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PALEONTOLOGIC ASSESSMENT OF THE ALAMEDA AVENUE/KIPLING STREET INTERCHANGE, LAKEWOOD, COLORADO

October 22, 2001

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Performed under State of Colorado Paleontological Permit 2001-22

SUMMARY

A paleontologic field survey of the Alameda Avenue/Kipling Street interchange in Lakewood, Colorado, was conducted on October 16, 2001. The study area lies at the intersection of Sections 9, 10, 15, and 16, T. 4 S., R. 69 W. (Figure 1). The boundaries of the paleontological study area were delineated on alignment diagrams and aerial photographs provided to Rocky Mountain Paleontology by Metcalf Archeological Consultants. Based on the project description, the proposed construction will mostly involve the existing grade, and excavations will not extend to a significant depth except for the 20' deep 3' diameter excavations needed to replace traffic signals.

The field survey consisted of a pedestrian inspection of the study area for 1) surface fossils, 2) exposures of potentially fossiliferous rocks, and 3) areas in which fossiliferous rocks or younger potentially fossiliferous surficial deposits could be exposed or otherwise impacted during construction. Prior to the field survey, literature and museum record searches were conducted in order to assess the paleontologic sensitivity of the study area and the geologic units present within it.

As mapped by Lindvall (1978), the study area contains two geologic units. These include the Pleistocene Verdos Alluvium and imported artificial fill. Both of these units have low paleontologic potential. The Upper Cretaceous and Paleocene Denver/Arapahoe Formations (undifferentiated on Lindvall's 1978 map), which have moderate and low paleontologic potential, respectively, may be present at a shallow depth near the western edge of the study area, but no evidence of these units occurs within it. Because the proposed construction involves only minimal excavations, it is unlikely that the Denver/Arapahoe Formations will be impacted by this project. The surficial deposits within the study area are poorly exposed due to the gentle terrain, vegetative cover, and existing roads and buildings.

No previously documented fossil occurrences from within the study area are recorded in the fossil locality databases of the University of Colorado Museum and the Denver Museum of Nature and Science, and none were found in the scientific literature. No fossils were found during the field survey for this study.

Based on the results of this study, immediate paleontologic clearance is recommended. Although unlikely, it is possible that scientifically significant fossils are present within the Verdos Alluvium, and could be impacted during construction. Because Pleistocene-aged bones may be only partially mineralized and are often superficially similar to modern bones, they can be difficult to distinguish. If any sub-surface bones or other potential fossils are found within the study area during construction, the CDOT staff paleontologist should be notified immediately to assess their significance.

SURVEY PROCEDURES

This study was conducted at the request of Metcalf Archeological Consultants, Inc., Eagle, Colorado. Prior to the field survey, literature and museum record searches were conducted in order to 1) determine whether any known fossil localities occur within the study area, 2) assess the potential for disturbance of these localities during construction, and 3) evaluate the paleontologic potential of the rock formations and/or surficial deposits within the study area. The museums included in the record search included the University of Colorado Museum (UCM), and the Denver Museum of Nature and Science (DMNS). The paleontologic field survey for this study was conducted on October 16, 2001. The study area lies at the intersection of Sections 9, 10, 15, and 16, T. 4 S., R. 69 W., at the Alameda Avenue and Kipling Street Interchange in Lakewood, Colorado (Figure 1). The boundaries of the paleontological study area were delineated on alignment diagrams and aerial photographs provided to Rocky Mountain Paleontology by Metcalf Archeological Consultants. According to the project description, most of the proposed construction will involve the existing grade, and excavations will not extend to a significant depth except for the 20' deep 3' diameter excavations needed to replace traffic signals. Therefore, subsurface disturbance will be minimal. The paleontologic field survey for this study consisted of a 100% pedestrian inspection of the study area for 1) surface fossils, 2) exposures of potentially fossiliferous rocks, and 3) areas in which fossiliferous rocks or younger potentially fossiliferous surficial deposits could be exposed or otherwise impacted during construction.

RESOURCE ASSESSMENT GUIDELINES

The paleontologic potential of the study area was evaluated using criteria proposed by the Society of Vertebrate Paleontology (Reynolds, 1995) and Raup (1987):

The Society of Vertebrate Paleontology (SVP) has developed standard guidelines for the assessment and mitigation of adverse impacts to nonrenewable paleontological resources (Reynolds, 1995). Notably, the SVP defines protection of paleontologic resources to include:

- "a) assessment of the potential for property to contain significant nonrenewable paleontologic resources which might be directly or indirectly impacted, damaged, or destroyed by development, and
- b) formulation and implementation of measures to mitigate adverse impacts, including permanent preservation of the site and/or permanent preservation of salvaged materials in established institutions."

Raup (1987) proposed the following criteria for the evaluation of paleontologic resources:

- Type 1: Formations known to produce large numbers of vertebrate fossils are considered to have high paleontologic potential.
- Type 2: Formations known to produce abundant numbers of invertebrate, plant, and trace fossils, but that rarely produce vertebrate fossils, are considered to have moderate paleontologic potential.

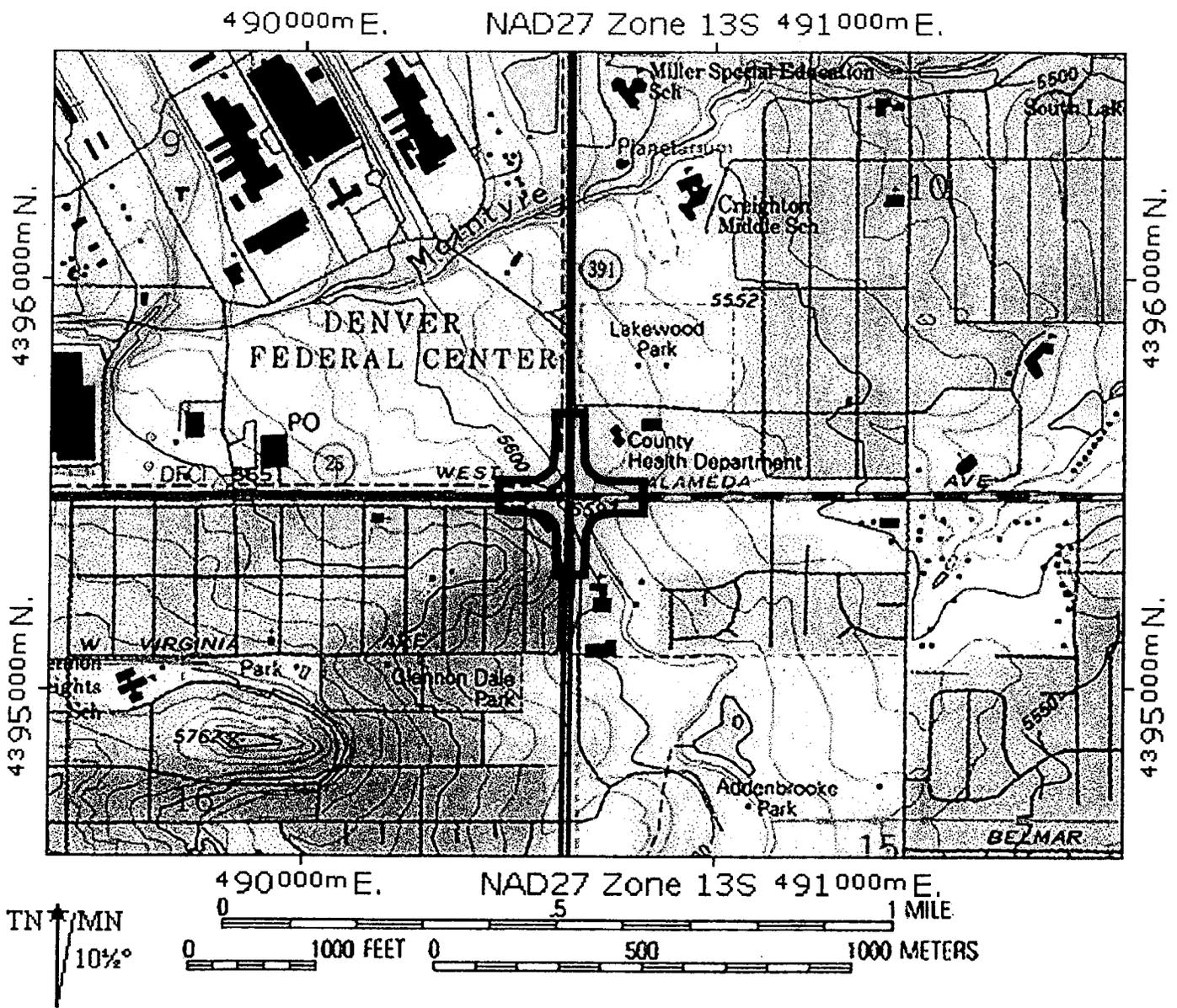


Figure 1. Map showing the approximate boundaries of the paleontological study area in red.

Type 3: Formations that only rarely produce fossils are considered to have low paleontologic potential.

In general, invertebrate, plant, and trace fossils occur in large numbers when they are found, are not considered as significant as relatively uncommon vertebrate fossils.

GEOLOGY AND PALEONTOLOGY

The study area contains two geologic units. These include the Verdos Alluvium and imported artificial fill (Lindvall, 1978). Both of these units have low paleontologic potential (Type 3 of Raup, 1987).

The Pleistocene Verdos Alluvium (Kansan) consists of light brown to reddish brown, poorly sorted stratified gravel, containing lenses of clay, silt, and sand (Lindvall, 1978) (Qv, Figure 2). Stones within it are mostly weathered and coated with calcium carbonate. This unit, which averages 15 feet in thickness but is as much as 30 feet thick, has been dated at approximately 600,000 years old based on its correlation with the Pearlette Ash of Kansas. A strongly developed calcium carbonate-enriched zone (relict soil) occurs in its upper part. Pleistocene-aged deposits, particularly alluvium, may contain mineralized or partially mineralized animal bones, invertebrates, and plant remains of paleontologic significance. In Colorado, the most common Pleistocene fossils include the bones of mammoth, bison, deer, and small mammals (Cook, 1930, 1931; Emslie, 1986; Hunt, 1954; Scott, 1963; unpublished UCM and DMNS collections data). In alluvial deposits, these fossils are mostly isolated and are relatively rare, and thus Pleistocene alluvium is typically considered to have low paleontologic potential (Type 3 of Raup, 1987). Specimens identified as fossil horse and camel have been found in the Verdos Alluvium (Scott, 1978; unpublished USGS fossil locality data), but it is considered to have low paleontologic potential because fossils are only rarely preserved within it.

The artificial fill consists of clay, silt, sand, gravel, and a variety of man-made debris which is generally 5 to 15 feet thick, and which is used in highway, building, and other construction projects (Lindvall, 1978) (af, Figure 2). It has no paleontologic potential.

SURVEY RESULTS

No fossils were found within the study area during the field survey for this study. Neither the UCM nor the DMNS have any records of fossil occurrences from within the study area, and no reports of fossils from within it were found in the scientific literature. No bedrock exposures are present, and the surficial deposits are poorly exposed due to the gentle terrain, vegetative cover, and existing roads and buildings. The Alameda Avenue/Kipling Street interchange is built mostly on imported artificial fill on top of, and surrounded by, Verdos Alluvium. The Upper Cretaceous and Paleocene Denver/Arapahoe Formations are mapped as being near the western edge of the study area (Lindvall, 1978), but there was no evidence of either of these formations within it. Because the proposed construction involves only minimal excavations, it is unlikely that bedrock Denver/Arapahoe Formations will be impacted.

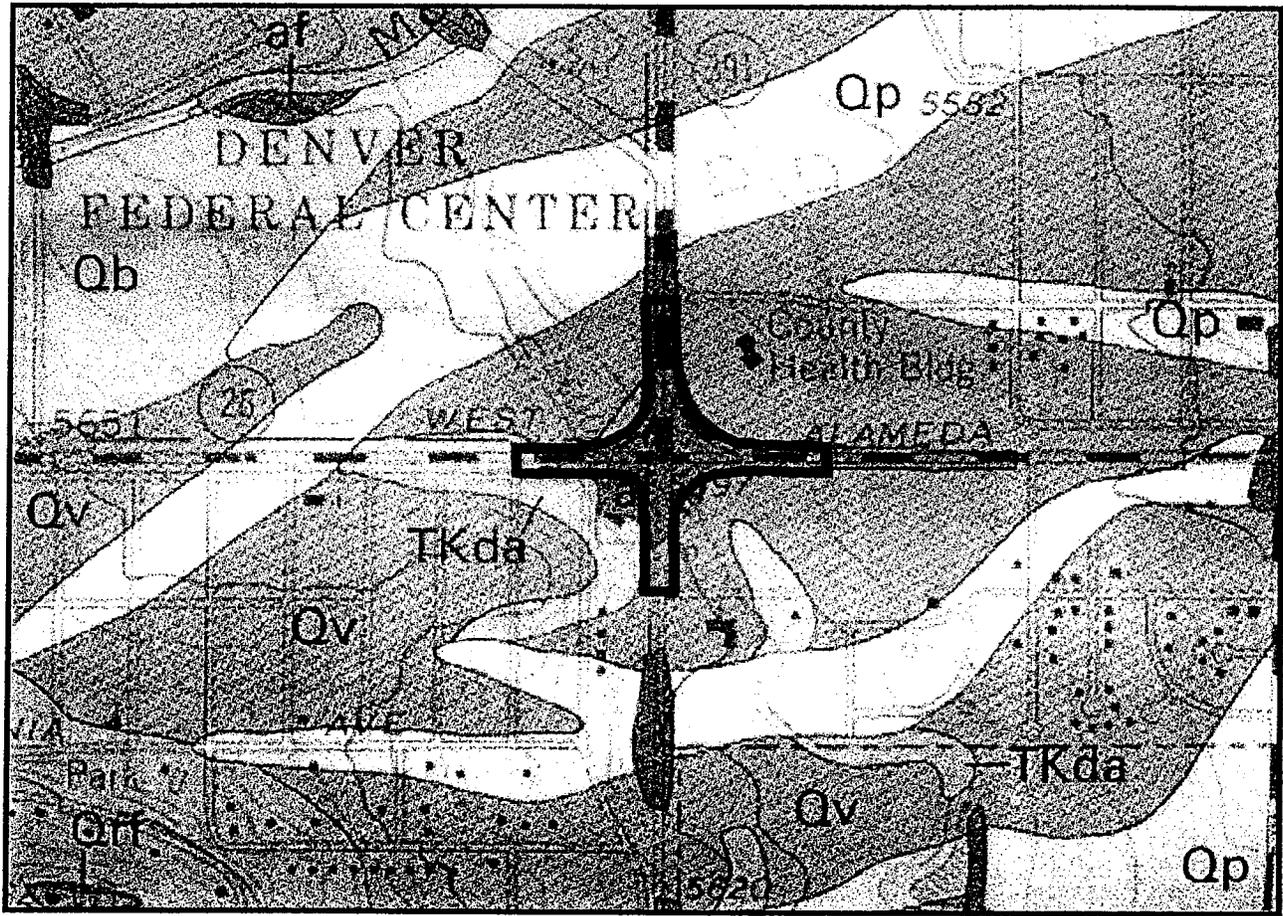


Figure 2. Geologic map showing the boundaries of the paleontological study area in red (map adapted from Lindvall, 1978).

RECOMMENDATIONS

Based on the results of this study, the following recommendations are made:

- 1) There are no previous records of fossils from within the study area, and the geologic units within it have low paleontologic potential. Therefore, immediate paleontologic clearance is recommended.

- 2) Although unlikely, it is possible that scientifically significant fossils could be preserved in the Verdos Alluvium, and that these could be impacted during construction. Because Pleistocene-aged bones may be only partially mineralized and are often superficially similar to modern bones, they can be difficult to distinguish. If any sub-surface bones or other potential fossils are found anywhere within the study area during construction, the CDOT staff paleontologist should be notified immediately to assess their significance.

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PALEONTOLOGIC ASSESSMENT OF THE SH7/US 85 INTERCHANGE, BRIGHTON, COLORADO

January 10, 2002

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Performed under State of Colorado Paleontological Permit 2001-22

SUMMARY

A paleontologic field survey of the site of the SH7/US 85 Interchange in Brighton, Colorado, was conducted on January 8, 2002. The study area extends from the intersection of Miller Avenue and Bridge Street (SH7) east to the intersection of Bridge Street and First Avenue, and from Egbert Street north to Walnut Street (SW $\frac{1}{4}$ SW $\frac{1}{4}$ Section 6, and NW $\frac{1}{4}$ NW $\frac{1}{4}$ NW $\frac{1}{4}$ Section 7, T. 1 S., R. 66 W.). The proposed construction consists of three alternatives for improvements to the existing interchange, all of which were evaluated for paleontologic resources.

The field survey consisted of a 100% pedestrian inspection of the study area for 1) surface fossils, 2) exposures of potentially fossiliferous rocks, and 3) areas in which fossiliferous rocks or younger potentially fossiliferous surficial deposits could be exposed or otherwise impacted during construction. Prior to the field survey, literature and museum record searches were conducted in order to assess the paleontologic sensitivity of the study area and the geologic units present within it.

The late Pleistocene Louviers and Broadway Alluvium are the only geologic units within the study area, and because these units are known to contain few fossils, they are considered to have low paleontologic potential. No previously documented fossil occurrences from within the study area are recorded in the databases of the University of Colorado Museum and the Denver Museum of Nature and Science, and none were found in the scientific literature. No fossils were found during the field survey for this study. Based on the project description, the proposed construction will involve mostly the existing grade, and excavations will not extend to a significant depth. Therefore, it is highly unlikely that potentially fossiliferous bedrock will be impacted by the proposed construction.

Based on the results of this study, immediate paleontologic clearance is recommended for all three construction alternatives. Although unlikely, it is possible that scientifically significant fossils are present within the Louviers and Broadway Alluvium, and could be impacted during construction. If any sub-surface bones or other potential fossils are found within the study area during construction, the CDOT staff paleontologist should be notified immediately to assess their significance.

RESOURCE ASSESSMENT GUIDELINES

The paleontologic potential of the SH7/US85 Interchange was evaluated using criteria proposed by Raup (1987), and the **Probable Fossil Yield Classification (PFYC)** developed by the U.S. Forest Service.

Rocky Mountain Paleontology has modified the PFYC to include fossil plants. This five-tier scheme is summarized below:

- **Class 1:** Igneous and metamorphic geologic units (excluding tuffs) that are not likely to contain recognizable fossil remains. Ground-disturbing activities will not require mitigation except in rare circumstances.
- **Class 2:** Sedimentary geologic units that are not likely to contain vertebrate fossils or scientifically significant invertebrate (or plant) fossils. Ground-disturbing activities are not likely to require mitigation.
- **Class 3:** Fossiliferous sedimentary geologic units where fossil content varies in significance, abundance, and predictable occurrence. Ground-disturbing activities will require sufficient mitigation to determine whether significant paleontologic resources occur in the area of a proposed action. Mitigation beyond initial findings will range from no further action necessary to full and continuous monitoring of significant localities during the action.
- **Class 4:** Class 4 geologic units are Class 5 units that have lowered risks of human-caused adverse impacts and/or lowered risk of natural degradation. Proposed ground-disturbing activities will require assessment to determine whether significant paleontologic resources occur in the area of a proposed action and whether the action will impact the resources. Mitigation beyond initial findings will range from no further mitigation necessary to full and continuous monitoring of significant localities during the action. This classification will often not be applied until after on-the-ground assessments are made.
- **Class 5:** Highly fossiliferous geologic units that regularly and predictably produce vertebrate fossils and/or scientifically significant invertebrate (or plant) fossils, and that are at high risk of natural degradation and/or human-caused adverse impacts. These areas are likely to be poached. Mitigation of ground-disturbing activities is required and may be intense. Areas of special interest and concern should be designated and intensely managed.

Raup's (1987) criteria for the evaluation of paleontologic resources:

Type 1: Formations known to produce large numbers of vertebrate fossils are considered to have high paleontologic potential.

Type 2: Formations known to produce abundant numbers of invertebrate, plant, and trace fossils, but that rarely produce vertebrate fossils, are considered to have moderate paleontologic potential.

Type 3: Formations that only rarely produce fossils are considered to have low paleontologic potential.

In general, invertebrate, plant, and trace fossils occur in large numbers when they are found, are not considered as significant as relatively uncommon vertebrate fossils.

SURVEY PROCEDURES

This study was conducted at the request of Metcalf Archaeological Consultants, Inc., Eagle, Colorado. Prior to the field survey, literature and museum record searches were conducted in order to 1) determine whether any known fossil localities occur within

the study area, 2) assess the potential for disturbance of these localities during construction, and 3) evaluate the paleontologic potential of the rock formations and/or surficial deposits within the study area. The museums included in the record search included the University of Colorado Museum (UCM), and the Denver Museum of Nature and Science (DMNS). The study area extends from the intersection of Miller Avenue and Bridge Street (SH7) east to the intersection of Bridge Street and First Avenue, and from Egbert Street north to Walnut Street (SW¼ SW¼ Section 6, and NW¼ NW¼ NW¼ Section 7, T. 1 S., R. 66 W.) (Fig. 1) The proposed construction consists of three alternatives for improvements to the existing interchange, all of which were evaluated for paleontologic resources during the literature and file searches and field survey. The field survey was conducted on January 8, 2002, and consisted of a 100% pedestrian inspection of the study area for 1) surface fossils, 2) exposures of potentially fossiliferous rocks, and 3) areas in which fossiliferous rocks or younger potentially fossiliferous surficial deposits could be exposed or otherwise impacted during construction.

GEOLOGY AND PALEONTOLOGY

The Louviers and Broadway Alluvium are the only geologic units within the study area. The late Pleistocene (Wisconsin) Louviers Alluvium consists of gravel, sand, silt, and clay forming terraces as much as 60 feet above the modern stream drainages (Trimble and Machette, 1979). It has produced scattered vertebrate fossils including the remains of mammoth, bison, horse, camel, jackrabbit, ground squirrel, and prairie dogs in the Denver area (Scott, 1962, 1963; unpublished UCM fossil locality data). Because it contains scientifically significant fossils, the Louviers Alluvium should be considered a Class 3 geologic unit according to the Probable Fossil Yield Classification (see p. 1), but because these fossils are relatively uncommon, the Louviers Alluvium is considered to have low paleontologic potential (Type 3 of Raup, 1987).

The late Pleistocene (late Wisconsin) Broadway Alluvium overlies the Louviers Alluvium, and consists of gravel, sand, silt, and clay forming alluvial terrace deposits commonly 20-35 feet above modern stream drainages (Trimble and Machette, 1979). It has produced skeletal remains of mammoth, bison, horse, camel, and white-tailed prairie dog from along the South Platte River (Hunt, 1954; Kihm, 1984). Like the Louviers Alluvium, the Broadway Alluvium is a Class 3 geologic unit according to the PFYC. Because fossils are relatively uncommon in the Broadway Alluvium, it is also considered to have low paleontologic potential (Type 3 of Raup, 1987).

SURVEY RESULTS

No fossils were found within the study area during the field survey for this study. Neither the UCM nor the DMNS have any records of fossil occurrences from within the study area, and no reports of fossils from within it were found in the scientific literature. No bedrock exposures are present, and the surficial deposits are poorly exposed due to the gentle terrain and existing construction (Fig. 2). Based on the project description, the proposed construction will involve mostly the existing grade, and excavations will not extend to a significant depth. Therefore, it is unlikely that potentially fossiliferous bedrock will be impacted by the proposed construction.

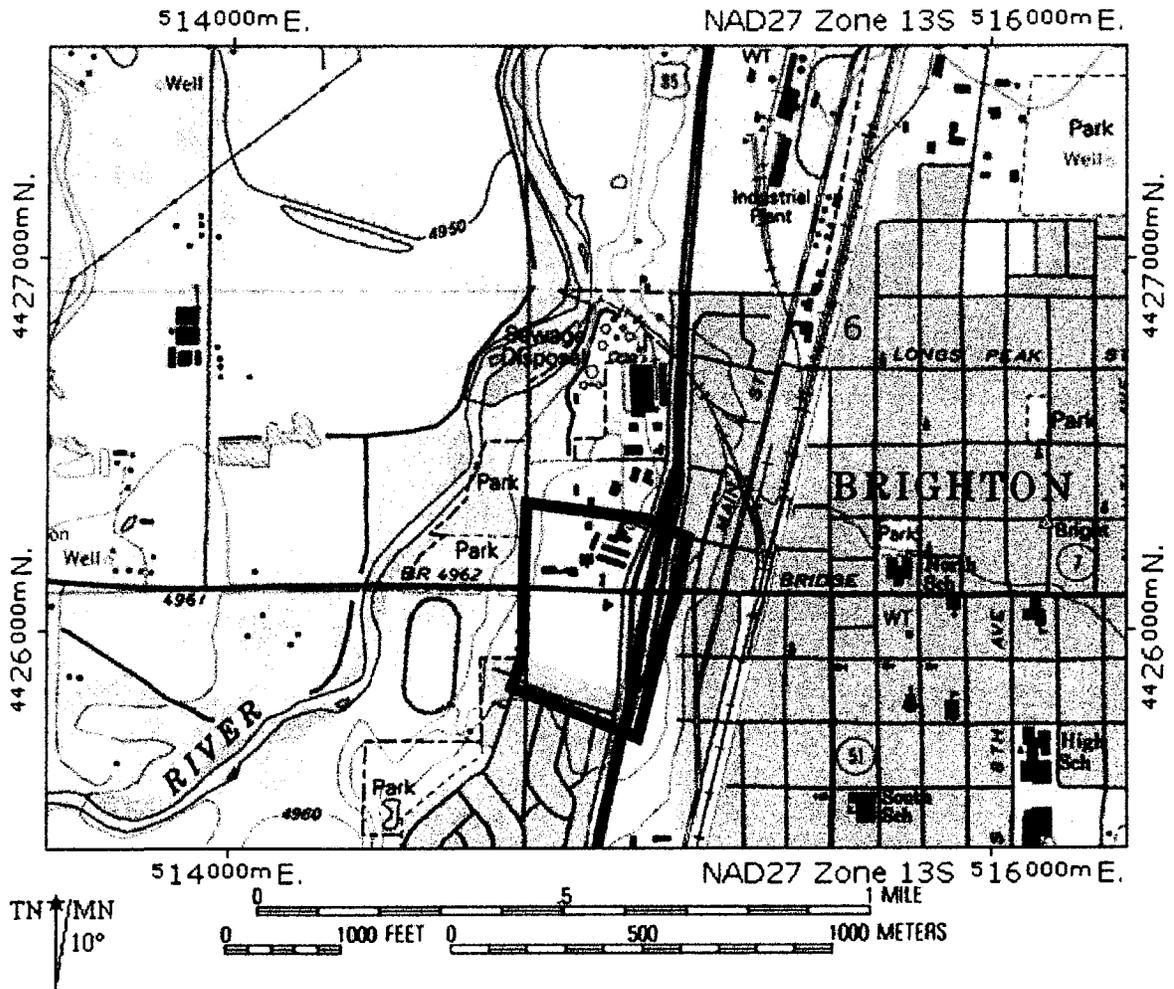


Figure 1. Location map showing the approximate boundaries of the paleontological study area in blue.



Figure 2. View looking east along SH 7 at the US 85 Overpass in Brighton, Colorado.

RECOMMENDATIONS

Based on the results of this study, the following recommendations are made:

- 1) There are no previous records of fossils from within the study area, and the surficial deposits within it have low paleontologic potential. It is unlikely that fossiliferous bedrock will be impacted by this project. Therefore, immediate paleontologic clearance is recommended for all three of the proposed construction alternatives.

- 2) Although unlikely, it is possible that scientifically significant fossils could be present in the Louviers and Broadway Alluvium within the study area. Because Pleistocene-aged bones may be only partially mineralized and are often superficially similar to modern bones, they can be difficult to distinguish. If any sub-surface bones or other potential fossils are found anywhere within the study area during construction, the CDOT staff paleontologist should be notified immediately to assess their significance.

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