

Geologic Resource Evaluation Scoping Summary

Fort Larned National Historic Site, Kansas

Prepared by Katie KellerLynn
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Geologic Resources Division
National Park Service
US Department of the Interior



The Geologic Resource Evaluation (GRE) Program provides each of 270 identified natural area National Park System units with a geologic scoping meeting and summary (this document), a digital geologic map, and a geologic resource evaluation report. The purpose of scoping is to identify geologic mapping coverage and needs, distinctive geologic processes and features, resource management issues, and monitoring and research needs. Geologic scoping meetings generate an evaluation of the adequacy of existing geologic maps for resource management, provide an opportunity to discuss park-specific geologic management issues, and if possible include a site visit with local experts.

On May 14, 2008, the National Park Service held a GRE scoping meeting for Fort Larned National Historic Site in conjunction with scoping for Tallgrass Prairie National Preserve. The meeting was held at the Prairie Coffee House in Cottonwood Falls, Kansas. Participants at the meeting included NPS staff from the historic site and the Geologic Resources Division, and cooperators from the Kansas Geological Survey and Colorado State University (see table 2). Along with Superintendents Stephen Miller (Tallgrass Prairie National Preserve), Kevin McMurry (Fort Larned National Historic Site) welcomed the group and provided background information about the national historic site. Bob Sawin (Kansas Geological Survey) highlighted the geology and some geologic and cultural resource connections at Fort Larned. Tim Connors (Geologic Resources Division) facilitated the assessment of map coverage, and Lisa Norby (Geologic Resources Division) led the discussion regarding geologic features, processes, and associated resource management issues.

Park and Geologic Setting

Named for Col. Benjamin F. Larned—paymaster general of the District of Kansas and the Territories at the outset of the Civil War—Fort Larned was established in 1859 on the vast prairie in western Kansas near the midpoint of the Santa Fe Trail. For many years Fort Larned was the only post between Fort Leavenworth, Kansas, and Fort Lyon, Colorado. Troops stationed here were instrumental in protecting mail coaches, freighters, and other traffic along the trail. As the site of an Indian agency, Fort Larned was also instrumental in maintaining friendly relations with Plains Indians. This area was the hunting grounds for the Comanche, Kiowa, Arapahos, and Southern Cheyenne; some Pawnee, Sioux, and Plains Apache also moved through the area. The “settlers’ complex” at the fort, including a hardware store, mess hall, bar, and residences, was a “melting pot” of culture.

Many historically famous people such as Buffalo Bill and Kit Carson were stationed at Fort Larned. During scoping Kevin McMurry referred to Fort Larned as “Custer’s First Stand.” Civil War hero George Armstrong Custer was posted in and around Fort Larned in the late 1860s. As part of the Hancock expedition in 1867, Custer encountered his first plains Indians and wild buffalo at the site (http://www.kdheks.gov/news/web_archives/1998/9501.htm).

After its reign as guardian of the northern portion of the Santa Fe Trail, the fort became private property and the center of a large ranching operation. Congressman Bob Dole was instrumental in the establishment of Fort Larned as a national historic site in 1968. Since that time, the National Park Service has restored the fort, including 12 historic buildings, to the 1860s period. Restoration returned structures to their original appearance and included period furnishings. Today the 120-ha (300-ac) national historic site is one of the nation’s best-preserved, mid-19th-century western military posts. Visitors have the opportunity to experience military life on the Santa Fe Trail during reenactments on summer holiday weekends (i.e., Memorial Day and Labor Day weekends) and selected weekends throughout the year (e.g., during “Candlelight Tour” and

“Christmas Past”). Cavalry personnel, cooks, and soldiers demonstrate “living history” for the interpretive period 1860–1869.

A separate unit preserves the historic ruts that a constant succession of freight caravans created from 1860 to 1878 along the Santa Fe Trail. The National Park Service is currently conducting a resource study of an “Indian village,” 42 km (26 mi) from the national historic site; this locale may also become part of the interpreted history of the Fort Larned area (Kevin McMurry, Fort Larned National Historic Site, communication during scoping, May 14, 2008).

Located 10 km (6 mi) west of Larned, Kansas, Fort Larned bridges the Smoky Hills and Arkansas (pronounced “Ar-Kansas” by Kansans) River physiographic regions. The fort is located on the floodplain of the Pawnee River, specifically a broad, flat alluvial plain consisting of Quaternary sand, gravel, silt, and clay. Lower Cretaceous Dakota Formation (shale and sandstone layers), Graneros Shale, and Greenhorn Limestone underlie pasture lands north of the fort. Located 7 km (4 mi) southwest of the fort unit, the detached Santa Fe Trail Ruts unit lies on gently rolling uplands of Dakota sandstone. Both units lie on the western edge of the Kansas’ mixed-grass prairie region.

Geologic Mapping Plan for Fort Larned National Historic Site

During scoping, Tim Connors (Geologic Resources Division) showed some of the main features of the GRE Program’s digital geologic maps, which reproduce all aspects of paper maps, including notes, legend, and cross sections, with the added benefit of being GIS compatible. The NPS GRE Geology-GIS Geodatabase Data Model incorporates the standards of digital map creation for the GRE Program and allows for rigorous quality control. Staff members digitize maps or convert digital data to the GRE digital geologic map model using ESRI ArcGIS software. Final digital geologic map products include data in geodatabase and shapefile format, layer files complete with feature symbology, FGDC-compliant metadata, a Windows HelpFile that captures ancillary map data, and a map document that displays the map and provides a tool to directly access the HelpFile. Final products are posted at <http://science.nature.nps.gov/nrddata/>. The data model is available at <http://science.nature.nps.gov/im/inventory/geology/GeologyGISDataModel.cfm>.

When possible, the GRE Program provides large scale (1:24,000) digital geologic map coverage for each unit’s area of interest, which is often composed of the 7.5-minute quadrangles that contain NPS-managed lands. Fort Larned National Historic Site has two 7.5-minute quadrangle of interest: Fort Larned and Garfield (fig. 1). Maps of this scale (and larger) are useful to resource managers because they capture most geologic features of interest and are spatially accurate within 12 m (40 ft). The process of selecting maps for management begins with the identification of existing geologic maps in the vicinity of the National Park System unit. Scoping session participants then discuss mapping needs and select appropriate source maps for the digital geologic data (table 1) or, if necessary, develop a plan to obtain new mapping.

During scoping, participants agreed that Bill Johnson’s (Kansas Geological Survey) 1:24,000-scale map of portions of Pawnee County, when completed, would be the best source for the final GRE product. This map will refine the preliminary map (GMAP 74981), which superseded McLaughlin (1949) (GMAP 74960). Johnson’s 1:24,000-scale maps are field maps (i.e., pencil lines on paper), which the Kansas Geological Survey will make available to the National Park Service and the public. However, the final Pawnee County map that the Kansas Geological Survey publishes will be at a scale of 1:50,000. During scoping, KGS geologists estimated that this project would be done in 2010. The GRE Program plans to get updates from the Kansas Geological Survey on when Johnson’s new map will be completed. If geologic data are needed in the interim, GRE staff has scans of GMAP 74960 (see table 1); however, GRE staff has no plans for digitizing this map at the present time.

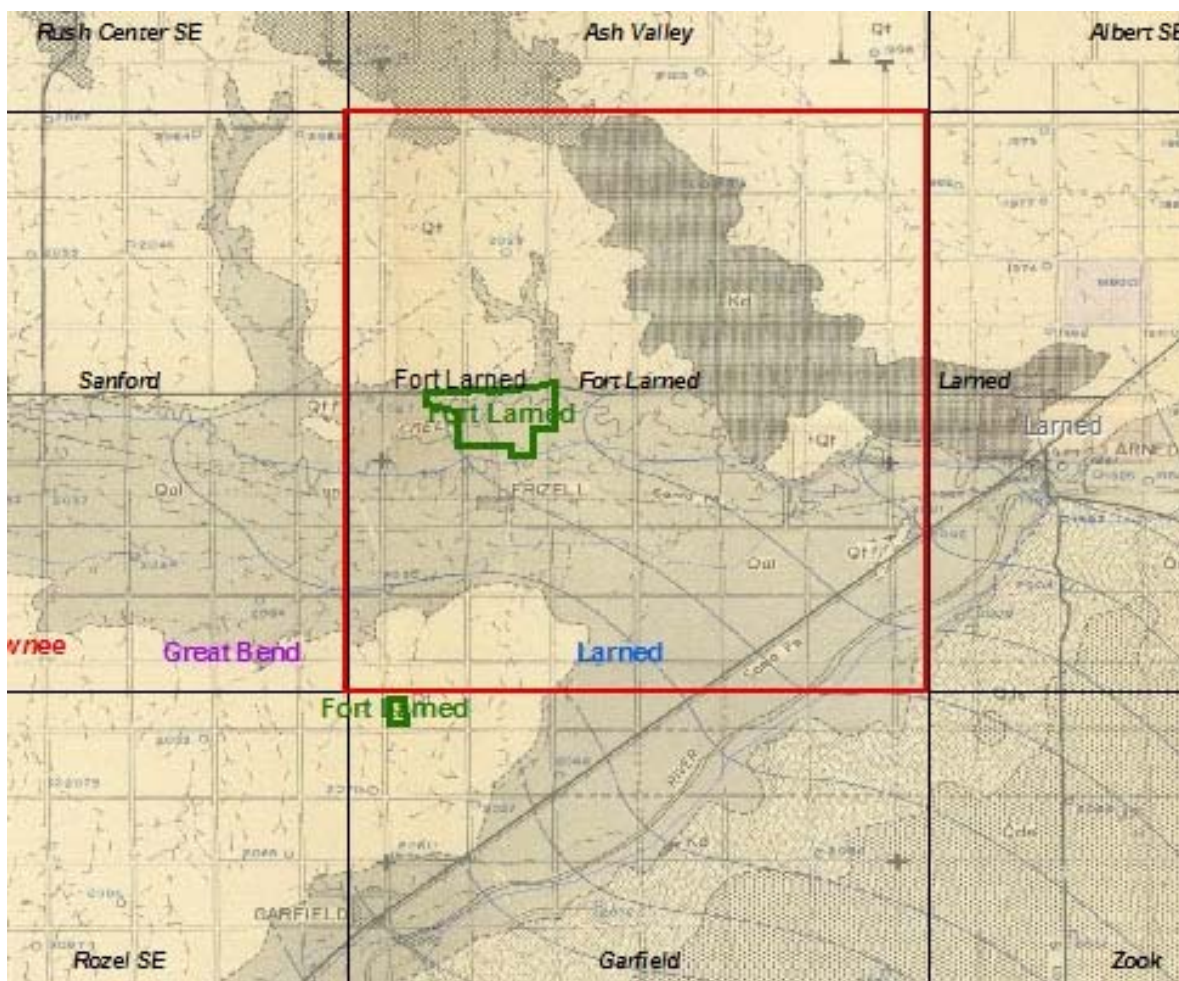


Figure 1. Area of Interest for Fort Larned National Historic Site. Two 7.5' quadrangles cover Fort Larned National Historic Site: Larned and Garfield. The 7.5' quadrangles are labeled in black on the figure. Fort Larned is situated on the Larned 30' x 60' sheet (labeled in blue) and the Great Bend 1° x 2° quadrangle (labeled in purple).

Table 1. Source Maps for Fort Larned National Historic Site

GMAP	Reference	Format	GRE appraisal
74981	Johnson, W. C. 2003. <i>Preliminary geologic field maps of portions of Pawnee County, Kansas</i> . Scale 1:24,000. Open-File Report 2003-24. Lawrence, KS: Kansas Geological Survey.	Paper	2008-0625: KGS geologists suggested using this publication, which supersedes earlier 1949 map (GMAP 74960). Publication is being redone (estimated completion date 2010); GRE need status updates from KGS.
74960	McLaughlin, T. G. 1949. <i>Map of Pawnee and Edwards counties, Kansas, showing geology and water-table contours, 1944–1945</i> . Scale 1:24,000. Plate 1. Bulletin 80. Lawrence, KS: Kansas Geological Survey.	Paper	2008-0508: Bob Sawin (KGS) recommends as best available large-scale map; not in NGMDB but on KGS Web site so downloaded; appears to show more detail than GMAP 74114 so may likely use
74114	Stoeser, D. B., G. N. Green, L. C. Morath, W. D. Heran, A. B. Wilson, D. W. Moore, and B. S. Van Gosen. 2005. <i>Preliminary integrated geologic map databases for the United States: Central states—Montana, Wyoming, Colorado, New Mexico, Kansas, Oklahoma, Texas, Missouri, Arkansas, and Louisiana</i> . Scale 1:100,000. Open-File Report OF-2005-1351. Reston, VA: U.S. Geological Survey.	Digital	2008-0508: GMAP 74960 shows more detail

Notes: GMAP numbers are identification codes for the GRE Program's database.

KGS = Kansas Geological Survey; Web site: <http://www.kgs.ku.edu/Publications/pubIndex.html>

NGMDB = USGS National Geological Map Database; Web site: http://ngmdb.usgs.gov/ngmdb/ngm_compsearch.html

Geologic Features, Processes, and Related Management Issues

The scoping session for Fort Larned National Historic Site provided the opportunity to develop a list of geologic features and processes, which will be further explained in the final GRE report. During the meeting, participants did not prioritize the issues, but discussion made it clear that “geological connections” to the natural and cultural landscape are significant for management, interpretation, and planning. These connections are discussed first, followed alphabetically by other features and processes.

Geologic Connections

Management of Fort Larned National Historic Site primarily considers cultural resources; however, information about natural resources can help achieve cultural goals. Fort Larned is situated at the confluence of the Pawnee and Arkansas rivers. Apparently access to water influenced the decision of where to locate the fort. The meandering river and related oxbow gave natural protection on three sides of the fort, leaving only the south side open, which is flat for miles, giving a good view of any approaching Indians (<http://www.nps.gov/fols>). Additionally, shallow groundwater in the alluvium provided an additional source of water. The location also provided access to building materials: Cretaceous bedrock such as Greenhorn Limestone and the Dakota Formation (shale and sandstone layers) are exposed in the uplands and outcrops in the vicinity of the fort.

Greenhorn Limestone has a distinctive layer known as “fencepost limestone,” which was used for that purpose and as building stone. Many window sills and thresholds at the fort are made of Greenhorn Limestone. Locally, Greenhorn Limestone is referred to as “shell rock” because of the clam fossils it contains (see “Paleontological Resources” section).

Another harder, denser (than Greenhorn) limestone was also used in thresholds at the fort. Described as “Kansas marble,” Bob Sawin (Kansas Geological Survey) speculates that this may be Funston Limestone, perhaps from near Fort Riley (formerly known as Fort Funston). If desired by park staff, Bob Sawin would be willing to try to confirm his speculation and positively identify this rock. Historian George Elmer has not found documentation of particular rock types, sources, or uses in historical records. Smaller blocks of this same stone (perhaps waste material from trimming and the thresholds) were used sporadically in the walls on the backsides of some of the buildings.

Both randomly shaped and cut blocks of Dakota sandstone are used in the buildings at Fort Larned. Walls are generally between 0.6 and 1.2 m (2 and 3 ft) thick. Apparently, older buildings (earlier in the building process) are composed of irregularly shaped blocks; later, blocks were dressed and fitted. Fort builders extracted Dakota sandstone from a quarry at Jenkins Hill, about 0.8 km (0.5 mi) from the national historic site. Park staff would like to preserve this quarry and the numerous historically significant signatures carved into the rocks there. Visitors and inhabitants of the fort also chipped their names and a date into the building stones at the fort. Park staff wants to improve signage to preserve these historic carvings and deter creation of new ones.

The red, iron-stained rock of Pawnee Rock is Dakota sandstone. Pawnee Rock was an important landmark along the Santa Fe Trail and the site of Indian battles. Although Pawnee Rock is historically significant and periodically considered for inclusion as part of the national historic site, park staff has little interest in taking on this obligation because of recent notoriety.

For restoration of the blockhouse in the 1980s, park staff established a quarry location next to the original military quarry. However, most of the repair materials are donated stones removed from old building foundations in the local area. The army maps list three quarries all east of the fort, between Larned and the fort. The largest is located 5 km (3 mi) to the east, near the present location of the Larned State Hospital.

Disturbed Lands

Disturbed lands are those parklands where the natural conditions and processes have been directly impacted by mining, oil and gas production, development (e.g., facilities, roads, dams, abandoned campgrounds, and user trails), agricultural practices (e.g., farming, grazing, timber harvest, and abandoned irrigation ditches), overuse, or inappropriate use. The Disturbed Lands Restoration Program, administered by the Geologic Resources Division, usually does not consider lands disturbed by natural phenomena (e.g., landslides, earthquakes, floods, hurricanes, tornadoes, and fires) for restoration unless influenced by human activities.

Modern mining is a management concern for Fort Larned. Northwest of the fort is an active quarry for fencepost limestone. Dakota sandstone is mined in Larned. Perhaps the greatest concern, however, is sand and gravel extraction in the Arkansas River south of Larned, which could also occur in the Pawnee River valley. All of these operations are outside of the site's boundary.

Another management issue is agricultural activity, which surrounds the national historic site. No farming or grazing has occurred at Fort Larned since 1968 and much of the landscape is restored prairie. In 2004 a biological inventory estimated that 76% of Fort Larned National Historic Site is formerly cropped grassland that has undergone continuing prairie restoration (Delisle and Busby 2004). Management of prairie includes controlled burns.

Energy Development

Fort Larned is surrounded by oil and gas wells, primarily to the north and west. The closest operation, which is probably abandoned, is 3 km (2 mi) north of the historic site. The closest active operation is the Fort Larned Field, 0.8 km (0.5 mi) north of Larned. Most wells were drilled in the 1970s at depths of approximately 610 m (2,000 ft).

Another concern for energy development is wind energy. Kansas already hosts wind farms, with proposed development 5 km (3 mi) north of the national historic site. The concern is primarily for the preservation of views. At present, no wind turbines exist in the fort's viewshed (Kevin McMurphy, Fort Larned National Historic Site, e-mail, August 4, 2008).

Eolian Features and Processes

Winds at Fort Larned are constant with only rare periods of calm. Not surprisingly then, loess (windblown dust) covers much of the area, including uplands and rolling farmlands (National Park Service 1979). Though not in the historic site itself, sand dunes are part of the landscape and are within Fort Larned's viewshed. Dunes occur in the Arkansas River corridor, primarily south and east of Larned. The source of eolian material is fluvially deposited Rocky Mountain sediments that have been reworked by the wind. Active dunes occur in pasturelands as close as 0.8 km (0.5 mi) but typically within 5 or 6 km (3 or 4 mi) of the river; these are younger and steeper than the dunes farther south, which are stabilized with vegetation or part of croplands.

Fluvial Features and Processes

Geologists characterize the landscape of Fort Larned National Historic Site as an alluvial valley with meandering streams. The fort was built on Pawnee River alluvium. As mentioned in the "Geologic Connections" section, an oxbow feature, probably with historical significance, is part of the landscape and influenced the positioning of the fort. This feature was shown in original drawings of the quarter master.

Fort Larned National Historic Site lies within the drainage area of the Pawnee River, which empties into the Arkansas River. Today as a result of irrigation practices, the streambeds are dry, and both the Pawnee and Arkansas rivers flow only after significant precipitation events. Flooding is rare, at least in the past decade. Irrigation and other agricultural practices have facilitated soil erosion on the Pawnee River, which in turn has

increased turbidity levels and eliminated much of the riparian vegetation. The overall deterioration of water quantity and quality has led to the decline of much of the resident aquatic life (Becker et al. 1986).

The Pawnee River watershed is very large so State agencies keep a close eye on it (Kevin McMurry, Fort Larned National Historic Site, e-mail, September 17, 2008). The Kansas Geological Survey monitors well water quality and quantity. The Kansas Department of Health and Environment monitors surface water quality. The Kansas Water Office monitors watershed issues. Licensed water system operators on the Fort Larned staff submit routine potable water samples to Kansas Department of Health and Environment for analysis. In 2000, the NPS Water Resources Division completed a basic water quality assessment of the historic site (National Park Service 2000).

Paleontological Resources

Paleontological Resource Inventory and Monitoring, Southern Plains Network (Koch and Santucci 2003) states that no discoveries of paleontological resources have been made within the boundaries of Fort Larned National Historic Site. However, Rolfe Mandel suggests that extinct Pleistocene fauna may occur within and below a 10,000-year-old paleosol within the historic site (Rolfe Mandel, University of Kansas and Kansas State University, e-mail, May 19, 2008). Mandel's dissertation study area included Fort Larned National Historic Site. He took deep cores on the property and as a result has interpreted the landscape and underlying valley fills (see Mandel 1994). According to correspondence on May 19, 2008, "Most of the property is on the T-1 terrace of the Pawnee River. There is a prominent buried paleosol about 3.5 m below the T-1 surface, and organic carbon from the upper 10 cm of the paleosol yielded a radiocarbon age of 10,100±130 years B.P. Hence, there is high potential for Paleoindian cultural deposits associated with the buried paleosol, and extinct Pleistocene fauna may occur within and below the paleosol."

Furthermore, though not in situ, the Greenhorn Limestone is fossiliferous. Hence, Cretaceous (145.5–65.5 million years ago) *Inoceramus* clams are onsite in the fort's building stone.

Seismicity

The risk of a large earthquake in the vicinity of Fort Larned is low. However, historic records document at least 25 earthquakes between 1867 and 1976, and seismographs recorded more than 100 between 1977 and 1989 in Kansas (Steeple and Brosius 1996). Most of these were microearthquakes and too small to be felt. The largest recorded earthquake in Kansas hit the Manhattan area in 1867. It toppled chimneys and cracked foundations and was felt as far away as Dubuque, Iowa (Steeple and Brosius 1996). Closer to the national historic site, a magnitude IV earthquake on the modified Mercalli scale (magnitude 3 or 3.5 on the Richter scale) occurred in Ford County in 1904. In 1929, a magnitude V earthquake on the modified Mercalli scale (magnitude 3.5 or 4 on the Richter scale) was felt in Geary County. The Kansas Geological Survey has published earthquake intensities for Kansas (DuBois and Wilson 1978); a historic earthquake map is posted at http://www.kgs.ku.edu/Publications/pic3/pic3_1.html.

Unique Geologic Resources

Perhaps the most distinctive resource related to geology at the national historic site is the wagon ruts along the Santa Fe Trail. During scoping, Kevin McMurry (Fort Larned National Historic Site) expressed concerns for preservation as a result of erosion from recently plowed fields and prairie dogs. Filling of the ruts with windblown dust is not a concern.

References

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Table 2. GRE Scoping Cooperators for Fort Larned National Historic Site

Name	Affiliation	Title	Phone	E-Mail
Rex Buchanan	Kansas Geological Survey	Deputy Director	785-864-2106	rex@kgs.ku.edu
Nick Callaghan	Kansas Geological Survey and Data Access and Support Center (DASC)	GIS Analyst	785-864-2132	nick@kgs.ku.edu
Tim Connors	Geologic Resources Division	Geologist	303-969-2093	tim_connors@nps.gov
Katie KellerLynn	Colorado State University	Geologist/Research Associate	801-608-7114	katiekellerlynn@msn.com
Rolfe Mandel	University of Kansas and Kansas Geological Survey	Associate Professor and Associate Scientist	785-864-2171	mandel@kgs.ku.edu
Kevin McMurtry	Fort Larned National Historic Site	Superintendent	620-285-6911	kevin_mcmurtry@nps.gov
Lisa Norby	Geologic Resources Division	Geologist	303-969-2318	lisa_norby@nps.gov
Bob Sawin	Kansas Geological Survey	Geologist	785-864-2099	bsawin@kgs.ku.edu