GEOMORPHOLOGICAL RECONNAISSANCE OF THE LAKE DARDANELLE AND OZARK LAKE PROJECT AREAS, ARKANSAS RIVER, ARKANSAS

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PREFACE

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The investigation was performed during the period 3 June 1985 to 15 December 1985 by Dr. Lawson M. Smith, Chief, Regional Studies Unit (RSU), Engineering Geology Applications Group (EGAG), Engineering Geology and Rock Mechanics Division (EGRMD), Geotechnical Laboratory (GL), US Army Engineer Waterways Experiment Station (WES), Vicksburg, MS. Valuable assistance in the field and in the office was provided by CPT Eric G. Woerner, Geologist, RSU. Mr. Bennie Washington drafted the figures and plates contained in the report. Mr. Robert Dunn, Environmental Resources Section, Planning Division, US Army Engineer District, Little Rock, and Dr. W. J. Bennett, Archeological Assessments Inc., Nashville, AR, both provided valuable data and illuminating discussions in the field.

The investigation was performed under the direct supervision of Mr. John H. Shamburger, Chief, EGAG, and the general supervision of Dr. Don Banks, Chief, EGRMD, and Dr. William F. Marcuson, Chief, GL. The Commander and Director of the WES during the conduct of the investigation was COL Robert C. Lee, CE. The Technical Director was Dr. Robert W. Whalin.

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PART I: INTRODUCTION

Background

1. A geomorphological reconnaissance of the Lake Dardanelle and Ozark Lake project areas on the Arkansas River, Arkansas, was conducted by the US Army Engineer Waterways Experiment Station (WES) at the request of the US Army Engineer District, Little Rock. The purpose of the investigation was to provide a geomorphological foundation for use in the planning and execution of subsequent cultural resource surveys in the Lake Dardanelle and Ozark Lake project areas. Specific objectives of the study were: (1) delineation of the major geomorphic features and processes of the area; (2) reconstruction, to the extent possible, of the geomorphological evolution of the area; and (3) estimation of the occurrence and location of buried archeological sites in the project area. Due to a substantial limitation in time and funds available for the project, only a reconnaissance level study was conducted. However, results of this study should be of significant value in the subsequent planning and execution of cultural resource investigations in the Lake Dardanelle and Ozark Lake project areas.

Study Areas

2. The Lake Dardanelle project areas, for the purposes of this investigation, includes the area of Lake Dardanelle and adjacent lands to an elevation of 360 feet mean sea level (msl), as indicated on 1:24,000 scale US Geological Survey (USGS) topographic quadrangles of the area. Lake Dardanelle extends upstream from Dardanelle Lock and Dam (river mile 205.5) near Dardanelle, AR, to Ozark Lock and Dam (river mile 256.8) at Ozark, AR, a distance of 51.3 river miles. Lake Dardanelle covers a surface area of 34,300 acres at a conservation pool level of 338 ft msl in parts of Franklin, Johnson, Yell, Pope, and Logan counties. An additional approximate 10,000 acres of adjacent land is included in the study area. At Dardanelle

Lock and Dam, the total drainage area of the Arkansas River and its tributaries is 153,703 square miles.

3. The Ozark Lake project area includes Ozark Lake and adjacent lands to an elevation of 390 feet msl as indicated on 1:24,000 scale USGS topographic quadrangles. Ozark Lake extends upstream from Ozark-Jeta Taylor Lock and Dam to Lock and Dam 13 (river mile 292.8), a distance of 16.1 river miles. Ozark Lake covers a surface area of 10,600 acres at a conservation pool level of 370 ft msl in parts of Franklin, Crawford, and Sebastian Counties. Approximately 18,000 addition acres of adjacent land is included in the project area.

4. Situated in the Arkansas Valley District of the Ouachita Mountains physiographic province, the study areas consist of parts of the alluvial valley of the Arkansas River and the lower valleys of its principle tributaries in the region, including Sixmile Creek, Horsehead Creek, Cane Creek, Spadra Creek, Big Shoal Creek, Big Piney Creek, Delaware Creek, and Illinois Bayou in Lake Dardanelle and White Oak Creek, Little Mulberry Creek, Mulberry River, Frog Bayou, and Big Creek in Ozark Lake (Figure 1). In the study areas, the Arkansas River flows in a general east southeast direction through a relatively narrow valley eroded into Pennsylvanian sandstone and shale formations. The width of the Arkansas River alluvial valley varies from less than one mile at Dardanelle Lock and Dam and Ozark-Jeta Taylor Lock and Dam to approximately 5 miles near Coal Hill, AR, and is strongly controlled by the highly complex geologic structure and lithologic variability of the area. Landforms of the area are profoundly influenced by the occurrence of a number of east-west trending anticlines and synclines (whose local relief may be as much as 1600 feet), numerous faults, and a substantial variability in the erosional resistance of the geologic formations of the area. In the vicinity of Coal Hill and Mulberry, the Arkansas River has been successful in widening its valley due to the occurrence of less resistant geologic strata and a general lack of large-scale structural constrictions such as anticlinal ridges. The effect of local lithology and structure on valley development is also evident in the tributary valleys, such as Big Piney, Big Shoal and White Oak Creeks, whose valley widths vary considerably due to local geologic structure and lithology.

PART II: METHODS OF GEOMORPHOLOGICAL INVESTIGATION

Geomorphological Data

5. Data used in the geomorphological investigation of the Lake Dardanelle and Ozark Lake project areas were obtained from previously published reports, maps, and charts, and field observations. Several published geologic studies of the area contained valuable information used in the compilation of the geomorphological maps (Haley, 1961, 1968; Haley and Hendricks, 1971; Merewether, 1971; Merewether and Haley, 1960, 1969). Geologic maps at the scale of 1:24,000 contained in these reports were used to map the distribution of certain geomorphic features, including rock outcrops and Arkansas River terraces in some locations. Soil maps contained in county soil bulletins were also examined for information useful in the discrimination of various geomorphic features (Soil Conservation Service, 1971, 1977, 1980, 1981; Deeter, 1915). Primary definition and delineation of geomorphic features was achieved through the interpretation of black and white aerial photography taken in 1940, 1958, 1967, and 1984. Topographic data were obtained from eighteen 1:24,000 scale USGS topographic quadrangles of the area, a recent (1984) 1:100,000 scale USGS metric topographic map (Russellville, AR) and two early USGS 1:125,000 scale topographic quadrangles (Fort Smith, Magazine Mountain and Dardanelle, published in 1890).

Geomorphological Mapping Procedure

6. Geomorphic features of the project areas were defined using the geologic, pedologic, topographic, and photographic data in combination and delineated on the seventeen 1:24,000 quadrangles. Due to the limited amount of time available for geomorphic mapping and the quality of the aerial photography, only the major landforms were delineated. For example, Arkansas River point bars were identified, but the ridges and swales which comprise the point bar were not. In the tributary valleys, with the exception of Illinois Bayou Valley, floodplains were mapped as undifferentiated since the aerial photography was not of sufficient quality to allow the identification of all of the fluvial landforms which occur in the tributary valleys. However, abandoned

tributary channels and courses, where visible, were identified in the tributary valleys.

7. Upon completion of the preliminary geomorphic maps of the study areas, field reconnaissance of the Lake Dardanelle and Ozark Lake areas was conducted. The objectives of the field reconnaissance were (1) to check the accuracy of the geomorphic maps; (2) to identify small scale features which were to visible on the topographic maps or aerial photographs, such as low terraces on the tributary floodplains; (3) to examine the shallow stratigraphy of locations having a potential for buried archeological sites; and (4) to examine the pedogenic horizons of area landforms to estimate their general age and geomorphic stability. Field reconnaissance of the two areas was limited to sites accessible by 4-wheel drive vehicle or by boat due to the short period of time available for the reconnaissance and the large areas to be covered. The existence of numerous roads and boat docks in the Lake Dardanelle study area enabled the reconnaissance effort to cover much of the terrestrial area by vehicle and all of the major tributaries and a significant part of the river by boat. At several sites in the Lake Dardanelle area, shallow subsurface samples were obtained with a hydraulic soil sampling machine which were useful in identifying geomorphic processes and potential areas of buried sites.

8. The field reconnaissance of Ozark Lake was hampered by flood conditions on the major tributaries and high flow on the Arkansas River, making boating unsafe. Consequently, no reconnaissance by boat was conducted in the Ozark Lake area. Many local roads were also blocked by floodwater, substantially limiting access to the project area. However, several important field observations were still possible in the Ozark Lake area, and in some instances, floodwaters accentuated landform boundaries.

9. Field observations made in the study areas were used to modify the geomorphic maps where necessary. Data derived during the field reconnaissance were then combined with existing geologic, soils, and topographic information (including the geomorphic maps of this study) and archeological data to develop the framework of a geomorphological chronology of the study areas and to estimate the potential location of buried cultural resources. On Plates 1-7, the major geomorphic features of the Lake Dardanelle and Ozark Lake study areas are shown on a series of geomorphic maps (Figure 2). In the

following paragraphs, the origin and characteristics of the geomorphic features identified on the geomorphic maps are discussed.

Description of Geomorphic Features

10. Sixteen types of geomorphic features were mapped in the study area. These geomorphic features are grouped as being formed by the Arkansas River or by tributary streams. Arkansas River features have an "A" prefix in the map symbol (i.e. "ACo" for an abandoned Arkansas River course), tributary features have a "T" prefix in the map symbol (i.e. "TCo" for an abandoned tributary course). Fluvial geomorphic features formed by the Arkansas River and the larger tributaries are similar in origin, however dissimilar in scale. For this reason similar types of geomorphic features, such as Arkansas River point bars and tributary point bars are discussed under a single heading.

11. Point bar (APb, TP). Streams migrate laterally to satisfy an equilibrium relationship between its various flow conditions, type and amount of sediment load, bed and bank materials, and the sinuosity of its channel. Channel migration occurs as the outside bank, or "cut bank" is eroded and a lateral sandbar is deposited against the inside bank. As migration progresses, the inside of the meander becomes a series of ridges (relict lateral bars) and swales (resulting troughs between the ridges). Collectively the series of ridges and swales comprise the point bar landform that frequently dominates the landscape of an alluvial valley formed by an actively meandering stream. Point bar deposits are as thick as the total depth of the channel that formed them and fine upward texturally from the maximum size of the bedload material through sand, silt, and often clay (at the top of the deposit). The sand and gravel substratum is deposited through lateral accretion (channel migration) and the silt and clay topstratum is the product of vertical (overbank) accretion.

12. Point bar deposits make up the majority of the Arkansas River Valley alluvium in the study area. Arkansas River point bar deposition is well illustrated inside of a large meander of the Arkansas River adjacent to Morrison Bluff (Plate 3) and Cuba Bottom north of Ragon Mountain (Plate 4). Much of the alluvium in the larger tributary valleys is also probably point bar deposition, although large areas of tributary valleys are wrapped as

undifferentiated tributary floodplain. In the largest tributary, Illinois Bayou, tributary point bar deposits were discriminated in obvious locations.

13. Lateral bar (ALb). Lateral bars were wrapped adjacent to the Arkansas River channel. Lateral bars are longitudinal lobes of sandy sediment formed on the edge of the channel, often on the leading edge of a point bar. Although lateral bars are usually part of a larger single point bar, they were discriminated in this study as being recent (primarily historic) deposits of the Arkansas River, which may be attached to much older point bar deposits. No lateral bar deposits were delineated in tributary valleys.

14. Middle bar (AMb). Like lateral bars, middle bars of the Arkansas River are the result of historic sedimentation. Middle bars in the Arkansas are surrounded by river channel and are formed when local channel geometry or decreased channel slope causes a decrease in sediment transport capacity, resulting in channel aggradation. Many middle bars are ephemeral features, existing for only a few years until they are subsequently destroyed by a local resurgence of sediment transport capacity. Occasionally, middle bars will grow high enough to permit the establishment of vegetation and then become islands, such as the case of Okane Island (Plates 1, 2, and 7).

15. Abandoned channel (ACh, TCh). Individual loops of actively meandering channels are often cut off during periods of flood. Natural cutoffs usually occur in two ways. A highly sinuous channel may cut off a single loop by cutting through its narrow neck and plugging the "arms" of the abandoned channel with its bedload material (usually sand). The result is a highly arcuate, completely recurved lake, almost totally removed hydraulically from the active channel. Abandoned channels may also form when the main flow path is diverted through a prominent swale on the point bar (described below) during high flow stages, which then becomes the main flow channel. The old main flow channel is gradually abandoned as the stream migrates away from it. However, the "chute cut" abandoned channel fills much more rapidly (receiving flow during high stages and sedimentation during flood recession) than the "neck cut" abandoned channel (which may remain as a lake for several thousand years). Abandoned channels ultimately are filled predominantly with fine-grained sediment--chute cutoffs are filled with fine sand, silt, and clay while neck cutoffs are filled primarily with clay and silt.

16. Numerous small abandoned tributary channels occur in the valleys of the larger tributaries in the study area. Abandoned channels of the Arkansas

River are mapped in the Vine Prairie and Richland township areas of the Ozark Lake study area.

17. Abandoned course (ACo, TCo). Similar to the abandoned channel is the abandoned course, a relict channel segment which contains several to many connected meanders. The major difference between the two is the mode of abandonment. Unlike the abandoned channel, the abandoned course is formed when the main flow path is diverted through the streambank to a completely new position on the floodplain creating a new "meander belt" (consisting of a channel and its adjacent abandoned channels). The process is known as channel avulsion and may happen gradually or in response to a single flood. Channel avulsions usually occur gradually as an increasing amount of flow is diverted through the new, more hydraulic efficient channel and the old channel is progressively filled with sand, silt, and clay.

18. Short segments of abandoned tributary courses are common in the larger tributary valleys, such as Mulberry River (Plate) Horsehead Creek (Plate), Big Piney Creek (Plate), Big Shoal Creek (Plate) and Illinois Bayou (Plate). An abandoned Arkansas River course occurs along the southern edge of McLean Bottom in the present location of a reach of Sixmile Creek (Plate).

19. Undifferentiated floodplain (AU, TU). Much of the area in tributary valleys and in the Arkansas Valley in the Vine Prairie area is classified as "undifferentiated floodplain." This geomorphic feature is probably 80 to 90 percent point bar subdued or buried by relatively thick vertical accretion deposits of silt and clay. The remaining 10 to 20 percent of undifferentiated floodplain is most likely backswamp, comprised totally of vertical accretion deposits of clay with silt deposited behind the meander belt of the active stream during floods. Backswamps are broad, flat basin areas lower in elevation than the adjacent "mature" meander belt ridges and are usually the locus of new channels formed during a channel avulsion.

20. Natural levees (dot pattern). Natural levees are formed when the streambank is overtopped during flood stages and sediment suspended in the flood flow is deposited overbank immediately adjacent to the channel. The resulting landform is a low, wedge-shaped ridge paralleling the channel, with its maximum height being adjacent to the outside bank of a meander. Natural levees in the Arkansas River Valley are well developed, most likely due to a generous supply of silt and fine sand in the sediment load of the Arkansas

River in this region. Natural levee deposits are not discriminated in the tributary valleys due to the scale of the geomorphic maps, however, most of the present and abandoned tributary courses and channels have thin (1-2 feet) natural levee deposits next to them.

21. Tributary alluvial fan (TF). Where tributary streams exit upland areas of steep valleys and flow out into large open areas such as broad alluvial plains, they rapidly lose stream energy due to a decreased channel slope, a change in hydraulic geometry of the channel, or a loss of discharge through streambed infiltration. The result of the loss of stream energy is sediment deposition and the development of a fan shaped wedge of alluvium which is thickest at the point where the stream exits the uplands. Small tributary fans occur throughout the study area where small streams exit the uplands and flow out onto the Arkansas River floodplain or the floodplains of the larger tributaries. With the exception of one fan, all of the tributary fans are too small to be mapped at the scale of 1:24,000. The exception is the large tributary fan formed by Illinois Bayou as it exits a narrow gorge and enters its broad alluvial valley in the SW1/4 of Section 17, T8N, R20W, about four miles north of Russellville, AR (Plate 11). The Illinois Bayou fan slopes downstream from an elevation of approximately 353 ft msl at the fan head to 341 ft msl at the toe of the fan.

22. Terrace (AT, TT). Terraces in alluvial valleys are former floodplain surfaces which have been abandoned when the local channel goes through a cycle of bed erosion and subsequent creation of a new floodplain at a lower level. Terraces may form as a result of the local stream responding to a major external factor (i.e. drop in local base level) or they may be the product of the natural geomorphic evolution of a stream system in the absence of major changes in external variables effecting stream behavior. Terraces are common in most alluvial valleys of several thousand years age or older.

23. Six separate terrace levels of the Arkansas River were identified in the Arkansas Valley in and adjacent to the study area, ranging in elevation from 260 to 15 feet above the active floodplain. Only the lowest Arkansas River terrace occurs extensively in the study area in the vicinity of the mouth of Big Shoal Creek (sections 10, 15, and 22, T8N, R23W, Plate 9). Smaller areas of Arkansas River terrace representing low hillslopes eroded into higher terrace levels also occur within the study area, as illustrated by the area mapped "AT" in the NW1/4 Sec. 19, T8N, R22W (Plate 9). These

geomorphic features (erosional hillslopes on the edge of high Arkansas River terraces) are similar in active erosional processes to areas mapped as upland slope (US).

24. Many terrace levels have been observed in the tributary valleys. As many as six terrace levels may exist in some of the larger tributary valleys. The higher (greater than 12 feet above the modern floodplain) terraces are most likely at least as old as late Pleistocene (late Wisconsinan). Numerous low terraces also exist in the areas mapped as undifferentiated tributary floodplain (TU), as observed in the field, but, due to their scale, are not identified on the geomorphic maps. These low tributary terraces, ranging in elevation from 2 to 12 feet above the modern floodplain, were formed during the Holocene (last 12,000 years). As a general rule, the higher the terrace is above the modern floodplain, the greater its age.

25. Upland slope (US). The alluvial valleys of the Arkansas River and its tributaries are bounded by valley walls eroded into the local Pennsylvanian rock. Where these valley walls are exposed in the study area, they are mapped as upland slope (US), meaning the geomorphic feature is a surface formed by erosion of Pennsylvanian formations. Upland slope areas, as mapped, have a wide range of local slope, from gentle (2-3%) to vertical. On the more gentle slopes (less than 15%), these surfaces are usually covered by a well developed residual soil developed in the host rock (typically sandstone or shale). This residual soil is characterized by its well developed pedogenic horizons and yellowish-orange color. A large area originally mapped as tributary terrace near Delaware, AR (sec. 1, T7N, R22W, Plate 10) was observed in the field as actually a low gentle erosional slope (US) developed in Pennsylvanian sandstone. Local rock outcrops in tributary valleys (SE1/4, SE1/4, sec. 23, T9N, R23W, Plate 4) are also mapped as upland slope.

26. Former Arkansas River Bank. Progressive lateral migration of the Arkansas River throughout at least the last half of the Holocene has resulted in the formation of a number of low crescent shaped ridges bounded on the convex side by thick belts of natural levee deposits. These ridges, usually two to four meters (six to twelve feet) high and 1.5 to 2.5 km (1.0-1.5 mi) long, represent the outside banks of former Arkansas River meanders. The thick adjacent natural levee deposits suggest a period of temporary channel stability on the order of 50-500 years as the natural levee grew in height and width. These broad ridges are steep on the concave (inside) and gentle on the

convex (outside) flanks, and are considerably larger, higher, and less numerous than the many pointbar ridges which are the dominant landform of the Arkansas River floodplain. Several well developed former Arkansas River Banks are delineated on the "Lavaca" Geomorphic Map (Plate 2) near the mouth of Big Creek.

PART III: GEOMORPHIC DEVELOPMENT OF THE LAKE DARDANELLE AREA

Introduction

27. Geomorphic features in the Arkansas River Valley indicate that the Arkansas River has been in the general location of the present channel for many (hundreds) thousands of years, certainly much longer than it is likely that native Americans have inhabited the area. The presence of high Arkansas River terraces at five levels above the historic floodplain all identify former time periods in the gradual erosive formation of the Arkansas River Valley. The weathering (pedogenic) horizons in the Arkansas River terraces suggest their increasing antiquity with elevation, with even the lowest terrace (15 feet above the historic floodplain) containing a mature soil, suggestive of possibly 10,000-12,000 years age. A similar geomorphic history is evident in the tributary valleys on a smaller scale. In the following section a brief discussion is presented on the apparent geomorphic history of the Ozark Lake, Lake Dardanelle study area. This discussion is based on the consideration of the geomorphic and chronometric data available. Geomorphic data are derived from Plates 1-7 and field observations. Chronometric data are taken from archeological site occurrence of various ages, field observations of soil horizons, and historic maps.

Geomorphic Development of the Arkansas River Floodplain

28. Confinement of the Arkansas River by steep valley walls of erosion resistant geologic strata within a relatively narrow valley has resulted in the frequent reworking of floodplain landforms by the meandering Arkansas River. Examination and comparison of historic maps and aerial photographs, the occurrence of archeological sites, and the "recent" appearance of landforms in the field all indicate that much of the existing Arkansas River floodplain within the study area has formed within historic times. As previously mentioned, all of the areas mapped as lateral bar or middle bar are almost certainly historic in age. Many point bar areas are also historic, including areas on Plates 1, 2, 5, 6, 7, 14, and 16.

29. The only areas of prehistoric landforms within the Arkansas River floodplain in the Lake Dardanelle study area are (1) areas mapped as point bar

in sections 27, 28, 29, N1/2 section 32, NE1/4, NE 1/4 section 33, sections 34 and 35 T9N, R25W, Plate 5; and (2) the area mapped as natural levee over point bar adjacent to the left descending bank northeast of Goose Island, Plates 15 and 16. Only these two areas within the Arkansas River floodplain in the Lake Dardanelle study area appear to have escaped reworking by the Arkansas River in historic times. Area (1) mentioned above could be on the order of 3,000-4,000 years old, area (2) as much as 2,000 years old.

30. In the Ozark Lake study area several areas of prehistoric landforms exist within the Arkansas River floodplain. The most extensive area consists of the area north of the Arkansas River in the floodplain from the mouth of Frog Bayou east (down-river) to the mouth of Mulberry River (Plates 1 and 2). Broad areas of natural levees adjacent to the modern Arkansas River, former Arkansas River banks, and a large abandoned Arkansas River channel appear to be areas of high probability of site occurrence in this portion of the Ozark Lake area. Lateral migration of the Arkansas River in the reach from Mulberry River downstream to Ozark appears to have been minimal during at least the last several hundred (probably 1000-2000) years (Plates 3 and 4). Consequently the probability of site occurrence on the natural levees overlying lateral bars and pointbars is high, and the potential location of buried sites within the natural levee deposits is significant. Most other areas in the Arkansas River floodplain in the Ozark Lake study area are historic to very late prehistoric in age.

31. Former floodplain levels of the Arkansas River (terraces) are also important potential areas of prehistoric cultural resource occurrence. Several separate Arkansas River terraces were identified in the vicinity of the study areas, however, only the lowest terrace occurs within the study areas. The lowest Arkansas River terrace is probably late Wisconsinan to early Holocene in age, based on its position and elevation relative to the historic floodplain, the degree of dissection of its surface by local streams, and the moderate maturity of the surficial pedogenic profile. Fisk (1944) stated that the Arkansas River was charged with substantial amounts of glacial outwash during the late Pleistocene, forming a large alluvial fan where it entered the Mississippi River alluvial valley. However, the lack of broad low terraces in the Arkansas Valley and extensive accordant backwater terraces in the tributary valleys suggests minor influence of glacial outwash in the late Pleistocene and early Holocene history of the Arkansas River Valley.

Considering the relatively small percentage of the Arkansas River Basin which was directly influenced by Pleistocene glaciation, the apparent absence of substantial amounts of glacial outwash in the Arkansas River Valley is not surprising.

32. Most of the landforms of the tributary valleys are of sufficient age to have archeological sites on them, especially the various terrace levels of the tributaries. These tributary terraces indicate the complex late Pleistocene and Holocene histories of the tributary valleys. In the next paragraphs, the apparent geomorphic history of the major tributary valleys is presented.

Geomorphic Development of Tributary Valleys

33. The geomorphic evolution of the tributaries of the Arkansas River is largely influenced by the actions of the Arkansas River. Major changes in stream regime in the Arkansas River are translated through the tributaries in like manner. Aggradation of the Arkansas River will cause commitant aggradation in the tributaries as the local base level is elevated. Correspondingly, incision by the Arkansas River will cause a lowering of local base level and incision by the tributary streams. Therefore, it is important to understand the geomorphic evolution of tributary streams when investigating the history of the main channel, and vice versa.

34. The major tributary valleys of the Arkansas River in the Lake Dardanelle study area, Sixmile Creek, Horsehead Creek, Cane Creek, Spadra Creek, Big Shoal Creek, Big Piney Creek, Delaware Creek, and Illinois Bayou and Vache Grasse Creek, Big Creek, Frog Bayou, Mulberry Creek, Onion Creek, and White Oak Creek in the Ozark Lake study area all exhibit well developed alluvial valleys with adjacent terraces, indicating their geomorphic development over a period of time which dates well back into the Pleistocene. Like the Arkansas River, the tributary streams are also profoundly influenced by local lithologic and structural control, however the tributaries have been successful in eroding their valleys in some areas to the point where a broad floodplain and several terraces have been formed. All of the trunk channels of the tributary streams have evolved to the meandering phase, in most cases meandering freely in their alluvial valleys. Abandoned channels and courses are common in all of the tributary valleys except Spadra Creek Valley and

Onion Creek, which probably contain these alluvial features, but their delineation was not possible due to the scale of the aerial photography and the contour interval of the topographic map.

35. The existence of several low terraces varying in elevation from 2 to 12 feet above the historic floodplains of the tributary valleys indicates the complex nature of the geomorphic development of the tributary valleys throughout the Holocene. Detailed geomorphological investigations of the tributary valleys might reveal a commonality in the geomorphic history of the tributaries which would most likely be a product of a common response of the tributaries to geomorphic activity of the Arkansas River. Conversely, detailed studies might also indicate that the tributaries are "out of phase" with each other, responding differently to the geomorphic activity of the Arkansas River. This complex response of the tributary streams is common in nature, and can be explained by the natural episodic adjustment of stream systems to geomorphic thresholds, such as the abandonment of a stream course of channel, or the development of tributary fans.

36. Since detailed geomorphological investigations were not conducted of the tributary valleys, it is not known if the tributaries are in or out of phase with respect to each other. However, from an examination of the geomorphic maps and consideration of field observations in all of the tributary valleys, several general statements can be made regarding the apparent geomorphic development of the tributary valleys.

- a. The tributary valleys are much more stable geomorphologically than the Arkansas River Valley in the study area.
- b. The tributary streams would have been more sensitive to Holocene climatic change/variability than the Arkansas River, but the response of the tributaries, while probably similar in result, would not necessarily have occurred simultaneously throughout the study area.
- c. The low terraces in the tributary valleys are most likely the product of the local complex geomorphic evolution of the tributary valley and are probably not correlative among the tributary valleys.
- d. The higher tributary terraces at about 15-20 feet above the historic floodplains of the tributaries are quite possibly correlative within the study area and possibly correlative with the lowest Arkansas River terrace.
- e. All of the tributary streams have probably been in the meandering phase for at least the last 3,000 years, as indicated by

the distribution of archeological sites. Some of the abandoned tributary channels and courses are 2,000-3,000 years old.

f. Several feet of vertical accretion of sediment is common in the floodplains of the tributary valleys. Much of this surficial sediment could be less than 200 years in age.

g. Areas of natural levee formation are not as well defined in the tributary valleys as they are in the Arkansas River floodplain. Vertical accretion of sediment is more uniformly distributed in the tributary valleys than in the Arkansas River floodplain, and less concentrated along present channels and abandoned channels and courses.

h. More abandoned channels and courses occur in the tributary valleys than are shown on the geomorphic maps, especially in the lower reaches of the tributary valleys where they may be masked by natural levees of the Arkansas River.

PART IV: SIGNIFICANCE OF LAKE DARDANELLE GEOMORPHOLOGY TO CULTURAL RESOURCE INVESTIGATIONS

Use of Geomorphological Data in Cultural Resource Investigations

37. The purpose of this investigation was to provide a geomorphological foundation for use in the planning and execution of subsequent cultural resource surveys in the Lake Dardanelle and Ozark Lake project areas. In keeping with this purpose, it is useful to consider the various uses of geomorphological data in cultural resource investigations. Geomorphological investigations conducted in support of future cultural resource investigations should produce results which would be useful in providing:

- a. Geomorphological information which will be of use in predicting site occurrence and extent.
- b. Guidance for the location of areas or features which are likely to contain buried sites.
- c. Guidance for the location of areas or features which are likely to contain sites of specific age or cultural component.
- d. Geomorphological information useful in predicting the probability of site destruction by natural geomorphic processes.
- e. A landscape/landform (or geomorphic feature) classification and delineation necessary to establish site-landscape/landform associations.
- f. Paleoenvironmental data critical to the evaluation of the cultural resources of a region.

The third objective of this investigation pertains to letter (b) above, however, all of the uses stated above will be discussed briefly in terms of the geomorphological study of the Lake Dardanelle and Ozark Lake project areas.

Prediction of Site Occurrence

38. Examination of the occurrence of archeological sites in the study area reveals several important relationships. In Table 1, the occurrence of documented archeological sites with known cultural components is tabulated by the geomorphic feature which the sites are associated with. From Table 1 it can be seen that the greatest percentage (37%) of sites occur on natural levees of the Arkansas River. Remaining Arkansas River landforms underlie an additional 22 percent of known sites in the two study areas.

Table 1

Occurrence of Archeological Sites on Geomorphic Features, Lake Dardanelle Study Area

Geomorphic Feature	Cultural Component of Site					
	Archaic	Woodland	Mississippian	Late Prehistoric	Historic	All Components
Arkansas River Point Bar	2	3	4	0	2	11
Arkansas River Terrace	7	0	0	1	0	8
Arkansas River Natural Levee	20	11	8	2	5	46
Arkansas River Lateral Bar	1	0	0	0	0	1
Arkansas River Middle Bar	0	0	0	0	0	0
Abandoned Arkansas River Course	0	0	0	0	0	0
Abandoned Arkansas River Channel	3	1	3			7
Tributary Terrace	13	2	0	2	4	21
Undiff. Tributary Floodplain	9	1	1	2	0	13
Tributary Point Bar	5	0	0	1	0	6
Abandoned Tributary Channel	2	0	0	0	0	2
Abandoned Tributary Course	1	0	0	0	0	1
Tributary Alluvial Fan	1	0	0	0	0	1
Upland Slope	4	0	1	0	1	6
All Geomorphic Features	68	18	17	8	12	123

Thirty six percent of the known sites in the two areas are located in tributary valleys, with the majority (28%) occurring on tributary terraces or undifferentiated tributary floodplain. These statistics suggest that the probability of locating archeological sites is greatest on natural levees of the Arkansas River and in the tributary valleys, especially on tributary terraces.

Location of Buried Sites

39. Geomorphic processes which are responsible for burial of archeological sites are (1) vertical accretion (sedimentation) during floods; (2) alluvial fan deposition; and (3) colluvial deposition at the base of hillslopes. Vertical accretion is responsible for the formation of natural levees in the Arkansas River floodplain and broad floodplain sedimentation in the tributary valleys. Colluvial deposition has occurred at the base of hillslopes on the edge of the tributary valley floodplains and terraces. The large alluvial fan formed by Illinois Bayou may contain cultural strata which have been buried during vertical deposition on the fan. Natural levee deposits adjacent to stable reaches of the Arkansas River are also areas of high probability for site burial. Consequently, areas which could possibly contain buried archeological sites include the Arkansas River natural levees, almost any of the better drained areas of the tributary floodplains, colluvial slopes at the base of upland slopes or terrace escarpments, and the Illinois Bayou alluvial fan.

Other Uses of the Geomorphological Data for Cultural Resource Investigations

40. The data and observations of this investigation will be useful to a subsequent cultural resource survey of the project area for the items mentioned in letters d-f above. Sufficient chronometric data are not available for the location of sites of specific age or cultural component with the exception that the amount of time available for site occupation increases with terrace elevation in the tributary valleys. The potential for site destruction is greatest in the Arkansas River floodplain where rapid lateral migration of the river has undoubtedly destroyed many archeological sites. Classification and delineation of geomorphic features on Plates 1-17 provides a

basis for the establishment of site-geomorphic feature associations identified in Table 1 which will be valuable in the development of a cultural resource survey strategy. While the amount of data available for paleoenvironmental reconstruction of the study area was minimal due to the constraints of the investigation, the landscape/landform associations illustrated on the geomorphic maps present a foundation for the development of detailed paleoenvironmental data at a future time.

REFERENCES

Deeter, E. B. 1915. Soil Survey of Yell County, Arkansas, US Bureau of Soils, Washington, DC.

Fisk, H. N. 1944. Geological Investigation of the Alluvial Valley of the Lower Mississippi River, US Army Corps of Engineers, Mississippi River Commission, Vicksburg, MS.

Haley, B. R. 1961. Geology of Paris Quadrangle, Logan County, AR, Arkansas Geological and Conservation Commission Information Circular No. 20-B, 40 p.

__________. 1968. Geology of the Scranton and New Blaine Quadrangles, Logan and Johnson Counties, Arkansas, US Geological Survey Professional Paper 536-B, 10 p.

Haley, B. R. and Hendricks, T. A. 1971. Geology of the Van Buren and Lavaca Quadrangles, Arkansas and Oklahoma, US Geological Survey Professional Paper 657-A, 41 p.

Merewether, E. A. 1971. Geology of the Knoxville and Delaware Quadrangles, Johnson and Logan Counties and Vicinity, Arkansas, US Geological Survey Professional Paper 657-B, 18 p.

Merewether, E. A. and Haley, B. R. 1960. Geology of Delaware Quadrangle, Logan County and Vicinity, Arkansas, Arkansas Geological and Conservation Commission Information Circular No. 20-A, 30 p.

__________. 1969. Geology of the Coal Hill, Hartman, and Clarksville Quadrangles, Johnson County and Vicinity, Arkansas, US Geological Survey Professional Paper 536-C, 27 p.

Soil Conservation Service. 1971. Soil Survey of Franklin County, Arkansas, US Department of Agriculture, Washington, DC.

__________. 1977. Soil Survey of Johnson County, Arkansas, US Department of Agriculture, Washington, DC.

__________. 1980. Soil Survey of Logan County, Arkansas, US Department of Agriculture, Washington, DC.

__________. 1980. Soil Survey of Pope County, Arkansas, US Department of Agriculture, Washington, DC.