Paleontological Assessment for South Wadsworth Boulevard/Waterton Road Intersection Jefferson County, Colorado

Prepared for

Jacobs Engineering Group Inc.

Prepared by

SWCA Environmental Consultants

July 2010

Revised March 2011

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PROJECT SUMMARY

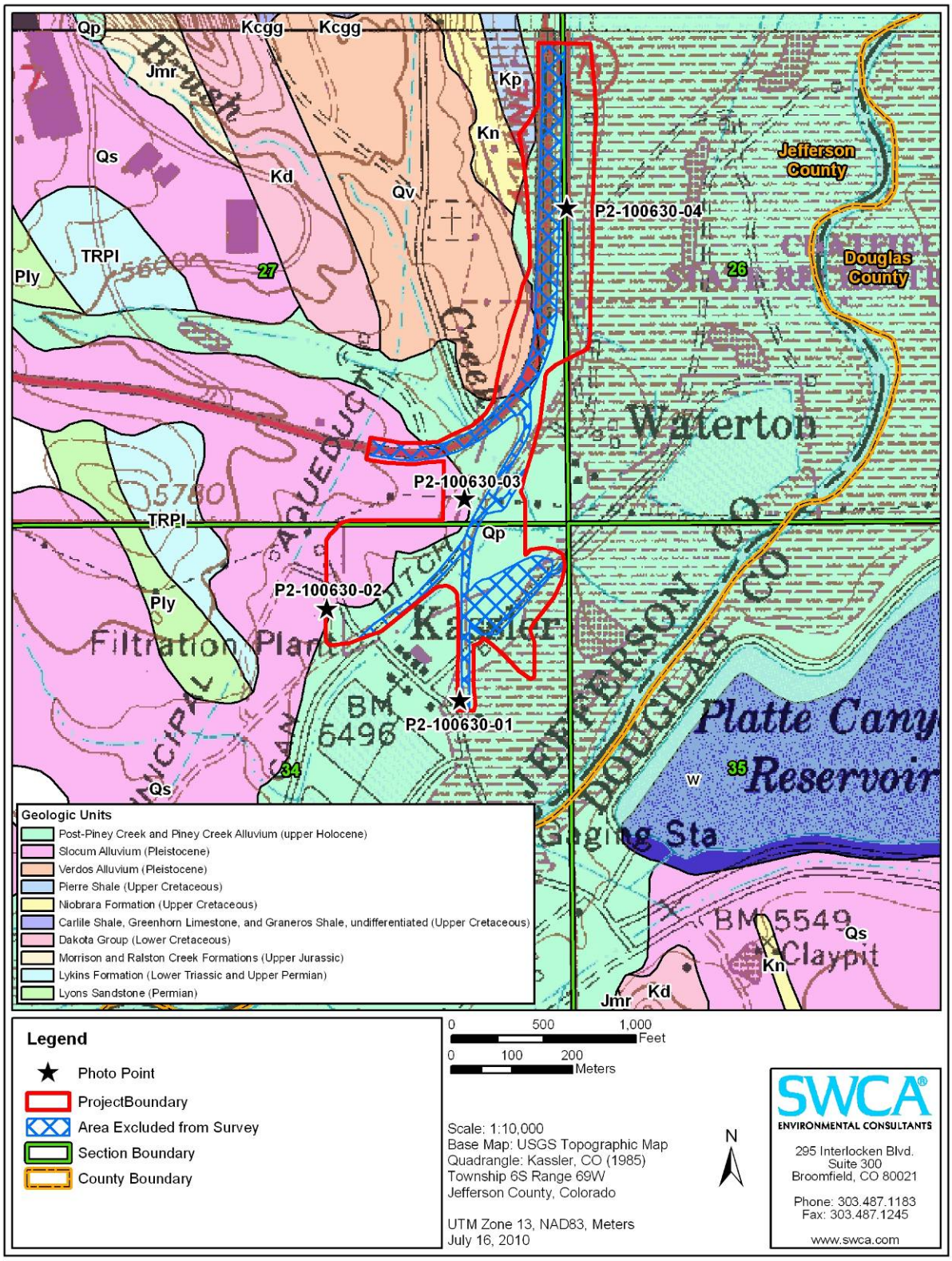
A paleontological assessment was conducted by SWCA Environmental Consultants (SWCA) at the request of Jacobs Engineering Group Inc. (Jacobs) in order to comply with the requirements of the Colorado Department of Transportation (CDOT). Copies of this report were provided to Jacobs. Additional copies will be kept on file at the SWCA office in Broomfield, Colorado.

Table 1. Project Summary Table.

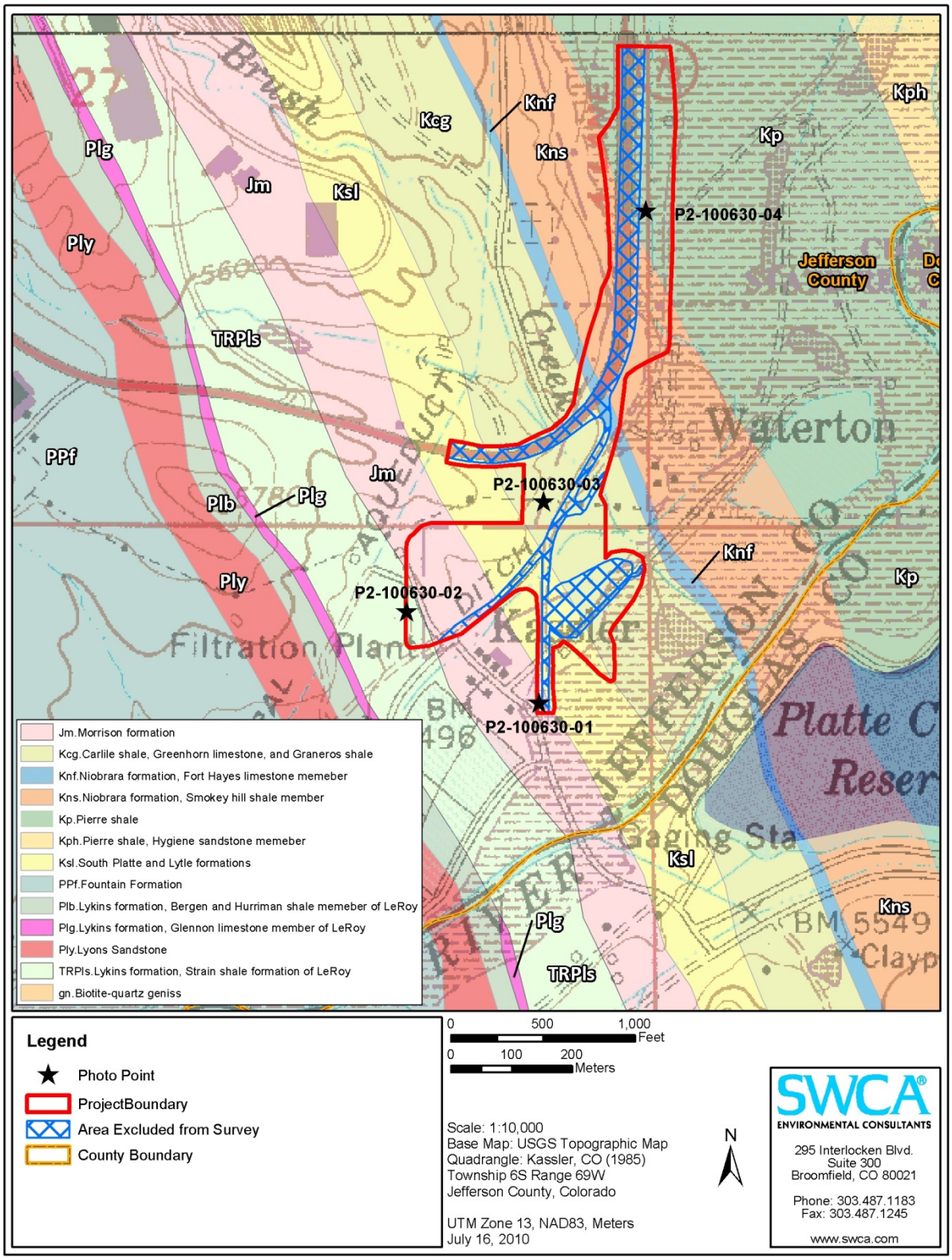
Location name	South Wadsworth Boulevard/Waterton Road Intersection
Location description	Proposed intersection improvements
Survey date	6/30/2010
Area of potential effect	Sections 26, 27, 34 and 35, Township 6 South, Range 69 West in Jefferson County, Colorado (USGS 7.5-minute Kassler quadrangle)
Survey area	Project area along both sides of proposed improvements (see Map 1). Detailed construction design plans were not available for this analysis. It is assumed based on the project description and topography that most ground disturbance will be at or close to existing grade.
Geology	Holocene – Post-Piney Creek and Piney Creek Alluvium (PFYC Class 2) Pleistocene – Slocum Alluvium (PFYC Class 3a), Verdos Alluvium (PFYC Class 3a) Cretaceous-Niobrara Formation (PFYC Class 3a)
Paleontology results	No previously or newly recorded fossil localities are located within the APE.
Recommendations	Based on the results of this study, immediate paleontological clearance is recommended because, with the exception of a small outcrop of Niobrara Formation, there are no exposures of paleontologically sensitive bedrock within the project area. According to geotechnical data provided to SWCA by Jacobs, paleontologically sensitive bedrock geologic units within the project area occur at a depth that is unlikely to be impacted by construction. If any subsurface 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 and make further mitigation recommendations.

INTRODUCTION

At the request of Jacobs and as required by CDOT, SWCA conducted a paleontological assessment for the South Wadsworth Boulevard/Waterton Road Intersection (Jefferson County Project No. 6-69-03-3652). The entire project area was surveyed, and comprises the area of potential effect (APE). It is located in Sections 26, 27, 34, and 35 of Township 6 South, Range 69 West (Maps 1 and 2). The State of Colorado Permit for this project is No. 2010-68.



Map 1. Project area map for the South Wadsworth Boulevard/Waterton Road Intersection showing Quaternary surficial deposits within the APE (Scott 1963a).



Map 2. Project area map for the South Wadsworth Boulevard/Waterton Road Intersection showing bedrock geology within the APE (Scott 1963b).

The South Wadsworth Boulevard/Waterton Road Intersection Project will provide a grade-separation at the existing intersection. Construction would include some minor widening on existing South Wadsworth Boulevard from Lockheed Martin to the north.

The project addresses safety for the two turning movements that currently cause congestion. First, it would eliminate the movement requiring traffic to turn left from southbound South Wadsworth Boulevard to Waterton Road by providing that movement via the new flyover ramp. Second, the Preferred Alternative improves the left-turn movement from northbound Waterton Road into Lockheed Martin by removing the southbound Wadsworth to Waterton traffic from the mix and providing a protected acceleration lane on southbound Wadsworth for those making the left turn from Waterton towards the Lockheed Martin entrance. Detailed construction design plans were not available for this analysis. However, based on the project description and topography of the project area, it is assumed that most ground disturbance will be at or close to existing grade.

STANDARDS

The Colorado Historical, Prehistorical and Archaeological Resources Act of 1973 (CRS 24-80-401 to 411, and 24-80-1301 to 1305) defines permitting requirements and procedures for the collection of prehistoric resources, including paleontological resources, on state lands, and actions that should be taken in the event that resources are discovered in the course of state-funded projects and on state-owned/administered lands. Based on this legislation, CDOT requests assessments on state-owned and/or state-administered lands that have the potential to contain significant paleontological resources, and mitigation monitoring during ground disturbance in these areas. This study will be reviewed by CDOT, and CDOT must fulfill the Federal Highway Administration's National Environmental Policy Act requirements under the Colorado Historical, Prehistorical and Archaeological Resources Act. This paleontological assessment, consisting of a literature and record search and a field survey, was conducted at the request of Jacobs in accordance with CDOT requirements. It was conducted using federal guidelines (Bureau of Land Management [BLM] Manual H-8270-1; BLM Instructional Memorandum [IM] 2008-009; BLM IM 2009-011) for the assessment and management of paleontological resources because these guidelines are widely used by paleontological consultants and accepted by most agencies.

The objectives of this assessment were to locate, evaluate, document, and protect paleontological resources located on Colorado state lands for the purpose of ensuring that the proposed project does not inadvertently damage or destroy scientifically significant paleontological resources. This report describes the paleontological resources in the APE for this project and includes mitigation recommendations.

METHODS

Lori S. Browne conducted the survey; Georgia E. Knauss prepared the final report; and Dr. Paul C. Murphey, principal investigator, reviewed the final report. Geographical information system specialist Mike Agena prepared the maps.

Records Search Methods

Records searches were conducted to 1) determine whether any previously recorded fossil localities occur in the project area; 2) assess the potential for disturbance of these localities during construction; and 3) evaluate the paleontological sensitivity in the project APE. Paleontological records maintained by the Denver Museum of Nature and Science, the University of Colorado Museum, and the Colorado State Historic Preservation Office were searched to determine the presence of previously documented fossil localities in the project APE.

Resource Assessment Methods

Geologic units (bedrock formations and surficial sedimentary deposits) have been assigned a Potential Fossil Yield Classification System (PFYC) ranking by the Colorado BLM regional paleontologist based on the taxonomic diversity and abundance of previously recorded scientifically significant fossil occurrences from each geologic unit, and the potential for future discoveries. This ranking was used in the preparation of this report.

Field Survey Methods

The survey was designed to 1) determine the surface presence of previously unknown significant vertebrate fossils and/or noteworthy occurrences of invertebrate, plant, or trace fossils; and 2) evaluate potential adverse impacts to subsurface paleontological resources during construction.

The paleontological field survey covered the designated APE within the project boundary. The project APE was inspected for 1) surface fossils, 2) exposures of potentially fossiliferous rock, and 3) areas in which fossiliferous rock would be exposed or otherwise impacted during construction.

DISTRIBUTION OF DATA

Copies of this report will be submitted to Jacobs. A hardcopy file will be retained at SWCA's Broomfield office along with relevant field notes, maps, and other data.

GEOLOGY AND PALEONTOLOGY

According to the geologic mapping of bedrock and surficial units by Scott (1963a, 1963b), the project area contains a number of mapped bedrock geologic units that are, with the exception of the Niobrara Formation based on field observations, covered by three younger surficial sedimentary deposits (Maps 1 and 2). The three surficial units within the project area include the Pleistocene Verdos and Slocum alluvium, and the Holocene Post-Piney and Piney Creek alluvium. The Kassler quadrangle geologic map (Scott 1963a) indicates that a number of Cretaceous and older geologic bedrock units are present within in this area. However, geotechnical boring data from within the project area provided by Jacobs indicates that bedrock is buried at a depth of between 40 and 50 feet and the project construction is not expected to reach these depths. As stated above, only the Niobrara Formation was observed at the surface. This section of the report discusses the geology and paleontology of the Niobrara

Formation and surficial sedimentary deposits because these units are likely to be impacted by the proposed construction.

NIOBRARA FORMATION

The Upper Cretaceous Niobrara Formation is a stratigraphically complex geologic unit. It has been subdivided into the Fort Hays Limestone Member and the conformably overlying Smoky Hill Shale Member, and is partially stratigraphically equivalent with the Mancos Shale. The Smoky Hill Shale Member consists of yellowish-orange to brown shale interbedded with thin gray and white chalk beds, and thin rare limestone beds. The Fort Hays Limestone Member is composed primarily of gray limestone with lesser amounts of chalky limestone and shale. The Niobrara Formation is widely distributed, and was deposited mostly in nearshore marine settings during the second late Cretaceous transgressive-regressive cycle.

Most fossil vertebrates known from the Niobrara Formation have been discovered in the Smoky Hill Shale Member in Kansas, although other geographic areas have produced less abundant and less well-preserved vertebrate remains. Among the most well known Niobrara Formation fossils from Kansas are articulated skeletons of pterosaurs, fishes (including rare sharks), birds, and numerous plesiosaurs, mosasaurs, and turtles. Free-swimming crinoids (sea lilies) have also been reported (Cobban 1995). Mosasaurs, plesiosaurs, and fishes have been discovered within the Smoky Hill Shale Member of the Niobrara Formation in Larimer County, Colorado (Anthony and Smith 1992; Martz 1996). Fossil marine mollusks, cephalopods, and foraminifers are also locally abundant within the Niobrara Formation throughout its distribution. Niobrara Formation fossils have been the subject of numerous paleontological studies (Anthony and Smith 1992; Cobban 1995; Feager and Smidt 1992; Martz 1996; Russell 1993; and many others).

In the prior version of this report, it was stated that no exposures of bedrock were observed within the project area. However, on a subsequent field visit, CDOT Staff Paleontologist Steve Wallace observed weathered exposures of Niobrara Formation on the western shoulder of Wadsworth Boulevard north of Waterton Road. However, no fossils were observed. The further distribution of the Niobrara Formation underlying the project area is shown in Map 2. Although fossil invertebrates are locally common in this unit, the Niobrara Formation contains less abundant fossil vertebrates throughout most of its distribution. Therefore, both members of the Niobrara Formation are considered to have moderate paleontological sensitivity (PFYC Class 3) within the project area.

PLEISTOCENE SURFICIAL DEPOSITS, GENERAL

In general, Pleistocene surficial deposits, particularly alluvium, may contain mineralized or partially mineralized animal bones, invertebrates, and plant remains of paleontological significance. With the exception of some caves, hot springs, and tar deposits, these fossils typically occur in low density and usually consist of scattered and poorly preserved remains. Nevertheless, many Pleistocene fossils provide important paleobiologic, paleobiogeographic, and paleoenvironmental information and are therefore scientifically important. The most common Pleistocene vertebrate fossils include the bones of mammoth, bison, deer, and small mammals; but other taxa including horse, lion, cheetah, wolf, camel, antelope, peccary,

mastodon, and giant ground sloth have been reported from the Rocky Mountain region (Cook 1930, 1931; Emslie 1986; Graham and Lundelius 1994; Gillette and Miller 1999; Gillette, McDonald, and Hayden 1999; Gillette, Bell, and Hayden 1999; Heaton 1999; Hunt 1954; Lewis 1970; Smith et al. 1999; unpublished paleontological data, Denver Museum of Nature and Science).

Verdos Alluvium

The Pleistocene (Kansan) Verdos Alluvium consists of light brown to reddish-brown poorly sorted stratified gravel containing lenses of clay, silt, and sand, with larger and more abundant boulders near the mountains (Lindvall 1979). Clasts are mostly weathered and coated with calcium carbonate (Lindvall 1979; Scott 1962). It is as much as 40 feet thick, and contains a 2- to 4-foot-thick calcium carbonate enriched zone (relict soil) near its top. Locally, Verdos Alluvium contains thin beds of white volcanic ash, and has been dated at approximately 600,000 years old based on its correlation with the Pearlette Ash of Kansas (Scott 1963a). Fossils are uncommon in the Verdos Alluvium, but specimens identified as horse and camel have been found in the unit (Scott 1978; unpublished USGS fossil locality data). The Verdos Alluvium has low to moderate paleontological sensitivity (PFYC Class 3a).

Slocum Alluvium

The Pleistocene (Illinoian) Slocum Alluvium is composed of brown to reddish-brown well-stratified pebbly clay and silt interlayered with gravel cobbles and boulders, with larger and more abundant boulders closer to the mountains (Lindvall 1979). Clasts within the unit are typically altered by weathering and coated with calcium carbonate (Scott 1962). It contains a well-developed calcium carbonate enriched zone (relict soil) in its upper part. The Slocum Alluvium is generally 15 to 20 feet thick, but is locally up to 40 feet thick. Although the remains of bison, horse, prairie dog, gopher, Richardson's ground squirrel, and mollusks have been found in this unit (Scott 1963a, 1962), fossils are generally uncommon and poorly preserved. Because it contains few but scientifically important fossils, the Slocum Alluvium is considered to have low to moderate paleontological sensitivity (PFYC Class 3a).

PINEY CREEK AND POST-PINEY CREEK ALLUVIUM

Holocene Post-Piney Creek and Piney Creek Alluvium consist of gravel, sand, silt, and clay within modern stream drainages and adjacent floodplains and slightly older lower alluvial terraces. Clasts are coarse close to the mountain front and decrease in grain size downstream. The total thickness is less than 20 feet (Trimble and Machette 1979).

Although Piney Creek and Post-Piney Creek Alluvium are known to contain animal and plant remains (e.g., Hunt 1954), these are the unfossilized remains of modern species, and deposits of Holocene age are generally considered too young to contain in-situ fossils. As such, Post-Piney Creek and Piney Creek Alluvium have low paleontological sensitivity (PFYC Class 2).

RESULTS

This section presents the results of the records search and field survey conducted for Jacobs for the South Wadsworth Boulevard/Waterton Road Intersection Project.

PREVIOUSLY DOCUMENTED LOCALITIES

No previously documented fossil localities occur within the APE. However, Pleistocene fossil localities, including the well known Lamb Spring site, are known from within 1 mile of the project area. Geologic information associated with these localities indicates that they are from a surficial geologic unit not present within the project area.

PALEONTOLOGICAL SENSITIVITY

The paleontological sensitivity of the geologic unit(s) within the project APE (Scott 1963a, 1963b; Trimble and Machette 1979) have been classified according to the PFYC by the BLM and are summarized in Table 2.

Table 2. Paleontological Sensitivities of Geologic Units in the APE.

Geologic Unit	Map Symbol*	Age	Typical Fossils	PFYC
Post-Piney Creek Alluvium, Piney Creek Alluvium	Qp	Upper Holocene	No in-situ fossils in Holocene deposits.	Class 2
Slocum Alluvium	Qs	Pleistocene	Uncommon and typically poorly preserved but potentially scientifically important occurrences of mammals.	Class 3a
Verdos Alluvium	Qv	Pleistocene	Uncommon and typically poorly preserved but potentially scientifically important occurrences of mammals.	Class 3a
Smokey Hill Shale Member, Niobrara Formation	Kns	Late Cretaceous	Locally abundant marine invertebrates (mostly mollusks), less common vertebrates.	Class 3a
Fort Hays Limestone Member, Niobrara Formation	Knf	Late Cretaceous	Locally abundant marine invertebrates (mostly mollusks), less common vertebrates.	Class 3a

* Trimble and Machette 1979

FIELD SURVEY

The field survey results are summarized in Table 3, as are the recommendations based on this survey.

Table 3. Field Survey Results and Recommendations.

Location	Sections 26, 27, 34 and 35, Township 6 South, Range 69 West in Jefferson County, Colorado (USGS 7.5-minute Kassler quadrangle)
Survey date	6/30/2010
Surveyor	Lori S. Browne
Geological formation(s)	Holocene – Post-Piney Creek and Piney Creek Alluvium (PFYC Class 2) Pleistocene – Slocum Alluvium (PFYC Class 3a), Verdos Alluvium (PFYC Class 3a) Cretaceous- Niobrara Formation (PFYC Class 3a)
Reference	Scott 1963a, 1963b; Trimble and Machette 1979
Description	Proposed intersection improvements. Based on project description and topography, most ground disturbance is anticipated to be at or close to existing grade.
Topography	Low rolling hills in the southwest portion of the project area, cut by moderate, shallow-walled, north/south-trending drainages. Northeast and southeast portions of the project area are nearly flat.
Bedrock exposure status	As reported by CDOT Staff Paleontologist Steve Wallace (personal communication, March 2, 2011), minor exposures of weathered Niobrara Formation are present along the west shoulder of Wadsworth Boulevard, between 360 and 580 feet north of Waterton Road. This outcrop was not reported in the original version of this report. No other bedrock exposures were observed within the project area (Figures 1–4).
Geological description	Limited exposures of surficial sedimentary deposits are locally exposed within the project area.
Fossil status	No previously or newly recorded fossil localities are located within the APE.
Fossil description	Not applicable.
Recommendation	Based on the results of this study, immediate paleontological clearance is recommended because exposures of paleontologically sensitive bedrock within the project area are minimal, consisting only of moderately sensitive Niobrara Formation, and no fossils were observed within it. The other bedrock geologic units within the project area occur at a depth that exceeds the depth of the anticipated construction construction disturbance. If any subsurface 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 and make further mitigation recommendations.

Figure 1. View north along Wadsworth Boulevard from photo point P2-100630-01.

Figure 2. View slightly east of north from photo point P2-100630-02.

Figure 3. View slightly east of north from photo point P2-100630-03.

Figure 4. View slightly west of south at photo point P2-100630-04.

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