(Cretaceous ammonite fossil)

FAULTS, FOSSILS & CANYONS

Significant Geologic Features on Public Lands in Colorado

eologic Advisory Group
to
ureau of Land Management
February 1986

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GEOLOGIC ADVISORY GROUP TO

BUREAU OF LAND MANAGEMENT

February, 1986

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PREFACE

A cooperative agreement between the Department of Natural Resources, State of Colorado, and the Bureau of Land Management - Colorado State Office (BLM), signed in April 1984, defines the responsibilities of the State of Colorado and the Bureau of Land Management in the identification and evaluation of geologic features on BLM lands in Colorado (see Appendix A). Submission of this final report to BLM fulfills the responsibilities of the Colorado Natural Areas Program and the Colorado Department of Natural Resources as outlined in the cooperative agreement.

The cooperative agreement between the Colorado Department of Natural Resources and the Bureau of Land Management is based in part on an existing Memorandum of Understanding (MOU) executed in January 1983 between Colorado Department of Natural Resources and the Bureau of Land Management - Colorado (see Appendix B). The MOU describes a process for identification, registration, and designation of those areas managed by BLM which qualify as state natural areas and BLM Special Management Areas (e.g., areas which possess unique or exemplary natural features of statewide or national significance).

Results of the work by the BLM Geologic Advisory Group are summarized in this report. Site-specific information is presented by BLM district: Canon City, Craig, Grand Junction, and Montrose. Appendices to the report contain additional information on the evaluation of geologic sites for the Geologic Advisory Group.

INTRODUCTION AND SUMMARY

Purpose of Geologic Advisory Group. The BLM-Geologic Advisory Group, consisting of experts in the fields of geology and paleontology, was established by the Department of Natural Resources. The Geologic Advisory Group has two principal functions:

1) to identify and evaluate geologic sites on BLM lands in Colorado which may qualify for special management area designation (Research Natural Areas, Outstanding Natural Areas, or Areas of Critical Environmental Concern); and

2) to recommend appropriate management to BLM for the identified significant features.

The Geologic Advisory Group provided a systematic and professional review of existing data on rare or exemplary geologic features which are used for scientific research or education on BLM lands in Colorado and provide additional data on geologic features on BLM lands where necessary. Members of the Geologic Advisory Group include professional geologists from Colorado's academic institutions, research community, industry, and federal and state agencies (Appendix C).

Results of Site Evaluations. Thirty-nine geologic sites were evaluated by the BLM Geologic Advisory Group. Information on these sites is contained in Appendix D (Summary of GAG Sites). Twenty-five of the evaluated sites were recommended by the GAG for Special Management Area (SMA) designation based upon the significance of their geologic features. Eleven of these 25 areas were recommended by the GAG as Research Natural Areas (RNA); eight sites were recommended as Outstanding Natural Areas (ONA) for geologic features; four areas were recommended as Special Management Areas (SMA); and one area was recommended for a recreational (REC) designation.

The initial list of areas considered by the Geologic Advisory Group was weighted with nationally or regionally known sites containing significant geologic features. Recommendations made by the GAG emphasize the national importance of these geologic features.

The "SMA" (Special Management Area) designation used by the GAG has no official status within BLM statutes or regulations. The GAG used a "Special Management" Area denotation to highlight the importance of the geologic features of a site without assigning any particular management recommendation defined by statute or regulation to a site. The Special Management Area designation can be used as one element by BLM in the selection of areas for ACEC designation. The GAG did not recommend any areas for Area of Critical Environmental Concern (ACEC) designation. Research Natural Areas or Outstanding Natural Areas will be designated in conjunction with ACEC designation in accordance with BLM regulations. A recreational designation (REC) was developed by the GAG to specify the interpretive use by the public of geologic sites.

Seven areas were not recommended by the GAG for Special Management Area designation. Recommendations by the GAG for no Special Management Area designations were based on size of site, ownership status, lack of uniqueness or significance of geologic features, and the extent of modifications to geologic features by human activities or natural forces. Consideration by the GAG of six other sites was deferred until field evaluations could be completed.

Site Information Summaries. Site information summaries for each of the geologic features evaluated by the GAG are listed alphabetically by BLM district (Canon City, Craig, Grand Junction, and Montrose) in Chapter Two of this report.

Benefits of GAG to BLM and State. One of the principal benefits to both the BLM and the State of Colorado resulting from the work of the Geologic Advisory Group is the contribution of voluntary expert professional identification, review, and evaluation of the scientific importance of geologic features of BLM lands. The cooperative aspects of the Geologic Advisory Group -- state and federal cooperation, and public and private sector cooperation -- help to ensure that reasonable and balanced land and resource management decisions are made in Colorado by BLM. The GAG provides an important forum for researchers and educators to supply information on the natural values of BLM lands to its land managers.

THE GEOLOGIC ADVISORY GROUP PROCESS

The Geologic Advisory Group functions on two levels:

1) identification, evaluation, and assessment by GAG members of significant geological sites within his/her particular area of expertise; and

2) periodic meetings of the entire Geologic Advisory Group to review and evaluate site information, and to make management recommendations.

Five meetings of the Geologic Advisory Group were held prior to completion of this report. The first meeting was held on November 10, 1983, in Boulder, Colorado, and focused on a review of proposed site evaluation guidelines, draft site evaluation forms, and initial assessments of previously identified geologic sites on BLM lands in Colorado. Well-known geologic sites on BLM lands that were identified in earlier studies were also considered by the Geologic Advisory Group. GAG members proposed additional sites that they believed qualified for further assessment. Previously identified geologic sites and GAG proposed sites constituted the initial 39 geologic sites assessed by the GAG. The GAG reviewed draft guidelines for identifying and evaluating geologic features on BLM lands. A draft site evaluation form was considered by the GAG. Recommendations were made on its content and format. Thirty-nine sites were proposed by members of the Geologic Advisory Group for further consideration, including twelve previously identified sites on BLM lands

(see "Final Report: Natural Landmarks of the Southern Rocky Mountain Region," Thorne Ecological Institute, 1980).

A second meeting of the GAG was held on January 10, 1984, in Boulder, Colorado, to consider preliminary evaluations and recommendations on sites. Further revisions to the draft site evaluation form were made. A final site evaluation form was distributed to GAG members. The GAG made final recommendations on several sites at this meeting. Action was deferred on identified sites requiring additional information or further field work.

On-site field evaluations are a valuable part of the Geologic Advisory Group's assessment of significant geological sites. The GAG met for a three-day field session, May 7-9, 1984, in Grand Junction, Colorado to complete site evaluations, and to consider management recommendations for significant geologic areas in the BLM - Grand Junction District. The GAG field-evaluated ten sites and made management recommendations for several of them. A 1984 summer field schedule for further site evaluations was developed. Several GAG members performed field evaluations during the 1984 field season.

The Geologic Advisory Group again met on September 27, 1984, at Boulder, Colorado, following the summer field season, to complete the site evaluation and management recommendation phase of the project. Further field work and site evaluations will be performed by the Geologic Advisory Group and information provided in subsequent documents.

The Geologic Advisory Group met for another three-day field session, May 14-16, 1985, in Montrose, Colorado, to perform site evaluations, and to consider management recommendations for significant geologic areas in the BLM-Montrose District. Four sites were evaluated in the field and management recommendations completed by the GAG. A 1985 field evaluation for additional site evaluations was developed.

GUIDELINES FOR IDENTIFICATION OF GEOLOGIC FEATURES ON BLM LANDS IN COLORADO

The Geologic Advisory Group developed guidelines for the identification and evaluation of geologic sites on BLM lands to provide a uniform, and systematic, procedure for performing site identifications and evaluations (see Appendix E). The GAG guidelines focus on delineation of sites by national or statewide significance, and on the justification of ranking of high priority sites.

Five general criteria were used to evaluate each identified site.

1) Site is not expected to be lost due to natural catastrophe, development, land use change, or errors in management.

2) Site contains a geologic feature that is unusual, or is of statewide or national significance.

3) Site has significant fossil evidence illustrating the evolution of life (see Appendix E - Addendum: Paleo Guidelines).

4) Site is an example of scenic grandeur, high aesthetic value, or unusual natural features.

5) Site exhibits or possesses classic research or educational opportunities.

Identified sites must exhibit certain scientific and resource values.

1. Quality of the site
   Site contains an excellent example of a geologic feature or process which is particularly well-suited for research, teaching, or interpretive use (e.g., faulting, folding, mass wasting phenomena, stratigraphic sequence, history of life on earth).

2. Condition of the site
   Site is relatively free of disturbance, can withstand some land uses, or is adequately protected from disturbance.

3) Viability of the site
   Condition of the site can be maintained in the future with appropriate management.

4) Defensibility of the site
   Site is geographically or topographically removed from areas of development where possible, or has a small likelihood of being in the path of development, or has appropriate protective management through the BLM planning process where natural values outweigh development values. Site will be designed to minimize potential conflicts with existing land use values.

Specific guidelines for evaluating significant paleontological resources were developed by the Geologic Advisory Group (see Appendix E). The guidelines for significant paleontological resources were adopted, in part, from similar guidelines used by the State of New Mexico's Bureau of Mines and Mineral Resources for determining mitigation of impacts to paleontological resources from coal mining. These guidelines form the basis of a recently signed (1984) Memorandum of Understanding between BLM New Mexico and the State of New Mexico for paleontological mitigation procedures on BLM managed lands within New Mexico.

The Geologic Advisory Group Guidelines contain three principal special management area designations used by BLM, and defined in the Code of Federal Regulations: Research Natural Area (RNA); Outstanding Natural Area (ONA); and Area of Critical Environmental Concern (ACEC).

Research Natural Area (RNA). Research Natural Areas are defined in 43 CFR 8223.0-5 and 43 CFR 2071 as areas: "established and maintained for the primary purpose of research and education because the land has . . . the following characteristics . . . (4) a typical representation of common geologic, soil, or water features; or (5) outstanding or unusual geologic, soil, or water features" (emphasis added). Natural areas shall be used in a manner consistent with the purpose for which the area is designated. "The area shall be used by scientists and educators in a manner which is nondestructive and consistent with the purpose of the research natural area." Areas established as Research Natural Areas shall be of sufficient number and size to adequately provide for scientific study, research, and demonstration purposes.

Outstanding Natural Area (ONA). Outstanding Natural Areas are defined in 43 CFR 2071.1 (IV) as "areas of outstanding scenic splendor, natural wonder, or scientific importance that merit special attention and care in management to insure their preservation in their natural condition." These areas are relatively undisturbed and "representative of rare botanical, geological, or zoological characteristics of principal interest for scientific and research purposes." Outstanding Natural Areas are established to preserve scenic values and areas of natural wonder where management of recreation activities is necessary to preserve those characteristics.

Area of Critical Environmental concern (ACEC). An Area of Critical Environmental Concern (43 CFR 1610.7) is an area "within the public lands where special management attention is required to protect and to prevent irreparable damage to important historic, cultural, or scenic values, fish and wildlife resources, or other natural systems or processes, or to protect life and safety from the natural hazards" (FLPMA, sec. 103, 1976). BLM regulations (43CFR 1610) require that identification of potential ACEC's shall be given "priority" in the "inventory of all public lands and their resources and other values." A potential ACEC "shall not change or prevent change of the management or use of public lands." A potential ACEC must meet certain relevance and importance criteria.

Several other management categories were developed by the Geologic Advisory Group which pertain to areas not covered by the RNA, ONA, and ACEC management classifications.

SITE EVALUATION FORM

The following information and recommendations are included for each evaluated site:

1) recommended name;

2) approximate site boundaries containing identified geologic feature(s);

3) summary of significance of geologic feature(s); and

4) management recommendation and rationale for recommendation.

The site evaluation form used by the Geologic Advisory Group was designed to contain pertinent geological information for BLM managers and other users, to permit easy access to information via a variety of queries, and to be compatible with current data management systems used by the Colorado Natural Areas Program. Specific information on each site is stored on an automated data system maintained at the University of Colorado Museum in Boulder. Access to data by BLM users is provided bythe University of Colorado Museum. Information contained on the GAG site evaluation form is compatible for use with other geological and paleontological information sources in Colorado (e.g., the Colorado Natural Areas Inventory, Colorado Department of Natural Resources).

The site evaluation form (Appendix F) contains an element occurrence code which is the principal accessing component. This code specifies BLM district and resource area, the principal significant geologic feature on the site, and the geologic age of the site. The database can be queried using the ranking of the site (global, national, state) and by county. The site evaluation form contains information on the "value" of the site for scientific research or education, possible threats to the site, existence of public access, and management recommendations. The automated section of the site evaluation form includes space for an abstract summarizing the geological importance of the site. A more detailed, non-automated narrative bibliography for additional information on the geological feature is included on the site evaluation form.

Areas evaluated by the Geologic Advisory Group were given a composite ranking according to the international and national (G) or statewide (S) significance of the site. Numbers following the letters in the composite ranking indicate the priority of the site (e.g., 1 = highest priority, extremely rare; 4 = lowest priority, numerous occurrences). For example, G1S1 sites are extremely rare worldwide and statewide, vulnerable to loss, and of the highest priority for protection. The GAG identified and evaluated several areas having geologic features that may be common nationwide, but which are of particular importance, either statewide or locally, for scientific research and educational purposes. The geological significance of these locally important areas has resulted in management recommendations encouraging recognition, by BLM, of the importance of such areas for research and education.

The sensitivity of sites to human impacts or to public use is indicated on the site evaluation form. Some areas include recommendations for restricted access for research purposes.

The existing or potential scientific value of the site is denoted on the site evaluation form. A value spectrum for each site was prepared by the Geologic Advisory Group. The highest scientific use priorities are those with type locality, type specimen, current scientific research, future research potential, and academic training values.

A general category of Special Management Area (SMA) was used to identify areas which contained significant geologic features, but where the geologic feature was evident over a large area, the area had complex

land ownership, or the importance ranking of the geologic feature did not justify more specific management designations. Other management recommendations used by the Geologic Advisory Group included off-road vehicle restrictions (ORV), recreational or public use designations (REC), site specific surface stipulations (STP) such as "no surface occupancy," and no special management necessary (NON). Off-road vehicle stipulations were recommended by the GAG for sites that would be damaged by ORV use, but that could tolerate other public uses. Site specific stipulations (i.e., no surface occupancy) were recommended for certain sites to protect geologic values or to restrict public access during particular times or seasons. Recreational or public use designations of sites by the GAG was used to encourage interpretive or active public use of certain geologic areas. A designation of no special management by the GAG meant that the geologic feature was common or that the site was too difficult to manage.

The Geologic Advisory Group reviewed and evaluated the existing and potential degree and type of threat to the geologic areas. This degree of threat was ranked from immediate to unknown. The type of threat was evaluated, ranging from natural forces (weathering and erosion) to human impacts from collecting, vandalism, mining, development, or destructive land uses.

PALEONTOLOGICAL PERMITS IN COLORADO

The BLM - Colorado State Office is responsible for reviewing and approving paleontological permit applications. Since permit authority under the Antiquities Act of 1906 has recently been eliminated, the Federal Land Policy and Management Act of 1976 is currently used to issue land use permits for paleo resource use. The Geologic Advisory Group provides expertise to the BLM State Office in order to facilitate the review of paleontological permits in Colorado. The GAG is expected to review between five and ten paleontological permit applications annually.

COLORADO NATURAL AREAS PROGRAM

The Colorado Natural Areas Program coordinates the BLM Geologic Advisory Group under provisions of a Cooperative Agreement between the Bureau of Land Management and the Colorado Department of Natural Resources for the BLM Geologic Advisory Group. The Colorado Natural Areas Program (CNAP), Colorado Department of Natural Resources, identifies, registers, and designates areas in Colorado which have retained or reestablished their natural character. By state law (C.R.S. 36-10-101 *et seq.*), these areas typify native vegetation and associated biological and geologic features, provide habitat for rare or endangered plant or animal species, or include geologic or other natural features of scientific or educational value.

Identification of potentially qualified non-geologic natural areas occurs primarily through the Natural Areas Inventory. The Inventory identifies potential natural areas which provide habitats for threatened, endangered, and other rare plant and animal species and plant communities - living resources faced with immediate threats. The Inventory has not systematically identified and evaluated geologic features in Colorado,

nor will it provide a systematic identification in the future. The Colorado Natural Areas Inventory will incorporate data on Colorado's geologic features generated by the Geologic Advisory Group into its data base. Information developed by the BLM Geologic Advisory Group on geologic features will be used by the Colorado Natural Areas Program to work with BLM to recommend management for scientifically important sites which are of statewide or national significance. Several examples of this type of cooperation currently exist (e.g., Kremmling Cretaceous Ammonite Locality, Fruita Paleontological Locality, Indian Springs Trace Fossil Locality, Garden Park Fossil Locality).

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CANON CITY DISTRICT

SITE INFORMATION SUMMARY

SITE NAME: Garden Park Fossil Site Locality

LOCATION: T17S R70W, S23, 26, 27, 28, 33, 34
County: Fremont
USGS 7.5' Quad: Cooper Mountain

SIGNIFICANT FEATURES: The Garden Park Fossil Area is one of the most important Late Jurassic vertebrate localities in North America. Excavations in the Morrison Formation in the area has produced 20 genera and 19 described species of fossil fish, turtles, rhynchocephalians, crocodiles, dinosaurs, and mammals. Of these vertebrates, the Garden Park area is the type locality of 8 species of vertebrates, and is the type locality of the dinosaur genera Allosaurus, Camarasaurus, Ceratosaurus, and Diplodocus. Excavations in the area started in the mid-1870's. Almost every major natural history museum in the United States has specimens from the Garden Park area. The amount of fossil vertebrate material, and the long history of museum excavations (which continues today) in the area, is unique for any Morrison locality in Colorado, and is comparable only to Como Bluff in Wyoming and the Dinosaur Quarry in Utah. Unlike Como Bluff and Dinosaur Quarry, the Garden Park area produces dinosaurs throughout the Morrison Formation, not only in the upper parts of the formation. The Morrison Formation in the area also produces abundant freshwater mollusks and arthropod fossils, and is the type locality for 13 species of freshwater clams and snails, and three species of freshwater ostracodes. The Ralston Creek Formation in the area has produced a species of Leptolepis -- the oldest genera of teleost fish. The area contains well-exposed outcrops of upper Jurassic and lower Cretaceous rocks, and has numerous, large-scale landslides at the base of the Dakota Sandstone.

GENERAL DESCRIPTION: The area contains intermittent sagebrush - pinyon-juniper community interspersed among rock outcroppings.

AREA: 1280A

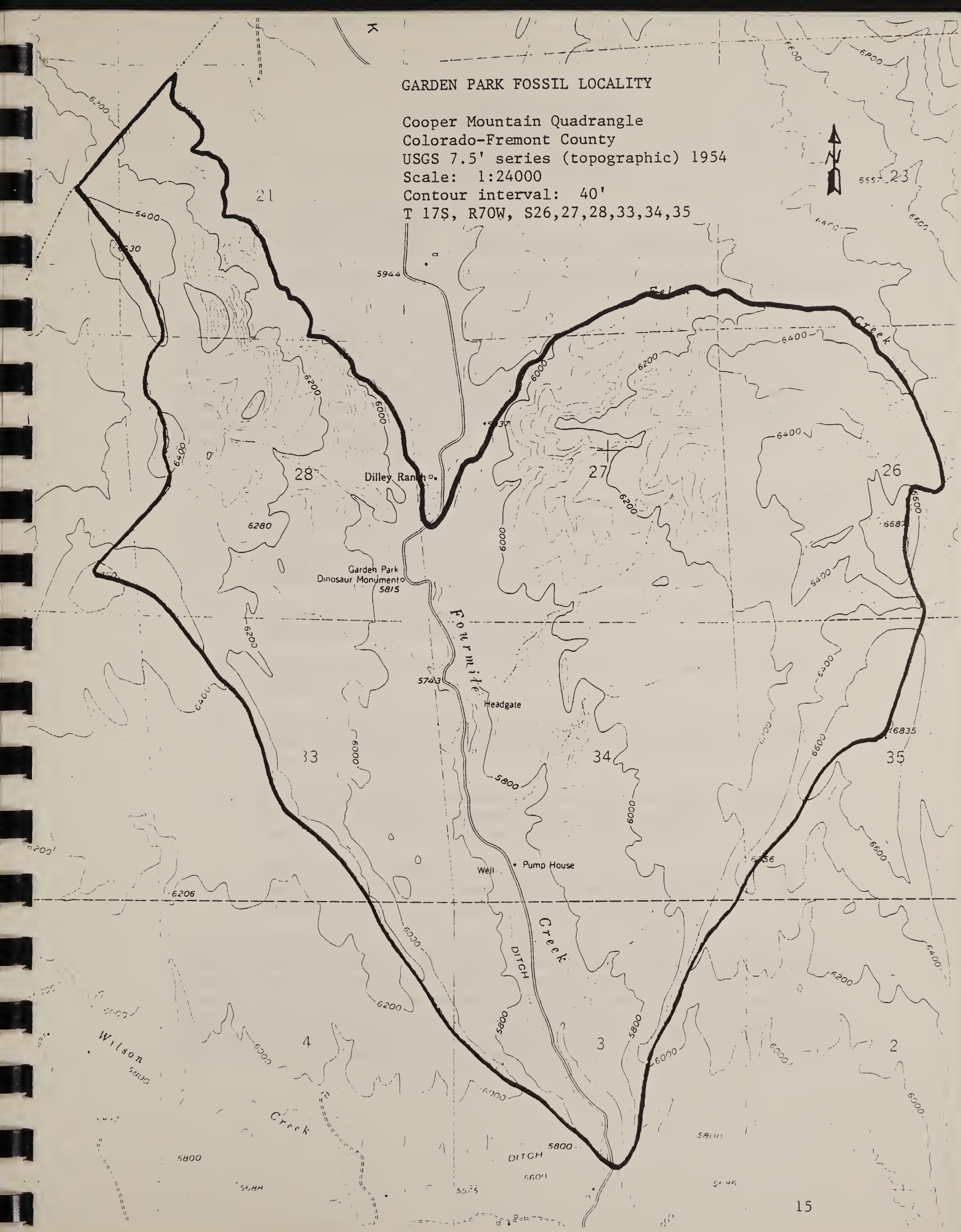
OTHER SIGNIFICANT VALUES: Garden Park Fossil Area contains a plant species of special concern to the State of Colorado -- Eriogonum brandegei Rydberg, Brandege Wild buckwheat. The species is listed as a Category 2 species (species requiring some additional study prior to a determination of threatened and endangered status) by the U. S. Fish and Wildlife Service (USFWS Notice of Review Category 2 - Federal Register, 1983). Eriogonum brandegei occurs in the Upper Arkansas physiographic region and is found in Chaffee and Fremont Counties in Colorado. The plant is endemic to Colorado, displays an ability to colonize disturbed lands in the form of roadcuts, and could be used in research on the revegetation of disturbed lands.

GAG RECOMMENDATION: RNA - Research Natural Area designation due to ongoing paleontological research and future paleontological research potential. Significant educational value due to historical paleontological importance of site and ongoing research effort. Site has interpretive value due to ease of access and public land ownership pattern. GAG field evaluations occurred on April 25-26, 1985, and between October and December, 1985.

BOUNDARY JUSTIFICATION: The locality includes part of the southern half of Garden Park, between the escarpments which topographically define the park, and includes the Four Mile Creek drainage. The historic Cope Quarry and the current Denver Museum of Natural History Quarry are included within the boundaries.

GARDEN PARK FOSSIL LOCALITY

Cooper Mountain Quadrangle
Colorado-Fremont County
USGS 7.5' series (topographic) 1954
Scale: 1:24000
Contour interval: 40'
T 17S, R70W, S26,27,28,33,34,35



SITE INFORMATION SUMMARY

SITE NAME: Indian Springs Trace Fossil Locality

LOCATION: T18N, R69W, S4, 5, 9
County: Fremont
USGS 7.5' Quads: Cooper Mountain, Phantom Canyon

Eight miles north of Florence and west of Lower Phantom Canyon

SIGNIFICANT FEATURES: The locality contains a unique assemblage of trace fossils, body fossils, and sedimentary structures, including body fossil evidence of Ostracoderms, Merostomes, and Trilobites. The locality is the type locality of eight Ichnogenera. The association of sedimentary structures and trace and body fossils is unique and of international interest. Important discoveries from this locality (which includes adjacent private property) are:

- an oro-bronchial mold of an ostracoderm showing the anatomy and configuration of the bronchial pouches used for respiration.
- the earliest fossil record and first occurrence of the walking, foraging, and burrowing activity of the ancestral horseshoe crab.
- the earliest record of scorpionid locomotion and some indications of scorpionid morphology.
- the first record of fossil Eurypterids in the western United States.
- the first body trace fossil evidence of the extinct arthropod known as Aglaspid, previously known from one locality in Minnesota-Wisconsin.
- detailed walking and swimming tracks of the giant Isotelid Trilobite revealing important data on the nature, structure, and function of both the epipodite and pre-epipodite.
- body fossil evidence of an extinct Merostome revealing the ventral side of the animal; this provides the basis for the recognition of a new family, genus, and species.

The locality contains an esturaine species and associated fauna and ichnofauna which demonstrates that the primitive vertebrates were part of an ecosystem including merostomes, arachnids, and trilobites. The later Paleozoic association of merostomes and ostracoderms was apparently a relationship established early in their evolution. It may have been this predator-prey relationship that stimulated the evolution of heterostracan armor plate and ultimately the vertebrate skeleton.

GENERAL DESCRIPTION: The area consists of rolling terrain and rock outcroppings, dominated by pinyon-juniper woodland and perennial grass understory with ponderosa pine in lower area.

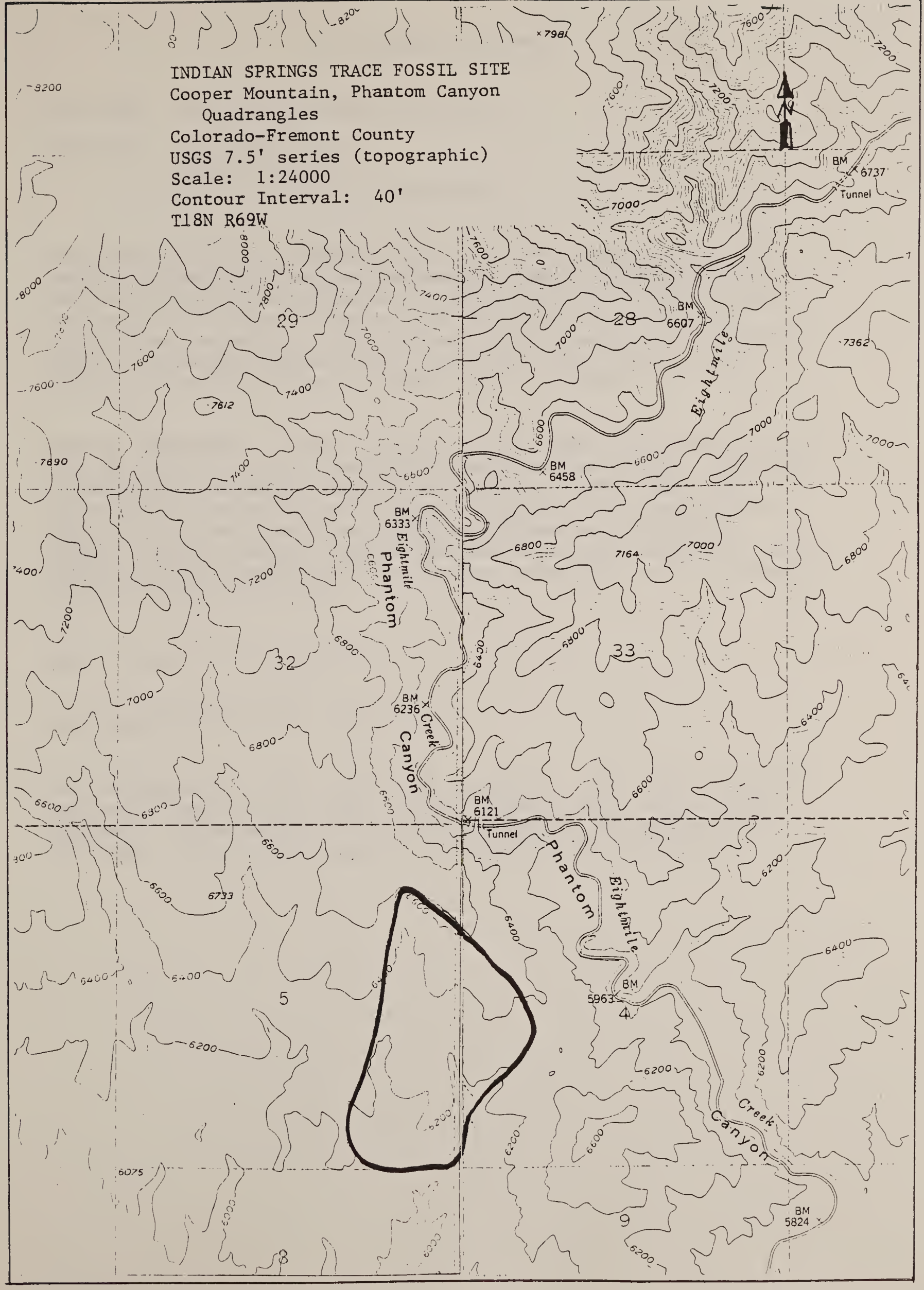
AREA: 150 A.

OTHER SIGNIFICANT VALUES: Private property (40A.) portion of the locality is a designated Colorado Natural Area and a registered National Natural Landmark. This portion of the locality is used as an interpretive natural area and for scientific research.

GAG RECOMMENDATION: RNA - Research Natural Area for ongoing scientific research and for educational and interpretive use. A GAG field evaluation occurred on April 25-26, 1985. The GAG also recommended initiating a withdrawal from mineral entry and amending the existing Management Framework Plan to include special management provisions.

BOUNDARY JUSTIFICATION: Locality contains known occurrences of body and trace fossil evidence from the Harding Formation (Middle Ordovician) in Colorado. Proposed boundaries were identified to BLM in 1980. The area, recommended as an RNA, has been registered by the Colorado Natural Areas Program (1983).

INDIAN SPRINGS TRACE FOSSIL SITE
Cooper Mountain, Phantom Canyon
Quadrangles
Colorado-Fremont County
USGS 7.5' series (topographic)
Scale: 1:24000
Contour Interval: 40'
T18N R69W



SITE INFORMATION SUMMARY

SITE NAME: Lower Phantom Canyon Paleo Site

LOCATION: T18S R69W, S4, 9
County: Fremont
USGS 7.5' Quad: Phantom Canyon

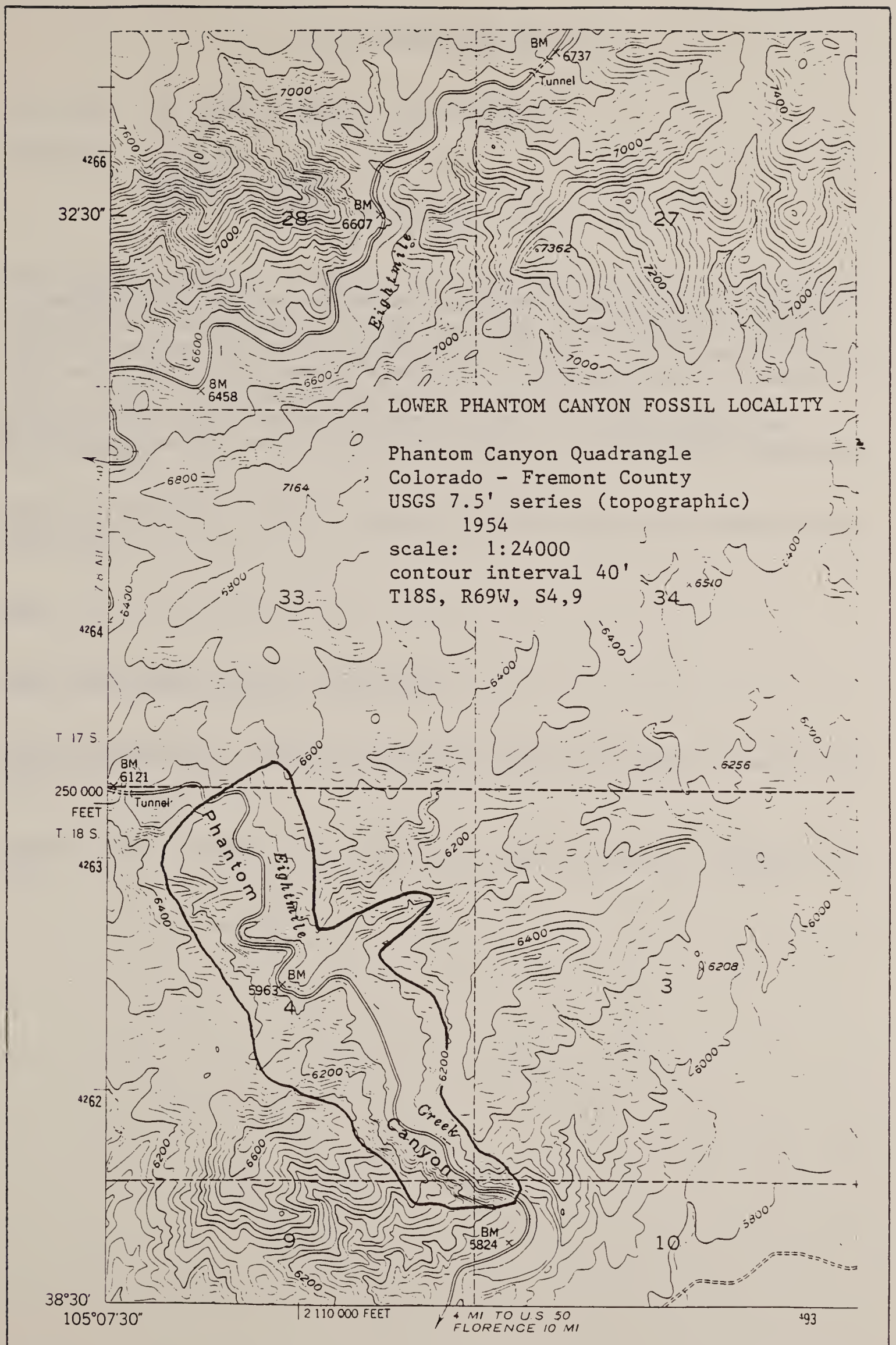
SIGNIFICANT FEATURES: Phantom Canyon is a scenic canyon which is cut through Precambrian igneous and metamorphic complex unconformably overlain by Ordovician Manitou and Harding Formations. Phantom Canyon displays faults, folds, unconformities, and excellent Ordovician stratigraphic sequences. Trace and body fossil remains are similar to those of the nearby Indian Spring Trace Fossil site, but of lesser quality. Trace fossils are extremely rare in Colorado.

GENERAL DESCRIPTION: Phantom Canyon is a box canyon, in some places less than 40 feet wide, cut in the Precambrian Pikes Peak granite. Jointing in the granite frequently controls the canyon's course. Near its southern end, the canyon cuts through Precambrian schist and gradually opens out with the transition across the Precambrian - Paleozoic contact. Pinyon-juniper scrub oak and semi-arid shrub communities with a perennial grass understory are the dominant vegetation, with cottonwoods present in more mesic areas.

AREA: Pending field evaluation.

OTHER SIGNIFICANT VALUES: None known.

GAG RECOMMENDATION: NON - No special management. GAG field evaluation occurred on April 25-26, 1985. Private property posed public access problems. GAG determined that existing management was appropriate at this time. The area has supported research and educational use.


LOWER PHANTOM CANYON FOSSIL LOCALITY
Phantom Canyon Quadrangle
Colorado - Fremont County
USGS 7.5' series (topographic)
1954
scale: 1:24000
contour interval 40'
T18S, R69W, S4,9
Eightmile
Phantom Canyon Creek
BM 6737
Tunnel
BM 6607
BM 6458
BM 6121
Tunnel
BM 5963
BM 5824
7362
7164
6510
6256
6208
28
27
33
34
4
3
9
10
T 17 S.
T. 18 S.
250 000 FEET
4266
4264
4263
4262
32'30"
38°30'
105°07'30"
2 110 000 FEET
4 MI TO U.S. 50
FLORENCE 10 MI

SITE INFORMATION SUMMARY

SITE NAME: Spring Gulch Fossil Fish Locality

LOCATION: T49N, R9E, S13
County: Fremont
USGS 7.5' Quad: Wellsville

SIGNIFICANT FEATURES: Devonian fish remains are the only fossils found in the Parting Formation and known from several localities in Colorado and Wyoming. Spring Gulch provides excellent stratigraphic sequences from the Precambrian through Mississipian periods. Spring Gulch is an ideal setting for interpretive geology of the Wellsville Syncline and is used by several colleges and universities for educational purposes. Spring Gulch contains disarticulated fragments of Bothriolepis and Holoptychcus in the red siltstone-dolomite bed in the Parting Formation.

GENERAL DESCRIPTION: Typical semi-arid shrub, grass, and pinyon-juniper vegetation.

AREA:

OTHER SIGNIFICANT VALUES: None known.

GAG RECOMMENDATION: Deferred pending GAG field evaluation (scheduled for 1986).

BOUNDARY JUSTIFICATION: Deferred pending field evaluation scheduled for 1986.

SITE INFORMATION SUMMARY

SITE NAME: Twin Mountain Structure Complex

LOCATION: T18S, R71W, S11, 12
County: Fremont
USGS 15' Quad: Cover Mountain, Royal Gorge

SIGNIFICANT FEATURES: Complexly folded and faulted strata adjacent to Highway 50 provides ideal setting for geology field classes (Twin Mountain is used by universities and colleges). Precambrian Manitou Limestone contact is unique for showing minor relief. Ordovician Harding and Fremont Formations are fossiliferous and well-exposed.

GENERAL DESCRIPTION: Area contains typical shrub, grass, and pinyon-juniper vegetation complex on rocky terrain.

AREA: Deferred pending field evaluation.

OTHER SIGNIFICANT VALUES: None known.

GAG RECOMMENDATION: Deferred pending GAG field evaluation (1986).

BOUNDARY JUSTIFICATION: Deferred pending GAG field evaluation.

SITE INFORMATION SUMMARY

SITE NAME: Upper Arkansas Canyon Scenic Study Area

LOCATION: T49N R10E
County: Fremont
USGS 7.5' Quad: Wellsville, Howard

SIGNIFICANT FEATURES: Part of Arkansas Canyon which is used by universities, colleges, and state geological societies for educational and interpretive purposes. The Arkansas River Canyon exposes steeply dipping Ordovician to Pennsylvanian age strata and textbook examples of folding, faulting, and unconformities.

GENERAL DESCRIPTION: Area contains typical shrub, grass, and pinyon-juniper vegetation complex on rocky (outcrop) terrain.

AREA:

OTHER SIGNIFICANT VALUES:

GAG RECOMMENDATION: Deferred pending GAG field evaluation (scheduled for 1986).

BOUNDARY JUSTIFICATION: Pending 1986 field evaluation.

CRAIG DISTRICT

SITE INFORMATION SUMMARY

SITE NAME: Blacks Gulch

LOCATION: T2N, R96W, S27
County: Rio Blanco
USGS 7.5' Quad: White River City

SIGNIFICANT FEATURES: Blacks Gulch is the best fossil vertebrate locality of Lysite (middle early Eocene) Age in Colorado. It has produced several hundred good specimens including the type of Lophiparamys debequensis. This site produces good Lysitean fauna with good quality material. A reasonably complete upper dentition of the primate Cantius abditus, possibly the best known specimen, was recently collected from this site. Erosion constantly produces new specimens of scientific merit.

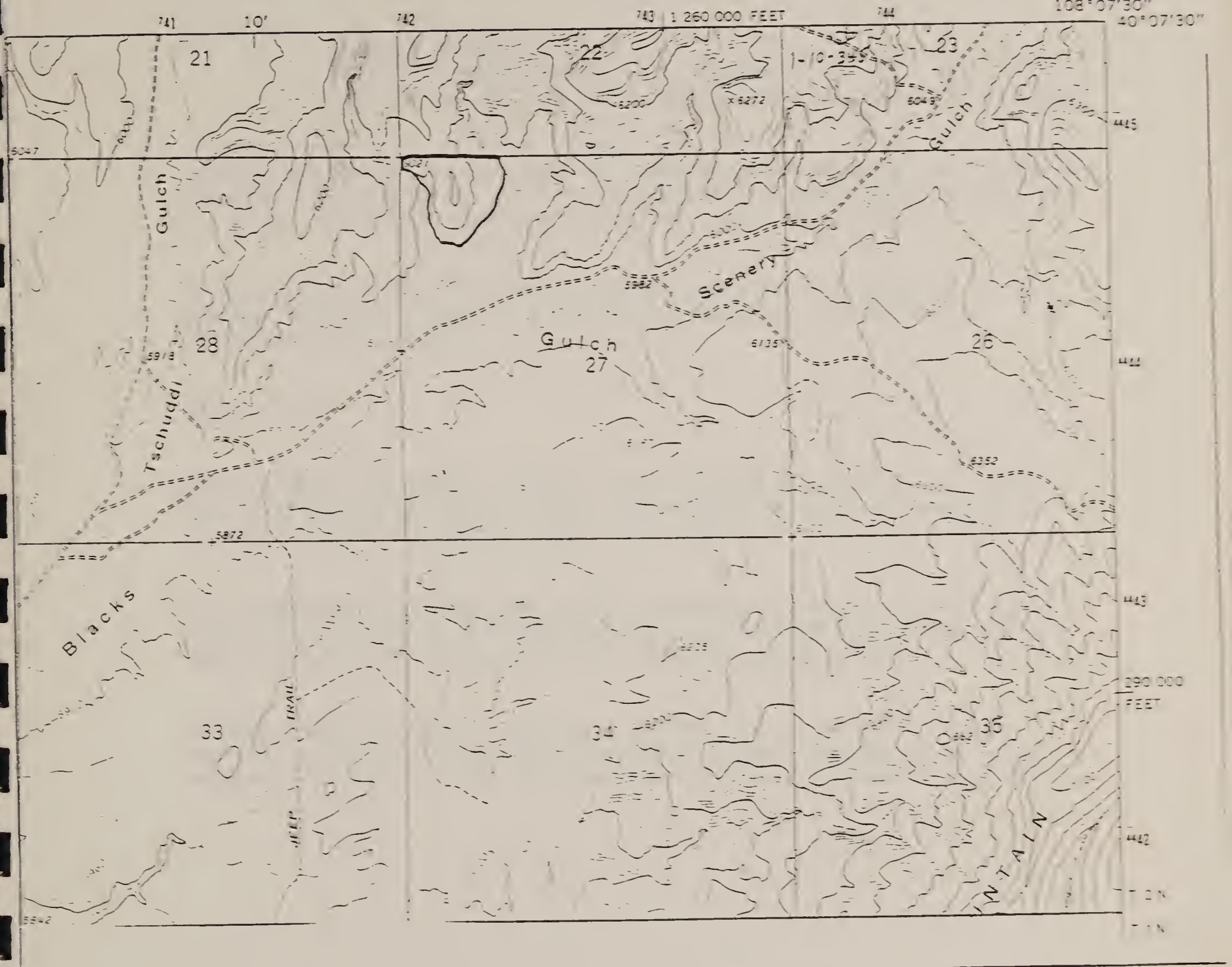
GENERAL DESCRIPTION: The area contains a gently rolling and highly eroded terrain with a semi-arid shrubland community dominated by sagebrush.

AREA: 20A.

OTHER SIGNIFICANT VALUES: None known.

GAG RECOMMENDATION: RNA - Research Natural Area for ongoing research projects by several universities. Oil and gas leases should be issued with no surface occupancy (NSO) stipulations attached to the leases for the identified area.

BOUNDARY JUSTIFICATION: The area includes the cliff faces with the fossil-bearing strata and the fossil producing area at the base of the cliffs. The highly erodable soils require periodic prospecting for fossils.



BLACKS GULCH (BONEANZA)

White River City Quadrangle
Colorado - Rio Blanco County
USGS 7.5' series (topographic)
1966
scale: 1:24000
contour interval 20'
T2N, R96W, S27

SITE INFORMATION SUMMARY

SITE NAME: Calico Draw Paleo Locality

LOCATION: T5N, R99W, S3, 4, 9, 10
County: Moffat
USGS 7.5' Quad: Indian Water Canyon
Sixty miles west of Craig and three miles south of Deer Lodge.

SIGNIFICANT FEATURES: The site has produced several species of dinosaurs based on sparse material. A fairly complete diplodocid from the locality is in the collection of Brigham Young University, Provo, Utah.

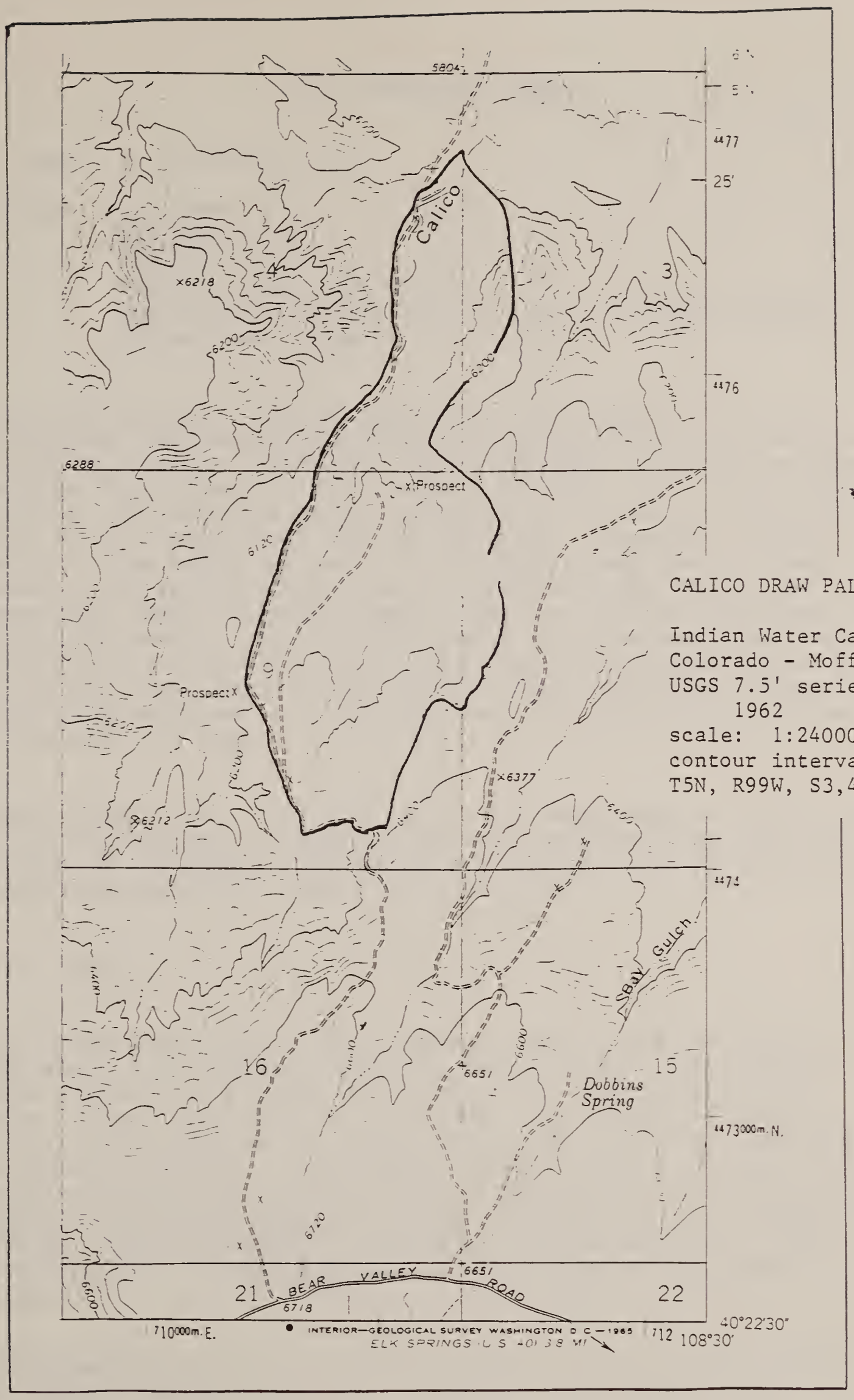
GENERAL DESCRIPTION: The area contains intermittent stands of pinyon-juniper in a semi-arid environment consisting primarily of sagebrush and saltbush.

AREA: 180A.

OTHER SIGNIFICANT VALUES: BLM has ranked the scenic quality as A-B for this area due to the colorful red cliffs and rock outcrops contrasting with the sagebrush gray and dark green pinyon-juniper in the valley.

GAG RECOMMENDATION: NON - No special management area designation. The area does not contain sufficiently rich or scientifically unique fossil material to justify designation as a special management area.

BOUNDARY JUSTIFICATION: Evidence of earlier excavations is clearly visible. Future potential paleontological excavations should be monitored to ensure compliance with appropriate environmental regulations.



CALICO DRAW PALEO LOCALITY

Indian Water Canyon Quadrangl
Colorado - Moffat County
USGS 7.5' series (topographic
1962
scale: 1:24000
contour interval 40'
T5N, R99W, S3,4,9,10

SITE INFORMATION SUMMARY

SITE NAME: Cross Mountain Canyon

LOCATION: T6N, R98W, S13, 14, 22, 23
T6N, R97W, S18
County: Moffat
USGS 15' Quad: Elk Springs
Approximately 50 miles west of Craig to Colorado National Monument Deer Lodge Park.

SIGNIFICANT FEATURES: Rugged canyon is a classic example of a superimposed river gorge first established on the Browns Park formation (Tertiary - Oligocene - Miocene), then eroded down a thousand feet into the Uinta Mountain Group (Proterozoic) in the core of the Cross Mountain anticline. The Madison Limestone (Mississippian) forms the canyon rim, making vertical cliffs more than 200 feet high. The canyon is deeper than it is wide toward the mouth of the canyon. Cross Mountain Canyon is bounded on the west by a large, well-exposed fault zone that brings Mancos Shale (upper Cretaceous) against Madison Limestone and offsets the Bishop Conglomerate. Vertical displacement is approximately 5000 feet with Mesozoic strata west of the fault in contact with Paleozoic strata east of the fault. Cross Mountain Canyon's many spectacular geologic features are contained in a relatively small area resulting in an area of great educational value.

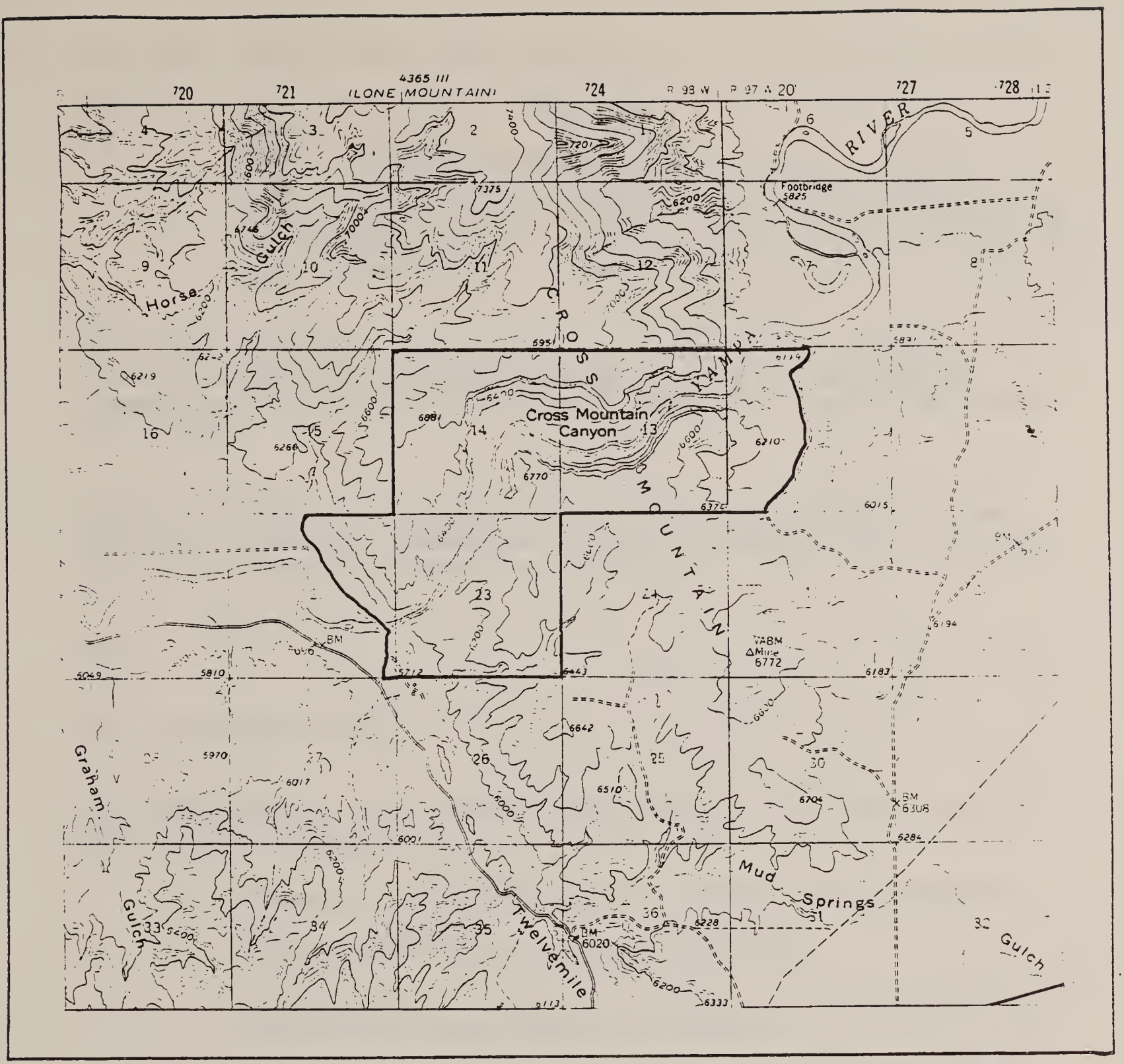
GENERAL DESCRIPTION: The scenic, three mile long canyon is carved by the Yampa River through Cross Mountain, which is uplifted along faults at both ends of the canyon. Semi-arid sagebrush and pinyon-juniper woodland communities comprise the vegetation on the area.

AREA: 1500 A.

OTHER SIGNIFICANT VALUES: Cross Mountain Canyon is a BLM Wilderness Study Area. Cross Mountain Canyon has been assigned a scenic quality rating A by BLM and a rating of 5 (highest) for scarcity within the region. Visual sensitivity is rated High -- Cross Mountain Canyon is visually interesting due to its contrasting land form to the immediate surrounding landscapes. Cross Mountain Canyon is one of Colorado's few remaining natural canyon's unaltered by human impacts. Cross Mountain is habitat for Penstemon yampaensis (USFWS - Category 3C) and threatened in Colorado. Three threatened or endangered fish species occur in Cross Mountain Canyon: Ptychocheilus lucius, Gila cypha, and Xyrauchen texanus.

GAG RECOMMENDATION: ONA - Outstanding Natural Area for scenic quality and exemplary geologic features. The area is used regularly for educational purposes.

BOUNDARY JUSTIFICATION: Area includes canyon and approximately one-half mile back from the canyon rims as well as the west end of canyon to include rocks affected by the fault.



CROSS MOUNTAIN

Elk Springs Quadrangle
Colorado - Moffat County
USGS 15' series (topographic)
1960
scale: 1: 62500
contour interval 40'
T6N, R97W, S18
T6N, R98W, S13, 14, 22, 23

SITE INFORMATION SUMMARY

SITE NAME: Douglas Pass Insect Locality

LOCATION: T5S, R101W, S7/T5S, R102W, S23
County: Garfield
USGS 7.5' Quad: Foundation Creek
Area is situated near Douglas Pass in western Garfield County, approximately 30 miles north of Fruita. The area is readily accessible by road and contains outcrops of the Green River Formation.

SIGNIFICANT FEATURES: Type locality for several fossil insects, including a recently described Tipulidae (Diptera). The excellent preservation of the fossil insects makes this site unique in the western United States.

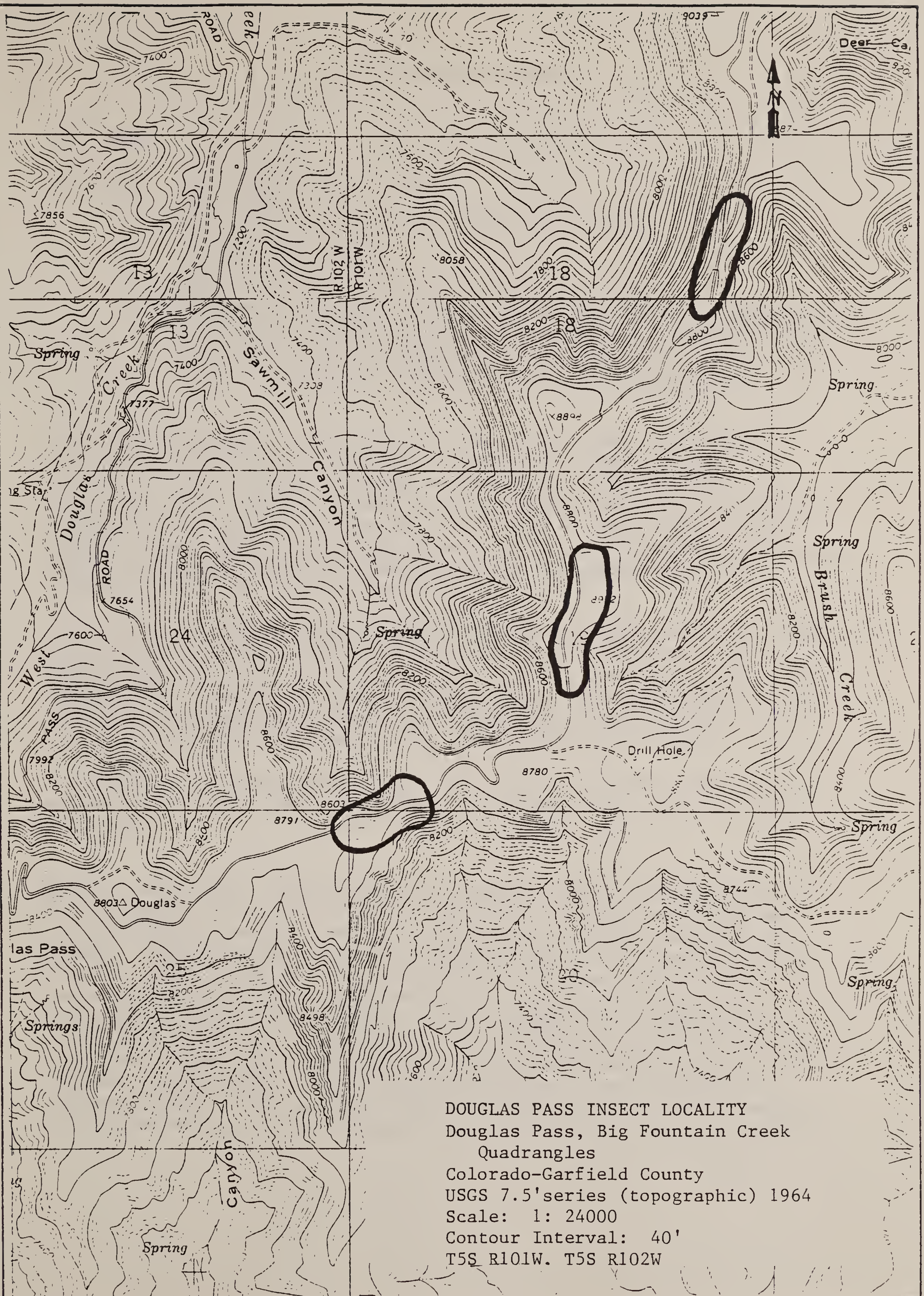
GENERAL DESCRIPTION: The area contains platey shales typical of the Green River Formation. Vegetation consists of montane forest and shrub communities interspersed among rock outcrops.

AREA:

OTHER SIGNIFICANT VALUES:

GAG RECOMMENDATION: NON - The GAG field evaluation in 1985 resulted in the following recommendations:

- No special management due to inadequate site information.
- Public access makes management difficult.
- Douglas Pass is a topotype locality - a locality from which previously unknown species are found.
- Another representative Green River formation with fossil insects with restricted public access should be protected.



DOUGLAS PASS INSECT LOCALITY
Douglas Pass, Big Fountain Creek
Quadrangles
Colorado-Garfield County
USGS 7.5'series (topographic) 1964
Scale: 1: 24000
Contour Interval: 40'
T5S R101W. T5S R102W

SITE INFORMATION SUMMARY

SITE NAME: Irish Canyon

LOCATION: T9N, R101W, S1-3, 11-12
T9N, R100W, S5-8
T10N, R101W, S2-5, 8-11, 13-16, 21-27, 34-36
T10N, R100W, S30-31
County: Moffat
USGS 7.5' Quad: Big Joe Basin, Irish Canyon
Northwest of Maybell on County Road 10N, north of Highway 318. In NW Moffat County, generally between Cold Springs Mountain and Vermillion Creek, encompassing Irish Canyon in its entirety and most of Limestone Ridge to Limestone Gap.

SIGNIFICANT FEATURES: This area is an excellent example of stream superposition and piracy resulting in a beheaded stream valley. The stream in Irish Canyon was pirated by Vermillion Creek in early Pleistocene time, leaving a 1000-foot-deep gorge high and dry without a headwaters and opened to a wind gap at its head. The beheaded stream valley contains the only continuous and complete stratigraphic section of Paleozoic through Tertiary sedimentary rocks representative of NW Colorado geology on the Uinta Overthrust.

The site has excellent examples of the two major Uinta Mountain erosional surfaces: the Gilbert Peak Surface and the Bear Mountain Surface. Remnants of the latter surface are rare in the eastern Uintas. More than four miles of strata are continually exposed in one stratigraphic section. Although the rock units have been correlated and described, their depositional histories have not been extensively studied.

Irish Lakes, two intermittent ponds, are the most notable aquatic feature on the site. Such natural ponds are rare in western Colorado at low elevations.

GENERAL DESCRIPTION: Approaching the proposed site from the southwest, the panorama includes the Vermillion Creek Gap (a superimposed stream) and the dramatic entrance to Irish Canyon (an abandoned superimposed stream). Twelve geologic units are exposed and visible from the rim of Vermillion Gap. Rock units that outcrop in the area range in age from Precambrian to Quaternary with every period represented except the Ordovician, Silurian, and Devonian. The Precambrian is represented by the Uinta Mountain Group that plunges to the southeast below the Tertiary Browns Park Formation. The Paleozoic and Mesozoic section consists of eighteen stratigraphic units of marine/nonmarine clastic and marine carbonate origin: The Section is about 13,100 feet thick and is bounded by the Precambrian on the southwest and the Uinta Thrust Fault (Sparks

Fault) on the northeast. The Tertiary is composed of three gently dipping formations outcropping in the area and unconformably overlap the older formations with an overall thickness of 7400 feet. The Paleozoic and Mesozoic strata uniformly strike northwest-southeast, forming ridges in the more resistant sandstones and limestones and valleys in the less resistant siltstones, mudstones, and shales. The strata dip at approximately 30 degrees northeast at the contact with the Precambrian and are nearly vertical and locally overturned at the leading edge of the Uinta Thrust plate. The Canyon is colorful and scenic.

OTHER SIGNIFICANT VALUES: Cultural -- petroglyphs occur on the site and are delineated by a small interpretive site. Prehistoric use of the area has been demonstrated by the findings of the Fremont and Ute cultures. Scenic -- Irish Canyon has a high scenic value rating. Irish Canyon has 6 highly ranked plant species of special concern (Colorado Natural Areas Inventory) and several plant associations of special concern.

AREA: Approximately 11,400 A.

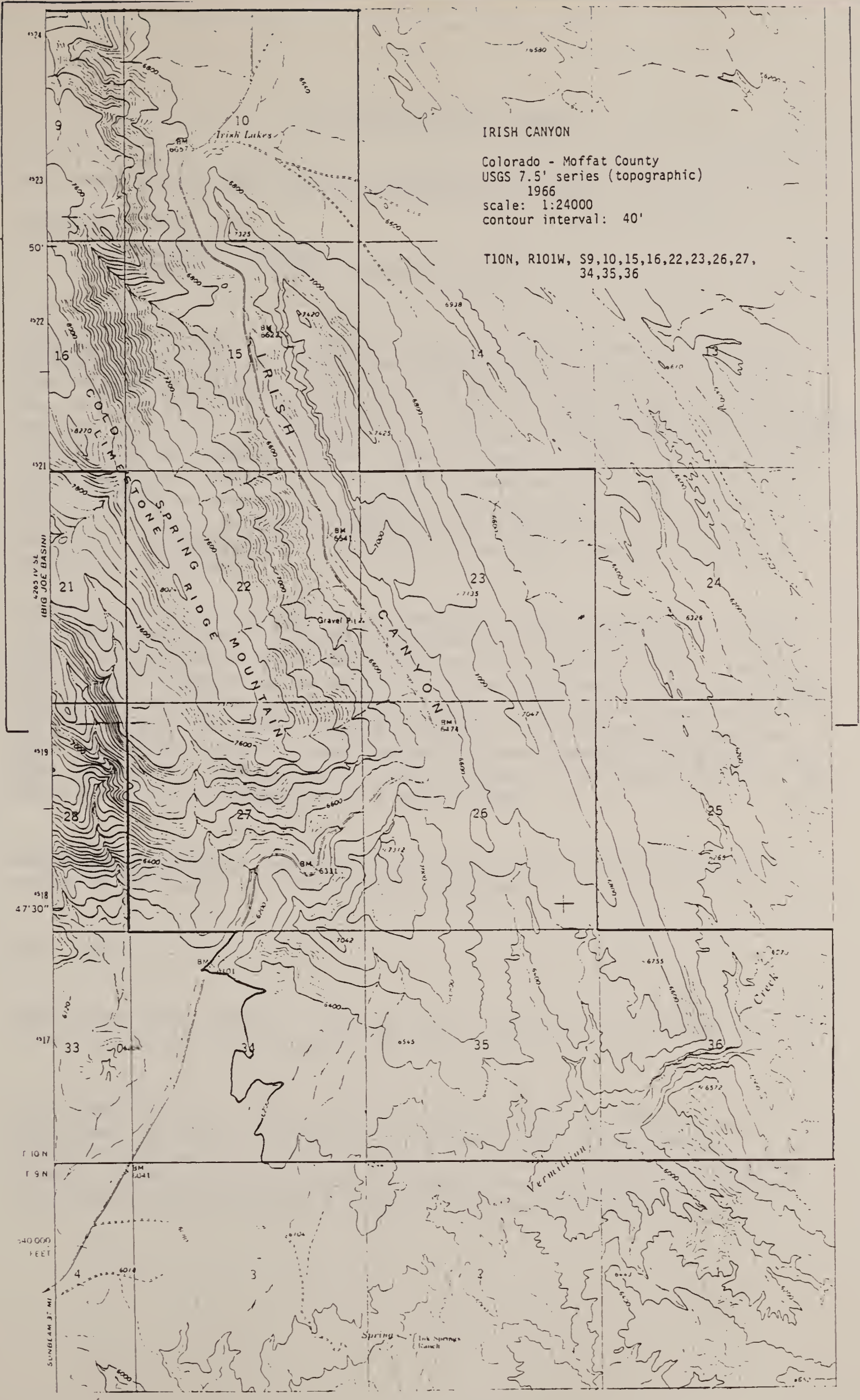
GAG RECOMMENDATION: ONA - Outstanding Natural Area for scenic quality and exemplary geologic features; used for educational purposes. The geology of Irish Canyon is known nationally. Geology organizations and universities frequently schedule field trips to study the geologic exposures.

BOUNDARY JUSTIFICATION: The boundary encloses the minimum area encompassing the scenic and geologic values of the proposed site. A county road through Irish Canyon provides access to the site.

IRISH CANYON

Colorado - Moffat County
USGS 7.5' series (topographic)
1966
scale: 1:24000
contour interval: 40'

T10N, R101W, S9,10,15,16,22,23,26,27,
34,35,36



SITE INFORMATION SUMMARY

SITE NAME: Kremmling Cretaceous Ammonite Locality

LOCATION: T3N, R80W
County: Grand
USGS 7.5' Quad: Hinman Reservoir

SIGNIFICANT FEATURES: Exceptional marine fossils from the Cretaceous period (65 million years ago), including an unusual concentration of giant ammonites (Placenticeras ssp.) as well as numerous other marine invertebrate fossils: Baculites ssp., Nautilus (Eutrephoceras alcensence Reeside), Bivalves (Inoceramus ssp.), and Gastropods. The fossils are in a sandstone outcropping and are usually found in large ovate calcareous concentrations. Among the known biota found on the locality are 25 fossils which were previously unknown. Description of the new fossil biota will result in the designation of the locality as a topotype locality - a unique locality from which new fossil species have been originally described.

Future research is expected to document the unique ecological history associated with the rich fossil assemblage on this locality. Although poorly understood, a rapid and extensive incursion of tropical waters, and biotas, thousands of miles north of the Cretaceous Tropics occurred during the Cretaceous Age for less than one million years and apparently was followed by its equally rapid retreat. The concentration of the giant ammonites suggests a mass mortality event among the ammonites and other molluscks, perhaps due to rapid changes in the chemistry or in the temperature of the seaway or to a major storm.

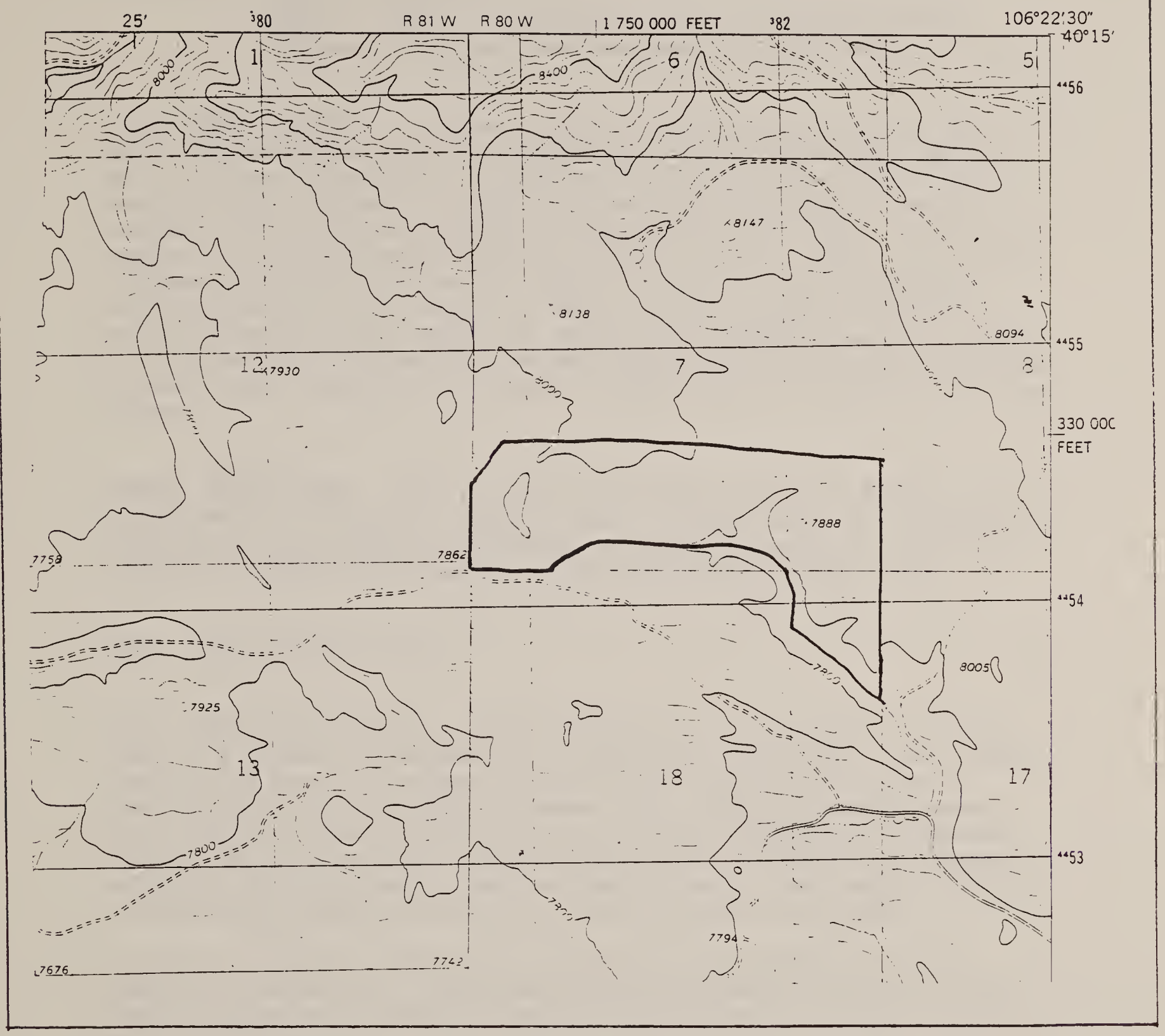
GENERAL DESCRIPTION: Sagebrush and grasses cover rolling topography broken up by ridges and sandstone outcroppings.

AREA: 160 A.

OTHER SIGNIFICANT VALUES: Area may have archeological importance, cultural artifacts are reported from this area.

GAG RECOMMENDATION: RNA - Research Natural Area for research and educational purposes. Locality is internationally known due to uniqueness and wealth of fossil material and will be used for baseline studies. Commercial collecting has damaged the locality and requires careful monitoring to protect locality from further vandalism.

BOUNDARY JUSTIFICATION: Area contains sandstone outcropping which is known to have marine fossils. The area was registered in 1983 by the Colorado Natural Areas Program. Adjacent state-owned land (State Board of Land Commissioners) containing the sandstone outcropping was registered in 1984 by the Colorado Natural Areas Program.



KREMMLING CRETACEOUS AMMONITE LOCALITY

Hinman Reservoir Quadrangle
Colorado - Grand County
USGS 7.5'series (topographic)
1980
scale: 1:24000
contour interval 40'
T3N, R80W, S7,18

SITE INFORMATION SUMMARY

SITE NAME: Lookout Mountain - Vermillion Bluffs

LOCATION: T11N, R99W, S35-36
County: Moffat
USGS 7.5' Quad: Sheepherder Spring; Coffee Pot Spring
Northwest of Maybell and southwest of Powder Wash.

SIGNIFICANT FEATURES: Lookout Mountain is the highest point on the Vermillion Bluffs on the divide between Vermillion Basin and Sand Wash Basin. Lookout Mountain is an erosional outlier of the Gilbert Peak erosion surface capped by Bishop Conglomerate (Oligocene). Lookout Mountain is an excellent example of an isolated, flat-topped erosion remnant of a once-extensive middle Tertiary alluvial plain. The Bishop Conglomerate consists of cobbly, pebbly flood alluvium and mudflows derived from the Uinta Mountains, about 15 miles to the southwest. Eocene Cathedral Bluffs member of the Wasatch formation and Laney member of the Green River formation form well-exposed badlands below the Bishop caprock, particularly on the Vermillion Basin side. Excellent long-range vistas.

GENERAL DESCRIPTION: The site consists of the Vermillion Bluffs with Lookout Mountain being the highest point at 8,120 feet. The vegetation in the area is a semi-arid shrubland community dominated by sagebrush, shadscale saltbush, Utah juniper, and various perennial grasses.

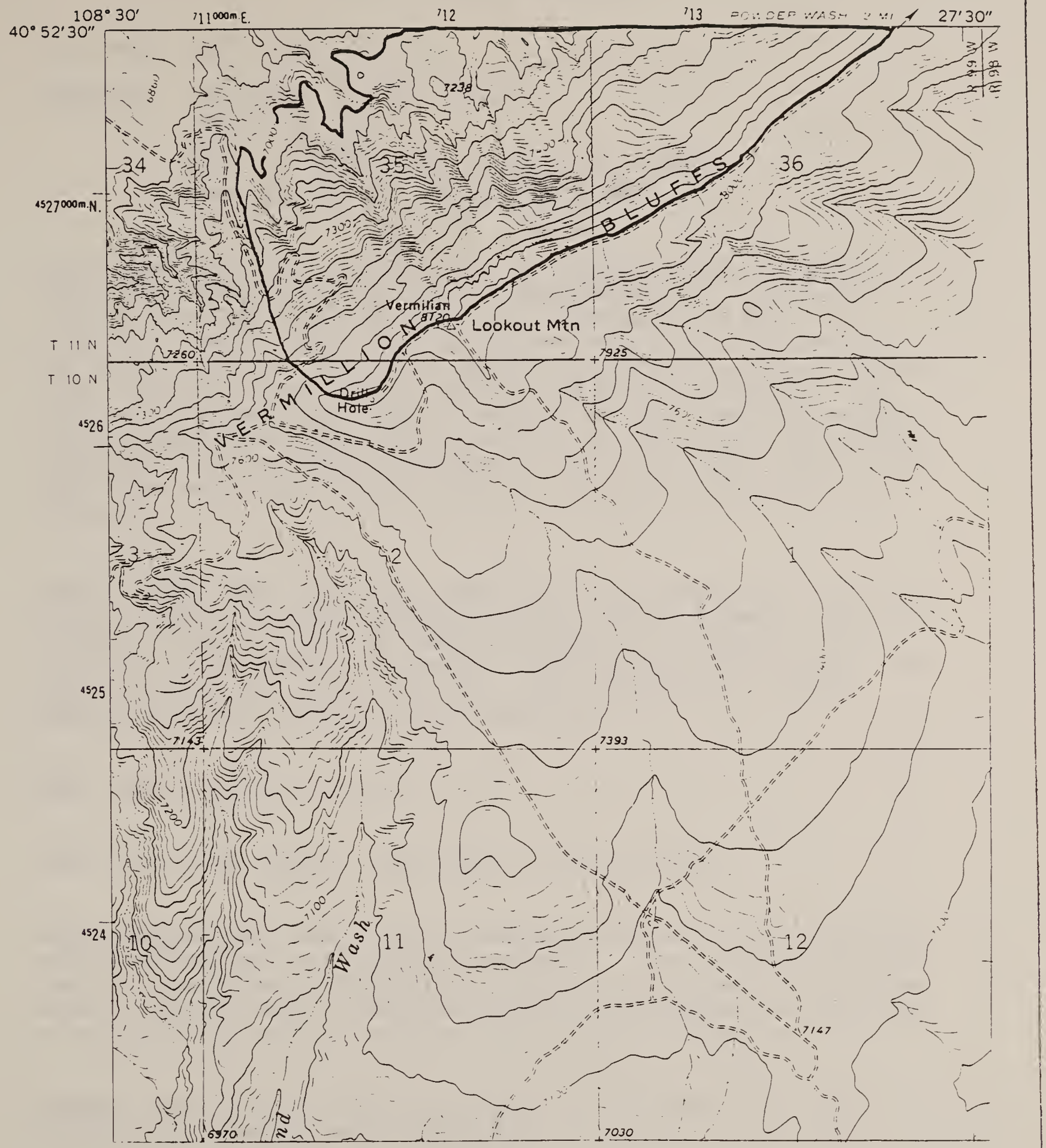
AREA: Approximately 640 A.

OTHER SIGNIFICANT VALUES: Lookout Mountain and the Vermillion Bluffs comprise a dramatic escarpment of 1,700 feet in elevation. The viewshed from Lookout Mountain encompasses the Vermillion Creek drainage, Limestone Ridge, Irish Canyon, Diamond Peak, Middle Mountain, Powder Wash, Sand Wash, and the southern crest of Horseshoe Basin in Wyoming. The area contains Holocene and Pleistocene landslide deposits composed of earthflows and rotational slumps on steep slopes. These deposits are situated below Lookout Mountain and form spectacular badlands.

The site is within a larger area identified for the BLM due to its vegetation components. Five plant species of special concern and two plant associations of special concern (Colorado Natural Areas Inventory) occur in this area.

GAG RECOMMENDATION: ONA - Outstanding Natural Area for scenic qualities and opportunities for geologic interpretations. No surface occupancy (NSO) stipulations attached to oil and gas leases in identified area will protect the geologic features on the identified site.

BOUNDARY JUSTIFICATION: The proposed boundary encloses the best representative examples of the described geologic features.



LOOKOUT MOUNTAIN - VERMILLION BLUFFS

Sheepherder Springs Quadrangle
Colorado - Moffat County
USGS 7.5' series (topographic)
1969
scale: 1:24000
contour interval 20'
T11N, R99W, S35,36

SITE INFORMATION SUMMARY

SITE NAME: Skull Creek Anticline

LOCATION: T4N, R100W, S18-20 & 29-31;
T4N, R101W, S20-29
County: Moffat
USGS 7.5' Quads: Skull Creek, Lazy Y Point
Seventy miles west of Craig on US 40.

SIGNIFICANT FEATURES: This colorful, well-exposed anticline is on the flank of Blue Mountain in the eastern Uinta Mountains. The site has colorful erosional forms and large scale jointing in the Weber Sandstone. Exposed rocks range in age from Pennsylvania to Cretaceous and include the Weber, Park City, Woodside, Chinle, Glen Canyon, Entrada, Stump, Morrison, Cedar Mountain, Dakota, and Mancos Formations. The anticline is asymmetrical, and the outcropping rocks make sharp hogbacks and dipslopes on the south limb, especially the Dakota and Glen Canyon Formations, and dipslopes and rimrocks on the north, west, and east. The Skull Creek Anticline is one of the best exposed small anticlines in Colorado.

GENERAL DESCRIPTION: The Skull Creek Anticline is adjacent to U.S. 40, but has a very wild aspect immediately back from the highway. The area is characterized by steep and rugged topography with expansive rock outcrops, cliffs, numerous drainages, and colorful erosional forms. The site is crossed by a rough jeep road. The vegetation is a typical sagebrush and pinyon/juniper plant communities.

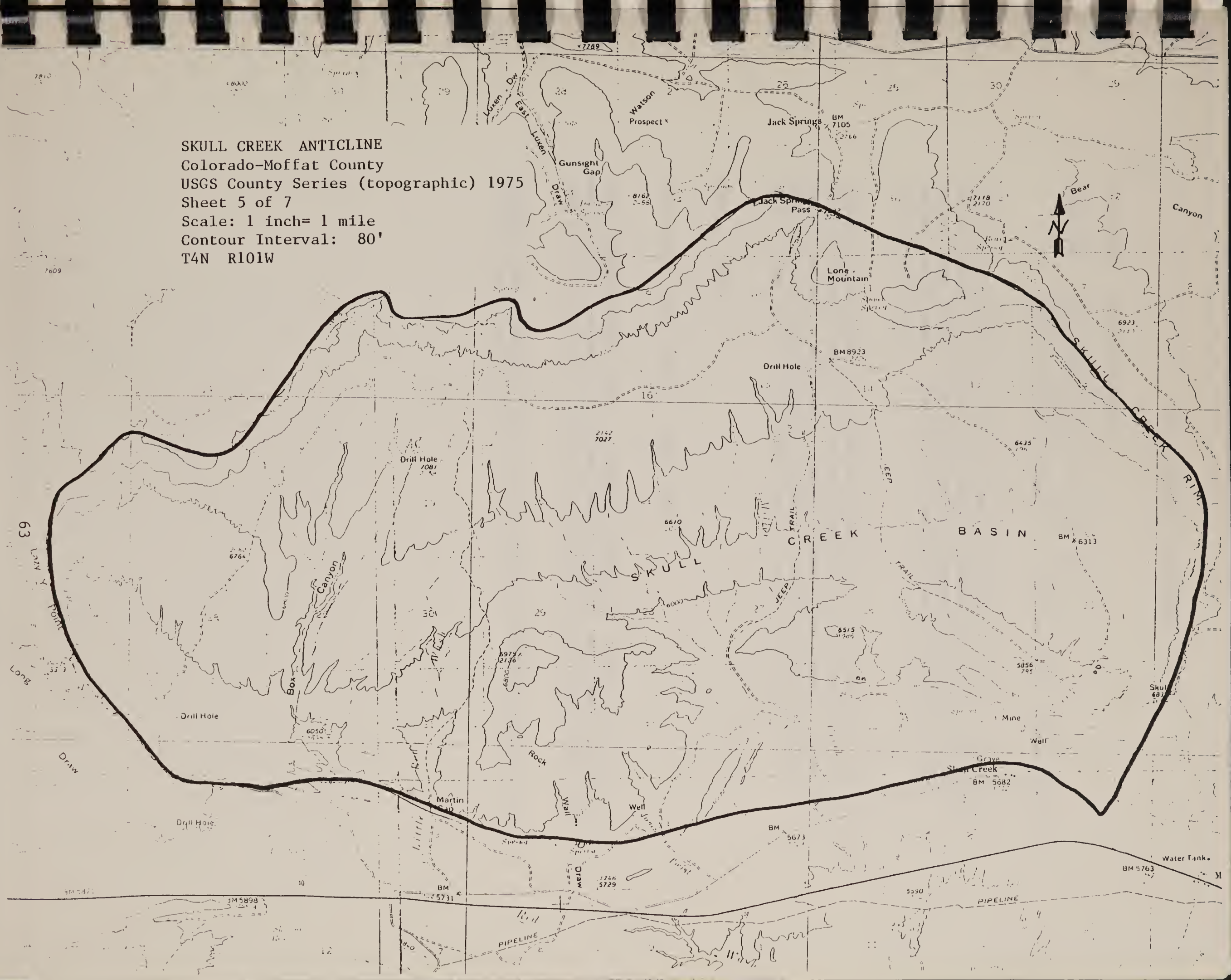
AREA: Approximately 53,760 A.

OTHER SIGNIFICANT VALUES: Scenic and wilderness values.

GAG RECOMMENDATION: SMA - Special Management Area for scenic qualities and educational and interpretive opportunities. Most land uses will not impair the qualities of the geologic feature. If oil and gas development occurs, specific lease stipulations on drilling placements and roads may be appropriate to protect the scenic opportunities of the area.

BOUNDARY JUSTIFICATION: The area encompasses the entire anticline, including the complete Skull Creek rim.

SKULL CREEK ANTICLINE
Colorado-Moffat County
USGS County Series (topographic) 1975
Sheet 5 of 7
Scale: 1 inch= 1 mile
Contour Interval: 80'
T4N R101W



SITE INFORMATION SUMMARY

SITE NAME: Wolford Mountain

LOCATION: T2N, R80W, S19, 20, 29, 30, 31, 32
County: Grand
USGS 7.5' Quad: Kremmling. Junction Butte, Hinman Reservoir.

SIGNIFICANT FEATURES: Wolford Mountain contains extensive exposures of the Cretaceous Pierre Shale with many invertebrate fossil occurrences. The Williams Range Thrus Fault and many younger faults occur in the complex fault zone. Exposures of the Troublesome Formation contain vertebrate fossils.

GENERAL DESCRIPTION: Precambrian granite overlies Cretaceous shale. The older rocks were thrust up and over younger rocks during the Larimide Orogeny (mountain building). Sagebrush and grass community cover a gently rolling topography at the base of Wolford Mountain. Montane forest types occur on the upper levels of Wolford Mountain.

AREA: 2,560 A.

OTHER SIGNIFICANT VALUES: None known.

GAG RECOMMENDATION: NON - No Special Management. Area is used for education and research by several universities. No threats to the area have been identified. Existing uses compatible with educational use.

BOUNDARY JUSTIFICATION: Area contains geologic features which are used by educational institutions.

WOLFORD MOUNTAIN
Kremmling, Hinman Reservoir Quads
Colorado-Grand County
USGS 7.5' series (topographic) 1981
Scale: 1:24000
Contour Interval: 40'
T2N R80W S19,20,29,30

GRAND JUNCTION DISTRICT

SITE INFORMATION SUMMARY

SITE NAME: Black Ridge Angiosperm Locality

LOCATION: T11S, R103W, S13
County: Mesa
USGS 7.5' Quad: Battleship Rock
Area is situated within the Black Ridge Wilderness Study Area west of the Colorado National Monument.

SIGNIFICANT FEATURES: The site has produced a 115 - 120 million year old sycamore which may be among the world's oldest known flowering plants. Further research is necessary to substantiate existing data.

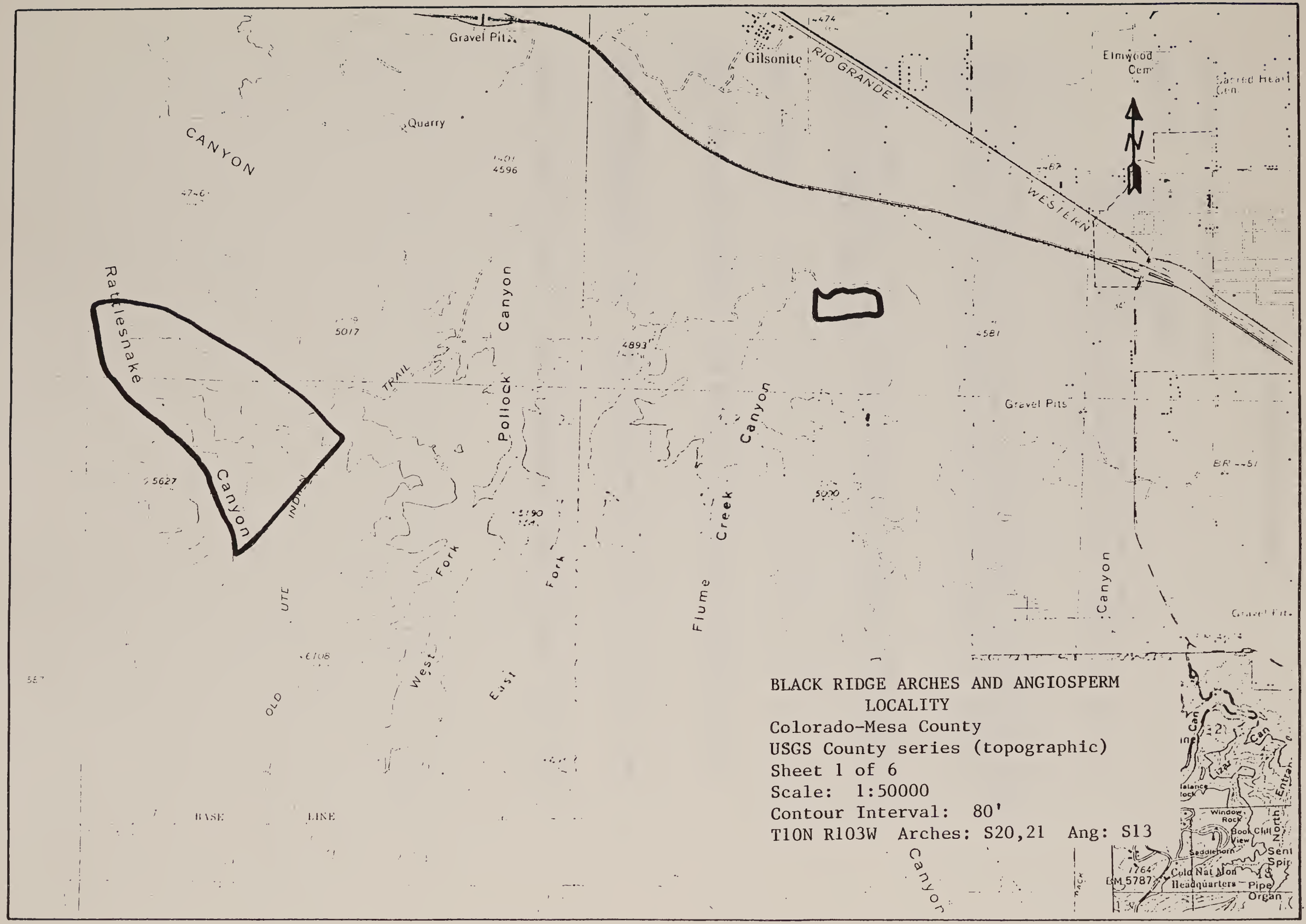
GENERAL DESCRIPTION: The locality contains a pinyon-juniper woodland with interspersed clearings of sagebrush and grass.

AREA: 40 A.

OTHER SIGNIFICANT VALUES: Site is contained in a BLM Wilderness Study Area which has the second largest collection of natural arches in the world (Arches National Park has the largest collection of arches).

GAG RECOMMENDATION: RNA - Research Natural Area due to continuing paleontological research interest. Several colleges and universities and USGS have conducted research on this site. Field evaluation by GAG required prior to final boundary recommendation.

BOUNDARY JUSTIFICATION: Final boundary recommendation deferred pending 1986 field evaluation.



BLACK RIDGE ARCHES AND ANGIOSPERM LOCALITY
Colorado-Mesa County
USGS County series (topographic)
Sheet 1 of 6
Scale: 1:50000
Contour Interval: 80'
T10N R103W Arches: S20,21 Ang: S13

SITE INFORMATION SUMMARY

SITE NAME: Black Ridge Arches

LOCATION: T10S, 11S, R103W
County: Mesa
USGS 7.5' Quad: Ruby Canyon, Sieber Canyon
Area is within Black Ridge Wilderness Study Area west of Colorado National Monument.

SIGNIFICANT FEATURES: Site contains second largest collection of natural arches in the world: approximately 200 arches occur in the Entrada and Wingate Formations (Arches National Park has the largest collection of Arches).

GENERAL DESCRIPTION: Area contains sagebrush-pinyon-juniper woodland community and intermittent grassland meadows. Rolling rocky terrain and outcrops dominate the area.

AREA: 2000 A.

OTHER SIGNIFICANT VALUES: BLM Wilderness Study Area and high scenic values.

GAG RECOMMENDATION: ONA - Outstanding Natural Area for geologic and scenic qualities.

BOUNDARY JUSTIFICATION: Area includes Rattlesnake Canyon arch complex.

SITE INFORMATION SUMMARY

SITE NAME: Cactus Park Gravels

LOCATION: T14S, R99W, S6
County: Mesa
USGS 7.5' Quad: Jacks Canyon

SIGNIFICANT FEATURES: The area contains a unique fluvial gravel deposit which will aid in determining the recent geologic history of Unaweep Canyon. Several hypotheses relating to the erosion of Unaweep Canyon have suggested an ancestral stream drainage southwestward along Dominquez Canyon to Cactus Park and through Unaweep Canyon to the Dolores River. The potential ancestral streams include the Colorado River, Gunnison River, and Uncompahgre River. It is assumed that the ancestral stream deposited the gravels in Cactus Park.

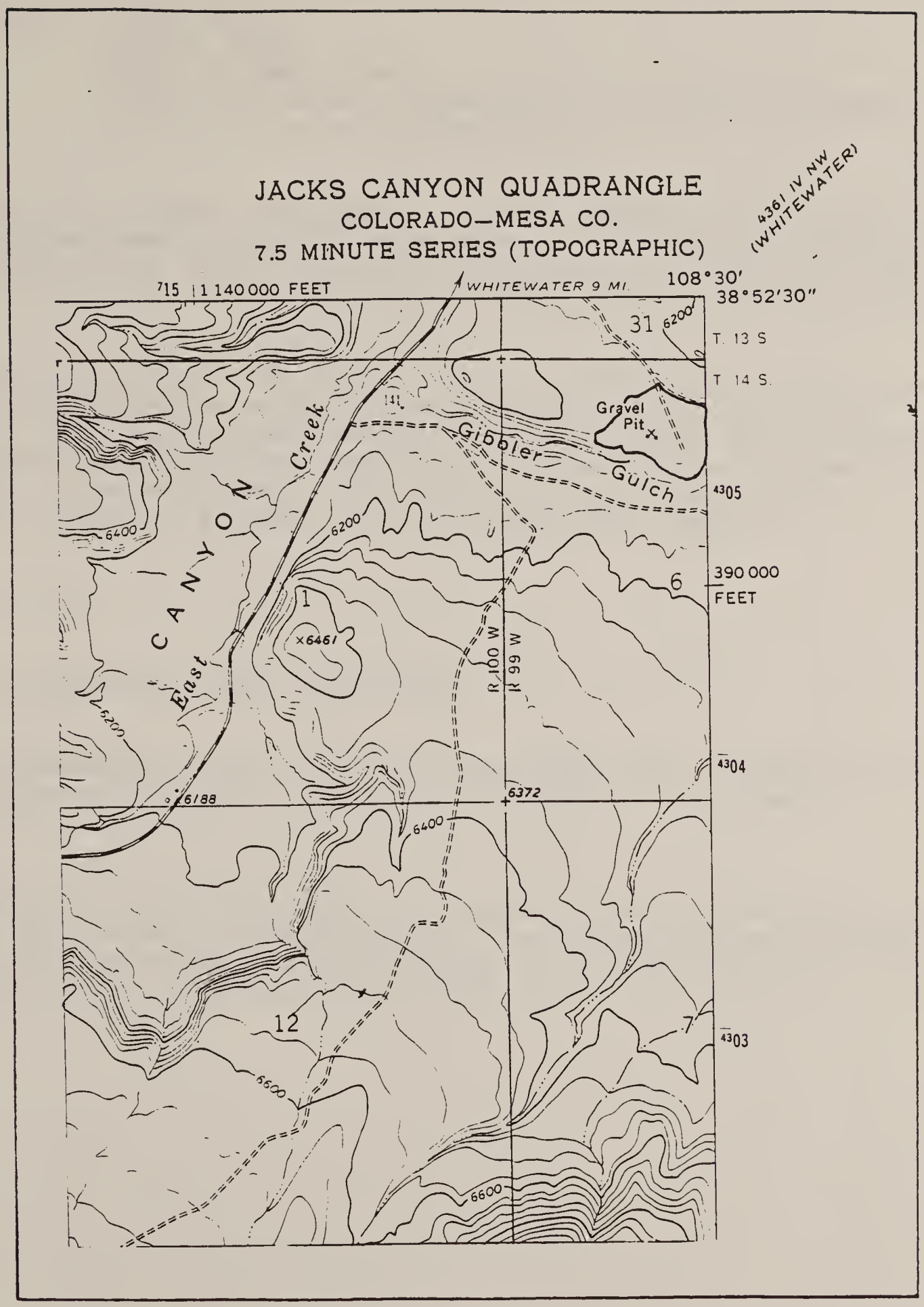
GENERAL DESCRIPTION: The gentry rolling former stream valley floor is cut along the Cactus Park Fault by the eroded channel of an intermittent branch of Gibbler Creek. The small residual sandstone bedrock outcrops form low cliffs along the gulch and small ridges and hills in the proposed area. The valley floor is sage and grass covered with isolated stands of pinyon-juniper woodland community.

AREA: 5 A.

OTHER SIGNIFICANT VALUES: None known.

GAG RECOMMENDATION: RNA - Research Natural Area: Area is used regularly by local colleges for educational and research purposes. Research by USGS has occurred on the site.

BOUNDARY JUSTIFICATION: Prescribed area contains remaining gravel deposit, mined-out deposit site, and top of deposit. Gravel from deposit was used to construct state highway through Unaweep Canyon and is removed occasionally by local residents. Remaining gravel deposit is minimal and requires protection by fencing from continued taking.



CACTUS PARK GRAVELS

Jacks Canyon Quadrangle
Colorado - Mesa County
USGS 7.5' series (topographic)
1972
scale; 1:24000
contour interval 40'
T14S, R99W, S6

SITE INFORMATION SUMMARY

SITE NAME: Debeque Canyon Landslide

LOCATION: T10S, R97W, S7
County: Mesa
USGS 7.5' Quad: Cameo
Three miles north of Highway 65 intersection with Highway 6-24 on SE side of Colorado River.

SIGNIFICANT FEATURES: Area contains a small landslide feature displaying repeated movement of three differing modes. The sandstones with shale interbeds are of fluvial origin and have resulted in slope failure and debris production. The bedding plane features are of outstanding quality.

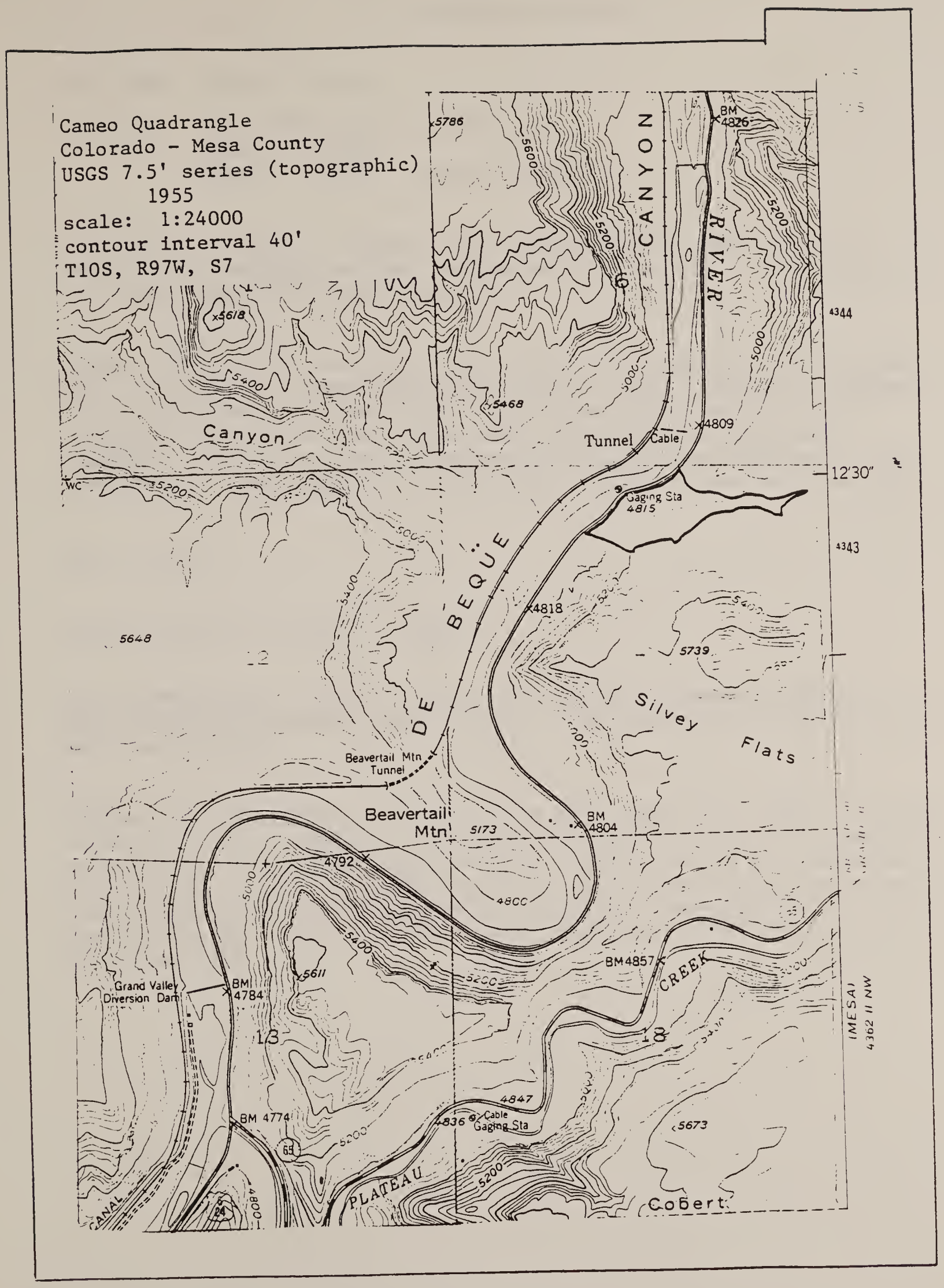
GENERAL DESCRIPTION: The landslide occurs on the northwest-facing steep cliffs which form the valley wall of the Colorado River in Debeque Canyon. The channel sandstones and claystone interbeds form a stair-step topography that is sparsely vegetated with pinyon-juniper and semi-arid shrubs, except where there is disturbance caused by slope failure. Fossil evidence of dinosaurs has been found on the landslide.

AREA: 5 A.

OTHER SIGNIFICANT VALUES: None known.

GAG RECOMMENDATION: NON - No Special Management Area recommendation due to nature of the geologic feature and commonness of landslides in Colorado.

BOUNDARY JUSTIFICATION: The area is bounded by the Colorado River on the north and northwest, by Roberts Canyon floor on the north and northeast and by the rim of the cliff on the south. This area included all of the existing landslide debris and the source area.



Debeque Canyon Landslide

SITE INFORMATION SUMMARY

SITE NAME: Dotsero Crater

LOCATION: T4S, R86W, S33; T5S, R86W, S4
County: Eagle
USGS 7.5' Quad: Glenwood Springs

SIGNIFICANT FEATURES: Dotsero Crater and its associated lava flow represent the youngest volcano, estimated at 4,150 years, in Colorado and is a good example of recent volcanism.

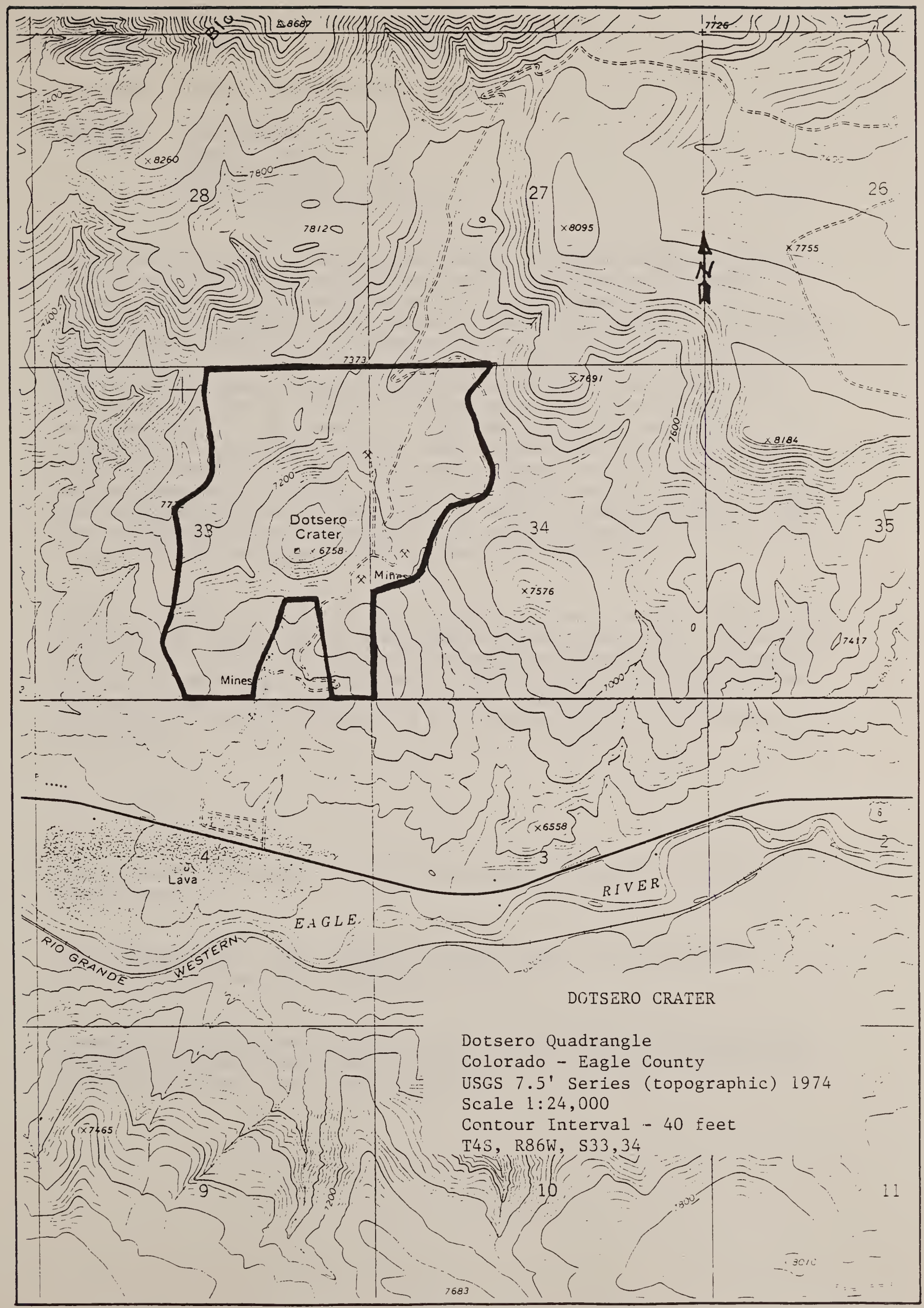
GENERAL DESCRIPTION: Dotsero Crater is 800 feet deep and 1/3 mile wide with a lava flow of almost one mile (crossing I-70). Sagebrush dominates the lava substrates on the valley floor, greasewood dominates on the colluvium and alluvium substrates with a pinyon-juniper woodland community. The area contains semidesert shrubland and semidesert forest communities. Good example of successional stages of vegetation on lava.

AREA: 340 A.

OTHER SIGNIFICANT VALUES: Unknown.

GAG RECOMMENDATION: ACEC - Area of Critical Environmental Concern. Special access agreements may need to be completed with BLM Resource Area and private owner.

BOUNDARY JUSTIFICATION: The area is the best example of recent volcanism in Colorado and is used for educational purposes by several colleges and universities. The number of active mining claims will present management difficulties for BLM. Although Dotsero Crater is modified extensively by cinder mining, the GAG recommendation emphasizes the geologic significance of the area and the need to preserve part of the crater for educational use.



DOTSERO CRATER

Dotsero Quadrangle
Colorado - Eagle County
USGS 7.5' Series (topographic) 1974
Scale 1:24,000
Contour Interval - 40 feet
T4S, R86W, S33,34

SITE INFORMATION SUMMARY

SITE NAME: Fruita Paleontological Locality

LOCATION: T1N, R3W, S13, 24
County: Mesa
USGS 7.5' Quad: Mack
Three miles SW of Fruita.

SIGNIFICANT FEATURES: The locality contains a unique record of Mesozoic vertebrate fossils, including a new species of tricondontid mammal (significant for its association with a diverse mammalian fauna). In addition, three species of multituberculates, four species of dryolestid eupanotheres, one species of fabrosaurid ornithischian, three species of crocodillians, two species of sphenodontid squamates, two species of carnivorous dinosaurs (Ceratosaurus and Allosaurus), one species of Brachiosaurus, and two species of Stegosaurus (Colorado state fossil) have been found on the locality. The completeness and excellent preservation of the late Jurassic small vertebrates on the locality, including examples of some of the oldest mammal fossils found in the Western Hemisphere, is unique, given the limited world-wide distribution and incompleteness of the late Jurassic small vertebrate fossils. The rich assortment of small, terrestrially adapted vertebrate fossils found on the locality makes the locality especially important.

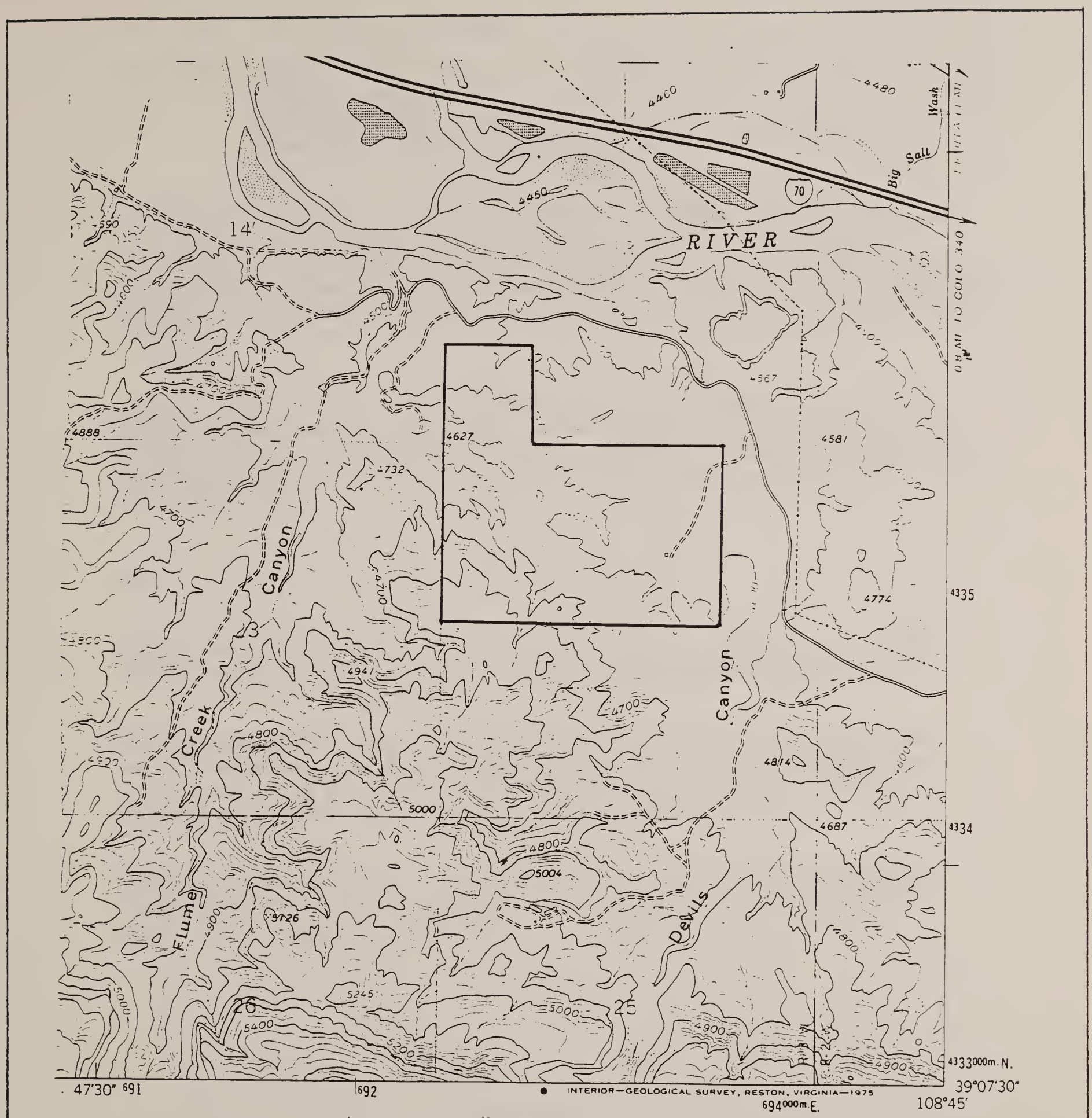
GENERAL DESCRIPTION: The area is typical in aspect for the Grand Valley, consisting of undulating terrain mixed with rocky outcrops. The locality contains outcroppings of the Morrison Formation deposited approximately 140 million years ago and composed of the lower Salt Wash Sandstone and the upper Bushy Basin Shale. The Morrison Formation is the most fossiliferous formation within the Grand Valley and has produced fossils since 1900.

AREA: 280 A.

OTHER SIGNIFICANT VALUES: Adjacent to proposed Black Ridge Wilderness Study Area.

GAG RECOMMENDATION: RNA - Research Natural Area for international significance of Mesozoic vertebrate fossils.

BOUNDARY JUSTIFICATION: Locality has been withdrawn from mineral entry and fenced by BLM. Fenced area contains active research location and includes the known fossil bearing strata.



FRUITA PALEONTOLOGICAL LOCALITY

Mack Quadrangle
Colorado - Mesa County
USGS 7.5' series (topographic)
1973
scale: 1:24000
contour interval 20'
T1N, R3W, S13,24

SITE INFORMATION SUMMARY

SITE NAME: The Gateway Palisade

LOCATION: T15S, R104W, S36
County: Mesa
USGS 7.5' Quad: Gateway
About three miles north of Gateway.

SIGNIFICANT FEATURES: The area contains a sandstone monolith that ends in a 2000' vertical ridge abutment of spectacular scenic beauty. Stratigraphic relationships are displayed which help to interpret the depositional pattern of the southwest flanks of the ancestral Uncompahgre Uplift of the Permian. Unconformable contacts in the Triassic units are displayed clearly.

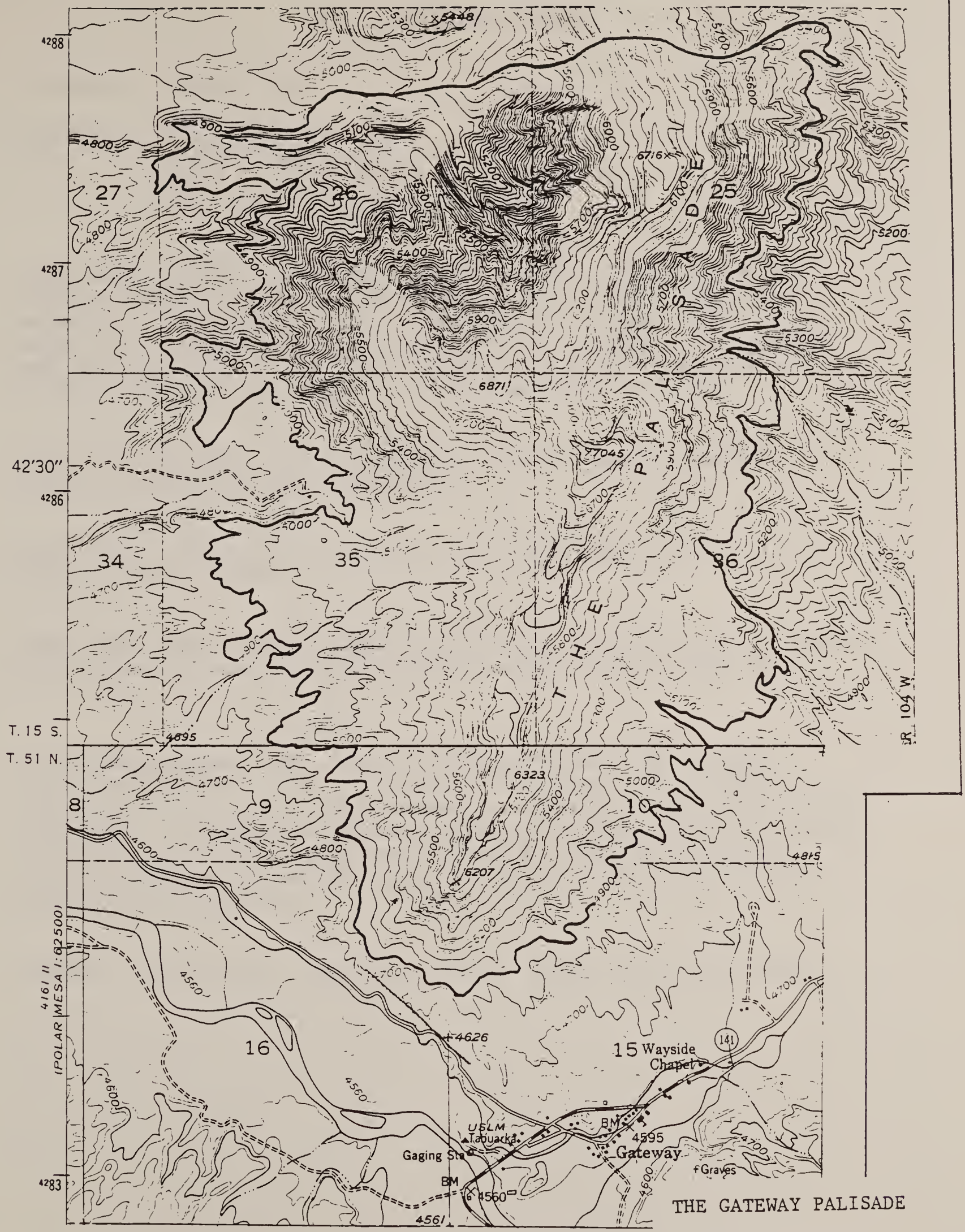
GENERAL DESCRIPTION: The area forms part of the north wall of the Dolores River and the sedimentary units eroded in alternating cliff and slope topography. Sparse semi-desert vegetation of various brush, grass, and shrub types occur with some pinyon-juniper woodland occurring in protected areas.

AREA: 1920 A.

OTHER SIGNIFICANT VALUES: Site has spectacular scenic quality (BLM scenic quality rating A) and is within a BLM Wilderness Study Area.

GAG RECOMMENDATION: ONA - Outstanding Natural Area for geologic and scenic qualities. Area is recognized nationally for its display of stratigraphic relationships and its importance in interpreting the geology of Unaweep Canyon and southwest Colorado.

BOUNDARY JUSTIFICATION: Prescribed area contains ridge abutment and escarpment face from rim to bottom of ridge, which includes the geologically important sections.



THE GATEWAY PALISADE

Gateway Quadrangle
Colorado - Mesa County
USGS 7.5'series (topographic)
1960
scale: 1:24000
contour interval 20'
T15S, R104W, S25,26,35,36
T51N, R19W, S9, 10, 15, 16

SITE INFORMATION SUMMARY

SITE NAME: Gypsum Cliffs

LOCATION: T4S, R86W, S31, 34
County: Eagle
USGS 7.5' Quad: Gypsum
Cliffs north of Gypsum, along I-70.

SIGNIFICANT FEATURES: The Gypsum Cliffs are excellent exposures of deformed gypsum, carbonates, and shales of the Pennsylvanian Minturn Formation. The deformation is due to the plastic flow of Eagle Valley Evaporites. The contorted interbedded silicic, carbonate, and gypsum beds are exposed in cliffs easily visible from I-70. The cliffs occur in the north flank of the evaporite-formed Eagle River Anticline.

GENERAL DESCRIPTION: The area contains scattered pinyon-juniper-sagebrush-grassland vegetation complex.

AREA: 30 A. Outcrop in SE quarter of S31 most important due to the quality of the exposure.

OTHER SIGNIFICANT VALUES: Several plant associations of special concern to Colorado are known from the vicinity and may occur on the sites.

GAG RECOMMENDATION: SMA - Special Management Area. No apparent management conflicts exist on the site. Interpretive sign could be placed along I-70 and at the BLM campground near the identified site for public use. The GAG will request assistance from the Colorado Department of Highways and Colorado Geological Survey for signing of site. A pull-out will have to be constructed in IFO if an interpretive sign is placed on the interstate.

BOUNDARY JUSTIFICATION: Best exposure for interpretation and signing.

GYPSUM CLIFFS

/// BEST EXPOSURES VISIBLE FROM BLM CAMPGROUND

Gypsum Quadrangle
Colorado - Eagle County
USGS 7.5' series (topographic)
1962
scale; 1:24000
contour interval 40'
T4S, R85W, S31-34

SITE INFORMATION SUMMARY

SITE NAME: Juanita Natural Bridge

LOCATION: T18W, R5ON
County: Mesa
USGS 7.5' Quad: Juanita Arch
15 miles SW of Gateway off State Highway 141 and across Dolores River.

SIGNIFICANT FEATURES: One of the few natural bridges in Colorado, Juanita Natural Bridge occurs in a tributary canyon to the Dolores River.

GENERAL DESCRIPTION: Southwest Colorado canyon country consisting of sandstone outcroppings and escarpments with scattered pinyon-juniper in semi-arid shrub community. Cottonwood and shrub vegetation occurs along water courses.

AREA: 640 A.

OTHER SIGNIFICANT VALUES: Scenic - spectacular canyon country vistas.

GAG RECOMMENDATION: Deferred pending field evaluation (scheduled for 1986).

BOUNDARY JUSTIFICATION: Deferred pending field evaluation.

JUANITA ARCH
Juanita Arch Quadrangle
Colorado-Mesa County
USGS 7.5' series (topographic) 1960
Scale: 1:24000
Contour Interval: 20'
T5ON R18W S20,29,30,31

SITE INFORMATION SUMMARY

SITE NAME: McCoy Fan Deltas

LOCATION: T1S, R83W, S31;
T1S, R84W, S35, 36;
T2S, R83W, S6;
T2S, R84W, S1, 2
County: Eagle, Routt
USGS 7.5' Quads: Blue Hill, McCoy

SIGNIFICANT FEATURES: Excellent exposures of Pennsylvanian fan deltas, including topset, foreset, and bottom set beds, distributary channels, storm washover fans, and nearshore marine carbonates. Nearshore carbonates are highly fossiliferous with marine invertebrates.

GENERAL DESCRIPTION: The McCoy fan deltas are some of the best exposed ancient deltas in the Rocky Mountain region. The deltas were formed by alluvial fan distributaries off the Ancestral Front Range, which deposited sediment loads into the marine waters of the Pennsylvanian Central Colorado Trough. The area contains sediments deposited in alluvial fans, in fan deltas, as nearshore marine clastics, and as nearshore marine carbonates. Interbedded with the fan delta deposits are marine limestones containing abundant fossils. The area around McCoy has produced 114 species of invertebrates, three species of vertebrates, and four species of plants, and is the type of area for 19 species of Pennsylvanian plants and animals. Vegetation consists of semi-arid shrub and pinyon-juniper communities.

AREA: 1,040 A.

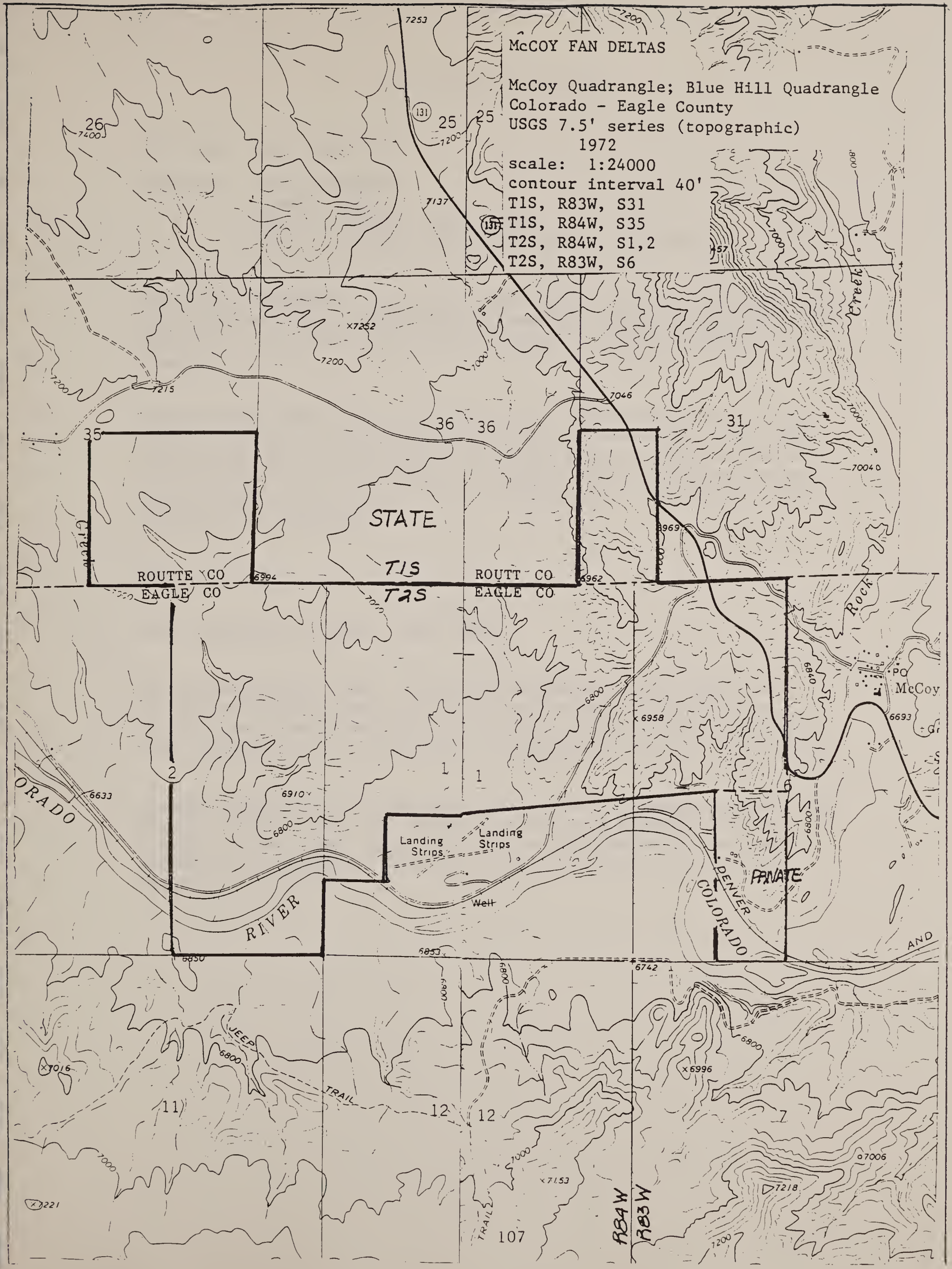
OTHER SIGNIFICANT VALUES: Area is adjacent to popular Colorado River access point for river rafting.

GAG RECOMMENDATION: ONA - Outstanding Natural Area for geologic values. The area is the site of ongoing sedimentology and paleontology research and is regularly used for educational purposes by several universities in the state and the region.

BOUNDARY JUSTIFICATION: The denoted area is the primary use area for research and educational purposes and contains easily accessible geological features.

McCOY FAN DELTAS

McCoy Quadrangle; Blue Hill Quadrangle
Colorado - Eagle County
USGS 7.5' series (topographic)
1972
scale: 1:24000
contour interval 40'
T1S, R83W, S31
T1S, R84W, S35
T2S, R84W, S1,2
T2S, R83W, S6



SITE INFORMATION SUMMARY

SITE NAME: Nancy Hanks Gulch

LOCATION: T14S, R100W, S11
County: Mesa
USGS 7.5' Quad: Jacks Canyon
Area is situated ten miles southwest of Whitewater.

SIGNIFICANT FEATURES: Area shows alteration by hydrothermal processes of the sandstone units overlying the Precambrian complex in the mid to late Tertiary. The altered area contains minerals, including amethyst and copper.

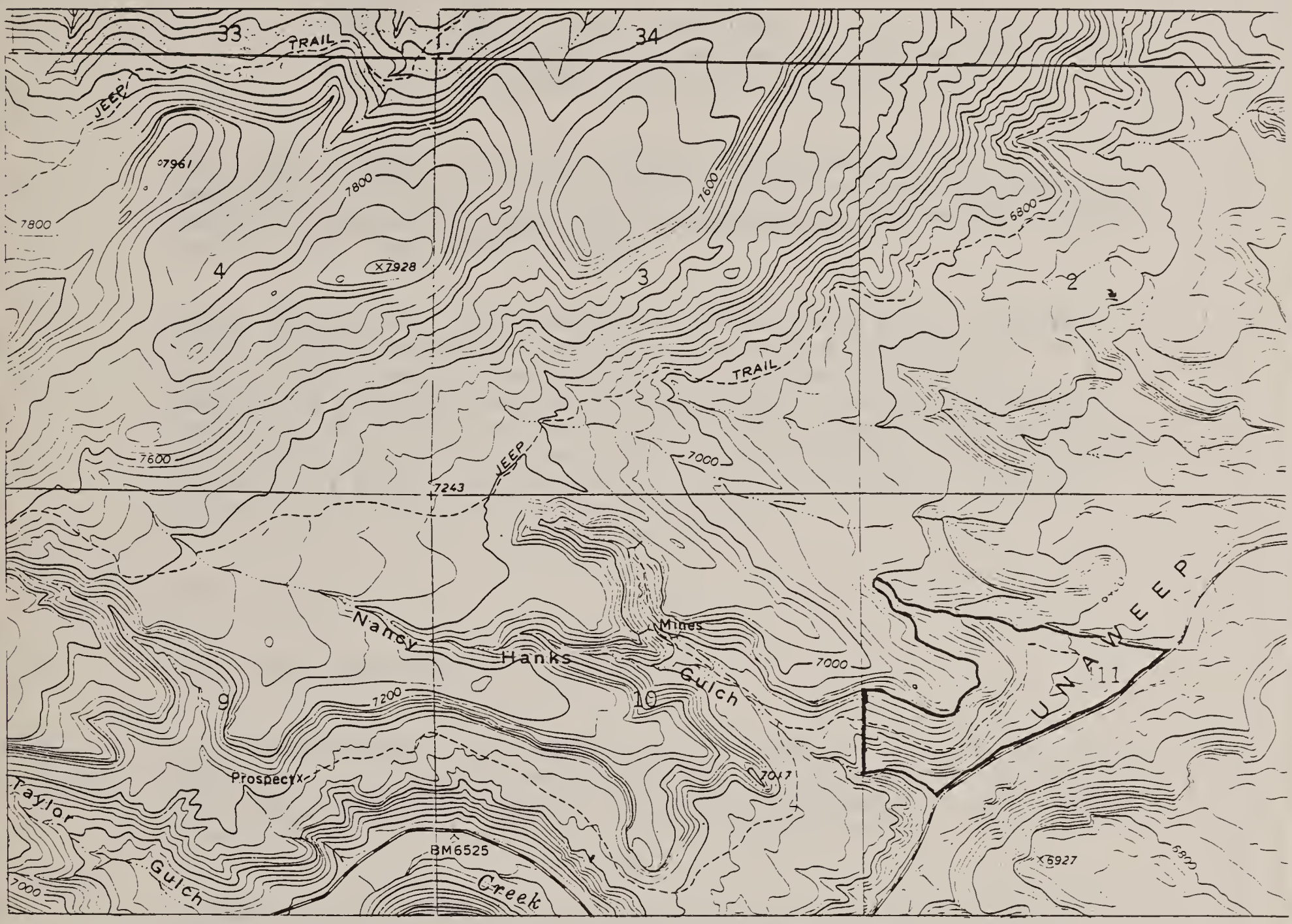
GENERAL DESCRIPTION: The silicified veins occur on both sides of the valley floor and extend up the steep cliffs of Precambrian schist and granite and into the overlying Triassic age mudstones and sandstones. The alluvium in the valley floor is vegetated with cottonwood, willow, various shrubs and grasses. The rock slopes are sparsely covered with pinyon-juniper woodland.

AREA: 7 A.

OTHER SIGNIFICANT VALUES: None known.

GAG RECOMMENDATION: NON - no special management area designation. Existence of patented mining claims and land ownership pattern make specific management prescriptions difficult for this site. Identified area is important for educational and interpretive use by local colleges.

BOUNDARY JUSTIFICATION: The boundaries include the exposed areas of the mineralized veins that are visible from the main highway. The area extends up Nancy Hanks Gulch and could be expanded to include the vein extension in that area. Patented mining claims exist within the identified boundaries.



NANCY HANKS GULCH

Jacks Canyon Quadrangle
Colorado - Mesa County
USGS 7.5' series (topographic)
1972
scale: 1:24000
contour interval 40'
T14S, R100W, S11

SITE INFORMATION SUMMARY

SITE NAME: Rabbit Valley Locality

LOCATION: T10S, R104W, S1, 8, 9, 16, 17
County: Mesa
USGS 7.5' Quad: Bitter Creek Well
Site is located west of Grand Junction near the Colorado-Utah border at the Rabbit Valley interchange on I-70.

SIGNIFICANT FEATURES: the site contains a large section of a Camarasaurus axial skeleton in channel sandstone and has also produced elements of Allosaurus, Camarasaurus, Camptosaurus, and perhaps two other species from a lower shale horizon.

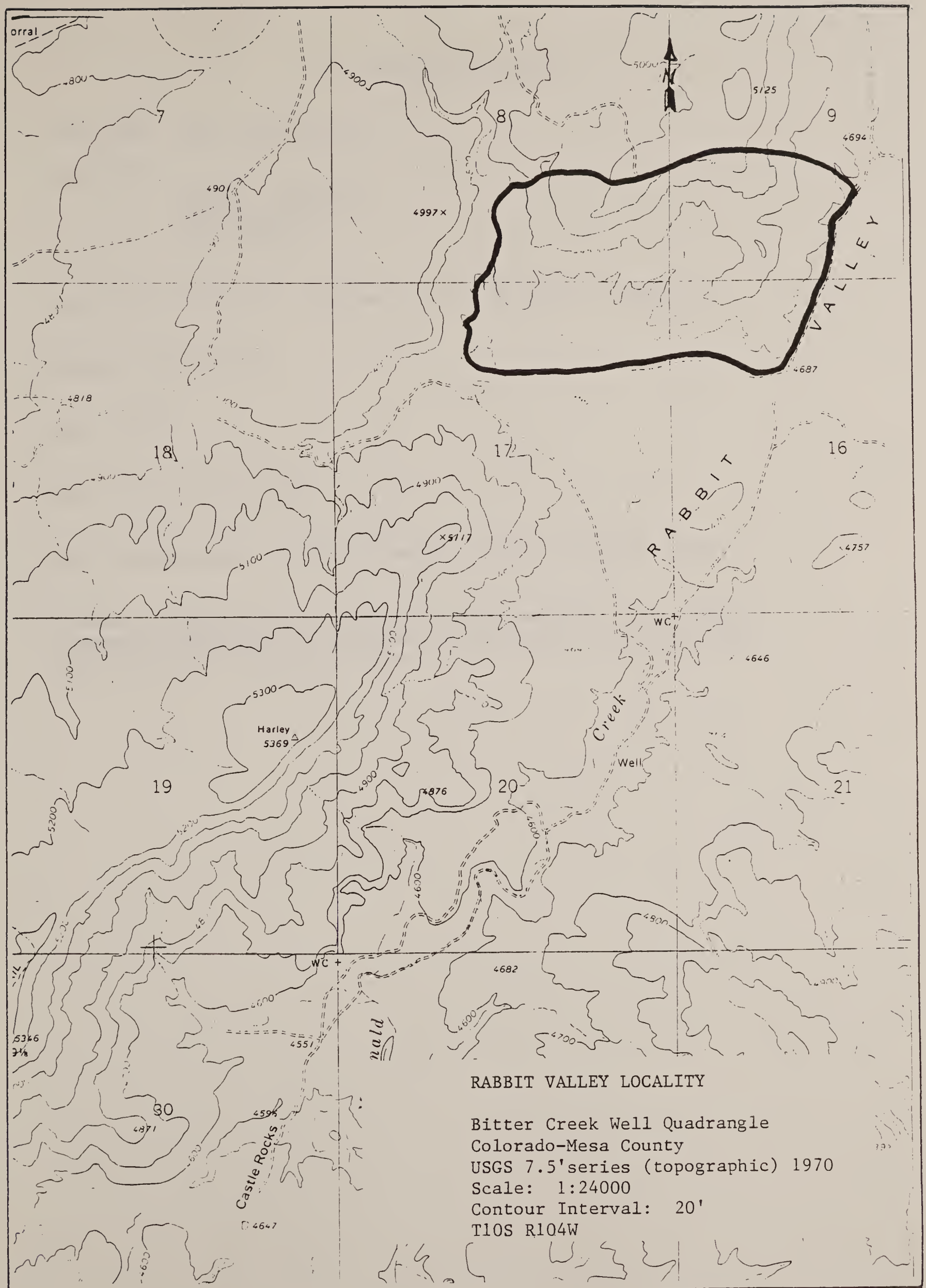
GENERAL DESCRIPTION: Rabbit Valley is located north of the Colorado River along the northwest flank of the Uncompahgre Uplift. The area contains sandy loam soils which are highly erosive. The area is dominated by sandstone outcrops on steep slopes. Geologic formations outcropping on the site are the Jurassic Morrison Formation, Brushy Basin Member overlaid by the Cretaceous Burro Canyon Formation. Vegetation on the area is a desert shrub community consisting of perennial grasses, pinyon-juniper, saltbush, and desert shrubs.

AREA: 320 A.

OTHER SIGNIFICANT VALUES: None known.

GAG RECOMMENDATION: RNA - Research Natural Area for research and education. The Museum of Western Colorado (Grand Junction) has excavated fossil material from the site. A cooperative agreement has been signed between the BLM and the Museum to jointly manage the site.

BOUNDARY JUSTIFICATION: Includes area required for public education/ interpretive use as well as for continuing research on site. The research area contains the core fossiliferous area based on recent field surveys. The expanded interpretive area is less fossiliferous, but contains fossil bone which can be used in situ for educational and interpretive purposes.



RABBIT VALLEY LOCALITY

Bitter Creek Well Quadrangle
Colorado-Mesa County
USGS 7.5'series (topographic) 1970
Scale: 1:24000
Contour Interval: 20'
T10S R104W

SITE INFORMATION SUMMARY

SITE NAME: Roan Creek Goblins

LOCATION:
County: Garfield
USGS 7.5' Quad:
T9S R100W S3

SIGNIFICANT FEATURES: Erosional feature in Wasatch formation.

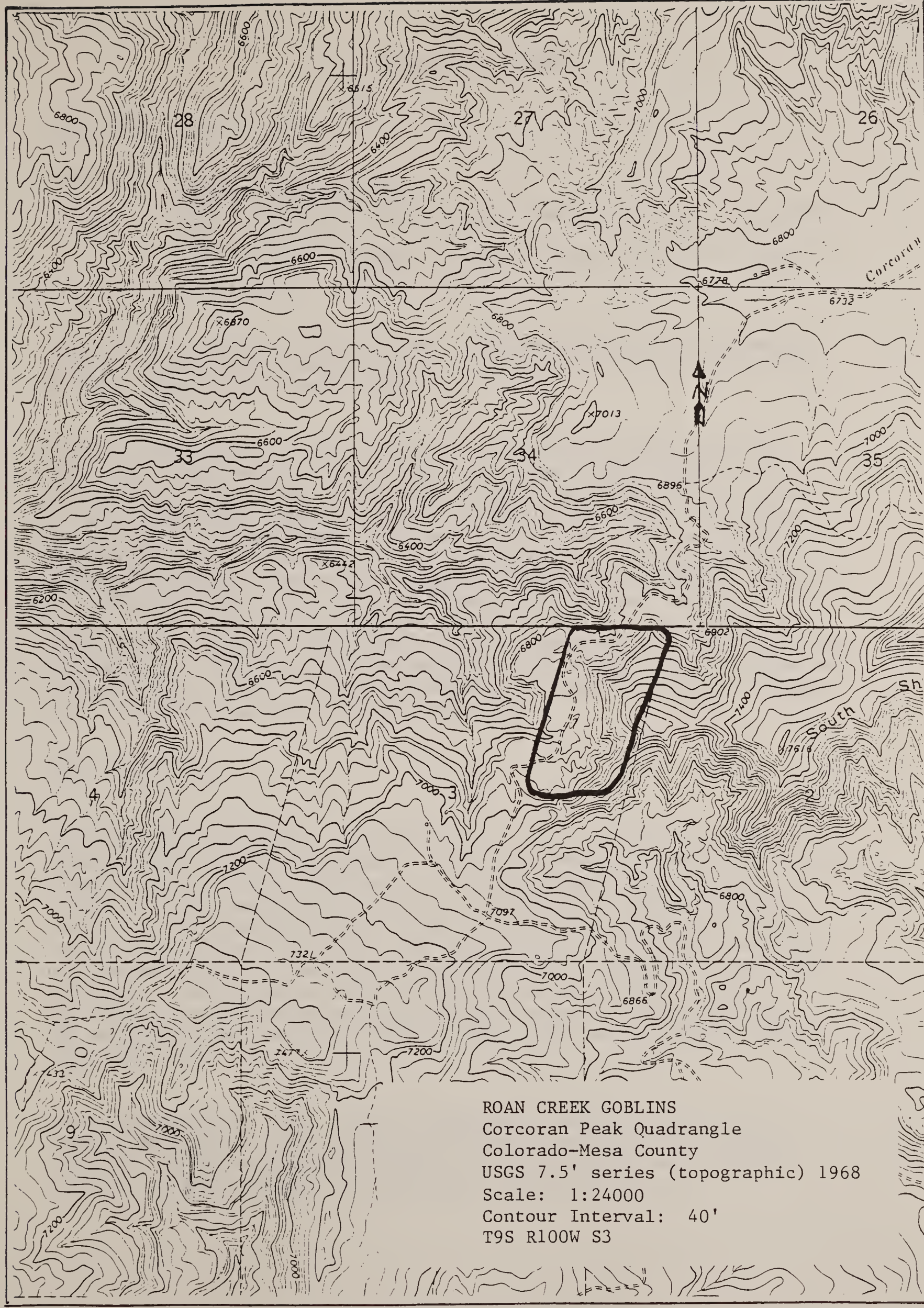
GENERAL DESCRIPTION:

AREA: 80 A.

OTHER SIGNIFICANT VALUES:

GAG RECOMMENDATION: Deferred pending further evaluation (1986).

BOUNDARY JUSTIFICATION: Follows erosional feature. A no surface occupancy stipulation for the area is delineated in the BLM-Grand Junction Resource Management Plan.



ROAN CREEK GOBLINS
Corcoran Peak Quadrangle
Colorado-Mesa County
USGS 7.5' series (topographic) 1968
Scale: 1:24000
Contour Interval: 40'
T9S R100W S3

SITE INFORMATION SUMMARY

SITE NAME: Sinbad Valley

LOCATION: T48, 49N, R19W
County: Mesa, Montrose
USGS 7.5' Quads: Mt. Waas 4SE, Juanita Arch, Mt. Peale 1NE, Roc Creek.
15 miles SW of Gateway off State Highway 141, west of Salt Creek Road.

SIGNIFICANT FEATURES: Sinbad Valley is the exposed core of a breached salt-piercement anticline in a scenic structural section of the Colorado Plateau known as the Paradox Basin.

GENERAL DESCRIPTION: Sinbad Valley is a broad oval depression about eight miles long and four miles wide, encircled by high inward facing escarpments. Elevational differences from valley floor to rim average 1,500 - 2,000 feet. Rocks exposed in Sinbad Valley range in age from Pennsylvanian, in the lower slopes and valley floor, to Lower Cretaceous in the upper part of the outer rim. The broad floor of Sinbad Valley consists chiefly of the Paradox Member of the Hermosa Formation, which is mostly halite (rock salt), gypsum, limestone, sandstone, and shale. The halite is not exposed, because of its high solubility, but in the subsurface it comprises about 40% of the Paradox Member. Almost half the valley floor is Quaternary alluvium covered with sparse brush, pinyon and juniper, and grasses. The Paradox Member occasionally protrudes through the alluvium as low hills almost free of soil.

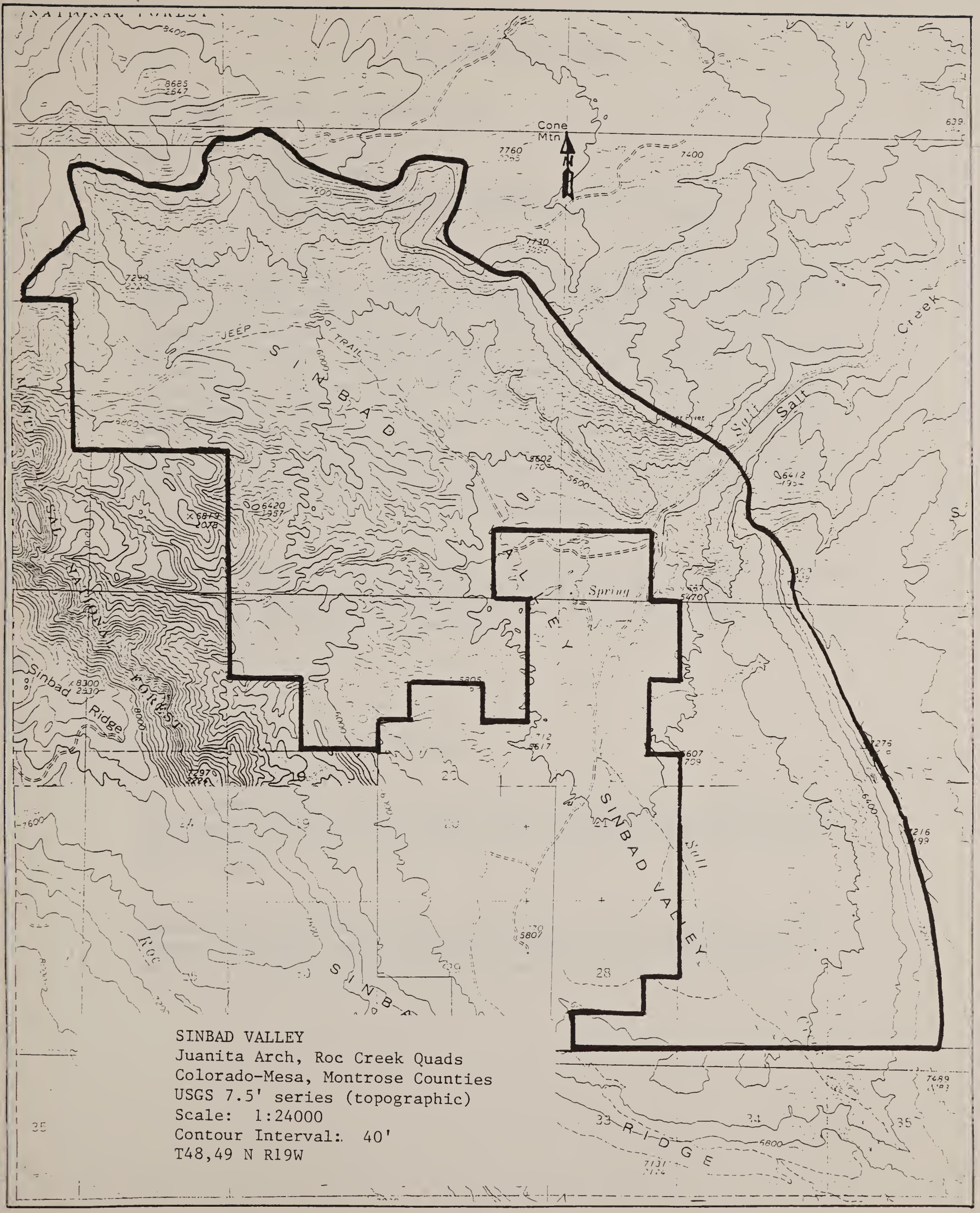
AREA: 10,250 A.

OTHER SIGNIFICANT VALUES: Sinbad Valley is scenic with the encircling rims adding a dramatic backdrop. The valley rims vary from steep, brushy forested slopes to bare outcrops. Rock exposures on the north and northeast walls contain Triassic and Jurassic rocks forming brightly colored cliffs hundreds of feet high, particularly the Wingate, Kayenta, Navajo, and Entrada Formations. In many places the rims are broken by well-exposed faults. The core of the anticline is completely encircled by faults. All of these faults resulted from the collapse of the anticline, brought on largely by erosional exposure of the salt core, accompanied by salt extrusion and solution, and loss of support to the overlying rocks.

GAG RECOMMENDATION: SMA - Special Management Area from the rim of Sewemup Mesa to the floor of Sinbad Valley; rim-floor: three sections north of Salt Creek and three sections south of Salt Creek. Sinbad Valley is a good example of a collapsed salt anticline in a

self-contained and scenic area. The geologic value of Sinbad Valley is having the area available for educational use in a relatively undisturbed condition. Minimal disturbance within the valley or on the valley rim will not harm the geologic features.

BOUNDARY JUSTIFICATION: Part of the proposed area is within the Sewemup Wilderness Study Area. The best stratigraphic exposures are contained in the delineated area.



SINBAD VALLEY
Juanita Arch, Roc Creek Quads
Colorado-Mesa, Montrose Counties
USGS 7.5' series (topographic)
Scale: 1:24000
Contour Interval: 40'
T48,49 N R19W

SITE INFORMATION SUMMARY

SITE NAME: Unaweep Canyon Overlook

LOCATION: T14S, R100W, S16
County: Mesa
USGS 7.5' Quad: Jack Canyon
Twelve miles southwest of Whitewater on Highway 141

SIGNIFICANT FEATURES: Overlook provides an awesome view of Unaweep Canyon, a scenic canyon which is the postulated course of the Gunnison and Colorado Rivers prior to their diversion in late Tertiary time. The Unaweep Canyon Overlook provides a panoramic view of outstanding geological features. Narrow V-shaped gorges at both ends of the canyon grade into a classic U-shape implying glaciation. The valley is surmounted by sheer granite walls hundreds of feet high and drainage divide near the valley center. The stratigraphy is similar to that of nearby Colorado National Monument. Precambrian rocks are correlative with those of the Black Canyon of the Gunnison. Despite the evidence of glaciation, no glacial moraines have been identified. Area has major granite types; granite has quartz pegmatites. A major unconformity, Precambrian to Triassic, is visible on the site.

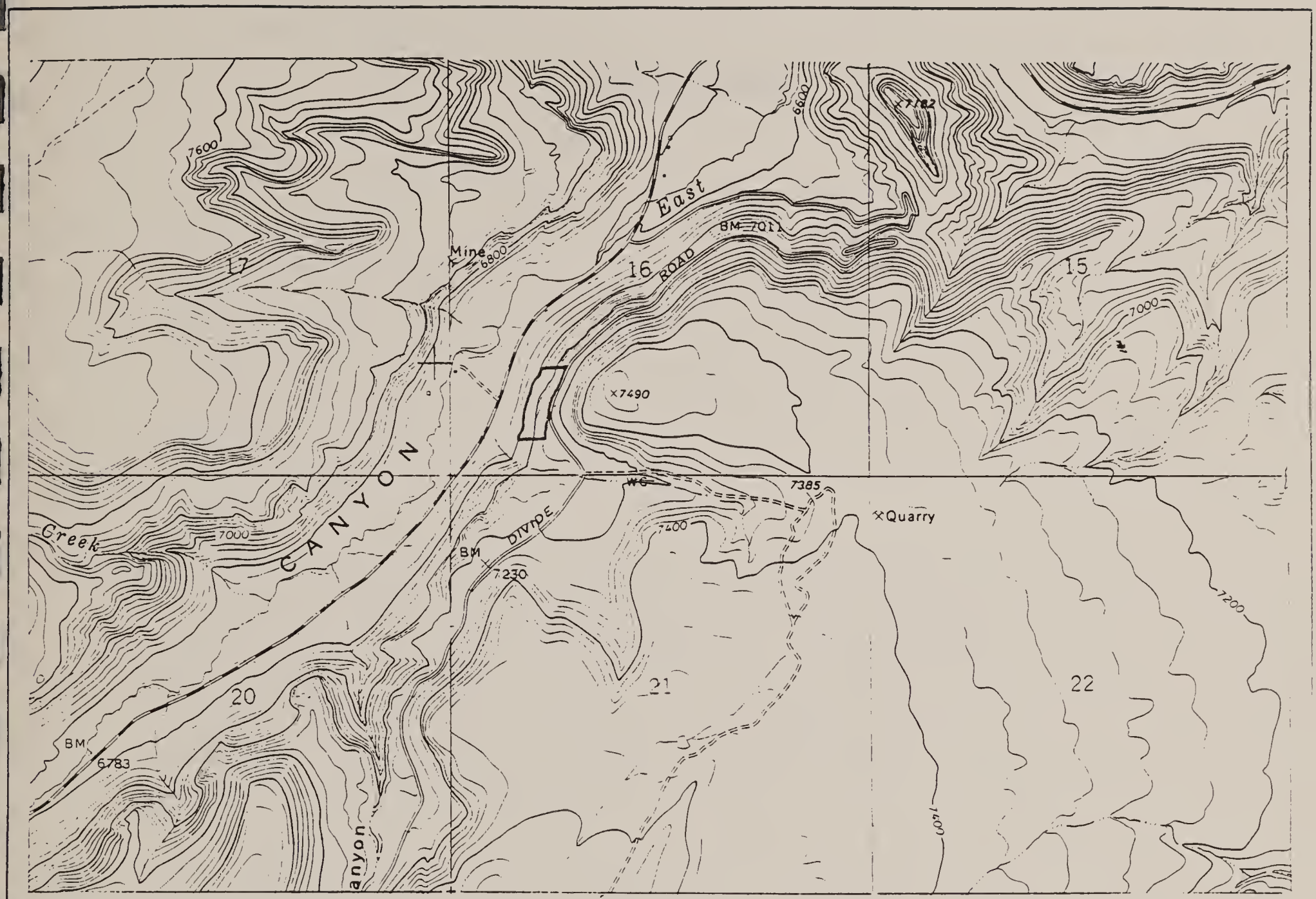
GENERAL DESCRIPTION: The overlook includes a small section of the canyon rim that slopes very gently to the abrupt drop from the edge. The predominant vegetation is typical pinyon-juniper woodland with some trees that are of impressive size and age.

AREA: 5 A.

OTHER SIGNIFICANT VALUES: Scenic.

GAG RECOMMENDATION: REC - Recreational designation for placement of interpretive sign on Divide Creek Road to encourage appropriate public use and to explain the significance of the geologic features visible from the overlook.

BOUNDARY JUSTIFICATION: Area contains best site for panoramic view of Unaweep Canyon and could include the historic Taylor Ranch Granite Quarry, if land exchange occurred between BLM and private owners.



UNAWEEP CANYON OVERLOOK

Jacks Canyon Quadrangle
Colorado - Mesa County
USGS 7.5' series (topographic)
1972
scale: 1:24000
contour interval 40'
T14S, R100W, S16

MONTROSE DISTRICT

SITE INFORMATION SUMMARY

SITE NAME: Dolores Canyon Meanders

LOCATION: T47N, R19W, S35, 36
T46N, R18W, S31, 12
T46N, R18W, S31
T46N, R19W, S1, 2, 10, 11, 12, 13, 14, 23, 25, 26, 35, 36
T47N, R18W, S30, 31
County: Montrose
USGS 7.5' Quads: Anderson Mesa, Bull Canyon, Paradox

SIGNIFICANT FEATURES: Dolores River Canyon Meanders are located in the canyonlands area of the Colorado Plateau. The meanders of the Dolores River cut the plateau between Little Gypsum Valley on the south and Paradox Valley on the north. The cliffs of the incised meanders have exposures of dipping layers of the Chinle Formation, Wingate Sandstone, Kayenta Formation, Navajo Sandstone, and Morrison Formation. The incised meanders resemble the Goosenecks of the San Juan River, but are of added interest because of the adjacent salt structure and related structural and geomorphic features.

GENERAL DESCRIPTION: The deeply incised, meandering Dolores River Canyon system is cut down through a series of sedimentary strata. Colorful ledges and massive cliffs and jumbled talus slopes combine with the Dolores River to produce spectacular scenery. Vegetation varies with terrain and elevation. The canyon rim and mesas support a pinyon-juniper woodland with interspersed sagebrush dominated open areas. The canyon slopes support a mixture of desert shrubs (sagebrush, mormon tea, squawbush, buffaloberry) and scattered pinyon-juniper, cottonwoods, and ponderosa pine. Riparian vegetation (cottonwood, willow, tamarisk) is common in the canyon bottoms.

AREA: 15,300 A.

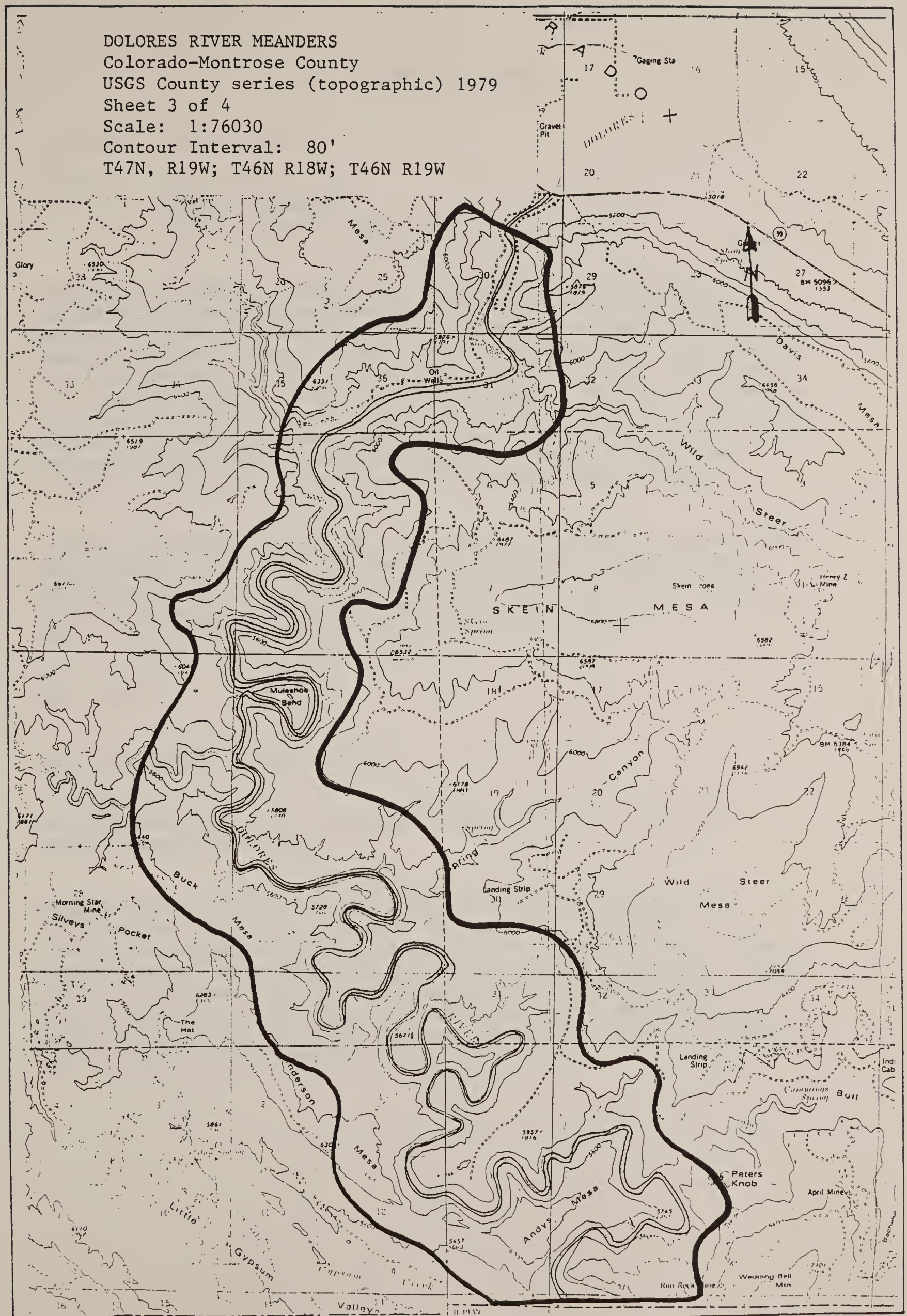
OTHER SIGNIFICANT VALUES: The recommended site is within the Dolores River Canyon Wilderness Study Area and adjacent to the proposed Coyote Wash Natural Area which contains occurrences of plants and plant communities of special concern to the State of Colorado. These include Erigeron kachinensis (Kachina fleabane), which is extremely rare and endangered throughout its range (ranked G1S1 by Colorado Natural Areas Inventory) and a candidate species for listing as threatened or endangered (USFWS Category II - Federal Register, 1983). Mimulus eastwoodiae (Eastwood Monkey Flower) is ranked as critically imperiled in Colorado.

The Hilana jamesii-Oryzopsis hymenoides-Stipa comata (Galleta-Indian Ricegrass-Needle-and-Thread) Great Basin Grassland is endangered throughout its range. Coyote Wash contains one of the few known occurrences of this plant association in Colorado.

GAG RECOMMENDATION: ONA - Outstanding Natural Area designation for scenic qualities of geologic features. Area is used for educational purposes. Public use will not affect geological features. No threats are known to geological features.

BOUNDARY JUSTIFICATION: The identified geologic area contains the most exemplary geologic features and is contained within the wilderness study area. The selected boundary utilizes both legal and topographic boundaries.

DOLORES RIVER MEANDERS
Colorado-Montrose County
USGS County series (topographic) 1979
Sheet 3 of 4
Scale: 1:76030
Contour Interval: 80'
T47N, R19W; T46N R18W; T46N R19W



SITE INFORMATION SUMMARY

SITE NAME: Horseshoe Basin

LOCATION: T43N, R6W, S27, 28
County: Hinsdale
USGS 7.5' Quad: Handies Peak

SIGNIFICANT FEATURES: Horseshoe Basin in the San Juan Mountains of southwest Colorado contains numerous large rock glaciers (periglacial features), resembling debris-covered glaciers of ice. The surfaces are hummocky and uneven. Depressions resembling crevasses are present with ridges and depressions at the lower ends. The ends of the rock glaciers are steep and abrupt, rising as much as 100 feet. The debris forming the rock glaciers comes from mass wasting of the tuffs and flows of the Burns and Henson Formations between the Silverton and Lake City calderas of the San Juan volcanic field. Horseshoe Basin contains the largest rock glaciers in extensive accumulations in the Henson Creek drainage.

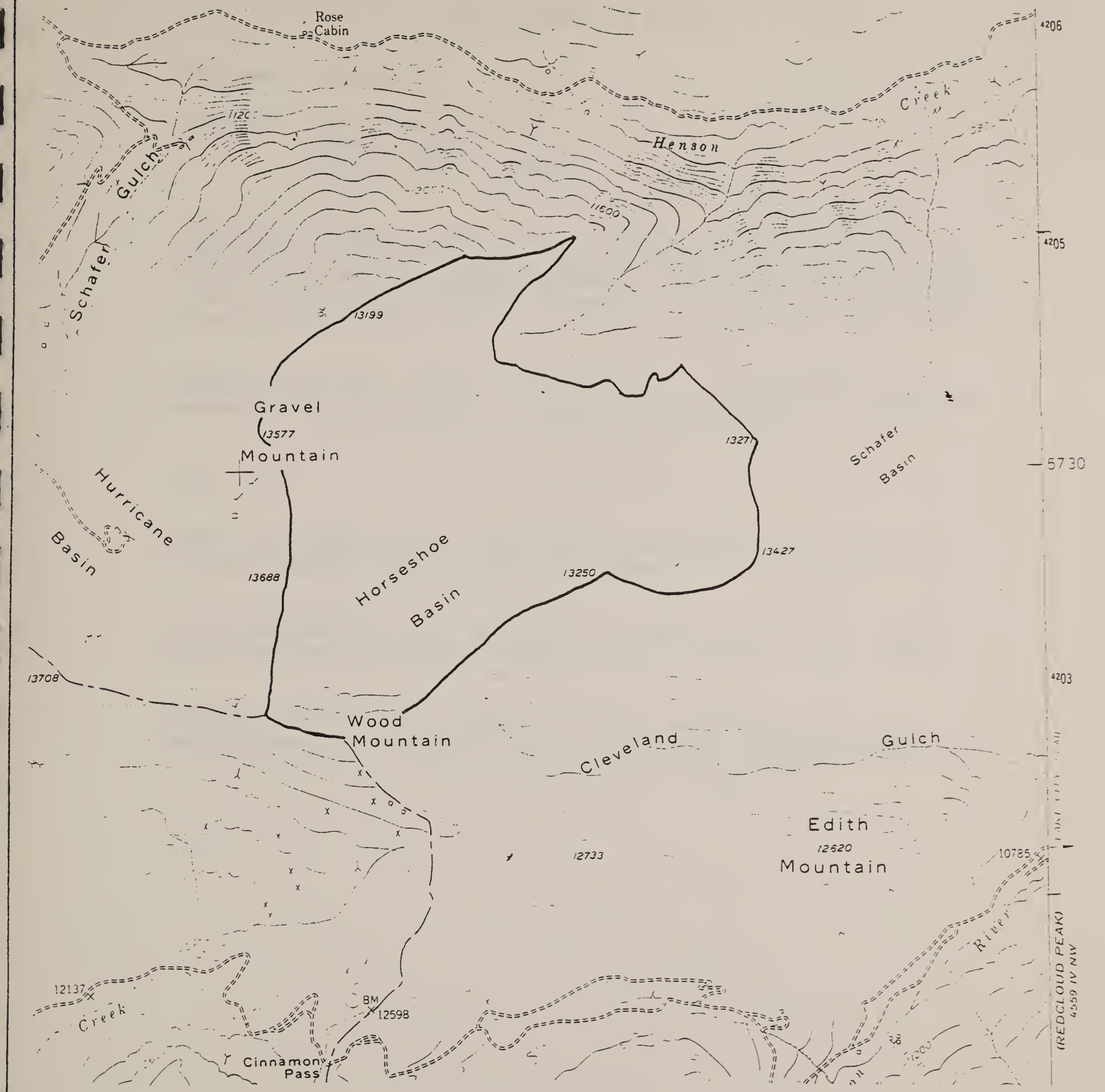
GENERAL DESCRIPTION: Elevation of Horseshoe Basin ranges between 12,000' and 13,700', with most of the area above timberline. Alpine tundra vegetation occurs in delicate clumps on the rocky slopes and in the talus. The rugged, glaciated terrain is isolated and scenic, consisting mostly of rock debris, boulder fields, and talus slopes.

AREA: 650 A.

OTHER SIGNIFICANT VALUES: Unknown

GAG RECOMMENDATION: ONA - Outstanding Natural Area for scenic and exemplary geologic features.

BOUNDARY JUSTIFICATION: Horseshoe Basin is situated between the Silverton and Lake City calderas in the San Juan volcanic field. The calderas and associated volcanic rocks and ore deposits give the area greater geologic value than that of the glacial features alone. Private mining claims cover part of Horseshoe Basin. Although Horseshoe Basin may not be unique in any single characteristic, the combination of geologic features, access, and land ownership, make it one of the best possibilities in the range for scientific research.



HORSESHOE BASIN

Handies Peak Quadrangle
Colorado - Hinsdale County
USGS 7.5' series (topographic) 1955
scale: 1:24000
contour interval 40'
T43N, R6W, S27-28

SITE INFORMATION SUMMARY

SITE NAME: Needle Rock

LOCATION: T15S, R91W, S27, 22
County: Delta
USGS 7.5' Quad: Crawford

SIGNIFICANT FEATURES: Core or neck of tertiary volcano which rises 800 feet above the valley floor as a result of millions of years of the erosion of sedimentary formations around it. The igneous plug originated as molten rock intruded through sedimentary rock during active volcanism 25 million years ago.

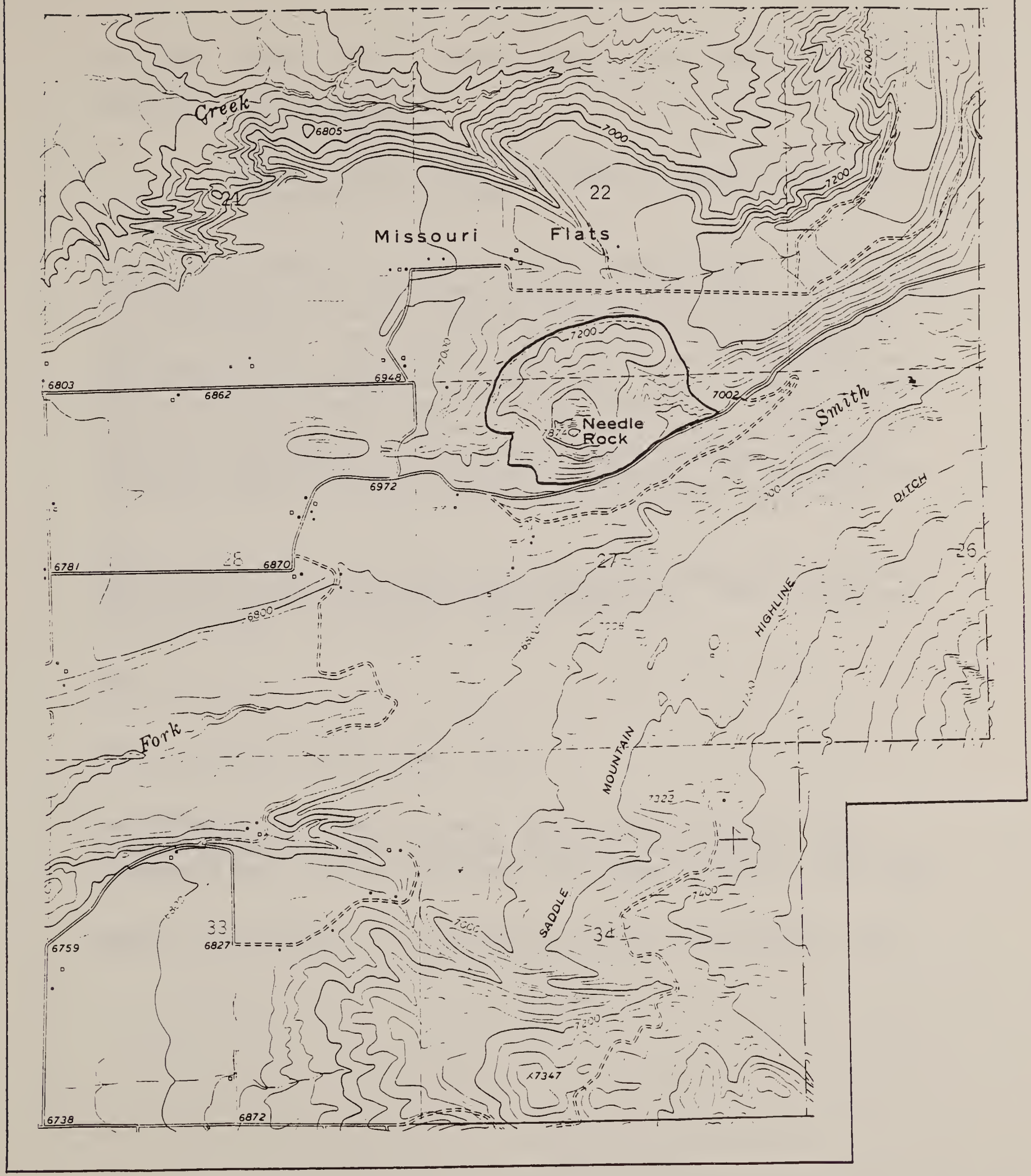
GENERAL DESCRIPTION: Base of Needle Rock has a pinyon-juniper-grassland community. The rock monolith is barren of vegetation.

AREA: 80 A.

OTHER SIGNIFICANT VALUES: Area used for educational and recreational purposes. Needle rock has high scenic value.

GAG RECOMMENDATION: RNA - ONA designation may be appropriate. Support RNA as previously designated (1965) by BLM.

BOUNDARY JUSTIFICATION: Existing boundaries which include the rock monolith and lands around its base are sufficient. The existing BLM RNA is registered by the Colorado Natural Areas Program (1979).



NEEDLE ROCK

Crawford Quadrangle
Colorado - Delta County
USGS 7.5' series (topographic)
1979
scale: 1:24000
contour interval 40'
T15S, R91W, S22, 27

SITE INFORMATION SUMMARY

SITE NAME: Paradox Valley - Dolores Canyon Triassic Fish Locality

LOCATION: T47N, R18W, S36
County: Montrose
USGS 7.5' Quad: Paradox
Access is by dirt road 2 1/2 miles southwest of Bedrock, in the Dolores River Canyon

SIGNIFICANT FEATURES: The Paradox Valley - Dolores Canyon site is one of the best Triassic fish localities in western North America. The locality is an important area for the study of the evolution of bonyfishes and species radiation. Bonyfishes from the locality include Turseodus dolorensis and other Semionotidae, Coelanthidae, and Palaeniscid fishes. The area has also produced an un-named shark. Triassic fish localities are rare in western North America and this locality near Bedrock has future research potential. Other Triassic vertebrates are found at this locality, in addition to Triassic fish. Various phytosaur (armored crocodile) remains have been found on the locality. The area has been richly fossiliferous, producing numerous disarticulated specimens.

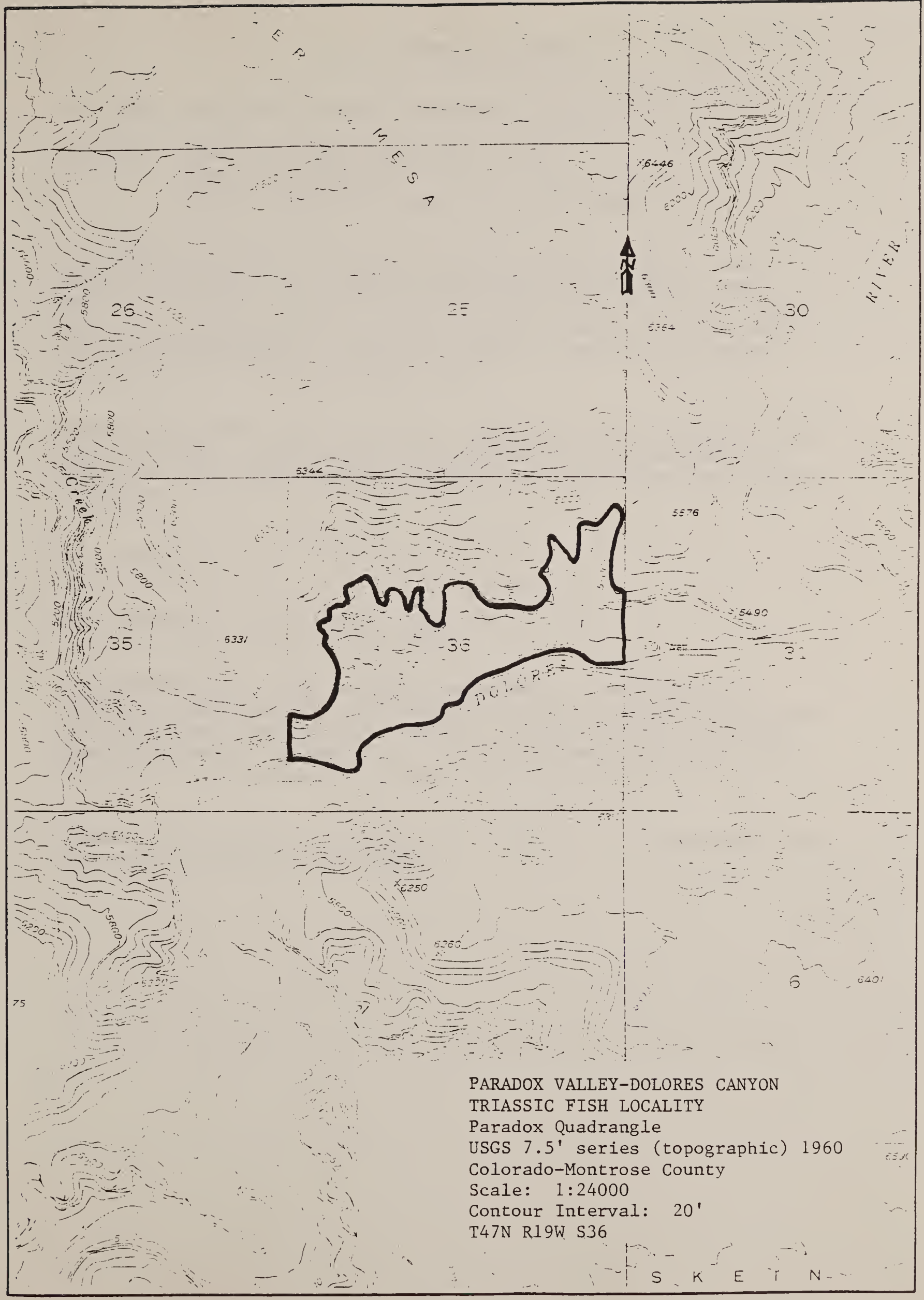
GENERAL DESCRIPTION: The area is characterized by semi-arid shrubland consisting of sagebrush-saltbush plant communities. Rocky terrain and outcrops (sandy, red mudstones) dominate the area.

AREA: 160 A.

OTHER SIGNIFICANT VALUES: None known.

GAG RECOMMENDATION: RNA - Research Natural Area designation due to research productivity and to rarity of fossil fish locality. The recommended RNA is within the Dolores River Canyon Wilderness Study Area.

BOUNDARY JUSTIFICATION: Area encompasses known fossil-producing area.



PARADOX VALLEY-DOLORES CANYON
TRIASSIC FISH LOCALITY
Paradox Quadrangle
USGS 7.5' series (topographic) 1960
Colorado-Montrose County
Scale: 1:24000
Contour Interval: 20'
T47N R19W S36

SITE INFORMATION SUMMARY

SITE NAME: Placerville Permian Vertebrate Locality

LOCATION: T44N, R11W, S30; T43N, R11W, S11,12
County: San Miguel
USGS 7.5' Quads: Placerville, Little Cone

SIGNIFICANT FEATURES: Placerville Permian Vertebrate Site is the only Permian vertebrate site in Colorado with good preservation of bone material. Five new species are recorded from this site; it is a type locality for these species. The site yielded remains from sail-backed vertebrate Platyhistrix. The Cutler Formation has produced several vertebrate fossils of Early Permian age.

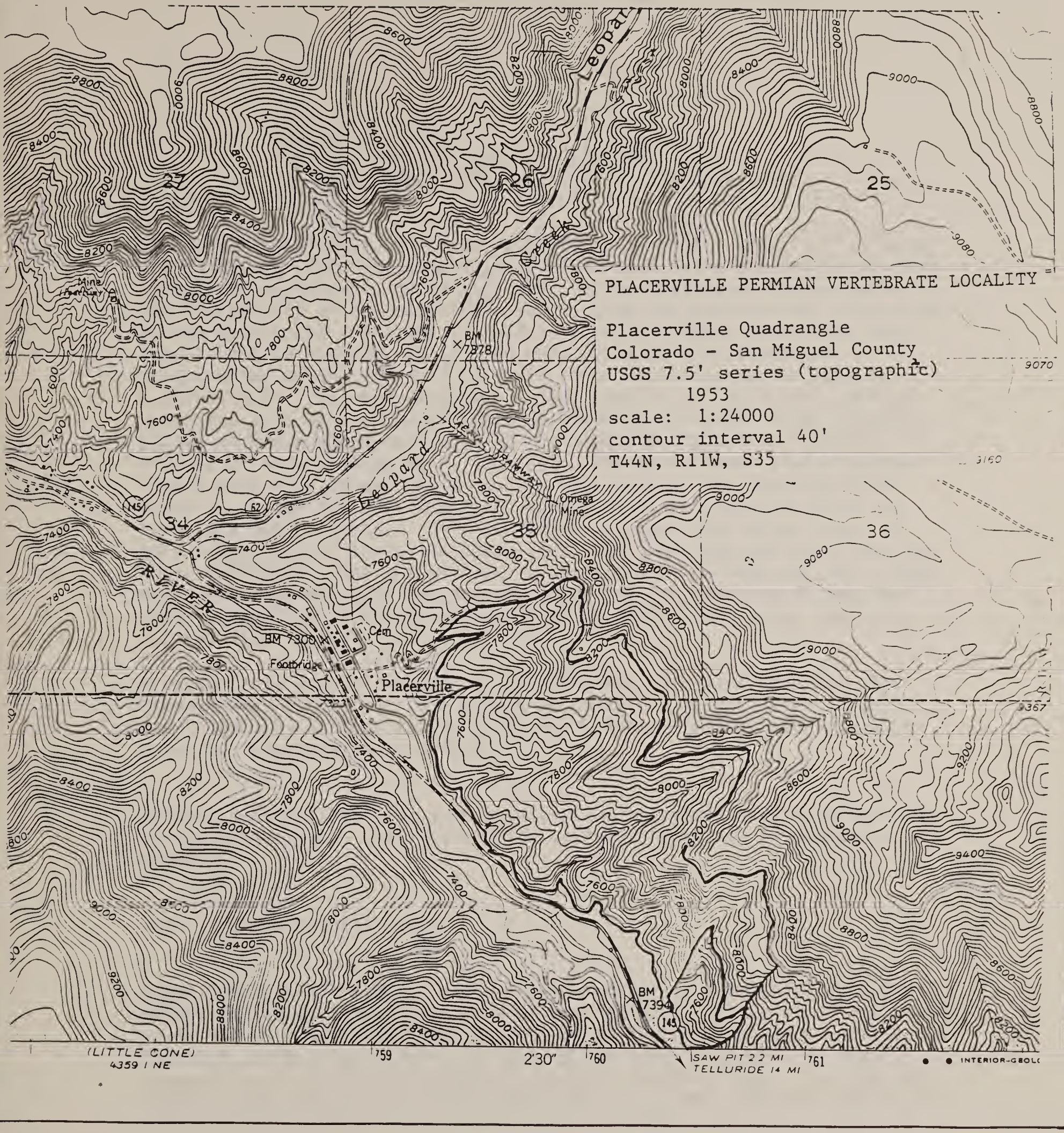
GENERAL DESCRIPTION: The area occurs along steep bluffs adjacent to the San Miguel River. Vegetation consists of semi-arid and montane shrub communities with pinyon-juniper woodlands or conifer forest interspersed throughout.

AREA: 280 A.

OTHER SIGNIFICANT VALUES: None known.

GAG RECOMMENDATION: NON- no special management. The scarcity of vertebrate fossil material, the fragmented quality of the bone, and the intermixed land ownership pattern of this locality combine to provide adequate protection for the site. The area has been described in the scientific literature and will support continuing research.

BOUNDARY JUSTIFICATION: Pending field evaluation - will encompass area described in scientific literature.


PLACERVILLE PERMIAN VERTEBRATE LOCALITY
Placerville Quadrangle
Colorado - San Miguel County
USGS 7.5' series (topographic)
1953
scale: 1:24000
contour interval 40'
T44N, R11W, S35
Leopard Creek
Leopard
RIVER
Placerville
Omega Mine
Tramway
Mine
Cem
Footbridge
BM 7878
BM 7394
BM 7308
25
26
27
34
35
36
(LITTLE CONE)
4359 I NE
759
760
761
2'30"
SAW PIT 2.2 MI
TELLURIDE 14 MI

SITE INFORMATION SUMMARY

SITE NAME: Slumgullion Earthflow

LOCATION: T43N, R4W, S12 - 15
County: Hinsdale
USGS 7.5' Quad: Lake San Cristobal
Two miles southeast of Lake City on Highway 149.

SIGNIFICANT FEATURES: The area contains an excellent example of a large translational landslide complex, well developed in an area which has many landslides in volcanic rocks that overlie the Cretaceous Mancos Shale. The instability of the earthflow results from the hydrothermal alteration of the basalt cap overlying the volcanic tuffs. These areas have been transformed to unstable muds. The area was glacially steepened, contributing to the instability. The first of these massive landslides occurred about 700 years ago when a huge mass of volcanic rock, perhaps saturated with water from rain and melting snow, slumped from a glacial cirque on the northeastern edge of the Lake City Caldera on Cannibal Plateau at an elevation of 11,500 feet. The mass flowed like a viscous liquid down a tributary valley to the Lake Fork of the Gunnison River where it spread out and dammed the Lake Fork of the Gunnison River to form Lake San Cristobal. This earthflow is about four miles long. A more recent active landslide began about 300 years ago and overrides the older earthflow. The active flow is about 2.4 miles long and 500 - 1000 feet wide. Movement of the younger earthflow, as great as 20 feet per year in some areas, causes trees on the landslide surface to lean in various directions.

Although this kind of feature is not uncommon in alpine Colorado, the Slumgullion Earthflow is one of the most visible to the general public and is unusual in that its movement has dammed the Lake Fork - Gunnison River to form Lake San Cristobal.

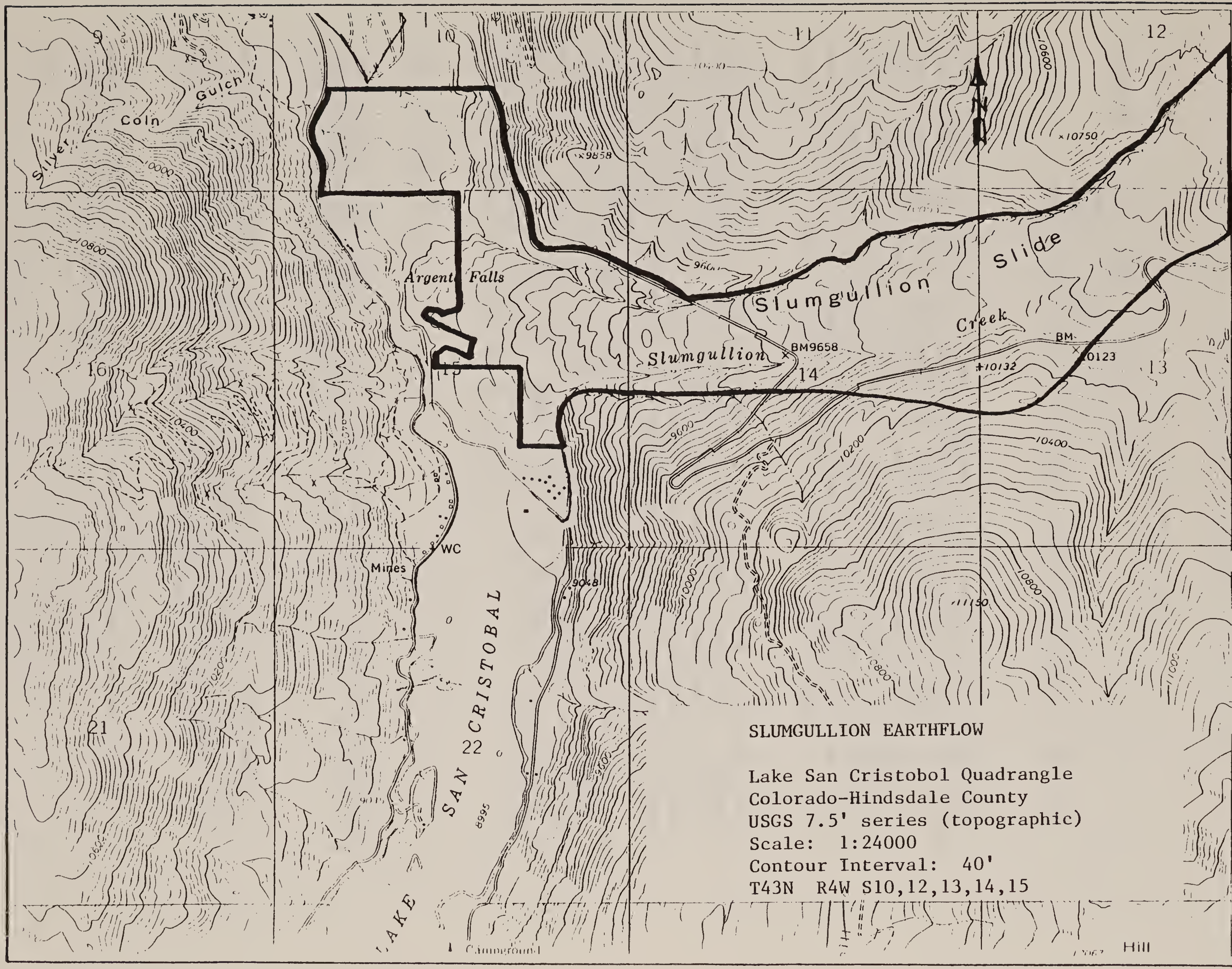
GENERAL DESCRIPTION: The sparse vegetation is representative of montane forest communities. Soil coloration varies from yellow to orange to brown.

AREA: Approximately 1600 A.

OTHER SIGNIFICANT VALUES: the area was initially recommended as a BLM Wilderness Study Area (later dropped from further consideration due to size) and as a National Natural Landmark by the National Park Service. The U. S. Forest Service has designated the area it manages on the Slumgullion Earthflow as a Special Geologic Interest Area. The Colorado Natural Areas Program has designated the U. S. Forest Service land on the Slumgullion Earthflow as a Colorado Natural Area.

GAG RECOMMENDATION: RNA-ONA -- Research Natural Area or Outstanding Natural Area for scientific value, continuing scientific research activity, and educational and interpretive value. The earthflow is nationally recognized as a textbook example of mass wasting phenomena. USGS has done research on the earthflow.

BOUNDARY JUSTIFICATION: The area includes the major part of the earthflow which occurs on public land. Colorado Highway 149 cuts through the earthflow. Public access is easy; several highway pullouts permit easy observation of the earthflow. Slumgullion Earthflow (BLM) was registered in 1984 by the Colorado Natural Areas Program. Slumgullion Earthflow (USFS) was registered in 1980 and designated in 1983 as a Colorado Natural Area by the Colorado Natural Areas Program.


Silver
Coln
Gulch
10000
10800
10400
16
21
Argent Falls
15
x9858
11
12
x10750
10600
9600
Slumgullion Slide
Slumgullion
BM9658
14
Creek
BM
10123
+10132
13
10200
10400
WC
Mines
9048
10000
11150
10800
LAKE SAN CRISTOBAL
22
8995
Campground
Hill
SLUMGULLION EARTHFLOW
Lake San Cristobol Quadrangle
Colorado-Hindsdale County
USGS 7.5' series (topographic)
Scale: 1:24000
Contour Interval: 40'
T43N R4W S10,12,13,14,15

SITE INFORMATION SUMMARY

SITE NAME: Ute Indian Fault Zone and Geologic Area

LOCATION: T15S, R94W; T50-51N, R9W
County: Delta, Montrose
USGS 7.5' Quad:
Access by trails, dirt roads, and river from U.S. 550 near Olathe.

SIGNIFICANT FEATURES: This well exposed fault zone trends along the lower Black Canyon of the Gunnison River in the Gunnison Gorge Recreation Area, one of the best exposed fault zones in Colorado. Large pre-Laramide low-angle faults have had renewed movements in Laramide time. Dark Precambrian granite is thrust against and over brightly colored Mesozoic sedimentary rocks. Actual fault planes are exposed in several places. The Laramide displacement varies laterally from several hundred feet to zero, taken up by drag and monoclinal draping.

GENERAL DESCRIPTION: The area is at the northwest end of the Gunnison Uplift and contains a semi-arid desert shrubland association -- desert holly, ephedra, yucca, serviceberry, and sagebrush dominate. Jurassic and Cretaceous rocks overlie Precambrian metamorphic and igneous rocks. The outer rims of the canyon are capped by Dakota sandstone. The inner rims of the canyon are Precambrian rocks. The area contains many interesting metamorphic features. The elevation differential ranges from 5,200' at river level to 8,000' at Green Mountain, with corresponding vegetation ranges. The area is very scenic, and the rocks are very well exposed in cliffs and steep slopes. Parts of the area are accessible by rough jeep trails, others by river raft or foot trails. Small private land in-holdings at south end of the area.

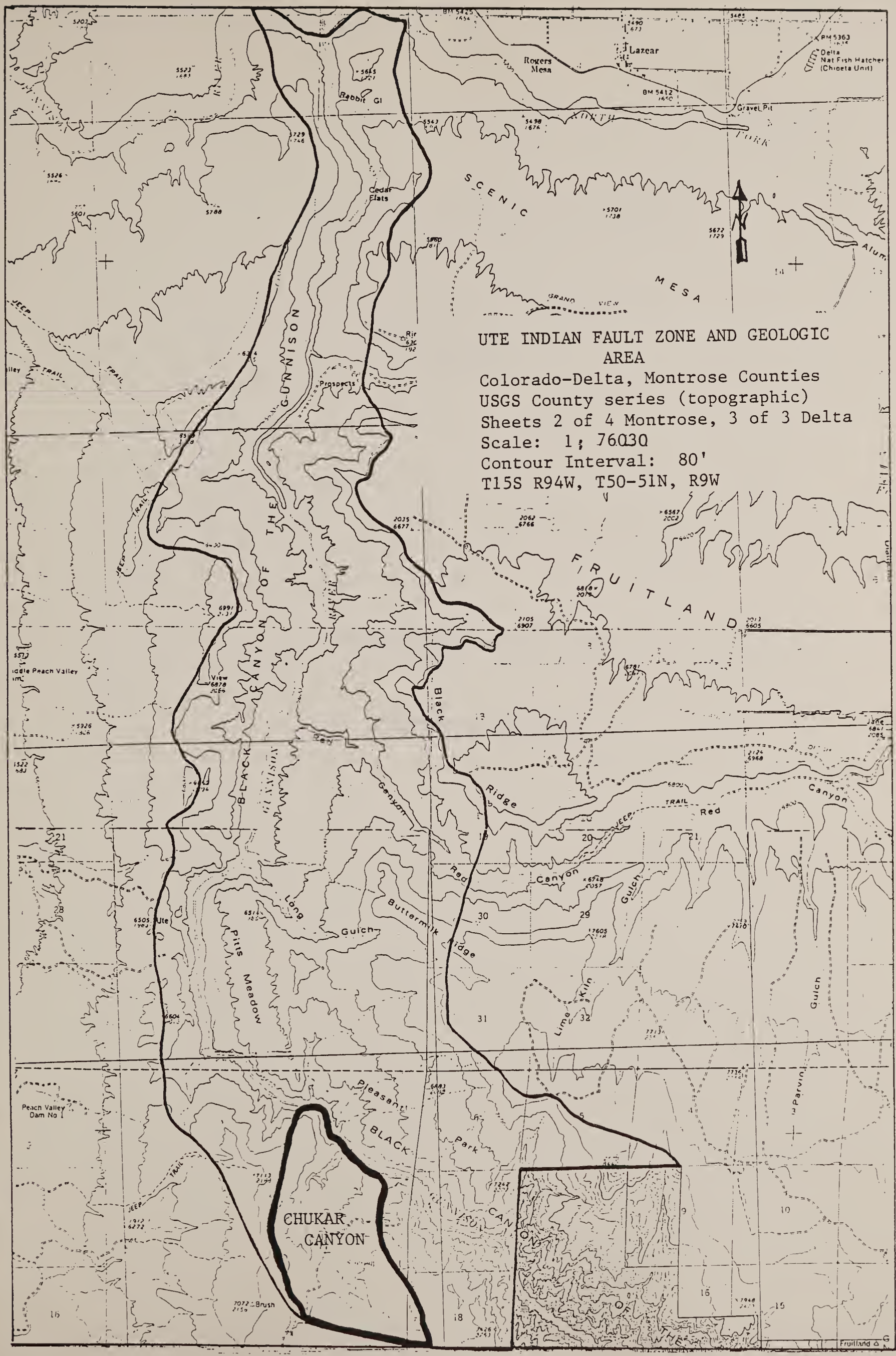
AREA: 19,000 acres.

OTHER SIGNIFICANT VALUES: This scenic and isolated area has substantial fishing and white-water recreational values. This area is included in a Wild and Scenic River nomination.

GAG RECOMMENDATION: ONA - Outstanding Natural Area for approximately 1,800 acre area of Chukar Canyon which abuts the boundary of the Black Canyon of the Gunnison National Monument. SMA-special management area for 17,000 acres of the Gunnison Gorge for geologic features.

BOUNDARY JUSTIFICATION: ONA boundaries should extend to the Dakota sandstone rims of the canyon.

6454


UTE INDIAN FAULT ZONE AND GEOLOGIC AREA
Colorado-Delta, Montrose Counties
USGS County series (topographic)
Sheets 2 of 4 Montrose, 3 of 3 Delta
Scale: 1; 76030
Contour Interval: 80'
T15S R94W, T50-51N, R9W
CHUKAR CANYON
Lazear
Rogers Mesa
Gravel Pit
Cedar Flats
Rabbit Gl
Prospects
SCENIC
MESA
GRAND VIEW
GUNNISON
CANYON OF THE GUNNISON RIVER
FRUITLAND
BLACK
Ridge
Canyon
Red
Gulch
Buttermilk
Lang
Pitts Meadow
Lime Kiln
Parvin
Pleasant
Park
Peach Valley Dam No 1
Middle Peach Valley
Ute
Brush
Delta Nat Fish Hatcher (Chipeta Unit)
Alum
TRAIL
JEEP

57

APPENDIX A

BLM Geologic Advisory Group

Cooperative Agreement

COOPERATIVE AGREEMENT CO-910-CA4-0165

Between

THE STATE OF COLORADO, BY AND THROUGH
THE DEPARTMENT OF NATURAL RESOURCES

And

THE U. S. DEPARTMENT OF THE INTERIOR
BUREAU OF LAND MANAGEMENT
COLORADO STATE OFFICE

This Cooperative Agreement, made and entered into by and between the State of Colorado, by and through the Department of Natural Resources (the Department), and the U. S. Department of the Interior, Bureau of Land Management, Colorado State Office (the Bureau or BLM), is based in part on an existing Memorandum of Understanding (CSO-150) executed in January, 1983, between the parties hereto.

WHEREAS, pursuant to CSO-150, BLM will provide the Colorado Natural Areas Program (CNAP), within the Department, with information as to natural and scientific values on BLM lands in Colorado and, in return, the CNAP will evaluate such data and recommend appropriate places for consideration for special management/natural area designation; and

WHEREAS, the basis for the Memorandum of Understanding is based on BLM programs and responsibilities, as defined in P.L. 94-579, sections 201 and 203, and 43 CFR 8223 and 8352 and OMB Circulars A-95 and A-102; and on CNAP's responsibilities as defined in the Colorado Natural Areas Act (C.R.S. 1973, 36-10-101, et seq. (1982 Cum. Supp.)); and

WHEREAS, the Department is responsible for the management of the State of Colorado's natural resources, including but not limited to, natural areas as defined in the Act; and

WHEREAS, the Bureau is that agency of the Federal Government responsible for the administration and management of BLM lands and for the federal mineral estate underlying a significant portion of the private and public lands within the State of Colorado; and

WHEREAS, it is the objective of the Bureau to identify and manage those areas of scientific, scenic, special or rare value on BLM lands by providing sound evaluation and management of such areas for the benefit of the American people, giving due concern to the interests of the citizens of Colorado; and

WHEREAS, it is the objective of the Department to identify, and register and designate, where possible, areas of scientific, scenic, special or rare value on BLM lands, as Colorado Natural Areas; and

WHEREAS, since the Bureau and the Department have common goals in the identification and management of special management/natural areas, coordination and cooperation is necessary to avoid duplication of effort.

NOW THEREFORE, it is hereby agreed that:

1. BLM and the Department will cooperate on a joint project for the identification and management of significant geologic areas occurring on BLM lands in Colorado.

2. The Bureau shall:

   A. Provide the Department an amount not to exceed $4,250.

   B. Provide the Department with an additional amount not to exceed $5,700 of Fiscal Year 1984 funds during the term of this agreement if and when said funds become available; and shall notify the Department when said funds become available.

C. Provide the Department with BLM personnel, on a limited basis, to 1) perform their responsibilities as members of the Geologic Advisory Group described in paragraph 3(A); and 2) assist the Department in the field surveys, and the identification and evaluation of, geologic sites on BLM lands in Colorado.

D. Provide such functions and facilities, as maps, field office support, and other functions that will assist the Department in completion of the objectives of the project described in this agreement.

3. The Department shall:

A. Coordinate the Geologic Advisory Group (GAG) consisting of experts in the fields of geology and paleontology. During the term of this agreement, this group will give both the Bureau and the Department information, evaluation, and recommendations regarding the identification and recordation of <u>significant</u> geologic sites and structures on Bureau lands in Colorado. The group shall have at least four (4) Bureau representatives, and the balance of the committee shall be appointed by the Department not to exceed 30 members.

B. Develop, through the GAG, a current listing, with area descriptions and site evaluations, of known significant geologic sites and features located on Bureau lands in Colorado. This listing shall include, at a minimum, legal descriptions of proposed boundaries, land status, geologic structure/type, significance, and professional/scientific value.

C. Develop, through the GAG, proposed boundaries for each site referred to in paragraph 3B, which shall be drawn on appropriate 7 1/2-Minute USGS Quad maps.

D. Develop management recommendations for <u>each</u> site/type of geologic significance determined by GAG to be qualified for special management designation. These management recommendations will identify whether a site/type should be considered as a Research Natural Area (RNA), an Outstanding Natural Area (ONA), or an Area of Critical Environmental Concern (ACEC), pursuant to federal regulations referred to in the recitals of this agreement. If the site(s) do(es) not qualify for the above designations, this shall also be determined. Each recommendation will be in the following format:

a. An appropriate designation (RNA/ONA/ACEC).
b. Approximate boundaries for such designation(s).
c. A site form/evaluation form for each site designation.
d. Rationale as to the recommended designation(s).
e. Strategy for implementing these recommendation(s).
f. A suggested name for each site.

E. Submit to BLM a draft report containing findings/information referred to in paragraph 3A, 3B, 3C, and 3D, on or before September 15, 1984. Six copies of the final report shall be submitted to BLM CO-931, Colorado State Office, 1037 20th Street, Denver, Colorado 80202, no later than December 31, 1984, and shall be spiral bound, paginated, and illustrated by photographs (photo negatives shall become property of BLM).

F. Provide for the inclusion of data gathered by the GAG in the State of Colorado GGCC computer system and/or the Colorado Natural Heritage computer system.

4. Nothing in this agreement will be construed as limiting or affecting in any way the authority or legal responsibility of the Bureau or the Department, or as binding either the Bureau or the Department to perform beyond the respective authority of each, or to require either party to assume or expend any sum in excess of appropriations available.

5. This agreement shall be effective on the date of the last signature hereto and shall continue through December 31, 1984.

6. Changes may be initiated by written notice to the other party 30 days prior to the proposed effective date of the change. If the change is agreeable to the other party, and if funding is available to perform additional work required, the change may be implemented. Changes shall be documented by a modification of this Cooperative Agreement. The modification shall be signed by authorized officials at the same level as the original signatory parties.

7. If required by either party to this Cooperative Agreement, the Cooperative Agreement may be terminated. Such termination action may be initiated by written notice to the other party 30 days prior to the proposed effective date of termination. A modification to this agreement shall be issued to document the effective date of termination. The termination modification shall be signed by authorized officials at the same level as the original signatory parties. Prior to the effective date of termination, the rights and duties of both parties shall continue in full force and effect.

8. Each and every provision of the Cooperative Agreement is subject to the laws of the State of Colorado and the laws of the United States.

IN WITNESS WHEREOF, the parties hereto have caused this document to be executed on this 10th day of April, 1984.

DEPARTMENT OF NATURAL RESOURCES, STATE OF COLORADO

By: David H. Getches Date: April 10, 1984

David H. Getches, Executive Director

BUREAU OF LAND MANAGEMENT, COLORADO

By: Paul A. Bates Date: March 16, 1984

Contracting Officer

APPENDIX B

BLM-DNR Memorandum of Understanding

CO-931
8206
CSO-150

MEMORANDUM OF UNDERSTANDING

BETWEEN

THE DIRECTOR OF THE DEPARTMENT OF

NATURAL RESOURCES, STATE OF COLORADO

AND

U.S. DEPARTMENT OF THE INTERIOR

BUREAU OF LAND MANAGEMENT, COLORADO

This Memorandum of Understanding (MOU), made and entered into by the Executive Director, Department of Natural Resources, State of Colorado, and the State Director, Bureau of Land Management, Colorado (BLM), to provide cooperation between BLM and Colorado's Natural Areas Program (CNAP) in related plans and activities. Specifically, the intent of this MOU is to describe objectives and responsibilities, and associated terminology, both of the State of Colorado's Natural Areas Program, BLM's Natural History and Recreation Resource Management Programs, and the Areas of Critical Environmental Concern (ACEC) Process; to discuss the purposes of and uses for CNAP's Natural Heritage Inventory; to delincate the process for identification, evaluation, and registration of areas on or over public lands having significant elements of natural diversity; and for subsequent designation and administration of suitable registered areas as State Natural Areas. It also spells out other cooperative responsibilities of the Colorado Department of Natural Resources and the Colorado Bureau of Land Management in the ongoing administration of both pre and post-designation aspects of the State's Natural Areas Program.

BLM's responsibilities are outlined pursuant to the Federal Land Policy and Management Act (FLPMA) of 1976, Public Law 94-579. BLM's authority to establish and maintain Natural Areas is contained in Sections 102, 201, and 203 of P.L. 94-579 and in 43 CFR 2070, 2071, 8223, and 8352. Areas of Critical Environmental Concern are described in Sections 102, 103, 201, and 202 of P.L. 94-579, and in 43 CFR 1610 specifically, Section 102(a)(8) of FLPMA directs the BLM to manage the public lands to preserve and protect certain lands in their natural condition "where such action is appropriate." Section 202(c) of this Act gives priority to the designation and protection of these areas of critical environmental concern. CNAP's responsibilities are outlined pursuant to the Natural Areas Act as set forth in C.R.S., 1973, 36-10-101, et seq., (Cum. Supp. 1979).

This MEMORANDUM OF UNDERSTANDING is made and entered into by the Executive Director, Colorado Department of Natural Resources, hereinafter referred to as the "EXECUTIVE DIRECTOR," and the United States Department of Interior, Bureau of Land Management, acting by and through the State Director, Colorado, hereinafter referred to as the "STATE DIRECTOR."

WHEREAS, definitions of terms used in this agreement relating to the Colorado Natural Areas Program are:

a) "Articles" or "articles of designation" means the articles of designation filed by or at the direction of the owner of a natural area, or a government agency having administration or control thereof, with the Department of Natural Resources and accepted by the Department in the process of the designation of a natural area. It is a legal document signed by the landowner or administering agency and representatives of the State of Colorado which describes attributes of the property being designated, landowner and State responsibilities, and includes or makes provision for a site management plan.

b) "Council" means the Natural Areas Council created by Section 36-10-106 of the Colorado Natural Areas Act within the Colorado Department of Natural Resources.

c) "Department" means the Colorado Department of Natural Resources.

d) "Designated natural area" means a natural area which is formally designated under the provisions of the Colorado Natural Areas Act.

e) "Elements of Natural Diversity" are typical, unusual, outstanding, threatened, or endangered types or categories of:

(1) undisturbed native plant communities
(2) aquatic ecosystems
(3) special animals and plants (Federal and State Threatened and Endangered, proposed T/E, and other biologically sensitive species)
(4) geologic features
(5) special habitats (e.g., sand dunes)

f) "Natural area" means a physical and biological area which either retains or has reestablished its natural character, although it need not be completely undisturbed, and which typifies native vegetation and associated biological and geological features or provides habitat for rare or endangered animal or plant species or includes geologic or other natural features of scientific or educational value. A natural area is further described as one or a combination of the following:

(1) Scientific Areas are natural areas established for the protection of a fragile, rare, or exemplary ecologic community, plant or animal species, or geologic features; improvements should be considered on a case-by-case basis; access is restricted and research is encouraged. All BLM Research Natural Areas are defined in 43 CFR 8223.0-5.

(2) Interpretive Areas are natural areas having rare or representative examples of natural diversity capable of withstanding moderate use for educational purposes; interpretive devices, nature trails and observation platforms are permitted if appropriately designed. BLM's Outstanding Natural Areas are defined in 43 CFR 6525.0-5 and 43 CFR 2070. Interpretive Areas can include ERAs authorized by the District Manager.

(3) Scenic Areas, which qualify as natural areas, may contain obvious man-made intrusions impossible to exclude, and are capable of withstanding moderate to heavy visitation use. Some BLM Outstanding Natural Areas would be included here, as defined in 43 CFR 2071.1.

Buffer areas may occur as integral parts of these three types of areas to provide greater protection for the inherent values of the natural area. Developments, such as parking areas, interpretive devises, and picnic areas would be allowed only in these buffer areas.

g) "Program" means the Statewide Colorado Natural Areas Program established by the Colorado Natural Areas Act.

h) "Program Director" means the Director of the Colorado Natural Areas Program.

i) "Registry" is a list of areas having significant elements of natural diversity which have been determined by the Council to meet natural area criteria, and which are suitable for Natural Area designation. It will also be referred to as the Natural Areas Program Registry.

j) "Site Evaluation Form" means a standard form used during the Registry process to describe natural area potential by location, owner, significant examples of natural diversity, other noteworthy ecological attributes, and by current or potential uses of the land.

k) "System" means those natural areas designated under the provisions of the Colorado Natural Areas Act for which Articles of Designation have been accepted by the Department.

1) "Inventory" means the Program's Natural Heritage Inventory, a comprehensive, statewide, manual and computerized data base containing site-specific, ecological and geologic information on Colorado's significant elements of natural diversity.

AND those relating to the Bureau of Land Management are:

a) "Activity Plans" are detailed action plans for specific program activities, such as wildlife, range, recreation, etc. The plan:

- conceptually sets forth direction for management (administration, development, and protection);
- identifies specific management actions to be implemented;
- establishes the sequence for implementing these component management actions; and
- provides a basis for monitoring the accomplishment of specific program objectives.

b) "District Managers" means any or all of the four BLM field managers located in Craig, Grand Junction, Montrose, and Canon City.

c) "Environmental Reporting" means that an Environmental Assessment (EA) or Environmental Impact Statement (EIS) will be prepared as required by Section 102(2)(c) of the National Environmental Policy Act.

d) "Outstanding Natural Area," as defined in 43 CFR 2071.1 and 43 CFR 6225.0-5, means an area established to preserve scenic values and areas of natural wonder. The preservation of these resources in their natural condition is the primary management objective.

e) "Research Natural Area," as defined in 43 CFR 8223.0-5, means an area that is established and maintained for the primary purpose of research and education because the land has one or more of the following characteristics:

(1) a typical representation of a common plant or animal association;
(2) an unusual plant or animal association;
(3) a threatened or endangered plant or animal species;
(4) a typical representation of common geologic, soil, or water features; or
(5) outstanding or unusual geologic, soil, or water features.

f) "Suitability" means the potential ability of the land and its resources to provide for certain types of uses, goods, and services, given certain desired outcomes and alternative management strategies.

g) "Areas of Critical Environmental Concern" (ACEC) means areas within the public lands where special management attention is required to protect and prevent irreparable damage to important historic, cultural, or scenic values, fish and wildlife resources or other natural systems or processes, or to protect life and safety from natural hazards.

h) "Resource Management Plan (RMP)" means a land-use plan as prescribed by the Federal Land Policy and Management Act. The RMP establishes in a written document, among other things, land areas for limited, restrictive, or exclusive use; designations, including ACEC designation; allowable resource uses, etc.

THE EXECUTIVE DIRECTOR:

1. Has the administrative responsibility for the Colorado Natural Areas Program pursuant to the 1977 Colorado Natural Areas Act, including:

   a. Developing the Inventory necessary to meet the legislative direction for identification of potential natural areas and to provide relevant information to other public and private agencies in land-use/decision-making processes on all lands in Colorado; and

   b. Registering and designating areas through voluntary agreements with private and public landowners in Colorado, those sites having rare or exemplary native plant communities, geologic features and landforms, aquatic ecosystems habitat for threatened and endangered plant and animal species (Federal and State), or for other plants and animals of special biological concern (proposed threatened and endangered, peripheral, disjunct, etc.), and special habitats.

THE DISTRICT MANAGERS:

1. Are responsible for identifying and, where appropriate, protecting and providing for public use and enjoyment of areas having significant elements of natural diversity in the form of plant and animal associations, threatened or endangered plant or animal species, and geologic, soil, or water features or other unusual or outstanding natural characteristics that are found on the BLM-administered public lands in Colorado.

2. Will designate and manage those significant resources as Research Natural Areas, Outstanding Natural Areas, or as Areas of Critical Environmental Concern, if they are determined to be suitable, through the MFP/RMP process, for such designation. Said designation will be made for the protection of significant examples of natural ecosystems and of elements of natural diversity for comparison with those influenced by man; for protection of threatened and endangered species of plants and animals; for various types of natural history research; and for education and interpretation.

3. Will inventory and obtain data on BLM-administered public lands as an integral part of the MFP/RMP process, in all of its phases; and will utilize data obtained through the Inventory to assist in the identification of potential Natural Areas, ACEC's, or other appropriate designations for these public lands.

4. Will determine existing and future potentials for management of the public lands in the Resource Management Planning process, when appropriate, in accordance with Natural Area designation criteria and ACEC designation guidelines.

NOW, THEREFORE, the parties agree to the following procedures in consideration of those responsibilities and common interests which pertain to the:

A. Registry, Designation, and Administration of Natural Areas on BLM Lands

The process to be followed in registration and designation of State Natural Areas on BLM-administered public lands will include the relevant procedures of both agencies listed below.

(1) Registry

(a) Upon identification, primarily through the Program's Inventory, BLM inventory or public information, of potential natural areas having significant elements of natural diversity, deemed by either party to have potential for natural area designation, the Colorado Natural Areas Council may consider the area for inclusion on the Colorado Natural Areas Program Registry. Request by the EXECUTIVE DIRECTOR for BLM's approval for the registry of an area on BLM-administered land will be sent to the respective DISTRICT MANAGER(S).

(b) Written approval of the responsible District Manager(s) is required prior to the registry of an area by the Council. Registry of an area due to its special ecological or geological characteristics does not imply (1) that planning considerations required for

suitability determination, including need, manageability and availability, have been made, (2) that the registered area is available for natural area designation, nor (3) that special protective measures will necessarily be undertaken by BLM in management of these public lands. In the event that subsequent Bureau or other action may disqualify an area (i.e., that it no longer would meet Registry criteria), the area may be removed from the Registry by either party. Notice that an area has been so registered will be provided by the Executive Director to the responsible District Manager(s). The District Manager(s) may notify the Executive Director of registry or deregistry.

(2) Designation

(a) The Council may request that a Registered area be considered by the appropriate DISTRICT MANAGER for designation by the Department. Such a request will be made by the EXECUTIVE DIRECTOR to the appropriate DISTRICT MANAGER(S) upon the recommendation of the Council, and will contain a draft Articles of Designation describing the public land area(s) involved, a description of the elements of natural diversity that are present, and a proposed management recommendation for the site.

(b) Designation by the Department must be consistent with the applicable BLM land-use plan. Where existing BLM land-use planning is either inconsistent or nonspecific, a category I land-use plan amendment would fulfill this requirement.

(c) An area will become a designated CNAP Natural Area and a BLM Natural Area (RNA/ONA/ACEC) upon the signing of the Articles of Designation by the EXECUTIVE DIRECTOR and the appropriate DISTRICT MANAGER(S). The EXECUTIVE DIRECTOR will forward a signed copy of the Articles of Designation to the appropriate DISTRICT MANAGER(S).

(d) The DISTRICT MANAGER(S) may elect to initiate such formal BLM designation action independent of any Department initiative. In these cases, areas designated by BLM will be considered by the Council, but may or may not be subsequently designated as Natural Areas by the Department.

(3) Administration

(a) Authority for administration of these areas lies with the Bureau of Land Management through the respective District Managers.

(b) Administration of a designated Natural Area will be in accordance with the provisions of a mutually agreed upon management framework included in, or attached to, the signed Articles of Designation for the area, including all subsequent amendments and revisions.

Both parties will work cooperatively on designated Natural Areas to develop joint studies, inventories, and other research-oriented activities which are complementary to the natural areas goals of BLM and the Program to make such areas available for compatible educational uses.

(c) Both parties will encourage educational use of interpretive natural areas on BLM lands by educational institutions, and by the general public.

B. Natural Heritage Inventory

The Inventory was developed to assist in meeting the Program's legislative directive to identify and evaluate potential natural areas in Colorado, and to assist in planning and decision-making processes for lands in Colorado by public and private agencies.

The BLM agrees to:

(1) Continue to assist the Inventory by providing the Program, when possible, with pertinent information on the Program-identified elements of natural diversity occurring on BLM-administered lands in Colorado.

(2) When appropriate, incorporate use of the Inventory data in all phases of the BLM Planning Process. This will include, but not be limited to:

(a) Preparation of Environmental Impact Statements and Environmental Assessments on BLM-administered public lands including any lands being considered for leases for coal, oil and gas, oil shale, mining or grazing;

(b) Identification and evaluation by BLM of potential Areas of Critical Environmental Concern, areas unsuitable for surface coal mining, Research Natural Areas, and Outstanding Natural Areas;

(c) Use the Inventory to review petitions submitted to BLM by the Office of Surface Mining for areas unsuitable for surface coal mining.

The Department agrees to:

(1) Provide BLM, upon receipt of a written request, with appropriate Inventory data in a concise and efficient manner. Every effort will be made to provide this information within 30 days.

THESE TWO PARTIES further agree that:

1. This understanding covers only public lands administered by the Bureau of Land Management in the State of Colorado.

2. Upon receipt of unfavorable comments from either party, regarding the application of inventory or any aspect of this Memorandum, further consultation will be sought by the other party if that party yet deems it desirable to pursue the matter in question.

3. Diligent effort will be made to make an initial response to registry and designation recommendations of either party within 30 days of receipt.

4. This Memorandum shall become effective on the date when last signed and shall remain in force until terminated by mutual agreement, by amendment or abolishment of P.L. 94-579 by Congress, or by either party upon thirty days notice in writing to the other party of its intention to terminate upon a date indicated.

5. Nothing in this agreement will be construed as limiting or affecting in any way the authority or legal responsibility of the Executive Director or the State Director, or as binding either the State of Colorado or the Bureau of Land Management to perform beyond the respective authority of each, or to require either party to assume or expend any sum in excess of appropriations available.

IN WITNESS THEREOF, the parties hereto have executed this understanding as of the last date written below:

12/21/82
Date

Executive Director, Department of Natural Resources

1/10/83
Date

State Director, Colorado Bureau of Land Management

APPENDIX C

BLM Geologic Advisory Group

BUREAU OF LAND MANAGEMENT
GEOLOGIC ADVISORY GROUP

* Mr. Harley Armstrong
Museum of Western Colorado
248 South Fourth Street
Grand Junction, Colorado 81501
242-0971

* Dr. Frederic Athearn
Bureau of Land Management
1037 Twentieth Street
Denver, Colorado 80202

* Dr. Sandra Blackstone
University of Denver Law School
1900 Olive Street
Denver, Colorado 80220

* Dr. William Braddock
Geology Department, Campus Box 250
University of Colorado
Boulder, Colorado 80309
492-6195

* Mr. Henry Davis
Peabody Coal Company
10375 East Harvard Avenue, Suite 400
Denver, Colorado 80231
337-5903

* Dr. Jack Ellingson
Fort Lewis College
Durango, Colorado 81301
247-7244

* Mr. Emmett Evanoff
CU Museum - Geology Section, Box 315
University of Colorado
Boulder, Colorado 80309
492-8069

* Dr. William Fischer
Geology Department
Colorado College
Colorado Springs, Colorado 80903-7150
632-4223

* Mr. Wally Hansen
U. S. Geological Survey
P. O. Box 250466, Mail Stop 913
Denver Federal Center
Denver, Colorado 80225
236-1294

* Mr. Rod Herrick
Bureau of Land Management
455 Emerson, P.O. Box 248
Craig, Colorado 80205
824-8261

* Dr. Greg Holden
Geology Department
Colorado School of Mines
Golden, Colorado 80401
273-3805

* Dr. James Johnson
Geology Department
Mesa College
Grand Junction, Colorado 81501
248-1354

* Dr. Erle Kauffman
Geology Department, Campus Box 250
University of Colorado
Boulder, Colorado 80309
492-8141

* Mr. Don Lindsey
Star Route, Box 153
Elizabeth, Colorado 80107
646-3739

* Mr. James Madsen
Utah State Historical Society
300 Rio Grande
Salt Lake City, Utah 84101
801-533-4563

* Mr. James Maytum
Champlin Petroleum Company
P. O. Box 1257
Englewood, Colorado 80150
779-2691

* Dr. Malcolm McCallum
Geology Department
Colorado State University
Fort Collins, Colorado 80523
491-6250

* Ms. Elizabeth McReynolds
Bureau of Land Management
764 Horizon Drive
Grand Junction, Colorado 81501
243-6552

* Mr. P. A. Meyer
Consulting Geologist
2834 Pierson Way
Lakewood, Colorado 80215
233-8115

* Dr. Michael Middleton
University of Wisconsin-
River Falls
Department of Geology
River Falls, Wisconsin

* Mr. Robert Neel
NICOR Mineral Ventures
Suite 4200
4949 South Syracuse Street
Denver, Colorado 80237
694-4936

* Dr. Thomas Prather
Geology Department
Western State College
Gunnison, Colorado 81230
943-2092 (o); 641-0469 (h)

* Dr. Peter Robinson
CU Museum - Geology Section, Box 218
University of Colorado
Boulder, Colorado 80309
492-8069

Mr. Carlos Sauvage
Bureau of Land Management
764 Horizon Drive
Grand Junction, Colorado 81501
243-6552

* Dr. Lee Shropshire
Geology Department
University of Northern Colorado
Greeley, Colorado 80639
351-2285

6296

* Mr. Jim Soule
Colorado Geological Survey
1313 Sherman Street, Room 715
Denver, Colorado 80203
866-2611

Mr. Ben Sprouse
Bureau of Land Management
Gunnison Basin Resource Area
11 South Park
Montrose, Colorado 81401
249-6624

Mr. Roger Underwood
Bureau of Land Management
3080 East Main Street
P. O. Box 311
Canon City, Colorado 81212
275-0631

Mr. Jim Wilkinson
Bureau of Land Management
764 Horizon Drive
Grand Junction, Colorado 81501
243-6552

Mr. Kermit Witherbee
Bureau of Land Management
2020 Arapahoe Street
Denver, Colorado 80205

GEOLOGIC ADVISORY GROUP

Armstrong, Harley
M.B.S., Museum Studies, University of Colorado, 1982.

Project archeologist/paleontologist,
Grand River Institute, Grand Junction (1978 - present).

Director, Grand River Laboratories
(replication, restoration, and conservation of museum objects) (1982 - present).

Athearn, Frederic J.
Ph.D., History, University of Texas, 1974.

Bureau of Land Management, Paleontology Program Leader (1984-present)

Bureau of Land Management, Cultural Resources Program Leader (1984-present)

Bureau of Land Management, Natural History Program Leader,
(1981 - present).

Bureau of Land Management, State Historian, Colorado State Office (1975 - present).

Blackstone, Sandra
Ph.D., Mineral Economics, Colorado School of Mines, 1979.
J.D., University of Denver, 1977.

Professor, Law School, University of Denver
(1982 - present).

Deputy Director for Energy and Minerals, Bureau of Land Management, Washington, D.C. (1980 - 1982).

Manager of Minerals Development - Synthetic Fuels,
Rocky Mountaion Energy Company (1978 - 1980).

Braddock, William
Ph.D., Geology, Princeton University, 1959.

Professor, Department of Geological Sciences, University of Colorado (1956 - present.

Research Geologist. U.S. Geological Survey (part time, 1952 - present).
Geological mapping of northern Colorado Front Range.

Research and teaching interests are in regional and structural geology.

Davis, Henry E.
B.S., Range/Watershed Management, Utah State University, 1952.

Director of Land and Reserve Development, Peabody Coal Company - Rocky Mountain Division.
Responsible for acquisition and disposal of surface and coal lands and for coal related exploration and development activities in Colorado, Montana, New Mexico, Utah, and Wyoming.

Mining engineer (Missouri), Area mining engineer (Illinois and Ohio), Land agent (Western Division), Peabody Coal Company (31 years service).

Range Conservationist, Bureau of Land Management (1952 - 1954).

Ellingson, Jack A.
Ph.D., Geology, Washington State University, 1968.

Professor and chairman, Department of Geology, Fort Lewis College (1970 - present).
Teaching and research interests include mineralogy, igneous and metamorphic petrology, and structural geology.

NSF Research Grant (1981).
Fellow, Geological Society of America.

Evanoff, Emmett
Ph.D., Geology, University of Colorado, (in progress).
M.S., Geology, University of Colorado, 1983.
M.S., Geology, University of Wyoming, 1978.

Graduate student, Department of Geology, University of Colorado (1981 - present).

Instructor, Department of Geology, University of Colorado (1984).

Research interests are in the paleontology of Cenozoic nonmarine mollusks, Cenozoic stratigraphy of the Rocky Mountains, and fluvial sedimentology. Research projects have included the paleontology of Paleocene and Pleistocene nonmarine mollusks from Colorado, Wyoming, and Montana.

Dissertation topic: Oligocene nonmarine mollusks of the White River formation in central Wyoming and northwest Nebraska.

Fischer, William A.
Ph.D., Geology, University of Colorado, 1953.

Emeritus Professor of Geology, Colorado College (1982 - present)

Instructor - Professor and Chairman, Department of Geology, Colorado College (1949 - 1982).

Consultant (1955 - 1982).

Ford Foundation Fellow, Scripps Institution of Oceanography (1953).

Research interests include morphology and evolution of trace fossils and primitive vertebrates.

Hansen, Wallace R.
B.S., Geology, University of Utah, 1941.

U. S. Geological Survey, Research Geologist: Southern Rocky Mountains, Colorado Piedmont, Colorado Plateau (1946 - present).

Outstanding performance award, USDI (1958).

Past President, Colorado Scientific Society (1966) and Lifetime Honorary Member (1976).

Editor, Association of Engineering Geologists (1971 - 1973).

Meritorius Service Award, U.S. Department of the Interior 1969).

Distinguished Service Medal, USDI (1979).

More than 100 published reports and geologic maps on Rocky Mountain region, New England, Alaska, and elsewhere.

Holden, Gregory S.
Ph.D., Geology, University of Wyoming, 1977.

Associate Professor, Department of Geology, Colorado School of Mines (1978 - present).

Teaching: Petrology and Field Methods; Advanced Igneous Petrology.

Research: Metasomatic reactions in limestones, metamorphic conditions and systematics in Colorado's Front Range.

Kauffman, Erle G.
Ph.D., Geology, University of Michigan, 1961.

Professor and Chairman, Department of Geological Sciences, University of Colorado (1981 - present).

Curator, Department of Paleobiology, U.S. National Museum (Smithsonian Institution) (1960 - 1980).

Adjunct Professor of Geology, George Washington University (1962 - present).

Visiting Professor of Geology, Oxford University, England (1970 - 1971).

Visiting Professor of Geology, University of Tubigen, Germany (1974).

Fellow, Geological Society of America.

President, Paleontological Society (1982).

"Scientist of the Year" Award, Rocky Mountain Association of Geologists (1977).

Distinguished Lecturer, American Association of Petroleum Geologists (1984).

Current reseearch projects include: (a) study of the evolution of benthec marine communities since the Jurassic; (b) study of extinction, especially massive and/or catastrophic extinction of its causes in the Mesozoic and the Cenozoic; (c) study of evolution of biogeographic units in relation to plate tectonics and paleoclimate and paleoceanographic evolution in the Mesozoic and early Cenozoic.

Lindsey, K. Don
M.A., Zoology, University of Colorado, 1971.

Curator of Paleontology, Denver Museum of Natural History (1971 - 1984).

Research Interests: Mesozoic, mammals and dinosaurs and field excavations of Jurassic mammals and dinosaurs.

Madsen, James H.
M.S., Geology, University of Utah, 1969.

Utah State Paleontologist, Division of State History, Salt Lake City, Utah, and Adjunct Curator of Vertebrate Paleontology, Utah Museum of Natural History (1977 - present).

Principal Investigator, Cleveland - Lloyd Dinosaur Quarry, Utah - National Natural Landmark (1971 - present).

Curator of Vertebrate Paleontology, Utah Museum of Natural History, and Curator and Assistant Research Professor, Department of Geological and Geophysical Sciences, University of Utah (1970 - 1977).

Paleontological Consultants (1969 - present).

Maytum, James R.
M. S., Geology, University of California, San Diego, 1967.

Regional Exploration Manager, Champlin Petroleum Company.

Various technical and managerial assignments with Texaco Oil Company and Champlin Oil Company (1966 - present). Major responsibilities include all phases of exploration geology, geophysics, and land operations in Western United States, Canada, and foreign countries.

McCallum, M. E.
Ph.D., University of Wyoming, 1964.

Professor of Geology, Department of Earth Sciences, Colorado State University (1962 - present).

Teaching and research interests include igneous and metamorphic petrology and strucutre, and mineral resources.

Fellow, Geological Society of America.

Fellow, Mineral Society of America.

McReynolds, Elizabeth
B.A., Geology, Mesa College, 1980.

Geologist, Bureau of Land Management (Colorado - Grand Junction Resource Area) (1983 - present). Responsible for leasable minerals and development of procedures for implementing paleontological program into multiple-use resource planning.

Geologist, Bureau of Land Management (Colorado - Grand Junction District) (1978 - 1983). Responsible for environmental assessments related to saleable minerals and patented mining claims.

Meyer, P. A.
B.S., Geological Engineer, Colorado School of Mines, 1950.

Consulting Geological Engineer (1983 - present).

Chief Geologist, Rocky Mountain Energy Company (mining subsidiary of Union Pacific Corporation) (1957 - 1983).

Regional Geologist, Climax Molybdenum Company (1957 - 1967).

Middleton, Michael D.
Ph.D., Geology, University of Colorado, 1983.

Assistant Professor, Department of Geology, University of Wisconsin - River Falls (1984 - present).

Research interests in mammalion evolution spanning the Cretaceous-Tertiary boundary, and the geology and paleontology of the Denver Basin.

Neel, Robert
M.S., Geology, University of Rochester, 1951.

Manager of land, NICOR Mineral Ventures, Denver (1984 - present).

Consultant, National Park Service, San Francisco (1972 - 1973).

Exploration Geologist, Bear Creek Oil Company, Spokane.

District Manager and Geologist, Shell Oil Company - rocky Mountain Region (1957 - 1965).

Prather, Thomas L.
Ph.D., Geology, University of Colorado, 1964.

Professor of Geology, Western State University (1965 - present).

Research and teaching interest in regional and structural geology.

Robinson, Peter
Ph.D., Geology, Yale University, 1960.

Professor and Curator of Geology, University of Colorado - Museum (1961 - present).

Director, University of Colorado - Museum (1971 - 1982).

Research interests include vertebrate paleontology with emphasis on the morphology and evolution of mammalian fauna.

Sauvage, Carlos
B.A., Outdoor Recreation Administration, Colorado State University, 1974.

Bureau of Land Management, Recreation Planner (Wyoming, Utah, Colorado) (1974 - present).
Responsible for all aspects of recreational use on federal lands in BLM district, including evaluation of scenic and visual qualities of geologic features.

Shropshire, Kenneth Lee
Ph.D., Geology, University of Colorado, 1974.

Professor, Department of Geology, University of Northern Colorado (1965 - present).

NSF Science Faculty Fellowship (1972).

Consulting Geologist (1965 - present).

Soule, James M.
M.S., Geology, University of New Mexico, 1971.

Senior Engineering Geologist, Colorado Geological Survey (1974 - present).
Directed studies of geologic hazards and related problems in Colorado, particularly slope stability problems related to land use planning.

Project Geologist, U.S. Geological Survey (1972 - 1974).
Studies of ground resource in the Colorado Front Range.

Sprouse, Benjamin
B.S., Geology, University of Southern Colorado, 1975.

Geologist, Bureau of Land Management (Oregon - Coos Bay Resource Area) (1975 - 1980).
(Colorado - Gunnison Basin Resource Area) (1981 - 1984).
Colorado - Montrose District) (1984 - present).
Responsible for all aspects of mineral resource management, emphasizing coal and hard minerals.

Underwood, Roger
B.S., Geology, Oklahoma State University, 1968.
Geology, University of Missouri (1968 - 1971).

District Geologist, Bureau of Land Management (North Dakota, Colorado) (1973 - present).
Responsible for managing federal minerals, including review of leases, claims, saleable minerals, and environmental impact assessments.

Wilkinson, James
B.S., Geology, Texas A&M University, 1968.

District Geologist, Bureau of Land Management (Arizona, Montana, Alaska, Colorado) (1972 - present).
Responsible for managing federal minerals, including review of leases, claims, saleable minerals, and environmental impact assessments.

Geological consultant (1971 - 1972).

Witherbee, Kermit
M. A., Geology, State University of New York, 1974.

Bureau of Land Management (Colorado State Office), Lead Petroleum Geologist (1984 - present).

Bureau of Land Management, Area and District Geologist (1982 - 1984).

Minatome Corporation, Project Manager (1979 - 1982).

Power Resources Corporation, Exploration Geologist 1977 - 1979).

Bureau of Land Management (Wyoming State Office), Geologist (1976 - 1977).

Consulting Geologist (1974 - 1976.

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APPENDIX D

Summary of GAG Sites

SUMMARY OF GAG SITES

Special Management Area Recommendations

Canon City

Garden Park Fossil Locality - RNA (1/19/84) Canon City/Lindsey
Indian Springs Trace Fossil Site - RNA (1/19/84) Canon City/Fischer

Craig

Blacks Gulch - Bonanza - RNA (9/27/84) Craig/Robinson
Cross Mountain Canyon - ONA (5/9/84) Craig/Shropshire, Hansen
Irish Canyon - ONA (5/9/84) Craig/Hansen, Witherbee
Kremmling Cretaceous Ammonite Locality - RNA (1/19/84) Craig/Kauffman
Lookout Mountain - Vermillion Bluffs - ONA (9/27/84) Craig/Hansen
Skull Creek Anticline - SMA (5/9/84) Craig/Hansen, Witherbee

Grand Junction

Black Ridge Angiosperm Locality - RNA (5/9/84) Grand Junction/Kauffman, Wolfe
Black Ridge Arches - ONA (5/9/84) Grand Junction/Wilkinson, Johnson, Sauvage
Cactus Park Gravels - RNA (5/9/84) Grand Junction/Johnson
Dotsero Crater - ONA (9/27/84) Grand Junction/Johnson, Wilkinson
Fruita Paleo Site - RNA (1/19/84) Grand Junction/Robinson et.al.
Gateway Palisade - ONA (5/9/84) Grand Junction/Hansen, Johnson
Gypsum Cliffs - SMA (9/27/84) Grand Junction/Evanoff, Johnson, Wilkinson
McCoy Fan Deltas - ONA (9/27/84) Craig/Evanoff
Rabbit Valley Fossil Locality - RNA (5/9/84) Grand Junction/McReynolds, Armstrong, Lindsey, Madsen
Rough Canyon - SMA (5/9/84) Grand Junction/Johnson, Wilkinson
Sinbad Valley - SMA (5/9/84) Grand Junction/Hansen, Johnson
Unaweep Canyon Overlook - REC (5/9/84) Grand Junction/Hansen, Johnson

Montrose

Dolores Canyon Meanders - ONA (9/27/84) Montrose/Ellingson
Horseshoe Basin - ONA (1/19/84) Montrose/Ellingson
Needle Rock - RNA/ONA (9/27/84) Montrose/Johnson, Sprouse
Paradox Valley - Dolores Canyon Triassic Fish Locality - RNA (5/16/15) Montrose/ Robinson, Armstrong
Slumgullion Earthflow - RNA (1/19/84) Montrose/Soule
Ute Indian Fault Zone and Geologic Area - ONA/SMA (5/16/85) Montrose/Hansen

Evaluated - No SMA Recommendation (NON)

Canon City

Lower Phanatom Canyon Paleo Locality - NON (3/85) Craig/Fischer

Craig

Calico Draw - NON (9/27/84) Craig/Madsen, Robinson, Witherbee
Douglas Pass Insect Locality - NON (9/27/84) Craig/Armstrong, McReynolds
Wolford Mountain - NON (1/19/84) Craig/Braddock

Grand Junction

Debeque Canyon Slide - NON (1/19/84) Grand Junction/Johnson
Nancy Hanks Gulch - NON (5/9/84) Grand Junction/Johnson

Montrose

Placerville Permian Vertebrate Locality - NON (5/16/85) Montrose/Robinson, Evanoff

Deferred Pending Further Evaluation

Canon City

Spring Gulch Fossil Locality - Canon City/Fischer
Twin Mountain Structure Complex - Canon City/Fischer, Underwood
Upper Arkansas Canyon - Canon City/Fischer, Underwood

Grand Junction

Grand Hogback - Grand Junction/Soule
Juanita Natural Bridge - Grand Junction/Johnson, Sauvage
Roan Creek Goblins - Grand Junction/McReynolds, Sauvage

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APPENDIX E

Guidelines for Identification of Geologic Features

GUIDELINES FOR IDENTIFICATION OF GEOLOGIC FEATURES ON BLM LANDS IN COLORADO

Purpose

The Geologic Advisory Group makes recommendations to the Bureau of Land Management on the importance of geologic features on lands which BLM manages in Colorado. Final recommendations of the Geologic Advisory Group will include: (1) information on geologic sites of statewide or national significance occurring on lands in Colorado managed by BLM; (2) justification for the ranking of high priority sites; and (3) recommended management alternatives for the high priority sites.

Guideline Criteria

The following general criteria are used to evaluate each geologic feature or site.

1) Site is not expected to be lost due to natural catastrophe, development, land use change, or errors in management.

2) Site represents an unusual geologic feature or is of statewide or national significance.

3) Site has significant fossil evidence illustrating the development of life (see addendum: paleo guidelines).

4) Site is an example of scenic grandeur, high aesthetic value, or unusual natural features.

5) Site exhibits or possesses classic research or educational opportunities.

Scientific Values

1. Quality of the site

Site contains an excellent example of a geologic feature or process which is particularly well-suited for research, teaching, or interpretive use (e.g., faulting, folding, mass wasting phenomena, stratigraphic sequence, history of life on earth).

2. Condition of the site

Site is relatively free of disturbance, can withstand some land uses, or is adequately protected from disturbance. The compability of mining or other land uses with the identified scientific values will be evaluated on a site-by-site basis.

3. Viability of the site

Condition of site can be maintained in the future with appropriate management.

4. Defensibility of the site

Site is geographically or topographically removed from areas of development where possible, or has a small likelihood of being in the path of development, or protective management can be implemented through the BLM planning process where natural values outweigh development values. Site will be designed to minimize potential conflicts with existing land uses. Factors taken into consideration include existing oil and gas development on the site, existing roads and access routes, existing or proposed mineral development, grazing, and recreational use.

Recommended Management

Site will be ranked by the advisory group according to the above criteria. Justification for the ranking on each site will be included in the recommended management alternatives. Areas will be considered for three designated area categories: research natural area, outstanding natural area, and area of critical environmental concern.

Research Natural Areas

Research natural areas are defined in 43 CFR 8223.0-5 as areas "established and maintained for the primary purpose of research and education because the land has . . . the following characteristics . . . (4) a typical representation of common geologic, soil or water features; or (5) outstanding or unusual geologic, soil, or water features." Natural areas shall be used in a manner consistent with the purpose for which the area is designated. "The area shall be used by scientists and educators in a manner which is nondestructive and consistent with the purpose of the research natural area."

Outstanding Natural Areas

Outstanding natural areas are established to preserve scenic values and areas of natural wonder. The preservation of these resources in their natural condition is a primary management objective of BLM. Outstanding natural areas, as defined in 43 CFR 2071.1 (IV), are "areas of outstanding scenic spendor, natural wonder, or scientific importance that merit special attention and care in management to insure their preservation in their natural condition." These areas are relatively undisturbed and "representative of rare botanical, geological, or zoological characteristics of principal interest for scientific and research purposes."

Areas of Critical Environmental Concern (ACEC)

An area of critical environmental concern is an area "within the public lands where special management attention is required to protect and to prevent irreparable damage to important historic, cultural or scenic values, fish and wildlife resources, or other natural systems or processes, or to protect life and safety from natural hazards" (FLPMA, sec. 103(a), 1976). BLM regulations require that identification of potential ACECs shall be given "priority" in the "inventory of all public lands and their resource and other values." The identification of potential ACECs "shall not change or prevent change of the management or use of public lands." A potential ACEC must meet the following criteria:

1) Relevance. The area contains a significant historic, cultural, or scenic value; a fish or wildlife resource or other natural system or process; or natural hazard.

2) Importance. The area shall have "substantial" significance and values. This criterion generally requires qualities of more than local significance and special worth, consequence, meaning, distinctiveness, or cause for concern. A natural hazard is important if it is a threat to life or property.

Site Inventories

Inventoried sites will include those areas on BLM lands which are currently used for educational and research purposes, sites identified in the literature or reports (e.g., "Natural Landmarks of the Southern Rocky Mountain Region, National Park Service), and sites recommended by BLM and participating geologists.

ADDENDUM: PALEO GUIDELINES
GUIDELINES FOR IDENTIFICATION OF GEOLOGIC
FEATURES ON BLM LANDS

I. Guidelines for Significant Paleontological Resources*

For purpose of these guidelines, significance is defined as the estimation of scientific or educational importance of paleo materials. Fossil material which satisfies the following criteria is considered significant.

A. Materials Inventoried

1) Vertebrate material

a. complete skull and/or jaw
b. articulated or complete skeleton
c. concentration of vertebrate material
d. unique or rare occurrence
e. intimate association with paleo environment

2) Invertebrate material

a. good-excellent preservation of shell material
b. concentrations of diverse material
c. intimate association with paleo environment
d. stratigraphic sequence

3) Plant material

a. well preserved plant material
b. petrified wood
c. fossil stumps
d. intimate association of fossil plant and animal materials

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* The paleo guidelines are adopted from similar guidelines used by the State of New Mexico Energy and Minerals Department for determining mitigation of impacts on paleontological resources from coal mining.

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B. Functional Analysis

The functional analysis consists of reviewing the inventoried materials and establishing the importance of mitigation or the need for alternatives.

1) Does material contribute to faunal or floral lists?

2) Does the material significantly contribute to the systematics of the group or groups collected?

3) Does the material contribute to our knowledge of the functional anatomy of the organism?

4) Does the material contribute to our knowledge of biostratigraphy, paleoecology, or taxonomy of the occurring organisms?

5) Does the material possibly contribute to a potential museum exhibit?

C. Criteria Used for Determination of Need for Mitigation

1) complete (i.e., greater than 75%) skeleton(s)

2) skulls and/or articulated material

3) whole isolated bones

4) significant concentration of fragmentary but identifiable elements; in general, significant would be 40 - 50 elements/ton of matrix or 10 fragments /m surface

APPENDIX F

Site Evaluation Form

BLM GEOLOGICAL ADVISORY GROUP
SITE EVALUATION FORM

EO CODE [G _ _ _ _ _ _ _ _ _ . _ _ _]

SITE NAME [_ _]

marg num: [_ _ _ _ _ _]   ident: [_ _]

FEATURES: [_ _ Ø _ _ Ø _ _ Ø _ _]   AGE: [_ _ Ø _ _ Ø _ _ Ø _ _]

CLASSIFICATION: [_ _] SUFFIX: [_ _ _ _]
[_ _] SUFFIX: [_ _ _ _]
[_ _] SUFFIX: [_ _ _ _]

FIELD EVAL DATE:
[_ _ Ø _ _ Ø _ _ _ _] last obs: [1 9 _ _ Ø _ _ Ø _ _] first obs: [1 _ _ _]

RANK: [G _ S _] state [C O] all county codes [C O _ _ _ Ø _ _ _ _ _ Ø _ _ _ _ _ Ø]
county code: [_ _ _ _ _ _ _ _] ALL COUNTY NAMES: [_ _ _ _ _ Ø _ _ _ _ Ø _ _ _ _ _ Ø _ _ _ _ _ Ø]

all quad codes [_ _ _ _ _ _ _ _ Ø _ _ _ _ _ _ _ _ _ Ø _ _ _ _ _ _ _ _ _ Ø _ _ _ _ _ _ _ _ _]

ALL QUAD
NAMES [_ _]

precision:[_ _] lat:[_ _ _ _ _ _ _] long: [_ _ _ _ _ _ _]
s: [_ _ _ _ _ _ _] n: [_ _ _ _ _ _ _] e: [_ _ _ _ _ _ _] w: [_ _ _ _ _ _ _]

TOWN RNG: [_ _ _ _ _ _ _ _ _] SECT: [_ _] merid: [_ _]
TRS COMM: [_ _]
phys prov: [_ _] watershed: [_ _ _ _ _ _ _ _ _ _ _] natural region: [_ _ _ _]

ELEVATION: [_ _ _ _ _ _ _] SIZE: [_ _ _ _ _ _ _] FEDERAL [_ _ _ _ _ _] STATE [_ _ _ _ _ _]
PRIVATE [_ _ _ _ _ _] LOCAL [_ _ _ _ _ _]

DIREC- [_ _
TIONS: _
_ _]

OWNER: [B L M _]

CONTACT: [_ _]

SITE SENSITIVITY: [_] VALUE [_ _ _] THREAT [_ _] MANAGE: [_ _ _] ACCESS [_]
BOUNDARIES [_]

best [_ _
source: _]
all source codes: [_ _ _ _ _ _ _ _ _ _ Ø Ø _ _ _ _ _ _ _ _ _ _ Ø Ø _ _ _ _ _ _ _ _ _ _ Ø Ø
_ _ _ _ _ _ _ _ _ _ Ø Ø _ _ _ _ _ _ _ _ _ _ Ø Ø]

ABSTRACT:

SUMMARY:

REFERENCES:

SUBMITTED BY: [_ _] DATE: [_ _ _ _ _ _ _ _]
REVIEWED BY: [_ _]
[_ _] DATE: [_ _ _ _ _ _ _ _]

mapper: [_ _ _ _ _ _ _ _ _ _ _ _ _] qc: [_ _] update: [_ _ _ _ _ _ _ _]

INSTRUCTIONS
BLM GEOLOGICAL ADVISORY GROUP
SITE EVALUATION FORM

GENERAL

Complete the sections on the Site Evaluation Form (SEF) which have capital letters. Sections with lower case letters will be completed by the data managers at the Colorado Natural Heritage Inventory.

The SUMMARY section should be used for further explanations or where space is limited. Each section on the SEF to be completed by the evaluator is explained in detail below. The underlined section headings correspond to the appropriate sections on the SEF.

EO CODE

THE ELEMENT OCCURRENCE CODE is the main information accessing component of the SEF. EO CODE contains: G = Geologic Feature, five spaces for the BLM district and resource area code (see below), two spaces for denoting the principal geologic feature associated with the site (see below), two spaces for geologic age of the site (see below), and three spaces following the decimal point (to be filled in by CNHI) for the occurrence number of geologic sites in the appropriate resource area.

EO CODE [G [_ _ _ _ _] [_ _] [_ _] . _ _ _]
Code ID; Dist. & RA; Principal Feature; Age; Occurrence #/RA

[_ _ _ _ _]
Dist. Code; RA Code

BLM DISTRICT CODE

Grand Junction	070
Montrose	030
Craig	010
Canon City	050

BLM RESOURCE AREA CODE

Grand Junction	01	Kremmling	06
Glenwood Springs	02	Little Snake	07
Gunnison Basin	03	White River	08
San Juan	04	Northeast	09
Uncompahgre Basin	05	Royal Gorge	10
		San Luis	11

SITE NAME

Fill in name of site, leaving one (1) space between words and abbreviating where necessary.

FEATURES

Fill in SIGNIFICANT GEOLOGIC FEATURES/PROCESSES associated with the site using the two (2) digit codes provided below. Space is allowed for four (4) important features, beginning with the principal feature coded into the EO CODE. If the site has more than four significant features, the additional features should be explained in the SUMMARY section.

I. ACTIVE PROCESSES

01 Landslides, Avalanches
02 Earthflows, mudslides, rock glaciers, creep features
03 Streams

II. GEOMORPHIC FEATURES

10 Glacial (glacial basins, moraines, other features)
11 Fluvial - Erosional (spines, towers, hogbacks, canyons)
12 Fluvial - Depositional (plains, plateaus, mesas; stream deposits
13 Aeolian (dunes, blowouts)
14 Weathering (caves)

III. STRUCTURAL FEATURES

20 Faulting
21 Folding
22 Jointing
23 Non-igneous intrusions (e.g., diapers)

IV. VOLCANISM/PLUTONISM

30 Cones
31 Calderas
32 Lava flows
33 Ash flow (tuff)
34 Major plutons (batholiths, stocks, laccoliths)
35 Sills and dikes
36 Metamorphic complex
37 Geothermal (hot springs, mud pots)

V. STRATIGRAPHIC FEATURES

40 Sedimentary features
41 Stratigraphic sequences

VI. MINERALS, UNIQUE ROCK TYPES

50 Mines, quarries
51 Surface

VII. FOSSIL (PALEONTOLOGY)

60 Fossil vertebrates
61 Fossil invertebrates
62 Fossil plants
63 Trace fossils
64 Paleo communities (reefs, etc.)

VIII. BIOTIC

70 Vegetation (rare or special plants associated with feature)
71 Animals (rare or special animals associated with feature)

IX. SCENIC, RECREATIONAL

80 Scenic, recreational

AGE

Space is available for listing four (4) geologic periods associated with significant features on the identified site. Each period is denoted by a two (2) digit code. If the site spans several time periods, show the most recent and oldest periods which bound the geologic age. Detailed explanations can be put into the SUMMARY.

01	Recent	10	Triassic
02	Pleistocene	11	Permian
03	Pliocene	12	Pennsylvanian
04	Miocene	13	Mississippian
05	Oligocene	14	Devonian
06	Eocene	15	Silurian
07	Paleocene	16	Ordovician
08	Cretaceous	17	Cambrian
09	Jurassic	18	Precambrian

CLASSIFICATION

List stratigraphic classifications associated with principal/ significant features. Space exists for three entries. Fill in name in first line with appropriate suffix, using accepted USGS abbreviations (left justify). Further explanations can be put in the SUMMARY.

[_ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _] [_ _ _ _]
Stratigraphic classification Suffix

Suffix

GROUP	FORMATION	MEMBER	OTHER	or	ROCK NAME				
GR	FM	MBR	(e.g. BD)		SS	SH	LS	CHK	CGL	etc.

(e.g. [M O R R I S O N _ _ _ _ _ _ _ _ _ _ _ _] [F M _ _]

FIELD EVALUATION DATE

Fill in month (two (2) digits), day (two (2) digits), year (four (4) digits) of field observation date which provided date for site evaluation.

LAST OBSERVATION

Most recent field observation, if different from field evaluation date (year, month, day). Enter, if known.

FIRST OBSERVATION

Year of first recorded field observation. Enter, if known.

RANK
(Importance Ranking - Significance of Site)

RANK is a four (4) digit code to identify global, national, and statewide importance of site. Complete both a global/national and state ranking.

Worldwide or National Importance

G1 Extremely rare; less than five known sites, or best known site, worldwide and vulnerable to loss.

G2 Rare; less than 20 sites worldwide and vulnerable to loss; less than five sites nationally or best known site nationally.

G3 Regional importance; less than 100 known sites worldwide or nationally or best regional site, may be vulnerable to loss. Found locally in a restricted area.

G4 Numerous examples globally and nationally, although rare locally.

Statewide Importance

S1 Extremely rare in state; less than five known sites or best known site in state, vulnerable to loss.

S2 Rare in state; less than 20 known sites or best known site in state, vulnerable to loss.

S3 Locally important; more than 20 sites statewide.

S4 Numerous examples statewide.

ALL COUNTY NAMES

Fill in all county names (abbreviated by first four (4) letters in name) on which site occurs (see attachment 1). Leave one (1) space between each county name. Use SUMMARY for additional information.

ALL QUAD NAMES

Fill in all USGS 7.5' quad names on which site exists. Leave one (1) space between each quad name (use SUMMARY for additional information).

TOWNSHIP, RANGE, SECTION (TOWN RNG SECT)

Fill in legal description, including section where majority of area exists.

TRS COMM

Include any additional information on legal description, including additional sections where site exists, leave one (1) space between each word.

ELEVATION

Elevation of highest feature on site (feet above sea level) or approximate elevation of the total area (right justify).

SIZE

Estimated size of site in acres (BLM land) (right justify).

FEDERAL, STATE AND LOCAL, PRIVATE

Estimated size of site in acres which is in federal (other than BLM), state and local, and private ownership (right justify).

DIRECTIONS

Fill in directions to site using most easily accessible route (including public access) from nearest population center (leave space between each word - abbreviate if necessary).

OWNER

Name and location (city) of BLM Resource Area where site is located.

CONTACT

BLM district geologist or BLM resource area manager or most knowledgeable person on the site.

SITE SENSITIVITY

Fill in one (1) digit code indicating whether or not geologic values of the site are: sensitive, requiring restricted access or use by "excavation" permit only; somewhat sensitive, requiring use by general "collecting" permit only; or, not sensitive, unrestricted public use is appropriate.

S	Sensitive/Restricted; permitted use
P	Collecting permit
N	Not Sensitive; public use o.k.

VALUE

Evaluation of existing or potential value of site: scientific research, educational, or public. If site contains more than one value (e.g., research and educational use), use two (2) digit code for principal use of site and use SUMMARY section to elaborate (right justify).

S1	Type locality; research
S2	Current research
S3	Future research
E1	Academic training (exemplary or representative feature used for educational purposes)
E2	Interpretive (facilities used for interpretive displays or public information; e.g., Dinosaur National Monument)
P1	Public use

MANAGE

Recommendation for appropriate management for site based on geological values -- three (3) digit code for recommended management.

RNA	research natural area (most restrictive)
ONA	outstanding natural area (scenic, recreational, public use)
ACE	area of critical environmental concern (multiple use - red flag; less restrictive)
SMA	special management area (general category)
ORV	off-road-vehicle restrictions
REC	recreational designation
STP	site specific surface stipulations -- use stipulations (e.g., no surface occupancy, avoidance, seasonal)
NON	no special management necessary

THREAT: DEGREE/TYPE

Two (2) digit code for delineating degree and type of threat to site or geological features. Indicate degree of threat in first space and type of threat in second space. Use SUMMARY for further explanation.

	Degree
I	Immediate (Directly exploited or threatened by natural forces).
T	Threatened (Feature may have alternative or other proposed uses).
U	Unknown.
0	None.

	Type
W	Weathering/erosion (natural forces)
C	Collectors (private/commercial)
V	Vandalism
M	Mining
D	Development (Structures, Roads)
R	Secondary Use (public, off-road vehicles)
0	None

(e.g., I W = immediate threat to a paleo site due to weathering)

ACCESS

One (1) digit code to indicate status of public access to the site. Public access is defined as a public land corridor from a public access point or permission to cross private property to public land has been granted by private owner.

Y	Public access
N	No public access

BOUNDARIES

One (1) digit code to indicate whether or not site boundaries are mapped on USGS 7.5' quads.

Y	Boundaries mapped
N	Boundaries not mapped

ABSTRACT

500 space limit to include a brief description of geological importance of site and keywords; one (1) space between words.

SUMMARY

(Not automated - no word limit).

REFERENCES

List of references using accepted USGS citation rules and using no abbreviations. List best source first.

SUBMITTED BY AND DATE

Name of evaluator and date evaluation completed.

REVIEWED BY AND DATE

Name of reviewer(s) and date(s) review completed.

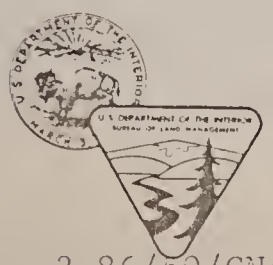
County Abbreviations Used in Text

ADAM = Adams
ALAM = Alamosa
ARAP = Arapahoe
ARCH = Archuleta
BACA = Baca
BENT = Bent
BOUL = Boulder
CHAF = Chaffee
CHEY = Cheyenne
CLEA = Clear Creek
CONE = Conejos
COST = Costilla
CROW = Crowley
CUST = Custer
DELT = Delta
DENV = Denver
DOLO = Dolores
DOUG = Douglas
EAGL = Eagle
ELBE = Elbert
ELPA = El Paso
FREM = Fremont
GARF = Garfield
GILP = Gilpin
GRAN = Grand
GUNN = Gunnison
HINS = Hinsdale
HUER = Huerfano
JACK = Jackson
JEFF = Jefferson
KIOW = Kiowa
KITC = Kit Carson
LAKE = Lake
LAPL = La Plata
LARI = Larimer
LASA = Las Animas
LINC = Lincoln
LOGA = Logan
MESA = Mesa
MINE = Mineral
MOFF = Moffat
MONZ = Montezuma
MONT = Montrose
MORG = Morgan
OTER = Otero
OURA = Ouray
PARK = Park
PHIL = Phillips
PITK = Pitkin
PROW = Prowers
PUEB = Pueblo
RIOB = Rio Blanco
RIOG = Rio Grande
ROUT = Routt
SAGU = Saguache
SANJ = San Juan
SANM = San Miguel
SEDG = Sedgwick
SUMM = Summit
TELL = Teller
WASH = Washington
WELD = Weld
YUMA = Yuma

Presented by:

Colorado Natural Areas Program
Colorado Department of Natural Resources

and



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Colorado
2020 Arapahoe Street
Denver, CO 80205

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	DATE DUE		

Faults, fossils, and canyons: Significant geologic features on public lands in Colorado.