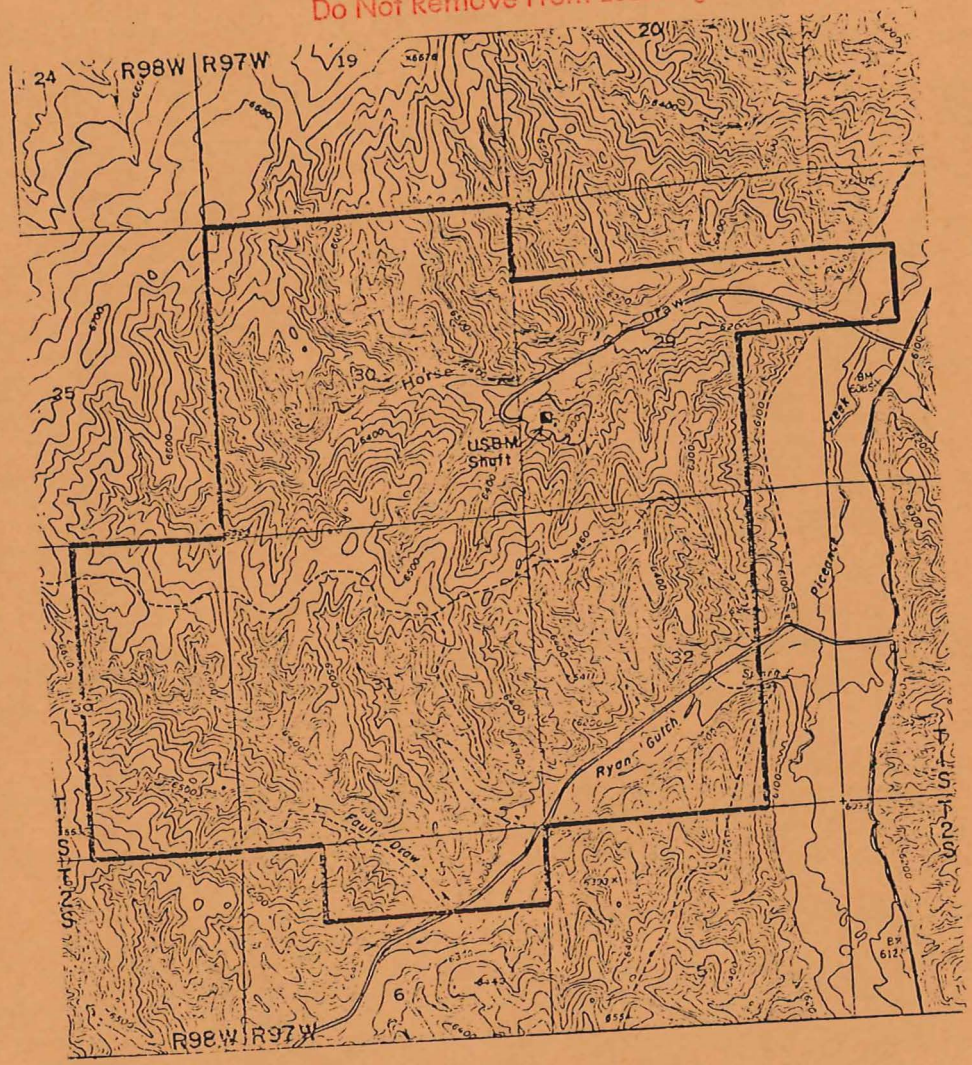
Detailed Geologic Mapping
U. S. Bureau of Mines Tract
Piceance Creek Basin
Rio Blanco County, Colorado



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16. Abstract

This is a geologic study of the U.S. Bureau of Mines Oil Shale Tract in the Piceance Creek Basin of Rio Blanco County, Colorado for the preparation of a set of detailed surface geologic maps, measurement and identification of joint attitudes and frequencies, and the classification and mapping of the soils of the area.

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Detailed Geologic Mapping

U. S. Bureau of Mines Tract

Piceance Creek Basin

Rio Blanco County, Colorado

Prepared for

U. S. Bureau of Mines
Denver Federal Center
Denver, Colorado

By

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Denver, Colorado

April 21, 1978

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I. INTRODUCTION

Purpose and Scope

This report and the accompanying maps summarize and present the results of a geologic study of the U. S. Bureau of Mines Oil Shale Tract, Piceance Creek Basin, Colorado. The purpose of this study was to 1) prepare detailed surface geologic maps of the area showing the major bedrock formations and surficial deposits, joint systems, faults, and other discontinuities, with their respective orientations, 2) measure and map joint attitudes and frequencies at joint stations on the tract, and 3) classify and map the soils of the area. Interest was to be particularly focused on the geology in the immediate vicinity of the shaft site and planned location of the U. S. Bureau of Mines demonstration oil shale mine.

The scope of the work involved, 1) a photogeologic evaluation of the area using vertical color aerial photography, 2) a field check of the photogeology, 3) a field check of the results of previous geologic and geophysical studies performed in the area, 4) joint station measurements in the field, 5) field measurement of a representative stratigraphic section of the area, and 6) compilation and presentation of the acquired data. Plane table mapping, geophysical surveying, drilling, and equal area net analysis of joints were not undertaken as a part of this project.

This study was authorized by Contract No. S0271034 dated September 20, 1977, between the U. S. Bureau of Mines and Amuedo and Ivey.

Location and Accessibility of Area

The study area, U. S. Bureau of Mines Oil Shale Tract, is located in the north-central portion of the Piceance Creek basin in Rio Blanco County, northwestern Colorado (Fig. 1). The greater portion of the tract lies west and north of the intersection of Ryan Gulch and Piceance Creek and covers parts of T.1S., R.97W., T.2S., R.97W. and T.1S., R.98W. (Fig. 2). The area extends about two and a half miles east to west, two and a quarter miles north to south, and covers approximately four square miles (2560 acres).

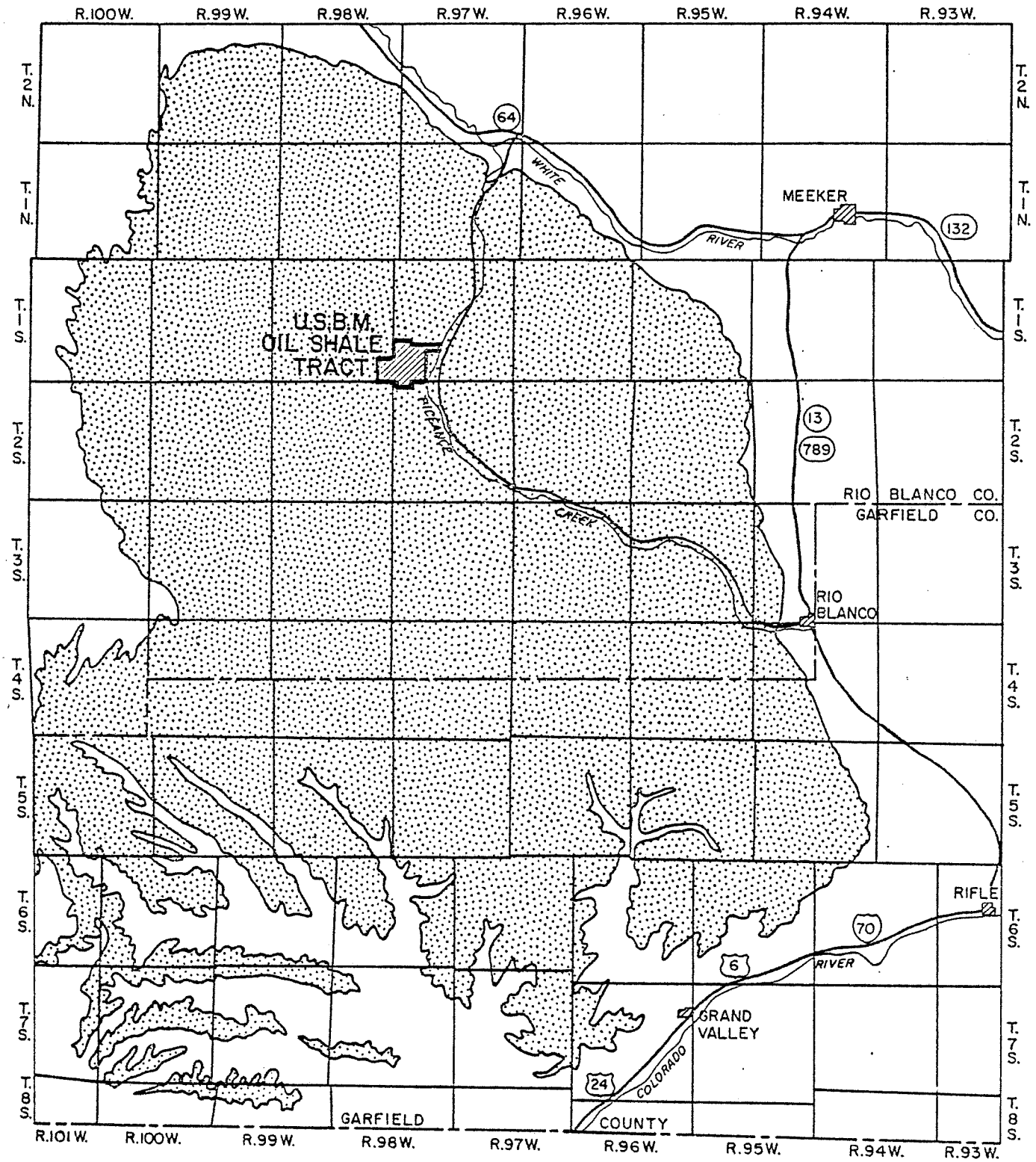
Access to the study area from Rifle is via Colorado Highway 13 and 789 to Rio Blanco, and then via the Piceance Creek road to Ryan Gulch or the shaft site in Horse Draw (see Fig. 1). Driving distance from Rifle to the shaft site is approximately 49 miles.

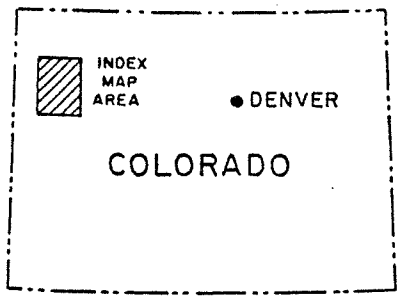
Improved dirt roads enter the southern and northern parts of the study area up Ryan Gulch and Horse Draw, respectively (see Fig. 2). Two jeep trails provide access to the eastern and central portions of the tract. The northwestern and southwestern parts of the tract are accessible only on foot.

Drainage and Topography

The project area is part of the Piceance Creek basin, a regional drainage feature whose master stream is Piceance Creek. This stream flows in a northward direction just east of the tract.

All drainage on the tract is intermittent with the exception of Piceance Creek, which crosses the northeastern tip of the tract. Drainage in the northern half of the area is southeastward and northeastward

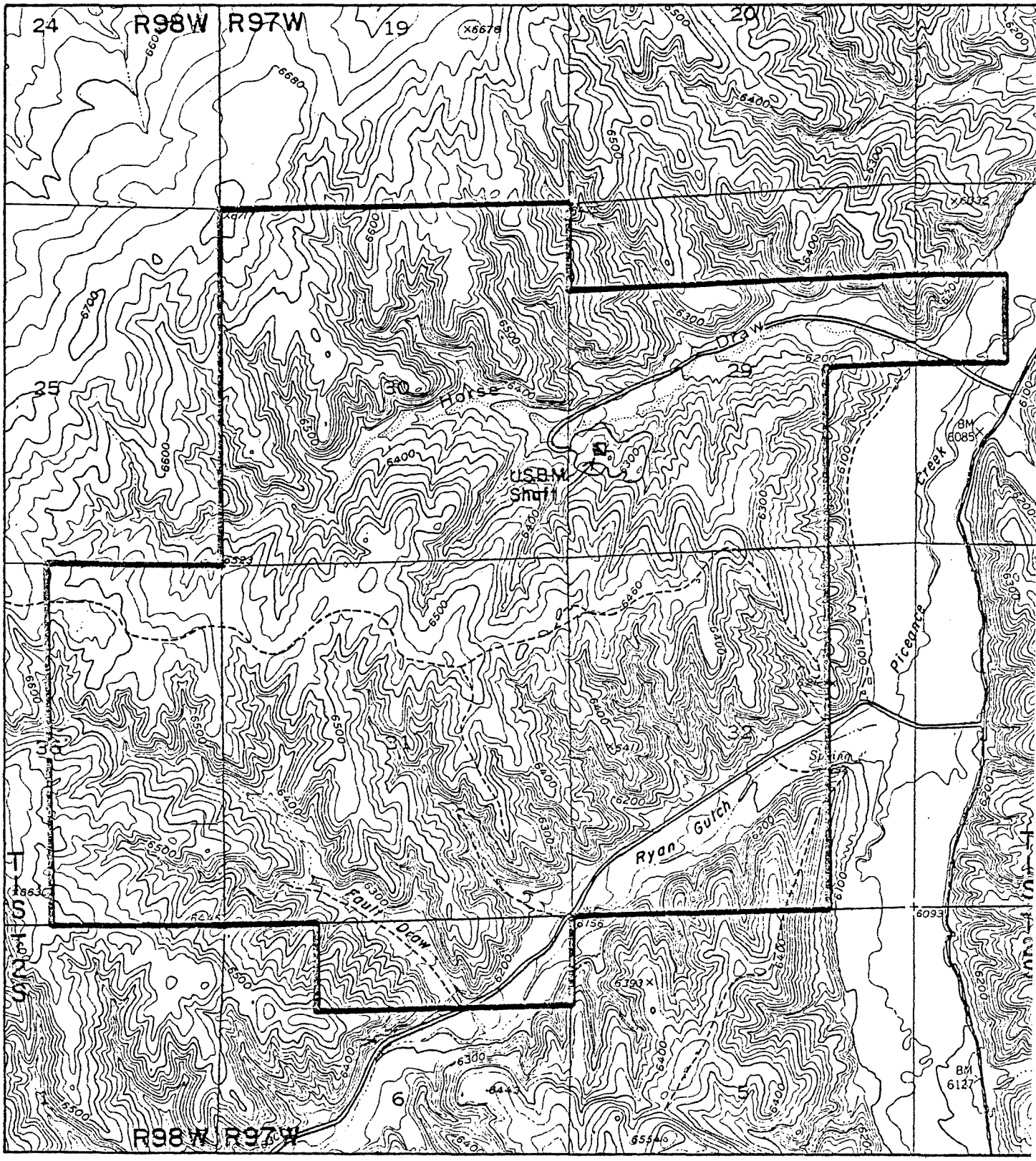




AREA UNDERLAIN BY PARACHUTE CREEK MEMBER OF GREEN RIVER FORMATION (INCLUDES PRINCIPAL OIL SHALE ZONES)

INDEX MAP

FIGURE 1



LOCATION MAP

U.S. Bureau of Mines Oil Shale Tract

Scale 1"= 2000'

Road (paved)

Road (improved dirt)

Jeep trail

FIGURE 2

into Horse Draw which, in turn, drains eastward to Piceance Creek. On the southern half of the tract, drainage is primarily southeastward into northeast-draining Ryan Gulch.

The drainage is incised into a rather youthful surface, and topographic relief is generally around 200 to 400 feet. The maximum relief on the tract is about 650 feet, which is the difference between the maximum elevation of 6,710 feet in the northwestern corner of the tract and the minimum elevation of less than 6,060 feet along Piceance Creek in the northeastern corner of the area.

The tract is characterized by having a central broad, interfluvial divide from which drainage flows southeastward into Ryan Gulch and northeastward into Horse Draw. The valleys created by this drainage are young; being narrow, V-shaped, and steep walled. The topography south of Ryan Gulch and north of Horse Draw is of the same juvenile character. Horse Draw, Ryan Gulch, and the Piceance Creek valley display more maturity by having flat floors, alluvial fans and, in the case of Piceance Creek, stream meanders.

Previous Studies

Previous geological and geophysical studies that have dealt specifically with the U. S. Bureau of Mines Oil Shale Tract and the immediate vicinity are as follows.

During the years 1960-1973, D. C. Duncan of the U. S. Geological Survey conducted geologic field mapping studies of the Square S Ranch 7 1/2 minute quadrangle map (scale 1:24,000), of which the U. S. Bureau

of Mines Oil Shale Tract is a part. In 1976, Duncan published a preliminary geologic map of the quadrangle (Duncan, 1976).

In the period October 5, 1975-January 24, 1976, three core holes designated U.S.B.M. 01, U.S.B.M. 01A, and U.S.B.M. 02A were drilled on the tract. Personnel of the U. S. Geological Survey logged the core of these holes for lithology and core index, a numerical representation of the engineering character of the rock. The results of these studies were summarized by Snyder and Terry (1977). A number of geophysical logs were run on these holes for the U. S. Bureau of Mines by the Birdwell Division of Seismograph Service Corporation.

The Environmental Research Institute of Michigan conducted a remote sensing analysis and geophysical surveys of the area in 1975-1976 and reported their findings in a report for the U. S. Bureau of Mines (ERIM, 1976).

Pilot Hole "X", a test drill hole for the ventilation shaft of the U. S. Bureau of Mines demonstration oil shale mine, was drilled by ESI Drilling, Inc. between October 1 and October 25, 1976. Golder Associates, Inc. supervised the drilling, geophysical logging and hydrologic testing of this hole (Golder Associates, Inc., 1977).

II. SUMMARY AND CONCLUSIONS

This report summarizes the results of a study of the surface geology of the U.S.B.M. oil shale tract. The primary purpose of the study was to gather data on the structural geology of the tract so that this data would be available for use in the planning of an experimental mine. Included within the scope of this study was the mapping of geologic contacts, dips, faults, axes and joints. This mapping was first done, stereoscopically, on aerial photographs; additional mapping was later done in the field at the time the photo interpretations were checked. The field work also included measuring a stratigraphic section and determining joint strikes and dips at 43 stations. While in the field a particular effort was made to locate faults reported by previous workers. In addition to the photogeologic and field work a study of the available literature of the area was made. Structure contour maps by other workers were reviewed as were reports on a number of geophysical investigations. The results of previous soils mapping by the Soil Conservation Service were used to construct a soils map of the tract area.

The surface rocks of the tract are sedimentary beds of Tertiary age. Only two stratigraphic units, the Uinta Formation and the Thirteenmile Creek Tongue of the Green River Formation, are exposed within the area. The Uinta is composed of yellow-brown, fine-grained sandstones and gray, somewhat calcareous siltstones. This unit both underlies and overlies the light-gray marlstones of the Thirteenmile Creek Tongue.

Structurally the tract is located on or near the northwestward trending axis of the Piceance basin. Dips within the tract are low

(usually less than two degrees) and reflect small, local flexures rather than the regional structure. Form-lining of photo and field-measured dips indicates the presence of a broad, westward-plunging anticlinal nose in the northern part of the tract and a southwestward-plunging nose in the central and southern parts of the tract. A shallow syncline separates the two anticlinal features.

Two faults trend N70°W across the southern edge of the tract area. Evidence of faulting along this trend is well expressed on the air photos and in the field. Following the usage of previous workers the two faults are shown as bounding a graben. However, the field evidence indicates that, within the area of the tract, this faulting could also be interpreted as a fault zone rather than as a graben.

Field or photo evidence was not found to support the existence of the faults located by the geophysical investigations. In some cases this lack of evidence is due to colluvial and alluvial cover. It may also be that the "geophysical faulting" took place before the surface rocks were deposited and hence occurs only in the subsurface. Examination of surface outcrops shows that there are many examples of seemingly erratic dips which might be misinterpreted as due to faulting. It is believed that such dips are better interpreted as products either of cross-bedding or of subaqueous slumping at the time of deposition.

Strikes, dips and frequencies of joints were measured at 43 stations. These data were plotted on rosette diagrams which subsequently were posted to a copy of the geologic map. The joint rosette patterns and the fold axes revealed by form-lining were evaluated together and, on the basis of this evaluation, the tract was sub-divided into four structural zones.

Composite joint rosettes were prepared for each structural zone. A fifth composite rosette representing the sum of all the joints on the tract was also made. The rosette which depicts the joints of the zone in which the planned experimental mine lies is of particular interest. It shows that the major surface joint directions in the mine area are N60°-80°W and N40°-60°E. These trends are lines of weakness and they should be taken into account when planning the orientations of the rooms and pillars of the experimental mine.

III. MATERIALS AND PROCEDURES

Aerial Photographs and Base Maps

Aerial photography for the project was received on October 6, 1977. This consisted of two sets of 35 vertical color photographs at a scale of 1:6,000 taken on September 14, 1977 by Kucera and Associates, Inc. The photos were shot in four west to east flight lines of nine photos each, except for one line of eight photos. Approximately nine and a half square miles of land surface are covered by the photos.

A preliminary base map film of the study area at a scale of 1:6,000 was produced by enlarging (4X) a portion of the U.S.G.S. Square S Ranch 7 1/2 minute topographic map. Photogeologic annotations were compiled from the individual photos to an enlargement of a single photo covering the entire quadrangle (quad-centered photo). The topographic film was placed over the quad-centered photo and all annotations were transferred to the film. Paper prints made from this film were used during the field mapping program.

Final topographic base map films of the project area were produced by Kucera and Associates, Inc. and consist of 21 maps at a scale of 1:1,200 and one 1:6,000 scale map. The latter map is a composite of the larger scale maps.

Photogeologic Evaluation

The aerial photography was stereoscopically evaluated for geologic contacts, key beds, faults, dips, alignments and joints. Localities that

were considered to be possible joint measurement stations were marked. These joint measurement stations, or joint stations, were areas that appeared to have outcropping rock exposed in a manner that would allow a three-dimensional analysis of joint attitudes and frequencies to be made on the ground. Outcrops of rock that might be helpful for regular geologic mapping purposes were also identified. Various cultural features including roads, jeep trails, drill pads, houses, and areas where vegetation had been chained off were annotated. Later, during the field period, the planned location of the mine was plotted to the photography as well. Drainage and the aerial photography control points were annotated as location aids in field work, and as control for the transfer of data from the photos to a preliminary base map. The annotations were made with various colored pencils to mylar film overlays on every other photo.

Field Work

A two-man party spent 12 days in the field during the period October 19-30, 1977. The major goals were to 1) prepare a surface geologic map by checking and refining the photogeologic interpretation, especially geologic contacts, key beds, and faults, 2) check previously reported faults, and 3) measure the attitude and frequency of joints on the tract at various joint stations. A stratigraphic section was measured to aid in the description of the major lithologic units of the area.

After arrival on the tract it became apparent that the only geologic contacts that could be field mapped were the top and bottom of the Thirteenmile Creek Tongue of the Green River Formation. These contacts

were field checked throughout their outcrop area; refinements were made in the location of the contacts but no major departures from the photogeologic mapping were found.

Strikes and dips on the upper contact of the Thirteenmile Creek Tongue were taken with a Brunton compass at a few localities on the tract. Measurements on bedding within the Uinta Formation were not attempted due to the irregular nature of the lithology (see Section IV, Stratigraphy).

The "Dudley Graben" fault zone, located in the southwestern corner of the tract, was carefully examined, with the aim of refining its location and extent, and also acquiring a knowledge of indications to look for for further faulting elsewhere on the tract. The faults inferred by the Environmental Research Institute of Michigan from their geophysical data were also investigated.

Joint dips, strikes, and frequencies were logged at 43 joint stations. The strike and dip of each joint set at an outcrop was measured with a Brunton compass. The frequency of the joints in each set was determined by counting their number, normal to the joint strike direction, within a measured distance. All joint frequencies were normalized to a distance of 100 feet. For instance, if five joints of a specific joint set were counted in 20 feet, the normalized number of joints would be 25. All observations and computations were recorded in the field on special joint station data sheets which are presented as Appendix A of this report.

In addition, a number of isolated joints other than those at the joint stations were measured in the field and located on the aerial

photographs. These joints are presented as single joints on the final maps.

Stratigraphic sections were measured at two localities; on the slopes just west of Piceance Creek in the SE 1/4, sec. 29, T.1S., R.97W., and on a hillslope in the SE 1/4, NE 1/4, sec. 30, T.1S., R.97W. north of the shaft site. The measured section immediately west of Piceance Creek includes the Thirteenmile Creek Tongue of the Green River Formation and, below it, a portion of the Uinta Formation (Unit 4). The measured section north of the shaft site consists of that portion of the Uinta Formation (Unit 5) that overlies the Thirteenmile Creek Tongue (see Section IV, Stratigraphy). Measurements were made with a hand level and 100 foot measuring tape.

A general log of each field day's events, observations, and interpretations was kept.

Modifications and corrections of geologic contacts, key beds, faults, dips and joints were made directly to the aerial photographs. Joint station locations and the measured sections were also plotted on the aerial photography. The scale of the photographs was large enough to allow accurate plotting of these features and localities.

Post-field Work Activities

Office work performed after returning from the field consisted of 1) transferring field annotations and field-generated data to the quad-centered photo, 2) construction of a stratigraphic column from the measured sections, 3) construction of rose diagrams for each joint station, 4) preparation and completion of five geologic maps, one joint

rosette map, one structural zone map, and a soils map, and 5) report writing.

The field data were transferred from the aerial photos to the quad-centered photo. All bedding and joint strikes were oriented with respect to true north. An annotated film overlay of all the information on the quad-centered photo was made to assist in the construction of the final geologic maps.

A stratigraphic columnar section (Plate 1) was constructed at the scale 1"=20' using the field records of the measured sections.

Rose diagrams for each of the 43 joint stations were prepared to illustrate normalized joint strike directions. The top half of each rosette shows the number of joints measured within 10 degree segments of azimuth. The lower half of the rosette shows the percentage of joints which lie within each 10 degree segment relative to the total number of joints measured at the station.

A final geologic map (Plate 2) was constructed by transferring the annotated geology from the film overlay of the quad-centered photo to the 1:6,000 scale topographic base map, which covers the entire project area. Final geologic maps (Plates 6, 7, 8, 9) were also made for sheets 7, 8, 12 and 13 of the 1:1,200 scale topographic base map series. These four sheets cover the area of the proposed mine. The geology for these maps was enlarged from the 1:6,000 scale base map.

Two maps, the Joint Rosette Map (Plate 4) and the Structure Zone Map (Plate 5), were compiled on sepia film copies of the 1:6,000 scale geologic map. The Joint Rosette Map displays the rose diagram of each joint station in the project area. The center of each rosette is

positioned on the exact location of the corresponding joint station. An exception is joint station 13 which lies to the west of the map and is not placed on its exact locality. The Structure Zone Map depicts the results of an evaluation of the Joint Rosette Map and the Geologic Map.

The soils map (Plate 3), also at the scale of 1:6,000, was compiled in the following manner. Soils data, consisting of a rudimentary soils "map" of the tract and written descriptions of the soil types shown on the map, were supplied to Amuedo and Ivey by the Meeker, Colorado office of the Soil Conservation Service (U.S.D.A.). The soils "map" was a mosaic of xerox copies of aerial photos on which the soil boundaries of the area had been drawn. Using drainage and roads as control, the soils "map" (approximate scale 1:24,000) was enlarged to fit the U.S.B.M. topographic base (1:6,000). The 1:6,000 air photos and the topographic contours of the base were used to adjust the positions of the soils boundaries where necessary.

IV. GEOLOGY

Stratigraphy

The bedrock units of the Piceance Creek basin are of Late Cretaceous and Tertiary age. Rocks of the Mesaverde Group (Late Cretaceous) crop out around the basin margin and constitute the oldest bedrock units in the area. Overlying the Mesaverde are Tertiary rocks including, in ascending order; the Paleocene Ohio Creek Conglomerate; an unnamed unit of Paleocene age that is an equivalent of the Fort Union Formation; and the Eocene Wasatch, Green River and Uinta Formations (Donnell, 1961; Cashion and Donnell, 1974).

The Uinta Formation complexly intertongues with the underlying Green River Formation. The light-colored marlstone tongues of the Green River form convenient mapping units in the middle of the basin. The names, descriptions, and relationships of these various marlstone tongues are described by Duncan and others (1974), O'Sullivan (1975), and Hail (1977).

In the study area, the predominant bedrock unit is the Uinta Formation (see Geologic Maps, Plates 2, 6, 7, 8, 9). The Thirteenmile Creek Tongue (Tgtu) of the Green River Formation divides the Uinta Formation into two parts; Unit 4 (Tu_4) underlies the Thirteenmile Creek Tongue and Unit 5 (Tu_5) overlies the Thirteenmile Creek Tongue (Duncan, 1976). The relationship and characteristics of the Uinta Formation and the Thirteenmile Creek Tongue are graphically represented on Plate 1, the Columnar Section.

Unit 4 of the Uinta Formation consists of sandstones and siltstones with some marlstone. The sandstones are yellowish brown to yellowish gray, very fine to fine grained, medium to thick bedded, and silty in part. Some of the sandstones show cross-bedding, concretions, and cavities. The siltstones have even bedding planes, are light gray to gray to grayish brown, thin bedded to laminated and, in places, are calcareous. The marlstone is gray to grayish white, even bedded, calcareous and very thin bedded to laminated. The sandstones form small cliffs or steep slopes, and the siltstones and marlstones form moderate to low-angle slopes. Unit 4 is over 207 feet thick on the eastern part of the tract.

The Thirteenmile Creek Tongue is a light-gray, even-bedded, very thin-bedded to laminated marlstone. In the vicinity of the tract the tongue has been reported to contain three or four thin, rich oil shale beds (Duncan, 1976), but these were not identified or mapped as a part of this study. The upper contact of the tongue is distinct and forms an excellent mapping horizon in the eastern half of the tract. The lower portion of the tongue is gradational with siltstones of Unit 4 of the Uinta Formation. The thickness of the Thirteenmile Creek Tongue on the tract varies between 20 and 70 feet.

Unit 5 of the Uinta Formation is composed predominantly of sandstone beds with some siltstone. The sandstones are brown to yellowish brown to grayish brown, medium to very fine grained, thin to thick bedded and silty in part. Locally they are irregularly bedded or cross-bedded, and(or) concretionary. The siltstone is light gray and very thin bedded to laminated. Some of the sandstones are cliff-forming while other

sandstones and the siltstones form steep to low-angle slopes. Unit 5 is over 228 feet thick in the northern part of the study area.

The lithology of the Uinta Formation is irregular, both laterally and vertically, as a result of the fluvial environment in which it was deposited. Deposition by streams whose channels were constantly shifting has produced beds that are lenticular and that grade laterally into units of differing character. Bedding ranges from even to highly irregular due to cross-bedding, differential compaction, or plastic flow prior to lithification. Occasionally these processes create features that appear to be structurally formed, although in reality they represent original depositional features. An outcrop located on the north side of Horse Draw just northwest of the shaft site is a typical case. Its steeply-dipping beds appear to be either the result of faulting or, perhaps, massive cross-bedding. On closer examination, however, subaqueous slumping at the time of deposition is a more plausible explanation.

The highly irregular nature of the Uinta Formation may have produced the geophysical anomalies that the ERIM study classified as faults. Rapid changes in rock type will cause significantly different resistivity readings. Such readings could be interpreted by the unwary as the product of faulting.

Scattered throughout the Uinta Formation are resistant nodules, pods, lenses and thin beds of a red to reddish-brown, siliceous sandstone. These sandstones were formed by the concentration of silica during diagenesis. The sandstones frequently have the same fracture directions (N.60°-70°W.) throughout the area.

An attempt was made to map key beds in the Uinta Formation as an aid in structural mapping. In the northern and eastern parts of the

area it was possible to map resistant sandstones over a distance of between seven and eight miles. In the southern half of the area, however, resistant sandstones were not continuous enough to be mapped over any appreciable distance.

Various surficial deposits cover portions of the study area and include alluvium (Qal), alluvial fans (Qf), colluvium (Qc), and terrace deposits (Qt). In some instances the surficial materials were combinations of two deposits, such as terrace and colluvium deposits (Qtc).

The alluvium consists of gray, brown, and buff silt and sand. Alluvial fans consist of angular boulders and pebbles mixed with silt and sand. The colluvium is mainly silt and sand. The terrace deposits are older stream deposits containing rounded pebbles and boulders. Duncan (1976) considers the alluvial deposits to be Holocene (Recent) in age and the terrace deposits to be of older Pleistocene age. Artificial fill (af) which forms the drill pad for the shaft at Horse Draw also is mapped as Holocene.

Structure

The U.S.B.M. Oil Shale Tract lies near the northwestward-trending axis of the Piceance basin. Superimposed on the regional basin structure are minor flexures and faults which have a more immediate effect on the structure of the tract area. Dips within the tract do not exceed five degrees and usually amount to only one or two degrees.

The structure of the tract was examined both at the surface and in the subsurface. Dips at the surface, because of their low values, were difficult to measure directly with a Brunton compass or an Abney level.

Dips of contacts and beds could have been accurately determined by plane table, but because of time and cost considerations this approach was not used. In lieu of plane tabling, the three-point method was used to check dips wherever possible. The surface used for the three point solutions was the top of the Thirteenmile Creek Tongue; elevations on this surface were read from the topographic base. This method was adequate for those areas in which the Thirteenmile Creek Tongue cropped out, that is for about 20 percent of the tract. In the remaining 80 percent of the tract there were no lithologic contacts suitable for structure mapping and no dips were obtained.

A number of dip and strike directions was determined by stereoscopic examination of the air photos. The accuracy and number of photogeologic dips was limited by the lack of suitable outcrops and contacts and by the low value of the dips themselves.

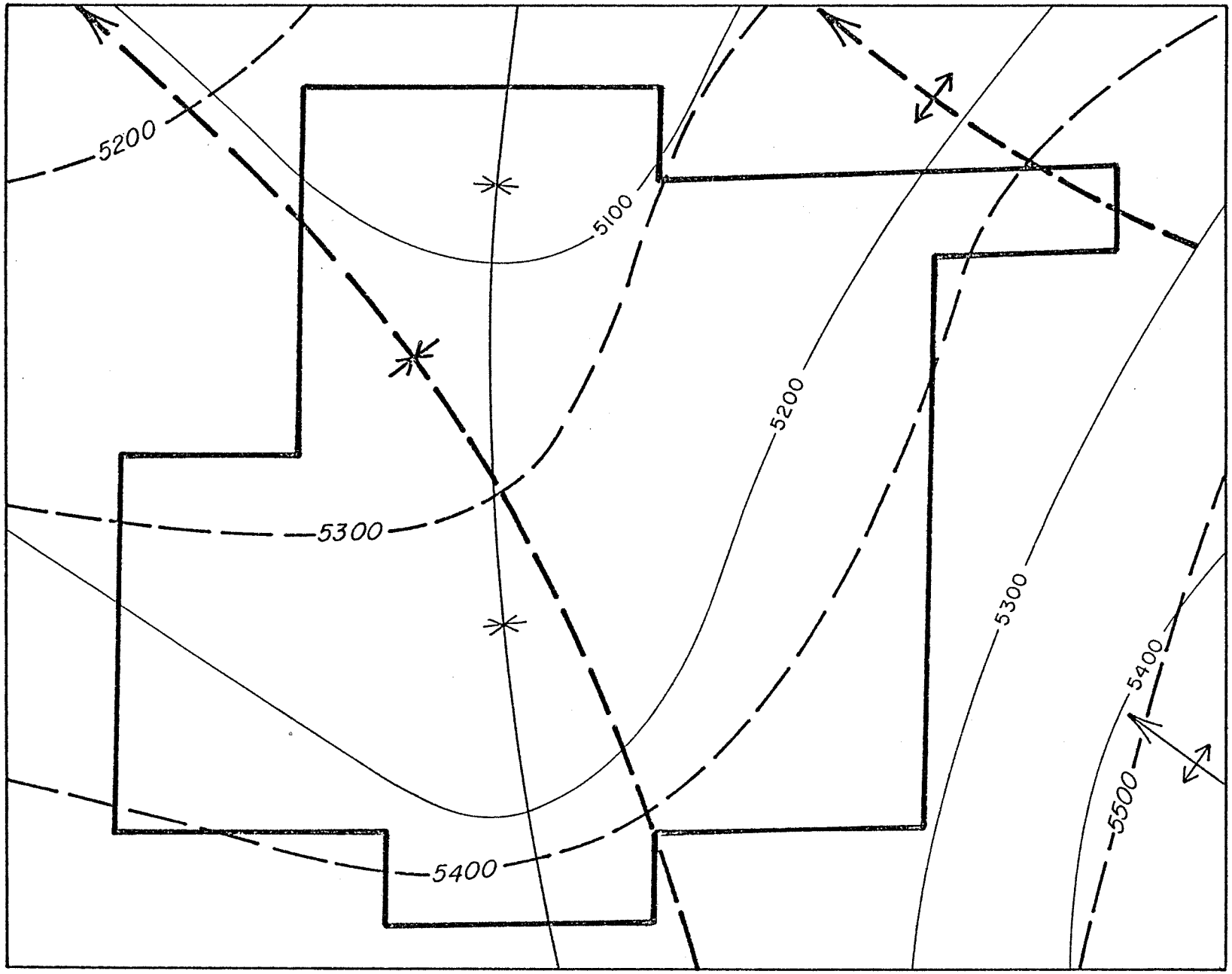
All of the surface dips were posted to a copy of the geologic base and were used to construct a structure form-line map on which was delineated the fold axes. Nearly all of the tract could be form-lined by projecting and extrapolating trends, although most of the dips occurred in the eastern part.

Local Folds - Structure form-lining of the tract indicated the presence of two broad anticlinal noses plunging to the west. One axis trends east-west across the northern part of the tract; the other trends northeastward to eastward across the central and southern part of the tract (Plate 4). The two anticlinal structures are separated by a shallow syncline which trends and plunges to the southwest.

Subsurface structure maps have been made by Duncan (1976) and by Terry and Snyder (1977). The former drew his map on the top of the Mahogany Zone; the latter drew their map on the base of the same zone. Although they differ in detail both maps show a northward-plunging syncline as the major structural feature of the tract area (Figure 3). The difference between these subsurface trends and the apparent surface trends shown on Plate 4 may be due to the unconformities which occur between the Mahogany Zone and the top of the Thirteenmile Creek Tongue. Donnell (1961, p. 861) notes that "Some folding of the older members of the Green River formation may have occurred before and during the deposition of the Evacuation Creek member (equals Thirteenmile Creek Tongue and lower Uinta Formation) and therefore may not be reflected in the surface rocks in the interior of the basin."

Faults - Because of the effects which faulting might have on an underground mine, an intensive effort was made in the field and during the photogeologic study to identify and map the faults of the area. Previous investigations (ERIM, 1976) in Fault Draw and Horse Draw had indicated a considerable amount of faulting in these areas and they were examined particularly closely.

Two major faults cross the southern edge of the U.S.B.M. tract. They form the boundaries of a down-dropped block which has been informally named the "Dudley Graben" (ERIM, 1976). At Ryan Gulch road the two faults are about 100 feet apart but appear to merge into a single fault about 3,000 feet northwest of the road (Plate 2). This single fault dies out in the southwestern corner of the tract.



AXIS CONTOUR

DUNCAN, 1976

TERRY and SNYDER, 1977

COMPARATIVE STRUCTURE CONTOUR MAP

SCALE 1: 24,000

FIGURE 3

The faults which bound the graben strike N70°W and are probably vertical, or near-vertical. The graben itself extends southeastward beyond the area of present mapping and has a total length of about 12 miles (Austin, 1971). The amount of vertical offset in the graben could not be determined within the project area; however, geologic mapping by Duncan indicates at least 100 feet of offset in the west wall of Piceance Creek valley (Duncan, 1976).

The faults shown on the accompanying geologic map (Plate 2) were first identified on the air photos and were later confirmed by walking them out in the field. Brecciation, fault gouge, strong calcite veining and abundant calcite float were all used as field evidence of faulting. One or another of these indicators was found throughout the mapped lengths of the faults.

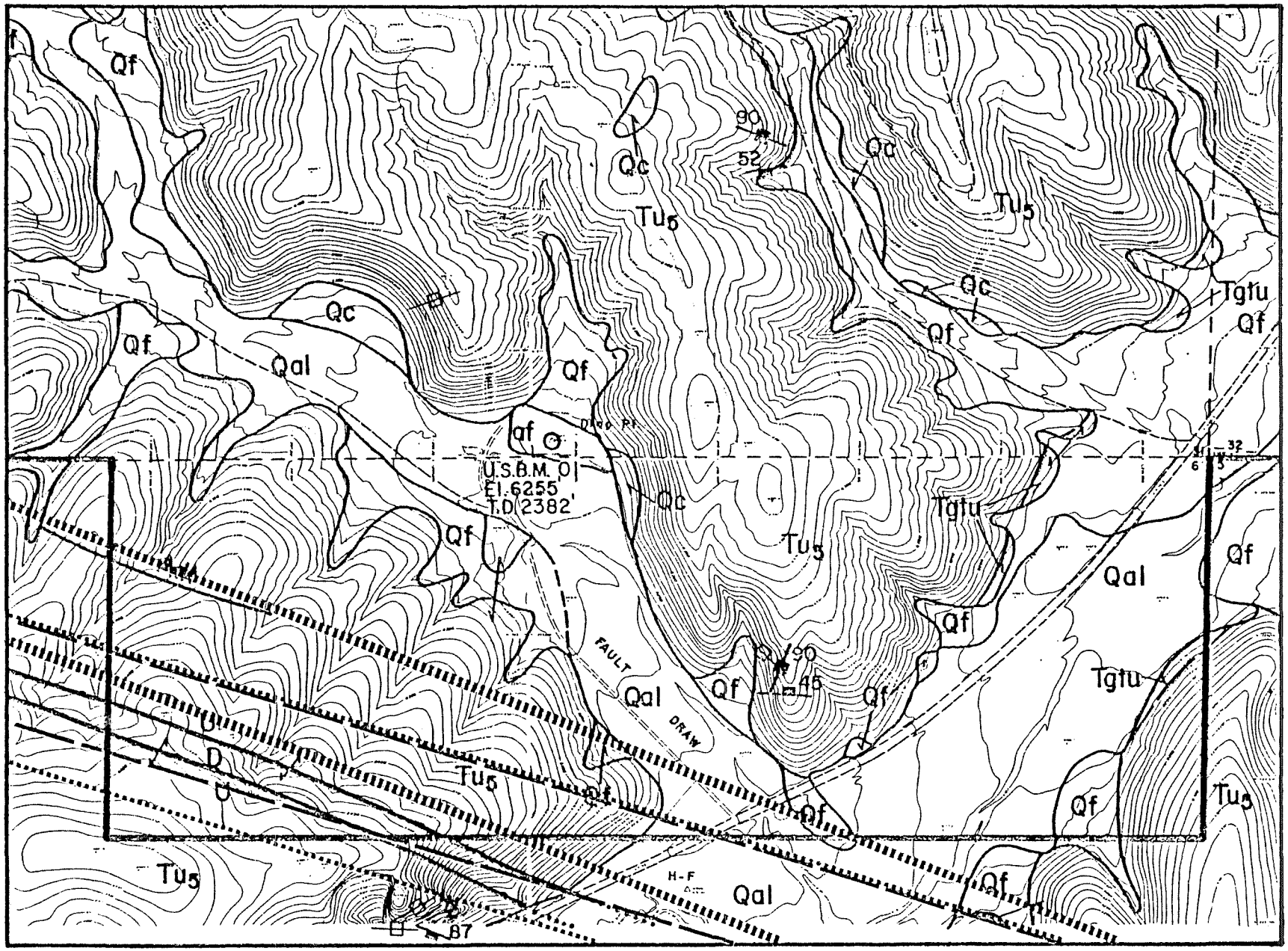
Study of the air photos also indicated a series of alignments which parallel the faults and lie 250 to 600 feet north of them. The main components of each alignment are a series of topographic saddles. Such an alignment of saddles often is indicative of faulting; however, when the alignments were walked out in the field none of the fault indicators listed above were found.

A considerable effort was made in the field to locate those faults which were reported in the ERIM study. This study consisted of a number of geophysical investigations conducted in Fault Draw, Horse Draw and along Ryan Gulch road. One result of these investigations was the identification of four north-eastward trending subsurface faults in the vicinity of U.S.B.M. drill hole OIA. Three of these faults were identified (by ERIM) in the subsurface of the next draw to the north and

these were projected northward toward Horse Draw. The projected faults were connected with other northward trending faults which were identified by the geophysical work done around the present shaft site (Fig. 40, p. A-73, ERIM, 1976).

During the course of AI's field work the surface locations of all of the geophysically identified faults were carefully walked out. Neither offset of beds nor indicators of faulting were found. This lack of surface evidence could be ascribed to the fact that throughout most of the length of the faults there is substantial colluvial or alluvial cover; however, no evidence of faulting could be found in the cliffs north and northeast of U.S.B.M. OIA where exposures are good. It could be that the faults found during the ERIM study were formed before the surface rocks were deposited and thus can only be identified in the subsurface. Consideration should be given to the possibility that these apparent faults are actually depositional discontinuities.

The faults bounding the so-called "Dudley Graben" are located differently on the ERIM maps (Fig. 29 p. 101, Fig. 29 p. A-56, Fig. 40 p. A-73, ERIM, 1976) than on Duncan's map (Duncan, 1976). The ERIM maps show the north fault passing through the hill which forms the southwest corner between Fault Draw and Ryan Gulch (Figure 4). Exposures are fairly good here and they show no evidence of faulting; neither do any of the fault indicators occur on the hillside. The present field work indicates that the graben is located in about the same position as shown by Duncan (Plate 2). That is, the entire graben of this study is about where the various south faults of the ERIM study are located; the north faults of the ERIM study are 500 to 700 feet beyond the north fault of this study.



ERIM Fig. 29 p. 101

ERIM Fig. 29 p. A-56

ERIM Fig. 40 p. A-73

COMPARISON OF LOCATIONS OF "DUDLEY GRABEN"

It should be kept in mind that in Ryan Gulch there is no neatly down-dropped block bounded by two fault planes (as is the case where the graben is exposed in Piceance Creek valley). Instead, there is a zone of crushing, brecciation and calcite veins. Thus designation of this zone as a graben may not be totally accurate.

During the course of the field work it became apparent that at a number of outcrops there were erratic dips which might be misinterpreted as due to faulting. Close examination of these outcrops shows that such dips are probably due either to cross-bedding or to subaqueous slumping at the time of deposition of the beds.

Joints - An inspection of the Joint Rosette Map (Plate 4) shows that there is no over-all, tract-wide pattern of jointing. An attempt was made to outline areas or zones within which the major joints of each station had nearly the same bearing. Again, no well-defined areas of similar jointing were immediately apparent.

It was then decided to approach the structural zonation of the tract from a different aspect. A paper print of the Joint Rosette Map was structure form-lined, using photogeologic and field measured dips to control the directions of the form lines. This form-lining revealed the presence of the surficial anticlinal noses mentioned above.

The rosettes were then re-examined to see if there was some relationship between joint trends and fold structures. The major joint sets at each station were evaluated with respect to the nearest anticlinal or synclinal axis. According to Badgley, "Joints generally may be referred to the pre-dominant structural trend of a deformed region. This predominant

trend is frequently expressed by fold axes." (Badgley 1965, p. 99). He goes on to describe three major classes of joints: longitudinal joints which tend to parallel fold axes, cross joints which are roughly normal to fold axes and diagonal joints which tend to occur in paired intersecting sets. Their orientation of the diagonal joints is such that the trend of the fold axis bisects the obtuse angle formed by the intersecting sets.

When the trends of the major joints were compared with the nearest fold axis trend it was found that nearly all of the joints could be classified as either longitudinal, cross or diagonal. In view of this fairly good agreement between the theoretical and actual relationship of the major joint trends and fold trends, the tract area was subdivided into structural zones. The fold axes were used as the identifying characteristic of each zone; the joint data were used to locate the boundaries between the zones.

Four structural zones and the joint rosettes for each are shown on Plate 4. The four rosettes were made by summing the joints of all of the stations which lie in a given zone. By combining the joints of all four zones a fifth rosette was produced which shows the major joint trends of the tract as a whole.

Of the four structural zones, Zone B is of particular interest because it is the location of the planned experimental mine. The rosette for Zone B shows that the major joint trends are N60°-80°W and N40°-60°E. These joint trends are lines of weakness, a fact which should be kept in mind when planning the orientations of the rooms and pillars of the experimental mine.

V. SOILS

The soils map (Plate 3) which accompanies this report is derived from preliminary mapping done by the Soil Conservation Service. No original soils mapping was done during the course of this study and the soils boundaries shown on Plate 3 are, with minor modifications, the same as those shown on the map supplied to Amuedo and Ivey by the S.C.S.

Nine soil types have been recognized within the project area. Three of these units, the Hagga loam, the Havre loam, and the Glendive fine sandy loam, are found only in the floodplains of Piceance Creek and Ryan Gulch. The occurrence of the Rivra channery loamy sand is nearly coincident with the alluvial fans, terraces, and colluvial deposits bordering Ryan Gulch and Piceance Creek. This unit also occupies the flat-bottoms of the larger tributaries of the two main valleys. Four units, the Rentsac channery sandy loam, the Redcreek-Rentsac complex, the Piceance fine sandy loam and the Yamac loam, are found on nearly level upland surfaces and on moderate to steep slopes. The last soils type, the Rock Outcrop-Torriorthents complex, consists of cliffs and(or) occupies the steep slopes of the larger valleys of the area.

Very detailed descriptions of the nine soil types were provided by the Soil Conservation Service. In the interest of brevity the detailed descriptions were paraphrased and the shortened versions are given below. For the complete description of each soil type and for their engineering characteristics and land use capabilities, the reader is referred to Appendix B.

Hagga Loam

The Hagga loam consists of deep, poorly drained soils that formed in alluvium weathered from calcareous sedimentary bedrock. Hagga loam occurs on narrow valley bottoms and floodplains which have slopes of zero to five percent. Typically, the surface layer is a light-brownish-gray clay loam about nine inches thick. The subsoil is light-brownish-gray clay loam with common, fine, distinct mottles and is about 18 inches thick. The underlying layer is light-brownish-gray to light-gray clay loam or silty clay loam, stratified with lenses of loamy fine sand, clay loam, fine sandy loam and silty clay loam one to 12 inches thick. The substratum extends to 60 inches or more. Natural vegetation consists of sedges, rushes, and water-tolerant grasses.

Havre Loam

The Havre loam is a deep, well-drained soil that formed in calcareous mixed alluvium derived from sedimentary rocks. The Havre loam occupies low stream terraces and floodplains with slopes of zero to three percent. Typically, the upper part of the surface layer is brown light loam about five inches thick. The lower part of the surface layer is dark-grayish-brown light loam about 22 inches thick. The underlying material is a brown, stratified loam and silty clay loam about 14 inches thick and overlies a buried stratified loam to sandy loam with distinct mottles to over 60 inches. The vegetation is mainly green needlegrass, bluebunch wheatgrass, forbs and shrubs.

Glendive Fine Sandy Loam

The Glendive fine sandy loam is a deep, well drained soil that formed on alluvium weathered mainly from sedimentary bedrock. The soil occupies floodplains, terraces and fans and occurs on slopes of two to 15 percent. Typically, the surface layer is a pale-brown, fine sandy loam about 12 inches thick. The underlying material is stratified loams, sandy loams and loamy sands to a depth of over 60 inches. The native vegetation is mainly mid and short grasses.

Rentsac Channery Sandy Loam

The Rentsac channery sandy loam is a shallow, well drained soil that is found on foothills and ridge tops with slopes of five to 50 percent. It formed in residuum derived from sandstone. Typically, the surface layer is a grayish-brown, channery, sandy loam about five inches thick. The lower part of the surface layer is a brown, very channery, sandy loam about four inches thick. The underlying material is a very pale-brown, very flaggy, sandy loam about seven inches thick and overlies fractured, hard sandstones. Native vegetation is usually dominated by pinyon pine and Utah juniper with an understory of mid and short grasses. There are occasional mountain mahogany and bitterbrush.

Redcreek-Rentsac Complex

The complex is made up of about 60 percent Redcreek soil, 30 percent Rentsac soil and 10 percent Rock Outcrop, Piceance fine sandy loam and Yamac loam. The soil complex occurs on foothill slopes and ridges which have surface slopes of five to 30 percent.

Redcreek soil is similar to Rentsac soil but differs in being non-skeletal. Typically, the surface layer is a pale-brown, sandy loam about six inches thick. The substratum is a sandy loam about 12 inches thick and rests on massive sandstone.

Rentsac soil is shallow, well drained and stony. It forms in residuum derived from highly fractured, hard sandstone. Typically, the surface layer is a pale-brown, very channery, sandy loam about four inches thick. The underlying layer is a pale-brown, very channery, sandy loam about seven inches thick. The substratum is a pale-brown, very flaggy, sandy loam about seven inches thick and rests on hard, fractured sandstone.

The native vegetation on this soil complex is dominated by pinyon pine and Utah juniper with an understory of mid and short grasses.

Piceance Fine Sandy Loam

The Piceance fine sandy loam is a moderately deep, well-drained soil developed on upland slopes and ridges. It formed from a residuum derived in part from sandstone and in part from aeolian material. This soil occurs on five to 15 percent slopes. Typically, the surface layer is brown, fine sandy loam about four inches thick. The upper subsoil is a brown, fine sandy loam about six inches thick. The lower subsoil is a light-yellowish-brown loam about 12 inches thick. The substratum is very pale-brown, very channery, sandy loam about 15 inches thick and overlies hard sandstone. There is a layer of strong lime accumulation in the lower part of the subsoil and substratum. Natural vegetation consists of sagebrush and short grasses.

Yamac Loam

Yamac loam is a deep, well-drained soil developed on rolling uplands and ridges. It formed in alluviul and aeolian materials and occurs on slopes of three to 15 percent. Typically, the surface layer is brown loam about four inches thick. The upper subsoil layer is a brown clay about six inches thick. The lower subsoil layer is light-yellowish-brown loam about 25 inches thick. The underlying layer is pale-brown loam and overlies light-yellowish-brown, fine sandy loam to 60 inches or more. Native vegetation on this soil is dominated by mid and short grasses.

Rivra Channery Loamy Sand

The Rivra channery loamy sand is a deep, somewhat excessively drained, soil which occurs on alluvial fans and narrow stream bottoms. It formed on coarse alluvium derived from sandstone and calcareous shale bedrock and occurs on three to eight percent slopes. Typically, the surface layer is pale-brown, channery, loamy sand about six inches thick. The upper part of the underlying material consists of light-yellowish-brown, channery sand about 30 inches thick. The lower part of the underlying material consists of pale-brown and light-yellowish-brown, channery sand, very channery sand, and channery loamy fine sand. The soil is highly calcareous throughout. Natural vegetation consists mainly of low brush and grasses.

Rock Outcrop - Torriorthents Complex

This complex occurs mainly on southerly facing slopes. The unit is found on strongly sloping to extremely steep mountain slopes and canyon

bluffs. The Rock Outcrops occur mainly as vertical sandstone and shale cliffs or slumped and tilted dike-like outcrops. These outcrops make up about 60 percent of the mapping unit. The Torriorthentic soils of the unit range from very shallow to moderately deep, with an occasional deep soil on the lower slopes. They make up the remaining 40 percent of the mapping unit and are generally light in color, calcareous, fine to coarse in texture and contain varying amounts of rock fragments. The vegetation is characteristically very sparse and consists of scattered pinyon and juniper and a few shrubs and grasses.

VI. CREDITS

This project was performed under the general supervision of J. B. Ivey, and under the direct supervision of the undersigned. R. A. Lindvall was the project geologist and participated with the undersigned in all aspects of the office and field work.

Respectfully submitted,

Addison R. Myers

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APPENDIX A

JOINT STATION

FIELD DATA SHEETS

AMUEDO AND IVEY
GEOLOGISTS
DENVER, COLORADO

USBMines Joint Station Field Data PROJ. NO.
RBOSP Field Mapping Project SHEET NO. 1 OF 1
MADE BY ART RAL DATE Oct. 22 CHECKED BY DATE

Joint Station Number J-1

Area: USBM Exp. Mine S.Ut Line 100' Bearing S74°E

Formation: Uinta Tu 4

Lithology: Sandstone, massive, y-brn

Strike and Dip of Beds: Approx. horiz.

	Direction of Joint Set	Dip of Joint Set	Number of Joints Counted	Normalized Number of Joints	Development of Joints
Joint Set 1	N52°E	77°-87° SE	5	5	
Joint Set 2					
Joint Set 3					
Joint Set 4					
Joint Set 5					
Joint Set 6					

- COMMENTS -

No other sets with faces or lengths of 5.0'
Sandstone - channel type, crossbedded, massive

A-02

SP T9554A

AMUEDO AND IVEY
GEOLOGISTS
DENVER, COLORADO

USBUMines Joint Station Field Data PROJ. NO.
RBOSP Field Mapping Project SHEET NO. 1 OF 1
MADE BY ARM RAL DATE 10/24/77 CHECKED BY DATE

Joint Station Number J-2

Area:

Formation: 13 Mile Creek Tongue

Lithology: Marlstone

Strike and Dip of Beds: WSW 2°

Set #1 Line 30', bearing S45°E
Set #2 Line 10', bearing N30°E

	Direction of Joint Set	Dip of Joint Set	Number of Joints Counted	Normalized Number of Joints	Development of Joints
Joint Set 1	N45°E	Vert	10/30	33	
Joint Set 2	N60°-70°W	Vert	1/10	10	
Joint Set 3					
Joint Set 4					
Joint Set 5					
Joint Set 6					

- COMMENTS -

AMUEDO AND IVEY
GEOLOGISTS
DENVER, COLORADO

USBuMines Joint Station Field Data PROJ. NO.
RBOSP Field Mapping Project SHEET NO. 1 OF 1
MADE BY RBI DATE Oct 24 1977 CHECKED BY DATE

Joint Station Number J-3

Set #1 Line 25, bearing N20-

Area:

Formation: Uinta TU5

Lithology: Sandstone, yf-cm, fn-grnd.

Strike and Dip of Beds: Horizontal

	Direction of Joint Set	Dip of Joint Set	Number of Joints Counted	Normalized Number of Joints	Development of Joints
Joint Set 1	N65-70°W	Vert	11/25	44	Poor fac- less tidal's
Joint Set 2					
Joint Set 3					
Joint Set 4					
Joint Set 5					
Joint Set 6					

- COMMENTS -

A-64

SP 1165AA

AMUEDO AND IVEY
GEOLOGISTS
DENVER, COLORADO

Subsurface Joint Station Field Data — PROJ. NO.

RBOSP Field Mapping Project — SHEET NO. 1 OF 1

MADE BY ARM RAL DATE Oct. 24, 1977 CHECKED BY ____ DATE ____

Joint Station Number J-4

Area:

Formation: Uinta Tu 5

Lithology: Sandstone, massive, x-bedded, fn-grnd

Strike and Dip of Beds: Horizontal to 5° original dip

	Direction of Joint Set	Dip of Joint Set	Number of Joints Counted	Normalized Number of Joints	Development of Joints
Joint Set 1	N 29° W	49° W			
Joint Set 2					
Joint Set 3					
Joint Set 4					
Joint Set 5					
Joint Set 6					

- COMMENTS -

AMUEDO AND IVEY
GEOLOGISTS
DENVER, COLORADO

USBuMines Joint Station Field Data PROJ. NO.
RBOSP Field Mapping Project SHEET NO. 1 OF 1
MADE BY ART DATE Oct. 24 1977 CHECKED BY DATE

Joint Station Number J-5

Area:

Formation: 13 Mile Creek Tongue

Lithology: Marlstone

Strike and Dip of Beds: Approx. horiz.

	Direction of Joint Set	Dip of Joint Set	Number of Joints Counted	Normalized Number of Joints	Development of Joints
Joint Set 1	N80-84°W	67°-70° N	4		
Joint Set 2	N 40°W	73° E	1		
Joint Set 3	N 10° E	50° W	1		
Joint Set 4	N 23° E	73° E	1		
Joint Set 5					
Joint Set 6					

- COMMENTS -

Cut on south side of pipe yard. Joints not long enough or numerous enough to normalize

A-66

SP 1856A

AMUEDO AND IVEY
GEOLOGISTS
DENVER, COLORADO

USBumines Joint Station Field Data PROJ. NO. ----
RBOSP Field Mapping Project SHEET NO. 1 OF 1
MADE BY ART/RAL DATE Oct. 24, 1977 CHECKED BY ____ DATE ____

Joint Station Number J-6

Set 1 Line 20', bearing N15°W
Set 2 Line 15', bearing N48°W

Area:

Formation: Uinta Tu 4

Lithology: Siltstone, marly

Strike and Dip of Beds: Approx. horiz

	Direction of Joint Set	Dip of Joint Set	Number of Joints Counted	Normalized Number of Joints	Development of Joints
Joint Set 1	N75°E	Vert	7/20	35	Good
Joint Set 2	N42°E	65° W	4/15	26	
Joint Set 3					
Joint Set 4					
Joint Set 5					
Joint Set 6					

- COMMENTS -

Measured in bottom of narrow creek bed trending N32°W
Longest joint 3' w/ 6" face

AMUEDO AND IVEY
GEOLOGISTS
DENVER, COLORADO

USBuMines Joint Station Field Data PROJ. NO. ---
RBOSP Field Mapping Project SHEET NO. 1 OF 1
MADE BY ARM DAL DATE Oct 24, 1977 CHECKED BY _____ DATE _____

Joint Station Number J-7

Set 1 Line 50', bearing 112

Area:

Formation: Vinta Tu 5

Lithology: Sandstone, yl-brn, fn-grnd

Strike and Dip of Beds: Approx. horiz

	Direction of Joint Set	Dip of Joint Set	Number of Joints Counted	Normalized Number of Joints	Developmen of Joints
Joint Set 1	N60°-70°W	Vert	15/50	30	
Joint Set 2					
Joint Set 3					
Joint Set 4					
Joint Set 5					
Joint Set 6					

- COMMENTS -

No joint faces more than 1' sq.

SP T566A

AMUEDO AND IVEY
GEOLOGISTS
DENVER, COLORADO

USBuMines Joint Station Field Data PROJ. NO.
RBOSP Field Mapping Project SHEET NO. 1 OF 1
MADE BY ART DATE Oct 24 1977 CHECKED BY DATE

Joint Station Number J-3

Area:

Set 1 Line 15', bearing N45°W
Set 2 Line 5', bearing N25-30°E

Formation: Uinta Tus

Lithology: Sandstone, massive, yl-brn, fn-grnd

Strike and Dip of Beds: Approx 2° to southwest

	Direction of Joint Set	Dip of Joint Set	Number of Joints Counted	Normalized Number of Joints	Development of Joints
Joint Set 1	N45°E	Vert	4/15	26	
Joint Set 2	N60-65°W	Vert	5/10	50	
Joint Set 3					
Joint Set 4					
Joint Set 5					
Joint Set 6					

- COMMENTS -

Set 1
Massive sandstones w/ poorly developed bedding. Joints are large (10' high on face of cliff) but their surfaces are rough, uneven and not planar. Set 1 not found in red-brown Ss lenses.

Set 2.
Occurs in quartzitic, fine-grained sandstone. These are red-brown when wxd and are single beds 8"-18" thick. They occur in lenses + pods and are small but well-developed planar joints. Normalized value is probably way too high. Got 5 joints in five feet of outcrop but that was all of outcrop. Set 2 is not found in massive sandstones above + below red-brown lens.

AMUEDO AND IVEY
GEOLOGISTS
DENVER, COLORADO

USBuMines Joint Station Field Data — PROJ. NO.
RBOSP Field Mapping Project — SHEET NO. 1 OF 1
MADE BY ARE DATE 8-25-77 CHECKED BY — DATE

Joint Station Number J-9

Area:

Set 1 Line 50', bearing N50°W
Set 2 Line 15', bearing N20°E

Formation: Units Tu 5

Lithology: Sandstone, massive, fn-grained, buff to yl-brn

Strike and Dip of Beds: Approx horiz

	Direction of Joint Set	Dip of Joint Set	Number of Joints Counted	Normalized Number of Joints	Development of Joints
Joint Set 1	N32°-45°E	60°W to 60°E	6/50	12	
Joint Set 2	N60°-70°W	45° to 50° S	6/40	15	
Joint Set 3					
Joint Set 4					
Joint Set 5					
Joint Set 6					

- COMMENTS -

Massive sandstone (1'-4' beds) poor bedding, joints widely spaced, joint surfaces irregular rather than planar.

SP 7155AA

AMUEDO AND IVEY
GEOLOGISTS
DENVER, COLORADO

Boulders Joint Station Field Data PROJ. NO.

RBOSP Field Mapping Project SHEET NO. 1 OF 1

MADE BY ARM DATE Oct. 25, 1977 CHECKED BY DATE

Joint Station Number J-10

Area:

Formation: Unita Tus

Lithology: Sandstone, massive, yl-brn, fn-grained

Strike and Dip of Beds: Approx. horizontal

	Direction of Joint Set	Dip of Joint Set	Number of Joints Counted	Normalized Number of Joints	Development of Joints
Joint Set 1	N55°-60°W	Vert	4/10'	40	
Joint Set 2	N70° W	45° N	4/10'	40	
Joint Set 3	N 80°-85° W	Vert	2/10'	20	
Joint Set 4					
Joint Set 5					
Joint Set 6					

- COMMENTS -

Soil cover and wide joint spacing make measurements difficult. Normalized values are probably too high.

Sandstones massive to cross-bedded. Cross beds have dips of 10°-12° in places

AMUEDO AND IVEY
GEOLOGISTS
DENVER, COLORADO

RBOSP Field Mapping Project SHEET NO. 1 OF 1

MADE BY ARM DATE Oct. 25, 1977 CHECKED BY _____ DATE _____

Joint Station Number J-11

Area:

Formation: Unit Tus

Lithology: Sandstone, massive & cross-bedded, yl-brn, fn-grnd.

Strike and Dip of Beds:

	Direction of Joint Set	Dip of Joint Set	Number of Joints Counted	Normalized Number of Joints	Developmen of Joints
Joint Set 1	N 80° E	70° NE			
Joint Set 2	N 70° E	40° SE			
Joint Set 3	N 20° W	65° SW			
Joint Set 4	N 35° W	45° NE			
Joint Set 5	N 37° W	67° SW			
Joint Set 6					

- COMMENTS -

Not enough joints to normalize

SP 1956A

AMUEDO AND IVEY
GEOLOGISTS
DENVER, COLORADO

USBuMines Joint Station Field Data PROJ. NO.
RBOSP Field Mapping Project SHEET NO. 1 OF 1
MADE BY RAL DATE Oct. 23, 1977 CHECKED BY DATE

Joint Station Number JT2

Area:

Formation: Uinta Tus

Lithology: Sandstone, massive to thick-bedded, yl-brn, fn-grnd

Strike and Dip of Beds: Approx. horizontal

	Direction of Joint Set	Dip of Joint Set	Number of Joints Counted	Normalized Number of Joints	Development of Joints
Joint Set 1	E-W	45 S			
Joint Set 2	N12°E	65°W			
Joint Set 3	N-S	65E			
Joint Set 4	N20°E	72°E			
Joint Set 5	N41°W	70°NE			
Joint Set 6					

- COMMENTS -

Not enough joints in any set to normalize for that set

AMUEDO AND IVEY
GEOLOGISTS
DENVER, COLORADO

USBuMines Joint Station Field Data PROJ. NO.
RBOSP Field Mapping Project SHEET NO. 1 OF 1
MADE BY ARA DATE Oct. 25. 1977 CHECKED BY DATE

Joint Station Number J-12

Area:

Formation: Uinta Tu.5

Lithology: Sandstone, massive, fn - grained, yl-brn

Strike and Dip of Beds: Approx. horiz

	Direction of Joint Set	Dip of Joint Set	Number of Joints Counted	Normalized Number of Joints	Development of Joints
Joint Set 1	N80°-90°W.	75°-85°S	10/50	20	Good
Joint Set 2	N40°-45°E	80° NW			
Joint Set 3	N20°E				
Joint Set 4	N-S				
Joint Set 5	N-60°W	75°SW			
Joint Set 6					

- COMMENTS -

Exposure measured on top of rim were exceptionally good and Set 1 was well developed

Sets # 3 + 4 not numerous enough in any one place to normalize

A-11

SP 7695AA

AMUEDO AND IVEY
GEOLOGISTS
DENVER, COLORADO

USBUMines Joint Station Field Data PROJ. NO.
RBOSP Field Mapping Project SHEET NO. 1 OF 1
MADE BY ASM DATE Oct 25, 1977 CHECKED BY DATE

Joint Station Number J-44

Area:

Formation: Uinta To S

Lithology: Sandstone, massive, to thick-bedded to cross-bedding, yl-brn, fn-grnd

Strike and Dip of Beds:

	Direction of Joint Set	Dip of Joint Set	Number of Joints Counted	Normalized Number of Joints	Development of Joints
Joint Set 1	N70°W	50°S	11/20	55	
Joint Set 2	N23°E	Vert			
Joint Set 3	N66°E	80°S			
Joint Set 4					
Joint Set 5					
Joint Set 6					

- COMMENTS -

Jointing is probably not as intense as normalization indicates. Outcrop forms prow-like cliff and rock may be more broken up here because of topographic exposure

Joint Station Number J-15

Area:

Formation: Uinta Fm

Lithology: Sandstone, massive to thick-bedded, fn-grnd, gy-brn

Strike and Dip of Beds: Approx horizontal

	Direction of Joint Set	Dip of Joint Set	Number of Joints Counted	Normalized Number of Joints	Development of Joints
Joint Set 1	N 85° W	50° S	7/40	17	
Joint Set 2	N 55° E	75° W	10/40	25	
Joint Set 3	N 12-15° E	60 W			
Joint Set 4	N 40° E	Vert			
Joint Set 5					
Joint Set 6					

COMMENTS

Sets 1+2 well developed and expressed. Joints 3' to 6' long in most cases

Sets 3+4 do not have enough joints to maximize

USBuMines Joint Station Field Data PROJ. NO.
RBOSP Field Mapping Project SHEET NO. 1 OF 1
MADE BY RAL DATE Oct 26, 1977 CHECKED BY DATE

Joint Station Number J-16

Area:

Formation: Uinta Tus

Lithology: Sandstone, massive to thin bedded, yl-brn, fn-grnd

Strike and Dip of Beds:

	Direction of Joint Set	Dip of Joint Set	Number of Joints Counted	Normalized Number of Joints	Development of Joints
Joint Set 1	N35°E	60° SE	10/50	20	
Joint Set 2					
Joint Set 3					
Joint Set 4					
Joint Set 5					
Joint Set 6					

- COMMENTS -

No other joint sets visible, Set 1 joints are long 10'-12' in outcrop face but their surfaces are uneven.

Joint Station Number J-17

Area:

Formation: Uinta Tus

Lithology: Sandstone, massive to x-bedded, yl-brn, fn-grnd

Strike and Dip of Beds:

	Direction of Joint Set	Dip of Joint Set	Number of Joints Counted	Normalized Number of Joints	Development of Joints
Joint Set 1	N65°-70°W	45°-55°N	10/25	40	
Joint Set 2	N20°W	40°W			
Joint Set 3	N60°-70°E	60°N			
Joint Set 4	N85°W	50°N	8/25	32	
Joint Set 5	N55°W	45° E			
Joint Set 6					

- COMMENTS -

Outcrop is cut on north side of road. Outcrop is heavily fractured and broken

SP 1166AA

Joint Station Number J-18

Area:

Formation: Uinta Tus

Lithology: Sandstone, very massive, w/-6mm, fn-grnd

Strike and Dip of Beds: Approx. horizontal

	Direction of Joint Set	Dip of Joint Set	Number of Joints Counted	Normalized Number of Joints	Development of Joints
Joint Set 1	N 30° E	60° S	3/10	30	
Joint Set 2	N 55°-60° W	50°-55° S	4/20	20	
Joint Set 3	N 40° E	65° N			
Joint Set 4					
Joint Set 5					
Joint Set 6					

- COMMENTS -

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Joint Station Number J-19

Area:

Formation: Uinta Tus

Lithology: Sandstone, thick-bedded to massive, yl-brn, fn-grnd

Strike and Dip of Beds: Approx horizontal

	Direction of Joint Set	Dip of Joint Set	Number of Joints Counted	Normalized Number of Joints	Development of Joints
Joint Set 1	N45°E	60°-70°W	4/20	20	
Joint Set 2	N60°E	57°S			Cliff face 3'
Joint Set 3	N80°E	80°N			
Joint Set 4	N60°-70°W	55°-60°S	5/10	50	
Joint Set 5					
Joint Set 6					

- COMMENTS -

Set 4 has spacing of about 1' thru 10' of outcrop and in other joints thru the next 10'. Could either be normalized as 100 cross

SP 1795AA

Joint Station Number J-21

Area:

Formation: Unita Tus

Lithology: Sandstone, massive, fn – grnd, yl-brn

Strike and Dip of Beds: Appears horizontal

	Direction of Joint Set	Dip of Joint Set	Number of Joints Counted	Normalized Number of Joints	Development of Joints
Joint Set 1	N 50°E	55°-75°W	10/40	25	
Joint Set 2	N 35°-40°E	Vert.	9/15	60	
Joint Set 3	N 70°W	43°W	8/25	32	
Joint Set 4	N-S	60°E			
Joint Set 5					
Joint Set 6					

- COMMENTS -

Exposure of rock and of joints very good. Have a decent joint count. Joints 5'-20' long

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Joint Station Number J-21

Area:

Formation: Uinta Tus

Lithology: Sandstone, thin to massive bedded, g/-brn, fn-grnd.

Strike and Dip of Beds: Approx. horiz

	Direction of Joint Set	Dip of Joint Set	Number of Joints Counted	Normalized Number of Joints	Development of Joints
Joint Set 1	N 85°E	80°N to Vert	5/25	20	
Joint Set 2	N50°E	55°N			
Joint Set 3					
Joint Set 4					
Joint Set 5					
Joint Set 6					

- COMMENTS -

SP 11664A

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MADE BY RAL DFM DATE Oct. 26, 1977 CHECKED BY DATE

Joint Station Number J-22

Area:

Formation: Uinta T_{U5}

Lithology: Sandstone, thin to thick bedded, gy-brn, fn-grnd

Strike and Dip of Beds: Approx. horizontal

	Direction of Joint Set	Dip of Joint Set	Number of Joints Counted	Normalized Number of Joints	Development of Joints
Joint Set 1	N25°-30°E	60°-80°S	12/40	30	
Joint Set 2	N70°W	Vert			
Joint Set 3	N10°E	70°E			
Joint Set 4	N60°W	50°S			
Joint Set 5	N40°E	60°-85°NW	6/20	30	
Joint Set 6					

- COMMENTS -

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USBuMines Joint Station Field Data PROJ. NO. 1021
RBOSP Field Mapping Project SHEET NO. 1 OF 1
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Joint Station Number J-23

Line 100' Bearing N35
Note recompute no o
joints for normalizati

Area:

Formation: Uinta Tu5

Lithology: Sandstone, massive to thin bedded, fn-grnd, yl-brn

Strike and Dip of Beds: Approx horizontal

	Direction of Joint Set	Dip of Joint Set	Number of Joints Counted	Normalized Number of Joints	Development of Joints
Joint Set 1	N 50° E	50°N	4/100	4	Local- all fou occur within h 12mm distance
Joint Set 2	N50° W	Vert	4/100	4	
Joint Set 3	N30°-55E	80°S	11/100	11	
Joint Set 4	N12°E	Vert	5/100	5	
Joint Set 5	N-S	Vert	3/100	3	
Joint Set 6	N30°E	70°S	2/100	2	

- COMMENTS -

100' of tape laid out alongside outcrop.

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Joint Station Number J-24

Area:

Formation: Uinta Fm

Lithology: Sandstone, extremely massive, fn-grnd, yl-brn

Strike and Dip of Beds:

	Direction of Joint Set	Dip of Joint Set	Number of Joints Counted	Normalized Number of Joints	Development of Joints
Joint Set 1	N 40E	80°S	11/60	18	
Joint Set 2	N 4°E	Vert			
Joint Set 3	N 80°E	50°S	6/20	30	
Joint Set 4					
Joint Set 5					
Joint Set 6					

- COMMENTS -

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Joint Station Number J-25

Area:

Formation: Uinta Tu 5

Lithology: Sandstone, thick-bedded to massive, fn-grnd, yl-brn

Strike and Dip of Beds: Approx. horizontal

	Direction of Joint Set	Dip of Joint Set	Number of Joints Counted	Normalized Number of Joints	Development of Joints
Joint Set 1	N 40° E	Vert	7/20	35	
Joint Set 2	N 65° E	78° N			
Joint Set 3	N 3° E	Vert			
Joint Set 4	N 12° W	80° S			
Joint Set 5	N 70° E	70° N	8/15	53	
Joint Set 6					

- COMMENTS -

SP 11664A

Joint Station Number J-26

Area:

Formation: Uinta Tu5

Lithology: Sandstone, massive, fn-grnd, yl-brn

Strike and Dip of Beds: Approx. horizontal

	Direction of Joint Set	Dip of Joint Set	Number of Joints Counted	Normalized Number of Joints	Development of Joints
Joint Set 1	N 60° W	45° S	6/30	20	
Joint Set 2	N 60° W	40° N	5/30	16	
Joint Set 3	N 30° E	70° W			
Joint Set 4	N 40° E	60° W			
Joint Set 5	N 25° W	60° S	8/20	40	
Joint Set 6					

- COMMENTS -

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USBuMines Joint Station Field Data PROJ. NO.
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MADE BY RAL JEI DATE Oct 27, 1977 CHECKED BY DATE

Joint Station Number J-27

Area:

Formation: Uinta Tu 5

Lithology: Sandstone, massive, yl-brn, fn-grnd

Strike and Dip of Beds: Approx. horizontal

	Direction of Joint Set	Dip of Joint Set	Number of Joints Counted	Normalized Number of Joints	Development of Joints
Joint Set 1	N 20° E	80°W-80°E	15/40	37	
Joint Set 2	N55°E	80°N			
Joint Set 3	N 90°E	Vert			
Joint Set 4	N55°E	52-67°N	4/10	40	
Joint Set 5	N45°E	V			
Joint Set 6	N 5°W	65°W			

- COMMENTS -

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Subsurface Joint Station Field Data — PROJ. NO.

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MADE BY ARH DATE Oct 27, 1977 CHECKED BY _____ DATE _____

Joint Station Number J-25

Area:

Formation: Uinta Tu 5

Lithology: Sandstone thin & med bedded f-m - med, y/l-brn

Strike and Dip of Beds: Approx. horizontal

	Direction of Joint Set	Dip of Joint Set	Number of Joints Counted	Normalized Number of Joints	Development of Joints
Joint Set 1	N 60-70°W	Vert	18/25	72	In sandstone ledge 3' thick
Joint Set 2	N 60° E	80° S	5/10	50	All localized in 7' of 20' exposure
Joint Set 3	N 50° E	45°-55° S	8/10	20	
Joint Set 4					
Joint Set 5					
Joint Set 6					

- COMMENTS -

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MADE BY ABI DATE Oct 27, 1977 CHECKED BY ____ DATE ____

Joint Station Number J-39

Area:

Formation: Uinta Tus

Lithology: Sandstone, massive, fn-grnd., gt-brn

Strike and Dip of Beds: Approx. horizontal

	Direction of Joint Set	Dip of Joint Set	Number of Joints Counted	Normalized Number of Joints	Development of Joints
Joint Set 1	N55°W	60°S			
Joint Set 2	N40°E	70°N			
Joint Set 3	N55°E	60°S	11 joints counted in 30' line parallel to N65°E		
Joint Set 4	N65°E	70°S	15 N65°E / Normalized would equal 25		
Joint Set 5	N50°E	80°S			
Joint Set 6	N30°E	65°N			
	N15°W	60°E			

- COMMENTS -

Joint Station Number J-30

Area:

Formation: Uinta Tos

Lithology: Sandstone, extremely massive, fn-grnd, yl-brn

Strike and Dip of Beds: Approx. horizontal

	Direction of Joint Set	Dip of Joint Set	Number of Joints Counted	Normalized Number of Joints	Development of Joints
Joint Set 1	N50°-55°E	V	8/33	24	
Joint Set 2	N80°W	V to 70°S	13/100	13	Joints 10'-30' long, faces ~~too irregular~~ to 4' high, very straight
Joint Set 3	N10°E-N10°W	V to ±10°	7/30	23	
Joint Set 4	N35°-45°E	58° W	5/33	15	
Joint Set 5					
Joint Set 6					

- COMMENTS -

Set 2 Have 8 joints in area of 5' on outcrop that is 30' across
Set 3 Have had a dozen scattered joints w/ like trend
Set 4 Located 200' south of first three sets
Set 5 " " " " " " "

All joints tend to be quite long and wide spaced, Normal to mesa surface over broad expanses

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Joint Station Number J-31

Area:

Formation: Uinta Tu 5

Lithology: Sandstone, massive, fn-grnd, yl-brn

Strike and Dip of Beds: Approx. horizontal

	Direction of Joint Set	Dip of Joint Set	Number of Joints Counted	Normalized Number of Joints	Developmer of Joints
Joint Set 1	N 60° E	Vert to ±10°	8/25	32	
Joint Set 2	N 70°-75° W	50° S	20/80	40	
Joint Set 3	N 35°-N 45° E	Vert to 80° S	5/20	25	
Joint Set 4					
Joint Set 5					
Joint Set 6					

- COMMENTS -

Have photos of outcrop showing the three joint sets

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Joint Station Number J-32

Area:

Formation: Uinta Tuff

Lithology: Sandstone, thin-bedded to massive, fn-to med-grnd, yl-brn

Strike and Dip of Beds: Approx horizontal

	Direction of Joint Set	Dip of Joint Set	Number of Joints Counted	Normalized Number of Joints	Development of Joints
Joint Set 1	N60-65°W	Vert ± 10°	15/20	75	In ferruginous red brown sdst.
Joint Set 2	N75-80°W	70° S			Joint 41 down cliff, but no sign at top
Joint Set 3	N55°W	Vert to 75°S	5/10	50	
Joint Set 4	N10° E	40°W			Three joints, 5' to 10' long - but no enough to map
Joint Set 5	N30°E	40°E			
Joint Set 6					

- COMMENTS -

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RBOSP Field Mapping Project — SHEET NO. 1 OF 1
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Joint Station Number J-33

Area:

Formation: Uinta Tu 4

Lithology: Sandstone, medium-bedded, yl-brn to tn (buff), fn-grnd

Strike and Dip of Beds: Approx. horizontal

	Direction of Joint Set	Dip of Joint Set	Number of Joints Counted	Normalized Number of Joints	Development of Joints
Joint Set 1	N80°-85°W	70°-80°N	6/20	30	
Joint Set 2	N 10° E	50° E			
Joint Set 3	N 70° W	Vert			Red brn fer[illegible]
Joint Set 4					
Joint Set 5					
Joint Set 6					

- COMMENTS -

SP TH664A

Joint Station Number J-34

Area:

Formation: Uinta, Tu 4

Lithology: Sandstone, thin-bedded to massive, fn-grnd, yl-brn

Strike and Dip of Beds: Approx. horizontal

	Direction of Joint Set	Dip of Joint Set	Number of Joints Counted	Normalized Number of Joints	Development of Joints
Joint Set 1	N35°E	65° W	5/10	50	
Joint Set 2	N5° E	Vert			
Joint Set 3	N18°E	75°E			
Joint Set 4					
Joint Set 5					
Joint Set 6					

- COMMENTS -

Not enough of "sets" 2+3 to normalize

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Joint Station Number J-35

Area:

Formation: Uinta, Tuf

Lithology: Sandstone, med-bedded to massive, fn-grnd, yl-brn

Strike and Dip of Beds: 2°-3°, south southwest

	Direction of Joint Set	Dip of Joint Set	Number of Joints Counted	Normalized Number of Joints	Development of Joints
Joint Set 1	N20°E	65°W			
Joint Set 2	N65°W	58°N			
Joint Set 3	N58°E	64°N	9/25	36	
Joint Set 4	N25°E	Vert			
Joint Set 5					
Joint Set 6					

- COMMENTS -

Set 3 was only one w/ sufficient number of joints to normalize

SP 11664A

Joint Station Number J-36

Area:

Formation: Uinta Tu5

Lithology: Sandstone, extremely massive, fn-grnd, yl-brn

Strike and Dip of Beds: Approx. horizontal

	Direction of Joint Set	Dip of Joint Set	Number of Joints Counted	Normalized Number of Joints	Development of Joints
Joint Set 1	N70°-80°W	40°S	8/20	40	
Joint Set 2	N5° W	Ver.			Joint Trace 6' long
Joint Set 3	N12°E	65°E			Joint face 4'x6' Trace 10' long
Joint Set 4	N60°W	45°S			
Joint Set 5					
Joint Set 6					

- COMMENTS -

Only Set 1 had sufficient number of joints to normalize. Some of other joints were quite large even though they aren't often repeated

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MADE BY RAM DATE Oct. 29/1977 CHECKED BY DATE

Joint Station Number J-37

Area:

Formation: Uinta Tu4

Lithology: S

Strike and Dip of Beds:

	Direction of Joint Set	Dip of Joint Set	Number of Joints Counted	Normalized Number of Joints	Developme of Joints
Joint Set 1	N60°W	V	12/15	80	Red, ferru sandstone
Joint Set 2	N67°E	61°S			
Joint Set 3	N17°E	65°E			
Joint Set 4	N-S	65°W			
Joint Set 5	N10W	55°N	9/25	36	
Joint Set 6	N60°-70°W	55°S			Massive sandst
	N35°-45°E	50-60° W	7/15	50	Massive sandst
	N35°-75°W	40°-50°E	8/20	40	

- COMMENTS -

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Joint Station Number J-38

Area:

Formation: Uinta Tu 4

Lithology: Sandstone

Strike and Dip of Beds:

	Direction of Joint Set	Dip of Joint Set	Number of Joints Counted	Normalized Number of Joints	Development of Joints
Joint Set 1	N35°-35°E	60°-70°W	6/15	40	Thin-bedded, highly shattered sandstone
Joint Set 2	N45-50°E	40°-70°N	12/100	12	Joints few in number but length of 10'-20' down cliff
Joint Set 3					
Joint Set 4					
Joint Set 5					
Joint Set 6					

- COMMENTS -

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Joint Station Number J-29

Area:

Formation: Uinta Tuff

Lithology: Sandstone, thick-bedded, fine-grained, silty, yl-brn to buff

Strike and Dip of Beds:

	Direction of Joint Set	Dip of Joint Set	Number of Joints Counted	Normalized Number of Joints	Development of Joints
Joint Set 1	N 15°-25° W	60° E	12/30	40	
Joint Set 2	N 45°-55° E	60°-65° N	6/15	40	
Joint Set 3	N 85° W	75° S			25' down dip
Joint Set 4	N ?? ° E	55° S			
Joint Set 5	N 50° W	65° S			10' down dip A-C
Joint Set 6					

- COMMENTS -

SP 7955A

Joint Station Number J-40

Area:

Formation: Uinta Tu 4

Lithology: Sandstone, fn-grnd, yl-brn

Strike and Dip of Beds: Approx. horizontal

	Direction of Joint Set	Dip of Joint Set	Number of Joints Counted	Normalized Number of Joints	Development of Joints
Joint Set 1	N26°E	32°S			
Joint Set 2	N30°E	55°S	9/25	36	Joints 3' to 4' down cliff face
Joint Set 3	N20°-30°E	50°-60°N	10/20	50	Massive sandstone, 3' down cliff face
Joint Set 4					
Joint Set 5					
Joint Set 6					

- COMMENTS -

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MADE BY ABJ PAI DATE Oct. 29, 1977 CHECKED BY ____ DATE ____

Joint Station Number JT1

Area:

Formation: Unita Tcf

Lithology: Sandstone, massive to cross-bedded, fn-grnd, yl-brn

Strike and Dip of Beds:

	Direction of Joint Set	Dip of Joint Set	Number of Joints Counted	Normalized Number of Joints	Development of Joints
Joint Set 1	N 40-50° E	Vert to 60°N to 80° S	12/20	60	Both open, irregular, sandstone
Joint Set 2	N 20° E	48° W			Massive sand, joint surface rare
Joint Set 3	N 35° E	V ± 10°	4/10	40	
Joint Set 4	N 60° E	Vert			
Joint Set 5	N 85° W	Vert 55°N			
Joint Set 6	E-W	70° N			
	N 80° E	57° S			12' down slope face

- COMMENTS -

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USBuMines Joint Station Field Data PROJ. NO.
RBOSP Field Mapping Project SHEET NO. 1 OF 1
MADE BY ABZ DATE Oct. 29 1977 CHECKED BY DATE

Joint Station Number J-42

Area:

Formation: Uinta Tuf

Lithology: Sandstone, massive, fn-grnd, yl-brn

Strike and Dip of Beds: Approx. horizontal

	Direction of Joint Set	Dip of Joint Set	Number of Joints Counted	Normalized Number of Joints	Development of Joints
Joint Set 1	N30-40 E	60-65 S	10/15	66	
Joint Set 2	N40°E	50°N			Single joint but has striations down dip.
Joint Set 3					
Joint Set 4					
Joint Set 5					
Joint Set 6					

- COMMENTS -

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USBuMines Joint Station Field Data PROJ. NO. [illegible]
RBOSP Field Mapping Project SHEET NO. 1 OF 1
MADE BY RAI DATE Oct 29, 1977 CHECKED BY _____ DATE _____

Joint Station Number J-43

Area:

Formation: Uinta To 4

Lithology: Sandstone, massive, f-grn w/abd. red staining on joint faces, fn-grnd

Strike and Dip of Beds: Approx. horizontal

	Direction of Joint Set	Dip of Joint Set	Number of Joints Counted	Normalized Number of Joints	Development of Joints
Joint Set 1	N 42° E	Vert ± 5°			Large face to
Joint Set 2	E-W	45° N	11/30	36	
Joint Set 3	N-S to 5° E	50° E			2 joints 20' long
Joint Set 4	N 80° E	30° N			3 joints 10' l
Joint Set 5	N 75° W	80° S			
Joint Set 6	N 48° W	55° N			Face is 3'
	N 58° W	55° N			

- COMMENTS -

SP 1166AA

APPENDIX B

PRELIMINARY SOILS DESCRIPTIONS

Note: The following soils descriptions were supplied by the Meeker office of the Soil Conservation Service (U.S.D.A.). These descriptions are preliminary in nature and do not reflect the standards and official position of the Soil Conservation Service.

Hagga Series

The Hagga series consist of deep, poorly drained soils that formed in alluvium weathered from calcareous sedimentry bedrock. Hagga soils are on narrow valley bottoms and floodplains and have slopes of 0 to 5 percent. The mean annual precipitation is about 16 inches and the mean annual air temerature is about 44 degrees F.

Hagga soils are similar to the Noel, Rista, Villy and Lallie soils and are near the Glendive, Rivra and Havre soils. Noel and Rista soils have fine-silty control sections. Lallie soils contain more than 35 percent clay and have montmorillonitic minerology. Glendive, Rivra and Havre soils are all well drained, Glendive soils are coarse-loamy, Rivra soils are sandy skeletal throughout.

Typical pedon of Hagga loam, 0 to 5 percent slopes, 1160 feet north of intersection of Ryan Gulch road and Piceance Creek Highway, 475 feet west of Piceance Creek highway in SW$\frac{1}{4}$, NW$\frac{1}{4}$, section 33, T.1S., R.97W.:

A11--0 to 5 inches; light brownish gray (2.5Y 6/2) loam, dark grayish brown (10YR 4/2) moist; weak fine granules in surface inch otherwise moderate medium granular structure; soft, very friable, slightly sticky and slightly plastic; many very fine and fine few medium roots; many very fine and fine, few medium vesicular pores; strongly effervescent; moderately alkaline; abrupt wavy boundary. (3 to 8 inches thick)

A13g--9 to 27 inches; light brownish gray (2.5Y 6/2) light clay loam, dark grayish brown (10YR 4/2) moist; thin lenses with dark brown

Hagga Series

(10YR 4/3) moist; common fine distinct brown (10YR 5/3 and 7.5YR 4/4) mottles; moderate medium granular and subangular blocky structure; hard, friable, sticky and plastic; many very fine and fine, few medium roots; common very fine and fine, few medium tubular pores; strongly effervescent; moderately alkaline; abrupt wavy boundary. (10 to 24 inches thick)

C1g--27 to 31 inches; light brownish gray (2.5Y 6/2) fine sandy loam, grayish brown (2.5Y 5/2) moist; few fine distinct brown (7.5YR 4/4) and dark grayish brown (2.5Y4/2) mottles; massive; soft, very friable; common very fine and fine, few medium roots; strongly effervescent; moderately alkaline; abrupt wavy boundary. (3 to 12 inches thick)

A1bg--31 to 37 inches; light brownish gray (2.5Y 6/2) light silty clay loam, brown (10YR 4/3) moist; common fine, faint, dark grayish brown (10YR 4/2 and 2.5Y 4/2) mottles; massive; hard, friable, sticky and plastic; few very fine to medium roots; few very fine and fine tubular pores; strongly effervescent; clear wavy boundary. (0 to 8 inches thick)

C1bg--37 to 47 inches; light gray (5Y 7/1) fine sandy loam, varigated-70 percent olive gray (5Y 5/2) - 30 percent gray (N/5) moist; massive; slightly hard, very friable, slightly sticky and slightly plastic; few fine roots; strongly effervescent; moderately alkaline.

These soils are saturated and have temporary water tables for six months or more during most years unless they are artificially drained. In uncultivated areas these soils may have a thin O horizon less than 4 inches thick.

Hagga Series

The A horizon has hue of 2.5Y or 10YR, value of 4 to 6 moist, 5 or 6 dry and chroma of 3 or less moist and dry. This horizon is commonly loam but may be fine sandy loam or silt loam. The control section is predominantly clay loam, but is stratified with lenses ranging to fine sand and 1 to 12 inches thick. Mottles in the epipedon range from faint to promenent with chroma of 3 to 6, value 5 to 6 and hue of 10 YR or 7.5YR. The substratum below 40 inches is always underlain with a massive silty or clayey substrata, restricting water penetration or deep percolation. Color of the substratum range in hue from 10YR to 5BG on the Gley chart.

9-Hagga loam, 0 to 5 percent slopes

This is a deep, poorly drained soil on narrow valley bottoms and flood-plains at elevations of 5,800 to 7,200 feet. It formed in calcareous alluvium from sedimentary rocks. The average annual precipitation is about 16 inches, mean annual air temperature is about 44 degrees F., and the frost-free season is about 85 to 105 days.

Typically the surface layers is light brownish gray mainly loam about 9 inches thick. The subsoil is light brownish gray clay loam with common fine distinct mottles and about 18 inches thick. The substratum is light brownish gray to light gray clay loam or silty clay loam, stratified with lenses of fine sandy loam, loam, silt loam and fine sand 1 to 12 inches thick. The substratum also contain faint to prominent mottles and a fluctuating water table about 6 months or more.

Included in this unit are small areas of Glendive fine sandy loam, Rivra channery loamy sand and Havre loam all with similar slopes. Also included are small areas with a saline surface as well as textures of fine sandy loam or silt loam.

Permeability is moderately slow. Effective rooting depth is 20 to 40 inches. Available water capacity is very high. Organic matter content in the surface layer is high. Surface runoff is slow and erosion hazard is slight.

This soil is used primarily for meadow hay, livestock grazing, and some wildlife habitat.

9-Hagga loam

The potential native vegetation on this soil is dominated by western wheatgrass, Nebraska sedge, basin wildrye, slender wheatgrass, tufted hairgrass, rushes, yarrow, herbaceous sage, milkweed, and herbaceous cinquefoil. When the range condition deteriorates; forbs, sedges, and rushes increase. In poor condition, shrubs, undesirable weeds and annual plants are abundant.

Soil drainage, irrigation water management, land smoothing or land leveling and fertilizer management are practices which will maintain or improve the production of this soil.

Deferred grazing is required during the spring and summer months when these soils are extremely wet. Grazing management will maintain and improve ~~deteriorating~~ range conditions. Seeding is advisable if the range is in poor condition. Suitable for seeding are western wheatgrass, slender wheatgrass, basin wildrye and tufted hairgrass. For successful seedings, prepare a seedbed and drill the seed. Seedbed preparation and planting may need to be done in the late summer because of the soil's inherent wetness. The grasses selected should meet the seasonal requirements of livestock. Brush management may be required to improve deteriorated sites producing woody shrubs in abundance.

This soil has fair potential for waterfowl habitat and fishponds. These soils also provide some food and cover for mule deer, cottontail rabbit and some muskrat.

Hagga soils have poor potential for sanitary facilities; community development, recreation areas (other than fish ponds and limited waterfowl hunting) and for source materials. Wetness and rare flooding are the

9-Hagga loam

major features restricting their use.

Capability unit Vw;dry, IVw, irrigated.

Range Site - Swale Meadow

3.39/18

CC0551 SOIL SURVEY INTERPRETATIONS

MLRA(S): 42 HAGGA SE
SPT/LB. 4-76
TYPIC FLUVAQUENTS, FINE-LOAMY, MIXED (CALCAREOUS), FRIGID

THE HAGGA SERIES CONSIST OF DEEP, POORLY-DRAINED SOILS FORMED IN CALCAREOUS ALLUVIUM ON NARROW VALLEY BOTTOMS AND ON FLOODPLAINS. TYPICALLY, THE SURFACE LAYER IS A LOAM AND 5 INCHES THICK. THE UNDERLYING LAYER IS STRATIFIED LOAMY FINE SAND, CLAY LOAM, FINE SANDY LOAM, AND SILTY CLAY LOAM EXTENDING TO 60 INCHES OR MORE. NATURAL VEGETATION IS SEDGES, RUSHES, AND WATER-TOLERANT GRASSES. AVERAGE ANNUAL PRECIPITATION IS ABOUT 16 INCHES AND THE FR
FREE SEASON IS 85 TO 105 DAYS, SLOPES ARE 0 TO 5 PERCENT.

ESTIMATED SOIL PROPERTIES

DEPTH (IN.)	USDA TEXTURE	UNIFIED	AASHTO	FRACT >3 IN (PCT)	PERCENT OF MATERIAL LESS THAN 3" PASSING SIEVE NO. 4	10	40	200	LIQUID LIMIT	PLA TIC IND
0-5	L, SIL, FSL	CL-ML	A-4	0	100	100	85-95	60-75	20-30	5-
5-60	SR-SICL-LFS	CL	A-6	0	100	100	80-100	55-80	30-40	10-

DEPTH (IN.)	PERMEABILITY (IN/HR)	AVAILABLE WATER CAPACITY (IN/IN)	SOIL REACTION (PH)	SALINITY (MMHOS/CM)	SHRINK-SWELL POTENTIAL	CORROSIVITY STEEL	CONCRETE	EROSION FACTORS K	T	WIND ERODI GROUP
0-5	0.6-2.0	0.18-0.18	7.9-8.4	-	LOW	MODERATE	LOW	.20	5	4
5-60	0.2-0.6	0.14-0.17	7.9-8.4	-	MODERATE	HIGH	LOW	.24		

FLOODING FREQUENCY	DURATION	MONTHS	HIGH WATER TABLE DEPTH (FT)	KIND	MONTHS	CEMENTED PAN DEPTH (IN)	HARDNESS	BEDROCK DEPTH (IN)	HARDNESS	SUBSIDENCE INIT. (IN)	TOTAL (IN)	HYD GRP	POTEN FROS ACTI
RARE			0.5-1.0	APPARENT	MAY-JUN	-		>60		-		B/D	HIG

SANITARY FACILITIES

SEPTIC TANK ABSORPTION FIELDS	SEVERE-WETNESS,PERCS SLOWLY
SEWAGE LAGOON AREAS	SEVERE-WETNESS,FLOODS,SEEPAGE
SANITARY LANDFILL (TRENCH)	SEVERE-WETNESS,SEEPAGE
SANITARY LANDFILL (AREA)	SEVERE-WETNESS,SEEPAGE
DAILY COVER FOR LANDFILL	POOR-WETNESS

SOURCE MATERIAL

ROADFILL	POOR-WETNESS,LOW STRENGTH,FROST ACTION
SAND	UNSUITED
GRAVEL	UNSUITED
TOPSOIL	POOR-WETNESS

WATER MANAGEMENT

POND RESERVOIR AREA	FAVORABLE
EMBANKMENTS DIKES AND LEVEES	LOW STRENGTH,SHRINK-SWELL,WETNESS
EXCAVATED PONDS AQUIFER FED	FAVORABLE
DRAINAGE	FROST ACTION,PERCS SLOWLY,WETNESS
IRRIGATION	WETNESS,SLOW INTAKE,FLOODS
TERRACES AND DIVERSIONS	WETNESS,PERCS SLOWLY
GRASSED WATERWAYS	WETNESS,PERCS SLOWLY

COMMUNITY DEVELOPMENT

SHALLOW EXCAVATIONS	SEVERE-WETNESS
DWELLINGS WITHOUT BASEMENTS	SEVERE-WETNESS,FLOODS
DWELLINGS WITH BASEMENTS	SEVERE-WETNESS,FLOODS
SMALL COMMERCIAL BUILDINGS	SEVERE-WETNESS,FLOODS
LOCAL ROADS AND STREETS	SEVERE-WETNESS,FROST ACTION,LOW STRENGTH
LAWNS, LANDSCAPING AND GOLF FAIRWAYS	

REGIONAL INTERPRETATIONS

B-08

RECREATION

CAMP AREAS	SEVERE-WETNESS,FLOODS	PLAYGROUNDS	SEVERE-WETNESS,FLOODS
PICNIC AREAS	SEVERE-WETNESS	PATHS AND TRAILS	SEVERE-WETNESS

CAPABILITY AND PREDICTED YIELDS -- CROPS AND PASTURE (HIGH LEVEL MANAGEMENT)

CLASS-DETERMINING PHASE	CAPABILITY	NIRR	IRR,	NIRR	IRR,	NIRR	IRR,	NIRR	IRR,	NIRR	IRR,	NIRR	IRR,	NIRR	IRR,	NIRR	IRR,	NIRR	IRR,
ALL	5W																		

WOODLAND SUITABILITY

CLASS-DETERMINING PHASE	ORD SYM	MANAGEMENT PROBLEMS: EROSION HAZARD	EQUIP. LIMIT	SEEDLING MORTALITY	WINDTH. HAZARD	PLANT COMPET.	POTENTIAL PRODUCTIVITY: IMPORTANT TREES	SITE INDX	TREES TO PLANT
							NONE		

WINDBREAKS

CLASS-DETERMING PHASE	SPECIES	HT	SPECIES	HT	SPECIES	HT	SPECIES	HT
	NONE							

WILDLIFE HABITAT SUITABILITY

CLASS-DETERMINING PHASE	POTENTIAL FOR HABITAT ELEMENTS: GRAIN & SEED	GRASS & LEGUME	WILD HERB.	HARDWD TREES	CONIFER PLANTS	SHRUBS	WETLAND PLANTS	SHALLOW WATER	OPENLD WILDLF	POTENTIAL AS HABITAT FOR: WOODLD WILDLF	WETLAND WILDLF	RANGELD WILDLF
ALL	POOR	FAIR	FAIR	-	-	POOR	FAIR	FAIR	FAIR	V. POOR	FAIR	POOR

POTENTIAL NATIVE PLANT COMMUNITY (RANGELAND OR FOREST UNDERSTORY VEGETATION)

COMMON PLANT NAME	PLANT SYMBOL (NASPN)	PERCENTAGE COMPOSITION (DRY WEIGHT) BY CLASS DETERMINING PHASE: ALL
WESTERN WHEATGRASS	AGSM	40
SEDGE	CAREX	25
SLENDER WHEATGRASS	AGTR	5
EASIN WILDRYE	ELCI2	5
RUSH	JUNCU	5
POTENTIAL PRODUCTION (LBS./AC. DRY WT):		
FAVORABLE YEARS		2500
NORMAL YEARS		2000
UNFAVORABLE YEARS		1500

FOOTNOTES

Havre Series

The Havre series consists of deep, well drained soils that formed in calcareous mixed alluvium. Havre soils are on floodplains and low terraces and have slopes of 0 to 8 percent. The mean annual precipitation is about 16 inches and the mean annual air temperature is about 44 degrees F.

Havre soils are similar to Uffens, Glenburg, Hagga, Rivra, and Glendive and are near Hagga, Rivra, and Glendive, soils. Uffens soils are natric and saline. Glenburg occur in a mesic temperature zone. Glenburg, Rivra, and Glendive have sandier control sections. Hagga soils are poorly drained.

Typical pedon of Havre loam, 0 to 8 percent slopes, 700 feet west, 500 feet south of the center of section 29, T.1S., R.98W.:

Ap--0 to 5 inches; light gray (10YR 7/2) loam, brown (10YR 4/3) moist; weak coarse platy structure parting to moderate fine granules; slightly hard, friable, slightly sticky and slightly plastic; few very fine and fine tubular pores; common very fine and fine roots; calcareous, moderately alkaline; clear smooth boundary. (4 to 8 inches thick)

A1--5 to 27 inches; light gray (10YR 7/2) loam, dark grayish brown (10YR 4/2) moist; moderate fine and medium subangular blocky structure; slightly hard, friable, sticky and plastic; few very fine and fine tubular pores; common very fine and fine roots; calcareous, moderately alkaline; clear smooth boundary. (18 to 26 inches thick)

C1--27 to 41 inches; light gray (10YR 7/2) stratified loam and silty clay loam; brown (10YR 5/3) moist; weak medium subangular blocky structure; slightly hard, friable, sticky and plastic; few very fine tubular pores; common very fine and fine roots; calcareous, strongly alkaline; clear wavy boundary. (10 to 18 inches thick)

A1b--41 to 48 inches; grayish brown (10YR 5/2) loam, very dark grayish brown (10YR 3/2) moist; weak coarse subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; common fine distinct, yellowish brown (10YR 5/8) moist, mottles; few fine roots; calcareous, strongly alkaline; clear wavy boundary. (4 to 9 inches thick)

C1g--48 to 60 inches; light brownish gray (10YR 6/2) stratified loam and sandy loam, grayish brown (10YR 5/2) moist; massive; slightly hard, very friable, slightly sticky and slightly plastic; many medium distinct yellowish brown (10YR 5/8) moist, mottles calcareous, strongly alkaline.

These soils are more than 40 inches deep but may be underlain by contrasting materials between 40 to 60 inches in places. Fine filaments or threads of lime or salts may be present throughout part or all of the C horizon in some areas. Dark salt concretions occur in the upper C horizons when exposed as cut banks for considerable time. The 10 to 40 inch control section contains 18 to 35 percent clay.

38-Havre loam, 0 to 3 percent slopes

This is a deep, well drained soil on floodplains and low terraces at elevations of 5,800 to 7,000 feet. It formed in mixed alluvium from sedimentary rocks. The average annual precipitation is about 16 inches, average annual air temperature is about 44 degrees F., and average frost-free period is about 85 to 105 days.

Typically the upper part of the surface layer is brown light loam about 5 inches thick. The lower part of the surface layer is dark grayish brown light loam about 22 inches thick. The underlying material is a brown stratified loam and silty clay loam about 14 inches thick, and overlies a buried stratified loam to sandy loam with distinct mottles to over 60 inches.

Included in this unit are small areas of Hagga loam, Glendive fine sandy loam, and Rivra channery loamy sand, all having slopes of 0 to 3 percent.

Permeability is moderate. Effective rooting depth is 60 inches or more. Available water capacity is high. Organic matter content in the surface is medium. Surface runoff is medium and erosion hazard is slight.

This soil is used for irrigated pasture and hay, livestock grazing, and wildlife habitat.

Irrigation water management and fertilizer management are practices which will maintain or improve the production of this soil.

The potential native vegetation on this soil is dominated by basin wildrye, western wheatgrass, streambank wheatgrass, Nevada bluegrass, squirreltail, fleabane, big sagebrush, rubber rabbitbrush, and fourwing saltbush. When the range condition deteriorates forbs, weedy annuals, and woody shrubs, including greasewood and snakeweed, increase.

Grazing management will maintain and improve ~~deteriorating~~ range conditions. Seeding is advisable if the range is in poor condition. Suitable for seeding are basin wildrye, western wheatgrass, streambank wheatgrass, and Nevada bluegrass. The grasses selected should meet the seasonal requirements of livestock. For successful seeding, prepare a seedbed and drill the seed. Brush management may be required to improve deteriorated sites that are producing more woody shrubs than normally found in the potential plant community.

Havre soils have a fair potential for cottontail rabbit and mule deer. They obtain much of their food from the grasses, forbs, and brush, and obtain their shelter primarily from the brush.

Havre soils have fair potential for most sanitary facilities. Rare and brief flood hazard is the main limiting feature for sanitary facilities. Before any community development or recreational development is planned on this soil, a detailed study on the duration and frequency of flooding needs to be made. On site studies will permit for planning of measures to reduce flood hazard where it does exist. Havre soils have fair potential for sources of road fill material. Low strength and shrink-swell are the main limiting features. Havre soils have good potential for topsoil.

Capability unit IIIe, irrigated

IIIc, nonirrigated

Range Site - Foothill Swale

MLRA(S): 52, 58 HAVRE SERIE
REV. RER. 7-75
USTIC TORRIFLUVENTS, FINE-LOAMY, MIXED (CALCAREOUS), FRIGID

THE HAVRE SERIES CONSISTS OF DEEP, WELL-DRAINED SOILS FORMED IN ALLUVIUM. TYPICALLY, THESE SOILS HAVE A LOAM SURFACE LAYER ABOUT 8 INCHES THICK, OVER STRATIFIED LOAM, SILT LOAM, CLAY LOAM, AND FINE SANDY LOAM UNDERLYING MATERIAL. THEY OCCUPY LOW STREAM TERRACES AND FLOOD PLAINS IN A 10 TO 14 INCH PRECIPITATION ZONE. THE VEGETATION IS MAINLY GREEN NEEDLEGRASS, BLUEBUNCH WHEATGRASS, FORBS, AND SHRUBS. THE GROWING SEASON IS 90 TO 135 DAYS. SLOPES ARE 0 TO 4 PERCENT.

ESTIMATED SOIL PROPERTIES

DEPTH (IN.)	USDA TEXTURE	UNIFIED	AASHTO	FRACT >3 IN (PCT)	PERCENT OF MATERIAL LESS THAN 3" PASSING SIEVE NO. 4	10	200	LIQUID LIMIT	PLASTICITY INDEX
0-8	L	ML, CL-ML	A-4	0	100	100	80-95 60-75	20-30	NP-10
0-8	SICL	CL	A-6	0	100	100	95-100 85-95	25-40	10-20
0-8	SIL	ML, CL	A-4, A-6	0	100	100	90-100 75-90	30-40	5-15
8-60	SR-FSL-CL	ML, CL-ML	A-4	0	100	100	80-95 50-80	15-25	NP-10

DEPTH (IN.)	PERMEABILITY (IN/HR)	AVAILABLE WATER CAPACITY (IN/IN)	SOIL REACTION (PH)	SALINITY (MMHOS/CM)	SHRINK-SWELL POTENTIAL	CORROSIVITY STEEL	CONCRETE	EROSION FACTORS K	T	WIND EROD. GROUP
0-8	0.6-2.0	0.16-0.20	7.4-8.4	<4	LOW	HIGH	LOW	.28	5	5
0-8	0.2-0.6	0.14-0.18	7.4-8.4	<4	MODERATE	HIGH	LOW	.37	5	7
0-8	0.6-2.0	0.18-0.22	7.4-8.4	<4	LOW	HIGH	LOW	.37	5	6
8-60	0.6-2.0	0.14-0.20	7.4-8.4	<8	LOW	HIGH	LOW	.28		

FLOODING FREQUENCY	DURATION	MONTHS	HIGH WATER TABLE DEPTH (FT)	KIND	MONTHS	CEMENTED PAN DEPTH (IN)	HARDNESS	BEDROCK DEPTH (IN)	HARDNESS	SUBSIDENCE INIT. (IN)	TOTAL (IN)	HYD GRP	POTENTIAL FROST ACTION
RARE			>6.0			-		>60		-		B	MODERATE

SANITARY FACILITIES

SEPTIC TANK ABSORPTION FIELDS	MODERATE-FLOODS, PERCS SLOWLY
SEWAGE LAGOON AREAS	SEVERE-FLOODS
SANITARY LANDFILL (TRENCH)	MODERATE-FLOODS
SANITARY LANDFILL (AREA)	MODERATE-FLOODS
DAILY COVER FOR LANDFILL	GOOD SICL: FAIR-TOO CLAYEY

SOURCE MATERIAL

ROADFILL	FAIR-FROST ACTION, LOW STRENGTH
SAND	UNSUITED
GRAVEL	UNSUITED
TOPSOIL	L, SIL: GOOD SICL: FAIR-TOO CLAYEY

WATER MANAGEMENT

POND RESERVOIR AREA	SEEPAGE
EMBANKMENTS DIKES AND LEVEES	LOW STRENGTH, PIPING
EXCAVATED PONDS AQUIFER FED	DEEP TO WATER
DRAINAGE	0-2%: FAVORABLE 2+%: SLOPE
IRRIGATION	0-2%: FAVORABLE 2+%: SLOPE, ERODES EASILY
TERRACES AND DIVERSIONS	FAVORABLE
GRASSED WATERWAYS	FAVORABLE

COMMUNITY DEVELOPMENT

SHALLOW EXCAVATIONS	MODERATE-FLOODS
DWELLINGS WITHOUT BASEMENTS	SEVERE-FLOODS
DWELLINGS WITH BASEMENTS	SEVERE-FLOODS
SMALL COMMERCIAL BUILDINGS	SEVERE-FLOODS
LOCAL ROADS AND STREETS	MODERATE-FROST ACTION, LOW STRENGTH
LAWNS, LANDSCAPING AND GOLF FAIRWAYS	

REGIONAL INTERPRETATIONS

RECREATION

CAMP AREAS	L.SIL: MODERATE-DUSTY SICL: MODERATE-TOO CLAYEY, DUSTY	PLAYGROUNDS	0-2% L.SIL: MODERATE-DUSTY 0-2% SICL: MODERATE-TOO CLAYEY, DUSTY 2+% L.SIL: MODERATE-SLOPE, DUSTY 2+% SICL: MODERATE-TOO CLAYEY, DUSTY, SLOPE
PICNIC AREAS	L.SIL: MODERATE-DUSTY SICL: MODERATE-TOO CLAYEY, DUSTY	PATHS AND TRAILS	L.SIL: MODERATE-DUSTY SICL: MODERATE-TOO CLAYEY, DUSTY

CAPABILITY AND PREDICTED YIELDS — CROPS AND PASTURE (HIGH LEVEL MANAGEMENT)

CLASS-DETERMINING PHASE	CAPABILITY		WHEAT, WINTER (BU)		BARLEY (BU)		OATS (BU)		ALFALFA HAY (TONS)		SUGAR BEETS (TONS)		CORN SILAGE (TONS)			
	NIRR	IRR.	NIRR	IRR.	NIRR	IRR.	NIRR	IRR.	NIRR	IRR.	NIRR	IRR.	NIRR	IRR.	NIRR	IRR.
0-2%	3C	2C		55		80		90		7.0		22		25		
2+%	3E	2E		55		80		90		7.0		22		25		
CHANNELED	6E															

WOODLAND SUITABILITY

CLASS-DETERMINING PHASE	ORD SYM	MANAGEMENT PROBLEMS: EROSION HAZARD	EQUIP. LIMIT	SEEDLING MORT'Y.	WINDTH. HAZARD	PLANT COMPET.	POTENTIAL PRODUCTIVITY: IMPORTANT TREES	SITE INDX	TREES TO PLANT
ALL	20	SLIGHT	SLIGHT	SLIGHT	SLIGHT	MODERATE	PLAINS COTTONWOOD		PLAINS COTTONWOOD

WINDBREAKS

CLASS-DETERMIN'G PHASE	SPECIES	HT	SPECIES	HT	SPECIES	HT	SPECIES	HT
ALL	SIBERIAN PEASHRUB		COMMON CHOKECHERRY		WHITE WILLOW		PONDEROSA PINE	
	TATARIAN HONEYSUCKLE		SKUNKBUSH SUMAC		GOLDEN WILLOW		BLUE SPRUCE	
	LILAC		SILVER BUFFALOBERRY		PLAINS COTTONWOOD		ROCKY MT. JUNIPER	

WILDLIFE HABITAT SUITABILITY

CLASS-DETERMINING PHASE	POTENTIAL FOR HABITAT ELEMENTS: GRAIN & SEED	GRASS & LEGUME	WILD HERB.	HARDWD TREES	CONIFER PLANTS	SHRUBS	WETLAND PLANTS	SHALLOW WATER	OPENLD WILDLF	POTENTIAL AS HABITAT FOR: WOODLD WILDLF	WETLAND WILDLF	RANGELD WILDLF
0-2% IRR.	GOOD	GOOD	FAIR	GOOD	-	FAIR	GOOD	FAIR	GOOD	GOOD	FAIR	FAIR
2+% IRR	GOOD	GOOD	FAIR	GOOD	-	FAIR	FAIR	V. POOR	GOOD	GOOD	POOR	FAIR
NIRR	FAIR	GOOD	FAIR	GOOD	-	FAIR	V. POOR	V. POOR	FAIR	GOOD	V. POOR	FAIR

POTENTIAL NATIVE PLANT COMMUNITY (RANGELAND OR FOREST UNDERSTORY VEGETATION)

COMMON PLANT NAME	PLANT SYMBOL (NRCS)	PERCENTAGE COMPOSITION (DRY WEIGHT) BY CLASS DETERMINING PHASE: L	SICL
BLUEBUNCH WHEATGRASS	AGSP	27	10
WESTERN WHEATGRASS	AGSM	15	32
GREEN NEEDLEGRASS	STVI4	10	15
NEEDLEANDTHREAD	STCO4	20	
BLUE GRAMA	BOGR2	5	5
PRAIRIE JUNEGRASS	KOCR	3	3
SANDBERG BLUEGRASS	POSE	3	3
PLAINS MUHLY	MUCU3		5
OTHER ANNUAL GRASSES	AAGG	2	2
OTHER ANNUAL FORBS	AAFF	10	20
BIG SAGEBRUSH	ARTR2	5	5
ROSE	ROSA+		
COMMON SNOWBERRY	SYAL		
REDOSIER DOGWOOD	COST4		
POTENTIAL PRODUCTION (LBS./AC. DRY WT): FAVORABLE YEARS		1600	1100
NORMAL YEARS			
UNFAVORABLE YEARS		700	800

FOOTNOTES

1 BASED ON THE LOW END OF MODERATE PERMEABILITY.

1/76
LWW/DR

Glendive Series

The Glendive series consist of deep, well drained soils that formed in alluvium weathered mainly from sedimentry bedrock. Glendive soils are in narrow valley bottoms and have slopes of 2 to 15 percent. The mean annual precipitation is about 16 inches, and the mean annual air temperature is about 43 degrees F.

Glendive soils are similar to the Glenburg, Kornman, Glending, Havre and Rivra soils, and are near the Havra and Rivra soils. Glenburg, Glending and Kornman soils are all in the mesic temperature zone. Havre soils have between 18 and 35 percent clay in the control section. Rivra soils have a sandy skeletal control section.

Typical pedon of Glendive fine sandy loam, 2 to 15 percent slopes, about 300 feet south of Ryan Gulch Road, 75 feet east of fence in the NE¼ of NE¼ of section 12, T.2S., R.98W.:

A1--0 to 12 inches; pale brown (10YR 6/3) fine sandy loam, brown (10YR 5/3) moist; moderate coarse platy parting to weak fine granular structure; soft, friable, slightly sticky and slightly plastic; common very fine and fine roots; moderately alkaline; clear wavy boundary. (6 to 12 inches thick)

C1--12 to 39 inches; pale brown (10YR 6/3) stratified loam and sandy loam, brown (10YR 4/3) moist; weak to medium moderate subangular blocky structure parting to weak to medium fine subangular

Glendive Series

blocky structure; slightly hard, friable, slightly sticky and slightly plastic; few very fine tubular pores; common very fine and fine roots; strongly alkaline; clear wavy boundary. (12 to 30 inches thick)

C2--39 to 78 inches; light brown (7.5YR 6/4) highly stratified loams, sandy loams, and loamy sands; dark brown (7.5YR 4/4) moist; structureless; slightly hard, very friable, nonsticky and nonplastic; few fine roots; strongly alkaline.

Coarse fragments, one-fourth to three-fourths inch in diameter, make up 5 to 15 percent of the 10 to 40 inch control sections. Reaction ranges from moderately to strongly alkaline.

1/76
DKA

41-Glendive fine sandy loam, 2 to 15 percent slopes

This is a deep, well drained soil on valley bottoms at 5,900 to 7,600 feet. It formed in mixed alluvial materials, mainly derived from sedimentary rocks. The average annual precipitation is about 16 inches, average annual air temperature is about 43 degrees F., and average frost-free period is 80 to 105 days.

Typically the surface layer is a pale brown fine sandy loam about 12 inches thick. The underlying material is stratified loams, sandy loams, and loamy sands to a depth of over 60 inches.

Included in this unit are small areas of Rivra gravelly loamy fine sand, Havre loam, and Hagga loam, all having slopes of 2 to 9 percent slopes.

Permeability is moderate. Effective rooting depth is 60 inches or more. Available water capacity is moderate. Organic matter content in the surface is medium. Surface runoff is slow and erosion hazard moderate.

This soil is used for livestock grazing and wildlife habitat. Limited acreage is in irrigated pasture.

The potential native vegetation is dominated by basin wildrye, western wheatgrass, streambank wheatgrass, Indian ricegrass,

41-Glendive fine sandy loam

squirreltail, fleabane, big sagebrush, rubber rabbitbrush, fourwing saltbrush and winterfat. When the range condition deteriorates forbs, weedy annuals and woody shrubs including greasewood and snakeweed increase.

Grazing management will maintain and improve ~~deteriorating~~ range conditions. Seeding is advisable if the range is in poor condition. Suitable for seeding are basin wildrye, western wheatgrass, streambank wheatgrass and Indian ricegrass. The grasses selected should meet the seasonal requirement of livestock. For successful seeding, prepare a seedbed and drill the seed. Brush management may be required to improve deteriorated sites that are producing more woody shrubs than normally found in the potential plant community.

This soil is used by cottontail rabbit and wild geeds and pheasant. They obtain much of their food and shelter from this soil. Mule deer winter range is an important use for this soil.

Irrigation water management and fertilizer management will maintain or improve soil tilth and production when irrigation water is available.

41–Glendive fine sandy loam

This soil has poor ootential for community development, sanitary facilities, and intensive recreational areas. Rare flooding would be the main limiting feature on Glendive soils for these uses. This soil is a good source for road fill material; a fair source of topsoil because of small stones; a poor source of sand because of excess fines; and is unsuited as a source of gravel.

Capability unit IVe, nonirrigated; range site Foothill Swale.

MLRA(S): 52 GLENDIVE SERIES
REA. 4-74
USTIC TORRIFLUVENTS, COARSE-LOAMY, MIXED (CALCAREOUS), FRIGID

THE GLENDIVE SERIES CONSISTS OF DEEP, WELL DRAINED SOILS FORMED IN ALLUVIUM. TYPICALLY THESE SOILS HAVE A LOAM SURFACE LAYER OVER UNDERLYING MATERIAL THAT IS A LOAM OR SILT LOAM IN THE UPPER PART AND FINE SANDY LOAM IN THE LOWER PART. THEY OCCUPY FLOOD PLAINS, TERRACES AND FANS IN A 10 TO 14 IN. PRECIPITATION ZONE. SLOPES ARE 0 TO 4 PERCENT. THE NATIVE VEGETATION IS MAINLY MID AND SHORT GRASSES. THE GROWING SEASON IS 105 TO 135 DAYS.

ESTIMATED SOIL PROPERTIES

DEPTH (IN.)	USDA TEXTURE	UNIFIED	AASHO	FRACT >3 IN (PCT)	PERCENT OF MATERIAL LESS THAN 3" PASSING SIEVE NO. 4	10	40	200	LIQUID LIMIT	PLASTICITY INDEX
0-16	L, SIL, FSL	ML, CL-ML	A-4	0	100	100	80-90	55-70	20-25	4-10
16-60	SR-FSL-LFS	SM	A-4, A-2	0	95-100	75-100	60-80	25-45	15-30	NP-4

DEPTH (IN.)	PERMEABILITY (IN/HR)	AVAILABLE WATER CAPACITY (IN/IN)	SOIL REACTION (PH)	SALINITY (MMHOS/CM)	SHRINK-SWELL POTENTIAL	CORROSIVITY STEEL	CORROSIVITY CONCRETE	EROSION FACTORS K	EROSION FACTORS T	WIND ERODI. GROUP
0-16	0.6-2.0	0.14-0.20	6.6-8.4	<4	LOW	HIGH	LOW	.20	5	5
16-60	2.0-6.0	0.14-0.16	7.4-9.0	2-8	LOW	HIGH	LOW	.20		

FLOODING FREQUENCY	FLOODING DURATION	FLOODING MONTHS	HIGH WATER TABLE DEPTH (FT)	HIGH WATER TABLE KIND	HIGH WATER TABLE MONTHS	CEMENTED PAN DEPTH (IN)	CEMENTED PAN HARDNESS	BEDROCK DEPTH (IN)	BEDROCK HARDNESS	SUBSIDENCE INIT. (IN)	SUBSIDENCE TOTAL (IN)	HYD GRP	POTENTIAL FROST ACTION
RARE			>6.0			-		>60		-		B	MODERATE

SANITARY FACILITIES

SEPTIC TANK ABSORPTION FIELDS	MODERATE-FLOODS
SEWAGE LAGOON AREAS	SEVERE-SEEPAGE, FLOODS
SANITARY LANDFILL (TRENCH)	SEVERE-SEEPAGE
SANITARY LANDFILL (AREA)	SEVERE-SEEPAGE
DAILY COVER FOR LANDFILL	GOOD

COMMUNITY DEVELOPMENT

SHALLOW EXCAVATIONS	MODERATE-FLOODS
DWELLINGS WITHOUT BASEMENTS	SEVERE-FLOODS
DWELLINGS WITH BASEMENTS	SEVERE-FLOODS
SMALL COMMERCIAL BUILDINGS	SEVERE-FLOODS
LOCAL ROADS AND STREETS	MODERATE-FROST ACTION, FLOODS, LOW STRENGTH

REGIONAL INTERPRETATIONS

SOURCE MATERIAL

ROADFILL	FAIR-FROST ACTION, LOW STRENGTH
SAND	POOR-EXCESS FINES
GRAVEL	UNSUITED
TOPSOIL	FAIR-EXCESS SALT

WATER MANAGEMENT

POND RESERVOIR AREA	SEEPAGE
EMBANKMENTS DIKES AND LEVEES	PIPING, LOW STRENGTH
EXCAVATED PONDS AQUIFER FED	NO WATER
DRAINAGE	FROST ACTION, FLOODS
IRRIGATION	ERODES EASILY, SEEPAGE
TERRACES AND DIVERSIONS	ERODES EASILY, PIPING
GRASSED WATERWAYS	ERODES EASILY

RECREATION

CAMP AREAS	MODERATE-DUSTY	PLAYGROUNDS	0-2%: MODERATE-DUSTY 2+%: MODERATE-SLOPE,DUSTY
PICNIC AREAS	MODERATE-DUSTY	PATHS AND TRAILS	MODERATE-DUSTY

CAPABILITY AND PREDICTED YIELDS -- CROPS AND PASTURE (HIGH LEVEL MANAGEMENT)

CLASS-DETERMINING PHASE	CAPABILITY		WHEAT, WINTER (BU)		WHEAT, SPRING (BU)		BARLEY (BU)		ALFALFA HAY (TONS)							
	NIRR	IRR.	NIRR	IRR.	NIRR	IRR.	NIRR	IRR.	NIRR	IRR.	NIRR	IRR.	NIRR	IRR.	NIRR	IRR.
ALL	3E	2E	30	-	25	45	35	60	1.5	5.0						

WOODLAND SUITABILITY

CLASS-DETERMINING PHASE	ORD SYM	MANAGEMENT PROBLEMS: EROSION HAZARD	EQUIP. LIMIT	SEEDLING MORT'Y.	WINDTH. HAZARD	PLANT COMPET.	POTENTIAL PRODUCTIVITY: IMPORTANT TREES	SITE INDX	TREES TO PLANT
							NONE		

WINDBREAKS

CLASS-DETERMIN'G PHASE	SPECIES	HT	SPECIES	HT	SPECIES	HT	SPECIES	HT
ALL	SIBERIAN PEASHRUB TARTAR. HONEYSUCKLE LILAC		SIBERIAN ELM GREEN ASH COMMON CHOKECHERRY		RUSSIAN-OLIVE SILVER BUFFALOBERRY SKUNKBUSH SUMAC		PONDEROSA PINE ROCKY MT. JUNIPER BLUE SPRUCE	

WILDLIFE HABITAT SUITABILITY

CLASS-DETERMINING PHASE	POTENTIAL FOR HABITAT ELEMENTS: GRAIN & SEED	GRASS & LEGUME	WILD HERB.	HARDWD TREES	CONIFER PLANTS	SHRUBS	WETLAND PLANTS	SHALLOW WATER	POTENTIAL AS HABITAT FOR: OPENLD WILDLF	WOODLD WILDLF	WETLAND WILDLF	RANGELD WILDLF
IRR.	GOOD	GOOD	GOOD	-	GOOD	FAIR	GOOD	POOR	GOOD	-	POOR	FAIR
NIRR	FAIR	GOOD	GOOD	-	GOOD	FAIR	GOOD	POOR	FAIR	GOOD	POOR	FAIR

POTENTIAL NATIVE PLANT COMMUNITY (RANGELAND OR FOREST UNDERSTORY VEGETATION)

COMMON PLANT NAME	PLANT SYMBOL (NLSPN)	PERCENTAGE COMPOSITION (DRY WEIGHT) BY CLASS DETERMINING PHASE: L.SIL	FSL
WESTERN WHEATGRASS	AGSM	25	15
THICKSPIKE WHEATGRASS	AGDA	20	
NEEDLEANDTHREAD	STCO4	20	20
GREEN NEEDLEGRASS	STVI4	5	5
LITTLE BLUESTEM	ANSC2	5	20
PRAIRIE SANDREED	CALO	5	10
BLUE GRAMA	BOGR2	5	5
WINTERFAT	ELLAS	3	2
SILVER SAGEBRUSH	ARCA13	2	2
SAND DROPSEED	SPCR		3
SIDEOATS GRAMA	BOCU		2
OTHER PERENNIAL FORBS	PPFF	3	3
OTHER PERENNIAL GRASSES	PPGG	2	3
OTHER ANNUAL FORBS	AAFF	2	5
OTHER SHRUBS	SSSS	3	5
POTENTIAL PRODUCTION (LBS./AC. DRY WT): FAVORABLE YEARS		1800	1800
NORMAL YEARS			
UNFAVORABLE YEARS		900	900

FOOTNOTES

1 EXCESSIVE PERMEABILITY RATE MAY CAUSE POLLUTION OF GROUND WATER.

Rentsac Series

The Rentsac series consists of shallow, well drained soils formed in residuum from sandstone. Rentsac soils are on foothills (upland entrenched terrace) and have slopes which are 5 to 50 percent. Mean annual precipitation is about 16 inches and the mean annual air temperature is about 44 degrees F.

Rentsac soils are similar to the Redcreek, Redwash and Thermopolis soils and are near the Blazon, Forelle, Piceance, Redcreek and Yamac soils. Redcreek soils are not skeletal. Redwash soils have lithic contact at depths of 3 to 10 inches. Thermopolis soils have paralithic contact at depths of 10 to 20 inches. The Blazon soils are derived from shale. The Forelle and Yamac soils are deep and the Forelle soil has a thin argillic horizon. Piceance soils are 20 to 40 inches deep over bedrock.

Typical pedon of Rentsac channery sandy loam, 5 to 50 percent slopes, NE¼ of NE¼ of section 10, T.2S., R.99W.:

A1--0 to 5 inches; grayish brown (10YR 5/2) channery sandy loam, dark brown (10YR 3/3) moist; weak very fine granular structure; soft, very friable, nonsticky and nonplastic; 25 percent sandstone channery; common very fine and fine roots; slightly effervescent, moderately alkaline; clear smooth boundary. (3 to 6 inches thick)

Ac--5 to 9 inches; brown (10YR 5/3) very channery sandy loam, brown (10YR 4/3) moist; massive; soft, very friable, nonsticky and nonplastic;

Rentsac Series

50 percent sandstone channery and 10 percent flags; common very fine to coarse roots; strongly effervescent, moderately alkaline; gradual smooth boundary. (3 to 6 inches thick)

C1--9 to 16 inches; very pale brown (10YR 7/3) very flaggy sandy loam, light yellowish brown (10YR 6/4) moist; structureless; soft, very friable, nonsticky and nonplastic; 80 percent sandstone channery and flags 2 to 10 inches in diameter and 1 to 2 inches thick; common fine to coarse roots spreading laterally; strongly effervescent, moderately alkaline; clear wavy boundary. (5 to 8 inches thick)

R—16 inches; hard sandstone.

Rock fragments in the A horizon ranges from 20 to 40 percent, most of which are less than 3 inches long. The depth to bedrock ranges from 10 to 20 inches. The underside and along cracks of the rock fragments in the Ac and C1 have thin coatings in some pedons. The 10 to 20 inch section has a clay content of 10 to 18 percent.

The Ac horizon has 60 percent coarse fragments with 10 percent more than 3 inches in length.

The C1 horizon has 80 percent coarse fragments with 15 percent being channery and 65 percent flags in size.

Reaction is moderately alkaline throughout.

63-Rentsac channery sandy loam, 5 to 50 percent slopes.

This is a shallow, well drained soil on foothills and ridge tops at elevations of 6,000 to 7,600 feet. It formed in residuum on sandstone that is usually horizontally fractured. The average annual precipitation is about 16 inches, average annual air temperature is about 44 degrees F., and frost-free period is about 80 to 105 days.

The Rentsac soil comprises about 80 percent of the map unit. The remaining percentage is comprised of inclusions of Rock Outcrop, Redcreek soils, Yamac soils in narrow areas too small to delineate, Piceance soils, and soils similar to Rentsac that are less than 10 inches to bedrock. A few small areas have slopes steeper than 50 percent.

Typically the surface layer is a grayish brown channery sandy loam about 5 inches thick. The lower part of the surface layer is a brown very channery sandy loam about 4 inches thick. The underlying material is a very pale brown very flaggy sandy loam about 7 inches thick and overlies fractured hard sandstone.

Permeability is rapid. Effective rooting depth is less than 20 inches. Organic matter content in the surface layer is medium. Available water capacity is very low. Surface runoff is medium and erosion hazard is slight to moderate.

This soil is used primarily for livestock grazing, wildlife habitat, and recreation.

63-Rentsac channery sandy loam

The potential native vegetation on this soil is usually dominated by pinyon pine and Utah juniper with an understory of Indian ricegrass, needle-and-thread, beardless wheatgrass, stemless goldenweed, and an occasional mountain mahogany and bitterbrush.

When the pinyon-juniper canopy is less than 10 percent, beardless wheatgrass, Indian ricegrass, and big sagebrush dominate. Numerous forbs, low rabbitbrush, and smooth horsebrush are present in minor amounts. When the vegetation deteriorates under the pinyon-juniper, only occasional forbs or woody shrubs exist. On areas where the pinyon-juniper canopy is less than 10 percent, forbs, weedy plants, and woody shrubs increase when abused and deteriorated.

Grazing management will maintain and improve ~~deteriorating~~ range conditions. Seeding is not advisable on this soil because of stoniness, depth to rock, and steep slopes. Brush management may be required when woody shrubs dominate the site. Areas dominated by pinyon pine and Utah juniper may be improved by selective thinning. This would improve the understory resource while obtaining firewood and posts. Young pinyon pine make desirable Christmas trees.

These soils are well suited to the production of Utah juniper and pinyon pine. It is capable of producing 7 cords per acre in a stand which will average 5 inches in diameter measured at one foot. The limiting soil feature is the severe erosion hazard. Special attention must be given to minimize soil erosion. The low water holding capacity of the soil and

63-Rentsac channery sandy loam

the limited rooting depth can influence seedling survival. (woodland suitability group 4d)

Rentsac soils have fair potential for mule deer and poor potential for cottontail rabbit and snowshoe hare. They receive only sparce cover and shelter from this soil. These soils have poor potential for community development and as source materials. Depth to rock, stoniness, and slopes are the main limiting features.

Capability unit VIIe

~~Range Site: Stony Foothills~~

Woodland - Pinyon-Juniper

MLRA(S): 46, 52, 58, 59 RENTSAC SERIE
COC-RER, 3-75
LITHIC USTIC TORRIORTHENTS, LOAMY-SKELETAL, MIXED (CALCAREOUS), FRIGID

THE RENTSAC SERIES CONSISTS OF SHALLOW, WELL-DRAINED SOILS FORMED IN MATERIALS WEATHERED FROM SANDSTONE. TYPICALLY THESE SOILS HAVE A CHANNERY LOAM SURFACE AND THE UNDERLYING MATERIAL IS CHANNERY LOAM OR VERY CHANNERY AND FLAGGY LOAM. THEY OCCUPY UPLANDS IN A 10 TO 15 INCH PRECIPITATION ZONE. THE NATIVE VEGETATION IS MAINLY MID AND SHORT GRASSES. THE GROWING SEASON IS 105 TO 135 DAYS. SLOPES ARE 0 TO 45 PERCENT. SANDSTONE IS AT DEPTHS OF 4 TO 20 INCHES.

ESTIMATED SOIL PROPERTIES

DEPTH (IN.)	USDA TEXTURE	UNIFIED	AASHTO	FRACT >3 IN (PCT)	PERCENT OF MATERIAL LESS THAN 3" PASSING SIEVE NO. 4	10	40	200	LIQUID LIMIT	PLASTICITY INDEX
0-7	CN-L	GM, ML	A-2, A-4	5-10	50-80	35-75	30-65	25-55	20-35	NP-10
0-7	FLV-L	GM	A-2	65-80	55-65	35-45	30-40	25-35	20-35	NP-5
0-7	CNV-L	GM	A-1	5-10	35-45	25-35	15-30	10-25	-	NP
7-18	CNV-L, FL-L, CNV-SL	GM	A-1	20-40	30-55	20-30	15-30	10-25	-	NP
18	UWB									

DEPTH (IN.)	PERMEABILITY (IN/HR)	AVAILABLE WATER CAPACITY (IN/IN)	SOIL REACTION (PH)	SALINITY (MMHOS/CM)	SHRINK-SWELL POTENTIAL	CORROSIVITY STEEL	CORROSIVITY CONCRETE	EROSION FACTORS K	EROSION FACTORS T	WIND EROD. GROUP
0-7	0.6-2.0	0.09-0.14	6.6-7.8	-	LOW	HIGH	LOW	.37	1	5
0-7	2.0-6.0	0.04-0.08	6.6-7.8	-	LOW	HIGH	LOW	.24	1	8
0-7	2.0-6.0	0.04-0.08	6.6-7.8	-	LOW	HIGH	LOW	.24	1	8
7-18	2.0-6.0	0.04-0.10	7.4-8.4	<4	LOW	HIGH	LOW	.24		
18										

FLOODING FREQUENCY	FLOODING DURATION	FLOODING MONTHS	HIGH WATER TABLE DEPTH (FT)	HIGH WATER TABLE KIND	HIGH WATER TABLE MONTHS	CEMENTED PAN DEPTH (IN)	CEMENTED PAN HARDNESS	BEDROCK DEPTH (IN)	BEDROCK HARDNESS	SUBSIDENCE INIT. (IN)	SUBSIDENCE TOTAL (IN)	HYD GRP	POTENTIAL FROST ACTION
NONE			>6.0			-		4-20	HARD	-		C	MODERAT

SANITARY FACILITIES

SEPTIC TANK ABSORPTION FIELDS	0-15%: SEVERE-DEPTH TO ROCK 15+%: SEVERE-SLOPE,DEPTH TO ROCK
SEWAGE LAGOON AREAS	0-7%: SEVERE-DEPTH TO ROCK,SEEPAGE 7+%: SEVERE-SLOPE,DEPTH TO ROCK,SEEPAGE
SANITARY LANDFILL (TRENCH)	0-25%: SEVERE-DEPTH TO ROCK,SEEPAGE 25+%: SEVERE-SLOPE,DEPTH TO ROCK,SEEPAGE
SANITARY LANDFILL (AREA)	0-15%: SEVERE-SEEPAGE 15+%: SEVERE-SLOPE,SEEPAGE
DAILY COVER FOR LANDFILL	0-15%: POOR-SMALL STONES,THIN LAYER, AREA RECLAIM 15+%: POOR-SLOPE,SMALL STONES,THIN LAYER

COMMUNITY DEVELOPMENT

SHALLOW EXCAVATIONS	0-15%: SEVERE-DEPTH TO ROCK,SMALL STONES 15+%: SEVERE-SLOPE,DEPTH TO ROCK, SMALL STONES
DWELLINGS WITHOUT BASEMENTS	0-15%: SEVERE-DEPTH TO ROCK 15+%: SEVERE-SLOPE,DEPTH TO ROCK
DWELLINGS WITH BASEMENTS	0-15%: SEVERE-DEPTH TO ROCK 15+%: SEVERE-SLOPE,DEPTH TO ROCK
SMALL COMMERCIAL BUILDINGS	0-8%: SEVERE-DEPTH TO ROCK 8+%: SEVERE-SLOPE,DEPTH TO ROCK
LOCAL ROADS AND STREETS	0-15%: SEVERE-DEPTH TO ROCK 15+%: SEVERE-SLOPE,DEPTH TO ROCK
LAWNS, LANDSCAPING AND GOLF FAIRWAYS	

SOURCE MATERIAL

ROADFILL	0-25%: POOR-DEPTH TO ROCK,THIN LAYER 25+%: POOR-SLOPE,DEPTH TO ROCK,THIN LAYER
SAND	UNSUITED
GRAVEL	UNSUITED-THIN LAYER
TOPSOIL	0-15%: POOR-THIN LAYER,AREA RECLAIM, SMALL STONES 15+%: POOR-SLOPE,THIN LAYER,SMALL STONES

WATER MANAGEMENT

POND RESERVOIR AREA	0-4%: DEPTH TO ROCK,SEEPAGE 4+%: SLOPE,DEPTH TO ROCK,SEEPAGE
EMBANKMENTS DIKES AND LEVEES	THIN LAYER,PIPING
EXCAVATED PONDS AQUIFER FED	NO WATER
DRAINAGE	
IRRIGATION	
TERRACES AND DIVERSIONS	0-8%: DEPTH TO ROCK,ROOTING DEPTH 8+%: SLOPE,DEPTH TO ROCK,ROOTING DEPTH
GRASSED WATERWAYS	0-4%: ROOTING DEPTH 4+%: ROOTING DEPTH,SLOPE

REGIONAL INTERPRETATIONS

RECREATION

CAMP AREAS	0-8% CN: MODERATE-SMALL STONES 8-15% CN: MODERATE-SLOPE,SMALL STONES 15+% CN: SEVERE-SLOPE 0-15% FLV,CNV: SEVERE-SMALL STONES 15+% FLV,CNV: SEVERE-SLOPE,SMALL STONES	PLAYGROUNDS	0-6%: SEVERE-SMALL STONES 6+%: SEVERE-SMALL STONES,SLOPE
PICNIC AREAS	0-8% CN: MODERATE-SMALL STONES 8-15% CN: MODERATE-SLOPE,SMALL STONES 15+% CN: SEVERE-SLOPE 0-15% FLV,CNV: SEVERE-SMALL STONES 15+% FLV,CNV: SEVERE-SLOPE,SMALL STONES	PATHS AND TRAILS	0-15% CN: MODERATE-SMALL STONES 15-25% CN: MODERATE-SLOPE,SMALL STONES 25+% CN: SEVERE-SLOPE 0-25% FLV,CNV: SEVERE-SMALL STONES 25+% FLV,CNV: SEVERE-SLOPE,SMALL STONES

CAPABILITY AND PREDICTED YIELDS -- CROPS AND PASTURE (HIGH LEVEL MANAGEMENT)

CLASS-DETERMINING PHASE	CAPABILITY															
	NIRR	IRR.	NIRR	IRR.	NIRR	IRR.	NIRR	IRR.	NIRR	IRR.	NIRR	IRR.	NIRR	IRR.	NIRR	IRR.
ALL	6E															

WOODLAND SUITABILITY

CLASS-DETERMINING PHASE	ORD SYM	MANAGEMENT PROBLEMS					POTENTIAL PRODUCTIVITY		TREES TO PLANT
		EROSION HAZARD	EQUIP. LIMIT	SEEDLING MORT'Y.	WINDTH. HAZARD	PLANT COMPET.	IMPORTANT TREES	SITE INDX	
							NONE		

WINDBREAKS

CLASS-DETERMIN'G PHASE	SPECIES	HT	SPECIES	HT	SPECIES	HT	SPECIES	HT
	NONE							

WILDLIFE HABITAT SUITABILITY

CLASS-DETERMINING PHASE	POTENTIAL FOR HABITAT ELEMENTS									POTENTIAL AS HABITAT FOR:			
	GRAIN & SEED	GRASS & LEGUME	WILD HERB.	HARDWD TREES	CONIFER PLANTS	SHRUBS	WETLAND PLANTS	SHALLOW WATER	OPENLD WILDLF	WOODLD WILDLF	WETLAND WILDLF	RANGELD WILDLF
ALL	POOR	POOR	FAIR	-	-	FAIR	V. POOR	V. POOR	POOR	-	V. POOR	FAIR

POTENTIAL NATIVE PLANT COMMUNITY (RANGELAND OR FOREST UNDERSTORY VEGETATION)

COMMON PLANT NAME	PLANT SYMBOL (NSPN)	PERCENTAGE COMPOSITION (DRY WEIGHT) BY CLASS DETERMINING PHASE: ALL
BLUEBUNCH WHEATGRASS	AGSP	40
PRAIRIE SANDREED	CALO	20
GREEN NEEDLEGRASS	STVI4	10
NEEDLEANDTHREAD	STCO4	5
WESTERN WHEATGRASS	AGSM	5
BLUE GRAMA	BOGR2	5
OTHER ANNUAL GRASSES	AAGG	5
OTHER ANNUAL FORBS	AAFF	5
OTHER SHRUBS	SSSS	5
POTENTIAL PRODUCTION (LBS./AC. DRY WT):		
FAVORABLE YEARS		800
NORMAL YEARS		
UNFAVORABLE YEARS		400

FOOTNOTES

Redcreek Series

The Redcreek series consists of shallow, well drained soils that formed in sandy material weathered from underlying calcareous sandstone. Redcreek soils are on mountain sideslopes and ridges and have slopes of 5 to 30 percent. Mean annual precipitation is about 16 inches and the mean annual air temperature is about 44 degrees F.

Redcreek soils are similar to the Redwash, Rentsac, and Thermopolis soils and are near the Forelle, Rentsac, and Yamac soils. Redwash soils have a lithic contact at depths of 3 to 10 inches. Rentsac soils are skeletal. Thermopolis soils have paralithic contact at depths of 10 to 20 inches. The Forelle and Yamac soils are deep and the Forelle soil has a thin argillic horizon.

Typical pedon of Redcreek sandy loam, 5 to 30 percent slopes, about 900 feet north of SW$\frac{1}{4}$ corner, section 18, T.3S., R96W.

All--0 to 2 inches; pale brown (10YR 6/3) sandy loam, brown (10YR 4/3) moist; weak fine granular structure; soft, very friable nonsticky and nonplastic; calcareous, mildly alkaline, clear smooth boundary. (2 to 4 inches thick)

A12--2 to 6 inches; pale brown (10YR 6/3) sandy loam, brown (10YR 4/3) moist; weak fine subangular blocky structure parting to weak fine granules; soft, very friable, nonsticky and nonplastic; strongly calcareous, moderately alkaline; clear wavy boundary. (2 to 4 inches thick)

C1--6 to 11 inches; very pale brown (10YR 7/3) sandy loam, pale brown (10YR 6/3) moist; massive; slightly hard, very friable, nonsticky and nonplastic; strongly calcareous moderately alkaline; abrupt smooth boundary. (3 to 5 inches thick)

R--19 inches plus; hard sandstone.

The A horizon has a value of 6 or 7 dry, 4 or 5 moist and chroma of 3 or 4 dry and moist. This horizon is commonly a loamy sand or sandy loam. The C horizon has a value of 6 or 7 dry, 5 or 6 moist and chroma of 3 or 4 dry and moist. This horizon is commonly a sandy loam, but may contain 15 to 35 percent coarse fragment near the contact. Thickness of the solum ranges from 10 to 20 inches. Reaction is mildly alkaline to moderately alkaline throughout.

66--Redcreek-Rentsac complex, 5 to 30 percent slopes

These moderately sloping to steep soils are on foothill slopes and ridges at elevations of 6,000 to 7,600 feet. Average annual precipitation is about 16 inches, and the mean annual air temperature is about 44 degrees F. Redcreek soils make up about 60 percent of the mapping unit, and Rentsac soils make up about 30 percent. Redcreek soil is similar to the Rentsac soil but differs in being non-skeletal. About 10 percent of the unit is Rock Outcrop, Piceance fine sandy loam, and Yamac loam.

Redcreek soils are shallow and well drained. It formed in residuum from massive sandstone that weathers rapidly.

Typically, the surface layer is a pale brown sandy loam about 6 inches thick. The substratum is a sandy loam about 12 inches thick, and rests on massive sandstone.

Permeability is moderately rapid. The effective rooting depth is 10 to 20 inches, and the available water capacity is very low. Surface runoff is slow, and the erosion hazard is slight.

Rentsac soils are shallow, well drained and stony. It formed in residuum from sandstone which is highly fractured and hard.

Typically, the surface layer is a pale brown very channery sandy loam about 4 inches thick. The underlying layer is a pale brown very channery sandy loam about 7 inches thick. The substratum is a pale brown very flaggy sandy loam about 7 inches thick and rests on hard fractured sandstone.

66--Redcreek-Rentsac complex

Permeability is rapid. Effective rooting depth is 10 to 20 inches, and available water capacity is very low. Surface runoff is slow and erosion hazard slight.

These soils are used primarily for livestock grazing and wildlife habitat.

The potential native vegetation on these soils is dominated by pinyon pine and Utah juniper with an understory of beardless wheatgrass, Indian ricegrass, sedge, Junegrass, spiny goldenwood, low phlox, serviceberry, mountain mahogany, and big sagebrush. When the vegetation deteriorates under the pinyon-juniper grass species are almost absent, while forbs and woody shrubs increase to a sparse stand.

Management of the vegetation should be designed to maintain a wood product and a grazing value. Selective thinning of the pinyon-juniper would improve the understory resource for grazing while obtaining firewood, posts, and Christmas trees from young pinyon pine. These soils are well suited to the production of Utah juniper and pinyon pine. It is capable of producing 13 cords per acre in a stand which will average 5 inches in diameter measure at one foot. The limiting soil feature is the moderate erosion hazard. Special attention must be given to minimize soil erosion. Soil depth and the resulting low water holding capacity can influence seedling survival.

These soils have fair potential for deer and snowshoe hare.

66--Redcreek-Rentsac complex

These soils have poor potential for community development, and as source materials. Depth to rock, stoniness, and slopes are the main limiting features.

Capability unit VIe

Woodland Site - Pinyon-Juniper, suitability group 3d

SOIL SURVEY INTERPRETATIONS

Rio Blanco Co., Colo.

MLRA(S): 32 — STATE: WYOMING — AUTHOR: DRA — DATE: 2-76 — KIND OF UNIT: SERIES — UNIT NAME: 65 – REDCREEK

CLASSIFICATION: [illegible]

DESCRIPTION: THE REDCREEK SERIES CONSIST OF SHALLOW WELL DRAINED SOILS FORMED IN CALCAREOUS MATERIAL WEATHERED FROM SANDSTONE. TYPICALLY THE SURFACE IS A SANDY LOAM ABOUT 6 INCHES THICK. THE UNDERLYING LAYER IS A CHANNERY SANDY LOAM ABOUT 13 INCHES THICK AND IS UNDERLAIN BY SANDSTONE. NATURAL VEGETATION IS PINYON-JUNIPER WITH SPARSE UNDERSTORY. MEAN ANNUAL PRECIPITATION IS ABOUT 10 INCHES. MEAN ANNUAL SOIL TEMPERATURE IS ABOUT 44 F. AND THE FROST-FREE SEASON IS 90 TO 110 DAYS. ELEVATION RANGES FROM 6,000 TO 7,000 FEET. SLOPES ARE 5 TO 30 PERCENT.

Depth (in)	USDA Texture	Unified	AASHO	Fract. >3 in. (pct)	Percent of material passing sieve no.					
0-6	SL, FSL	SM	A-2, A-4	0	90-100	85-95	50-80	25-50	20-30	NP-10
6-11	SL, FSL, CN-SL, CN-FSL	SM	A-2, A-4	0	70-90	65-85	40-70	20-45	20-30	NP-10
11-19	UWB									
19	UWB									

Depth (in)	Permeability (in/hr)	Available water capacity (in/in)	Soil reaction (pH)	Salinity	Shrink-swell potential	Corrosivity: steel	Corrosivity: concrete	Erosion factors		Wind erod. group
SAME DEPTH AS ABOVE	2.0-6.0	0.11-0.15	7.4-8.4	—	LOW	HIGH	LOW	.32	1	3
	2.0-6.0	0.11-0.15	7.4-8.4	—	LOW	HIGH	LOW			

Flooding	High water table	Cemented pan	Bedrock depth (in)	Bedrock hardness	Subsidence	Potential frost action
NONE	>6.0	—	20-40		—	LOW

Sanitary facilities		Source material	
Septic tank absorption fields	SEVERE - DEPTH TO ROCK	Roadfill	POOR - THIN LAYER, AREA RECLAIM
Sewage lagoons	SEVERE - DEPTH TO ROCK	Sand	UNSUITED
Sanitary landfill (trench)	SEVERE - DEPTH TO ROCK	Gravel	UNSUITED
Sanitary landfill (area)	SEVERE - SEEPAGE	Topsoil	POOR - SMALL STONES, AREA RECLAIM, THIN LAYER
Daily cover for landfill	POOR - THIN LAYER, AREA RECLAIM		

Community development		Water management	
Shallow excavations	SEVERE - DEPTH TO ROCK	Pond reservoir area	SLOPE, SEEPAGE, DEPTH TO ROCK
Dwellings without basements	SEVERE - DEPTH TO ROCK	Embankments, dikes and levees	THIN LAYER, SEEPAGE
Dwellings with basements	SEVERE - DEPTH TO ROCK	Excavated ponds aquifer fed	NO WATER
Small commercial buildings	SEVERE - DEPTH TO ROCK	Drainage	NOT NEEDED
Local roads and streets	5-15%: SEVERE - DEPTH TO ROCK; 15-30%: SEVERE - SLOPE, DEPTH TO ROCK	Irrigation	SLOPE, DROUGHTY
		Terraces and diversions	SLOPE, DEPTH TO ROCK
Regional interpretations		Grassed waterways	ROOTING DEPTH, DROUGHTY

SCS Soils-5 – 5/3/75

66-REDCREEK

RANGE SITE	6-10% SLIGHT 10-20% MODERATE - SLOPE 20+% SEVERE - SLOPE	SAME
PINYON AREAS	5-8% SLIGHT 8-20% MODERATE - SLOPE 20+% SEVERE - SLOPE	5-8% SLIGHT 8-20% MODERATE - SLOPE 20+% SEVERE - SLOPE

CLASS DETERMINING PHASE	CAPABILITY
ALL	6E

CLASS DETERMINING PHASE	TYPE						IMPORTANT TREES	% COVER	TREES TO PLANT
ALL							PINYON PINE ROCKY MOUNTAIN JUNIPER UTAH JUNIPER	45	

NONE

CLASS DETERMINING PHASE											
ALL	POOR	POOR	POOR	—	GOOD	GOOD	V. POOR	V. POOR	POOR	POOR	V. POOR	FAIR

	COMMON PLANT NAME	PLANT SYMBOL	ALL
PLANTS	BEARDLESS WHEATGRASS	AGCA	10
	INDIAN RICEGRASS	ORHY	10
	SEDGE	CAREX	5
	NEVADA BLUEGRASS	PONE3	5
	JUNEGRASS	KOCR	3
		POSE	4
	SPINY GOLDENWEED	HASP2	3
	LONG PHLOX	PHLO	3
	SCARLET GLOBEMALLOW	SPCO	2
		PPFE	2
	SERVICEBERRY	AMAL2	20
	TRUE MT. MAHOGANY	CEMO2	20
	BIG SAGEBRUSH	ARTR2	10
		ESSS	5

POTENTIAL PRODUCTION (KG/HA/AC DRY WT)	FAVORABLE YEARS	350
	NORMAL YEARS	250
	UNFAVORABLE YEARS	150

NOTES: POORLY UNDERSTOOD

Piceance Series

The Piceance series consist of moderately deep, well drained soils that formed in residuum from sandstone and modified with aeolian materials. Piceance soils are on upland slopes and ridges and have slopes of 5 to 15 percent. Mean annual precipitation is about 16 inches and the mean annual air temperature is about 42 degrees F.

Piceance soils are similar to the Chaperton, Rickman and Yamac soils and are near the Forelle, Redcreek, Rentsac and Yamac soils. Chaperton soils are calcareous throughout. Rickman soils are calcareous and have hues 5YR or redder. Yamac soils lack bedrock at depths of 20 to 40 inches. The Forelle soils have thin argillic horizons and are deep. Redcreek and Rentsac soils have bedrock at depths less than 20 inches.

Typical pedon of Piceance fine sandy loam, 5 to 25 percent slopes, NE¼ of NE¼ of section 33, T.2S., R.99W.:

A1--0 to 4 inches; brown (10YR 5/3) fine sandy loam, dark brown (10YR 3/3) moist; moderate medium granular structure; soft, very friable, slightly sticky and slightly plastic; many fine roots; noncalcareous, mildly alkaline; clear smooth boundary. (3 to 5 inches thick)

B1--4 to 10 inches; brown (10YR 5/3) fine sandy loam, brown (10YR 4/3) moist; weak medium subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; many fine roots; noncalcareous, mildly alkaline; clear wavy boundary. (3 to 7 inches thick)

Piceance Series

B2--10 to 22 inches; light yellowish brown (10YR 6/4) loam, yellowish brown (10YR 5/4) moist; moderate medium subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; ten percent channery rock fragments; common fine and medium roots; noncalcareous, mildly alkaline; clear wavy boundary. (6 to 14 inches thick)

Cca--22 to 37 inches; very pale brown (10YR 7/3) very channery sandy loam, pale brown (10YR 6/3) moist; massive; slightly hard, friable; visible lime in thin seams, 55 percent channery material which is less than 3 inches in length; calcareous, moderately alkaline; clear wavy boundary. (8 to 18 inches thick)

R--37 inches; hard fine-grained sandstone.

Depth to the lithic contact ranges from 20 to 40 inches. Depth to the calcareous material ranges from 12 to 36 inches. Content of rock fragments (mainly fine channery) ranges from 0 to 10 percent in the A and B horizons. Content of rock fragments in the Cca ranges from 25 to 80 percent and commonly exceeds 50 percent.

The A horizon has hue of 10YR or 7.5YR, value of 5 or 6 dry, 3 or 4 moist and chroma of 3 or 4.

The B horizon has hue of 10YR or 7.5YR, value of 5 through 7 dry, 4 or 5 moist and chroma of 3 through 6. Texture is dominantly a loam but includes fine sandy loam, and sandy clay loam, clay content ranges from 18 to 35 percent.

The C horizon has hue of 10YR or 7.5YR and the fine earth fraction ranges in texture from sandy loam to sandy clay loam.

70-Piceance fine sandy loam, 5 to 15 percent slopes

This is a moderately deep, well drained soil on upland slopes and ridges at elevations of 6,500 to 7,500 feet. It formed in residuum from sandstone and modified with aeolian material. The average annual precipitation is about 16 inches, average annual air temperature is about 42 degrees F., and average frost-free period is about 80 to 105 days.

Included in this unit are small areas of Yamac loam, Forelle loam, and Redcreek-Rentsac complex all having slopes of 5 to 15 percent. Also, included in this unit are small areas of soils which have darker surface layers, which occur at upper elevations of this unit.

Typically the surface layer is brown fine sandy loam about 4 inches thick. The upper subsoil is a brown fine sandy loam about 6 inches thick. The lower subsoil is light yellowish brown loam about 12 inches thick. The substratum is very pale brown very channery sandy loam about 15 inches thick and overlies hard sandstone. There is a layer of strong lime accumulation in the lower part of the subsoil and substratum.

Permeability is moderately rapid. Effective rooting depth is 20 to 40 inches. Available water capacity is low. Organic matter content in the surface is medium. Surface runoff is slow to medium and erosion hazard slight to moderate.

This soil is used primarily for livestock grazing, wildlife habitat, and limited recreation.

70-Piceance fine sandy loam

The potential native vegetation on this soil is dominated by bluebunch wheatgrass, western wheatgrass, needle-and-thread, bluegrasses, sand lupine, Rocky Mountain sweetvetch, and big sagebrush. When the range condition deteriorates, forbs and woody shrubs including rabbitbrush increase.

Grazing management will maintain and improve ~~deteriorating~~ range conditions. Seeding is advisable if the range condition is poor. Suitable for seeding is bluebunch wheatgrass, western wheatgrass, and needle-and-thread. For successful seeding, prepare a seedbed and drill the seed. The grasses selected should meet the seasonal requirements of livestock. Brush management may be required to improve deteriorated sites that are producing more woody shrubs than normally found in the potential plant community.

These soils have good potential for mule deer, snowshoe hare, and blue grouse. They obtain much of their food and shelter from this soil.

These soils have fair potential for community development and poor potential as source materials. Depth to rock and reclamation of barrow areas are the main limiting features.

5-8% 8+%

Capability unit IVe and VIc.

Range Site - Rolling Loam

CO0532 S O I L I N T E R P R E T A T I O N S R E C O R D

MLRA(S): 48 PICEANCE SERI
REV. RO. 11-76
BOROLLIC CAMBORTHIDS, FINE-LOAMY, MIXED

THE PICEANCE SERIES CONSISTS OF MODERATELY DEEP, WELL-DRAINED SOILS FORMED IN RESIDUUM FROM SANDSTONE AND LOCAL AEOLIAN MATERIAL. THE SURFACE IS VERY FINE SANDY LOAM, ABOUT 10 IN. THICK. THE SUBSOIL IS LOAM, ABOUT 12 IN. THICK. THE SUBSTRATUM IS A VERY CHANNERY SANDY LOAM, ABOUT 15 INCHES THICK OVER HARD SANDSTONE. NATURAL VEGETATION IS SAGEBRUSH AND SHORTGRASSES. AVERAGE ANNUAL PRECIPITATION IS ABOUT 16 INCHES. FROST-FREE SEASON IS 80 TO 105 DAYS. SLOPES ARE 2 TO 25 PERCENT.

ESTIMATED SOIL PROPERTIES

DEPTH (IN.)	USDA TEXTURE	UNIFIED	AASHTO	FRACT >3 IN (PCT)	PERCENT OF MATERIAL LESS THAN 3" PASSING SIEVE NO. 4	10	40	200	LIQUID LIMIT	PLASTICITY INDEX
0-10	VFSL, L	ML, CL-ML	A-4	0	85-100	85-100	80-90	50-75	15-30	NP-10
10-22	L, SCL, CL	CL, CL-ML	A-4, A-6	0	85-100	80-100	80-90	50-75	20-35	5-15
22-37	CNV-SL, CNV-L, CNV-SCL	GM, GM-GC	A-2, A-1	5-10	20-50	20-50	15-40	10-35	15-25	NP-10
37	UWH									

DEPTH (IN.)	CLAY (PCT)	MOIST BULK DENSITY (G/CM3)	PERMEABILITY (IN/HR)	AVAILABLE WATER CAPACITY (IN/IN)	SOIL REACTION (PH)	SALINITY (MMHOS/CM)	SHRINK-SWELL POTENTIAL	EROSION FACTORS K	T	WIND EROD. GROUP	ORGANIC MATTER (PCT)	CORROSIVITY STEEL	CONCRET
0-10			2.0-6.0	0.15-0.17	7.4-8.4	-	LOW	.37	2	5		HIGH	LOW
10-22			0.6-2.0	0.15-0.17	7.4-8.4	-	MODERATE	.37					
22-37			2.0-6.0	0.04-0.07	7.9-8.4	-	LOW	.10					
37													

FLOODING FREQUENCY	DURATION	MONTHS	HIGH WATER TABLE DEPTH (FT)	KIND	MONTHS	CEMENTED PAN DEPTH (IN)	HARDNESS	BEDROCK DEPTH (IN)	HARDNESS	SUBSIDENCE INIT. (IN)	TOTAL (IN)	HYD GRP	POTENTIAL FROST ACTION
NONE			>6.0			-		20-40	RIPPABLE	-		B	LOW

SANITARY FACILITIES

SEPTIC TANK ABSORPTION FIELDS	2-15%: SEVERE-DEPTH TO ROCK 15+%: SEVERE-SLOPE,DEPTH TO ROCK
SEWAGE LAGOON AREAS	2-7%: SEVERE-DEPTH TO ROCK,SEEPAGE 7+%: SEVERE-SLOPE,DEPTH TO ROCK,SEEPAGE
SANITARY LANDFILL (TRENCH)	SEVERE-DEPTH TO ROCK,SEEPAGE
SANITARY LANDFILL (AREA)	2-15%: SEVERE-SEEPAGE 15+%: SEVERE-SLOPE,SEEPAGE
DAILY COVER FOR LANDFILL	2-15%: POOR-SMALL STONES,AREA RECLAIM 15+%: POOR-SLOPE,SMALL STONES,AREA RECLAIM

CONSTRUCTION MATERIAL

ROADFILL	POOR-THIN LAYER,AREA RECLAIM
SAND	UNSUITED
GRAVEL	UNSUITED
TOPSOIL	2-15%: POOR-AREA RECLAIM 15+%: POOR-SLOPE,AREA RECLAIM

WATER MANAGEMENT

POND RESERVOIR AREA	DEPTH TO ROCK,SLOPE,SEEPAGE
EMBANKMENTS DIKES AND LEVEES	THIN LAYER
EXCAVATED PONDS AQUIFER FED	NO WATER
DRAINAGE	SLOPE,DEPTH TO ROCK
IRRIGATION	SLOPE,ROOTING DEPTH,DROUGHTY
TERRACES AND DIVERSIONS	DEPTH TO ROCK,SLOPE
GRASSED WATERWAYS	DROUGHTY,SLOPE

BUILDING SITE DEVELOPMENT

SHALLOW EXCAVATIONS	2-15%: SEVERE-DEPTH TO ROCK 15+%: SEVERE-SLOPE,DEPTH TO ROCK
DWELLINGS WITHOUT BASEMENTS	2-8%: MODERATE-DEPTH TO ROCK,SHRINK-SWELL 8-15%: MODERATE-SLOPE,DEPTH TO ROCK, SHRINK-SWELL 15+%: SEVERE-SLOPE
DWELLINGS WITH BASEMENTS	2-15%: SEVERE-DEPTH TO ROCK 15+%: SEVERE-SLOPE,DEPTH TO ROCK
SMALL COMMERCIAL BUILDINGS	2-4%: MODERATE-DEPTH TO ROCK,SHRINK-SWELL 4-8%: MODERATE-SLOPE,DEPTH TO ROCK, SHRINK-SWELL 8+%: SEVERE-SLOPE
LOCAL ROADS AND STREETS	2-8%: MODERATE-DEPTH TO ROCK,SHRINK-SWELL 8-15%: MODERATE-DEPTH TO ROCK,SLOPE, SHRINK-SWELL 15+%: SEVERE-SLOPE
LAWNS, LANDSCAPING AND GOLF FAIRWAYS	

REGIONAL INTERPRETATIONS

PICCANCE SERIES

RECREATIONAL DEVELOPMENT

CAMP AREAS	2-8%: MODERATE-DUSTY 8-15%: MODERATE-SLOPE,DUSTY 15+%: SEVERE-SLOPE	PLAYGROUNDS	2-6%: MODERATE-DEPTH TO ROCK,SLOPE,DUSTY 6+%: SEVERE-SLOPE
PICNIC AREAS	3-8%: MODERATE-DUSTY 8-15%: MODERATE-SLOPE,DUSTY 15+%: SEVERE-SLOPE	PATHS AND TRAILS	2-15%: MODERATE-DUSTY 15+%: MODERATE-SLOPE,DUSTY

CAPABILITY AND YIELDS PER ACRE OF CROPS AND PASTURE (HIGH LEVEL MANAGEMENT)

CLASS-DETERMINING PHASE	CAPABILITY	NIAH	IAH,	NIAW	IAW,	NIAN	IAN,	NIAH	IAH,	NIAH	IAH,	NIAH	IAH,	NIAH	IAH,	NIAG	IAG
5-9%	4C																
9+%	6E																

WOODLAND SUITABILITY

CLASS-DETERMINING PHASE	ORD SYM	MANAGEMENT PROBLEMS: EROSION HAZARD	EQUIP. LIMIT	SEEDLING MORTALITY	WINDTH. HAZARD	PLANT COMPET.	POTENTIAL PRODUCTIVITY: COMMON TREES	SITE (1&2)*	TREES TO PLANT
							NONE		

WINDBREAKS

CLASS-DETERMINING PHASE	SPECIES	HT	SPECIES	HT	SPECIES	HT	SPECIES
	NONE						

WILDLIFE HABITAT SUITABILITY

CLASS-DETERMINING PHASE	POTENTIAL FOR HABITAT ELEMENTS: GRAIN & SEED	GRASS & LEGUME	WILD HERB.	HARDWD TREES	CONIFER PLANTS	SHRUBS	WETLAND PLANTS	SHALLOW WATER	POTENTIAL AS HABITAT FOR: OPENLD WILDLF	WOODLD WILDLF	WETLAND WILDLF	RANG WILD
ALL	POOR	POOR	FAIR	-	-	FAIR	V. POOR	V. POOR	POOR	-	V. POOR	FAI

POTENTIAL NATIVE PLANT COMMUNITY (RANGE AND OR FOREST UNDERSTORY VEGETATION)

COMMON PLANT NAME	PLANT SYMBOL (NLSPN)	PERCENTAGE COMPOSITION (DRY WEIGHT) BY CLASS DETERMINING PHASE: ALL
BLUEBUNCH WHEATGRASS	AGSP	15
WESTERN WHEATGRASS	AGSM	25
NEEDLEANDTHREAD	STCO4	5
PRAIRIE JUNEGRASS	KOCR	5
LUPINE	LUPIN	2
LOW PHLOX	PHHO	2
AMERICAN VETCH	VIAM	1
ERIOGONUM	ERIOG	1
BIG SAGEBRUSH	ARTR2	20
DOUGLAS RABBITBRUSH	CHVI8	5
SASKATOON SERVICEBERRY	AMAL2	3
OTHER PERENNIAL GRASSES	PPGG	5
OTHER PERENNIAL FORBS	PPFF	4
OTHER SHRUBS	SSSS	5
POTENTIAL PRODUCTION (LBS./AC. DRY WT): FAVORABLE YEARS		1200
NORMAL YEARS		950
UNFAVORABLE YEARS		700

FOOTNOTES

Yamac Series

The Yamac series consists of deep, well drained soils that formed in alluvium and aeolian materials. Yamac soils are on rolling uplands and ridges and have slopes of 2 to 15 percent. Mean annual precipitation is about 14 inches and mean annual air temperature is about 44 degrees F.

Yamac soils are similar to the Chaperton and Rickman soils and are near Forelle, Piceance, and Rentsac soils. Chaperton and Rickman soils have bedrock at 20 to 40 inch depths. Forelle soils have argillic horizons. Piceance soils overlie bedrock at 20 to 40 inch depths and are noncalcareous in the upper horizons.

Typical pedon of Yamac loam, 5 to 15 percent slopes, SW¼ of SW¼ section 2, T.2S., R.99W.:

A1--0 to 4 inches; brown (10YR 5/3) loam, brown (10YR 4/3) moist; weak fine and medium platy parting to moderate very fine subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; slightly effervescent; moderately alkaline; clear smooth boundary. (3 to 6 inches thick)

B2--4 to 10 inches; brown (7.5YR 5/4) clay loam, brown (10YR 4/4) moist; weak medium and coarse prismatic structure parting to moderate fine and medium subangular blocks; slightly hard, friable, sticky and plastic; calcareous; moderately alkaline; clear wavy boundary. (5 to 12 inches thick)

Yamac Series

The Yamac series consists of deep, well drained soils that formed in alluvium and aeolian materials. Yamac soils are on rolling uplands and ridges and have slopes of 2 to 15 percent. Mean annual precipitation is about 14 inches and mean annual air temperature is about 44 degrees F.

Yamac soils are similar to the Chaperton and Rickman soils and are near Forelle, Piceance, and Rentsac soils. Chaperton and Rickman soils have bedrock at 20 to 40 inch depths. Forelle soils have argillic horizons. Piceance soils overlie bedrock at 20 to 40 inch depths and are noncalcareous in the upper horizons.

Typical pedon of Yamac loam, 5 to 15 percent slopes, SW$\frac{1}{2}$ of SW$\frac{1}{4}$ section 2, T.2S., R.99W.:

A1--0 to 4 inches; brown (10YR 5/3) loam, brown (10YR 4/3) moist; weak fine and medium platy parting to moderate very fine subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; slightly effervescent; moderately alkaline; clear smooth boundary. (3 to 6 inches thick)

B2--4 to 10 inches; brown (7.5YR 5/4) clay loam, brown (10YR 4/4) moist; weak medium and coarse prismatic structure parting to moderate fine and medium subangular blocks; slightly hard, friable, sticky and plastic; calcareous; moderately alkaline; clear wavy boundary. (5 to 12 inches thick)

B3ca--10 to 15 inches; light yellowish brown (10YR 6/4) loam, yellowish brown (10YR 5/4) moist; moderate medium subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; common, medium soft masses of calcium carbonate; moderately alkaline; clear wavy boundary. (4 to 10 inches thick)

C1ca--15 to 36 inches; very pale brown (10YR 7/3) loam, pale brown (10YR 6/3) moist; weak medium and coarse subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; well disseminated calcium carbonate; calcareous; strongly alkaline; gradual wavy boundary. (10 to 20 inches thick)

C2--36 to 60 inches; light yellowish brown (10YR 6/4) fine sandy loam, yellowish brown (10YR 5/4) moist; weak medium and coarse subangular blocky structure; soft, friable, slightly sticky and slightly plastic; well disseminated calcium carbonate; calcareous; moderately alkaline.

Some pedons are noncalcareous in the upper horizons. Most profiles contain 0 to 20 percent of fine channery chips throughout.

Reaction ranges from moderately alkaline in the surface to strongly alkaline in the subsoil.

73--Yamac loam, 3 to 15 percent slopes

This is a deep, well drained soil on rolling uplands and ridges at elevations of 6,100 to 7,100 feet. It formed in alluvial and aeolian materials. The average annual precipitation is about 14 inches, average annual air temperature is about 44 degrees F., and average frost-free period is about 80 to 105 days.

Typically the surface layer is brown loam about 4 inches thick. The subsoil layer is a brown clay loam about 6 inches thick. The lower subsoil layer is light yellowish brown loam about 25 inches thick. The underlying layer is pale brown loam and overlies light yellowish brown fine sandy loam to 60 inches or more.

Included in this unit are small areas of Forelle, Piceance, and Rentsac soils, all having slopes of 5 to 15 percent. Also included in this unit are a few small natric spots 10 to 50 feet in diameter.

Permeability is moderate. Effective rooting depth is 60 inches or more. Available water capacity is high. Organic matter content in the surface layer is medium. Surface runoff is medium and erosion hazard is slight.

This soil is used primarily for livestock grazing and wildlife habitat. They have a fair potential for dryland crops and sprinkler irrigation, if water is available. They may be used also for recreation, community development, and source material for topsoil in the foreseeable future.

The potential native vegetation on this soil is dominated by western wheatgrass, streambank wheatgrass, Junegrass, sedge, needle-and-thread, dwarf rabbitbrush, big sagebrush, winterfat, cushion phlox, and skeleton loco. When the range condition deteriorates, forbs and woody shrubs increase.

Grazing management will maintain and improve ~~deteriorating~~ range conditions. Seeding is advisable if the range is in poor condition. Suitable for seeding are western wheatgrass, streambank wheatgrass, Junegrass, and Indian ricegrass. The grasses selected should meet the seasonal requirements of livestock. For successful seeding, prepare a seedbed and drill the seed. Brush management may be required to improve deteriorated sites that are producing more woody shrubs than normally found in the potential plant community.

These soils have fair potential for mule deer, snowshoe hare, and blue grouse.

These soils have fair to good potential for community development and source materials for road fill and topsoil. Slopes are the main limiting features on these soils.

Capability unit IVe, 3 to 8 percent slopes
VIe, 8 to 15 percent slopes

Range Site - Clayey Foothills

MLRA(S): 46, 52, 53, 58
COC-RER, 7-74
BOROLLIC CAMBORTHIDS, FINE-LOAMY, MIXED

YAMAC SER

THE YAMAC SERIES CONSISTS OF DEEP, WELL-DRAINED SOILS FORMED IN ALLUVIUM. TYPICALLY, THESE SOILS HAVE A LOAM SURFACE LAYER, LOAM SUBSOILS, AND LOAM UNDERLYING MATERIALS. THEY OCCUPY FANS, TERRACES, AND FOOT SLOPES IN A 10 TO 14 INCH PRECIPITATION ZONE. THE NATIVE VEGETATION IS MAINLY MID AND SHORT GRASSES. THE GROWING SEASON IS 105 TO 135 DAYS. THE SLOPES ARE 0 TO 15 PERCENT.

ESTIMATED SOIL PROPERTIES

DEPTH (IN.)	USDA TEXTURE	UNIFIED	AASHTO	FRACT >3 IN (PCT)	PERCENT OF MATERIAL LESS THAN 3" PASSING SIEVE NO. 4	10	40	200	LIQUID LIMIT	PLASTICITY INDEX
0-5	L	ML	A-4, A-6	0	95-100	95-100	85-95	60-75	20-40	NP-15
0-5	CL	CL	A-6	0	95-100	95-100	90-100	70-80	25-40	10-20
5-60	L	ML	A-4, A-6	0	95-100	95-100	85-95	60-75	20-40	NP-15

DEPTH (IN.)	PERMEABILITY (IN/HR)	AVAILABLE WATER CAPACITY (IN/IN)	SOIL REACTION (PH)	SALINITY (MMHOS/CM)	SHRINK-SWELL POTENTIAL	CORROSIVITY STEEL	CORROSIVITY CONCRETE	EROSION FACTORS K	EROSION FACTORS T	WIND ERODI GROUP
0-5	0.6-2.0	0.14-0.20	6.6-8.4	-	LOW	HIGH	LOW	.37	5	5
0-5	0.6-2.0	0.12-0.18	6.6-8.4	-	LOW	HIGH	LOW	.32	5	6
5-60	0.6-2.0	0.14-0.20	7.9-8.4	<4	LOW	HIGH	LOW	.37		

FLOODING FREQUENCY	FLOODING DURATION	FLOODING MONTHS	HIGH WATER TABLE DEPTH (FT)	HIGH WATER TABLE KIND	HIGH WATER TABLE MONTHS	CEMENTED PAN DEPTH (IN)	CEMENTED PAN HARDNESS	BEDROCK DEPTH (IN)	BEDROCK HARDNESS	SUBSIDENCE INIT. (IN)	SUBSIDENCE TOTAL (IN)	HYD GRP	POTENTIAL FROST ACTION
NONE			>6.0			--		>60				B	MODERATE

SANITARY FACILITIES

SEPTIC TANK ABSORPTION FIELDS	0-2%: MODERATE-PERCS SLOWLY 8+%: MODERATE-SLOPE,PERCS SLOWLY
SEWAGE LAGOON AREAS	0-2%: MODERATE-SEEPAGE 2-7%: MODERATE-SLOPE,SEEPAGE 7+%: SEVERE-SLOPE
SANITARY LANDFILL (TRENCH)	SLIGHT
SANITARY LANDFILL (AREA)	0-8%: SLIGHT 8+%: MODERATE-SLOPE
DAILY COVER FOR LANDFILL	0-8%: GOOD 8+%: FAIR-SLOPE

COMMUNITY DEVELOPMENT

SHALLOW EXCAVATIONS	SLIGHT
DWELLINGS WITHOUT BASEMENTS	0-2%: MODERATE-FROST ACTION,LOW STRENGTH 8+%: MODERATE-SLOPE,FROST ACTION, LOW STRENGTH
DWELLINGS WITH BASEMENTS	0-8%: MODERATE-LOW STRENGTH 8+%: MODERATE-SLOPE,LOW STRENGTH
SMALL COMMERCIAL BUILDINGS	0-4%: MODERATE-LOW STRENGTH 4-8%: MODERATE-SLOPE,LOW STRENGTH 8+%: SEVERE-SLOPE
LOCAL ROADS AND STREETS	0-8%: MODERATE-FROST ACTION,LOW STRENGTH 8+%: MODERATE-SLOPE,FROST ACTION, LOW STRENGTH

REGIONAL INTERPRETATIONS

SOURCE MATERIAL

ROADFILL	FAIR-FROST ACTION,LOW STRENGTH
SAND	UNSUITED
GRAVEL	UNSUITED
TOPSOIL	0-8% L: GOOD 8+% L: FAIR-SLOPE 0-8% CL: FAIR-TOO CLAYEY 8+% CL: FAIR-SLOPE,TOO CLAYEY

WATER MANAGEMENT

POND RESERVOIR AREA	0-4%: FAVORABLE 4+%: SLOPE
EMBANKMENTS DIKES AND LEVEES	PIPING,LOW STRENGTH,HARD TO PACK
EXCAVATED PONDS AQUIFER FED	NO WATER
DRAINAGE	0-2%: FROST ACTION 2+%: SLOPE,FROST ACTION
IRRIGATION	0-2%: FAVORABLE 2+%: SLOPE
TERRACES AND DIVERSIONS	0-8%: PIPING 8+%: SLOPE,PIPING
GRASSED WATERWAYS	0-4%: FAVORABLE 4+%: SLOPE

RECREATION

CAMP AREAS	0-8% L: SLIGHT 8+% L: MODERATE-SLOPE 0-8% CL: MODERATE-TOO CLAYEY 8+% CL: MODERATE-SLOPE,TOO CLAYEY	PLAYGROUNDS	0-2% L: SLIGHT 2-6% L: MODERATE-SLOPE 0-2% CL: MODERATE-TOO CLAYEY 2-6% CL: MODERATE-SLOPE,TOO CLAYEY 6+%: SEVERE-SLOPE
PICNIC AREAS	0-8% L: SLIGHT 8+% L: MODERATE-SLOPE 0-8% CL: MODERATE-TOO CLAYEY 8+% CL: MODERATE-SLOPE,TOO CLAYEY	PATHS AND TRAILS	L: SLIGHT CL: MODERATE-TOO CLAYEY

CAPABILITY AND PREDICTED YIELDS -- CROPS AND PASTURE (HIGH LEVEL MANAGEMENT)

CLASS-DETERMINING PHASE	CAPABILITY		WHEAT, WINTER (BU)		WHEAT, SPRING (BU)		BARLEY (BU)		ALFALFA HAY (TONS)							
	NIRR	IRR.	NIRR	IRR.	NIRR	IRR.	NIRR	IRR.	NIRR	IRR.	NIRR	IRR.	NIRR	IRR.	NIRR	IRR.
0-2%	3C	2C	35	-	30	45	40	65	1.5	5.0						
2-8%	3E	2E	32	-	27	42	40	62	1.5	4.8						
8+%	4E		29	-	25		38		1.0							

WOODLAND SUITABILITY

CLASS-DETERMINING PHASE	ORD SYM	MANAGEMENT PROBLEMS					POTENTIAL PRODUCTIVITY		
		EROSION HAZARD	EQUIP. LIMIT	SEEDLING MORT'Y.	WINDTH. HAZARD	PLANT COMPET.	IMPORTANT TREES	SITE INDX	TREES TO PLANT
							NONE		

WINDBREAKS

CLASS-DETERMIN'G PHASE	SPECIES	HT	SPECIES	HT	SPECIES	HT	SPECIES	HT	SPECIES	HT
ALL	SIBERIAN PEASHRUB		RUSSIAN-OLIVE		GREEN ASH		PONDEROSA PINE			
	TATARIAN HONEYSUCKLE		SIBERIAN CRABAPPLE		SIBERIAN ELM		SCOTCH PINE			
	COMMON CHOKECHERRY		SILVER BUFFALOBERRY		GOLDEN WILLOW		BLUE SPRUCE			

WILDLIFE HABITAT SUITABILITY

CLASS-DETERMINING PHASE	POTENTIAL FOR HABITAT ELEMENTS								POTENTIAL AS HABITAT FOR:			
	GRAIN & SEED	GRASS & LEGUME	WILD HERB.	HARDWD TREES	CONIFER PLANTS	SHRUBS	WETLAND PLANTS	SHALLOW WATER	OPENLD WILDLF	WOODLD WILDLF	WETLAND WILDLF	RANGELD WILDLF
ALL	FAIR	FAIR	FAIR	-	-	FAIR	V. POOR	V. POOR	FAIR	-	V. POOR	FAIR

POTENTIAL NATIVE PLANT COMMUNITY (RANGELAND OR FOREST UNDERSTORY VEGETATION)

COMMON PLANT NAME	PLANT SYMBOL (NLSPN)	PERCENTAGE COMPOSITION (DRY WEIGHT) BY CLASS DETERMINING PHASE: ALL
BLUEBUNCH WHEATGRASS	AGSP	45
GREEN NEEDLEGRASS	STVI4	10
CANBY BLUEGRASS	PCCA	10
WESTERN WHEATGRASS	AGSM	10
NEEDLEANDTHREAD	STCO4	10
BLUE GRAMA	BOGR2	5
OTHER ANNUAL FORBS	AAFF	5
OTHER SHRUBS	SSSS	5
SANDBERG BLUEGRASS	POSE	-
POTENTIAL PRODUCTION (LBS./AC. DRY WT):		
FAVORABLE YEARS		1400
NORMAL YEARS		
UNFAVORABLE YEARS		900

FOOTNOTES

Rivra Series

The Rivra series consists of deep, somewhat excessively drained soils that have formed in mixed alluvium of calcareous sandstone and shale origin. Rivra soils are on alluvial fans and in narrow valleys with slope gradients of 2 to 8 percent. Mean annual precipitation is about 16 inches and the mean annual air temperature is about 45 degrees F.

Rivra soils are similar to the Glendive, Havre, and Hanly soils and are near the Glendive and Havre soils. Glendive soils differ in being mainly sandy loam at 10 to 40 inch depths. Havre soils are fine-loamy in the 10 to 40 inch control section. Hanly soils are sandy and not skeletal.

Typical pedon of Rivra channery loamy sand, 2 to 8 percent slopes, 1.5 mile up Ryan Gulch Road from Piceance Road, 200 feet north of road, in SE¼ SE¼ section 31, T.1S., R.98W.:

A1--0 to 6 inches; pale brown (10YR 6/3) channery loamy sand, brown (10YR 4/3) moist; weak fine granular structure; soft, very friable, non-sticky and nonplastic; common very fine and fine roots; calcareous; moderately alkaline; 20 percent fine channery, clear wavy boundary. (2 to 7 inches thick)

Rivra Series (2)

C1--6 to 16 inches; light yellowish brown (10YR 6/4) channery sand, dark yellowish brown (10YR 4/4) moist; massive; soft, very friable, nonsticky and nonplastic; common very fine to medium roots; calcareous, moderately alkaline; 20 percent fine channery; clear wavy boundary. (5 to 25 inches thick)

C2--16 to 21 inches; light yellowish brown (10YR 6/4) very channery sand, dark yellowish brown (10YR 4/4) moist; massive; soft, very friable, nonsticky and nonplastic; common very fine to medium roots; calcareous, moderately alkaline; 50 percent channery, of which two-thirds is coarse; 5 percent flags; clear wavy boundary. (0 to 10 inches thick)

C3--21 to 37 inches; light yellowish brown (10YR 6/4) very channery sand; dark yellowish brown (10YR 4/4) moist; massive; soft, very friable, nonsticky and nonplastic; common very fine to medium roots; calcareous, strongly alkaline; 40 percent channery of which one-half is coarse; abrupt wavy boundary. (0 to 20 inches thick)

A1b--37 to 42 inches; pale brown (10YR 6/3) channery loamy fine sand, dark brown (10YR 4/3) moist; massive; slightly hard, very friable, nonsticky and nonplastic; few roots; calcareous, strongly alkaline; 30 percent fine channery; abrupt wavy boundary. (0 to 7 inches thick)

Rivra Series (3)

IIc1--42 to 50 inches; light yellowish brown (10YR 6/4) very channery sand, dark yellowish brown (10YR 4/4) moist; massive; slightly hard, very friable, nonsticky and nonplastic; few roots; calcareous, strongly alkaline; 40 percent fine channery; clear wavy boundary. (0 to 20 inches thick)

IIc2--50 to 60 inches; light yellowish brown (10YR 6/4) very channery sand, dark yellowish brown (10YR 4/4) moist; massive; loose, very friable, nonsticky and nonplastic; calcareous, strongly alkaline; 40 percent fine channery; clear wavy boundary.

The soil is 60 inches, or more, deep. Coarse fragments make up 35 to 50 percent, or more, of the 10 to 40 inch depth. Reaction is moderately alkaline. And, except for the A horizon in some pedons, the soil is calcareous throughout.

The A horizon is light brownish gray or pale brown. The texture is variable, ranging from fine sandy loam to sand, and contains 15 to 35 percent channery.

The control section (10 to 40 inch depth) averages as channery loamy sand, and is comprised of lenses which range from very channery coarse sand to loamy fine sand, and which range from nearly channery free to extremely channery. Color is pale brown, light yellowish brown, or very pale brown. In some pedons the soils contain thin buried darker colored A horizons.

3 4 9

75--Rivra channery loamy sand, ~~2 to 9~~ percent slopes

This is a deep somewhat excessively drained soil on alluvial fans and on narrow stream bottoms at elevations between 5,800 and 6,800 feet. It formed in coarse alluvium from sandstone and shale origin. The average annual precipitation is about 16 inches, average annual air temperature is about 45 degrees F., and average frost-free period is about 80 to 105 days.

Typically the surface layer is pale brown channery loamy sand about 6 inches thick. The upper part of the underlying material, to a depth of 37 inches, consists of light yellowish brown very channery sand. The lower part of the underlying material, between 37 and 60 inches, consists of pale brown and light yellowish brown channery sand very channery sand, and channery loamy fine sand. Rivra soils are highly calcareous throughout.

Included in this unit are small areas of Glendive fine sandy loam and Havre loam. Also included are small areas of moderately deep soils.

Permeability is rapid. Effective rooting depth is 60 inches or more. Available water holding capacity is low. Organic matter content is low. Surface runoff is medium and erosion hazard is medium.

This soil is used almost entirely for livestock grazing and wildlife habitat. Small areas have been worked as a source of road material.

75--Rivra channery loamy sand

The potential native vegetation on Rivra soils is dominated by western wheatgrass, bluebunch wheatgrass, needle-and-thread, Indian ricegrass, fringed sage, big sagebrush, low rabbitbrush, and an occasional fourwing saltbush and winterfat. When the range condition deteriorates, forbs and woody shrubs, including tall rabbitbrush and greasewood, increase.

Grazing management will maintain or improve ~~deteriorating~~ range conditions. Seeding is advisable if the range condition is poor. Suitable for seeding is western wheatgrass, bluebunch wheatgrass, and Indian ricegrass. For successful seeding, prepare a seedbed and drill the seed. The grasses selected should meet the seasonal requirements of livestock. Brush management may be required to improve deteriorated sites that are producing more woody shrubs than normally found in the potential plant community.

Rivra soils have a fair potential for cottontail rabbit and mule deer. They use grasses, forbs, and brush for food and obtain their shelter primarily from the brush.

Rivra soils have poor potential for sanitary facilities. The high percentage of sand and rapid permeability are the main limiting features. Special precautions must be taken in installing septic tank absorption fields in this soil, since the rapid permeability may cause ground water pollution.

75--Rivra channery loamy sand

This soil has a fair to good potential for community development with slope being the main limiting feature. As source material, this soil has poor potential for topsoil, because it is too sandy. As a source of roadfill material, it has fair to good potential, with slopes and area reclaim being the main limiting feature.

Capability unit VIe

Range Site - Rolling Loam

SOIL SURVEY INTERPRETATIONS

Rio Blanco Co., Colo.

MLRA(S): 48 — STATE: COLORADO — KIND OF UNIT: SERIES — UNIT NAME: 75 – RIVRA — DATE: 5/78 — UNIT MODIFIER: NON-FLOODED

THE RIVRA [illegible] SOILS CONSIST OF DEEP EXCESSIVELY DRAINED COARSE MATERIALS ON OUTWASH FANS. TYPICALLY THE SURFACE LAYER IS CHANNERY LOAMY SAND ABOUT 6 INCHES THICK. [illegible] CHANNERY SAND ABOUT 21 INCHES THICK AND IS UNDERLAIN BY CHANNERY LOAMY SANDS AND SANDS TO 60 INCHES OR MORE. NATURAL VEGETATION IS MAINLY LOW BRUSH AND GRASSES. AVERAGE ANNUAL PRECIPITATION IS ABOUT 15 INCHES AND THE FROST-FREE SEASON IS ABOUT 85 TO 125 DAYS. SLOPES ARE 2 TO 8 PERCENT.

Depth (in)	USDA Texture	Unified	AASHTO	Fract. >3 in (pct)	Percent passing sieve no. 4	10	40	200	Liquid limit	Plasticity index
0-6	CN-LS, CN-SL	SM, GM	A-2, A-1	0-5	50-80	45-75	40-60	15-30	—	NP
6-27	CN-S, CN-LS	SM, GM, GP-GM	A-2, A-1	0-5	50-75	45-70	35-55	5-20	—	NP
27-60	CN-LS, CNV-S	SM, GM, GP-GM	A-1, A-2	0-10	30-75	25-60	15-45	5-20	—	NP

Depth (in)	Permeability (in/hr)	Available water capacity (in/in)	Soil reaction (pH)	Salinity (mmhos/cm)	Shrink-swell potential	Corrosivity steel	Corrosivity concrete	Erosion factors K	T	Wind erod. group
Same depth as above	2.0-6.0	0.05-0.09	7.9-9.0	—	LOW	MODERATE	LOW	.15	5	8
	6.0-20.0	0.04-0.13	7.9-9.0	—	↓	↓	↓	.10		
	6.0-20.0	0.04-0.09	7.9-9.0	—	↓	↓	↓	.10		

Flooding frequency	Duration	Months	High water table depth (ft)	Kind	Months	Cemented pan depth	Hardness	Bedrock depth (in)	Hardness	Subsidence initial	Total	Hydrologic group	Potential frost action
NONE			>6			—		>60		—		A	LOW

SANITARY FACILITIES

Use	Rating
Septic tank absorption fields	2-8%: SLIGHT
Sewage lagoons	ALL: SEVERE – SEEPAGE, SLOPE
Sanitary landfill (trench)	ALL: SEVERE – SEEPAGE, TOO SANDY
Sanitary landfill (area)	ALL: SEVERE – SEEPAGE
Daily cover for landfill	POOR – TOO SANDY, SEEPAGE

SOURCE MATERIAL

Use	Rating
Roadfill	ALL: GOOD
Sand	POOR – EXCESS FINES
Gravel	UNSUITED
Topsoil	POOR – TOO SANDY, SMALL STONES

WATER MANAGEMENT

Use	Rating
Pond reservoir area	SEEPAGE, SLOPE
Embankments, dikes and levees	SEEPAGE, UNSTABLE FILL
Excavated ponds aquifer fed	NO WATER
Drainage	
Irrigation	DROUGHTY, SLOPE
Terraces and diversions	TOO SANDY, PIPING
Grassed waterways	DROUGHTY, SLOPE

COMMUNITY DEVELOPMENT

Use	Rating
Shallow excavations	ALL: SEVERE – CUTBANK CAVE
Dwellings without basements	ALL: SLIGHT
Dwellings with basements	ALL: SLIGHT
Small commercial buildings	2-4%: SLIGHT; 4-8%: MODERATE – SLOPE
Local roads and streets	ALL: SLIGHT

REGIONAL INTERPRETATIONS

UNIT NAME: 75- RIVRA
UNIT MODIFIER: NON-FLOODED

CAMP AREAS	ALL: MODERATE - TOO SANDY	PLAYGROUNDS	2-6%: MODERATE - SMALL STONES, TOO SANDY
			6+%: SEVERE - SLOPE, TOO SANDY
PICNIC AREAS	ALL: MODERATE - TOO SANDY	PATHS AND TRAILS	ALL: MODERATE - TOO SANDY

CLASS-DETERMINING PHASE	CAPABILITY
ALL	6E

CLASS-DETERMINING PHASE	IMPORTANT TREES	TREES TO PLANT
	NONE	

CLASS-DETERMINING PHASE	[illegible]
	NONE

CLASS-DETERMINING PHASE												
ALL	POOR	FAIR	FAIR	—	—	FAIR	V. POOR	V. POOR	FAIR	—	V. POOR	FAIR

COMMON PLANT NAME	PLANT SYMBOL	
BIG SAGEBRUSH	ARTR2	20
GREASEWOOD	SAVE4	10
GREENS RABBITBRUSH	CHGR?	10
WESTERN WHEATGRASS	AGSM	20
INDIAN RICEGRASS	ORHY	5
BLUEBUNCH WHEATGRASS	AGSP	5
BUCKWHEAT	ERIOG	5
PRICKLY PEAR CACTUS	OPPO	5
	PPFF	5
	PPGG	5
	SSSS	10

POTENTIAL PRODUCTION (LBS/AC. DRY WT)

FAVORABLE YEARS	1000
NORMAL YEARS	750
UNFAVORABLE YEARS	500

NOTES

RT-- Rock Outcrop - Torriorthents complex, 15 to 90 percent slopes :

This complex mapping unit occurs mainly on southerly facing aspects in the western three-quarters of the county. The unit is on strongly sloping to extremely steep mountain slopes and canyon bluffs. The Rock Outcrops occur mainly as vertical sandstone and shale cliffs or uplifted and tilted dike-like outcrops. These outcrops make up about 60% of the mapping unit. The Torriorthentic soils of the unit range mostly from very shallow to moderately deep with an occasional deep soil on th lower slopes. They will make up the remaining 40% of the mapping unit. These soils are generally light in color, calcareous, fine to coarse in texture, and contain varying amounts of rock fragments.

The vegetation is characteristilly very sparse with scattered p pinyon and juniper trees with a few shrubs and grasses.

This soil unit has severe limitations for uses such as sanitary facilities, roads and streets, and community developments due to the shallowness of the soils, rock content and steepness of slope. They also are poor sources of materials for roadfill, sand or gr gravel,and topsoil due to the thin layer of material, stone content and problems of area reclamation.

This unit is used for very limited livestock grazing but is used as winter habitate by mule deer.

Capability Unit -- VIIIe

GREEN THIRTEEN

Siltstone and sandstone interbedded: siltstone, gray, even-bedded, thin-bedded; weathers light-gray; sandstone, brown to yellowish-brown, fine- to medium-grained, thin-bedded; forms moderate to steep slopes; contact with overlying Thirteenmile Creek often gradational.

Siltstone: gray, even-bedded, very thin-bedded to laminated; weathers light-gray; contains sparse, thin-bedded, fine-grained, gray sandstone beds; forms low to flat slopes.

Marlstone: gray, even-bedded, very thin-bedded to laminated; weathers light grayish-white; forms low to flat slopes.
Siltstone: light-gray to gray, even-bedded, thin-bedded, slightly calcareous forms moderate to low slopes.
Siltstone: gray, even-bedded, very thin-bedded, platy, calcareous; contains sparse, thin beds of fine-grained sandstone; forms moderate to low slopes.

Tu_4
UINTA FORMATION-UNIT 4

Sandstone: yellowish-gray to yellowish-brown, fine-grained, silty, even-bedded, very thin- to thin-bedded, platy; forms moderate slopes.

Sandstone: yellowish-orange to yellowish-gray, fine-grained, cross-bedded, massive, friable; forms cliff.
Sandstone with sparse very thin-bedded siltstone: yellow to yellowish-gray to orange, fine-grained, even-bedded, thin-bedded.
Sandstone: yellow to grayish-yellow, fine-grained, uneven-bedded, medium- to thick-bedded, friable, some clay; forms moderate slopes.
Siltstone and some interbedded very fine-grained sandstone; light-gray to grayish-brown, even-bedded, very thin-bedded, platy; forms low slope; hard, quartzitic, fine-grained, reddish-brown sandstone ledge at top of unit.
Sandstone: brown to light-yellowish-brown, fine-grained, uneven-bedded, massive, some clay; forms cliff.
Sandstone: light-yellowish-brown, fine-grained, even-bedded, thin- to medium-bedded; forms moderate slopes.
Sandstone: light-yellowish-brown, fine-grained, cross-bedded, medium-bedded to massive, some clay, limonite stained; contains oval and spheroidal cavities three to six inches in diameter; forms cliff.
Siltstone and interbedded very fine-grained sandstone, buff to light-gray to light-brown, even-bedded, thin-bedded, platy.
Soil and scree from overlying cliff.

Outwash fan.

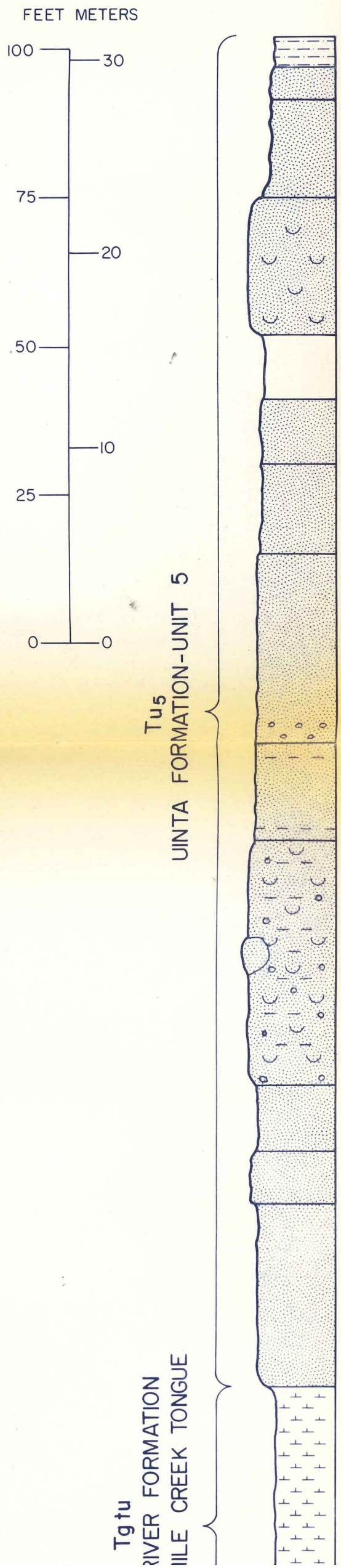
EXPLANATION

Sandstone
Concretionary sandstone
Channeled sandstone
Silty sandstone
Siltstone
Marlstone

NOTE: Interval from base of section to top of Thirteenmile Creek Tongue was measured in the SW 1/4 of the SE 1/4 of sec. 29, T.1S., R.97W. Interval from top of Thirteenmile Creek Tongue to top of section was measured in the SE 1/4 of the NE 1/4 of sec. 30, T.1S., R.97W.

COLUMNAR SECTION
U.S.B.M. OIL SHALE TRACT
RIO BLANCO COUNTY, COLORADO

SCALE: 1" = 20'



Siltstone: light-gray, very thin-bedded to laminated; no outcrop; float only; forms top of hill or ridge.

Sandstone: yellowish-brown, fine-grained; no outcrop; float only; forms very low slope.

Sandstone: light-gray to tan to light-brown, fine-grained, very thin-bedded, platy; no outcrop; float only; forms very low slope.

Sandstone: yellowish-brown, fine-grained, cross-bedded, massive; forms cliffs and moderate slopes.

Covered.

Sandstone: yellowish-grayish-brown, very fine-grained, thin-bedded, platy; forms low slopes.

Sandstone: yellowish-brown to grayish-brown, medium-grained, massive, soft, friable; forms low to moderate slope.

Sandstone: grayish-yellow to brownish-yellow, fine-grained, platy; upper 10 feet of unit contains interbedded hard, quartzitic, thin-bedded, medium-grained dark-gray, salt and pepper sandstone; weathers reddish-brown; lower five feet of unit contains sparse reddish-brown sandstone nodules and ledges up to one foot thick.

Sandstone: grayish-yellow to yellowish-brown, silty, uneven-bedded, thin- to medium-bedded; forms moderate slope.

Sandstone: light-yellowish-brown to orange, very fine-grained, silty, cross-bedded to very uneven-bedded, massive; contains spheroidal to ovate cavities one to five inches in diameter; contains giant nodule of hard, reddish-brown sandstone six feet in diameter; forms cliff and very steep slopes.

Sandstone: yellowish-brown to buff to light-gray, very fine- to fine-grained, uneven-bedded, thin- to thick-bedded; forms moderate to steep slopes.

Sandstone: yellow to yellowish-brown, fine-grained, massive, forms steep slopes.

Sandstone: brown to olive-brown, very fine-grained, thin-bedded, platy; contains sparse medium-thick beds of medium-grained brown sandstone; forms moderate to steep slopes.

Marlstone: light-gray, even-bedded, very thin-bedded to laminated, platy, calcareous; forms moderate to steep slopes.

	Qtc	Terrace – Colluvium deposits
EOCENE	Tu_5	Uinta Formation, Unit 5
	Tgtu	Green River Formation, Thirteenmile Creek Tongue
	Tu_4	Uinta Formation, Unit 4

GEOLOGIC SYMBOLS

- 2 — Strike and dip – Field measured
- Strike and dip – Photogeologic, dip less than 3°
- 7 — Apparent dip < Photogeologic, no dip value shown / Field measured, dip value shown
- 60 — Dipping joint – Field measured
- 90 — Vertical joint – Field measured
- Joint – Photogeologic
- Fault – Dashed where approximate, dotted where concealed. Sense of movement (U/D) indicated
- Anticlinal axis – Location approximate
- Synclinal axis – Location approximate
- Adt — Distinctive alignment (d – drainage, t – topography)
- Geologic contact – Dashed where approximate
- k — k — Key bed
- Line of measured section
- Drill hole location
- U.S.B.M. mine shaft

AMUEDO AND IVEY

U.S. BUREAU OF MINES

U.S.B.M. MINING ENVIRONMENTAL RESEARCH FACILITY

GEOLOGIC MAP OF U.S.B.M. OIL SHALE TRACT

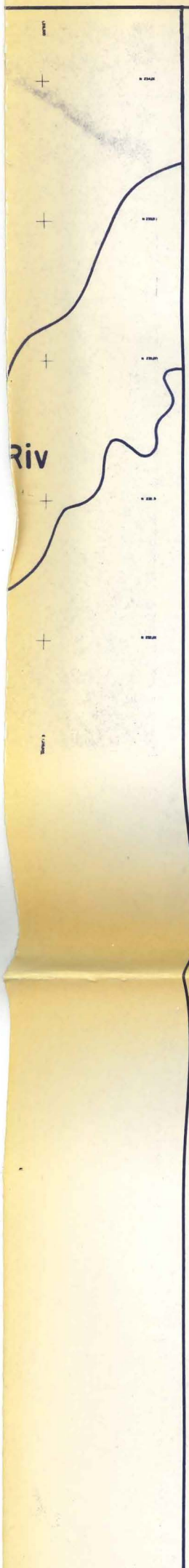
RIO BLANCO COUNTY, COLORADO

SCALE: 1"= 500'	CONTOUR INTERVAL: 10'
GEOLOGY: A.R. MYERS, R.A. LINDVALL	DRAFTING: H.A.H. SCHLENDER
DATE: APRIL 1978	MAP NO. 7627 – 1

PLATE 2

STRATIGRAPHIC UNITS

AGE			
HOLOCENE		af	artificial fill
QUATERNARY		Qf	Alluvial fan deposits
		Qal	Alluvium
		Qc	Colluvium
		Qt	Terrace deposits
		Qtc	Terrace – Colluvium deposits
EOCENE		Tu_5	Uinta Formation, Unit 5
		Tgtu	Green River Formation, Thirteenmile Creek Tongue
		Tu_4	Uinta Formation, Unit 4

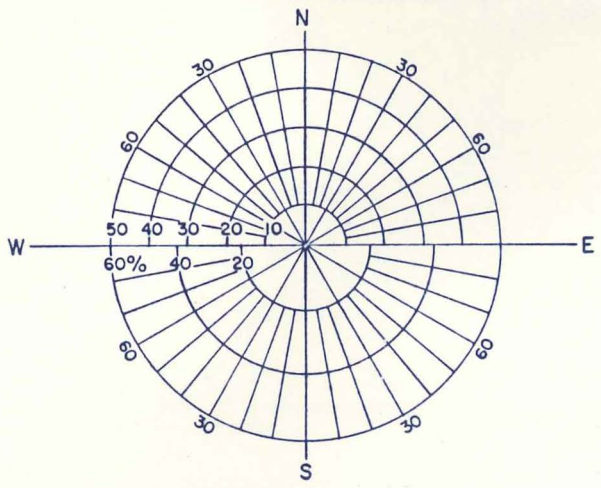


EXPLANATION

Hag	Hagga loam, 0% – 5% slopes
Hav	Havre loam, 0% – 3% slopes
Gle	Glendive fine sandy loam, 2% – 15% slopes
Ren	Rentsac channery sandy loam, 5% – 50% slopes
Red-Ren	Redcreek – Rentsac complex, 5% – 30% slopes
Pic	Piceance fine sandy loam, 5% – 15% slopes
Yam	Yamac loam, 3% – 15% slopes

PLATE 4

BEARING AND NORMALIZED NUMBER
OF FRACTURES AT THE JOINT STATION



BEARING AND PERCENTAGE OF NORMALIZED
FRACTURES AT THE JOINT STATION

The upper half of the rosette shows the (normalized) number of joints whose strikes fall within each 10° segment of the semicircle. Each of the five nested semicircles represents 10 joints. Where there are more than 50 joints within a 10° interval the wedge/segment is extended beyond the outermost semicircle to a scaled-distance-equivalent of the actual number of joints whose strikes lie within the 10° interval at hand. In some cases there are only a few joints within a given 10° interval. In order to make these joints visible on the rosette the wedge/segment is filled in solid to the 10 semicircle even though there may be fewer than 10 joints whose strikes fall within the interval.

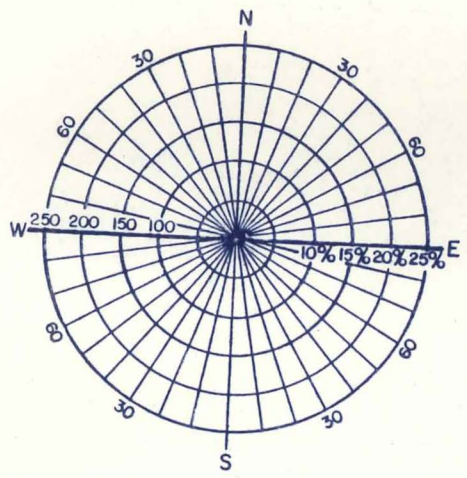
The lower half of the rosette shows the percentage of (normalized) joints whose strikes fall within each 10° segment of the semicircle. That is, the number of joints within each 10° interval is expressed as a percentage of the total number of joints measured at the joint station. Each of the three nested semicircles represents 20 percent of the total number of joints. Where the joints in one 10° interval comprise more than 60 percent of the total number of joints measured at the joint station, the wedge/segment is extended beyond the outermost semicircle. This extension is scaled so that the wedge/segment shows the correct percentage value for those joints whose strikes lie within the 10° interval at hand. In some cases the joints within a 10° interval are only a few percent of the total number of joints. In order to make this percentage visible on the rosette the wedge/segment is filled in solid to the 20% semicircle even though the percentage of joints whose strikes fall within the interval may be less than 20.

STRATIGRAPHIC UNITS

AGE		
HOLOCENE	af	artificial fill
QUATERNARY	Qf	Alluvial fan deposits
	Qal	Alluvium
	Qc	Colluvium
	Qt	Terrace deposits
	Qtc	Terrace – Colluvium deposits
EOCENE	Tu_5	Uinta Formation, Unit 5
	Tgtu	Green River Formation, Thirteenmile Creek Tongue
	Tu_4	Uinta Formation, Unit 4

GEOLOGIC SYMBOLS

BEARING AND NORMALIZED NUMBER OF FRACTURES IN ZONE OR TRACT



BEARING AND PERCENTAGE OF NORMALIZED FRACTURES IN ZONE OR TRACT

The upper half of the rosette shows the (normalized) number of joints whose strikes fall within each 10° segment of the semi-circle. Each of the five nested semicircles represents 50 joints. Where there are more than 250 joints within a 10° interval, the wedge/segment is extended beyond the outermost semicircle to a scaled-distance-equivalent of the actual number of joints whose strikes lie within the 10° interval at hand.

The lower half of the rosette shows the percentage of (normalized) joints whose strikes fall within each 10° segment of the semi-circle. That is, the number of joints within each 10° interval is expressed as a percentage of the total number of joints measured at the joint station. Each of the five nested semicircles represents five percent of the total number of joints. Where the joints in one 10° interval comprise more than 25 percent of the total number of joints measured at the joint station, the wedge/segment is extended beyond the outermost semicircle. This extension is scaled so that the wedge/segment shows the correct percentage value for those joints whose strikes lie within the 10° interval at hand.

STRATIGRAPHIC UNITS

AGE		
HOLOCENE	af	artificial fill
QUATERNARY	Qf	Alluvial fan deposits
	Qal	Alluvium
	Qc	Colluvium
	Qt	Terrace deposits
	Qtc	Terrace – Colluvium deposits
EOCENE	Tu_5	Uinta Formation, Unit 5
	Tgtu	Green River Formation, Thirteenmile Creek Tongue
	Tu_4	Uinta Formation, Unit 4

GEOLOGIC SYMBOLS

STRATIGRAPHIC UNITS

AGE			
HOLOCENE	af	artificial fill
QUATERNARY	Qf	Alluvial fan deposits
	Qal	Alluvium
	Qc	Colluvium
	Qt	Terrace deposits
	Qtc	Terrace – Colluvium deposits
EOCENE	Tu_5	Uinta Formation, Unit 5
	Tgtu	Green River Formation, Thirteenmile Creek Tongue
	Tu_4	Uinta Formation, Unit 4

GEOLOGIC SYMBOLS

PLATE 7

MATCH TO SHEET 9

STRATIGRAPHIC UNITS

AGE			
HOLOCENE		af	artificial fill
QUATERNARY		Qf	Alluvial fan deposits
		Qal	Alluvium
		Qc	Colluvium
		Qt	Terrace deposits
		Qtc	Terrace – Colluvium deposits
EOCENE		Tu_5	Uinta Formation, Unit 5
		Tgtu	Green River Formation, Thirteenmile Creek Tongue
		Tu_4	Uinta Formation, Unit 4

GEOLOGIC SYMBOLS

PLATE 8

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MATCH TO SHEET 13

STRATIGRAPHIC UNITS

AGE			
HOLOCENE	af		artificial fill
QUATERNARY	Qf		Alluvial fan deposits
	Qal		Alluvium
	Qc		Colluvium
	Qt		Terrace deposits
	Qtc		Terrace – Colluvium deposits
EOCENE	Tu_5		Uinta Formation, Unit 5
	Tgtu		Green River Formation, Thirteenmile Creek Tongue
	Tu_4		Uinta Formation, Unit 4

GEOLOGIC SYMBOLS