



Ms. Beth Boaz, Activity Manager
Bureau of Reclamation
Eastern Colorado Area Office
11056 W. County Road 18E
Loveland, CO 80537-9711

June 15, 2007

Dear Ms. Boaz:

I am writing to voice my opinion concerning the portion of Jimmy Camp Creek that has been proposed as a potential reservoir for the city of Colorado Springs. I am a working paleobotanist, chief curator, and Vice President of Research and Collections at the Denver Museum of Nature & Science with 17 years of direct experience concerning the paleontology of the Denver Basin. In this letter, I will argue that the fossil resources of the Jimmy Camp Creek and adjacent Corral Bluffs are regionally and globally significant and that they merit some combination of preservation, mitigation, and interpretation. Any plan for the region must be aware of and accommodate the special challenges presented by this unique paleontological resource and I would strongly encourage decision makers to consider alternate sites for the proposed reservoir.

I have been familiar with the Jimmy Camp Creek area since 1991 and have been undertaking active research on the property since 1996. In this context, my teams accessed the property in question with the support and permission of Colorado Springs Department of Parks and Recreation and the Banning-Lewis Ranch (managed at the time by Palmer-McAlister). Since 1996, I have led the Denver Basin Project, a multidisciplinary research effort to study the stratigraphy, hydrology, and paleontology of the Denver Basin (see <http://www.dmns.org/main/en/General/Science/Online+Science/Denver+Basin+Project/>). Our work is science-driven and has been funded by the National Science Foundation, the Colorado Water Conservation Board, the office of the Colorado State Engineer and we have collaborated with the Colorado Geological Survey, the U. S. Geological Survey, the University of Colorado at Boulder, the Colorado State University, Colorado College, and the Colorado Springs Department of Parks and Recreation. The website listed above contains PDFs of numerous scientific papers that we have published concerning the geology, paleontology, and hydrology of the Denver Basin. Many of these are listed at the end of this letter.

The Denver Basin by our definition is the geologic structure that stretches from Colorado Springs to Greeley and from the Front Range border fault to Limon. The geological formations exposed in the basin are in ascending order: the Fox Hills Formation, Laramie Formation, the D1 Synorogenic Sequence (also known as the Arapahoe Conglomerate, Denver Formation, and

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Dawson Formation), the D2 Synorogenic Sequences (also known as the upper Dawson Formation), the Castle Rock Rhyolite and the Castle Rock Conglomerate. The proposed reservoir location occurs on Jimmy Camp Creek just north of Colorado highway 94 east of Colorado Springs. Geologically this is in the extreme southwest corner of the Denver Basin.

The exposures at Jimmy Camp Creek and the adjacent Corral Bluffs are extremely important for the following reasons: 1) The narrows at Jimmy Camp Creek contains one of the three best exposures of the Cretaceous-Tertiary (K-T) boundary in the Denver Basin and one of the top 25 in the world; 2) both the Jimmy Camp Creek Valley and the adjacent Corral Bluffs include some of the most extensive surface exposures and badland outcrops in the Denver Basin; 3) this area is extremely fossiliferous and contains fossil mammals, dinosaurs, fossil leaves, and very large petrified trees from the Late Cretaceous and early Paleocene time periods. I will discuss each of these elements in separate sections below. I acknowledge but will not discuss the historical and ecological value of the area since those topics are not in my direct expertise.

1-The K-T boundary at Jimmy Camp Creek

The K-T boundary is the moment in time that separates the Cretaceous Period from the Tertiary Period. Our best estimate places this event at 65.5 ± 0.3 million years ago. The K-T boundary is famous because it is coincident with the extinction of the dinosaurs and many other organisms that were alive at the end of the Cretaceous Period. Since the early 1980s, there has been scientific consensus that this extinction was caused by the impact of a 10 km diameter asteroid or comet on the northwest corner of the Yucatan Peninsula in Mexico. In a sequence of layered sedimentary rocks, the K-T boundary can be expected to be expressed as a single thin layer. At other sites in North America, this layer which is composed of the fallout from the airborne debris of the asteroid/comet impact is approximately 1 cm thick. In situations where the sedimentary rock layers are horizontal, the K-T boundary will be expressed as a 1 cm layer that follows and maps onto topographic contour lines. In cases where the sedimentary rocks are not horizontal, the situation is more complicated and the K-T boundary will intersect the ground surface in a line that is a function of both the dip of the bedrock and the complexity of the surface topography. It is this latter situation that occurs at Jimmy Camp Creek. At the intersection of Jimmy Camp Creek and Colorado Highway 94, the sedimentary strata dip to the north/northeast at approximately 20 degrees. This dip shallows to the north and north of the Banning-Lewis homestead the dip is less than 5 degrees.

In practice, the K-T boundary in terrestrial rocks (those rocks formed on land as opposed to those formed under the seas) cannot be recognized by direct field observation. It must be uniquely identified by four independent laboratory tests: stratigraphic palynology to determine the extinction of Cretaceous pollen and spore species, magnetostratigraphy to determine the presence of reversed magnetic polarity, neutron activation analysis to identify the K-T iridium anomaly, and mineralogical analysis to determine the presence of shock-metamorphosed mineral grains. Many K-T boundary sites are tentatively known because they have not yet been confirmed to test positive on all four tests. At present, only 5 locations in the world exhibit positive responses on all four tests. To date, the section at Jimmy Camp Creek has been confirmed as the K-T boundary based on stratigraphic palynology and magnetostratigraphy, making it one of 27 similar sites worldwide. In theory, the K-T boundary should form an oval pattern of outcrop around the Denver Basin. In practice, there is so little surface outcrop in the Denver Basin that the K-T

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boundary is only known at the surface in three locations: Jimmy Camp Creek, the West Bijou site of the Plains Conservation Center, and the southeast corner of South Table Mountain near Golden. The West Bijou site has positive results for all four tests.

The K-T boundary at Jimmy Camp Creek is poorly known simply because not enough research has been done to define it. The outcrops of the K-T boundary stratigraphy at Jimmy Camp Creek are superb and the potential exists for this to be one of the top ten K-T boundary sites in the world. The rough location of the K-T boundary at Jimmy Camp Creek is the area where Jimmy Camp Creek narrows and turns west just to the north of the Banning-Lewis homestead. This is also the proposed site of the dam that would impound the Jimmy Camp Creek Reservoir. It is thus likely that the proposed reservoir would bury (under the dam) and/or flood (under the reservoir) one of the most significant K-T boundary sections in Colorado and the world. Were the reservoir project to go forward, I would recommend mitigation to define and analyze the K-T boundary. This work should proceed excavation and be concurrent with it as the excavation may unearth significant stratigraphic sections and fossils.

2-Natural geologic outcrops

The valley of Jimmy Camp Creek and the adjacent Corral Bluffs form the largest contiguous natural surface outcrops of the D1 synorogenic sequence (also known as the Arapahoe, Denver and Dawson formations) in the Denver Basin. Exposures south of Colorado Highway 94 include superb outcrops of the Fox Hills Sandstone and the Laramie Formation. Collectively, this is the most continuous and complete surface exposure of latest Cretaceous and early Paleocene strata in the Denver Basin. These formations are only sporadically exposed around the rest of the basin and they are extremely significant since they comprise the main bedrock aquifers that supply groundwater to El Paso and Douglas County communities.

These outcrops occur as high bluffs, rounded badlands, stream- and gully-wall exposures and as subtle surfaces exposed on the prairie. Due to property ownership and restricted access, these areas are poorly known by the public and remain a hidden and under-utilized open-space asset for the region. Specific outcrops are rarely recognized as resources in their own right and that is largely a function of the poor state of knowledge of the Denver Basin stratigraphy and the lovely outcrops of older rocks that occur along the western margin on the Denver Basin (e. g. Garden of the Gods, Red Rocks etc.). The reality is that the Jimmy Camp Creek and Corral Bluffs outcrops are unique in the Denver Basin and should be preserved in their natural state for the enjoyment of the citizens of Colorado.

3-Fossil resources

The valley of Jimmy Camp Creek and the adjacent Corral Bluffs are extremely fossiliferous. The exposed rock layers range in age from 70 to 64 million years old and represent the Maastrichtian Stage of the Cretaceous Period and the Puercan and possibly Torrejonian Land Mammal stage of the Paleocene epochs. With the exception of the Pierre Shale and lower Fox Hills Sandstone, all of the exposed units were deposited under terrestrial conditions and the fossils are derived from terrestrial plant and animals. The most common fossils in this area are leaf compressions, petrified and carbonized wood, and the bones and teeth of mammals and dinosaurs (and other reptiles). The fossil leaves occur throughout the section and are only discovered by excavation

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since they weather away at the same rate as the bedrock. The petrified wood and logs and the bones and teeth occur at the surface since they are more resistant than the surrounding bedrock.

Since 1991 the Denver Museum of Nature and Science has collected all of these different types of fossils. Our preliminary fieldwork suggests that the area is extremely rich in fossils and that any land use plans must make accommodation for preservation, ongoing research, and interpretation. The nature of the bedrock in this area is such that new fossils are continually being exposed by erosion and it is not sufficient to simply sweep the area once and consider the work done.

I will summarize the fossil resources by type, discussing: 1) plant compressions; 2) petrified logs and trunks; 3) dinosaurs and other reptiles; 4) mammals.

Fossil plant compressions are ubiquitous in the Laramie Formation and D1 Synorogenic sequence. They occur as prints of leaves, twigs, seeds, fruits, and cones in sandstone, mudstone, or siltstone. They also occur as fossils of microscopic pollen and spores in mudstone and claystone. They can literally be found at almost any natural outcrop of suitable lithology in the Jimmy Camp Creek-Corral Bluffs area. As such, this area provides the single best place in the Denver Basin to study the floral response to the K-T boundary. Fossil plants are discovered by excavation and are not obvious to simple surface excavation. It can be expected that any construction-based excavation will regularly encounter fossil leaf sites. The most appropriate method to excavate fossil leaf sites is to create a bench quarry and remove a statistically valid sample of 500-1000 fossil leaves or other plant organs. Fossil pollen can be sampled by collected small (<100 mg) samples of mudstone. To date, DMNS has excavated less than ten leaf quarries in this area. We have sampled over 20 fossil pollen sites. These fossils are stored at DMNS, are available for inspection and research, and are part of an ongoing National Science Foundation funded 4-year research project. One of the fossil leaf sites also preserved an extremely rare fossil bird feather and highly unusual salamander footprints.

Petrified wood is unusually common in this area. The banks of Jimmy Camp Creek expose upright and in-place petrified trunks at a site between CO 94 the Banning-Lewis Ranch house and there is a superb petrified logjam exposed along the upper ledges of Corral Bluffs. In this area a single and extensively exposed sandstone bed contains dozens of large horizontal petrified logs ranging up to 4 feet in diameter and as long as 50 feet. These logs have never been studied or analyzed and should be an integral part of any land use plan for the area. Collectively, these logs represent one of the finest fossil forests in Colorado yet they are poorly known both to science and the public. The area also includes a host of carbonized trunks. At one location in the proposed reservoir area, there is a buried forest of carbonized and in place fossil palm trunks.

Dinosaur bones are relatively common below the K-T boundary but no partial or whole skeletons have yet been discovered. The potential for their discovery is high, especially if any excavation occurs. The bones of turtles and bones, scutes, and teeth of crocodiles are the most common vertebrate fossils in the area and occur throughout the Jimmy Camp Creek Valley and adjacent Corral Bluffs. DMNS excavated a nearly complete skull of an unnamed crocodile on the flanks of the Corral Bluffs in 2000.

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Fossil mammals from the Paleocene portion of the section are some of the most important fossils in the area. University of Colorado PhD. student Mike Middleton based his dissertation on these fossils. Represented by teeth, jaws, and bones, the mammal fossils from Corral Bluffs represent one of the most significant Puercan-aged mammal assemblages in the world. DMNS re-sampled these fossils in 1999-2000 and the resulting specimens were described by Dr. Jaelyn Eberle (2003). These fossils represent the best example of Puercan mammals in Colorado and one of the top 20 Puercan mammal sites in the world.

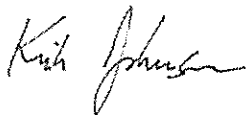
In summary, this area is regionally significant because its extensive natural outcrops are the best exposures of Late Cretaceous and early Paleocene strata in the Denver Basin and they provide nearly unique access to the rich fossil resources of the Denver Basin. The area is globally significant for three main reasons: 1) It contains a superb but not-fully-researched exposure of the Cretaceous-Tertiary boundary; 2) It contains a large and significant but largely unknown fossil forest; and 3) Fossil mammals from this area represent one of the top 20 sites in the world for the preservation of mammals from the first 1 million years of the age of mammals.

Land use planning for this area should: 1) accommodate present and ongoing research including exploration and excavation; 2) be prepared to support salvage paleontology during any excavation or construction; 3) strongly consider plans for how to preserve both the natural outcrops and the exposed and buried fossil resources; and 4) build an interpretive plan that could possibly include guided trails, interpretive signage, and even an interpretive center.

Given the uniqueness of these paleontological resources, their burial or flooding by the proposed reservoir seems unfortunate and I would like to strongly encourage decision makers to consider other alternatives. I would be more than happy to meet with appropriate groups to discuss strategies to support the optimal treatment of paleontological resources.

I can be reached for additional information or comment at 303-370-6448 or at kirk.johnson@dmns.org.

Sincerely



Kirk Johnson, Ph. D.
Chief Curator and
Vice President of Research and Collections

cc:

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