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## 4.8 Paleontology

Paleontological resources are the mineralized (fossilized) remains of prehistoric plant and animal organisms, as well as the mineralized impressions (trace fossils) left as indirect evidence of the form and activity of such organisms. These non-renewable resources may be scientifically significant and are protected by the Colorado Historical, Prehistorical and Archaeological Resources Act of 1973.

Paleontological resource investigations of the Valley Highway project area were completed in 2003 by Rocky Mountain Paleontology (RMP, 2003). CDOT's staff paleontologist officially concurred with the findings of the study. Field surveys were conducted on April 28 and July 10, 2003. The field surveys consisted of a combination of drive-by and pedestrian inspections of the study area for 1) surface fossils, 2) exposures of potentially fossiliferous (fossil-containing) rocks, and 3) areas in which fossiliferous rocks or younger potentially fossiliferous surficial deposits could be exposed or otherwise impacted during ground-disturbing activities. In advance of the field survey, literature and museum record searches were conducted in order to assess the paleontological sensitivity of the study area and the geologic units present within it. Museums included in the record search included the University of Colorado Museum and the Denver Museum of Nature and Science, the two primary paleontological repositories in the area. The paleontological sensitivity of the study area was evaluated using criteria proposed by Raup (1987), and the probable fossil yield classification (PFYC) developed by the U.S. Forest Service (USFS, 1996).

### 4.8.1 Current Conditions

The study area includes seven mapped geologic units (Lindvall 1978, Shroba 1980) as well as artificial fill. Surficial deposits include Broadway Alluvium, eolian sand, colluvium, Piney Creek Alluvium, Post-Piney Creek Alluvium, and artificial fill, from roughly oldest to youngest. These units all have low paleontological sensitivity (Type 3 of Raup 1987; Class 2 of PFYC). The only bedrock geologic unit within the study area is the Denver Formation, which contains locally abundant and scientifically significant plant fossils and less common vertebrate fossils, and has moderate to high paleontological sensitivity (Type 2 of Raup 1987; Class 3 of PFYC). Attesting to the paleontologic sensitivity of the Denver Formation, the University of Colorado Museum has over 600 vertebrate fossils from 59 localities in the Denver Formation from around the Denver Basin.

The paleontological sensitivities of the geologic units within the study area are summarized in **Table 4.8-1**, and their approximate locations are shown in **Figure 4.8-1**. With moderate to high paleontologic sensitivity, the Denver Formation underlies the surficial deposits within the survey corridor at various and largely unpredictable depths because of the varying thickness of surficial alluvial, eolian, and colluvial deposits. Isolated and relatively small surface exposures of the Denver Formation were mapped by Lindvall (1978) and Shroba (1980), but none was observed during the field survey.

No fossils were found during the field survey for this study; however, previously documented scientifically significant fossils have been reported from surficial deposits of late Pleistocene age and rocks of the Denver Formation within and near the study area. Those localities occurring within the museum record search area are listed in **Table 4.8-2**.

**Table 4.8-1 Geologic Units within the Project Area and their Paleontologic Sensitivities**

Rock Unit	Reported Thickness	Age	Sensitivity
Denver Formation	N/A (bedrock)	Cretaceous	Moderate to high; Class 3 of PFYC
Broadway Alluvium	~ 18–30 ft	Pleistocene	Low; Class 2 of PFYC
eolian sand	~ 10–30 ft	Holocene to Pleistocene	Low; Class 2 of PFYC
colluvium	< 5 ft	Holocene to Pleistocene	Low; Class 2 of PFYC
Piney Creek Alluvium	~ 18–25 ft	Holocene	Low; Class 2 of PFYC
Post-Piney Creek Alluvium	~ 3–10 ft	Holocene	Low; Class 2 of PFYC
Artificial Fill	~ 5–15 ft	Recent	Low; Class 2 of PFYC

Sources: Lindvall, 1978; Shroba 1980

PFYC – probable fossil yield classification

**Table 4.8-2 Fossil Localities within the Valley Highway EIS Project Area**

Repository or Data Source	Locality Number or Name	Formation or Age	Location	Fossils Found
DMNS	224	Pleistocene	T. 4 S., R. 68 W., Section 9	Mammoth tooth
DMNS	1086	Pleistocene	T. 4 S., R. 68 W., Section 22	Mammoth teeth and tusk, horse tooth
DMNS	1089	Pleistocene	T. 4 S., R. 68 W., Section 23	Camel vertebrae
DMNS	1091	Pleistocene	T. 4 S., R. 68 W., Sections 16 and 22	Mammoth tooth
DMNS	1096	Pleistocene	T. 4 S., R. 68 W., Section 15	Mammoth tooth
DMNS	1285	Cretaceous	T. 4 S., R. 68 W., Section 22	Plants
DMNS	2029	Cretaceous	T. 4 S., R. 68 W., Section 21	Plants
Rocky Mountain Paleontology	DD040602-01	Cretaceous	T. 4 S., R. 68 W., Sections 21 and 22	Plants

Source: Rocky Mountain Paleontology, 2003

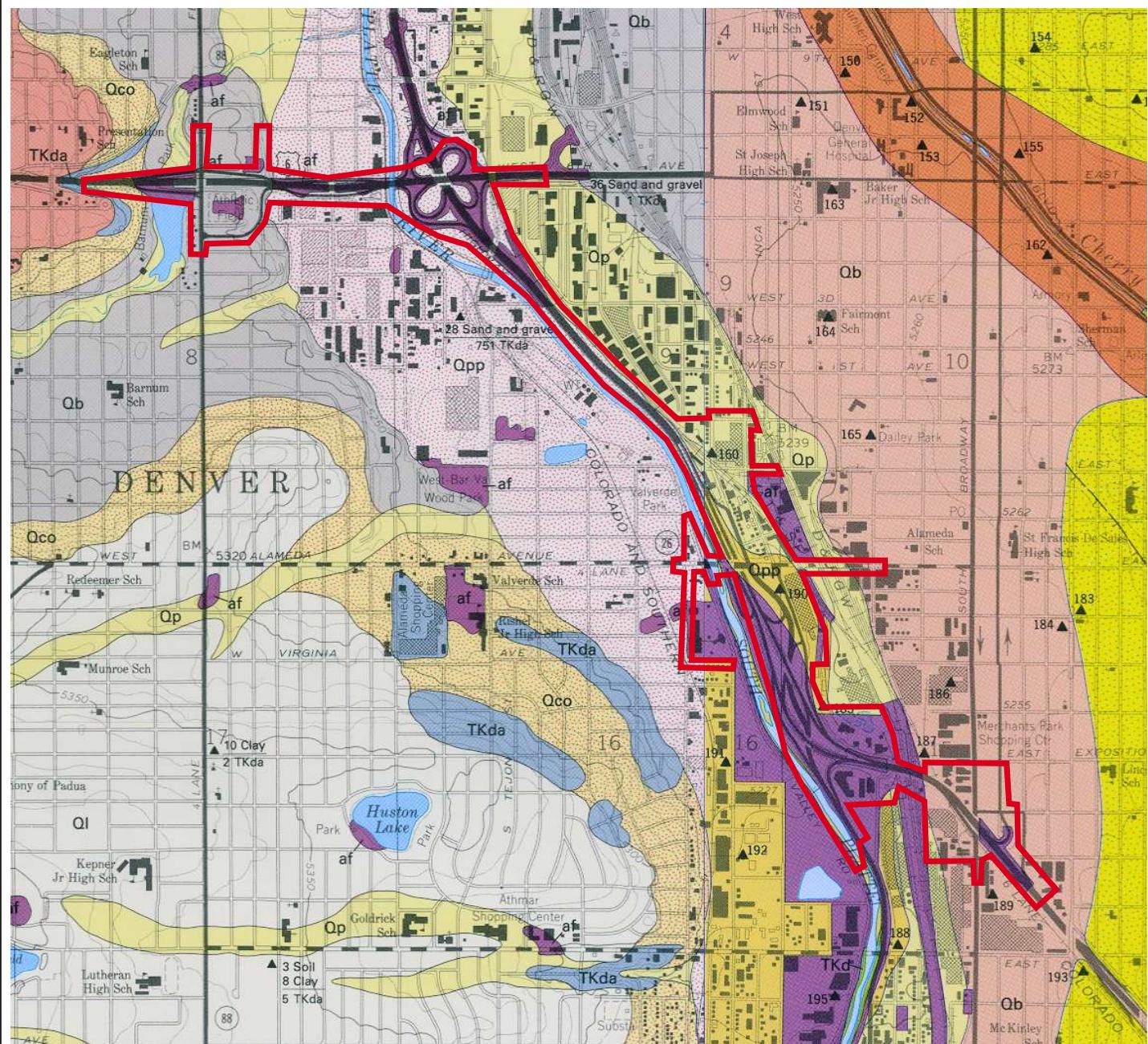
DMNS – Denver Museum of Nature and Science

R - range

S - south

T - township

W - west



#### Legend

<b>af</b>	= Artificial Fill	<b>Qp</b>	= Piney Creek Alluvium
<b>Qc</b>	= Colluvium	<b>Qb</b>	= Broadway Alluvium
<b>Qes</b>	= Eolian Sand	<b>TKd&amp;TKda</b>	= Denver Formation
<b>Qpp</b>	= Post-Piney Creek Alluvium		<b>—</b> = Project Area

Source : Lindvall, 1978 and Shroba, 1980



## Geologic Map of the Valley Highway Project Area



Figure 4.8-1

## 4.8.2 Consequences of the Alternatives

### 4.8.2.1 NO ACTION ALTERNATIVE

No impacts to paleontological resources would occur under the No Action Alternative.

### 4.8.2.2 SYSTEM ALTERNATIVES 1, 2, AND 3

Ground disturbance from highway construction activities associated with the System Alternatives 1, 2, and 3 may potentially cause direct impacts (damage or destruction) to paleontological resources. It is not possible to predict the extent of such impacts due to the unknown specific distribution of fossils within the geologic units in the study area. The fossiliferous Denver Formation bedrock is of greatest concern but impacts would have to be evaluated on a project-specific basis because of the varying and unpredictable thickness of the Pleistocene and Holocene sediments which cover it. Pleistocene surface deposits may also contain small quantities of important fossils subject to project impacts from ground disturbance during construction, but their spatial distribution cannot be predicted.

### 4.8.2.3 PREFERRED ALTERNATIVE

As with System Alternatives 1, 2, and 3, ground disturbance from highway construction activities associated with the Preferred Alternative may potentially cause direct impacts (damage or destruction) to paleontological resources. It is not possible to predict the extent of such impacts due to the unknown specific distribution of fossils within the geologic units in the study area. The fossiliferous Denver Formation bedrock is of greatest concern but impacts would have to be evaluated on a project-specific basis because of the varying and unpredictable thickness of the Pleistocene and Holocene sediments which cover it. Pleistocene surface deposits may also contain small quantities of important fossils subject to project impacts from ground disturbance during construction, but their spatial distribution cannot be predicted.

## 4.8.3 Mitigation Measures

Construction monitoring of areas where Denver Formation rocks may be disturbed will be conducted, as appropriate. As project design plans are finalized, the CDOT paleontologist will review them to evaluate the extent of impacts to the Denver Formation, and the scope of monitoring work, if any, which is required.

Although the paleontologic sensitivity of the surficial deposits (primarily alluvium) within the study area is low because they typically contain few fossils, construction personnel will be made aware of the potential to encounter fossils while excavating. If any sub-surface bones, leaf impressions, or other potential fossils are found during construction, the CDOT paleontologist will be notified immediately to assess their significance and make further recommendations.