	32ME2260 to 2263, 32ME2265	13995
2014	Tinti, C.		A Class III Cultural Resource Inventory & Limited Site Testing for 32ME2526 & a Haul Road Corridor in Mercer County, ND	32ME2526	15335
2015	Jackson, M.	D. Toom	Dakota Westmoreland Corporation West Beulah Mine Expansion 2014 Evaluative Testing of Two Archeological Sites, Mercer County, ND	32ME2543, 32ME2348	15778
2015	Stine, E.	J. Harty	Roughrider Electric Cooperative: Investigations at IEA369 in Dunn County, ND	32DU142	16132
2015	Leroy, A.	M. Hull	MC-Heinert 144-94-2215H-1 Well Pad and Access Road: Additional Phase 2 Evaluative Testing of 32DU1904 in Dunn County, ND	32DU1904	16141

of 50 auger probes and nine shovel probes dug during testing. All six of the 1-x-1-m test units yielded artifacts. The recovered artifacts included chipped stone tools and flaking debris, ground stone tools, bone, fire-cracked rock, and shell. However, high densities of these sorts of artifacts mean very little if the artifacts (along with their functions, raw materials, etc.) are not assignable to specific episodes of occupation, archaeological complexes, or cultural periods. Intact, low density, single-component cultural deposits can yield important information.

When developers cannot avoid historic properties, there is sure to be close attention paid to site significance evaluations. The effects from this scrutiny have been more positive than negative for archaeology. For example, it has become clear that greater numbers of artifacts are not necessarily indicative of sites with greater potential to yield important information. In fact, just the opposite may sometimes be the case. Larger sites and denser artifact deposits typically signify places that were recurrently occupied, and the resultant palimpsest deposits result in an obscured archaeological record. It has been concluded that well-stratified sites especially are significant in this SU as in all other parts of the state (cf. Artz 1988a:21).

The listing of test excavation project reports on file at the ND SHPO shows that 16 prehistoric sites were tested along the Northern Border Pipeline right-of-way in the Knife River drainage basin. Testing of another two (32DU37 and 32DU285) was followed up with small salvage excavations. The same analytical methodology was applied to all the excavated materials from all the Northern Border sites. The same analytical methodology has been applied to significant numbers of other tested sites in this SU in the KRF quarry area and along the Southwest Water Pipeline right-of-way (e.g., Artz 1986; Root et al. 1985, 1986). These projects have generated a large database which can be used to evaluate the importance of the application of methodologies which generate comparable data in archaeology.

During 1988 and 1989, a proposed county road improvement project necessitated test excavations at 11 sites in Mercer County. Three sites (32ME454, 32ME1035, and 32ME1040) were recommended eligible for the NRHP. Site 32ME454 is a quarry and lithic workshop, principally comprised of KRF flakes. A Besant projectile point dates the site. Investigators suggest it was used as a field camp. The recovered artifact assemblage indicates, “The technology utilized in the lithic reduction industry may have changed through time” (Christensen and Whitehurst 1989:12). Site 32ME1035 is a multi-component, dense lithic scatter mainly composed of KRF. A McKean projectile point dates deposits at the site to 3000-600 BC (ibid.:27). Surface collection included Besant and Late Prehistoric points, and a large corner-notched biface (ibid.:29). Site 32ME1040 differs from sites 32ME454 and 32ME1035 because it contains stone circles and cairns in addition to a lithic scatter. The density of the lithic scatter and the presence of the stone circles suggest a relatively intense, short-term occupations (ibid.:40). Moreover, the differing degrees of patination indicate multiple occupational episodes (ibid.).

Site 32MZ1005 is a moderately dense, multi-component cultural material scatter located on the edge of a ridge dividing the Little Missouri and Little Knife rivers (Newberry and Olson 1991). Projectile points dating to approximately 1400 BP were observed during the initial inventory of the sites. Buried deposits are present in portions of the site not affected by erosion from intermittent streams. Test excavation consisted of 135 shovel probes and eight formal test units. The artifact assemblage includes ceramics (Talking Crow ware), flaking debris, and bone (ibid.). Obsidian, sourced to Obsidian Cliff, was collected. The ceramic type and obsidian hydration tests confirm the site is multi-component (ibid.:72). The artifact assemblage is like that found at 24RL1225 (Nollmeyer Village in eastern Montana). Investigators suggest that site 32MZ1005 is "one of series of localities occupied by groups moving between the Yellowstone River Valley and the Missouri Coteau" (ibid.:71).

Sites 32OL336 and 32OL337, situated approximately 150 m apart on a terrace of the west bank of Otter Creek, were tested in 1997 by NDDOT archaeologists (Christensen 1998). The sites are cultural material scatters, primarily composed of KRF flakes, and likely the remnants of short-term campsites (ibid.:11). In addition to lithics, granitic fire-cracked rock and ceramics (Plains Woodland or Plains Village) were recovered from site 32OL336. Investigators suggest the site was occupied in the last 1,000 years (ibid.:12). The artifact assemblage at site 32OL337 included a piece of fire-cracked rock, KRF stone tools (a spokeshave, a biface, a drill, and a Pelican Lake projectile point). The drill and point were observed on the surface during the initial inventory (ibid.:9). A Late Plains Archaic age is proposed for the site. Further work is recommended for both sites, as they are located along Otter Creek between the Knife and Missouri rivers.

Site 32ME365, a lithic procurement site, is located on an upper terrace above Antelope Creek within the Knife River valley. Investigators note that the site is east of the KRF primary source area and therefore has the potential to elucidate prehistoric quarrying activities outside of the delineated primary source area. Test excavation included 116 shovel probes and five test units (Hiemstra 2005:ii). The artifact assemblage includes 22 cores/tested raw material, seven unpatterned flake tools, six early-stage bifaces/biface fragments, one scraper, an unidentifiable projectile point fragment, 1,749 pieces of debitage, and one hearth (ibid.:21-26). Knife River flint was the lithic raw material for 36 of the tools and 99.7% of the debitage (ibid.:21, 27). Twenty pieces of debitage appear to have been heat-altered/burned (ibid.:32). Investigators conclude that the site appears to have functioned as a lithic procurement locale with at least one KRF quarry pit and three activity areas/workshops (ibid.:33). Cultural/temporal affiliation of the site was undeterminable during the limited testing in 2004. However, the presence of a projectile point base and burned debris indicate that this issue could be addressed with additional excavation.

Energy Development

Coteau Mining

Test excavation for Coteau began in 1989 (Peterson and Brownell 1989). Archaeological site 32ME175 is on a native prairie-covered upland flat with intermittent drainages bordering the south and east. Testing consisted of the excavation of 410 shovel probes and 10 formal excavation units (ibid.:24). Archaeological features observed at the site include: 70 stone circles, 15 stone arcs, 54 cairns, one charcoal stain, and one charcoal-filled pit (ibid.:18). The artifact assemblage comprised faunal bone fragments, fire-cracked rock, ceramics, chipped stone tools, and chipped stone flaking debris (KRF=98%; ibid.:34). Temporal information for the site was gleaned from the recovery of seven projectile point fragments, including a McKean Lanceolate point and several Late Prehistoric points (ibid.). Population estimates were derived by (1) assuming 4-11 people inhabited a structure, (2) inclusion of the all the site's stone circles in a single component, and (3) dividing the number of stone circles into Occupation B (low density of artifacts) opposed to Occupation A (high density of artifacts) (ibid.:39). Considering the number of features, investigators speculate that the stone circles with moderate to high densities of artifacts may have been populated by 234-638 people and 116-319 people for stone circles with lesser artifact densities (ibid.:39-40).

Three archaeological components were identified at 32ME175 (ibid.:38-39). Component A was dated to the Middle Plains Archaic with a McKean point. Component B was dated with a radiocarbon sample from a roasting pit. The resultant date indicates a Pelican Lake or Late Plains Archaic occupation. Stone features and ceramics were used to date Component C. Check-stamped ceramics date it to AD 1200-1700. Component C likely was used multiple times. Investigators recommend 32ME175 as eligible for listing in the NRHP because it retains contextual integrity and the potential to address research questions concerning settlement and subsistence strategies, and stone feature placement (ibid.:41).

A 1994 cultural resource investigation identified two stone feature sites (32ME158 and 32ME776) in the KRSU (Boughton and Peterson 1994). Site 32ME158, situated above sloughs to the south and southwest, is a large site with 47 stone circles and three cairns. In contrast, 32ME776, located on the east slope of a knoll above a drained slough, consists of four stone circles and one arc.

Testing at 32ME158 included a shovel probe inside each of 39 stone circles and a formal test unit within each cairn. The stone circle diameters ranged between 3-7.5 m and the size of the cairns exceeded 3 m (ibid.:32). Seventeen stone circles contained chipped stone flaking debris and excavation of the cairns yielded flaking debris, a core, and bison bone (ibid.:43). Varying amounts of lithic reduction occurred at the site. Investigators suggest the site has been occupied multiple times based on the clustering of the features, and rock densities and size of the stone features (ibid.:44).

Test excavation at 32ME776 was like 32ME158. Two of the stone circles were tested with shovel probes and one formal test unit was placed in a third stone circle (ibid.:46). The test unit contained flaking debris and one utilized flake blade (ibid.). Investigators speculate that 32ME776 was a habitation site which may have been an extension of 32ME158 (ibid.:49).

In 2000 a large test excavation project was undertaken to examine 179 previously unevaluated sites within three mining expansion areas in central Mercer County (Boughton et al. 2001). Testing involved the excavation of 403 m² from test units, shovel tests, shovel probes, and soil cores (ibid.). Thirty-five prehistoric sites were recommended eligible for listing in the NRHP. Further, archaeologists suggest 13 sites have the potential to yield information concerning research questions presented in the State Plan, particularly those concerning stone circles and prehistoric hunting strategies.

Two of the mine expansion areas are within the KRSU and one is in the Garrison SU. Within the KRSU, the sites include 84 stone circle/cairn sites, 52 stone circle sites, 5 stone circle/cairn/alignment sites, 4 stone circle/alignment sites, 4 cairn sites, 1 stone circle/cairn/petroform site, 12 lithic scatters, and one lithic/bone scatter (ibid.). Of the 163 sites within the KRSU, 30 were recommended eligible for listing in the NRHP. A combination of factors was used to determine eligibility including site size, artifact density per site, site location, integrity of the site, and "uncommon feature characteristics" (ibid.:11.1). Investigators provide an example of this evaluation process: "For instance, 32ME108 demonstrated a lower artifact density than many of the other eligible sites. At the same time, it contained stone ring features that are greater than 10 m in size. As such, this site had a greater potential of providing information on the function of unusually large stone rings than the other sites within the sample" (ibid.:11.1).

Dakota Westmoreland Mining

Dakota Westmoreland Corporation proposed a western expansion of the Beulah mine. In 2012, evaluative testing was conducted at several lithic scatters and a stone circle site. No further work was recommended at all but the stone circle site, 32ME2262, due to lack of diagnostic artifacts or datable material (Toom and Jackson 2012:iii). Site 32ME2262 is on an upland bench covered by native prairie. A five-meter diameter, complete stone circle is the only surficial feature (ibid.:6.1). Four test units and 17 shovel probes excavated inside and outside of the circle uncovered 18 tools, 254 pieces of chipped stone flaking debris, 31 fractured rocks, and one piece of animal bone (ibid.:6.10). Lithic raw material includes KRF, Rainy Buttes silicified wood, basalt, and porcellanite (ibid.:6.19). The presence of a stone circle and tools, flaking debris, and fractured rock indicate this could be an occupational site.

Lake Ilo

In 1990, Phase II cultural resource evaluations were undertaken at the Lake Ilo National Wildlife Refuge (LINWR) in central Dunn County (William et al. 1992). Lake Ilo resulted from damming Spring Creek in the 1930s. The Lake Ilo basin is west of the confluence of the Spring and Murphy creeks, southeast of the Killdeer Mountains and north of the Knife River. The impetus for the investigations was safety issues with the Lake Ilo Dam operated by the US Fish and Wildlife Service. Twenty-six of the 37 archaeological sites were recommended eligible for listing in the NRHP. The importance of these sites to the understanding of North Dakota prehistory cannot be overstated. The refuge is on the northwestern edge of the KRF primary source area with diagnostic artifacts dating as far back as the Paleo period. The following discussion *very* briefly summarizes the LINWR investigations. For a comprehensive report of the findings the reader is directed to William et al. (1992).

The 1990 fieldwork at archaeological sites in the LINWR included 105 backhoe trenches (1,238.2 m), 120 excavation units (56.2 m^3), 184 auger samples, and 2,893 mi^2 of controlled surface collection (ibid.:67-68). Four of the thirteen prehistoric sites (32DU954, 32DU955, 32DU966, and 32DU972) were sub-divided into areas of concentration (ibid.:17). For example, due to its size and significance 32DU955 was split into concentration areas 32DU955A through 32DU955E. The total artifact assemblage across all the sites consisted of 58,424 specimens, including: 51,848 pieces of chipped stone flaking debris; 2,753 stone tools; 1,920 pieces of natural KRF; 693 pieces of fire-cracked rock; 655 pieces of shell; 380 pieces of bone; 151 historic materials; 11 pieces of burnt KRF; one piece of charcoal; one bone tool; one pot sherd;

and five miscellaneous items (ibid.). Approximately 72% of this sample was recovered during controlled surface collection at 32DU955A (ibid.). Ninety-eight classifiable projectile points, spanning from the early Paleo to Late Prehistoric periods, were recovered (ibid.:71). In summarizing site investigations, William et al. (1992:524) state: “It can be noted that prehistoric remains exist in two basically different settings and contexts: in partially or completely eroded condition on the exposed lakebed, and in relatively less eroded condition in areas above the high-water line of the lake (2190.5-foot elevation).” The report concludes with significance evaluations and management recommendations for the recorded Lake Ilo cultural properties.

Stone Circle and Cairn Sites

As of 31 December 2020, 293 stone feature sites have been formally tested in the KRSU, largely due to development and expansion of the energy sector (Table 3.8). For sites to be listed in Table 3.8 there had to be **formal testing (at least one 1-x-1-m unit)** at the site. Review of the literature reveals the changing research questions addressed over time for stone circles. The table was developed so these data are readily available for researchers.

The monograph on stone circle sites in *Plains Anthropologist Memoir 19* is a valuable source of information (Davis 1983). Compilations of radiocarbon dates from sites in McLean, Mercer, and Oliver counties can be found in Strait and Peterson (2007:4.6-4.8), in Mclean County (Thomas and Peterson 2010:6.2-6.3) and from Besant/Sonota sites in Deaver and Deaver (1987). A useful discussion of single stone circle site function based on ethnographic accounts is available in Gregg et al. (1983:[3]864-869). An assessment of nomadic settlement-subsistence structure and bison ecology is discussed by Hanson (1983b:1342-1417). Suggested uses of cairns include markers for events and travel routes, bracing poles for a variety of camp structures, caches, drive lines, or covering a burial. Hecker (1937-1950:161) reports that piles of stones were placed over buffalo chip fireplaces to heat stones used to dry meat. Additional references for stone features sites can be found in the reference section of the Cultural Heritage Form.

National Register of Historic Places

Fifty-four sites were specified in the NRHP nomination for the Lynch Knife River Flint Quarries District. This 6,375-acre area represents one of the largest known flint quarrying complexes in North America (Loendorf et al. 1984:4). The Lynch Quarry sits in the heart of the proposed Lynch Knife River Flint Quarry National Historic District. The Keeper of the NRHP rendered a formal determination of eligibility for the proposed district at the national level of significance. Due to landowner disagreements over federal recognition of the district in the 1980s, it was never formally nominated.

The sentiments of the landowners have changed considerably over the ensuing years and now many wish to see these cultural resources protected (Damita Hiemstra, personal communication 2008). The Lynch Quarry site proper (32DU526) covers 693 acres and is the largest of the known KRF quarry sites. The Lynch Knife River Flint Quarry Site was designated a National Historical Landmark in 2011 (Hiemstra 2010). A much smaller quarry site, the Crowley Flint Quarry (32ME201) in Mercer County, is managed by the State Historical Society of North Dakota (SHSND).

Table 3.8: Formally Tested Stone Feature Sites in the Knife River Study Unit, 31 December 2020.

<table>
<tr><th>Site Number</th><th>Tested Feature Type</th><th>Test Unit Location</th><th>Cultural Material</th><th>Comments</th><th>Cultural/Temporal Affiliation</th><th>MS #</th></tr>
<tr><td>32DU92</td><td>Circles</td><td>Inside, outside</td><td>Yes</td><td></td><td>Pre-Plains Village</td><td rowspan="4">3456</td></tr>
<tr><td rowspan="2">32DU94</td><td>Circles</td><td>Inside, outside</td><td>Yes</td><td></td><td>Pre-Plains Village</td></tr>
<tr><td>Cairn</td><td>Inside, outside</td><td>No</td><td></td><td></td></tr>
<tr><td>32DU105</td><td>Circle</td><td>Inside</td><td>Yes</td><td></td><td></td></tr>
<tr><td>32DU108</td><td>Circles</td><td>Inside, outside</td><td>Yes</td><td></td><td></td><td rowspan="2">3173</td></tr>
<tr><td>32DU109</td><td>Circles</td><td>Inside, outside</td><td>Yes</td><td></td><td></td></tr>
<tr><td>32DU184</td><td>Cairn</td><td>Outside</td><td>Yes</td><td>Quarry site</td><td></td><td>4273</td></tr>
<tr><td>32DU190</td><td>Circles</td><td>Inside, outside</td><td>Yes</td><td></td><td></td><td>3415</td></tr>
<tr><td>32DU190</td><td>Circles</td><td>Inside, outside</td><td>Yes</td><td></td><td></td><td rowspan="2">4151</td></tr>
<tr><td>32DU205</td><td>Circle</td><td>Inside</td><td>Yes</td><td></td><td></td></tr>
<tr><td>32DU425</td><td>Circles</td><td>Inside, outside</td><td>Yes</td><td></td><td></td><td rowspan="2">3173</td></tr>
<tr><td>32DU434</td><td>Circle</td><td>Inside, outside</td><td>Yes</td><td></td><td></td></tr>
<tr><td>32DU964</td><td>Circle</td><td>Inside, outside</td><td>Yes</td><td>Roasting pit
Radiocarbon dating
Paleoethnobotanical analysis
Pigment
Obsidian</td><td>Pelican Lake
Plains side-notched
Prairie side-notched
Late Prehistoric</td><td>7855</td></tr>
<tr><td>32DU1180</td><td>Circle</td><td>Inside, outside</td><td>Yes</td><td></td><td></td><td>7299</td></tr>
<tr><td>32ME108</td><td>Circles</td><td>Inside</td><td>Yes</td><td></td><td></td><td>9942</td></tr>
<tr><td>32ME117</td><td>Circles</td><td>Inside, outside</td><td>Yes</td><td></td><td>Late Prehistoric</td><td>3834</td></tr>
<tr><td rowspan="2">32ME144</td><td>Circles</td><td>Inside</td><td>Yes</td><td></td><td></td><td rowspan="4">8531</td></tr>
<tr><td>Cairn</td><td>Inside</td><td>Yes</td><td></td><td>McKean
Plains side-notched</td></tr>
<tr><td>32ME145</td><td>Circles</td><td>Inside</td><td>Yes</td><td></td><td></td></tr>
<tr><td>32ME147</td><td>Cairns</td><td>Inside</td><td>Yes</td><td></td><td></td></tr>
<tr><td>32ME147</td><td>Cairn</td><td>Inside</td><td>No</td><td></td><td></td><td>9942</td></tr>
<tr><td>32ME149</td><td>Circle</td><td>Inside</td><td>No</td><td></td><td></td><td rowspan="3">8531</td></tr>
<tr><td>32ME150</td><td>Circles</td><td>Inside</td><td>Yes</td><td></td><td></td></tr>
<tr><td>32ME151</td><td>Circle</td><td>Inside</td><td>Yes</td><td></td><td></td></tr>
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<tr><td>32ME151</td><td>Cairns</td><td>Inside</td><td>Yes</td><td></td><td></td><td>9942</td></tr>
<tr><td rowspan="2">32ME152</td><td>Circle</td><td>Inside</td><td>Yes</td><td></td><td></td><td rowspan="3">8531</td></tr>
<tr><td>Cairn</td><td>Inside</td><td>Yes</td><td></td><td></td></tr>
<tr><td>32ME153</td><td>Circle</td><td>Inside</td><td>Yes</td><td></td><td></td></tr>
<tr><td rowspan="2">32ME153</td><td>Circles</td><td>Inside</td><td>Yes</td><td></td><td></td><td rowspan="2">9942</td></tr>
<tr><td>Cairn</td><td>Inside</td><td>Yes</td><td></td><td></td></tr>
<tr><td>32ME154</td><td>Circle</td><td>Inside</td><td>Yes</td><td></td><td></td><td rowspan="2">8531</td></tr>
<tr><td>32ME155</td><td>Circle</td><td>Inside</td><td>Yes</td><td></td><td></td></tr>
<tr><td>32ME155</td><td>Cairn</td><td>Inside</td><td>Yes</td><td></td><td></td><td>9942</td></tr>
<tr><td>32ME156</td><td>Circle</td><td>Inside</td><td>Yes</td><td></td><td></td><td>8531</td></tr>
<tr><td>32ME156</td><td>Circle</td><td>Inside</td><td>Yes</td><td></td><td></td><td>9942</td></tr>
<tr><td>32ME158</td><td>Cairns</td><td>Inside</td><td>Yes</td><td></td><td></td><td>6347</td></tr>
<tr><td>32ME158</td><td>Cairns</td><td>Inside</td><td>Yes</td><td></td><td></td><td>6689</td></tr>
<tr><td>32ME163</td><td>Cairn</td><td>Outside</td><td>Yes</td><td>Hearth (charcoal)
Radiocarbon dating
Multiple occupations</td><td>Plains Woodland</td><td>4712</td></tr>
<tr><td>32ME166</td><td>Circles</td><td>Inside</td><td>Yes</td><td>Red stain</td><td>Besant</td><td>3548</td></tr>
<tr><td rowspan="2">32ME166</td><td>Circles</td><td>Inside, outside</td><td>Yes</td><td>Red stain</td><td>Pelican Lake</td><td rowspan="2">3561</td></tr>
<tr><td>Cairns</td><td>Inside</td><td>Yes</td><td></td><td></td></tr>
<tr><td rowspan="2">32ME166</td><td>Circles</td><td>Inside, outside</td><td>Yes</td><td>Grooved maul
Hearth
Radiocarbon dating
Obsidian hydration
Phosphate testing</td><td>Besant</td><td rowspan="2">4886</td></tr>
<tr><td>Cairns</td><td>Outside</td><td>Yes</td><td>Phytolith analysis
Phosphate testing
Macrofloral analysis</td><td>Duncan
Besant</td></tr>
<tr><td>32ME167</td><td>Circles</td><td>Inside</td><td>Yes</td><td></td><td></td><td>4713</td></tr>
<tr><td>32ME167</td><td>Circles</td><td>Inside</td><td>Yes</td><td></td><td></td><td rowspan="2">8531</td></tr>
<tr><td>32ME168</td><td>Circle</td><td>Inside</td><td>Yes</td><td></td><td></td></tr>
<tr><td>32ME169</td><td>Circles</td><td>Inside</td><td>Yes</td><td></td><td>Pelican Lake</td><td>4713</td></tr>
<tr><td>32ME169</td><td>Circles</td><td>Inside</td><td>Yes</td><td>Hearths</td><td>McKean</td><td>9942</td></tr>
</table>

Site Number	Tested Feature Type	Test Unit Location	Cultural Material	Comments	Cultural/Temporal Affiliation	MS #
				Radiocarbon dating Microfloral analysis	Besant Pelican Lake Plains side-notched Prairie side-notched	
32ME170	Circle	Inside	Yes			8531
32ME171	Circle	Inside	Yes			
32ME175	Circles	Inside, outside	Yes	Roasting pit Radiocarbon dating	McKean lanceolate Late Plains Archaic Late Prehistoric	4914
32ME175	Cairn	Inside	Yes	Burial Ceramics Grooved maul		5799
32ME175	Circles	Inside, outside	Yes	Ceramics Mussel shell Hearths Radiocarbon dating Pollen analysis Macrofloral analysis Blood residue analysis Obsidian hydration	Parallel-oblique flaked McKean Hanna Pelican Lake Besant Avonlea Plains Village Prairie side-notched	6270
32ME181	Circle	Inside	No			8531
32ME182	Circles	Inside, outside	Yes	Hearth		3898
	Cairn	Inside, outside	Yes			
32ME183	Circle	Inside	Yes			8531
32ME184	Circle	Inside	Yes			
32ME186	Circle	Inside	Yes			
32ME187	Cairn	Inside	Yes			
32ME190	Circle	Inside	Yes			
32ME191	Circle	Inside	Yes			
32ME192	Circle	Inside	Yes			
32ME199	Circles	Inside	Yes			4255
	Cairn	Inside	Yes			
32ME204	Circle	Inside	No			8531

Site Number	Tested Feature Type	Test Unit Location	Cultural Material	Comments	Cultural/Temporal Affiliation	MS #
32ME204	Cairn	Inside	Yes			9942
32ME206	Circles	Inside	Yes			8531
	Cairns	Inside	Yes		McKean	
32ME207	Circle	Inside	No			
32ME209	Circles	Inside	Yes			
32ME209	Circle	Inside	No			9942
32ME211	Circle	Inside	Yes			8531
32ME212	Circle	Inside	No			
32ME214	Circles	Inside	Yes			
32ME218	Circle	Inside, outside	Yes			2530
	Cairn	Inside, outside	Yes			
32ME220	Circles	Inside, outside	Yes	Radiocarbon dating Obsidian hydration	Besant Plains Village	5163
	Cairns	Inside, outside	Yes			
32ME225	Circle	Inside	No			8531
32ME226	Circle	Inside	Yes			
32ME227	Circles	Inside	Yes			
32ME228	Circle	Inside	Yes			
32ME230	Circle	Inside	Yes			
32ME231	Circle	Inside	No			
32ME232	Circles	Inside	Yes			
	Cairns	Inside	Yes		Prairie side-notched	
32ME232	Circles	Inside	Yes			9942
	Cairns	Inside	Yes	Radiocarbon dating	Prairie side-notched Plains Village	
32ME233	Circle	Inside	Yes			8531
32ME238	Circle	Inside	Yes			
32ME241	Circle	Inside	Yes			
32ME242	Circles	Inside	Yes			
32ME244	Circle	Inside	No			

Site Number	Tested Feature Type	Test Unit Location	Cultural Material	Comments	Cultural/Temporal Affiliation	MS #
32ME245	Circle	Inside	No			
32ME245	Cairn	Inside	Yes	Radiocarbon dating	Late Plains Woodland/ Plains Village	9942
32ME247	Circle	Inside	Yes			8531
32ME250	Circle	Inside	Yes			
32ME251	Circle	Inside	No			
32ME252	Circle	Inside	Yes			3548
	Cairns	Inside	Yes			
32ME254	Circles	Inside, outside	Yes		Parallel-oblique flaked Besant	5798
	Cairn	Inside	Yes			
32ME254	Circles	Inside, outside	Yes	Hearths Radiocarbon dating Oxidizable carbon ratio dating Macrofloral analysis Pollen analysis Blood residue analysis	Oxbow McKean Duncan Hanna Besant Late Prehistoric	7180
32ME254	Cairns	Inside	Yes			7180
32ME285	Circle	Inside	No			8531
32ME423	Circles	Inside	Yes			2960
	Cairn	Inside	No			
32ME427	Cairn	Inside	Yes		Late Prehistoric	3860
32ME427	Cairn	Inside, outside	Yes			9144
32ME437	Circles	Inside, outside	Yes			10733
32ME443	Cairn	Inside	Yes			
32ME444	Circle	Inside, outside	Yes			
32ME563	Circle	Inside	Yes			3225
32ME566	Circle	Inside	Yes			
32ME566	Circles	Inside	No			8748
32ME567	Circles	Inside	Yes			3225
	Cairn	Inside	Yes			

Site Number	Tested Feature Type	Test Unit Location	Cultural Material	Comments	Cultural/Temporal Affiliation	MS #
32ME567	Circles	Inside	Yes			8748
32ME568	Circles	Inside	Yes			3225
32ME568	Circle	Inside	Yes	Radiocarbon dating Obsidian sourcing	Besant	10231
32ME631	Circles	Inside, outside	No			3834
32ME635	Circles	Inside, outside	No			
32ME636	Cairns	Inside	Yes			
32ME637	Cairn	Outside	No			
32ME643	Circles	Inside, outside	Yes			
	Cairns	Inside, outside	Yes			
32ME660	Cairn	Outside	No			
32ME677	Circle	Inside	No	Ceramics (surface)	Plains Village	
32ME681	Circles	Inside	Yes	Basalt chopper		3115
32ME697	Circle	Inside	No			8531
32ME698	Circle	Inside	Yes			
32ME701	Circle	Inside	No			
32ME705	Circle	Inside	No			
32ME745	Circle	Inside	Yes			
32ME747	Circle	Inside	Yes			
32ME749	Circle	Inside	No			
32ME753	Circle	Inside	Yes			
32ME754	Circles	Inside	Yes			
	Cairn	Inside	Yes			
32ME754	Circles	Inside	Yes	Radiocarbon dating	Besant	9942
	Cairn	Inside	Yes			
32ME755	Circles	Inside	Yes			8531
32ME755	Circle	Inside	Yes	Hearth Radiocarbon dating Macrofloral analysis	Early Plains Archaic	9942
	Cairn	Inside	Yes	Radiocarbon dating	Historic (AD 1880s)	

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<tr><th>Site Number</th><th>Tested Feature Type</th><th>Test Unit Location</th><th>Cultural Material</th><th>Comments</th><th>Cultural/Temporal Affiliation</th><th>MS #</th></tr>
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<tr><td>32ME757</td><td>Circle</td><td>Inside</td><td>Yes</td><td></td><td></td></tr>
<tr><td>32ME757</td><td>Circles</td><td>Inside</td><td>Yes</td><td></td><td></td><td>9942</td></tr>
<tr><td>32ME770</td><td>Circle</td><td>Inside</td><td>Yes</td><td></td><td></td><td>8531</td></tr>
<tr><td>32ME776</td><td>Circle</td><td>Inside</td><td>Yes</td><td></td><td></td><td>6347</td></tr>
<tr><td>32ME799</td><td>Circles</td><td>Inside, outside</td><td>Yes</td><td>Red pigment
Stone-rimmed depressions
Earthen mounds</td><td>Late Plains Archaic or Early/Middle Plains Woodland</td><td>3898</td></tr>
<tr><td>32ME799</td><td>Circles</td><td>Inside</td><td>Yes</td><td>Ceramics
Obsidian hydration
Radiocarbon dating
Cairns; stone-line depressions; earthen mounds</td><td>Pelican Lake
Besant
Samantha
Late Prehistoric</td><td>4270</td></tr>
<tr><td rowspan="2">32ME799</td><td>Circles</td><td>Inside, outside</td><td rowspan="2">Yes</td><td rowspan="2">Post molds/Bone uprights
Hearths
Ceramics
Obsidian sourcing
X-ray fluorescence
Thermoluminescence dating</td><td rowspan="2">Duncan
Yonkee
Pelican Lake
Besant
Avonlea
Plains side-notched
Prairie side-notched
Un-notched triangular</td><td rowspan="2">5463</td></tr>
<tr><td>Cairns</td><td>Inside</td></tr>
<tr><td>32ME819</td><td>Circles</td><td>Inside</td><td>Yes</td><td></td><td></td><td>4093</td></tr>
<tr><td>32ME828</td><td>Circle</td><td>Outside</td><td>Yes</td><td></td><td></td><td rowspan="2">4156</td></tr>
<tr><td>32ME830</td><td>Cairn</td><td>Inside</td><td>No</td><td></td><td></td></tr>
<tr><td>32ME834</td><td>Cairn</td><td>Inside</td><td>Yes</td><td></td><td></td><td>4093</td></tr>
<tr><td>32ME835</td><td>Circle</td><td>Inside</td><td>Yes</td><td></td><td></td><td>5294</td></tr>
<tr><td>32ME847</td><td>Circles</td><td>Inside, outside</td><td>Yes</td><td>Hearths
Ceramics</td><td>Late Plains Woodland</td><td>5097</td></tr>
<tr><td>32ME847</td><td>Circles</td><td>Inside, outside</td><td>Yes</td><td>Post molds/Bone uprights
Hearths
Ceramics
Radiocarbon dating
X-ray fluorescence
Thermoluminescence dating
Pollen analysis</td><td>McKean
Pelican Lake
Avonlea
Samantha
Prairie side-notched</td><td>5463</td></tr>
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Site Number	Tested Feature Type	Test Unit Location	Cultural Material	Comments	Cultural/Temporal Affiliation	MS #
				Phosphate sampling, analysis		
32ME851	Circle	Inside, outside	Yes			4711
32ME1016	Circle	Inside	Yes			4609
32ME1036	Circle	Inside, outside	Yes			4719
32ME1040	Circles	Outside	Yes	Associated lithic scatter		
	Cairns	Outside	Yes	Associated lithic scatter		
32ME1075	Circle	Inside	Yes		Early Plains Archaic	6007
32ME1214	Circles	Inside	Yes			5932
	Cairn	Inside	Yes			
32ME1234	Circle	Inside, outside	Yes			
32ME1245	Circles	Inside	Yes			
	Cairns	Inside	Yes			
32ME1309	Circle	Inside	Yes			8531
32ME1311	Cairn	Inside	No			
32ME1317	Circle	Inside	Yes			
32ME1318	Circle	Inside	No			
32ME1320	Circle	Inside	No			
32ME1322	Circle	Inside	Yes			
32ME1323	Circle	Inside	Yes			
32ME1328	Circles	Inside	No			6321
32ME1465	Circle	Inside	No			8531
32ME1468	Circle	Inside	No			
32ME1469	Circle	Inside	No			
32ME1471	Circle	Inside	Yes			
32ME1472	Circle	Inside	Yes			
32ME1473	Circle	Inside	No			
32ME1474	Circle	Inside	Yes			
32ME1475	Circle	Inside	Yes			
32ME1476	Circle	Inside	No			

Site Number	Tested Feature Type	Test Unit Location	Cultural Material	Comments	Cultural/Temporal Affiliation	MS #
32ME1477	Circle	Inside	Yes			
32ME1478	Circle	Inside	Yes			
	Cairn	Inside	Yes		Prairie side-notched	
32ME1478	Cairn	Inside	Yes		Besant Avonlea Prairie side-notched	9942
32ME1479	Circle	Inside	No			8531
32ME1480	Circle	Inside	Yes			
32ME1481	Circle	Inside	No			
32ME1482	Circle	Inside	Yes			
32ME1482	Circle	Inside	Yes	Hearth Radiocarbon dating Macrofloral analysis	Historic (AD 1786-1866)	9942
32ME1484	Circle	Inside	Yes			8531
32ME1485	Circle	Inside	Yes			
32ME1487	Circle	Inside	Yes			
32ME1488	Circle	Inside	Yes			
	Circles	Inside	Yes			9942
32ME1491	Circle	Inside	Yes			8531
	Cairn	Inside	No			
32ME1491	Cairns	Inside	Yes		Pelican Lake	9942
32ME1492	Circle	Inside	Yes			8531
32ME1493	Circle	Inside	Yes			
32ME1493	Circles	Inside	Yes			9942
32ME1495	Circle	Inside	Yes			8531
32ME1496	Cairn	Inside	Yes			
32ME1497	Circle	Inside	No			
32ME1498	Circle	Inside	Yes			
32ME1499	Circle	Inside	No			
32ME1500	Circle	Inside	Yes			
32ME1501	Circle	Inside	Yes			

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<tr><td>32ME1505</td><td>Circle</td><td>Inside</td><td>No</td><td></td><td></td></tr>
<tr><td>32ME1506</td><td>Circles</td><td>Inside</td><td>Yes</td><td></td><td></td></tr>
<tr><td>32ME1510</td><td>Circle</td><td>Inside</td><td>No</td><td></td><td></td></tr>
<tr><td rowspan="2">32ME1513</td><td>Circle</td><td>Inside</td><td>Yes</td><td>Possible hearth</td><td></td></tr>
<tr><td>Cairns</td><td>Inside</td><td>Yes</td><td>Bone tools
Ceramics</td><td>Plains side-notched
Prairie side-notched</td></tr>
<tr><td rowspan="2">32ME1513</td><td>Circles</td><td>Inside</td><td>Yes</td><td>Hearths
Radiocarbon dating</td><td>Pelican Lake
Besant
Plains side-notched
Prairie side-notched</td><td rowspan="2">9942</td></tr>
<tr><td>Cairns</td><td>Inside</td><td>Yes</td><td>Burial
Ceramics
Macrofloral analysis</td><td>Plains side-notched
Prairie side-notched</td></tr>
<tr><td>32ME1514</td><td>Circle</td><td>Inside</td><td>Yes</td><td></td><td></td><td rowspan="18">8531</td></tr>
<tr><td>32ME1515</td><td>Circle</td><td>Inside</td><td>Yes</td><td></td><td></td></tr>
<tr><td>32ME1516</td><td>Circle</td><td>Inside</td><td>Yes</td><td></td><td></td></tr>
<tr><td>32ME1517</td><td>Circle</td><td>Inside</td><td>No</td><td></td><td></td></tr>
<tr><td>32ME1519</td><td>Circle</td><td>Inside</td><td>Yes</td><td></td><td></td></tr>
<tr><td>32ME1520</td><td>Circle</td><td>Inside</td><td>Yes</td><td></td><td></td></tr>
<tr><td>32ME1521</td><td>Circle</td><td>Inside</td><td>Yes</td><td></td><td></td></tr>
<tr><td>32ME1524</td><td>Cairn</td><td>Inside</td><td>Yes</td><td></td><td>Plains side-notched</td></tr>
<tr><td>32ME1526</td><td>Circle</td><td>Inside</td><td>No</td><td></td><td></td></tr>
<tr><td>32ME1529</td><td>Circles</td><td>Inside</td><td>Yes</td><td></td><td></td></tr>
<tr><td>32ME1530</td><td>Circle</td><td>Inside</td><td>Yes</td><td></td><td></td></tr>
<tr><td>32ME1531</td><td>Circle</td><td>Inside</td><td>No</td><td></td><td></td></tr>
<tr><td rowspan="2">32ME1533</td><td>Circle</td><td>Inside</td><td>Yes</td><td></td><td></td></tr>
<tr><td>Cairn</td><td>Inside</td><td>Yes</td><td></td><td></td></tr>
<tr><td>32ME1534</td><td>Circle</td><td>Inside</td><td>Yes</td><td></td><td></td></tr>
<tr><td>32ME1536</td><td>Circle</td><td>Inside</td><td>No</td><td></td><td></td></tr>
<tr><td>32ME1537</td><td>Circle</td><td>Inside</td><td>Yes</td><td></td><td></td></tr>
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Site Number	Tested Feature Type	Test Unit Location	Cultural Material	Comments	Cultural/Temporal Affiliation	MS #
	Cairn	Inside	No			
32ME1539	Circle	Inside	Yes			
32ME1540	Circle	Inside	Yes			
32ME1542	Circle	Inside	Yes			
	Cairns	Inside	Yes			
32ME1545	Circle	Inside	Yes			
32ME1551	Circle	Inside	Yes			
32ME1552	Circle	Inside	No			
32ME1553	Circle	Inside	Yes			
32ME1554	Circle	Inside	Yes			
32ME1554	Circle	Inside	Yes			9942
32ME1556	Circle	Inside	Yes			8531
32ME1557	Circle	Inside	No			
32ME1558	Circle	Inside	Yes			
32ME1560	Circle	Inside	No			
32ME1561	Circle	Inside	Yes			
32ME1562	Circle	Inside	Yes			
32ME1563	Circle	Inside	Yes			
32ME1565	Circle	Inside	No			
32ME1570	Circle	Inside	No			
32ME1571	Circle	Inside	Yes			
32ME1571	Cairns	Inside	Yes			9942
32ME1572	Circle	Inside	Yes			8531
32ME1572	Cairn	Inside	Yes	Radiocarbon dating	Historic (AD 1730-1810)	9942
32ME1573	Circle	Inside	No			8531
32ME1574	Circle	Inside	Yes			
32ME1575	Circle	Inside	Yes			
32ME1577	Circle	Inside	Yes	Ceramics	Besant	
32ME1578	Circle	Inside	Yes	Ceramics	Mortlach	

Site Number	Tested Feature Type	Test Unit Location	Cultural Material	Comments	Cultural/Temporal Affiliation	MS #
32ME1579	Circle	Inside	Yes			
32ME1580	Circle	Inside	Yes		Besant	
32ME1584	Circle	Inside	Yes			
32ME1586	Circle	Inside	Yes			
32ME1588	Circle	Inside	Yes			
32ME1589	Circle	Inside	Yes			
	Cairns	Inside	Yes		Hanna	
32ME1589	Cairns	Inside	Yes		Hanna	9942
32ME1599	Circle	Inside	No			8531
32ME2180	Cairn	Inside, outside	Yes			9144
32ME2181	Circle	Inside, outside	No			
	Cairn	Inside, outside	No			
32ME2231	Circle	Inside, outside	Yes			10733
32ME2232	Circles	Inside, outside	Yes			
32ME2262	Circle	Inside, outside	Yes			13995
32ME2526	Circle	Inside	No			15335
32ME2470	Cairn	Inside	Yes			17952
32ME2473	Circles	Inside, outside	Yes	Hearths Macrofloral analysis Radiocarbon dating Optically stimulated luminescence	Paleo-Indian (Goshen) Late Plains Woodland Besant Plains Village	
32ME2475	Circles	Inside, outside	Yes	Macrofloral analysis Radiocarbon dating Hartville Uplift chert	Pelican Lake McKean Besant Plains side-notched	
32ME2476	Circles	Inside, outside	Yes	Basalt Radiocarbon dating	Pelican Lake Plains Equestrian	
32ME2488	Cairns	Inside	No			

Major Excavation Projects

The ratio of major excavations to test excavations in the KRSU is surprisingly low (Table 3.9). Most of the major excavations have been at strip mines and the LINWR. The work at 32DU508 in the Lynch Knife River Flint Quarries District, while generating quantities of new information commensurate with a well-designed major excavation, was described by the report authors as a “small-scale exploratory testing program” (Ahler and Christensen 1983:i).

Mitigative measures were undertaken at 32ME799-Area K (Boekel-Renner site) and 32ME847 in 1989 because of construction on the Southwest Pipeline project (Sanders 1992). The sites are located on ridgetops approximately 1.5 miles west of the Beulah Trench. Interpretations of the data recovery results from both sites were supplemented by analyses of lithics, fauna, ceramics, stratigraphy, macroflora, pollen, and phosphate samples. These analyses allowed investigators to provide answers to research questions outlined for the sites. The reader is directed to Sanders (ibid.) for a comprehensive discussion of the sites and interpretations. The following discussion is a synopsis gleaned from that manuscript.

Site 32ME799 is a stone feature and earthen mound site. Diagnostic artifacts recovered from surface collection and excavation at the site date from the Middle Plains Archaic through the Late Prehistoric periods. Specifically, the Besant, Avonlea, Pelican Lake, and Plains side-notched styles are represented (ibid.:6-19). Further, ceramics characteristic of the Woodland period were collected (ibid.:6-23). Site 32ME847 is a stone feature and cultural material scatter site. Identifiable projectile points date two distinct occupations at the site to the Avonlea Complex (ibid.:7-2). In fact, 43 Avonlea points were documented in the upper two cultural layers (ibid.:7-32). Hearths, bone filled pits, bone uprights, and a post mold were documented at the sites.

In 1990, an extensive data recovery program was required at the Alkali Creek site (32DU336-SEE) resulting from the Halliday Flood Prevention Project (Metcalf and Ahler 1995). The site is in rolling uplands, southeast of the confluence of Alkali and Spring creeks. It is within the north-central portion of the KRF primary source area. Glacial gravels in the area contain nodules of KRF.

The Alkali Creek site functioned as a KRF quarrying site for approximately 10,000 years (ibid.:ii). Prior to the burial of the site by mid-Holocene alluvium, it was heavily exploited by people during the Paleo and Late Archaic/Middle Woodland periods (ibid.). Features and diagnostic artifacts recovered at the Alkali Creek site reflect its rich history. Features include quarrying pits, lithic workshops, hearths, and large amounts of bovid and canid bones (ibid.). Most of the artifact assemblage consists of lithic materials. Investigators note, “Projectile points found suggest affiliations with named cultural complexes including Goshen, Hell Gap, and possibly Agate Basin and Alberta for Paleo, Calf-Creek and Mummy Cave for the Early Plains Archaic, Oxbow and Duncan-Hanna for the Middle Plains Archaic, Besant for the Late Archaic or Middle Plains Woodland, and unnamed Late Prehistoric” (ibid.:2). Radiocarbon assays were generated.

Table 3.9: Major Excavation Projects in the Knife River Study Unit, 31 December 2020.

Year	First Author	Second Author	Title	Sites Excavated	MS #
1978	Franke, N.		Report of the Salvage Excavation at 32ME102	32ME102	216
1983	Good, K.	M. Schreiner	Archaeological Test Excavation Project: Site 32ME423, Northeast Permit Area, Indian Head Mine, Mercer Co., ND	32ME423	2960
1983	Root, M.	M. Gregg	Archeology of the Northern Border Pipeline, ND: Vol. 4, The Emerson Site, 32DU285: Lithic Reduction and Settlement in the Knife River Flint Primary Source Region	32DU285	3457
1986	Greiser, T.	G. Fox	Excavation of Site 32ME644 on Glenharold Mine Area I, Mercer Co., ND.	32ME644	4041
1989	Deaver, K.	S. Deaver	Onion Ring, 32ME166, A Tipi Ring Site in Central ND, Mercer Co.	32ME166	4886
1990	Deaver, K.		Mitigation of Site 32ME220 Mercer Co., ND	32ME220	5163
1991	Sanders, P.	T. Larson	The 1989 Archaeological Investigations at 32ME797, 32ME799 & 32ME847 Along the Southwest Pipeline Project, Mercer Co., ND	32ME799, 32ME847	5463
1992	Späth, C.		Dunn County Road Improvement T144N R97W Section 26 & 27 Dunn Co., ND Data Recovery at 32DU985	32DU985	5987
1993	Stine, E.	A. McKibbin	Hanging Out at the Rock: Excavation at 32ME1089, Mercer Co., ND	32ME1089	6008
1993	Root, M.	J. Van Nest	Site 32DU955A: Folsom Occupation of the Knife River Flint Primary Source Area Phase III (Part 1) Archaeological Data Recovery at Lake Ilo National Wildlife Refuge, Dunn Co., ND: Interim Report for 1992-1993 Investigation	32DU955	6204
1994	Root, M.	A. Emerson	Archaeology of the Bobtail Wolf Site (32DU955A): 1993-1994 Progress Report	32DU955	6415
1995	Peterson, L.	L. Peterson	The Bees Nest Site, Mercer Co., Mitigation of a Multi-Component Stone Ring Site in Central ND Vol. 2	32ME175	6270
1995	Metcalf, M.	S. Ahler	Alkali Creek in Dunn Co.: A Stratified Record of Prehistoric Flint Mining in ND (Appendices I-VIII)	32DU336	6649

Year	First Author	Second Author	Title	Sites Excavated	MS #
1996	Boughton, J.	K. Vander-Steen	Data Recovery of 13 Sites Located in the North Mine Extension Area, Mercer Co., ND	32ME158	6689
1998	Winzler, S.	J. Boughton	Data Recovery at 32ME254 Mercer Co., ND	32ME254	7180
2000	Feiler, E.		Sites 32DU964B, 32DU965B & 32DU972H: Results of the Supplemental Testing Program, Lake Ilo National Wildlife Refuge, Dunn Co, ND	32DU964 to 965, 32DU972	7847
2000	Feiler, E.		Site 32DU965A: A Multicomponent Workshop/Campsite Location, Knife River Flint Primary Source Area, Dunn Co., ND	32DU965	7848
2000	William, J.		Site 32DU954F (Big Coat): Mitigation Efforts at a Multicomponent Site in the Lake Ilo National Wildlife Refuge, Dunn Co., ND	32DU954	7849
2000	William, J.		The Big Black Site (32DU955C) A Folsom Complex Workshop in the Knife River Flint Quarry Area, ND	32DU955	7850
2000	William, J.	J. Zabel	Site 32DU954G: An Early Plains Archaic Workshop in the Lake Ilo National Wildlife Refuge, Dunn Co., ND	32DU954	7851
2000	Shifrin, L.		Young-Man-Chief (32DU955D): A Folsom, Late Plains Archaic, & Late Prehistoric Site	32DU955	7852
2000	Shifrin, L.		Investigations at Hard Horn (32DU972E): Archaic Occupations in the Knife River Flint Quarry Area	32DU972	7853
2000	Shifrin, L.		Investigations at the Smells Site (32DU966C): A Multicomponent Camp and Lithic Workshop in the Knife River Flint Quarry Area	32DU966	7854
2000	Shifrin, L.	A. Emerson	Packs Antelope (32DU964 Lower): A Late Prehistoric Stone Circle Site in the Knife River Flint Quarry Area	32DU964	7855
2000	Root, M.		The Archaeology of the Bobtail Wolf Site in Dunn Co., ND	32DU955A	7856
2006	Hope, S.	J. Boughton	Coteau: Data Recovery in the West Mine Area, Mercer Co., ND	32ME108, 32ME147, 32ME151, 32ME153, 32ME155 to 156, 32ME169, 32ME204, 32ME209, 32ME232, 32ME245, 32ME754 to 755, 32ME757, 32ME1478,	9942

Year	First Author	Second Author	Title	Sites Excavated	MS #
				32ME1482, 32ME1488, 32ME1491, 32ME1493, 32ME1513, 32ME1554, 32ME1571 to 1572, 32ME1589	
2007	Boughton, J.		Data Recovery at Site 32ME568 in Mercer Co., ND	32ME568	10231
2011	Cooper, J.	J. Artz	Archaeological Mitigation at 32DU965 for Construction of the Lake Ilo Residence Sewer System, Dunn County, ND	32DU965	12942
2014	Peterson, L.		Coyote Creek: Data Recovery at 32ME2350, A Prehistoric Lithic Scatter in Mercer County, ND	32ME2350	15544
2016	Peterson, L.	C. Tinti	Coyote Creek Mine: Data Recovery of 17 Sites in Mercer County, ND	32ME2432, 32ME2436, 32ME2438, 32ME2446, 32ME2447, 32ME2451, 32ME2453, 32ME2454, 32ME2458, 32ME2466, 32ME2467, 32ME2470, 32ME2471, 32ME2473, 32ME2475, 32ME2476, 32ME2488	017952

Numerous research questions steered the Alkali Creek project. The general topics outlined by the project supervisors include: (1) understanding site formation processes, (2) paleoenvironmental reconstruction, (3) technology, (4) non-quarry activities, (5) organizational strategies and group mobility, (6) cultural chronology and culture history, (7) KRF patination studies, and (8) development of hunter-gatherer theory (ibid.:25-26). These topics were addressed by integrating geoarchaeological, floral, and faunal analyses into the archaeological investigation. The complex nature of the Alkali Creek site and the archaeological investigation thereof are comprehensively discussed by Metcalf and Ahler (1995).

Energy Development and Expansion

Mining

Several major excavation projects have been undertaken in central North Dakota resulting from Coteau's mining operations. Investigators (Deaver 1990; Deaver et al. 1989) have noted that there is a general trend within the mining region: small- to medium-sized stone feature sites date to the Besant phase. Similarities of the sites are function (satellite field camps), re-use, and utilization of KRF and other local (cherts, quartzite) and nonlocal (obsidian) materials. Research topics posed for these sites include: (1) site chronology, (2) types and frequency of lithic raw materials, (3) site function, and (4) subsistence strategy (Deaver 1990:18). Mitigation of a portion of the Bees Nest site (32ME175) was required in 1993 due to expansion of mining operations in the Life-of-Mine area. Excavation was conducted on the seven acres of the site within the area of impact. The multi-component stone feature site covers 64 acres of glaciated rolling uplands (Peterson and Peterson 1995:1.1). The site is approximately seven miles south of the Missouri River. Intermittent wetlands are additional water sources in the area.

Several research topics were outlined prior to mitigation of the Bees Nest site. The six general research topics are: (1) chronology, (2) paleoenvironment, (3) settlement and site function, (4) diet and subsistence, (5) lithic technology, and (6) external relations and exchange (ibid.:3.1-3.10). Specific questions were posed by investigators for each topic. In addition to diagnostic artifacts and other data collected during excavation, supplemental analyses (radiocarbon, pollen, macrofloral, blood residue, obsidian hydration, and obsidian x-ray fluorescence) informed investigators as to the history of occupation (ibid.). Nine components have been identified at the Bees Nest site, including one possible Paleo occupation, one Middle Plains Archaic occupation, one McKean Complex occupation, two Besant occupations, a Late Prehistoric occupation, two Plains Village occupations, and one historic occupation (ibid.:6.6-6.8).

The results of the archaeological work conducted at the Bees Nest site suggest that the stone circles were temporary base camps where tool manufacture and maintenance, floral and faunal processing, and possibly ceremonial activities occurred. The primary lithic raw material used was KRF. No season seems to have been favored over another. The grand scale and complexity of the Bees Nest site provide archaeologists with an opportunity to reconstruct human occupation of the area over thousands of years.

Site 32ME254 is another large (130-acre), multi-component stone feature site within the Coteau mining area. Mitigation of the site was conducted in 1997. The site is in a similar setting as that of the Bees Nest site and comparable research topics were addressed (Winzler et al. 1998:3.1-3.6).

Five components at 32ME254 have been delineated, including: Oxbow, McKean, Pelican Lake, and Besant complexes and the Plains Village/Late Prehistoric period (ibid.:7.1-7.2). In addition to establishing a site chronology, investigators relayed other conclusions about 32ME254. First, there does not appear to be a correlation between lithic density and stone circle size or wall density (ibid.:7.3). Second, the frequency of discarded tools inside and outside of a stone feature is not significantly different (ibid.). Third, a variety of floral (bulrush seeds, grasses, and a member of the umbel family) and faunal (bison, mice, rabbits, deer, and squirrel/beaver/porcupine) resources found within the area were exploited by its inhabitants (ibid.:7.4). Finally, because no Paleo component was observed at the site, research questions concerning Paleo subsistence strategies and lithic technologies were revised. Rather, general questions pertaining to subsistence and lithics of local prehistoric groups were posed (ibid.).

In 2005, 263 m² was excavated in Coteau's West Mine Area (Hope et al. 2006). Again, the excavation efforts focused on stone circle and cairn sites. The environmental setting consists of glaciated rolling uplands and prairie potholes. Several answers to posed research questions were presented by Hope et al. (ibid.:7.1-7.5). A summary of the substantive results is provided here.

First, a strong indicator that a site functions as a base camp (with associated activities) is the presence of interior hearths containing higher densities of bone and chipped stone tools. Conversely, lesser densities of these artifact types suggest satellite camps and specialized endeavors. Second, the density of flaking debris increases as the size of the stone circle increases. Third, large cairns were constructed in single construction episodes. In this investigation, 85% of the projectile points found in cairns date to the Late Prehistoric period. Finally, due to erosion, stone circles generally are located on ridge edges where glacial cobbles are numerous. The patterns of stone feature placement conform to the landscape.

Data recovery occurred at 32ME2350 due to development of the Coyote Creek Mine by North American Coal (Peterson 2014). Three block excavations were place within the lithic scatter site. A total of 42 m² of soil was excavated yielding chipped stone tools and flaking debris, tested raw material, and faunal fragments. The lithic artifacts indicated the early stages of the reduction process and the small amount and poor quality of the tested raw material reflect the prehistoric procurement strategy (ibid.:42). Radiocarbon dates reveal multiple occupations, including Late Plains Woodland and Equestrian/Historic periods at this site (ibid.).

Lake Ilo

After completion of inventory and testing projects at the LINWR (see Inventory Projects and Test Excavation Projects sections above), Phase III mitigation of the Bobtail Wolf site (32DU955A) was undertaken from 1992-1994 (Root 1993; Root and Emerson 1994). With intact cultural deposits dating from the Paleo to the Late Prehistoric periods, the site functioned as a

KRF procurement location, lithic workshop, and field camp (Root 1993, 2000; Root and Emerson 1994). The site is located on a low Pleistocene terrace of Spring Creek in the western portion of the KRF primary source area. The size of the Bobtail Wolf site is 1.75 ha (Root 2000:5). Fieldwork included excavation of formal test units, block excavations, and trenches, totaling 489 m² (ibid.:2).

Several research questions, developed prior to excavation, influenced the investigators' approaches to and analyses of the Bobtail Wolf site. As stated by Root (ibid.:14-18), the research topics include: (1) the ages of site occupations; (2) site and regional geologic history; (3) procurement of KRF; (4) KRF reduction technology; (5) campsite activities; (6) Folsom projectile point technology; and (7) the organization of Folsom tool production, group mobility, and exchange.

The Bobtail Wolf site was divided into three geologic areas. The Leonard Paleosol (dating to the Paleo period) preserved across portions of the site is referred to as "terrace areas" (ibid.). Above the Leonard Paleosol, the Early Plains Archaic component is found in terrace veneer sediments (ibid.). On the surface and in deposits nearest the surface, Paleo, Plains Archaic, and Late Prehistoric components have been impacted by erosion and are disordered. Paleo deposits also are present in the "central rise," a subtle (deflated) rise in the center of the Spring Creek floodplain (ibid.). Investigators labeled areas virtually void of artifacts as the "Holocene channel-belt" (ibid.).

Paleo components include well-stratified Folsom deposits and eroding surface expressions of the Hell Gap and Cody complexes (ibid.:363). The terrace areas and the central rise yielded thousands of Folsom artifacts. Relatively trace amounts of cultural material dating to the Early Plains Archaic period was recovered from atop the Folsom component in the western and southern parts of the site (ibid.). Archaic and Late Prehistoric components were found muddled together on the surface and in shallow deposits (ibid.). Continual erosion and deflation have taken their toll on the site.

Most of the artifact assemblage is Folsom. In fact, fully two-thirds of the tools and three-quarters of the debitage are from that component (ibid.:366). Five percent of the assemblage dates to the Archaic and the remainder comes from surface and mixed deposits (ibid.). Approximately 12,700 stone tools and over three million flakes were recovered at the site (ibid.:367). The composition of the artifact assemblage indicates that occupants prepared blanks for transport away from the campsite but during the Folsom period evidence from all stages of tool production has been found. Knife River flint was not the only lithic material present at the site. Indeed, other materials such as Rainy Buttes silicified wood (RBSW) were discarded here. The small number of preserved large mammal remains, primarily bison, suggests people carried out single hunts and came back to the site to process the kills (ibid.).

The Big Black site (32DU955C) is located approximately 300 m north of the Bobtail Wolf site (William 2000a:1). During 1993 and 1994, data recovery was conducted at the site as part of the dam safety project at Lake Ilo. The approach to archaeological work at the Big Black site resembled that of the Bobtail Wolf site because the setting, geomorphology, function, and artifact assemblages are similar, and may relate to one another (ibid.). Investigators suggest the

Big Black site was used as a field camp, lithic workshop, and "minor" lithic procurement locale during the Folsom, Middle Plains Archaic, Late Plains Archaic, and Plains Village periods (ibid.). Specifically, the Folsom occupations across the site reveal different stages of tool manufacture (ibid.).

Several research questions were posed before the project began and evolved as excavation progressed. As summarized by William (2000:12-14), general research categories include: (1) site chronology; (2) non-KRF lithic resources and subsistence-settlement patterns; (3) environmental change and geologic processes; (4) settlement, technology, and KRF; and (5) KRF procurement and distribution.

The area of the Big Black site is 21,000 m² (ibid.:15). Data recovery consisted of 2,050 m² of surface collection and excavations covering 403.05 m² (ibid.). The artifact assemblage includes 1,577 stone tools and 241,275 flakes (ibid.). A significant quantity of RBSW artifacts is present. The intact Folsom deposits contain the densest number of artifacts, 963 stone tools and 189,886 flakes (ibid.:1). Investigators predict that more Folsom deposits exist at the site and future work is recommended.

The Young-Man-Chief site (32DU955D) is a third locality within the 32DU955 site complex. Data recovery was conducted here in 1993 but ceased after a month due to flooding caused by summer rains (Shifrin 2000c:1). However, investigators were able to glean some information from the site, increasing the body of knowledge concerning prehistory at Lake Ilo.

The Young-Man-Chief site functioned as a field camp and lithic workshop during the Folsom, Late Plains Archaic, and Late Prehistoric periods. The site is located on a Pleistocene terrace, west of Spring Creek. The approach to archaeological investigations here resembled those of the Bobtail Wolf and Big Black sites.

The area of the Young-Man-Chief site is 44 m² (ibid.:99). Intact Folsom-age deposits contain tools made of KRF and nonlocal raw materials (ibid.:1). The recovery of Pelican Lake and Avonlea projectile points from mixed contexts indicate the site was occupied in later times as well (ibid.:68). The abundant evidence of core reduction and biface manufacture suggest the importance of the site as a lithic workshop. To a lesser degree, the presence of expedient and patterned flake tools and fire-cracked rock indicate field camp activities (ibid.). Other artifacts found at the site are chipped stone flaking debris, shell, faunal remains, and historic items. Observed lithic raw material types include RBSW, TRSS, chert, chalcedonies, quartz, meta-quartzite, and silicified wood (ibid.:52).

Shifrin (2000:11-12) identifies several research topics that investigators hoped to address with work at the Young-Man-Chief site. These topics are: (1) chronometric studies; (2) geologic processes and environmental change; (3) site function and settlement organization; (4) mobility and extra-local contact patterns; and (5) issues in lithic technology.

During excavation of the Bobtail Wolf, Big Black, and Young-Man-Chief sites, a distinction was made between bifaces and ultrathin bifaces (Root 2000, 2007; Shifrin 2000; William 2000). First coined by Stan Ahler, the term "ultrathin" refers to bifaces that are wide and thin with width-to-thickness ratios documented up to 20:1 (Root 2007:1). Once a distinction had been made, other archaeologists remarked that this type of biface had been observed at various sites in the Great Plains. Investigators (ibid.) state, "[T]he thin cross section with the maximum thickness near the edges creates an efficient cutting edge by reducing frictional drag on the rest of the tool surfaces during use. The single defect, however, is that the brittle stone is easy to break if it strikes a bone or other substance (Root, William, Kay, and Shifrin 1999:164)." It has been suggested that the ultrathins were used as meat knives to make bison jerky (Jodry 1998).

Another "megasite" investigated at LINWR is 32DU954 (William et al. 2000:1). Data recovery was undertaken at 32DU954F (Big Coat site) and 32DU954G in 1993 and 1994, respectively. Site 32DU954F dates from the Paleo through Late Prehistoric periods (William 2000b:1). Cultural materials recovered from the multi-component site suggest it functioned as a field camp, lithic workshop, and possible KRF procurement area (ibid.). Occupation of 32DU954G appears to have been more limited, dating to the Paleo/Early Plains Archaic and the Late Plains Archaic periods (William et al. 2000:1). It appears the site functioned as a short-term field camp and lithic workshop (ibid.:2). In addition to chipped stone tools and flaking debris, fire-cracked rock, and faunal remains were collected at the sites. Unfortunately, work at both sites ended abruptly due to inclement weather conditions.

Site 32DU965 is somewhat like other sites within the LINWR. It consists of sub-sites that are multi-component field camps and lithic workshops. However, it differs from these sites because it is situated on uplands, not a terrace remnant (Feiler 2000). The uplands are south of Lake Ilo, along the former Spring Creek channel. Feiler (2000) reports preliminary findings for 32DU965A.

Numerous other archaeological sites were investigated during the early 1990s at the LINWR, including portions of 32DU694B (Packs Antelope site), 32DU965B, 32DU966C (Smells site), 32DU972E (Hard Horn site), and 32DU972H (Feiler 2000; Shifrin 2000a, b; Shifrin et al. 2000). The recovery efforts indicate these sites were multi-component field camps and lithic workshops, dating to the Paleo, Plains Archaic, and Late Prehistoric periods. Evidence of site functionality is substantiated by the number of stone tools, chipped stone flaking debris, bone tools, fire-cracked rock, faunal remains, and rock features (one stone circle and cairn at 32DU964).

In 2010, a mitigation project was conducted at the LINWR site 32DU965 because of a new sewer system for the on-site U.S. Fish and Wildlife residence (Cooper et al. 2011). The setting is on a Pleistocene terrace of Spring Creek which has undergone multiple fluvial events (ibid.:4). A trench was opened at the site. Joe Artz, the project geoarchaeologist, identified potential quarry pits. He posed two questions before the block unit was excavated: (1) are the basin-shaped features KRF quarry pits? and (2) how do the results of the 2010 investigation compare to Feiler's results (2000:3)? Artz determined that the 2010 excavation contains deeper deposits and succeeding block unit excavation indicates it is a location of a lithic workshop.

Investigators recommend future research at 32DU965 include establishing (1) the vertical and horizontal extent of the site, (2) the range of activities over time, (3) the sequence and dates of erosional events, and (4) the degree of post-depositional disturbances (ibid.:50-52).

The excavation consisted of a 2-x-3-m rectangular block unit place in a high potential location based on inspection of the open trench for the sewer line. Excavation down to 130 centimeters below surface (cmbs) revealed a buried paleosol and 783 artifacts, including bifaces, scrapers, chipped stone tools, hammerstones, chipped stone flaking debris, and mammal bone fragments. Level 5 contained the most artifacts which may indicate an isolated flintknapping session. Investigators identify the location as an area of early stage and/or core reduction and quarry tasks (Ahler 1986), as this is supported by the amount of cortex on the flaking debris. The analytical units at 32DU965 are Late Plains Archaic and/or Late Prehistoric (0-30 cmbs), Middle/Early Plains Archaic (30-80 cmbs), and Paleoindian/Leonard Paleosol (80-110 cmbs).

Other Work

Reports of work other than Section 106 compliance inventories, site evaluations, and impact-mitigating excavations have mostly focused on KRF, especially its geomorphic context, physical characteristics, and variations in use through time. Clark (1985) examined over 600 projectile points from private collections in the KRF quarry heartland and assigned them to time periods based on typological dating. Information was recorded on stone material types and patination. The Paleo period was represented by 5.3% of the specimens, Early Archaic 6.4%, Middle Archaic 23.6%, Late Archaic 44.8%, and late prehistoric 19.9% (Clark 1985:Table 2). <u>What is the most appropriate method for evaluating variations in intensity of use of the quarries through time?</u>

The widely accepted importance of sites in the KRSU is reflected in the attention to monitoring and management planning. However, the reports of other work are quite limited considering KRF utilization is one of the broadest and most important research topics in Northern Plains archaeology. This limitation can be explained in part by the attention paid to KRF by the archaeological community and the low level of funding to support analysis and reporting outside of the Section 106 process. It is a great benefit to have grant support for projects such as Clark's study of KRF projectile points and government agency financial support for publication and broad dissemination of reports such as *The Knife River Flint Quarries: Excavations at Site 32DU508* (Ahler 1986). Graduate student research has generated significant new information.

The North Dakota Department of Transportation (NDDOT) sponsored a project in the KRF primary source area centered on ND Highway 200. The following is a summary offered by the authors (Metcalf et al. 2009).

> *KRF Predictive Model: Resource Distribution and Use through Time in Dunn and Mercer Counties, North Dakota*
>
> The KRF importance in the prehistoric past has led to a diverse range of research topics for archeologists and geologists alike. Time and space need to be accounted for in assessing the distribution of the raw material throughout the region and continent. These concepts are addressed in multiple research paths beginning with the raw material formation in peat bogs in the Eocene age. Thousands of years after the formation of the raw

material, the glacial systems sweeping through the area and retreating caused the raw material to erode out of its bed. Boulders of the material were also knocked loose, as the apron of the KRF was exposed through deflation of the landscape. More significantly, meltwater channels where runoff of melting glacial water poured from the leading edge of the ice mass swept the newly freed smaller raw material downstream to be deposited along the shores and stream beds. Two main arterial routes the waters took were down the Knife River and Spring Creek. These waterways were coated with hunks of the raw material, sometimes multiple episodes of deposition occurred to form layers of stream tumbled cobbles and pebbles. As the stream flow weakened, the larger-sized rocks would fall out in sedimentary layers. Thus, as one moves downstream away from the original formation deposits, the smaller the rocks become. Cobbles and pebbles of KRF (named for one of the two major deposits) were quickly buried beneath sandy deposits as the glaciers retreated and the streams lost most of their force.

Since the retreat of those glaciers, Native Americans have harvested the raw material as tool stone, recognizing the large quantity and high quality of the material. Over the centuries, the tool stone source area has been widely utilized and a projected 200 hectares have been quarried in the primary source area (Ahler 1986:105). Some of the material was taken for personal use while still greater quantities were removed for use as trade materials later in time. This trade network extended over the central United States and southern Canada, ranging as far east as Ohio and down into Texas. Although through most of prehistory access to the KRF was thought to be egalitarian, there is evidence that at certain point(s) this access was controlled as the demand for KRF as a trade good varied through time.

The KRF Predictive Model project began through the sponsorship of the North Dakota Department of Transportation. Numerous road and bridge projects depend on the assessment of existing roads and possible clearing of new routes through the heart of the KRF primary source area. The area surrounding North Dakota State Highway 200 has a high site density and road work is nearly impossible without impacting the cultural resources. To understand the regional cultural resources and assess some more economical approaches to cultural resource management in these counties, a predictive model plan was devised. As the KRF's presence in these counties is a dominating feature in the archeological record, the model is essentially being developed to understand the influence that the presence and distribution of KRF has over settlement patterns through time. The predictive model would address the distribution of geologic and sedimentological (soils) characteristics, as well as landform changes, cultural resource occurrence, and ethnographic and paleo-botanical data, adding all into a geographic information system (GIS). The mapped model would be useful for the KRF primary source area as well as adaptable for other regions in the state. Additional layers could be introduced as more information is gathered in the future.

During the summer of 2009, geophysicists undertook topographic mapping and the creation of a digital elevation model (DEM) for a relatively small portion of the Lynch Knife River Flint Quarry (32DU526) (Wiewel et al. 2009). A robotic total station was used to collect over 20,000 elevation points in a 90-x-120-m area (ibid.:3). Sub-centimeter accuracy revealed depressions and associated spoil piles created by prehistoric quarrying. Then, a GIS was used to produce a DEM of one-half meter resolution of a portion of the site surface. A magnetic gradiometry survey of 1,800 m² showed a lack of magnetism at depression features and increased magnetism at the spoil pile features, filled-in quarry pits, and historic debris (ibid.:13). Investigators recommend more geophysical survey, and a targeted excavation and coring program.

Publications

It is critical for archaeologists to publish their work to enhance public support and understanding of the value of conducting formal archaeological investigations. In the 2021 edition of the Archaeological Component of the State Plan, we include a table (Table 3.10) in each study unit of selected publications available to general audiences. Of particular interest may be the journal of the Plains Anthropological Society (*Plains Anthropologist*) and the journal of the North Dakota Archaeological Association (*North Dakota Archaeology*), in addition to published books.

Table 3.10: Selected References for the Knife River Study Unit, in addition to those listed in Table 3.6.

Author(s)	Year	Reference
Ahler, Stanley A.	1975	Pattern and Variety in Extended Coalescent Lithic Technology. PhD dissertation, Department of Anthropology, University of Missouri, Columbia.
Ahler, Stanley A.	1977	Lithic Resource Utilization Patterns in the Middle Missouri Subarea. In Trends in Middle Missouri Prehistory: A Festschrift Honoring the Contributions of Donald J. Lehmer, edited by W. R. Wood. *Plains Anthropologist* Memoir No. 13, Pt. 2. 22(78):132-150.
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Paleo-Indian Period

Paleo-Indian period sites have been documented in the KRSU. Sites in the quarry area with *documented intact* deposits of Paleo-age include 32ME175, 32DU181, 32DU182, 32DU185, 32DU224, 32DU336, 32DU452, 32DU461, 32DU490, possibly 32DU508, 32DU954, and 32DU955. Information from studies of those deposits has led to a proliferation of realistic, answerable research questions. The earliest people here expended great effort on a local resource—KRF—which was prized by the earliest peoples throughout the Plains (cf. Artz 1988a:1).

Paleoenvironmental Modeling

Environmental conditions are known to have been generally mesic, at least during the early and middle portions of the Paleo period, because numerous artifact deposits of this age within the KRF quarry area have been found contained within the Leonard paleosol. For example, in a tested portion of the several-hundred acre Many Earths KRF quarry-workshop site (32DU490), Paleo deposits within the Leonard paleosol are the deepest cultural stratum in a layered sequence running through Early, Middle, and Late Plains Archaic and up to late prehistoric/Plains Village (Root and Van Nest 1985:140, 196). This buried topsoil represents a span of time within the early Holocene during which vegetation was relatively dense, land surfaces were stable, and wind erosion was minimal (Clayton et al. 1976). Regional biomass and human carrying capacity should have been quite high. Spring Creek sedimentation rates increased dramatically sometime after ca. 9500 RCYBP (Root et al. 1986:496) indicating a shift to arid climatic conditions. Regional biomass and human carrying capacity should then have dropped significantly.

Vigorous attempts to recover stratified undisturbed sediment samples from sloughs to build detailed pollen sequences for paleoenvironmental modeling have yielded disappointing results (cf. Root et al. 1986:489-491). The principal problem with the pollen sample columns parallels a major problem in the archaeological deposits: the compression of 10,000 years of accumulated sediments into 1 m or 2 m thick bands which have lost their integrity through postdepositional disturbance processes such as bioturbation. <u>Any well-dated uncontaminated early Holocene sedimentary contexts encountered during excavations should be sampled for pollen to aid in understanding Early Holocene environments in the Knife River basin.</u>

Cultural Chronology

Quite a variety of methods have been employed in attempts to document the presence of Paleo cultural deposits in this SU. Foremost among these is radiocarbon dating of soil humates from buried topsoils thought possibly to be Leonard paleosols containing intact artifact deposits (e.g., Artz 1989; Root et al. 1986:137, 423-426). However, a persistent problem with these "dirt dates" is contamination with tiny particles of lignite introducing ancient carbon and yielding dates which are older than the soils and associated artifacts (cf. Artz 1988a:21; Root ed. 1983:80-82). Contamination with recent humates tends to render some dirt dates younger than they should be. Great care must be taken in decontaminating samples of organic material that are radiocarbon dated. This goes not only for sites in this SU, but in locations throughout western North Dakota where windblown powdered lignite may have become incorporated in site sediments.

Data concerning the frequency and intensity of KRF patination have been used to document prehistoric re-excavation of quarry areas and for ordering excavated artifact samples according to relative chronological age (Ahler 1986:105). Most Paleo KRF diagnostics are moderately and heavily patinated whereas later-period points are lightly patinated and unpatinated (cf. Root et al. 1986:445). How does intensity of KRF patination vary with depth of burial in archaeological contexts?

Settlement Behavior

Throughout prehistory, the KRF primary source area attracted people who came to the north-central portions of the KRSU to collect flint. Northern Plains Paleo peoples are thought to have been mobile hunter-gatherers of the sort who would have used portions of Knife River basin periodically, perhaps scheduling time each year for KRF quarrying, and possibly also focusing on floral or faunal resources which were then abundant (but which are now unimagined). The KRF quarry area probably has the densest concentration of intact Paleo components in the state. However, it will require considerable care to extract settlement behavioral information for specific episodes of occupation due to a condition referred to as the "palimpsest conundrum" (Root et al. 1986:451): "rates of sedimentation are generally slow and it is likely that the artifactual remains from multiple occupations were often deposited on the same former land surface or on surfaces that were vertically separated by only a few centimeters of sediment. Thus, single excavation levels and culture analytic units are likely to contain artifacts from several or many individual occupational episodes. Each of these distinct occupational episodes may have been functionally distinct (cf. Binford 1982). Artifacts from different occupations may also be inextricably mixed by postdepositional vertical artifact movements." How can functional settlement types be defined and identified in Paleo site studies?

Native Subsistence Practices

Bison rib fragments from the Paleo deposits at the Many Earths site (32DU490) and other, fragments of bison bone from 32DU452A are possible indicators of Paleo subsistence from the KRF primary source area (Root et al. 1986:468). There is little else to date from archaeological contexts. Environmental modeling for the early Holocene is probably the quickest way to identify the range of floral and faunal resources utilized by Paleo peoples. It can be hypothesized that all readily available and economically important floral and faunal resources were exploited to some extent. Early Holocene paleontological finds should be excavated with an eye toward gaining a better understanding of the plant and animal resource potentials of Paleo times.

Technologies

Flintknappers such as Gary Merlie of Decatur, Illinois, have commented on the toughness of KRF and the desirability of this attribute when it comes to fashioning cutting edges that will stand up to heavy use. The durability of KRF may have been a significant factor in its selection for making a variety of cutting and scraping tools from Paleo times onward throughout prehistory. How does the durability of KRF tools compare with the durability of the same sorts of tools made from other materials? Answers to this question will require replicative experimental studies possibly in combination with materials science modeling. Making and using tools of different materials would make a good project for students, avocationals, or professionals.

Heat treatment of KRF (intentional thermal alteration) is another consideration germane to components of all ages from Paleo to protohistoric. The fracturing characteristics of heat treated KRF are more like glass than raw KRF, and thermally altered KRF is often readily identifiable because of its increased luster, darkened inclusions, and overall darkened coloration with reference to "raw" KRF (Ahler 1983). Knife River flint appears not to have been routinely heat treated as some other tougher materials such as Swan River chert were. Nevertheless, sometimes it was. Did people ever heat treat KRF during the Paleo period? Confirmation of intentional thermal alteration is usually difficult to come by. Thermal alteration sometimes happens incidentally (1) when objects are in proximity to hearths (Artz 1988a:20) and (2) when natural burns occur. However, heat-damaged flint is usually distinguishable from successfully, intentionally thermally altered flint.

There is little question that large tabular pieces of KRF were well-suited for Paleo biface production technologies as modeled by Callahan (1979) and evidenced by Paleo deposits at KRF workshop sites. It may be that biface production peaked in terms of relative intensity during Paleo times (cf. Root et al. 1986:406).

Artifact Styles

Paleo point styles reported by Clark (1985:73) and Root et al. (1986:436) to be represented by surface finds in the KRF quarry area include Folsom, Plainview/Midland (Goshen?), Eden, Scottsbluff, Alberta, Frederick, Angostura/Agate Basin, Pryor Stemmed, and Hell Gap/Agate Basin. Earlier Clovis finds are reported for 32DU602 and 32DU603 in the ND SHPO site files, but they have not been written up.

Ahler and Geib (2000:817) provide a well-developed explanation for Folsom point design and adaptation. They recommend the model be "tested and refined through studies of finished point and preform length, artefact proportions and fracture patterns, basal margin treatment, use-wear in archaeological specimens and through actualistic studies of experimental point/haft arrangements."

The Scottsbluff point excavated from the Leonard paleosol of the Aggie Brown Member of the Oahe Formation at 32DU452 (Root et al. 1985:Figure 17b) displays greater stylistic affinities with southern and western Scottsbluff styles than it does with eastern styles (e.g., Buckmaster and Raquette 1988). Yet KRF was used to make both the pronounced-shoulder and indistinct-shoulder forms. Are shoulder morphology variations of Scottsbluff points attributable to geographic variations, temporal diversity, or both?

Regional Interaction

An excellent indication of the extent of regional interaction during Paleo times can be gained by examining the geographic extent of occurrence of KRF Paleo points. After reviewing the literature, Loendorf et al. (1984:13-15) concluded that KRF attained its widest distribution during two periods of time: (1) from about 8000 to 6000 BC in the Paleo period and (2) from about 1000 BC to AD 500 in Late Archaic to Middle Woodland times. "The most distant reported occurrence of KRF artifacts includes a Paleo-age projectile point and scrapers from Warren County, Pennsylvania" some 1,200 miles distant from the quarries (Ahler 1986:5). What Paleo KRF artifact occurrences can be documented to expand the maximum distribution of KRF as illustrated by Ahler (1986:4)? What nonlocal materials from Paleo sites in the Knife River basin indicate any greater extent of regional interaction?

Historic Preservation Goals, Priorities, and Strategies

Nowhere does it appear to be more evident than in reports of excavations from the KRF quarry area that optimal advancements in understanding prehistoric cultural deposits are only possible when there is comparability of data from different projects. This is exemplified by comparability in methods of artifact recovery and data collection applied by Ahler, Artz, Root, and their methodological colleagues at KRF quarry and workshop sites since the 1980s and the findings generated by those investigators.

Archaeologists should continue to work with landowners and landowner-collectors to record sites and document collections. Kermit Nordsven, owner of the Nordsven Quarry site (32DU461), had a collection recorded and reported by Clark (1985) containing Scottsbluff, Hell Gap, and Parallel-Oblique flaked points amongst other later materials. Most of these pieces were reportedly found around 32DU464 (Root et al. 1986:268). Albert Schwenk had picked up materials throughout the Knife River basin for decades and amassed a gigantic artifact collection. In the early 1980s, Dale Davidson of the BLM-Dickinson office worked with Schwenk recording some of the finds. Through this effort, Eden point finds were recorded for 32DU110, 32DUx131, 32DUx132, 32DU602, and 32DU603 (Jack Stewart, personal communication to Mike Gregg, December 1989). The Schwenk collection was auctioned off by pieces and lots to artifact collectors from elsewhere and is lost to North Dakota archaeology.

LIDAR should be utilized to identify and record quarry sites. This technology should be used in the planning of testing and excavation projects.

Plains Archaic Period

Early, Middle, and Late Archaic components have been documented at sites in the Knife River basin. As in most parts of the state, Early Archaic deposits are least common and Middle and Late Archaic deposits are more common.

Paleoenvironmental Modeling

At 32DU336 in Halliday along Spring Creek, excavations have revealed that prehistoric peoples in early Holocene times may have collected KRF cobbles directly from stream gravel deposits that were exposed in the bottomland (cf. Artz 1988a:18). This procurement practice would have differed from the more prominently recognized (1) quarry pit surface mining in the terrain along the margins of the valley (Ahler 1986; Loendorf et al. 1984) and (2) simple surface collecting here and there across the rolling plains (cf. Gregg 1983b:117). This revelation has been surprising to some because there are few exposures of stream gravels along the stream bottoms today, and such gravels have probably not been exposed since Early Plains Archaic times prior to the onset of the Altithermal droughts. Were KRF cobbles and other gravels widely exposed in the numerous alluvial valleys of the KRSU during terminal Pleistocene and early Holocene times? Were they then buried by windblown sediments during the arid Altithermal episodes? Regarding geology of the Alkali Creek site (32DU336-SEE), Metcalf and Ahler (1995:52) state "Eventually enough of the site was exposed for Artz and Ahler [1989] to recognize that a cap of younger Holocene alluvium buried a portion of a Pleistocene terrace containing KRF-bearing gravels. They demonstrated the presence and antiquity of KRF artifacts in gravelly quarry spoil deposits lying below, and sealed by, the early Holocene Leonard Paleosol." Paleoclimatic reconstruction and geomorphological studies of mid-Holocene contexts should continue to be central to investigations of Archaic cultural deposits in this and other SU.

Prospects are good for upgrading paleoenvironmental models for the Archaic periods by studying ecofactual remains from specific strata of the Oahe Formation found to contain Archaic components. Knowledge of the general ages of the various members, submembers, and paleosols of the Oahe Formation spanning the entire Holocene often enables identifying the general age of archaeological deposits when they are contained within distinct soil strata in the Knife River basin. What are the most likely depositional contexts for good preservation of pollen and phytolyths? Soils throughout North Dakota in general and the Knife River basin are recognized as being "pollen poor" soils. Persistent wetting and drying of soils plus alkalinity combine to destroy high percentages of pollen grains and phytolyths so that even delicate pollen recovery procedures seldom aid in generating samples to use in environmental reconstruction (cf. Scott and Lewis 1983).

Cultural Chronology

Early Archaic components were identified based on typological dating at two sites near Spring Creek along the Southwest Pipeline right-of-way. A side-notched point similar to the Hawken style (cf. Frison et al. 1976:Figure 11b) was surface collected at 32ME794 (Gregg et al. 1985:50). Oxbow points were recovered by test excavation at the Goodman Creek site (32ME796) (Artz 1986:260, 263) and 32ME154 (Winzler et al. 1998:7.1-7.2).

The deepest cultural zone at the Emerson site (32DU285) lies in an Altithermal-age sedimentary context thought to represent the Pick City Member of the Oahe Formation (William 1983c:253). Although no diagnostics were recovered from this zone and there were no radiocarbon dates for it, it probably represents an Early Archaic deposit.

There are Early Archaic deposits in the KRF quarry area at 32DU452 and 32DU181 (Root et al. 1986:410, 414). As at the Emerson site, at 32DU181 the Early Archaic deposit is in a Pick City sedimentary context, but in this case overlying a distinct representation of the Paleo-age Leonard paleosol (Root and Van Nest 1985:269-299). Did the Spring Creek valley, fed along its length by many springs, provide Early Archaic peoples with at least a partial refugium from mid-Holocene drought as posited by Artz et al. (1987:9.15)?

Scarcity of Oxbow components from excavated contexts must be a matter of sampling error rather than an expression of actual scarcity of Oxbow occupation in the KRSU. Clark identified 54 Oxbow points in her sample of 609 typed points from the KRF quarry area (Clark 1985:74). Also, considerable use of KRF in surrounding regions by people with Oxbow material culture is evidence for Oxbow procurement in the quarry area. One possible Oxbow component has been identified from a deeply buried humic horizon at 32DU429 near Dunn Center (Kay and Van Nest 1984:195; Root et al. 1986:413), but the dirt date of 3555±63 RCYBP (SUM-131) is quite late for Oxbow. An Oxbow component was identified at 32ME154, as were subsequent McKean, Pelican Lake, Besant, and Plains Village/Late Prehistoric components (Winzler et al. 1998:7.1-7.2). Is there any solid evidence for intact single component Oxbow deposits dating later than 2500 BC anywhere in this SU?

Regarding the Middle Archaic period, it is suggested that less common occurrences of McKean Lanceolate points in comparison with greater numbers of Duncan point finds and even more Hanna forms is evidence for increased intensity of use of the KRF quarry area during the Middle Archaic period by peoples with material culture attributable to these three complexes (cf. Clark 1985:74). A McKean Lanceolate point was excavated in a Slow Creek terrace edge setting in one of a series of buried soils along with artifacts and stratigraphic information indicating lithic workshop activities, possible camp occupation, and possibly KRF quarrying (Root et al. 1986:185). This discovery is in a setting where mid-to late-Holocene sediments are well-stratified. Another was discovered in a level underlying Late Archaic materials at 32DU452 on a bench overlooking the Spring Creek floodplain (Root et al. 1985:63). A McKean point was recovered at the Bees Nest site (32ME175), dating Component A (Peterson and Brownell 1990:38). The Bees Nest site is a large, multi-component stone feature site located in native prairie on an upland flat, overlooking intermittent drainages to the south and east (cf. 32ME154 in Winzler et al. 1998). In what depositional contexts are McKean Lanceolate components most likely to be found?

A Middle Archaic cultural zone assignable to the Duncan complex was encountered in a small block excavation at 120 to 130 cm below ground surface at the Goodman Creek site (32ME796) (Artz 1989b:43). Duncan components are fairly common throughout the basin. One is recorded at 32DU44 just to the east of the Killdeer Mountains (Root, Kordecki, and Meier 1983:752). Another intact component was revealed by testing at 32DU461 in the KRF quarry area (Root et al. 1986:335).

Hanna components are recorded at 32DU23 along the western margin of the Killdeer-Glen Ullin glacial meltwater channel (Root, Kordecki, and Meier 1983:769-778). There is another at 32DU71 in the Murphy Creek valley southwest of Dunn Center (Root 1983o:Figure 15.8a,c). Hanna points were very well represented by 52 specimens in Clark's sample of 609 diagnostics from the KRF quarry area (1985:74). Do increased numbers of Hanna point finds indicate increased intensity of occupation in terminal Middle Archaic times in the Knife River basin?

Pelican Lake and other unnamed Late Archaic complexes with corner-notched dart points appear to be abundant in surveyed portions of the KRSU. Although corner-notched points were made in varying frequencies throughout most of prehistory (cf. Gregg 1985c:116-117), the surface-discovery and shallow subsurface-discovery of most of these KRSU specimens indicates late Holocene geomorphic contexts and thus Late Archaic temporal placement. Corner-notched points evincing probable Late Archaic occupations along the Northern Border Pipeline transect through the Knife River basin include 32DU37 (Artz et al. 1983:Figure 4.1c,g); 32DU71 (Root 1983o:Figure 15.8b); 32DU67 (Root 1983b:Figure 17.4k); 32DU68 (Root 1983c:Figure 17.4i); 32DU290 (Billeck 1983c:Figure 18.4a,b); 32DU284, 32DU44, 32DU284, 32DU77, 32SK11, and 32MO238 plus several isolated finds (Root, Kordecki, Billeck et al. 1983:Figure 15.7b, e, f; Root, Kordecki, and Meier 1983:Figure 14.6c, i, j, l; Figure 14.18j, l). Site 32DU200 is a Late Archaic site in the Knife River bottomlands near the town of Marshall (Gregg et al. 1985:61-62). What evidence is there for different archaeological complexes being represented by distinctive forms of corner-notched dart points at components within the Knife River basin?

Settlement Behavior

Early Archaic components are represented by such small-excavated samples that it is not possible to identify any specific functional settlement types. However, for the later periods, sufficiently large samples have been excavated to recognize or infer the former presence of base camps, field camps, and lithic workshop locations. At the multi-component stratified Emerson site (32DU285) on a low bluff overlooking the Knife River in the west-central portion of the SU, the two most prominent cultural zones in a 94 m^2 block excavation were a Middle Archaic deposit dated 3670±280 RCYBP (UCR-1582) and a Late Archaic deposit dated stratigraphically between 3000 and 2000 BP (William 1983c:254, 257). Both deposits were assessed as representing warm season field camps where KRF procurement and processing tasks predominated. Evidence supporting this assessment for the Middle Archaic zone included: (1) a relatively low frequency of artifacts and features per volume of matrix; (2) a thin cultural deposit indicative of short-term occupation; (3) presence of tested KRF and primary reduction flaking debris; (4) an abundance of flaking debris concentrations, broken or rejected unfinished stone tools; (5) occurrence of functional or worn out tools used for maintenance tasks; (6) low frequency of finished or expended patterned chipped stone tools; and (7) no indication of fixed residential structures (ibid.:255). The inference of warm-season occupation was based on the open, windswept bluff-top setting. All test and salvage excavations projects should attempt to identify the functional settlement types represented by remains from sampled components. Where should Archaic base camp deposits be anticipated, and what types of remains evince base camp activities?

Activities represented in the Duncan cultural zone sampled by a 15 m^2 Goodman Creek site included stone tool manufacture, use of unprepared surface hearths, resource processing, equipment maintenance tasks, and cooking (Artz 1989b:78-79). Stone tool repair and maintenance were evidenced by traces of small flakes of quartzite, chert, and porcellanite in conjunction with a lack of cores and unfinished tools of those materials. The low density of bone refuse along with the unprepared nature of the hearths led to the inference that food processing and consumption was not an important aspect of the settlement (ibid.). Settlement behavior must be reconstructed from activities represented by small samples of cultural remains recovered from small-excavated areas because most Section 106 salvage/mitigation archaeology is not geared to recovery of representative samples of entire site deposits.

Native Subsistence Practices

Subsistence remains are uncommon in Archaic components in this SU based on results from the considerable amount of testing and salvage excavation which has been reported. This is due partly to poor preservation contexts where organic subsistence remains in shallow deposits are rapidly decomposed by biological agents in conjunction with frequent freeze-thaw cycles. In some cases, however, stone tools used for processing subsistence resources are found where traces of the actual resources have decomposed. An example is the recovery of a large complex anvil stone of coarse-grained sandstone from the primary cultural zone of Middle and Late Archaic remains at the Misty Mountain site (32DU37) (Gregg 1983b:115). Use-wear on the working surface indicated processing of materials such as berries, dried meat, or bone, which could not be specifically identified. How did the floral and faunal resource potential of the Knife River basin vary through the Archaic periods?

Technologies

The early stages of flintknapping technological sequences are well represented in the KRF primary source area throughout the Archaic Period. But they are also well represented in the southwestern North Dakota source areas for silicified wood and TRSS. How important was KRF to Archaic technologies in comparison with technologies of earlier and later stone-age times?

Duncan flintknapping reduction sequences, both for producing bifaces and flake blanks, are represented in samples from a 15 m^2 block excavation at the Goodman Creek site (32ME796) (Artz 1989b:72-74). These reduction sequences can be reconstructed by studying discarded tools as well the flaking debris by-products of the knapping. Can anything be identified in the stone toolmaking sequences of the McKean Lanceolate, Duncan, and Hanna complexes that will aid in distinguishing them?

Certainly, the density of sites and surface mining pits in the KRF quarry area stand as prominent testimony to the economic and technological importance of KRF throughout prehistory. Additional affirmation can be seen in the high densities of large sites in areas peripheral to the quarry area proper. An example is the Misty Mountain site (32DU37) at the head of the Knife River basin on the eastern footslopes of the Killdeer Mountains where hundreds of prehistoric occupations may be represented in a total site area of 40-50 ha (100 acres or more) (Gregg 1983b). Some 76 m^2 of mitigating excavation was carried out in several portions of this stratified site transected by the Northern Border Pipeline.

Archaic technologies other than chipped stone technologies are poorly represented in excavated samples due to (1) poor preservation conditions and (2) the lack of investigation of residential base settlements where cultural deposits have more diverse artifact and feature contents than in sites of short-term occupation. What potentially are the most favorable contexts for preservation of organic remains in Archaic-age sites in the KRSU?

Artifact Styles

A bifacial cutting tool from the Duncan cultural zone at the Goodman Creek site (32ME796) is a basally notched form which bears some resemblance to the McKean Lanceolate style, but it is distinctly asymmetrical in outline with one steeply and irregularly retouched blade margin (Artz 1989b:69,72). What is the range of variation of McKean Lanceolate forms?

More efforts need to go into defining corner-notched point forms having different cultural/temporal affiliations. Corner-notched, arrowpoint-sized specimens have been found in Late Archaic and Early Plains Woodland contexts in the James River SU (Gregg 1987d:258; Gregg et al. 1986:147). For southwestern Manitoba, Syms reserves the Pelican Lake point type name for medium-to-small, straight-sided, deeply corner-notched point forms (1980:364-370). He distinguishes these smaller Pelican Lake points from distinctly larger and earlier corner-notched forms which he classifies as "Archaic Barbed." There is considerable variation in corner-notched point forms.

Regional Interaction

Given the widespread distribution of KRF across the Northern Plains and into adjacent regions during the Late Plains Archaic period, "we can be confident in inferring that many distinct groups visited the quarries during this several thousand-year long period. The wide variety of corner-notched point forms may well reflect this phenomenon" (Root et al. 1986:446).

A heavy-duty scraping tool made from an exhausted core of Miocene flint in the Duncan cultural zone of the Goodman Creek site (Artz 1989b:72) suggests movement of the Middle Archaic group responsible for the deposit within a territory extending southwestward to the Sentinel Butte locality. What is the range of interaction indicated by nonlocal lithic materials in Late Archaic components in the KRSU?

Historic Preservation Goals, Priorities, and Strategies

A high priority should be given to identifying subsistence remains which can be attributed to specific Archaic complexes. If this is given a high priority, then excavation will focus on cultural deposits with firmly established cultural/temporal affiliations. Also, as a result of this priority, residential base settlements, undocumented for any of the Archaic periods in this SU to date, would be more likely to be targeted for salvage excavation because high densities of subsistence remains are expected in the refuse at residential bases.

Plains Woodland Period

Early, Middle, and Late Woodland components are to be expected throughout this SU. In an Early Woodland cultural zone deposited between 550 and 410 BC at the Naze site (32SN246) along the James River, KRF accounted for more than 75% of an excavated sample of flaking debris (Picha and Gregg 1987:Table 7.5). Such a high level of KRF utilization suggests direct procurement rather than acquisition through exchange relations.

Paleoenvironmental Modeling

Oddly, although the Besant/Sonota Middle Woodland complex is the most renown of all prehistoric complexes for intensity of KRF utilization in components throughout the Northern Plains, Besant/Sonota deposits with ceramics are rare in the KRF quarry area. In the quarry area, what must be aceramic Early and Middle Woodland components are necessarily classified as "Late Archaic" and contribute to the dense artifact deposits of 2,000-3,000 years ago which are thought to evince the "peak time of KRF use" (cf. Root et al. 1986:472). Besant/Sonota components in Spring Creek floodplain settings may be expected to occur in 1,500-2,000-year-old buried humic horizons such as those at 32DU159, 32DU193, and 32DU224 (cf. Root et al. 1986:493). Are Besant/Sonota components in the Knife River basin often found contained within buried topsoils indicating mesic conditions and high biotic resource potential during Middle Woodland (or Late Archaic) times?

Cultural Chronology

It has been proposed that KRF patination may be a key to determining the gross ages of some artifact deposits in western North Dakota. Root et al. (1986:446) suggested that a KRF assemblage with at least 15% to 20% of the artifacts having moderate, heavy, or eroded patination can be expected to be 1,500 years old or older. Such assemblages can be suggested to date to Middle Plains Woodland or earlier times. Patination thus has potential utility for (1) gross relative dating of samples as well as (2) sorting older artifacts from more recent artifacts in mixed samples. A moderately or heavily patinated KRF assemblage associated with cordmarked potsherds in a single component deposit indicates an Early or Middle Plains Woodland temporal affiliation. A similar KRF assemblage associated with thin, well-made ceramics would indicate a multiple component deposit. Any moderately or heavily patinated KRF artifacts (but not necessarily any other brown chert or chalcedony) from unquestionably Late Woodland or Plains Village contexts should be prominently reported because of their scarcity and importance in understanding variations in rates of KRF patination in differing depositional contexts. The many environmental variables that influence the rate of KRF patination have limited the potential uses of patination information in the interpretation of the archaeological record (Van Nest 1985:325).

Settlement Behavior

Rarely Early Woodland settlement has been documented in the Knife River basin. Middle Woodland sites are present and recorded as Besant and Besant/Sonota. Deaver (1990) and Deaver et al. (1989) note that a general trend within the Coteau mining region is the small- to medium-sized stone feature sites date to the Besant Phase. These sites tend to share other characteristics such as function, re-use, and lithic raw material exploitation. Other Middle Woodland components are identified generically as Late Archaic when Besant side-notched points and Sonota ceramics are lacking. Middle Woodland/Late Archaic occupation at 32DU159 in the KRF quarry area may be classifiable as a field camp (cf. Root et al. 1986:411-412). Site 32ME166 at Coteau was assessed by Kuehn (1984) as a Besant base camp or tipi field camp. Does lack of Sonota ceramics indicate a lack of Middle Woodland residential base settlement in the interior of the Knife River basin?

A possible Avonlea component at the Goodman Creek site (32ME796) (Artz 1986:261-262) has the potential to yield significant information concerning Late Woodland settlement. This intact deposit contains potsherds, stone tools, flaking debris, butchered bone, and fire-cracked rock (ibid.:245). The artifact diversity alone indicates some sort of a residential base or field camp is likely represented. Are Avonlea sites generally poorly represented in the eastern portion of the Avonlea range in most of North Dakota but well represented in the KRF primary source area? Results of investigations during the past 40 years indicate this is so.

Native Subsistence Practices

Broad arrays of subsistence remains are rare at most temporarily occupied, basin-interior sites regardless of time period. But it should be possible to identify special-purpose food procurement and processing sites related to big game hunting. Such sites should be expected in and around good hunting places such as stream valleys, margins of wetlands, wooded draws, and wooded north slopes of buttes and valley walls. The deeper the site burial, the more likely it will be that organic subsistence remains are preserved. What subsistence remains should be expected at Early, Middle, and Late Woodland components in the Knife River drainage?

Technologies

Woodland ceramic technologies in western North Dakota are best known from sites in the Southern Missouri River SU such as Besant/Sonota from High Butte (Wood and Johnson 1973) and Late Woodland from Cross Ranch (Ahler et al. 1981, 1982). What technological attributes can be used to differentiate Woodland ceramics from Plains Village ceramics at high levels of probability? This question will be difficult to approach with data from sites in the interior portions of the basin because sherd samples are typically very small here. The low frequency of sherds is characteristic not only of Woodland deposits, but later Plains Village deposits as well.

Cordmarked exterior surfaces are often viewed as an indicator of Woodland rather than Plains Village cultural/temporal affiliation in this part of North Dakota. At 32DU508 for example, fragments of "an apparently cord-roughened pottery vessel" found in the workshop portion of the site were interpreted as a probable indicator of Woodland occupation (Ahler 1986:105).

Middle Woodland (or Late Archaic) KRF flintworking techniques appear to have emphasized production of large, nonbipolar, percussion flake blanks which were reduced into patterned bifacial cutting tools and projectile points (cf. Ahler and Van Nest 1985:193-194; Root et al. 1986:411). This represents a shift from earlier Archaic and Paleo technologies which involved a considerable amount of percussion knapping of large biface blanks directly from tabular cobbles of flint.

At some time during late prehistoric (Late Woodland or Plains Village) times, perhaps after the widespread adoption of bow and arrow weaponry, the bipolar core reduction technology became very common in workshops in the KRF quarry area (Ahler and Van Nest 1985:16). Granite boulders exposed on the surface near quarries were often used as anvils, and the relatively recent debris from the bipolar knapping is found in great quantities in near-surface contexts around such boulders (for example, 32ME1089). At the Many Earths site (32DU490), one 1-x-1-m test unit placed alongside one of these boulder anvils was estimated to contain nearly 50,000 pieces of flaking debris within 27 cm of the present ground surface (Root et al. 1986:406). Despite the obvious importance of late prehistoric bipolar core reduction, the purpose of this form of flake blank production is not clearly understood. What was the main purpose of late prehistoric/Late Woodland/Plains Village bipolar flake blank production?

Artifact Styles

The Avonlea arrow point is a distinctively styled Late Woodland artifact. Clark (1985:74) recognized 11 Avonlea points in the sample of 609 she identified from the KRF quarry area. Forty-three Avonlea points were recovered from the upper two cultural levels at 32ME847 (Sanders and Larson 1991:7-33). Further, actual KRF quarrying by people with Avonlea material culture has been documented at 32DU184 along Slow Creek a mile south of the Lynch Quarry District boundary (Root et al. 1986:121).

Avonlea points and ceramics have been recovered from a shallowly buried cultural stratum in Area A at the Goodman Creek site (32ME796) (Artz 1986: 261-262). Although five ceramic vessels are thought to be represented by 26 sherds from two 1-x-1-m test units, the sherds are too small to display any stylistic features (cordmarked, simple stamped, and smoothed exterior surface treatments are present in the sample). What styles (i.e., wares and types) of ceramics might be expected in Avonlea components in the Knife River basin and elsewhere in western North Dakota?

Regional Interaction

Most of the obsidian found in North Dakota sites is from western Rocky Mountain sources, and it is thought to have most likely been obtained by exchange mechanisms rather than direct procurement (Baugh and Nelson 1988:81). Obsidian seems to begin appearing as an exchanged commodity in Late Archaic sites, and it is occasionally found in components dating to subsequent periods. However, the peak intensity of obsidian exchange across the Northern Plains was during the Middle Woodland period (ibid.:87). Obsidian, from Obsidian Cliffs, was recovered from Besant Complex deposits at 32ME166, 32ME175, and 32ME220 (Lynelle Peterson to Paul Picha 2007, personal communication). Obsidian from southeastern Idaho/Black Hills was found at 32ME799 in Sonota Complex component (ibid.). Site 32MZ1005, located on a ridge dividing the Little Missouri and Little Knife rivers, yielded obsidian sourced to Obsidian Cliffs. Obsidian hydration tests and recovery of Talking Crow ware ceramics date the site to

1400 BP (Newberry and Olson 1991:72). Are obsidian artifacts more likely to represent Middle Plains Woodland occupations than occupations of any other cultural/temporal affiliation when they are found at campsites in the interior portions of the Knife River basin?

Historic Preservation Goals, Priorities, and Strategies

A primary goal and top priority should be to identify more Woodland pottery, and a strategy to enhance prospects for such identifications would be to stop field sorting and begin laboratory sorting of materials recovered during shovel/auger probing, test excavations, and salvage excavations. Many small potsherds have undoubtedly gone undetected in quarter-inch mesh screen loads of site matrix and have been discarded or forced through the screen along with small lumps of dry soil. Waterscreening a sample of every level of every unit is also essential for recovery of small potsherds. There are some archaeologists who do not waterscreen on a regular basis. Size-grading ceramics in mechanical screens destroys fragile specimens. Carefully analyzing surface treatment of larger "cordmarked" sherds and reconstructions is essential to understanding manufacturing techniques and ware definitions.

Plains Village Period

Plains Village earthlodge residential bases in the Knife-Missouri confluence locality are overwhelmingly late Plains Village in age, but the confluence locality was utilized at least from the time of the earliest Villagers of the Clark's Creek phase (AD 1200-1300) and probably during the preceding Formative Village times as well (cf. Ahler 1988a:77; Lovick and Ahler 1982:13). Plains Village components should be abundant along the Knife River.

Paleoenvironmental Modeling

Use of the Knife River basin by Villagers would have partly depended upon the nature of floral and faunal resource availability which in turn was heavily influenced by climatic conditions. But ecofactual data are scarce for the various climatic regimes of the Neo-Atlantic (AD 850-1250), Pacific (AD 1250-1550), and Neo-Boreal (AD 1500-1883) episodes because Plains Village deposits in the interior usually have poor integrity. They are typically shallowly buried and thus subject to disturbance by a host of destructive biotic and cultural processes. Attempts should be made to identify deeply buried intact Plains Village deposits and sample them for both ecofacts and artifacts to increase understanding of the paleoenvironmental conditions of Plains Village times.

Cultural Chronology

Plains Village and other late prehistoric components are poorly represented in the sample of shallow and often mixed site deposits tested in the KRF quarry area (Root et al. 1986:476). Diagnostic artifacts are uncommon with reference to Village sites along the Missouri, and datable single component Plains Village deposits are rare. Methodologies need to be developed for identifying Plains Village components at field camps and locations in the interior portions of the KRSU.

Settlement Behavior

Based on ethnographic and ethnohistoric analogies with the Mandan and Hidatsa, Plains Village activity areas should have a widespread distribution through the KRSU. Beyond the earthlodge villages there should have been field camps, hunting locations, wild plant material collecting locations, KRF quarrying locations, stations and caches of various sorts, and sacred and religious sites. Did Plains Village settlement systems, which included residential bases near the mouth of the Knife River, extend throughout the entire KRSU?

Native Subsistence Practices

Earthlodge villages were situated at the Knife-Missouri confluence in part because the locality enabled hunting and gathering sufficient to supplement gardening to support permanent aggregations of hundreds of people. To what extent were the subsistence resources of the interior Knife River basin relied upon to support the permanent settlements at the confluence?

Technologies

Information should abound in this SU (as in the other western North Dakota SU) concerning Plains Village lithic, ceramic, and bone technologies outside of the earthlodge village core areas. What was the extent of KRF surface mining by Villagers in comparison with peoples who lived other lifeways? Were ceramic clay resources of the interior Knife River basin used by the Villagers? Were bone raw materials preformed at kill and butchering sites the way lithic raw materials were pre-formed at lithic workshop sites?

A bison scapula digging tool radiocarbon dated to 200±50 RCYBP (SMU-1196) from the quarry area at 32DU508 may be evidence for late prehistoric or protohistoric Plains Village quarrying (Ahler 1986:105). Are there diagnostic Plains Village lithic technological procedures that can be identified in lithic artifact assemblages to enable distinguishing Plains Village artifact deposits from those of contemporary non-Villagers?

Plains Village ceramic technology is nowhere near as well-represented at sites in the Knife River basin interior as in the earthlodge residential bases along the Missouri River. Technological attributes and mere hints of vessel form become as important as stylistic traits in identifying cultural/temporal affiliations of small samples of sherds from surface collections and limited tests in the primary source area. For example, a vessel from 32DU429 was appraised to be of Late Woodland or Plains Village affiliation because exterior surfaces of body sherds were smoothed, and neck sherds indicated a constricted orifice (Kay and Van Nest 1984:195). Within 32ME175, Component C contained check-stamped ceramics dating to AD 1200-1700 (Peterson and Brownell 1990:39).

Artifact Styles

Initial age estimates for archaeological deposits typically involve typological considerations. Culturally and/or temporally diagnostic artifact styles are important in the process of identifying historic properties. However, while the village sites in the confluence locality abound in diagnostic artifacts, sites in the interior often have deposits which are sparse or lacking in obvious stylistic diversity. There is a need to identify more styles of artifacts, especially chipped stone materials that endure in archaeological deposits, which are diagnostic of Plains Village sites.

Regional Interaction

Knife River flint was distributed widely through Plains Village populations of the Northern Plains, especially those with Extended and Terminal Middle Missouri material culture. All Middle Missouri sites show a consistent selection for KRF regardless of the distance and directions to the primary source area (Ahler 1977:148). This preference was perpetuated by later Coalescent peoples in North Dakota. At the Lower Hidatsa site at the mouth of the Knife River, KRF constitutes more than 93% of the flaking debris assemblages throughout the duration of occupation from ca. AD 1680-1780 (Ahler and Weston 1981:186, 190). This pattern persisted into the Historic period. Analyses of lithic assemblages from Lower Hidatsa Village and Sakakawea Village in the Knife River Indian Villages (KNRI) document that KRF was the preferred lithic material during the decline of native lithic technology throughout the Euro-American contact period (Ahler and Weston 1981; Goulding 1980; (William et al. 1983:50). Did local Villagers living along the nearby Missouri River control access to the primary source area or otherwise control the distribution of KRF into surrounding regions?

Occurrences of exotics other than lithics from distant source areas can be expected to be uncommon at sites within the basin because of the temporary nature of most occupations and resultant restricted diversity of artifact deposits. Exotic stones should be well represented in situations where tool kits were refurbished, and worn-out tools made from other materials were discarded. Less frequently, other sorts of exotics may be found. *Antalis dentalium* shell recovered at 32DU508 (Ahler and Christensen 1983:286) is quite likely a late prehistoric or protohistoric Plains Village artifact because it was during this period that *Antalis dentalium* was commonly exchanged from its Pacific Coast source area into the exchange networks of the Northern Plains Villagers (Brine et al. 1983:18.9).

Historic Preservation Goals, Priorities, and Strategies

A hypothetical model should be developed for Plains Village use of the Knife River basin. The model could be based on existing ethnographic, ethnohistoric, and archaeological data. The model should identify the range of site types which should be expected as well as their likely distribution.

Plains Equestrian Period

Components of this period are distinguished primarily by the occurrence of European trade goods. Ethnohistoric documentation should be compiled for use of the KRSU by horse-mounted Villagers as well as horse-mounted hunter-gatherers.

Paleoenvironmental Modeling

The period 1780-1880 is the final one-third of the Neo-Boreal climatic episode (cf. Wendland 1978a, 1978b). There are records of temperature and precipitation for the Knife-Missouri confluence locality from as early as the fall-winter-spring of 1804-1805 in the records of the Lewis and Clark expedition. The journals and other records of the trappers, traders, and explorers of this era also contain information concerning the density and distribution of floral and faunal resources (cf. Hanson 1983b:1359-1363). A detailed account should be prepared of the environmental circumstances of the confluence locality and as much of the interior basin as possible. This could become the "present" with which prehistoric environmental conditions could be compared.

Cultural Chronology

The chronology of Plains Village cultures reflects several severe cultural changes which took place during the Equestrian period. Major epidemics of European diseases decimated the Villagers in the early 1780s and again in the 1830s. They had been the dominant cultural force on the Northern Plains for centuries, but that dominance was taken over by the Equestrian peoples. When did the Villagers lose control of the Knife River basin, and how do Plains Village chronological shifts in the upper Knife-Heart region (cf. Ahler 1988a:77) bear upon the cultural chronology of the basin as a whole?

Settlement Behavior

After the Equestrian peoples became dominant over the Villagers, there were changes in the Villagers' settlement practices. Attacks from equestrian groups sometimes kept the Villagers pinned in the earthlodge communities. How did Plains Village settlement behavior in the Knife River basin change because of population decline and the cultural changes of the Equestrian period?

Native Subsistence Practices

Population decline and warfare should have had a significant effect on the Villagers' harvesting of the faunal and floral subsistence resources in the Knife River basin. Did Equestrian peoples fill the niche of hunters and gatherers of natural resources in the Knife River basin upon the decline of Plains Village cultural dominance?

Technologies

Decline of native technologies and adoption of European metal implements acquired through trade during the AD 1700s and 1800s is documented at numerous village sites along the Missouri River in the Dakotas (e.g., Goulding 1981; Toom 1979). However, KRF and other stones continued to be chipped for tools well into the Equestrian period. Alfred Bowers related to Stan Ahler the story of a discovery "of wooden quarrying tools at one of the major KRF quarries near Horse Nose Butte in Dunn County. Crows Heart, a Mandan, reported to Bowers his finding of fire-hardened ash digging sticks or poles at one of the flint quarries while he and friends were hunting in the area in the 1870s" (Ahler 1986:106). How late did KRF quarrying persist, and what were the last Native American uses for this stone material?

Peter Fidler was told by the Piegans of southern Saskatchewan in 1793 that they did not burn coal in their tents because of its noxious odor (Russell 1989:60-61). Native Americans of the Northern Plains were aware of lignite as a potential fuel source, but did they use it for anything?

Artifact Styles

Styles of glass beads have been used to date protohistoric occupations at several sites in the interior of the Knife River basin. While some styles can be dated quite specifically, others cannot. One bead from the multi-component stratified Emerson site (32DU285) was of a style manufactured and distributed between AD 1650 and 1890 (William 1983c:261). What styles of glass beads and other trade goods can be expected in the KRSU, and what are the dates of manufacture?

Regional Interaction

Native American interaction networks were more extensive during the Equestrian period than at any time during prehistory. Studies of these interaction networks have specifically included the Villagers who lived in the Knife-Missouri confluence locality during the Equestrian period (cf. Wood 1972, 1974). Not only did horses enable faster and more distant interchanges between natives, but also the fur trade network extended contacts indirectly to Europe. What is the evidence that KRF declined in importance as a trade commodity through the first half of the Equestrian Period?

Historic Preservation Goals, Priorities, and Strategies

A top priority should be to develop approaches for distinguishing between Plains Village and Equestrian archaeological deposits of the Equestrian period in the portions of the Knife River basin removed from the Plains Village heartland of the Knife-Missouri locality. One strategy for approaching this problem would be to comparatively study archaeological deposits left by people who lived those different lifeways during that period.