

Chapter Two: Resource Description

CHAPTER OVERVIEW

Chapter two describes the special resources of the Waco Mammoth Site. A summary description of Pleistocene mammoths (genus *Mammuthus*) is presented to provide context for the resource type, followed by a description of each of the four fundamental resource components that together constitute the special resources of the Waco Mammoth Site.

PLEISTOCENE MAMMOTHS (*MAMMUTHUS*)

Mammoths are members of the order *Proboscidea*, and are related to the modern elephant, especially the Asiatic elephant (*Elephas maximus*). Mammoths lived in North America during the Pleistocene Epoch, a time period about 2,000,000 years in length that ended roughly 10,000 years ago.

Paleontologists theorize that representatives of the southern mammoth (*Mammuthus meridionalis*), which originated in Eurasia, migrated to North America from northeastern Siberia by way of the Bering Land Bridge during the early Pleistocene (at least 1.7 million years ago). In North America, the southern mammoth evolved into the imperial mammoth (*Mammuthus imperator*) during the middle Pleistocene. By the end of the middle Pleistocene, the Columbian mammoth (*Mammuthus columbi*) had evolved from the imperial mammoth. It became the largest of the three species, with a shoulder height reaching 12 to 14 feet. The Columbian mammoth preferred the more temperate to subtropical regions of the United States, Mexico, and Central America; fossils are found distributed across most of the North American continent. The Columbian mammoth is the species of mammoth found at the Waco Mammoth Site.

The woolly mammoth (*Mammuthus primigenius*) is smaller (10 feet at shoulder height) than the Columbian mammoth and is the most commonly recognized mammoth species by the general public. Similar to the Columbian mammoth, the woolly mammoth is a descendant of the southern mammoth, although the woolly mammoth evolved in Eurasia. Paleontologists theorize the woolly mammoth migrated to North America from Eurasia much later than the Columbian mammoth, approximately 35,000 and 18,000 years ago during the latter stages of the late Pleistocene.

Woolly mammoths typically inhabited the northern, colder regions of the continent, with a distribution mainly restricted to Alaska and Canada; however, remains have been discovered as far south as Kansas.

References can be found to yet another New World mammoth species, Jefferson's mammoth (*Mammuthus jeffersonii*), which has been found mostly around the Great Lakes region, although some paleontologists theorize this species to be synonymous with *Mammuthus columbi*.

The smallest of the New World mammoth species is the island dwelling pygmy mammoth (*Mammuthus exilis*). The remains of this creature have been found exclusively on San Miguel, Santa Rosa, and Santa Cruz Islands of Channel Islands National Park. Columbian mammoths originally inhabited the islands, but paleontologists theorize that over time and through a series of environmental stresses—such as shrinking habitat from rising sea levels during the end of the last Ice Age, overcrowding, and drought—natural selection favored smaller individuals, ultimately producing *Mammuthus exilis*. Evolving from Columbian mammoths, pygmy mammoths were considerably smaller (4–8

feet at shoulder height) than their predecessors.

All New World mammoths became extinct about 11,000 years ago. There is much debate on the cause of the late Pleistocene mammalian extinction, theories range from disease or Paleo-Indian predation, to climatic or environmental change.

To date, 24 Columbian mammoths have been discovered at the Waco Mammoth Site. Eighteen specimens have been excavated and removed, four have been partially excavated and remain *in situ*, one was encountered while taking soil core samples for a geologic study, while another was recently found within the northwest wall of the excavation pit after a storm event eroded a portion of the wall. The resources of the Waco Mammoth Site include four fundamental resource components: the geologic context of the discovery site, the *in situ* specimens, the collected specimens, and the associated archival records.

GEOLOGIC CONTEXT OF THE DISCOVERY SITE

The current understanding of the site's geological context, as presented by Baylor University's Dr. Lee Nordt during the study team's initial site visit in July 2005, is summarized as follows:

The site is located on the second and third terrace level above the Bosque River within a partially excavated wooded ravine containing highly erodible silt/clay soils. It appears the paleosols are 4–5 meters thick before encountering bedrock. The site is a freely drained environment, without a high water table. The site is unusual in that it is at the contact or border between two ecosystems represented on each side of the drainage. There are two terraces straddling the site that are composed of different sediments, derived from two different sources: The Bosque River and the Brazos River. The Bosque River only drains black land prairie soils, which are clay rich and contain mostly calcareous alluvium exclusively from a limestone source. In

contrast, the Brazos River drains some black land prairie soils but mostly siliceous based sediments containing quartzite and chert. Documenting the sequence of terrace deposits may potentially reveal an earlier confluence position of the Brazos and Bosque Rivers.



Aerial view looking SW over the Waco Mammoth Site

Initial dating efforts of the Waco Mammoth Site were attempted during the mid-1980s. Baylor University staff working with geochemist Dr. Herb Hass, Southern Methodist University, Texas, attempted radiocarbon dating on two samples; one sample was sent to Stafford Research Laboratories, Boulder, Colorado. The results of one sample came up inconclusive because it required the preservation of collagen, which unfortunately was not found. The second indicated a date of 28,000 years before present (BP); this then became the de facto date of the mammoth event. Pollen records for the area only go back 18,000 BP.

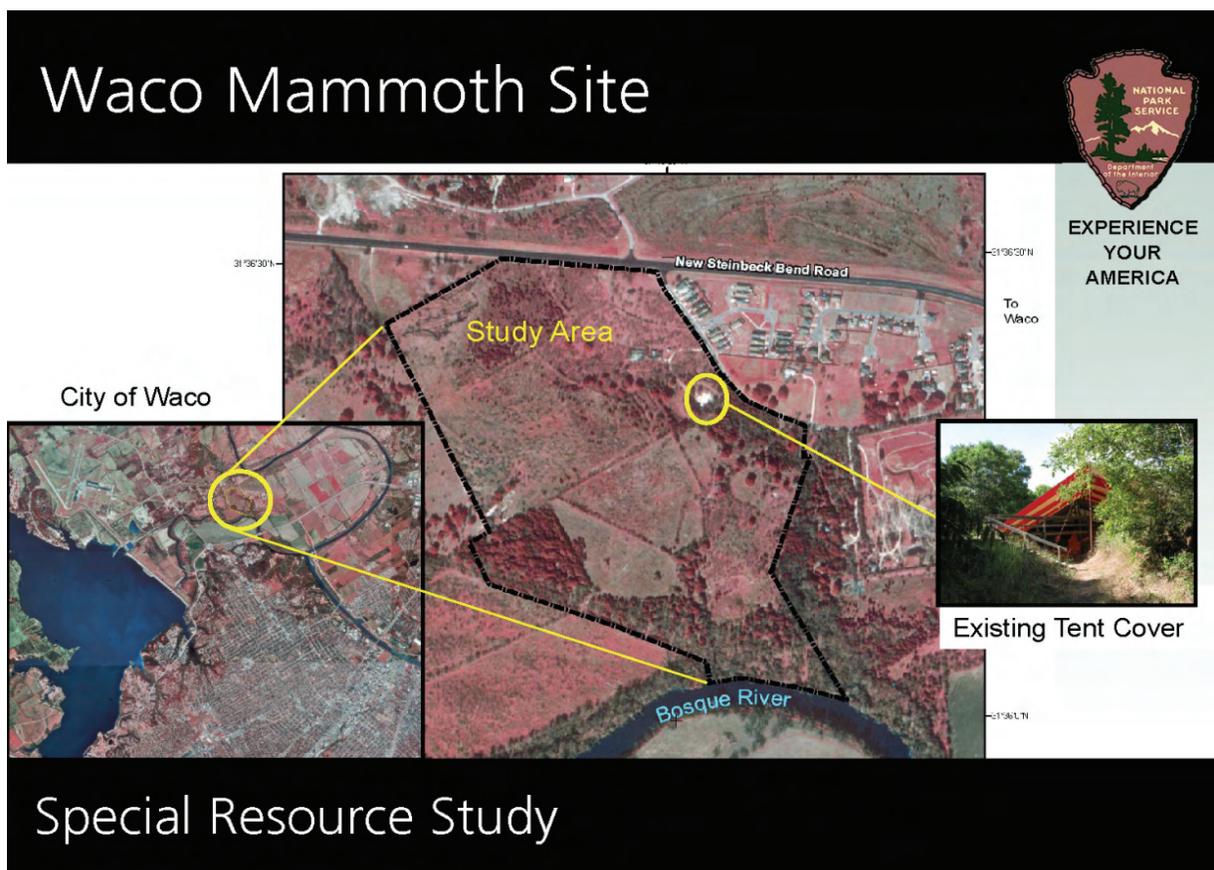
The estimated time of accumulation (28,000 BP) seemed too early based on the location of the mammoth herd within the terrace sequence. Another testing method was tried utilizing uranium series dating of the tooth enamel. The results of this test were not initially considered accurate because they were much older than the expected age of the site. Dr. Steve Foreman, University of Illinois, Chicago, was then contacted to attempt optically stimulated luminescence testing, a fairly new technique which dates the last time quartz deposits in the alluvial sediments were exposed to daylight. Samples were taken around, above, and below the mammoth bones. The technique indicated that it had

been 58,000–73,000 years since the deposits had been exposed. This additional testing led to a change in the interpretation of the age of the site to approximately 68,000 BP rather than 28,000 BP. This older date is what is currently presented in the Waco Mammoth Site exhibit in the Mayborn Museum Complex.

In an effort to determine the extent of the resource still buried at the site, ground-penetrating radar was attempted but proved unsuccessful primarily due to the lack of contrast between the densities of the soil and the mammoth bones.

The recent research conducted by John Bongino as a part of his masters' thesis completed in August 2007 through Baylor

University's Department of Geology has provided valuable additional information and interpretation of the soil stratigraphy and geologic context of the site. During the initial visit to the site by the study team, Mr. Bongino presented an overview of the research he was conducting to more accurately map the microstratigraphy of the site. He was attempting to provide a time line for the death of the mammoths, and confirm whether it was a single catastrophic event. His work has resulted in a refinement of the understanding of the circumstances surrounding the concentration of mammoths discovered there. His findings indicate that a herd of at least 19 adult female and juvenile mammoths succumbed in a single event, while also suggesting there were subsequent accumulations later in time.



IN SITU SPECIMENS

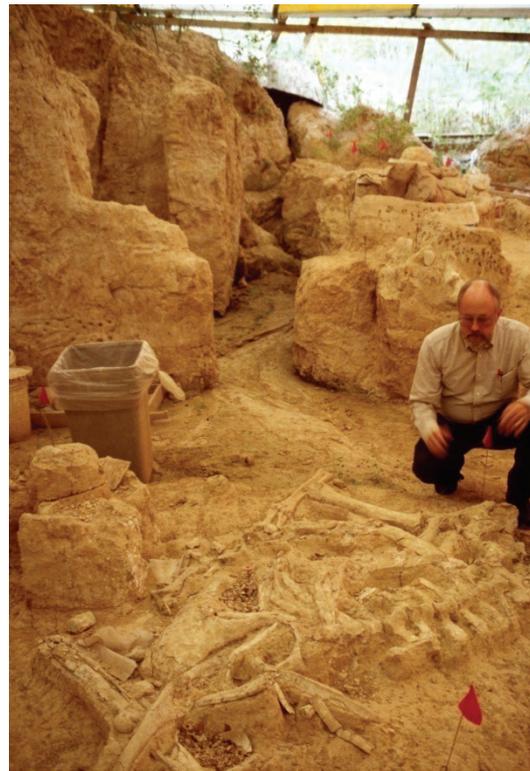
Under a 40' x100' tent structure that covers the upper part of the excavation area, the partially uncovered *in situ* material represents the remains of four Columbian mammoths (*Mammuthus columbi*): an almost complete skeleton of an adult bull, parts of a juvenile skeleton, the exposed skull of a female and its skeleton which has not been fully exposed, plus parts of other mammoth skeletons. In addition, there is a western camel (*Camelops hesternus*) skeleton, minus the skull, which was removed as a protective measure by Baylor University in 2005. Also, a deciduous canine tooth from a juvenile saber tooth cat (*cf. Smilodon*) was found in association with the remains of an unidentified animal whose bones are too small to be mammoth. Another mammoth was discovered 11 feet below the ground surface during subsurface coring 75 feet northeast of the covered, upper excavation area of the site, while another was recently found within the northwest wall of the upper excavation pit after a storm event eroded a portion of the wall.



Waco Mammoth Site upper excavation area, overlooking the in situ bull mammoth

The excavation pit retains a soil profile wall on three sides with a 9- to 10-foot depth to the pit floor on the upper end. On the open end, the pit connects with the initial discovery area or lower excavation area. Excavation efforts have been ongoing since 1978, when the bones were first discovered by Paul Barron and Eddie Bufkin who brought the find to the attention of David Lintz of Baylor University's Strecker

Museum. The initial excavation efforts took an archeological approach to the work based on a potential association with Paleo-Indians. Soil pillars in the upper portion of the site were left in place to retain a reference sample of the soil stratigraphy. All sediments removed were screened as part of the excavation process. Evidence of human activity was not found, shaping the current theory of the site as a natural event and not a kill site. The site is now known to predate the entrance of humans into North America.



Upper excavation area, in situ prehistoric camel



Dr. Greg McDonald, paleontologist and NPS Senior Curator of Natural History providing guidance on in situ specimen preservation.

COLLECTED SPECIMENS

Collected specimens are currently being stored in Baylor University's recently opened (May 2004) Mayborn Museum Complex. A majority of the specimens are from the lower, southwest section of the excavation area where 16 mammoth skeletons were collected during a mass removal in the 1990s as the exposed specimens were being threatened by stormwater runoff.



Waco Mammoth Site lower excavation area

Parts of a juvenile skeleton (specimen #18 in figure #1) over the bull's tusk were removed as part of the casting effort during the mid 1990s. The lower female (specimen #21) from the upper concentration was removed later after erosion threatened its integrity. The collection includes 18 articulated or semi-articulated remains of Columbian mammoths, a Western camel skull, a molar from a dwarf antelope (*cf. Capromeryx*), and a giant tortoise shell (*Geochelone sp.*). A majority of the larger parts of the specimens are encased in 93 plaster field jackets and have not been prepared.



Collection storage in Mayborn Museum Complex

Preparation efforts remain to be completed that would include establishing protocols and documentation methods; removing specimens from field jackets; removing sediment from the bones; hardening the bones by impregnating with plastic if needed; reassembling broken pieces; re-associating separated material with original specimens; documenting, cataloging, and placing prepared specimens in cabinets or on shelving; and making them available for study or for casting for interpretive exhibits. There are also 137 boxes of collected material from the site, 11 of which contain soil samples. Approximately 30%–40% of the boxes contain mammoth bones that were washed from the exposed skeletons during storm events in 1978, 1981, 1984, and 1986. Staff from the Mayborn Museum Complex are currently sorting specimens and attempting to associate them with specific skeletons.

ARCHIVAL RECORDS

The archival records include slides and photographs of the excavation efforts, field notes, field maps, stratigraphic cross sections, research files, correspondence, grant proposals, and other records pertaining to the site.

A condition assessment of the collections and archives was conducted in February 2006 by Dr. Greg McDonald, NPS senior curator of natural history. A copy is included in appendix B.

**Figure 1: Waco Mammoth Site
Plan Map**

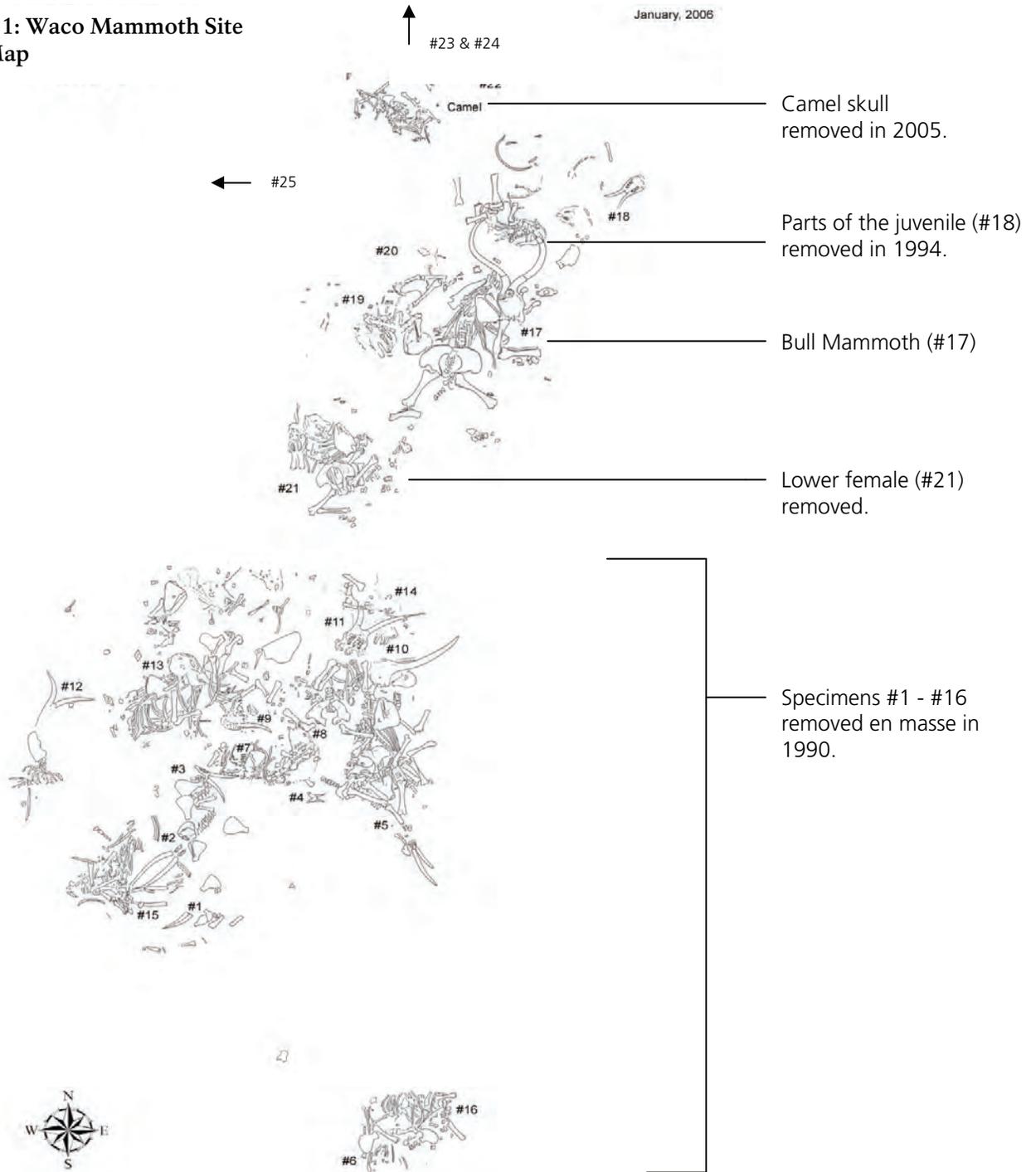


Figure 1 illustrates the original positions of 21 of the 24 known mammoth specimens and camel mapped by Ralph Vinson. Specimens #23, #24, and #25 have not as yet been recorded on the map. The female mammoth specimen #23 is only partially uncovered and located just north of the camel specimen #22. The 23rd mammoth (specimen #24) is approximately 75 feet northeast of the upper concentration and was encountered 11 feet below the ground surface during soil core sampling in 1996. This specimen has not been excavated. Bones from what appears to be the 24th mammoth (specimen #25) were partially revealed along the west wall after a storm event in 2007.

CHRONOLOGY OF EVENTS ASSOCIATED WITH THE WACO MAMMOTH SITE

Calvin Smith, who was the director of Baylor University's Strecker Museum from 1984 until his retirement in 2003, graciously provided a majority of the information regarding the years from 1978 through 2002 presented below.

- 1978 –1980** The remains of five Columbian mammoths were discovered by Eddie Bufkin and Paul Barron and excavated by David Lintz from the Strecker Museum and George Naryshkin of the Department of Geology at Baylor University.
- 1981 –1983** No excavation activities during this time.
- 1984** In February, three additional specimens were found eroding out of the bank.
- Under the direction of Calvin Smith, the newly appointed director of the Strecker Museum, excavations were begun in May expanding the discovery to a total of eleven mammoths by July.
- The first of many grants was received from the Cooper Foundation, \$2,500 to explore the size and scope of the site.
- A 5" rainfall inundated the site in October resulting in more animals being exposed.
- Another grant was received from the Cooper Foundation, \$26,800 to build a diversion dam, purchase and erect a tent over the excavated area, and to hire Ralph Vinson as the chief excavator and coordinator of the volunteer efforts.
- By December a total of 15 mammoths had been identified including a 45 year old female with a juvenile lying across her tusks.
- Dr. Gary Haynes visited the site for the first time and stated that it was "the largest concentration of extinct proboscideans to die from the same event known to science."
- 1985 –1986** Excavations of the specimens continued with only one additional mammoth discovered.
- 1987** At the request and encouragement of Dr. Haynes and with a \$10,500 grant from the Cooper Foundation, the Strecker Museum and Baylor University in conjunction with the Annual Meeting of the Texas Archaeological Society hosted the symposium, "Mammoths, Mastodons and Human Interaction" which had 500 attendees from across the country.
- 1990** Baylor initiated a mass removal of 16 specimens from the site, utilizing the assistance of numerous volunteers including the Dallas Paleontological Society and the Central Texas Archaeological Society, many students from Baylor University, and another grant from the Cooper Foundation of

\$16,975. The bones were placed in storage in Baylor University's Strecker Museum.

1991 Baylor University initiated additional explorations of the upper portion of the site. The herd bull that Dr. Haynes had predicted might be in the area was discovered with a juvenile over his right tusk. The Cooper Foundation provided additional grants of \$7,975, \$9,000, and \$17,800 during this period of time.

1992 *Proboscidean and Paleoindian Interactions* edited by J.W. Fox, C. B. Smith, and K.T. Wilkins, was published by Baylor University Press. The book is a compilation of papers presented at the 1987 symposium "Mammoths, Mastodons and Human Interaction" held in Waco, Texas. Included in this publication under chapter four is *Herd Bunching at the Waco Mammoth Site: Preliminary Investigations, 1978-1987*.

1994 Calvin Smith contacted Joe Taylor of Mt. Blanco Casting Company from Crosbyton, Texas to cast the bull and juvenile *in situ* so their relative positions could be recorded. After receiving another grant for \$14,300 from the Cooper Foundation, the largest field latex mold of an *in situ* specimen made to date was achieved between April 1st and June 3rd. This resulted in over 40 "mother molds" that could be separated and reassembled in the lab for the final process of pouring a fiberglass cast of the two specimens. The cast is currently exhibited in Baylor University's Mayborn Museum Complex, successor to the Strecker Museum.

The camel, the deciduous tooth from a saber-toothed cat, and the 22nd mammoth were discovered.

1996 Ground penetrating radar was attempted on areas surrounding the excavation site without success.

Sam Jack McGlasson donated 4.93 acres to the city of Waco (an area surrounding and including the excavation site). Conditions of the conveyance require the city to use the property for research, educational, and/or tourism purposes and for the city to enter into an agreement with Baylor University concerning the maintenance of the property as an educational resource for the citizens of Waco, visitors and researchers.

The 23rd Mammoth was discovered when a student doing soil core samples encountered what was believed to be a mammoth pelvis. This specimen is 75 feet from the upper excavation area and has not been excavated.

1997 Calvin Smith presented a paper on the site and its importance, to the 30th International Geological Congress in Beijing, China making it known to the global scientific community.

1999 The first development proposal for the site was commissioned by the city of Waco. The proposal recommended developing the site as a 200-acre regional park with recreational amenities, and included a master plan illustration for the site, building program, and cost estimates.

- 2000** A second development plan was produced and presented by Calvin Smith which included a modified program for the park, planning and funding goals, budget, time table, maps, and a proposal for a cooperative venture.
- With gifts from Buddy Bostick and Don and Pam Moes to Baylor University, 55 acres of land connecting the site with the Bosque River was purchased by Baylor University.
- 2001** With a major reduction by Liz McGlasson in the asking price for an additional 50 acres bordering Steinbeck Bend Road and with an additional gift from Buddy Bostick, Baylor University purchased the remaining land encompassing the site to extend the buffer around the excavated area.
- Congressman Chet Edwards introduced legislation to direct the secretary of the interior to conduct a special resource study of the Waco Mammoth Site.
- 2002** During the spring of 2002, the city commissioned a feasibility study of the resource by Lord Cultural Resources Planning and Management Inc. The effort included an analysis of conservation and preservation needs; potential visitor experience; space, facilities, and capital costs; governance and staffing; and market/financial analysis. Based on the recommendations of the study completed in June 2003, excavation efforts were discontinued and public access to the site was restricted to avoid resource degradation.
- On December 16, Public Law 107-341 authorized the special resource study for the Waco Mammoth Site.
- 2004** In May, Baylor University's Mayborn Museum Complex (former Strecker Museum) was opened to the public. The collection and archives from the Waco Mammoth Site were moved from the Strecker Museum into the geology/paleontology collections room of the new museum. A full room interpretive exhibit of the Waco Mammoth Site was presented in the Hall of Natural History. A dynamic walk-in diorama featuring a cast of the skeletal remains of the herd's bull with a juvenile cradled in its tusks can be viewed through a thick glass floor over the exhibit. A continuous loop film depicts what is believed to be the last moments of the herd's survival before they perished. Static and interactive interpretive displays on mammoths were presented as well, and remain to interpret the site.
- 2005** The camel skull was removed as a protective measure due to emerging drainage channels forming in the excavation pit from stormwater runoff.
- Baylor University graduate student John Bongino initiated research into the site's microstratigraphy. The goal of the study was to attempt to establish a timeline for the deaths of the mammoths, reconstruct the depositional history of the site, terrace formation, and the prehistoric relationship of the two river systems.
- Funding to initiate the special resource study was first made available.

- 2006** Congressman Edwards secured a \$200,000 grant through Save America's Treasures Program administered by the National Park Service for the purpose of replacing the tent and erecting a more durable shelter over the *in situ* specimens, enhancing site security, and making the site accessible to the public.
- Waco Mammoth Foundation chartered by the city of Waco and Baylor University. The foundation initiated a major fundraising campaign to support resource protection efforts and visitor access accommodations for the site.
- Design contract awarded to Coterra-Reed for the design of an excavation shelter to protect the *in situ* specimens and to provide for controlled public access to the Waco Mammoth Site.
- 2007** John Bongino completed his master thesis in August. His work has resulted in a refinement of the understanding of the circumstances surrounding the concentration of mammoths discovered there. His findings indicate that a herd of at least 19 adult female and juvenile mammoths succumbed in a single event, while also suggesting there were subsequent accumulations later in time.
- 2008** The Waco Mammoth Foundation succeeded in their fundraising efforts and collected over \$3 million dollars to support the construction of an excavation shelter and to accommodate visitor access to the site. The city of Waco's Department of Parks and Recreation is planning to contract for the construction in 2008.