

Arkansas Post National Memorial

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 Service units with a geologic scoping meeting, a digital geologic map, and a geologic resource evaluation report. Geologic scoping meetings generate an evaluation of the adequacy of existing geologic maps for resource management, provide an opportunity for discussion of park-specific geologic management issues and, if possible, include a site visit with local experts. The purpose of these meetings is to identify geologic mapping coverage and needs, distinctive geologic processes and features, resource management issues, and potential monitoring and research needs. Outcomes of this scoping process are a scoping summary (this report), a digital geologic map, and a geologic resource evaluation report.

The National Park Service held a GRE scoping meeting for Arkansas Post National Memorial on April 23, 2007 at Hot Springs National Park in Arkansas. Tim Connors (NPS-GRD) facilitated the discussion of map coverage and Bruce Heise (NPS-GRD) led the discussion regarding geologic processes and features at the memorial. Participants at the meeting included NPS staff from the park, Geologic Resources Division, Arkansas Geological Survey, U.S. Geological Survey as well as cooperators from Colorado State University (see table 1). This scoping summary highlights the GRE scoping meeting for Arkansas Post National Memorial including the geologic setting, the plan for providing a digital geologic map, a prioritized list of geologic resource management issues, a description of significant geologic features and processes, lists of recommendations and action items, and a record of meeting participants.

Park and Geologic Setting

Arkansas Post National Memorial, established on July 6, 1960, commemorates several historic events integral to the history of the lower Mississippi River Valley including the first semi-permanent European settlement in 1686, a Revolutionary War skirmish in 1783, the first territorial capital of Arkansas from 1819 to 1821, and an American Civil War battle in 1863. Arkansas Post National Memorial covers 758.51 acres (Federal: 564.37 acres) in southeastern Arkansas near the confluence of the Arkansas, White, and Mississippi Rivers. The memorial sits 14 km (9 miles) south of Gillett and 27 km (17 miles) northeast of Dumas, AR. A second unit, the Menard Mound Unit (ca. 1997, ~350 acres), located ~8 km (5 miles) southeast of the main unit, preserves ancient Native American artifacts. The main unit (Memorial Unit) of the memorial sits entirely within the 7.5-minute Arkansas Post quadrangle whereas the Osotuooy Unit (aka. Menard Mound unit) is within the Watson 7.5-minute quadrangle. These quadrangles are part of the boundary area between the Western Gulf Coastal Plain and the Mississippi River Alluvial Plain physiographic provinces. The geology in this area consists of deep, flat-lying fluvial sediments of Quaternary age. Geologic units include alluvium, overbank, and terrace deposits. Gentle swells, oxbow lakes, floodplains, and sloping bluffs characterize the landscape at the memorial.

Geologic Mapping for Arkansas Post National Memorial

During the scoping meeting Tim Connors (NPS-GRD) showed some of the main features of the GRE Programs digital geologic maps, which reproduce all aspects of paper maps, including notes, the legend, and cross sections, with the added benefit of GIS compatibility. The NPS GRE Geology-GIS Geodatabase Data Model incorporates the standards of digital map creation set for the GRE Program. Staff members digitize maps or convert digital data to the GRE digital geologic map model using ESRI ArcMap software. Final digital geologic map products include data in geodatabase, shapefile, and coverage format, layer files, FGDC-compliant metadata, and a Windows HelpFile that captures ancillary map data. Completed digital maps are available from the NPS Data Store at <http://science.nature.nps.gov/nrdata/>.

When possible, the GRE program provides large scale (1:24,000) digital geologic map coverage for each park's area of interest, usually composed of the 7.5-minute quadrangles that contain park lands (figure 1). Maps of this scale (and larger) are useful to resource management because they capture most geologic features of interest and are positionally accurate within 40 feet. The process of selecting maps for management use begins with the identification of existing geologic maps and mapping needs in vicinity of the park. Scoping session participants then select appropriate source maps for the digital geologic data to be derived by GRE staff as well as determine areas in need of further mapping or refinement. Table 2 (at the end of this document) lists the source maps chosen for Arkansas Post National Memorial as well as any further action required to make these maps appropriate for inclusion.

ARPO consists of the Memorial Unit (Arkansas Post 7.5'; Gillett 15') and the Osotouy Unit (Watson 7.5' and Red Fork 15'). Large-scale Geologic map coverage is desired for the entire 7.5' quadrangles that each unit resides on. There are a few geologic maps that cover the ARPO area, but none at a desired large-scale of 1:24,000 and in GIS format. The existing maps are as follows:

- Gillett 15' (containing the Arkansas Post 7.5'): GMAP 74677 (Haley, B.R., 2007, Reconnaissance Geologic Map of the Gillett 15' Quadrangle, Arkansas, Arkansas Geological Commission, unpublished 15' field sheet, 1:62,500 scale)
- Red Fork 15' (containing the Watson 7.5'): GMAP 74678 (Haley, B.R., 2007, Reconnaissance Geologic Map of the Red Fork 15' Quadrangle, Arkansas, Arkansas Geological Commission, unpublished 15' field sheet, 1:62,500 scale)
- Arkansas state geologic map: GMAP 74114 (Stoeser, D.B.;Green, G.N.;Morath, L.C.;Heran, W.D.;Wilson, A.B.;Moore, D.W.;Van Gosen, B.S., 2005, Preliminary integrated geologic map databases for the United States: central states -- Montana, Wyoming, Colorado, New Mexico, Kansas, Oklahoma, Texas, Missouri, Arkansas, and Louisiana, U.S. Geological Survey, Open-File Report OF-2005-1351, 1:100,000 scale)
- Little Rock-Helena 1x2 Quaternary map: GMAP 74639 (Saucier, R.T., 1994, Quaternary Deposits of the Helena-Little Rock 1x2 sheets IN Geomorphology and Quaternary geologic history of the lower Mississippi Valley (Plate 7 of 28), , Volume II, plate 7 / 28, 1:250,000 scale)

As a result of the GRE scoping session, the Arkansas Geological Survey (AGS) is proposing to extract both the Arkansas Post 7.5' and Watson 7.5' quadrangles from the smaller-scale unpublished 15' sheets as digital GIS products to supply to the NPS. These would also be compared/contrasted/merged with the existing works by R.T. Saucier on the "Quaternary Deposits of the Helena-Little Rock 1x2 sheet" (GMAP 74639) and "Configuration of Suballuvial Surface of the Helena-Little Rock 1x2 sheet" (GMAP 74652), as well as the existing state geologic map (GMAP 74114) to produce the best detailed map for the ARPO area of interest. The AGS will deliver this map to the NPS in a digital-GIS based format as well; GRE will then subsequently "convert" the data to the NPS geologic model.

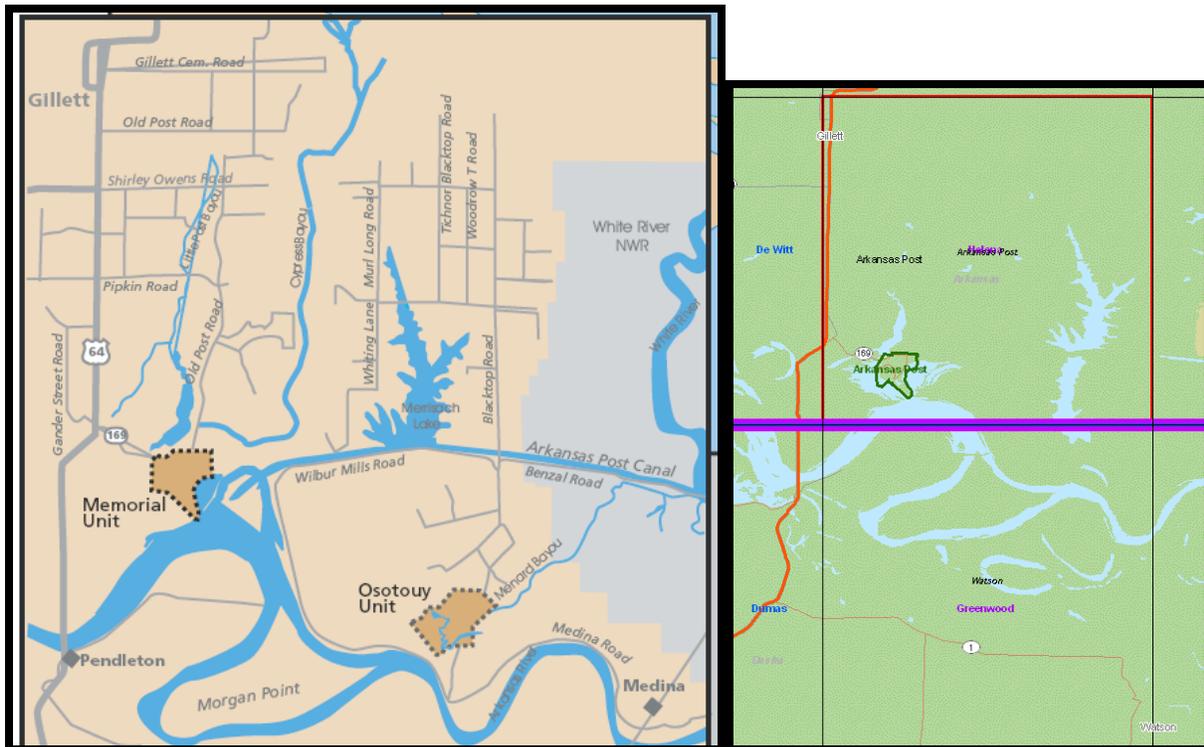


Figure 1. LEFT: Map of ARPO units (7.5' quadrangle boundaries not shown; hoping to acquire Menard Mounds unit shapefile from ARPO Leo Acosta)

Table 2 lists the source maps chosen for Arkansas Post National Memorial, in addition to a unique "GMAP ID" number assigned to each map by GRE staff for data management purposes, map scale, and action items.

Additional items of interest pertaining to geologic mapping from the scoping

The memorial has some interest in determining the timing of the different levels of terrace deposits (using extensive trenching), seismic hazard assessment, and mass wasting vulnerability maps.

Geologic Resource Management Issues

The scoping session for Arkansas Post National Memorial 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 prioritized the most significant geologic issues as follows:

- (1) Fluvial issues
- (2) Mass wasting
- (3) Surrounding disturbances
- (4) Seismic potential
- (5) Paleontological resources

Fluvial Issues

The primary natural resource at Arkansas Post National Memorial is the Arkansas River. Fluvial issues at Arkansas Post National Memorial include flooding along the Arkansas River and channel morphology changes. The park contains floodplain, terrace, and alluvial deposits associated with fluvial processes. A series of levees, locks, and dams constructed by the Army Corps of Engineers control the river flow in the memorial area. The corps constructed these features to provide a reliable navigation route for commerce to Oklahoma and to maintain the current channel.

Additionally, the overall level of the river is artificially higher than historic levels to increase navigability. By raising the river level, low-lying surrounding areas were inundated including Post bayou and Post bend. The engineered structures attempt to provide flood control with limited success especially during peak flows following seasonal storm events.

Dredging is a significant concern for the memorial. Dredging for sand and gravel resources serves to deepen local channels and maintain current navigation routes. Impacts of local dredging along the Arkansas and White Rivers on the natural resources at the monument are poorly understood. Dredging will affect the sediment budget of the area's waterways in addition to channel morphology.

Lacustrine resources at the memorial include oxbow lakes associated with the meandering river pattern as well as a 9-acre man-made lake (Post Lake). At the Menard Mounds unit, there is another lacustrine feature, Lake Dumont, in addition to a large, traversing bayou that also serves as a drainage for local agriculture. There may be a threat to the quality of the mound unit's wetland areas from local land use activities.

The Arkansas River and the high bluffs above it played significant roles in the historical development of the memorial. From Native Americans to European settlers, people used the local waterways for transportation and as trade routes. The high bluffs above the river served as strategic high ground in the early settlement of the lower Mississippi Valley and during battle skirmishes. The park is interested in determining the old river course and wants to understand the shoreline evolution to interpret the area's history for visitors. Knowledge of the historic river course at the Menard Mound unit may focus archaeological inventory and study efforts.

Mass Wasting

There is potential for slope creep and mass wasting at the memorial. The geologic units underlying the floodplains and bluffs below the memorial contain sands, muds, and clays. These fluvial

sediments are entirely unconsolidated and easily eroded. These units pose a problem when exposed along even moderate slopes, terrace scarps, and natural levees and/or when undercut. The 6-m-high (20-ft) bluff and cutbank between the memorial and the Arkansas River is eroding and sloughing into the river. Cultural resources are lost in this process. Cultural features at the Menard Mound unit are susceptible to degradation from erosion. Some sites have already washed away at the main unit despite shoreline anchoring efforts. The lock and dam system of the Arkansas River mitigates some of the potential mass wasting hazard and rip rap structures are present on all shorelines of the main memorial unit.

Surrounding Disturbances

Both units at Arkansas Post National Memorial were clearcut of original forests during early development. The removal of stabilizing vegetation enhances erosion and increases sediment load in local streams and rivers. At present, old agricultural units dot the landscape at the Menard Mound unit and park resource managers are deciding whether to restore the original forest or maintain the open areas. In this same unit, a local road used by farmers as part of a land grant agreement may impact cultural resources.

Local economic resources include sand and gravel dredged from the Arkansas and White Rivers. This dredging impacts the sediment budget and channel morphology. Additional environmental concerns stem from regional coal bed methane and natural gas prospecting operations. These are focused south of the memorial in a basin centered on Desha County. Prospecting attempts may impact the memorial's viewshed.

Seismic Potential

Though far from any tectonic plate boundary, the earthquake of 1812 along the New Madrid fault, some 160 km (100+ miles) away from Arkansas Post National Memorial, was the largest ever recorded ($M \sim 8.0$) in the continental United States. Geologists estimate that this earthquake was strongly felt over 130,000 sq. km (50,000 sq. miles). Effects from this event included sand blows (patches of sand erupted onto the ground when seismic waves pass through wet, loose sand), new lakes forming, and a change in the course of the Mississippi River. Geologists from the University of Memphis and the University of Arkansas are now trenching in the general vicinity of the monument to determine whether a local north-south trending seismic zone is present. In 1976, some magnitude 4-5 earthquakes occurred near Marked Tree, Arkansas. A recent seismic event ($M=2.2$) occurred near Earle, Arkansas some 60 km (40 miles) from the memorial. A sizable seismic event in the memorial area could have significant impacts on the park infrastructure as well as the course of the Arkansas and White Rivers.

Paleontological Resources

There is potential for significant fossil localities at the memorial. Exposed along the White River near Crockett's Bluff are Pleistocene-age mammal fossil remains. Similar remains may exist at Arkansas Post National Memorial. These could only be exhumed at low water levels due to the abundance of younger sediments atop the Pleistocene-age units. Knowledge of the extent of the paleontological resources in the area may also influence future expansion efforts for the memorial.

Features and Processes

Arkansas Post National Memorial sits at the end of the Grand Prairie area. The local rivers were and continue to be important trade and transportation routes. This area is a local topographic high making this spot strategic during indigenous and later military settlement. Fluvial features including rivers, streams, oxbow lakes, meanders, cutbanks, and bars dominate the landscape at Arkansas Post National Memorial. Fluvial processes of riverine flow, erosion, sediment transport, and channel migration as well as anthropogenic efforts to control these processes continue to sculpt the memorial landscape. These features and processes played key roles in the historic events that the memorial commemorates. Cultural resources are at risk to damage from flood and erosion processes.

Recommendations

- (1) Perform paleochannel studies and river terrace age dating to determine past river courses and better understand the evolution of the shoreline.
- (2) Cooperate with the Arkansas Geological Survey to obtain refined geologic maps of the memorial area
- (3) Perform a comprehensive paleontological inventory of the historic site, especially focusing on lowermost geologic units of Pleistocene age.
- (4) After establishing baseline conditions (water quality, stream channel morphology, etc.), monitor changes to the watershed at the Menard Mount unit to indicate any influences from surrounding development.
- (5) Incorporate historical land use evolution and delineation studies and the effects of geology on the site's history into interpretive programs.
- (6) Obtain results from Arkansas geochemical study to determine baseline levels of heavy metals from soils, sediments, and stream sediments at depths up to 46 cm (18 inches) in the memorial area.

Action Items

- (1) GRE needs to contact Pete Biggam on soils inventory mapping status for the memorial.
- (2) GRE will produce digital geologic map for the site (see above geologic mapping section).
- (3) GRE will collaborate with the Arkansas Geological Survey to determine the best way to refine the geologic map coverage for the memorial area.
- (3) Site may be interested in determining the shoreline evolution of the Arkansas River.
- (4) GRE report author needs to obtain documentation from the Army Corps of Engineers regarding the lock and dam system construction and maintenance for the Arkansas River.
- (5) GRD will contact Vince Santucci (NPS-GWMP) regarding a possible paleontological inventory for the memorial.
- (6) GRE report writer should obtain land grant agreement documentation for local road in Menard Unit.
- (7) GRE report writer will contact Andrew Grose (Reston, VA) regarding soil studies for eastern Arkansas.

References

www.nps.gov/arpo (accessed April 30, 2007)

www.topozone.com (accessed May 1, 2007)

www.usace.army.mil/ (accessed May 1, 2007)

Summerfield, M.A. 1991. *Global Geomorphology*. Longman Scientific and Technical: Essex, England.

Table 1. Scoping Meeting Participants

Name	Affiliation	Position	Phone	E-Mail
Acosta, Leo	NPS-ARPO	Resource Management	870-548-2210	leo_acosta@nps.gov
Chandler, Angela	Arkansas Geological Survey	Geologist	501-683-0114	angela.chandler@arkansas.gov
Connors, Tim	NPS – GRD	Geologist	303-969-2093	Tim_Connors@nps.gov
Greco, Deanna	NPS – GRD	Geologist	303-969-2351	Deanna_greco@nps.gov
Hanson, Doug	Arkansas Geological Survey	Geologist	501-683-0115	doug.hanson@arkansas.gov
Hays, Philip D.	US Geological Survey	Geologist	479-575-7343	pdhays@usgs.gov
Heise, Bruce	NPS – GRD	Geologist	303-969-2017	Bruce_Heise@nps.gov
Hudson, Mark	US Geological Survey	Geologist	303-236-7446	mHUDSON@usgs.gov
Kresse, Tim	US Geological Survey	Hydrologist	501-228-3616	tkresse@usgs.gov
Prior, Bill	Arkansas Geological Survey	Geologist	501-683-0117	Bill.prior@arkansas.gov
Rudd, Steve	NPS-HOSP	Geologist	501-620-6733	Stephen_rudd@nps.gov
Thornberry-Ehrlich, Trista	Colorado State University	Geologist-Report Writer	757-416-5928	tthorn@cnr.colostate.edu
White, Bekki	Arkansas Geological Survey	State Geologist	501-296-1880	bekki.white@arkansas.gov

Table 2. GRE Mapping Plan for Arkansas Post National Memorial

¹GMAP numbers are unique identification codes used in the GRE database.

GMAP ID	REFERENCE	appraisal	GRE action required	URL	scale
74677	Haley, B.R., 2007, Reconnaissance Geologic Map of the Gillett 15' Quadrangle, Arkansas, Arkansas Geological Commission, unpublished 15' field sheet, 1:62500 scale	2007-0724: AR GS will extract & digitize out the Arkansas Post 7.5' for ARPO as part of GRE contract and will improve/verify/edge-match with Watson 7.5' (from Red Fork 15'). GRE received scan from AGC. Covers all of ARPO 7.5' qoi (Arkansas Post 7.5') and 3 other quads (Tichnor, One Horse Store, Gillett 7.5's). Will likely just crop to Arkansas Post 7.5' for GRE purposes. Need full citation info from AGC (author, date). This will supercede the AR state geologic map in this area (GMAP 74114) and should also supercede or enhance Saucier's maps (GMAPs 74639 & 74652). GRE will then obtain from AR GS and convert to NPS geologic model	conversion	E:\gis-nps_by_gmap_id\74677_gillett_AR_7.5'	62500
74678	Haley, B.R., 2007, Reconnaissance Geologic Map of the Red Fork 15' Quadrangle, Arkansas, Arkansas Geological Commission, unpublished 15' quadrangle, 1:62500 scale	2007-0724: Red Fork 15' contains Watson 7.5', which is of interest for ARPO for Menard Mounds (Osotouy unit) identified during GRE scoping. GRE received scan from AGC; south of ARPO qoi and it covers (4) 7.5' quadrangles (Watson, Dumas, Kelso, Winchester 7.5's). AR GS will extract Watson 7.5' and digitize and deliver to NPS as per agreement. Need full citation info from AGC (author, date). This should then supercede AR state geologic map (GMAP 74114) and Saucier plates for Helena 1x2 in ARPO qoi's (GMAPs 74639 & 74652). GRE will then obtain from AR GS and convert to NPS geologic model	conversion	E:\gis-nps_by_gmap_id\74678_red_fork_AR_7.5'	62500
74114	Stoeser, D.B.;Green, G.N.;Morath, L.C.;Heran, W.D.;Wilson, A.B.;Moore, D.W.;Van Gosen, B.S., 2005, Preliminary integrated geologic map databases for the United States: central states -- Montana, Wyoming, Colorado, New Mexico, Kansas, Oklahoma, Texas, Missouri, Arkansas, and Louisiana, U.S. Geological Survey, Open-File Report OF-2005-1351, 1:100000 scale	2007-0724: for ARPO, the Arkansas state geologic map shows at least 3 units broken out for Arkansas Post 7.5'; linework looks similar to that shown on GMAP 74677 (Gillett 15') and GMAPs 74639 & 74652 (Saucier's Helena 1x2; Quaternary), but is distinct from it; need to ask at scoping the sources for this map. In absence of any better digital data, GRE could use this, but will try to obtain better large-scale dedicated 7.5' mapping for ARPO	conversion	http://pubs.usgs.gov/of/2005/1351/	100000

GMAP ID	REFERENCE	appraisal	GRE action required	URL	scale
74639	Saucier, R.T., 1994, Quaternary Deposits of the Helena-Little Rock 1x2 sheets IN Geomorphology and Quaternary geologic history of the lower Mississippi Valley (Plate 7 of 28), , Volume II, plate 7 / 28, 1:250000 scale	2007-0724: quick perusal looks very similar to GMAP 74114 (Arkansas state geology) in ARPO area; during scoping it was mentioned this was likely the source for the compiled AR state map, which makes this credible source to use in absence of larger-scale dedicated data in ARPO area. However, GRE has proposals to get better, detailed mapping for Arkansas Post and Watson 7.5' quadrangles, so this will likely become superceded by that project. Not known to be digital, but GRE told that USACE may have digitized it; needs follow-up by GRE		E:\gis-nps_by_gmap_id\74639_MS_valley_07_helena-little_rock_1x2_Quaternary	250000
74652	Saucier, R.T., 1994, Configuration of Suballuvial Surface of the Helena-Little Rock 1x2 sheets IN Geomorphology and Quaternary geologic history of the lower Mississippi Valley (Plate 20 of 28), , Volume II, plate 20 / 28, 1:250000 scale	2007-0724: doesn't show much in ARPO area; of limited utility to resource management as few outcrops in ARPO area. Not known to be digital but USACE may have it; needs followed up on. Will likely become superceded by newer AR GS activities in ARPO area		E:\gis-nps_by_gmap_id\74652_MS_valley_20_helena-little_rock_1x2_suballuvial	250000