Lithologic Map Unit Properties Table: Knife River Indian Villages National Historic Site

Gray-shaded units are not mapped within Knife River Indian Villages National Historic Site.

Age	Map Unit (Symbol)		Geologic Description	Geologic Features and Processes	Geologic Resource Management Issues	Geologic History
QUATERNARY (Holocene)	Oahe Formation	Unit 7 (Qo7)	Silt, clay, sand, and gravel. Variable in color, sorting, and thickness. Deposited primarily as alluvium, but also contains colluvium. *Alluvium*. Interlayers of yellowish-brown and grayish-brown calcareous clay, silt, and very fine- to coarse-grained sand. Contains sedimentary structures common to rivers, cultural artifacts, and fossils. Ranges in thickness from < 1 m (3 ft) to > 12 m (39 ft). Underlies alluvial terraces and the modern floodplain along the Knife and Missouri rivers. *Colluvium*. Deposits reflect upslope source material: (1) brown to gray, silty clay below steep slopes of Paleocene sediment, (2) grayish-brown to dark-gray pebble loam at the base of hillslopes composed of till or gravel, and (3) sandy silt similar to **Qo5** below loess covered slopes.	**Features that Connect Geology and Archeology**—Forms the modern floodplain of the Knife River. The unit contains cultural artifacts. **Paleontological Resources**—Contains fossils of terrestrial and aquatic gastropods, bison, elk, and other mammal bones. Bioturbation by plants, earthworms, rodents, and humans has disrupted most of the primary sedimentary structures. **Fluvial Geomorphic Features**—Contains climbing ripple cross-beds, flat beds, large- and small-scale cross-beds, diffuse beds, lenses of charcoal, and wood. Secondary deposits include carbonate nodules and iron- stained siltstone nodules.	**Impacts Resulting from the Garrison Dam**—Narrow active channel confined by banks of **Qo7**. **Flooding of the Knife River**—Inundation due to ice jams, rapid ice melt, and seasonal flood events. **Bank Erosion on the Knife River**—Erosion caused by ice gouging, precipitation, Missouri River backflow, and lateral migration of the channel. **Impacts of Bank Erosion on Archeological Sites and Infrastructure**—Erosion threatens archeological sites (Elbee and Taylor bends), Mercer County Road 18 (Taylor Bend), the Two River hiking trail (Loop Bend), and the historic site boundary (Noname Bend). **Slope Movement**—River bank collapse. **Paleontological Resource Inventory and Monitoring**—Field-based, park-specific survey, inventory, and identification of fossils in museum collection should be considered. Combined archeological and paleontological projects will collect fossils with little disturbance to cultural material.	**The Past 12 Thousand Years (Cenozoic Era): Holocene Thaw**—Poorly bedded sand, silt, and clay represent vertical accretion (overbank) deposits. Lateral accretion (point-bar) deposits consist of sand and silt containing climbing ripple cross-beds, large and small scale cross-beds, and thin clay layers. Gravel and coarse sand represent channel-lag deposits. Some alluvium has been reworked by aeolian and colluvial processes. The alluvial deposits represent upper flow regime, lower flow regime, and stagnant water of river channels and floodplains. Colluvium was deposited in swales, intermittent stream valleys, and at the base of hillslopes.
		Unit 6 (Qo6)	Light-yellowish-brown to very-dark-brown, well-sorted, fine- to medium-grained aeolian sand, which has been reworked from the terraces and floodplains. Forms dune topography and a continuous sand sheet that grades into silt of **Qo5**. Up to 10 m (33 ft) thick.	**Features that Connect Geology and Archeology**—May contain cultural artifacts. **Fluvial Geomorphic Features**—Contains low-angle cross-bedding and flat bedding. Paleosols in floodplains. **Aeolian Features**—Contains sand dunes, sand sheets, and blowouts.	None reported.	**The Past 12 Thousand Years (Cenozoic Era): Holocene Thaw**—Vegetation stabilized the dunes or sand sheet. Paleosols formed during episodes of increased precipitation. The dunes became unstable during dry periods. A species of *Populus* dated at 325 years BP in an adjacent unit suggests that the uppermost paleosol probably began forming roughly at that time. Paleosol development ceased in 1928 CE with the initiation of the Dust Bowl in the 1930s.
QUATERNARY (Pleistocene and Holocene)		Unit 5 (Qo5)	Alternating layers of light-brown and dark-brown, generally massive, very fine-grained sandy silt with a few pebbles and cobbles. The dark-colored bands are less well sorted and contain more organic material than the light-colored bands. Maximum thickness is 5 m (16 ft). Only mapped where it is at least 1 m (3.3 ft) thick. Accumulations > 1 m (3.3 ft) are restricted to flat-lying areas, such as terraces having slopes < 5°. Divided into four members based on color and stratigraphy (in ascending order): (1) pale-brown silt of the Mallard Island Member, (2) light-brown to very dark-brown silt of the Aggie Brown Member, (3) light-gray to pale-yellow silt of the Pick City Member, and (4) grayish-brown silt of the Riverdale Member.	**Features that Connect Geology and Archeology**—May contain cultural artifacts. **Paleontological Resources**—Common fossils are terrestrial gastropods and bone fragments of large mammals. This unit is bioturbated and contains rodent burrows and other burrows, possibly made by insects. **Aeolian Features**—Loess from pulverized rock fragments.	**Slope Movement**—Potential erosion of unit with increased precipitation and flooding due to global climate change. **Paleontological Resource Inventory and Monitoring**—Field-based, park-specific survey, inventory, and identification of fossils in museum collection should be considered. Combined archeological and paleontological projects will collect fossils with little disturbance to cultural material.	**The Past 12 Thousand Years (Cenozoic Era): Holocene Thaw**—Wind eroded silt from unstable floodplains and deposited it on the terraces and uplands as loess, some of which was subsequently reworked by slope wash and floodwaters. Dark-colored layers contain more humic material than light-colored layers and represent a cool, moist climate when vegetation increased and hillslopes stabilized. Lighter colored layers represent warm, dry climates when hillslopes became unstable due to sparse vegetation, and silt was removed from the unstable hillslopes by slope wash or wind.
	Coleharbor Formation	Unit 4 (Qc4)	Light- to grayish-brown layers of moderately well-sorted, fine-grained sand, silt, and clay deposited on the uplands. Often covered by postglacial marsh or slough sediment.	**Lake (Lacustrine) Features**—Contains fine laminations in some outcrops and disturbed and convoluted beds of silt and clay. No fossils.	Not mapped in the historic site.	**From 2 Million to 12 Thousand Years Ago (Cenozoic Era): Pleistocene Deep Freeze**—Deposited in glacial lakes or water-filled depressions on till by density currents.

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QUATERNARY (Pleistocene and Holocene)	Coleharbor Formation	Unit 3 (Qc3)	Light-gray, brown, and reddish-brown, poorly to moderately well-sorted silty sand, sand, and gravel composed of a heterogeneous mixture of igneous, metamorphic, and sedimentary rock fragments. Commonly found below terrace surfaces and is covered in many places with a thin layer of aeolian or alluvial sediment of the Oahe Formation. Thickness ranges from <1 m (3 ft) in cut terraces to >20 m (70 ft) in fill terraces.	**Fluvial Geomorphic Features**—High-angle, large-scale and trough cross-bedding resulting from glacial meltwater. Locally folded and faulted.	**Slope Movement**—Potential erosion with increased precipitation and flooding due to global climate change.	**From 2 Million to 12 Thousand Years Ago (Cenozoic Era): Pleistocene Deep Freeze**—Sediment was deposited in river beds (fluvial), meltwater channels (glaciofluvial), and along shorelines (beach). Part of **Qc3** was deposited on ice, causing faulting and folding of the sand and gravel after the ice melted. **Qc3** overlies Paleocene deposits and is interlayed with lake sediment of **Qc4** and till of **Qc2**.
		Unit 2 (Qc2)	Unsorted gray to light-olive-brown, pebbly clay-loam containing occasional cobbles and boulders. No distinct bedding. No fossils.	**Glacial Features**—Till (unsorted mixture of clay, silt, sand, gravel, and boulders).	None reported.	**From 2 Million to 12 Thousand Years Ago (Cenozoic Era): Pleistocene Deep Freeze**—Deposited as till. Various units have been differentiated along the bluffs of Lake Sakakawea.
PALEOGENE (Paleocene)	Sentinel Butte/ Bullion Creek Formations, undivided (Tsb)		All Paleocene deposits cropping out in the study area are included within the undivided Bullion Creek/Sentinel Butte Formations. These formations consist of poorly lithified yellow, brown, gray, and white sand, silt, silty clay, and clay, with some carbonaceous shale and lignite. **Tsb** is generally found along streams and hillslopes where erosion has removed younger material.	**Paleontological Resources**—Pollen, plant macrofossils (roots, stumps, petrified wood fruits, leaves), fungal spores, freshwater bivalves and gastropods, ostracodes, fish, giant salamanders, turtles, champsosaurs (aquatic reptiles), crocodilians, mammals, and invertebrate trace fossils have been found in the formations outside Knife River Indian Villages National Historic Site. **Fluvial Features**—Sand, silt, silty clay, and clay deposited in channel, overbank, and marsh environments.	**External Energy Issues: Coal Development**—Limited exposures of lignite are found in **Tsb** in the surrounding region. They do not present an issue for the historic site. **Paleontological Resource Inventory and Monitoring**—Field-based, park-specific survey, inventory, and identification of fossils in museum collection should be considered. Combined archeological and paleontological projects will collect fossils with little disturbance to cultural material.	**From 66 Million to 2 Million Years Ago (Cenozoic Era): Paleocene Swamps and Seas and Climate Change**—**Tsb** represents channel, overbank, and marsh deposits that formed in humid, subtropical environments similar to the climate of south Florida today.

Based on Reiten (1983).