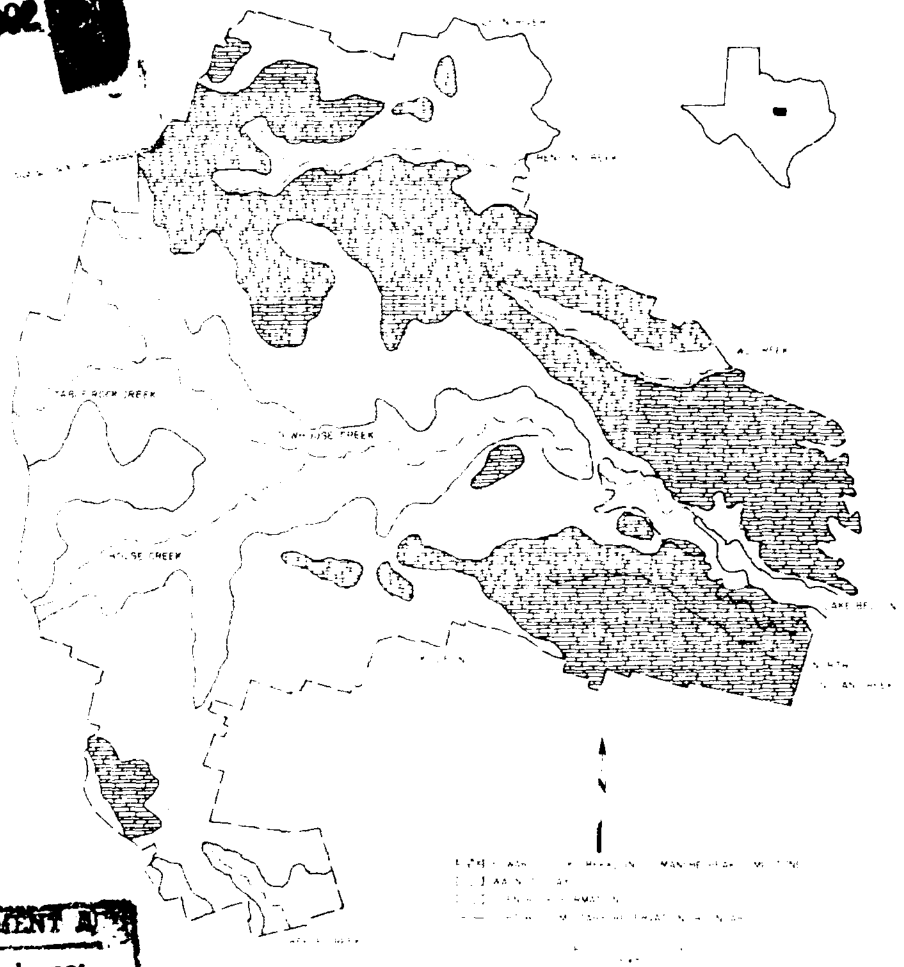
ARCHAEOLOGICAL GEOLOGY OF THE FORT HOOD MILITARY RESERVATION FT. HOOD, TEXAS

by
Lee C. Nordt



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This report represents a study of the archaeological geology of eight streams within Fort Hood. The original report has been edited for distribution to the general public.

The cover design reflects the areas studied during this project.

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with a foreword by
David L. Carlson

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Archaeological Geology of the Fort Hood Military Reservation,
Fort Hood, Texas

Submitted in Partial Fulfillment
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The soils and alluvial stratigraphy of eight streams at Fort Hood, Texas, were investigated between September 1989 and July 1990 to develop a site-prediction model for interpreting the buried Prehistoric and Historic cultural record. The eight streams included the Leon River and seven upland creeks: Cowhouse, Table Rock, House, Owl, Henson, Reese, and North Nolan. Soil-sediment analyses of seven soil pedons, radiocarbon assays of 50 samples,

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and field investigations that included over 100 trenches and cutbanks, revealed three geomorphic surfaces and five stratigraphic units common to the upland streams and four geomorphic surfaces and six stratigraphic units unique to the Leon River. The geomorphic surfaces were designated, from oldest to youngest, as T3, T2, T1, and T0. Common to all streams were five informally recognized stratigraphic units named the Jackson (≈15,000 B.P.), Georgetown (≈11,000 to 8200 B.P.), Fort Hood (8000 to 4800 B.P.), West Range (4300 to 600 B.P.), and Ford (600 B.P. to present). The older Reserve alluvium (>15,000) was unique to the Leon River basin. Late Quaternary climatic shifts, coupled with supply and depletion of upland soils, were apparent mechanisms governing periods of channel degradation and aggradation.

In the seven upland drainage basins, Terrace 2 (T2) was underlain by the Jackson alluvium, while T1, a composite terrace, was underlain by the Georgetown, Fort Hood, and West Range alluvium. On all upland streams except Cowhouse, a low-relief topographic scarp separated the Fort Hood and West Range alluvium and warranted subdivision of T1 into T1a and T1b components, respectively. The Royalty paleosol, which formed in the Georgetown alluvium, was always buried beneath the Fort Hood or West Range alluvium. The Ford alluvium, which underlies T0 (the active floodplain), grades up to, and partly overlaps T1b on the small upland steams, but is inset to T1b on Cowhouse Creek by a low-relief topographic scarp. In the Leon river basin, T3 was underlain by the Reserve alluvium, T2 the Jackson alluvium, and T1 the Georgetown (?) alluvium. T0 and the Ford alluvium bury the Fort Hood and West Range alluvium.

Recovery potentials for cultural sites were none for the Jackson, low for the Georgetown, low to medium for the Fort Hood, low to high for the West Range, and low for the Ford alluvium. Site recovery potentials are greatest in overbank and point bar facies of meandering steams such as the Leon River and Cowhouse Creek, and in fine-grained facies of the smaller steams where the confluenced with larger streams. Braided environments of the intermediate and small steams contained the fewest sites. Relatively rapid rates of valley aggradation throughout the middle and late Holocene precluded the formation and burial of soils and long-term occupational surfaces. As a result, buried sites tend to be preserved within spatially superposed sedimentary contest. In contract landform surfaces contain mixed cultural assemblages spanning long time periods. The T3 and T2 surfaces contain components spanning all known cultural periods of Central Texas. Terrace 1 of Cowhouse Creek contains the Early Archaic to Historic, while T1a and T1b of the smaller streams contain the Early Archaic to Historic, and Middle Archaic to Historic record, respectively. The Neoarchaic and Historic is restricted to T0.

FOREWORD

David L. Carlson

Since 1978 over 2200 archaeological sites have been recorded at Fort Hood. The vast majority of these sites are located on eroded, upland surfaces where ten thousand years are compressed within the top few inches. Deeply stratified sites, in which each occupation is protected by a sterile deposit of sediment, are not found here. In the following report, Lee Nordt focuses his attention on alluvial deposits within the post where such deeply stratified sites could be found. This study provides critical information to cultural resource managers because buried sites are more likely to be missed during an archaeological survey than any other kind of site. When discovered in the midst of construction, these sites have the greatest potential to cause delays. Buried sites are rare and they often contain information about the past that is poorly represented or completely missing from sites on upland settings.

One of the major goals of this investigation was to provide a set of geomorphic maps that would identify the alluvial deposits on the post along the Leon River, Cowhouse, Table Rock, House, Owl, Henson, Reese, and North Nolan Creeks. These floodplain deposits and the colluvial fans that flank them are the places where buried sites might be encountered. Floodplain deposits are not all equal in their potential to contain buried sites. Some deposits are greater than the roughly 12,000-14,000 years during which Texas was occupied by prehistoric peoples. Other deposits represent accumulations during major flooding episodes that would have removed any archaeological sites that might have been present. The classification of the various deposits and their potential for containing buried sites involves a careful examination of the age of the deposit, the type of stream flows which produced it, the rate at which the deposit accumulated, and the degree to which the deposit has been eroded and removed by subsequent flooding. This report is not final word on Fort Hood alluvial deposits, but it represents a significant increase in our understanding of the post. The conclusions in this report are based on 50 radiocarbon age determinations, the examination of countless exposures and over 100 machine-excavated trenches. We are now able to compare the depositional sequence at Fort Hood with other areas of the state such as the Brazos River, the Colorado River, and the Medina River.

In addition to providing the necessary information to anticipate buried sites, Nordt's study of the post provides us with information about past climates and past population levels on the post. Data from the post and the surrounding area demonstrate that the climate was cooler and moister about 12,000 to 8,000 years ago. During this time the distinctive Georgetown Alluvium was deposited. The end of this period is marked by a brief period of landscape stability during which the Royalty Paleosol developed. After 8,000 years ago Texas, along with the southwestern and the midwestern U.S., entered a period that was warmer and dryer (the Altithermal). These dryer conditions lasted until about 4,000 years ago. This period is marked on the post by the deposition of the Fort Hood Alluvium, which seems to have resulted from erosion of upland soils during seasonal storms. After about 4,300 years ago, deposition of the fine-grained sediments of the Fort Hood Alluvium ceased and the coarser sediments of the West Range Alluvium begin to accumulate. This shift may correlate with a period of greater moisture that increased stream flows and accelerated erosion of upland bedrock. About 800 years ago, the period of increased moisture ends and is marked by the deposition of the Ford Alluvium that includes erosion triggered by European settlement in the area.

This basic summary of climatic change provides archaeologists with a foundation for studying the ways in which the prehistoric inhabitants of the post adapted to the area. Some general information regarding population levels during this period is provided by the buried hearths which Nordt discovered while conducting his study. These data generally confirm an apparent increase in the number of sites between 1,200 and 2,600 years. This increase in sites had been recognized on the basis of surface surveys, but its confirmation in buried deposits helps us to rule out depositional factors as the cause of the pattern. "The Archaeological Geology of Fort Hood" is an outstanding example of a study that serves two important purposes. It provides crucial information for cultural resources managers on the locations of potentially significant prehistoric sites. It also provides baseline information on cycles of aggradation and erosion in the Lampasas Cut Plain that will be of value to geomorphologists, archaeologists, and anyone interested in Holocene paleoenvironments.

ABSTRACT

The soils and alluvial stratigraphy of eight streams at Fort Hood, Texas, were investigated between September 1989 and July 1990 to develop a site-prediction model for interpreting the buried Prehistoric and Historic cultural record. The eight streams included the Leon River and seven upland creeks: Cowhouse, Table Rock, House, Owl, Henson, Reese, and North Nolan. Soil-sediment analyses of seven soil pedons, radiocarbon assays of 50 samples, and field investigations that included over 100 trenches and cutbanks, revealed three geomorphic surfaces and five stratigraphic units common to the upland streams and four geomorphic surfaces and six stratigraphic units unique to the Leon River. The geomorphic surfaces were designated, from oldest to youngest, as T3, T2, T1, and T0. Common to all streams were five informally recognized stratigraphic units named the Jackson (≈15,000 B.P.), Georgetown (≈11,000 to 8200 B.P.), Fort Hood (8000 to 4800 B.P.), West Range (4300 to 600 B.P.), and Ford (600 B.P. to present). The older Reserve alluvium (>15,000) was unique to the Leon River basin. Late Quaternary climatic shifts, coupled with supply and depletion of upland soils, were apparent mechanisms governing periods of channel degradation and aggradation.

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Numerous professionals provided assistance in a variety of ways throughout the investigation period. Kimbal Smith and Jack Jackson provided logistical assistance, computer time, and information about the Historic and Prehistoric archaeological record at Fort Hood. They have also encouraged local and national field excursions to expose the geoarchaeological work at Fort Hood to many other professionals and their viewpoints.

I thank David Carlson for contractual and logistal guidance, for being patient through some particularly tough times and for offering his thoughts on the Prehistory of Fort Hood. Blaine Ensor provided orientation to the Fort and his personal views on Prehistoric archaeology of Central Texas. Randy Korgel spend many days in the field patiently taking neat field notes through both good and bad weather conditions. Trenching coordination was under the direction of Bill Roberts whose patience and flexibility is also greatly appreciated.

On several field trips Mike Waters provided valuable suggestions concerning stratigraphic interpretations, environments of deposition, and research design. Tom Hallmark was instrumental in soil genesis interpretations and modelling, while Larry Wilding provided critical soil micromorphological interpretations. John Jacob spent a great deal of time in the initial stages of this project describing and sampling soils. His soil laboratory coordinating efforts are also greatly appreciated. Mike Mungoven provided rock climbing gear on two occasions for sampling hearths and writing descriptions on cutbanks that only geomorphology and archaeology could motivate one to do. Others who contributed ideas during field excursions were Mike Blum, Chris Caran, and Rolfe Mandel.

David Carlson, Tom Hallmark, Vance Holliday, Jack Jackson, Kimbal Smith and Mike Waters reviewed the manuscript and provided valuable organizational, editorial, and interpretive comments. Gloria Conrad not only patiently typed, but edited the manuscript, a rare quality for a secretary not directly involved in a project.

Lastly, I thank my family, Kathy and Garrison, for patiently standing by me and enduring the long absences and long hours put forth in preparing this manuscript.

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INTRODUCTION AND OBJECTIVES

As part of the cultural resource management program at Fort Hood, Texas (Fig. 1), Delivery Order #8 (Contract 5885HO8) was issued, which mandated the construction of a working model for the temporal and spatial delimitation of culturally relevant sediments. Previous investigations in and around Central Texas demonstrated the importance of utilizing geoarchaeological principles and methods to locate buried cultural resources (Blum, 1989; Blum, 1992; Ferring, 1986, 1990a,b; Hall, 1988; Mandel, n.d.). Unconsolidated alluvial sediments bordering major streams in the form of terraces and floodplains, were the sediments most likely to be within the appropriate time range for containing buried cultural sites. Consequently, the eight largest streams in Fort Hood were targeted for geoarchaeological investigation. From largest to smallest they are the Leon River, and Cowhouse, Table Rock, House, Owl, Henson, Reese and North Nolan Creek (Fig. 2). The specific objectives of this investigation were to: 1) locate and map the distribution of culturally relevant sediments and construct a landform map; 2) identify the major alluvial stratigraphic units, interpret their depositional histories, and establish a stream-specific and regional numerical stratigraphic chronology; and 3) develop a site-prediction model for interpreting the buried Historic and Prehistoric archaeological record. Collectively, these objectives can be used for assistance in making cultural resource management decisions and future site testing plans.

STUDY AREA AND BACKGROUND

Fort Hood is situated on the dissected eastern margin of the Edwards Plateau in Central Texas and is part of the Great Plains Physiographic Province. Hill (1901) named the southern portion of this region the "Lampasas Cut Plain" because of the prominent flat-topped ridges bounded by broad, low lying erosional stream valleys. These landscape features bear a close relationship with mapped geomorphic surfaces and soil distributions.

Fort Hood is situated on the boundary between the subtropical subhumid and subtropical humid climatic zone in Texas (Larkin and Bomar, 1983). Annual precipitation is approximately 800 mm with average annual low and high temperatures of 11.5°C and 25.5°C, respectively. Intensive convectional rain storms commonly develop at the boundary between moist tropical air from the Gulf of Mexico and the southerly flow of dry continental air. In the presence of long narrow drainage basins with sparse vegetative cover, exposed limestones, and steep slopes, these storms have generated some of the largest flood-magnitude events in the world (Baker, 1975).

GEOLOGY OF FORT HOOD

Major rock units that crop out in the Fort Hood area are Lower Cretaceous and parallel ancient north-south trending marine shorelines (Barnes, 1979). Sediments from Lower Cretaceous formations were deposited as part of a series of marine transgression and regression cycles within an overall transgressive trend (Adkins, 1932; Rose, 1972). Marine transgression proceeded from the east along a broad shallow shelf as a result of structural subsidence of the East Texas Basin. Deposition of sediments in this low energy environment resulted in formation of limestones, marls, shales, and clays (Davis, 1974; Moore, 1969; Stricklin et al., 1971; and Nelson, 1973). Prograding fluvial and strandline sands, although not as abundant, were also deposited during relatively brief periods of terrigenous sediment influx, primarily from North Texas, Oklahoma, and Arkansas (Owen, 1979; Anderson, 1989). Couplets of resistant limestones and nonresistant limestones, sands, sandstones, and shales have produced a micro-stepped landscape on backwearing upland slopes in the Fort area.

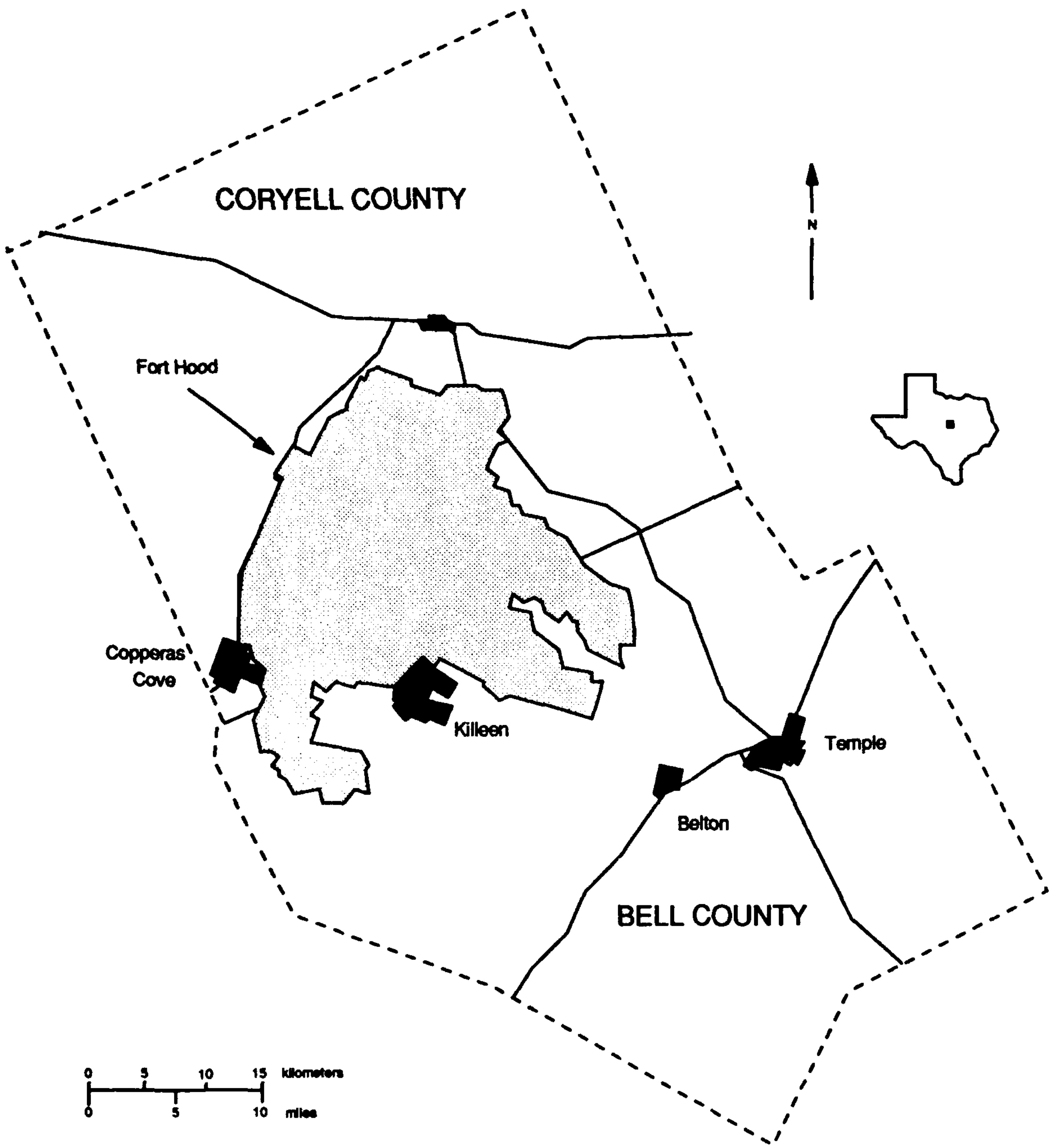


Figure 1. Location of Fort Hood in Bell and Coryell Counties.

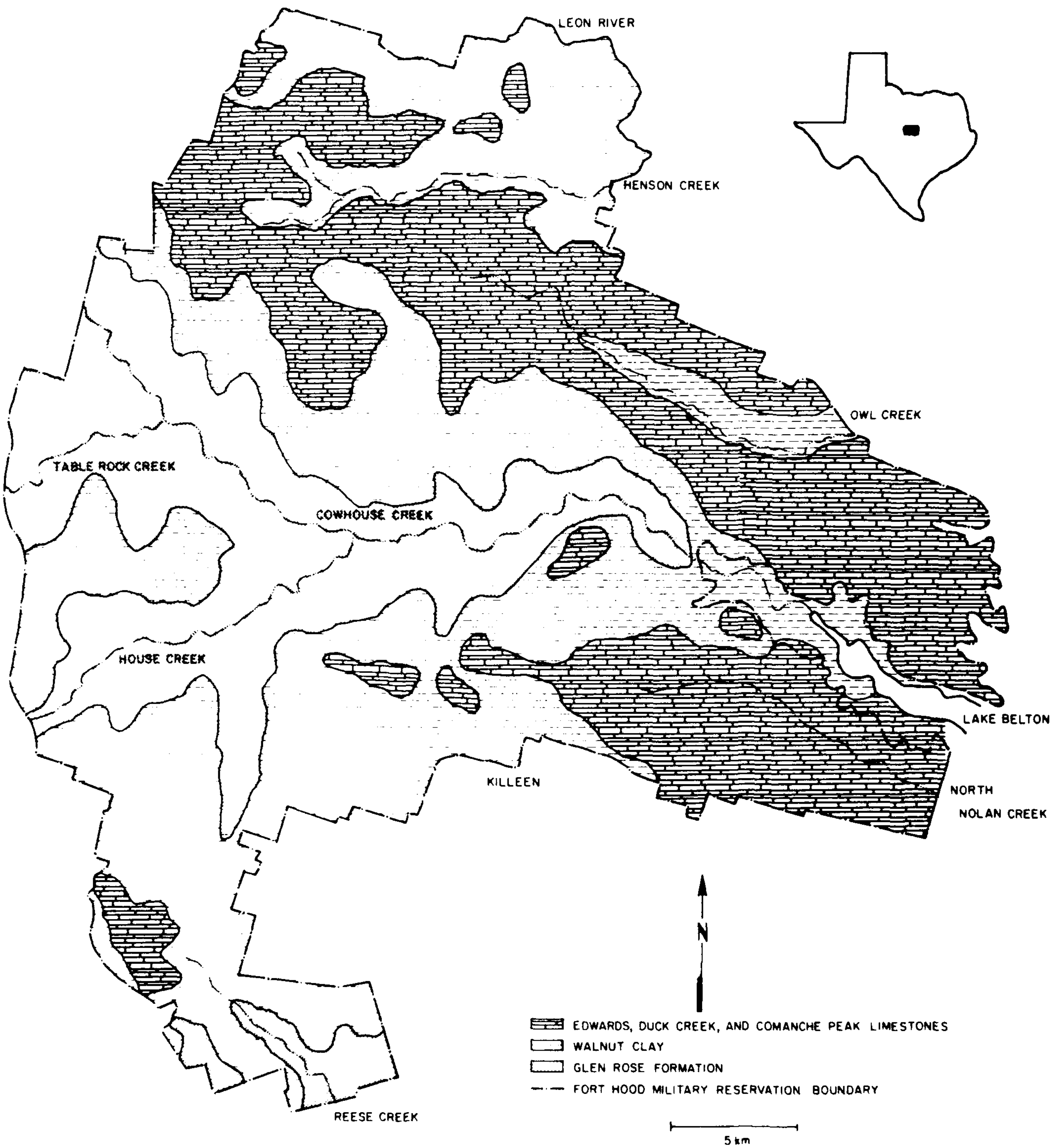


Figure 2. Map of the Fort Hood Military Reservation showing the geological units and locations of the eight streams investigated.

The Cretaceous formations, from lower to upper, that are principal contributors of Quaternary alluvium in the Fort area, are summarized below (Barnes, 1979) (Figs. 2, 3):

(1) Glen Rose Formation - fine-grained, chalky to hard limestone; interbedded dark gray clay and marl; partly arenaceous.

(2) Paluxy Sand - light gray to red, very fine grained quartz sands; locally interbedded shales and limestones (minor component).

(3) Walnut Clay - nodular and chalky clay, limestone, and shale.

(4) Comanche Peak Limestone - hard and nodular, gray to white limestone; numerous shale partings.

(5) Edwards Limestone/Kiamichi Clay undifferentiated - massive, rudistid limestone, abundant chert; nodular clay, limestone, and shale.

Contributions from the Cretaceous formations produce alluvial sediments that are abundant in sand-sized carbonates, calcareous muds, and large limestone clasts and chert nodules.

LANDSCAPE EVOLUTION OF THE FORT HOOD AREA

The earliest record of post-Cretaceous fluvial deposition in the Lampasas Cut Plain is preserved as scattered water-worn siliceous channel lag on the high flat-topped ridges of the Edwards Formation (Hayward et al., 1990). These gravels were presumably deposited by ancestral Central Texas rivers as they migrated across the Edwards Limestone and Kiamichi Clay undifferentiated formations thus forming what are now remnants of the "High" surface of Hayward and Others and the Manning surface of this study (Fig. 3). Hayward et al. (1990) correlate this surface with the Callahan Divide of North Central Texas which is stratigraphically 60 to 70 m above the southeastward projection of the Southern High Plains. This indicates that the Manning surface pre-dates deposition of the Ogallala Formation beneath the High Plains. By inference, because the Ogallala was deposited sometime between late Miocene and late Pliocene (Byrd, 1971; Walker, 1978; Gustafson and Finley, 1985), the Manning surface is at least Miocene in age (Hayward et al., 1990).

Approximately 25 to 35 m below the Manning surface, and resting primarily on the Walnut Clay and Comanche Peak Limestone, lies the broad gently rolling "Intermediate" surface of Hayward et al. (1990) and the Killeen surface of this study (Fig. 3). This landscape formed sometime after the late Tertiary as widespread valley entrenchment initiated abandonment of the Manning surface. The Killeen surface then formed as a result of long-term landscape stability and pedimentation as the Manning surface and underlying rock of the Edwards Limestone and Kiamichi Clay undifferentiated formations retreated laterally. Tributaries that sculptured the Killeen surface were left as part of a relict drainage network containing erosional and depositional counterparts that graded down to high terrace remnants deposited by trunk streams such as the Brazos and Leon Rivers when they flowed some 25 to 30 m above their modern floodplains. Colluvial soils with petrocalcic horizons at the base of the slope connecting the Manning and Killeen surfaces, provides evidence that lateral retreat of the Manning surface has been inactive for some time. The age of the Killeen surface is problematic; however, because it lies above the highest terraces of the Brazos and Leon Rivers (thought to be middle to late Pleistocene in age), an early to middle Pleistocene age has been proposed (Hayward et al., 1990).

The Killeen surface was abandoned sometime after the middle Pleistocene during the last major episode of valley entrenchment (Hayward et al., 1990). Since its initiation, several cut and fill episodes have followed forming prominent alluvial and strath terraces, particularly in the larger

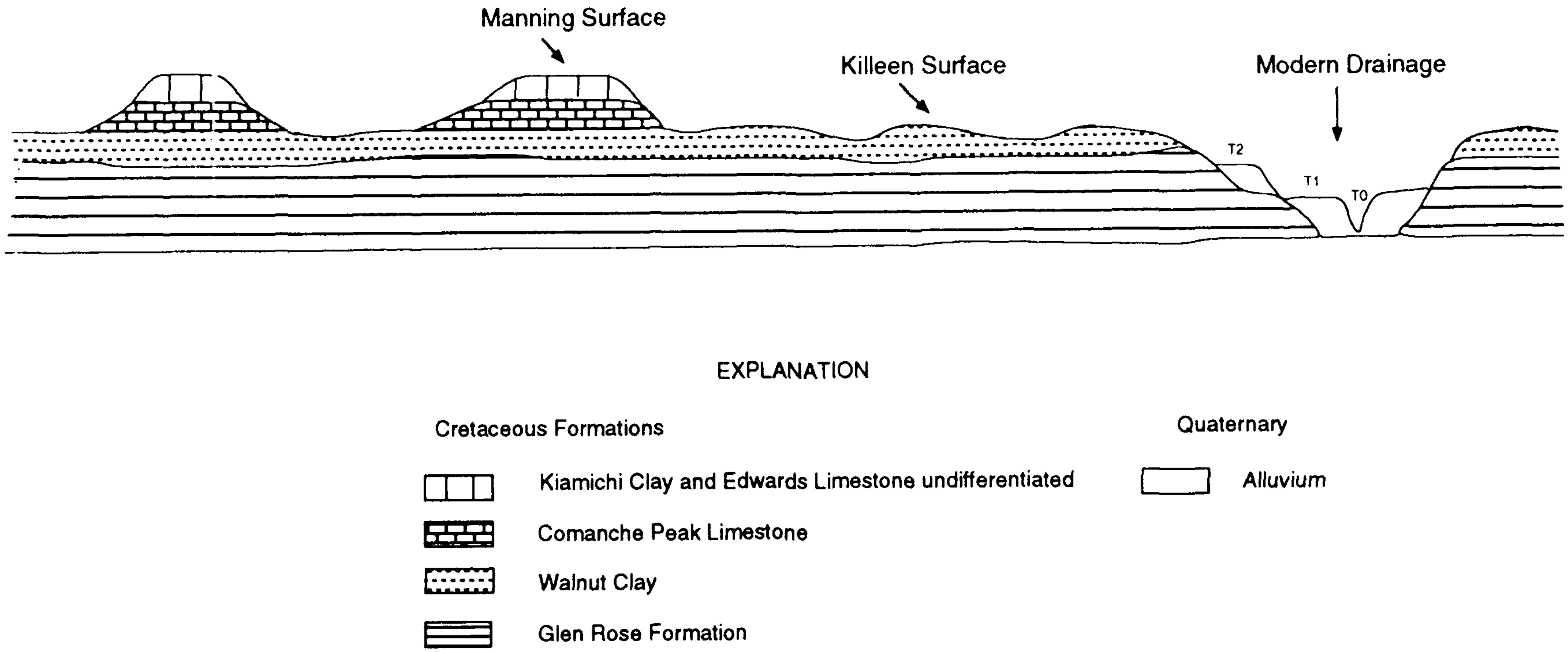


Figure 3. Schematic geologic and landscape cross-section of the Lampasas Cut Plain, Central Texas (no scale).

stream valleys (Fig. 3). These terraces and the modern stream valleys are late Pleistocene to Holocene in age. Modern channels are commonly entrenched 25 to 30 m below the Killeen surface.

LATE QUATERNARY ALLUVIAL SEQUENCES OF SELECTED CENTRAL TEXAS STREAMS

There have been no previous geomorphic investigations conducted on streams flowing through Fort Hood; consequently, late Quaternary alluvial histories of the region are poorly understood. For the purpose of developing a preliminary working model of Quaternary landscape evolution and climate change of the Fort Hood area, and how these processes relate to surface and subsurface cultural preservation, this review focuses mainly on those alluvial histories that have a numerical chronological framework and on those areas that have an established palynological record.

On the Clear Fork Branch of the Brazos River in North Central Texas, Mandel (n.d.) recognized one major Pleistocene terrace and a large Holocene valley fill consisting of four landform-sediment assemblages. The four Holocene fills accumulated prior to 7430 B.P., from 7500 to 1300 B.P., after 2000 B.P., and during the last 200 years. Widespread early and middle Holocene tributary erosion was occurring contemporaneously with rapid valley aggradation in larger valleys such as Clear Fork Branch. Most aggradational and soil forming episodes of the smaller tributaries were confined to the late Holocene. Entrenchment and subsequent floodplain aggradation of the modern Clear Fork Branch and tributaries did not occur until after 1500 B.P.

Holliday (1985a,b,c) has extensively studied the late Quaternary history of several intermittent streams (draws) of the Southern High Plains of Texas. Following latest Pleistocene fluvial deposition, lacustrine and marsh sedimentation proceeded from about 11,000 to 8500 B.P. Landscape stability and soil formation followed until about 6500 B.P. along with intermittent eolian deposition along valley margins. From about 6500 to 4500 B.P. at least two episodes of eolian erosion and/or sedimentation took place with soil formation and deposition occurring contemporaneously in some areas. During the period from about 4500 to 1000 B.P. slow aggradation and concomitant soil formation proceeded but was interrupted during the last 1000 years by discrete periods of eolian activity, slopewash, and renewed soil formation.

From paleoflood and paleobotanical interpretations of fine-grained alluvium contained in a rock shelter along the Pecos River in Southwest Texas, Patton and Dibble (1982) recognized two mesic climatic periods during the Holocene. Mesic periods centered around 9500 and between 3200 and 2400 B.P. and were characterized by frequent, uniform flooding conditions and deposition of fine-grained sediments. Warmer intervening periods resulted in low frequency, nonuniform flood events and deposition of coarse-grained sediments. Holloway et al. (1987) also concluded from pollen interpretations of an east-central Texas bog, that climatic conditions about 2000 to 3000 years ago were more mesic than today.

Blum and Valastro (1989) identified several periods of fluvial deposition during both the Pleistocene and Holocene in the Pedernales River basin in Central Texas. The oldest fill was estimated to be early to middle Pleistocene based on degree of soil calcium carbonate accumulation. Later periods of Pleistocene deposition were ongoing near 33,000 and 17,000 B.P.. An episode of widespread valley incision took place sometime between 17,000 and 10,000 B.P. and was followed by aggradation from about 10,000 to 7000 B.P. (now believed to be 10,000 to 5,000; personal communication from Blum, 1991). A brief period of valley erosion occurred again during the middle

Holocene after which aggradation was reactivated and maintained between about 4000 and 1000 B.P. The last 1000 years was characterized by increasing drying conditions accompanied by localized aggradation and a hydrological shift to more infrequent, high intensity flood events. Depositional facies at this time were dominated by overbank deposition and floodplain construction.

On a small tributary to the Double Mountain Fork River of the Brazos River basin in Northwest Texas, Blum (1989) reported that fluvial deposition was ongoing 13,500 B.P., that two periods of alluvial fan deposition were proceeding at 4780, and 860 to 520 B.P., respectively, and that a second period of fluvial activity was occurring around 1910 to 1750 B.P.

The Concho and Colorado Rivers in Northwest Texas were described by Blum and Valastro (n.d.) as having two high-level late Pleistocene terrace fills and two Holocene fills. Early Holocene filling took place between 10,000 and 5200 B.P., while late Holocene aggradation occurred between 4600 to 1000 B.P. In some areas Holocene fills were separated by an erosional unconformity or a buried soil. The modern floodplain regime was a product of drier climatic conditions that have persisted since about 1000 B.P.

From the paleobotanical, paleontological, and archaeological record, and a review of literature of late Quaternary alluvial chronologies and paleoclimates of the Rolling Plains of Texas and Oklahoma, Hall (1988, 1990) submits that the late Pleistocene was cooler and wetter than the present. He also suggests that early Holocene stream deposits were either deeply buried or removed by later erosive events. Further, he suggests that the middle Holocene, from 7000 to 4000 B.P., was marked by one or two brief cycles of increased aridity and valley entrenchment, followed by wetter conditions, with concomitant formation of thick cumulic soils, between 2000 and 1000 B.P. After a brief but significant period of channel entrenchment about 1000 B.P., presumably initiated by a shift to drier climatic conditions, aggradation proceeded, but subsequently slowed enough from 600 to 450 B.P. for another brief period of soil development.

Ferring (1990a,b) has summarized numerous alluvial stream chronologies in the Rolling Plains of southern and southwest Oklahoma, and North Central Texas. He concluded that early Holocene sediments were truncated and largely removed by middle and late Holocene erosional episodes and that rapid valley filling began around 4000 B.P. and continued until 2000 B.P., after which valley filling slowed and soil forming processes became dominant. Around 1000 B.P., brief widespread channel trenching took place. This was followed by renewed and continued aggradation until around 500 B.P. After a brief soil forming episode, modern deposition and incipient soil formation began.

Caran and Baumgardner (1990) completed a paleoenvironmental assessment of the Texas Rolling Plains spanning the Quaternary. In sum, during the late Pleistocene (300,000? to >35,000 B.P.) rapid westward recession of the High Plains escarpment provided a sediment source for coalescing alluvial fans migrating eastward. From about 25,000 to 8000 B.P. much of the region was covered by shallow perennial lakes corresponding with more humid climatic conditions. A rapid transition followed as intermittent streams and ephemeral ponds became more prevalent, reflecting increased aridity and diminished vegetative cover. This trend has continued into modern times producing flashy, nonuniform, stream flow.

All of the previous authors postulate that climate change was the causal mechanism inducing alluvial aggradational and degradational episodes during the Quaternary. Following this model, shifts to drier climatic conditions promoted channel incision and removal of sediments. If, however, the drier conditions were prolonged, vegetative cover diminished and sediment yields increased, promoting coarse-grained channel aggradation, fan deposition, or eolian sedimentation. Conversely, cooler and wetter conditions generally reduced sediment yields and initiated slow, fine-grained sedimentation, and gave rise to general landscape stability and soil formation. In contrast to this model, however, Blum and Valastro (1989) speculate that relatively humid conditions during the late Holocene produced coarse-grained aggradation of the Pedernales River. It is possible, therefore, that cut-and-fill modelling of fluvial systems is stream specific.

Based on the previous review a regionalized model of late Quaternary alluvial landscape evolution is constructed. Streams of Central Texas during the late Pleistocene underwent one to several episodes of alluviation, now represented by terraces situated above broad Holocene valley fills. The climate during full glacial conditions of the late Pleistocene was cooler and probably wetter than present and supported vast woodland areas (Bryant and Holloway, 1985). The latest Pleistocene transition to warmer and drier conditions (Bryant and Holloway, 1985) probably initiated widespread episodes of valley erosion documented throughout much of Central Texas. Valley filling commenced during the early Holocene, possibly driven by summer monsoonal rains that were active up until at least 9000 B.P. (Kutzbach and Guetter, 1986; COHMAP, 1988). Between 8000 and 4000 B.P. climatic conditions became warmer and drier which in some areas precipitated channel trenching and/or eolian erosion or sedimentation. Locally, much of the early Holocene alluvial record was lost as a result. Between 3000 and 1000 B.P. cooler and wetter conditions prevailed as fluvial aggradation, accompanied by cumulic soil formation, proceeded. Since 1000 B.P. climatic conditions again shifted to warmer and drier, thus inducing channel trenching which was followed by fluvial deposition and in some areas eolian deposition and minimal soil development.

METHODS

Papers in recent years have established methods for conducting surface and subsurface geoarchaeological investigations. The investigative procedures followed in this paper were adapted from Bettis and Benn (1984), Gardner and Donahue (1985), and Waters (1992).

Analyses of topographic maps, soil surveys, and aerial photographs of the eight Fort Hood streams targeted for study, were undertaken to assess geomorphic and soil relations. Construction of geomorphic maps for each of the eight streams relied on 1:24,000 U.S. Geological Survey and 1:4800 U.S. Corps of Engineer topographic maps, 1:24,000 U.S. Department of Agriculture aerial photographs, and field observations. For landform designations T0 represents the most frequently flooded surface and T1, T2, and so on, represent higher terraces that are infrequently flooded or not flooded at all (Brackenridge, 1988).

Field reconnaissance proceeded with four principal goals in mind: 1) to identify the major alluvial landforms for assistance in construction of the geomorphic maps; 2) to examine cutbank exposures for identifying informal stratigraphic units and establishing their relative temporal order; 3) to collect radiocarbon samples from critical stratigraphic loci for verification of the relative stratigraphic ordering; and 4) to locate trenching sites for testing the accuracy of landform maps and stratigraphic relations.

Forty-six cutbank exposures were described from areas containing sampled radiocarbon materials and displaying important lateral, and/or vertical, stratigraphic relations. No one exposure revealed a complete late Quaternary sequence. Instead, the geologic history was composited by interpretations and correlations among individual exposures revealing only part of the stratigraphic record. To test the accuracy of the landform maps and the lateral extensiveness of the stratigraphic units identified in the cutbank exposures, ninety-one trenches were excavated along transects crossing the major alluvial landforms within each of the eight drainage basins. Trenching was performed by a Gradall and subsequently described to a depth of 2 to 3 m.

Soil-stratigraphic descriptions of both cutbanks and trenches included horizonation, texture, color, reaction to HCl, structure and consistence, boundary, and identification of special features, following standard procedures outlined by Birkeland (1984), Holliday (1990), and Soil Survey Staff (1981). Soils were classified according to Soil Survey Staff (1990).

Subsurface sediments were grouped into informal stratigraphic units with unit A designated as the oldest and each successive letter representing progressively younger units. These units were packages of sediment bound by laterally traceable unconformities expressed as surface soils, buried soils, or nonsoil. An individual unit could have varying internal sedimentological character and was typically time-transgressive.

Complete soil characterization (Hallmark et al., 1986) was performed on samples collected from five trenches on Cowhouse Creek and two trenches on Table Rock Creek. Analysis included determination of particle size distribution, organic carbon, calcium carbonate and iron content, pH, bulk density, clay mineralogy, and thin section analysis. These properties were used for detection of stratigraphic discontinuities, soil reconstruction analysis, and as chronological indicators in the absence of numerical dating techniques. All discussions of mapped surface soils were taken from the Soil Survey of Coryell County (McCaleb, 1985) and the Soil Survey of Bell County (Huckabee et al., 1977).

Radiocarbon assays were performed by Beta Analytic Inc. (Beta), the University of Texas Radiocarbon Laboratory (TX), and Geochron Laboratories Division (GX). Eighteen radiocarbon ages were determined from charcoal obtained from hearths and middens, fourteen from dispersed charcoal, one from wood, and five each from bulk sediment and bulk soil humates. The only pretreatment for humate dating was the removal of roots and carbonates. All ages were corrected for carbon-isotope fractionation and presented in years before present (B.P.).

RADIOCARBON INTERPRETATIONS

Radiocarbon ages were used to numerically date the relative alluvial stratigraphic sequences of the eight streams. When possible, charcoal samples obtained from cultural features or dispersed sources were used for stratigraphic dating. In the absence of charcoal, bulk soil and sediment humates were dated. Less confidence is placed on the humate ages than the charcoal, however, because of potential contamination problems. Four charcoal and bulk humate pairs demonstrate that humate ages may be 300 to 1700 years older than charcoal (Appendix J).

Humates may be dating older than charcoal as the result of two factors. The first is that the organic carbon that is being dated in alluvial settings is derived in large part from eroded surface horizons of upland soils. Because surface soil horizons consistently carry a mean residence time of 200 to 1500 years (Mathews, 1985), and because eroded subsoils carry even older carbon than the topsoils, humate ages in alluvial settings may be a minimum of 200 to 1500 years older than the event that deposited them. A second factor is that at any given time a stream will be eroding alluvial or Cretaceous sediments in cutbank positions or channel bottoms that are older than the erosive event. The cretaceous Walnut Clay is the most extensive geologic unit being eroded in the Military Reservation, which is undoubtedly being incorporated into alluvial sediments to some degree. Redeposition of older alluvial and cretaceous sediments would then produce humate radiocarbon ages older than a cultural feature associated with the sediments. Long-term subaerial exposure, would, of course, bring the humate ages more in line with charcoal ages, or potentially make them younger than charcoal ages. There is no way, however, to predict how long this takes.

Because of the problems associated with humate dating, charcoal ages in this report were accepted first. Those humate ages not rejected solely on stratigraphic grounds, were accepted and interpreted with caution, under the assumption that they may be dating somewhat older than the event that deposited them.

ALLUVIAL STRATIGRAPHY

In this section there is a discussion of results and interpretations of the landforms, alluvial stratigraphy, soils, and radiocarbon ages of the eight streams investigated on the Fort Hood Military Reservation. Cowhouse Creek was the stream most crucial for reconstructing the late Quaternary alluvial stratigraphic history in the Fort area because of the large number of available cutbank exposures that revealed important stratigraphic relations and the large number of radiocarbon datable materials found therein. As a result, Cowhouse Creek provided a base line temporal and spatial stratigraphic framework to which the seven other streams were compared. The same stratigraphic and landform designations are therefore used in the discussion of all eight streams.

COWHOUSE CREEK

Cowhouse Creek is part of the larger Leon and Brazos River watersheds and drains approximately 1700 km^2 of lower Cretaceous limestones, shales, marls, clays, and minor amounts of sand (Fig. 2). Relief within the basin ranges from 460 to 180 m. Within the study area Cowhouse is a perennial meandering to straight stream with a sinuosity of 1.3 and channel gradient of 1.4 m/km. Discharge records near Killeen over a six year period during the 1920's and 1940's reveal maximum and minimum discharges of 1780 and 0 cubic meters per second, respectively (Dougherty, 1980). This demonstrates that flood magnitudes vary considerably. The most common modern depositional mesoforms are attached lateral and point bars with occasional longitudinal and chute bars.

Within Fort Hood, Cowhouse Creek can arbitrarily be subdivided by the Impact Area into an upper and lower basin (Figs. 4a and 4b). The modern Cowhouse flows on the Glen Rose limestone which also forms the outer bedrock valley wall leading into the uplands. Ten to fifteen meters above T2, the highest terrace along Cowhouse, the outer bedrock valley wall leads into the Killeen surface which is underlain in this area by the Walnut Clay. In the lower valley, however, T2 ends abruptly at the base of a steep slope leading up to the Manning surface which is underlain by the undifferentiated Kiamichi Clay and Edwards formation.

Three alluvial landforms, T2, T1, and T0, are mapped in the Cowhouse Creek drainage basin as shown in Figure 4. Also shown are the soil-stratigraphic description localities taken from 28 trenches (TR1-28) and 18 cutbank exposures (CB1-18). Selected soil-stratigraphic profiles are displayed in Figure 5 and shown descriptively, along with the remaining localities, in Appendix A. From these descriptions five stratigraphic units and one buried paleosol were recognized which are

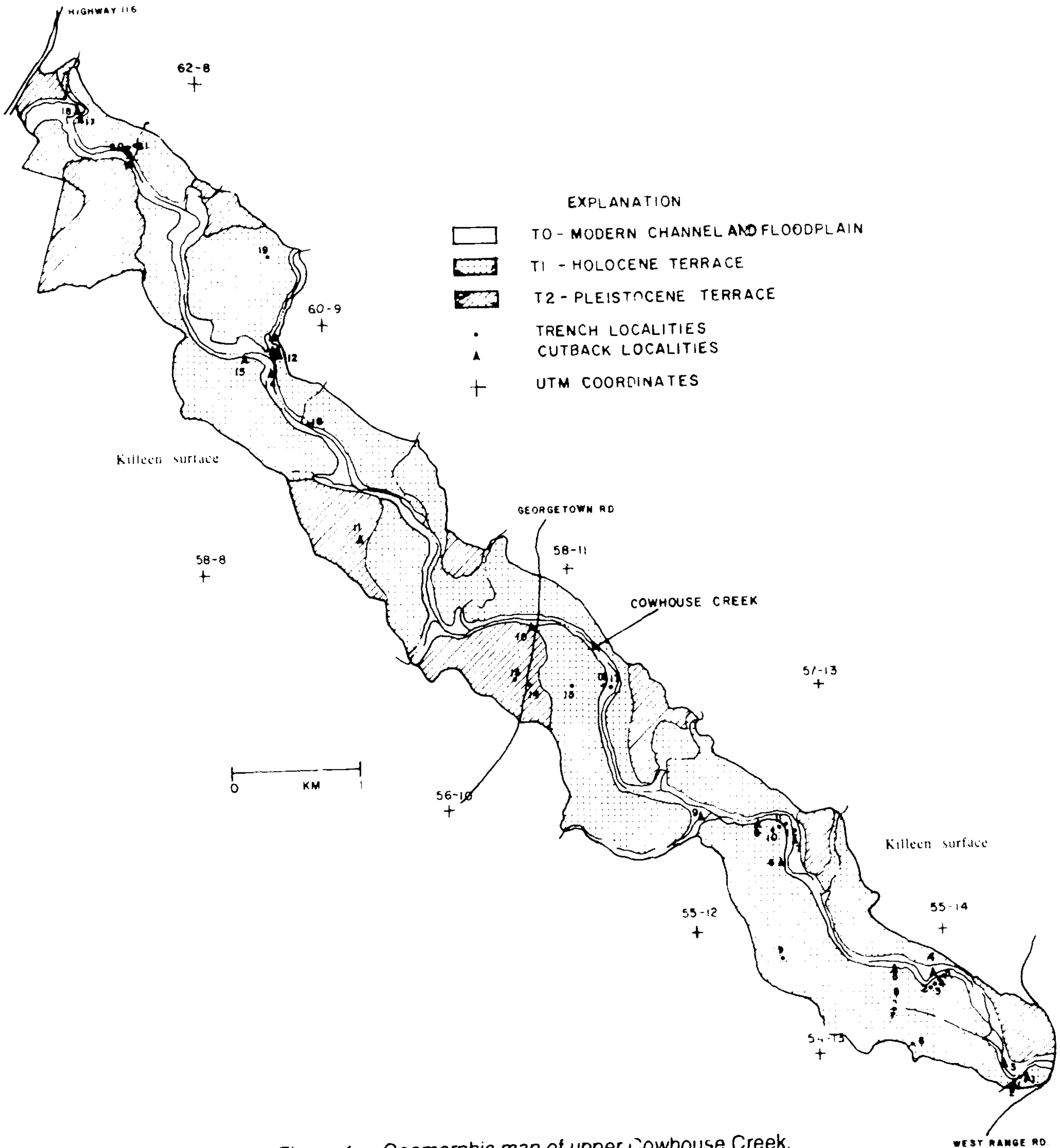


Figure 4a. Geomorphic map of upper Cowhouse Creek.

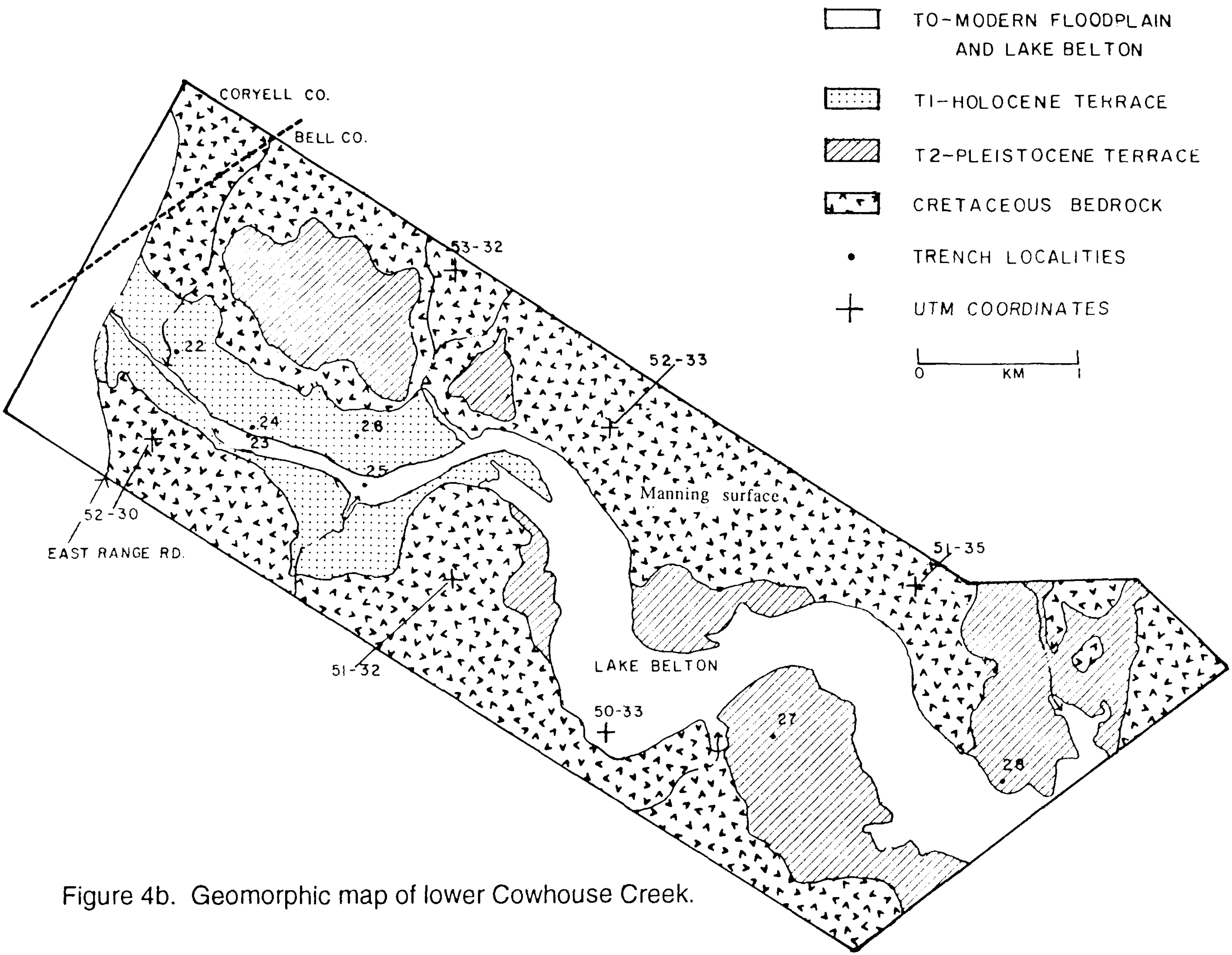


Figure 4b. Geomorphic map of lower Cowhouse Creek.

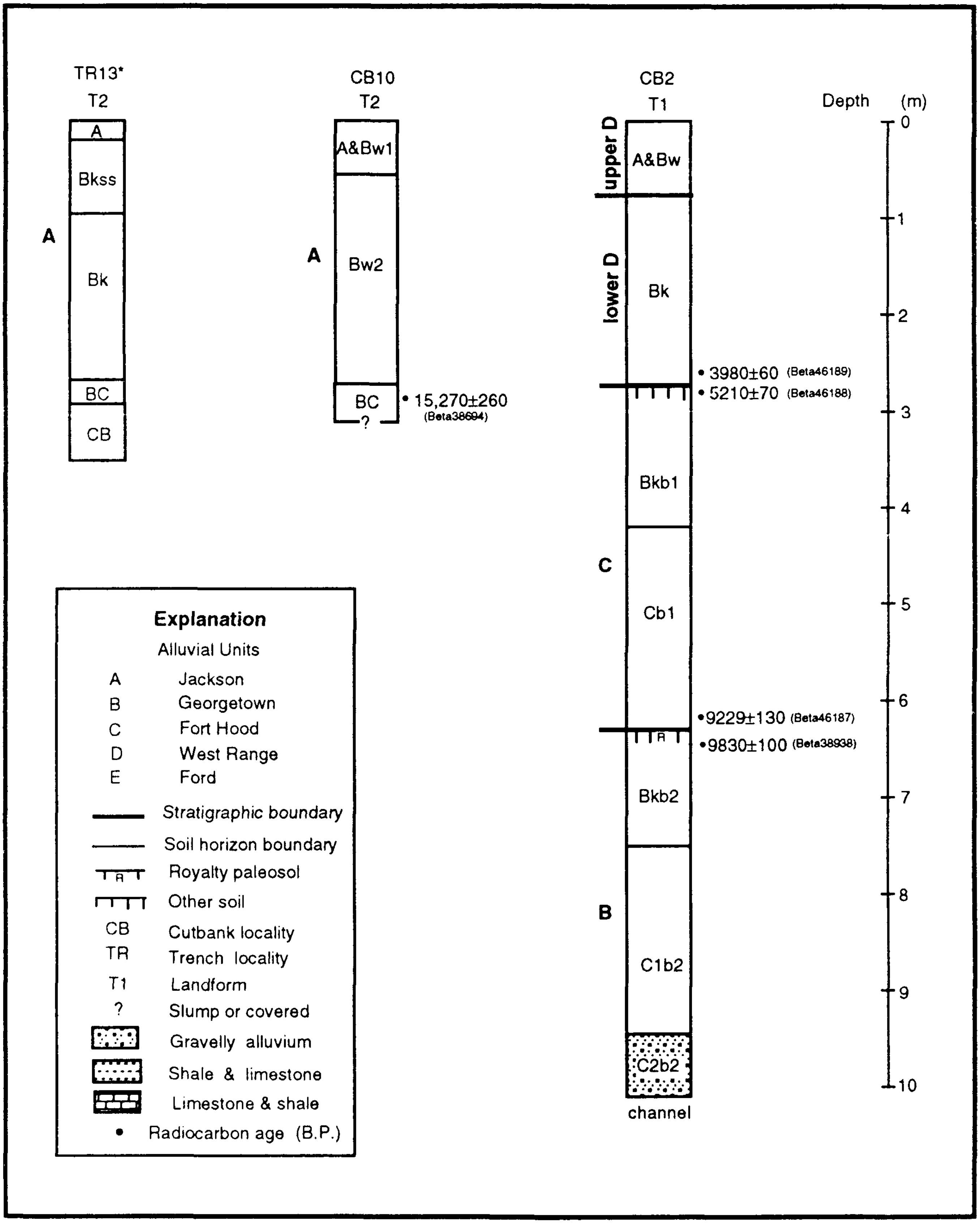


Figure 5. Selected soil stratigraphic profiles of units A,B and C of Cowhouse Creek. Charcoal ages are in bold and bulk humate ages in plain text (see Appendix A for soil stratigraphic descriptions, *Appendix I for soil characterization, and Appendix J for radiocarbon assays).

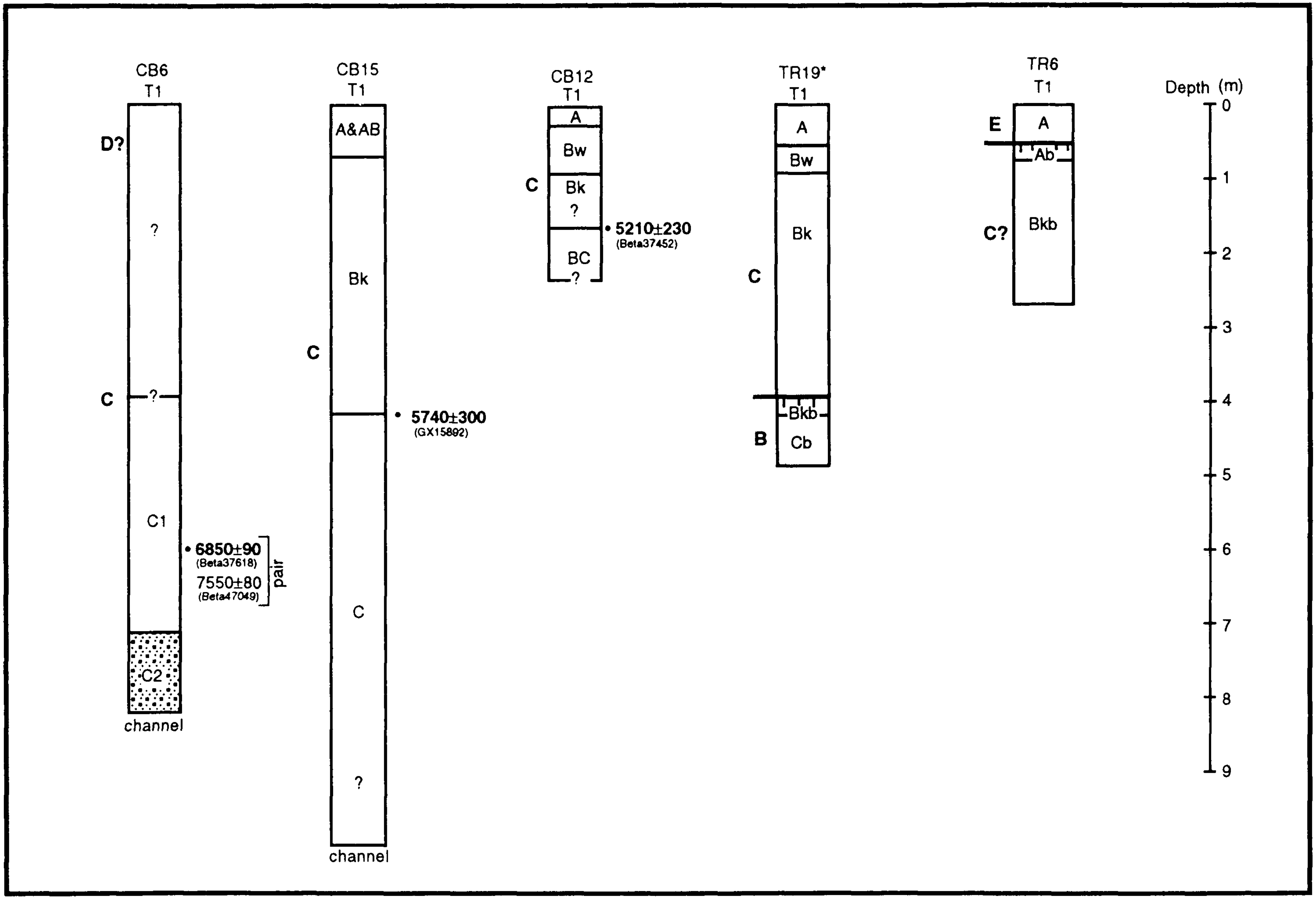


Figure 5 (continued). Selected soil stratigraphic profiles of units B and C of Cowhouse Creek.

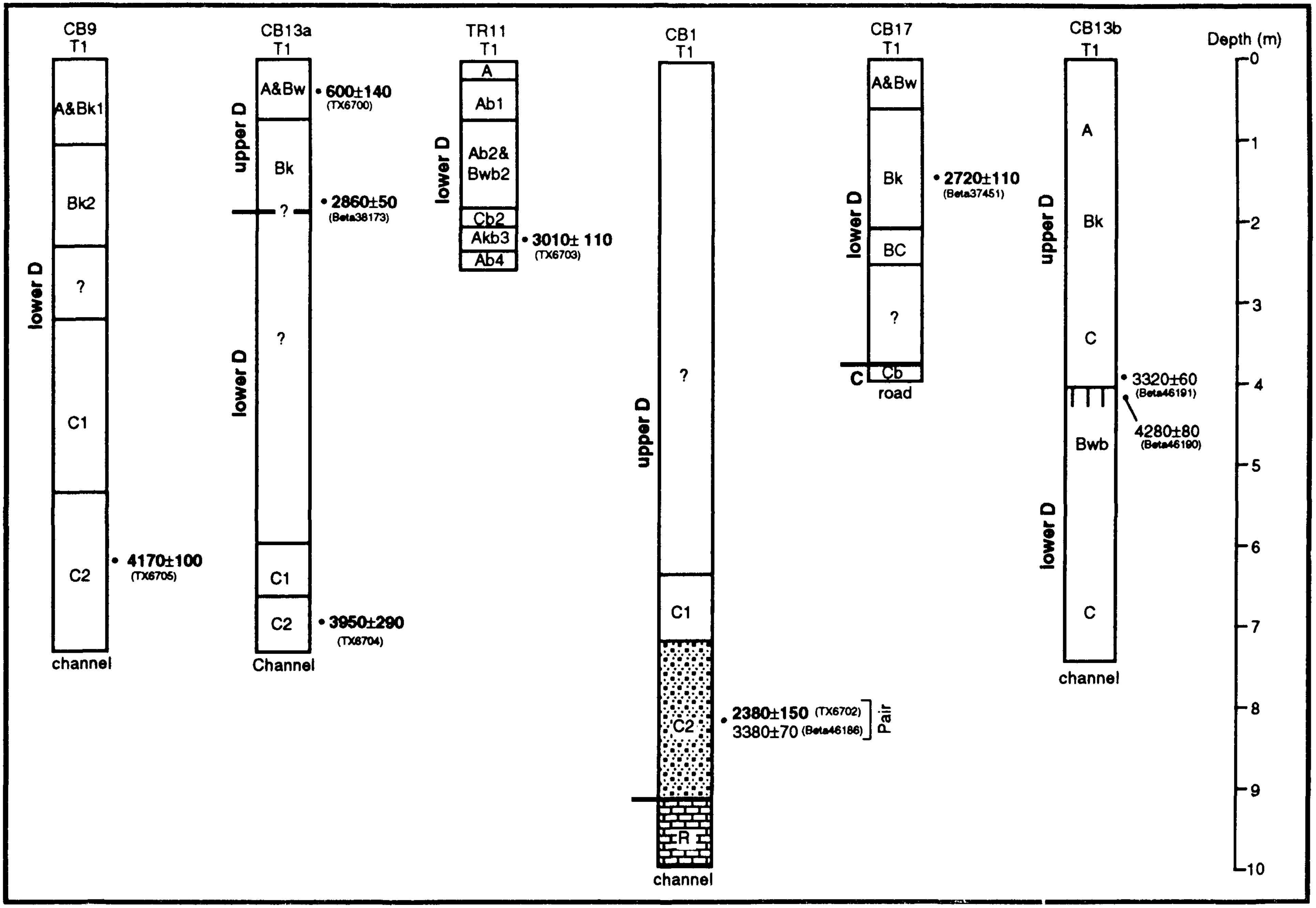


Figure 5 (continued). Selected soil stratigraphic profiles of units D and E of Cowhouse Creek.

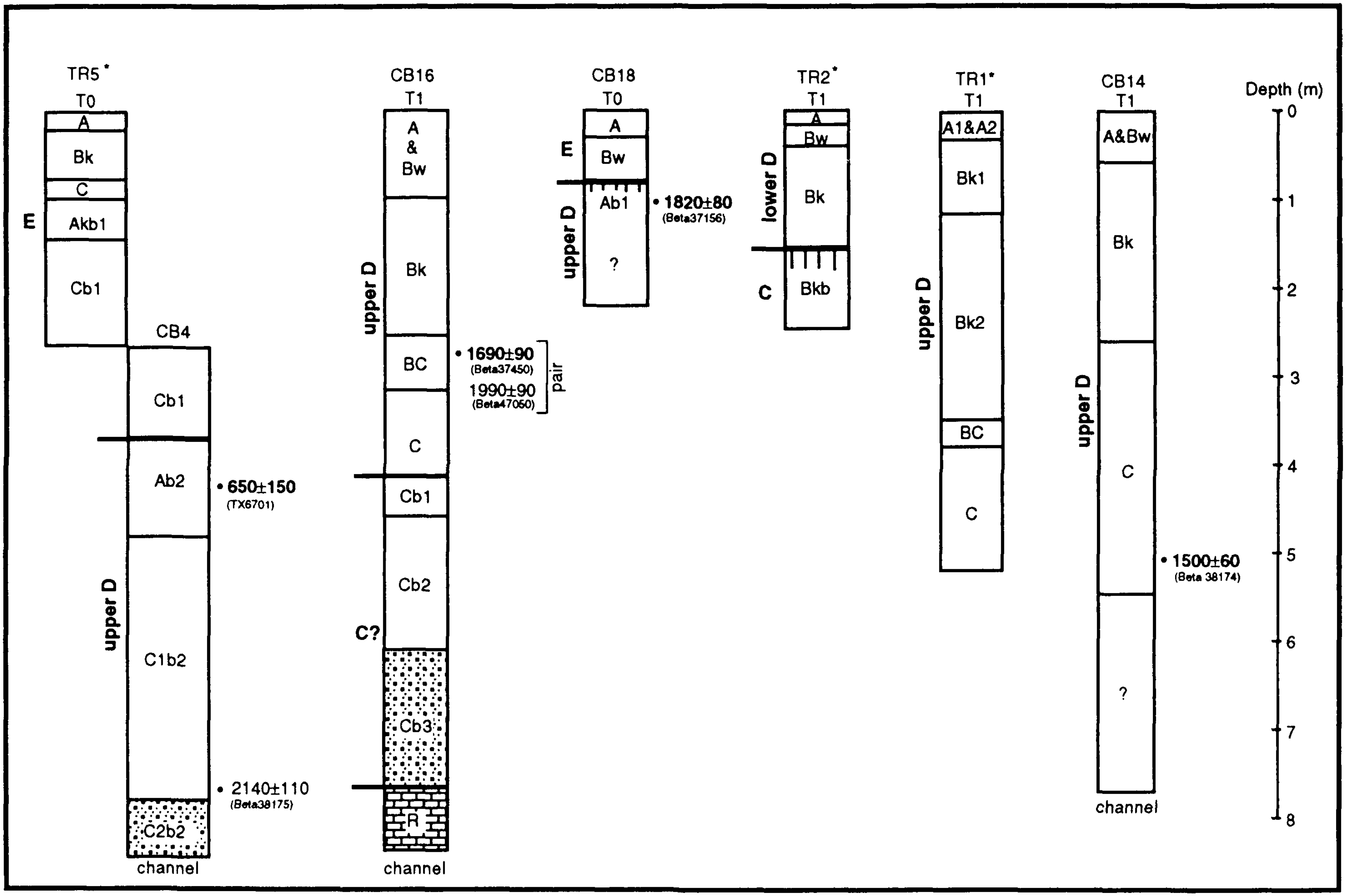


Figure 5 (continued). Selected soil stratigraphic profiles of units C, D and E of Cowhouse Creek.

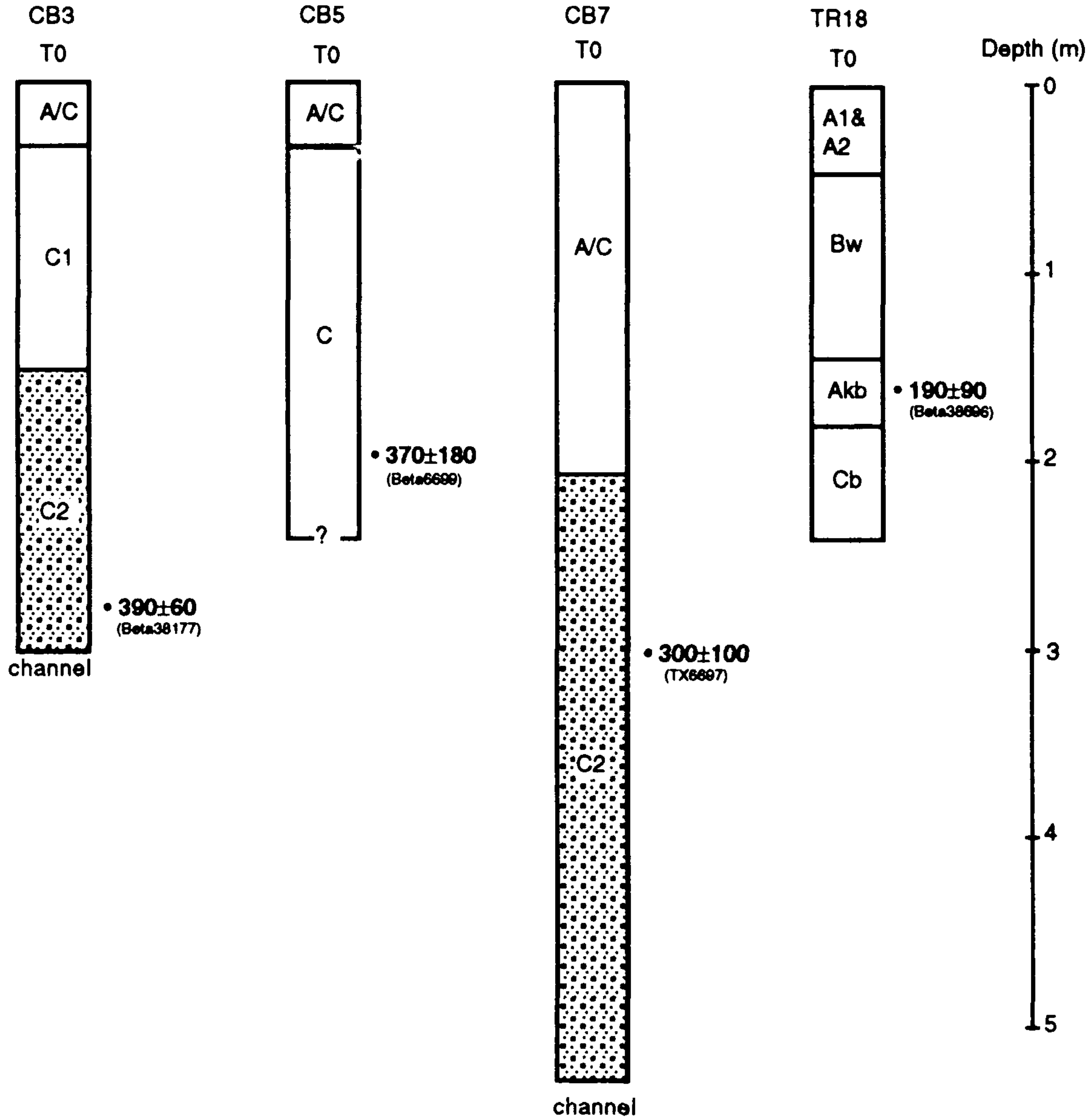


Figure 5 (continued). Selected soil stratigraphic profiles of unit E of Cowhouse Creek.

shown in the composite geologic cross section in Figure 6. These units are controlled in time by radiocarbon ages from seventeen charcoal samples (nine from cultural features and eight from dispersed sources), one from a log, and three from bulk humates (two sediment and one soil)(Appendix J). Characterization of five soil pedons representing the major stratigraphic units, are summarized in Appendix I.

Terrace 2 (T2)

Of the three geomorphic surfaces bordering Cowhouse Creek, Terrace 2 (herein referred to as T2) is the highest. This terrace is situated about 15 to 16 m above the modern channel and 10 to 15 m below the Killeen Surface/Walnut Clay (Figs. 4 and 5; TR13, 14, 27, 28; CB10, 11). Terrace 2 is relatively flat and featureless and consists of paired depositional remnants which implies time synchronity between pairs, and indicates a relict valley width of up to 1.5 km. East of East Range Road in the lower basin, T2 merges with the waterline of Lake Belton.

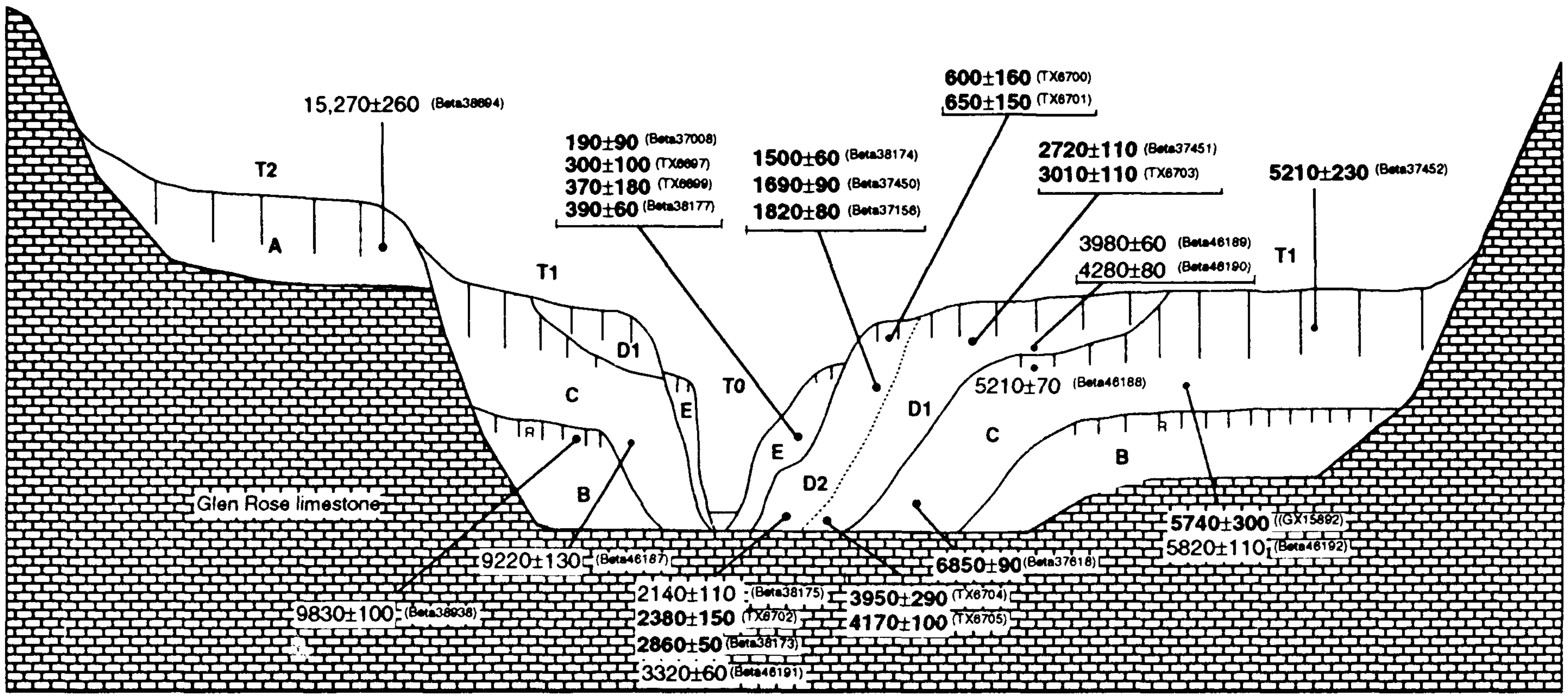
Two exposures (Figs. 4 and 5; CB10, 11) and one trench (Figs. 4 and 5; TR13) reveal that the alluvium beneath T2, named the Jackson alluvium (A), rests unconformably on a bedrock strath cut into the Glen Rose Limestone. Alluvial thickness reaches a maximum of 4 m and consists of two facies. The lower facies contains laterally accreted channel gravels that are occasionally cemented and overlain by massive to trough cross-stratified sands, occasionally interbedded with clayey and silty channel fills. The upper facies consists of 1 to 2.5 m of yellowish brown and strong brown, loams and sandy clay loams, that fine upward to clay loams. Soils of the Lewisville series (McCaleb, 1985) are mapped in the topstratum sediments beneath T2; however, they typically exhibit A-Bss-Bk profiles with noncalcareous A horizons not diagnostic of Lewisville soils. The presence of slickensides and cracking smectitic clays are, however, diagnostic properties of Vertisols (Chromusterts), thus placing pedons of T2 into an unknown soil series (for characterization see Appendix I, Cowhouse Creek, TR13).

Equal proportions of topstratum and bottomstratum facies exhibiting a fining upward sequence indicates that the Jackson alluvium was deposited by a meandering bedload stream. A bulk humate age of 15,270 ±260 (Beta 38694) B.P. was obtained from fine-grained channel fill sediments about 2.8 m below the T2 surface (Figs. 4 and 5; CB10). This age, because it was obtained from non-soil material, suggests that deposition of the Jackson fill was ongoing at this time. Radiocarbon ages from the Jackson and Georgetown alluvium indicate that a period of widespread bedrock valley trenching took place sometime between 15,000 and 10,000 B.P., the result of which abandoned the T2 floodplain and initiated scouring of the modern Holocene valley.

Terrace 1 (T1)

Terrace 1 (herein referred to T1) constitutes the broad featureless paired surface bordering Cowhouse Creek. It is 8 to 10 m above the modern channel and 5 to 7 m below T2. Below East Range Road T1 grades beneath the waterline of Lake Belton at the valley constriction. Terrace 1 is not subdivided because the underlying units all crop out to nearly the same surface elevation.

Terrace 1 is underlain by three stratigraphic units, the Georgetown (B), Fort Hood (C), and West Range (D), and is therefore, considered a composite terrace by Brackenridge (1981) and a diachronsus terrace (time-transgressive) by Bull (1991). The Georgetown alluvium is the oldest unit beneath T1. It is always deeply buried, rests unconformally on a scoured bedrock valley floor near the same depth as the modern channel, and is unconformably overlain and truncated by the Fort Hood alluvium (Figs. 4, 5, and 6; CB2, 8). The Georgetown consists of 1 to 2 m of fine, well-sorted channel



EXPLANATION

Alluvial Units

A - Jackson
B - Georgetown
C - Fort Hood
D1 - lower West Range
D2 - upper West Range
E - Ford

• Radiocarbon age (B.P.)
T0 - Landform
Royalty Paleosol
Other soil

3m

Figure 6. Generalized composite geologic cross section of Cowhouse Creek. Charcoal ages are shown in bold and bulk humate ages in plain text (sample ages not shown are Beta46178 and 46186; see Appendix J).

gravels abruptly overlain by 1 to 3 m of massive yellow and pale brown loams to silty clay loams. The proportion of topstratum and bottomstratum facies reflect deposition by a meandering stream.

The Georgetown alluvium is capped by a truncated Bk horizon named the Royalty paleosol. It is characterized by brown clay loams and silty clay loams containing encrusted filamentous carbonates. A radiocarbon age of 9830 ±100 B.P. (Beta 38938) (Figs. 4 and 5; CB2) was determined from bulk humates from this horizon which probably represents the base of the soil. This age, however, may be as much as 1700 years older than the event that deposited the sediment (see the section on Radiocarbon Interpretations, page 13). Accordingly, deposition and soil formation was ongoing no earlier than 9830 B.P. An age of 9220 ±130 (Beta 46187) was determined from humates just above the erosional unconformity surfacing the Royalty paleosol. This demonstrates that soil formation under stable landscape conditions could have been no more than about 800 years. This implies that the encrusted filaments and threads may have in part developed cumulicly during relatively long-term slow alluvial deposition and possibly even after truncation and burial while the soil was still within the effective wetting zone from the overlying subaerial surface.

The next two younger alluvial units, the Fort Hood (Unit C) and the West Range (Unit D), crop out at the surface of the T1 tread. The Fort Hood alluvium comprises by volume about one-half of the total alluvium beneath T1 and is concentrated in the outer half of the T1 floodplain (Figs. 4 and 5; TR6, 7, 8, 9, 10, 15, 19, 22, 26; CB 12, 15). The basal unconformity with the bedrock valley floor is at the same depth as the modern channel and the Georgetown alluvium. Fort Hood alluvial aggradation, however, reaches a maximum thickness of 10 m which buries the Georgetown with as much as 5 m of alluvium. In some areas lateral migration of the Fort Hood channel system completely removed the Georgetown alluvium. Moderately well sorted, fine to medium basal gravels commonly contained in cross-bedded sets 1 to 3 m thick, typically grade upward to 5 to 7 m of fine-grained, yellowish brown to dark yellowish brown overlying point bar and distal floodplain deposits. Although the Fort Hood channel type appears to have been meandering, as much as 60 percent of the sediments were deposited as topstratum facies indicating a suspended load stream. Within, and slightly outside the modern meanderbelt, 1 to 3 m of the uppermost Fort Hood alluvium was truncated and then backfilled by West Range alluvium (Figs. 4 and 5; TR2[1], 3, 4, 20, 21; CB2, 6, 17). Charcoal radiocarbon ages demonstrate that the bulk of Fort Hood sediments were deposited between 6850 ±90 B.P. (Beta 37618) and 5210 ± 230 B.P. (Beta 37452). Based on a humate age deposition could have begun as early as 9220 ± B.P. in some places.

Subordinate fan deposits were entering from local upland tributaries onto T1 during the time of Fort Hood alluviation (Figs. 4 and 5; TR6). Fan facies apparently aggraded and interfingered with fluvial valley fill sediments and do not represent discrete temporal sediment packages sealed within the fluvial deposits. Soil characteristics on these facies, excluding the upper 47 cm of Historic overwash, are very similar to soils formed in the Fort Hood overbank fluvial facies.

Where not truncated or buried by the younger West Range alluvium, soils developed in fluvial and fan facies of the Fort Hood alluvium have been forming for about 5000 years. These soils commonly exhibit dark silty clay loam surface horizons that grade down into Bk horizons with 10 to 20 percent encrusted filamentous carbonates (See Appendix I, Cowhouse Creek, TR19). Even though Fort Hood soils classify as Calciustolls (Mollisols with Calcic horizons) similar to the Lewisville Series,

[1] See Appendix I, Cowhouse Creek, TR2.

they are typically mapped as phases of the Bosque Series (McCaleb, 1985). This is probably due in large part to the difficulty in delineating two adjacent, but dissimilar soils forming in sediments cropping out to the same surface elevation in a floodplain or terrace setting.

A shift in channel sediment load, possibly accompanied by an increased in discharge, occurred sometime between 5210 and 4170 ± 100 B.P. (TX 6705) which initiated alluviation of the next younger unit, the West Range. The West Range alluvium is the youngest of the three units beneath T1, is erosionally inset to the Fort Hood alluvium within and slightly outside of the modern Cowhouse Creek meanderbelt (Figs. 4 and 5; TR1, 11, 16; CB1, 4, 9, 13, 14, 16, 18), and in places laterally overlaps the Fort Hood alluvium (Figs. 4 and 5; TR2, 3, 4, 20, 21, 24; CB2, 6, 17). The unconformable contact with the underlying bedrock valley floor is to a similar depth as the other two fills beneath T1. West Range is subdivided into two stratigraphic members (units D1 and D2) based on radiocarbon ages and geomorphic and cross cutting relations. Basal ages of 4170 and 3950 ± 290 B.P. (TX 6704) (Figs. 4 and 5; CB9, 13) from charcoal mark the initiation of lower West Range alluviation (D1) which continued up until approximately 2720 ± 110 B.P. (Beta 37451) or shortly thereafter (Figs. 4 and 5; TR2, 11; CB13, 17). Aggradation proceeded until a surface elevation nearly equal to the Fort Hood alluvial surface was attained making surface geomorphic distinction between the two units problematic.

A second episode of channel incision began between 2720 B.P. and 2380 ± 150 B.P. (TX 6702) (Figs. 4 and 5; CB13, 1) and was followed by deposition which did not terminate until near 600 ± 140 B.P. (TX 6700) (Figs. 4 and 5; CB4, 13). This upper West Range member (D2) vertically aggraded to within 1 m of the surface of the lower member and Fort Hood alluvium producing a topographic scarp between the two which is most clearly expressed in the upper Cowhouse Creek basin. In the lower basin, which includes CB2 of the upper basin (Fig. 4), the upper member overlaps the lower and grades laterally to the elevation of the Fort Hood alluvium.

Bulk humate ages cannot be used to determine the timing of cutting and filling between the upper and lower West Range members. Ages from a bulk humate (3380 ± 70 B.P., Beta 46186) and charcoal pair at Cutbank 1 (CB1) (2380 ± 150) demonstrate that humates are dating older than charcoal. Furthermore, at this same locality about 5 m above the humate/charcoal pair, a bulk sediment humate age of 3580 ± 100 B.P. (Beta 38176) was determined and is clearly stratigraphically inconsistent. Consequently, the bulk humate ages at this section are rejected. Bulk humate ages from CB13b (Fig. 5; not described in Appendix) show the second episode of West Range channel cutting to be between 4280 ± 80 B.P. (Beta 46190) and 3320 ± 60 B.P. (Beta 46191). These ages are also taken to be slightly older than the actual erosional event. Again, more confidence is placed on the charcoal ages.

Sedimentological character between the two members of the West Range alluvium is similar. The channel facies typically consists of one to three meters of fine to medium, moderately well-sorted, gravels and sands deposited in laterally accreted point bars. Brown and dark brown, loamy topstratum deposits either directly overlie channel fills or laterally truncate and partly onlap the Fort Hood alluvium. Lithology, sedimentary structures, and facies relationships point to a relict coarse-grained bedload meandering stream.

The West Range alluvium is capped by soils mapped as part of the Bosque Series (McCaleb, 1985). These soils typically consist of brown and loamy A-Bk profiles with 5 to 15% mycelial carbonates. They are time-transgressive and have been forming for as much as 2800 years on the lower West Range member, but for as little as 600 years on the upper member. They classify as Mollisols (Calciustolls) with minimally developed calcic horizon on the lower member and as Haplustolls on the upper member (see Appendix I, Cowhouse Creek, TR1).

Terrace 0 (T0)

The active floodplain (T0) includes the modern Cowhouse Creek channel, bar, and overbank sediments and is the only surface of the three that floods on a regular basis (Figs. 4 and 5; TR5, 12, 17, 18, 23, 25; CB3, 4, 5, 7, 18). The floodplain is spatially confined to a narrow segment traversing the middle of T1 because the deeply entrenched modern channel carries a high volume of water at bankfull-stage. The modern sediments, named the Ford alluvium, are erosionally inset to the older Holocene alluvium and consists of laterally accreted point bar sands and gravels and vertically accreted brown to very pale brown, loams and sandy loams. Modern gravel and sand point bars have accreted to several meters above the low-flow channel as a result of wide variations in stream discharge. Overbank deposits are located exclusively within the modern meanderbelt. They have aggraded vertically to within 1.5 to 3 m of T1, and occasionally overlie truncated and deeply buried West Range alluvium. On both sides of straight channel segments, as much as 7.5 m of overbank deposits have accumulated. Surface soils are poorly developed having A-Bk or A-Bw profiles that classify as Entisols (Ustifluvents) or Inceptisols (Ustochrepts) (see Appendix I, Cowhouse Creek, TR5).

A suite of radiocarbon ages, all determined from dispersed and culturally-derived charcoal, demonstrate that channel metamorphosis, accompanied by slight bedrock incision relative to the other Holocene units, occurred sometime between 600 and 400 B.P., and that deposition has been ongoing since. Radiocarbon ages also suggest that 2 to 3 m of Ford alluvium has been deposited on T0 during the last 200 to 300 years in overbank positions up to 7.5 m above the modern channel.

TABLE ROCK CREEK

Table Rock Creek, an intermittent tributary of Cowhouse Creek, drains approximately 175 km^2 of lower Cretaceous limestones, shales and marls (Fig. 2). Sinuosity is 1.3, channel gradient 3.2 m/km, and drainage basin relief 350 to 220 m. Valley length of Table Rock within the Fort is about 7 km. Table Rock, which flows on the Glen Rose Limestone, represents a transitional braided/meandering stream (Schumm and Brackenridge, 1987) as evidenced by lateral and mid-channel longitudinal bars in straight stream segments and point bars on meander bends. The Killeen surface underlain by the Walnut Clay is adjacent to all parts of the late Quaternary alluvial valley of Table Rock Creek.

Three alluvial landforms T2, T1, and T0, are mapped in the Table Rock Creek drainage basin as shown in Figure 7. Terrace 1 is subdivided into T1a and T1b components for Table Rock. Also shown on Figure 7 are the soil-stratigraphic description localities taken fron 12 trenches (TR1-12) and 7 cutbank exposures (CB1-7). Selected soil-stratigraphic profiles are displayed in Figure 8 and shown descriptively, along with the remaining localities, in Appendix B. From these descriptions, five stratigraphic units and one buried paleosol were recognized which are shown in the composite geologic cross section in Figure 9. These units are controlled in time by radiocarbon ages from five charcoal samples (four from cultural features and one from dispersed sources), and one from bulk sediment humates (Appendix J). Characterization of two soil pedons are summarized in Appendix I.

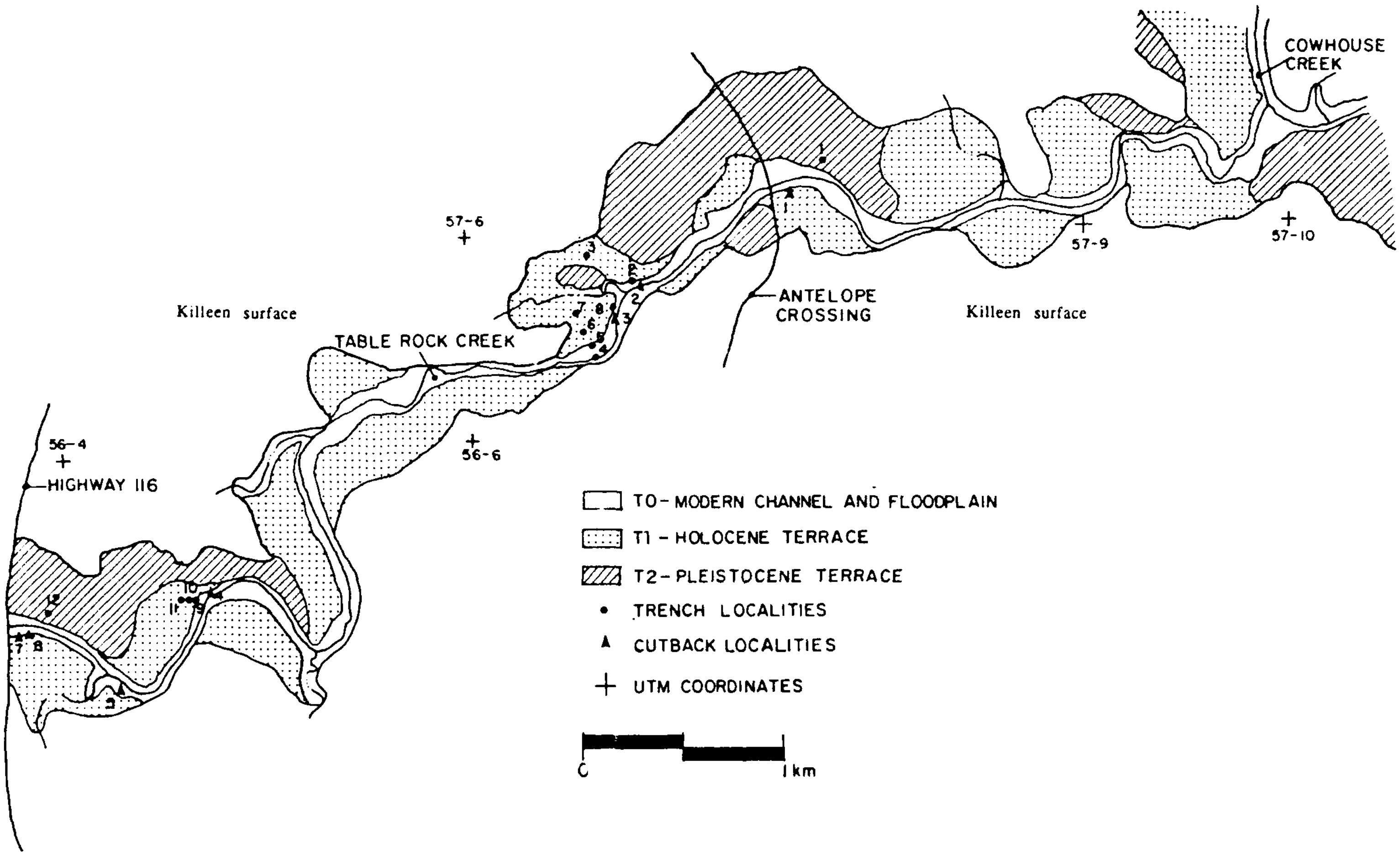


Figure 7. Geomorphic map of Table Rock Creek.

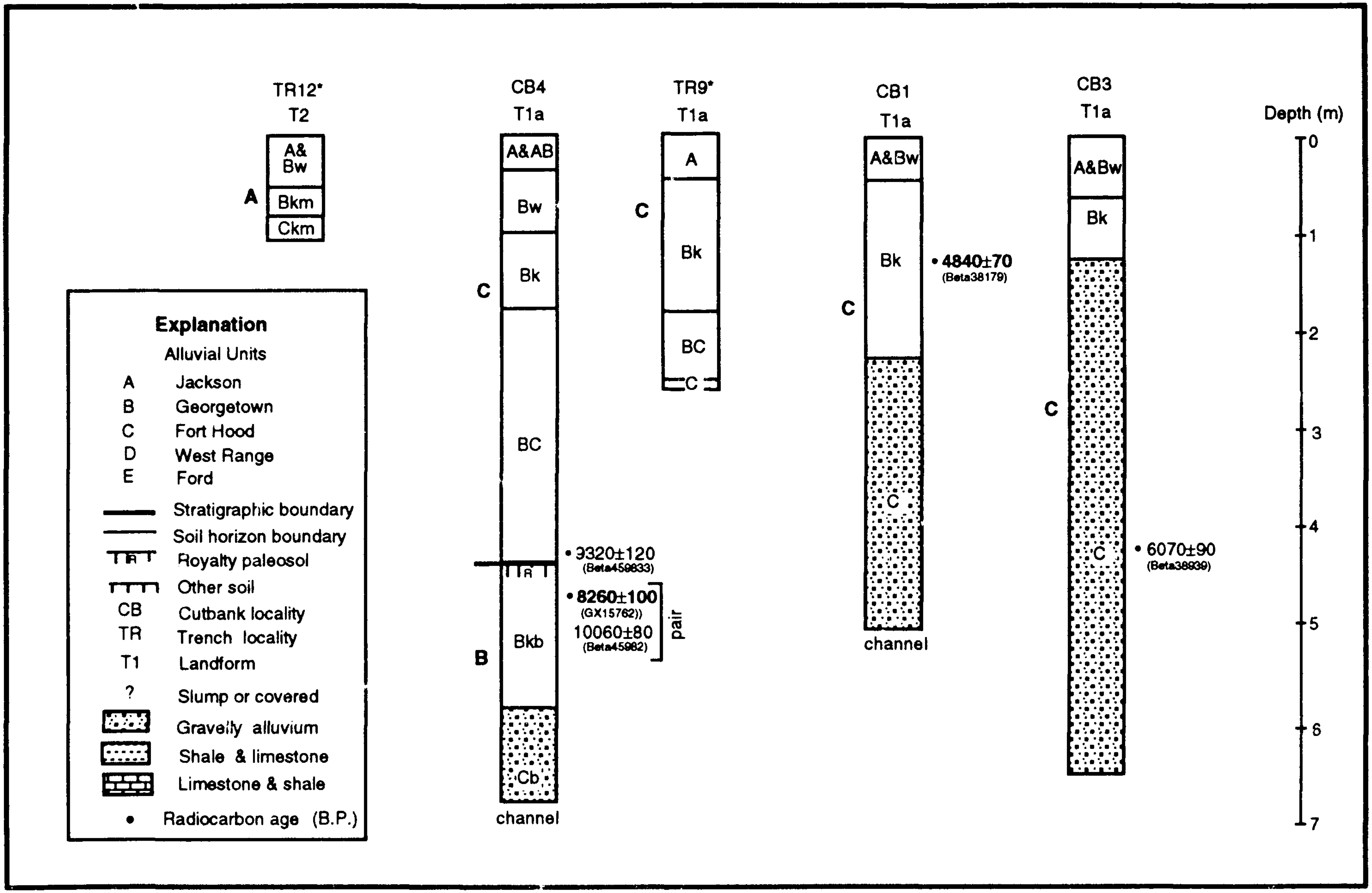


Figure 8. Selected soil stratigraphic profiles of units A, B and C of Table Rock Creek. Charcoal ages are shown in bold and bulk humates in plain text (see Appendix B for soil stratigraphic descriptions, *Appendix I for soil characterization, and Appendix J for radiocarbon assays).

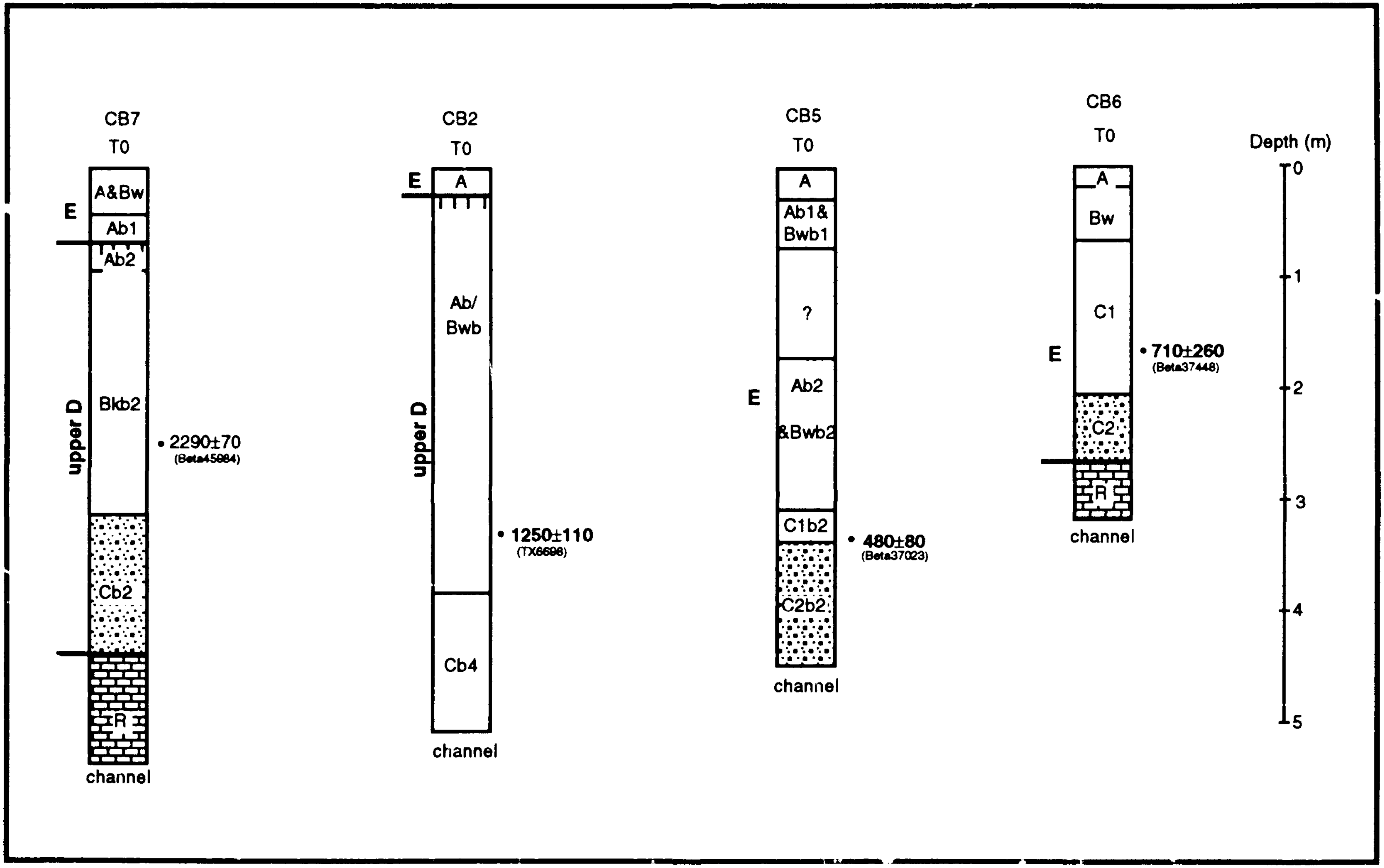


Figure 8 (continued). Selected soil stratigraphic profiles of units D and E of Table Rock Creek.

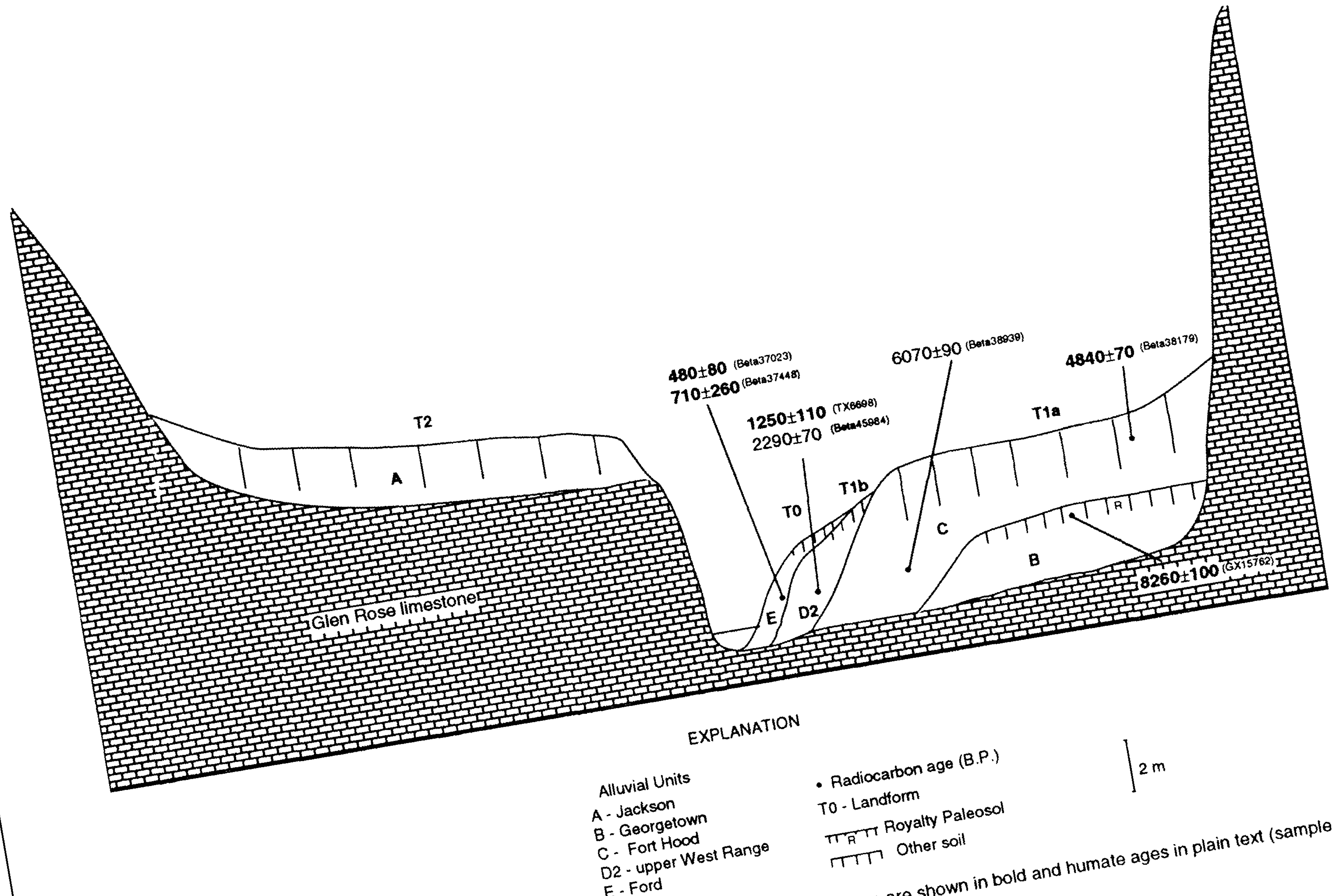


Figure 9. Generalized composite geologic cross section of Table Rock Creek. Charcoal ages are shown in bold and humate ages in plain text (sample ages not shown are Beta45982 and 45983; see Appendix J).

Terrace 2 (T2)

Terrace two (T2) is a flat, gently sloping, featureless depositional terrace situated about 10 to 12 m above the modern Table Rock channel (Figs. 7 and 8; TR1, 12). The base of the alluvial fill rests on a bedrock strath cut into the Glen Rose Limestone about 9 to 10 m above the modern channel. Terrace 2 is confined primarily to the north side of the valley indicating that the valley was constructed as the stream system migrated in a net southward direction. Terrace 2 often grades imperceptibly up to the uplands of the Killeen surface. Geomorphic evidence near TR1 suggests that there may be two surface levels and two underlying alluvial units associated with T2, but further data are needed to make a more conclusive assessment.

The fill beneath this terrace consists of 2 to 3 m of predominantly poorly sorted, fine to coarse gravels, overlain by 1 to 2 m of clayey and loamy topstratum deposits. Gravelly cross-bedded sets in basal positions suggest a relict bedload meandering stream, although the abundance of gravels may represent localized braiding. The overlying soils are commonly reddish brown to strong brown, clay loams and clays with filamentous carbonates that may contain petrocalcic horizons in areas with near-surface gravels. These A-Bk and A-Bkm profiles classify as Mollisols (Calciustolls; see Appendix I, TR12) and are mapped as part of the Lewisville series (McCaleb, 1985). No radiocarbon ages are available from this unit, although reddish brown Bk subsoils, noncalcareous A horizons, and stratigraphic position suggest a late Pleistocene age and correlation with the Jackson alluvium (A) of Cowhouse Creek.

Terrace 1 (T1a)

Unlike Cowhouse Creek, T1 of Table Rock is subdivided into T1a and T1b components. This division is made because a low-relief topographic scarp separates units correlated to the Fort Hood (T1a) and West Range (T1b) alluvium. Terrace 1a comprises most of the T1 surface mapped in Figure 7 and is confined to the outer half to two-thirds of the T1 valley. This surface also includes subordinate colluvial fan facies originating from Killeen and Manning side slopes. Terrace 1a is underlain by units correlated with the Fort Hood (Figs. 7 and 8; TR2, 3, 5, 6, 7, 9, 10, 11; CB1, 3, 4) and Georgetown alluvium (Figs. 7 and 8; CB4). The Georgetown, which is always truncated and buried beneath 3 to 4 m of Fort Hood alluvium, consists of 2 to 3 m of yellowish brown and gray, loam to sandy clay loam point bar and overbank deposits which grade down to well-sorted, granule to pebble sized channel gravels. The eroded Bk horizon capping this unit contains encrusted filamentous carbonates and is correlated with the Royalty paleosol. Charcoal obtained from a hearth in this soil dated to 8260 ± 100 B.P. (GX 15762) which is considerably younger than a paired bulk humate age of 10060 B.P. (Beta 45982) (Fig. 8). This age discrepancy places doubt on the 9320 ± 120 B.P. (Beta 45983) bulk humate age from just above the erosional unconformity surfacing the Royalty paleosol. The 8260 B.P. charcoal age probably more closely represents the end of deposition of the Georgetown alluvium than does the 10060 B.P. humate age.

The Fort Hood alluvium is the dominant unit beneath T1a. It unconformably overlies the Georgetown alluvium and consists of two distinct lithofacies both representing braided to transitional braided-meandering channel regimes. The gravelly bedload type occurs at CB3 (Figs. 7 and 8) and is characterized by over 6 m of horizontal and cross-bedded stacked channel gravels with few interbedded yellowish brown, loamy channel fills. The upper A-Bw-Bk profiles contain diffuse gravels in a dark brown, sandy clay loam matrix with few carbonatic pendants and classify as Mollisols with incipient calcic horizons (Calciustolls or Haplustolls). The second channel type consists of stacked fine-grained channel fills (Figs. 7 and 8; CB1) sometimes overlain by thick clay loam topstratum facies in which Mollisols (Calcuistolls) with Bk horizons and encrusted filamentous carbonates have formed (Figs. 7 and 8; CB1, 4). Soil mapping units of the Coryell County Soil Survey (McCaleb, 1985) do not correspond with the alluvial landforms mapped in this report. Lewisville and Bosque soils are often mapped on any of the landforms.

A charcoal age places the end of Fort Hood aggradation to near 4840 ± 10 B.P. (Beta 38179). Initiation of aggradation is more difficult to interpret, but certainly began after 8260 B.P. A bulk humate age of 6070 ± 90 B.P. (Beta 38939) indicates that deposition was ongoing at this time, or possibly shortly thereafter. These ages, plus carbonate morphology, yellowish brown colors, and soil classification, strongly substantiate correlation with the Fort Hood alluvium of Cowhouse Creek (see Appendix I, Table Rock Creek, TR9). Based on charcoal ages, the shift from the meandering stream of Georgetown times to braiding during Fort Hood times occurred sometime between 8260 but before 4840 B.P. which is consistent with channel metamorphosis of Cowhouse Creek during this same period.

Terrace 1 (T1b)

The T1b landform is confined to a narrow surface inset to T1a within the modern meanderbelt (Figs. 7 and 8; TR8; CB2, 7). A 1250 ± 110 B.P. (Texas 6698) radiocarbon age, mycelial soil carbonate morphology, grayish brown sediment color, and loamy textures all point to a correlation with the upper West Range alluvium of Cowhouse Creek. Deposition probably continued up until near 710 ± 260 B.P. (Beta 37448), which is the oldest age from the overlying Ford aluvium. A bulk humate age of 2290 ± 70 B.P. (Beta 45984) determined from bulk humate at CB7 is tentatively correlated with the upper West Range alluvium.

Although the base of the upper West Range member is at the same depth as that of the Fort Hood alluvium, vertical aggradation was somewhat less and as a result portions of T1b are overlain by recent flood deposits of the Ford alluvium (T0). West Range topstratum sediments are typically brown loams with few to common mycelial carbonates in Bk horizons which classify as Mollisols (Haplustolls). Bottomstratum deposits are brown to yellowish brown, loams to sandy loams with few pebble to cobble size gravels that are occasionally cross-stratified. This unit is dominated by fine and medium grained overbank facies in one section (Figs. 7 and 8; CB2) and numerous superimposed cut-and-fill sequences in another section (Figs. 7 and 8; CB7), indicating that floodplain construction occurred by braiding and/or transitional meandering-braiding channels.

Terrace 0 (T0)

The active floodplain of Table Rock Creek is confined to a narrow inset zone bordering the entrenched modern channel (Figs. 7 and 8; TR4, 8; CB2, 5, 6, 7). Topstratum sediments may directly overlie modern channel and bar deposits or truncate and onlap portions of the West Range alluvium. Lithology is characterized by dark brown to pale brown, loamy and sandy stratified beds. Modern gravel bars, either exposed or partly buried, represent the bottomstratum facies and rest on the bedrock valley floor at about the same depth as the older Holocene units. Weakly developed soil profiles classify as Mollisols (Haplustolls) and Inceptisols (Ustochrepts) and are mapped here, as on T1b, as part of the Bosque series (McCaleb, 1985). This unit is correlated with the Ford alluvium because of radiocarbon ages of 710 and 480 ± 80 B.P. (Beta 37023) which demonstrates that the abrupt transition from West Range to Ford alluviation occurred between 1250 and 710 B.P.

OWL CREEK

Within the study area Owl Creek drains approximately 72 km^2 of shales and limestones, has a sinuosity of 1.1, channel gradient of 3.4 m/km, and drainage basin relief ranging from 320 to 230

m. Only the lowermost 6 km of Owl Creek, above its confluence with Preachers Creek and below the Impact Area, was investigated. Owl is an intermittent stream which displays channel braiding within a larger meanderbelt system and flows predominantly on the Walnut Clay. The Killeen surface is intricately intermingled with T2 on the north side of the basin while the south side is bordered by steep bluffs leading up to the Manning surface.

Three alluvial landforms, T2, T1, and T0 are mapped in the Owl Creek drainage basin as shown in Figure 10. T1 is further subdivided into T1a and T1b componendts in Figures 11 and 12. Also shown on Figure 10 are the soil-stratigraphic description localities taken from 10 trenches (TR1-10) and 7 cutbank exposures (CB1-7). Selected soil-stratigraphic profiles are displayed in Figure 11 and shown descriptively, along with the remaining localities, in Appendix C. From these descriptions five stratigraphic units and one buried paleosol were recognized which are shown in the composite geologic cross section in Figure 12. These units are controlled in time by radiocarbon ages from three charcoal samples (one from a cultural feature and two from dispersed sources), and three bulk humates (one sediment and two soil) (Appendix J).

Terrace 2 (T2)

The earliest alluvial event recorded in the Owl Creek basin is contained beneath the undulating T2. Terrace 2 is mapped as a complex with the Killeen surface on the north end of the drainage basin some 9 to 20 m above the modern channel (Figs. 10 and 11; TR6; CB3). Terrace 2 grades up to the older Killeen surface in this area, with its north-side position indicating net southward channel migration and drainage basin development. The valley of Owl Creek, as well as the other smaller valleys, may have been excavated during Killeen times and subsequently reworked by streams during the late Quaternary.

Multiple surfaces of T2, along with underlying multiple cuts-and-fills observed adjacent to CB6 (Figs. 10 and 11), suggests a multi-component alluvial fill beneath this terrace which thickens and becomes more complex downstream. This alluvium is 2 to 4 m thick and consists of 1 to 2 m consists of poorly-sorted, pebble and cobble size gravels that grades up into 1 to 2 m of yellowish brown, strong brown, and light yellowish brown, clay loam topstratum deposits. The A-Bw and A-Bss soil profiles, and noncalcareous surface horizons, indicate significant removal of carbonates and a correlation with the late Pleistocene Jackson alluvium. The soils on T2 and the Killeen surface are, however, mapped mainly as part of the nonalluvial Brackett-Topsey association (McCaleb, 1985). Soils formed directly from the Jackson alluvium tend to classify as Vertisols (Chromusterts or Pellusterts). Facies relationships reflect a meandering bedload or a meandering-braided transitional stream.

Terrace 1 (T1a)

Terrace 1 (T1) is divided into two geomorphic components, T1a and T1b, based on topographic expression. Two stratigraphic units lie beneath T1a, the deeply buried Georgetown alluvium and the overlying and surficially exposed Fort Hood alluvium (Figs. 10 and 11; CB6). The lower fill is considered to be the Georgetown because of stratigraphic position sedimentological character, and a radiocarbon age of 11,325 ± 150 B.P. (GX 15763) obtained from humates from the Royalty paleosol (Bk horizon). In addition, a mammoth tooth was discovered near the basal contact with the Walnut Clay, although it is unclear whether this tooth originated from the older Jackson alluvium or from the Georgetown alluvium itself; however, it does indicate the presence of Pleistocene megafauna in this area. The Royalty paleosol capping the Georgetown alluvium, overlies 1 to 1.5 m of light yellowish brown and olive yellow, sandy clay loam which grades down to 1 to 2

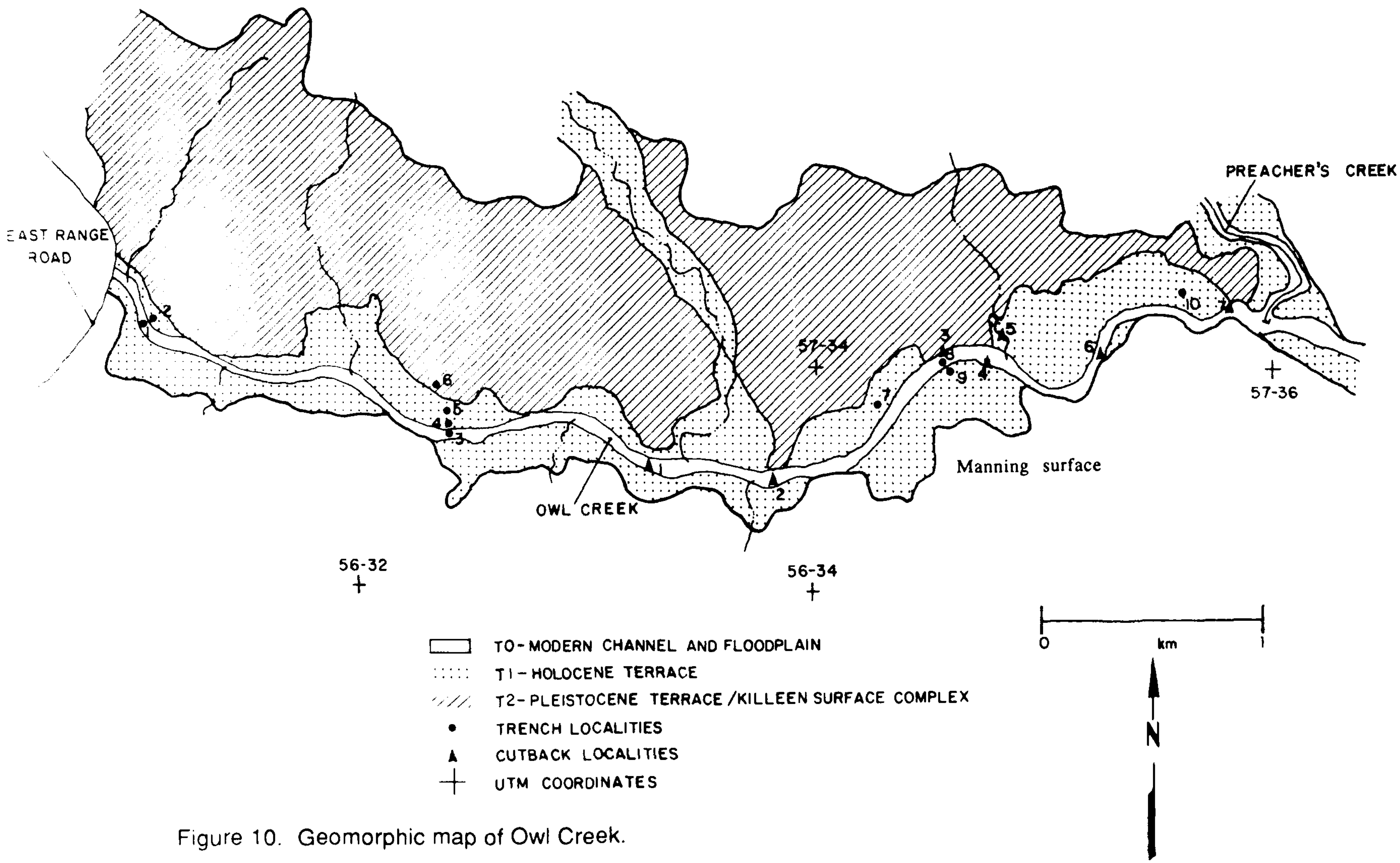


Figure 10. Geomorphic map of Owl Creek.

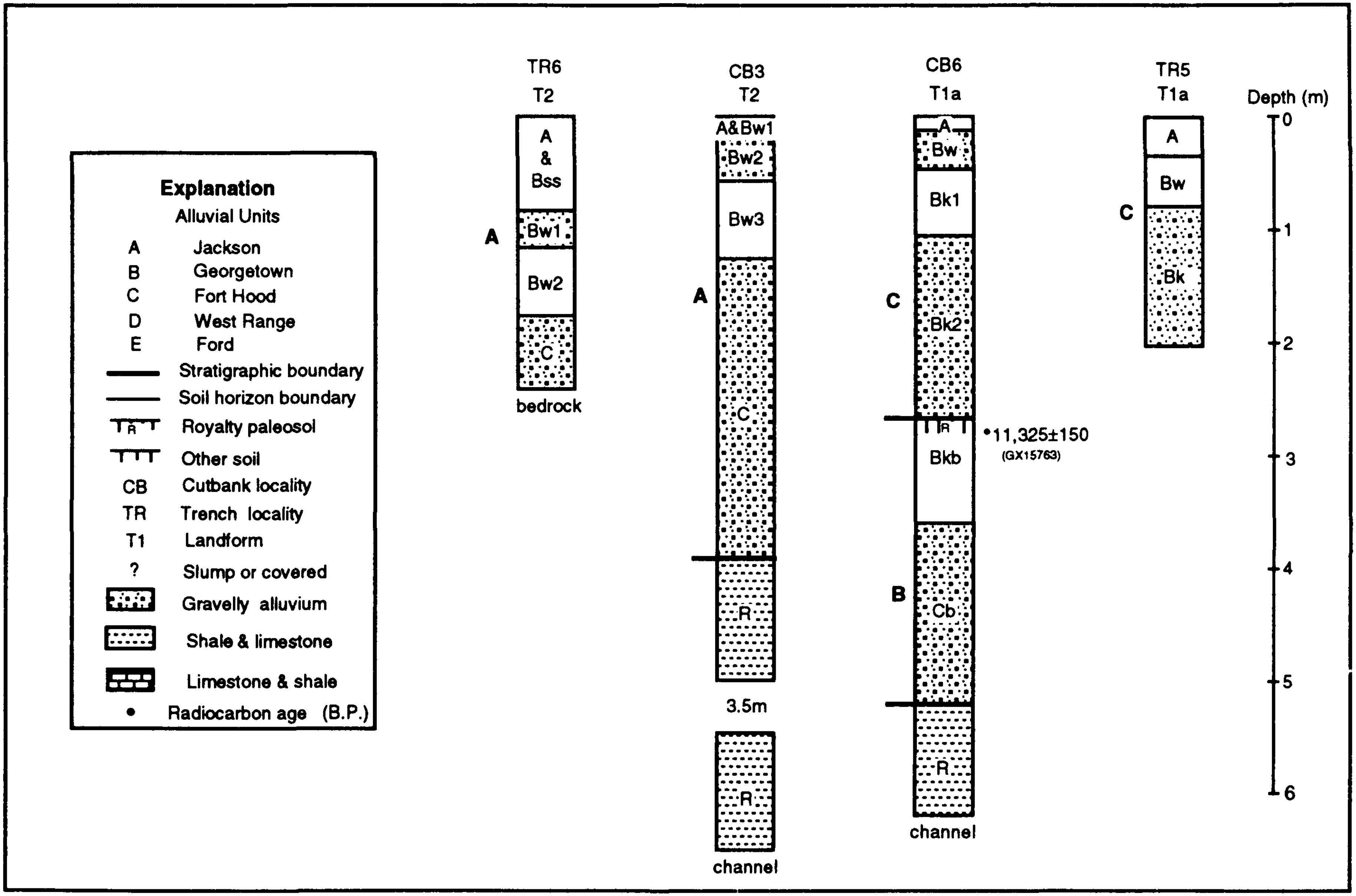


Figure 11. Selected soil stratigraphic profiles of units A, B and C of Owl Creek. Charcoal ages are shown in bold and bulk humate ages in plain text (see Appendix C for soil stratigraphic descriptions and Appendix J for radiocarbon assays).

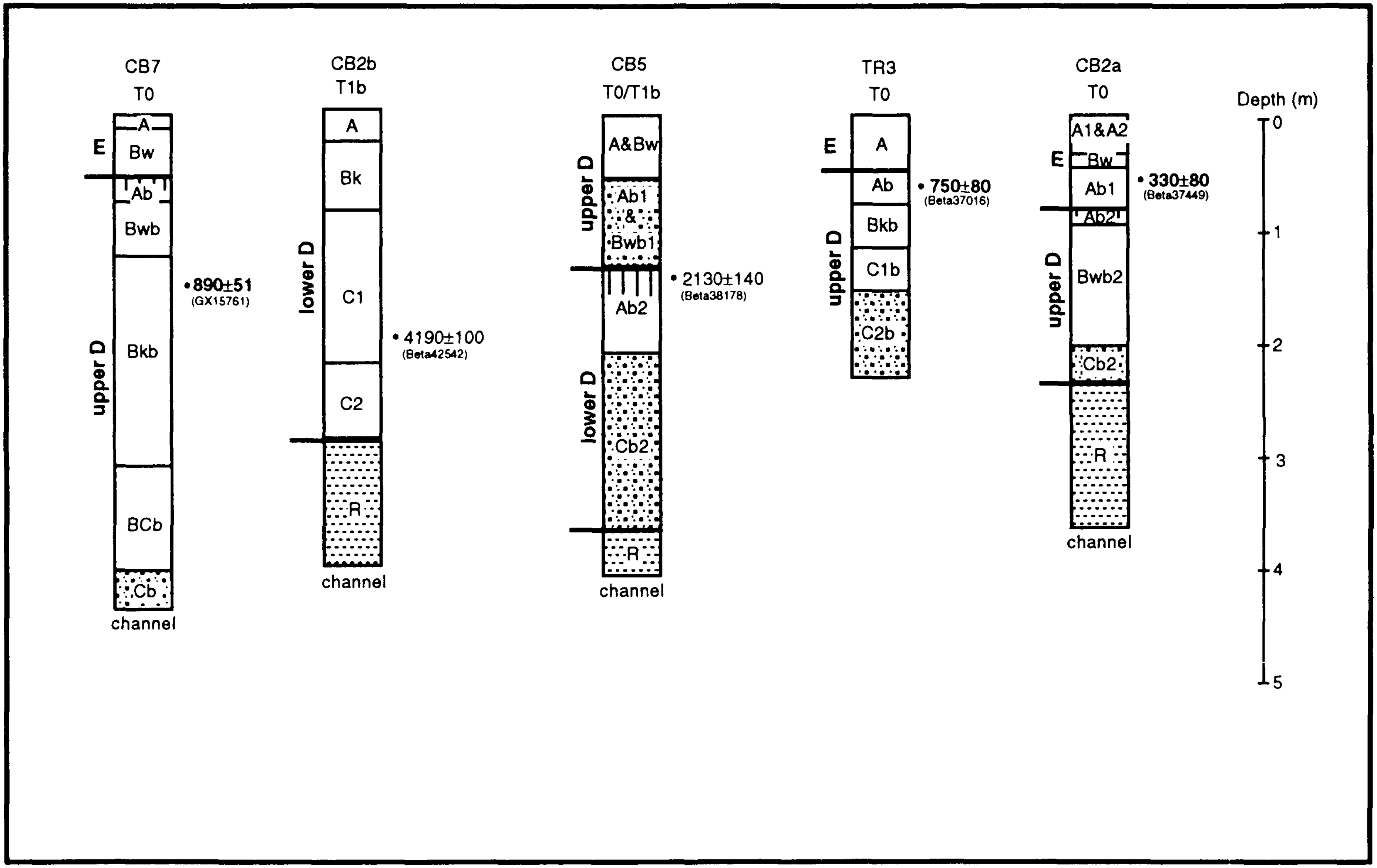


Figure 11 (continued). Selected soil stratigraphic profiles of units D and E of Owl Creek.

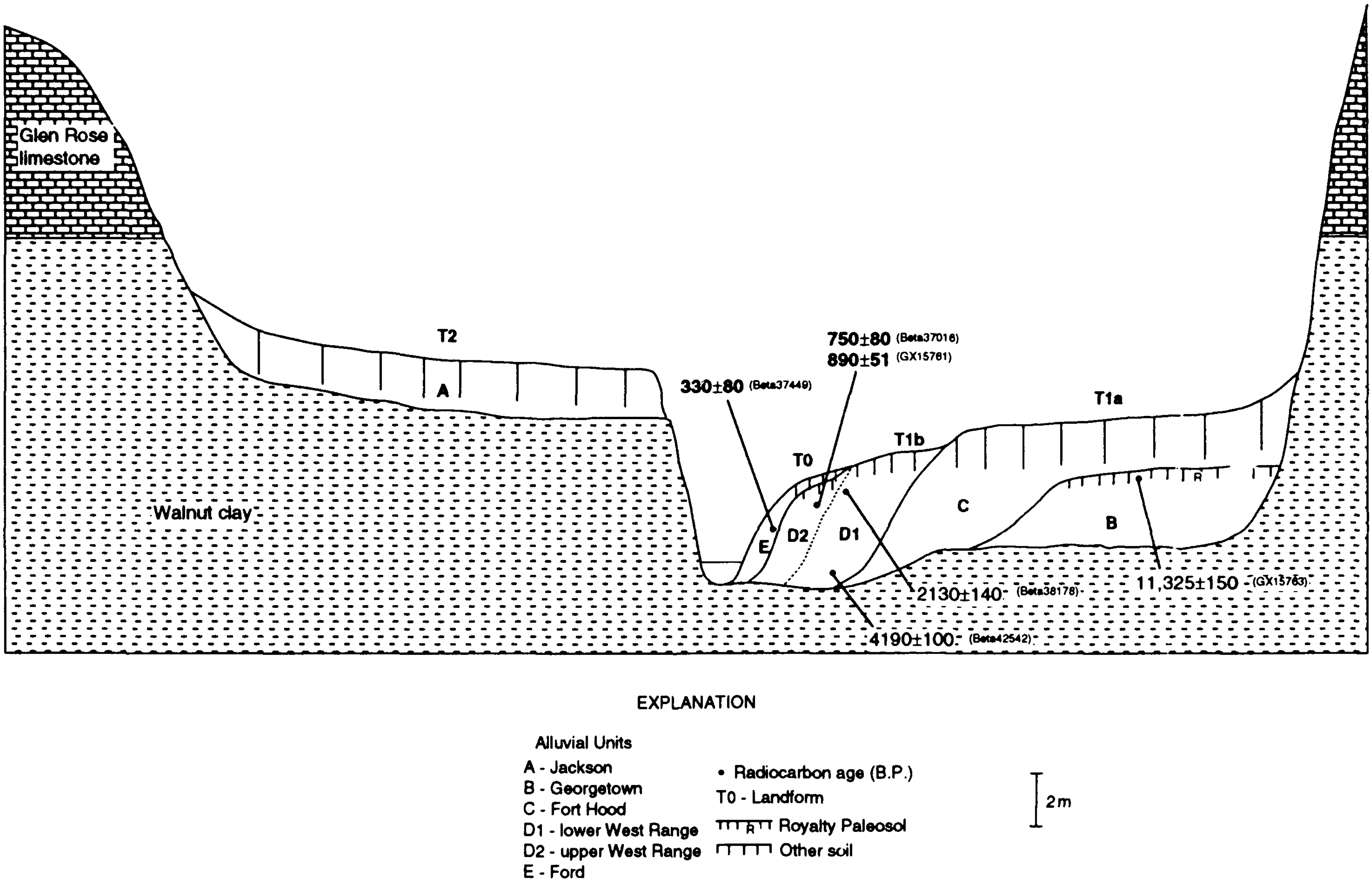


Figure 12. Generalized composite geologic cross section of Owl Creek. Charcoal ages are shown in bold and humate ages in plain text (see Appendix J).

m of well-sorted granule to pebble size gravels resting on the Walnut Clay about 1 m above modern channel level. Like the Georgetown of other streams, a meandering channel type seems to have been active during this time.

The Fort Hood channel regime has either completely removed or truncated upper sections of the Georgetown alluvium (Figs. 10 and 11; TR2, 5, 7, 9, 10; CB6). The Fort Hood alluvium comprises much of the total valley fill of Owl Creek and consists of about 2 m of a gravelly and yellowish brown, loamy bottomstratum facies that grades to yellowish brown, clay loam topstratum facies containing few to common diffuse gravels. The soils formed in these sediments have A-Bk profiles with 4 to 10% encrusted filamentous carbonates that classify as Mollisols (Calciustolls). Most areas are mapped as part of the Lewisville series (McCaleb, 1985). Limited exposures suggest deposition by a relatively fine-grained braided stream although as much as one-third of the surface deposits near the outer valley wall may be of colluvial or alluvial fan origin. These fans grade to, and interfinger with, the Fort Hood alluvium rather than representing discrete depositional entities. Humate ages from adjacent units tentatively bracket the age of the Fort Hood alluvium to between 11,325 B.P. and 4190 ± 100 B.P. (Beta 42542).

Terrace 1 (T1b)

Based on bulk humate ages of 4190 B.P. and 2130 ± 140 B.P. (Beta 38178), the fill beneath T1b is tentatively correlated with the lower member of the West Range alluvium (Figs. 11 and 12; CB2b, 4, 5) of Cowhouse Creek. As discussed earlier, the basal age of 4190 B.P. may be somewhat older than the event that deposited the sediment containing the humates. The 2130 B.P. age, because contemporaneous humus was incorporated into the A horizon before burial, may more closely approximate the time of alluvial deposition.

The lower West Range fill is erosionally inset to, and vertically aggraded to within 1 m of, the T1a surface and is confined to positions within the modern meanderbelt. Terrace 1a and T1b cannot, however, be separated for mapping purposes because of the small areal exposure of T1b. In support of channel braiding at this time, the lower West Range alluvium contains stacked, horizontally-bedded, pebble to cobble size gravels interbedded with thin, yellowish brown and grayish brown, channel fill clay loams. Soil profiles commonly contain gravelly A-Bk horizons with few mycelial carbonates and classify as Mollisols (Haplustolls), although most areas are mapped as part of the Lewisville series (Calciustolls) (McCaleb, 1985).

Shortly after 2130 B.P., a period of channel erosion occurred that truncated the early West Range member and initiated deposition of the upper member, which continued up until at least 750 ± 80 B.P. (Beta 37016) but to no later than 330 ± 80 B.P. (Beta 37449) (Figs. 11 and 12; TR3, 4; CB2a, 7). Although gravel-rich sediments were being transported down some tributaries at this time, most upper West Range aggradation came from low competency stream deposition in the form of brown loams and sandy clay loams deficient in gravels. A weakly expressed Mollisol (Haplustolls) developed at the surface of this unit which is typically buried by overbank deposition from the younger Ford alluvium (T0).

Terrace 0 (T0)

A radiocarbon age of 330 B.P. suggests correlation of the fill beneath T0 to the Ford alluvium (Figs. 11 and 12; TR1, 3, 8; CB1, 2a, 7). This unit is erosionally inset to T1b along inner meander bends and in places truncates and overlaps upper portions of T1b.

Upper point bar and overbank facies typically consist of alternating beds of brown and very pale brown, clay loams and sandy loams. The modern surface soils typically classify as Entisols (Uslifluvents) while weakly expressed darker zones may represent incipient buried soils within these sediments. Soils developed in Ford alluvium were included in the Bosque series for mapping purposes (McCaleb, 1985). Both attached and longitudinal bars comprise the bottom stratum facies of the Ford alluvium.

HOUSE CREEK

House Creek has a drainage basin area of about 168 km^2 and relief of 400 to 200 m. The modern intermittent and partly braided channel is incising the Glen Rose Limestone while the tributary network contributes shales and limestones from the surrounding Walnut Clay. Sinuosity is 1.2, channel gradient 4.9 m/km, and channel length within the study area about 13 km. House Creek empties into Cowhouse Creek shortly after entering the Impact Area below West Range Road.

Three alluvial landforms, T2, T1, and T0, are mapped in the House Creek drainage basin as shown in Figure 13. Terrace 1 (T1) is subdivided into T1a and T1b components in Figures 14 and 15. Also shown in Figure 13 are the soil-stratigraphic description localities taken from eight trenches (TR1-8) and three cutbank exposures (CB1-3). Selected soil stratigraphic profiles are displayed in Figure 14 and shown descriptively, along with the remaining localities, in Appendix D. From these descriptions, five stratigraphic units and one buried paleosol were recognized which are shown in the composite geologic cross section in Figure 15. These units are controlled in time by two bulk humate radiocarbon ages (Appendix J) and by correlation to other streams with dated alluvial sequences.

Terrace 2 (T2)

The highest and oldest terrace of House Creek is depositional and designated as T2. Terrace 2 is inset to the Killeen surface and situated about 8 to 11 m above the modern channel (Figs. 13 and 14; TR7, 8). In areas where T2 is not present, a 20 to 30 m bedrock bluff separates T1 and the Killeen surface. T2 slopes gently down towards T1 in some areas and is confined to the northern portion of the valley demonstrating net southward valley construction.

The fill beneath T2 consists of 1 to 2 m of olive yellow and light olive brown, gravelly loam bottomstratum facies, overlain by sediments that have developed into Mollisols (Calciustolls) having very dark brown to red and yellowish brown, clayey A-Bss-Bk profiles. Soils are typically mapped as part of the Lewisville series (McCaleb, 1985), although they often classify as Vertisols (Chromusterts). Limited exposures indicate deposition by a relict meandering bedload stream. Noncalcareous surface horizons, stratigraphy, and position suggest a correlation with the late Pleistocene Jackson alluvium.

Terrace 1 (T1a)

Terrace 1 (T1) can be divided into T1a and T1b components in the House Creek basin. Two alluvial units underlie T1a which comprises most of the surface area of T1. The T1a surface, which is about 1 m above T1b, overlies the Georgetown and Fort Hood alluvium. The Georgetown fill was identified in only one exposure (Figs. 13 and 14; CB2) and consists of nearly 3 m of brown and light brownish gray, clay loam that grades down to 1 m of massive brown and light brownish gray, sandy clay loam. The upper 2 m is a truncated Bk horizon correlated with the Royalty paleosol that probably formed cumulicly in this area. Bulk humates from this soil dated to 8050 ± 100 B.P. (Beta 45980). Deposition occurred in a low competency meandering stream; possibly in ponded areas on the floodplain or in channel areas where springs were active.

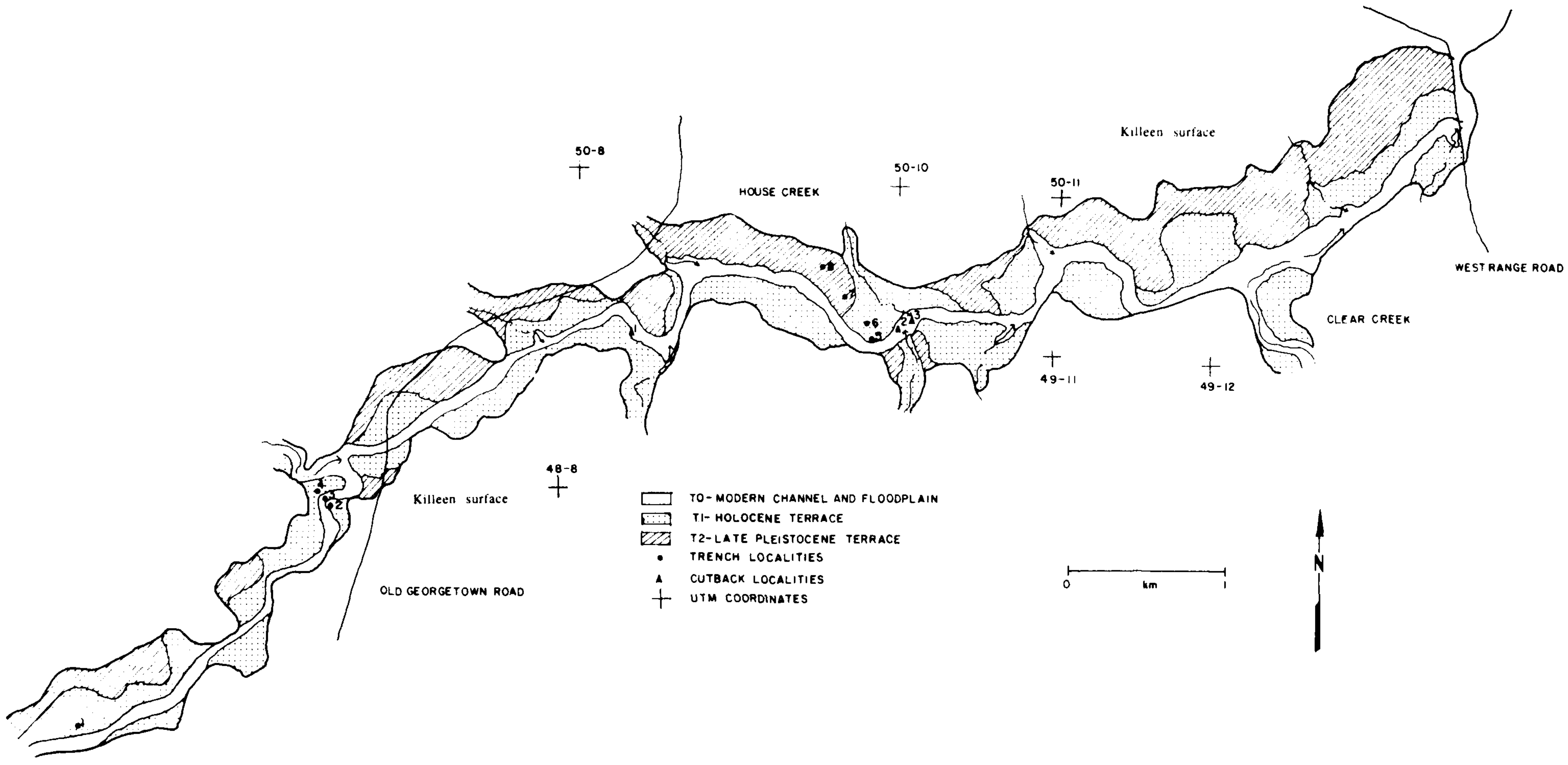


Figure 13. Geomorphic map of House Creek.

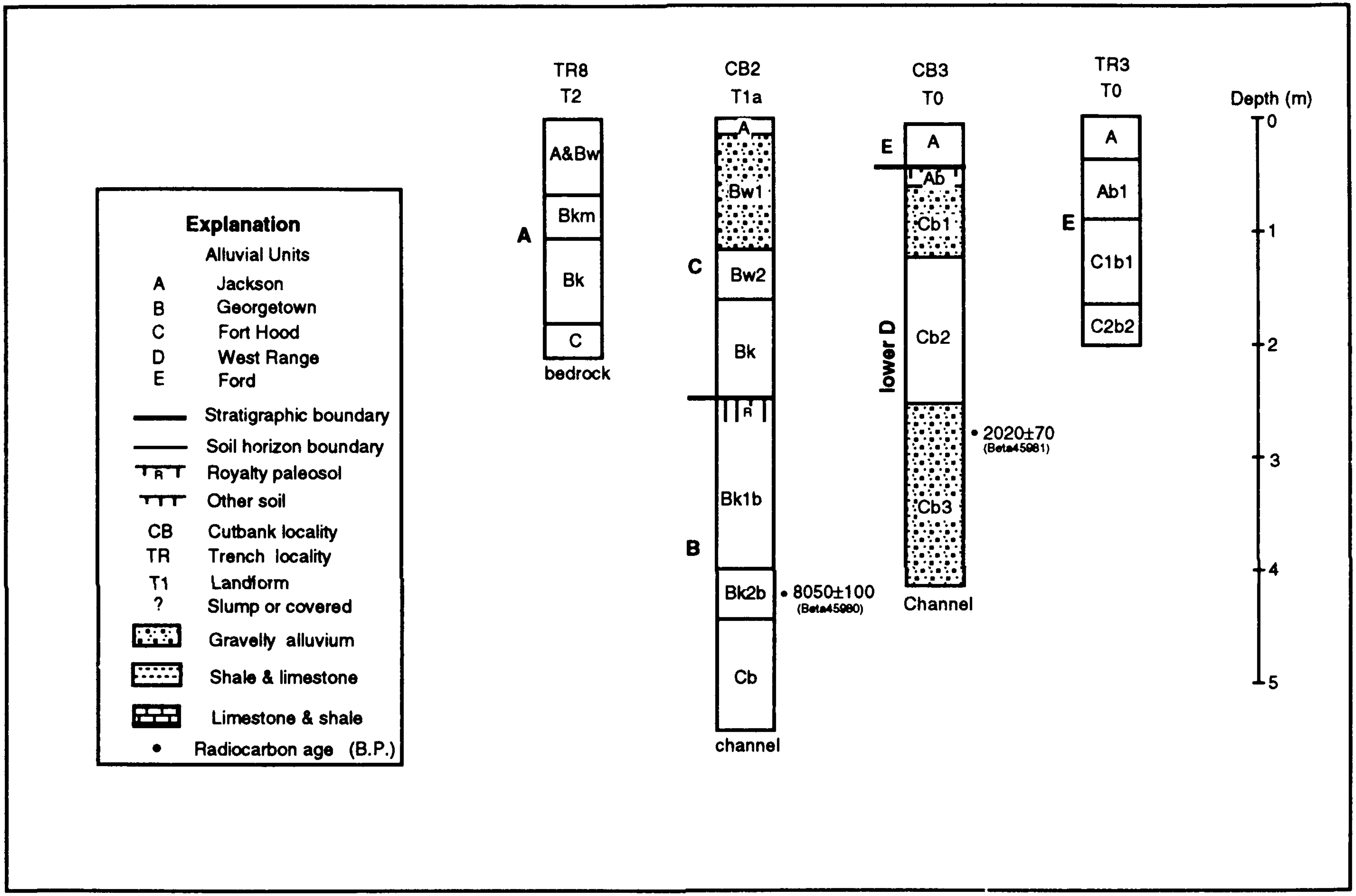


Figure 14. Selected soil stratigraphic profiles of House Creek. All ages are from bulk humates (see Appendix D for soil stratigraphic descriptions and Appendix J for radiocarbon assays).

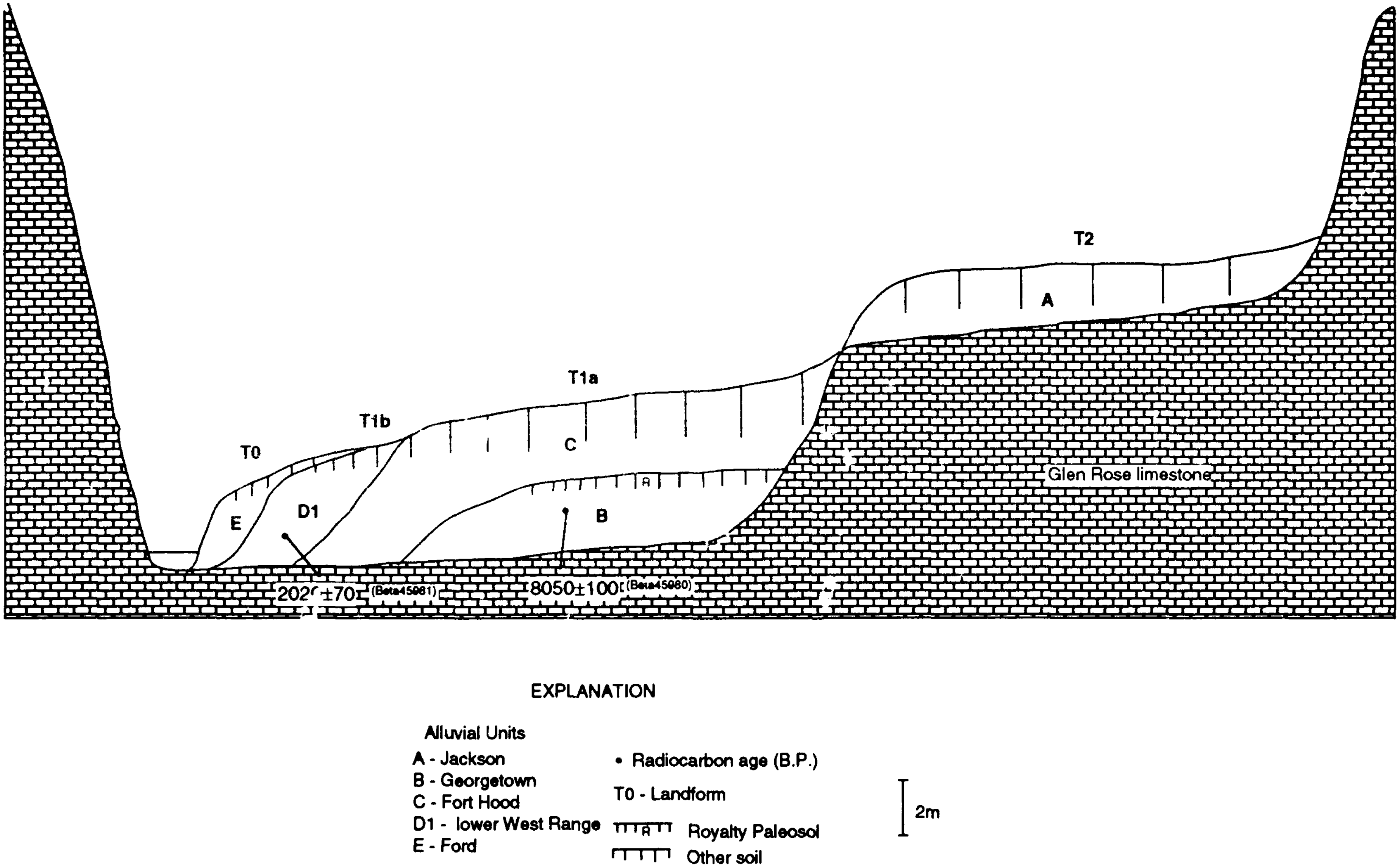


Figure 15. Generalized composite geologic cross section of House Creek. All ages are from bulk humates (see Appendix J).

The unit overlying the Georgetown alluvium is correlated with the Fort Hood alluvium (Figs. 13 and 14; TR1, 4, 6; CB2). This fill typically consists of basal yellowish brown, loams and sandy clay loams with interbedded and stacked channel gravels. These deposits grade to soils with A-Bk profiles having surface and subsurface colors of very dark brown and yellowish brown, respectively, that classify as Mollisols (Calciustolls). These soils west of Old Georgetown Road are mapped as Lewisville, but to the east they may be mapped as either Lewisville or Bosque (McCaleb, 1985). Relatively fine-grained sediments with diffuse gravels and stacked channel fills indicates deposition by a relict a fine-grained braided or transitional meandering-braided stream system.

Terrace 1 (T1b)

Terrace 1b (T1b) is inset to T1a by an erosional unconformity. The surface of T1b grades gently up to the T1a surface which forms a topographic scarp that is about 1 m higher and sometimes difficult to discern. Soils at the surface of T1b have weakly expressed gravelly and loamy A-Bw or A-Bk profiles with few mycelial carbonates that classify as Mollisols (Haplustolls) or Inceptisols (Ustochrepts) and which are mapped as part of the Bosque series (McCaleb, 1985). The stacked sequence of braided channel gravels, interbedded with brown to grayish brown, loams and sandy clay loams, is correlated with the lower West Range alluvium of Owl Creek because of similarities in sediment character, stratigraphic position and a bulk sediment humate age of 2020 ± 70 B.P. (Beta 45981) (Figs. 13 and 14; TR2, 5; CB3). This age suggests that deposition of the braided lower West Range member was ongoing as late as 2000 B.P. on House Creek. As House Creek nears the confluence of Cowhouse Creek within the Impact Area, meandering and concomitant fine-grained deposition becomes more dominant. West Range has also accumulated to the same surface elevation as the Fort Hood alluvium in this area. The upper West Range alluvium was not identified, although it may occurr as small buried remnants.

Terrace 0 (T0)

Terrace 0 (T0) represents the active floodplain which follows the narrow entrenched valley containing the modern channel (Figs. 13 and 14; TR3, 5; CB1, 3). The unit beaneath T0 is correlated with the Ford alluvium which is erosionally inset to the West Range alluvium, but at a slightly lower elevation, and in places gently grades up to and partly overlaps T1b and the West Range alluvium. Overbank sediments typically consist of alternating beds of dark brown and light yellowish brown to yellowish brown, clay loams to sandy loams which grade down to partially covered modern point and longitudinal gravel bars. Soils are mapped as part of the Bosque series (McCaleb, 1985).

HENSON CREEK

The Henson Creek drainage basin within Fort Hood is subdivided into two geomorphic provinces (Figs. 16a and 16b). The upper half, west of the Impact Area, is largely erosional, and contains only narrow and shallow valley fills. Sinuosity is 1.05, channel gradient 6.7 m/km, and drainage area 66 km^2 in this area. Henson Creek east of the Impact Area, and down to the confluence with the Leon River, contains considerably more valley alluvium, a shallower gradient, and a sinuosity of 1.26. Henson is largely braided in its upper reaches, meandering in its lower reaches, and flows on the Walnut Clay throughout its entire course. In the upper basin, the Killeen surface borders the Henson alluvial deposits on the north while steep bluffs rising up to the Manning surface border it on the south. The lower basin is bounded on all sides by the Killeen surface. In the uppermost basin the landforms and underlying alluvial sequence becomes too complex to differentiate. The landform/sediment assemblage is therefore mapped as a complex in this area.

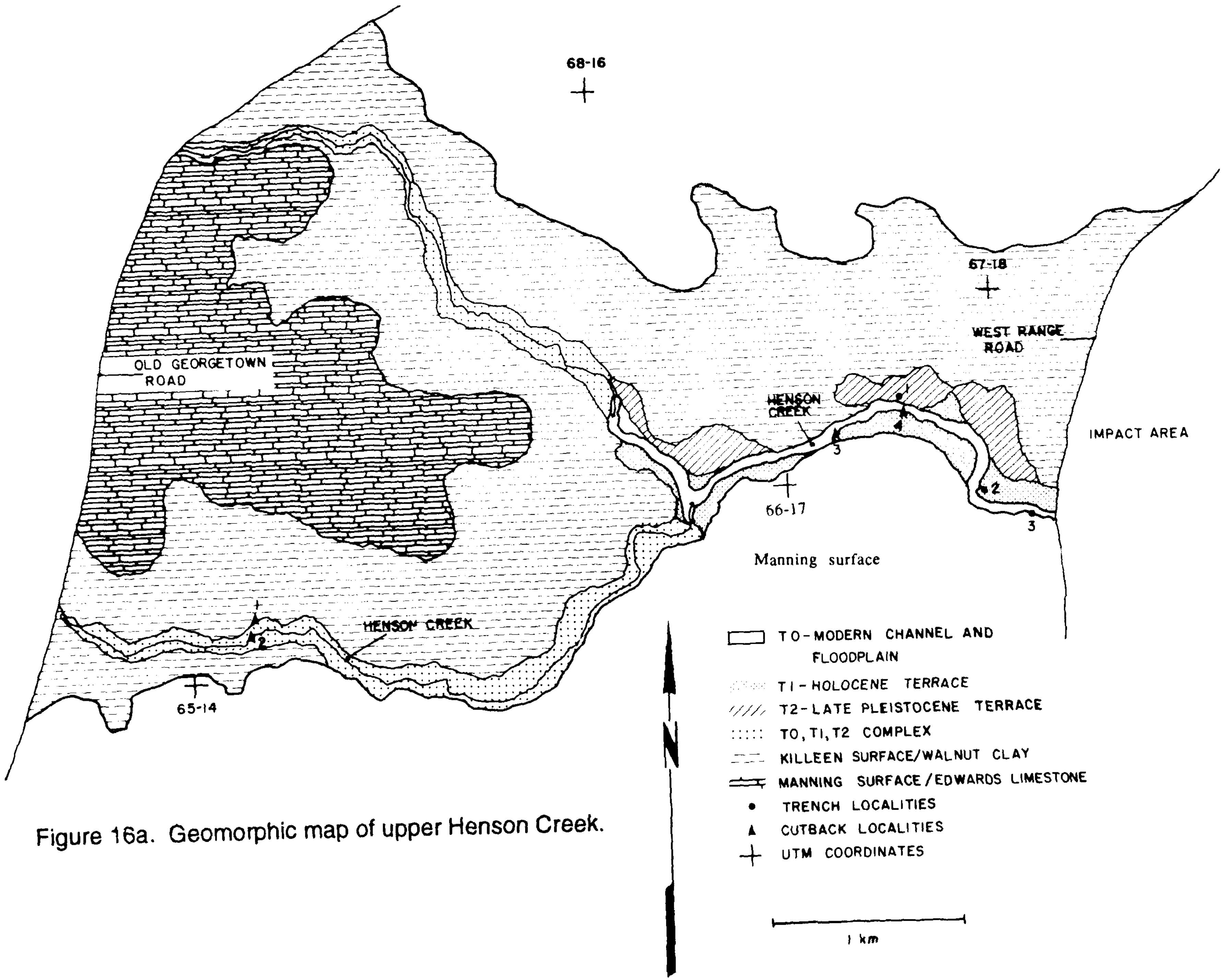


Figure 16a. Geomorphic map of upper Henson Creek.

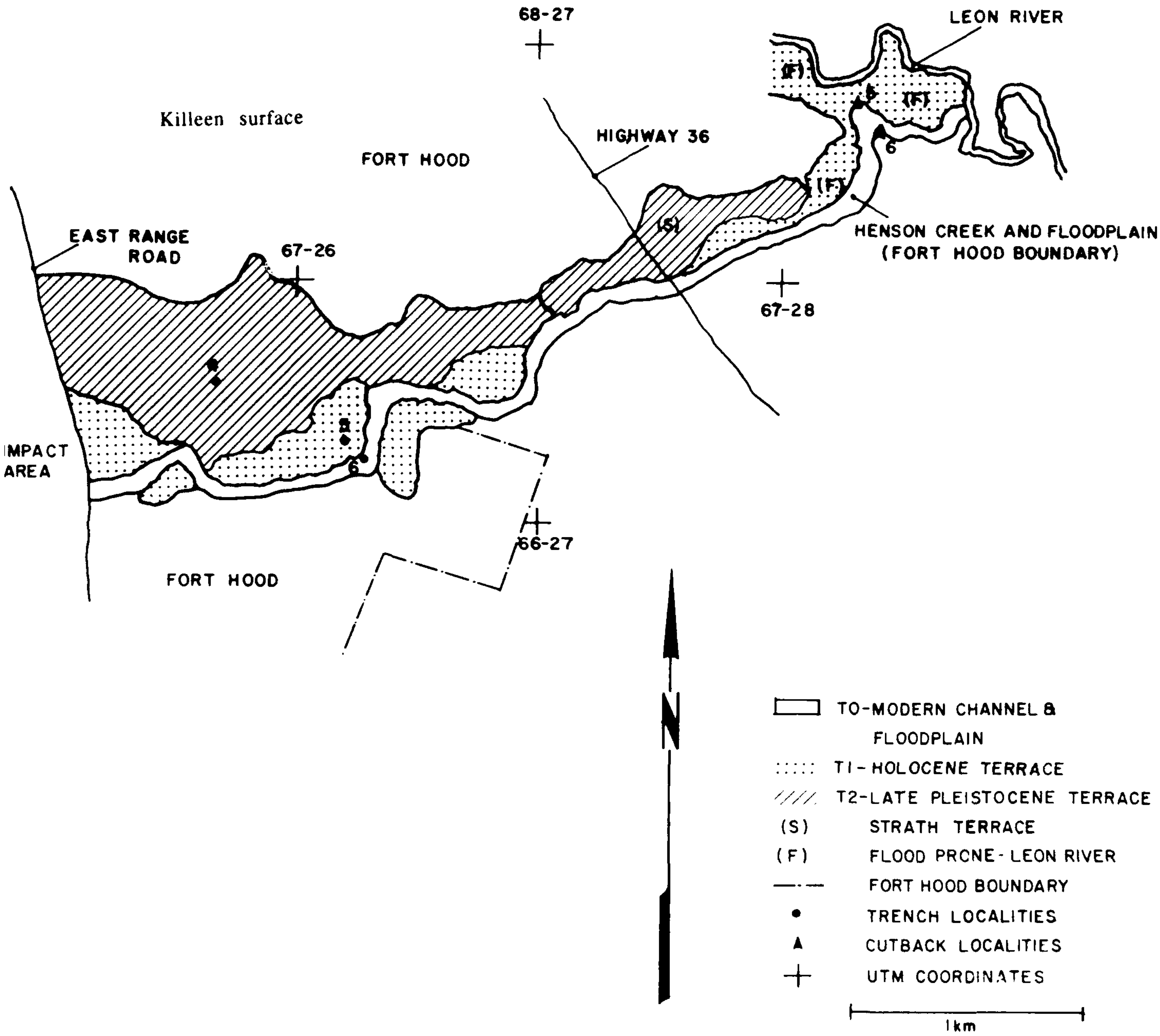


Figure 16b. Geomorphic map of lower Henson Creek.

Three alluvial landforms, T2, T1, and T0, are mapped in the Henson Creek drainage basin as shown in Figure 16. Terrace 1 (T1) is divided into two geomorphic components in Figures 17 and 18. Also shown in Figure 16 are the soil-stratigraphic description localities taken from six trenches (TR1-6) and six cutbank exposures (CB1-6). Selected soil stratigraphic profiles are displayed in Figure 17 and shown descriptively, along with the remaining localities, in Appendix E. From these descriptions, five stratigraphic units and one buried paleosol were recognized which are shown in the composite geologic cross section in Figure 18. These units are controlled in time by radiocarbon ages from two charcoal samples (one from a cultural feature and one from dispersed sources) and two from bulk humates (one sediment and one soil) (Appendix J).

Terrace 2 (T2)

Trenches 1 (TR1) and 4 (TR4) (Figs. 16 and 17) are representative of the alluvial fill beneath T2. The upper sediments are weathered to black over strong brown, clayey soils with slickensides that classify as Vertisols (Pellusterts). In the upper basin, T2 is mapped as either the Krum series or Brackett-Topsey association, and in the lower basin as the Denton or Lewisville series (McCaleb, 1985). Fine and medium, horizontal to cross-bedded basal gravels, were observed in several exposures. The total fill is 1 to 3 m and rests on a bedrock ledge 2 m above the modern waterline. This bedrock ledge was presumably cut during a period of channel incision shortly before, or during, deposition of this unit. Terrace 2 is a depositional terrace that is overlain by a thin alluvial fill and situated 5 to 6 m above the modern channel. This is somewhat less, however, than other streams of comparable size. Noncalcareous topsoils in some areas and stratigraphic position warrant a tentative correlation with the Jackson alluvium.

Terrace 1 (T1)

In Henson Creek, the geomorphic surfaces of the Holocene valley fill are subdivided into T1 and T0 rather than T1a and T1b because *T1b is* largely buried by modern flood sediments. The Georgetown alluvium of Henson Creek was identified in two exposures within the Impact Area (descriptions not in this report) beneath T1. A bulk humate age of 9110 ± 100 B.P. (Beta 44298) was obtained from soil humates from the Royalty paleosol capping this unit which is consistent with other ages for the Georgetown alluvium. The Georgetown in this area consists of 1 to 2 m of fine, well-sorted basal gravels, sometimes expressed as dipping cross-beds, overlain by 1 m of massive to bioturbated yellowish loams that grade up into the brown Royalty paleosol containing common encrusted carbonates.

The Fort Hood alluvium beneath T1 comprises the bulk of Holocene sediments along Henson Creek. This fill consists of yellowish brown, gravelly clay loams typically overlying either light yellowish brown, sandy clay loams and loams, or horizontal to cross bedded basal channel gravels (Figs. 16 and 17; TR2, 5). These sediments appear to have been deposited in a braided stream carrying a fine-grained sediment load. Soils formed in this fill are generally mapped as Bosque or Lewisville which are similar to those of Owl and Table Rock Creek (McCaleb, 1985). Typically, soil profiles consist of clay loam or sandy clay loam A-Bk horizons with encrusted and mycelial carbonates. The Fort Hood alluvium transitions to fine-grained meandering downstream as channel gradients decrease downstream (Figs. 16 and 17; CB5).

Terrace 0 (T0)

The modern floodplain of Henson Creek is mapped as T0 which broadens considerably near the confluence with the Leon River floodplain. In the central and upper basin of Henson Creek (Fig. 16a), the West Range alluvium contains stacked braided couplets of dark brown to pale olive brown,

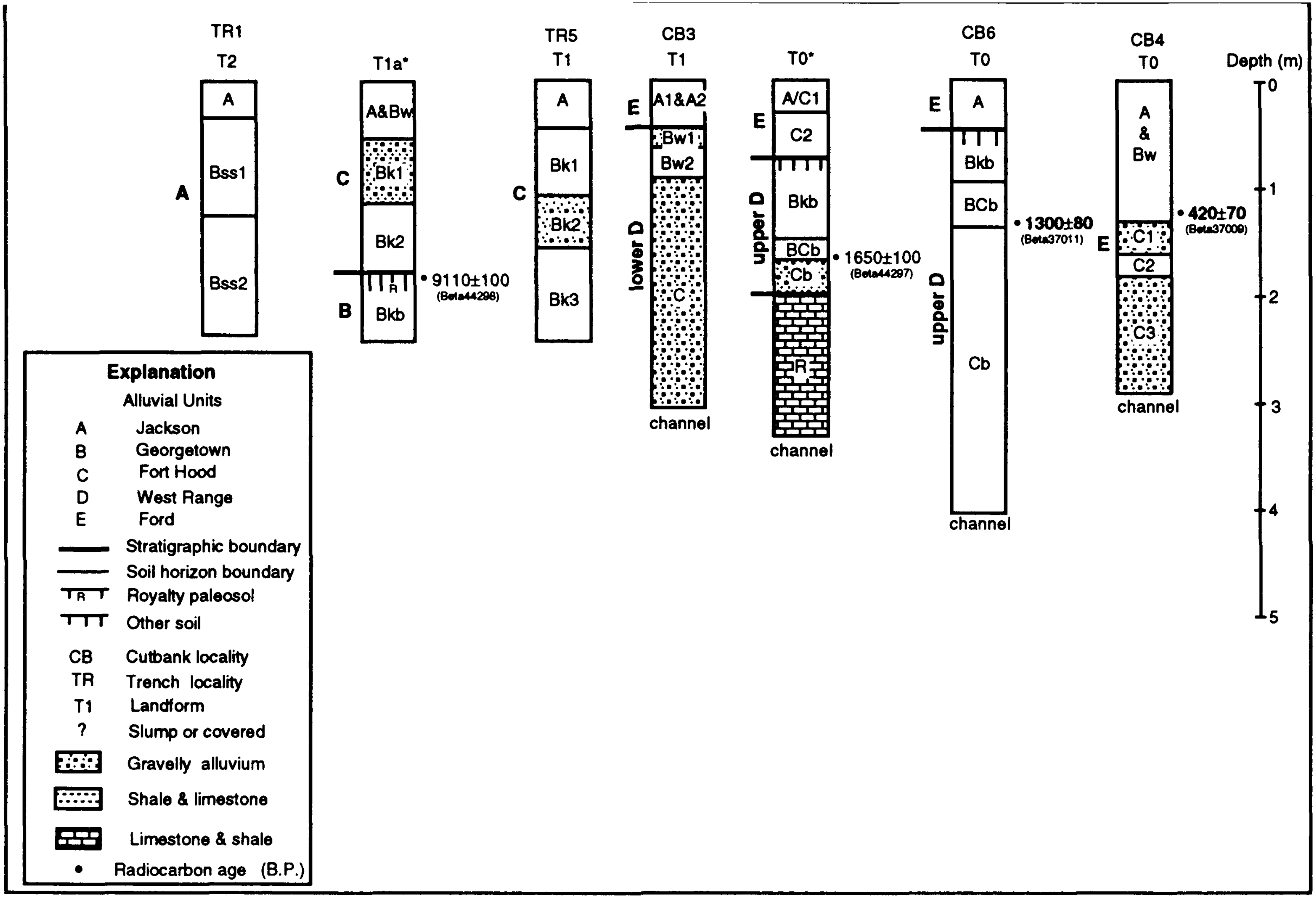


Figure 17. Selected soil stratigraphic profiles of Henson Creek. Charcoal ages are shown in bold and bulk humate ages in plain text (see Appendix E for soil stratigraphic descriptions and Appendix J for radiocarbon assays; *Impact Area sites are not formally described in this report).

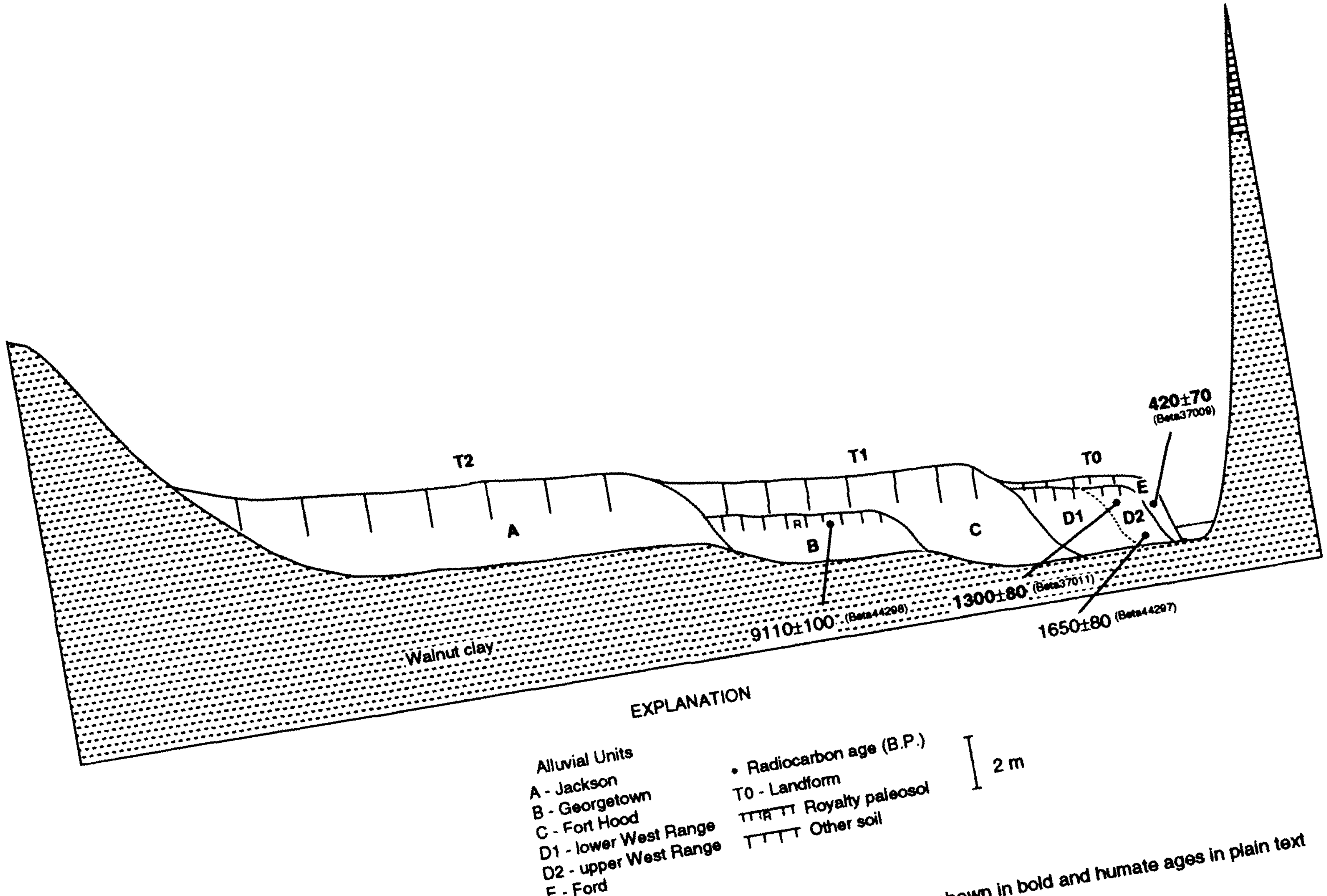


Figure 18. Generalized geologic composite cross section of Henson Creek. Charcoal ages are shown in bold and humate ages in plain text (see Appendix J).

gravelly and loamy beds. A clay loam A-Bw soil profile containing few mycelial carbonates (Figs. 16 and 17; CB3) developed in these deposits before it was buried by Ford alluvium. These characteristics and relationships are similar to those for the lower West Range alluvium at Owl Creek that dated to 2130 B.P. and 4190 B.P. and at House Creek that dated to 2020 B.P. and is correlated as such.

Within the Impact Area, the non-braided upper West Range member was present and dated to 1650 ± 80 B.P. (Beta 44297) near the basal bedrock contact. This is a humate age, however, that may be dating slightly older than the time of deposition (Fig. 17).

In the lower Henson Creek basin (Fig. 16b) depositional facies of both the West Range and Ford alluvium grade to those representative of fine-grained meandering. In this area Ford sediments overlie not only the West Range but also the Fort Hood alluvium. Based on a radiocarbon age of 1300 ± 80 B.P. (Beta 37011) from the lower basin (Figs. 16 and 17; CB6), correlation to the upper West Range alluvium is substantiated.

The Ford alluvium, which is erosionally inset to the West Range alluvium, dated to 420 ± 70 B.P. (Beta 37009) from hearth charcoal at CB4 (Figs. 16 and 17). The gravelly point and longitudinal bar facies of the Ford fill are overlain by stratified dark brown and very dark brown, clay loams to silty clay loams, and light yellowish brown and grayish brown, sandy clay loams and loams (Figs. 16 and 17; TR3, 6; CB2, 3, 4, 5, 6). Soils of T0 are generally mapped as Bosque throughout the basin (McCaleb, 1985). Based on radiocarbon ages, the last episode of channel trenching occurred between 1300 B.P. and 420 B.P. on Henson Creek.

REESE CREEK

Reese Creek drains about 57 km^2 of the Walnut Clay, but through progressive valley incision is now flowing on the Glen Rose Limestone. Sinuosity and channel gradient are 1.1 and 7.6 m/km, respectively, while drainage basin relief is 139 m. Reese is an intermittent braided-meandering stream that enters the Lampasas River south of Fort Hood. The Killeen surface is the dominant landform surrounding the alluvial sequence of Reese Creek.

Three alluvial landforms, T2, T1, and T0, are mapped in the Reese Creek drainage basin as shown in Figure 19. Also shown on Figure 19 are the soil-stratigraphic description localities taken from six trenches (TR1-6) and one cutbank exposures (CB1). Selected soil stratigraphic profiles are displayed in Figure 20 and shown descriptively, along with the remaining localities, in Appendix F. From these descriptions, five stratigraphic units were recognized which are shown in the composite geologic cross section in Figure 21. These units are controlled in time by correlation and radiocarbon ages from two charcoal samples (one from a cultural feature and one from dispersed sources) (Appendix J).

Terrace 2 (T2)

Only one remnant of T2 was identified and described along the relatively long and narrow valley of Reese Creek (Figs. 20 and 21; TR3). Trench 3 (TR3) and one cutbank exposure show about 3 m of fill characterized by 1 to 2 m of basal cross-bedded gravels grading up to an A-Bw-Bk soil profile having a brown, clay loam surface horizon overlying a yellowish brown and strong brown, clay loam subsurface horizon. Encrusted carbonates in the Bk horizon were few to common. This soil classifies as a Mollisol (Calciustoll) and is mapped as the Krum/Lewisville association (Huckabee, et al., 1977). The A horizon is calcareous in this locality because the T2 surface is partly erosional and

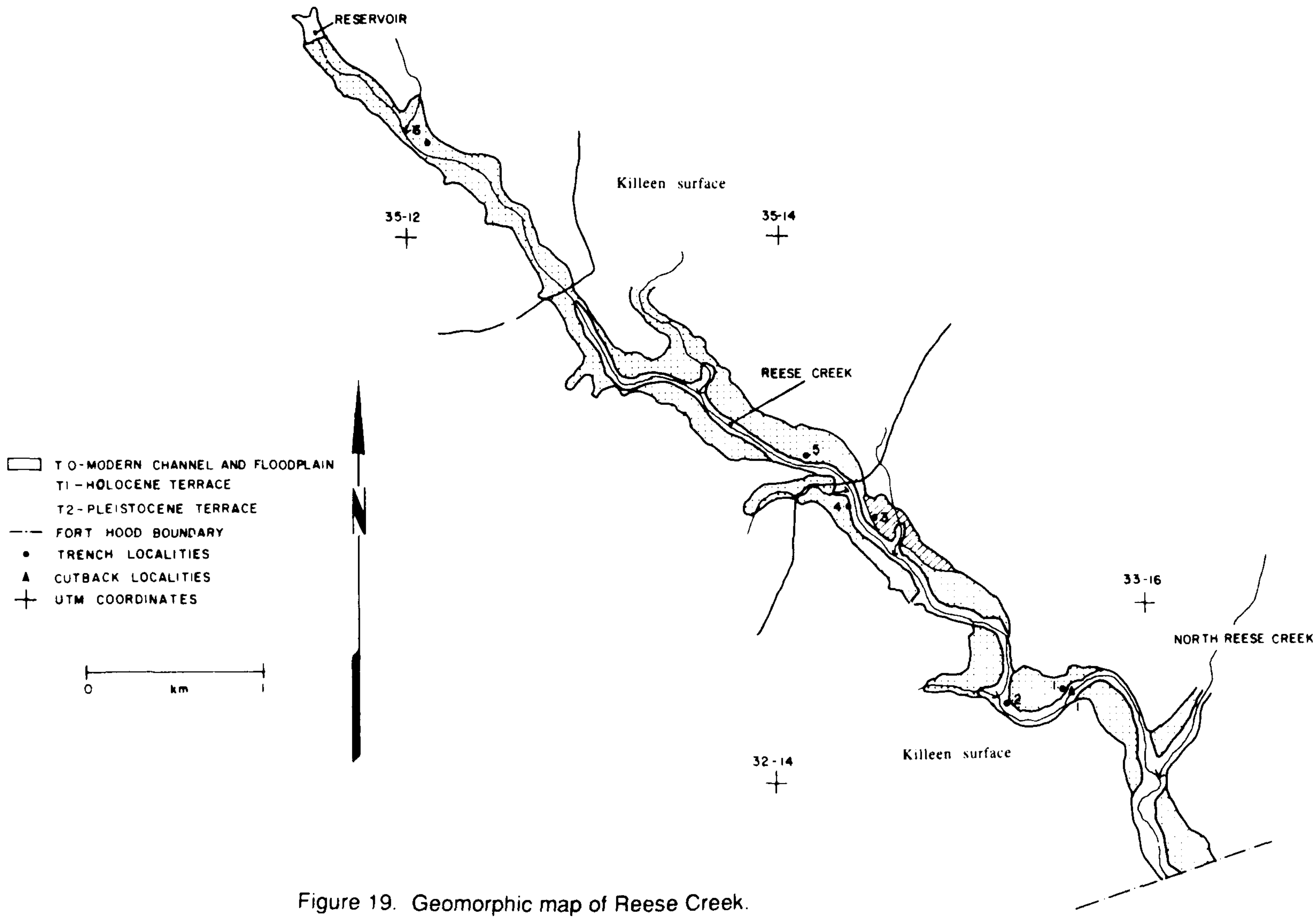


Figure 19. Geomorphic map of Reese Creek.

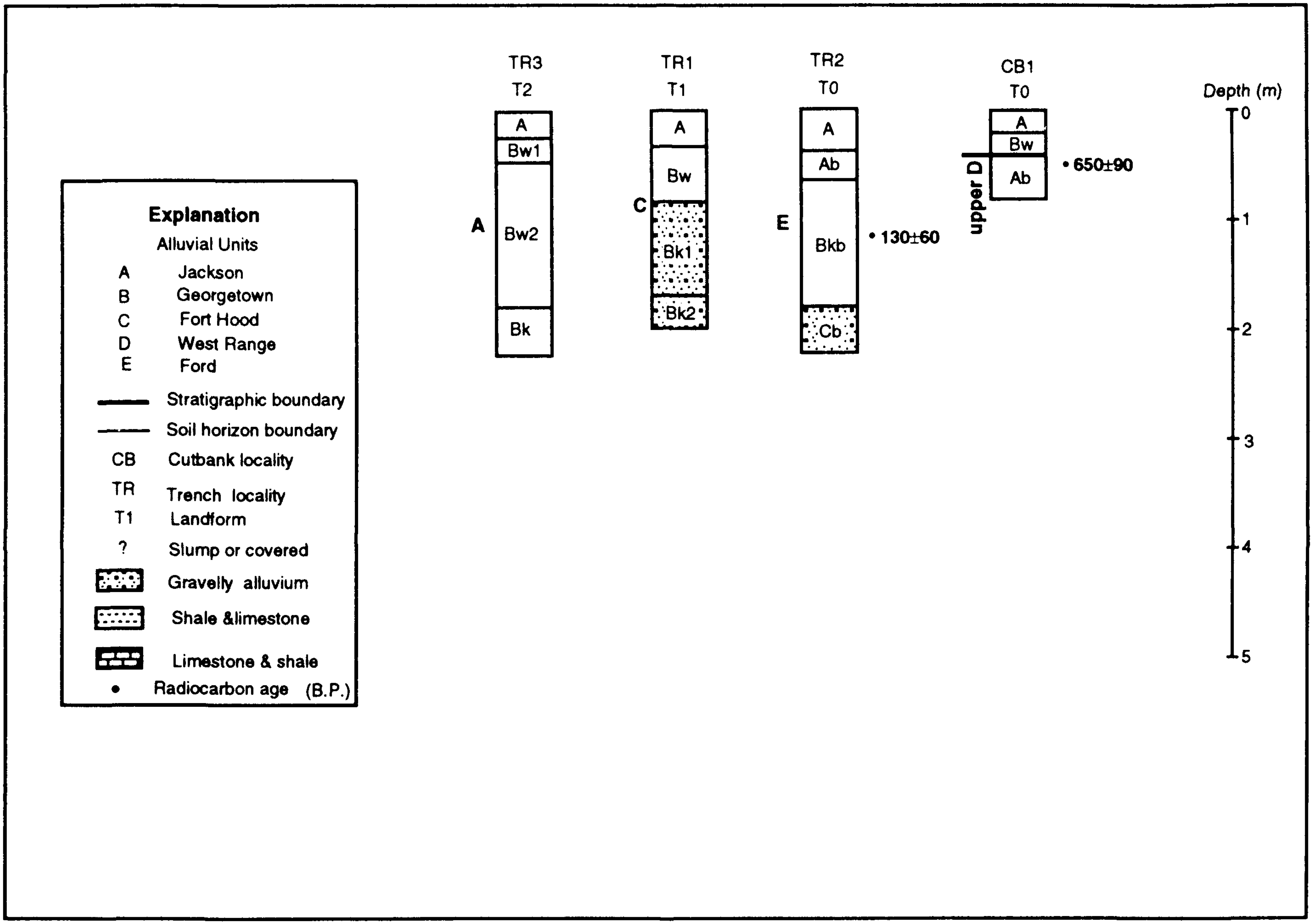


Figure 20. Selected soil stratigraphic profiles of Reese Creek. All ages are from charcoal (see Appendix F for soil stratigraphic descriptions and Appendix J for radiocarbon assays).

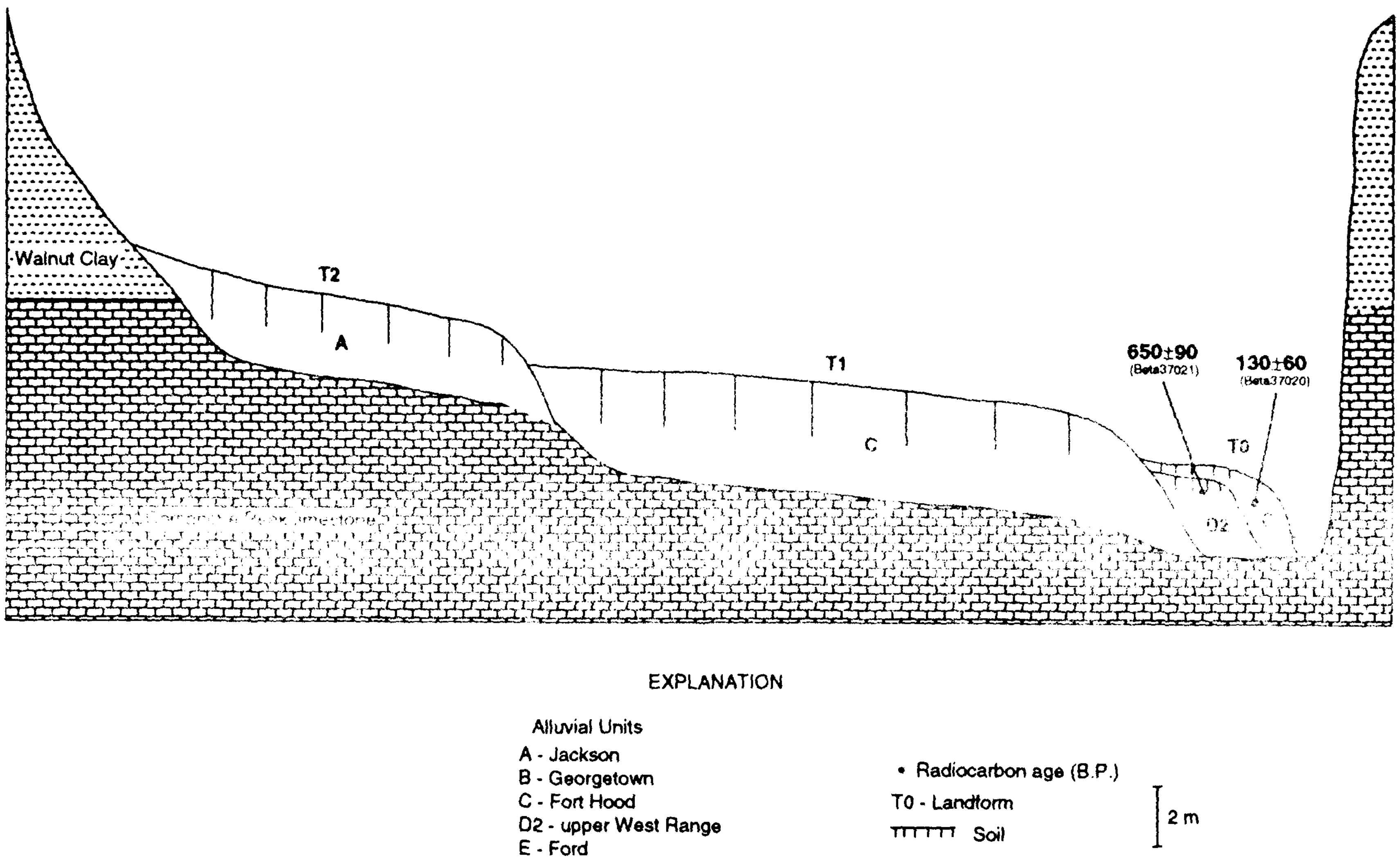


Figure 21. Generalized composite geologic cross section of Reese Creek. Alll ages are from charcoal (see Appendix J).

unstable which subsequently exposed subsurface horizons of carbonate enrichment to the surface. This fill is tentatively correlated with the Jackson alluvium. Stream type was probably transitional meandering-braided or braided.

Terrace 1 (T1)

Most alluvium in the Reese Creek valley is contained beneath T1 which borders both sides of the modern channel (Figs. 20 and 21; TR1, 5, 6). Soil profiles capping the alluvium are typically 2 to 3 m thick and contain A-Bw or A-Bw-Bk horizon sequences with very dark brown surfaces. Encrusted carbonates in Bk horizons are few to common. These soils typically classify as Mollisols (Haplustolls or Calciustolls) and are mapped as part of the Krum/Lewisville association (Huckabee, et al., 1977). The underlying alluvium typically consists of light yellowish brown, olive brown and dark yellowish brown, clay loams. Gravels tend to increase slightly with depth and suggests a braided-meandering stream but with an abundance of fines. This fill is correlated with the Fort Hood alluvium based on color, texture, and position.

Terrace 0 (T0)

The modern entrenched channel and adjacent floodplain are not mappable in the upper reaches of the drainage basin, but enlarge considerably below the confluence with North Reese Creek. The modern floodplain, as mapped in Figure 19, is included in mapped areas of the Krum/Lewisville association in the upper basin, but is delineated separately as the Bosque series in the lower basin (Huckabee, et al., 1977). A radiocarbon age of 650 ± 90 B.P. (Beta 37021) (Figs. 19 and 20; CB1) indicates that remnants of the upper West Range member are buried beneath Ford alluvium. The braided lower member of the West Range alluvium was not identified. Based on a radiocarbon age of 130 ± 60 B.P. (Beta 37020), the floodplain fill is correlated with the Ford alluvium which is laterally inset to the Fort Hood alluvium without overlap. The facies assemblage is similar to the previously discussed smaller streams having 1 to 2 m of basal channel gravels and an abundance of stratified overbank fines (Figs. 19 and 20; TR2, 4; CB1).

NORTH NOLAN CREEK

North Nolan Creek is enclosed within a narrow bedrock basin and derives all of its sediment from the Comanche Peak and Edwards Limestones. The surrounding upland geomorphic surface contains steep slopes rising up to the Manning surface. The modern alluvial valley is about 30 m lower than the Manning surface which is a typical elevational difference between the Manning and Killeen surface. The North Nolan basin, therefore, may be part of a valley that was eroded during construction of the Killeen surface. Soils of the three geomorphic surfaces, T2, T1, and T0, are mapped as part of the Krum/Lewisville association (Huckabee, et al., 1977). North Nolan has the smallest drainage basin of the streams under investigation covering only 51 km^2 and has a sinuosity and channel gradient of 1.02 and 5.2 m/km, respectively. The modern channel is largely fine-grained and braided.

Three alluvial landforms, T2, T1, and T0, are mapped in the North Nolan Creek drainage basin as shown in Figure 22. Also shown are the soil-stratigraphic description localities taken from eight trenches (TR1-8). Complete descriptions are summarized in Appendix G. From these descriptions, three stratigraphic units were recognized which are shown in the composite geologic cross section in Figure 23. These units are controlled in time by correlation to other stream basins.

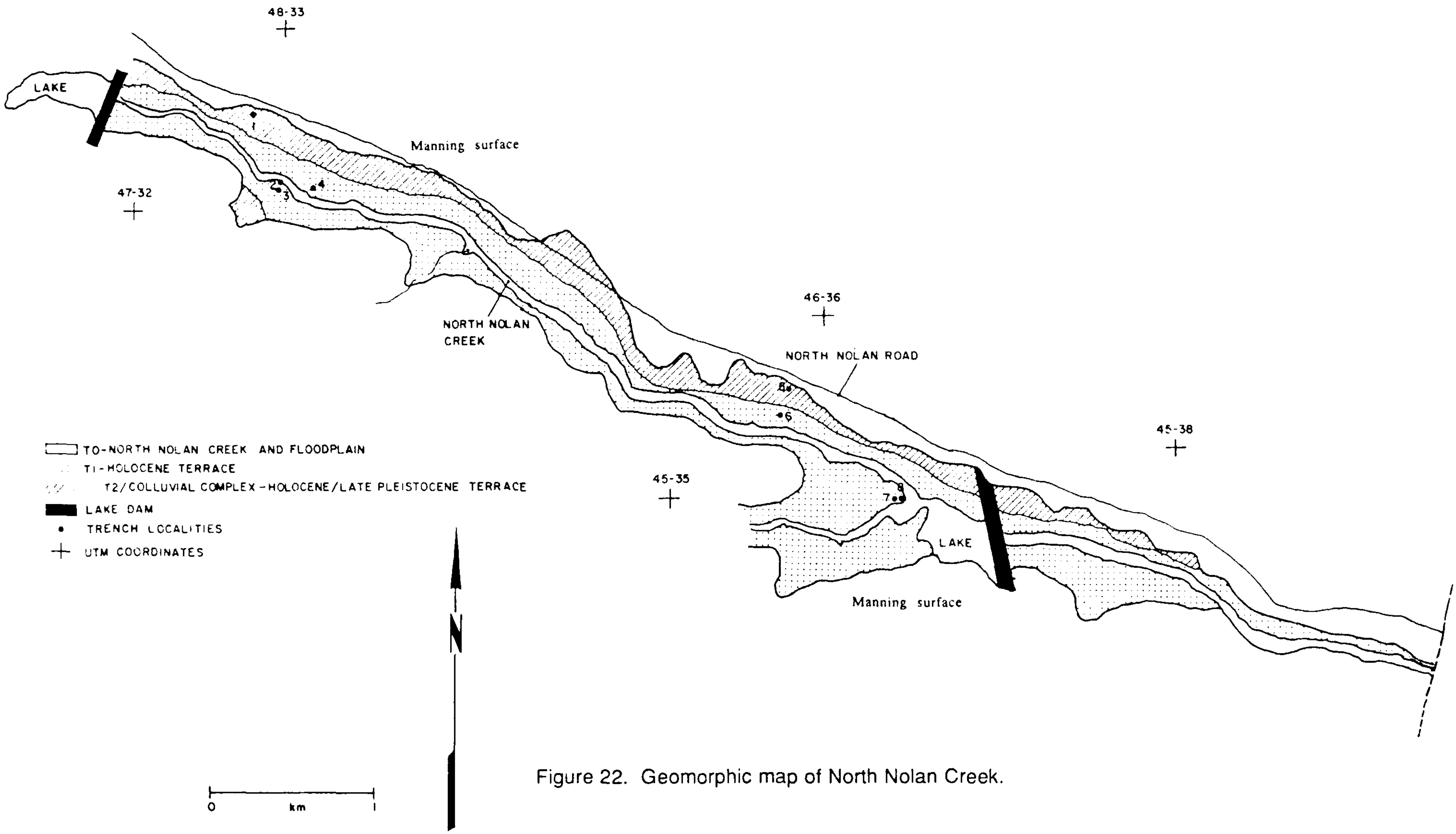


Figure 22. Geomorphic map of North Nolan Creek.

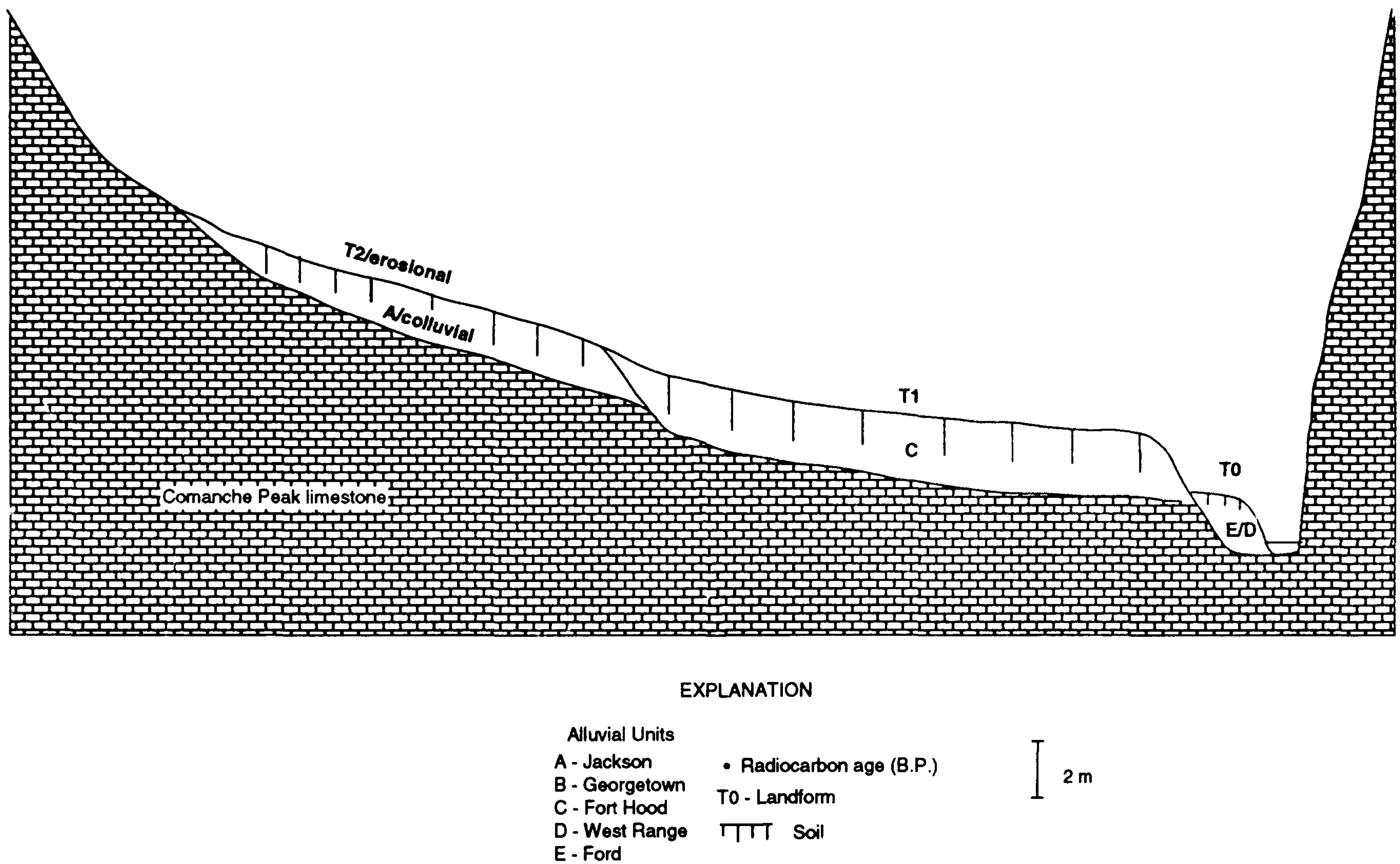


Figure 23. Generalized composite geologic cross section of North Nolan Creek.

Terrace 2 (T2)

Terrace 2 (T2) occurs extensively along the north side of the drainage basin as a sloping alluvial/colluvial complex 6 to 8 m above the modern channel. Because this fill thins rapidly upslope, and because the soil profile is well developed, relatively long term surface stability is inferred. Terrace 2 may have been truncated during widespread late Pleistocene valley incision, but probably has been stable since that time (Fig. 22; TR1, 5). Even if the fill is colluvial, the event occurred during the late Pleistocene and justifies correlation with the Jackson alluvium on a temporal basis.

Terrace 1 (T1)

Terrace 1 (T1) forms a depositional terrace 4 m above the modern channel with a basal alluvial/bedrock contact at 1 to 1.5 m above modern channel level (Fig. 22; TR2, 3, 4, 6, 7, 8). The lower 0.5 to 1 m consists of horizontally stratified, granule and pebble sized gravels, within a yellow and brown clayey to loamy matrix. Surface soils are typically Vertisols with black to very dark gray, clayey A horizons overlying grayish brown to dark brown, clayey Bss horizons with slickensides. These soils are mapped, however, as part of the Krum/Lewisville association which are Mollisols (Huckabee, et al., 1977). Terrace 1 forms the major surface bordering North Nolan and is tentatively correlated with the Fort Hood alluvium. The sediments were probably deposited from a channel carrying a fine-grained sediment load.

Terrace 0 (T0)

A complex sedimentary sequence is erosionally inset to T1 in a laterally confined and entrenched valley. These relatively fine-grained braided sediments flood on a regular basis and are correlated with the T0/Ford alluvium assemblage. The West Range alluvium has not been identified, but if present, will probably occur only as small remnants within this entrenched valley fill. Although T0 is mapped along much of North Nolan Creek, mapping of Bosque soils is limited to the channel reach below the lower lake dam (Fig. 22).

LEON RIVER

The Leon River drainage basin above Gatesville covers about 6000 km^2 of mostly limestones and calcareous clays and sands. The Leon River meanderbelt forms the northern boundary of Fort Hood and exhibits a relatively small radius of curvature compared with a much larger relict valley meander. Leward (1969) believes these large valley meanders were formed during times of higher discharge during the Pleistocene. In the study area, the Leon River flows on the Walnut Clay, has a sinuosity of 1.5, and channel gradient of 0.74 m/km. Average annual discharge between 1950 and 1975 was 5550 m^3/s (Dougherty, 1980). The alluvial sequence in the Leon River basin in this area is completely enclosed by the Killeen surface.

Four alluvial landforms, T3, T2, T1, and T0, are mapped in the Leon River drainage basin as shown in Figure 24. Also shown are the soil-stratigraphic description localities taken from twelve trenches (TR1-12) and three cutbank exposures (CB1-3). Selected soil stratigraphic profiles are displayed in Figure 25 and shown descriptively, along with the remaining localities, in Appendix H. From these descriptions, six stratigraphic units were recognized which are shown in the composite geologic cross section in Figure 26. These units are controlled in time by radiocarbon ages from three charcoal samples (all from cultural features) and one from bulk soil humates (Appendix J).

Terrace 3 (T3)

The earliest recorded alluvial event of the Leon River is contained beneath T3, which is a large partially dissected depositional terrace situated nearly 21 m above the modern channel. In

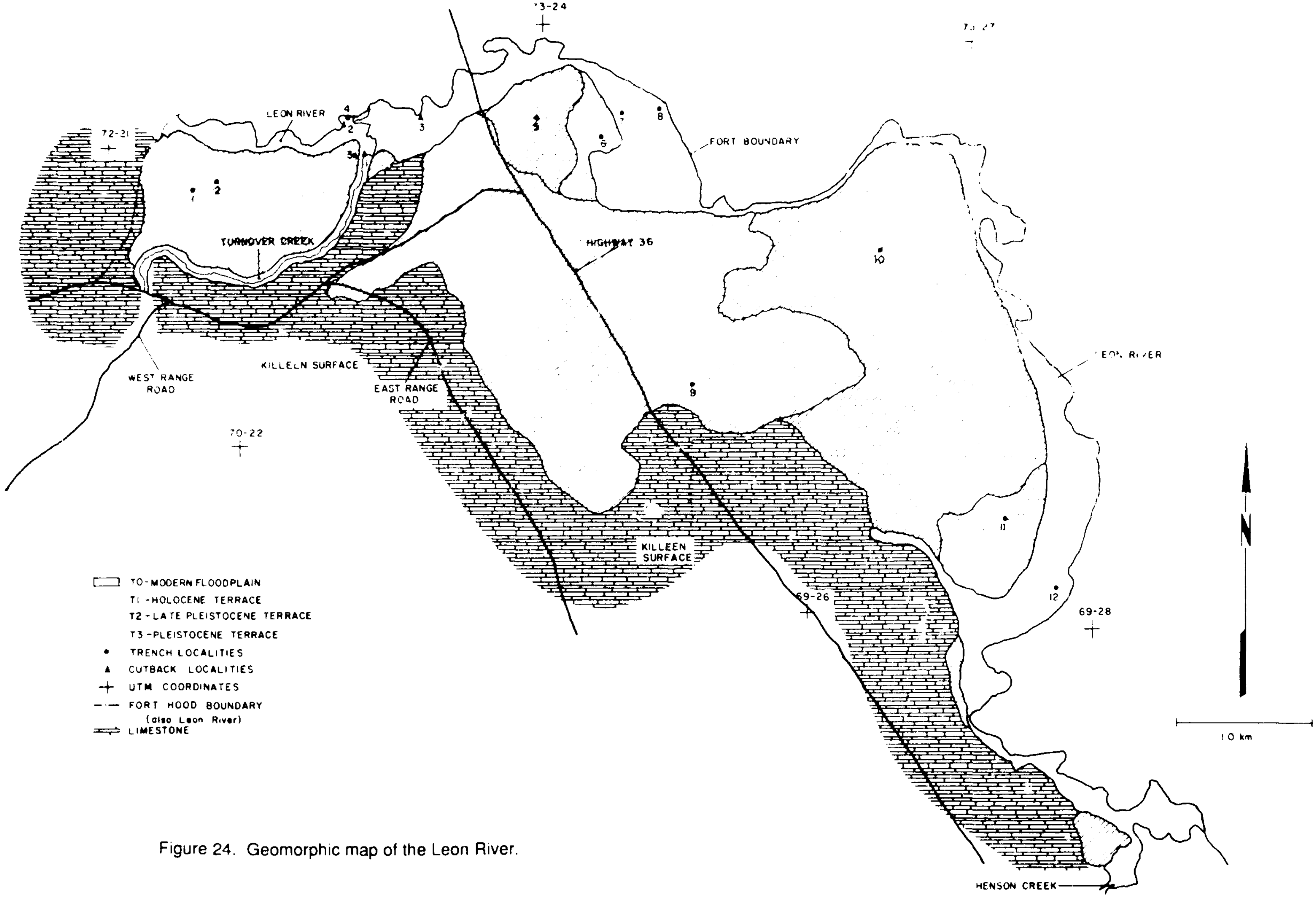


Figure 24. Geomorphic map of the Leon River.

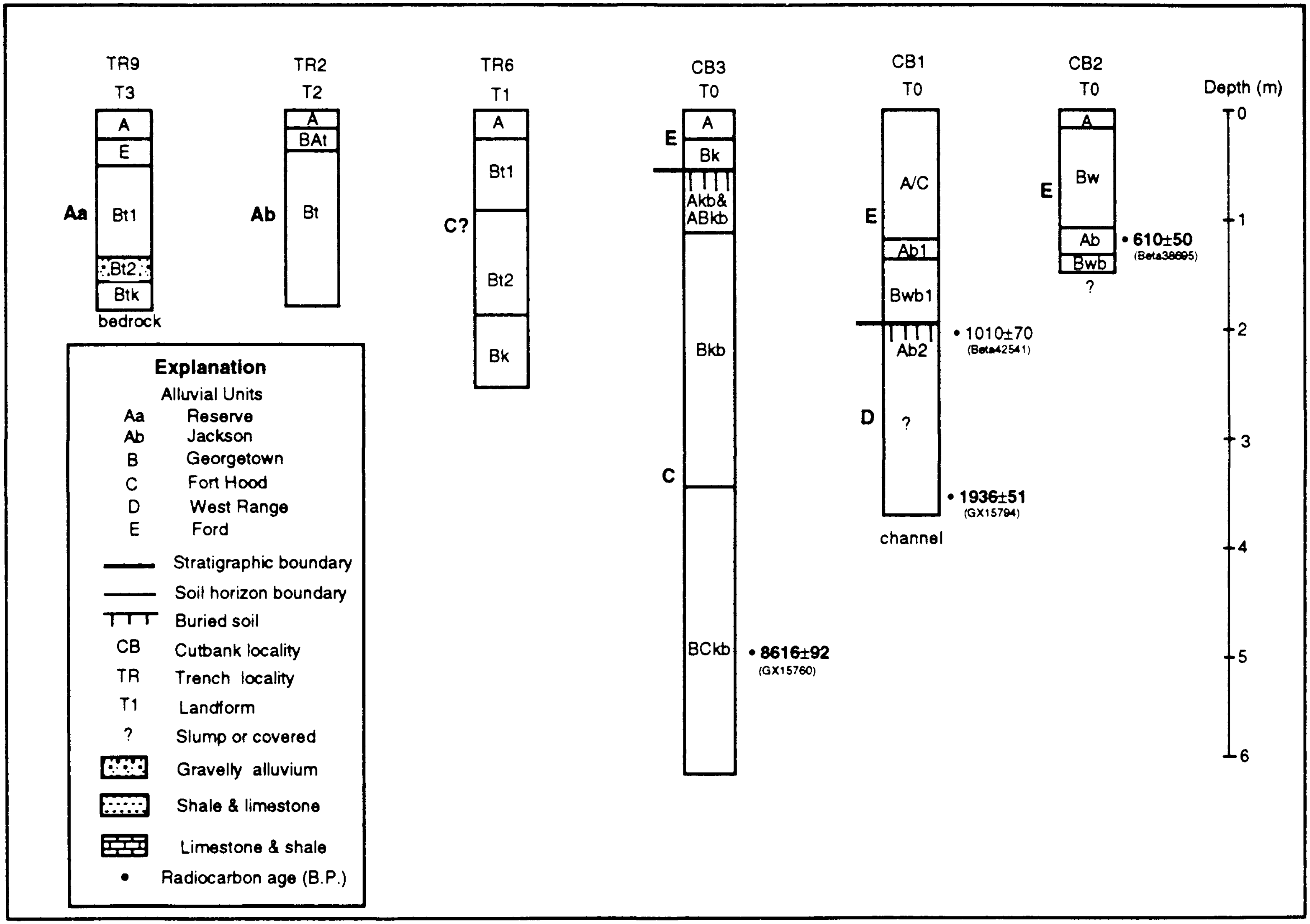


Figure 25. Selected soil stratigraphic profiles of the Leon River. Charcoal ages are shown in bold and bulk humate ages in plain text (see Appendix H for soil stratigraphic descriptions and Appendix J for radiocarbon assays).

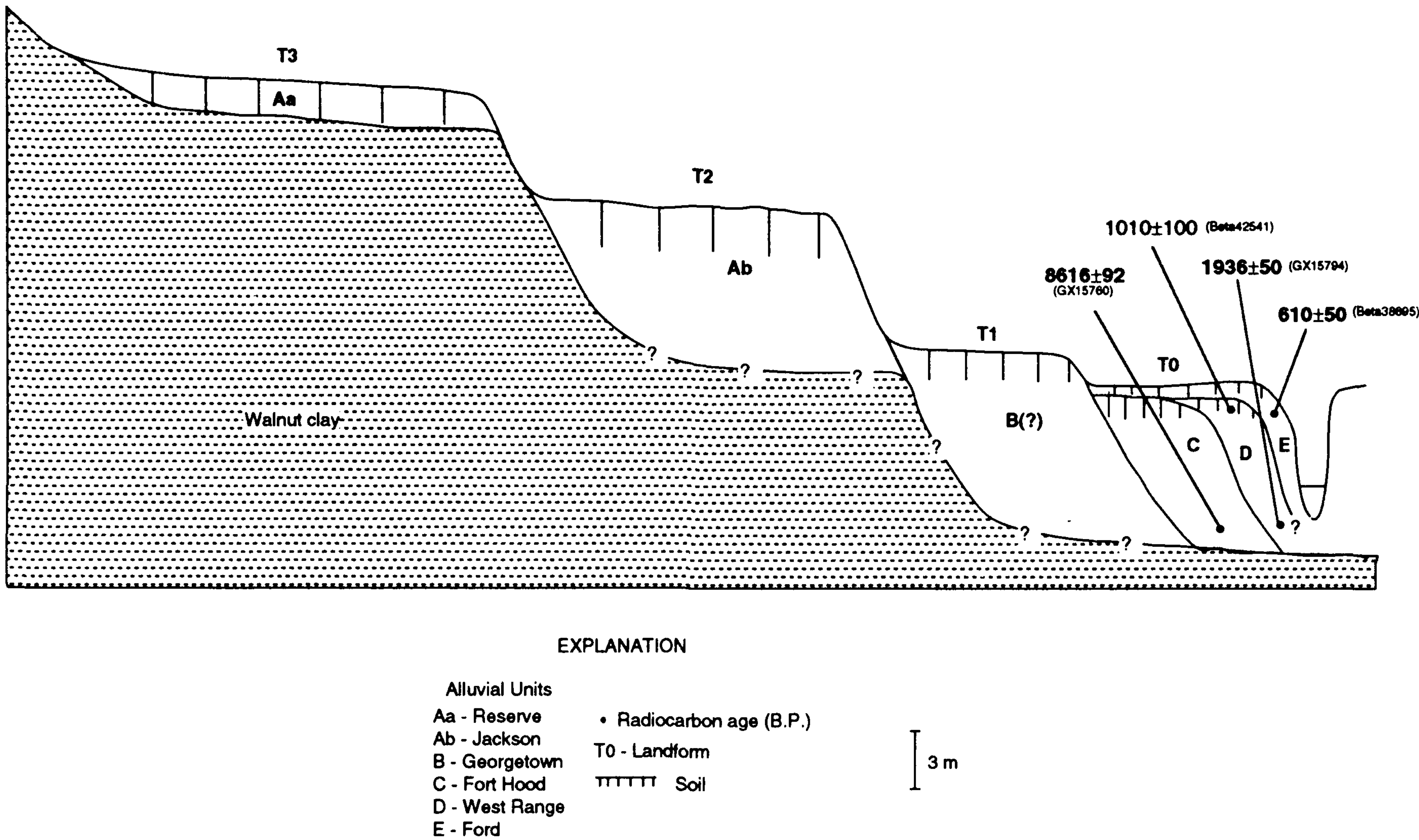


Figure 26. Generalized composite geologic cross section of the Leon River. Charcoal ages are shown in bold and humates in plain text (see Appendix J).

contrast to the carbonatic mineralogies of the local streams, sediments of the Leon have mixed to siliceous mineralogies which weather and transform rather easily into well-developed alfisols which support deciduous hardwood vegetation. This fill consists of less than 2 m of soil-weathered sediments displaying A-E-Bt profiles with clay loam to sand clay loam subsoils (Paleustalfs) (Figs. 24 and 25; TR9). Noncalcareous sola and thick red Bt horizons point to a Pleistocene age for this unit, which is designated the Reserve alluvium (Aa). Much of T3 is mapped as part of the Minwells series (McCaleb, 1985).

Terrace 2 (T2)

Regionally, T2 is the most extensive terrace bordering the Leon River and is situated about 16 m above the modern channel (Figs. 24 and 25; TR1, 2, 3, 5, 10). This terrace is paired, slightly undulating, and sustains mainly deciduous hardwood vegetation. The underlying fill is loamy and grades down to poorly-sorted gravels at about 4 m. Because of limited exposures the basal contactwith the bedrock or another stratigraphic unit was not observed. Surface soils typically contain noncalcareous A-Bt or A-E-Bt profiles that classify as Alfisols (Paleustalfs). Surfaces are dark brown, sandy loam to loamy sand, while subsurfaces have reddish hues of sandy clay loams with distinct clay films. Much of this terrace is mapped as part of the Bastsil series (McCaleb, 1985).

Trenches 1 (TR1) and 3 (TR3) were excavated in a carbonatic Lewisville soil typical of local upland streams. This soil is very similar to that of other late Pleistocene T2 soils of the local streams and was apparently deposited by Turnover Creek at the same time T2 of the Leon was being constructed (Figs.24 and 25; TR2). Terrace 2 of the Leon is therefore correlated with T2 and the Jackson alluvium (Ab) of the upland streams and dated to around 15,000 B.P. The channel and sediment character of the Leon during the Pleistocene is unresolved, although stream competency appears to have been somewhat greater than those during Holocene times.

Terrace 1 (T1)

Small remnants of a terrace located about 1.5 m above the modern floodplain and 8.5 to 9 m above the modern channel are designated T1 (Figs. 24 and 25; TR6, 11). Two possibilities for the origin of this terrace are proposed. The first is that channel incision and subsequent valley filling produced a sandy alluvial terrace inset to T2. The second is that during channel incision and abandonment of T2, the Jackson alluvium beneath T2 was truncated without concomitant deposition thus forming an erosional terrace at a lower elevation. If the first hypothesis is correct, the age of this fill is between the late Pleistocene (unit A) and early/middle Holocene (unit C) and therefore may be correlative with the Georgetown alluvium (unit B). However, if the second hypothesis is correct, the truncated surface could be of Georgetown age while the underlying sediments of late Pleistocene Jackson age. This issue remains unresolved.

Terrace 1 soils have weakly expressed sandy loam A-Bt or A-E-Bt profiles with minimally expressed argillic horizons that are mapped as part of the Bastsil Series (McCaleb, 1985). Minimal profile development and incomplete leaching of carbonates resulting in calcareous lower sola, suggests a surface age of less than 10,000 B.P. A speck of charcoal was sampled from a red Bt at 81 cm (Figs. 24 and 25; TR6) that accrelator dated to 940 ± 59 B.P. (GX 15759), but was rejected because an 8616 ± 92 B.P. (GX 15760) age (Figs. 24 and 25; CB3) was obtained from charcoal in the stratigraphically younger Fort Hood alluvium beneath T0. The charcoal speck in the red Bt was probably intrusive, perhaps from a tree root.

Terrace 0 (T0)

Modern flood sediments, mapped mostly as the Bosque series (McCaleb, 1985), extend perpendicularly away from the modern meanderbelt as a thin fine-grained drape that buries both the Fort Hood and West Range alluvium. Therefore, T1a and T1b equivalents of the upland streams are buried by T0 on the Leon and considered part of the subsurface stratigraphic record. The older of these buried units, the Fort Hood, is erosionally inset to the Georgetown/Jackson alluvium beneath T1. Based on interpretations from sediment cores at the Highway 36 bridge crossing, the depth to bedrock for the Fort Hood alluvium is about 7 to 10 m. Limited natural exposures and a Giddings probe core of the Fort Hood alluvium display yellowish brown, sandy clay loams with occasional basal channel fills that fine upward to thick Lewisville soils (Calciustolls) containing dark yellowish brown, clay loam Bk horizons with common encrusted carbonate filaments. Surface horizons are characterized by very dark grayish brown clay loams (Figs. 24 and 25; CB3). The Fort Hood alluvium is typically buried by 30 to 50 cm of recent flood overwash of the Ford alluvium. Stratigraphic position, color, and soil carbonate morphology are very similar to the Fort Hood alluvium of the local upland streams, however, a radiocarbon age from a depth of 5 m (CB3) indicates that deposition of this unit in the Leon River basin had begun by 8616 B.P. rather than 6850 B.P. in the upland tributary basins. Fort Hood deposition occurred in a fine-grained meandering stream that reflected a provenance shift from siliceous mineralogies of the late Pleistocene alluvium beneath T3, T2, and T1, to more clayey carbonatic mineralogies of the Holocene valley fills beneath T0.

Radiocarbon ages of 1010 ± 70 B.P. (Beta 42541) and 1936 ± 51 B.P. (GX 15794) substantiate correlation of the next younger inset unit beneath T0 to the upper West Range alluvium (Figs. 24 and 25; TR7, 12; CB1). The 1010 B.P. age came from a soil capping the upper West Range alluvium that lost 50 to 100 cm of upper horizons to erosion during early Ford times. Deposition of the upper West Range, therefore, probably continued past 1010 B.P. but terminated before 610 ± 50 B.P. (Beta 38695). A charcoal radiocarbon age of 190 ± 60 B.P. (Beta 38696) from the upper buried West Range soil (CB1) was rejected because of its stratigraphic inconsistency relative to other radiocarbon ages. The charcoal was probably intrusive from a modern tree root. The West Range alluvium is apparently not widespread in the Leon River basin and like the Fort Hood alluvium, is covered by recent flood sediments. A relatively thick cumulic Mollisol (Haplustoll) caps this unit where not severely truncated. Dark gray to brown, silty clay loam to clay A-Bw or A-Bk profiles with minimal calcics, may be present. The soils grade down to brown and pale brown loamy point bar deposits. Depth functions are not known but are probably similar to the other Holocene units.

Modern channel and point bar facies are confined to the modern meanderbelt and consists of cross-stratified to massive pale brown, loams and sands. Horizontally stratified, very dark grayish brown clay loam, and very pale brown sandy loam overbank facies, drape the partially vegetated banks of the entrenched Leon or the laterally adjacent older Holocene deposits (Figs. 24 and 25; TR4, 7, 8, 12; CB1, 2, 3). McCaleb (1985) maps the broad T0 surface as phases of the Bosque series. A radiocarbon age of 610 B.P. supports correlation of this unit with the Ford alluvium.

REGIONAL ALLUVIAL STRATIGRAPHY AND INTERPRETATIONS

The eight streams investigated in this study have been grouped into large, medium, and small on the basis of drainage basin size (Table 1). The Leon River and Cowhouse Creek are designated as large drainage basins; Table Rock and House Creeks as intermediate; and Owl, Henson, Reese and North Nolan Creeks as small. These subdivisions are useful for discussing regional stratigraphy and geoarchaeological interpretations.

Stream Size	Large		Intermediate		Small			
Drainage Basin	Leon	Cowhouse	Table Rock	House	Owl	Henson	Reese	North Nolan
Drainage Basin Size (km^2)	9174	1583	174	168	72	66	57	51
Sinuosity	1.5	1.3	1.3	1.2	1.1	1.05	1.1	1.02
Channel gradient (m/km)	0.74	1.3	3.2	4.9	3.4	6.7	7.6	5.2
modern channel type	meandering		meander-braid transition		meander-braid transition			

Table 1. Drainage basin analysis of the eight streams investigated, Fort Hood, Texas.

TERRACES

Three major alluvial landforms, Terraces 2, 1, and 0 (abbreviated T2, T1, and T0), are mapped in the Fort Hood Military Reservation. Terrace 2 ranges from 5 to 8 m above the modern channel on intermediate and small streams and from 12 to 15 m above the modern channel on large streams. Terrace 2 is paired in the large basins, but sometimes unpaired in the intermediate and small basins. An underlying bedrock strath commonly crops out 2 to 10 m above channel level on Cowhouse Creek and the intermediate and small streams. Depth to bedrock beneath T2 of the Leon River is unknown, although based on one exposure it is at a minimum of 5 m. In addition, a third terrace (T3) is present only on the Leon River and is approximately 25 m above the modern channel. This terrace is of minor extent within the study area. The bedrock floor beneath T3 is typically within a depth of 2 m of the alluvial surface.

Terrace 1 forms a prominent, rarely flooded terrace 4 to 10 m above the modern channel in all streams basins but the Leon River. Terrace 1 is subdivided into T1a and T1b components on the intermediate and small streams, because of an intervening low-relief scarp. This terrace is therefore diachronous or time-transgressive. Because of the scale of mapping, however, T1a and T1b could not be differentiated on the geomorphic maps. On Cowhouse Creek the absence of a scarp makes T1a/T1b distinction difficult, therefore, T1 was not subdivided. Although T1 tends to be paired on the large streams, it forms unpaired remnants on some of the intermediate and small streams, probably because of higher channel and valley gradients and increased stream power that is expended through downcutting rather than by widespread lateral channel migration. This process commonly forms ingrown meanders and unpaired terrace remnants (Brackenridge, 1984) such as T2 and T1 of the small and intermediate streams.

Terrace 0 is limited to the narrow and entrenched modern meanderbelts and channels and represents the active flood zone. Modern maximum annual flood stage, which marks the maximum elevation above the modern channel that T0 will occur, is about 7 m on Cowhouse Creek and 4 to 5 m on the intermediate and small streams. In the Leon River basin, however, T0 is much more laterally extensive covering most of what is T1 on the upland streams. The Terrace 1 nomenclature of the Leon River is consequently shifted to the next terrace which is the surface for two sandy alluvial remnants not present in the upland basins. This terrace is situated 1 to 1.5 m above T0 and floods only occasionally. Modern maximum annual flood stage for the Leon River is about 7 to 8 m.

ALLUVIAL STRATIGRAPHY

Six stratigraphic units are recognized throughout the eight drainage basins investigated. From oldest to youngest, they are the Reserve, Jackson, Georgetown, Fort Hood, West Range and Ford alluvium. Except for the Reserve alluvium, which is limited to the Leon River basin, the stratigraphic units are generally correlative from basin to basin and show relative completeness and synchroneity of the stratigraphic record. There is also a predictable relationship between terrace levels and underlying stratigraphic units. Temporal boundaries within the stratigraphic framework are controlled in time by 50 radiocarbon ages.

Reserve Alluvium

The Reserve alluvium is recognized only in the Leon River basin. It occurs beneath T3 about 21 m above the modern channel. Based on one trench (Figs. 24 and 25; TR9), this unit consists principally of soil- weathered sediment about 2 m thick resting directly on bedrock. Diffuse gravels are present throughout the profile. The soil is a well-developed, noncalcareous Alfisol with a brown sandy loam A horizon over a red clayey subsoil. It is mapped as part of the Minwells series (McCaleb, 1985). Radiocarbon ages are not available from the Reserve alluvium, however, it is older than 15,000 B.P. based on radiocarbon age extrapolation from the Jackson alluvium of Cowhouse Creek (Fig. 27).

Jackson Alluvium

The Jackson alluvium is mapped as a thin sediment assemblage beneath T2 in all stream basins. Exposures at Table Rock and Owl Creek, however, suggest that multiple episodes of valley aggradation are contained beneath this terrace which at present cannot be separated. In addition, there are localized strath terraces along Owl and Henson Creek that reflect lateral stream planation without significant alluvial deposition. Thin valley fills and straths suggest minimal supply of sediment to the drainage network during the late Pleistocene. This is consistent with cooler and wetter climates conducive to dense vegetative cover, intense in situ soil weathering, and minimal soil erosion (Bull, 1991).

Exposures of the Jackson alluvium reveal equal proportions of channel and overbank facies in Cowhouse Creek and the intermediate and small streams, and sandy point bar facies in the Leon River (Fig. 27). Facies assemblages indicate the presence of relict bedload channel meandering, possibly of the meandering-braided type (Schumm and Brackenridge, 1987), for the upland streams at this time. Coevally, the Leon River probably exhibited a sandy meanderbelt system.

A late Pleistocene age is proposed for the Jackson alluvium based on the 15,230 B.P. radiocarbon age determined from bulk humates on the Jackson alluvium in the Cowhouse Creek basin (Fig. 27). Similar floodplain aggradation was occurring in the upper Brazos River basin at 13,500 B.P. (Blum, 1989) and in the Pedernales River basin at 17,000 B.P. (Blum and Valastro, 1989). The soil at the dated locality on Cowhouse Creek is noncalcareous in the upper 20 cm which is commonly the case in other upland streams for soils developed in the Jackson alluvium and is used as a correlation marker. In addition, soils formed in these sediments have generally developed into Vertisols because of sand and silt size carbonate dissolution and the subsequent accumulation of a clayey residium derived from carbonate occluded clays (Nordt and Hallmark, 1990). Where gravels are located in near-surface contexts, discontinuous petrocalcic horizons may be present. These petrocalcics, however, appear to be dissolving under modern climate conditions, perhaps as a result of post-depositional surface erosion and subsequent deepening of the effective wetting front down into the petrocalcics. Soils formed from the Jackson alluvium on Cowhouse Creek and the intermediate streams are generally mapped as Lewisville (McCaleb, 1985), although in small tributaries Krum and sometimes the Denton-Brackett association are mapped (Huckabee, et al., 1977). Leon River soils of this time period have thick, red, noncalcareous Bt horizons, and are mapped as Minwells soils which have mixed rather than carbonatic mineralogies (McCaleb, 1985).

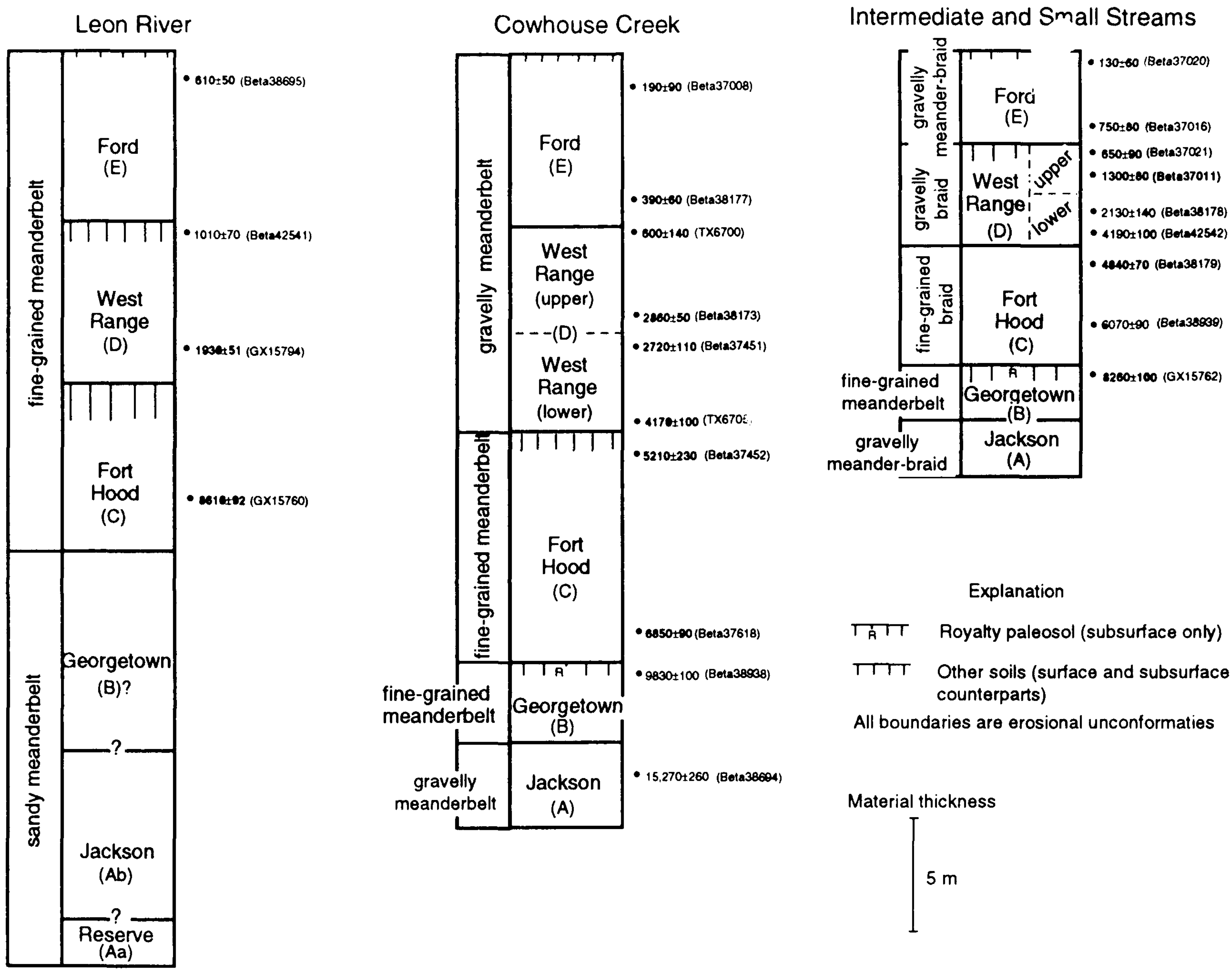


Figure 27. Regional stratigraphic columns correlating the five major stratigraphic units of the Leon River, Cowhouse Creek, and intermediate and small streams (maximum thicknesses shown). Only those ages critical to bracketing the stratigrapnic units are shown. Charcoal ages are shown in bold and humate ages in plain text. When possible, only charcoal ages are shown.

Georgetown Alluvium

Based on bulk humate radiocarbon ages from the Jackson and Georgetown alluvium, a major episode of valley incision ensued sometime between about 15,000 and 11,000 B.P. (Fig. 27), which is consistent with widespread regional channel trenching at this time in Texas (Blum and Valastro, 1989; Ferring, 1990a,b). Some humate ages, however, are older than the event that deposited the sediments containing the humates. The episode of widespread valley degradation may have occurred 1000 to 1700 years later than these ages indicate. The sediment character and channel type associated with the Georgetown alluvium does not seem to reflect the stream power needed to incise and remove up to 10 m of hard limestone or unconsolidated alluvium within a 3000 year period between abandonment of T2 and initiation of Georgetown filling. Accordingly, the broad bedrock valleys that contain Holocene alluvium may be relict and a product of some erosive event predating the late Pleistocene. Brackenridge (1984), however, shows by implication that vertical downcutting of this magnitude into limestone within similar time constraints occurred on the Duck River in Tennessee. Consequently, downcutting of the magnitude described above, and within the given time constraints, could have occurred in the Fort Hood area. Thus it remains unresolved whether channels that deposited the Georgetown alluvium or channels that predated the Georgetown, eroded the valleys that the Holocene units have filled.

Widespread valley filling of the Georgetown alluvium ensued until about 8200 B.P. as a result of relatively uniform, nonepisodic base flow favoring actively meandering streams. The Georgetown alluvium in the upland basins consists of 2 to 5 m of fine, well-sorted channel gravels overlain by massive to bioturbated yellow and gray, loams that typically grade into upper clay loams and silty clay loams exhibiting strong blocky and prismatic pedogenic structure. In some localities, particularly the intermediate and small streams, fine-grained, mottled gray and yellow sediments reflect what may have been local floodplain marshes or wetlands. Given that climatic conditions were sufficiently wet to support a significant upland vegetative cover at this time, rapid upland knickpoint migration, in response to the lowered base level of the trunk drainage network, may not have occurred, thus limiting the source of Georgetown alluvium to reworking of Jackson sediment.

In both the fluvial and marsh settings, remains of the truncated Royalty paleosol (Bk horizon) marks the abrupt upper boundary of the Georgetown alluvium while the lower soil boundary is gradational into the underlying massive loams. Modern analogues show that filaments and threads form by the downward movement of water along macrovoids with subsequent precipitation on ped faces as water moves into ped interiors by capillary forces during dessication (Nordt and Hallmark, 1990). In contrast, groundwater carbonates are dissemenated because of the upward flow of water preferentially throughout the matrix by capillary forces (Sobecki and Wilding, 1983). Under middle and late Holocene climatic conditions the development of encrusted filaments and threads of calcium carbonate does not reach steady state until after 2000 to 5000 years of soil development (Nordt and Hallmark, 1990). The encrusted filaments and threads of the Royalty paleosol therefore formed under relatively stable landscape conditions or cumulicly during slow long-term sediment accumulation. Assuming that bulk humate ages are comparable from a relative viewpoint at CB2 of Cowhouse Creek and CB4 of Table Rock Creek, then a maximum of 800 to 900 years of landscape stability was attained for formation of the Royalty paleosol. This indicates that the paleosol and encrusted filaments and threads in these areas formed during both landscape stability and cumulicly during long-term slow alluvial deposition.

All of the radiocarbon ages for the Georgetown alluvium were determined from the Royalty paleosol and show a wide range of ages (11,325 to 8260 B.P.). It has been demonstrated that bulk humate ages in some areas are older than paired charcoal ages. Accordingly, the youngest age from the Royalty palesol is from hearth charcoal (8260 B.P.) which is the more accurate indication of the termination of Georgetown alluviation. A second possibility for the wide variation in ages, however, is that the paleosol is time transgressive because of: 1) the variation in termination of alluvial deposition and time zero of soil formation (within a basin or among basins), 2) the variation in time at which the soil was truncated by the meandering and braided streams during later Fort Hood times, or 3) the depth to which the soil was truncated prior to burial. There is some evidence supporting the first two hypothesis. For example, the youngest age (8260 B.P.) from this soil came from a Bk horizon on Table Rock Creek (Figs. 7 and 8; CB4) that had fewer pedogenic carbonates than older Royalty soils from other streams. This indicates that the Royalty soil on Table Rock may have been subaerially exposed for less time than on the other streams prior to truncation by the Fort Hood stream channel. More radiocarbon dating of charcoal is needed to resolve this issue.

It is uncertain whether the Georgetown alluvium is present in the Leon River basin. As discussed earlier, T1 of the Leon River overlies two isolated remnants about 1 m above the active floodplain that may correlate with the Georgetown alluvium of the upland streams. Under this assumption, the Georgetown alluvium was deposited from a sandy meanderbelt depositional system which was not truncated and buried during later alluvial events.

Based on the regional pollen record for central Texas, the climate during the deposition of the Georgetown alluvium was presumably transitional between the cool-wet late Pleistocene climate and warm-dry Holocene (Bryant and Holloway, 1985; Hall, 1988). Numerous investigators have suggested that this transition extended to as late as between 8500 to 8000 B.P. and was followed by drier conditions during the middle, and possibly even late, Holocene (Patton and Dibble, 1982; Holliday, 1985b,c; Caran and Baumgardner 1990; Ferring, 1990a,b). This supports sedimentalogic evidence at Fort Hood for uniform perennial stream flow, rapid aggradation, and possible marsh deposition between 11,000 and 8,000 B.P.

Fort Hood Alluvium

The Fort Hood alluvium is the most ubiquitous unit in the study area and underlies most of T1 of Cowhouse Creek, T1a of the intermediate and small streams, and T0 of the Leon River. Truncation of the Georgetown alluvium and initiation of Ford Hood alluviation and floodplain construction, occurred sometime between 8200 and 6800 B.P. based on charcoal ages (Fig. 27). Although two bulk humate ages, which sometimes date older than charcoal, show that Fort Hood alluviation began as early as 9300 B.P., an 8000 B.P. age seems more probable. Based on a charcoal age, deposition of the Fort Hood alluvium in the Leon River basin began by 8600 B.P. (Fig. 27).

Exposures of the Fort Hood alluvium on large streams show thick, fine-grained topstratum sediments overlying relatively thin cross-bedded channel gravels typical of fine-grained meanderbelt deposition. Blum and Valastro (1989) and Brackenridge (1984) have described similar fluvial depositional environments during the early Holocene in limestone valleys of Central Texas and Tennessee, respectively. In the intermediate and small basins, fine-grained sediments also dominate the Fort Hood stratigraphy, although with a greater abundance of diffuse gravels and in some cases distinctive gravel beds much higher in alluvial sections. Sedimentalogical character, and numerous stacked fine-grained channel cuts-and-fills on the intermediate and small streams, are similar to the fine-grained end member of the Donjek type for distal braided depositional models (Miall, 1978). This model describes stream braiding where well defined active channels are separated from overbank facies by at least several meters of vertical relief.

Surface soils of the Fort Hood alluvium typically have distinctive yellowish brown, silty clay loam A-Bk profiles with encrusted carbonate filaments. In coarser parent materials, however, these carbonates may exhibit mycelial forms or be precipitated on gravel-bottoms as pendants. Where Fort Hood alluvium is truncated and overlain by the West Range alluvium on Cowhouse Creek, typically within the modern meanderbelt, only lower sola of the soils developed on the Fort Hood alluvium remain. On the Leon River, however, only the uppermost A horizons of Fort Hood soils were truncated and subsequently buried by the Ford alluvium. Soils developed on the Fort Hood alluvium are never buried by younger alluvium outside of the modern meanderbelt on T1 of Cowhouse Creek nor in any localities of T1a on the intermediate and small streams. In most areas of the upland streams, soils that formed from the Fort Hood alluvium are mapped as either Lewisville or Bosque (McCaleb, 1985). In the small streams a Krum-Lewisville association is sometimes mapped on this surface (Huckabee, et al., 1977).

From palynological data, Bryant and Holloway (1985) demonstrate that the wet-cool climates of the late Pleistocene shifted to warm and dry during the Holocene. More specifically, between 8000 to 6500 B.P. and proceeding until at least 5000 to 4500 B.P., much of Central to Northwest Texas was undergoing a warming trend (Hall, 1988; Holliday, 1989) that was accompanied by slow fluvial deposition and soil formation (Ferring, 1990b), eolian sedimentation (Holliday, 1989; Caran and Baumgardner, 1990), and fan deposition (Blum, 1989; Mandel, n.d.). Blum (1992) also documents fluvial deposition spanning this period, but shows that it began slightly earlier at about 10,000 B.P. This climatic shift to warmer and drier conditions may have been the catalyst for brief channel trenching or stream metamorphosis as low frequency, high intensity rainstorms increased. Following this model, deposition of the Fort Hood alluvium proceeded as the surrounding uplands became progressively depleted of vegetation which resulted in increased runoff and sediment yields. This sediment was most likely derived from thick, fine-grained upland soils that formed during the Pleistocene as the newly entrenched tributary network migrated into the Killeen surface stripping upper soil horizons. The reddish-yellow hue of the Fort Hood sediments suggests that the upland soils that were eroded were well-oxided. This process culminated in deposition of the fine-grained, yellowish brown Fort Hood sediments. Following this climatic model, infilling of Fort Hood alluvium in the Leon valley may have commenced earlier than the upland streams because the headwaters of the Leon River begin in northwest Texas where climatic conditions are somewhat drier. Accordingly, geomorphic thresholds were lower in this region so that the surrounding uplands were more susceptible to vegetative depletion and landscape instability, resulting in upland soil stripping and valley filling. As the effects of this drying trend moved southeastward soil stripping and valley infilling would have then occurred in the local Fort Hood streams. Furthermore, Mandel (n.d.) has shown that in North Centeral Texas depositional episodes of tributary streams may lag behind those of trunk streams. This may also be the case with the Leon River and the upland tributary streams at Fort Hood.

According to Schumm (1977), a decrease in discharge accompanied by an increase in sediment load, results in decreased channel depth and sinuosity and increased channel gradient. This is precisely what occurred during the early Holocene for the intermediate and small streams as channels adjusted to increased sediment loads by braiding. The large streams, however, were able to maintain relatively deep and somewhat sinuous, low gradient, meandering channels probably because of their large basins and high geomorphic thresholds which resisted fluvial adjustments such as channel metamorphosis.

West Range Alluvium

Between 4800 and 4300 B.P. the channel network throughout Fort Hood adjusted to an increase in coarse-grained sediment load. The shift to coarse-grained sedimentation, which resulted in deposition of the West Range alluvium between 4300 and 600 B.P. (Fig. 27), may be explained by one of two working models. One is that as Holocene drying continued, and many of the deep fine-grained soils of entrenched sections of the Killeen surface were eroded, larger proportions of parent rock were being stripped and delivered to the trunk streams. The increased abundance of bedload sediment and subsequent imbalance between sediment load and discharge may have induced channel metamorphosis by decreasing sinuosities and increasing width-depth ratios, even in the absence of a shift in stream discharge. Previous investigators have demonstrated the important relationship, which may or may not be climatically induced, between drainage basin soil sediment supply and fluvial erosional and depositional cycles (Bull, 1991; Tonkin and Basher, 1990).

An alternative mechanism for delivering coarse-grained sediment to the trunk channel network after 4300 B.P. was an increase in discharge in response to wetter and possibly cooler climatic conditions. Such a shift in climate at this time has been inferred from alluvial sequences in North Central Texas and Oklahoma (Ferring, 1990a, b; Hall, 1988, 1990). Wetter conditions would have stabilized upland hillslopes by increasing vegetative cover, reducing sheet erosion, and effectively slowing the rate of knickpoint migration into the Killeen surface. Continued downcutting within the previously entrenched tributary network would have provided significant quantities of parent rock for delivery into trunk streams. The relatively higher stream discharges at this time would presumably have had the competency to carry the newly introduced coarse-grained sediment. In support of this model, Blum and Valastro (1989) attribute coarse-grained sediment transport by the Pedernales River between 4000 and 1000 B.P. to wet climatic conditions that produced higher effective discharges and competency levels. Either of the above models explains the presence of shallow stacked channel fills of the small and intermediate streams during this time and may account for the limited lateral channel migration of the larger meandering streams.

The West Range alluvium is subdivided into two members based on radiocarbon ages, sediment texture, and geomorphic relations. Deposition of the lower member began near 4300 B.P.

and terminated sometime between 2800 and 2400 B.P. Bulk humate ages indicate that deposition was ongoing until as late as 1700 B.P. on some tributaries. Cowhouse Creek was undergoing floodplain construction of the lower West Range member by bedload meandering streams shortly after 4300 B.P. as evidenced by U-shaped channels and epsilon cross-bedding of sands and gravels. Simultaneously, the intermediate and small streams were undergoing coarse-grained braiding similar to the coarse-grained end member of the braided Scott type which is characterized by superimposed longitudinal bars (Miall, 1978). The Leon River stratigraphy at this time was characterized by deposition of medium-grained point bars and slowly accreting cumulic surface soils. The dichotomy in depositional mode between the large meandering streams and intermediate and small braiding streams, may be explained in terms of drainage basin size: small basins are representative of headwater settings with steep slopes that result in flashy intermittent discharges, while large basins are representative of trunk streams with shallow slopes that result in more uniform perennial discharges.

Deposition of the upper West Range member began as early as 2800 B.P. but in places began as late as 1700 B.P. (based on bulk humate ages), and ended sometime between 800 and 600 B.P. This unit exhibits less vertical relief between channel and overbank facies than the lower member and is therefore commonly buried beneath Ford sediments. The exception is on Cowhouse Creek where the upper West Range member is typically subaerially expressed. The sediment character in the intermediate and small basins is finer-grained than the lower member except in some local tributaries where gravel-rich sediments are evident. The lower West Range member is preserved most in Cowhouse, House, Owl, and upper Henson Creeks. The upper member is most ubiquitous in Cowhouse, Table Rock, Owl and lower Henson Creeks, and the Leon River.

When all West Range ages are grouped, there is a temporal overlap between the upper and lower members of this unit. There is also temporal overlap between the upper member of the West Range and the basal Ford alluvium. This demonstrates that periods of channel incision or deposition occurred within a predictable but rather wide time range and that, for example, times of deposition of a particular stratigraphic unit were not contemporaneous between basins. The West Range alluvium in total is slightly more time-transgressive than the Fort Hood alluvium, even though the sediments are confined to the modern meanderbelt and comprise by volume less alluvium than the Fort Hood alluvium. When rates of aggradation are calculated for the individual West Range members, the time transgressive nature of the depositional events between these members and the Fort Hood alluvium are similar.

Most West Range alluvium was deposited within the modern meanderbelts beneath T1 of Cowhouse Creek, T1b and T0 of the intermediate and small streams, and T0 of the Leon River. Bedrock incision and lateral channel migration during West Range alluviation on the intermediate and small streams, abandoned the Fort Hood fill on a bedrock ledge 0.5 to 1 m above the modern channel thalweg. As a result, West Range aggradation proceeded only to within about 1 m of the T1a surface and has subsequently been partially covered by a thin veneer of Ford sediments. In this setting, the upper West Range alluvium is always buried by Ford sediments beneath T0. In contrast, West Range alluvium aggraded up to the same surface level as the Fort Hood alluvium in overbank positions on Cowhouse Creek, and was not buried by more recent sedimentation events. On the Leon River a thin drape of Ford alluvium has buried both the West Range and Fort Hood alluvium. West Range alluvium is apparently not present, or is truncated and deeply buried, in Reese and North Nolan Creeks.

Most soils formed from the West Range alluvium in the three major drainage basins (Table 1) are mapped as part of the Bosque series (McCaleb, 1985; Huckabee, et al., 1977) and are for the most part spatially confined to the modern meanderbelt except for thin, more laterally extensive, flood drapes. Soils typically have colors that are grayish brown, in contrast to the yellowish brown soils developed in the Fort Hood alluvium, and display loamy A-Bk and A-Bw profiles (Mollisols) with mycelial carbonate forms. The abundance of secondary carbonate forms is less than in the Fort Hood soils although the abundance is still great enough in many profiles to meet the minimum requirements for calcic horizons, particularly on the lower West Range member or in older sections of the upper member (Nordt and Hallmark, 1990).

Ford Alluvium

The pollen record and alluvial sequences from Central Texas to Oklahoma suggest that approximately 1000 B.P. climatic conditions became warmer and drier relative to the previous 1000 years (Hall, 1988, 1990; Blum, 1992). In support of this proposal, radiocarbon ages from Fort Hood demonstrate that stream metamorphosis, and possible brief channel trenching, occurred shortly after 1000 B.P. and that channel and overbank filling has been proceeding since this time (Fig. 27). It is difficult to perceive of significant vertical channel trenching, however, when the channel facies of both the West Range and Ford alluvium are at nearly the same bedrock basal level, particularly on the large streams. Rapid fluvial adjustments in response to a shift in sediment load or discharge, without significant channel incision, seems to be the likely cause of stream metamorphosis at this time.

The Ford alluvium lies beneath T0, is confined to the innermost meanders, and consists of modern and partially buried channel bars and superimposed overbank deposits. With the exception of the Leon River, which principally exhibits point bar bedforms, modern upland channels are characterized by both braiding and meandering channel forms. Braiding is evident where multiple channels are separated by longitudinal bars in straight channel segments while point bars accumulate on the insides of acute meander bends. In either case, relatively fine-grained overbank sediments are an important sedimentary component and by their stratified nature wide fluctuations in flood magnitudes can be inferred. In addition, during the last 50 years nearly 30 cm of fresh coarse-grained sediment has been deposited on top of the Ford alluvium beneath T0 in overbank positions in all stream valleys.

In the intermediate and small stream valleys the Ford alluvium partly truncates and onlaps both members of the West Range alluvium. On Cowhouse Creek the Ford alluvium is for the most part inset to the West Range fill without overlap, while on the Leon River it thinly buries both the Fort Hood and West Range alluvium. The soils beneath T0 in the Ford alluvium, as well as in the West Range alluvium, are mapped as part of the Bosque series (McCaleb, 1985; Huckabee, et al., 1977).

GEOARCHAEOLOGICAL INTERPRETATIONS

Surface survey of the archaeological record does not permit the detection of subsurface sites nor the interpretation of the geomorphic contexts within which surface and subsurface sites are found. Butzer (1982) argues that stratigraphic and geomorphic principles, along with principles from a full array of environmental subdisciplines, must be employed to reconstruct and fully comprehend the contextual setting of cultural sites. Furthermore, Waters (1992) states that the temporal and spatial stratigraphic framework must be established before site forming processes can be interpreted or before the landscape at the time of cultural occupation can be properly understood. Waters (1992) and Gardner and Donahue (1985) recognize that the archaeological record is subjected to one of three processes in alluvial settings. The first process is deposition, which depending on its rapidity, may bury multi-component sites in a stratigraphically controlled column. The second process is erosion, which may disturb or remove sites from the alluvial setting. The importance of this process is that the resulting preserved archaeological record can bias interpretations of prehistoric population densities and distributions. The last process involves erosional and depositional acquiescence which results in landscape stability and soil formation thus providing a living surface for single or multiple occupations. Following these thoughts, Bettis and Benn (1984) argue that the buried archaeological record is a dependent variable in alluvial landscapes in that artifactual preservation, absence, and distribution are dependent in large part on the depositional and erosional record, and landscape stability. In addition, Ferring (1986) has shown how rates of sediment accumulation influence buried artifactual densities, patterns, and preservation while Holliday (1990), in a summary of his work and others, has shown how soils can be used for archaeological interpretations as stratigraphic markers for dating deposits, reconstructing paleoclimates, and interpreting past living surfaces. Collectively, the above concepts have been incorporated into the subdiscipline of archaeology termed "geoarchaeology" which has emerged during the last decade for the purpose of placing buried and surface sites in their proper spatial and temporal stratigraphic context for accurate environmental and cultural assessment (Butzer, 1982; Waters, 1992).

The regional alluvial stratigraphic model constructed for the eight major streams at Fort Hood provides a temporal and spatial environmental context for the placement of the buried archaeological record. The stratigraphic framework provides insights into the following archaeological objectives:

1) regional identification and distribution of culturally relevant sediments,
2) identification and distribution of sediments spanning a particular cultural period,
3) relative probability potentials of recovering cultural sites from specific alluvial units,
4) establishment of the time-transgressiveness of mixed cultural assemblages surfacing alluvial landforms,
5) estimation of ages of cultural sites discovered in the future by placement of the site within the temporal alluvial stratigraphic framework, and
6) a means of providing management strategies for cultural site testing plans, or for the recovery or preservation of buried sites.

In the following discussion, the cultural periods and their chronological aspects follow that of Prewitt (1981, 1985) for the Central Texas region. This classification is from oldest to youngest: Paleoindian (>8500 B.P.), Early Archaic (8500 B.P. to 4650 B.P.), Middle Archaic (4650 B.P. to 2250 B.P.), Late Archaic (2250 B.P. to 1250 B.P.), Neoarchaic (1250 B.P. to 200 B.P.), and Historic (200 B.P. to present).

Site recovery potentials are estimated for each stratigraphic unit. These potentials are based on: the preservation of individual stratigraphic units that may contain sites, the ages of the stratigraphic units, the number of physical observations of buried sites per unit, and the depositional environment of each unit. The site recovery potentials are relative and rated as high, medium, low, and none. Each of the five regionally correlated stratigraphic units are now addressed from a geoarchaeological perspective.

RESERVE AND JACKSON ALLUVIUM

As evidenced from one radiocarbon age and our current knowledge of the antiquity of North American human occupancy, the Reserve and Jackson alluvium are not within the appropriate time-frame for containing known early cultural sites (Table 2). These units could only contain potential pre-clovis remains, if such exists. The surface of the Reserve and Jackson alluvium, T3 and T2, respectively, may contain, however, a nondiscrete mixed cultural assemblage spanning the entire Prehistoric and Historic cultural record of Central Texas (Figs. 28, 29, 30).

Many soils in the upland basins that developed in the Jackson alluvium are Vertisols. As a result, the shrinking and swelling clays associated with these soils form cracks that may extend to depths of at least a meter in the subsurface. Cultural materials may fall into these cracks and become incorporated into the older alluvium and must not be interpreted as being coeval with alluvial deposition.

GEORGETOWN ALLUVIUM

The Georgetown alluvium is deeply buried beneath middle to late Holocene deposits except in North Nolan and Reese Creeks where it has not been identified, and in the Leon River basin where isolated remnants crop out. Where buried, the Georgetown alluvium may be encountered at any location beneath T1 or T1a at minimum depths of 2 to 4 m. The fluvial systems at this time were aggrading by meandering except in local low-energy ponded or slack water areas. The age of the Georgetown alluvium was determined in part from bulk humates sampled from the Royalty paleosol. These ages range from about 11,000 B.P. to 9000 B.P. and may indicate that deposition of Georgetown alluvium terminated at different times in different basins. However, because bulk humates commonly date older than charcoal, termination of Georgetown alluviation may have occurred closer to 8000 B.P. based on a charcoal age. The Royalty paleosol probably developed both cumulicly and under brief landscape stability. The maximum period of landscape stability was probably 800 to 900 years.

Paleoindian sites may be vertically superimposed within the massive point bar facies of the Georgetown alluvium or preserved within the Royalty paleosol. Most of the A horizon of the paleosol, however, was stripped during Fort Hood channel trenching and lateral migration (Figs. 28, 29). Accordingly, at least part of the Paleoindian record within alluvium of the upland streams has not been preserved systemically. This does not mean, however, that sites cannot be found in the underlying point bar facies which is a common occurrence in younger alluvial units. Because of stripping of Royalty surface horizons and fragmentary preservation of the Georgetown alluvium, a low probability for site recovery is assigned (Table 2).

Because all of the Georgetown radiocarbon ages are obtained from the Royalty paleosol, and because the ages vary significantly, this soil, the stratigraphic unit, and the sites found within, may be time-transgressive. Only one site, deeply buried on Table Rock Creek (Fig. 7, Appendix B; CB4), has been located in this paleosol in the study region. It dated to 8260 B.P., thus placing it in the

Surface Site Preservation		Subsurface Site Preservation					
Landform	Cultural Divisions	Allostratigraphy[d]	Cultural Divisions	Streams			
				Leon	Cowhouse	Table Rock	Other
T3[a], T2	All	Reserve[a] or Jackson (A, Aa, Ab)	—	—	—	—	—
T1[a]	Paleoindian (?) and younger	Georgetown (B)	Paleoindian	+	+	+	+ or -
T1a[b], T1[c]	Early Archaic and younger	Fort Hood (C)	Early Archaic	++	++	+ or ++	+
T1b[b], T1[c]	Middle Archaic and younger	West Range (D)	Middle and Late Archaic, Neoarchaic	+++	+++	++	+
T0	Neoarchaic and Historic	Ford (E)	Neoarchaic and Historic	+	+	+	+

[a] applies to Leon River only.
[b] applies to all streams except Cowhouse Creek and the Leon River.
[c] applies to Cowhouse Creek only.
[d] applies to all streams unless otherwise stated.

Table 2. Preservation potentials for surface and subsurface cultural sites (- none; + low; ++ medium; +++ high; + or ++ facies dependent).

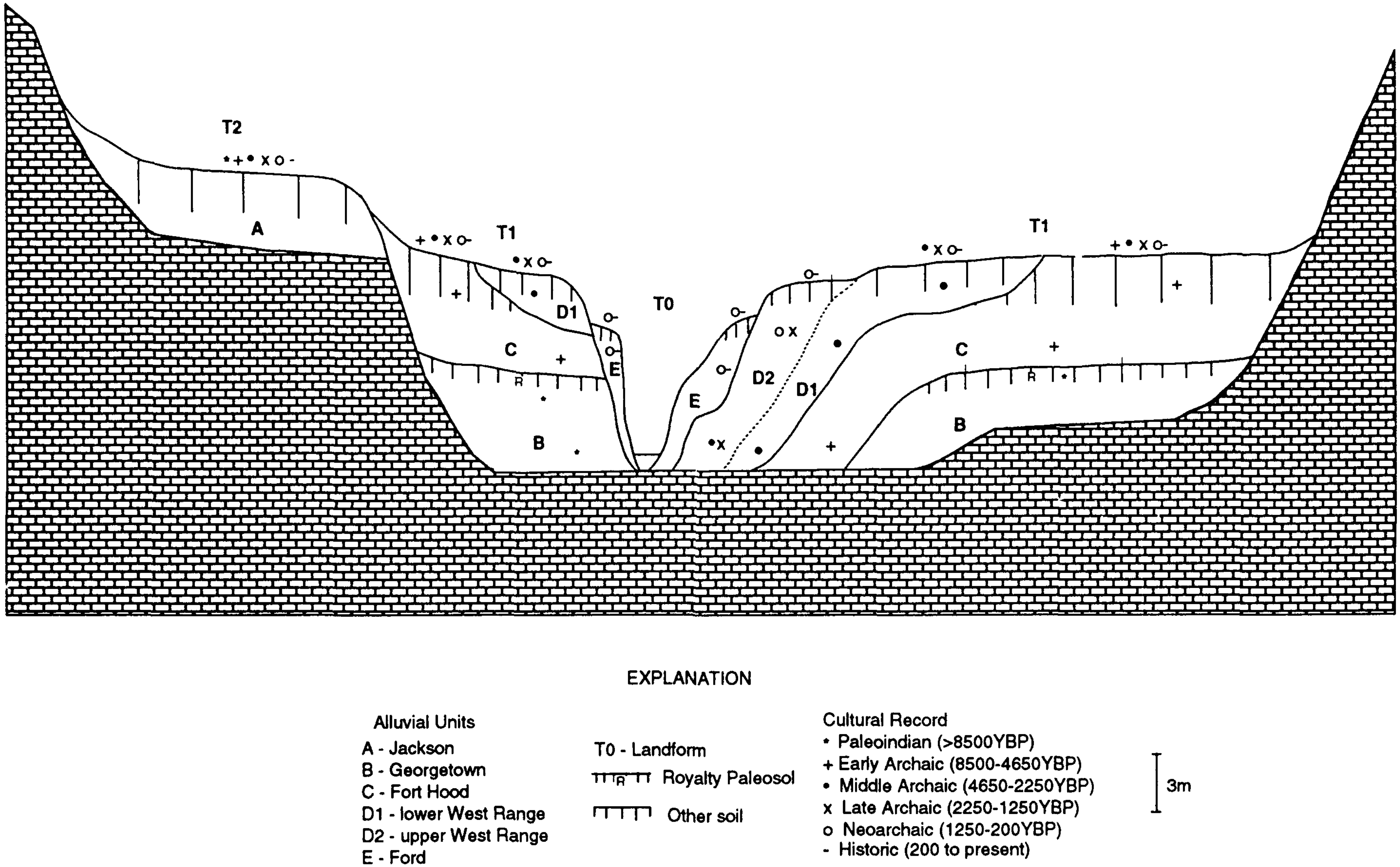


Figure 28. Generalized composite geologic cross section of Cowhouse Creek showing subsurface and surface site potentials.

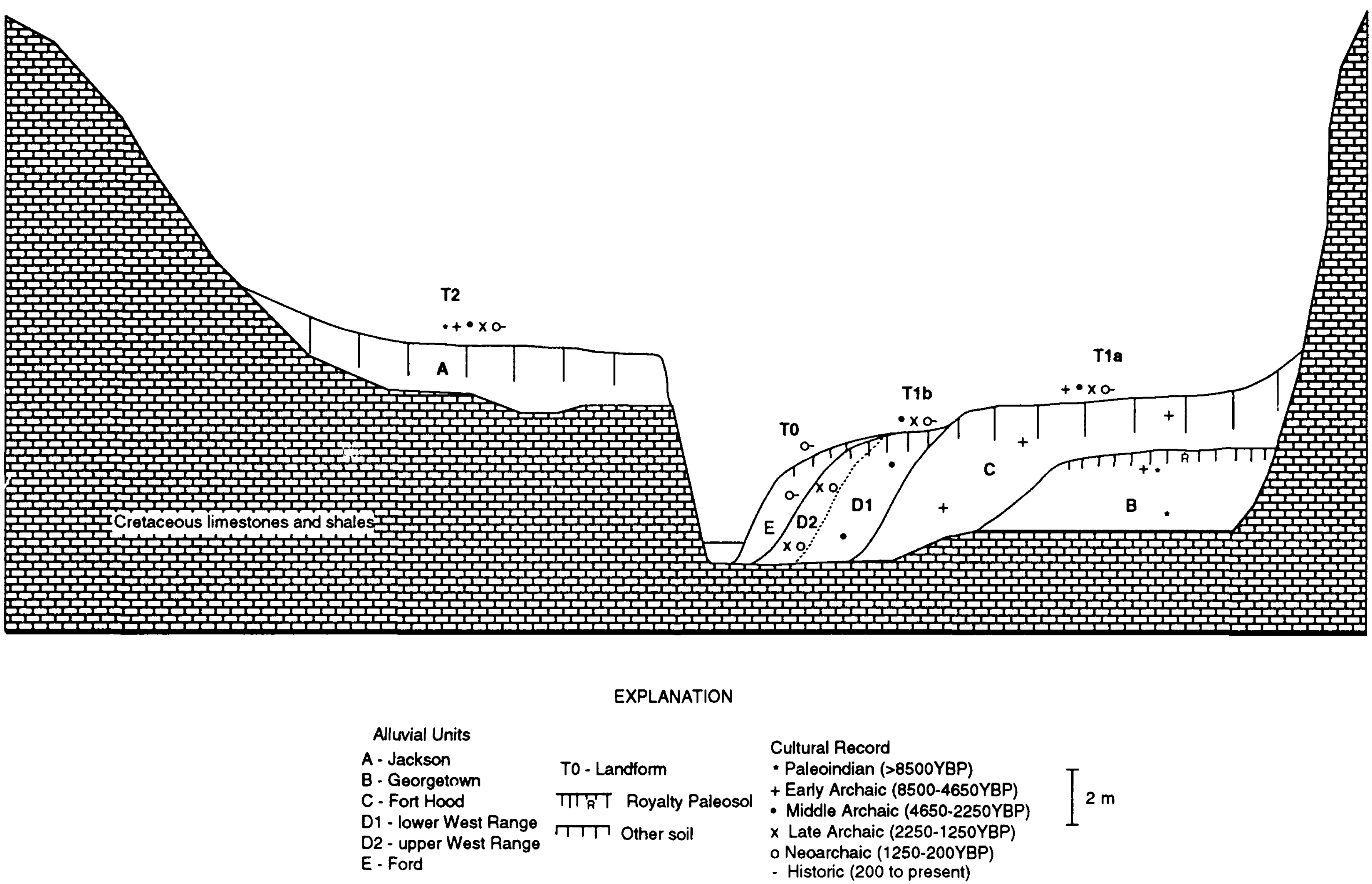
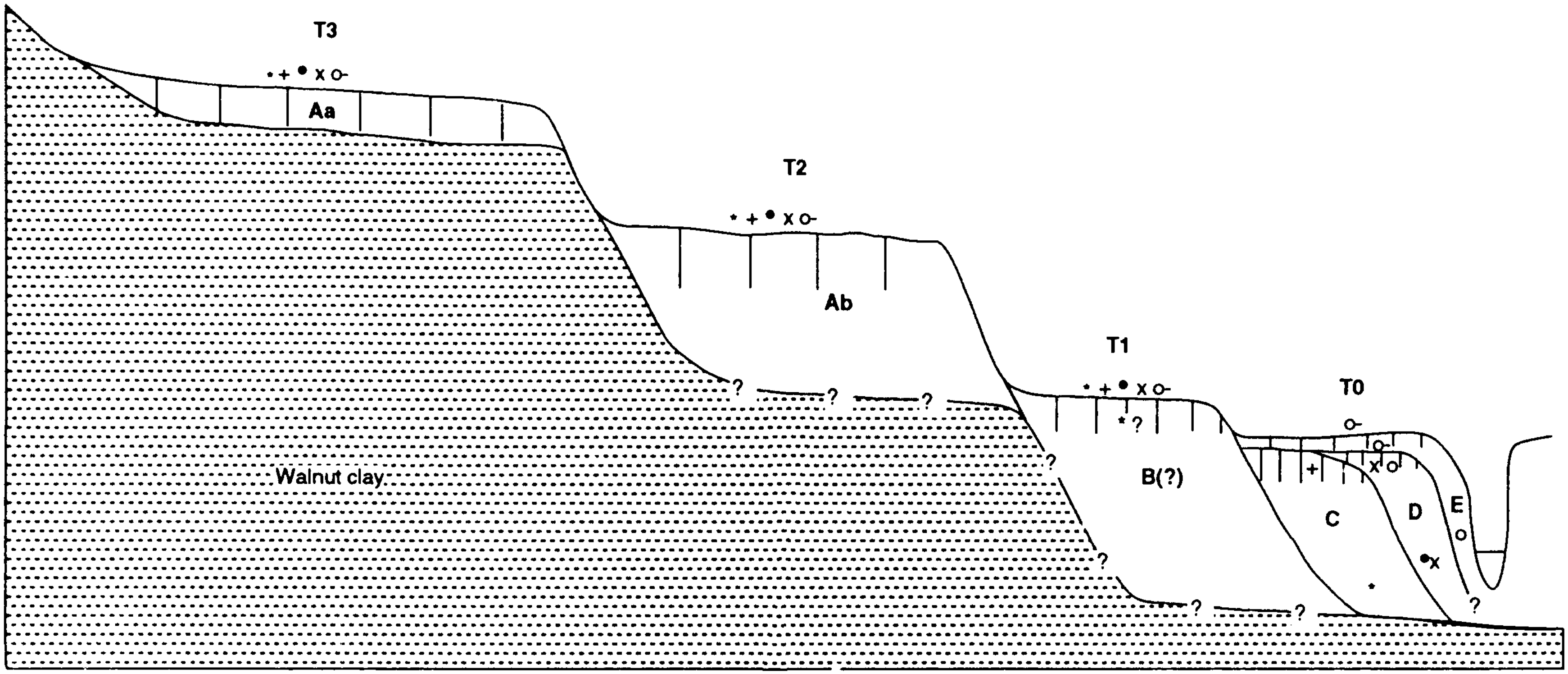


Figure 29. Generalized composite geologic cross section representative of the intermediate and small streams showing subsurface and surface site potentials.



EXPLANATION

Alluvial Units
A - Jackson
B - Georgetown
C - Fort Hood
D - West Range
E - Ford

T0 - Landform
Soil

Cultural Record
• Paleoindian (>8500YBP)
+ Early Archaic (8500-4650YBP)
• Middle Archaic (4650-2250YBP)
x Late Archaic (2250-1250YBP)
o Neoarchaic (1250-200YBP)
- Historic (200-present)

3 m

Figure 30. Generalized composite geologic cross section representative of the Leon River showing subsurface and surface site potentials.

Circleville phase of the Early Archaic. It appears, however, that most sites found in this paleosol will be Paleoindian. In the Leon River basin, Paleoindian sites would probably be confined to the upper few meters of the Georgetown alluvium beneath T1 (tentative) and in the deepest portions of the Fort Hood alluvium beneath T0 (CB3) (Fig. 30).

FORT HOOD ALLUVIUM

Deposition of the Fort Hood alluvium spanned much of the Early Archaic between 8000 and 4800 B.P. (Fig. 28). Deposition during this time was characterized by fine-grained meandering on large streams and fine-grained meandering and braiding on intermediate and small streams (Fig. 27). Relief between channel and overbank facies on the meandering streams such as the Leon, Cowhouse, and Table Rock, was as much as 8 to 10 m. Two sites on Cowhouse Creek (Fig. 4, Appendix A; CB15 and adjacent to CB4) and one on the Leon River (Fig. 24, Appendix H; CB3), all representing temporary sites (small fire-cracked rock features), were encountered at a depth of nearly 8 m on near-channel point bars, while five additional sites, three on Cowhouse (Fig. 4, Appendix A; CB15, CB12, and adjacent to CB13), one on Table Rock (Fig. 7, Appendix B; CB1), and one on the Leon (Fig. 24; intersection of the Fort Hood Boundary and the county bridge crossing in UTM block 72-21), were found within a depth of 1 to 3 m in overbank facies (Figs. 28, 29, 30). This demonstrates that site-depth can vary significantly within the Fort Hood alluvium of these streams. Following classification proposed by Ferring (1986), a moderate depositional rate for the Fort Hood alluvium was calculated for Cowhouse Creek. The absence of paleosols in the Fort Hood alluvium throughout the study area also substantiates moderately rapid deposition and indicates that sites will be discretely sealed vertically, thus diminishing the occurrence of mixed cultural assemblages.

The transitional meandering-braided sequences of the intermediate and small streams may also contain sites at varying depths, but a braided depositional environment resulting from unpredictable high-magnitude flood events may have produced a more disfavorable occupation surface than on the larger streams. Furthermore, if sites were present, and none have been found to date, post occupational fluvial destruction is likely. If future sites are discovered they would probably not be contained in a systemic context.

There is an increase in recognition of buried sites in the Fort Hood alluvium (8000 to 4800 B.P.) relative to the Georgetown alluvium throughout much of the Fort. Surface abundance of Early Archaic sites also increases during this time (Mueller-Wille and Carlson, 1990). Therefore, recovery potentials for the Fort Hood alluvium are considered moderate for the Leon River and Cowhouse Creek compared to a low rating for the Georgetown alluvium. Because of channel braiding on the intermediate and small streams during Fort Hood deposition, potentials for recovery of sites in systemic contexts is considered low (Table 2). During the last 5000 years probably no more than 1/3 of the buried archaeological record in the Fort Hood alluvium has been lost from middle and late Holocene erosion, and modern channel trenching and lateral migration.

The Fort Hood alluvium lies beneath T1 or T1a on the outer half to two-thirds of the broad T1 surface mapped adjacent to each upland stream. This surface became stable no sooner than 5000 to 4800 B.P. but no later than 4300 B.P. and as a result surface sites may be nondiscrete and span the entire Middle Archaic to present (Table 2). On the Leon River, the T1 or T1a equivalent to the upland streams are truncated and buried by late Holocene and modern sedimentation (T0). This buried T1 surface was minimally truncated in some areas as early as 3000 to 4000 years ago by West Range erosion, but as late as 600 to 800 years ago by Ford erosion in other areas. As a result, the potential for site recovery on this buried surface will span the Late Archaic to early Neoarchaic, and be devoid of late Neoarchaic and Historic remains.

The outer portions of T1 near the bedrock valley walls, particularly on the intermediate and small streams, contain small localized colluvial drapes and alluvial fans. The timing of deposition is uncertain although soil development suggests that many of these landforms have been stable for as much as 4000 to 5000 years. A trenched alluvial fan on Cowhouse Creek indicates that fan deposition was synchronous with valley alluviation rather than representing discrete intervening periods of fan deposition. Cultural sites would therefoie be incorporated randomly within this fill and not sealed on a specific long-term living surface.

It is difficult to assess the hunter-and-gatherer perception of a stable land surface. The flood frequency during Fort Hood times, given calculated depositional rates, was high, flooding perhaps 4 to 5 times annually. If this flood frequency was perceived as threatening, then T2 would have been a strategically important occupation surface because of its stability and proximity to a major water source. If, however, T1 or T1a was not perceived as unstable, occupation of T2 or T1 during this time may have been equally favorable. In addition, site distributions on each of the major landforms may vary according to whether the sites were established when the occupying surface was an active floodplain verses a later time period when the surface represented an abandoned floodplain or terrace (Ferring, 1990a).

WEST RANGE ALLUVIUM

Between 4800 and 4300 B.P., major channel systems in the Fort area were shifting from fine-grained to coarse-grained meandering and braiding (Fig. 27). On the Leon and Cowhouse, where meandering was evident, the accompanying erosional phase was confined to the central portion of the T1 floodplain which completely removed the Fort Hood alluvium in channel positions, but only the upper 1 to 3 m of the surface soil in overbank positions. Much of the Early and Middle Archaic record was lost from middle and late Holocene upper lateral truncation of the soils developed in Fort Hood alluvium. As a result a 1000 to 4000 year unconformity occurs on the horizontal erosional surface separating the West Range and Fort Hood alluvium within the upper 3 m. Lateral overbank truncation and back filling at this time was not as extensive on the intermediate and small streams where the Fort Hood and West Range alluvium are laterally inset to each other without vertical overlap, thus precluding unconformable vertical vacuities within these respective units. A topographic scarp commonly separates T1a and T1b in these areas.

Deposition of the two members of the West Range alluvium took place between 4300 and 600 B.P. which potentially contains the Middle and Late Archaic and early Neoarchaic cultural record (Figs. 28, 29, 30). Most sites, however, occur in the upper West Range alluvium which was deposited between about 2800 and 600 B.P. Furthermore, upper West Range sites occur with greater frequency near stream confluences, particularly near the confluence of Cowhouse with Two Year Old and Cottonwood Creek, and the Leon River with Turnover and Henson Creek. The absence of distinguishable paleosols, coupled with a moderate depositional rate, suggests preservation of discrete superimposed sites in both West Range members. Two sites (Fig. 4, Appendix A; CB1, 9) were recognized at depths of 6 to 8 m in the Cowhouse Creek basin, although most are within the upper 3 m (Fig. 4, Appendix A; CB14, 16, 17, 18; TR11), while only two sites (Fig. 24, Appendix H; CB1) were documented in the West Range alluvium of the Leon River, mainly because of the scarcity of exposures.

Site potentials on the large streams are higher in the West Range alluvium than any other unit rendering a high probability assignment for this unit (Table 2). Although there are more sites listed in Appendix J that date between 1200 and 600 B.P. than between 3000 and 1200 B.P., the greatest number of buried sites were recognized during the latter time period. Many of these sites were not dated, and therefore not listed, because of the redundance of dating numerous sites from the same facies within a given stratigraphic unit. Given equal exposures of both the Fort Hood and West Range alluvium (trenches and cutbanks), and less total sediment volume of the West Range alluvium (both members combined), the high site-frequency found in the latter suggests that utilization of the area during the late-Middle to early Neoarchaic, between about 2800 and 600 B.P., may have been higher than at any previous time. Even though the West Range alluvium is slightly more time-transgressive than the Fort Hood alluvium, this conclusion seems justified based on a much greater recognition of sites in the West Range alluvium.

The factor limiting site preservation on small and intermediate streams for the lower West Range member is not the availability of culturally relevant sediments, but the unfavorable preservation conditions associated with channels undergoing flashy and sometimes episodic flood discharges (Table 2). Gravel channel facies make up a higher proportion of the total sediment volume in these braided streams, and because of rapid channel shifting, sites that were on these gravelly facies would have been subsequently reworked by erosion. In contrast, the upper West Range member is finer-grained along many of these streams and has a slightly greater potential for site preservation. The fine-grained upper West Range member is commonly preserved on Table Rock Creek (Fig. 7; CB2), Owl Creek (Fig. 10; TR3; CB7), and Reese Creek (Fig. 19; CB1).

Because both West Range members are not present in all stream basins, chronological vacuities are common in sediments spanning the late Holocene. For example, Table Rock is missing the lower West Range member and with it the buried cultural record spanning from about 4300 to around 2500 to 2000 B.P. The same also probably applies to Reese, North Nolan, and the lower Henson Creek basins. In contrast, the upper West Range member is absent for the most part in House, North Nolan, and the upper Henson Creek basins. As a result the cultural record between 2500 and 600 B.P. may be missing from the alluvial record.

Because of the lateral time-transgressiveness of the West Range alluvium, surface stability was attained anywhere from 2000 to 600 B.P. making T1b, and the zone within the meanderbelt of T1 of Cowhouse Creek, available for occupation from the late-Middle Archaic to the present. Many sites spanning from about 1000 to 600 B.P., however, have been truncated or buried by Ford erosion or sedimentation in the intermediate and small basins. During this time T1a of the intermediate and small streams would have probably been inundated only during high magnitude floods.

FORD ALLUVIUM

While the Ford alluvium comprises an appreciable portion of the stratigraphic column (Fig. 27), its chronostratigraphic signature is considerably less. This situation is due in large part to the rapidity of deposition during the last 400 to 800 years which reduced the temporal range relative to the material thickness. Sites in this unit should, and do, reflect vertical spatial separation and low site densities as a result. Site potentials are assessed as low for the Ford alluvium on all streams because of the low volume of sediment preservation, extensive basal gravelly facies, and a limited time range of sedimentation.

As with the Fort Hood and West Range alluvium, time-synchronous facies distributions of the Ford alluvium vary vertically by as much as 7 m on the Leon and Cowhouse and by 4 to 6 m on the intermediate and small streams. Therefore, sites can potentially be encountered at all depths within the Ford alluvium even though all sites so far in the upland streams were detected in overbank sediments no more than 3.5 m deep because of the dense basal gravels (Figs. 28, 29, 30).

Hall (1988, 1990) believes that the last 1000 years has been drier than the period from 2000 to 1000 B.P. Alternating beds of coarse and fine textures deposited considerably above modern channels during the last 700 to 800 years may reflect flashy flood events resulting from drier climatic conditions (see soil textures,

Appendix I). Intervening dark zones may or may not be incipient paleosols, but site occurrences are not restricted to these darker zones.

Late Neoarchaic and Historic cultures are contained within the Ford sediments, while Historic materials are most commonly encountered within the uppermost 20 to 50 cm. Subsequent to brief channel trenching between 600 and 400 B.P. the T1 floodplain in the upland streams was abandoned and possibly perceived as a more suitable surface for occupation.

This last period of channel entrenchment and lateral overbank truncation removed significant portions of the West Range alluvium and the Middle and Late Archaic record along with it. At the contact where Ford sediments truncate and overlay West Range sediments, a phenomenon restricted to the intermediate and small streams, there is potentially a 100 to 500 year time unconformity. This vertical unconformity does not exist on Cowhouse Creek where the West Range and Ford alluvium are laterally inset.

SUMMARY AND CONCLUSIONS

The last 15,000 years at Fort Hood is marked by identifiable periods of alluvial erosion, deposition, and soil formation. These periods show remarkable synchroneity among the eight streams investigated which facilitates interbasin stratigraphic correlations and the interpretation of the buried and surface cultural record. A summary of the cultural and alluvial stratigraphic chronologies is shown on Figure 31.

Subsurface Site Preservation

The potential for recovering buried Prehistoric archaeological sites in Fort Hood includes most of every recognized cultural stage, and at least parts of most phases. Net deposition during the last 10,000 years, excluding conformable depositional hiatuses (diastems), represents as much as 70 percent of the temporal record and can be subdivided into four chronologically discrete, and unconformably bound, stratigraphic units (Fig. 27). The Jackson alluvium (~15,000 B.P.), at the current state of knowledge, precedes the accepted antiquity of human occupancy in North America. However, if sites are found they would be pre-clovis. The Georgetown alluvium and Royalty paleosol (~11,000 to 8000 B.P.) may contain Paleoindian sites; the Fort Hood alluvium (8000 to 4800 B.P.), Early Archaic sites; the West Range alluvium (4300 to ~600 B.P.), Middle Archaic to early Neoarchaic sites; and the Ford alluvium (~600 B.P. to present), late Neoarchaic and Historic sites.

About 20 to 30 percent of the temporal record has been lost to erosion and sediment removal during the Holocene (Fig. 27). These erosional periods have fragmented much of the archaeological record. Estimated major erosional periods within the Holocene occurred sometime around 8000 B.P. and between 4800 and 4300 B.P. and 800 and 400 B.P. These relatively brief erosional periods removed portions of the late Paleoindian, Early Archaic (Circleville phase), Middle Archaic (Clear Fork phase), and Neoarchaic (Austin/Toyah phases) record. An additional brief period of channel erosion may have also removed small portions of the San Marcos or Uvalde phase between 2800 and 1700 B.P. Soil formation (Royalty paleosol) occurred between about 9,000 and 8000 B.P., although considerable portions of this soil were subsequently lost to erosion and then deeply buried. Because of moderately rapid Holocene deposition, and erosion of the Royalty paleosol, periods of soil formation make up very little of remaining stratigraphic record.

Several conclusions can be drawn concerning the influence of the alluvial stratigraphic record on the buried archaeological record. During the last 8000 years, rapid valley filling precluded the development of well expressed soils within the alluvium and as a result, the burial and preservation of discrete, short-term, sites is common. In the Fort Hood, West Range and Ford alluvium, vertical facies exhibit wide depth-ranges which

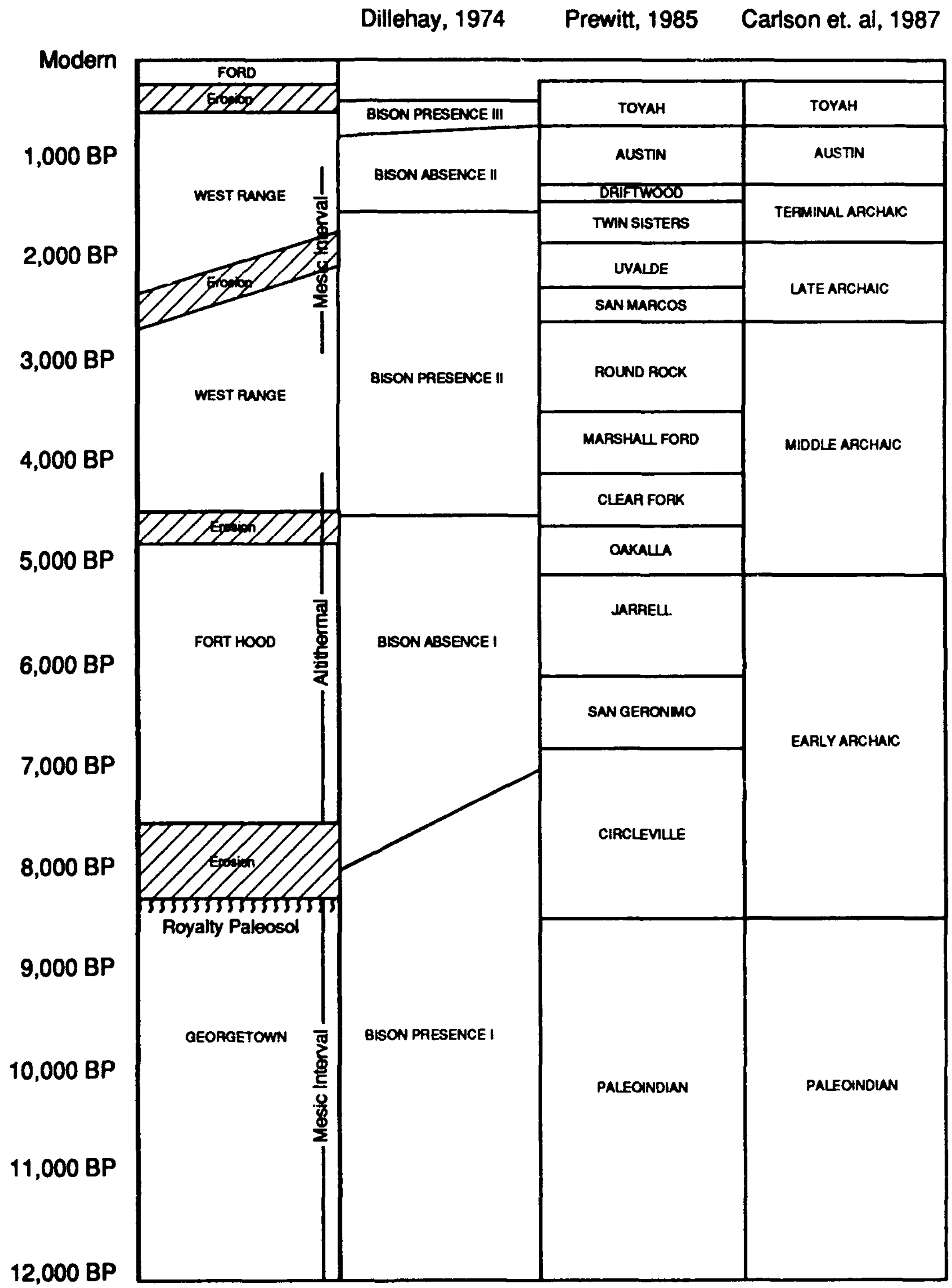


Figure 31. Fort Hood cultural and alluvial stratigraphic chronologies.

influences depth functions of these encampment sites. Furthermore, sites are better preserved in meandering stream environments than braided, and in overbank facies more than point bar facies, because of the competency levels associated with deposition of these units. Also, upper portions of the Lewisville soil capping the Fort Hood alluvium was laterally truncated in the central portion of the Cowhouse Creek floodplain during an erosional episode just prior to deposition of the lower West Range member. This event produced a 1000 to 3000 year time unconformity at the contact between these two units in the upper 3 m beneath T1. In the intermediate and small basins, Bosque soils capping the West Range alluvium (T1b) were laterally truncated during early Ford erosion (T0) thus producing a similar vertical chronological unconformity, but of only 100 to as much as 400 to 500 years.

Surface Site Preservation

The alluvial landforms in all eight stream basins are separated by subsurface erosional unconformities. A prominent scarp of at least several meters marks the erosional contact separating T2 and T1 in all stream basins. On the intermediate and small streams, a low relief topographic scarp in many places marks an additional erosional contact and warrants subdivision of T1 into T1a and T1b components. This scarp is absent on Cowhouse Creek because underlying units crop out to the same surface elevation. On the Leon River this scarp is buried by modern sediments. On Cowhouse, T0 is inset to T1 at a 1 to 2 m lower elevation while on the intermediate and small streams T0 grades imperceptibility into T1b. On the Leon, T0 covers what is the equivalent to T1 on the other streams.

The spatial distribution and ages of these landforms influence the surface archaeological record. Terrace 2 on all streams, and T3 on the Leon River, potentially contains the entire Prehistoric and Historic cultural record compressed on its surface, while T1a (T1 in outer valley of Cowhouse) contains the Middle Archaic to Historic, T1b (T1 within meanderbelt of Cowhouse Creek) the late-Middle/Late Archaic to Historic, and T0 the Historic. Site preservation is expected to diminish with increasing surface age because of bioturbation, soil shrink/swell, and other natural disturbances. Furthermore, because T1a of the intermediate and small streams and T1 outside the modern meanderbelt of Cowhouse Creek are the most ubiquitous surfaces in the study area, they may contain the greatest number of sites and bias the preserved surface cultural record in the alluvial valleys to the Middle Archaic to present. Mixed site assemblages spanning specifically the late Holocene to present should be relatively rare because of the sparse surficial exposure of T1b and the T1 area within the modern meanderbelt of Cowhouse Creek. The Middle to Late Archaic surface record will be absent on the T0 floodplain of the Leon River because of burial by Ford sedimentation during the last 600 to 700 years.

Population Inferences

Within context of the alluvial stratigraphic framework buried site densities appear to gradually increase from 10,000 to 3000 B.P., peak between 2800 and 600 B.P., and then decrease. The early to middle portion of the peak population density period predicted here is consistent with that of Prewitt (1981, 1985) for the Central Texas archaeological record. There also appears to be a correlation with the bison, and possibly paleoclimatic, record (Fig. 31). Caution must be taken, however, in making Prehistoric population inferences at Fort Hood. First, the volume of preserved Ford sediments is much less than the West Range and Fort Hood alluvium. Consequently, it is problematic whether a population decrease occurred after 600 B.P. or whether there was minimal deposition and/or preservation of site-preserving overbank facies of the Ford alluvium. This same argument is valid to some degree for the fragmentary Georgetown alluvium. A second factor to consider is the relationship between population density and procurement strategies and population distributions. Carlson (personal communication, 1992) has documented a decrease in surface site frequency between 1200 and 200 B.P. within the Military Reservation. Yet in the early part of this period there are numerous documented buried sites in this report. A possible explanation for this is that population densities did not decrease during this time, but rather there was a shift in procurement strategies to floodplain settings, possibly because of drier climatic conditions. Many sites during this time period would therefore be buried rather than subaerially exposed. This same phenomenon could have also caused a population shift to floodplain settings during earlier West Range times. A complete assessment of surface and subsurface site evolution is needed before further conclusions can be drawn.

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APPENDIXES

Explanation for Soil-Stratigraphic Descriptions
Appendixes A - H

- See geomorphic maps for description localities.
- TR = trench descriptions; CB = cutbank descriptions.
- All colors are dry unless otherwise stated.
- All horizons are calcareous and strongly effervescent unless otherwise stated.
- Few = 0-2%, common = 2-20%, many = >20%.
- Subangular blocky structure = most surface horizons; angular blocky and prismatic structure = most subsurface horizons; structural grade tends to be massive to weak for Ford (E) soils, weak to moderate for West Range (D) soils, and moderate to strong for Fort Hood (C), Georgetown (B), and Jackson (A) soils.
- AB and BC = transition horizons.

  Bw = weakly expressed subsurface horizon.

  Bk = accumulation of pedogenic (soil) carbonates; most forms are pseudomycelial; however, by definition in this report mycelial forms are fluffy while encrusted forms are etched into ped faces.

  Bss = characterized by shrink/swell clays.

  Bt = accumulation of translocated clay.

  Ab, Bkb = buried soils (paleosols).

  C = nonsoil
- Gravelly = 15 to 35% gravel, 0.2 to 7.5 cm in diameter; cobbly = 15 to 35% gravels > 7.5 cm in diameter; modifiers - very = 35 to 60% gravels or cobbles and extremely = > 60% gravels and cobbles; most gravels and cobbles are subrounded to angular.

Appendix A
Soil Stratigraphic Descriptions
Cowhouse Creek

TR1; (See Appendix I).

TR2; (See Appendix I).

TR3; (See TR2).

TR4; West Range colluvium (lower D) over Fort Hood alluvium (C); T1-T0 topographic scarp; 4% slope.

(D) A & Bw	0-45 cm; brown (10YR 4/3) loam; dispersed charcoal in lower half; clear boundary.
(D) Bk1	45-70 cm; brown (10YR 4/3) loam; >20% mycelial carbonates; gradual boundary.
(C) Bk2	70-260 cm; dark yellowish brown (10YR 4/4) to brown (10YR 4/3) silty clay loam; 2 to 20% mycelial and encrusted carbonates with latter increasing with depth.

TR5; (See Appendix I and CB4).

TR6; Ford colluvium (E) over Fort Hood alluvium (C); T0 or T1; 2% slope.

(E) A	0-47 cm; very pale brown (10YR 7/4) ripple stratified sandy loam with laminae of dark brown (10YR 3/3) and yellowish brown (10YR 5/4) clay loam to loam; abrupt boundary.
(C) Ab	47-82 cm; very dark brown (10YR 2/2) to very dark grayish brown (10YR 3/2) clay loam; 5% limestone fragments; gradual boundary.
(C) Bkb	82-235 cm; dark brown (10YR 3/3) clay loam with 5% mycelial carbonates; grades to dark yellowish brown (10YR 4/4) clay loam with 15% encrusted carbonates at 195 cm.

TR7; Fort Hood alluvium; T1; tributary channel fill.

A	0-28 cm; very dark gray (10YR 3/1) silty clay; gradual boundary.
Bw	28-150 cm; dark grayish brown (2.5YR 4/2) silty clay with few fine limestone fragments grading to yellowish brown (10YR 5/4) silty clay with slickensides.

TR8; Fort Hood alluvium; T1; tributary margin; 1 to 2% slope.

A & Bw	0-48 cm; very dark grayish brown (10YR 3/2) to dark brown (10YR 3/3) clay loam; gradual boundary.
Bk	48-208 cm; brown (10YR 4/3) clay loam with 3 to 5% mycelial carbonates grading to dark yellowish brown (10YR 4/4) and yellowish brown (10YR 5/4) clay loam with 2 to 5% encrusted carbonates.

TR9; Fort Hood alluvium; T1; flat.

A	0-21 cm; very dark grayish brown (10YR 3/2) clay loam; gradual boundary.

Bk	21-210 cm; dark brown (10YR 4/3) silty clay loam with 2% mycelial carbonates grading to dark yellowish brown (10YR 4/4) silty clay loam with 6 to 8% encrusted carbonates.

TR10; Fort Hood alluvium; T1 topographic scarp; 4% slope.

A	0-26 cm; very dark grayish brown (10YR 3/2) loam; horizon gradually thickens downslope; gradual boundary.
Bk	26-225 cm; brown to (10YR 3/2) yellowish brown (10YR 5/4) clay loam with carbonates grading from 2 to 3% mycelial to 5% encrusted forms.

TR11; West Range alluvium (lower); T1; flat.

A	0-24 cm; very dark grayish brown (10YR 3/2) silty clay loam; gradual boundary.
Ab1	24-78 cm; black (10YR 2/1) silty clay loam; dispersed charcoal; possibly two A horizons; gradual boundary.
Ab2 & Bwb2	78-188 cm; very dark grayish brown (10YR 3/2) to dark brown (10YR 3/3) silty clay loam; 1 to 4% mycelial carbonates; hearth at 185 cm; clear boundary.
Cb2	188-208 cm; brown (10YR 4/3) and dark grayish brown (10YR 4/2) loam.
Akb3	208-240 cm; brown (10YR 5/3) silt loam; 2 to 4% mycelial carbonates; hearth charcoal age of 3010 ±110 at 230 cm; hearth also 1 m to north in trench; clear boundary.
Ab4	240-256 cm; dark grayish brown (10YR 4/2) silty clay loam.

TR12; Ford alluvium; T0; narrow inset to T1 and 1 m lower; 0 to 1% slope.

A	0-40 cm; brown (10YR 5/3) sandy loam; clear boundary.
Ab	40-80 cm; dark brown (10YR 3/3) clay loam; clear boundary; articulated army ration cans at contact between A and Ab.
Cb/Bwb	80-160 cm; dark brown clay and clay loam interbedded with brown loams interspersed with gravel beds.

TR13; (See Appendix I).

TR14; Jackson colluvium and alluvium; T2-T1 topographic scarp; 7% slope.

A	0-10 cm; colluvial wash (?); dark brown (10YR 3/3) clay loam; clear boundary.
Ab	10-47 cm; very dark grayish brown (10YR 3/2) clay loam; gradual boundary.

Bk 47-195 cm; dark brown (7.5YR 4/4) clay loam grading to clay with slickensides; 2 to 5% encrusted carbonates.

<u>TR15</u>; Fort Hood alluvium; T1, flat.

A & Bw 0-57 cm; very dark grayish brown (10YR 3/2) clay loam grading to dark brown (10YR 3/3); gradual boundary.

Bk 57-300 cm; brown (10YR 4/3) clay loam grading to dark yellowish brown (10YR 4/4) clay loam; grading from 2 to 4% mycelial to 5% encrusted carbonates.

<u>TR16</u>; West Range alluvium (upper?); T1; adjacent to slough; 1 to 2% slope.

A1 & A2 0-51 cm; dark grayish brown (10YR 4/2) to dark brown (10YR 4/3) clay loam; clear boundary.

Bk 51-171 cm; dark brown (10YR 3/3) clay loam; 2 to 4% mycelial carbonates; gradual boundary.

C 171-290 cm; massive very pale brown (10YR 7/4) sandy loam and brown (10YR 5/3) sandy clay loam.

<u>TR17</u>; Ford alluvium; T0; flat; 7.5 m to channel floor.

A/C 0-280 cm; alternating beds (5 cm to 30 cm thick) and laminae of light yellowish brown (10YR 6/4) to brown (10YR 4/3) sand and sandy loam and very dark grayish brown (10YR 3/2) to dark brown (10YR 3/3) loam; all beds dip to modern channel; gravel lense from 181 to 218 cm.

<u>TR18</u>; Ford alluvium; T0; 6.0 m above modern channel floor; surface slopes (2 to 4%) up to T1 surface 2 m higher.

A1 & A2 0-44 cm; very dark grayish brown (10YR 3/2) and dark brown (10YR 3/3) loam; clear boundary.

Bw 44-146 cm; very dark grayish brown (10YR 3/2) loam with 1-2% mycelial carbonates and few yellowish brown (10YR 5/4) sand patches; gradual boundary.

Ab 146-180 cm; very dark grayish brown (10YR 3/2) loam with 2% mycelial carbonates; hearth charcoal age of 190 ± 90 at 180 cm; gradual boundary.

Cb 180-240 cm; brown (10YR 4/3) sandy loam; massive.

<u>TR19</u>; (See Appendix I).

<u>TR20</u>; West Range alluvium (lower D) over Fort Hood alluvium (C); T1; 1% slope.

(D) A & Bw 0-93 cm; very dark grayish brown (10YR 3/2) to dark brown (10YR 3/3) loam; gradual boundary.

(D) Bk — 93-188 cm; brown (10YR 4/3) loam with 4% mycelial carbonates; yellowish brown (10YR 5/4) in lower part; gradual boundary.

(C) Bkb — 188-230 cm; yellowish brown (10YR 5/4) clay loam with 6 to 8% encrusted carbonates.

TR21; West Range fan facies ? (lower D) over Fort Hood alluvium (C); T1; 1% slope towards tributary.

(D) A & Bw — 0-75 cm; black (10YR 2/1) to very dark brown (10YR 2/2) clay loam; clear boundary marked by thin gravel line.

(D) Bw — 75-141 cm; dark brown (10YR 3/3) clay loam; 1 to 2% mycelial carbonates; gradual boundary.

(C) Bk1b — 141-197 cm; yellowish brown (10YR 5/4) silty clay loam with 2 to 3 encrusted carbonates; thin gravel line in middle; gradual boundary.

(C) Bk2b — 197-250 cm; dark yellowish brown (10YR 4/4) silty clay loam with 8 to 10% encrusted carbonates.

CB1; West Range alluvium (upper); T1; 1% slope (See TR1).

Slump — 0-670 cm; dark grayish brown to brown; a bulk humate age of 3580 ± 100 from 160 to 270 cm depth but 8 m to left of this description (rejected).

C1 — 670-750 cm; massive yellowish brown (10YR 5/4) sandy clay loam; abrupt boundary.

C2 — 750-980 cm; epsilon cross bedded gravel and pale brown (10YR 5/4) sand; medium gravels, moderately well sorted; abrupt boundary; dispersed charcoal age of 2380 ± 150 and paired bulk humate age of 3380 ± 70 at 830 cm.

R — 980-1060 cm; Glen Rose limestone; water line at 1060 cm.

CB2; Upper West Range alluvium (D2) over lower West Range alluvium (D1) over Fort Hood alluvium (C) over Georgetown alluvium (B); T1; flat.

(D2) A & Bw — 0-91 cm; brown (10YR 4/3) loam; gradual boundary (upper D).

(D1) Bk — 91-274 cm; dark grayish brown (10YR 4/2) loam with 5-15% mycelial carbonates; abrupt boundary; thin gravel line (lower D); bulk humate age of 3980 ± 80 from 260 to 270 cm.

(C) Bkb1 — 274-421 cm; dark yellowish brown (10YR 4/4) silty clay loam with 18 to 20% encrusted carbonates grading to yellowish brown (10YR 5/4) with 5 to 8% encrusted carbonates; truncated T1a soil; gradual boundary; bulk humate age of 5210 ± 70 from 280 to 290 cm.

(C)	Cb1	421-631 cm; yellowish brown (10YR 5/4) sandy clay loam; massive; thin sand and gravel lense at base; abrupt boundary; a bulk humate age of 9220 ± 130 from 620 to 630 cm.
(B)	Bkb2	631-746 cm; brown (10YR 5/3) silty clay loam with 10% encrusted carbonates; truncated Royalty paleosol; bulk humate age of 9830 ± 100 from 680 cm; gradual boundary.
(B)	C1b2	746-946 cm; massive yellow (10YR 7/6) and very pale brown (10YR 7/3) silt loam to loam; abrupt boundary.
(B)	C2b2	946-1010 cm; fine, well sorted gravels in matrix similar to above; waterline at 1010 cm.

CB3; Ford alluvium; T0; gently undulating.

	C1	0-165 cm; finely bedded very pale brown sand (10YR 7/4) and very dark grayish brown (10YR 3/2) silty clay loam; abrupt dipping boundary.
	C2	165-314 cm; medium and coarse, moderately well sorted, slightly dipping and imbricated gravels in a very pale brown (10YR 7/4) loamy matrix; log age of 390 ±60 at waterline.

CB4; Ford alluvium (E) over West Range alluvium (upper D); T0; narrow inset to T1 about 1.5 m lower.

(E)	A/C	0-266 cm; (See TR5)
(E)	Cb1	266-369 cm; coarsens downward to very pale brown (10YR 7/4) sand; abrupt boundary.
(D)	Ab2	369-446 cm; dark brown (10YR 3/3) silty clay loam with occasional faint sandy laminae; gradual boundary; hearth charcoal age of 650 ± 160 in middle.
(D)	C1b2	446-778 cm; alternating beds of brown (10YR 4/3) silt loam and silty clay loam, and yellowish brown (10YR 5/4) and pale brown (10YR 6/3) sandy clay loam to sandy loam; slight coarsening downward; abrupt boundary; bulk humate age of 2140 ± 110 from dark zone at base of horizon.
(D)	C2b2	778-843 cm; moderately well sorted gravels in loamy matrix; waterline at 843 cm.

CB5; Ford alluvium; T0; 5.5 m above modern channel floor; narrow inset to T1 about 1.5 m lower; gently undulating.

	A/C	0-200 cm; alternating beds of light yellowish brown (10YR 6/4) sand and very dark grayish brown (10YR 3/2) clay loam; clear boundary; a dispersed charcoal age of 370 ± 180 from burned zone at base horizon.
	C	200-240 cm; massive pale brown (10YR 6/3) sandy loam.

CB6; Fort Hood alluvium; T1; upper 2 m may be West Range alluvium; flat; C1 and C2 horizon are channel fill sediments inset to adjacent basal gravels 1 to 2 m thick.

Slump	0-400 cm (approximate).
C1	400-631 cm; mottled yellowish brown (10YR 5/4) and yellow (10YR 7/6) sandy clay loam grading to mottled grayish brown (10YR 5/2) and yellowish brown (10YR 5/6) silty clay loam; dispersed charcoal age of 6650 ± 90 at 625 cm.
C2	631-750 cm; yellowish brown (10YR 5/5) silty clay loam within medium trough crossbeds; waterline at 750 cm; approximately 1 m of additional alluvium below waterline.

CB7; Ford alluvium; T0; undulating ridge/swale.

A/C1	0-207 cm; multiple beds of yellowish brown (10YR 5/4) sandy loam to very dark grayish brown (10YR 3/2) silty clay loam; abrupt boundary.
C2	207-539 cm; horizontally bedded to slightly dipping imbricated gravel beds with occasional fine laminae of varying textures; age of 300 ± 100 from dispersed charcoal in a loamy bed at 310 cm.

CB8; Fort Hood alluvium (C) over Georgetown alluvium (B); T1; 0 to 1% slope.

Slump	0-400 cm (approximate).
(C) C1	400-440 cm; dark yellowish brown (10YR 4/4) to brownish yellow (10YR 6/6) silty clay loam; abrupt boundary.
(B) C2	440-520 cm; mottled brownish yellow (10YR 6/6) and yellow (10YR 8/6) silt loam; abrupt boundary.
(B) C3	520-662 cm; fine, well sorted horizontal and trough cross bedded gravels in pale brown (10YR 7/4) matrix; abrupt boundary.
R	662-847 cm; Glen Rose limestone down to waterline.

CB9; West Range alluvium (lower); T1; flat; from Cottonwood Creek tributary cutbank.

A & Bk1	0-105 cm (inaccessible).
Bk2	105-230 cm; brown (10YR 4/3) silty clay loam with 10% encrusted filaments.
Slump	230-320 cm.
C1	320-538 cm; fine beds of very pale brown (10YR 7/4) sandy loam and brown (10YR 4/3) silty clay loam grading to massive mottled grayish brown (10YR 5/2) and yellowish brown (10YR 5/4) silty clay loam; gradational.

C2	538-770; channel fill consisting of alternating beds of mottled light grayish brown (10YR 6/2) and dark yellowish brown (10YR 6/4) clay loam and very pale brown (10YR 7/4) loamy sand; lower 130 cm is slumped down to channel; a dispersed charcoal age (adjacent to cultural site) of 4170 ± 100 at about 600 cm.

CB10; Jackson alluvium; T2; road gully on T2/T1 scarp; upper part colluvial (?).

A & Bw1	0-60 cm; brown (10YR 4/3) sandy clay loam grading to pale brown (10YR 6/3) sandy clay loam; partially disturbed surface; few fine and medium scattered limestone gravels; colluvium; gradual boundary.
Bw2	60-265 cm; very pale brown (10YR 7/3) sandy clay loam with yellowish brown (10YR 5/4) mottles and few fragments of clay loam; common pitted nonpedogenic calcium carbonate nodules; colluvium; gradual boundary.
BC or C	265-290 cm; massive light gray (10YR 7/2) silty clay loam mottled with yellowish brown (10YR 5/4); bulk humate age of 15270 ± 260 from 280 to 290 cm; alluvium.

CB11; Jackson alluvium; T2; gravel pit; 45 cm of overburden.

A	0-17 cm; dark brown (7.5YR 3/2) clay loam; gradual boundary.
Bw1	17-112 cm; reddish brown (5YR 4/6) to reddish yellow (5YR 7/6) clay loam; 5 to 8% pitted nonpedogenic carbonate nodules; clear boundary.
Bw2	112-240 cm; yellowish red (5YR 4/6) and reddish yellow (7.5YR 7/6) sandy clay loam with 5 to 10% pitted nonpedogenic carbonate nodules grading to yellowish red (5YR 5/6) and very pale brown (10YR 8/4) sandy loam; clear boundary.
C	240-430 cm; horizontal fine and medium, moderately well sorted gravels; occasional trough cross strata in light brown loamy matrix interspersed.

CB12; Fort Hood alluvium; T1; roadcut.

A & Bw	0-91 cm; dark brown (10YR 3/3) to yellowish brown (10YR 5/4) clay loam; gradual boundary.
Bk	91-100 cm; brown (10YR 5/3) clay loam with 5% mycelial and encrusted carbonates.
Slump	100-162 cm.
BC	162-235 cm; yellowish brown (10YR 5/4) silty clay loam; hearth charcoal age of 5210 ± 230 at 162 cm.

CB13; West Range alluvium; T1; Two Year Old Creek tributary alluvium.

A & Bw	0-71 cm; very dark grayish brown (10YR 3/2) loam; gradual boundary; hearth charcoal age of 600 ± 140 at 47 cm (upper D).

Bk	71-188 cm; brown (10YR 4/3) loam with 2-8% mycelial carbonates; gradual boundary; dispersed charcoal age of 2860 ± 50 at 179 cm (boundary of upper and lower D).
Slump	188-593 cm.
C1	593-675 cm; mottled pale brown (10YR 6/3) and dark grayish brown (10YR 4/2) clay loam; dispersed charcoal; gradual boundary (lower D).
C2	675-745 cm; mottled grayish brown (10YR 5/2) and yellowish brown (10YR 5/6) clay loam; dispersed charcoal age of 3950 ± 290 from lower 40 cm (lower D).

CB14; West Range alluvium (upper); T1; slightly inset to upper T1; 1 to 2% slope.

A & Bw	0-59 cm; very dark grayish brown (10YR 3/2) to dark brown (10YR 3/3) loam; gradual boundary.
Bk	59-276 cm; brown (10YR 4/3) loam; few sandy patches of yellowish brown (10YR 7/4); 2 to 3% mycelial carbonates; gradual boundary; undated hearth at 219 cm.
C	276-806 cm; massive brown (10YR 4/3, 5/3) loam; partly slumped; dispersed charcoal age of 1500 ± 60 at 571 cm.

CB15; Fort Hood alluvium; T1; flat.

A & AB	0-68 cm; very dark grayish brown (10YR 3/2) loam; gradual boundary.
Bk	68-379 cm; dark brown (10YR 4/3) to dark yellowish brown (10YR 4/4) silty clay loam with 7-10% mycelial and 10-14% encrusted carbonates in upper and lower horizons, respectively; occasional sand laminae in lower part; hearth charcoal age of 5740 ± 300 at 379 cm; clear boundary.
C	379-930 cm; medium trough cross strata infilled with yellowish brown (10YR 5/4) and very pale brown (10YR 7/4) loams and sandy loams bounded by gravel stringers; a hearth bulk humate age of 5820 ± 110 from 684 cm.

CB16; West Range alluvium (upper D) over Georgetown (B?) alluvium; T1; narrow inset 1 m lower than upper T1b.

(E) A & Bw	0-100 cm; very dark grayish brown (10YR 3/2) loam; gradual boundary.
(E) Bk	100-255 cm; dark brown (10YR 4/3) to brown (10YR 5/3) loam with 5-10% mycelial carbonates; gradual boundary.
(E) BC	255-315 cm; brown (10YR 5/3) loam; slight coarsening downward; gradual boundary; hearth charcoal age of 1690 ± 90 at 275 cm.
(E) C	315-420 cm; yellowish brown (10YR 5/4) loam; massive; abrupt boundary.

(B?)	Cb1	420-462 cm; yellowish brown (10YR 5/5) silty clay loam with few pitted carbonate nodules; gradual boundary.
(B)	Cb2	462-610 cm; massive, mottled, very pale brown (10YR 7/4) and yellowish brown (10YR 5/6) silt loam; abrupt boundary.
(B)	Cb3	610-765 cm; alternating beds of fine and medium gravels horizontally bedded in brown loamy matrix; abrupt boundary.
	R	765-840 cm; Glen Rose limestone down to waterline.

CB17; West Range alluvium (lower D) over Fort Hood alluvium (C); T1; road cut.

(D)	A & Bw	0-62 cm; very dark grayish brown (10YR 3/2) loam; gradual boundary.
(D)	Bk	62-208 cm; brown (10YR 4/3) loam with 2-10% mycelial carbonates; hearth charcoal age of 2720 ± 110 at 147 cm; gradual boundary.
(D)	BC	208-252 cm; very dark grayish brown (10YR 3/2) grading to brown (10YR 5/3) loam with 5-8% fine scattered limestone clasts.
Slump		252-373 cm.
(C)	Cb	373-393 cm; yellowish brown (10YR 5/4) sandy clay loam.

CB18; Ford alluvium (E) over West Range alluvium (upper D); T0; narrow inset to tributary about 1.0 m lower.

(E)	A	0-65 cm; very dark grayish brown (10YR 3/2) loam; gradual boundary.
(E)	Bw	65-80 cm; yellowish brown (10YR 5/4) loam; clear boundary.
(D)	Ab1	80-110 cm; dark brown (10YR 3/3) with common yellowish brown (10YR 5/4) sand patches; hearth charcoal age of 1820 ± 80 at 110 cm.
Slump		110+

TR22; Fort Hood alluvium; T1; gently undulating.

A	0-40 cm; dark brown (10YR 3/3) clay loam; gradual boundary.
Bk	40-205 cm; brown (10YR 4/3) to dark yellowish brown (10YR 4/4) with 2% mycelial carbonates grading to 10 to 15% mixed mycelial and encrusted carbonates; few pitted carbonate nodules; thin gravel line at 110 cm.

TR23; Ford alluvium; T0; 0 to 1% slope.

A1 & A2	0-52 cm; very dark grayish brown (10YR 3/2) to dark brown (10YR 3/3) loam; gradual boundary.
Bw	52-101 cm; brown (10YR 5/3) sandy loam; clear boundary.

Ab	101-131 cm; dark brown (10YR 3/3) loam; gradual boundary.
Cb	131-200 cm; brown (10YR 4/3) sandy loam to loamy sand; massive.

TR24; West Range alluvium; T1; 1% slope.

A1 & A2	0-85 cm; dark brown (10YR 3/3) loam; gradual boundary.
Bk	85-220 cm; brown (10YR 4/3) grading to yellowish brown (10YR 5/4) clay loam with 2-5% mycelial carbonates.

TR25; Ford alluvium; T0; 0-1% slope.

A/C	0-155 cm; alternating beds of very dark grayish brown (10YR 3/2) to dark brown (10YR 3/3) silty clay loam and yellowish brown (10YR 5/4) sandy loam with occasional laminae of the above.

TR26; Fort Hood alluvium; T1; flat narrow remnant.

A & Bw	0-75 cm; very dark brown (10YR 2/2) to very dark grayish brown (10YR 3/2 clay loam; common fine gravels in lower part; clear boundary.
Bk	75-180 cm; dark yellowish brown (10YR 4/4) clay loam with 5% mycelial carbonates in upper part grading to 10% mixed mycelial and encrusted forms; thin gravel line near 75 cm; gradual boundary.
BC	180-240 cm; dark yellowish brown (10YR 5/4) clay loam; few fine and medium gravels.

TR27; Jackson alluvium; T2; 1% slope.

A & Bw	0-63 cm; very dark grayish brown (10YR 3/2) clay loam; gradual boundary; noncalcareous.
Bss1	63-107 cm; mixed very dark grayish brown (10YR 3/2) and dark brown (7.5YR 3/3) clay with slickensides; clear boundary.
Bss2	107-127 cm; mixed dark brown (7.5YR 3/2) and dark yellowish brown (10YR 4/4) clay with 15% pitted nonpedogenic carbonate nodules; few slickensides; clear boundary.
Bss3	127-215 cm; reddish yellow (7.5YR 7/6) grading to reddish brown (5YR 4/4) clay; common patchy clay films; few slickensides and few pitted nonpedogenic carbonate nodules.

TR28; Jackson alluvium; T2; 1% slope.

A	0-35 cm; very dark grayish brown (10YR 3/2) clay loam; gradual boundary; noncalcareous.
Bss1	35-127 cm; dark brown (10YR 3/3, 4/3) clay with common slickensides and few fine gravel clasts; clear boundary.

Bss2	127-205 cm; strong brown (7.5YR 4/4) and reddish yellow (7.5YR 7/6) clay with 30 to 50% matrix supported fine and medium gravels.

Appendix B
Soil Stratigraphic Descriptions
Table Rock Creek

TR1; Jackson alluvium; T2; 1% slope.

A	0-29 cm; very dark brown (7.5YR 3/3) clay loam; gradual boundary (slightly calcareous).
Bk	29-260 cm; dark brown (7.5YR 4/3) grading to strong brown (7.5YR 4/6, 5/6) clay loam and sandy clay loam; few patchy mycelial carbonates throughout with 5-20% encrusted forms in lower half; few to common pitted nonpedogenic carbonate nodules throughout.

TR2; Fort Hood alluvium; T1a/T1b topographic scarp; 4% slope.

A	0-35 cm; black (10YR 2/1) clay loam; gradual boundary.
Bw	35-123 cm; yellowish brown (10YR 5/4) clay loam; abrupt boundary marked by gravel line.
Bk	123-240 cm; dark yellowish brown (10YR 4/4) to yellowish brown (10YR 5/4) clay loam with 3 to 5% encrusted carbonates; thin gravel lines at 157 and 210 cm.

TR3; Fort Hood alluvium; T1a; channel fill facies; flat.

A	0-18 cm; very dark gray (10YR 3/1) clay; gradual boundary.
Bss	18-272 cm; very dark grayish brown (10YR 3/2) grading to dark brown (10YR 4/3) clay with slickensides; gradual boundary.
BC	272-315 cm; mottled pale yellow (2.5Y 7/4) and brownish yellow (10YR 6/6) clay.

TR4; Ford alluvium, T0; gently undulating; 4.25 m above channel modern floor.

A	0-36 cm; very dark grayish brown (10YR 3/2) loam; gradual boundary.
C	36-310 cm; alternating beds of brownish yellow (10YR 6/6), yellowish brown (10YR 5/4) and dark yellowish brown (10YR 4/4) gravelly sandy loam and sandy loam; beds dip towards modern channel.

TR5; Fort Hood alluvium; T1a/T0 topographic scarp; 5% slope; 5.25 m above channel floor.

A	0-27 cm; very dark brown (10YR 2/2) gravelly clay loam; gradual boundary.
Bk	27-110 cm; dark brown (10YR 3/3) gravelly loam grading to dark yellowish brown (10YR 4/4) loam; 2-3% mycelial carbonates; abrupt boundary.
C	110-270 cm; yellowish brown (10YR 5/6) with variegated colors of yellow and brown gravelly sandy loam; common medium beds of horizontally stratified gravel.

TR6; Fort Hood alluvium; T1a; 1% slope.

A	0-31 cm; very dark brown (10YR 2/2) loam; gradual boundary.
Bk	31-103 cm; dark brown (10YR 3/3) grading to yellowish brown (10YR 5/4) loam; few scattered gravels; 2 to 4% mycelial carbonates; abrupt boundary.
C	103-250 cm; yellowish brown (10YR 5/6) massive gravelly sandy clay loam.

TR7; Fort Hood alluvium; T1a; 1% slope.

A	0-22 cm; dark brown (10YR 3/3) loam; gradual boundary.
Bw	22-119 cm; dark yellowish brown (10YR 4/4) clay loam to loam with few patchy mycelial carbonates; abrupt boundary.
Bk	119-162 cm; yellowish brown (10YR 5/4) gravelly loam with 15% soft carbonate masses grading to gravelly loam; case-hardened by pedogenic carbonates; abrupt boundary.
C	162-240 cm; yellow and brown massive gravelly sandy loam.

TR8; Ford alluvium (E) over West Range alluvium (upper D?); T0; narrow inset 1.5 m below T1a.

(E) A	0-36 cm; light yellowish brown (10YR 6/4) loamy sand; abrupt boundary.
(E) Ab1	36-164 cm; cumulic and/or stacked A horizons from very dark brown (10YR 2/2) to dark brown (10YR 3/2) loam; few patchy mycelial carbonates; gravel line at base.
(D?) Akb2	163-234 cm; very dark brown (10YR 2/2) loam with 5% mycelial carbonates; abrupt boundary with gravel line.
(D?) Bkb2	234-265 cm; dark brown (10YR 3/3) loam with 3% mycelial carbonates.

TR9; (See Appendix I).

TR10; (See TR9).

TR11; (See TR9).

TR12; (See Appendix I).

CB1; Fort Hood alluvium; T1a/T1b topographic scarp; 2% slope; loamy channel fill.

A & Bw	0-36 cm; dark brown (10YR 3/3) to brown (10YR 4/3) loam with 30% fine gravels in lower part; clear boundary.
Bk	36-221 cm; dark yellowish brown (10YR 4/4) sandy clay loam grading to sandy loam; mycelial carbonates from 2 to 5%; 2 to 5% diffuse fine gravels; thin gravel line at 92 cm; hearth humate age of 4840 ± 70 at 122 cm; abrupt boundary.

	C	221-448 cm; alternating beds of horizontally and planar/trough cross bedded yellowish brown (10YR 5/5) gravelly sand and sand down to near waterline; mottled brown (10YR 5/3) and yellowish brown (10YR 5/6) just above waterline.

CB2; Ford alluvium (E) over West Range alluvium (upper D); T1b; narrow inset to T1a about 1 m lower.

(E)	A	0-18 cm; brown (10YR 4/3) loam; clear boundary.
(D)	Ab/Bwb	18-392 cm; five alternating A and Bw sequences averaging 30 to 100 cm thick; A horizons are dark brown (10YR 3/3) loam to sandy clay loam; B horizons are dark brown (10YR 3/3), yellowish brown (10YR 5/4), and very pale brown (10YR 7/4) loam to sandy loam; 1 to 3% mycelial carbonates throughout; hearth age of 1250 ± 110 at 300 cm; uncertain E/D contact.
(D)	C	392-503 cm; very pale brown (10YR 7/4) loamy matrix with few to common fine and medium trough cross bedded gravels down to waterline.

CB3; Fort Hood alluvium (C); T1a; 1% slope.

	A & Bw	0-45 cm; very dark grayish brown (10YR 3/2) sandy clay loam with 5% fine and medium diffuse gravels; abrupt boundary.
	Bk	45-114 cm; dark brown (10YR 3/3) grading to dark yellowish brown (10YR 4/4) sandy clay loam; 3 to 8% mycelial carbonates in matrix and as pendants; 5 to 20% fine and medium diffuse gravels; abrupt boundary.
	C	114-659 cm; upper half is yellowish brown (10YR 5/6) horizontally bedded gravel loam; gravels poorly sorted and medium; lower half (gravelly channel fill) is horizontally to epsilon cross bedded with gravels in yellowish brown (10YR 5/6) matrix down to waterline; occasional small and medium muddy channel fills; humate age of 6070 ± 90 from muddy channel fill at 370 cm.

CB4; Fort Hood alluvium (C) over truncated Royalty paleosol capping the Georgetown alluvium (B); T1a; flat.

(C)	A & AB	0-46 cm; very dark brown (10YR 2/2) grading to dark brown (10YR 3/3) clay loam; gradual boundary.
(C)	Bw	46-100 cm; dark yellowish brown (10YR 4/4) clay loam; gradual boundary.
(C)	BK	100-179 cm; dark yellowish brown (10YR 4/4) sandy clay loam with 6 to 8% encrusted carbonates; gradual boundary.
(C)	BC	179-440 cm; dark yellowish brown (10YR 4/4) and yellowish brown (10YR 5/4) sandy clay loam to loam; coarsens downward; abrupt

boundary; a bulk humate age of 9320 ± 120 from 430 to 440 cm (rejected).

(B) Bkb — 440-604 cm; mottled brown (10YR 5/3) and strong brown (7.5YR 4/6) grading to mottled grayish brown (10YR 4/2) and yellowish brown (10YR 5/6) sandy clay loam; 3% encrusted carbonates; gradually coarsens with depth; gradual boundary; hearth charcoal age of 8260 ± 100 and a paired bulk humate age of 10060 ± 80 (rejected) from about 480 cm.

(B) Cb — 604-703 cm; medium to coarse, moderately well sorted gravels down to waterline.

CB5; Ford alluvium; T0; 0 to 1% slope.

A — 0-26 cm; dark brown (10YR 3/3) loam; clear boundary.

Ab1 & Bwb1 — 26-75 cm; very dark grayish brown (10YR 3/2) grading to dark brown (10YR 3/3) loam.

Slump — 75-180 cm.

Ab2 & Bwb2 — 180-322 cm; very dark grayish brown (10YR 3/2) clay loam grading to dark brown (10YR 3/3) clay loam grading to dark brown (10YR 3/3) sandy clay loam; faint ripple marks in lower part; abrupt boundary.

C1b2 — 322-358 cm; ripple laminated light yellowish brown (10YR 6/4) sandy loam and very dark grayish brown (10YR 3/2) sandy clay loam; two thin gravel lines; burned zone in upper part; abrupt boundary; dispersed charcoal age of 480 ± 80 from 350 cm.

C2b2 — 358-453 cm; moderately well sorted, fine and medium gravels in brown loamy matrix down to water line.

CB6; Ford alluvium; T0; narrow surface inset, and grading up to, T1b surface.

A — 0-16 cm; very dark grayish brown (10YR 3/2) loam; few sand patches (10YR 7/4); gradual boundary.

Bw — 16-74 cm; brown (10YR 4/3) loam with faint laminations of brownish yellow (10YR 6/6); clear boundary.

C1 — 74-212 cm; ripple laminations of dark brown (10YR 3/3) clay loam and very pale brown (10YR 7/4) loam and sandy loam; hearth charcoal age of 710 ± 260 at 166 cm; abrupt boundary.

C2 — 212-278 cm; massive fine and medium gravels in brown loamy matrix.

R — 278-328 cm; Glen Rose limestone down to channel.

CB7; Ford alluvium (E) over West Range alluvium (upper D); T0; 2% slope.

(E)	A & Bw	0-34 cm; dark brown (10YR 3/3) loam grading to brown (10YR 5/3) loam with sand patches; clear boundary.
(E)	Ab1	34-59 cm; dark brown (10YR 3/3) loam with sand patches; abrupt boundary.
(D)	Ab2	59-80 cm; very dark grayish brown (10YR 3/2) loam; gradual boundary.
(D)	Bkb2	80-301 cm; dark brown (10YR 3/3) loam with 3 to 5% mycelial carbonates; occasional sand patches; abrupt boundary; a bulk humate age of 2290 ± 70 from 220 to 230 cm.
(D)	Cb2	301-426 cm; yellowish brown (10YR 5/4) loamy and gravelly, (poorly sorted); slight coarsening downward.
	R	426-526 cm; Glen Rose limestone down to waterline.

Appendix C
Soil Stratigraphic Descriptions
Owl Creek

TR1; Ford alluvium; T0; narrow inset 3.5 m above modern channel.

A	0-25 cm; dark brown (10YR 3/3) loam with faint light yellowish brown (10YR 6/4) sandy bedding planes; clear boundary.
Ab1	25-50 cm; dark brown (10YR 3/3) loam; gradual boundary.
Cb1	50-87 cm; bedding planes of brown (10YR 5/3) and yellow (10YR 7/8) clay loam and loam; clear boundary.
Akb2	87-135 cm; very dark grayish brown (10YR 3/2) sandy clay loam with 5% mycelial carbonates; abrupt boundary.
Cb2	135-250 cm; moderately well sorted fine to coarse gravels in tan and brown matrix dipping towards modern channel.

TR2; Fort Hood alluvium; T1a; flat; 5.5 m above modern channel.

A1 & A2	0-72 cm; very dark brown (10YR 2/2) clay loam with 15% fine and medium gravels grading to 40%; clear boundary.
Bk	72-195 cm; dark yellowish brown (10YR 4/4) clay loam with 8-10% mycelial carbonates grading to 10-15% encrusted carbonates; two gravel lines in lower part.

TR3; Ford alluvium (E) over West Range alluvium (upper D); T0; undulating and inset to T1b; 2.8 m above modern channel.

(E) A	0-49 cm; very dark grayish brown (10YR 3/2) clay loam; clear boundary.
(D) Ab	49-78 cm; very dark grayish brown (10YR 3/2) sandy clay loam; gradual boundary; dispersed charcoal age of 750 ± 80.
(D) Bkb	78-116 cm; dark brown (10YR 4/3) sandy clay loam with 3-4% mycelial carbonates; abrupt gravel line boundary.
(D) C1b	116-152 cm; dark grayish brown (10YR 4/2) massive sandy clay loam; abrupt boundary.
(D) C2b	152-230 cm; medium and coarse moderately well sorted gravels in gray and tan matrix.

TR4; West Range alluvium (upper D); T1b; 3.7 m above modern channel.

A	0-38 cm; dark brown (10YR 3/3) loam with few fine gravels; gradual boundary.
Bk	38-110 cm; yellowish brown (10YR 5/4) loam with 3% mycelial carbonates; abrupt boundary.

C	110-215 cm; fine and medium gravels in brown and yellow matrix; at 215 cm is contact with the Walnut clay (Cretaceous).

TR5; Fort Hood alluvium; T1a; 5.5 m above modern channel; flat.

A	0-36 cm; very dark brown (10YR 2/2) clay loam; gradual boundary.
Bw	36-80 cm; dark yellowish brown (10YR 4/4) clay loam with gravel line at base.
Bk	80-200 cm; dark yellowish brown (10YR 4/4) gravelly clay loam with 6 to 8% encrusted carbonates grading to strong brown (7.5YR 4/6) with patchy encrusted carbonates.

TR6; Jackson alluvium; T2; undulating; 10 m above channel.

A & Bss	0-82 cm; very dark gray (10YR 3/1) clay; slickensides in lower part; upper 42 cm is noncalcareous.
Bw1	82-117 cm; gravelly dark brown (10YR 3/3) clay loam with few yellow (10YR 7/8) mottles; common pitted nonpedogenic carbonate nodules; gradual boundary.
Bw2	117-172 cm; light yellowish brown (10YR 7/4) and brown (10YR 5/3) clay loam with few pitted carbonate nodules grading to light gray (10YR 7/2) and yellow (10YR 7/8) silty clay loam; clear boundary.
C	172-230 cm; massive fine and medium gravels in tan and yellow matrix; Walnut clay at base.

TR7; Fort Hood alluvium; T1a; flat 6 m above modern channel.

A	0-49 cm; very dark grayish brown (10YR 3/2) clay loam; few fine gravels; gradual boundary.
Bk	49-101 cm; brown (10YR 5/3) clay loam with 3 to 5% mycelial carbonates; few fine gravels; clear boundary.
Bkm	101-157 cm; dark yellowish brown (10YR 4/4) carbonate cemented matrix; clear boundary.
C	157-188 cm; massive fine and medium gravels in dark yellowish brown (10YR 4/4) matrix; clear boundary.
Bkb	188-225 cm; dark yellowish brown (10YR 4/4) clay loam with 10 to 12% encrusted and mycelial carbonates.

TR8; Ford alluvium; T0; narrow inset 3 m above modern channel.

A1 & A2	0-41 cm; very dark grayish brown (10YR 3/2 moist) clay loam with few fine gravels with depth; abrupt boundary.

C 41-106 cm; alternate beds of fine gravel and sand (brown); clear boundary.

Akb 106-135 cm; brown (10YR 5/3) sandy clay loam with 5% mycelial carbonates; clear boundary.

Cb 135-175 cm; very pale brown (10YR 5/3) gravelly sand coarsening downward.

TR9; Fort Hood alluvium; T1a; flat 5 m above channel.

A 0-16 cm; very dark grayish brown (10YR 3/2) sandy clay loam with common fine gravels; abrupt boundary.

Bw 16-31 cm; dark brown (10YR 3/3) gravelly sandy clay loam; clear boundary.

Bk 31-173 cm; yellowish brown (10YR 5/4) gravelly sandy clay loam grading to pale brown (10YR 6/3); 10% mycelial carbonates; abrupt boundary.

C 173-220 cm; dark yellowish brown (10YR 4/4) massive gravelly clay loam.

TR10; Fort Hood alluvium; T1a; flat 5.5 m above channel.

A1 & A2 0-32 cm; very dark grayish brown (10YR 3/2) clay loam; gradual boundary.

BA 32-55 cm; yellowish brown (10YR 5/4) clay loam; gradual boundary.

Bk 55-215 cm; yellowish brown (10YR 5/4) clay loam grading to sandy clay loam; 4 to 8% mycelial carbonates.

CB1; Ford alluvium; T0; narrow inset.

C 0-213 cm; coarsening downward sequence from laminated and finely bedded dark brown silty clay loam (10YR 3/3) and very pale brown (10YR 7/4) sand grading to sands and gravelly sands in a brown matrix.

CB2a; Ford alluvium (E) over West Range alluvium (upper D); T0; narrow inset grading up to T1b.

(E) A1 & A2 0-35 cm; very dark grayish brown (10YR 3/2) sandy clay loam; clear boundary.

(E) Bw 35-46 cm; very dark grayish brown (10YR 3/2) sandy clay loam with common brownish yellow (10YR 6/6) sand patches.

(E) Ab1 46-81 cm; very dark grayish brown (10YR 3/2) clay loam; clear boundary; dispersed charcoal age of 330 ± 80 at 52 cm.

(D) Ab2 81-96 cm; very dark gray (10YR 3/1) clay loam; gradual boundary.

(D) Bwb2	96-201 cm; dark brown (10YR 3/3) grading to brown (10YR 5/3) sandy clay loam; clear boundary.
(D) Cb2	201-232 cm; mottled dark grayish brown (2.5Y 4/2) and olive yellow (2.5 6/6) fine gravelly sandy clay loam.
R	232-362 cm; Walnut clay down to channel.

CB2b; West Range alluvium (lower D); T1b; 2% slope; 20 m north of T2a.

A	0-27 cm; dark brown (10YR 3/3) sandy clay loam; gradual boundary.
Bk	27-88 cm; dark brown (10YR 3/3) grading to brown (10YR 4/3) with 3 to 4% mycelial carbonates; 5 to 10% fine gravels; abrupt boundary.
C1	88-224 cm; alternating beds of brown (10YR 5/3) gravelly clay loam (horizontal) and mottled grayish brown (10YR 5/2) and yellowish brown (10YR 5/6) clay loam; channel and channel fill deposits; a bulk humate age of 4190 ± 100 from a channel fill at 210 cm; abrupt boundary.
C2	224-289 cm; poorly sorted medium to coarse gravels in loamy grayish brown and brown matrix.
R	289-400 cm; Walnut clay down to waterline.

CB3; Jackson alluvium; T2; 1% slope.

A & Bw1	0-25 cm; dark brown (10YR 3/3) silty clay grading to dark brown (7.5YR 3/4); gravel line at 16 cm; abrupt boundary.
Bw2	25-51 cm; dark brown (10YR 3/3) massive gravelly clay loam; clear boundary.
Bw3	51-127 cm; yellowish brown (10YR 5/6, 5/8) silty clay loam with 10 to 15% pitted nonpedogenic carbonate nodules; abrupt boundary.
C	127-387 cm; strong brown (7.5YR 4/4) loamy matrix dominated by massive to cross bedded gravels; slight coarsening downward.
R	387-950 cm; Walnut clay down to channel.

CB4; see CB2b.

CB5; West Range alluvium (upper D) over West Range alluvium (lower D); T1b; 1 to 2% slope; possible fan facies over fluvial facies.

Road spoil	0-14 cm.
A & Bw	14-57 cm; dark brown (10YR 3/3) grading to light yellowish brown (10YR 6/4) sandy clay loam; few fine gravels; abrupt boundary (upper D).

Ab1 & Bwb1	57-132 cm; very dark grayish brown (10YR 3/2) gravelly clay loam grading to dark brown (10YR 3/3) gravelly sandy clay loam; 2 to 3% mycelial carbonate; abrupt boundary (upper D).
Ab2	132-208 cm; multiple buried A horizons separated by thin gravel lines; very dark grayish brown (10YR 3/2) clay loam; 2% mycelial carbonates; bulk humate age of 2130 ± 140 from 135 cm; clear boundary (lower D).
Cb2	208-367 cm; poorly sorted fine to coarse massive gravels in loamy brown matrix; coarsens downward; abrupt boundary (lower D).
R	367-410 cm; Walnut clay down to channel.

CB6; Fort Hood alluvium (C) over Georgetown alluvium (B); T1a; 1 to 2% slope.

(C) A	0-10 cm; very dark brown (10YR 2/2) sandy clay loam; common gravels; clear boundary.
(C) Bw	10-48 cm; very dark grayish brown (10YR 3/2) sandy clay loam; 45% fine and medium gravels; clear boundary.
(C) Bk1	48-107 cm; dark brown (10YR 3/3) sandy clay loam with 2% mycelial carbonates grading to brown (10YR 4/3) with 6 to 8% mycelial carbonates; 15% fine and medium gravel; gradual boundary.
(C) Bk2	107-262 cm; yellowish brown (10YR 5/4) sandy clay loam; 40% fine and medium gravel grading to 60%; clear boundary; 8% encrusted carbonates; clear boundary.
(B) Bkb	262-356 cm; (Royalty paleosol) dark grayish brown (10YR 4/2) clay loam with 15% encrusted carbonates grading to mottled light yellowish brown (10YR 6/4) and light olive brown (2.5Y 5/6) sandy clay loam with encrusted carbonates beginning to coalesce; few fine gravels; bulk humate age of 11,325 ± 150 from upper 20 cm; gradual boundary.
(B) Cb	356-516 cm; olive yellow (2.5Y 6/6) and light gray (2.5Y 7/2) sandy clay loam matrix with 50 to 70% fine moderately well sorted gravels.
R	516-600 cm; Walnut clay down to water line.

CB7; Ford (E) alluvium over West Range alluvium (upper D); T0; 1 to 2% slope.

(E) A	0-10 cm; very dark grayish brown (10YR 3/2) sandy clay loam; abrupt boundary.
(E) Bw	10-24 cm; dark brown (10YR 3/3) gravelly sandy clay loam to sandy clay loam; abrupt boundary.
(D) Ab	24-76 cm; very dark grayish brown (10YR 3/1.5) silty clay loam; gradual boundary.

(D) Bwb	76-129 cm; very dark grayish brown (10YR 3/2) silty clay loam; gradual boundary.
(D) Bkb	129-310 cm; dark brown (10YR 3/3) to brown (10YR 4/3) clay loam; mycelial carbonates increase from 2 to 8% with depth; a charcoal hearth age of 890 ± 51 at 157 cm; gradual boundary.
(D) BCb	310-435 cm; mottled grayish brown (10YR 5/2) and yellowish brown (10YR 5/6) sandy clay loam; abrupt boundary.
(D) Cb	435-465 cm; 50% fine gravels in sandy clay loam matrix like above.

Appendix D
Soil Stratigraphic Descriptions
House Creek

TR1; Fort Hood alluvium (?); T1a; 1 to 2% slope.

A & Bw1	0-64 cm; very dark grayish brown (10YR 3/2) to brown (10YR 4/3) clay loam; 5% gravels; gradual boundary.
Bw2	64-106 cm; brown (10YR 5/3) silty clay loam; abrupt boundary.
C1	106-139 cm; gravelly (70%) light yellowish brown (10YR 6/4) loam; clear boundary.
C2	139-162 cm; mottled light brownish gray (2.5Y 6/2) and olive yellow (2.5Y 6/6) silty clay loam; 10% fine gravels; bedrock at 162 cm which is about 1 to 2 m above channel.

TR2; West Range alluvium (lower?); T1b; 1 to 2% slope; ≈ 3 m above modern channel.

A	0-51 cm; black (10YR 2/1) gravelly sandy clay loam; clear boundary.
Bk1	51-113 cm; very dark grayish brown (10YR 3/2) loam; 60% gravels; mycelial carbonates incase gravels; abrupt boundary.
Bk2	113-180 cm; dark brown (10YR 3/3) loam; 4 to 6% mycelial carbonates; few fine gravels; gradual boundary.
BC	180-222 cm; dark grayish brown (2.5Y 4/2) loam; few fine gravels; abrupt boundary.
C	222-280 cm; massive light gray (2.5Y 7/2) gravelly loam.

TR3; Ford alluvium; T0; 2.5 m above modern channel.

A	0-39 cm; very dark brown (10YR 2/2) clay loam; clear boundary.
Ab	39-92 cm; dark brown (10YR 3/3) loam; clear boundary.
C1b	92-166 cm; alternating beds of light yellowish brown (10YR 6/4) loam and sand to dark brown (10YR 3/3) loam and silty clay loam; 50% gravel decreasing with depth; abrupt boundary.
C2b	166-199 cm; gravelly coarse sandy loam; light gray (10YR 7/2) and yellowish brown (10YR 5/6); water table in lower part.

TR4; Fort Hood alluvium; T1; flat; 3.8 m above modern channel.

A & Bw	0-51 cm; very dark brown (10YR 2/2) clay loam grading to dark brown (10YR 3/3) loam; 2 to 5% gravels; abrupt boundary.
Bkm	51-78 cm; fine and medium poorly sorted gravels (discontinuous) with coalescing carbonates and thin discontinuous laminar cap; clear boundary.
C1	78-170 cm; horizontally stratified gravels in mottled white (10YR 8/2) and yellowish brown (10YR 5/6) loamy matrix; abrupt boundary.

C2	170-180 cm; light grayish brown (2.5Y 6/2) and light olive brown (2.5Y 5/6) silty clay loam; massive.

TR5; Ford alluvium (E) over West Range alluvium (lower D); T0; flat.

(E) A	0-24 cm; very dark grayish brown (10YR 3/2) clay loam; gravel line at base.
(D) Ab & Bwb	24-65 cm; very dark grayish brown (10YR 3/2) loam; 5 to 10% gravels in lower part.
(D) Bk1b	65-132 cm; bedded gravelly loam and loam (colors above); 3 to 4% mycelial carbonates; abrupt boundary.
(D) Bk2b	132-181 cm; dark yellowish brown (10YR 4/4) loam; 3 to 4% mycelial carbonates; abrupt boundary.
(D) Cb	181-270 cm; massive yellowish brown (10YR 5/4) loam; 60% medium gravels.

TR6; Fort Hood alluvium; T1; 4.5 m above modern channel; flat.

A	0-39 cm; black (10YR 2/1) clay loam; gradual boundary.
Bw	39-105 cm; dark brown (10YR 3/3) to brown (10YR 4/3) clay loam; gradual boundary.
Bk	105-213 cm; dark yellowish brown (10YR 4/4) clay loam; 5 to 9% carbonates grading from mycelial to encrusted forms; clear boundary.
C	213-250 cm; massive fine to coarse gravelly loam; dark brown (7.5YR 4/4) to strong brown (7.5YR 4/6).

TR7; Jackson alluvium; T2; 2% slope.

A1 & A2	0-46 cm; very dark brown (10YR 2/2) clay loam; noncalcareous; gradual boundary.
Bss	46-130 cm; very dark grayish brown (10YR 3/2) to brown (10YR 4/3) clay; common slickensides; common dark yellowish infills (10YR 4/4); clear boundary.
Bk1	130-166 cm; yellowish brown (10YR 5/6) and dark brown (10YR 3/3) clay loam; 25% coalescing carbonatic masses; gradual boundary.
Bk2	166-250 cm; mottled light grayish brown (2.5Y 6/2) and olive yellow (2.5Y 6/6) loam; 5 to 10% encrusted carbonates; few fine pitted carbonatic nodules.

TR8; Jackson alluvium; T2; 1% slope.

A & Bw	0-68 cm; very dark brown (10YR 2/2) with 30% dark reddish brown (5YR 3/3) in lower part; clay; abrupt boundary; noncalcareous.
Bkm	68-143 cm; dark reddish brown to red (2.5Y 4/6) clay loam; upper part has discontinuous thin laminar cap down to 40% coalescing soft carbonate nodules; 25% fine gravels; clear boundary.
C	143-208 cm; mottled light gray (2.5Y 7/2) and light olive brown (7.5Y 5/6) loam; bedrock at 208 cm.

CB1; Ford alluvium; T0; 1% slope.

A/C	0-393 cm; alternating beds of dark brown (10YR 3/3) loam and very dark grayish brown (10YR 3/2) silty clay loam; 393 cm is waterline.

CB2; Fort Hood alluvium (C) over Georgetown alluvium (B); T1a; 1% slope.

(C) A	0-13 cm; black (10YR 2/1) sandy clay loam; abrupt boundary.
(C) Bw1	13-114 cm; dark brown (10YR 3/3) sandy clay loam; 40 to 70% fine and medium moderately well sorted gravels; abrupt boundary.
(C) Bw2	114-158 cm; dark yellowish brown (10YR 4/4) clay loam; 5% gravels; gradual boundary.
(C) Bk	158-242 cm; dark yellowish brown (10YR 4/4) clay loam; 15% encrusted carbonates; thin gravel line at base; abrupt boundary.
(B) Bk1b	242-389 cm; brown (10YR 5/3) and dark yellowish brown (10YR 4/6) clay loam; 15 to 20% encrusted carbonates; gradual boundary.
(B) Bk2b	389-436 cm; light brownish gray (10YR 6/2) and yellowish brown (10YR 5/6) clay loam to clay; 2 to 4% encrusted carbonates; 3% fine pitted nodules; common iron manganese stains; gravel line at base; abrupt boundary.
(B) Cb	436-541 cm; massive sandy clay loam; same colors as above; water line at 541 cm.

CB3; Ford alluvium (E) over West Range alluvium (lower D); T0; 1% slope.

(E) A	0-41 cm; dark brown (10YR 3/3) loam; coarsens downward.
(D) Ab	41-55; very dark grayish brown (10YR 3/2) loam; common sand patches; abrupt boundary.
(D) Cb1	55-117 cm; dark brown (10YR 3/3) gravelly loam; coarsens downward; abrupt boundary.

(D) Cb2	117-244 cm; brown (10YR 4/3) and grayish brown (10YR 5/2) sandy loam to sandy clay loam; massive fine gravels from 5 to 20%; abrupt boundary.
(D) Cb3	244-405 cm; moderately well sorted, fine and medium gravels up to 70%; gray and brown loamy matrix; gravels more abundant and angular with depth; waterline at 405 cm.

Appendix E
Soil Stratigraphic Descriptions
Henson Creek

TR1; Jackson alluvium; T2; 1 to 2% slope; 5 m above channel.

A	0-35 cm; black (10YR 2/1) clay; gradual boundary; noncalcareous.
Bss1	35-123 cm; very dark gray (10YR 3/1) clay; few slickensides; few pitted nonpedogenic carbonate nodules in lower part; gradual boundary.
Bss2	123-235 cm; strong brown (7.5YR 4/5) clay grading to reddish yellow (7.5YR 5/6) with 10 to 20% fine gravels; 5 to 10% pitted carbonatic nodules.

TR2; Fort Hood alluvium; T1; 1% slope.

A & AB	0-53 cm; very dark grayish brown (10YR 3/2) grading to dark brown (10YR 3/3) sandy clay loam; gradual boundary.
Bk	53-115 cm; pale brown (10YR 6/3) clay loam with 1 to 2% mycelial carbonates; clear boundary.
C	115-245 cm; light yellowish brown (10YR 6/4) and yellowish brown (10YR 5/6) sandy clay loam matrix with 60% fine and medium dipping gravel.

TR3; Ford alluvium; T0; undulating levee.

A/C1	0-95 cm; alternating beds of light brownish yellow (2.5Y 5/6) sand and grayish brown (2.5Y 5/2) sandy clay loam to silty clay loam; occasional fine ripples; abrupt.
C2	95-220 cm; gray and brown sandy matrix with 70% fine to medium gravels dipping to modern channel.

TR4; Jackson alluvium; T2; flat.

A1 & A2	0-42 cm; black (10YR 2/1) to very dark gray (10YR 3/1) clay; gradual boundary; noncalcareous.
Bss	42-69 cm; very dark grayish brown (10YR 3/2) clay; many distinct slickensides; clear boundary; slightly calcareous.
BC	69-95 cm; strong brown (7.5YR 4/6) and olive brown (2.5Y 4/8) gravelly clay; abrupt boundary.
R	95 cm; limestone.

TR5; Fort Hood alluvium; T1; flat.

A	0-46 cm; very dark grayish brown (10YR 3/2) clay loam with 8% fine gravels in lower part; abrupt boundary.
Bk1,Bk,Bk3	46-240 cm; dark brown (10YR 3/3) sandy clay loam abruptly to brown (10YR 4/3) gravelly sandy clay loam to dark yellowish brown (10YR 4/4)

clay loam; carbonates grade from 1% mycelial to 10% mixed mycelial and encrusts in lower part.

TR6; Ford alluvium (E) over West Range alluvium (upper D?); T0; undulating levee.

(E) A	0-22 cm; fine strata of light yellowish brown (10YR 6/4) sandy loam and very dark grayish brown (10YR 3/2) clay loam; abrupt boundary.
(D) Ab	22-61 cm; very dark grayish brown (10YR 3/2) sandy clay loam; gradual boundary.
(D) Bwb	61-125 cm; dark brown (10YR 3/3) sandy clay loam; clear boundary.
(D) Cb	125-250 cm; brown loamy matrix with 50 to 70% medium gravels dipping to modern channel.

CB1; Jackson alluvium or Walnut clay (?); T2 complex or Killeen surface (?); 2% slope.

A	0-48 cm; very dark gray (10YR 3/1) clay; gradual boundary.
Bw	48-155 cm; gray brown (2.5Y 5/2) clay with few pressure faces and nonpedogenic carbonate nodules; gradual boundary.
BC	155-245 cm; mottled white (10YR 8/1) and light olive brown (2.5Y 5/6) clay; few fine gravels in lower part; few iron manganese stains.

CB2; Ford alluvium; T0; 1% slope.

A/C	0-112 cm; multiple beds of dark brown (10YR 3/3) and very dark grayish brown (10YR 3/2) clay loam to silty clay loam; channel floor at 200 cm.

CB3; Ford alluvium (E) over West Range alluvium (lower D?); T0; 1 to 2% slope.

(E) A1 & A2	0-45 cm; very dark brown (10YR 2/2) clay loam; few fine diffuse gravels; abrupt boundary.
(D) Bw1	45-62 cm; dark brown (10YR 3/3) gravelly clay loam; abrupt boundary.
(D) Bw2	62-90 cm; very dark gray (10YR 3/1) clay loam; few fine diffuse gravels; abrupt boundary.
(D) C	90-288 cm; upper 100 cm is horizontally stratified beds of fine and medium gravel and mottled light olive brown (2.5Y 5/6) and light grayish brown (10YR or 2.5Y 5/2) clay loam to sandy clay loam; grades to massive poorly sorted fine and medium gravels with shale clasts; channel and bedrock at 288 cm.

CB4; Ford alluvium; T0; narrow inset to T1 about 1 m lower.

A & Bw	0-130 cm; faint beds of dark brown (10YR 3/3), very dark grayish brown (10YR 3/2), and dark grayish brown (2.5Y 4/2) silty clay loam; abrupt boundary; dispersed charcoal age of 420 ± 70 from 117 to 130 cm.

C1	130-159 cm; well sorted dark brown (10YR 3/3) gravelly clay loam; abrupt boundary.
C2	159-180 cm; dark brown (10YR 3/3) clay loam; abrupt boundary.
C3	180-290 cm; moderately well sorted massive gravels in dark brown (10YR 3/3) to dark grayish brown (2.5Y 4/2) clay loam matrix; bedrock and channel at 290 cm.

CB5; Ford alluvium (E) over Fort Hood alluvium (C); T0 of Leon River; flat.

(E) A	0-21 cm; dark brown (10YR 3/3) clay loam; gravel line at base.
(C) Ab & ABb	21-79 cm; dark brown (10YR 3/3) clay loam; gradual boundary.
(C) Bkb	79-290 cm; brown (10YR 4/3) to dark yellowish brown (10YR 4/4) clay loam; 3 to 4% mycelial carbonates grading to 4% encrusted carbonates; waterline at 335 cm.

CB6; Ford alluvium (E) over West Range alluvium (upper D); T0; 1% slope.

(E) A	0-48 cm; very dark grayish brown (10YR 3/2) clay loam; clear boundary.
(D) Bkb	48-95 cm; very dark grayish brown (10YR 3/2) clay loam; 6 to 8% mycelial carbonates; gradual boundary.
(D) BCb	95-137 cm; dark brown (10YR 3/3) clay loam; hearth charcoal age of 1300 ± 80 at 137 cm.
(D) Cb	137-330 cm; massive brown (10YR 5/3) sandy clay loam; waterline at 330 cm.

Appendix F
Soil Stratigraphic Descriptions
Reese Creek

TR1; Fort Hood alluvium; T1; 1% slope.

A	0-37 cm; very dark brown (10YR 2/2) clay loam; abrupt boundary; gravel line.
Bw	37-81 cm; dark yellowish brown (10YR 4/4) clay loam; few fine gravels; abrupt boundary marked by gravel line.
Bk1	81-167 cm; dark yellowish brown (10YR 4/4) clay loam; 15% fine and medium gravels; 10 to 20% encrusted carbonates; abrupt boundary marked by gravel line.
Bk2	167-197 cm; strong brown (7.5YR 4/4) clay loam; 8% fine gravels; 5 to 8% encrusted carbonates.1

TR2; Ford alluvium; T0; 1% slope.

A	0-39 cm; dark grayish brown (2.5Y 4/2) loam; sand patches; abrupt boundary.
Ab	39-65 cm; very dark grayish brown (2.5Y 3/2) sandy clay loam; clear boundary.
Bkb	65-185 cm; dark brown (10YR 3/3) sandy clay loam grading to grayish brown (2.5Y 5/2) sandy loam; 5 to 10% mycelial carbonates; abrupt boundary; dispersed charcoal age of 130 ± 60 at 125 cm.
Cb	185-220 cm; gravelly (fine) sand; yellow and brown.

TR3; Jackson alluvium; T2; 1 to 2% slope; 4.5 m above modern channel.

A	0-25 cm; brown (10YR 4/3) clay loam; gradual boundary.
Bw1	25-48 cm; strong brown (7.5YR 4/6); gradual boundary.
Bw2	48-172 cm; yellowish brown (10YR 5/6) clay loam grading to reddish yellow (7.5YR 5/6); 10% fine and medium gravels; 20% pitted nonpedogenic carbonate nodules in lower part; gravel line at 115 cm.
Bk	172-220 cm; strong brown (7.5YR 4/6) clay; 10% encrusted carbonates.

TR4; Ford alluvium; T0; levee.

A	0-17 cm; brown (10YR 5/3) and dark brown (10YR 3/3) loam; abrupt boundary.
Ab	17-34 cm; very dark grayish brown (10YR 3/2) loam; abrupt boundary; articulated army ration cans at 25 cm.
Cb	34-165 cm; alternating layers and laminae of brownish yellow (10YR 6/6) and very pale brown (10YR 7/4) sand and very dark grayish brown

(10YR 3/2) and dark grayish brown (2.5Y 4/2) clay loam and silty clay loam.

TR5; Fort Hood alluvium; T1; flat; 3 m above modern channel.

A	0-23 cm; very dark brown (10YR 2/2) clay loam; gradual boundary.
Bw	23-88 cm; very dark grayish brown (10YR 3/2) clay loam grading to mottled brown (10YR 5/3) and brownish yellow (10YR 6/6); few fine gravels; gravel line at base.
Bk	88-195 cm; light yellowish brown (2.5Y 6/4) and light olive brown (2.5Y 5/8) sandy clay loam; 8% encrusted carbonates decreasing with depth; few fine gravels; abrupt boundary.
C	195-210 cm; 60% fine to coarse gravel in a red, brown and yellow loamy matrix.

TR6; Fort Hood alluvium (?); T1; 2% slope; 2.5 m above channel.

A & Bw1	0-73 cm; very dark grayish brown (10YR 3/2) clay loam; few fine gravels; gradual boundary.
Bw2	73-185 cm; light olive brown (2.5Y 5/3) grading to light brownish gray (2.5Y 6/2); common pressure faces; 10% pitted nonpedogenic carbonate nodules; abrupt.
R	185 cm; bedrock.

CB1; Ford alluvium (E) over West Range alluvium (upper D); T0; 1 to 2% slope; road cut; 2 m above modern modern channel.

(E) A	0-20 cm; very dark grayish brown (10YR 3/2) clay loam; gradual boundary.
(E) Bw	20-41 cm; dark brown (10YR 3/3) clay loam; gradual boundary.
(D) Ab	41-80 cm; very dark grayish brown (10YR 3/2) clay loam; <2% mycelial carbonates; hearth charcoal age of 650 ± 90 at 55 cm.

Appendix G
Soil Stratigraphic Descriptions
North Nolan Creek

TR1; Jackson alluvium/colluvium; T2/erosional; 5% slope.

A1 & A2	0-44 cm; very dark brown (10YR 2/2) clay loam; gradual boundary; few fine gravels.
Bss	44-150 cm; dark brown (7.5YR 3/4) clay loam; with few slickensides grading to reddish yellow (7.5YR 6/6) loam; 25% nonpedogenic pitted nodules; 5% fine gravels; abrupt boundary.
R	150 cm; limestone.

TR2; Fort Hood alluvium; T1; flat; 3 m above modern channel.

A1 & A2	0-78 cm; very dark gray (10YR 3/1) clay loam; clear boundary.
Bw	78-205 cm; dark grayish brown (2.5Y 4/2) clay loam; grading to light grayish brown (2.5Y 6/2); 8% hard and soft carbonate nodules; gravel line at 143 cm; clear boundary.
C	205-240 cm; light brown and yellow loam with 60% medium and coarse angular gravels.

TR3; Fort Hood alluvium; T1; flat; 3.5 m above modern channel.

A	0-24 cm; very dark gray (10YR 3/1) clay; few carbonate clasts; gradual boundary.
Bss	24-200 cm; very dark grayish brown (10YR 3/2) clay; common slickensides; common pitted nonpedogenic carbonate nodules; abrupt boundary.
C	200-250 cm; yellow and brown clayey matrix with 60% fine and medium gravels; bedrock at 250 cm.

TR4; Fort Hood alluvium; T1; flat; 4 m above modern channel; bedrock ledge 1.5 m above channel.

A	0-35 cm; black (10YR 2/1) clay; 2% pitted nonpedogenic carbonate nodules; gradual boundary.
Bss	35-132 cm; black (10YR 2/1) clay; common slickensides; few pitted carbonate nodules; clear boundary.
BC1	132-184 cm; light grayish brown (2.5Y 4/2) and brownish yellow (10YR 6/8) clay loam; few pitted carbonate nodules; abrupt boundary with nodular gravel line.
BC2	184-246 cm; pink (7.5YR 7/4) and brownish yellow (10YR 6/8) clay loam; several gravel lines of pitted carbonate nodules.

TR5; Jackson alluvium/colluvium; T2/erosional; 5% slope.

A	0-41 cm; very dark grayish brown (10YR 3/2) clay loam; gradual boundary.

Bss 41-105 cm; dark yellowish brown (10YR 4/4) clay loam with very dark yellowish brown (10YR 3/2) infillings; many pitted nonpedogenic nodules; clear boundary.

Bk 105-218 cm; strong brown (7.5YR 4/4) clay loam grading to reddish yellow (5YR 4/6); many soft and hard carbonatic nodules; clear boundary.

C 218-258 cm; light gray brown (10YR 7/2) silt loam.

TR6; Fort Hood alluvium; T1; 2% slope.

A 0-33 cm; very dark gray (10YR 3/1) clay; few fine limestone fragments; gradual boundary.

Bss 33-70 cm; very dark gray (10YR 3/1) clay with common slickensides; few fine nonpedogenic pitted nodules; abrupt boundary.

C 70-130 cm; limestone.

TR7; Fort Hood alluvium; T1; 1% slope.

A 0-27 cm; very dark gray clay; few pitted nonpedogenic carbonate nodules; gradual boundary.

Bss 27-244 cm; very dark grayish brown (10YR 3/2) clay grading to light grayish brown (2.5Y 5/2) at base; common pitted carbonate nodules and slickensides throughout.

TR8; See TR7.

Appendix H
Soil Stratigraphic Descriptions
Leon River

TR1; Jackson alluvium; T2; 1% slope; inset from Turnover Creek.

A & AB	0-38 cm; very dark grayish brown (10YR 3/2) clay loam; gradual boundary.
Bss1	38-109 cm; strong brown (7.5YR 4/4) and reddish brown (5YR 4/4) clay loam to silty clay loam; common slickensides; few pitted nonpedogenic carbonate nodules; gradual boundary.
Bss2	109-190 cm; reddish brown (5YR 5/4) silty clay loam; common slickensides; pitted carbonate nodules grading to common encrusted carbonates; few patchy clay films.

TR2; Jackson alluvium; T2; 1% slope; profile is noncalcareous throughout.

A	0-18 cm; yellowish brown (10YR 5/4) fine sandy loam; abrupt boundary.
BAt	18-35 cm; dark brown (7.5YR 3/3) sandy clay loam; many distinct clay films; gradual boundary.
Bt	35-175 cm; dark reddish brown (5YR 3/4) sandy clay loam with common to many yellowish red (5YR 5/6, 5/8) mottles; many distinct clay films.

TR3; Jackson alluvium; T2/T1 erosional scarp of Turnover Creek; 2% slope.

A1 & A2	0-55 cm; very dark grayish brown (10YR 3/2) clay loam; gradual boundary.
Bk1	55-132 cm; strong brown (7.5YR 4/6) clay loam; 3 to 10% encrusted carbonates; few pitted nonpedogenic carbonate nodules; gradual boundary.
Bk2	132-225 cm; yellowish brown (10YR 5/4) and very pale brown (10YR 7/4) clay loam; many coalescing encrusted carbonates; 10% pitted carbonate nodules; few patchy clay films.

TR4; Ford alluvium; T0; see CB2.

TR5, Jackson alluvium; T2; 1% slope (all horizons are noncalcareous).

A	0-29 cm; strong brown (7.5YR 4/6) loamy fine sand; clear boundary; neutral.
Bt1	29-134 cm; red (2.5YR 5/8) sandy clay loam; many clay films (2.5YR 3/6); slightly acid; gradual boundary.
Bt2	134-210 cm; yellowish red (5YR 5/8) sandy clay loam; common clay films (2.5YR 3/6); medium acid; few skeletans in lower part.

TR6; Georgetown alluvium (?); T1; 1% slope; profile is calcareous beginning at 135 cm.

A	0-29 cm; dark yellowish brown (10YR 4/4) fine sandy loam; moderately alkaline; gradual boundary.

Bt1 — 29-94 cm; yellowish red (5YR 5/8) sandy clay loam; many patchy clay films; strongly alkaline; gradual boundary.

Bt2 — 94-186 cm; reddish yellow (7.5YR 6/8) sandy loam; common patchy clay films; strongly acid; clear boundary.

Bk — 186-250 cm; reddish yellow (7.5YR 7/6) to very pale brown (10YR 7/4) sandy loam; 2 to 4% filamentous carbonates.

TR7; Ford alluvium (E) over West Range alluvium (C); T0; flat.

(E) A1 & A2 — 0-50 cm; very dark grayish brown (10YR 3/2) silty clay loam; gradual boundary.

(C) Ab — 50-80 cm; very dark gray (10YR 3/1) silty clay loam; gradual boundary.

(C) Bkb — 80-220 cm; very dark grayish brown (10YR 3/2) silty clay loam grading to dark grayish brown (10YR 4/2) and brown (10YR 4/3); 2 to 10% mycelial carbonates.

TR8; Ford alluvium; T0; levee.

A1 & A2 — 0-41 cm; very dark grayish brown (10YR 3/2) clay loam; clear boundary.

A/C — 41-210 cm; alternating beds of very dark grayish brown (10YR 5/4) to very pale brown (10YR 7/4) loam and sandy loam; undated hearth at 156 cm.

TR9; Reser ve alluvium; T3; 1% slope; upper 150 cm is noncalcareous.

A — 0-25 cm; very dark grayish brown (10YR 3/2) sandy loam; 10% fine siliceous gravels; clear boundary.

E — 25-50 cm; yellowish brown (10YR 5/4) sandy loam; 10% fine siliceous gravels; abrupt boundary.

Bt1 — 50-131 cm; red (10R 4/6) and yellowish brown (10YR 5/6) clay with light gray brown (10YR 7/2) increasing with depth; few pressure faces (same gravels as above); abrupt boundary.

Bt2 — 131-150 cm; yellowish brown (10YR 5/6), light gray brown (10YR 7/2) and red (10R 3/6) clay; 50% fine gravels; abrupt boundary.

Btk — 150-180 cm; same colors as above; clay; few soft carbonatic masses in lower part; few limestone fragments; abrupt; calcareous.

R — 180 cm; limestone.

TR10; Jackson alluvium; T2; flat.

A — 0-12 cm; very dark grayish brown (10YR 3/2) sandy loam; gradual boundary.

E		12-49 cm; yellowish brown (10YR 5/4) sandy loam; gradual boundary.
Bt1		49-159 cm; light brown (7.5YR 6/4) and reddish yellow (7.5YR 6/6) sandy clay loam; common red mottles; few patchy clay films; few iron manganese nodules; skeletans in lower part; gradual boundary.
Bt2		159-209 cm; red (2.5YR 5/8) and reddish yellow (7.5YR 7/6) sandy clay loam; few iron manganese nodules; common skeletans.

<u>TR11</u>; Georgetown alluvium (?); T1; 1% slope; only the C horizon is calcareous.

A		0-25 cm; very dark grayish brown (10YR 3/2) sandy loam; gradual boundary.
E		25-52 cm; very pale brown (10YR 7/4) sandy loam; gradual boundary.
Bt		52-131 cm; strong brown (7.5YR 5/6) sandy loam; few patchy clay films; gradual boundary.
BC		131-222 cm; strong brown (7.5YR 5/8) sandy loam; gradual boundary.
C		222-250 cm; reddish yellow (7.5YR 6/8) loamy sand.

<u>TR12</u>; Ford alluvium (E) over West Range alluvium (D?); T0; back of levee.

(E)	A & Bw	0-51 cm; very dark grayish brown (10YR 3/2) clay loam grading to yellowish brown (10YR 5/4); abrupt boundary.
(E)	C	51-90 cm; laminated beds of very pale brown (10YR 7/3) sandy loam and dark brown (10YR 3/3) clay loam; clear boundary.
(D)	Ab	90-165 cm; very dark gray (10YR 3/1) clay loam; gradual boundary.
(D)	Bwb	165-200 cm; dark brown (10YR 3/3) and very dark gray (10YR 3/1) silty clay; 8% pitted nonpedogenic carbonate nodules.

<u>CB1</u>; Ford alluvium (E) over West Range alluvium (D); T0; Turnover Creek.

(E)	A/C	0-114 cm; multistrata of brownish yellow (10YR 6/8) sandy loam and very dark grayish brown (10YR 3/2) clay loam; abrupt boundary.
(E)	Ab1	114-129 cm; very dark grayish brown (10YR 3/2) clay loam; clear boundary.
(E)	Bwb1	129-192 cm; brown (10YR 4/3) clay loam; abrupt boundary.
(D)	Ab2	192-?; very dark grayish brown (10YR 3/2) clay; many pressure faces; hearth bulk humate age of 1010 ± 70 from upper 20 cm.
(D)	Slump	?-367 cm; brown (10YR 4/3) loam; charcoal hearth age of 1936 ± 51 from 367 cm; 367 cm is waterline.

CB2; Ford alluvium; T0; flat.

A	0-18 cm; dark brown (10YR 3/3) loam; gradual boundary.
Bw	18-110 cm; very dark grayish brown (10YR 3/2) to dark brown (10YR 3/3) loam and clay loam; occasional sand patches and ripple marks; clear boundary.
Ab	110-129 cm; very dark grayish brown (10YR 3/2) clay loam; hearth charcoal age of 610 ± 50 from 124 cm; gradual boundary.
Bwb	129-145 cm; dark brown (10YR 3/3) sandy clay loam.

CB3; Ford alluvium (E) over Fort Hood alluvium (C); T0; flat.

(E) A	0-28 cm; very dark grayish brown (10YR 3/2) clay loam; gradual boundary.
(E) Bk	28-53 cm; dark brown (10YR 3/3) loam; 20% mycelial (fluffy) carbonates; clear boundary.
(C) Akb&ABkb	53-11 cm; very dark grayish brown (10YR 3/2) clay loam; 5 to 10% mycelial carbonates; gradual boundary.
(C) Bkb	111-336 cm; dark yellowish brown (10YR 4/4) to yellowish brown (10YR 5/4) clay loam; 5 to 8% encrusted carbonates; few patchy clay films; gradual boundary.
(C) BCkb	336-600 cm; yellowish brown (10YR 5/5) sandy clay loam; 2 to 3% encrusted carbonates; few patchy clay films; hearth charcoal age of 8616 ± 92 at 500 cm; waterline about 700 cm.

APPENDIX I

Soil Characterization Data

Cowhouse Creek

Soil Series:	Lewisville Variant
Pedon:	S90TX-099-001
Pedon Classification:	Udic Chromusterts, fine, montmorillonitic, thermic
Location:	**TR13**, Cowhouse Creek, Fort Hood, Coryell County, Texas
Landform:	T2
Parent Material:	Carbonatic Alluvium
Stratigraphic Unit:	Jackson Alluvium (A)
Topography:	1% slope
Collectors:	Nordt, Hallmark, Wilding, and Drees

Horizon	Depth (cm)	Soil description (colors for moist soil unless stated)
A1	0-8	Very dark brown (10YR 2/2) clay loam, very dark brown (10YR 2/2) dry; moderate fine and medium subangular blocky and weak fine granular structure; very hard; few fine pores; common fine and medium roots; few sand-sized carbonate grains; noncalcareous; clear smooth boundary.
A2	8-14	Very dark brown (10YR 2/2) clay loam, very dark brown (10YR 2/2) dry; moderate fine and medium subangular blocky structure; very hard; common fine and medium roots; few sand-sized carbonate grains; noncalcareous; gradual smooth boundary.
BAk	14-38	Very dark brown (10YR 2/2) clay, very dark brown (10YR 2/2) dry; moderate medium prismatic parting to moderate coarse angular blocky structure; very hard; common fine and medium roots; common brown (7.5YR 4/4) worm casts; few to common (2%) medium (1 cm) hard highly pitted carbonate nodules (nonpedogenic); slightly calcareous; gradual wavy boundary.
Bkss1	38-66	Dark brown (7.5YR 3/4) clay, dark brown (7.5YR 3/4) dry; moderate coarse prismatic parting to moderate coarse angular blocky structure; very hard; common fine and medium pores; few fine roots; common very dark brown (10YR 2/2) channel fillings on vertical ped faces; common brown (7.5YR 4/4) worm casts in matrix; few sand-sized carbonate grains; few to common (2%) medium (1 cm) highly pitted carbonate nodules (nonpedogenic); few pressure faces and slickensides in lower part of horizon; roots flattened against ped faces; strongly effervescent; gradual wavy boundary.
Bkss2	66-98	Strong brown (7.5YR 4/6) clay, brown (7.5YR 4/4) dry; very hard; common fine and medium pores; few fine roots; few very dark brown (10YR 2/2) channel fillings on vertical ped faces; few brown (7.5YR 4/4) worm casts in matrix; few sand-sized carbonate grains; few (1%) medium (1-2 cm) highly pitted carbonate nodules (nonpedogenic); common intersecting slickensides and parallelipipeds; few medium 7.5YR 5/6 pockets of carbonate-rich material similar to horizon

		below; few fine thin carbonate filaments on some ped faces; roots flattened against ped faces; strongly effervescent; clear wavy boundary.
Bk1	98-120	Strong brown (7.5YR 4/6) clay loam, strong brown (7.5YR 5/6) dry; weak coarse subangular blocky parting to weak fine and medium subangular blocky structure; hard; few fine pores; very few fine roots; common brown (7.5YR 4/4) worm casts in matrix; about 40% of horizon composed to 7.5YR 6/6 material of similar texture but appears to be higher in carbonate content; common (15%) medium (2-3 cm) hard carbonate nodules; common (15-20%) carbonate filaments and threads throughout; hard nodules are not as pitted as above; strongly effervescent; clear wavy boundary.
Bk2	120-150	Reddish yellow (7.5YR 6/6) clay loam; many coarse faint reddish yellow (7.5YR 7/6) and many coarse faint reddish yellow (7.5YR 6/8) mottles; weak coarse subangular blocky parting to weak fine and medium subangular blocky structure; hard; very few fine roots; common brown (7.5YR 4/4) worm casts in matrix; common (5-10%) medium (1-2 cm) hard carbonate nodules (nonpedogenic); common (10%) carbonate filaments and threads; strongly effervescent; gradual wavy boundary.
Bk3	150-190	Strong brown (7.5YR 5/6) sandy clay loam; many coarse faint reddish yellow (7.5YR 7/6) and common coarse distinct yellowish red (5YR 4/6) mottles; weak coarse subangular blocky parting to weak medium subangular blocky structure; very hard; very few fine roots; common brown (7.5YR 4/4) worm casts in matrix; few to common (2%) medium (1-2 cm) hard carbonate nodules (nonpedogenic); common (3%) carbonate filaments and threads; common 1-2 mm root channels; 30-40% of horizon reworked by biotic activity; strongly effervescent; gradual wavy boundary.
Bk4	190-213	Yellowish brown (10YR 5/6) sandy clay loam; many coarse faint yellowish brown (10YR 5/4) and common coarse distinct brown (7.5YR 4/4) mottles; weak coarse subangular blocky parting to weak medium subangular blocky structure; very hard; very few fine roots; common brown (7.5YR 4/4) worm casts in matrix; few thin patchy clay films; very few medium hard carbonate nodules; few (1%) carbonate filaments and threads; common 1-2 mm root channels; 30-40% of horizon reworked by biotic activity; strongly effervescent; gradual wavy boundary.
Bk5	213-250	Yellowish brown (10YR 5/6) sandy clay loam; many coarse faint yellowish brown (10YR 5/4) and brown (7.5YR 4/4) mottles; weak coarse subangular blocky parting to weak medium subangular blocky structure; very hard; very few fine and medium roots; many brown

		(7.5YR 4/4) worm casts in matrix; few thin patchy brown (7.5YR 4/4) clay films; very few medium hard carbonate nodules; few (1%) carbonate filaments and threads; common 1-2 mm root channels; 30-40% of horizon reworked by biotic activity; strongly effervescent; gradual wavy boundary.
BC	250-270	Reddish yellow (7.5YR 6/6) loam; common medium faint brownish yellow (10YR 6/8) mottles; structureless massive; hard; very few fine and medium roots; common brown (7.5YR 4/4) worm casts in matrix; few thin patchy brown (7.5YR 4/4) clay films; common biochannel and biopores 1 mm diameter; large biocasts with white fungal growth; few limestone clasts 0.5 to 1 cm diameter; strongly effervescent.

SOIL CHARACTERIZATION LABORATORY
SOIL AND CROP SCIENCES DEPT., THE TEXAS AGRICULTURAL EXPERIMENT STATION

SOIL SERIES: LEWISVILLE VARIANT — PEDON NUMBER: S90TX-099-001
SOIL FAMILY:
LOCATION:

			PARTICLE SIZE DISTRIBUTION (MM)											
			SAND						SILT		CLAY			
LAB NO	DEPTH (CM)	HORIZON	VC (2.0-1.0)	C (1.0-0.5)	M (0.5-0.25)	F (0.25-0.10)	VF (0.10-0.05)	TOTAL (2.0-0.05)	FINE (0.02-0.002)	TOTAL (0.05-0.002)	FINE (< 0.0002)	TOTAL (< 0.002)	TEXTURE CLASS	COARSE FRAG-MENTS %
			%											
3995	0- 8	A1	0.4	0.3	0.4	7.0	12.6	20.7	22.2	39.6	15.9	39.7	CL	0
3996	8- 14	A2	0.2	0.3	0.3	6.5	13.3	20.6	22.0	34.5	23.5	44.9	C	0
3997	14- 38	BAK	0.1	0.4	0.4	6.9	13.8	21.6	18.6	31.7	28.7	46.7	C	0
3998	38- 66	BKSS1	0.4	0.4	0.8	6.9	13.6	22.1	20.1	33.0	27.2	44.9	C	0
3999	66- 98	BKSS2	0.6	0.7	1.3	8.2	13.8	24.6	20.4	32.2	26.5	43.2	C	0
4000	98-120	BK1	1.1	1.4	3.5	12.3	14.8	33.1	22.4	33.7	20.0	33.2	CL	8
4001	120-150	BK2	0.6	2.1	7.0	17.7	18.6	46.0	20.3	30.3	14.7	23.7	L	9
4002	150-190	BK3	2.2	3.0	7.8	18.7	19.3	51.0	16.9	29.7	11.3	19.3	L	6
4003	190-213	BK4	1.9	2.9	9.6	20.3	17.9	52.6	16.8	29.5	10.1	17.9	FSL	2
4004	213-250	BK5	1.8	2.5	7.1	16.1	18.5	46.0	20.2	35.0	10.3	19.0	L	4
4005	250-270	BC	0.9	1.7	6.9	15.2	19.3	44.0	20.7	36.5	10.1	19.5	L	5

LAB NO	ORGN C %	PH (H2O) 1:1	NH4OAC EXTR BASES CA	MG	NA	K	TOTAL	KCL EXTR AL	NAOAC CEC	ECEC	BASE SAT	ESP	SAR	CAL-CITE	DOLO-MITE	CACO3 EQ	GYP SUM
			MEQ/100G								%			%			
3995	2.25	7.6	56.7	2.0	0.0	2.2	60.9		33.9		100	0	0	4.2	0.0	4.2	
3996	1.73	7.6	58.5	1.7	0.0	1.8	62.0		34.8		100	0	0	3.0	0.0	3.0	
3997	1.30	7.6	62.7	1.6	0.0	1.2	65.4		32.8		100	0	0	4.3	0.0	4.3	
3998	0.97	7.7	62.9	1.2	0.2	0.6	65.0		29.8		100	1		11.4	0.0	11.4	
3999	0.72	7.8	65.8	1.3	0.1	0.5	67.8		27.1		100	0		20.0	0.0	20.0	
4000	0.35	7.8	54.8	0.9	0.2	0.4	56.4		18.8		100	1		38.6	0.0	38.6	
4001	0.26	7.9	54.9	1.0	0.1	0.3	56.3		11.5		100	1		48.1	0.0	48.1	
4002	0.42	7.9	52.6	0.9	0.0	0.3	53.8		9.9		100	0		51.1	0.0	51.1	
4003	0.23	8.0	52.0	1.0	0.1	0.3	53.4		8.8		100	1		52.8	0.0	52.8	
4004	0.01	8.0	51.7	0.9	0.0	0.3	52.9		9.2		100	0		51.3	0.0	51.3	
4005	0.06	8.0	52.2	1.1	0.0	0.3	53.6		9.0		100	0		49.8	0.0	49.8	

SOIL CHARACTERIZATION LABORATORY
SOIL AND CROP SCIENCES DEPT., THE TEXAS AGRICULTURAL EXPERIMENT STATION

SOIL SERIES: LEWISVILLE VARIANT — PEDON NUMBER: S90TX-099-001
SOIL FAMILY:
LOCATION:

LAB	SATURATED PASTE EXTRACT										BULK DEN			WATER CONTENT			
	ELEC	H2O									0.33	AIR		0.10	0.33	15	CD
NO	COND	CONT	CA	MG	NA	K	CO3	HCO3	CL	SO4	BAR	DRY	COLE	BAR	BAR	BAR	FE
	MMHOS/CM	%	MEQ/L								G/CC		CM/CM	WT%			%
3995	0.5	73	4.8	0.2	0.1	0.3	0.0	4.1	0.0	0.0	1.12	1.56	0.117		47.4		0.8
3996	0.4	79	4.2	0.2	0.1	0.2	0.0	2.9	0.0	0.0	1.25	1.68	0.104		40.0		0.8
3997	0.4	76	3.9	0.2	0.1	0.1	0.0	3.0	0.0	0.0	1.30	1.71	0.096		34.9		0.9
3998											1.33	1.75	0.096		33.7		0.9
3999											1.40	1.78	0.083		31.3		0.9
4000											1.43	1.56	0.029		25.3		0.7
4001											1.47	1.61	0.031		29.2		0.4
4002											1.47	1.62	0.033		24.8		0.3
4003																	0.3
4004											1.41	1.59	0.041		27.5		0.3
4005											1.55	1.70	0.031		22.8		0.3

LAB	CLAY MINERALOGY									SKELETAL MINERALOGY		
NO	SM	VR	MI	IN	KK	GI	QZ	FD	CA	QZ	FD	CA
3995												
3996												
3997	**		**		**		*					
3998												
3999	**		*		**		*		*			
4000												
4001												
4002												
4003												
4004												
4005	**		*		**		*		*			

SM=SMECTITE VR=VERMICULITE MI=MICA IN=INTERSTRATIFIED
KK=KAOLINITE GO=GOETHITE QZ=QUARTZ FD=FELDSPAR CA=CALCITE
T=TRACE *=0-10% **=10-50% ***=GREATER THAN 50%

SOIL CHARACTERIZATION LABORATORY
SOIL AND CROP SCIENCES DEPT., THE TEXAS AGRICULTURAL EXPERIMENT STATION

SOIL SERIES: LEWISVILLE VARIANT PEDON NUMBER: S90TX-099-001
SOIL FAMILY:
LOCATION:

LAB NO	PARTICLE SIZE DISTRIBUTION (CLAY-FREE BASIS)													
	SAND						SILT			RATIOS				
	VCS	C	M	F	VF	TOTAL	C	F	TOTAL	S/SI	FSI/CSI	VFS/FS	FC/TC	CEC/CLAY
	%													
3995	0.7	0.5	0.7	11.6	20.9	34.3	28.9	36.8	65.7	0.5	1.3	1.8	0.4	0.85
3996	0.4	0.5	0.5	11.8	24.1	37.4	22.7	39.9	62.6	0.6	1.8	2.0	0.5	0.78
3997	0.2	0.8	0.8	12.9	25.9	40.5	24.6	34.9	59.5	0.7	1.4	2.0	0.6	0.70
3998	0.7	0.7	1.5	12.5	24.7	40.1	23.4	36.5	59.9	0.7	1.6	2.0	0.6	0.66
3999	1.1	1.2	2.3	14.4	24.3	43.3	20.8	35.9	56.7	0.8	1.7	1.7	0.6	0.63
4000	1.6	2.1	5.2	18.4	22.2	49.6	17.0	33.5	50.5	1.0	2.0	1.2	0.6	0.57
4001	0.8	2.8	9.2	23.2	24.4	60.3	13.1	26.6	39.7	1.5	2.0	1.1	0.6	0.48
4002	2.7	3.7	9.7	23.2	23.9	63.2	15.9	20.9	36.8	1.7	1.3	1.0	0.6	0.51
4003	2.3	3.5	11.7	24.7	21.8	64.1	15.4	20.5	35.9	1.8	1.3	0.9	0.6	0.49
4004	2.2	3.1	8.8	19.9	22.8	56.8	18.3	24.9	43.2	1.3	1.4	1.1	0.5	0.48
4005	1.1	2.1	8.6	18.9	24.0	54.7	19.6	25.7	45.3	1.2	1.3	1.3	0.5	0.46

Soil Series:	Lewisville Variant
Pedon:	S90TX-099-002
Pedon Classification:	Vertic Calciustolls, fine, montmorillonitic, thermic
Location:	**TR19**, Cowhouse Creek, Fort Hood, Coryell County, Texas
Landform:	T1
Parent Material:	Carbonatic Alluvium
Stratigraphic Unit:	Fort Hood Alluvium (C)
Topography:	nearly level
Collectors:	Nordt and Hallmark

Horizon	Depth (cm)	Soil description (colors for moist soil unless stated)
A1	0-16	Very dark brown (10YR 2/2) silty clay loam, very dark grayish brown (10YR 3/2) dry; moderate coarse subangular blocky parting to moderate fine subangular blocky structure very hard; common fine and medium roots; many worm casts; few sand sized carbonate grains; moderately alkaline; strongly effervescent; clear smooth boundary.
A2	16-32	Very dark brown (10YR 2/2) silty clay, very dark grayish brown (10YR 3/2) dry; weak coarse subangular blocky parting to moderate fine subangular blocky structure; hard; common fine and medium roots; common worm casts; few shell fragments; few sand sized carbonate grains; moderately alkaline; strongly effervescent; gradual wavy boundary.
AB	32-59	Very dark grayish brown (10YR 3/2) silty clay, very dark grayish brown (10YR 3/2) dry; moderate coarse subangular blocky parting to moderate medium subangular blocky structure; hard; few fine and medium roots; common worm casts; few shell fragments; few sand sized carbonate grains; moderately alkaline; strongly effervescent; gradual wavy boundary.
Bw	59-94	Dark brown (10YR 3/3) silty clay, dark brown (10YR 3/3) dry; weak coarse prismatic parting to moderate medium angular blocky structure; very hard; few fine and medium roots; common worm casts; few shell fragments; few sand sized carbonate grains; occasional medium (1 cm) hard irregular carbonate nodules that are somewhat pitted (nonpedogenic); moderately alkaline; strongly effervescent; clear wavy boundary.
Bk1	94-122	Dark yellowish brown (10YR 4/4) silty clay loam, dark yellowish brown (10YR 4/4) dry; weak medium prismatic parting to moderate medium angular blocky structure; very hard; very few fine roots; few worm casts; few shell fragments; few sand sized carbonate grains; common (3%) threads and filaments of carbonate concentrated on ped surfaces but also in some ped interiors; some small to medium wedge-

		shaped peds with distinct pressure faces; moderately alkaline; strongly effervescent; gradual wavy boundary.
Bk2	122-153	Dark yellowish brown (10YR 4/4) silty clay loam, dark yellowish brown (10YR 4/4) dry; moderate medium angular blocky structure; very hard; very few fine roots; few worm casts; few shell fragments; few sand sized carbonate grains; common (5%) threads and filaments of carbonate both on ped surfaces and in peds; some small to medium wedge-shaped peds with distinct pressure faces; moderately alkaline; strongly effervescent; gradual wavy boundary.
Bk3	153-189	Dark yellowish brown (10YR 4/4) silty clay loam; moderate medium prismatic parting to moderate medium angular blocky structure; very hard; very few fine roots; few shell fragments; few sand sized carbonate grains; common (7%) threads and filaments of carbonate both on ped surfaces and in peds; moderately alkaline; strongly effervescent; gradual wavy boundary.
Bk4	189-252	Dark yellowish brown (10YR 4/4) silty clay loam; moderate medium prismatic parting to moderate medium angular blocky structure; very hard; no roots; few shell fragments; few sand sized carbonate grains; common (9%) threads and filaments of carbonate both on ped surfaces and in peds; moderately alkaline; strongly effervescent.
BC	330-350	Yellowish brown (10YR 5/4) silty clay; hard; no roots; few hard segregations of carbonate about 1-2 cm in diameter; moderately alkaline; strongly effervescent.

REMARKS: **The BC horizon was sampled and described by hand auger. Additional depths are shown in Figure 5.**

SOIL CHARACTERIZATION LABORATORY
SOIL AND CROP SCIENCES DEPT., THE TEXAS AGRICULTURAL EXPERIMENT STATION

SOIL SERIES: LEWISVILLE | PEDON NUMBER: S89TX-099-002
SOIL FAMILY:
LOCATION:

LAB NO	DEPTH (CM)	HORIZON	PARTICLE SIZE DISTRIBUTION (MM) SAND VC (2.0-1.0)	C (1.0-0.5)	M (0.5-0.25)	F (0.25-0.10)	VF (0.10-0.05)	TOTAL (2.0-0.05)	SILT FINE (0.02-0.002)	TOTAL (0.05-0.002)	CLAY FINE (< 0.0002)	TOTAL (< 0.002)	TEXTURE CLASS	COARSE FRAG-MENTS %
			%											
4018	0- 16	A1	0.2	0.4	0.5	2.6	7.4	11.1	36.8	51.8	17.6	37.1	SICL	0
4019	16- 32	A2	0.3	0.4	0.6	2.9	7.1	11.3	36.9	47.7	22.6	41.0	SIC	0
4020	32- 59	AB	0.4	0.3	0.7	2.7	7.2	11.3	36.4	45.7	23.4	43.0	SIC	0
4021	59- 94	BW	0.4	0.7	0.9	3.5	8.7	14.2	34.0	43.7	23.1	42.1	SIC	0
4022	94-122	BK1	0.2	0.5	1.0	4.4	11.1	17.2	31.9	43.5	21.8	39.3	SICL	0
4023	122-153	BK2	0.2	0.4	0.6	4.5	12.0	17.7	32.1	44.5	21.5	37.8	SICL	0
4024	153-189	BK3	0.1	0.4	0.4	4.5	13.3	18.7	30.5	44.3	22.1	37.0	SICL	0
4025	189-252	BK4	0.2	0.3	0.4	3.8	12.1	16.8	30.8	44.8	22.5	38.4	SICL	0
4026	330-350	C	0.1	0.2	0.3	2.0	8.6	11.2	29.5	47.6	25.3	41.2	SIC	0

LAB NO	ORGN C %	PH (H2O) 1:1	NH4OAC EXTR BASES CA	MG	NA	K	TOTAL	KCL EXTR AL	NAOAC CEC	ECEC	BASE SAT	ESP	SAR	CAL-CITE	DOLO-MITE	CACO3 EQ	GYP SUM
			MEQ/100G								%			%			
4018	1.87	7.9	51.8	2.4	0.0	1.3	55.5		26.8		100	0	0	36.5	0.0	36.5	
4019	1.37	8.0	47.7	2.2	0.1	0.9	50.9		27.1		100	0	0	37.1	0.0	37.1	
4020	1.04	8.1	49.5	2.3	0.1	0.7	52.6		28.5		100	0	0	38.6	0.0	38.6	
4021	0.79	8.3	47.3	2.4	0.1	0.6	50.4		26.2		100	0	0	39.6	0.0	39.6	
4022	0.58	8.3	48.7	3.0	0.1	0.5	52.3		21.9		100	0	0	39.4	0.0	39.4	
4023	0.44	8.3	47.6	3.3	0.1	0.5	51.5		25.3		100	0	0	39.6	0.0	39.6	
4024	0.34	6.4	45.3	3.9	0.1	0.6	50.0		21.1		100	0		37.3	0.0	37.3	
4025	0.37	8.3	43.6	4.8	0.1	0.6	49.2		21.5		100	0		35.5	0.0	35.5	
4026	0.34	8.4	44.0	8.8	0.1	0.6	53.6		25.4		100	0		33.6	0.0	33.6	

LAB NO	SATURATED PASTE EXTRACT ELEC COND MMHOS/CM	H2O CONT %	CA	MG	NA	K	CO3	HCO3	CL	SO4	BULK DEN 0.33 BAR	AIR DRY	COLE CM/CM	WATER CONTENT 0.10 BAR	0.33 BAR	15 BAR	CD FE %
			MEQ/L								G/CC			WT%			
4018	0.5	61	4.4	0.3	0.2	0.3	0.0	4.4	0.2	0.3	1.23	1.54	0.078		32.8		0.4
4019	0.5	61	4.4	0.3	0.2	0.1	0.0	4.5	0.0	0.3	1.25	1.57	0.079		32.5		0.5
4020	0.4	61	3.5	0.3	0.2	0.1	0.0	3.9	0.0	0.1	1.31	1.67	0.084		34.1		0.5
4021	0.3	57	2.1	0.2	0.2	0.0	0.0	2.6	0.0	0.3	1.43	1.74	0.068		27.1		0.5
4022	0.2	56	1.7	0.2	0.2	0.0	0.0	1.9	0.2	0.1	1.39	1.73	0.076		29.1		0.5
4023	0.2	59	1.5	0.2	0.2	0.0	0.0	1.8	0.2	0.2	1.41	1.76	0.077		30.5		0.5
4024											1.42	1.76	0.074		29.3		0.5
4025											1.35	1.78	0.097		35.2		0.5
4026																	0.4

SOIL CHARACTERIZATION LABORATORY
SOIL AND CROP SCIENCES DEPT., THE TEXAS AGRICULTURAL EXPERIMENT STATION

SOIL SERIES: LEWISVILLE
SOIL FAMILY:
LOCATION:

PEDON NUMBER: S89TX-099-002

LAB	CLAY MINERALOGY									SKELETAL MINERALOGY		
NO	SM	VR	MI	IN	KK	GI	QZ	FD	CA	QZ	FD	CA
4018	**		**		**		*		*			
4019												
4020	**		**		**		*		**			
4021	**		*		**		*		**			
4022	**		*		**		*		**			
4023	**		*		**		*		**			
4024												
4025												
4026	***		*		**		*		**			

SM=SMECTITE VR=VERMICULITE MI=MICA IN=INTERSTRATIFIED
KK=KAOLINITE GO=GOETHITE QZ=QUARTZ FD=FELDSPAR CA=CALCITE
T=TRACE *=0-10% **=10-50% ***=GREATER THAN 50%

SOIL CHARACTERIZATION LABORATORY
SOIL AND CROP SCIENCES DEPT., THE TEXAS AGRICULTURAL EXPERIMENT STATION

SOIL SERIES: LEWISVILLE
SOIL FAMILY:
LOCATION:

PEDON NUMBER: S89TX-099-002

LAB NO	PARTICLE SIZE DISTRIBUTION (CLAY-FREE BASIS)									RATIOS				
	SAND						SILT							
	VCS	C	M	F	VF	TOTAL	C	F	TOTAL	S/SI	FSI/CSI	VFS/FS	FC/TC	CEC/CLAY
	%													
4018	0.3	0.6	0.8	4.1	11.8	17.6	23.9	58.5	82.4	0.2	2.4	2.9	0.5	0.72
4019	0.5	0.7	1.0	4.9	12.0	19.2	18.3	62.5	80.8	0.2	3.4	2.4	0.6	0.66
4020	0.7	0.5	1.2	4.7	12.6	19.8	16.3	63.9	80.2	0.2	3.9	2.7	0.5	0.66
4021	0.7	1.2	1.6	6.0	15.0	24.5	16.8	58.7	75.5	0.3	3.5	2.5	0.5	0.62
4022	0.3	0.8	1.6	7.2	18.3	28.3	19.1	52.6	71.7	0.4	2.8	2.5	0.6	0.56
4023	0.3	0.6	1.0	7.2	19.3	28.5	19.9	51.6	71.5	0.4	2.6	2.7	0.6	0.67
4024	0.2	0.6	0.6	7.1	21.1	29.7	21.9	48.4	70.3	0.4	2.2	3.0	0.6	0.57
4025	0.3	0.5	0.7	6.2	19.6	27.3	22.7	50.0	72.7	0.4	2.2	3.2	0.6	0.56
4026	0.2	0.3	0.5	3.4	14.6	19.0	30.8	50.2	81.0	0.2	1.6	4.3	0.6	0.62

Soil Series:	Bosque Variant
Pedon:	S90TX-099-003
Pedon Classification:	Cumulic Haplustolls, fine-loamy, carbonatic, thermic
Location:	**TR2**, Cowhouse Creek, Fort Hood, Coryell County, Texas
Landform:	T1
Parent Material:	Carbonatic Alluvium
Stratigraphic Unit:	West Range (lower D) over Fort Hood (C) Alluvium
Topography:	1% slope
Collectors:	Nordt and Jacob

Horizon	Depth (cm)	Soil description (colors for moist soil unless stated)
Ap	0-16	Dark grayish brown (10YR 4/2), grayish brown (10YR 5/2) dry; sandy clay loam; massive structure fractured into large platy blocks; extremely hard; common fine medium and few coarse roots; clear smooth boundary.
Bw	16-40	Dark grayish brown (10YR 4/2), grayish brown (10YR 5/2) dry; sandy clay loam; weak coarse subangular blocky structure; common worm casts; common fine and medium and few coarse roots; few patches of mycelial carbonates; few snail shells; few fine pores; very hard; few fine and medium roots; clear smooth boundary.
Bk1	40-76	Brown (10YR 4/3), grayish brown (10YR 5/2) dry; sandy clay loam; weak coarse prismatic structure parting to weak coarse angular blocky; many 'fluffy' mycelial carbonate threads and coats on ped faces and ped interiors; common fine and medium pores; few fine and medium roots; very hard; gradual smooth boundary.
Bk2	76-120	Yellowish brown (10YR 5/4), pale brown (10YR 6/3) dry; loam; weak medium and coarse prismatic structure parting to weak coarse angular blocky; carbonates as above except some mycelia have a more 'matted' appearance; few fine and medium roots; very hard; gradual smooth boundary.
Bk3	120-158	Brown (10YR 5/3), yellowish brown (10YR 5/4) dry; loam; moderate medium and coarse prismatic structure parting to moderate angular blocky; common fine and medium carbonate threads in reticulate pattern; 70% of threads are matted mycelia, 30% are stained and encrusted; few fine pores; few fine and medium roots; hard; gradual smooth boundary.
2Bk4b	158-221	Brown (10YR 4/3), yellowish brown (10YR 5/4) dry; silty clay loam; moderate fine and medium prismatic structure parting to moderate fine and medium subangular blocky; many carbonate threads as above, except 70% are stained and encrusted; few snail shells; common

		pedotubules; few fine and medium roots; common fine pores; hard; gradual smooth boundary.
2Bk5b	158-246	Brown (10YR 4/3), yellowish brown (10YR 5/4) dry; silty clay loam; moderate fine prismatic structure parting to moderate medium subangular blocky structure; common fine reticulated carbonate threads (all encrusted); common pedotubules; common fine pores; few fine roots; hard.

REMARKS: **Profile is calcareous throughout. Additional depths are shown in Figure 5.**

SOIL CHARACTERIZATION LABORATORY
SOIL AND CROP SCIENCES DEPT., THE TEXAS AGRICULTURAL EXPERIMENT STATION

SOIL SERIES: BOSQUE VARIANT

PEDON NUMBER: S90TX-099-003

SOIL FAMILY:

LOCATION:

LAB NO	DEPTH (CM)	HORIZON	SAND VC (2.0-1.0)	SAND C (1.0-0.5)	SAND M (0.5-0.25)	SAND F (0.25-0.10)	SAND VF (0.10-0.05)	SAND TOTAL (2.0-0.05)	SILT FINE (0.02-0.002)	SILT TOTAL (0.05-0.002)	CLAY FINE (< 0.0002)	CLAY TOTAL (< 0.002)	TEXTURE CLASS	COARSE FRAG-MENTS %
			%											
4027	0- 16	AP	0.5	1.0	4.3	22.4	21.8	50.0	17.3	33.0	9.1	17.0	L	1
4028	16- 40	BW	0.1	0.2	4.3	25.8	21.5	51.9	17.2	28.1	11.2	20.0	L	0
4029	40- 76	BK1	0.2	0.2	4.0	25.2	19.4	49.0	18.4	29.2	12.3	21.8	L	0
4030	76-120	BK2	0.0	0.1	2.3	19.6	21.0	43.0	21.4	33.6	13.7	23.4	L	0
4031	120-158	BK3	0.1	0.1	0.4	8.4	16.9	25.9	26.6	44.2	18.1	29.9	CL	0
4032	158-221	2BK4B	0.2	0.2	0.5	7.7	15.2	23.8	27.3	45.0	18.6	31.2	CL	0
4033	221-246	2BK5B	0.2	0.1	0.5	5.0	11.9	17.7	30.5	48.1	20.1	34.2	SICL	0

LAB NO	ORGN C %	PH (H2O) 1:1	NH4OAC EXTR BASES CA	MG	NA	K	TOTAL	KCL EXTR AL	NAOAC CEC	ECEC	BASE SAT	ESP	SAR	CAL-CITE	DOLO-MITE	CACO3 EQ	GYP SUM
			MEQ/100G								%			%			
4027	1.69	8.1	37.1	1.7	0.1	0.8	39.8		15.8		100	1		42.0	0.0	42.0	
4028	0.74	8.3	37.3	1.7	0.1	0.4	39.5		13.2		100	1		48.4	0.0	48.4	
4029	0.65	8.3	38.8	2.0	0.2	0.3	41.3		13.5		100	2		49.4	0.0	49.4	
4030	0.59	8.2	38.3	2.4	0.2	0.3	41.3		13.5		100	1	1	45.4	0.0	45.4	
4031	0.50	8.3	41.2	3.8	0.1	0.4	45.5		18.3		100	0	0	39.7	0.0	39.7	
4032	0.68	8.3	40.2	4.9	0.1	0.4	45.6		18.8		100	0	0	38.3	0.0	38.3	
4033	0.37	8.4	43.1	7.2	0.1	0.4	50.8		19.9		100	0	0	39.5	0.0	39.5	

LAB NO	SATURATED PASTE EXTRACT ELEC COND MMHOS/CM	H2O CONT %	CA	MG	NA	K	CO3	HCO3	CL	SO4	BULK DEN 0.33 BAR	BULK DEN AIR DRY	COLE CM/CM	WATER CONTENT 0.10 BAR	WATER CONTENT 0.33 BAR	WATER CONTENT 15 BAR	CD FE %
			MEQ/L								G/CC			WT%			
4027											1.58	1.75	0.035		21.6		0.2
4028											1.42	1.62	0.045		26.3		0.2
4029											1.32	1.60	0.066		30.3		0.2
4030	0.7	52	4.9	0.9	0.9	0.1	0.0	1.7	3.6	1.6	1.34	1.59	0.059		28.9		0.2
4031	0.5	60	3.6	0.8	0.4	0.0	0.0	1.5	2.0	0.8	1.33	1.54	0.050		30.9		0.3
4032	0.4	61	2.8	0.9	0.4	0.0	0.0	1.4	1.4	0.7	1.23	1.50	0.068		37.4		0.3
4033	0.4	62	2.4	1.5	0.3	0.0	0.0	1.9	0.8	1.4	1.27	1.54	0.066		36.1		0.3

SOIL CHARACTERIZATION LABORATORY
SOIL AND CROP SCIENCES DEPT., THE TEXAS AGRICULTURAL EXPERIMENT STATION

SOIL SERIES: BOSQUE VARIANT
SOIL FAMILY:
LOCATION:

PEDON NUMBER: S90TX-099-003

LAB	CLAY MINERALOGY									SKELETAL MINERALOGY		
NO	SM	VR	MI	IN	KK	GI	QZ	FD	CA	QZ	FD	CA
4027	**		*		**		*		**			
4028												
4029												
4030	**		*		**		*		**			
4031	**		*		**		*		**			
4032												
4033	**		*		**		*		**			

SM=SMECTITE VR=VERMICULITE MI=MICA IN=INTERSTRATIFIED
KK=KAOLINITE GO=GOETHITE QZ=QUARTZ FD=FELDSPAR CA=CALCITE
T=TRACE *=0-10% **=10-50% ***=GREATER THAN 50%

SOIL CHARACTERIZATION LABORATORY
SOIL AND CROP SCIENCES DEPT., THE TEXAS AGRICULTURAL EXPERIMENT STATION

SOIL SERIES: BOSQUE VARIANT — PEDON NUMBER: S90TX-099-003
SOIL FAMILY:
LOCATION:

LAB NO	PARTICLE SIZE DISTRIBUTION (CLAY-FREE BASIS) SAND VCS	SAND C	SAND M	SAND F	SAND VF	SAND TOTAL	SILT C	SILT F	SILT TOTAL	RATIOS S/SI	RATIOS FSI/CSI	RATIOS VFS/FS	RATIOS FC/TC	CEC/CLAY
	%													
4027	0.6	1.2	5.2	27.0	26.3	60.2	19.0	20.8	39.8	1.5	1.1	1.0	0.5	0.93
4028	0.1	0.3	5.4	32.3	26.9	64.9	13.6	21.5	35.1	1.8	1.6	0.8	0.6	0.66
4029	0.3	0.3	5.1	32.2	24.8	62.7	13.8	23.5	37.3	1.7	1.7	0.8	0.6	0.62
4030	0.0	0.1	3.0	25.6	27.4	56.1	16.0	27.9	43.9	1.3	1.7	1.1	0.6	0.58
4031	0.1	0.1	0.6	12.0	24.1	36.9	25.2	37.9	63.1	0.6	1.5	2.0	0.6	0.61
4032	0.3	0.3	0.7	11.2	22.1	34.6	25.7	39.7	65.4	0.5	1.5	2.0	0.6	0.60
4033	0.3	0.2	0.8	7.6	18.1	26.9	26.7	46.4	73.1	0.4	1.7	2.4	0.6	0.58

Soil Series: Bosque Variant
Pedon: S90TX-099-009
Pedon Classification: Pachic Calciustolls, fine-loamy, carbonatic, thermic
Location: **TR1**, Cowhouse Creek, Fort Hood, Coryell County, Texas
Landform: T1
Parent Material: Carbonatic Alluvium
Stratigraphic Unit: West Range (upper D)
Topography: nearly level
Collectors: Nordt and Hallmark

Horizon	Depth (cm)	Soil description (colors for moist soil unless stated)
A1	0-15	Very dark grayish brown (10YR 3/2) loam, very dark grayish brown (10YR 5/2) dry; moderate coarse subangular blocky parting to moderate medium subangular blocky structure; very hard; many fine and medium roots; moderately alkaline; strongly effervescent; clear smooth boundary.
A2	15-34	Very dark grayish brown (10YR 3/2) loam, very dark grayish brown (10YR 3/2) dry; weak coarse prismatic parting to weak medium and coarse subangular blocky structure; hard; common fine roots; common faunal casts; moderately alkaline; strongly effervescent; clear wavy boundary.
Bk1	34-53	Very dark grayish brown (10YR 3/2) loam, dark grayish brown (10YR 4/2) dry; weak coarse prismatic parting to moderate medium and coarse subangular blocky structure; hard; common fine roots; few faunal casts; many very thin carbonate mycelia on vertical ped faces of prisms; secondary carbonate is <1% of horizon volume; moderately alkaline; strongly effervescent; gradual smooth boundary.
Bk2	53-85	Very dark grayish brown (10YR 3/2) loam, grayish brown (10YR 5/2) dry; weak coarse prismatic parting to moderate medium subangular blocky structure; hard; common fine roots; few faunal casts; many very thin carbonate mycelia on vertical ped faces of prisms; secondary carbonate is <1% of horizon volume; moderately alkaline; strongly effervescent; gradual wavy boundary.
Bk3	85-118	Dark grayish brown (10YR 4/2) loam, grayish brown (10YR 5/2) dry; weak coarse prismatic parting to moderate medium subangular blocky structure; hard; few fine and medium roots; few faunal casts; common (15%) fine carbonate filaments and threads on surfaces of peds; common (5%) fine carbonate filaments and threads in interiors of peds; moderately alkaline; violently effervescent; gradual wavy boundary.

Bk4	118-155	Dark grayish brown (10YR 4/2) loam, grayish brown (10YR 5/2) dry; weak coarse prismatic parting to moderate medium subangular blocky structure; hard; few fine and medium roots; few faunal casts; common (15%) fine carbonate filaments and threads on surfaces of peds; common (5%) fine carbonate filaments and threads in interiors of peds; moderately alkaline; violently effervescent; gradual wavy boundary.
Bk5	155-166	Brown (10YR 4/3) loam, brown (10YR 5/3) dry; weak coarse prismatic parting to moderate medium subangular blocky structure; hard; very few fine roots; few faunal casts; few shell fragments; common (10%) fine carbonate filaments and threads on ped surfaces; common (5%) fine carbonate filaments and threads in interiors of peds; moderately alkaline; violently effervescent; clear smooth boundary.
Bk6	166-188	Brown (10YR 4/3) loam, brown (10YR 5/3) dry; moderate medium prismatic parting to moderate medium subangular blocky structure; hard; very few fine roots; few faunal casts; few shell fragments; many (20%) fine carbonate filaments and threads on ped surfaces; common (10%) fine carbonate filaments and threads in ped interiors; moderately alkaline; violently effervescent; gradual smooth boundary.
Bk7	188-215	Brown (10YR 4/3) loam, brown (10YR 5/3) dry; moderate medium prismatic parting to moderate medium subangular blocky structure; hard; very few fine roots; few faunal casts; few shell fragments; many (20%) fine carbonate filaments and threads on ped surfaces; common (10%) fine carbonate filaments and threads in ped interiors; moderately alkaline; violently effervescent.
Bk8	215-230	Brown (10YR 4/3) loam, brown (10YR 5/3) dry; weak coarse prismatic parting to weak medium subangular blocky structure; hard; very few fine roots; few faunal casts; common (10%) fine carbonate filaments and threads on ped faces; common (10%) fine carbonate filaments and threads in ped interiors; moderately alkaline; violently effervescent.

REMARKS: **Bk6 and Bk7 may have been a buried A horizon but has character of B horizon today.**

SOIL CHARACTERIZATION LABORATORY
SOIL AND CROP SCIENCES DEPT., THE TEXAS AGRICULTURAL EXPERIMENT STATION

SOIL SERIES: BOSQUE
SOIL FAMILY:
LOCATION:

PEDON NUMBER: S90TX-099-009

LAB NO	DEPTH (CM)	HORIZON	SAND VC (2.0-1.0)	SAND C (1.0-0.5)	SAND M (0.5-0.25)	SAND F (0.25-0.10)	SAND VF (0.10-0.05)	SAND TOTAL (2.0-0.05)	SILT FINE (0.02-0.002)	SILT TOTAL (0.05-0.002)	CLAY FINE (< 0.0002)	CLAY TOTAL (< 0.002)	TEXTURE CLASS	COARSE FRAGMENTS %
			%											
4165	0- 15	A1	0.4	0.6	7.0	23.0	18.0	49.0	18.7	31.2	10.5	19.8	L	0
4166	15- 34	A2	0.4	1.8	7.4	21.3	15.5	46.4	21.5	34.3	9.0	19.3	L	0
4167	34- 53	BK1	0.1	0.6	4.5	23.6	19.7	48.5	21.1	31.4	10.8	20.1	L	0
4168	53- 84	BK2	0.0	0.7	5.8	26.4	19.8	52.7	20.6	28.6	11.0	18.7	FSL	0
4169	85-118	BK3	0.1	0.4	3.2	22.3	21.3	47.3	22.7	31.8	12.6	20.9	L	0
4170	118-155	BK4	0.2	0.3	4.0	20.1	21.2	45.8	19.6	31.7	13.4	22.5	L	0
4171	155-166	BK5	0.0	0.2	2.0	17.5	22.6	42.3	19.4	34.6	14.0	23.1	L	0
4172	166-188	BK6	0.1	0.2	1.2	15.3	21.8	38.6	21.9	36.5	14.8	24.9	L	0
4173	188-215	BK7	0.1	0.4	3.0	16.4	17.4	37.3	23.4	37.0	15.6	25.7	L	0
4174	215-230	BK8	0.0	0.5	5.4	21.1	17.0	44.0	20.6	33.1	13.8	22.9	L	0

LAB NO	ORGN C %	PH (H2O) 1:1	NH4OAC EXTR BASES CA	MG	NA	K	TOTAL	KCL EXTR AL	NAOAC CEC	ECEC	BASE SAT	ESP	SAR	CALCITE	DOLOMITE	CACO3 EQ	GYPSUM
			MEQ/100G								%			%			
4165	1.18	8.1	47.2	2.1	0.1	0.4	49.8		14.6		100	1		46.1	0.0	46.1	
4166	1.89	8.0	47.0	2.0	0.1	0.7	49.9		16.3		100	1		46.4	0.0	46.4	
4167	0.97	8.2	47.0	2.3	0.1	0.3	49.8		13.2		100	1		46.2	0.0	46.2	
4168	0.94	8.3	45.5	2.3	0.1	0.3	48.2		10.7		100	1		49.7	0.0	49.7	
4169	0.70	8.3	47.8	2.5	0.1	0.3	50.7		11.5		100	1		47.5	0.0	47.5	
4170	0.69	8.3	47.9	2.8	0.1	0.3	51.1		11.7		100	1		46.0	0.0	46.0	
4171	0.72	8.2	47.9	3.3	0.1	0.3	51.5		12.4		100	1		42.6	0.0	42.6	
4172	0.62	8.2	50.1	3.9	0.1	0.4	54.5		13.1		100	1		42.1	0.0	42.1	
4173	0.72	8.3	50.8	4.2	0.1	0.4	55.5		14.1		100	1		44.4	0.0	44.4	
4174	0.66	8.3	45.5	4.1	0.1	0.3	49.9		12.2		100	1		49.1	0.0	49.1	

SOIL CHARACTERIZATION LABORATORY
SOIL AND CROP SCIENCES DEPT., THE TEXAS AGRICULTURAL EXPERIMENT STATION

SOIL SERIES: BOSQUE — PEDON NUMBER: S90TX-099-009
SOIL FAMILY:
LOCATION:

LAB NO	ELEC COND MMHOS/CM	H2O CONT %	CA	MG	NA	K	CO3	HCO3	CL	SO4	BULK DEN 0.33 BAR G/CC	BULK DEN AIR DRY G/CC	COLE CM/CM	WATER CONTENT 0.10 BAR WT%	WATER CONTENT 0.33 BAR WT%	WATER CONTENT 15 BAR WT%	CD FE %
			SATURATED PASTE EXTRACT (MEQ/L)														
4165											1.38	1.57	0.044		26.6		0.3
4166											1.31	1.50	0.046		30.4		0.3
4167											1.22	1.45	0.059		35.1		0.3
4168											1.21	1.44	0.060		35.7		0.3
4169											1.26	1.50	0.060		33.2		0.3
4170											1.27	1.58	0.076		31.8		0.3
4171											1.29	1.46	0.042		32.5		0.2
4172											1.30	1.48	0.044		32.5		0.3
4173											1.29	1.50	0.052		33.2		0.3
4174											1.28	1.47	0.047		33.9		0.3

LAB NO	CLAY MINERALOGY SM	VR	MI	IN	KK	GI	QZ	FD	CA	SKELETAL MINERALOGY QZ	FD	CA
4165												
4166										***		**
4167												
4168										***		**
4169												
4170										***		**
4171												
4172												
4173												
4174												

SM=SMECTITE VR=VERMICULITE MI=MICA IN=INTERSTRATIFIED
KK=KAOLINITE GO=GOETHITE QZ=QUARTZ FD=FELDSPAR CA=CALCITE
T=TRACE *=0-10% **=10-50% ***=GREATER THAN 50%

SOIL CHARACTERIZATION LABORATORY
SOIL AND CROP SCIENCES DEPT., THE TEXAS AGRICULTURAL EXPERIMENT STATION

SOIL SERIES: BOSQUE | PEDON NUMBER: S90TX-099-009
SOIL FAMILY:
LOCATION:

LAB NO	PARTICLE SIZE DISTRIBUTION (CLAY-FREE BASIS)													
	SAND						SILT			RATIOS				
	VCS	C	M	F	VF	TOTAL	C	F	TOTAL	S/SI	FSI/CSI	VFS/FS	FC/TC	CEC/CLAY
	%													
4165	0.5	0.7	8.7	28.7	22.4	61.1	15.6	23.3	38.9	1.6	1.5	0.8	0.5	0.74
4166	0.5	2.2	9.2	26.4	19.2	57.5	15.9	26.6	42.5	1.4	1.7	0.7	0.5	0.84
4167	0.1	0.8	5.6	29.5	24.7	60.7	12.9	26.4	39.3	1.5	2.0	0.8	0.5	0.66
4168	0.0	0.9	7.1	32.5	24.4	64.8	9.9	25.3	35.2	1.8	2.6	0.8	0.6	0.57
4169	0.1	0.5	4.0	28.2	26.9	59.8	11.5	28.7	40.2	1.5	2.5	1.0	0.6	0.55
4170	0.3	0.4	5.2	25.9	27.4	59.1	15.6	25.3	40.9	1.4	1.6	1.1	0.6	0.52
4171	0.0	0.3	2.6	22.8	29.4	55.0	19.8	25.2	45.0	1.2	1.3	1.3	0.6	0.54
4172	0.1	0.3	1.6	20.4	29.0	51.4	19.4	29.2	48.6	1.1	1.5	1.4	0.6	0.53
4173	0.1	0.5	4.0	22.1	23.4	50.2	18.3	31.5	49.8	1.0	1.7	1.1	0.6	0.55
4174	0.0	0.6	7.0	27.4	22.1	57.1	16.2	26.7	42.9	1.3	1.6	0.8	0.6	0.53

Soil Series: Bosque Variant
Pedon: S90TX-099-004
Pedon Classification: Typic Ustifluvents, coarse-loamy, carbonatic, thermic
Location: **TR5**, Cowhouse Creek, Fort Hood, Coryell County, Texas
Landform: T0
Parent Material: Carbonatic Alluvium
Stratigraphic Unit: Ford Alluvium (E)
Topography: 0 to 1% slope
Collectors: Jacob and Korgel

Horizon	Depth (cm)	Soil description (colors for moist soil unless stated)
A	0-25	Brown (10YR 4/3) loam, grayish brown (10YR 5/2) dry; moderate coarse and very coarse angular blocky structure; hard; few fine pores; common fine and medium roots; many very fine carbonate clasts; moderately alkaline; strongly effervescent; clear smooth boundary.
2Bk1	25-57	Brown (10YR 4/3) fine sandy loam, brown (10YR 5/3) dry; weak coarse subangular blocky structure; very hard; few medium and coarse roots; few shell fragments; many worm casts; few mycelial carbonates; many fine carbonate clasts; moderately alkaline; strongly effervescent; clear smooth boundary.
2Bk1	57-75	Brown (10YR 4/3) fine sandy loam, yellowish brown (10YR 5/4) dry; weak medium subangular blocky structure; hard; few medium and coarse roots; few shell fragments; common to many mycelial carbonates; many fine carbonate clasts, few large limestone fragments and pebbles; moderately alkaline; strongly effervescent; clear smooth boundary.
3C	75-100	Yellowish brown (10YR 5/4) fine sandy loam, very pale brown (10YR 7/3) dry; structureless massive; slightly hard; few medium and coarse roots; common sand lenses; sands are dominantly carbonate; common discontinuous loamy strata within horizon; loamy strata has common mycelia carbonates; moderately alkaline; strongly effervescent; clear smooth boundary.
4Akb1	100-114	Brown (10YR 4/3) loam, yellowish brown (10YR 5/4) dry; moderate medium and coarse subangular blocky structure; slightly hard; few medium and coarse roots; common scattered charcoal fragments; common mycelial carbonates; moderately alkaline; strongly effervescent; clear smooth boundary.
5Bwb1	114-122	Yellowish brown (10YR 5/4) loam, very pale brown (10YR 7/3) dry; weak medium subangular blocky structure; soft; few medium and coarse roots; sand grains are dominantly carbonates; notable sand

		lenses; moderately alkaline; strongly effervescent; gradual smooth boundary.
6Akb2	122-143	Dark brown (10YR 3/3) loam, brown (10YR 4/3) dry; weak medium subangular blocky structure; hard; few medium and coarse roots; few shell fragments; common mycelial carbonates; moderately alkaline; strongly effervescent; clear smooth boundary.
7C1b2	143-171	Dark brown (10YR 3/3) fine sandy loam, brown (10YR 4/3) dry; weak coarse prismatic structure; slightly hard; few medium roots; sand grains are dominantly carbonates; common patchy areas of mycelial carbonates; common scattered charcoal fragments; 30% of horizon as 10YR 5/3 (10YR 7/3, dry) discontinuous sand lenses; moderately alkaline; strongly effervescent; clear smooth boundary.
8C2b2	171-220	Dark brown (10YR 3/3) loam, brown (10YR 4/3) dry; weak coarse prismatic parting to weak medium subangular blocky structure; hard; few medium roots; common sand lenses; common scattered charcoal fragments; common to many mycelial carbonates; moderately alkaline; strongly effervescent; clear smooth boundary.
9C3b2	220-237	Yellowish brown (10YR 5/4) very gravelly sandy loam, pale brown (10YR 6/3) dry; structureless massive; few medium roots; gravel and coarse sand lenses; gravels and sands are carbonates; moderately alkaline; strongly effervescent; clear smooth boundary.
10C4b2	237-266	Yellowish brown (10YR 5/4) sandy loam, pale brown (10YR 6/3) dry; structureless massive; slightly hard; no roots; coarse sand lenses; on top of horizon is a loamy strata with mycelial carbonates; moderately alkaline; strongly effervescent.

SOIL CHARACTERIZATION LABORATORY
SOIL AND CROP SCIENCES DEPT., THE TEXAS AGRICULTURAL EXPERIMENT STATION

SOIL SERIES: BOSQUE VARIANT — PEDON NUMBER: S90TX-099-004
SOIL FAMILY:
LOCATION:

LAB NO	DEPTH (CM)	HORIZON	PARTICLE SIZE DISTRIBUTION (MM) SAND VC (2.0-1.0)	SAND C (1.0-0.5)	SAND M (0.5-0.25)	SAND F (0.25-0.10)	SAND VF (0.10-0.05)	SAND TOTAL (2.0-0.05)	SILT FINE (0.02-0.002)	SILT TOTAL (0.05-0.002)	CLAY FINE (< 0.0002)	CLAY TOTAL (< 0.002)	TEXTURE CLASS	COARSE FRAG-MENTS %
			%											
4034	0- 25	A	0.5	0.9	5.8	20.9	19.9	48.0	19.3	32.6	12.1	19.4	L	0
4035	25- 57	2BK1	0.2	1.8	12.7	29.6	20.5	64.8	12.2	20.7	8.1	14.5	FSL	0
4036	57- 75	2BK2	0.0	0.3	3.6	29.2	27.5	60.6	12.3	23.4	10.2	16.0	FSL	0
4037	75-100	3C	0.1	3.1	15.5	34.5	21.4	74.6	8.7	12.6	7.6	12.8	FSL	0
4038	100-114	4AKB1	0.1	3.0	16.0	17.1	14.0	50.2	18.0	30.6	11.2	19.2	L	0
4039	114-122	5BWB1	0.6	11.3	37.0	22.8	7.9	79.6	8.1	11.1	6.1	9.3	LS	0
4040	122-143	6AKB2	0.1	0.9	8.0	15.9	18.3	43.2	20.0	32.2	14.9	24.7	L	0
4041	143-171	7C1B2	0.1	1.2	13.6	33.5	14.9	63.3	14.0	21.1	8.9	15.6	FSL	0
4042	171-220	8C2B2	0.3	1.7	10.1	19.5	16.5	48.1	20.1	31.0	11.6	20.9	L	0
4043	220-237	9C3B2	5.7	15.7	25.9	17.1	8.3	72.7	11.0	14.0	7.3	13.3	SL	41
4044	237-266	10C4B2	1.4	8.5	24.5	19.3	10.5	64.2	13.3	21.2	8.8	14.6	SL	0

LAB NO	ORGN C %	PH (H2O) 1:1	NH4OAC EXTR BASES CA	MG	NA	K	TOTAL	KCL EXTR AL	NAOAC CEC	ECEC	BASE SAT	ESP	SAR	CAL-CITE	DOLO-MITE	CACO3 EQ	GYP SUM
			MEQ/100G								%			%			
4034	1.09	8.2	43.1	2.1	0.1	1.0	46.3		16.2		100	1		43.3	0.0	43.3	
4035	0.64	8.5	36.3	1.6	0.1	0.7	38.7		10.1		100	1		49.4	0.0	49.4	
4036	0.54	8.5	37.1	2.0	0.1	0.7	40.0		11.0		100	1		42.4	0.0	42.4	
4037	0.34	8.5	33.6	1.6	0.1	0.5	35.8		8.3		100	1		55.0	0.0	55.0	
4038	0.59	8.3	36.6	2.3	0.1	0.6	39.6		14.2		100	1		58.7	0.0	58.7	
4039	0.30	8.5	31.2	1.4	0.1	0.2	32.9		5.9		100	2		76.0	0.0	76.0	
4040	0.65	8.2	51.0	2.7	0.1	0.4	54.2		16.6		100	1		43.9	0.0	43.9	
4041	0.32	8.4	43.8	1.7	0.1	0.2	45.9		9.0		100	1		62.3	0.0	62.3	
4042	0.66	8.4	49.3	2.5	0.2	0.4	52.4		12.6		100	2		56.3	0.0	56.3	
4043	0.41	8.2	42.9	1.8	0.2	0.2	45.1		7.7		100	3		72.0	0.0	72.0	
4044	0.57	8.2	44.3	1.9	0.2	0.3	46.7		8.9		100	2		66.6	0.0	66.6	

SOIL CHARACTERIZATION LABORATORY
SOIL AND CROP SCIENCES DEPT., THE TEXAS AGRICULTURAL EXPERIMENT STATION

SOIL SERIES: BOSQUE VARIANT
SOIL FAMILY:
LOCATION:

PEDON NUMBER: S90TX-099-004

LAB NO	SATURATED PASTE EXTRACT: ELEC COND MMHOS/CM	H2O CONT %	CA	MG	NA	K	CO3	HCO3	CL	SO4	BULK DEN 0.33 BAR G/CC	BULK DEN AIR DRY G/CC	COLE CM/CM	WATER CONTENT 0.10 BAR WT%	WATER CONTENT 0.33 BAR WT%	WATER CONTENT 15 BAR WT%	CD FE %
			MEQ/L														
4034																	0.2
4035											1.29	1.58	0.070		30.0		0.2
4036																	0.2
4037																	0.2
4038																	0.2
4039																	0.2
4040																	0.3
4041																	0.2
4042											1.16	1.38	0.060		45.5		0.2
4043																	0.2
4044											1.01	1.23	0.068		50.9		0.2

LAB NO	CLAY MINERALOGY SM	VR	MI	IN	KK	GI	QZ	FD	CA	SKELETAL MINERALOGY QZ	FD	CA
4034	**		*		**		**		*			
4035	**		*		**		**		*	***		**
4036	**		*		**		**		*			
4037	**		*		**		**		*	***		**
4038	**		*		**		**		*			
4039												
4040	***		*		**		*		*	***		**
4041												
4042												
4043												
4044	**		*		**		**		*	***		**

SM=SMECTITE VR=VERMICULITE MI=MICA IN=INTERSTRATIFIED
KK=KAOLINITE GO=GOETHITE QZ=QUARTZ FD=FELDSPAR CA=CALCITE
T=TRACE *=0-10% **=10-50% ***=GREATER THAN 50%

SOIL CHARACTERIZATION LABORATORY
SOIL AND CROP SCIENCES DEPT., THE TEXAS AGRICULTURAL EXPERIMENT STATION

SOIL SERIES: BOSQUE VARIANT — PEDON NUMBER: S90TX-099-004
SOIL FAMILY:
LOCATION:

LAB NO	PARTICLE SIZE DISTRIBUTION (CLAY-FREE BASIS)									RATIOS				
	SAND						SILT							
	VCS	C	M	F	VF	TOTAL	C	F	TOTAL	S/SI	FSI/CSI	VFS/FS	FC/TC	CEC/CLAY
	%													
4034	0.6	1.1	7.2	25.9	24.7	59.6	16.5	23.9	40.4	1.5	1.4	1.0	0.6	0.83
4035	0.2	2.1	14.9	34.6	24.0	75.8	9.9	14.3	24.2	3.1	1.4	0.7	0.6	0.70
4036	0.0	0.4	4.3	34.8	32.7	72.1	13.3	14.6	27.9	2.6	1.1	0.9	0.6	0.69
4037	0.1	3.6	17.8	39.6	24.5	85.6	4.5	10.0	14.5	5.9	2.2	0.6	0.6	0.65
4038	0.1	3.7	19.8	21.2	17.3	62.1	15.6	22.3	37.9	1.6	1.4	0.8	0.6	0.74
4039	0.7	12.5	40.8	25.1	8.7	87.8	3.3	8.9	12.2	7.2	2.7	0.3	0.7	0.64
4040	0.1	1.2	10.6	21.1	24.3	57.4	16.2	26.6	42.8	1.3	1.6	1.2	0.6	0.67
4041	0.1	1.4	16.1	39.7	17.7	75.0	8.4	16.6	25.0	3.0	2.0	0.4	0.6	0.58
4042	0.4	2.2	12.8	24.7	20.9	60.8	13.8	25.4	39.2	1.6	1.8	0.8	0.6	0.60
4043	6.6	18.1	29.9	19.7	9.6	83.9	3.4	12.7	16.1	5.2	3.7	0.5	0.5	0.58
4044	1.6	10.0	28.7	22.6	12.3	75.2	9.2	15.6	24.8	3.0	1.7	0.5	0.6	0.61

Table Rock Creek

Soil Series: Not known
Pedon: S90TX-099-005
Pedon Classification: Petrocalcic Calciustolls, fine, montmorillonitic, thermic
Location: **TR12**, Table Rock Creek, Fort Hood, Coryell County, Texas
Landform: T2
Parent Material: Carbonatic Alluvium
Stratigraphic Unit: Jackson Alluvium (A)
Topography: 1% slope
Collectors: Jacob and Korgel

Horizon	Depth (cm)	Soil description (colors for moist soil unless stated)
A	0-7	Very dark gray (10YR 3/1), very dark grayish brown (10YR 3/2) dry, clay; moderate fine and medium subangular blocky structure; common fine and few medium roots; hard; clear smooth boundary.
Bss1	7-18	Dark reddish brown (5YR 3/3), brown (10YR 4/3) dry, clay; weak medium and coarse prismatic structure parting to moderate fine and medium angular blocky; common prominent pressure faces; very hard; common fine roots; clear smooth boundary.
Bss2	18-31	Dark reddish brown (5YR 3/3), brown (10YR 4/3) dry, clay; moderate coarse prismatic structure parting to moderate coarse and medium angular blocky and parallelepipeds; very hard; common fine roots along ped faces and through peds; common fine and medium angular limestone clasts; few flaky chert fragments; many distinct and prominent pressure faces and few faint slickensides; clear smooth boundary.
Bss3	31-55	Dark reddish brown (5YR 3/3), brown (10YR 4/3) dry, clay; moderate to strong coarse to very coarse prismatic structure parting to moderate coarse angular blocky and parallelepipeds; common medium and coarse angular limestone clasts; very hard; 60 to 80% of ped faces bounded by prominent grooved and intersecting slickensides dipping 20-30 degrees (measured) from the horizontal; abrupt smooth boundary.
2Bkm	55-83	Light brown (7.5YR 6/4), pink (7.5YR 7/4) dry, indurated material; 2-5 mm thick smooth laminar cap extends continuously across horizon with highly irregular topography; in places multiple laminar caps are separated by 2-5 cm 2Bkm material; dense laminations surround limestone gravels; clear smooth boundary.
2Ckm1	83-106	Strong brown (7.5YR 5/8), indurated gravelly layer; >70% limestone gravels; massive with faint to distinct bedding planes.
2Ckm2	106-130	White (10YR 8/1), massively bedded horizon; 20% limestone gravels.

REMARKS: A 1-5 cm thick coarse angular-gravel line lies between the Bss3 and 2Bkm horizons (some gravels are up 10 cm diameter). The gravel line (as well as the underlying laminar cap) follow an apparent channel dipping more than a meter. Common black pedotubules in all Bss horizons. All horizons above 2Bkm are non-calcareous.

SOIL CHARACTERIZATION LABORATORY
SOIL AND CROP SCIENCES DEPT., THE TEXAS AGRICULTURAL EXPERIMENT STATION

SOIL SERIES:
SOIL FAMILY:
LOCATION:

PEDON NUMBER: S90TX-099-005

LAB NO	DEPTH (CM)	HORIZON	SAND VC (2.0-1.0)	SAND C (1.0-0.5)	SAND M (0.5-0.25)	SAND F (0.25-0.10)	SAND VF (0.10-0.05)	SAND TOTAL (2.0-0.05)	SILT FINE (0.02-0.002)	SILT TOTAL (0.05-0.002)	CLAY FINE (< 0.0002)	CLAY TOTAL (< 0.002)	TEXTURE CLASS	COARSE FRAG-MENTS %
			%											
4045	0- 7	A	0.2	0.4	0.7	11.2	17.3	29.8	19.0	29.9	23.0	40.3	C	0
4046	7- 18	BW1	0.2	0.3	0.4	8.4	14.0	23.3	15.9	24.4	36.6	52.3	C	0
4047	18- 31	BW2	0.2	0.2	0.2	7.5	12.7	20.8	15.9	24.1	41.3	55.1	C	0
4048	31- 55	BW3	0.2	0.2	0.2	6.7	12.1	19.4	16.7	24.8	41.6	55.8	C	0
4049	55- 83	2BKM	13.2	13.7	12.9	14.2	7.7	61.7	14.2	18.2	12.5	20.1	SCL	0
4050	83-106	2CKM1	19.3	18.3	10.7	9.4	5.5	63.2	18.8	21.5	11.9	15.3	COSL	0

LAB NO	ORGN C %	PH (H2O) 1:1	NH4OAC EXTR BASES CA	MG	NA	K	TOTAL	KCL EXTR AL	NAOAC CEC	ECEC	BASE SAT	ESP	SAR	CAL-CITE	DOLO-MITE	CACO3 EQ	GYP SUM
			MEQ/100G								%			%			
4045	2.06	7.4	34.6	1.9	0.1	1.4	37.9		32.8		100	0	0	0.1	0.0	0.1	
4046	1.48	7.5	38.2	2.2	0.1	1.2	41.7		35.8		100	0	0	0.1	0.0	0.1	
4047	1.33	7.3	37.4	2.1	0.1	1.0	40.6		35.8		100	0		0.1	0.0	0.1	
4048	1.16	7.1	37.2	2.2	0.2	0.8	40.5		36.1		100	1		0.1	0.0	0.1	
4049	0.14	8.2	57.8	1.2	0.2	0.7	59.9		9.4		100	2		75.2	0.0	75.2	
4050	0.13	8.1	55.4	0.9	0.2	0.5	57.0		10.2		100	2		75.7	0.0	75.7	

LAB NO	SATURATED PASTE EXTRACT ELEC COND MMHOS/CM	H2O CONT %	CA	MG	NA	K	CO3	HCO3	CL	SO4	BULK DEN 0.33 BAR	BULK DEN AIR DRY	COLE CM/CM	WATER CONTENT 0.10 BAR	WATER CONTENT 0.33 BAR	WATER CONTENT 15 BAR	CD FE %
			MEQ/L								G/CC			WT%			
4045	0.4	70	3.3	0.2	0.2	0.1	0.0	1.3	0.2	0.3							1.0
4046	0.3	80	2.9	0.2	0.2	0.1	0.0	1.3	0.2	0.2							1.6
4047											1.25	1.86	0.142		38.1		1.6
4048											1.27	1.80	0.123		35.4		1.6
4049																	0.4
4050																	0.5

SOIL CHARACTERIZATION LABORATORY
SOIL AND CROP SCIENCES DEPT., THE TEXAS AGRICULTURAL EXPERIMENT STATION

SOIL SERIES:
SOIL FAMILY:
LOCATION:

PEDON NUMBER: S90TX-099-005

LAB	CLAY MINERALOGY									SKELETAL MINERALOGY		
NO	SM	VR	MI	IN	KK	GI	QZ	FD	CA	QZ	FD	CA
4045												
4046	**		*		**		**					
4047	**		*		**		**					
4C48												
4049	**		*		**		*		*			
4050												

SM=SMECTITE VR=VERMICULITE MI=MICA IN=INTERSTRATIFIED
KK=KAOLINITE GO=GOETHITE QZ=QUARTZ FD=FELDSPAR CA=CALCITE
T=TRACE *=0-10% **=10-50% ***=GREATER THAN 50%

SOIL CHARACTERIZATION LABORATORY
SOIL AND CROP SCIENCES DEPT., THE TEXAS AGRICULTURAL EXPERIMENT STATION

SOIL SERIES:
SOIL FAMILY:
LOCATION:

PEDON NUMBER: S90TX-099-005

LAB NO	PARTICLE SIZE DISTRIBUTION (CLAY-FREE BASIS) SAND						SILT			RATIOS				
	VCS	C	M		VF	TOTAL	C	F	TOTAL	S/SI	FSI/CSI	VFS/FS	FC/TC	CEC/CLAY
	%													
4045	0.3	0.7	1.2	18.8	29.0	49.9	18.3	31.8	50.1	1.0	1.7	1.5	0.6	0.81
4046	0.4	0.6	0.8	17.6	29.4	48.8	17.9	33.3	51.2	1.0	1.9	1.7	0.7	0.68
4047	0.4	0.4	0.4	16.7	28.3	46.3	18.3	35.4	53.7	0.9	1.9	1.7	0.7	0.65
4048	0.5	0.5	0.5	15.2	27.4	43.9	18.3	37.8	56.1	0.8	2.1	1.8	0.7	0.65
4049	16.5	17.1	16.1	17.8	9.6	77.2	5.0	17.8	22.8	3.4	3.6	0.5	0.6	0.47
4050	22.8	21.6	12.6	11.1	6.5	74.6	3.2	22.2	25.4	2.9	6.9	0.6	0.8	0.66

Soil Series: Lewisville Variant
Pedon: S90TX-099-007
Pedon Classification: Pachic Calcuistolls, fine-loamy, mixed, thermic
Location: **TR9**, Table Rock Creek, Fort Hood, Coryell County, Texas
Landform: T1a
Parent Material: Carbonatic Alluvium
Stratigraphic Unit: Fort Hood Alluvium (C)
Topography: nearly level
Collectors: Jacob and Nordt

Horizon	Depth (cm)	Soil description (colors for moist soil unless stated)
A	0-20	Very dark brown (10YR 2/2) clay loam; moderate very fine and fine subangular blocky structure; many sand-sized carbonate clasts; common snail shells; many earthworm casts; few fine and medium pores; many fine and medium roots; friable; gradual smooth boundary.
AB	20-36	Very dark brown (10YR 2/2) clay loam; weak coarse prismatic parting to moderate fine and medium subangular blocky structure; many sand-sized carbonate clasts; common fine and medium roots; slightly firm; clear smooth boundary.
BA	36-61	Very dark grayish brown (10YR 3/2) dry clay loam, dark brown (10YR 3/3) dry; weak coarse prismatic structure parting to moderate medium and coarse subangular blocky structure; many sand-sized carbonate clasts; few snail shells; common faint pressure faces; common fine and medium roots; few fine and medium pores; hard; clear smooth boundary.
BAk	61-78	Dark brown (10YR 3/3), brown (10YR 4/3) dry clay loam; weak medium and coarse prismatic parting to moderate fine and medium angular blocky structure; common sand-sized carbonate clasts; common snail shells; few coarse and very coarse angular limestone fragments; few matted mycelial carbonates; few fine and medium roots; few fine and medium pores; hard to very hard; clear smooth boundary.
Bk1	78-99	Dark yellowish brown (10YR 4/4) clay loam; moderate fine and medium prismatic parting to moderate medium angular and subangular blocky structure; common pressure faces; common fine matted mycelial carbonates; few stained and encrusted carbonate threads along root channels; few snail shells; few fine and medium roots; hard; gradual smooth boundary.
Bk2	99-134	Dark brown (7.5YR 3/2.5), dark yellowish brown (10YR 4/4) dry clay loam; moderate fine and medium prismatic parting to strong medium angular blocky structure; many threads of calcium carbonate in a

		reticulate pattern, 50% are stained and encrusted, 50% are 'matted' mycelial; few snail shells; slightly hard; clear smooth boundary.
Bk3	134-182	Dark yellowish brown (10YR 4/4) silty clay loam; weak medium and coarse prismatic parting to moderate medium subangular blocky structure; many stained and encrusted carbonate threads along root channels (no mycelia observed); few coarse limestone clasts; few snail shells; few fine roots; hard to very hard; clear smooth boundary.
2BCk	182-210	Dark yellowish brown (10YR 4/4) sandy clay loam; weak coarse subangular blocky structure; common encrusted reticulated carbonate threads throughout matrix; common medium limestone clasts; hard; clear smooth boundary.
2CBk	210-252	Dark yellowish brown (10YR 4/4) sandy clay loam; very weak coarse subangular blocky structure; common encrusted carbonate threads; common limestone gravels; very hard; clear smooth boundary.
3C	252-162	Yellowish brown (10YR 5/6) sandy loam; massive; loose to slightly friable; sand grains are dominantly carbonates.

SOIL CHARACTERIZATION LABORATORY
SCIL AND CROP SCIENCES DEPT., THE TEXAS AGRICULTURAL EXPERIMENT STATION

SOIL SERIES:
SOIL FAMILY:
LOCATION:

PEDON NUMBER: S90TX-099-007

LAB NO	DEPTH (CM)	HORIZON	SAND VC (2.0-1.0)	SAND C (1.0-0.5)	SAND M (0.5-0.25)	SAND F (0.25-0.10)	SAND VF (0.10-0.05)	SAND TOTAL (2.0-0.05)	SILT FINE (0.02-0.002)	SILT TOTAL (0.05-0.002)	CLAY FINE (< 0.0002)	CLAY TOTAL (< 0.002)	TEXTURE CLASS	COARSE FRAG-MENTS %
			PARTICLE SIZE DISTRIBUTION (MM) %											
4062	0- 20	A	0.4	0.6	1.9	9.4	13.4	25.7	22.0	35.1	17.7	39.2	CL	0
4063	20- 36	AB	0.3	1.0	3.1	12.7	13.9	31.0	21.1	30.2	22.0	38.8	CL	0
4064	36- 61	BA	0.3	1.1	3.4	13.7	13.1	31.6	19.2	29.8	21.2	38.6	CL	0
4065	61- 78	BAK	0.3	1.1	3.6	15.9	15.1	36.0	20.4	28.1	18.3	35.9	CL	0
4066	78- 99	BK1	0.2	0.8	2.4	12.8	15.0	31.2	21.3	30.9	20.1	37.9	CL	0
4067	99-134	BK2	0.3	0.9	2.4	12.6	16.2	32.4	23.0	31.0	19.9	36.6	CL	0
4068	134-182	BK3	0.4	1.6	4.8	17.0	19.3	43.1	18.8	28.6	15.7	28.3	CL	0
4069	182-210	2BCK	1.8	3.9	8.7	19.9	14.6	48.9	18.6	26.6	14.0	24.5	SCL	3
4070	210-252	2CBK	1.4	5.2	14.3	26.1	12.4	59.4	13.8	21.8	10.6	18.8	FSL	3
4071	252-262	3C	2.3	7.3	15.3	24.1	11.5	60.5	13.5	21.1	10.9	18.4	FSL	4

LAB NO	ORGN C %	PH (H2O) 1:1	NH4OAC EXTR BASES CA	MG	NA	K	TOTAL	KCL EXTR AL	NAOAC CEC	ECEC	BASE SAT	ESP	SAR	CAL-CITE	DOLO-MITE	CACO3 EQ	GYP SUM
			MEQ/100G								%	%		%			
4062	2.59	7.9	67.9	2.0	0.1	1.8	71.7		33.2		100	0	0	18.1	0.0	18.1	
4063	1.34	8.0	59.1	1.5	0.1	1.1	61.8		25.0		100	0	0	29.6	0.0	29.6	
4064	0.75	8.2	65.4	1.1	0.1	0.9	67.6		21.3		100	0		38.2	0.0	38.2	
4065	0.56	8.2	55.8	1.0	0.1	0.7	57.7		17.4		100	1		41.9	0.0	41.9	
4066	0.87	8.2	55.7	1.0	0.1	0.8	57.6		18.5		100	1		37.5	0.0	37.5	
4067	0.56	8.3	54.8	1.3	0.1	0.8	57.1		17.6		100	1		35.0	0.0	35.0	
4068	0.28	8.4	50.5	1.4	0.1	0.7	52.7		13.7		100	1		41.5	0.0	41.5	
4069	0.56	8.4	52.0	1.9	0.1	0.6	54.6		11.7		100	1		48.9	0.0	48.9	
4070	0.12	8.5	46.6	1.7	0.1	0.5	48.9		9.7		100	1		59.4	0.0	59.4	
4071	0.39	8.4	44.4	1.7	0.1	0.5	46.7		9.3		100	1		57.3	0.0	57.3	

SOIL CHARACTERIZATION LABORATORY
SOIL AND CROP SCIENCES DEPT., THE TEXAS AGRICULTURAL EXPERIMENT STATION

SOIL SERIES:
SOIL FAMILY:
LOCATION:

PEDON NUMBER: S90TX-099-007

LAB NO	SATURATED PASTE EXTRACT: ELEC COND MMHOS/CM	H20 CONT %	CA (MEQ/L)	MG (MEQ/L)	NA (MEQ/L)	K (MEQ/L)	CO3 (MEQ/L)	HCO3 (MEQ/L)	CL (MEQ/L)	SO4 (MEQ/L)	BULK DEN 0.33 BAR G/CC	BULK DEN AIR DRY G/CC	COLE CM/CM	WATER CONTENT 0.10 BAR WT%	WATER CONTENT 0.33 BAR WT%	WATER CONTENT 15 BAR WT%	CD FE %
4062	0.5	71	4.3	0.2	0.1	0.2	0.0	3.7	0.3	0.3	1.26	1.58	0.078		30.2		0.5
4063	0.4	62	4.2	0.2	0.1	0.1	0.0	4.1	0.1	0.2	1.30	1.65	0.083		30.1		0.5
4064											1.21	1.54	0.084		37.2		0.4
4065											1.33	1.61	0.066		32.0		0.4
4066											1.35	1.63	0.065		29.5		0.5
4067											1.36	1.69	0.075		30.3		0.4
4068											1.42	1.66	0.053		27.8		0.4
4069											1.37	1.59	0.051		27.8		0.3
4070											1.32	1.53	0.050		29.7		0.3
4071																	0.3

LAB NO	CLAY MINERALOGY: SM	VR	MI	IN	KK	GI	QZ	FD	CA	SKELETAL MINERALOGY: QZ	FD	CA
4062												
4063												
4064	**		**		**		*		**			
4065												
4066	**		**		**		*		**			
4067												
4068												
4069	**		**		**		*		**			
4070												
4071												

SM=SMECTITE VR=VERMICULITE MI=MICA IN=INTERSTRATIFIED
KK=KAOLINITE GO=GOETHITE QZ=QUARTZ FD=FELDSPAR CA=CALCITE
T=TRACE *=0-10% **=10-50% ***=GREATER THAN 50%

SOIL CHARACTERIZATION LABORATORY
SOIL AND CROP SCIENCES DEPT., THE TEXAS AGRICULTURAL EXPERIMENT STATION

SOIL SERIES:
SOIL FAMILY:
LOCATION:

PEDON NUMBER: S90TX-099-007

LAB NO	PARTICLE SIZE DISTRIBUTION (CLAY-FREE BASIS)													
	SAND						SILT			RATIOS				
	VCS	C	M	F	VF	TOTAL	C	F	TOTAL	S/SI	FSI/CSI	VFS/FS	FC/TC	CEC/CLAY
	%													
4062	0.7	1.0	3.1	15.5	22.0	42.3	21.5	36.2	57.7	0.7	1.7	1.4	0.5	0.85
4063	0.5	1.6	5.1	20.8	22.7	50.7	14.8	34.5	49.3	1.0	2.3	1.1	0.6	0.64
4064	0.5	1.8	5.5	22.3	21.3	51.5	17.2	31.3	48.5	1.1	1.8	1.0	0.5	0.55
4065	0.5	1.7	5.6	24.8	23.6	56.2	12.0	31.8	43.8	1.3	2.6	1.0	0.5	0.49
4066	0.3	1.3	3.9	20.6	24.2	50.2	15.5	34.3	49.8	1.0	2.2	1.2	0.5	0.49
4067	0.5	1.4	3.8	19.9	25.6	51.1	12.6	36.3	48.9	1.0	2.9	1.3	0.5	0.48
4068	0.6	2.2	6.7	23.7	26.9	60.1	13.7	26.2	39.9	1.5	1.9	1.1	0.6	0.49
4069	2.4	5.2	11.5	26.4	19.3	64.8	10.6	24.6	35.2	1.8	2.3	0.7	0.6	0.48
4070	1.7	6.4	17.6	32.1	15.3	73.2	9.8	17.0	26.8	2.7	1.7	0.5	0.6	0.51
4071	2.8	8.9	18.8	29.5	14.1	74.1	9.4	16.5	25.9	2.9	1.8	0.5	0.6	0.51

Appendix J
Radiocarbon Assay

Location[1]	Stratigraphic Unit[2]	Lab Number[3]	Age[4]	Materials
Cowhouse Creek				
TR18	E	Beta-37008	190 ± 90	charcoal-hearth
CB7	E	TX-6697	300 ± 100	charcoal-dispersed
CB5	E	TX-6699	370 ± 180	charcoal-dispersed
CB3	E	Beta-38177	390 ± 60	wood
CB13a	D2	TX-6700	600 ± 140	charcoal-hearth
CB4	D2	TX-6701	650 ± 160	charcoal-hearth
CB14	D2	Beta-38174	1500 ± 60	charcoal-dispersed
CB16	D2	Beta-37450	1690 ± 90	charcoal-hearth (pair)
CB16	D2	Beta-47050	2080 ± 70	bulk soil humate (pair-rejected)
CB18	D2	Beta-37156	1820 ± 80	charcoal-hearth
CB4	D2	Beta-38175	2140 ± 110	bulk sediment humate
CB1	D2	TX-6702	2380 ± 150	charcoal-dispersed (pair)
CB1	D2	Beta-46186	3380 ± 70	bulk sediment humate (pair-rejected)
CB17	D1	Beta-37451	2720 ± 110	charcoal-hearth
CB13a	D2	Beta-38173	2860 ± 50	charcoal-dispersed
TR11	D1	TX-6703	3010 ± 110	charcoal-hearth
CB13b	D2	Beta-46191	3320 ± 60	bulk sediment humate
CB1	D1	Beta-38176	3580 ± 100	bulk humate (rejected)
CB13a	D1	TX-6704	3950 ± 290	charcoal-dispersed
CB1	D1	Beta-46189	3980 ± 60	bulk soil humate
CB9	D1	TX-6705	4170 ± 100	charcoal-dispersed
CB13b	D1	Beta-46190	4280 ± 80	bulk soil humate
CB12	C	Beta-37452	5210 ± 230	charcoal-hearth
CB1	C	Beta-46188	5210 ± 70	bulk soil humate
CB15	C	GX-15892	5740 ± 300	charcoal-midden
CB15	C	Beta-46192	5820 ± 110	bulk sediment humate-hearth
CB6	C	Beta-37618	6850 ± 90	charcoal-dispersed (pair)
CB6	C	Beta-47049	7610 ± 80	bulk sediment humate (pair-rejected)
CB1	C	Beta-46187	9220 ± 130	bulk sediment humate
CB2	B	Beta-38938	9830 ± 100	bulk soil humate
CB10	A	Beta-38694	15270 ± 260	bulk sediment humate
Table Rock Creek				
CB5	E	Beta-37023	480 ± 80	charcoal-dispersed
CB6	E	Beta-37448	710 ± 260	charcoal-hearth
CB2	D2	TX-6698	1250 ± 110	charcoal-midden
CB7	D2	Beta-45984	2290 ± 70	bulk sediment humate
CB1	C	TX-6696	4680 ± 90	charcoal-hearth (duplicate)
CB1	C	Beta-38179	4840 ± 70	charcoal-hearth (duplicate)
CB3	C	Beta-38939	6070 ± 90	bulk sediment humate
CB4	C	Beta-45983	9320 ± 120	bulk sediment humate
CB4	B	GX-15762	8260 ± 100	charcoal-hearth (pair)
CB4	B	Beta-45982	10060 ± 80	bulk soil humate (pair-rejected)

Location[1]	Stratigraphic[2] Unit	Lab Number[3]	Age[4]	Materials
Owl Creek				
CB4	E	GX-15793	109 ± 53	charcoal-dispersed(rejected)
CB2a	E	Beta-37449	330 ± 80	charcoal-dispersed
TR3	D2	Beta-37016	750 ± 80	charcoal-dispersed
CB7	D2	GX-15761	890 ± 51	charcoal-hearth
CB5	D1	Beta-38178	2130 ± 140	bulk soil humate
CB2b	D1	Beta-42542	4190 ± 100	bulk sediment humate
CB6	B	GX-15763	11325 ± 150	bulk soil humate
House Creek				
CB3	D1	Beta-45981	2020 ± 70	bulk sediment humate
CB2	B	Beta-45980	8050 ± 100	bulk soil humate
Henson Creek				
CB4	E	Beta-37009	420 ± 70	charcoal-dispersed
CB6	D2	Beta-37011	1300 ± 80	charcoal-hearth
Impact Area[5]	D2	Beta-44297	1650 ± 80	bulk sediment humate
Impact Area[5]	B	Beta-44298	9110 ± 100	bulk soil humate
Reese Creek				
TR2	E	Beta-37020	130 ± 60	charcoal-dispersed
CB1	D2	Beta-37021	650 ± 90	charcoal-hearth
Leon River				
CB1	E	Beta-38696	190 ± 60	charcoal-dispersed(rejected)
CB2	E	Beta-38695	610 ± 50	charcoal-midden
CB1	D2	Beta-42541	1010 ± 70	bulk soil humate
CB1	D2	GX-15794	1936 ± 51	charcoal-hearth
CB3	C	GX-15760	8616 ± 92	charcoal-hearth
TR6	B(?)	GX-15759	940 ± 59	charcoal-dispersed(rejected)

1 CB - cutbank locality; TR - trench locality; see geomorphic maps for locations.

2 E - Ford alluvium; D - West Range alluvium; C - Fort Hood alluvium; B - GXrgetown alluvium; A - Jackson alluvium.

3 Beta = Beta Analytic Inc.; TX = University of Texas Radiocarbon Laboratories; GX = Geochron Laboratories Division

4 Radiocarbon ages in years before present (B.P.); $\delta\ ^{13}C$ corrected.

5 Not formally described in this report.