3.17 Paleontological Resources

Paleontology is a multidisciplinary science that combines elements of geology, biology, chemistry, and physics in an effort to understand the history of life on earth. Paleontological resources (or fossils) are the remains, imprints, or traces of once-living organisms preserved in rocks and sediments. These include mineralized, partially mineralized, and unmineralized bones and teeth, soft tissue, shells, wood, leaf impressions, footprints, burrows, and microscopic remains.

3.17.1 Regulations and Methods

Fossils are classified as nonrenewable scientific resources and are protected by various laws, ordinances, regulations, and standards across the country. Professional standards for the assessment and mitigation of adverse impacts on paleontological resources have been established by the Society of Vertebrate Paleontology (SVP 1995).

Paleontological Resources Issues

Direct and indirect impacts on significant nonrenewable paleontological resources, including:

- Fossil remains of vertebrates, invertebrates, and plants
- Fossil footprints and trace fossils
- Significant paleontological sites
- Taphonomic (conditions and processes of fossilization) context
- Stratigraphic record

3.17.1.1 Federal Laws

The following federal laws protect paleontological resources:

- **American Antiquities Act of 1906 1(6 USC 431-433).** Establishes a penalty for disturbing or excavating any historic or prehistoric ruin or monument or object of antiquity on federal lands as a maximum fine of $500 or 90 days in jail.
- **The National Environmental Policy Act of 1969, as amended (Pub. L. 91-190, 42 U.S.C. 4321-4347, January 1, 1970, as amended by Pub. L. 94-52, July 3, 1975, Pub. L. 94-83, August 9, 1975, and Pub. L. 97-258 § 4(b), Sept. 13, 1982).** Recognizes the continuing responsibility of the federal government to "preserve important historic, cultural, and natural aspects of our national heritage…" (Sec. 101 [42 USC § 4321]).
- **Federal Land Management and Policy Act of 1976 (43 USC 1712[c], 1732[b]); sec. 2, Federal Land Management and Policy Act of 1962 [30 USC 611]; Subpart 3631.0 et seq., Federal Register Vol. 47, No. 159, 1982.** Defines significant fossils as unique, rare, or particularly well-preserved; an unusual assemblage of common fossils; being of high scientific interest; or providing important new data concerning (1) evolutionary trends, (2) development of biological communities, (3) interaction between or among organisms, (4) unusual or spectacular circumstances in the history of life, or (5) anatomical structure.

Federal protection for scientifically significant paleontological resources applies to projects if any construction or other related project impacts occur on federally owned or managed lands, involve the crossing of state lines, or are federally funded. The applicability of these criteria for federal protection will be determined at the Tier 2 level.

3.17.1.2 State Regulations

The following state regulation protects paleontological resources:

- **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 collecting prehistoric resources, including paleontological resources, on state lands, and actions that should be taken if resources are discovered in the course of state-funded projects and on state-owned/administered lands. Based on this legislation, the Colorado Department of Transportation (CDOT) requests assessments on state-owned and/or state-administered lands that have the potential to contain significant paleontologic resources, and monitoring/mitigation during ground disturbance in these areas. This paleontological assessment was requested by CDOT because of their oversight of the Corridor PEIS area and the federal involvement. All aspects of this study meet or exceed state of Colorado requirements.

3.17.1.3 Resource Assessment Criteria and Methods

The PEIS Corridor contains 40 mapped geologic units. Many of these are known to contain fossils of varying taxonomic affinity, significance, and density across their distribution based on museum records (University of Colorado Museum and Denver Museum of Nature and Science, unpublished specimen and locality data), the scientific literature, and previous paleontological assessments and surveys within Colorado and adjacent Rocky Mountain states. The paleontological assessment criteria, sensitivities levels, and descriptions of all geologic units within the study Corridor were evaluated using the resource assessment criteria presented in Appendix N, Historic Property Survey, Native American Consultation, and Paleontological Resources.

Supporting Documentation

- Appendix A, Environmental Analysis and Data
- Appendix N, Historic Property Survey, Native American Consultation, and Paleontological Resources

The paleontological evaluation procedures for this study were conducted in accordance with SVP 1995 guidelines by qualified and permitted paleontologists, and are consistent with SVP 1995 guidelines for assessing the importance of paleontological resources in areas of potential environmental effect. No field survey was conducted for this study.

Geologic maps and reports covering the bedrock and surficial geology of the project site and vicinity were reviewed to determine the exposed and subsurface rock units, to assess the paleontological potential and determine the resource sensitivity of each rock unit, and to delineate their respective areal distributions within the Corridor.

Scientific and technical literature, geologic maps, and museum record searches were conducted to (1) determine whether any known fossil localities occur within the project 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 Corridor. The museums included in the record search included the University of Colorado Museum (UCM) and the Denver Museum of Nature and Science (DMNS).

3.17.2 Affected Environment

The PEIS Corridor contains 40 mapped bedrock geologic units and surficial deposits that range in age from latest Holocene (Recent) to Proterozoic. Bedrock units with moderate or high paleontological sensitivity occur in three general segments within the Corridor as shown on Figure 3.17-1.

- The first segment extends east from the western edge of the proposed Transit alternatives at Gypsum (milepost 140.0) for approximately 52.6 miles to east of Vail Pass (milepost 192.6).
- The second segment extends from the Frisco area (milepost 201.2) approximately 6.6 miles to just east of Dillon (milepost 207.8). This area contains Mesozoic units with moderate and high paleontological sensitivity.
- The third segment extends from milepost 258.3 for approximately 2.6 miles to the Corridor's eastern edge at the C-470 interchange (milepost 260.9). This area contains Paleozoic, Mesozoic and Cenozoic (Paleocene) units with moderate and high paleontological sensitivity.

The Morrison Formation, Pierre Shale, and Denver Formation are considered to have the highest sensitivity of the geological units present within the Corridor. These formations occur between the following mileposts:

- Mileposts 153.8 to 155.2 (Morrison Formation)
- Mileposts 158.2 to 158.5 (Morrison Formation)
- Mileposts 203.9 to 204.4 (Morrison Formation)
- Mileposts 206.3 to 207.8 (Pierre Shale)
- Mileposts 259.3 to 259.4 (Pierre Shale)
- Mileposts 258.9 to 259.0 (Morrison Formation)
- Mileposts 260.8 to 260.9 (Denver Formation)

All of these occurrences of the high-sensitivity formations are within the three highway segments identified above. Sensitivities and descriptions of all formations are provided in Appendix N. Metamorphic and igneous rock units with no paleontological sensitivity underlie the Corridor from milepost 192.6 to milepost 201.2, and from milepost 207.8 to milepost 258.3.

Throughout the Corridor, Pleistocene and Holocene surficial deposits with low paleontological sensitivity occur locally and overlie bedrock units with high, moderate, low, and no sensitivity as indicated on Figure 3.17-1.

3.17.2.1 Paleontologic Sites Within 500-Foot Area of Potential Effect

More than 80 previously documented fossil localities in the general vicinity of the Corridor (same township) are documented in the following: the paleontological databases of the UCM or the DMNS; in scientific literature or technical reports; or are unpublished but known to the authors of this report and/or the CDOT staff paleontologist. Eleven fossil localities are known to occur within the project Area of Potential Effect (APE) (Table 3.17-1), which is generally defined as extending 500 feet on either side of the existing I-70 pavement. Areas of paleontological sensitivity within most of the Corridor were described by Wallace (1996) and Murphey and Evanoff (1999).

Table 3.17-1. Previously Documented Significant Fossil Occurrences Within the 500-Foot APE for the Corridor PEIS

Data Source	Locality Number or Name	Geologic Unit and (Age)	Fossils
DMNS	1052	Dakota Group (Cretaceous)	Plants
DMNS	1278	Morrison Formation (Jurassic)	Reptile (dinosaur)
Memo from Steven Wallace, CDOT, 10/1/1996	N/A	Minturn Formation (Pennsylvanian)	Corals, bryozoans, echinoderms, brachiopods, bivalves, gastropods, cephalopods
Memo from Steven Wallace, CDOT, 10/1/1996; Murphey and Evanoff, 1999	N/A	Minturn Formation (Pennsylvanian)	Brachiopods, horn corals, cephalopods, *Calamites*, and conifer leaves
Murphey, 2000	N/A	Minturn Formation (Pennsylvanian)	Brachiopods, bivalves, gastropods, ammonites, trackways and burrows
Memo from Steven Wallace, CDOT, 10/1/1996	N/A	Benton Shale (Cretaceous)	Fish scales, oyster shells, small clam valves
Memo from Steven Wallace, CDOT, 10/1/1996	N/A	Pierre Shale (Cretaceous)	*Baculites* (uncoiled ammonite)
WIPS (in Murphey and Evanoff 1999)	N/A	Dakota Group (Cretaceous)	Trace fossils, fossil wood
UCM	95026	Chaffee Group-Dyer Limestone (Devonian)	Marine Invertebrates
UCM	81052	Morrison Formation (Jurassic)	Reptile (dinosaur)
Murphey and Evanoff, 1999	N/A	Leadville Limestone (Mississippian)	Marine Invertebrates

3.17.3 Environmental Consequences

3.17.3.1 Direct Impacts

Approach

The following section presents an assessment of the proposed project alternatives, direct impacts on paleontological resources, and as appropriate, proposed mitigation measures. Direct adverse impacts primarily concern the destruction of paleontological resources and the loss of information associated with paleontological resources. These adverse impacts could be lessened if a monitoring and mitigation program is implemented. With mitigation, a beneficial impact would be the potential salvage of paleontological resources. Construction may result in some destruction of paleontological resources and loss of associated information (adverse impact); however, construction also would expose fossils that may otherwise never have been exposed by natural means and make them available for salvage, subsequent data recovery, and scientific analysis (beneficial impact). The loss of any intact fossil that may be likely to yield information important to prehistory, or that embodies the distinctive characteristics of a type, period, or region, would be a significant adverse environmental impact on the paleontologic resources of a site.

Clearing, grading, and removal of fossiliferous sedimentary deposits within the 500-foot APE, as well as the unauthorized collection of fossil remains by construction personnel, could result in the loss of previously unrecorded fossil sites and remains. If subsurface fossils are present at the project site, it is likely that they would be disturbed or destroyed by construction excavations. There would be no adverse impacts in areas where excavation and grading are within artificial fill, Holocene alluvium and glacial deposits, or Proterozoic igneous and metamorphic rocks, as these materials are unfossiliferous. Thus, no mitigation measures would be required in these areas. All potential adverse impacts as a result of construction in areas of previously unrecorded fossil sites in Paleozoic, Mesozoic and Cenozoic sedimentary rocks and Pleistocene and early Holocene surficial deposits could be reduced to through the implementation of the mitigation measures described in section 3.17.4.

In its “standard guidelines for the assessment and mitigation of adverse impacts on nonrenewable paleontologic resources,” SVP (1995 p. 23) defines three categories of paleontologic sensitivity (potential) for rock units: high, low, and undetermined.

- **High Potential.** Rock units from which vertebrate or significant invertebrate fossils or suites of plant fossils have been recovered and are considered to have a high potential for containing significant nonrenewable fossiliferous resources. These units include, but are not limited to, sedimentary formations and some volcanic formations that contain significant nonrenewable paleontologic resources anywhere within their geographical extent, and sedimentary rock units

temporally or lithologically suitable for the preservation of fossils. Sensitivity includes both (1) the potential for yielding abundant or significant vertebrate fossils or for yielding a few significant fossils, large or small, vertebrate, invertebrate, or botanical and (2) the importance of recovered evidence for new and significant taxonomic, phylogenetic, ecologic, or stratigraphic data. Areas that contain potentially datable organic remains older than Recent, including deposits associated with nests or middens, and areas that may contain new vertebrate deposits, traces, or trackways are also classified as significant.

- **Low Potential.** Reports in the paleontological literature or field surveys by a qualified vertebrate paleontologist may allow determination that some areas or units have low potential for yielding significant fossils. Such units will be poorly represented by specimens in institutional collections.
- **Undetermined Potential.** Specific areas underlain by sedimentary rock units for which little information is available are considered to have undetermined fossiliferous potential.

For a more complete discussion of these categories see section N.10 in Appendix N, Historic Property Survey, Native American Consultation, and Paleontological Resources.

No Action Alternative

The No Action alternative would consist of several planned or permitted projects, which are described in detail in Chapter 2, Description and Comparison of Alternatives. No additional direct impacts on paleontological resources are anticipated to occur under the No Action alternative.

Minimal Action Alternative

Direct adverse impacts on paleontological resources may result from ground-disturbing activities related to excavation, clearing, grading, and removal of Paleozoic, Mesozoic, and Cenozoic sedimentary rocks and Pleistocene and early Holocene alluvial deposits at project sites.

The following describes Minimal Action component improvements anticipated in proximity to sensitive formations or fossil localities:

- Mileposts 153 to 155 – Potential adverse impacts on the Morrison Formation could occur as a result of curve safety modification construction. This formation has a high paleontological sensitivity ranking.
- Mileposts 167 to 169 – Potential adverse impacts on the Minturn Formation could occur as a result of interchange modification and westbound auxiliary lane construction. This formation has a moderate paleontological sensitivity ranking.
- Mileposts 169 to 173 – Known adverse impacts on the documented fossil locality at mileposts 171 to 173 could occur as a result of curve safety modifications, including the proposed Dowd Canyon Tunnel. Although the Minturn Formation has moderate paleontological sensitivity, the fossil locality has a higher sensitivity ranking because impacts on the resource would be known.
- Milepost 206 – Potential adverse impacts on the Pierre Shale Formation could occur as a result of interchange modification construction. This formation has a high paleontological sensitivity ranking.
- Mileposts 258 to 259 – Potential adverse impacts on the Morrison Formation could occur as a result of interchange modification construction. This formation has a high paleontological sensitivity ranking.
- There would be no adverse impact in areas of the project site where excavation and grading are within artificial fill, Holocene alluvium and glacial deposits, and Proterozoic igneous and metamorphic rock units, as these materials are unfossiliferous. Thus, no mitigation measures would be required in these areas. All potential adverse impacts as a result of construction in areas of previously unrecorded fossil sites in sensitive rock units rated as high or moderate could be reduced through the implementation of mitigation measures identified in section 3.17.4.

Transit Alternatives

The following describes impacts from Transit alternatives anticipated in proximity to sensitive formations or fossil localities:

- All Transit alternatives would have direct impacts on paleontological resources of moderate and high sensitivity from Eagle County Airport to Vail Pass, mileposts 140 to 192.6, because of the extended footprint and alignment along the outside of the highway.
- The Rail with IMC and AGS alternatives from Frisco to C-470 and the construction of the third tunnel bores at the Twin Tunnels and EJMT potentially would not adversely affect sensitive formations because these rock units are primarily igneous and metamorphic in origin and have no paleontological sensitivity. There are sensitive formations between C-470 and Vernon Canyon.
- Potential adverse impacts on the Pierre Shale could occur at milepost 206, resulting from construction of Transit alternatives. This formation has a high paleontological sensitivity ranking.
- Potential adverse impacts on the Morrison Formation between mileposts 258 to 259 could occur as a result of double-track construction. This formation has a high paleontological sensitivity ranking.

All potential adverse impacts as a result of construction in areas of previously unrecorded fossil sites in sensitive rock units rated as high or moderate could be reduced through the implementation of mitigation measures identified in section 3.17.4.

Highway Alternatives

The following describes impacts from Highway alternatives anticipated in proximity to sensitive formations or fossil localities:

- Mileposts 169 to 173 – Construction of two additional lanes may potentially adversely affect paleontological resources that are moderately sensitive.
- Mileposts 169 to 173 – Known adverse impacts on the documented fossil locality at mileposts 171 to 173 could occur as a result of auxiliary lane construction. Although the Minturn Formation has moderate paleontological sensitivity, the fossil locality has a higher sensitivity ranking because impacts on the resource would be known.
- The new tunnel bore proposed for Dowd Canyon may adversely affect the Minturn Formation and a known fossil locality. This formation has moderate sensitivity.
- Mileposts 213 to 247 – The Highway alternative actions from the Continental Divide to Floyd Hill would not adversely affect paleontological resources because the igneous and metamorphic rock units in the proposed construction area are unfossiliferous and have no paleontological sensitivity.

All potential adverse impacts as a result of construction in areas of previously unrecorded fossil sites in sensitive rock units rated as high or moderate could be reduced through the implementation of mitigation measures identified in section 3.17.4.

Combination Highway/Transit Alternatives

The direct impacts for the Combination Highway/Transit alternatives would be the same as those for the separate Transit and Highway alternatives, as are the recommended mitigation measures.

3.17.3.2 Indirect Impacts

No adverse indirect impacts on paleontological resources are expected to result from the continuing operation of the proposed improvements to the Corridor.

3.17.4 Mitigation Measures

The following mitigation measures have been developed to reduce adverse impacts of project construction on paleontological resources to a less than significant level. The measures are derived from the guidelines of the Society of Vertebrate Paleontology and meet the requirements of the Bureau of Land Management, US Forest Service, and the National Academy of Sciences. These mitigation measures have been used throughout the western US and have been demonstrated to be successful in protecting paleontological resources while allowing timely completion of construction.

As a nonrenewable resource, paleontological resources are unique. At the time fossils are discovered, they have already been subjected to various destructive processes, including predation, scavenging, disarticulation, transport, primary weathering, diagenesis, erosion, secondary weathering, and damage through ground disturbance. It is difficult to develop measurable performance standards for paleontological mitigation because (1) fossils have been damaged by natural processes before their discovery, (2) fossils are typically further damaged by construction activities that reveal their presence to paleontological monitors, and (3) there is no way to quantify how many fossils exist at the project site but were not exposed during construction. Therefore, the absence of fossils would not indicate failure of the mitigation measures. Paleontological mitigation seeks to salvage as many significant fossils as possible before their destruction during human-mitigated ground disturbance. Measurable performance standards in paleontology apply to monitoring and mitigation procedures, which ensure that fossil sites are documented thoroughly and accurately, and that fossils are collected according to professional paleontological standards. The following are mitigation measures relative to Tier 1 level of detail. Programmatic and project specific mitigation measures are described below.

3.17.4.1 Programmatic Mitigation Measures

Preconstruction Survey and Excavation

Paleontological assessments of potentially sensitive geologic units along the Corridor would include a literature and museum record search to determine whether any previously known fossil localities occur within or near the project Corridor, and a field survey of project areas containing geologic units with moderate and high paleontological sensitivity. Mitigation during field survey would include documentation and collection of surface fossils. The results of the searches and field survey would be compiled in an assessment report, which would include recommendations for additional paleontological mitigation work, including construction monitoring in moderately or highly sensitive units. The assessment report could recommend additional surface collecting, systematic excavation of a representative sample of the fossils present at a known locality before construction, and/or construction monitoring.

Construction Monitoring

1. Paleontological monitoring would include inspection of exposed rock units and microscopic examination of matrix to determine if fossils are present. This work would take place during construction. Paleontological monitors would follow earth-moving equipment and examine excavated sediments and excavation sidewalls for evidence of significant fossil resources. The monitors would have authority to temporarily divert grading away from exposed fossils to professionally and efficiently recover the fossil specimens and collect associated data. All efforts to avoid delays to construction would be made.
2. If construction personnel find any subsurface bones or other potential fossils during construction, work in the area would cease immediately and the CDOT staff paleontologist or other qualified and permitted paleontologist would be contacted immediately to evaluate the significance of the find. Once salvage or other mitigation measures (including sampling) are complete, the paleontologist would notify the construction supervisor that paleontologic clearance has been granted.
3. Paleontological monitors would be equipped with the necessary tools for the rapid removal of fossils and retrieval of associated data to prevent construction delays. This equipment includes handheld GPS receivers, digital cameras, cell phones, and laptop computers, as well as a toolkit containing specimen containers and matrix sampling bags, field labels, daily monitoring forms, field tools (such as awl, hammer, chisels, and shovel), and a plaster kit. Trucks would transport specimens and samples to an appropriate paleontological laboratory for processing.
4. In the laboratory, all fossils would be prepared, identified, analyzed, and inventoried. Specimen preparation and stabilization methods would be recorded for use by the designated curation facility. All specimens would be transferred to the designated curation facility and accompanied by the final paleontologic resources report and all data in hard and electronic copy.
5. A final paleontological resources report would include the results of the monitoring and mitigation program, an evaluation and analysis of the fossils collected (including an assessment of their significance, age, and geologic context), an itemized inventory of fossils collected including photographs where appropriate, an appendix of locality and specimen data with locality maps and photographs, an appendix of curation agreements and other appropriate communications, and a copy of the project-specific paleontological monitoring and mitigation plan.

3.17.4.2 Project-Specific Mitigation Measures

Preconstruction Survey and Excavation

Before construction, a qualified and permitted paleontologist would be retained to conduct project-specific paleontological assessments in areas of high, medium, or unknown paleontological sensitivity. Literature and museum record searches would be conducted to determine whether previously documented fossil localities occur within or near the project area, or elsewhere within the same geologic unit. Depending on the results of the searches, the anticipated impact on the unit, and the unit's sensitivity, a field survey would be required. The field survey would include a visual inspection of all potentially fossiliferous outcrops within the study area. All fossil occurrences, whether significant or not, would be documented. Documentation would include a complete record of the geographic coordinates and stratigraphic context of the fossils, and the lithologies of the fossil-bearing strata. All significant fossils would be collected during the survey, if possible, depending on the number present and their size. This is because it is often difficult to re-locate small fossils, and erosion and weathering are adverse impacts on fossils that can be prevented if the fossils are collected and removed from the site. The results of the searches and field survey would be analyzed and presented in an assessment report. This report would include a discussion of the geology and paleontology of the project area, a paleontological sensitivity evaluation, a list of all fossils collected and/or observed and their significance, fossil locality data sheets, the paleontological permit number under which the work was performed, and the name of the curation facility in which the fossils were reposited, if applicable. The assessment report would also include resource mitigation recommendations. If no significant fossils were found in the searches and/or observed during the field

survey, paleontologic clearance would typically be recommended. If all the significant fossils, or a statistically significant sample thereof, were collected from the surface of the locality during the survey, paleontologic clearance would also typically be recommended. Additional mitigation work would be recommended if significant fossils are known to remain on the surface, are partially exposed, or if there is a high probability that significant sub-surface fossils exist within the study area. This work could include additional surface collecting, or systematic excavation of a locality to salvage a significant fossil or collect a statistically significant sample of the fossil taxa present at the locality. If significant sub-surface fossils may be further affected during ground disturbance, construction monitoring may be recommended.

Construction Monitoring

1. Before the construction permit is issued, a qualified and permitted paleontologist would be retained to produce the mitigation plan and would be responsible for implementing the mitigation measures. This includes supervising the monitoring of construction excavations in areas with paleontological sensitivity (see below).
2. The qualified paleontologist would attend preconstruction meetings to consult with the grading and excavation contractors.
3. Language would be placed in the construction specifications to state that the paleontological monitor would be onsite during grading or trenching operations. The construction contractor would be instructed via the written specifications and at the preconstruction meeting to stop construction if fossils, as verified by the paleontological consultant, were unearthed. Work would cease within the vicinity of the fossils so that they could be recovered and removed from the site.
4. All project personnel would be required to attend a Worker Awareness Training Program before initiation of construction activities. The qualified paleontologist would administer the paleontologic resource portion of the training program. The program would educate construction personnel on the types of fossils that could be found in project excavations, their appearance, and penalties for illegal collecting.
5. If microfossils were present, the monitor would collect matrix for processing. To expedite removal of fossiliferous matrix, the monitor may request heavy machinery assistance to move large quantities of matrix out of the path of construction to designated stockpile areas. Testing of stockpiles would consist of screen-washing small samples (approximately 200 pounds) to determine if significant fossils were present. Productive tests would result in screen-washing of additional matrix from the stockpiles to a maximum of 6,000 pounds per locality to ensure recovery of a scientifically significant sample.
6. At each fossil locality, field data forms would be used to record the locality, measured stratigraphic sections, and appropriate scientific samples that were collected and submitted for analysis.
7. In the event of discovery of unanticipated fossil remains, such as unexpected concentrations of fossils, unusually large specimens, or discoveries in sediments in which they were not expected, all ground disturbance in the area would cease immediately. The qualified paleontologist and appropriate project personnel would be notified immediately to assess the significance of the find and make further recommendations.

Mitigation Measures in Areas of High Paleontological Sensitivity

Before initiation of all earth-moving construction activities in rock units of high paleontological sensitivity, a preconstruction paleontological survey and the Worker Awareness Training Program would be required, followed by continuous paleontological monitoring during all phases of construction. This monitoring protocol would apply to construction activities that occur in the Morrison Formation, the Pierre Shale Formation, and the Denver Formation.

Mitigation Measures in Areas of Moderate Paleontological Sensitivity

Before initiation of all earth-moving construction activities in those formations with moderate paleontological sensitivity, including the Minturn, Dotsero, Manitou, Chaffee Group, Leadville Limestone, Belden, Eagle Valley, Maroon, Fountain, Lyons Sandstone, Chinle, Ralston Creek, Dakota Sandstone, South Platte, Lytle, Benton Shale, Fox Hills Sandstone, Laramie, and Arapahoe Formations, a preconstruction paleontological survey and the Worker Awareness Training Program would be performed. Construction work conducted in these units would be then monitored on a spot-check basis.

Mitigation Measures in Areas of Low Paleontological Sensitivity

Pleistocene and early Holocene surficial deposits such as alluvium, colluvium, talus, landslide deposits, and glacial deposits have a low paleontological sensitivity ranking. A Worker Awareness Training Program would be conducted before the initiation of all construction activities. Monitoring would not be required, but spot-checking may be conducted in certain areas at the discretion of the CDOT Staff Paleontologist or Project Paleontologist. In the case of the Quaternary deposits, this would ensure that older underlying fossiliferous sediments were not being affected.

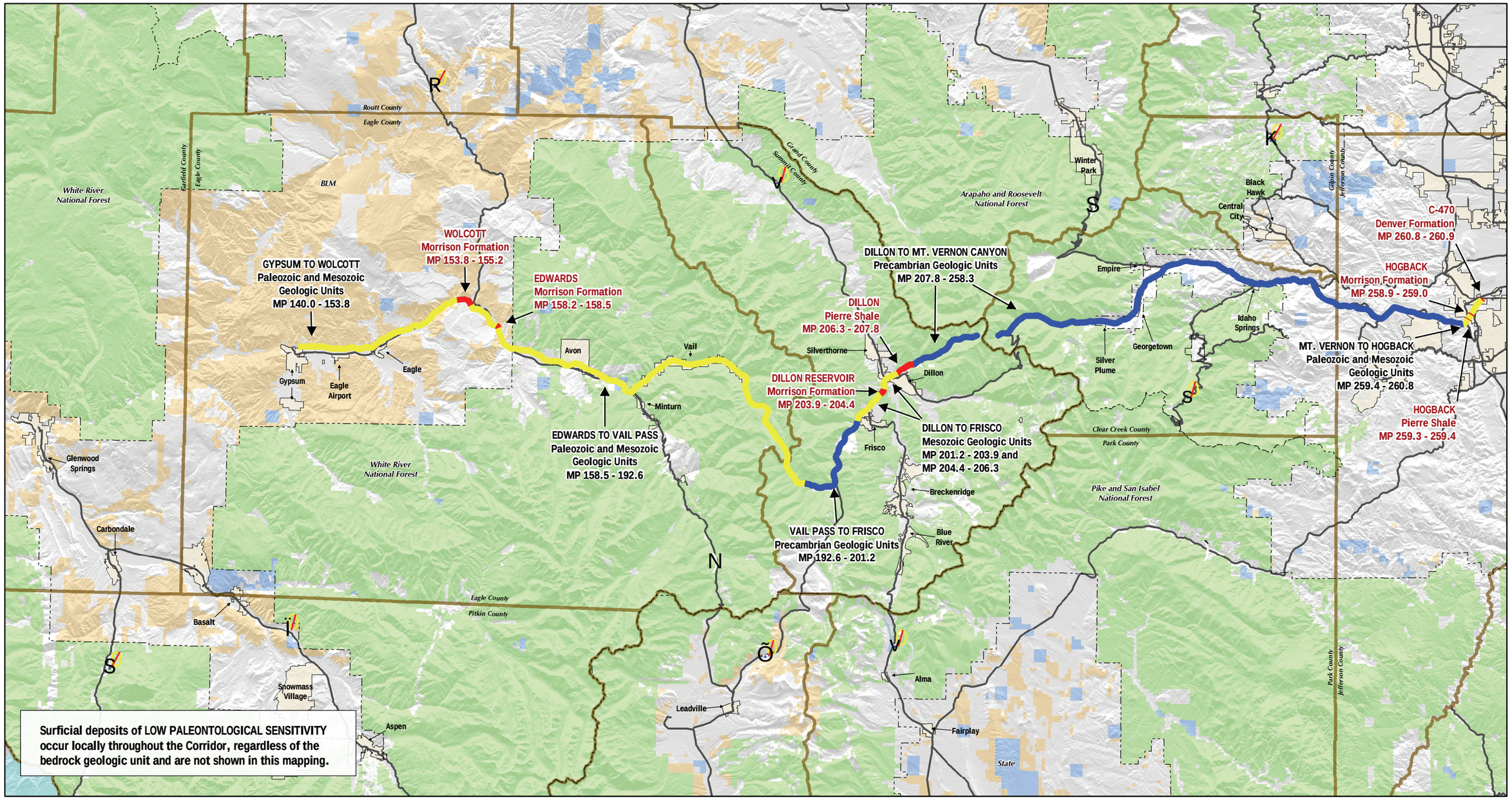

Figure 3.17-1. Paleontological Sensitivity of Bedrock Geologic Units