0008

UtahAmerican Energy, Inc.

February 19, 2004

Pam Grubaugh-Littig
Permit Supervisor
1594 West North Temple, Suite 1210
P.O. Box 145801
Salt Lake City, Utah 84114-5801

Incoming
C/007/013

Re: 04-004 Copy of the Kaiser Steel Corporation South Lease Coal Property PAP.

Dear Ms. Grubaugh-Littig,

Enclosed you will find (1) copy of the Kaiser Steel South Lease Coal Property Application. A copy was requested by DOGM to be used as a reference only.

This copy of the Kaiser Application is to be used as a reference by DOGM and is not to be amended to the Lila Canyon Extension Application. All applicable referenced portions of the Kaiser Application have been included in the Lila Canyon Extension Application.

Because the Kaiser Steel information is being submitted for reference only, C1 and C2 forms are not included.

Should you have any questions please call.

Sincerely,

R. Jay Marshall

R. Jay Marshall
Project Engineer

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APPLICATION FOR AN UNDERGROUND COAL MINE PERMIT

KAISER STEEL CORPORATION
SOUTH LEASE COAL PROPERTY
EMERY COUNTY, UTAH

VOLUME 6 OF 7

CHAPTER

VIII SOIL RESOURCES

IX VEGETATION RESOURCES

APPLICATION FOR
AN UNDERGROUND COAL MINE PERMIT
FOR
SOUTH LEASE COAL PROPERTY
EMERY COUNTY, UTAH

Submitted to

State of Utah Natural Resources & Energy
Division of Oil, Gas and Mining
4241 State Office Building
Salt Lake City, Utah 44114

by

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8.1 Scope

The discussions in this chapter on soil resources pertain primarily to the regulatory requirements of UMC 783.21, 783.27, 784.11(b), and 784.13(b).

Baseline soils information and soil qualities are presented. This information has been used to develop soil handling procedures and reclamation plans. The reclamation plans pertain primarily only to those areas scheduled for disturbance during the proposed permit term of 5 years.

8.2 Methodology

A third order soil survey has been completed for the Permit Area by soil classification specialists of the SCS (Soil Conservation Service) (Jensen, et al., 1980). A soils map of the Permit Area is presented in Plate VIII-1. Barring the presence of endangered species, toxic soils, or special engineering necessities, soil classification specialists confirm that a third order soil survey is sufficient for the relatively small areas disturbed by the surface effects of underground coal mining (Sellnow, Jensen, personal communications).

The soils of the areas to be disturbed have been mapped (Plates VIII-2 and VIII-3) and sampled for chemical analysis. Study of the literature, topography, soil and plant ecology of the areas to be disturbed have been used to develop the topsoil removal and handling plans in addition to the reclamation plans.

8.3 Soil Resource Information of Mine Plan Area

The soils in the Mine Plan Area have been surveyed in a third order soil survey by Jensen, et al., (1980) (Plate VIII-1).

A third order soil survey is normally sufficient for the relatively small disturbed areas incurred by underground mining operations (Steve Sellnow, personal communication), (Earl Jensen, personal communication).

At the present time the soil descriptions are still in draft form and a few minor inclusions[1] yet remain to be completely defined.

8.3.1 Soils Identification

Map Symbol	Designated Soils
BGC2	BG loam, 3 to 6 percent slopes, eroded
BL	Badland
BNE2	Chilton extremely bouldery, fine [illegible]y loam, low rainfall, 3 to 20 percent slopes, eroded
BWD2	Badland-Chipeta complex, 8 to 15 percent slopes
CHC2	Chipeta silty clay loam, 3 to 8 percent slopes, eroded
CLD2	Cliffdown very stony sandy loam, 3 to 15 percent slopes, eroded
EDF2	EA-Persayo-Badland complex, 8 to 40 percent slopes, eroded
EED2	EA-Badland complex, 8 to 15 percent slopes, eroded
GNA	Glenberg fine sandy loam, high rainfall, 1 to 3 percent slopes
HAC	Haverson loams, 3 to 8 percent slopes
MRG	Menefee-Rock outcrop complex, 40 to 70 percent slopes

[1]Cabba extremely bouldery loam, Falcon loam, Firo cobbly fine sandy loam, Guben extremely bouldery loam, Midfork bouldery loam.

8.3 Cont.

Map Symbol	Designated Soils
MUE	Cabba-Podo-Patmos complex, 3 to 30 percent slopes
NVF2	Lazear-Rock outcrop-Rubble land complex, 20 to 50 percent slopes
NXC	Lazear-Rock outcrop complex, high rainfall, 1 to 8 percent slopes
PEC2	Persayo loam, 3 to 8 percent slopes, eroded
RJA2	Ravola silt loam, saline, 0 to 3 percent slopes, eroded
RR	Rock outcrop-Rubble land-Badland complex
RVD	Rock outcrop-Sunup complex, 3 to 15 percent slopes

8.3.2 Soils Descriptions

The following are descriptions of the soil mapping units:

BGC2 BG LOAM, 3 TO 6 PERCENT SLOPES, ERODED

This BG soil is very deep and well drained. It occurs on dissected fan terraces and stream terraces at elevations of 4,700 to 5,300 feet (1,432 to 1,615m). This soil formed in alluvium derived mainly from sandstone and shale.

The average annual precipitation is 6 to 8 inches (15 to 20cm). Mean annual air temperature is 48° to 50°F (8.9° to 10.0°C), mean annual soil temperature is 50° to 52°F (10.0° to 11.1°C), and the average freeze-free season is 120 to 150 days. This soil occurs north of Woodside and in the vicinity of Mounds. Slopes are 3 to 6 percent and occur on all aspects. They are short to medium in length and convex in shape.

Present vegetation is dominantly Indian ricegrass, shadscale, galleta, threeawn, and winterfat.

Included in mapping are small areas of Persayo very cobbly clay loam, 15 to 30 percent slopes; Avalon loam, 1 to 5 percent slopes; and Glenton fine sandy loam, 1 to 6 percent slopes.

In a representative profile the surface layer is pale brown loam about 1 inch (2.5cm) thick. The subsoil is strong brown loam about 15 inches (38cm) thick. The upper substratum is white and very pale brown loam about 26 inches (66cm) thick. The lower substratum is light yellowish brown loam to a depth of 60 inches (152cm) or more. The soil has a very strong or strongly calcareous carbonate accumulation at a depth of about 16 inches (41cm).

Permeability is moderate. Available water capacity is about 7.8 to 10 inches (19.8 to 25.4cm) above a depth of 60 inches (152cm). Water supplying capacity is 4 to 5 inches (10.1 to 12.7cm). Organic matter content in the surface layer is very low. Effective rooting depth is about 60 inches (152cm). Surface runoff is slow and erosion hazard is moderate. The Erosion Condition Class is moderate-42. Rills are at intervals of about 15 to 50 feet (4.6 to 15.2m). The gullies are at intervals of about 200 to 400 feet (61 to 122m) with active erosion along less than 10 percent of their length.

This soil is used for rangeland and wildlife habitat.

The potential plant community is about 40 percent grasses, 20 percent forbs, and 40 percent shrubs. Important plants are galleta, hairy grama, Indian ricegrass, sand dropseed, desert trumpet, globemallow, wooly Indianwheat, Douglas rabbitbrush, Torrey Mormon-tea, shadscale and winterfat.

Practices needed for improving or maintaining vegetation include proper season of use, grazing for proper amounts of plant use, a planned system of grazing, and good water distribution.

This soil is in Capability Subclass VIIe, nonirrigated; Desert Loam D34 ecological site.

Taxonomic classification is coarse-loamy, mixed, mesic Typic Calciorthids.

A representative pedon of BG loam, 3 to 6 percent slopes, eroded, in mapping unit BGC located 2,500 feet (762m) south and 1,280 feet (390m) east of the NE corner of Section 27, T15S, R12E (Photo No. & Coord. 1-62, B-11) is used to represent this soil.

A1--0 to 1 inch (2.5cm); pale brown (10YR 6/3) loam, dark yellowish brown (10YR 4/4) when moist; weak thin platy structure that parts to weak fine granular; slightly hard, friable, slightly sticky, slightly plastic; few fine and medium roots; many very fine, common fine, and few medium pores; slightly calcareous, carbonates are disseminated; moderately alkaline (pH 8.4); abrupt smooth boundary.

B2--1 to 16 inches (2.5 to 41cm); strong brown (7/5YR 5/6) loam, brown (7.5YR 4/4) when moist; weak medium subangular blocky structure; hard, firm, sticky, plastic; few fine and medium roots, many very fine and fine, few medium pores; slightly calcareous, carbonates are disseminated; moderately alkaline (pH 8.2); clear smooth boundary.

C1ca--16 to 32 inches (41 to 81.3cm); white (10YR 8/2) loam, very pale brown (10YR 7/3) when moist; moderate medium subangular blocky structure; very hard, friable, slightly sticky, slightly plastic; few very fine and fine roots; common fine and few medium pores; very strongly calcareous, carbonates occur as powdery soft masses; strongly alkaline (pH 8.8); gradual smooth boundary.

C2ca--32 to 42 inches (81.3 to 106.7cm); very pale brown (10YR 8/3) loam, light yellowish brown (10YR 6/4) when moist; moderate medium subangular blocky structure; extremely hard, friable, slightly sticky, slightly plastic; few very fine and fine roots; common fine and few medium pores; 2 percent gravel; strongly calcareous, carbonates occur as powdery soft masses; strongly alkaline (pH 9.0); gradual smooth boundary.

C3--42 to 60 inches (106.7 to 152cm); light yellowish brown (10YR 6/4) loam, yellowish brown (10YR 5/6) when moist; moderate medium subangular blocky structure; very hard, firm, sticky, plastic; few very fine and fine roots; common fine and few medium pores; moderately calcareous, carbonates are disseminated; strongly alkaline (pH 8.6.)

The range in characteristics for this soil has not been determined.

BL BADLAND

Badland is a miscellaneous land type consisting of nearly barren steep to very steep shale outcrops; shale interbedded with sandstone; and sandstone capped hills. It is dissected by many intermittent drainage channels; local relief ranges between 25 and 500 feet (7.6 to 152m).

The Badland occurs primarily to the south and west of the Book Cliffs in Emery County and along the foot of Gentry Mountain on the western edge of the survey area.

Included are small areas of Chipeta silty clay loam, 8 to 15 percent slopes, eroded, primarily along drainages.

Runoff is very rapid and geologic erosion is active.

Badland supports only very sparse vegetation. It is used mainly for aesthetic purposes.

Badland is in Capability Subclass VIIIs, and is not placed in an ecological site.

BNE2 CHILTON EXTREMELY BOULDERY FINE SANDY LOAM, LOW RAINFALL, 3 TO 20 PERCENT SLOPES, ERODED.

This Chilton soil is very deep and somewhat excessively drained. It occurs on dissected alluvial fans and fan terraces at elevations of 5,300 to 6,100 feet (1,615 to 1,859m). This soil formed in alluvium and glacial outwash derived mainly from sandstone and shale.

The average annual precipitation is 9 to 11 inches (22.8 to 27.9cm). Mean annual air temperature is 45° to 47°F (7.2° to 8.3°C), mean annual soil temperature is 47° to 49°F (7.2° to 9.4°C), and the average freeze-free season is 115 to 140 days. This soil occurs in the vicinity of Horse Canyon. Slopes are 3 to 20 percent and occur on south, east and west aspects. They are medium in length and convex in shape.

Present vegetation is dominantly juniper, pinyon, Mormon-tea and prickly-pear.

Included in mapping are small areas of Ildefonso very stony loam, 8 to 30 percent slopes, eroded; Chilton very stony fine sandy loam, low rainfall, 15 to 30 percent slopes, eroded; Shingle extremely stony loam, low rainfall, 15 to 40 percent slopes, eroded.

In a representative profile the surface layer is pale brown extremely bouldery fine sandy loam about 3 inches (7.6cm) thick. The underlying layer is pale brown very bouldery sandy clay loam about 21 inches (53.3cm) thick. The next layer is light yellowish brown very cobbly sandy clay loam to a depth of 60 inches (152cm) or more.

Permeability is moderate. Available water capacity is about 5.0 to 7.5 inches (12.7 to 19.0cm) to a depth of 60 inches (152cm). Water supplying capacity is about 4 to 6 inches (10.2 to 15.2cm). Organic matter content in the surface layer is low. Effective rooting depth is about 60 inches (152cm) Surface runoff is medium and erosion hazard is high. The Erosion Condition Class is moderate-51. There are gullies 2 to 10 feet deep (.6 to 3.0m) about 200 to 500 feet (61 to 152m) apart. The gullies are fed by numerous well-defined rills. The coarse fragments on the surface reduce the erosion hazard in this unit.

This soil is used for rangeland and wildlife habitat.

The potential plant community is about 60 percent grasses, 13 percent forbs, and 27 percent shrubs. Important plants that grow are Salina wildrye, galleta, Indian ricegrass, sand dropseed, false-yarrow, globemallow, hairy goldaster, aster, Bigelow sagebrush, shadscale, Torrey Mormon-tea and Douglas rabbitbrush.

Practices for maintaining or improving vegetation include a planned system of grazing, grazing for the proper percent of plant use, and good water distribution.

This soil is in Capability Subclass VIIs, nonirrigated; Semidesert Bouldery Loam D34 ecological site.

Taxonomic classification is loamy-skeletal, mixed (calcareous), mesic Ustic Torriorthents.

A representative pedon of Chilton extremely bouldery fine sandy loam, low rainfall, 3 to 20 percent slopes, eroded, was described 1,000 feet (305m) west and 2,300 feet (701m) north of the SE corner, Section 16, T16S, R14E, SLBM (Photo No. & Coord. 1-74-A, B3).

A1--0 to 3 inches (0 to 7.6cm); pale brown (10YR 6/3) extremely bouldery fine sandy loam, dark brown (10YR 4/3) when moist; weak fine granular structure; slightly hard, friable, slightly sticky, slightly plastic; few very fine, fine and medium roots; few very fine and fine pores; 15 percent gravel, 15 percent cobbles, 35 percent stones, 5 percent boulders; moderately calcareous, carbonates are disseminated; moderately alkaline (pH 8.4) abrupt smooth boundary.

C1--3 to 24 inches (7.6 to 61cm); pale brown (10YR 6/3) very bouldery sandy clay loam, dark brown (10YR 4/3) when moist; weak fine subangular blocky structure; hard, firm, sticky, plastic; few very fine, fine and medium roots, common very fine and few fine pores; 15 percent gravel, 15 percent cobbles, 25 percent stones and boulders; slightly calcareous, carbonates are disseminated; strongly alkaline (pH 8.6); clear smooth boundary.

C2--24 to 49 inches (61 to 124cm); light yellowish brown (10YR 6/4) very cobbly sandy clay loam, grayish brown (10YR 5/2) when moist; moderate medium subangular blocky structure; very hard, firm, sticky, plastic; few very fine and fine roots, common very fine and few fine pores; 20 percent gravel, 20 percent cobbles, 10 percent stones; slightly calcareous, carbonates are disseminated; moderately alkaline (pH 8.2); gradual smooth boundary.

C3--49 to 60 inches (124 to 152cm); light yellowish brown (10YR 6/4) very cobbly sandy clay loam, dark grayish brown (10YR 4/2) when moist; massive; very hard, firm, sticky, plastic; few very fine and fine roots, few very fine and fine pores; 25 percent gravel, 20 percent cobbles, 5 percent stones; slightly calcareous, carbonates are disseminated; moderately alkaline (pH8.2).

The A horizon has hue of 10YR or 7.5YR and chroma of 3 or 4. It ranges from extremely bouldery fine sandy loam to extremely bouldery loam, and is 2 to 6 inches (5.0 to 15.2cm) thick.

The C horizon has hue of 10YR or 7.5YR. It ranges from very bouldery loam to very cobbly sandy clay loam. The C horizon is moderately alkaline or strongly alkaline.

BWD2 BADLAND-CHIPETA COMPLEX, 8 TO 15 PERCENT SLOPES, ERODED

This complex consists of about 60 percent Badland, moderately steep and 30 percent Chipeta silty clay loam, 8 to 15 percent slopes, eroded, and 10 percent inclusion of other soils.

This complex occurs on shale hills. The Badland is dissected shale outcrop and the Chipeta soil is on side slopes adjacent to drainages. Elevations are 4,100 to 6,600 feet (1,250 to 2,012m). The soils formed in residuum derived from shale.

The average annual precipitation is 6 to 8 inches (15.2 to 20.3cm). Mean annual air temperature is 47° to 52°F (8.3° to 11.1°C), mean annual soil temperature is 49° to 54°F (9.4° to 12.2°C), and the average freeze-free season is 120 to 160 days. This complex occurs south and west of East Carbon City and extends almost to Interstate Highway 70. Slopes are 8 to 15 percent and occur on all aspects. They are short in length and convex in shape.

Included in mapping are small areas of Persayo loam, 8 to 15 percent slopes, eroded and Bributte gravelly silty clay loam, 3 to 25 percent slopes.

Badland, moderately steep

Badland consists of moderately steep nearly barren beds of actively eroding shale, shale interbedded with sandstone, shale interbedded with gypsum, and occasionally small areas of shale capped by sandstone. The landscape is dissected by numerous intermittent drainage channels.

Runoff is rapid. The sediment potential is high during intense summer thunderstorms.

Badland supports only very sparse salt tolerant vegetation.

Badland is in Capability Subclass VIIIs, and is not placed in an ecological site.

Chipeta silty clay loam, 8 to 15 percent slopes, eroded

This Chipeta soil is shallow and well drained.

Present vegetation is dominantly mat saltbush, Nuttall saltbush, desert trumpet, big white aster, globemallow and galleta.

In a representative profile the surface layer is pale brown silty clay loam about 1 inch (2.5cm) thick. The underlying layer is pale brown silty clay loam about 6 inches (15.3cm) thick. The next layer is grayish brown silty clay loam underlain by weathered shale at a depth of 15 inches (38cm). This soil is moderately affected by salt.

Permeability is slow. Available water capacity is about 2.0 to 3.0 inches (5.0 to 7.6cm). Water supplying capacity is about 2 to 3 inches. Organic matter content in the surface layer is very low. Effective rooting depth is about 10 to 20 inches (25.4 to 50.8cm). Surface runoff is rapid and erosion hazard is high. The Erosion Condition Class is moderate-47 as a result of the movement of soil and surface litter.

This soil is used for rangeland and wildlife habitat.

The potential plant community is about 20 percent grasses, 15 percent forbs, and 65 percent shrubs. Important plants are galleta, Indian ricegrass, Salina wildrye, annual eriogonums, evening primrose, mat saltbush, Nuttall saltbush and shadscale.

Practices needed to improve or maintain the vegetation include the proper amount of plant use, the proper season of use, a planned system of grazing and good water distribution.

This soil is in Capability Subclass VIIs, nonirrigated; Desert Shallow Shale D34 ecological site.

Taxonomic classification is clayey, mixed (calcareous), mesic, shallow Typic Torriorthents.

A representative pedon of Chipeta silty clay loam, 3 to 8 percent slopes, eroded in mapping unit CHC2, located about 4.5 miles (7.2km) south and 6 miles (9.6km) west of the town of Green River at a point 3,000 feet (914m) south and 500 feet (152m) east of the NW corner of Section 33, T21S, R15E (Photo No. & Coord. 2-139, K-17).

A1--0 to 1 inch (0 to 2.5cm); pale brown (10YR 6/3) silty clay loam, brown (10YR 5/3) when moist; moderate medium subangular blocky structure that parts to strong very coarse granular; slightly hard, firm, sticky, plastic; few very fine roots; many very fine and few fine pores; 10 percent gravel; moderately calcareous, carbonates are disseminated; moderately alkaline (pH 8.4); abrupt smooth boundary.

C1--1 to 4 inches (2.5 to 10.1cm); pale brown (10YR 6/3) silty clay loam, brown (10YR 5/3) when moist; moderate coarse prismatic structure that parts to moderate thick platy; hard, firm, very sticky, plastic; few very fine roots; medium very fine pores; moderately calcareous, carbonates are disseminated; strongly alkaline (pH 8.8); abrupt smooth boundary.

C2--4 to 7 inches (10.1 to 17.7cm); pale brown (10YR 6/3) silty clay loam, grayish brown (10YR 5/2) when moist; massive; hard, firm, very sticky, plastic; common very fine roots; common very fine pores; moderately calcareous, carbonates are disseminated; very strongly alkaline (pH 9.4); clear smooth boundary.

C3--7 to 15 inches (17.7 to 38.1cm); grayish brown (2.5Y 5/2) silty clay loam, dark grayish brown (2.5Y 4/2) when moist; massive; hard, friable, sticky, plastic; common very fine and few fine roots; few very fine pores;

10 to 15 percent soft shale fragments; moderately calcareous, carbonates are disseminated; very strongly alkaline (pH 9.4); gradual smooth boundary.

C4r--15 inches (38.1cm); shale.

Depth to shale ranges from 10 to 20 inches (25.4 to 50.8cm). The range in other characteristics for this soil has not been determined.

CHC2 CHIPETA SILTY CLAY LOAM, 3 TO 8 PERCENT SLOPES, ERODED

This Chipeta soil is shallow and well drained. It occurs on shale hills at elevations of 4,000 to 6,000 feet (1,219 to 1,829m). This soil formed in residuum derived mainly from shale.

The average annual precipitation is 6 to 8 inches (15 to 20.3cm). Mean annual air temperature is 48° to 52°F (8.9° to 11.1°C), mean annual soil temperature is 50° to 54°F (10° to 12.2°C), and the average freeze-free season is 120 to 160 days. This soil occurs near the Woodside area and the town of Green River. Slopes are 3 to 8 percent and occur on all aspects. They are short and medium in length and convex in shape.

Present vegetation is dominantly mat saltbush, globemallow, Indian ricegrass, desert trumpet and big white aster.

Included in mapping are small areas of Badland; Greybull loam 3 to 8 percent slopes, eroded; Persayo extremely shaly loam, 8 to 30 percent slopes, eroded.

In a representative profile the surface layer is pale brown silty clay loam about 1 inch (2.5cm) thick. The underlying layer is pale brown silty clay loam about 6 inches (15cm) thick. The next layer is grayish brown silty clay loam overlying weathered shale at a depth of about 15 inches (38.1cm). This soil is moderately affected by salt.

Permeability is slow. Available water capacity is about 2.0 to 3.0 inches (5 to 7.6cm) above the shale. The water supplying capacity is about 2 to 3 inches (5 to 7.6cm). Organic matter content in the surface layer is very low. Effective rooting depth is about 10 to 20 inches (25.4 to 50.8cm). Surface runoff is rapid and erosion hazard is high. The Erosion Condition Class is moderate-47.

This soil is used for rangeland and wildlife habitat.

The potential plant community is about 20 percent grasses, 15 percent forbs, and 65 percent shrubs. Important plants are galleta, Indian ricegrass, Salina wildrye, annual eriogonums, evening primrose, mat saltbush, Nuttall saltbush and shadscale.

Practices needed to improve or maintain the vegetation include the proper amount of plant use, the proper season of use, a planned system of grazing and good water distribution.

This soil is in Capability Subclass VIIs, nonirrigated; Desert Shallow Shale D34 ecological site.

Taxonomic classification is a clayey, mixed (calcareous), mesic, shallow, Typic Torriorthent.

A representative pedon of Chipeta silty clay loam, 3 to 8 percent slopes, eroded, was described 4.5 miles (7.2km) south and 6 miles (9.6km) west of the town of Green River; 3,000 feet (914m) south and 500 feet (152m) east of the NW corner of Section 33, T21S, R15E (Photo No. & Coord. 2-139; K-17).

A1--0 to 1 inch (0 to 2.5cm); pale brown (10YR 6/3) silty clay loam, brown (10YR 5/3) when moist; moderate medium subangular blocky structure that parts to strong very coarse granular; slightly hard, firm, sticky, plastic; few very fine roots; many very fine and few fine pores; 10 percent gravel; moderately calcareous, carbonates are disseminated; moderately alkaline (pH 8.4); abrupt smooth boundary.

C1--1 to 4 inches (2.5 to 10.2cm); pale brown (10YR 6/3) silty clay loam, brown (10YR 5/3) when moist; moderate coarse prismatic structure that parts to moderate very coarse platy; hard, firm, very sticky, plastic; few very fine roots; many very fine pores; moderately calcareous, carbonates are disseminated; strongly alkaline (pH 8.8); abrupt smooth boundary.

C2--4 to 7 inches (10.2 to 17.8cm); pale brown (10YR 6/3) silty clay loam, grayish brown (10YR 5/2) when moist; massive; hard, firm, very sticky, plastic; common very fine roots; common very fine pores; moderately calcareous, carbonates are disseminated; very strongly alkaline (pH 9.4); clear smooth boundary.

C3--7 to 15 inches (17.8 to 38.1cm); grayish brown (2.5Y 5/2) silty clay loam, dark grayish brown (2.5Y 4/2) when moist; massive; hard, friable, sticky, plastic; common very fine and few fine roots; few very fine pores; 10 to 15 percent soft shale fragments; moderately calcareous, carbonates are disseminated; very strongly alkaline (pH 9.4); gradual smooth boundary.

C4r--15 inches (38.1cm); weathered shale.

Depth to weathered shale ranges from 10 to 20 inches (25.4 to 50.8cm).

The A horizon has hue of 10YR or 2.5Y, value of 5 or 6 dry, 4 or 5 moist and chroma is 1 to 3. Gravel content ranges from 0 to 10 percent. The A horizon is 1 to 4 inches (2.5 to 10.2cm) thick.

The C horizon has hue of 5Y, 2.5Y or 10YR, value of 5 or 6 dry, 3 to 5 moist and chroma of 1 to 3. It is silty clay loam, silty clay and shaly silty clay loam with 35 to 50 percent clay. Soft shale fragments range from 0 to 35 percent and hard fragments from 0 to 10 percent. The C horizon ranges from 12 to 19 inches (30.5 to 48.3cm) thick.

CLD2 CLIFFDOWN VERY STONY SANDY LOAM, 3 TO 15 PERCENT SLOPES, ERODED

This Cliffdown soil is very deep and somewhat excessively drained. It occurs on alluvial fans at elevations of 4,200 to 5,500 feet (1,280 to 1,676m). This soil formed in alluvium derived mainly from sandstone and shale.

The average annual precipitation is 6 to 8 inches (15.2 to 20.3cm). Mean annual air temperature is 48° to 52°F (8.9° to 11.1°C), mean annual soil temperature is 50° to 54°F (10° to 12.2°C), and the average freeze-free season is 125 to 165 days. This soil occurs at the foot of the Book Cliffs from Horse Canyon to the Green River and along the Price River from Woodside to its confluence with the Green River. Slopes are 3 to 15 percent and occur on west, north, and south aspects. They are medium in length and single to concave in shape.

Present vegetation is dominantly galleta, shadscale, annual lupine, Indian ricegrass, globemallow, and yellowbrush.

Included in mapping are small areas of CG very gravelly fine sandy loam, 1 to 8 percent slopes, eroded; Badland; and Persayo very cobbly clay loam, 15 to 30 percent slopes.

In a representative profile the surface layer is pale brown very stony sandy loam about 1 inch (2.5cm) thick. The underlying layer is light yellowish brown very gravelly fine sandy loam about 18 inches (45.7cm) thick. The next layer is light yellowish brown extremely gravelly sandy loam to a depth of 60 inches (152cm) or more.

Permeability is moderately rapid. Available water capacity is about 3.5 to 5.5 inches (8.9 to 13.9cm), to a depth of 60 inches (152cm). The water supplying capacity is about 2.5 to 4.5 inches (6.3 to 11.4cm). Organic matter content in the surface layer is very low. Effective rooting depth is greater than 60 inches (152cm). Surface runoff is medium and erosion hazard is high. The Erosion Condition Class is moderate-44. The soil shows evidence of active surface erosion in the form of plant-rock pedestals, rills, and infrequent gullies. The gullies are 10 to 30 feet (3.0 to 9.1m) deep.

This soil is used for rangeland and wildlife habitat.

The potential plant community is about 40 percent grasses, 20 percent forbs, and 40 percent shrubs. Important plants are galleta, hairy grama, Indian ricegrass, sand dropseed, desert trumpet, globemallow, wooly Indianwheat, Douglas rabbitbrush, Torrey Mormon-tea, shadscale and winterfat.

Practices needed for improving or maintaining vegetation include proper season of use, grazing for proper amounts of plant use, a planned system of grazing, and good water distribution.

This soil is in Capability Subclass VIIs; nonirrigated, Desert Loam D34 ecological site.

Taxonomic classification is loamy-skeletal, mixed (calcareous), mesic Typic Torriorthents.

A representative pedon of Cliffdown very stony sandy loam, 3 to 15 percent slopes, eroded, was described about 2,300 feet (701m) west and 200 feet (61m) north of the SE corner of Section 26, T18S, R14E (Photo No. & Coord. I-70, F-10).

A1--0 to 1 inch (0 to 2.5cm); pale brown (10YR 6/3) very stony sandy loam, brown (10YR 5/3) when moist; moderate medium subangular blocky structure; soft, friable; common very fine and few fine roots; many very fine and fine, few coarse vesicular pores; 35 percent gravel, and 15 percent stones and cobbles; moderately calcareous, carbonates are disseminated; moderately alkaline (pH 8.4); abrupt smooth boundary.

C1--1 to 19 inches (2.5 to 48.2cm); light yellowish brown (2.5Y 6/4) very gravelly fine sandy loam, olive brown (2.5Y 4/4) when moist; moderate medium subangular blocky structure; soft, friable; common very fine and few fine roots; common very fine pores; 30 percent gravel, 5 percent cobbles and 5 percent stones; moderately calcareous, carbonates are disseminated; strongly alkaline (pH 9.0); clear smooth boundary.

C2--19 to 60 inches (48.2 to 152cm); light yellowish brown (2.5Y 6/4) extremely gravelly sandy loam, light olive brown (2.5Y 5/4) when moist; massive; soft, friable; common very fine and few fine roots; 45 percent gravel, 10 percent cobbles and 10 percent stones; slightly calcareous, carbonates are disseminated; moderately alkaline (pH 8.0).

The A horizon has value of 5 or 6 dry and chroma of 3 or 4. It ranges from a very stony sandy loam to very stony fine sandy loam and is 1 to 10 inches (2.5 to 25.4cm) thick.

The C horizon has hue of 2.5Y or 10YR and value of 5 to 7 dry. It ranges from very gravelly loam to extremely gravelly sandy loam. The rock fragments range from 35 to 65 percent. The C horizon is moderately or strongly alkaline and is slightly or moderately calcareous.

EDF2 EA-PERSAYO-BADLAND COMPLEX, 8 TO 40 PERCENT SLOPES, ERODED

This complex consists of about 45 percent EA extremely cobbly silty clay loam, 15 to 40 percent slopes, eroded; 25 percent Persayo loam, 8 to 15 percent slopes, eroded; 20 percent Badland and 10 percent other soils. This complex occurs in shallow valley bottoms and remnant terraces at elevations of 5,300 to 5,700 feet (1,615 to 1,737m).

The EA soil occurs in the valley bottoms and the Persayo soil occurs on side slopes and terraces. The EA soil formed in alluvium from sandstone over residuum from shale and the Persayo soil is formed in residuum from shale.

The average annual precipitation is 6 to 9 inches (15.2 to 22.9cm). Mean annual air temperature is 47° to 50°F (8.3° to 10°C), mean annual soil temperature is 49° to 52°F (9.4° to 11.1°C), and the average freeze-free season is 120 to 150 days. This complex occurs 2 miles (3.2km) south of the intersection of the Horse Canyon Road and Highway 6 and 50.

Present vegetation is dominantly galleta, shadscale, scarlet globemallow, Indian ricegrass, and hairy grama.

Included in mapping are small areas of Ravola silt loam, 0 to 3 percent slopes, eroded; EA very cobbly loam, 3 to 8 percent slopes, eroded; EM cobbly loam, 3 to 20 percent slopes, eroded; Rubble land; and Persayo loam, 3 to 8 percent slopes, eroded.

This complex is used for rangeland and wildlife habitat.

EA extremely cobbly silty clay loam, 15 to 40 percent slopes, eroded

This EA soil is moderately deep and well drained.

Slopes are 15 to 40 percent and occur on all aspects. They are medium in length and single in shape.

In a representative profile the surface layer is grayish brown extremely cobbly silty clay loam about 2 inches (5cm) thick. The underlying layer is grayish brown and light brownish gray silty clay loam that is underlain by shale at depth of about 28 inches (71.1cm).

Permeability is very slow. Available water capacity is about 3.5 to 7.0 inches (8.9 to 17.8cm) above the shale. Water supplying capacity is about 3.0 to 5.0 inches (7.6 to 12.7cm). Organic matter content in the surface layer is very low. Effective rooting depth is about 20 to 40 inches (50.8 to 101.6cm). Surface runoff is medium and erosion hazard is high. The Erosion Condition Class is moderate-48.

The potential plant community is about 40 percent grasses, 20 percent forbs and 40 percent shrubs. Important plants are galleta, hairy grama, Indian ricegrass, bottlebrush squirreltail, scarlet globemallow, desert trumpet,

wooly Indianwheat, shadscale, other saltbushes, winterfat and Torrey Mormon-tea.

Practices needed to maintain or improve the range condition include the proper amount of plant use, the proper season of use, a planned system of grazing, and good water distribution.

This soil is in Capability Subclass VIIs, nonirrigated; Desert Loamy Shale D34 ecological site.

Taxonomic classification is fine, mixed (calcareous), mesic Typic Torriorthents.

A representative pedon of EA extremely cobbly silty clay loam, 15 to 40 percent slopes, eroded, was described 1 mile (1.6km) north and 0.5 mile (.8km) west of Woodside, at a point 2,300 feet (701m) south and 1,200 feet (366m) west of the NE corner of Section 36, T16S, R13E (Photo No. & Coord. 2-134-A, J-15).

A1--0 to 2 inches (0 to 5cm); grayish brown (2.5Y 5/2) extremely cobbly silty clay loam, dark grayish brown (2.5Y 4/2) when moist; weak medium subangular blocky structure; hard, firm, sticky and plastic; few very fine, fine, and medium roots; common fine pores; 25 percent gravel, 40 percent cobbles and stones; strongly calcareous, carbonates are disseminated; moderately alkaline (pH 8.0); abrupt smooth boundary.

C1--2 to 9 inches (5 to 22.9cm); light brownish gray (2.5Y 6/2) silty clay loam, dark grayish brown (2.5Y 4/2) when moist; weak medium subangular blocky structure; very hard, firm, sticky, plastic; few very fine, fine, and medium roots; common fine pores; strongly calcareous, carbonates are disseminated; strongly alkaline (pH 9.0); clear smooth boundary.

C2--9 to 22 inches (22.9 to 55.9cm); grayish brown (2.5Y 5/2) silty clay loam, dark grayish brown (2.5Y 4/2) when moist; weak medium subangular blocky structure; hard, firm, sticky, plastic; few very fine, fine, and medium roots; few fine pores; strongly calcareous, carbonates are disseminated; strongly alkaline (pH 9.0) clear smooth boundary.

C3--22 to 28 inches (55.9 to 71.1cm); light brownish gray (2.5Y 6/2) silty clay loam, grayish brown (2.5Y 5/2) when moist; massive; hard, firm, sticky, plastic; few very fine and fine roots; strongly calcareous, carbonates are disseminated; strongly alkaline (pH 8.8); abrupt smooth boundary.

C4r--28 inches (71.1cm); weathered shale.

Depth to weathered shale ranges from 20 to 40 inches (50.8 to 101.6cm).

The A horizon has hue of 2.5Y or 10YR, value of 4 to 6 dry, 4 or 5 moist, and chroma of 2 or 3. Gravel content ranges from 25 to 40 percent. Cobbles and stones range from 35 to 45 percent.

The C horizon has hue of 2.5Y or 10YR, value of 5 to 7 dry and 4 to 6 moist, and chroma of 2 to 4. It is silty clay loam or silty clay. The clay content ranges from 35 to 45 percent.

Persayo loam, 8 to 15 percent slopes, eroded

This Persayo soil is shallow and well drained.

Slopes are 8 to 15 percent and occur on all aspects. They are short and medium in length and convex-concave in shape.

In a representative profile the surface layer is pale brown fine sandy loam about 5 inches (12.7cm) thick. The underlying layer is pale brown shaly loam and overlies weathered shale at a depth of about 10 inches (25.4cm).

Permeability is moderate. Available water capacity is about 2.0 inches (5cm) above the shale. Water supplying capacity is about 2.0 to 2.5 inches (5 to 6.3cm). Organic matter content in the surface layer is very low. Effective rooting depth is about 10 to 20 inches (25.4 to 50.8cm). Surface runoff is medium and erosion hazard is high. The Erosion Condition Class is moderate-42. Flow patterns are well developed with intermittent deposits, and apparent movement of soil and surface litter.

The potential plant community is about 40 percent grasses, 20 percent forbs and 40 percent shrubs. Important plants are galleta, hairy grama, Indian ricegrass, bottlebrush squirreltail, scarlet globemallow, desert trumpet, wooly Indianwheat, shadscale, other saltbushes, winterfat and Torrey Mormon-tea.

Practices needed to maintain or improve the range condition include the proper amount of plant use, the proper season of use, a planned system of grazing, and good water distribution.

This soil is in Capability Subclass VIIs, nonirrigated; Desert Loamy Shale D34 ecological site.

A representative pedon of Persayo loam, 8 to 15 percent slopes, eroded, was described 2 miles (3.2km) south and 5 miles (8.0km) east of Wellington, 1,900 feet (579m) north and 2,100 feet (640m) west of the SE corner of Section 18, T15S, R12E (Photo No. & Coord. 1-64-A, I-2).

A1--0 to 5 inches (0 to 12.7cm); pale brown (10YR 6/3) fine sandy loam, brown (10YR 5/3) when moist; weak fine subangular blocky structure; slightly hard, friable, slightly sticky, slightly plastic; few very fine, fine and medium roots; common fine and few medium pores; moderately calcareous, carbonates are disseminated; strongly alkaline (pH 8.6); clear smooth boundary.

C1--5 to 10 inches (12.7 to 25.4cm); pale brown (10YR 6/3) shaly loam, brown (10YR 5/3) when moist; weak medium subangular blocky structure; slightly hard, firm, sticky, plastic; few very fine and fine roots; common very fine and few fine pores; strongly calcareous, carbonates are disseminated; strongly alkaline (pH 8.6); abrupt smooth boundary.

C2r--10 inches (25.4cm); shale.

Depth to shale ranges from 10 to 20 inches (25.4 to 50.8cm).

The A horizon has value of 4 to 6 dry, and chroma of 3 or 4. It is fine sandy loam or loam and is 2 to 6 inches (5 to 15.2cm) thick. The A horizon is moderately alkaline or strongly alkaline.

The C horizon has hue of 10YR or 2.5Y, value of 4 to 6 dry, and chroma of 1 to 4. It is shaly loam, loam, or silty clay loam with less than 35 percent clay content. The C horizon is slightly calcareous to strongly calcareous, and moderately alkaline to very strongly alkaline.

Badland

Badland consists of steep and very steep nearly barren beds of actively eroded shale; shale interbedded with sandstone; shale interbedded with gypsum; and occasionally small areas of shale capped by sandstone. The landscape is dissected by numerous intermittent drainage channels.

Runoff is very high and geological erosion is active.

Badland supports only very sparse salt tolerant vegetation.

Badland is in Capability Subclass VIIIs, and is not in an ecological site.

EED2 EA-BADLAND COMPLEX 8 TO 15 PERCENT SLOPES, ERODED

This complex consists of about 60 percent EA extremely cobbly silty clay loam, 8 to 15 percent slopes, eroded; 25 percent Badland, and 15 percent other soils.

This complex occurs on remnant terraces and small alluvial fans at elevations of 5,100 to 5,400 feet (1,554 to 1,646m). The EA soil is in the draws and the Badland occurs on the ridges. The soils formed in alluvium derived mainly from shale and sandstone.

The average annual precipitation is 6 to 9 inches (15.2 to 22.9cm). Mean annual air temperature is 47° to 50°F (8.3° to 10°C), mean annual soil temperature is 49° to 52°F (9.4° to 11.1°C), and the average freeze-free season is 120 to 150 days. This complex occurs approximately 10 miles (16.1km) south of East Carbon City. Slopes are 8 to 15 percent and on all aspects. They are medium in length and concave-convex in shape.

Included in mapping are small areas of Ravola silt loam, 0 to 3 percent slopes, eroded; EA very cobbly loam, 3 to 8 percent slopes, eroded; and Rubble land.

This complex is used for rangeland and wildlife habitat.

EA extremely cobbly silty clay loam, 8 to 15 percent slopes, eroded

This EA soil is moderately deep and well drained.

Present vegetation is dominantly galleta, shadscale, scarlet globemallow, and Indian ricegrass.

In a representative profile the surface layer is grayish brown extremely cobbly silty clay loam about 2 inches (5cm) thick. The underlying layer is grayish brown and light brownish gray silty clay loam underlain by shale at a depth of about 28 inches (71.1cm).

Permeability is slow. Available water capacity is about 3.5 to 7.0 inches (8.9 to 17.8cm) above the shale. Water supplying capacity is about 3.0 to 5.0 inches (7.6 to 12.7cm). Organic matter content in the surface layer is very low. Effective rooting depth ranges from 20 to 40 inches (50.8 to 101.6cm). Surface runoff is rapid and erosion hazard is high. The Erosion Condition Class is moderate-48. There are accumulations of soil and rock fragments behind small obstructions.

The potential plant community is about 40 percent grasses, 20 percent forbs and 40 percent shrubs. Important plants are galleta, hairy grama, Indian ricegrass, bottlebrush squirreltail, scarlet globemallow, desert trumpet, wooly Indianwheat, shadscale, other saltbushes, winterfat and Torrey Mormon-tea.

Practices needed to maintain or improve the range condition include the proper amount of plant use, the proper season of use, a planned system of grazing, and good water distribution.

This soil is in Capability Subclass VIIs, nonirrigated; Desert Loamy Shale D34 ecological site.

Taxonomic classification is fine, mixed (calcareous), mesic Typic Torriorthents.

A representative pedon of EA extremely cobbly silty clay loam, 8 to 15 percent slopes, eroded, was in mapping unit EDF2 located 1 mile (1.6km) north and 0.5 miles (.8km) west of Woodside, 2,300 feet (701m) south and 1,200 feet (366m) west of the NE corner of Section 36, T16S, R13E (Photo No. & Coord. 2-134-A, J-15) is used to represent this soil.

A1--0 to 2 inches (0 to 5cm); grayish brown (2.5Y 5/2) extremely cobbly silty clay loam, dark grayish brown (2.5Y 4/2) when moist; weak medium subangular blocky structure; hard, firm, sticky, plastic; few very fine, fine, and medium roots; common fine pores; 25 percent gravel, 40 percent cobbles and stones; strongly calcareous, carbonates are disseminated; moderately alkaline (pH 8.0); abrupt smooth boundary.

C1--2 to 9 inches (5 to 22.9cm); light brownish gray (2.5Y 6/2) silty clay loam, dark grayish brown (2.5Y 4/2) when moist; weak medium subangular blocky structure; very hard, firm, sticky, plastic; few very fine, fine, and medium roots; common fine pores; strongly calcareous, carbonates are disseminated; strongly alkaline (pH 9.0); clear smooth boundary.

C2--9 to 22 inches (22.9 to 55.9cm); grayish brown (2.5Y 5/2) silty clay loam, dark grayish brown (2.5Y 4/2) when moist; weak medium subangular blocky structure; hard, firm, sticky, plastic; few very fine, fine, and medium roots; few fine pores; strongly calcareous, carbonates and disseminated; strongly alkaline (pH 9.0); clear smooth boundary.

C3--22 to 28 inches (55.9 to 71.1cm); light brownish gray (2.5Y 6/2) silty clay loam, grayish brown (2.5Y 5/2) when moist; massive; hard, firm, sticky, plastic; few very fine and fine roots; strongly calcareous, carbonates are disseminated; strongly alkaline (pH 8.8); abrupt smooth boundary.

C4r--28 inches (71.1cm); weathered shale.

Depth to weathered shale ranges from 20 to 40 inches (50.8 to 101.6cm).

The A horizon has hue of 2.5Y or 10YR, value of 4 to 6 dry, 4 or 5 moist, and chroma of 2 or 3. Gravel content ranges from 25 to 40 percent. Cobbles and stones range from 35 to 45 percent.

The C horizon has hue of 2.5Y or 10YR, value of 5 to 7 dry and 4 to 6 moist, and chroma of 2 to 4. It is silty clay loam or silty clay. The clay content ranges from 35 to 45 percent.

Badland

Badland is a miscellaneous land type consisting of nearly barren steep to very steep shale outcrops; shale interbedded with sandstone; and sandstone capped hills. It is dissected by many intermittent drainage channels; local relief ranges between 25 and 500 feet (7.6 to 152m).

Runoff is very rapid and geologic erosion is active.

Badland supports only very sparse vegetation. It is used mainly for aesthetic purposes.

Badland is in Capability Subclass VIIIs, and is not placed in an ecological site.

GNA GLENBERG FINE SANDY LOAM, HIGH RAINFALL, 1 TO 3 PERCENT SLOPES

This Glenberg soil is very deep and well drained. It occurs on alluvial bottoms at elevations of 5,700 to 6,400 feet (1,737 to 1,950m). This soil formed in alluvium derived mainly from sandstone and shale.

The average annual precipitation is 12 to 14 inches (30.4 to 35.5cm). Mean annual air temperature is 47° to 49°F (8.3° to 9.4°C), mean annual soil temperature is 49° to 51°F (8.3° to 10.6°C), and the average freeze-free season is 115 to 140 days. This soil occurs west of Price along the South Fork of Gordon Creek. Slopes are 1 to 3 percent and occur on all aspects. They are short in length and single in shape.

Present vegetation is dominantly big sagebrush, sand dropseed, globemallow, Indian ricegrass, needle and thread and bottlebrush squirreltail.

Included in mapping are small areas of Haverson loam, high rainfall, 1 to 5 percent slopes; and an unnamed soil that is sand or a very gravelly sand.

In a representative profile the surface layer is light brownish gray fine sandy loam about 2 inches (5cm) thick. The underlying layer is grayish brown very fine sandy loam about 6 inches (15.2cm) thick. The next layer is light brownish gray loam and fine sandy loam to a depth of 60 inches (152cm) or more.

Permeability is moderate. Available water capacity is about 6.5 to 9.0 inches (16.5 to 22.9cm) to a depth of 60 inches (152cm). Water supplying capacity is about 6 to 8 inches (15.2 to 20.3cm). Organic matter content in the surface layer is low. Effective rooting depth is greater than 60 inches (152cm). Surface runoff is slow and erosion hazard is moderate. The Erosion Condition Class is slight-23.

This soil is used for rangeland, wildlife habitat, and recreation.

The potential plant community is about 60 percent grass, 10 percent forbs and 30 percent shrubs. Important plants are native bluegrasses, western wheatgrass, needle and thread, prairie junegrass, bluebunch wheatgrass, bottlebrush squirreltail, Salina wildrye, blue grama, scarlet globemallow, aster, meadow milkvetch, peavine, big sagebrush, Wyoming sagebrush, black sagebrush, yellowbrush and winterfat.

Practices for maintaining or improving vegetation include a planned grazing system, grazing for the proper percent of plant use, adequate fencing, and good water distribution.

Seeding is advisable if severe deterioration of potential plants has occurred.

This soil is in Capability Subclass VIc, Upland Loam D34, E47 ecological site.

Taxonomic classification is coarse-loamy, mixed, mesic Ustic Torrifluvents.

A representative pedon of Glenberg fine sandy loam, high rainfall, 1 to 3 percent slopes was described about 9 miles (14.5km) west of Price, 2,300 feet (701m) east and 2,200 feet (670m) north of SW corner of Section 11, T14S, R8E.

A1--0 to 2 inches (0 to 5cm); light brownish gray (2.5Y 6/2) fine sandy loam, very dark grayish brown (2.5Y 3/2) when moist; weak medium platy structure; slightly hard, friable, nonsticky, slightly plastic; common very fine, fine and few medium roots; common very fine pores; slightly calcareous; moderately alkaline (pH 8.2); abrupt smooth boundary.

C1--2 to 8 inches (5 to 20.3cm); grayish brown (10YR 5/2) very fine sandy loam, dark grayish brown (10YR 4/2) when moist; moderate medium subangular blocky structure; slightly hard, friable, nonsticky, slightly plastic; few very fine, fine and medium roots; common very fine, fine and few medium pores; moderately calcareous, carbonates are disseminated; moderately alkaline (pH 8.4); clear smooth boundary.

C2--8 to 20 inches (20.3 to 50.8cm); light grayish brown (2.5Y 6/2) loam, dark grayish brown (2.5Y 4/2) when moist; moderate medium subangular blocky structure; very hard, friable, slightly sticky, slightly plastic; few very fine, fine and medium roots; few very fine, fine and medium pores; slightly calcareous; strongly alkaline (pH 8.6); clear smooth boundary.

C3--20 to 60 inches (50.8 to 152cm); light grayish brown (2.5Y 6/2) fine sandy loam, dark grayish brown (2.5Y 4/2) when moist; massive; hard, friable, slightly sticky, slightly plastic; few very fine roots; moderately calcareous, carbonates are disseminated; strongly alkaline (pH 8.6).

The A horizon has hue of 7.5YR, 10YR and 2.5Y value of 5 or 6 dry and chroma of 2 to 4. It is typically fine sandy loam but includes loamy fine sand and very fine sandy loam. The A horizon is slightly to strongly calcareous and is 2 to 4 inches (5 to 10.1cm) thick.

The C horizon has hue of 7.5YR, 10YR and 2.5Y, value of 5 or 6 dry, and chroma of 2 to 4. It is typically fine sandy loam but ranges to very fine sandy loam and loam. The soil is stratified with thin layers of gravel to very gravelly fine sandy loam. The C horizon is slightly to strongly calcareous and is moderately to strongly alkaline.

HAC HAVERSON LOAM, 3 TO 8 PERCENT SLOPES

This Haverson soil is very deep and well drained. It occurs on sloping alluvial fans at elevations of 5,500 to 6,200 feet (1,676 to 1,889m). This soil formed in stratified, calcareous alluvium derived mainly from sandstone and shale.

The average annual precipitation is 10 to 12 inches (25.4 to 30.5cm). Mean annual air temperature is 47° to 49°F (8.3° to 9.4°C), mean annual soil temperature is 49° to 51°F (9.4° to 10.5°C), and the average freeze-free season is 115 to 140 days. This soil occurs in Clark Valley, near East Carbon City, Hiawatha and northeast of Wellington. Slopes are 3 to 8 percent and occur on all aspects. They are long in length and single in shape.

Present vegetation is dominantly big sagebrush, blue grama, Salina wildrye, winterfat, bottlebrush squirreltail and annual forbs.

Included in mapping are small areas of Glenberg very fine sandy loam, 3 to 6 percent slopes; Abra very fine sandy loam, 3 to 8 percent slopes; and Remmit very fine sandy loam, 1 to 6 percent slopes.

In a representative profile the surface layer is light brownish gray loam about 3 inches (7.6cm) thick. The underlying layer is very pale brown and pale brown loam and clay loam to a depth of 60 inches (152cm) or more.

Permeability is moderately slow. Available water capacity is about 9.0 to 11.5 inches (22.9 to 29.2cm) to a depth of 60 inches (152cm). The water supplying capacity is about 5.5 to 6.5 inches (13.9 to 16.5cm). Organic matter content in the surface layer is low. Effective rooting depth is greater than 60 inches (152cm). Surface runoff is slow and erosion hazard is moderate. The Erosion Condition Class is slight-30.

This soil is used for rangeland, wildlife habitat and recreation.

The potential plant community is about 50 percent perennial grasses, 15 percent forbs, and 35 percent shrubs. Important plants are Indian ricegrass, galleta, blue grama, Salina wildrye, needle and thread, globemallow, aster, pale evening primrose, locoweed, shadscale, fourwing saltbush, winterfat, big sagebrush, black sagebrush and yellowbrush.

Practices for maintaining or improving vegetation include a planned system of grazing, grazing for proper percent of plant use, and good water distribution.

Seeding may be advisable if the plant community shows much departure from potential. Seeding success may be attained during years of average or above average precipitation.

This soil is in Capability Subclass VIe, nonirrigated; Semidesert Loam (Sagebrush) D34 ecological site.

Taxonomic classification is fine-loamy, mixed (calcareous) mesic Ustic Torrifluvents.

A representative pedon of Haverson loam, 1 to 3 percent slopes in HAC located 2,300 feet (701m) west and 1,200 feet (366m) south of the NE corner of Section 18, T14S, R12E, in the Dugout Creek area of Clark Valley is used to represent this soil.

A1--0 to 3 inches (0 to 7.6cm); light brownish gray (10YR 6/2) loam, dark grayish brown (10YR 4/2) when moist; weak thin platy structure that parts to weak fine granular; slightly hard, friable, slightly sticky, slightly plastic; few fine, medium, and coarse roots; many very fine and few fine vesicular pores; strongly calcareous, carbonates are disseminated; moderately alkaline (pH 8.4); abrupt smooth boundary.

C1--3 to 10 inches (7.6 to 25.4cm); pale brown (10YR 6/3) loam, brown (10YR 4/3) when moist; weak medium subangular blocky structure; hard, friable, slightly sticky, plastic; few fine, medium and coarse roots; common very fine and fine pores; strongly calcareous, carbonates are disseminated; moderately alkaline (pH 8.4); clear wavy boundary.

C2--10 to 17 inches (25.4 to 43.2cm); very pale brown (10YR 7/3) loam, yellowish brown (10YR 5/4) when moist; weak medium subangular blocky structure; hard friable, slightly sticky, plastic; few fine roots; common very fine and fine pores; strongly calcareous, carbonates are disseminated; strongly alkaline (pH 8.8); clear wavy boundary.

C3--17 to 46 inches (43.2 to 116.8cm); pale brown (10YR 6/3) clay loam, yellowish brown (10YR 5/4) when moist; massive; very hard, firm, sticky, plastic; few fine roots; common very fine pores; strongly calcareous, carbonates are disseminated; strongly alkaline (pH 8.8); clear wavy boundary.

C4--46 to 60 inches (116.8 to 152cm); pale brown (10YR 6/3) loam, yellowish brown (10YR 5/4) when moist; massive; very hard, friable, slightly sticky, plastic; few very fine roots; common very fine pores; strongly calcareous, carbonates are disseminated; strongly alkaline (pH 8.6).

The range in characteristics has not been determined for this soil.

MRG--MENEFEE-ROCK OUTCROP COMPLEX, 40 TO 70 PERCENT SLOPES

This map unit is on south-facing canyon side slopes.

It is located in the canyons west of the Green River, east of Sunnyside and north of Price. Slopes are short in length and concave-convex in shape. The present vegetation is mainly pinyon, juniper, Salina wildrye, Mormon-tea, and a few scattered Douglas fir. Elevation is 5,000 to 8,100 feet (1,524 to 2,469m). The average annual precipitation is about 12 to 16 inches (30.5 to 40.6cm), the mean annual air temperature is 45° to 47°F, (7.2° to 8.3°C), and the average freeze-free season is 110 to 145 days.

This unit is 40 percent Menefee extremely bouldery loam, low rainfall, 40 to 70 percent slopes; 30 percent Rock outcrop, and 20 percent Shingle very shaly loam, low rainfall, 50 to 70 percent slopes, eroded. The Menefee soil is on steep and very steep canyon side slopes, the Rock outcrop is on canyon rims and ledges, and the Shingle soil is on steep and very steep canyon side slopes.

Included in this unit is about 5 percent Lazear sandy clay loam, 8 to 30 percent slopes on benches, 5 percent Guben extremely bouldery loam, 45 to 75 percent slopes on steep and very steep side slopes.

The Menefee soil is shallow and well drained. It formed in residuum and colluvium derived dominantly from sandstone and shale from the Green River Formation.

Typically, the surface layer is pale brown extremely bouldery loam about 2 inches (5cm) thick. The underlying layer is pale brown very fine sandy loam about 5 inches (12.7cm) thick. The next layer is light olive gray silt loam underlain by siltstone at a depth of about 9 inches (22.9cm). Depth to siltstone or shale ranges from 9 to 20 inches (22.9 to 50.8cm).

Permeability of the Menefee soil is moderate. Available water capacity, to a depth of 9 inches (22.9cm), is less than 2 inches (5cm). Water supplying capacity is 2 to 4 inches (5 to 10.2cm). The organic matter content of the surface layer is 1 to 3 percent. Effective rooting depth is 9 to 20 inches (22.9 to 50.8cm). Runoff is rapid, and the hazard of water erosion is high. The hazard of soil blowing is slight.

Rock outcrop consists of areas of exposed sandstone, siltstone and shale. It dominantly occurs on canyon rims and ledges.

The Shingle soil is shallow and well drained. It formed in residuum derived dominantly from shale.

Typically, the surface layer is pinkish gray very shaly loam about 3 inches (7.6cm) thick. The underlying layer is pinkish gray loam about 4 inches (10.2cm) thick. The next layer is very soft shale fragments to a depth of 14 inches (35.6cm) over weathered shale.

Permeability of the Shingle soil is moderately slow. Available water capacity, to a depth of 14 inches (35.6cm), is about 2 to 3 inches (5 to 7.6cm).

Water supply capacity is 2 to 3 inches (5 to 7.6cm). The organic matter content of the surface layer is 1 to 3 percent. Effective rooting depth is 10 to 20 inches (25.4 to 50.8cm). Runoff is rapid, and the hazard of water erosion is high. The hazard of soil blowing is slight.

This unit is used for range and wildlife habitat.

This Menefee soil is in Capability Subclass VIII and the Shingle soil is in Capability Subclass VIIe, nonirrigated.

MUE--CABBA-PODO-PATMOS COMPLEX, 3 TO 30 PERCENT SLOPES

This map unit is on bedrock controlled benches, canyon rims, and toe slopes. It is east of Range Creek, south of Nine Mile Canyon and west of the Green River Canyon. Slopes are short in length and concave-convex in shape. The present vegetation is mainly pinyon, juniper, Mormon-tea, blacksage and shadscale. Elevation is 5,900 to 8,200 feet (1,798 to 2,499m). The average annual precipitation is about 12 to 16 inches (30.5 to 40.6cm), the mean annual air temperature is 42° to 45°F (5.6° to 7.2°C) and the average freeze-free season is 60 to 120 days.

This unit is 30 percent Cabba gravelly loam, 3 to 30 percent slopes, 30 percent Podo gravelly sandy loam, 3 to 30 percent slopes, and 20 percent Patmos very gravelly loam, low rainfall, 3 to 30 percent slopes. The Cabba and Podo soils are intermixed on the landscape while the Patmos soil is found on toe slopes and small ridge slopes.

Included in this unit is about 10 percent Macar Variant fine sandy loam, 3 to 8 percent slopes on toe slopes and bench interiors; 5 percent Macar Variant silt loam, 3 to 15 percent slopes on toe slopes and some bench interiors; 5 percent Rock outcrop on canyon rims and on benches as sandstone outcrops.

The Cabba soil is shallow and well drained. It formed in colluvium and residuum derived dominantly from interbedded shale and sandstone.

Typically, the surface layer is pale brown gravelly loam about 2 inches (5cm) thick. The underlying layer is brown gravelly loam underlain by weathered shale at a depth of 13 inches (33cm). Depth to shale ranges from 10 to 20 inches (25.4 to 50.8cm).

Permeability of the Cabba soil is moderate. Available water capacity to a depth of 7 inches (17.8cm), is about 1 to 3 inches (2.5 to 7.6cm). Water supply capacity is 2 to 5 inches (5 to 12.7cm). The organic matter content of the surface layer is 1 to 3 percent. Effective rooting depth is 7 to 20 inches (17.8 to 50.8cm). Runoff is medium, and the hazard of water erosion is moderate. The hazard of soil blowing is slight.

The Podo soil is shallow and well drained. It formed in residuum and colluvium derived dominantly from sandstone.

Typically, the surface layer is brown sandy loam about 2 inches (5cm) thick. The underlying layer is brown loam about 6 inches (15.2cm) thick. The next layer is brown gravelly sandy loam underlain by fractured sandstone at a depth of about 11 inches (27.9cm). Depth to fractured sandstone ranges from 10 to 20 inches (25.4 to 50.8cm).

Permeability of the Podo soil is moderate. Available water capacity, to a depth of 11 inches (27.9cm), is about 1 to 3 inches (2.5 to 7.6 cm). Water supply capacity is 2 to 4 inches (5 to 10.2cm). The organic matter content of the surface layer is 1 to 3 percent. Effective rooting depth is 10 to 20 inches (25.4 to 50.8cm). Runoff is medium, and the hazard of water erosion is moderate. The hazard of soil blowing is slight.

NVF2 LAZEAR-ROCK OUTCROP-RUBBLE LAND COMPLEX, 20 to 50 PERCENT SLOPES, ERODED

This complex consists of about 55 percent Lazear sandy clay loam, high rainfall, 20 to 50 percent slopes, eroded; 15 percent Rock outcrop; 15 percent Rubble land; and 15 percent other soils.

This complex occurs on mountain slopes. There is no definite pattern of occurrence of the Lazear soil, Rock outcrop and Rubble land on the landscape. Elevations are 6,000 to 8,500 feet (1,829 to 2,591m). The soils formed in residuum and colluvium of sandstone.

The average annual precipitation is 12 to 14 inches (30.5 to 35.5cm). Mean annual air temperature is 45° to 47°F (7.2° to 8.3°C), mean annual soil temperature is 47° to 49°F (8.3° to 9.4°C), and the average freeze-free season is 100 to 120 days. This complex occurs south of Hiawatha and also east of the Book Cliffs. Slopes are 20 to 50 percent and occur predominantly on east and west aspects. They are short or medium in length and concave-convex in shape.

Included in mapping are small areas of Ildefonso very stony loam, 30 to 50 percent slopes.

This complex is used for rangeland and wildlife habitat.

Lazear sandy clay loam, high rainfall, 20 to 50 percent slopes, eroded

This Lazear soil is shallow and somewhat excessively drained.

Present vegetation is dominantly pinyon, juniper, Salina wildrye, birchleaf mountain mahogany, and snowberry.

In a typical profile the surface layer is reddish brown sandy clay loam about 3 inches (7.6cm) thick. The underlying layer is reddish brown loam underlain by sandstone at a depth of 7 inches (17.8cm).

Permeability is moderate. Available water capacity is about 2 to 3 inches (5 to 7.6cm) above the sandstone. Water supplying capacity is about 3 to 4 inches (7.6 to 10.2cm). Organic matter content in the surface layer is moderate. Effective rooting depth is about 3 to 20 inches (7.6 to 50.8cm). Surface runoff is rapid and erosion hazard is high. Erosion Condition Class is slight-31. Moderate movement of soil is visible as slight terracing against obstacles and as pedestals in well defined flow patterns.

The potential plant community consists of an overstory of pinyon pine and Utah juniper which has a canopy cover of about 20 percent. The natural vegetation consists of about 35 percent grasses, 10 percent forbs, 20 percent shrubs and 35 percent trees. Important plants are Salina wildrye, Indian ricegrass, muttongrass, Sandberg bluegrass, blue grama, needle and thread grass, squirreltail, western wheatgrass, rock goldenrod, *Hymenoxys* spp; Hood phlox, pentstemon, pinyon pine, Utah juniper, cliffrose, birchleaf mountain mahogany, Torrey Mormon-tea, winterfat, and big sagebrush.

The pinyon pine and Utah juniper are in Site Class III. The site index is less than 30 and the Woodland Suitability Group is 3d. The average woodland productivity is less than 3 cords of wood per acre. The potential for fence posts or Christmas trees is very poor.

Practices needed to improve or maintain the vegetation include grazing for the proper percent of plant use, a planned system of grazing, and good water distribution.

This soil is in Capability Subclass VIIs, nonirrigated; Upland Shallow Loam (Pinyon-Juniper) D34, E47 ecological site.

Taxonomic classification is loamy, mixed (calcareous) Mesic Lithic Ustic Torriorthents.

A representative pedon of Lazear sandy clay loam, high rainfall, 1 to 8 percent slopes in the NXC mapping unit described 6.5 miles (10.5km) north and 4.0 miles (6.4km) west of the confluence of the Green and Price Rivers; about 2,700 feet (823m) south and 800 feet (244m) west of the NE corner of Section 7, T17S, R15E (Photo No. & Coord. 1-63-A, I-12) is used to represent this soil.

A1--0 to 3 inches (0 to 7.6cm); reddish-brown (5YR 5/3) sandy clay loam, reddish brown (5YR 4/3) when moist; moderate fine granular structure, soft, friable, sticky, plastic;common very fine and fine, few medium and coarse roots; 5 percent fine gravel;strongly calcareous, carbonates are disseminated; strongly alkaline (pH 8.6);abrupt smooth boundary.

C1--3 to 7 inches (7.6 to 17.8cm); reddish brown (5YR 5/3) loam reddish brown (5YR 4/3) when moist; massive; soft, friable, slightly sticky, slightly plastic; common very fine and medium, few coarse roots; 15 percent soft fine gravel; strongly calcareous, carbonates are disseminated; strongly alkaline (pH 8.6); abrupt smooth boundary.

R--7 inches (17.8cm); sandstone.

Depth to bedrock ranges from 3 to 20 inches (7.6 to 50.8cm). The range in other characteristics of this soil has not been determined.

Rock outcrop

Rock outcrop is nearly bare exposed bedrock consisting mainly of sandstone, conglomerate sandstone and limestone.

Rock outcrop is in Capability Subclass VIIIs, and is not placed in an ecological site.

Rubble land

Rubble land is areas of stones and boulders virtually free of vegetation except for lichens.

Rubble land is in Capability Subclass VIIIs, and is not placed in a range site.

NXC LAZEAR-ROCK OUTCROP COMPLEX, HIGH RAINFALL, 1 TO 8 PERCENT SLOPES

This complex consists of about 65 percent Lazear sandy clay loam, high rainfall, 1 to 8 percent slopes; 25 percent Rock outcrop; and 10 percent other soils.

This complex occurs on bench and mesa tops. The Lazear soil is intermixed with the Rock outcrop. Elevations are 5,600 to 7,200 feet (1,707 to 2,194m). The Lazear soil formed in residuum from sandstone.

The average annual precipitation is 12 to 14 inches (30.5 to 35.6cm). Mean annual air temperature is 45° to 49°F (7.2° to 9.4°C), mean annual soil temperature is 47° to 51°F (8.3° to 10.6°C), and the average freeze-free season is 100 to 140 days. This complex occurs on the Book Cliffs and west of Helper. Slopes are 1 to 8 percent and on all aspects. They are medium and long in length and undulating in shape.

Present vegetation is dominantly pinyon, juniper, Salina wildrye, birchleaf mountain mahogany, and snowberry.

Included in mapping are small areas of a soil similar to Lazear except moderately deep and Shingle extremely stony loam, 8 to 20 percent slopes, eroded.

Lazear sandy clay loam, high rainfall, 1 to 8 percent slopes

This Lazear soil is very shallow and somewhat excessively drained.

In a representative profile the surface layer is reddish brown sandy clay loam about 3 inches (7.6cm) thick. The underlying layer is reddish brown loam underlain by sandstone at a depth of about 7 inches (17.8cm).

Permeability is moderate. Available water capacity is about 2 to 3 inches (5 to 7.6cm) above the sandstone. Water supplying capacity is about 3 to 4 inches (7.6 to 10.2cm). Organic matter content in the surface layer is low. Effective rooting depth is about 3 to 20 inches (7.6 to 50.8cm). Surface runoff is slow and erosion hazard is moderate. The Erosion Condition Class is slight-39.

This soil is used for rangeland and wildlife habitat.

The potential plant community consists of an overstory of pinyon pine and Utah juniper which has a canopy cover of about 20 percent. The natural vegetation consists of about 35 percent grasses, 10 percent forbs, 20 percent shrubs and 35 percent trees. Important plants are Salina wildrye, Indian ricegrass, muttongrass, Sandberg bluegrass, blue grama, needle and thread grass, squirreltail, western wheatgrass, rock goldenrod, *Hymenoxys* spp; Hood phlox, pentstemon, pinyon pine, Utah juniper, cliffrose, birchleaf mountain mahogany, Torrey Mormon-tea, winterfat, and big sagebrush.

The pinyon pine and Utah juniper are in Site Class III. The site index is less than 30 and the Woodland Suitability Group is 3d. The average woodland productivity is less than 3 cords of wood per acre. The potential for fence posts or Christmas trees is very poor.

Practices needed to improve or maintain the vegetation include grazing for proper percent of plant use, a planned system of grazing, and good water distribution.

This soil is in the Capability Subclass VIIs, nonirrigated; Upland Shallow Loam (Pinyon-Juniper) D34, E47 ecological site.

Taxonomic classification is loamy, mixed (calcareous) mesic Lithic Ustic Torriorthents.

A representative pedon of Lazear sandy clay loam, high rainfall, 1 to 8 percent slopes was described 6.5 miles (10.5km) north and 4.0 miles (6.4km) west of the confluence of the Green and Price Rivers; about 2,700 feet (823m) south and 800 feet (244m) west of the NE corner of Section 7, T17S, R15E (Photo No. & Coord. L-63-A, I-12).

A1--0 to 3 inches (0 to 7.6cm); reddish brown (5YR 5/3) sandy clay loam, reddish brown (5YR 4/3) when moist; moderate fine granular structure; soft, friable, sticky, plastic; common very fine and fine, few medium and coarse roots; 5 percent soft fine gravel; strongly calcareous, carbonates are disseminated; strongly alkaline (pH 8.6); abrupt smooth boundary.

C1--3 to 7 inches (7.6 to 17.8cm); reddish brown (5YR 5/3) loam, reddish brown (5YR 4/3) when moist; massive; soft, friable, slightly sticky, slightly plastic; common very fine and medium, few coarse roots; 15 percent soft fine gravel; strongly calcareous, carbonates are disseminated; strongly alkaline (pH 8.6); abrupt smooth boundary.

R--7 inches (17.8cm); sandstone.

Depth to sandstone ranges from 3 to 20 inches (7.6 to 50.8cm).

The A horizon is moderate or strongly calcareous and moderate or strongly alkaline. It is 1 to 5 inches (2.5 to 12.7cm) thick.

The C horizon is loam, sandy clay loam, and gravelly fine sandy loam. Gravel content ranges from 0 to 35 percent. The C horizon is moderately to strongly calcareous and moderately to strongly alkaline.

Rock outcrop

Rock outcrop is exposed bedrock consisting of sandstone, conglomerate sandstone and limestone.

Rock outcrop is in Capability Subclass VIIIs, and is not rated for an ecological site.

PEC2 PERSAYO LOAM, 3 TO 8 PERCENT SLOPES, ERODED

This Persayo soil is shallow and well drained. It occurs on rolling shale hills at elevations of 5,350 to 5,900 feet (1,631 to 1,798m). This soil formed in residuum derived mainly from shale and sandstone.

The average annual precipitation is 6 to 8 inches (15.2 to 20.3cm). Mean annual air temperature is 47° to 50°F (8.3° to 10°C), mean annual soil temperature is 49° to 52°F (9.4° to 11.1°C), and the average freeze-free season is 120 to 150 days. This soil occurs at the lower end of Clark Valley, in the Mounds area, and west of Cedar Mountain. Slopes are 3 to 8 percent and occur on all aspects. They are short in length and convex-concave in shape.

Present vegetation is dominantly shadscale, galleta, wedgeleaf Nuttall saltbush, hairy grama, and Indian ricegrass.

Included in mapping are small areas of Killpack fine sandy loam, 1 to 8 percent slopes and Persayo loam, 8 to 15 percent slopes, eroded.

In a representative profile the surface layer is a pale brown loam about 5 inches (12.7cm) thick. The underlying layer is pale brown shaly loam and overlies shale at a depth of about 10 inches (25.4cm).

Permeability is moderate. Available water capacity is about 2.0 inches (5cm) above the shale. Water supplying capacity is about 2.0 to 2.5 inches (5 to 6.3cm). Organic matter content in the surface layer is very low. Effective rooting depth is about 10 to 20 inches (25.4 to 50.8cm). Surface runoff is medium and erosion hazard is high. The Erosion Condition Class is moderate-42. There is apparent movement of soil and surface litter. There are also well defined flow patterns with intermittent deposits.

This soil is used for rangeland and wildlife habitat.

The potential plant community is about 40 percent grasses, 20 percent forbs and 40 percent shrubs. Important plants are galleta, hairy grama, Indian ricegrass, bottlebrush squirreltail, scarlet globemallow, desert trumpet, wooly Indianwheat, shadscale, other saltbrushes, winterfat and Torrey Mormon-tea.

Practices needed to maintain or improve the range condition include the proper amount of plant use, the proper season of use, a planned system of grazing, and good water distribution.

This soil is in Capability Subclass VIIs, nonirrigated; Desert Loamy Shale D34 ecological site.

Taxonomic classification is loamy, mixed (calcareous), mesic, shallow, Typic Torriorthents.

A representative pedon of Persayo loam, 3 to 8 percent, eroded, was described 2 miles (3.2km) south and 5 miles (8.0km) east of Wellington, 1,900

feet (579m) north and 2,100 feet (640m) west of the SE corner of Section 18, T15S, R12E (Photo No. & Coord. 1-64-A; I-2).

A1--0 to 5 inches (0 to 12.7cm); pale brown (10YR 6/3) loam, brown (10YR 5/3) when moist; weak fine subangular blocky structure; slightly hard, friable, slightly sticky, and slightly plastic; few very fine, fine, and medium roots; common fine and few medium pores; moderately calcareous, carbonates are disseminated; strongly alkaline (pH 8.6); clear smooth boundary.

C1--5 to 10 inches (12.7 to 25.4cm); pale brown (10YR 6/3) loam, brown (10YR 5/3) when moist; weak medium subangular blocky structure; slightly hard, firm, sticky, plastic; few very fine and fine roots; common very fine and few fine pores; 30 percent soft shale fragments; strongly calcareous, carbonates are disseminated; strongly alkaline (pH 8.6); abrupt smooth boundary.

C2r--10 inches (25.4cm); weathered shale.

Depth to shale ranges from 10 to 20 inches (25.4 to 50.8cm).

The A horizon has value of 5 or 6 dry, and chroma of 3 or 4. It is loam or fine sandy loam, and is 2 to 6 inches (5 to 15.2cm) thick. The A horizon ranges from moderately alkaline to strongly alkaline.

The C horizon has hue of 10YR or 2.5Y, value of 5 or 6 dry, and chroma of 1 to 3. It is loam, or silty clay loam with less than 35 percent clay. The C horizon ranges from slightly calcareous to strongly calcareous and moderately alkaline to strongly alkaline. The shale fragments are soft.

RJA2 RAVOLA SILT LOAM, SALINE, 0 TO 3 PERCENT SLOPES, ERODED

This Ravola soil is very deep, well-drained, and affected by salt. It occurs on alluvial fans and on narrow valley floors at elevations of 4,200 to 4,800 feet (1,280 to 1,463m). This soil formed in alluvium derived mainly from shale and sandstone.

The average annual precipitation is 6 to 8 inches (15.2 to 20.3cm). Mean annual air temperature is 50° to 52°F (10° to 11.1°C), mean annual soil temperature is 52° to 54°F (11.1° to 12.2°C), and the average freeze-free season is 150 to 165 days. This soil occurs in the area along Highway 6 and 50 between the Horse Canyon turnoff and Green River. Slopes are 0 to 3 percent and occur on all aspects. They are long in length and single in shape.

Present vegetation is dominantly Nuttall saltbush, inkweed, wedgeleaf Nuttall saltbush, greasewood and annual mustards.

Included in mapping are small areas of Ravola silt loam, 0 to 3 percent slopes, eroded and Ravola silt loam, saline, 0 to 3 percent slopes, severely eroded.

In a representative profile the surface layer is pale brown silt loam about 2 inches (5cm) thick. The next layer is brown silt loam to a depth of 60 inches (152cm) or more. Salinity effect ranges from slight in the surface to strong in the underlying layers.

Permeability is moderately slow. Available water capacity is about 5.0 to 7.5 inches (12.7 to 19cm) to a depth of 5 feet (1.5m) because of the salt in the soil. The water supplying capacity is about 3.5 to 4.5 inches (8.9 to 11.4cm). Organic matter content in the surface layer is very low. Effective rooting depth is about 60 inches (152cm). Surface runoff is slow and erosion hazard is moderate. The Erosion Condition Class is moderate-57. The soil is dissected by gullies 5 to 20 feet (1.5 to 6.1m) deep at 50 to 200 feet (15.2 to 61m) intervals, fed by rills 15 to 20 feet (4.6 to 6.1m) apart in a dendritic pattern.

This soil is used for rangeland and wildlife habitat.

The potential plant community is about 20 percent grasses, 20 percent forbs and 60 percent shrubs. Important plants are galleta, tall dropseed, Indian ricegrass, globemallow, Indianwheat, desert trumpet, beeweed, Nuttall saltbush, wedgeleaf Nuttall saltbush, mat saltbush, shadscale and winterfat.

Practices needed for maintaining or improving the vegetation include proper season of use, the proper amount of plant use, a planned system of grazing, and good water distribution.

This soil is in Capability Subclass VIIs, nonirrigated; Desert Salt Flat D35 ecological site.

Taxonomic classification is fine-silty, mixed (calcareous), mesic Typic Torrifluvents.

A representative pedon of Ravola silt loam, saline, 0 to 3 percent slopes, eroded, was described 4.5 miles (7.2km) west of Green River; 1,300 feet (396m) east and 20 feet (6.1m) north of the SW corner of Section 15, T22S, R15E (Photo No. & Coord. 2-139,E-18).

A1--0 to 2 inches (0 to 5cm); pale brown (10YR 6/3) silt loam, brown (10YR 4/3) when moist; moderate thin platy structure; soft, very friable, slightly sticky, slightly plastic; common very fine, few fine and medium roots; many very fine and few fine pores; moderately calcareous, carbonates are disseminated; very strongly alkaline (pH 9.2): abrupt smooth boundary.

C1--2 to 9 inches (5 to 22.9cm); brown (10YR 5/3) silt loam, dark grayish brown (10YR 4/2) when moist; moderate coarse subangular blocky structure; slightly hard, very friable, slightly sticky and slightly plastic; common very fine, few fine and medium roots; few very fine and common fine pores; moderately calcareous, carbonates are disseminated; strongly alkaline (pH 9.0); clear smooth boundary.

C2--9 to 60 inches (22.9 to 152cm); brown (10YR 5/3) silt loam, dark grayish brown (10YR 4/2) when moist; massive; slightly hard, very friable, slightly sticky, slightly plastic; common very fine, few fine and medium roots; common very fine and fine pores; moderately calcareous, carbonates are disseminated; strongly alkaline (pH 9.0).

The A horizon has a hue of 10YR or 2.5Y and chroma of 2 or 3 dry. It is typically silt loam but ranges to loam. The A horizon is moderately to very strongly alkaline.

The C horizon has a hue of 10YR or 2.5Y, value of 5 or 6 dry, and chroma of 2 or 3 dry. It is typically silt loam but is stratified by thin lenses of silty clay loam, fine sandy loam, very fine sand and loam in some pedons. The C horizon is moderately to very strongly alkaline.

RR ROCK OUTCROP-RUBBLE LAND-BADLAND COMPLEX

This complex consists of about 40 percent Rock outcrop; 35 percent Rubble land; and 25 percent Badland. It is on canyon and mesa escarpments. The Rock outcrop and Badland occur as alternating strata. The Rubble land occurs as narrow bands of rock debris that are fan shaped and originate from exposed and fractured sandstone lenses.

This complex is mapped throughout the survey area but primarily in the central and eastern part.

The Badland may support only very sparse salt tolerant vegetation.

This complex is used mainly for aesthetic purposes.

Rock outcrop

Rock outcrop is exposed bedrock consisting of sandstone, conglomerate sandstone and limestone.

Rock outcrop is in Capability Subclass VIIIs and is not rated for an ecological site.

Rubble land

Rubble land consists of areas covered by stones and boulders to the point that practically no soil is exposed.

Rubble land is in Capability Subclass VIIIs, and is not placed in an ecological site.

Badland

Badland consists of steep and very steep nearly barren beds of actively eroded shale, shale interbedded with gypsum, and occasionally small areas of shale capped by sandstone. The landscape is dissected by numerous intermittent drainage channels.

Runoff is very rapid. The sediment potential is high during intense summer thunderstorms.

Badland is in Capability Subclass VIIIs, and is not placed in an ecological site.

RVD ROCK OUTCROP-SUNUP COMPLEX, 3 TO 15 PERCENT SLOPES

This complex consists of about 70 percent Rock outcrop; 20 percent Sunup extremely gravelly fine sandy loam, 3 to 15 percent slopes; and 10 percent other soils.

This complex occurs on cuesta dipslopes and mesas. The Rock outcrop occurs as gently sloping to sloping exposures of conglomerate sandstone and the Sunup occurs as discontinuous pockets of soil surrounded by the Rock outcrop. Elevations are 4,800 to 7,000 feet (1,463 to 2,134m). The soils formed in residuum of conglomerate sandstone.

The average annual precipitation is 8 to 12 inches (20.3 to 30.5cm). Mean annual air temperature is 47° to 50°F (8.3° to 10°C), mean annual soil temperature is 49° to 52°F (9.4° to 11.1°C), and the average freeze-free season is 110 to 150 days. This complex occurs from the Green River to the western edge of Cedar Mountain between the Horse Canyon Junction and the town of Green River. Slopes are 3 to 15 percent and occur on all aspects. They are short in length and single to convex in shape.

Present vegetation is dominantly juniper, pinyon, cliffrose, Mormon-tea, bullgrass and galleta.

Included in mapping are small areas of Lazear loam, 3 to 15 percent slopes and Pinon fine sandy loam, low rainfall, 3 to 15 percent slopes.

This complex is used for rangeland and wildlife habitat.

Rock outcrop

Rock outcrop is exposed bedrock consisting of sandstone, conglomerate sandstone, and limestone.

Rock outcrop is in Capability Subclass VIIIs, and is not rated for an ecological site.

Sunup extremely gravelly fine sandy loam, 3 to 15 percent slopes

This soil is shallow and somewhat excessively drained.

In a representative profile the surface layer is light brown extremely gravelly fine sandy loam about 2 inches (5cm) thick. The underlying layer is light brown and very pale brown gravelly and very gravelly fine sandy loam underlain by conglomerate at a depth of about 11 inches (27.9cm).

Permeability is moderately rapid. Available water capacity is about 0.75 to 1.0 inches (1.9 to 2.5cm) above the sandstone. Water supplying capacity is about 1.5 to 2.5 inches (3.8 to 6.3cm). Organic matter content in the

surface layer is low. Effective rooting depth is about 5 to 20 inches (12.7 to 50.8cm). Surface runoff is medium and erosion hazard is high. The Erosion Condition Class is slight-37.

The potential plant community is about 30 percent grasses, 10 percent forbs and 60 percent shrubs and trees. Important plants are galleta, Indian ricegrass, needle and thread, Salina wildrye, ballhead gilia, globemallow, littleleaf mountain mahogany, winterfat, slenderbush eriogonum, shadscale, yellowbrush, Mormon-tea, greasebush, pinyon pine and Utah juniper.

The pinyon pine and Utah juniper are in Site Class III, the site index is 14±5 and the Woodland Suitability Group is 3d. The average production is less than 3 cords of wood per acre. The potential for fence posts and Christmas trees is very poor.

Practices needed to improve or maintain the vegetative cover include grazing for the proper percent of plant use, grazing for the proper season of use, and a well planned rotational system of grazing.

This soil is in Capability Subclass VIIs, nonirrigated; Semidesert Very Shallow Loam (Juniper-Pinyon) D34 ecological site.

Taxonomic classification is loamy-skeletal, mixed (calcareous), mesic Lithic Ustic Torriorthents.

A representative pedon of Sunup extremely gravelly fine sandy loam, 3 to 15 percent slopes was described 2,350 feet (716m) west and 2,200 feet (670m) south of the NE corner of Section 18, T20S, R14E (Photo No. & Coord. 6-30, H-16).

A1--0 to 2 inches (0 to 5cm); light brown (7.5YR 6/4) extremely gravelly fine sandy loam, dark brown (7.5YR 4/4) when moist; weak very fine subangular blocky structure; soft, very friable, slightly sticky, slightly plastic; few very fine roots; many very fine and fine pores; 75 percent gravel and 5 percent cobbles; moderately calcareous, carbonates are disseminated; moderately alkaline (pH 8.4); abrupt smooth boundary.

C1--2 to 4 inches (5 to 10.2cm); light brown (7.5YR 6/4) gravelly fine sandy loam, brown (7.5YR 5/4) when moist; massive; soft, very friable, slightly sticky, slightly plastic; few very fine roots; many very fine and few fine pores; 25 percent gravel; moderately calcareous, carbonates are disseminated; moderately alkaline (pH 8.2); abrupt smooth boundary.

C2--4 to 11 inches (10.2 to 27.9cm); very pale brown (10YR 7/3) very gravelly fine sandy loam, light yellowish brown (10YR 6/4) when moist; massive; soft, very friable, slightly sticky, slightly plastic; few very fine and fine roots; common very fine pores; 40 percent gravel; moderately calcareous, carbonates are disseminated; moderately alkaline (pH 8.4); abrupt smooth boundary.

R--11 inches (27.9cm); conglomerate.

Depth to conglomerate ranges from 5 to 20 inches (12.7 to 50.8cm).

The A horizon has hue of 7.5YR or 10YR, value of 5 or 6 dry, 4 or 5 moist, and chroma of 3 or 4. It is 1 to 2 inches (2.5 to 5cm) thick.

The C horizon has hue of 7.5YR, 10YR or 2.5Y, value of 5 to 7 dry, 4 to 6 moist, and chroma of 2 to 4. It is gravelly or very gravelly fine sandy loam. The C horizon contains from 25 to 65 percent gravel and 0 to 40 percent flagstones. It is moderately or strongly calcareous and moderately or strongly alkaline.

The following list and descriptions are of soils found as inclusions within the mapping units and which have not been previously described:

Abra very fine sandy loam, 1 to 3 percent slopes

Aquic Ustifluvent

Avalon loam, 1 to 5 percent slopes

Avalon fine sandy loam, 1 to 5 percent slopes

Beenom very gravelly fine sandy loam

Bributte gravelly silty clay loam, 3 to 25 percent slopes, eroded

CG very gravelly fine sandy loam, 1 to 8 percent slopes, eroded

Chilton very stony fine sandy loam, low rainfall, 15 to 30 percent slopes, eroded

Chilton extremely bouldery fine sandy loam, low rainfall, 3 to 20 percent slopes, eroded

Chipeta silty clay loam, 3 to 8 percent slopes, eroded

Comodore very stony, very fine sandy loam, 50 to 60 percent slopes, eroded

DI cobbly loam, 30 to 50 percent slopes, eroded

DK cobbly loam, 30 to 50 percent slopes

Glenberg very fine sandy loam, 3 to 6 percent slopes

Glenton fine sandy loam, 1 to 6 percent slopes

Greybull loam, 3 to 8 percent slopes

Haverson loam, high rainfall, 1 to 5 percent slopes

Havre loam, 3 to 8 percent slopes

Ildefonso very stony loam, 8 to 30 percent slopes

Killpack fine sandy loam, 1 to 8 percent slopes

Lazear loam, 3 to 15 percent slopes

Macar variant fine sandy loam

Moreno extremely bouldery loam

Parkay very stony loam

Patmos very gravelly loam, low rainfall

Persayo extremely shaly loam, 8 to 30 percent slopes, eroded

Persayo very cobbly clay loam, 15 to 30 percent slopes

Pinyon fine sandy loam, low rainfall, 3 to 15 percent slopes

Remmit very fine sandy loam, 1 to 6 percent slopes

Shingle extremely stony loam, 50 to 70 percent slopes, eroded

Warneke variant gravelly loam, 0 to 3 percent slopes

Zillion very stony fine sandy loam, 15 to 40 percent slopes

ABRA VERY FINE SANDY LOAM, 1 TO 3 PERCENT SLOPES

This Abra soil is very deep and well drained. It occurs on alluvial fans at elevations of 5,600 to 6,500 feet (1,707 to 1,981m). This soil formed in alluvium derived mainly from sandstone and shale.

The average annual precipitation is 10 to 12 inches (25.4 to 30.5cm). Mean annual air temperature is 47° to 49°F (8.3° to 9.4°C), mean annual soil temperature is 49° to 51°F (9.4° to 10.6°C), and the average freeze-free season is 115 to 140 days. This soil occurs south and west of Sunnyside, and also north and east of Wattis. Slopes are 1 to 3 percent and occur predominantly on southwest and east aspects. They are long in length and single in shape.

Present vegetation is dominantly big sagebrush, needle and thread, squirreltail, shadscale, and Indian ricegrass.

In a representative profile the surface layer is pale brown very fine sandy loam and loam about 7 inches (17.8cm) thick. The underlying layer is white loam and stony loam about 21 inches (53.3cm) thick. The next layer is light brownish gray very fine sandy loam to a depth of 60 inches (152cm) or more. The lower layer below depth of about 33 inches (83.8cm) is moderately saline.

Permeability is moderate. Available water capacity is about 7.5 inches to 10.0 inches (19 to 25.4cm) to a depth of 60 inches (152cm). Water supplying capacity is about 6 to 7 inches (15.2 to 17.8cm). Organic matter content in the surface layer is low. Effective rooting depth is greater than 60 inches (152cm). Surface runoff is slow and erosion hazard is slight. The Erosion Condition Class is slight-33.

This soil is used for rangeland and wildlife habitat.

The potential plant community is about 50 percent perennial grasses, 15 percent forbs, and 35 percent shrubs. Important plants are Indian ricegrass, galleta, blue grama, Salina wildrye, needle and thread, globemallow, aster, pale evening primrose, locoweed, shadscale, fourwing saltbush, winterfat, big sagebrush, black sagebrush and yellowbrush.

Practices for maintaining or improving vegetation include a planned system of grazing, grazing for proper percent of plant use, and good water distribution.

Seeding may be advisable if the plant community shows much departure from potential. Seeding success may be attained during years of average or above average precipitation.

This soil is in Capability Subclass VIc, nonirrigated; Semidesert Loam (Sagebrush) D34 ecological site.

Taxonomic classification is fine-loamy, mixed, mesic Ustollic Calciorthids.

A representative pedon of Abra very fine sandy loam, 1 to 3 percent slopes was described 4.8 miles (7.7km) east of Wattis; 2,500 feet (762m) south and 1,500 feet (457m) east of the NW corner of Section 16, T15S, R9E (Photo No. & Coord. 3-93-A, H-12).

A11--0 to 1 inch (0 to 2.5cm); pale brown (10YR 6/3) very fine sandy loam, dark grayish brown (10YR 4/2) when moist; weak thin platy structure that parts to weak fine granular; soft, friable; slightly sticky, slightly plastic; few fine roots; medium very fine pores; strongly calcareous, carbonates are disseminated; strongly alkaline (pH 8.6); abrupt smooth boundary.

A12--1 to 7 inches (2.5 to 17.8cm); pale brown (10YR 6/3) loam, brown (10YR 4/3) when moist; weak fine and medium granular structure; slightly hard, friable, slightly sticky, plastic; common fine, medium and coarse roots; common fine and medium pores; strongly calcareous, carbonates are disseminated; strongly alkaline (pH 8.6); clear smooth boundary.

C1ca--7 to 14 inches (17.8 to 35.5cm); white (10YR 8/2) loam, light brownish gray (10YR 6/2) when moist; moderate medium subangular blocky structure; hard, friable, sticky, plastic; few fine, medium, and coarse roots; common very fine and fine pores; 5 percent cobbles; strongly calcareous, carbonates occur as thin coatings on rock fragment sides and bottoms; strongly alkaline (pH 9.0); clear smooth boundary.

C2ca--14 to 21 inches (35.5 to 53.3cm); white (10YR 8/2) stony loam, light brownish gray (10YR 6/2) when moist; weak medium subangular blocky structure; hard, firm, sticky, plastic; few fine and medium roots; medium very fine pores; 5 percent gravel, 5 percent cobbles, and 10 percent stones; strongly calcareous, carbonates occur as thin coatings on rock fragment sides and bottoms; very strongly alkaline (pH 9.6); clear smooth boundary.

C3ca--21 to 28 inches (53.3 to 71.1cm); white (10YR 8/2) stony loam, light brownish gray (10YR 6/2) when moist; weak medium subangular blocky structure; weakly cemented, friable, slightly sticky, plastic; few fine and medium roots; many very fine pores; 5 percent gravel, 5 percent cobbles, and 10 percent stones; strongly calcareous, carbonates occur as thin coatings on rock fragment sides and bottoms; very strongly alkaline (pH 9.6); clear smooth boundary.

C4ca--28 to 33 inches (71.1 to 83.8cm); white (10YR 8/2) loam, light brownish gray (10YR 6/2) when moist; weak medium subangular blocky structure; hard friable, slightly sticky, slightly plastic; few fine and medium roots; medium very fine pores; strongly calcareous, carbonates are disseminated; very strongly alkaline (pH 9.6); abrupt smooth boundary.

C5--33 to 60 inches (83.8 to 152cm); light brownish gray (10YR 6/2) very fine sandy loam, grayish brown (10YR 5/2) when moist; massive; slightly hard, friable, slightly sticky, slightly plastic; few fine and medium roots; common very fine pores; moderately saline; strongly calcareous, carbonates are disseminated; very strongly alkaline (pH 9.4).

The range of characteristics has not yet been determined for this soil.

AQUIC USTIFLUVENT

An Aquic Ustifluvent is a soil found in dry climates with hot summers in which the moisture regime is reduced because the soil is water saturated at least some of the year.

It is a mineral soil generally found on flood plains and shows little horizon development because of its young age or recent wash.

The texture varies from fine to coarse depositional gradients and is finer than loamy sand at depths greater than 25cm.

AVALON LOAM, 1 TO 5 PERCENT SLOPES

This Avalon soil is very deep and well drained. It occurs on benches and terraces at elevations of 5,700 to 5,900 feet (1,737 to 1,798m). This soil formed in alluvium derived mainly from sandstone and shale.

The average annual precipitation is 6 to 8 inches (15.2 to 20.3cm). Mean annual air temperature is 47° to 49°F (8.3° to 9.4°C), mean annual soil temperature is 49° to 52°F (9.4° to 11.1°C), and the average freeze-free season is 115 to 140 days. This soil occurs south of Cleveland, south and west of Mounds, west and north of Woodside, and east and south of Clark Valley. Slopes are 1 to 5 percent and occur on all aspects. They are long in length and single in shape.

Present vegetation is dominantly shadscale, galleta, globemallow, Indian ricegrass, and wedgeleaf saltbush.

In a representative profile the surface layer is pale brown loam about 6 inches (15.2cm) thick. The subsoil is very pale brown clay loam about 7 inches (17.8cm) thick. Upper substratum is white clay loam about 36 inches (91.4cm) thick. The lower substratum is very pale brown loam to a depth of 60 inches (152cm) or more. A horizon of secondary carbonate accumulation occurs at a depth of about 13 inches (33cm).

Permeability is moderately slow. Available water capacity is about 9.0 to 10.5 inches (22.9 to 26.7cm) above a depth of 60 inches (152cm). Water supplying capacity is about 4 to 5 inches (10.2 to 12.7cm). Organic matter content in the surface layer is low. Effective rooting depth is about 60 inches (152cm). Surface runoff is medium and erosion hazard is moderate. The Erosion Condition Class is slight-35.

This soil is used for rangeland and wildlife habitat.

The potential plant community is about 40 percent grasses, 20 percent forbs, and 40 percent shrubs. Important plants are galleta, hairy grama, Indian ricegrass, sand dropseed, desert trumpet, globemallow, wooly Indianwheat, Douglas rabbitbrush, Torrey Mormon-tea, shadscale and winterfat.

Practices needed for improving or maintaining vegetation include proper season of use, grazing for proper amounts of plant use, a planned system of grazing, and good water distribution.

This soil is in Capability Subclass VIIs, nonirrigated; Desert Loam D34 ecological site.

Taxonomic classification is fine-loamy, mixed, mesic Typic Calciorthids.

A representative Avalon loam, 1 to 5 percent slopes was described 4 miles (6.4km) south of Cleveland, 2,400 feet (731m) south and 1,800 feet (549m) east of the NW corner of Section 7, T18S, R10E (Photo No. & Coord. 1-24-A; I-5).

A11--0 to 1 inch (0 to 2.5cm); pale brown (10YR 6/3) loam, dark grayish brown (10YR 4/2) when moist; weak thin platy structure; slightly hard, very friable, slightly sticky, slightly plastic; few fine and medium roots; 10 percent gravel; moderately calcareous, carbonates are disseminated; strongly alkaline (pH 8.6); abrupt smooth boundary.

A12--1 to 6 inches (2.5 to 15.2cm); pale brown (10YR 6/3) loam, brown (10YR 4/3) when moist; weak fine granular structure; slightly hard, friable, slightly sticky, plastic; few fine and medium roots; few very fine and fine pores; moderately calcareous, carbonates are disseminated; strongly alkaline (pH 8.8); clear smooth boundary.

B2--6 to 13 inches (15.2 to 33cm); very pale brown (10YR 7/3) clay loam, brown (10YR 5/3) when moist; weak fine subangular blocky structure; hard, firm, sticky, plastic; few fine and medium roots; common fine and few fine pores; moderately calcareous, carbonates are disseminated; strongly alkaline (pH 9.0); clear wavy boundary.

C1ca--13 to 26 inches (33 to 66cm); white (10YR 8/2) clay loam, pale brown (10YR 6/3) when moist; moderate medium subangular blocky structure; very hard, firm, sticky, plastic; few fine roots; common very fine and fine pores; 2 percent gravel; strongly calcareous, carbonates are in veins; very strongly alkaline (pH 9.6); clear wavy boundary.

C2ca--26 to 49 inches (66 to 124.5cm); very pale brown (10YR 8/3) clay loam, pale brown (10YR 6/3) when moist; moderate coarse subangular blocky structure; very hard, firm, sticky, plastic; few fine roots; many very fine pores; 2 percent gravel; strongly calcareous, carbonates are in veins; very strongly alkaline (pH 9.6); gradual wavy boundary.

C3--49 to 60 inches (124.5 to 152cm); very pale brown (10YR 7/3) loam, brown (10YR 5/3) when moist; massive; very hard, friable, slightly sticky, plastic; few fine pores; moderately calcareous, carbonates are disseminated; strongly alkaline (pH 8.6).

The A horizon has chroma of 2 to 4. It is loam or very fine sandy loam. Gravel content ranges from 0 to 10 percent. The A horizon is 1 to 10 inches (2.5 to 25.4cm) thick.

The B horizon has value of 6 or 7 dry, 4 or 5 moist, and chroma of 3 or 4.

The C horizon has value of 6 to 8 dry, 5 or 6 moist, and chroma of 2 to 4. It is clay loam or loam, and is strongly alkaline or very strongly alkaline.

Avalon fine sandy loam, 1 to 5 percent slopes

This Avalon soil is very deep and well drained.

Slopes are 1 to 5 percent and on all aspects. They are long in length and single in shape.

Present vegetation is dominantly black sagebrush, hairy grama, fourwing saltbush, and galleta.

In a representative profile the surface layer is brown fine sandy loam about 3 inches (7.6cm) thick. The subsoil is brown and pink loam about 11 inches (27.9cm) thick. The upper substratum is pinkish white loam about 21 inches (53.3cm) thick. The lower substratum is very pale brown fine sandy loam to a depth of about 60 inches (152cm) or more. A horizon of carbonate accumulation occurs at a depth of about 8 inches (20.3cm).

Permeability is moderate. Available water capacity is about 7.5 to 9.0 inches (19.0 to 22.9cm) to a depth of 60 inches (152cm). Water supplying capacity is about 4.0 to 5.0 inches (10.2 to 12.7cm). Organic matter content in the surface layer is very low. Effective rooting depth is about 60 inches (152cm). Surface runoff is slow and erosion hazard is moderate. The Erosion Condition Class is slight-17.

The potential plant community is about 40 percent grasses, 20 percent forbs, and 40 percent shrubs. Important plants are galleta, hairy grama, Indian ricegrass, sand dropseed, desert trumpet, globemallow, wooly Indianwheat, Douglas rabbitbrush, Torrey Mormon-tea, shadscale and winterfat.

Practices needed for improving or maintaining vegetation include proper season of use, grazing for proper amounts of plant use, a planned system of grazing, and good water distribution.

This soil is in Capability Subclass VIIe, nonirrigated; Desert Loam D34 ecological site.

Taxonomic classification is fine-loamy, mixed, mesic Typic Calciorthids.

A representative pedon of Avalon loam, 1 to 5 percent slopes, was described about 3 miles (4.8km) north of Sunnyside Junction at a point of 2,000 feet (609m) west and 2,900 feet (883m) south of the NE corner of Section 34, T14S, R12E, SLB (Photo No. & Coord. 1-64, L-11).

A1--0 to 3 inches (0 to 7.6cm); brown (7.5YR 5/4) fine sandy loam, brown (7.5YR 4/4) when moist; weak thin platy structure that parts to weak fine granular; soft, very friable, slightly sticky, slightly plastic; few very fine and fine roots; common very fine and fine, few medium pores; 5 percent gravel mixed with surface horizon; moderately calcareous, carbonates are disseminated; moderately alkaline (pH 8.4); abrupt smooth boundary.

B21--3 to 8 inches (7.6 to 20.3cm); brown (7.5YR 5/4) loam, brown (7.5YR 5/4) when moist; moderate medium subangular blocky structure; soft, very friable, slightly sticky, slightly plastic; common very fine and few fine

roots; common very fine and few fine pores; 5 percent gravel; moderately calcareous, carbonates are disseminated; strongly alkaline (pH 8.6); abrupt smooth boundary.

B22ca--8 to 14 inches (20.3 to 35.6cm); pink (7.5YR 7/4) loam, light brown (7.5YR 6/4) when moist; moderate medium subangular blocky structure; hard firm, slightly sticky, slightly plastic; few very fine roots; common very fine pores; strongly calcareous, carbonates are disseminated; strongly alkaline (pH 8.8); clear smooth boundary.

C2ca--14 to 35 inches (35.6 to 88.9cm); pinkish white (7.5YR 8/2) loam, pink (7.5YR 7/4) when moist; moderate medium subangular blocky structure; hard, friable, slightly sticky, slightly plastic; few very fine roots; few very fine pores; strongly calcareous, carbonates are disseminated; strongly alkaline (pH 9.0); clear smooth boundary.

C3--35 to 60 inches (88.9 to 152cm); very pale brown (10YR 7/3) fine sandy loam, light yellowish brown (10YR 6/4) when moist; massive; hard, firm, slightly sticky, slightly plastic; moderately calcareous, carbonates are disseminated; very strongly alkaline (pH 9.2).

Range in characteristics is not determined for this soil.

BEENOM VERY GRAVELLY FINE SANDY LOAM, 1 TO 8 PERCENT SLOPES

This map unit is on ridge tops and side slopes. Bruin Point, Bishop Ridge, Summerhouse Ridge, Steer Ridge, and Gooseneck Ridge. Slopes are long and single. Elevation is 8,000 to 8,700 feet (2,438 to 2,652cm). The average annual precipitation is about 16 to 20 inches (40.6 to 50.8cm), the mean annual air temperature is 38° to 45°F (3.3° to 7.2°C), and the average freeze-free season is 60 to 120 days.

The Beenom very gravelly fine sandy loam is shallow and well drained. It formed in residuum derived dominantly from sandstone and shale of the Green River Formation. The present vegetation is mainly black sagebrush, Salina wildrye, rabbitbrush, and larkspur.

Typically, the surface layer is brown very gravelly fine sandy loam about 2 inches (5cm) thick. The subsoil is brown loam about 8 inches (20.3cm) thick over sandstone. Depth to sandstone ranges from 10 to 20 inches (25.4 to 50.8cm).

Permeability of the Beenom very gravelly fine sandy loam is moderate. Available water capacity, to a depth of 10 inches (25.4cm), is less than 2 inches (5cm). Water supplying capacity is 3 to 5 inches (7.6 to 12.7cm). The organic matter content of the surface layer is 3 to 5 percent. Effective rooting depth is 10 to 20 inches (25.4 to 50.8cm). Runoff is medium and the hazard of water erosion is moderate. The hazard of soil blowing is slight.

The Beenom fine sandy loam soil is shallow and well drained. It formed in residuum derived dominantly from sandstone and shale. The present vegetation is mainly serviceberry, birchleaf mountain mahogany, Salina wildrye, big sagebrush, snowberry, chokecherry, and needle and thread.

Typically, the surface layer is dark yellowish brown fine sandy loam about 2 inches (5cm) thick. The upper 6 inches (15.2cm) of the subsoil is dark yellowish brown fine sandy loam. The lower 4 inches (10.1cm) is dark yellowish brown very cobbly sandy clay loam. Sandstone is at a depth of 12 inches (30.5cm). Depth to sandstone ranges from 10 to 20 inches (25.4 to 50.8cm).

Permeability of the Beenom fine sandy loam is moderate. Available water capacity, to a depth of 12 inches (30.5cm), is less than 2 inches (5cm). Water supplying capacity is 3 to 5 inches (7.6 to 15.2cm). The organic matter content of the surface layer is 3 to 5 percent. Effective rooting depth is 10 to 20 inches (25.4 to 50.8cm). Runoff is medium, and the hazard of water erosion is moderate. The hazard of soil blowing is slight.

This unit is used as rangeland and for wildlife habitat.

This unit is in Capability Subclass VIIs, nonirrigated.

BRIBUTTE GRAVELLY SILTY CLAY LOAM, 3 TO 25 SLOPES, ERODED

This Bributte soil is shallow and well drained. It occurs on rolling shale hills at elevations of 5,700 to 5,950 feet (1,737 to 1,814m). This soil formed in residuum derived mainly from shale.

The average annual precipitation is 6 to 9 inches (15.2 to 22.9cm). Mean annual air temperature is 47° to 49°F (8.3° to 9.4°C), mean annual soil temperature is 49° to 51°F (9.1° to 10.6°C), and the average freeze-free season is 115 to 140 days. This soil occurs east of Cleveland and west of Cedar Mountain. Slopes are 3 to 25 percent and occur on all aspects. They are short in length and concave-convex in shape.

Present vegetation is dominantly silverscale saltweed, wedgeleaf Nuttall saltbush, galleta, and desert trumpet.

In a representative profile the surface layer is weak red gravelly silty clay loam about 2 inches (5cm) thick. The underlying layer is weak red clay loam underlain by shale at a depth of about 8 inches (20.3cm). Soil cracks 6 inches (15.2cm) deep and 1 inch (2.5cm) wide occur every 12 to 18 inches (30.4 to 45.7cm) on ridge tops.

Permeability is slow. Available water capacity is about 0.5 to 3.5 inches (1.3 to 8.9cm) above the shale. Water supply capacity is about 1.0 to 3.5 inches (2.5 to 8.9cm). Organic matter content in the surface layer is very low. Effective rooting depth is about 5 to 20 inches (12.7 to 50.8cm). Surface runoff is rapid and erosion hazard is high. The Erosion Condition Class is moderate-43. Small rock and plant pedestals occur in well defined flow patterns.

This soil is used for rangeland and wildlife habitat.

The potential plant community is about 35 percent perennial grasses, 20 percent forbs and 45 percent shrubs. Important plants are galleta, Indian ricegrass, bottlebrush squirreltail, hairy grama, desert trumpet, Indian-wheat, silverscale saltweed, wedgeleaf Nuttall saltbush, other saltbushes, gray molly and sagebrush.

Practices for maintaining or improving vegetation include a planned system of grazing, grazing for the proper percent of plant use, and good water distribution.

This soil is in Capability Subclass VIIs, nonirrigated; Desert Clay D34, ecological site.

Taxonomic classification is clayey, montmorillonitic (calcareous), mesic, shallow Typic Torriorthents.

A representative pedon of Bributte gravelly silty clay loam, 3 to 25 percent slopes, eroded, was in mapping unit LJE2, is located 2,500 feet (762m) north and 1,500 feet (457m) west of the SE corner of Section 16, T17S, R11E (Photo No. & Coord. 1-39, G-10) is used to represent this soil.

A1--0 to 2 inches (0 to 5cm); weak red (2.5YR 5/2) gravelly silty clay loam, weak red (2.5YR 5/2) when moist; moderate fine granular structure; soft, very friable, sticky, plastic few very fine and fine roots; 20 percent gravel and 5 percent cobble on the surface; moderately calcareous, carbonates are disseminated; strongly alkaline (pH 9.0) abrupt smooth boundary.

C1--2 to 8 inches (5 to 20.3cm); weak red (2.5YR 5/2) clay loam, weak red (2.5YR 5/2) when moist; massive; hard, friable, sticky, plastic; few very fine and fine roots; common very fine pores; 5 percent gravel and 5 percent cobbles; moderately calcareous, carbonates are disseminated; very strongly alkaline (pH 9.2); abrupt wavy boundary.

C2r--8 to 15 inches (20.3 to 38.1cm); weathered shale.

Range in characteristics not determined for this soil, except depth to shale ranges from 5 to 20 inches (12.7 to 50.8cm). The clay content in the C horizon is more than 35 percent.

CG VERY GRAVELLY FINE SANDY LOAM, 1 TO 8 PERCENT SLOPES, ERODED

This CG soil is very deep and somewhat excessively drained. It occurs on dissected alluvial fans at elevations of 4,100 to 6,000 feet (1,250 to 1,829m). This soil formed in alluvium derived mainly from sandstone and shale.

The average annual precipitation is 6 to 8 inches (15.2 to 20.3cm). Mean annual air temperature is 48° to 52°F (8.9° to 11.1°C), mean annual soil temperature is 50° to 54°F (10° to 12.2°C), and the average freeze-free season is 120 to 165 days. This soil occurs at the foot of the Book Cliffs from Horse Canyon south to the Green River, along the Green River from its confluence with Range Creek, to the town of Green River, and along the west side of Cedar Mountain. Slopes are 1 to 8 percent and occur on all aspects. They are medium in length and single to concave in shape.

Present vegetation is dominantly shadscale, galleta, Indian ricegrass, ragweed, halogeton, and globemallow.

In a representative profile the surface layer is pale brown very gravelly fine sandy loam about 4 inches (10.2cm) thick. The subsoil is light yellowish brown very gravelly loam about 4 inches (10.2cm) thick. The substratum is very pale brown very gravelly loam and very cobbly fine sandy loam to depth of 60 inches (152cm) or more. Secondary carbonate accumulation occurs at a depth of about 8 inches (20.3cm).

Permeability is moderately rapid. Available water capacity is about 3.75 to 5.0 inches (9.5 to 12.7cm) to a depth of 60 inches (152cm). The water supplying capacity is about 2.5 to 4 inches (6.3 to 10.2cm). Organic matter content in the surface layer is very low. Effective rooting depth is about 60 inches (152cm). Surface runoff is slow and erosion hazard is moderate. The Erosion Condition Class is moderate-47. The mapping unit is dissected by gullies about 15 to 30 feet (4.6 to 9.1m) deep at about 200 to 400-foot (61 to 122m) intervals. Much of the active gully erosion is enhanced by runoff water from surrounding areas of Rock outcrop and Badland.

This soil is used for rangeland and wildlife habitat.

The potential plant community is about 40 percent grasses, 20 percent forbs, and 40 percent shrubs. Important plants are galleta, hairy grama, Indian ricegrass, sand dropseed, desert trumpet, globemallow, wooly Indianwheat, Douglas rabbitbrush, Torrey Mormon-tea, shadscale and winterfat.

Practices needed for improving or maintaining vegetation include proper season of use, grazing for proper amounts of plant use, a planned system of grazing, and good water distribution.

This soil is in Capability Subclass VIIe, nonirrigated; Desert Loam D34 ecological site.

Taxonomic classification is loamy-skeletal, mixed, mesic Typic Calciorthids.

A representative pedon of CG very gravelly fine sandy loam, 1 to 8 percent slopes, eroded was described near Green River at a point about 2,000 feet (610m) north of the SW corner Section 17, T20S, R16E SLBM. (Photo No. & Coord. 6-35, I-14).

A1--0 to 4 inches (0 to 10.2cm); pale brown (10YR 6/3) very gravelly fine sandy loam, brown (10YR 5/3) when moist; weak medium platy structure that parts to weak fine granular; soft, friable, nonsticky, slightly plastic; few very fine, fine, and medium roots; common very fine, fine and medium pores; 30 percent gravel, 7 percent cobbles, 1 percent stones; moderately calcareous, carbonates are disseminated; moderately alkaline (pH 8.4) abrupt smooth boundary.

B2--4 to 8 inches (10.2 to 20.3cm); light yellowish brown (10YR 6/4) very gravelly loam, yellowish brown (10YR 5/4) when moist; moderate medium subangular blocky structure; very hard, friable, sticky, plastic, few very fine and medium roots; common very fine and fine, few medium pores; 35 percent gravel, 10 percent cobbles; moderately calcareous, carbonates are disseminated; strongly alkaline (pH 8.6); clear smooth boundary.

C1ca--8 to 20 inches (20.3 to 50.8cm); very pale brown (10YR 7/3) very gravelly loam, pale brown (10YR 6/3) when moist; massive; hard, friable, nonsticky, slightly plastic; few very fine and fine roots, few fine and medium pores; 30 percent gravel, 15 percent stones; strongly calcareous, carbonates are disseminated and veined; strongly alkaline (pH 8.8); clear smooth boundary.

C2--20 to 60 inches (50.8 to 152cm); very pale brown (10YR 7/4) very cobbly fine sandy loam, pale brown (10YR 6/3) when moist; massive; hard, friable, nonsticky, slightly plastic; few very fine roots; 25 percent gravel, 15 percent cobbles, 5 percent stones; strongly calcareous, carbonates are disseminated; moderately alkaline (pH 8.2).

The A horizon ranges from 3 to 5 inches (7.6 to 12.7cm) thick.

The B horizon ranges from 3 to 6 inches (7.6 to 15.2cm) thick and is very gravelly loam or very gravelly very fine sandy loam with 35 percent rock fragments.

The C horizon has hue of 10YR or 2.5Y, value of 6 or 7 dry and chroma of 3 or 4. It ranges from very cobbly fine sandy loam to very gravelly loam to extremely gravelly sandy loam with 40 to 70 percent rock fragments. The C horizon is moderately or strongly calcareous and is moderately or strongly alkaline.

CHILTON VERY STONY FINE SANDY LOAM, LOW RAINFALL, 15 TO 30 PERCENT SLOPES, ERODED

This very deep and somewhat excessively drained soil is on dissected alluvial fans and fan terraces. It is in the vicinity of Chimney Rock, Horse Canyon, Hiawatha, Huntington Canyon, and Green River. It formed in alluvium and glacial outwash derived dominantly from sandstone and shale. Slopes are medium to long and convex. The present vegetation is mainly juniper, pinyon, Mormon tea, and pricklypear. Elevation is 5,500 to 7,100 feet (1,676 to 2,164m). The average annual precipitation is about 8 to 12 inches (20.3 to 30.5cm), the mean annual air temperature is 44° to 47°F (6.7° to 8.3°C), and the average freeze-free season is 100 to 130 days.

Typically, the surface layer is light yellowish brown very stony fine sandy loam 1 inch (2.5cm) thick. The underlying material is light brown cobbly fine sandy loam about 10 inches (25.4cm) thick. The next layer to a depth of 60 inches (152cm) or more is light brown and light yellowish brown very cobbly fine sandy loam.

Permeability of this Chilton soil is moderately rapid. Available water capacity, to a depth of 60 inches (152cm), is about 3.0 to 5.5 inches (7.6 to 13.9cm). Water supplying capacity is 4 to 6 inches (10.2 to 15.2cm). The organic matter content of the surface layer is 1 to 3 percent. Effective rooting depth is 60 inches (152cm) or more. Runoff is rapid, and the hazard of water erosion is high. The hazard of soil blowing is slight.

This unit is used for woodland, rangeland, and wildlife habitat.

The Chilton soil is in Capability Subclass VIIs, nonirrigated.

CHILTON EXTREMELY BOULDERY FINE SANDY LOAM, LOW RAINFALL, 3 TO 20 PERCENT SLOPES, ERODED

This very deep and well drained soil is on dissected alluvial fans and fan terraces. It is in the vicinity of Horse Canyon. It formed in alluvium and glacial outwash derived dominantly from sandstone and shale. Slopes are medium in length and convex. They face south, east and west. The present vegetation is mainly juniper, pinyon, Mormon tea, and prickly-pear. Elevation is 5,300 to 6,100 feet (1,615 to 1,859m). The average annual precipitation is about 9 to 11 inches (22.9 to 27.9cm), the mean annual air temperature is 45° to 47°F (7.2° to 8.3°C) and the average freeze-free season is 115 to 140 days.

Typically, the surface layer is pale brown extremely bouldery fine sandy loam 3 inches (7.6cm) thick. The underlying material is pale brown very bouldery sandy clay loam 21 inches (53.3cm) thick. The next layer to a depth of 60 inches (152m) or more is light yellowish brown very cobbly sandy clay loam.

Permeability of this Chilton soil is moderate. Available water capacity, to a depth of 60 inches (152cm), is about 5.0 to 6.0 inches (12.7 to 15.2cm). Water supplying capacity is 4 to 6 inches (10.2 to 15.2cm) The organic matter content of the surface layer is 1 to 3 percent. Effective rooting depth is 60 inches (152cm) or more. Runoff is medium, and the hazard of water erosion is moderate. The hazard of soil blowing is slight.

This unit is used for rangeland and wildlife habitat.

The Chilton soil is in Capability Subclass VIIs, nonirrigated.

CHIPETA SILTY CLAY LOAM, 3 TO 8 PERCENT SLOPES, ERODED

This Chipeta soil is shallow and well drained. It occurs on shale hills at elevations of 4,000 to 6,000 feet (1,219 to 1,829m). This soil formed in residuum derived mainly from shale.

The average annual precipitation is 6 to 8 inches (15.2 to 30.3cm). Mean annual air temperature is 48° to 52°F (8.0° to 11.1°C), mean annual soil temperature is 50° to 54°F (10° to 12.2°C), and the average freeze-free season is 120 to 160 days. This soil occurs near the Woodside area and the town of Green River. Slopes are 3 to 8 percent and occur on all aspects. They are short and medium in length and convex in shape.

Present vegetation is dominantly mat saltbush, globemallow, Indian ricegrass, desert trumpet and big white aster.

In a representative profile the surface layer is pale brown silty clay loam about 1 inch (2.5cm) thick. The underlying layer is pale brown silty clay loam about 6 inches (15.2cm) thick. The next layer is grayish brown silty clay loam overlying weathered shale at a depth of about 15 inches (38.1cm). This soil is moderately affected by salt.

Permeability is slow. Available water capacity is about 2.0 to 3.0 inches (5 to 7.6cm) above the shale. The water supplying capacity is about 2 to 3 inches (5 to 7.6cm). Organic matter content in the surface layer is very low. Effective rooting depth is about 10 to 20 inches (25.4 to 50.8cm). Surface runoff is rapid and erosion hazard is high. The Erosion Condition Class is moderate-47.

This soil is used for rangeland and wildlife habitat.

The potential plant community is about 20 percent grasses, 15 percent forbs, and 65 percent shrubs. Important plants are galleta, Indian ricegrass, Salina wildrye, annual eriogonums, evening primrose, mat saltbush, Nuttall saltbush and shadscale.

Practices needed to improve or maintain the vegetation include the proper amount of plant use, the proper season of use, a planned system of grazing and good water distribution.

This soil is in Capability Subclass VIIs, nonirrigated; Desert Shallow Shale, D34 ecological site.

Taxonomic classification is a clayey, mixed (calcareous), mesic, shallow, Typic Torriorthents.

A representative pedon of Chipeta silty clay loam, 3 to 8 percent slopes, eroded was described 4.5 miles (7.2km) south and 6 miles (9.6km) west of the town of Green River; 3,000 feet (914m) south and 500 feet (152m) east of the NW corner of Section 33, T21S, R15E (Photo No. & Coord. 2-139; K-17).

A1--0 to 1 inch (0 to 2.5cm); pale brown (10YR 6/3) silty clay loam, brown (10YR 5/3) when moist; moderate medium subangular blocky structure that parts to strong very coarse granular; slightly hard, firm, sticky, plastic; few very fine roots; many very fine and few fine pores; 10 percent gravel; moderately calcareous, carbonates are disseminated; moderately alkaline (pH 8.4); abrupt smooth boundary.

C1--1 to 4 inches (2.5 to 10.2cm); pale brown (10YR 6/3) silty clay loam, brown (10YR 5/3) when moist; moderate coarse prismatic structure that parts to moderate very coarse platy; hard, firm, very sticky, plastic; few very fine roots; many very fine pores; moderately calcareous, carbonates are disseminated; strongly alkaline (pH 8.8); abrupt smooth boundary.

C2--4 to 7 inches (10.2 to 17.8cm); pale brown (10YR 6/3) silty clay loam, grayish brown (10YR 5/2) when moist; massive; hard, firm, very sticky, plastic; common very fine roots; common very fine pores; moderately calcareous, carbonates are disseminated; very strongly alkaline (pH 9.4); clear smooth boundary.

C3-- 7 to 15 inches (17.8 to 38.1cm); grayish brown (2.5Y 5/2) silty clay loam, dark grayish brown (2.5Y 4/2) when moist; massive; hard friable, sticky, plastic; common very fine and few fine roots; few very fine pores; 10 to 15 percent soft shale fragments; moderately calcareous, carbonates are disseminated; very strongly alkaline (pH 9.4); gradual smooth boundary.

C4r--15 inches (38.1cm); weathered shale.

Depth to weathered shale ranges from 10 to 20 inches (25.4 to 50.8cm).

The A horizon has hue of 10YR or 2.5Y, value of 5 or 6 dry, 4 or 5 moist and chroma is 1 to 3. Gravel content ranges from 0 to 10 percent. The A horizon is 1 to 4 inches (2.5 to 10.2cm) thick.

The C horizon has hue of 5Y, 2.5Y or 10YR, value of 5 or 6 dry, 3 to 5 moist and chroma of 1 to 3. It is silty clay loam, silty clay and shaly silty clay loam with 35 to 50 percent clay. Soft shale fragments range from 0 to 35 percent and hard fragments from 0 to 10 percent. The C horizon ranges from 12 to 19 inches (30.5 to 48.3cm).

COMODORE VERY STONY VERY FINE SANDY LOAM, 50 TO 60 PERCENT SLOPES, ERODED

This Comodore soil is shallow and somewhat excessively drained. It occurs on mountain slopes at elevations of 6,800 to 8,100 feet (2,073 to 2,469m). This soil formed in colluvium derived mainly from sandstone.

The average annual precipitation is 16 to 18 inches (40.6 to 45.7cm). Mean annual air temperature is 43° to 45°F, (6.1° to 7.2°C), mean annual soil temperature is 45° to 47°F (7.2° to 8.3°C), and the average freeze-free season is 50 to 70 days. This soil occurs north of Wellington along the Book Cliffs. Slopes are 50 to 60 percent and occur on northwest and east aspects. They are long in length and convex in shape.

Present vegetation is dominantly Douglas fir, Salina wildrye, snowberry, serviceberry and big sagebrush.

In a representative profile the surface layer is very dark grayish brown very stony very fine sandy loam about 4 inches (10.2cm) thick. The underlying layer is very dark grayish brown very cobbly very fine sandy loam overlying sandstone at a depth of 14 inches (35.6cm).

Permeability is moderately rapid. Available water capacity is about 2.0 inches (5cm) above the sandstone. Water supplying capacity is about 3 to 5 inches (7.6 to 12.7cm). Organic matter content in the surface layer is moderate. Effective rooting depth is about 10 to 20 inches (25.4 to 50.8cm). Surface runoff is rapid and erosion hazard is high. The Erosion Condition Class is moderate-59. Soil and surface litter movement is apparent in well defined flow patterns. Gully erosion is limited to small widely spaced gullies fed by well defined rills.

This soil is used for rangeland and wildlife habitat.

The potential plant community is about 20 percent grasses, 5 percent forbs, 20 percent shrubs and 55 percent trees. About 85 percent of the trees are inland Douglas fir. Other trees of the site are Utah juniper, Rocky Mountain juniper, pinyon pine, bigtooth maple, Gambel oak and white fir. Important understory plants are elk sedge, slender wheatgrass, Nevada bluegrass, mountain junegrass, nodding bromegrass, bluebunch wheatgrass, Salina wildrye goldenrod, aster, Louisiana sagewort, lupine, showy goldeneye, wild geranium, birchleaf mountain mahogany, serviceberry, snowberry, Oregon grape, wild currant, dwarf maple, elderberry, and curlleaf mountain mahogany.

The site is producing very poor commercial timber that would be very difficult to harvest. Slopes are so steep and forage production so low that the site is of very little value for livestock. Principal use is for wildlife habitat.

This soil is in Capability Subclass VIIs, nonirrigated; Woodland Douglas Fir E47 ecological site.

Taxonomic classification is loamy-skeletal, mixed Lithic Cryoborolls.

A representative pedon of Comodore very stony very fine sandy loam, 50 to 60 percent slopes, eroded, was described in Dugout Creek northeast of Wellington; 2,100 feet (640m) east and 2,300 feet (701m) south of the NW corner of Section 23, T14S, R12E (Photo No. & Coord. 4-100-A, B-13).

A11--0 to 4 inches (0 to 10.2cm); very dark grayish brown (10YR 3/2) very stony very fine sandy loam, very dark brown (10YR 2/2) when moist; weak fine granular structure; soft, friable, slightly sticky, slightly plastic; common very fine, fine, medium and coarse roots; few very fine and fine pores; 15 percent gravel, 25 percent cobble and 20 percent stones; noncalcareous; mildly alkaline (pH 7.4); clear smooth boundary.

A12--4 to 14 inches (10.2 to 36.6cm); very dark grayish brown (10YR 3/2) very cobbly very fine sandy loam, very dark brown (10YR 2/2) when moist; weak fine granular structure; soft, friable, slightly sticky, slightly plastic; common very fine, fine, medium and coarse roots; few very fine pores; 15 percent gravel and 30 percent cobble; noncalcareous; mildly alkaline (pH 7.4); abrupt wavy boundary.

R--14 + inches (35.6+cm); fractured sandstone.

Depth to sandstone is 10 to 20 inches (25.4 to 50.8cm). The range in other characteristics of this soil has not been determined.

DI COBBLY LOAM, 30 TO 50 PERCENT SLOPES, ERODED

This DI soil is very deep and well drained. It occurs on mountain side slopes at elevations of 7,500 to 8,100 feet (2,286 to 2,469m). This soil formed in alluvium and colluvium derived mainly from sandstone.

The average annual precipitation is 14 to 18 inches (35.6 to 45.7cm). Mean annual air temperature is 43° to 45°F (6.1° to 7.2°C), mean annual soil temperature is 45° to 47°F (7.2° to 8.3°C), and the average freeze-free season is 50 to 70 days. This soil occurs in the Book Cliff areas northeast of Price. Slopes are 30 to 50 percent and occur on north, east or west aspects. They are medium in length and convex in shape.

Present vegetation is dominantly serviceberry, snowberry, birchleaf mountain mahogany, Salina wildrye, elk sedge and slender wheatgrass.

In a representative profile the surface layer is dark grayish brown cobbly loam about 5 inches (12.7cm) thick. The subsoil is grayish brown loam about 10 inches (25.4cm) thick. The substratum is light gray silty clay loam and silt loam to a depth of 60 inches (152cm) or more.

Permeability is moderately slow. Available water capacity is about 9 to 11 inches (22.9 to 27.9cm) above a depth of 60 inches (152cm). Water supplying capacity is about 8 to 12 inches (20.3 to 30.5cm). Organic matter content in the surface layer is moderate. Effective rooting depth is greater than 60 inches (152cm). Surface runoff is medium and erosion hazard is high. The Erosion Condition Class is moderate-43. Surface soil, litter and rock movement is apparent in well defined flow patterns. Slight pedestalling also occurs in the flow patterns. Some rills are in evidence at infrequent intervals over 10 feet (3m).

This soil is used for rangeland, wildlife habitat and recreation.

The potential plant community is about 40 percent grasses, 5 percent forbs and 55 percent shrubs. Important plants are bullgrass, Salina wildrye, bluebunch wheatgrass, muttongrass, Nevada bluegrass, slender wheatgrass, prairie junegrass, western wheatgrass, hawksbeard, locoweed, penstemon, sego lily, birchleaf mountain mahogany, Wyoming big sagebrush, black sagebrush, yellowbrush, serviceberry and snowberry.

Practices needed to maintain or improve the vegetation include grazing use during the proper season, a planned grazing system, and good water distribution.

This soil is in Capability Subclass VIIe, nonirrigated; Mountain Loam (Shrub) E47 ecological site.

Taxonomic classification is fine-loamy, mixed Typic Haploborolls.

A representative pedon of DI cobbly loam, 30 to 50 percent slopes, eroded, was described on Book Cliffs north of Sunnyside; 1,800 feet (549m) west and 600 feet (183m) south of the NE corner of Section 4, T14S, R13E.

A1--0 to 5 inches (0 to 12.7cm); dark grayish brown (10YR 4/2) cobbly loam, very dark grayish brown (10YR 3/2) when moist; weak fine granular structure; soft, friable, slightly sticky, slightly plastic; common very fine and fine roots; common very fine and fine pores; 15 percent gravel, 15 percent cobbles and some stones; slightly calcareous; moderately alkaline (pH 8.0); clear smooth boundary.

B2--5 to 15 inches (12.7 to 38.1cm); grayish brown (10YR 5/2) loam, very dark grayish brown (10YR 3/2) when moist; moderate medium subangular blocky structure; slighly hard, friable, slightly sticky, plastic; common very fine, fine few medium and coarse roots; common very fine, fine and medium pores; 5 percent gravel; slighly calcareous; moderately alkaline (pH 8.2); gradual smooth boundary.

C1--15 to 34 inches (38.1 to 86.4cm); light gray (10YR 7/2) silty clay loam, light yellowish brown (10YR 6/4) when moist; weak fine subangular blocky structure; hard, firm, sticky, plastic; common very fine, fine and few medium and coarse roots; common very fine, fine and medium pores; moderately calcareous, carbonates are disseminated; strongly alkaline (pH 8.6); gradual smooth boundary.

C2--34 to 60 inches (86.4 to 152cm); light gray (10YR 7/2) silt loam, light yellowish brown (10YR 6/4) when moist; massive; hard, firm, slightly sticky, plastic; few fine and medium roots; few very fine and fine pores; 5 percent gravel; moderately calcareous, carbonates are disseminated; strongly alkaline (pH 8.8).

The range in characteristics has not been determined for this soil.

DK COBBLY LOAM, 30 TO 50 PERCENT SLOPES

This DK soil is very deep and well drained. It occurs on mountain side slopes at elevations of 7,500 to 8,100 feet (2,286 to 2,469m). This soil formed in alluvium and colluvium derived mainly from sandstone.

The average annual precipitation is 14 to 18 inches (35.6 to 45.7cm). Mean annual air temperature is 43° to 45°F (6.1° to 7.2°C), mean annual soil temperature is 45° to 47°F (7.2° to 8.3°C), and the average freeze-free season is 50 to 70 days. This soil occurs in the Book Cliffs northeast of Price and north of Sunnyside. Slopes are 30 to 50 percent and occur on north, east and west aspects. They are medium to long in length and convex in shape.

Present vegetation is dominantly Douglas fir, serviceberry, snowberry, elk sedge, and mountain junegrass.

In a representative profile the surface layer is brown cobbly loam about 2 inches (5cm) thick. The subsoil is brown and yellowish brown loam and clay loam about 9 inches (22.9cm) thick. The upper substratum is pale brown silty clay loam about 24 inches (60.9cm) thick. The lower substratum is pale brown very stony silty clay loam to a depth of 60 inches (152cm) or more.

Permeability is moderately slow. Available water capacity is about 7.5 to 9.0 inches (19.0 to 22.9cm) above a depth of 60 inches (152cm). Water supplying capacity is about 8 to 12 inches (20.3 to 30.4cm). Organic matter content in the surface layer is moderate. Effective rooting depth is greater than 60 inches (152cm). Surface runoff is medium and erosion hazard is moderate. The Erosion Condition Class is slight-36.

This soil is used for rangeland and wildlife habitat.

The potential plant community is about 20 percent grasses, 5 percent forbs, 20 percent shrubs and 55 percent trees. About 85 percent of the trees are inland Douglas fir. Other trees of the site are Utah juniper, Rocky Mountain juniper, pinyon pine, bigtooth maple, Gambel oak and white fir. Important understory plants are elk sedge, slender wheatgrass, Nevada bluegrass, mountain junegrass, nodding bromegrass, bluebunch wheatgrass, Salina wildrye, goldenrod, aster, Louisiana sagewort, lupine, showy goldeneye, wild geranium, birchleaf mountain mahogany, serviceberry, snowberry, Oregon grape, wild currant, dwarf maple, elderberry, and curlleaf mountain mahogany.

This site is producing very poor commercial timber that would be very difficult to harvest. Slopes are so steep and forage production so low that the site is of very little value for livestock. Principal land use is for wildlife habitat.

This soil is in Capability Subclass VIIe, nonirrigated; Woodland Douglas Fir E47 ecological site.

Taxonomic classification is fine-loamy, mixed Typic Cryochrepts.

A representative pedon of DK cobbly loam, 30 to 50 percent slopes was described on Book Cliffs north of Sunnyside; 400 feet (122m) west and 800 feet (244m) south of the NE corner of Section 5, T14S, R13E.

O1--1/2 inch to 0 (1.3 to 0cm); partly decomposed needles, twigs and grass.

A1--0 to 2 inches (0 to 5cm); brown (10YR 4/3) cobbly loam, dark brown (10YR 3/3) when moist; weak thin platy structure that parts to weak fine granular; slightly hard, friable, slightly sticky, slightly plastic; few fine and medium roots; common very fine, fine and medium pores; 10 percent gravel, 20 percent cobbles and 5 percent stones; slightly calcareous; mildly alkaline (pH 7.4); abrupt smooth boundary.

B21--2 to 7 inches (5 to 17.8cm); brown (10YR 5/3) loam, dark grayish brown (10YR 4/2) when moist; moderate coarse subangular blocky structure; slightly hard, firm, sticky, plastic; few fine and medium roots; common very fine and fine pores; 5 percent gravel; slightly calcareous; mildly alkaline (pH 7.6); clear smooth boundary.

B22--7 to 11 inches (17.8 to 28cm); yellowish brown (10YR 5/4) clay loam, dark brown (10YR 4/3) when moist; moderate medium subangular blocky structure; hard, firm, sticky, plastic; common very fine, fine and medium roots; common very fine and fine pores; 5 percent gravel; moderately calcareous, moderately alkaline (pH 8.0); clear wavy boundary.

C1--11 to 26 inches (28 to 66cm); pale brown (10YR 6/3) silty clay loam, yellowish brown (10YR 5/4) when moist; moderate fine subangular blocky structure; hard, firm, sticky, plastic; few fine, medium and coarse roots; few very fine and fine pores; moderately calcareous; moderately alkaline (pH 8.0); clear smooth boundary.

C2ca--26 to 35 inches (66 to 89cm); pale brown (10YR 6/3) silty clay loam, brown (10YR 5/3) when moist; massive; hard, firm, sticky, plastic; few fine and medium roots; few very fine and fine pores; 5 percent gravel; strongly calcareous carbonates are in veins and salt masses; moderately alkaline (pH 8.4); clear smooth boundary.

C3ca--35 to 60 inches (89 to 152cm); pale brown (10YR 6/3) very stony silty clay loam, brown (10YR 5/3) when moist; massive; hard, firm, sticky, plastic; few fine and medium roots; few very fine pores; 20 percent gravel, 20 percent cobble and 15 percent stone; strongly calcareous, carbonates are in veins and soft masses; moderately alkaline (pH 8.4).

The range in characteristics for this soil has not been determined.

EA VERY COBBLY LOAM, 3 TO 8 PERCENT SLOPES, ERODED

This EA soil is moderately deep and well drained. It occurs on alluvial fans at elevations of 5,400 to 5,600 feet (1,646 to 1,707m). This soil formed in alluvium derived mainly from sandstone and residuum from shale.

The average annual precipitation is 6 to 8 inches (15.2 to 20.3cm). Mean annual air temperature is 48° to 51°F (8.9° to 10.6°C), mean annual soil temperature is 50° to 53°F (10° to 11.7°C), and the average freeze-free season is 120 to 150 days. This soil occurs southwest of East Carbon City, near Icelander Creek, and north of the Woodside area. Slopes are 3 to 8 percent and occur on north, south, and east aspects. They are medium in length and undulating in shape.

Present vegetation is dominantly shadscale, galleta, Indian buckwheat, pricklypear, aster, desert stickseed.

In a representative profile the surface layer is light brownish gray very cobbly loam about 3 inches (7.6cm) thick. The underlying layer is light brownish gray very cobbly clay loam about 8 inches (20.3cm) thick. The next layer is light brownish gray cobbly silty clay loam that is underlain by shale at a depth of 39 inches (99.1cm).

Permeability is slow. Available water capacity is about 2.5 to 3.75 inches (6.5 to 9.5cm) above the shale. The water supplying capacity is about 2 to 3 inches (5 to 7.6cm). Organic matter content in the surface layer is very low. Effective rooting depth is about 30 to 40 inches (76.2 to 101.6cm). Surface runoff is medium and erosion hazard is high. The Erosion Condition Class is moderate-50.

This soil is used for rangeland and wildlife habitat.

The potential plant community is about 40 percent grasses, 20 percent forbs and 40 percent shrubs. Important plants are galleta, hairy grama, Indian ricegrass, bottlebrush squirreltail, scarlet globemallow, desert trumpet, wooly Indianwheat, shadscale, other saltbushes, winterfat and Torrey Mormon-tea.

Practices needed to maintain or improve the range condition include the proper amount of plant use, the proper season of use, a planned system of grazing, and good water distribution.

This soil is in Capability Subclass VIIs, nonirrigated; Desert Loamy Shale D34 ecological site.

Taxonomic classification is fine, mixed (calcareous), mesic Typic Torriorthents.

A representative pedon of EA very cobbly loam, 3 to 8 percent slopes, eroded was described 3 miles (4.8km) south and 4 miles (6.4km) west of East Carbon City; 1,500 feet (457m) south and 5000 feet (1523m) west of the NE corner Section 21, T15S, R13E (Photo No. & Coord. 2-136-A, K-7).

A1--0 to 3 inches (0 to 7.6cm); light brownish gray (10YR 6/2) very cobbly loam, dark grayish brown (10YR 4/2) when moist; weak thin platy structure; soft, friable, slightly sticky, slightly plastic; few very fine and fine roots; common very fine vesicular pores; 20 percent gravel, 20 percent cobbles, and 5 percent stones; moderately calcareous, carbonates are disseminated; moderately alkaline (pH 8.4); abrupt smooth boundary.

A12--3 to 11 inches (7.6 to 27.9cm); light brownish gray (10YR 6/2) very cobbly clay loam, dark grayish brown (10YR 4/2) when moist; moderate coarse granular structure; soft, firm, sticky, plastic; few very fine roots; few very fine and fine pores; 15 percent gravel, 20 percent cobbles, 5 percent stones; moderately calcareous, carbonates are disseminated; strongly alkaline (pH 8.6); clear smooth boundary.

C1--11 to 35 inches (27.9 to 88.9cm); light brownish gray (2.5Y 6/2) cobbly silty clay loam, dark grayish brown (2.5Y 4/2) when moist; weak medium subangular blocky structure parting to moderate medium granular; slightly hard, very firm, sticky, plastic; few very fine and fine roots; few very fine pores; 15 percent gravel, and 10 percent cobbles; moderately calcareous, carbonates are disseminated; moderately alkaline (pH 8.4); clear smooth boundary.

C2--35 to 39 inches (88.9 to 99.1cm); light brownish gray (2.5Y 6/2) cobbly silty clay loam, dark grayish brown (2.5Y 4/2) when moist; weak medium subangular blocky structure parting to moderate coarse granular; slightly hard, very firm, sticky, plastic; few very fine and fine roots, common very fine and few fine pores; 15 percent gravel and 10 percent cobbles; moderately calcareous, carbonates are disseminated; moderately alkaline (pH 8.4); abrupt smooth boundary.

C3r--39 inches (99.1cm); weathered shale.

Depth to shale ranges from 30 to 40 inches.

The A horizon has hue of 2.5Y or 10YR. Rock fragment ranges from 35 to 50 percent. The A horizon is moderately alkaline or strongly alkaline.

The C horizon has hue of 2.5Y or 10YR, value of 4 to 6 dry, and chroma of 2 to 4. Rock fragments range from 20 to 35 percent. The C horizon is moderately alkaline or strongly alkaline, and is slightly calcareous or moderately calcareous.

EM cobbly fine sandy loam, 3 to 20 percent slopes, eroded

This EM soil is shallow and somewhat excessively drained.

Slopes are 3 to 20 percent and occur on east and west aspects. They are short in length and concave in shape.

Present vegetation is dominantly galleta, phacelia, pricklypear, shadscale, and lambsquarter.

In a representative profile the surface layer is very pale brown cobbly fine sandy loam about 2 inches (5cm) thick. The underlying layer is pale brown very stony sandy clay loam about 5 inches (12.7cm) thick. The next layer is light brownish gray very stony clay loam underlain by shale at a depth of about 13 inches (33cm).

Permeability is moderate. Available water capacity is about 2 inches (5cm) above the shale. The water supplying capacity is about 2 inches (5cm). Organic matter content in the surface layer is very low. Effective rooting depth is about 10 to 20 inches (25.4 to 50.8cm). Surface runoff is medium and erosion hazard is high. The Erosion Condition Class is moderate-41. Moderate movement of soil, coarse fragments and surface litter is apparent.

This soil is used for rangeland and wildlife habitat.

The potential plant community is about 45 percent grasses, 15 percent forbs and 40 percent shrubs. Important plants are Indian ricegrass, galleta, tall dropseed, blue grama, globemallow, desert trumpet, desert Indianwheat, shadscale, winterfat, black sagebrush and Torrey Mormon-tea.

Practices for improving or maintaining the vegetative cover include a planned system of grazing, grazing for the proper percent of plant use, and good water distribution.

This soil is in Capability Subclass VIIs, nonirrigated; Desert Shallow Loam D34 ecological site.

Taxonomic classification is loamy-skeletal, mixed (calcareous), mesic, shallow Typic Torriorthents.

A representative pedon of EM cobbly fine sandy loam, 3 to 20 percent slopes, eroded is in mapping unit EME2 located 3 miles (4.8km) south and 10 miles (16.1km) west of Green River; 1,500 feet (457m) south and 1,280 feet (390m) west of the NE corner of Section 27, T21S, R14E SLBM (Photo No. & Coord. 2-139, I-3) is used to represent this soil.

A1--0 to 2 inches (0 to 5cm); very pale brown (10YR 7/4) cobbly fine sandy loam, brown (10YR 5/3) when moist; moderate coarse granular structure; soft, very friable, slightly sticky; common medium roots; medium very fine pores; 15 percent gravel and 15 percent cobbles; slightly calcareous, carbonates are disseminated; strongly alkaline (pH 8.8); abrupt smooth boundary.

C1--2 to 7 inches (5 to 17.8cm); pale brown (10YR 6/3) extremely stony sandy clay loam, dark yellowish brown (10YR 4/4) when moist; moderate medium subangular blocky structures; slightly hard, very friable, sticky, slightly plastic; many very fine, common fine roots; common very fine pores; 20 percent gravel, 15 percent cobbles and 30 percent stones; slightly calcareous, carbonates are disseminated; strongly alkaline (pH 8.8); clear smooth boundary.

C2--7 to 13 inches (17.8 to 33cm); light brownish gray (10YR 6/2) very stony clay loam; pale brown (10YR 6/3) when moist; massive; slightly hard friable, sticky, plastic; common very fine roots; few very fine pores; 30 percent gravel, 10 percent cobbles and 20 percent stones; slightly calcareous, carbonates are disseminated; strongly alkaline (pH 8.6); clear smooth boundary.

C3r--13 inches (33cm); weathered shale.

Depth to weathered shale ranges from 10 to 20 inches (25.4 to 50.8cm). The range in other characteristic for this soil has not been determined.

GLENBERG VERY FINE SANDY LOAM, 3 TO 6 PERCENT SLOPES

This Glenberg soil is very deep and well-drained. It occurs on nearly level and gently sloping valley floors and terraces at elevations of 5,500 to 6,900 feet (1,676 to 2,103m). This soil formed in alluvium derived mainly from sandstone and shale.

The average annual precipitation is 10 to 12 inches (25.4 to 30.5cm). Mean annual air temperature is 47° to 49°F (8.3° to 9.4°C), mean annual soil temperature is 49° to 51°F (9.4°to 10.6°C), and the average freeze-free season is 115 to 140 days. This soil occurs in the vicinity of Hiawatha and in small areas near East Carbon City, Horse Canyon and Cedar Mountain. Slopes are 3 to 6 percent and occur on all aspects. They are long in length and single in shape.

Present vegetation is dominantly big sagebrush, blue grama, bullgrass, greasewood, fourwing saltbush and globemallow.

In a representative profile the surface layer is pale brown very fine sandy loam about 4 inches (10.2cm) thick. The underlying layers are pale brown and brown very fine sandy loam and loam to a depth of 60 inches (152cm) or more.

Permeability is moderate. Available water capacity is about 7.0 to 10.0 inches (17.8 to 25.4cm) to a depth of 60 inches (152cm). The water supplying capacity is about 6 to 7 inches (15.2 to 17.8cm). Organic matter content in the surface layer is very low. Effective rooting depth is 60 inches (152cm) or more. Surface runoff is slow and erosion hazard is moderate. The Erosion Condition Class is slight-34.

This soil is used for rangeland, wildlife habitat and recreation.

The potential plant community is about 50 percent perennial grasses, 15 percent forbs, and 35 percent shrubs. Important plants are Indian ricegrass, galleta, blue grama, Salina wildrye, needle and thread, globemallow, aster, pale evening primrose, locoweed, shadscale, fourwing saltbush, winterfat, big sagebrush, black sagebrush and yellowbrush.

Practices for maintaining or improving vegetation include a planned system of grazing, grazing for proper percent of plant use, and good water distribution.

Seeding may be advisable if the plant community shows much departure from potential. Seeding success may be attained during years of average or above average precipitation.

This soil is in Capability Subclass VIe, nonirrigated; Semidesert Loam (Sagebrush) D34 ecological site.

Taxonomic classification is coarse-loamy, mixed (calcareous), mesic Ustic Torrifluvents.

A representative pedon of Glenberg very fine sandy loam, 3 to 7 percent slopes was described 2 miles (3.2km) southeast of Hiawatha; 600 feet (183m) north and 2,600 feet (792m) west of the SE corner of Section 1, T16S, R8E (Photo No. & Coord. 2-83, J-5).

A1--0 to 4 inches (0 to 10.2cm); pale brown (10YR 6/3) very fine sandy loam, very dark grayish brown (10YR 3/2) when moist; weak medium granular structure; soft, very friable, slightly sticky, nonplastic; common very fine and medium roots; strongly calcareous, carbonates are disseminated; strongly alkaline (pH 8.6); abrupt smooth boundary.

C1--4 to 10 inches (10.2 to 25.4cm); pale brown (10YR 6/3) very fine sandy loam, dark grayish brown (10YR 4/2) when moist; massive; soft, very friable, nonsticky, nonplastic; common very fine, fine and medium roots; strongly calcareous, carbonates are disseminated; moderately alkaline (pH 8.4); abrupt wavy boundary.

A1b--10 to 14 inches (25.4 to 35.6cm); brown (10YR 5/3) loam, dark brown (10YR 4/3) when moist; weak medium subangular blocky structure; soft, very friable, slightly sticky, slightly plastic; common very fine, fine and medium roots; few fine pores; strongly calcareous, carbonates are disseminated; strongly alkaline (pH 8.8); abrupt wavy boundary.

C2--14 to 46 inches (35.6 to 116.8cm); pale brown (10YR 6/3) fine sandy loam, dark brown (10YR 4/3) when moist,: massive; soft very friable, nonsticky, nonplastic; common very fine and fine roots; common fine pores; this horizon contains a 1 inch (2.5cm) thick organic layer; strongly calcareous, carbonates are disseminated; strongly alkaline (pH 8.9); clear smooth boundary.

C3--46 to 60 inches (116.8 to 152cm); pale brown (10YR 6/3) loam, dark grayish brown (10YR 4/2) when moist; weak medium subangular blocky structure; hard, firm, slightly sticky, slightly plastic; common very fine and fine roots; many fine pores; strongly calcareous, carbonates are in veins; strongly alkaline (pH 9.0).

The A horizon has hue of 10YR and 2.5Y value of 5 or 6 dry and chroma of 2 or 3. It is typically very fine sandy loam but may include fine sandy loam and loamy fine sand. The A horizon is slightly to strongly calcareous and moderately to strongly alkaline. It is 2 to 4 inches (5 to 10.2cm) thick.

The C horizon has hue of 7.5YR, 10YR or 2.5Y, value of 5 or 6 dry and chroma of 2 to 4. It is typically loam but ranges to very fine and fine sandy loam. The C horizon is mainly massive but may include weak and moderate subangular blocky structure. It is slightly to strongly calcareous and is moderately to strongly alkaline.

GLENTON FINE SANDY LOAM, 1 TO 6 PERCENT SLOPES

This Glenton soil is very deep and well drained. It occurs on alluvial fans and valley floors at elevations of 4,000 to 5,600 feet (1,219 to 1,707m). This soil formed in alluvium derived mainly from sandstone and shale.

The average annual precipitation is 6 to 8 inches (15.2 to 20.3cm). Mean annual air temperature is 48° to 53°F (8.9° to 11.7°C), mean annual soil temperature is 50° to 55°F (10° to 12.8°C), and the average freeze-free season is 135 to 165 days. This soil occurs between Cedar Mountain and the Book Cliffs from Wellington to south of the town of Green River. Slopes are 1 to 6 percent and occur on all aspects. They are long in length and single in shape.

Present vegetation is dominantly galleta, halogeton, Russian thistle, Indian ricegrass, greasewood and shadscale.

In a representative profile the surface layer is pale brown fine sandy loam about 4 inches (10.2cm) thick. The underlying layer is pale brown and very pale brown loam and fine sandy loam to a depth of 60 inches (152cm) or more.

Permeability is moderate. Available water capacity is about 7.5 to 10 inches (19.0 to 25.4cm) to a depth of 60 inches (152cm). The water supplying capacity is about 4 to 5 inches (10.2 to 12.7cm). Organic matter content in the surface layer is very low. Effective rooting depth is 60 inches (152cm) or more. Surface runoff is slow and erosion hazard is moderate. The Erosion Condition Class is slight-38.

This soil is used for rangeland and wildlife habitat.

The potential plant community is about 40 percent grasses, 20 percent forbs, and 40 percent shrubs. Important plants are galleta, hairy grama, Indian ricegrass, sand dropseed, desert trumpet, globemallow, wooly Indianwheat, Douglas rabbitbrush, Torrey Mormon-tea, shadscale and winterfat.

Practices needed for improving or maintaining vegetation include proper season of use, grazing for proper amounts of plant use, a planned system of grazing, and good water distribution.

This soil is in Capability Subclass VIIe, nonirrigated; Desert Loam D34 ecological site.

Taxonomic classification is coarse-loamy, mixed (calcareous), mesic Typic Torrifluvents.

A representative pedon of Glenton fine sandy loam, 1 to 6 percent was described 3.5 miles (5.6km) south of Woodside; 2,200 feet (670m) west and 1,800 feet (549m) south of the NE corner of Section 33, T18S, R14E (Photo No. & Coord. 1-70, H-5).

A1--0 to 4 inches (0 to 10.2cm); pale brown (10YR 6/3) fine sandy loam, dark grayish brown (10YR 4/2) when moist; moderate coarse subangular blocky structure; slightly hard, friable, slightly sticky, slightly plastic; common very

fine roots; common very fine pores; moderately calcareous, carbonates are disseminated; strongly alkaline (pH 8.8); abrupt smooth boundary.

C1--4 to 18 inches (10.2 to 45.7cm); pale brown (10YR 6/3) loam, brown (10YR 4/3) when moist; moderate medium subangular blocky structure; soft, very friable, slightly sticky, slightly plastic; common very fine roots; common very fine pores; moderately calcareous, carbonates are disseminated; strongly alkaline (pH 9.0); clear smooth boundary.

C2--18 to 34 inches (45.7 to 86.4cm); very pale brown (10YR 7/3) fine sandy loam, brown (10YR 5/3) when moist; moderate medium subangular blocky structure; soft, very friable, slightly sticky, slightly plastic; common very fine roots; few very fine pores; moderately calcareous, carbonates are disseminated; moderately alkaline (pH 8.0); clear smooth boundary.

C3--34 to 48 inches (86.4 to 121.9cm); pale brown (10YR 6/3) loam, grayish brown (10YR 5/2) when moist; moderate medium subangular blocky structure; soft, very friable, slightly sticky, slightly plastic; few very fine roots; few very fine pores; moderately calcareous, carbonates are disseminated; moderately alkaline (pH 8.2); clear smooth boundary.

C4--48 to 60 inches (121.9 to 152cm); pale brown (10YR 6/3) fine sandy loam, brown (10YR 5/3) when moist; massive; soft, very friable, slightly sticky, slightly plastic; few very fine roots; few very fine pores; moderately calcareous, carbonates are disseminated; strongly alkaline (pH 9.0).

The A horizon has a hue of 10YR or 7.5YR, value of 5 or 6 dry, and chroma of 2 to 4. It is typically fine sandy loam but ranges to loam and very fine sandy loam. The A horizon is moderately or strongly alkaline and is 2 to 4 inches (5 to 10.2cm) thick.

The C horizon has a hue of 10YR or 7.5YR, value of 5 to 7 dry, and chroma of 3 or 4. It is typically loam and fine sandy loam but ranges to very fine sandy loam. The C horizon is moderately to strongly alkaline.

GREYBULL LOAM, 3 TO 8 PERCENT SLOPES

This Greybull soil is moderately deep and well drained. It occurs on foot slopes and toe slopes at the base of hills. Elevations are 5,300 to 5,500 feet (1,615 to 1,676m). This soil formed in alluvium derived mainly from shale and sandstone over residuum derived mainly from shale.

The average annual precipitation is 6 to 8 inches (15.2 to 20.3cm). Mean annual air temperature is 46° to 48°F (7.8° to 8.9°C), mean annual soil temperature is 48° to 50°F (8.9° to 10°C), and the average freeze-free season is 120 to 150 days. This soil occurs in the vicinity of Mounds. Slopes are 3 to 8 percent and occur on south and west aspects. They are medium in length and single to slightly concave in shape.

Present vegetation is dominantly Indian ricegrass, shadscale, Russian thistle, winterfat, galleta, and scarlet globemallow.

In a representative profile the surface layer is grayish brown loam about 3 inches (7.6cm) thick. The underlying layer is grayish brown loam underlain by weathered shale at a depth of about 34 inches (86.4cm). The layer below about 19 inches (48.3cm) is about 25 percent soft shale fragments that slake in water.

Permeability is moderate. Available water capacity is about 4.5 to 6.0 inches (11.4 to 15.2cm) above the shale. Water supplying capacity is about 3 to 4.5 inches (7.6 to 11.4cm). Organic matter content in the surface layer is very low. Effective rooting depth is about 20 to 40 inches (50.8 to 101.6cm). Surface runoff is medium and erosion hazard is moderate. The Erosion Condition Class is slight-26.

This soil is used for rangeland and wildlife habitat.

The potential plant community is about 40 percent grasses, 20 percent forbs, and 40 percent shrubs. Important plants are galleta, hairy grama, Indian ricegrass, sand dropseed, desert trumpet, globemallow, wooly Indianwheat, Douglas rabbitbrush, Torrey Mormon-tea, shadscale and winterfat.

Practices needed for improving or maintaining vegetation include proper season of use, grazing for proper amounts of plant use, a planned system of grazing, and good water distribution.

This soil is in Capability Subclass VIIe, nonirrigated; Desert Loam D34 ecological site.

Taxonomic classification is fine-loamy, mixed (calcareous), mesic Typic Torriorthents.

A representative pedon of Greybull loam, 3 to 8 percent slopes was described near Mounds about 2,000 feet (610m) north and 800 feet (244m) east of the SW corner of Section 25, T15S, R11E, SLBM (Photo No. & Coord. 1-37, C-16).

A1--0 to 3 inches (0 to 7.6cm); grayish brown (2.5Y 5/2) loam, dark grayish brown (2.5Y 4/2) when moist; weak fine granular structure; soft, friable, slightly sticky, plastic; few very fine, fine, and medium roots; moderately calcareous, carbonates are disseminated; moderately alkaline (pH 8.2); abrupt smooth boundary.

C1--3 to 10 inches (7.6 to 25.4cm); grayish brown (2.5Y 5/2) loam, dark grayish brown (2.5Y 4/2) when moist; moderate medium subangular blocky structure; hard, friable, slightly sticky, plastic; few very fine, fine, and medium roots; common very fine and fine, few medium pores; moderately calcareous, carbonates are disseminated; moderately alkaline (pH 8.4); clear smooth boundary.

C2--10 to 19 inches (25.4 to 48.3cm); grayish brown (2.5Y 5/2) loam, dark grayish brown (2.5Y 4/2) when moist; moderate medium subangular blocky structure; hard, friable, slightly sticky, plastic; few very fine and fine roots; few fine and medium pores; moderately calcareous, carbonates are disseminated; moderately alkaline (pH 8.4); clear smooth boundary.

C3--19 to 34 inches (48.3 to 86.4cm); grayish brown (2.5Y 5/2) loam, dark grayish brown (2.5Y 4/2) when moist; massive; hard, friable, slightly sticky, plastic; few very fine roots; 25 percent soft shale fragments; moderately calcareous, carbonates are disseminated; strongly alkaline (pH 8.6); clear smooth boundary.

C4r--34 inches (86.4cm); weathered shale.

The depth to weathered shale ranges from 20 to 40 inches (50.8 to 101.6cm).

The range in other characteristics has not yet been determined for this soil.

HAVERSON LOAM, HIGH RAINFALL, 1 TO 5 PERCENT SLOPES

This very deep, well drained soil is on alluvial fans and drainageways. It is located in Price Canyon and in the Book Cliffs. It formed in alluvium derived dominantly from sandstone and shale. Slopes are long in length and single in shape. The present vegetation is mainly big sagebrush, black sagebrush, greasewood, blue grama, Indian ricegrass and needle and thread. Elevation is 6,300 to 6,850 feet (1,920 to 2,088m). The average annual precipitation is about 12 to 14 inches (30.5 to 35.6cm), the mean annual air temperature is 47°to 49°F (8.3° to 9.4°C), and the average freeze-free season is 100 to 120 days.

Typically, the surface layer is brown loam about 6 inches (15.2cm) thick. The underlying material is pale brown loam and silt loam about 30 inches (76.2cm) thick. The next layer to a depth of 60 inches (152cm) or more is pale brown fine sandy loam.

Permeability of this Haverson soil is moderate. Available water capacity to a depth of 60 inches (152cm) is about 7.5 to 11.0 inches (19.0 to 27.9cm). Water supplying capacity is 6.5 to 8.0 inches (16.5 to 20.3cm). The organic matter content of the surface layer is 1 to 3 percent. Effective rooting depth is 60 inches (152cm) or more. Runoff is slow, and the hazard of water erosion is moderate. The hazard of soil blowing is moderate.

This unit is used for rangeland, wildlife habitat and recreation.

The Haverson soil is in Capability Subclass VIe, nonirrigated.

HAVRE LOAM, 3 TO 8 PERCENT SLOPES

This deep, well drained soil is on valley floors near Cottonwood Ridge, Jack's Canyon, and Nine Mile Canyon. It formed in alluvium derived dominantly from sandstone and shale. Slopes are single to concave. The present vegetation is mainly Wyoming big sagebrush, Indian ricegrass, Salina wildrye, stickseed, blue grama, and fourwing saltbush. Elevation is 6,900 to 7,300 feet (2,103 to 2,225m). The average annual precipitation is about 12 to 16 inches (30.5 to 40.6cm), the mean annual air temperature is 42° to 45°F (5.6° to 7.2°C), and the average freeze-free season is 60 to 120 days.

Typically, the surface layer is pale brown loam about 3 inches (7.6cm) thick. The underlying material to a depth of 51 inches (129.5cm), is pale brown loam. The next layer to a depth of 60 inches (152cm) or more is very pale brown sandy clay loam. In some areas the surface layer is gravelly loam. Depth to sandstone or shale in some areas ranges from 40 to 60 inches (101.6 to 152cm).

Permeability of this Havre soil is moderate. Available water capacity is about 8 to 10 inches (20.3 to 25.4cm). Water supplying capacity is 10 to 16 inches (25.4 to 40.6cm). The organic matter content of the surface layer is 1 to 3 percent. Effective rooting depth is 60 inches (152cm) or more. Runoff is medium, and the hazard of water erosion is moderate. The hazard of soil blowing is slight.

This unit is used as rangeland and for wildlife habitat.

The Havre soil is in Capability Subclass VIe, nonirrigated.

ILDEFONSO VERY STONY LOAM, 8 TO 30 PERCENT SLOPES

This Ildefonso soil is very deep and well drained. It occurs on benches, dissected outwash plains and toe slopes at elevations of 6,200 to 7,300 feet (1,890 to 2,225m). This soil formed in glacial outwash and alluvium derived mainly from sedimentary rocks.

The average annual precipitation is 12 to 14 inches (30.5 to 35.5cm) Mean annual air temperature is 45° to 47°F (7.2° to 8.3°C), mean annual soil temperature is 47° to 49°F (8.3° to 9.4°C), and the average freeze-free season is 100 to 140 days. This soil occurs around the foot of the mountains from Horse Canyon to Huntington Canyon. Slopes are 8 to 30 percent and occur on all aspects. They are medium in length and convex-concave in shape.

Present vegetation is dominantly pinyon, juniper, Salina wildrye, Indian ricegrass, black sagebrush, and birchleaf mountain mahogany.

In a representative profile the surface layer is pinkish gray very stony loam about 5 inches (12.7cm) thick. The underlying layer is light gray, very cobbly loam and very pale brown very stony loam about 42 inches (106.7cm) thick. The next layer is very pale brown very cobbly coarse sandy loam to a depth of 60 inches (152cm) or more. A horizon of secondary carbonate accumulation occurs at a depth of about 5 inches (12.7cm).

Permeability is moderately rapid. Available water capacity is about 3.75 to 5.0 inches (9.5 to 12.7cm) to a depth of 60 inches (152cm). Water supplying capacity is about 5 to 6 inches (12.7 to 15.2cm). Organic matter content in the surface layer is low. Effective rooting depth is greater than 60 inches (152cm). Surface runoff is medium and erosion hazard is moderate. The Erosion Condition Class is slight-32.

The soil is used for rangeland and wildlife habitat.

The potential plant community consists of an overstory of pinyon pine and Utah juniper with a canopy cover of about 30 percent. The natural vegetation consists of about 35 percent grasses, 5 percent forbs, 30 percent shrubs and 30 percent trees. Important plants are Salina wildrye, Indian ricegrass, western wheatgrass, needle and thread, penstemon, owl clover, globemallow, birchleaf mountain mahogany, cliffrose, Torrey Mormon-tea sagebrush spp., juniper and pinyon pine.

The pinyon pine and Utah juniper are in Site Class III, the site index is 38±8 and Woodland Suitablity Group is 3x. The average production is less than 4 cords of wood per acre. The potential for fence posts and Christmas trees is poor.

Practices needed to maintain or improve the vegetative cover include grazing for the proper percent of plant use, good water distribution and a well planned system of grazing.

This soil is in Capability Subclass VIIs, nonirrigated; Upland Stony Loam (Pinyon-Juniper) D34, E47 ecological site.

Taxonomic classification is loamy-skeletal, mixed, mesic Ustollic Calciorthids.

A representative pedon of Ildefonso very stony loam, 3 to 8 percent slopes in mapping unit IEC located in an area southeast of Hiawatha; about 1,900 feet (579m) south and 2,300 feet (701m) west of the NE corner of Section 1, T16S, R8E, SLBM (Photo No. & Coord. 2-83, H-5) is used to represent this soil.

A1--0 to 5 inches (0 to 12.7cm); pinkish gray (7.5YR 6/2) very stony loam, dark grayish brown (7.5YR 4/2) when moist; weak fine granular structure; slighty hard, friable, slightly sticky, slightly plastic; common fine and many coarse roots; common very fine and few fine pores; 20 percent gravel, 10 percent cobbles, 15 percent stones and boulders; strongly calcareous, carbonates are disseminated; strongly alkaline (pH 8.6); gradual wavy boundary.

C1ca--5 to 17 inches (12.7 to 43.2cm); light gray (10YR 7/2) very cobbly loam, grayish brown (10YR 5/2) when moist; massive; hard, friable, slightly sticky, slightly plastic; common fine and many coarse roots; few very fine pores; 10 percent gravel, 20 percent cobbles and 10 percent stones; strongly calcareous, carbonates are veined; strongly alkaline (pH 8.6); gradual wavy boundary.

C2ca--17 to 47 inches (43.2 to 119.4cm); very pale brown (10YR 7/3) very stony loam, brown (10YR 5/3) when moist; massive; hard, friable slightly sticky, slightly plastic; few fine and medium roots; many very fine and few fine pores; 15 percent gravel, 25 percent cobbles and 20 percent stones; strongly calcareous, carbonates occur as powdery soft masses; strongly alkaline (pH 8.8); gradual wavy boundary.

C3--47 to 60 inches (119.4 to 152cm); very pale brown (10YR 8/4) very cobbly coarse sandy loam, light yellowish brown (10YR 6/4) when moist; massive slightly hard, very friable; few fine roots; few fine pores; 20 percent gravel, 20 percent cobbles and 5 percent stones; strongly calcareous, carbonates are disseminated; strongly alkaline (pH 8.8).

The range in characteristics is not determined for this soil.

KILLPACK FINE SANDY, LOAM, 1 TO 8 PERCENT SLOPES

This Killpack soil is moderately deep and well drained. It occurs on valley side slopes at elevations of 4,100 to 5,700 feet (1,250 to 1,737m). This soil formed in alluvium and residuum derived mainly from shale and sandstone.

The average annual precipitation is 6 to 8 inches (15.2 to 20.3cm). Mean annual air temperature is 50° to 52°F (10° to 11.1°C), mean annual soil temperature is 42° to 54°F (5.6° to 12.2°C), and the average freeze-free season is 140 to 160 days. This soil occurs in the Woodside, Green River and Buckhorn Reservoir areas. Slopes are 1 to 8 percent and on all aspects. They are medium in length and convex in shape.

Present vegetation is dominantly Nuttall saltbush, Indian ricegrass, shadscale, winterfat, and galleta.

In a representative profile the surface layer is pale brown fine sandy loam about 8 inches (20.3cm) thick. The underlying layer is light brownish gray, silty clay loam underlain by shale at a depth of about 22 inches (56cm). There is 5 to 10 percent gravel in the surface layer.

Permeability is moderately slow. Available water capacity is about 3.0 to 4.0 inches (7.6 to 10.2cm) above the shale. Water supplying capacity is about 2.0 to 3.5 inches (5 to 8.9cm). Organic matter content in the surface layer is very low. Effective rooting depth is about 20 to 40 inches (50.8 to 101.6cm). Surface runoff is slow and erosion hazard is moderate. The Erosion Condition Class is slight-32.

This soil is used for rangeland and wildlife habitat.

The potential plant community is about 40 percent grasses, 20 percent forbs and 40 percent shrubs. Important plants are galleta, hairy grama, Indian ricegrass, bottlebrush squirreltail, scarlet globemallow, desert trumpet, wooly Indianwheat, shadscale, other saltbushes, winterfat and Torrey Mormon-tea.

Practices needed to maintain or improve the range condition include the proper amount of plant use, the proper season of use, a planned system of grazing, and good water distribution.

This soil is in Capability Class VIIe, nonirrigated; Desert Loamy Shale D34 ecological site.

Taxonomic classification is fine-silty, mixed (calcareous), mesic Typic Torriorthents.

A representative pedon of Killpack fine sandy loam, 1 to 8 percent slopes was described 3,100 feet (945m) south and 1,700 feet (518m) east of the NW corner of Section 1, T21S, R14E, 4.7 miles (7.5km) NE of Hatt Reservoir. (Photo No. & Coord. 2-139-A, C-8).

A1--0 to 4 inches (0 to 10.2cm); pale brown (10YR 6/3) fine sandy loam, brown (10YR 5/3) when moist; moderate medium subangular blocky structure; soft, very friable, slightly sticky, slightly plastic; few very fine roots; many very fine pores; 5 to 10 percent gravel; strongly calcareous, carbonates are disseminated; strongly alkaline (pH 8.8); abrupt smooth boundary.

C1--4 to 8 inches (10.2 to 20.3cm); pale brown (10YR 6/3) fine sandy loam, brown (10YR 5/3) when moist; moderately coarse subangular blocky structure; slightly hard, friable, sticky, slightly plastic; few very fine roots; common very fine pores; strongly calcareous, carbonates are disseminated; strongly alkaline (pH 8.8); abrupt smooth boundary.

C2--8 to 22 inches (20.3 to 55.6cm); light brownish gray (2.5Y 6/2) silty clay loam, light brownish gray (2.5Y 6/2) when moist; massive; hard, firm, sticky, plastic; common very fine roots; strongly calcareous, carbonates are disseminated; moderately alkaline (pH 8.4); clear smooth boundary.

C3r--22 inches (55.6cm); shale

The depth to soft shale ranges from 20 to 40 inches (50.8 to 101.6cm). The range in other characteristics has not been determined for this soil.

LAZEAR LOAM, 3 TO 15 PERCENT SLOPES

This soil is shallow and somewhat excessively drained. It formed in the residuum of sandstone.

Present vegetation is dominantly Salina wildrye, galleta, Utah juniper, pinyon, Mormon-tea and globemallow.

In a representative profile the surface layer is brown loam about 5 inches (12.7cm) thick. The underlying layer is brown gravelly loam over sandstone at a depth of about 10 inches (25.4cm). There is a thin mantle of gravel on the soil surface.

Permeability is moderately rapid. Available water capacity is about 2.0 to 3.0 inches (5 to 7.6cm) above the sandstone. The water supplying capacity is about 1 to 2 inches (2.5 to 5cm). Organic matter content in the surface layer is low. Effective rooting depth is about 5 to 20 inches (12.7 to 50.8cm). Surface runoff is medium and erosion hazard is moderate. The Erosion Condition Class is slight-37.

The potential plant community is about 30 percent grasses, 10 percent forbs and 60 percent shrubs and trees. Important plants are galleta, Indian ricegrass, needle and thread, Salina wildrye, ballhead gilia, globemallow, littleleaf mountain mahogany, winterfat, slenderbush eriogonum, shadscale, yellowbrush, Mormon-tea, greasebush, pinyon pine and Utah juniper.

The pinyon pine and Utah juniper are in Site Class III, the site index is 14±5 and the Woodland Suitability Group is 3d. The average production is less than 3 cords of wood per acre. The potential for fence posts and Christmas trees is very poor.

Practices needed to improve or maintain the vegetative cover include grazing for the proper percent of plant use, grazing for the proper season of use, and well planned rotational system of grazing.

This soil is in Capability Subclass VIIs, nonirrigated; Semidesert Very Shallow Loam (Juniper-Pinyon) D34 ecological site.

Taxonomic classification is loamy, mixed (calcareous), mesic Lithic Ustic Torriorthents.

A representative pedon of Lazear loam, 3 to 15 percent slopes was described about 1,000 feet (305m) east and 2,000 feet (610m) north of the SE corner of Section 25, T16S, R13E (Photo No. & Coord. 1-62A, G-17) (No General Land Office survey of the area).

A1--0 to 5 inches (0 to 12.7cm); brown (7.5YR 5/4) loam, dark brown (7.5YR 4/4) when moist; weak fine granular structure; soft, very friable, slightly sticky, slightly plastic; common very fine, fine and medium roots; 10 percent gravel; moderately calcareous, carbonates are disseminated; moderately alkaline (pH 8.4); abrupt wavy boundary.

C1--5 to 10 inches (12.7 to 25.4cm); brown (7.5YR 5/4) gravelly loam, dark brown (7.5YR 4/4) when moist; massive; soft, very friable, slightly sticky, slightly plastic; few fine, medium and coarse roots; 25 percent gravel; moderately calcareous, carbonates are disseminated; moderately alkaline (pH 8.4); abrupt wavy boundary.

R--10 inches (25.4cm); sandstone.

Depth to sandstone ranges from 5 to 20 inches (12.7 to 50.8cm).

The A horizon has hue of 7.5YR, 10YR, or 2.5Y and value of 5 or 6 dry. It is slightly or moderately calcareous, moderately or strongly alkaline, and is 1 to 5 inches (2.5 to 12.7cm) thick.

The C horizon has hue of 7.5YR, 10YR or 2.5Y, value of 5 to 7 dry, 4 to 6 moist, and chroma of 3 or 4. It is loam, gravelly loam and clay loam. Gravel content ranges from 0 to 35 percent. The C horizon is moderately or strongly calcareous and moderately or strongly alkaline.

MACAR VARIANT FINE SANDY LOAM, 3 TO 8 PERCENT SLOPES

This map unit is on mountain benches and toe slopes. It is located at the top of the Prickly Pear Canyon, south of the Stone Cabin gas fields, and the tops of Dry Canyon in the survey area. Slopes are convex-concave in shape and medium to long in length. Elevation is 6,600 to 8,000 feet (2,012 to 2,438m). The average annual precipitation is about 12 to 16 inches (30.5 to 40.6cm), the mean annual air temperature is 38° to 45°F(3.3° to 7.2°C), and the average freeze-free season is 60 to 120 days.

The Macar Variant fine sandy loam, 3 to 8 percent slopes is moderately deep and well drained. It formed in residuum derived dominantly from sandstone and shale. Slopes are 3 to 8 percent. The present vegetation is mainly black sagebrush, needle and thread grass, and western wheatgrass.

Typically, the surface layer is brown fine sandy loam about 2 inches (5cm) thick. The subsoil is brown loam about 3 inches (7.6cm) thick. The upper 11 inches (27.9cm) of the substratum is very pale brown loam. The lower part to a depth of 30 inches (76.2cm) is light gray and white loam. Calcareous sandstone is at a depth of 30 inches (76.2cm). A layer of carbonates is at a depth of about 9 inches (22.9cm).

Permeability of the Macar Variant fine sandy loam soil is moderate. Available water capacity is about 4.0 to 5.5 inches (10.2 to 14cm). Water supplying capacity is 6.0 to 8.5 inches (15.2 to 21.6cm). The organic matter content of the surface layer is 1 to 3 percent. Effective rooting depth is 20 to 40 inches (50.8 to 101.6cm). Runoff is medium, and the hazard of water erosion is moderate. The hazard of soil blowing is slight.

The Macar Variant silt loam, 3 to 15 percent slopes is moderately deep and well drained. It formed in residuum derived dominantly from sandstone, siltstone and shale. Slopes are 3 to 15 percent. The present vegetation is mainly Wyoming big sagebrush, Salina wildrye, western wheatgrass, and phlox.

Typically, the surface layer is pale brown silt loam about 3 inches (7.6cm) thick. The subsoil is brown loam about 8 inches (20.3cm) thick. The substratum is very pale brown and light brownish gray clay loam and loam about 11 inches (27.9cm) thick over shale at a depth of 22 inches (55.9cm)

This unit is used for rangeland and wildlife habitat.

This unit is in capability subclass VIe, nonirrigated.

MORENO EXTREMELY BOULDERY LOAM

This map unit is on mountain and canyon side slopes. It is in the vicinity of Whitmore and Emma Parks. Elevation is 7,100 to 8,700 feet (2,164 to 2,652m). The average annual precipitation is about 16 to 20 inches (40.6 to 50.8cm), the mean annual air temperature is 38° to 45°F (3.3° to 7.2°C), and the average freeze-free season is 60 to 120 days.

The Moreno soil is very deep and well drained. It formed in colluvium and alluvium derived dominantly from sandstone and shale. Slopes are short and concave. The present vegetation is mainly serviceberry, mountain big sagebrush, Salina wildrye, snowberry, and scattered Douglas fir.

Typically, the surface layer is brown extremely bouldery loam about 8 inches (20.3cm) thick. The subsoil is brown and reddish brown stony clay loam about 40 inches (101.6cm) thick. The substratum to a depth of 60 inches (152cm) or more is reddish brown clay loam. A layer of carbonates is at a depth of about 48 inches (122cm).

Permeability of the Moreno soil is moderate to a depth of 8 inches (20.3cm) and moderately slow below this depth. Available water capacity is about 7.5 to 10.0 inches (19.0 to 25.4cm). Water supplying capacity is 9 to 13 inches (22.9 to 33cm). The organic matter content of the surface layer is 3 to 5 percent. Effective rooting depth is 60 inches (152cm) or more. Runoff is rapid, and the hazard of water erosion is high. The hazard of soil blowing is slight.

This unit is used for wildlife habitat and rangeland.

This unit is in Capability Subclass VIIe, nonirrigated.

PARKAY VERY STONY LOAM

This map unit is on mountain side slopes. It is located in the Book Cliffs northwest of Sunnyside. Slopes are long in length and concave-convex in shape. The present vegetation is mainly Douglas fir, snowberry, native bluegrass, and Rocky Mountain juniper. Elevation is 6,750 to 8,750 feet (2,057 to 2,667m). The average annual precipitation is about 14 to 18 inches (35.6 to 45.7cm), the mean annual air temperature is 43° to 45°F (6.1° to 7.2°C), and the average freeze-free season is 80 to 100 days.

The Parkay very stony loam is very deep and well drained. It formed in colluvium derived dominantly from sandstone.

Typically, the surface is covered with a mat of leaves, twigs, and needles about 1 inch (2.5cm) thick. The surface layer is dark grayish brown very stony loam about 7 inches (17.8cm) thick. The subsoil is dark yellowish brown very cobbly loam about 13 inches (33cm) thick. The substratum to a depth of 60 inches (152cm) or more is yellowish brown very cobbly loam.

Permeability of the Parkay soil is moderate. Available water capacity, to a depth of 60 inches (152cm) is about 5 to 7.5 inches (12.7 to 19cm). Water supplying capacity is 6 to 10 inches (15.2 to 25.4cm). The organic matter content of the surface layer is 3 to 5 percent. Effective rooting depth is 60 inches (152cm) or more. Runoff is medium, and the hazard of water erosion is high. The hazard of soil blowing is slight.

This unit is used for wildlife habitat.

PATMOS VERY GRAVELLY LOAM, LOW RAINFALL

This map unit is on bedrock controlled benches, canyon rims, and toe slopes. It is east of Range Creek, south of Nine Mile Canyon and west of the Green River Canyon. Slopes are short in length and concave-convex in shape. The present vegetation is mainly pinyon, juniper, Mormon-tea, blacksage and shadscale. Elevation is 5,900 to 8,200 feet (1,798 to 2,499m). The average annual precipitation is about 12 to 16 inches (30.5 to 40.6cm), the mean annual air temperature is 42° to 45°F (5.6° to 7.2°C), and the average freeze-free season is 60 to 120 days.

The Patmos soil is moderately deep and well drained. It formed in colluvium and residuum derived dominantly from sandstone, siltstone, and shale.

Typically, the surface layer is brown very gravelly loam about 3 inches (7.6cm) thick. The upper 10 inches (25.4cm) of the underlying layer is brown or pale brown gravelly loam or very gravelly loam. The lower part to a depth of 23 inches (58.4cm) is pale olive very gravelly loam. Hard siltstone or shale is at a depth of 23 inches (58.4cm).

Permeability of the Patmos soil is moderate. Available water capacity, to a depth of 23 inches (58.4cm) is about 2 to 3.5 inches (5 to 8.9cm). Water supplying capacity is 5 to 7 inches (12.7 to 17.8cm). The organic matter content of the surface layer is 1 to 3 percent. Effective rooting depth is 20 to 40 inches (50.8 to 101.6cm). Runoff is medium, and the hazard of water erosion is moderate. The hazard of soil blowing is slight.

This unit is used for wildlife habitat and rangeland.

This unit is in Capability Subclass VIIs, nonirrigated.

PERSAYO EXTREMELY SHALY LOAM, 8 TO 30 PERCENT SLOPES, ERODED

This soil is shallow and well drained.

In a representative profile the surface layer is yellowish brown extremely shaly loam about 1 inch (2.5cm) thick. The underlying layer is yellowish brown and brown silty clay loam about 7 inches (17.8cm) thick. The next layer is light yellowish brown silt loam overlying weathered shale at a depth of about 15 inches (38.1cm). The 8 to 15-inch (20.3 to 38.1cm) depth is slightly affected by salt.

Permeability is moderately slow. Available water capacity is about 2.0 to 3.0 inches (5 to 7.6cm) above the shale. Water supplying capacity is about 2.0 to 3.0 inches (5 to 7.6cm). Organic matter content in the surface layer is very low. Effective rooting depth is about 4 to 20 inches (10.2 to 50.8cm). Surface runoff is rapid and erosion hazard is high. The Erosion Condition Class is moderate-51. Much of the soil surface layer has been eroded away and rills are in evidence at infrequent intervals of 10 feet (3m) or more. This landscape is dissected due to past erosion. It has gullies and ravines with vegetated side slopes 15 to 30 feet (4.6 to 9.1m) deep at intervals of 350 to 1,000 feet (107 to 305m).

The potential plant community is about 30 percent grasses, 15 percent forbs and 55 percent shrubs. Important plants are Indian ricegrass, galleta, bottlebrush squirreltail, Salina wildrye, threawn, desert trumpet, Indian-wheat, desert lupine, globemallow, mat saltbush, wedgeleaf Nuttall saltbush, Nuttall saltbush, shadscale, winterfat and Mormon-tea.

Practices needed to improve or maintain the vegetation include grazing for the proper percent of plant use, planned system of grazing, and grazing during the proper season of use.

This soil is in Capability Subclass VIIe, nonirrigated; Desert Shale D34 ecological site.

Taxonomic classification is loamy, mixed (calcareous), mesic, shallow Typic Torriorthents.

A representative pedon of Persayo extremely shaly loam, 8 to 30 percent slopes, eroded, was described 350 feet (107m) north and 2,000 feet (610m) west of the SE corner of Section 34, T20S, R14E (Photo No. & Coord. 2-141-A, G-7).

A1--0 to 1 inch (0 to 2.5cm); yellowish brown (10YR 5/4) extremely shaly loam, yellowish brown (10YR 5/4) when moist; moderate coarse granular structure; soft, very friable, sticky, slightly plastic; few very fine roots; many very fine and common fine pores; 50 percent very hard shale fragments and 15 percent cobbles; common gypsum crystals; moderately calcareous, carbonates are disseminated; moderately alkaline (pH 8.2); abrupt smooth boundary.

C1--1 to 4 inches (2.5 to 10.2cm); yellowish brown (10YR 5/4) silty clay loam, yellowish brown (10YR 5/4) when moist; weak medium prismatic structure that parts to moderate medium subangular blocky; soft, very friable, sticky,

slightly plastic; few very fine roots; many very fine pores; 5 percent soft shale fragments; few fine soft masses of gypsum; moderately calcareous, carbonates are disseminated; moderately alkaline (pH 8.4); abrupt wavy boundary.

C2--4 to 8 inches (10.2 to 20.3cm); brown (10YR 4/3) silty clay loam, brown (10YR 4/3) when moist; moderate medium subangular blocky structure; soft, friable, sticky, slightly plastic; common very fine and few fine roots; common very fine pores; 5 percent soft shale fragments; moderately calcareous, carbonates are disseminated; moderately alkaline (pH 8.2); clear smooth boundary.

C3--8 to 15 inches (20.3 to 38.1cm); light yellowish brown (10YR 6/4) silt loam, yellowish brown (10YR 5/4) when moist; massive; soft, very friable, sticky, slightly plastic; common very fine roots; common very fine pores; 25 percent soft shale fragments and 5 percent hard shale fragments; slightly saline; moderately calcareous, carbonates are disseminated; mildly alkaline (pH 7.6); clear smooth boundary.

C4r--15 inches (38.1cm); weathered shale.

Depth to weathered shale ranges from 4 to 20 inches (10.2 to 50.8cm).

The A horizon has hue of 10YR, 2.5Y, or 5Y, and chroma of 3 or 4.

The C horizon has hue of 10YR or 2.5Y, value of 4 to 6 dry, 4 or 5 moist, and chroma of 3 or 4. It is silty clay loam and silt loam. Weathered shale fragments range from 0 to 30 percent. The C horizon is mildly to strongly alkaline.

PERSAYO VERY COBBLY CLAY LOAM, 15 TO 30 PERCENT SLOPES

This Persayo soil is shallow and well drained.

Slopes are 15 to 30 percent and are facing all aspects. They are short to medium in length and are convex in shape.

Present vegetation is dominantly black sagebrush, shadscale, hairy grama, Salina wildrye, and yellowbrush.

In a representative profile the surface layer is light brownish gray very cobbly clay loam about 2 inches (5cm) thick. The underlying layer is light brownish gray silty clay loam about 2 inches (5cm) thick. The next layer is light brownish gray shaly silty clay loam and overlies weathered shale at a depth of about 11 inches (27.9cm). Shale fragments are mainly soft and the rock fragments occur mainly as a surface mantle.

Permeability is moderately slow. Available water capacity is about 2 inches (5cm) or less above the shale. Water supplying capacity is about 2.0 to 2.5 inches (5 to 6.3cm). Organic matter content in the surface layer is very low. Effective rooting depth is about 10 to 20 inches (25.4 to 50.8cm). Surface runoff is medium and erosion hazard is moderate. The Erosion Condition Class is slight-32.

The potential plant community is about 40 percent grasses, 20 percent forbs, and 40 percent shrubs. Important plants are galleta, hairy grama, Indian ricegrass, bottlebrush squirreltail, scarlet globemallow, desert trumpet, wooly Indianwheat, shadscale, other saltbushes, winterfat and Torrey Mormon-tea.

Practices needed to maintain or improve the range condition include the proper amount of plant use, the proper season of use, a planned system of grazing, and good water distribution.

This soil is in Capability Subclass VIIs, nonirrigated; Desert Loamy Shale D34 ecological site.

Taxonomic classification is loamy, mixed (calcareous), mesic, shallow Typic Torriorthents.

A representative pedon of Persayo very cobbly clay loam, 15 to 30 percent slopes was described 2,000 feet (610m) south and 1,100 feet (335m) east of the NW corner of Section 3, T15S, R12E, SLBM (Photo No. & Coord. 1-64-A, C-10).

A11--0 to 2 inches (0 to 5cm); light brownish gray (2.5Y 6/2) very cobbly clay loam, grayish brown (2.5Y 5/2) when moist; weak thin platy structure; soft, very friable, slightly sticky, slightly plastic; few very fine and fine roots; common very fine and few fine pores; 30 percent gravel, 15 percent cobbles, and 5 percent stones; slightly calcareous, carbonates are disseminated; strongly alkaline (pH 8.6); abrupt smooth boundary.

A12--2 to 4 inches (5 to 10.2cm); light brownish gray (2.5Y 6/2) silty clay loam, grayish brown (2.5Y 5/2) when moist; moderate subangular blocky structure that parts to weak fine granular; soft, very friable, sticky, plastic; few very fine and fine roots; common very fine and few fine pores; 2 percent gravel; slightly calcareous, carbonates are disseminated; moderately alkaline (pH 8.4); abrupt smooth boundary.

C1--4 to 11 inches (10.2 to 27.9cm); light brownish gray (2.5Y 6/2) silty clay loam, grayish brown (2.5Y 5/2) when moist; massive; slightly hard, friable, slightly sticky, slightly plastic; few very fine and fine roots; 35 percent soft shale fragments; slightly calcareous, carbonates and disseminated; strongly alkaline (pH 8.6).

C2r--11 inches (27.9cm); weathered shale.

Range in characteristics is not determined for this soil.

PINYON FINE SANDY LOAM, LOW RAINFALL, 3 TO 15 PERCENT SLOPES

This soil is shallow and somewhat excessively drained.

In a representative profile the surface layer is light brown fine sandy loam about 1 inch (2.5cm) thick. The next layer is light yellowish brown loam about 2 inches (5cm) thick. The substratum is very pale brown and light yellowish brown loam underlain by sandstone at a depth of about 15 inches (38.1cm). A horizon of carbonate accumulation occurs at a depth of 3 to 9 inches (7.6 to 29cm).

Permeability is moderate. Available water capacity is about 2.0 to 3.75 inches (5 to 9.5cm) above the sandstone. Water supplying capacity is about 2.5 to 4.0 inches (6.3 to 10.2cm). Organic matter content in the surface layer is low. Effective rooting depth is about 8 to 20 inches (20.3 to 50.8cm). Surface runoff is medium and erosion hazard is high. The Erosion Condition Class is slight-37.

The potential plant community is about 30 percent grasses, 10 percent forbs and 60 percent shrubs and trees. Important plants are galleta, Indian ricegrass, needle and thread, Salina wildrye, ballhead gilia, globemallow, littleleaf mountain mahogany, winterfat, slenderbush eriogonum, shadscale, yellowbrush, Mormon-tea, greasebush, pinyon pine and Utah juniper.

The pinyon pine and Utah juniper are in Site Class III, the site index is 14±5 and the Woodland Suitability Group is 3d. The average production is less than 3 cords of wood per acre. The potential for fence posts and Christmas trees is very poor.

Practices needed to improve or maintain the vegetative cover include grazing for the proper percent of plant use, grazing for the proper season of use, and a well planned rotational system of grazing.

This soil is in Capability Subclass VIIs, nonirrigated; Semidesert Very Shallow Loam (Juniper-Pinyon) D34 ecological site.

Taxonomic classification is loamy, mixed, mesic Lithic Ustollic Calciorthids.

A representative pedon of Pinyon fine sandy loam, low rainfall, 3 to 15 percent slopes, in mapping unit NUF2 located 1,500 feet (457m) south and 1,500 feet (457m) west of the NE corner of Section 29, T17S, R12E (Photo No. & Coord. 1-60, K-6) is used to represent this soil.

A11--0 to 1 inch (0 to 2.5cm); light brown (7.5YR 6/4) fine sandy loam, brown (7.5YR 5/4) when moist; medium thin platy structure; slightly hard, friable, slightly sticky, slightly plastic; few very fine roots; many very fine and fine, common medium pores; moderately calcareous, carbonates are disseminated; strongly alkaline (pH 8.6); abrupt smooth boundary.

B2ca--1 to 3 inches (2.5 to 7.6cm); light yellowish brown (10YR 6/4) loam, yellowish brown (10YR 5/4) when moist; weak fine granular structure; slightly hard, friable, slightly sticky, slightly plastic; few very fine roots; many very fine and fine, common medium pores; strongly calcareous, carbonates are in powdery soft masses; strongly alkaline (pH 8.6); clear smooth boundary.

C1ca--3 to 9 inches (7.6 to 22.9cm); very pale brown (10YR 7/4) loam, light yellowish brown (10YR 6/4) when moist; weak medium subangular blocky structure; slightly hard, friable, slightly sticky, slightly plastic; few very fine, common fine and medium roots; common fine and few medium pores; strongly calcareous, carbonates are in powdery soft masses; moderately alkaline (pH 8.4); clear smooth boundary.

C2--9 to 15 inches (29.9 to 38.1cm); light yellowish brown (10YR 6/4) loam, yellowish brown (10YR 5/4) when moist; massive; hard, friable, slightly sticky, slightly plastic; few very fine, common fine and medium roots; common fine and few medium pores; strongly calcareous, carbonates are in veins, on the undersides of rock fragments and disseminated; strongly alkaline (pH 8.8); abrupt smooth boundary.

R--15 inches (38.1cm); calcareous sandstone.

Depth to sandstone ranges from 8 to 20 inches (20.3 to 50.8cm).

The A horizon has value of 4 or 5 moist. It is fine sandy loam, very fine sandy loam, or loam. The A horizon is moderately to strongly calcareous and 3 to 9 inches (7.6 to 22.9cm) thick.

The Cca horizon has value of 7 or 8 dry, 6 or 7 moist, and chroma of 3 or 4 It is loam or silt loam and is moderately or strongly alkaline.

RAVOLA SILT LOAM, SALINE, 0 TO 3 PERCENT SLOPES, SEVERELY ERODED

This Ravola soil is very deep, well drained, and affected by salt. It occurs on alluvial fans and in narrow alluvial valleys at elevations of 4,200 to 4,800 feet (1,280 to 1,463m). This soil formed in alluvium derived mainly from shale and sandstone.

The average annual precipitation is 6 to 8 inches (15.2 to 20.3cm). Mean annual air temperature is 50° to 52°F (10° to 11.1°C), mean annual soil temperature is 52° to 54°F (11.1° to 12.2°C), and the average freeze-free season is 150 to 165 days. This soil occurs in the area along Highway 6 and 50 between the Horse Canyon turnoff and Green River. Slopes are 0 to 3 percent and occur on all aspects. They are long in length and single in shape.

Present vegetation is dominantly Nuttall saltbush, wedgeleaf Nuttall saltbush, inkweed, greasewood, and annual mustards.

In a representative profile the surface layer is light brownish gray silt loam about 2 inches (5cm) thick. The underlying layer is grayish brown silt loam about 14 inches (35.6cm) thick. The next layer is grayish brown silt loam to a depth of 60 inches (152cm) or more. The salinity effect is from slight in the surface to strong in the underlying layers.

Permeability is moderately slow. Available water capacity of the soil is high, but that available to plants is about 5.0 to 7.5 inches (12.7 to 19.0cm) to a depth of 60 inches (152cm) because of the salt in the soil. Water supplying capacity is about 3.5 to 4.5 inches (8.9 to 11.4cm). Organic matter content in the surface layer is very low. Effective rooting depth is about 60 inches (152cm). Surface runoff is slow and the erosion hazard is high. The Erosion Condition Class is high-69. This area is dissected by gullies that are 5 to 20 feet (1.5 to 6.1m) deep, 20 to 100 feet (6.1 to 30.5m) apart, fed by rills occuring every 1 to 10 feet (.3 to 3m) in a dendritic pattern.

This soil is used for rangeland and wildlife habitat.

The potential plant community is about 20 percent grasses, 20 percent forbs and 60 percent shrubs. Important plants are galleta, tall dropseed, Indian ricegrass, globemallow, Indianwheat, desert trumpet, beeweed, Nuttall saltbush, wedgeleaf Nuttall saltbush, mat saltbush, shadscale and winterfat.

Practices needed for maintaining or improving the vegetation include proper season of use, the proper amount of plant use, a planned system of grazing, and good water distribution.

This soil is in Capability Subclass VIIs, nonirrigated; Desert Salt Flats D34 ecological site.

Taxonomic classification is fine-silty, mixed (calcareous), mesic Typic Torrifluvents.

A representative pedon of Ravola silt loam, saline, 0 to 3 percent slopes, severely eroded was described 10 miles (16.1km) northwest of Green River; 1,600 feet (488m) west and 1,000 feet (305m) north of the SE corner of Section 5, T21S, R15E (Photo No. & Coord. 2-141-A, K-13).

A1--0 to 2 inches (0 to 5cm); light brownish gray (2.5Y 6/2) silt loam, dark grayish brown (2.5Y 4/2) when moist; moderate medium platy structure; slightly hard, friable, slightly sticky, plastic; common very fine roots; common very fine pores; moderately calcareous, carbonates are disseminated; moderately alkaline (pH 8.4); abrupt smooth boundary.

C1--2 to 16 inches (5 to 40.6cm); grayish brown (2.5Y 5/2) silt loam, dark grayish brown (2.5Y 4/2) when moist; massive; slightly hard, friable, slightly sticky, plastic; common very fine roots; common very fine pores; moderately calcareous, carbonates are disseminated; very strongly alkaline (pH 9.2); clear smooth boundary.

C2--16 to 27 inches (40.6 to 68.6cm); grayish brown (2.5Y 5/2) silt loam, dark grayish brown (2.5Y 4/2) when moist; massive; slightly hard, very friable, slightly sticky, plastic; common very fine roots; common very fine pores; moderately calcareous, carbonates are disseminated; very strongly alkaline (pH 9.4); clear smooth boundary.

C3--27 to 60 inches (68.6 to 152cm); grayish brown (2.5Y 5/2) silt loam dark grayish brown (2.5Y 4/2) when moist; massive; slightly hard, friable, slightly sticky, plastic; few very fine roots, many very fine pores; moderately calcareous, carbonates are disseminated; strongly alkaline (pH 8.6).

The A horizon has a hue of 2.5Y or 10YR and chroma of 2 or 3 dry. It is typically silt loam but ranges to loam. The C horizon is moderately to very strongly alkaline.

The C horizon has hue of 2.5Y or 10YR, value of 5 or 6 dry and chroma of 2 or 3. It is typically silt loam but silty clay loam occurs in some pedons mainly below a depth of 40 inches (101.6cm). The C horizon is moderately to very strongly alkaline.

REMMIT VERY FINE SANDY LOAM, 1 TO 6 PERCENT SLOPES

This Remmit soil is very deep and well drained. It occurs on benches at elevations of 6,900 to 7,000 feet (2,103 to 2,134m). This soil formed in alluvium derived mainly from sandstone and shale.

The average annual precipitation is 12 to 14 inches (30.5 to 35.6cm). Mean annual air temperature is 45° to 47°F (7.2° to 8.3°C), mean annual soil temperature is 47° to 49°F (8.3° to 9.4°C), and the average freeze-free season is 100 to 120 days. This soil occurs north of Wattis, on Wiregrass Bench and Long Bench. Slopes are 1 to 6 percent and occur on all aspects. They are medium to long in length and concave in shape.

Present vegetation is dominantly big sagebrush, needle and thread, pricklypear, western wheatgrass, and sand dropseed.

In a representative profile the surface layer is yellowish brown very fine sandy loam about 2 inches (5cm) thick. The subsoil is yellowish brown very fine sandy loam about 15 inches (38.1cm) thick. The substratum is light yellowish brown or very pale brown very fine sandy loam and fine sandy loam to a depth of more than 60 inches (152cm). The soil has a layer of carbonate accumulation below a depth of about 17 inches (43.2cm).

Permeability is moderate. Available water capacity is about 8.0 to 10.0 inches (20.3 to 25.4cm) above a depth of 60 inches (152cm). Water supplying capacity is about 6.0 to 8.0 inches (15.2 to 20.3cm). Organic matter content in the surface layer is low. Effective rooting depth is greater than 60 inches (152cm). Surface runoff is slow and erosion hazard is moderate. The Erosion Condition Class is slight-31.

This soil is used for rangeland and wildlife habitat.

The potential plant community is about 60 percent grass, 10 percent forbs and 30 percent shrubs. Important plants are native bluegrasses, western wheatgrass, needle and thread, prairie junegrass, bluebunch wheatgrass, bottlebrush squirreltail, Salina wildrye, blue grama, scarlet globemallow, aster, meadow milkvetch, peavine, big sagebrush, Wyoming sagebrush, black sagebrush, yellowbrush and winterfat.

Practices for maintaining or improving vegetation include a planned grazing system, grazing for the proper percent of plant use, adequate fencing, and good water distribution. Adequate brush control can be obtained by aerial spraying, plowing, chaining, railing, or burning.

Seeding is advisable if severe deterioration of potential plants has occurred.

This soil is in Capability Subclass VIe, nonirrigated; Upland Loam D34, E47 ecological site.

Taxonomic classification is coarse-loamy, mixed, mesic Ustollic Camborthids.

A representative pedon of Remmit very fine sandy loam, 1 to 6 percent slopes described in mapping unit AHC located 4.5 miles (7.2km) north and 3.5 miles (5.6km) east of Wattis Junction; about 2,700 feet (823m) south and 1,000 feet (305m) east of the NW corner of Section 16, R14S, R9E (Photo No. & Coord. 3-93, E-11) is used to represent this soil.

A1--0 to 2 inches (0 to 5cm); yellowish brown (10YR 5/4) very fine sandy loam, dark brown (10YR 3/3) when moist; weak medium platy structure; soft, very friable, nonsticky, nonplastic; few very fine, fine, and medium roots; few very fine and few medium pores; moderately alkaline (pH 8.2); abrupt smooth boundary.

B21--2 to 7 inches (5 to 17.8cm); yellowish brown (10YR 5/6) very fine sandy loam, dark yellowish brown (10YR 4/4) when moist; moderate medium subangular blocky structure; slightly hard, very friable, slightly sticky, slightly plastic; common very fine and few medium roots; common very fine and fine and few medium pores; moderately alkaline (pH 8.0); clear smooth boundary.

B22--7 to 17 inches (17.8 to 43.2cm); yellowish brown (10YR 5/6) very fine sandy loam, dark yellowish brown (10YR 4/4) when moist; moderate medium subangular blocky structure; hard, friable, slightly sticky, slightly plastic; common very fine and fine roots; common very fine, few fine and medium pores; moderately alkaline (pH 8.2); abrupt smooth boundary.

C1ca--17 to 26 inches (43.2 to 66cm); light yellowish brown (10YR 6/4) very fine sandy loam, yellowish brown (10YR 5/4) when moist; massive; hard, firm, slightly sticky, slightly plastic; few very fine and fine roots; few fine and medium pores; moderately calcareous, carbonates are in veins and soft powdery masses; moderately alkaline (pH 8.4); clear smooth boundary.

C2ca--26 to 46 inches (66 to 116.8cm); very pale brown (10YR 7/3) fine sandy loam, pale brown (10YR 6/3) when moist; massive; slightly hard, very friable, slightly sticky, slightly plastic; few very fine roots; 3 percent gravel; strongly calcareous, carbonates are in soft powdery masses; very strongly alkaline (pH 9.2); clear smooth boundary.

C3--46 to 60 inches (116.8 to 152cm); light yellowish brown (10YR 6/4) very fine sandy loam, yellowish brown (10YR 5/4) when moist; massive; slightly hard, friable, slightly sticky, slightly plastic; strongly calcareous, carbonates are disseminated; very strongly alkaline (pH 9.2).

The range in characteristics has not been determined for this soil.

SHINGLE EXTREMELY STONY LOAM, 50 TO 70 PERCENT SLOPES, ERODED

This shallow, well drained soil is on bench and fan terrace side slopes. It is along the base of the Book Cliffs from Horse Canyon to Huntington Canyon. It formed in colluvium and residuum derived dominantly from sandstone and shale. Slopes are short in length and concave-convex in shape. The present vegetation is mainly pinyon, juniper, Salina wildrye, Indian ricegrass, needle and thread, galleta, and birchleaf mountain mahogany. Elevation is 5,800 to 8,000 feet (1,768 to 2,438m). The average annual precipitation is about 12 to 14 inches (30.5 to 35.6cm), the mean annual air temperature is 45° to 47°F (7.2° to 8.3°C), and the average freeze-free season is 100 to 130 days.

Typically, the surface layer is light brownish gray extremely stony loam about 7 inches (17.8cm) thick. The underlying material is gray and light brownish gray silt loam about 12 inches (30.5cm) thick. Partially weathered shale is at a depth of 19 inches (48.3cm). Depth to shale ranges from 15 to 20 inches (38.1 to 50.8cm).

Permeability of this Shingle soil is moderately slow. Available water capacity, to a depth of 19 inches (48.3cm) is about 2.0 to 3.5 inches (5 to 8.9cm). Water supplying capacity is 3 to 6 inches (7.6 to 15.2cm). The organic matter content of the surface layer is 1 to 3 percent. Effective rooting depth is 15 to 20 inches (38.1 to 50.8cm). Runoff is rapid, and the hazard of water erosion is high. The hazard of soil blowing is slight.

This unit is used for rangeland and wildlife habitat.

The Shingle soil is in Capability Subclass VIIe, nonirrigated.

WARNEKE VARIANT GRAVELLY LOAM, 0 TO 3 PERCENT SLOPES

This shallow, well drained soil is on mesa tops and benches on the Book Cliffs. It formed in residuum derived dominantly from sandstone. Slopes are single to convex and medium to long. The present vegetation is mainly Wyoming big sagebrush, Salina wildrye, and western wheatgrass. Elevation is 7,000 to 7,400 feet (2,134 to 2,255m). The average annual precipitation is about 12 to 16 inches (30.5 to 40.6cm), the mean annual air temperature is 38° to 45°F (3.3° to 7.2°C), and the average freeze-free season is 60 to 120 days.

Typically, the surface layer is light yellowish brown gravelly loam about 4 inches (10.2cm) thick. The next layer is light yellowish brown loam about 4 inches (10.2cm) thick. Below this is very pale brown loam about 4 inches (10.2cm) thick over calcareous sandstone. A layer of carbonates is at a depth of about 4 inches (10.2cm). Depth to sandstone ranges from 10 to 20 inches (25.4 to 50.8cm) in some areas.

Permeability of the Warneke Variant soil is moderate. Available water capacity is less than 2 inches (5cm). Water supplying capacity is 3 to 5 inches (7.6 to 12.7cm). The organic matter content of the surface layer is 1 to 3 percent. Effective rooting depth is 10 to 20 inches (25.4 to 50.8cm). Runoff is low, and the hazard of water erosion is moderate. The hazard of soil blowing is slight.

This unit is used as rangeland and for wildlife.

This map unit is in Capability Subclass VIIs.

ZILLION VERY STONY FINE SANDY LOAM, 15 TO 40 PERCENT SLOPES

This deep, well drained soil is on steep escarpments of benches. It is located near Steer Ridge and Bishop Ridge in the Book Cliffs. It formed in colluvium and residuum derived dominantly from sandstone and shale. Slopes are convex in shape and short to medium in length. The present vegetation is mainly serviceberry, birchleaf mountain mahogany, big sagebrush and curlleaf mountain mahogany. Elevation is 7,200 to 8,000 feet (2,195 to 2,438m). The average annual precipitation is about 16 to 20 inches (40.6 to 50.8cm), the mean annual air temperature is 38° to 45°F (3.3° to 7.2°C), and the average freeze-free season is 60 to 120 days.

Typically, the surface layer is dark brown very stony fine sandy loam and cobbly fine sandy loam about 16 inches (40.6cm) thick. The upper 7 inches (17.8cm) of the subsoil is brown cobbly fine sandy loam. The lower 11 inches (27.9cm) is brown very cobbly fine sandy loam. The substratum to a depth of 60 inches (152cm) or more is brown very stony fine sandy loam.

Permeability of this Zillion soil is moderate. Available water capacity, to a depth of 60 inches (152cm), is about 6.0 to 7.0 inches (15.2 to 17.8cm). Water supplying capacity is 9 to 12 inches (22.9 to 30.5cm). The organic matter content of the surface layer is 5 to 10 percent. Effective rooting depth is 60 inches (152cm) or more. Runoff is rapid and the hazard of water erosion is high. The hazard of soil blowing is slight.

This unit is used for wildlife habitat.

The Zillion soil is in Capability Subclass VIe, nonirrigated.

The following list and descriptions are of the major soil series which comprise the mapping units.

BG

Cabba

Chilton

Chipeta

Cliffdown

Comodore

Datino

Elwood

Falcon

Firo

Glenberg

Guben

Haverson

Lazear

Menefee

Midfork

Patmos

Peso

Podo

Rabbitex

Rivra

Rivra Variant

Shingle

Sunup

BG SERIES (Moffat Series)*

The Moffat Series consists of deep, well drained, moderately rapid, permeable soils that formed in eolian and alluvial sediment. They are found on broad alluvial fans and plains and have slopes ranging from 1 to 8 percent. Mean annual air temperature is 50°F (10°C) and average annual precipitation is 7 inches (17.8cm). Elevation is 4,600 to 5,000 feet (1,402 to 1,524m). The type locality is Emery County, Utah; south of the Flat Tops; 840 feet (256m) north and 2,280 feet (695m) east of the SE corner, Section 34, T25S, R13E.

These soils are coarse, loamy, mixed, mesic Typic Calciorthids. A typical pedon is:

A11--0 to 1 inch (0 to 2.5cm); yellowish red (5YR 5/6) gravelly fine sand, yellowish red (5YR 4/6) moist; single grain; soft, very friable; few very fine and fine roots; 20 percent fine and medium pebbles on the soil surface; 15 percent pebbles in the soil horizon; slightly calcareous; carbonates are disseminated; mildly alkaline (pH 7.8); abrupt smooth boundary [1 to 12 inches (2.5 to 30.5cm) thick.]

A12--1 to 6 inches (2.5 to 15.2cm); yellowish red (5YR 5/6) loamy fine sand, yellowish red (5YR 5/6) moist; weak medium subangular blocky structure, soft, very friable; few very fine pores; 5 percent pebbles; moderately calcareous, carbonates are disseminated; mildly alkaline (pH 7.8); abrupt wavy boundary [0 to 9 inches (0 to 22.9cm) thick.]

C1ca--6 to 13 inches (15.2 to 33cm); light reddish brown (5YR 6/4) fine sandy loam, yellowish red (5YR 5/6) moist; weak medium subangular blocky structure; slightly hard, friable; few very fine roots; strongly calcareous; few very fine pores; strongly alkaline (pH 8.6); clear wavy boundary [5 to 18 inches (12.7 to 45.7cm) thick.]

C2ca--13 to 26 inches (33 to 66cm); pink (5YR 7/3) fine sandy loam, reddish yellow (5YR 6/6) moist; massive, hard, firm; few very fine roots; few very fine pores; strongly calcareous, carbonates are disseminated; strongly alkaline (pH 8.8); gradual wavy boundary [13 to 22 inches (33 to 55.9cm) thick.]

C3--26 to 40 inches (66 to 101.6cm); reddish yellow (5YR 6/6) fine sandy loam, reddish yellow (5YR 6/6) moist; massive, hard, firm, few very fine pores; moderately calcareous carbonates are disseminated; strongly alkaline (pH 8.8); clear wavy boundary [0 to 26 inches (0 to 66cm) thick.]

C4--40 to 60 inches (101.6 to 152cm); reddish yellow (5YR 6/6) fine sand, yellowish red (5YR 5/6) moist; massive; slightly hard, friable; moderately calcareous carbonates are disseminated; strongly alkaline (pH 8.6).

These soils are well drained. Runoff is typically slow but ranges to rapid depending upon slope. Permeability is moderately rapid. Moffat soils are typically used for rangeland. Indian ricegrass, galleta, blackbrush, four-wing saltbush and Mormon-tea are the principal plants.

*BGC and CGC2 have been correlated to the Moffat Series

CABBA SERIES

These soils are classified as loamy, mixed (calcareous), frigid, shallow, Typic Ustorthents. The Cabba series consists of shallow, well drained, moderately permeable soils that formed in residuum and colluvium derived dominantly from shale or siltstone of the Green River Formation.

These soils are on benches, canyon rims, and steep canyon side slopes at elevations of 5,000 to 8,200 feet (1,524 to 2,499m). Slope ranges from 3 to 70 percent. The average annual precipitation ranges from 12 to 16 inches (30.5 to 40.6cm), and the mean annual air temperature ranges from 42° to 45°F (5.6° to 7.2°C).

They are near the Podo, Guben, and Patmos soils.

Podo soils have hard sedimentary rock at depths of less than 20 inches (50.8cm). Guben and Patmos soils have depths greater than 20 inches (50.8cm).

A typical pedon of Cabba extremely bouldery loam, 40 to 70 percent slopes, was described on the slopes of Cottonwood Ridge; 250 feet (76m) west and 1,500 feet (457m) north of the southeast corner of Section 7, T13S, R16E (Photo No. & Coord. 1-57, J-15).

A1--0 to 3 inches (0 to 7.6cm); pale brown (10YR 6/3) bouldery loam, brown (10YR 4/3) moist; moderate medium granular that parts to fine granular structure; loose, slightly sticky, slightly plastic; common very fine and fine roots; 5 percent fine gravels, 10 percent cobbles 15 percent boulders; slightly calcareous, carbonates are disseminated; strongly alkaline (pH 8.6); abrupt smooth boundary.

C1--3 to 7 inches (7.6 to 17.8cm); brown (10YR 5/3) loam, brown (10YR 4/3) moist; mottles; weak fine granular structure; loose, slightly sticky, slightly plastic; common very fine and fine roots; slightly calcareous, moderately alkaline (pH 8.4); abrupt smooth boundary.

C2--7 to 15 inches (17.8 to 38.1cm); light yellowish brown (10YR 6/4) loam, yellowish brown (10YR 5/4) moist; massive; soft, friable, slightly sticky, slightly plastic; common very fine, fine roots; 5 percent shale fragments which slake in water; slightly calcareous, strongly alkaline (pH 8.8); abrupt smooth boundary.

C3r--15 inches (38.1cm); rippable shale; soft carbonate coatings on the surface of rocks.

Depth to soft shale or siltstone is 8 to 20 inches (20.3 to 50.8cm). Rock fragments are soft shale, siltstone with some sandstone fragments and range in size from fine gravel to large sandstone flags and boulders. The surface contains from 0 to 10 percent coarse fragments, but the control section contains less than 35 percent. These soils are commonly calcareous throughout.

The A horizon has hue of 2.5Y or 10YR, value of 5 to 7 dry, 3 to 5 moist, and chroma of 2 or 3. It is loam, bouldery loam, or gravelly loam.

The C horizon has hue of 2.5YR or 10YR, value of 5 or 6 dry, 4 or 5 moist, and chroma of 2 to 4. It is loam, silty clay loam, clay loam, gravelly loam, extremely gravelly loam. The C horizon is moderately calcareous or strongly calcareous and is moderately to strongly alkaline.

CHILTON SERIES

The Chilton series is a member of the loamy-skeletal, mixed (calcareous), mesic family of Ustic Torriorthents. Typically, Chilton soils have brown gravelly Loam A horizons over light brown gravelly loam Cca horizons in which some carbonate has accumulated. Below the Cca horizon is very gravelly loam soil material that is 4 or more feet (1.2m) thick.

Chilton soils are on fans and piedmonts at elevations of 5,800 to 6,800 feet (1,768 to 2,072m). Slopes range from 5 to 20 percent. These soils formed in alluvial sediments derived mostly from sandstone, schist, gneiss and limestone. At the type location the annual precipitation is 13 inches (33cm) of which most falls during the summer. Annual temperature is about 50°F (10°C). The type location is Torrance County, New Mexico; near the N 1/4 corner of Section 31, T3N, R6E.

Typifying Pedon: Chilton gravelly loam - rangeland.

A1--0 to 9 inches (0 to 22.9cm); brown (7.5YR 5/2) gravelly loam, dark brown (7.5YR 4/2) moist; weak and moderate very fine granular structure; soft, very friable; many fine roots; 25 percent gravel; calcareous with carbonates on pebbles; moderately alkaline (pH 8.2); gradual boundary; 4 to 10 inches (10.2 to 25.4cm)) thick.

C1ca--9 to 15 inches (22.9 to 38.1cm); light brown (7.5YR 6/4) gravelly loam, brown (7.5YR 5/4) moist; massive; soft, very friable; common fine and medium roots; about 35 percent gravel with calcium carbonate occurring as small concretions and as coatings on the pebbles; moderately alkaline (pH 8.4); gradual wavy boundary; 6 to 8 inches (15.2 to 20.3cm) thick.

C2--15 to 60 inches (38.1 to 152cm); light brown (7.5YR 6/4) very gravelly loam, brown (7.5YR 5/4) moist; massive; soft, very friable; few medium roots; about 50 percent of this horizon is gravel; calcareous, but less than in the horizon above; moderately alkaline (pH 8.4).

Rock fragments range from 35 to 65 percent in the control section. The pedons are calcareous throughout and are moderately alkaline (pH 7.9 through 8.4). Annual soil temperature is estimated as 50°F (10°C). The A horizon has hue of 7.5YR or 5YR, value of 4 through 6 dry and 3 through 5 moist, and chroma of 2 through 4. It is dark colored in some pedons but is too thin to be a mollic epipedon. The C1ca horizon has hue of 7.5YR or 5YR, value of 4 through 8 dry and 3 through 5 moist and chroma of 2 through 4. It is loam, clay loam, sandy clay loam or sandy loam, with 18 to 35 percent clay. This horizon contains 7 to 15 percent carbonates and 35 to 50 percent rock fragments, mostly gravel. The C2 horizon is similar to the C1ca horizon except that it contains about 5 percent less carbonates.

These soils are excessively drained: medium run-off: moderately rapid permeability.

Principal land uses are grazing and wildlife. Principal plants are blue grama, black grama, sand dropseed, cactus, juniper and pinyon pine.

CHIPETA SERIES

The Chipeta series is a member of the clayey, mixed (calcareous) mesic, shallow family of Typic Torriorthents. Typically, Chipeta soils are 10 to 20 inches (25.4 to 50.8cm) deep over soft shale, have a weak to moderate gypsum accumulation immediately above the shale, and have silty clay C horizons.

These soils are on gently sloping to steep uplands. Slopes are complex and range from 1 to 30 percent. These soils formed in residuum from alkaline marine shales containing gypsum. The climate is semiarid. The mean annual temperature is 47° to 52°F (8.3° to 11.1°C). The freeze-free period ranges from 110 to 160 days. Mean annual precipitation ranges from 6 to 11 inches (15.2 to 27.9cm). The type location is Emery County, Utah; 1 mile (1.6km) south and 1-1/2 miles (2.4km) east of Castle Dale, 1,000 feet (30.5m) south and 20 feet (6.1m) east of the NW corner of Section 11, T19S, R8E.

Typifying Pedon: Chipeta silty clay loam - cultivated.

Ap--0 to 5 inches (0 to 12.7cm); light brownish gray (2.5Y 6/2) silty clay loam, dark grayish brown (2.5Y 4/2) moist; weak fine blocky and subangular blocky structure; hard, firm, sticky, plastic; few fine and medium roots; few fine discontinuous pores; strongly calcareous, mildly alkaline (pH 7.7); clear smooth boundary; 1 to 5 inches (2.5 to 12.7cm) thick.

C1--5 to 13 inches (12.7 to 33cm); light brownish gray (2.5Y 6/2) silty clay, dark grayish brown (2.5Y 4/2) moist; moderate medium and fine blocky structure; hard, very firm, sticky, plastic; few fine and medium roots; few large continuous pores, few fine discontinuous pores; strongly calcareous, mildly alkaline (pH 7.6); clear wavy boundary; 6 to 10 inches (15.2 to 25.4cm) thick.

C2cs--13 to 17 inches (33 to 43.2cm); light brownish gray (2.5Y 6/2) silty clay, dark grayish brown (2.5Y 4/2) moist; weak, moderately thick platy breaking to weak medium blocky structure; hard, very firm, sticky plastic; few fine and medium roots; many fine crystals and mycelia-like veins of gypsum; 20 percent unweathered shale fragments; strongly calcareous, mildly alkaline (pH 7.4); gradual irregular boundary; 3 to 5 inches (7.6 to 12.7cm) thick.

R--17 inches (43.2cm); slightly weathered marine shale.

Range in Characteristics: Depth to shale ranges from 10 to 20 inches (25.4 to 50.8cm). Salinity ranges from moderate to strong. The soils are usually dry when not frozen unless irrigated. Mean annual soil temperatures are more than 47°F (8.3°C). The A1 horizon has hue of 10YR through 5Y, value of 6 through 8 dry, 4 through 6 moist, and chroma of 1 or 2. The control section below 10 inches (25.4cm) averages more than 35 percent clay and ranges from heavy silty clay loam to silty clay. Hue ranges from 10YR through 5Y, value is 5 or 6 dry, 4 or 5 moist, and chroma is 1 or 2. Amount of gypsum in the gypsic horizon ranges from 0.5 to 10.0 percent and gypsum crystals range from few to common.

Drainage and Permeability: These soils are well-drained, medium to rapid runoff; slow permeability. A few of the smoother areas of deeper soil are irrigated and used for growing grain and hay crops. At present, Nuttalls saltbush, mat saltbush, shadscale, and galleta grass are dominant.

CLIFFDOWN SERIES

The Cliffdown series is a member of the loamy-skeletal, mixed (calcareous), mesic family of Typic Torriorthents. Cliffdown soils typically have weakly expressed, light brownish gray A1 horizons, and stratified light brownish gray and light gray, gravelly and very gravelly sandy loam C horizons. They are calcareous and strongly alkaline.

Cliffdown soils are on smooth, nearly level and gently sloping alluvial fans at elevations of 5,100 to 5,600 feet (1,554 to 1,707m). Slope gradients are 0 to 4 percent. Eroded areas have very slightly convex ridges and concave swales. The soils formed in gravelly loamy alluvium from limestone, dolomite, tuffs, quartzite, and sandstone. The annual precipitation averages 6 to 8 inches (15.2 to 20.3cm). The mean January temperature is 35°F (1.7°C); July 71°F (21.7°C); and the mean annual temperature is about 53°F (11.7°C). The frost-free period is 130 to 150 days. The type location is Lincoln County, Nevada; about 500 feet (152m) north and 500 feet (152m) east of the center of Section 33, T1N, R56E.

Typifying Pedon: Cliffdown gravelly sandy loam - rangeland.

A1--0 to 3 inches (0 to 7.6cm); light brownish gray (10YR 6/2) gravelly sandy loam, dark brown (10YR 4/3) moist; weak thick platy structure; soft, very friable, nonsticky, nonplastic; common very fine and fine roots; common very fine and fine, and many very fine interstitial pores; 30 percent gravel; strongly effervescent; strongly alkaline (pH 8.6); clear smooth boundary; 2 to 4 inches (5 to 10.2cm) thick.

C1--3 to 13 inches (7.6 to 33cm); light brownish gray (10YR 6/2) gravelly fine sandy loam, dark brown (10YR 4/3) moist; massive; slightly hard, very friable, nonsticky, slightly plastic; many very fine and fine, and few medium roots; many very fine tubular, and many very fine interstitial pores; 30 percent gravel; violently effervescent; strongly alkaline (pH 8.6); clear smooth boundary; 8 to 12 inches (20.3 to 30.5cm) thick.

C2--13 to 20 inches (33 to 50.8cm); light gray (10YR 7/2) gravelly light fine sandy loam, brown (10YR 5/3) moist; massive; soft, very friable, nonsticky, nonplastic; many very fine and fine, and few medium roots; many very fine interstitial pores; 40 percent gravel; violently effervescent; strongly alkaline (pH 8.6); clear smooth boundary; 6 to 9 inches (15.2 to 22.9cm)) thick.

C3--20 to 32 inches (50.8 to 81.3cm); light gray (10YR 7/2) gravelly light fine sandy loam, brown (10YR 5/3) moist; massive; soft, very friable, nonsticky, nonplastic; many very fine and fine roots; many very fine and fine interstitial pores; 30 percent fine gravel; violently effervescent; strongly alkaline (pH 8.8); clear smooth boundary; to 14 inches (35.6cm) thick.

IIC4--32 to 42 inches (81.3 to 106.7cm); light gray (10YR 7/2) very gravelly light fine sandy loam, brown (10YR 5/3) moist; massive; soft, very friable, nonsticky, nonplastic; many very fine and fine roots; many very fine and fine interstitial pores; 50 percent fine gravel; violently effervescent; strongly alkaline (pH 8.5); clear smooth boundary; 8 to 14 inches (20.3 to 35.6cm) thick.

IIIC5--42 to 52 inches (106.7 to 132.1cm); light gray (10YR 7/2) gravelly light sandy loam, dark brown (10YR 4/3) moist; massive; soft, very friable, nonsticky, nonplastic; many very fine and fine roots; many very fine and fine interstitial pores; 30 percent gravel; violently effervescent; strongly alkaline (pH 8.5).

Cliffdown soils are usually dry during most years, mainly late spring, summer, and fall months. The mean annual soil temperature is 53° to 59°F (11.7° to 15°C). The lime content is such that the soil is at least slightly effervescent in the A1 horizon and strong or violently effervescent below. A weak Cca horizon is in some pedons, but is not characteristic. pH values range from 8.2 to 8.8. The soil has hue of 10YR or 7.5YR, value of 6 or 7 dry and 3 through 5 moist, and chroma of 2 through 4. The A1 horizon in some pedons is 1/2 unit of value darker than the C horizon. The control section is stratified and dominantly fine sandy loam or sandy loam modified by gravel. Strata of loamy fine sand, loamy sand and loam are included. The gravel content is variable but averages 35 to 50 percent by volume.

These soils are somewhat excessively drained; slow runoff; moderately rapid permeability. Cliffdown soils are used for grazing. The principal vegetation is common winterfat, bud sagebrush, and Indian ricegrass.

COMODORE SERIES

These soils are classified as loamy-skeletal, mixed Lithic Haploborolls.

The Comodore series consists of shallow, well drained, and moderately rapid permeable soils that formed in colluvium derived dominantly from sandstone.

These soils are on toe slopes and mountain side slopes at elevations of 6,800 to 8,100 feet (2,072 to 2,469m). Slope ranges from 50 to 60 percent. The average annual precipitation ranges from 14 to 18 inches (35.6 to 45.7cm), and the mean annual air temperature ranges from 43° to 45°F (6.1° to 7.2°C).

They are near the Beenom and Datino soils. Beenom soils have a layer of clay accumulation and Datino soils are deeper than 60 inches (152cm).

A typical pedon of Comodore very stony very fine sandy loam, 50 to 60 percent slopes, eroded, is located in Dugout Creek northeast of Wellington; about 2,100 feet (640m) east and 2,300 feet (701m) south of the NW corner of Section 23, T14S, R12E.

A11--0 to 4 inches (0 to 10.2cm); very dark grayish brown (10YR 3/2) very stony very fine sandy loam, very dark brown (10YR 2/2) moist; weak fine granular structure; soft, friable, slightly sticky, slightly plastic; common very fine, fine, medium and coarse roots; few very fine and fine pores; 15 percent gravel, 25 percent cobbles and 20 percent stones; mildly alkaline (pH 7.4); clear smooth boundary.

A12--4 to 14 inches (10.2 to 35.6cm); very dark grayish brown (10YR 3/2) very cobbly very fine sandy loam, very dark brown (10YR 2/2) moist; weak fine granular structure; soft, friable, slightly sticky, slightly plastic; common very fine, fine, medium and coarse roots; few very fine pores; 15 percent gravel and 30 percent cobbles; mildly alkaline (pH 7.4); abrupt wavy boundary.

R--14 + inches (35.6+cm); fractured sandstone.

The range in characteristics is not determined for this soil.

DATINO SERIES

These soils are classified as loamy-skeletal, mixed Typic Haploborolls.

The Datino series consists of very deep, well drained and moderately permeable soils that formed in colluvium derived dominantly from sandstone and shale.

These soils are on toe slopes of very steep mountain slopes at elevations of 6,800 to 8,100 feet (2,072 to 2,469m). Slope ranges from 40 to 60 percent. The average annual precipitation ranges from 16 to 18 inches (40.6 to 45.7cm), and the mean annual air temperature ranges from 43° to 45°F (6.1° to 7.2°C).

They are near the Comodore and Beenom soils. Comodore and Beenom soils have bedrock within 20 inches (50.8cm). Beenom soils have a layer of clay accumulation.

A typical pedon of Datino extremely stony fine sandy loam, 40 to 60 percent slopes, eroded, is located about 1/4 mile (.4km) south of Soldier Creek Mine; 2,400 feet (731m) west and 2,200 feet (670m) south of the NE corner of Section 18, T13S, R12E (Photo No. & Coord. 4-100, K-3).

A1--0 to 9 inches (0 to 22.9cm); brown (10YR 4/3) extremely stony fine sandy loam, dark brown (10YR 3/3) moist; weak fine granular structure; soft, friable, slightly sticky, slightly plastic; common very fine and fine, few medium and coarse roots; few very fine pores; 15 percent gravel, 25 percent cobbles and 25 percent stones; moderately alkaline (pH 7.9); clear smooth boundary.

B2--9 to 16 inches (22.9 to 40.6cm); brown (10YR 5/3) very stony loam, dark brown (10YR 4/3) moist; moderate medium subangular blocky structure; slightly hard, friable, slightly sticky, slightly plastic; few very fine, fine, medium and coarse roots; common very fine and fine, few medium pores; 15 percent gravel, 15 percent cobbles and 10 percent stones; slightly calcareous; moderately alkaline (pH 7.9); gradual wavy boundary.

C1ca--16 to 41 inches (40.6 to 104.1cm); brown (10YR 5/3) extremely stony fine sandy loam, dark brown (10YR 4/3) moist; massive; hard, friable, slightly sticky, slightly plastic; few very fine, fine, medium and coarse roots; common very fine and fine pores; 15 percent gravel, 25 percent cobbles and 30 percent stones; strongly calcareous, carbonates occur as soft powdery masses; moderately alkaline (pH 8.0); gradual smooth boundary.

C2--41 to 60 inches (104.1 to 152cm); brown (10YR 5/3) extremely stony very fine sandy loam, dark brown (10YR 4/3) moist; massive; slightly hard, friable, slightly sticky, slightly plastic; few very fine, fine, medium and coarse roots; few very fine pores; 15 percent gravel, 25 percent cobbles and 30 percent stones; moderately calcareous, carbonates are disseminated; moderately alkaline (pH 7.9).

The range in characteristics has not been determined for this soil.

ELWOOD SERIES

These soils are classified as loamy-skeletal, mixed Argic Cryoborolls.

The Elwood series consist of moderately deep, well drained, and moderately permeable soils that formed in residuum and colluvium derived dominantly from sandstone and shale.

These soils are on moderately steep to very steep mountain slopes at elevations of 7,900 to 9,500 feet (2,408 to 2,896m). Slope ranges from 50 to 70 percent. The average annual precipitation ranges from 20 to 30 inches (50.8 to 76.2cm), and the mean annual air temperature ranges from 32° to 38°F (0° to 3.3°C).

They are near the Decross, Adel, Benteen, Teton, Midfork and Zillion soils. Decross, Adel, Teton, and Benteen soils have fine-loamy control sections. Zillion, Decross, Adel, and Benteen soils have thick dark colored surface horizons. Midfork soil is very deep.

A typical pedon of Elwood extremely bouldery loam, 50 to 70 percent slopes located 1.0 mile (1.6km) south of the Valley Mountain Summit; 10,000 feet (3,048m) east of the SE corner of Section 7, T15S, R15E.

O1--1 inch to 0 (2.5 to 0cm); undecomposed twigs, needles, and leaves.

A1--0 to 4 inches (0 to 10.2cm); brown (10YR 4/3) extremely bouldery loam, dark brown (10YR 3/3) moist; moderate fine granular structure; hard, friable, slightly sticky, and slightly plastic; few fine, medium and coarse roots; 5 percent gravel, 5 percent cobble, 15 percent stones, 5 percent boulders; mildly alkaline (pH 7.6); abrupt smooth boundary.

B21t--4 to 13 inches (10.2 to 33cm); brown (10YR 4/3) very gravelly silt loam, dark brown (10YR 3/3) moist; weak fine subangular blocky parting to weak fine granular structure; hard, friable, slightly sticky, and slightly plastic; common fine and medium, and few coarse roots; 30 percent gravel, 10 percent cobbles, and 5 percent stones; mildly alkaline (pH 7.6); clear wavy boundary.

B22t--13 to 19 inches (33 to 48.3cm); brown (10YR 5/3) very gravelly silt loam, brown (10YR 4/3) moist; weak medium subangular blocky structure; hard, friable, slightly sticky, and slightly plastic; common very fine, and few medium roots; 30 percent gravel, 10 percent cobbles, 5 percent stones; mildly alkaline (pH 7.8); abrupt wavy boundary.

B23t--19 to 24 inches (48.3 to 61cm); brown (10YR 5/3) very gravelly silt loam, brown (10YR 4/3) moist; rock structure; hard, friable, slightly sticky, and slightly plastic; few very fine, fine and medium roots; 40 percent gravel, 10 percent cobbles, and 5 percent stones; slightly calcareous, carbonates are disseminated; moderately alkaline (pH 8.0); abrupt wavy boundary.

R--24 inches (61cm); sandstone.

A range of characteristics has not been determined for this series.

FALCON SERIES

These soils are classified as loamy, mixed Lithic Haploborolls.

The Falcon consists of shallow, well drained, and moderately permeable soils that formed in residuum derived dominantly from sandstone of the Green River Formation. These soils are on benches and mesa tops at elevations of 6,300 to 7,700 feet (1,920 to 2,347m). Slope ranges from 1 to 8 percent. The average annual precipitation ranges from 12 to 16 inches (30.5 to 40.6cm), and the mean annual air temperature ranges from 42° to 45°F (5.6° to 7.2°C).

They are near the Podo, Cabba, Havre, and Warneke Variant soils. Havre soils are deep. Podo, Cabba, and Warneke Variant soils have light colored surface layers.

A typical pedon of Falcon loam, 1 to 8 percent slopes was described on the ridge above Prickly Pear Canyon, located 2,800 feet (853m) south and 3,200 feet (975m) west of the Northeast corner of Section 21, T12S, R15E (Photo No. & Coord. 1-56, K-2).

A1--0 to 3 inches (0 to 7.6cm); dark brown (10YR 4/3) loam, very dark grayish brown (10YR 3/2) moist; weak fine granular structure; slightly hard, friable, slightly sticky, slightly plastic; common very fine and fine, few medium roots; moderately alkaline (pH 8.2); abrupt smooth boundary.

B2--3 to 8 inches (7.6 to 20.3cm); dark grayish brown (10YR 4/2) fine sandy loam, very dark brown (10YR 2/2) moist; weak fine subangular blocky structure; slightly hard, friable, slightly sticky, slightly plastic; common very fine, and fine, few medium roots; three percent gravel; moderately calcareous, carbonates are disseminated; moderately alkaline (pH 8.4); abrupt smooth boundary.

R--8 inches (20.3cm); calcareous sandstone.

Depth to bedrock is 7 to 20 inches (17.8 to 50.8cm). Rock fragments are gravel and cobbles with stones in some pedons and ranges from 0 to 35 percent.

The A horizon has value of 4 or 5 dry, 2 or 3 moist and chroma of 1 to 3. It is fine sandy loam, loam and gravelly loam.

The B horizon has hue of 10YR, 7.5YR, value of 4 or 5 dry, 2 or 3 moist; and chroma of 2 or 3. It is loam, gravelly loam, and fine sandy loam.

The C horizon where present has value of 5 or 6 dry, 4 or 5 moist, and chroma of 3 or 4.

All horizons are noncalcareous to moderately calcareous and neutral to moderately alkaline.

FIRO SERIES

These soils are classified as loamy-skeletal, mixed Lithic Haploborolls.

The Firo series consists of shallow, well drained, and moderately permeable soils that formed in residuum and local colluvium derived dominantly from calcareous sandstone.

These soils are on benches and ridge tops at elevations of 6,000 to 8,800 feet (1,829 to 2,682m). Slope ranges from 3 to 30 percent. The average annual precipitation ranges from 16 to 20 inches (40.6 to 50.8cm), and the mean annual air temperature ranges from 38° to 45°F (3.3° to 7.2°C).

They are near Repp, Doney, Beenom, Podo, Patmos soils, and Warneke Variant. Repp and Doney soils are greater than 40 inches (101.6cm) deep. Beenom soils have less than 35 percent rock fragments and have a layer of clay accumulation. Podo has a light colored surface. Patmos and Warneke Variant are greater than 20 inches (50.8cm) deep.

A typical pedon of Firo cobbly fine sandy loam, 3 to 30 percent slopes, located on Cottonwood Ridge, 2,800 feet (853m) north and 2,900 feet (883m) east of the SW corner of Section 23, T13S, R15E.

A1--0 to 2 inches (0 to 5cm); brown (10YR 4/3) cobbly fine sandy loam, very dark grayish brown (10YR 3/2) moist; weak medium platy structure; soft, very friable, slightly sticky, and slightly plastic; common very fine and fine roots; few fine pores; 20 percent gravel, 15 percent cobbles; noncalcareous, lime is disseminated; mildly alkaline (pH 7.4); abrupt smooth boundary.

B2--2 to 9 inches (5 to 22.9cm); brown (10YR 4/3) very cobbly loam, very dark grayish brown (10YR 3/2) moist; moderate coarse subangular blocky structure; slightly hard, friable, slightly sticky, and slightly plastic; common very fine, fine and medium roots; few fine and medium pores; 20 percent gravel, and 20 percent cobbles; noncalcareous, lime is disseminated; mildly alkaline (pH 7.4); abrupt wavy boundary.

R--9 inches (22.9cm); calcareous sandstone.

Depth to calcareous sandstone is 7 to 20 inches (17.8 to 50.8cm). Rock fragments are 35 to 65 percent in the control section.

The A horizon has hue of 7.5YR or 10YR, value of 3 to 5 dry, 2 or 3 moist, and chroma of 2 to 4. It is loam to extremely bouldery loam and cobbly to extremely stony fine sandy loam.

The B2 horizon where present has hue of 7.5YR or 10YR, value of 3 to 5 dry, 2 or 3 moist, and chroma of 2 to 4. It is very cobbly loam, gravelly fine sandy loam, loam, clay loam, very cobbly silt loam, of very gravelly loam; clay content is 18 to 35 percent.

A C horizon is present in some pedons with hue of 7.5YR or 10YR, value 4 to 6 dry, and chroma of 2 to 4. It is loam to very gravelly loam and extremely cobbly clay loam. The lower part may be strongly calcareous, but the soils are usually noncalcareous throughout.

GLENBERG SERIES

These soils are classified as coarse-loamy, mixed (calcareous), mesic Ustic Torrifluvents.

The Glenberg series consists of very deep, well drained, and moderately rapid permeable soils that formed in alluvium derived dominantly from sandstone and shale.

These soils are on flood plains, alluvial valley floors, and alluvial fans at elevations of 4,600 to 6,400 feet (1,402 to 1,951m). Slope ranges from 1 to 3 percent. The average annual precipitation ranges from 8 to 14 inches (20.3 to 35.6cm), and the mean annual air temperature ranges from 47° to 50°F (8.3° to 10°C).

They are near the Haverson, Abra and Harvey soils. Haverson, Abra and Harvey soils have more than 18 percent clay. Abra and Harvey soils have a horizon of carbonate accumulation.

A typical pedon of Glenberg fine sandy loam, high rainfall, 1 to 3 percent slopes was described about 9 miles (14.5km) west of Price, 2,300 feet (701m) east and 2,200 feet (671m) north of the SW corner of Section 11, T14S, R8E.

A1--0 to 2 inches (0 to 5cm); light brownish gray (2.5Y 6/2) fine sandy loam, very dark grayish brown (2.5Y 3/2) moist; weak medium platy structure; slightly hard, friable, nonsticky, slightly plastic; common very fine, fine and few medium roots; common very fine pores; slightly calcareous; moderately alkaline (pH 8.2); abrupt smooth boundary.

C1--2 to 8 inches (5 to 20.3cm); grayish brown (10YR 5/2) very fine sandy loam, dark grayish brown (10YR 4/2) moist; moderate medium subangular blocky structure; slightly hard, friable, nonsticky, slightly plastic; few very fine, fine and medium roots; common very fine, fine and few medium pores; moderately calcareous, carbonates are disseminated; moderately alkaline (pH 8.4); clear smooth boundary.

C2--8 to 20 inches (20.3 to 50.8cm); light grayish brown (2.5Y 6/2) loam, dark grayish brown (2.5Y 4/2) moist; moderate medium subangular blocky structure; very hard, friable, slightly sticky, slightly plastic; few very fine, fine and medium roots; few very fine, fine and medium pores; slightly calcareous; strongly alkaline (pH 8.6); clear smooth boundary.

C3--20 to 60 inches (50.8 to 152cm); light grayish brown (2.5Y 6/2) fine sandy loam, dark grayish brown (2.5Y 4/2) moist; massive; hard, friable, slightly sticky, slightly plastic; few very fine roots; moderately calcareous, carbonates are disseminated; strongly alkaline (pH 8.6).

The A horizon has hue of 7.5YR, 10YR and 2.5Y value of 5 or 6 dry and chroma of 2 to 4. It is typically fine sandy loam but includes loamy fine sand and very fine sandy loam. The A horizon is slightly to strongly calcareous and is 2 to 4 inches (5 to 10.2cm) thick.

The C horizon has hue of 7.5YR, 10YR, and 2.5Y, value of 5 or 6 dry, and chroma of 2 to 4. It is typically fine sandy loam but ranges to very fine sandy loam and loam. The soil is stratified with thin layers of gravel or very gravelly fine sandy loam. The C horizon is slightly to strongly calcareous and is moderately to strongly alkaline.

GUBEN SERIES

These soils are classified as loamy-skeletal Typic Calciborolls.

The Guben series consists of deep, well drained, moderately permeable soils that formed in colluvium and residuum derived dominantly from sandstone and shale of the Green River Formation.

These soils are on steep and very steep canyon side slopes at elevations of 5,000 to 8,400 feet (1,524 to 2,560m). Slope ranges from 30 to 75 percent. The average annual precipitation ranges from 16 to 20 inches (40.6 to 50.8cm), and the mean annual air temperature ranges from 42° to 45°F (5.6° to 7.2°C).

They are near the Cabba, Peso, and Lazear soils. Cabba and Lazear soils are shallow. Peso soils are moderately deep.

A typical pedon of Guben extremely bouldery loam, 40 to 75 percent slopes, was located in Prickly Pear Canyon; about 1,200 feet (366m) south and 2,000 feet (610m) east of the northwest corner of Section 14, T12S, R15E (Photo No. & Coord.) 1-55A, G-7).

O1--1/2 inch to 0 (1.3 to 0cm); litter of partially decayed pine needles and grasses.

A11--0 to 7 inches (0 to 17.8cm); grayish brown (10YR 5/2) extremely bouldery loam, very dark grayish brown (10YR 3/2) moist; weak fine granular structure; soft, very friable, slightly sticky, slightly plastic; common very fine, fine, medium and coarse roots; 15 percent gravel, 10 percent cobbles, 5 percent stones, 10 percent boulders; moderately calcareous, carbonates are disseminated; moderately alkaline (pH 8.2); clear wavy boundary.

A12--7 to 15 inches (17.8 to 38.1cm); pale brown (10YR 6/3) very stony loam, dark brown (10YR 3/3) moist; weak fine granular structure; soft, very friable, slightly sticky, slightly plastic; common very fine, fine, medium, coarse roots; 10 percent gravel, 15 percent cobbles, 20 percent stones; moderately calcareous, carbonates are disseminated; moderately alkaline (pH 8.4); clear broken boundary.

C1ca--15 to 30 inches (38.1 to 76.2cm); very pale brown (10YR 7/3) very stony loam, pale brown (10YR 6/3) moist; moderate medium subangular blocky structure; slightly hard, friable, slightly sticky, slightly plastic; common very fine, few fine, medium, coarse roots; few very fine, and fine pores; 10 percent gravel, 20 percent cobbles, 20 percent stones, 5 percent boulders; strongly calcareous, carbonates are disseminated; strongly alkaline (pH 8.6); clear smooth boundary.

C2--30 to 60 inches (76.2 to 152cm); light yellowish brown (10YR 6/4) extremely stony loam, brown (10YR 5/3) moist; moderate medium subangular blocky structure; slightly hard, friable, slightly sticky, slightly plastic; few very fine, fine, and medium roots; few very fine, medium common fine pores; 10 percent gravel, 20 percent cobbles, 25 percent stones, 5 percent boulders; moderately calcareous, carbonates are disseminated; strongly alkaline (pH 9.0).

The mollic epipedon is 7 to 16 inches (17.8 to 40.6cm) thick. Depth to bedrock is greater than 40 inches (101.6cm). The control section is commonly very stony loam but ranges to include fine sandy loam, very stony fine sandy loam in some pedons. Rock fragments are 35 to 60 percent in the control section and consist of gravel, cobbles, stones and boulders. These soils are commonly calcareous throughout.

The A horizon has hue of 10YR, value of 4 or 5 dry, 2 or 3 moist, and chroma of 1, 2 or 3. It is very stony loam to extremely bouldery loam.

The C horizon has hue of 10YR, value of 5 to 7 dry, 4 to 6 moist, and chroma of 3 or 4. The C horizon is moderately calcareous or strongly calcareous and is moderately to strongly alkaline.

HAVERSON SERIES

A1--0 to 6 inches (0 to 15.2cm); brown (10YR 5/3) fine sandy loam, grayish brown (10YR 5/2) moderate coarse subangular blocky structure; slightly hard, friable, slightly plastic; common very fine and few fine roots; common very fine and fine pores; moderately calcareous, carbonates are disseminated; strongly alkaline (pH 8.6); abrupt smooth boundary.

C1--6 to 16 inches (15.2 to 40.6cm); pale brown (10YR 6/3) loam, grayish brown (10YR 5/2) when moist; moderate coarse subangular blocky structure; hard, friable; slightly sticky, slightly plastic; few very fine roots; many very fine, few fine and medium pores; moderately calcareous, carbonates are disseminated; strongly alkaline (pH 8.8); clear wavy boundary.

C2--16 to 24 inches (40.6 to 61cm); pale brown (10YR 6/3) silt loam, grayish brown (10YR 5/2) when moist; moderate medium subangular blocky structure; hard, friable, sticky, plastic; few very fine roots; common very fine, few fine and medium pores; moderately calcareous, carbonates are disseminated; strongly alkaline (pH 8.8); abrupt smooth boundary.

C3--24 to 36 inches (61 to 91.4cm); pale brown (10YR 6/3) loam, brown (10YR 5/3) when moist; moderate medium subangular blocky structure; very hard, friable, slightly sticky, slightly plastic, few very fine and fine pores; moderately calcareous, carbonates are disseminated; strongly alkaline (pH 8.8); clear smooth boundary.

C4--36 to 45 inches (91.4 to 114.3cm); pale brown (10YR 6/3) fine sandy loam, brown (10YR 5/3) when moist; massive; very hard, firm, slightly sticky, slightly plastic; common very fine pores, cicada casts present; moderately calcareous, carbonates are disseminated; strongly alkaline (pH 8.8); clear smooth boundary.

C5--45 to 60 inches (114.3 to 152cm); pale brown (10YR 6/3) fine sandy loam, brown (10YR 5/3) when moist; massive; very hard, firm, slightly sticky, slightly plastic; common very fine pores; cicada casts present; moderately calcareous, carbonates are disseminated; strongly alkaline (pH 9.0).

LAZEAR SERIES

These soils are classified as loamy, mixed (calcareous), mesic Lithic Ustic Torriorthents.

The Lazear series consists of shallow, well drained, moderately permeable soils that formed in residuum derived dominantly from sandstone and shale.

These soils are on benches and mesa tops, side slopes and mountain side slopes at elevations of 4,800 to 8,500 feet (1,463 to 2,591m). Slope ranges from 1 to 50 percent. The average annual precipitation ranges from 8 to 14 inches (20.3 to 35.6cm), and the mean annual air temperature ranges from 45° to 50°F (7.2° to 10°C).

They are near the Nelman, Shingle, and Pinyon soils. Nelman soils are 20 to 40 inches (50.8 to 101.6cm) deep. Shingle soils are shallow over weathered shale. Pinyon soils have a layer of carbonate accumulation.

A typical pedon of Lazear loam, 3 to 15 percent slopes in mapping unit NSD located about 1,000 feet (30.5m) east and 2,000 feet (610m) north of the SE corner of Section 25, T16S, R13E (Photo No. & Coord. 1-62-A, G-1). (No General Land Office survey of the area.)

A1--0 to 5 inches (0 to 12.7cm); brown (7.5YR 5/4) loam, dark brown (7.5YR 4/4) moist; weak fine granular structure; soft, very friable, slightly sticky, slightly plastic; common very fine, fine and medium roots; 10 percent gravel; moderately calcareous, carbonates are disseminated; moderately alkaline (pH 8.4); abrupt wavy boundary.

C1--5 to 10 inches (12.7 to 25.4cm); brown (7.5YR 5/4) gravelly loam, dark brown (7.5YR 4/4) moist; massive; soft, very friable, slightly sticky, slightly plastic; few fine, medium and coarse roots; 25 percent gravel; moderately calcareous, carbonates are disseminated; moderately alkaline (pH 8.4); abrupt wavy boundary.

R--10 inches (25.4cm); sandstone.

Depth to sandstone ranges from 5 to 20 inches (12.7 to 50.8cm).

The A horizon has hue of 7.5YR, 10YR or 2.5Y, value of 5 or 6 dry. It is slightly or moderately calcareous, moderately or strongly alkaline, and is 1 to 5 inches (2.5 to 12.7cm) thick. The A horizon is loam, sandy clay loam, or fine sandy loam.

The C horizon has hue of 7.5YR, 10YR or 2.5Y, value of 5 to 7 dry, 4 to 6 moist and chroma of 3 or 4. It is loam, gravelly loam, and clay loam. Gravel content ranges from 0 to 35 percent. The C horizon is moderately or strongly calcareous and moderately or strongly alkaline.

The sandy clay loam phases are tax adjuncts to the Lazear series because they are 5YR in hue.

MENEFEE SERIES

These soils are classified as loamy, mixed (calcareous), mesic, shallow, Typic Ustorthents.

The Menefee series consists of shallow, well drained, and moderately permeable soils that formed in residuum and colluvium derived dominantly from shale, siltstone, and sandstone of the Green River Formation.

These soils are on canyon side slopes and escarpments at elevations of 5,000 to 8,100 feet (1,524 to 2,469m). Slope ranges from 40 to 70 percent. The average annual precipitation ranges from 12 to 16 inches (30.5 to 40.6cm), and the mean annual air temperature ranges from 45° to 47°F (7.2° to 8.3°C).

They are near the Lazear, Shingle, and Guben soils. Lazear soils are shallow over hard sandstone, siltstone, or shale. Guben soils are over 40 inches (101.6cm) in depth, and Shingle soils are drier three quarters of the time.

A typical pedon of Menefee extremely bouldery loam, 40 to 70 percent slopes located above Jack Creek, about 2.5 miles (4.0km) east and 4.5 miles (7.2km) south of the northeast corner of Section 9, T13S, R16E (Photo No. & Coord. 4-37, J-9).

A1--0 to 2 inches (0 to 5cm); pale brown (10YR 6/3) extremely bouldery loam, brown (10YR 4/3) moist; moderate coarse granular structure; soft, very friable, slightly sticky, slightly plastic; few very fine, and fine roots; moderately calcareous, carbonates are disseminated; strongly alkaline (pH 8.8); abrupt smooth boundary.

C1--2 to 7 inches (5 to 17.8cm); pale brown (10YR 6/3) loam, brown (10YR 4/3) moist; weak medium subangular blocky structure; soft, very friable, slightly sticky, slightly plastic; few very fine and fine roots; moderately calcareous, carbonates are disseminated; strongly alkaline (pH 8.6); abrupt smooth boundary.

C2--7 to 9 inches (17.8 to 22.9cm); light olive gray (5YR 6/2) silt loam, olive gray (5YR 5/2) moist; massive; slightly hard, friable, slightly sticky, plastic; few very fine and fine roots; few very fine pores; moderately calcareous, carbonates are disseminated; strongly alkaline (pH 8.8); abrupt smooth boundary.

C3r--9 inches (22.9cm); siltstone which is rippable and slakes in water.

The range in characteristics has not been determined for this series.

MIDFORK SERIES

These soils are classified as loamy-skeletal, mixed Typic Cryoborolls.

The Midfork series consists of deep, well drained, moderately slow permeable soils that formed in calcareous gravelly alluvium and colluvium derived dominantly from calcareous sedimentary rocks.

These soils are on gently sloping to very steep fans and mountainsides at elevations of 7,500 to 9,500 feet (2,286 to 2,896m).

Slope ranges from 50 to 70 percent.

The average annual precipitation ranges from 20 to 30 inches (50.8 to 76.2cm), and the mean annual air temperature ranges from 34° to 38°F (1.1° to 3.3°C).

They are near the Elwood, Macar, Quigley, and Podo soils. Elwood and Macar soils have bedrock within 40 inches (101.6cm). Podo soils have shallow control sections over sandstone and are neutral or slightly acid throughout. Quigley soils have fine-loamy control sections.

A typical pedon of Midfork bouldery loam, 50 to 70 percent slopes located about 4 miles (6.4km) west and 2 miles (3.2km) south of Rock Creek Ranch, 1,600 feet (488m) north and 950 feet (289m) east of the SW corner of Section 22, T15S, R16E.

O2--2 inches to 0 (5 to 0cm); partially decomposed twigs, leaves, and needles.

A11--0 to 1 inch (0 to 2.5cm); dark yellowish brown (10YR 4/4) bouldery loam, dark brown (7.5YR 3/2) moist; weak fine granular structure; soft, very friable, nonsticky, and nonplastic; few very fine and fine roots; neutral (pH 7.2); abrupt smooth boundary.

A12--1 to 7 inches (2.5 to 17.8cm); dark yellowish brown (10YR 4/4) clay loam, dark brown (10YR 3/3) moist; weak medium prismatic structure that parts to weak medium granular; slightly hard, firm, slightly sticky, and slightly plastic; common fine and few medium roots; few very fine and fine pores; 10 percent fine gravel; mildly alkaline (pH 7.8); clear smooth boundary.

C1--7 to 30 inches (17.8 to 76.2cm); yellowish brown (10YR 5/4) very channery loam, brown (10YR 4/3) moist; massive; slightly hard, firm, slightly sticky, and slightly plastic; common fine and few medium roots; 30 percent channers, 10 percent gravel, and 5 percent cobbles; slightly calcareous, carbonates are disseminated; mildly alkaline (pH 7.8); gradual smooth boundary.

C2--30 to 60 inches (76.2 to 152cm); yellowish brown (10YR 5/4) gravelly loam, brown (10YR 4/3) moist; massive; soft, friable, slightly sticky, and slightly plastic; few fine roots; 10 percent channers and 25 percent gravel; slightly calcareous, carbonates are disseminated; moderately alkaline (pH 8.4).

The mollic epipedon is 7 to 15 inches (17.8 to 38.1cm) thick. Depth to free carbonates ranges from 4 to 15 inches (10.2 to 38.1cm). Mean annual soil temperature is 36° to 40°F (2.2° to 4.4°C). The control section is commonly

gravelly loam or gravelly clay loam but ranges to include very channery loam in some pedons. Clay content is 18 to 35 percent. Rock fragments are 35 to 65 percent of the control section.

The A horizon has hue of 10YR or 7.5YR, value of 4 or 5 dry, 2 or 3 moist, and chroma of 2 to 4. The A horizon is neutral to moderately alkaline.

The C horizon has hue of 10YR or 7.5YR, value of 4 to 6 dry, 4 or 5 moist, and chroma of 2 through 4. The C horizon is mildly alkaline to strongly alkaline.

PATMOS SERIES

These soils are classified as loamy-skeletal, mixed (calcareous), frigid Typic Ustorthents.

The Patmos series consists of moderately deep, well drained, and moderately permeable soils that formed in colluvium and residuum derived dominantly from sandstone and shale.

These soils are on canyon rims and mountain side slopes at elevations of 5,900 to 9,000 feet (1,798 to 2,743m). Slope ranges from 3 to 70 percent. The average annual precipitation ranges from 12 to 20 inches (30.5 to 50.8cm), and the mean annual air temperature ranges from 38° to 45°F (3.3° to 7.2°C).

Doney, Frandsen, and Zahill soils are similar to the Patmos soils. Frandsen and Zahill soils have rock fragments less than 10 percent; Doney soils have soft sandstone, siltstone or limestone at 20 to 40 inches (50.8 to 101.6cm).

They are near the Cabba, Podo, Gappmayer Variant, Repp and Rabbitex soils. Cabba and Podo soils have depths less than 20 inches (50.8cm). Gappmayer Variant, Repp and Rabbitex soils have depths of 60 inches (152cm). Gappmayer Variant soils have a dark surface layer, and Rabbitex soils have a clay content greater than 18 percent.

Patmos extremely stony loam, 50 to 70 percent slopes; 20 miles (32.2km) north and 4.0 miles (6.4km) west of Martin; 1,100 feet (335m) north and 1,050 feet (320m) west of the SE corner of Section 6, T13S, R9E.

A1--0 to 3 inches (0 to 7.6cm); pale brown (10YR 6/3) extremely stony loam, brown (10YR 5/3) moist; moderate medium subangular blocky structure; soft, very friable, slightly sticky and slightly plastic; common very fine roots; few very fine pores; 40 percent cobbles and 5 percent stones; moderately calcareous, carbonates are disseminated; strongly alkaline (pH 8.6); abrupt smooth boundary.

C1--3 to 14 inches (7.6 to 35.6cm); pale brown (10YR 6/3) gravelly loam, brown (10YR 5/3) moist; moderate medium subangular blocky structure; soft, very friable, slightly sticky and slightly plastic; common very fine, few fine and medium roots; many very fine pores; 20 percent gravel and 5 percent cobbles; moderately calcareous, carbonates are disseminated; strongly alkaline (pH 8.8); clear smooth boundary.

C2--14 to 21 inches (35.6 to 53.3cm); pale brown (10YR 6/3) very cobbly loam, brown (10YR 5/3) moist; moderate medium subangular blocky structure; soft, friable, slightly sticky, and slightly plastic; common very fine, few fine roots; few very fine pores; 20 percent gravel, 25 percent cobbles, and 5 percent stones; moderately calcareous, carbonates are disseminated; strongly alkaline (pH 8.8); clear smooth boundary.

Cr--21 to 26 inches (53.3 to 66cm); fractured sandstone, common very fine roots; moderately calcareous, gradual smooth boundary.

R--26 inches (66cm); sandstone.

Mean summer soil temperature is 41° to 47°F (5° to 8.3°C). These soils are commonly calcareous throughout. Depth to sandstone, siltstone, or shale is 20 to 40 inches (50.8 to 101.6cm). Rock fragments are gravel, cobbles and stones ranging from 35 to 60 percent. Clay content is 15 to 25 percent.

The A horizon has hue of 5 or 6 dry, value of 4 or 5 moist, and chroma of 2 or 3. It is very gravelly to extremely stony loam.

The C horizon has hue of 10YR to 2.5YR, value of 5 to 7 dry, 4 to 6 moist, and chroma of 2 to 4. It is predominantly very gravelly, very cobbly fine sandy loam or loam.

PESO SERIES

These soils are classified as loamy-skeletal, mixed Typic Haploborolls.

The Peso series consists of moderately deep, well drained, moderately rapid permeable soils that formed in colluvium derived dominantly from sandstone and shale of the Green River Formation.

These soils are on steep to very steep mountain side slopes at elevations of 5,000 to 9,500 feet (1,524 to 2,896m). Slope ranges from 50 to 80 percent. The average annual precipitation ranges from 16 to 20 inches (40.6 to 50.8cm), and the mean annual air temperature ranges from 38° to 45°F (3.3° to 7.2°C).

They are near the Midfork and Comodore soils. Midfork soils are over 40 inches (101.6cm) deep. Comodore soils are shallow.

A typical pedon of Peso extremely bouldery fine sandy loam, 50 to 80 percent slopes, was described at the head of Big Canyon, 4.0 miles (6.4km) west, northwest of the mouth of Big Canyon on the Green River.

O--1/2 inch to 0 (1.3 to 0cm); litter layer of fir needles.

A1--0 to 3 inches (0 to 7.6cm); yellowish brown (10YR 5/4) extremely bouldery fine sandy loam, dark brown (10YR 3/3) moist; moderate coarse granular structure; slightly hard, very friable, slightly sticky, slightly plastic; many very fine, few very coarse roots; common very fine pores; 15 percent gravel; strongly calcareous, carbonates are disseminated; moderately alkaline (pH 8.4); abrupt smooth boundary.

B2--3 to 14 inches (7.6 to 35.6cm); yellowish brown (10YR 5/4) very gravelly fine sandy loam, dark brown (10YR 3/3) moist; weak medium subangular blocky structure; soft very friable, slight sticky, slightly plastic; common very fine, few very coarse roots; common very fine pores; 50 percent gravel, 10 percent cobbles; strongly calcareous, carbonates are disseminated; strongly alkaline (pH 8.6); abrupt smooth boundary.

C1--14 to 22 inches (35.6 to 55.9cm); yellowish brown (10YR 5/4) extremely cobbly fine sandy loam, brown (10YR 4/3) moist; massive; soft, very friable, slightly sticky, nonplastic; few very fine, few very coarse roots; 20 percent gravel, 50 percent cobbles; moderately calcareous, carbonates are disseminated; strongly alkaline (pH 8.8); gradual smooth boundary.

R--22 inches (55.9cm); very hard sandstone.

Depth to bedrock is 20 to 40 inches (50.8 to 101.6cm).

The control section is commonly very gravelly fine sandy loam but ranges to include very cobbly fine sandy loam, and cobbly loam in some pedons. Rock fragments are 35 to 60 percent and consist of gravel, cobbles, and stones. These soils are commonly calcareous throughout.

The A horizon has hue of 7.5YR or 10YR, value of 3 or 4 dry, 2 or 3 moist, and chroma of 2 or 3. It is extremely bouldery fine sandy loam and bouldery loam.

The C horizon has hue of 7.5YR or 10YR, value of 5 or 6 dry, 3 through 5 moist, and chroma of 3 or 4. The C horizon is moderately calcareous or strongly calcareous and is moderately or strongly alkaline.

This soil is a tax adjunct and differs from Peso by having less than 18 percent clay in the control section.

PODO SERIES

These soils are classified as loamy, mixed (calcareous), frigid Lithic Ustorthents.

The Podo series consists of shallow, well drained and moderately rapid permeable soils that formed in residuum and local colluvium derived dominantly from sandstone with some soils derived from limestone and shale.

These soils are on gently sloping benches, ridge tops, and side slopes of moderately steep to very steep hills and mountains at elevations of 5,200 to 8,400 feet (1,585 to 2,560m). Slope ranges from 1 to 70 percent. The average annual precipitation ranges from 12 to 20 inches (30.5 to 50.8cm), and the mean annual air temperature ranges from 42° to 45°F (5.6° to 7.2°C).

They are near the Detra Variant and Doney soils. Detra Variant and Doney soils have pedons deeper than 40 inches (101.6cm). Detra Variant soils have mollic epipedons.

A typical pedon of Podo very stony loam, 40 to 70 percent slopes located about 4.0 miles (6.4km) north of Bruin Point; 2,200 feet (671m) east and 100 feet (30m) south of the NW corner of Section 16, T13S, R14E.

A11--0 to 5 inches (0 to 12.7cm); grayish brown (10YR 5/2) very stony loam, dark grayish brown (10YR 4/2) moist; weak fine granular structure; hard, friable, slightly sticky, and slightly plastic; common very fine, fine, and medium roots; slightly calcareous, carbonates are disseminated; moderately alkaline (pH 8.2); abrupt smooth boundary.

A12--5 to 10 inches (12.7 to 25.4cm); light brownish gray (10YR 6/2) clay loam, dark grayish brown (10YR 4/2) moist; weak fine granular structure; hard firm, sticky, and plastic; common very fine and fine, few medium roots; few very fine and fine pores; 5 percent gravel; slightly calcareous, carbonates are disseminated; moderately alkaline (pH 8.0); abrupt smooth boundary.

C1--10 to 16 inches (25.4 to 40.6cm); light brownish gray (10YR 6/2) clay loam brown (10YR 4/3) moist; moderate medium subangular blocky structure; very hard, firm, sticky, and plastic; common very fine and fine, few medium roots; few very fine and fine pores; 5 percent gravel; moderately calcareous, carbonates are disseminated; moderately alkaline (pH 8.0); abrupt wavy boundary.

R--16 inches (40.6cm); sandstone.

Depth to lithic contact is 8 to 20 inches (20.3 to 50.8cm). Rock fragments are in individual horizons and range from 0 to 70 percent but average less than 35 percent in the control section. Mean annual soil temperature is 44° to 47°F (6.7° to 8.3°C) and the mean summer soil temperature is 59° to 64°F (15° to 17.8°C).

The A horizon has hue of 7.5YR or 10YR, value of 5 to 7 dry, 3 to 5 moist, and chroma of 2 to 4. Textures are loam, very stony loam, very bouldery sandy loam, stony sandy loam, sandy loam, gravelly loam, fine sandy loam, cobbly loam and very channery silt loam.

Some pedons have a thin B horizon with hue 10YR, value 4 to 5 dry, chroma 2 or 3 and textures similar to the A horizons.

The C horizon has hue of 5YR to 10YR, value of 5 to 7 dry, 4 to 5 moist, and chroma of 2 to 8. It is sandy loam, fine sandy loam, loam and gravelly loam, silt loam, channery silt loam, gravelly and sandy loam or light clay loam. The C horizon is slightly to strongly calcareous.

RABBITEX SERIES

These soils are classified as fine-loamy, mixed Typic Calciborolls.

The Rabbitex series consists of deep, well drained, and moderately permeable soils that formed in residuum and local colluvium derived dominantly from sandstone and shale.

These soils are on mountain side slopes and ridge tops at elevations of 6,500 to 9,000 feet (1981 to 2743m). Slope ranges from 25 to 70 percent. The average annual precipitation ranges from 16 to 20 inches(40.6 to 50.8cm), and the mean annual air temperature ranges from 38° to 45°F (3.3° to 7.2°C).

Rabbitex soils are similar to the Ipano, Kiev, and Quigley soils. Ipano soils have bedrock between 20 and 40 inches (50.8 to 101.6cm). Kiev soils have less than 10 percent rock fragments coarser than 2mm. Quigley soils have a noncalcareous B horizon extending to depths of 15 inches (38.1cm) overlying a layer of carbonate accumulation.

They are near the Patmos and Zillion soils. Patmos soils lack a dark surface layer; Zillion soils have greater than 35 percent coarse fragments and have a layer of clay accumulation.

A11--0 to 5 inches (0 to 12.7cm); dark brown (10YR 3/3) loam, very dark brown (10YR 2/2) dry; moderate, medium prismatic that parts to moderate medium granular structure; slightly hard, firm, slightly sticky, nonplastic; common very fine and fine roots; few very fine and fine pores; 10 percent gravel; mildly alkaline (pH 7.8); clear smooth boundary.

A12--5 to 12 inches (12.7 to 30.5cm); dark brown (10YR 3/3) channery loam, dark brown (10YR 3/3) dry, mottles; moderate, medium subangular blocky structure; soft, friable, slightly sticky, slightly plastic; common very fine and fine roots; few very fine and fine pores; 20 percent channers and 10 percent gravel; slightly calcareous; moderately alkaline (pH 8.2); clear smooth boundary.

B2ca--12 to 22 inches (30.5 to 55.9cm); yellowish brown (10YR 5/4) channery loam, brown (10YR 5/4) channery loam, brown (10YR 4/3) dry, weak medium subangular blocky structure; soft, friable, slightly sticky, slightly plastic; few very fine and medium, common fine roots; few very fine and fine pores; 20 percent channers and 5 percent gravel; slightly calcareous; moderately alkaline (pH 8.2); clear smooth boundary.

C1ca--22 to 30 inches (55.9 to 76.2cm); pale brown (10YR 6/3) gravelly loam, yellowish brown (10YR 5/4) dry; weak medium subangular blocky structure; soft, friable, slightly sticky, slightly plastic; few very fine and fine roots; few very fine and fine pores; 25 percent gravel; strongly calcareous, carbonates are disseminated and in soft masses; moderately alkaline (pH 8.4); clear smooth boundary.

C2ca--30 to 40 inches (76.2 to 101.6cm); pale brown (10YR 6/3) gravelly loam, yellowish brown (10YR 5/4) moist; massive; soft, friable, slightly sticky, slightly plastic; few very fine and fine roots; 15 percent gravel; strongly calcareous, carbonates are disseminated and in soft masses; moderately alkaline (pH 8.4); gradual smooth boundary.

C3ca--40 to 53 inches (101.6 to 134.6cm); pale brown (10YR 6/3) gravelly loam, yellowish brown (10YR 5/4) moist; massive; soft, friable, slightly sticky, slightly plastic; 20 percent gravel; strongly calcareous, carbonates are disseminated and in soft masses; moderately alkaline (pH 8.4); gradual smooth boundary.

C4--53 to 60 inches (134.6 to 152cm); very pale brown (10YR 7/3) loam, yellowish brown (10YR 5/4) moist; massive; soft, friable, slightly sticky, slightly plastic; 10 percent gravel-sized shale fragments; moderately calcareous, carbonates are soft masses; strongly alkaline (pH 8.6).

The mollic epipedon is 10 to 20 inches (25.4 to 50.8cm) thick.

Depth to bedrock is greater than 40 inches (101.6cm).

Mean annual soil temperature is 41° to 47°F (5° to 8.3°C). The control section is commonly loam to cobbly loam but ranges to include sandy clay loam to silt loam in some pedons. Thickness of the solum ranges from 10 to 30 inches (25.4 to 76.2cm).

Rock fragments coarser than 2mm range from 10 to 35 percent by volume in the control section.

The A horizon has hue of 3 to 5 dry, value of 1 to 3 moist, and chroma of 1 to 3. Clay content is 16 to 25 percent. It is dominantly loam through stony loam but ranges from fine sandy loam to clay loam in some profiles.

The B horizon has hue of 4 to 6, value of 4 and 5 moist, and chroma of 3 to 5. Clay content is 20 to 30 percent. The B layer ranges from 0 to 15 inches (0 to 38.1cm) thick. It is sandy clay loam, through silt loam and cobbly clay loam.

The Cca horizon has hue of 10YR and 2.5YR, value of 6 to 8 dry, 5 and 6 moist, and chroma of 2 to 4. It is gravelly sandy clay loam, gravelly and very cobbly loam.

Some pedons have a C horizon. The C layer ranges from 0 to 10 inches (0 to 25.4cm) thick. The C horizon has hue of 10YR and 2.5Y, value of 6 to 8 dry, 5 to 7 moist, and chroma of 2 to 4. It is loam to silt loam.

The A, B, Cca and C horizons are neutral to strongly alkaline.

RIVRA SERIES

These soils are classified as sandy-skeletal, mixed, frigid Ustic Torrifluvents.

The Rivra series consists of very deep, well drained, rapidly permeable soils that formed in alluvium derived dominantly from sandstone and shale. These soils are on alluvial bottoms at elevations of 4,600 to 7,200 feet (1,402 to 2,195m). Slope ranges from 0 to 8 percent. The average annual precipitation ranges from 12 to 16 inches (30.5 to 40.6cm), and the mean annual air temperature ranges from 43° to 45°F (6.1° to 7.2°C).

They are near the Havre and Glenberg soils. Havre and Glenberg soils have control sections finer than sandy loam, and Glenberg is mesic.

A typical pedon of Rivra extremely bouldery sandy loam, 1 to 8 percent slopes is located about 2.0 miles (3.2km) north and 4.0 miles (6.4km) east of Valley Mountain Summit; 850 feet (259m) north and 150 feet (46m) west of the SE corner of Section 25, T15S, R16E.

A1--0 to 3 inches (0 to 7.6cm); dark grayish brown (10YR 4/2) extremely bouldery sandy loam, very dark grayish brown (10YR 3/2) moist; moderate very coarse platy structure; soft, very friable, slightly sticky, and slightly plastic; common very fine and few fine roots; common very fine pores; 25 percent gravel; moderately calcareous, carbonates are disseminated; moderately alkaline (pH 8.0); abrupt smooth boundary.

C1--3 to 6 inches (7.6 to 15.2cm); yellowish brown (10YR 5/4) gravelly sandy loam, brown (10YR 4/3) moist; moderate very coarse platy structure; soft, very friable, nonsticky, and nonplastic; common very fine and few fine roots; few very fine pores; 25 percent gravel; strongly calcareous, carbonates are disseminated; strongly calcareous (pH 8.6); abrupt broken boundary.

C2--6 to 12 inches (15.2 to 30.5cm); brown (10YR 5/3) gravelly sandy loam, very dark grayish brown (10YR 3/2) moist; massive; soft, very friable, nonsticky, and nonplastic; few very fine and few medium roots; common very fine and few fine pores; 15 percent gravel and 5 percent cobbles; strongly calcareous, carbonates are disseminated; strongly alkaline (pH 8.6); abrupt smooth boundary.

C3--12 to 17 inches (30.5 to 43.2cm); yellowish brown (10YR 5/4) very gravelly sandy loam, dark yellowish brown (10YR 4/4) moist; massive; loose, nonsticky, and nonplastic; common very fine and few fine roots; 45 percent very fine gravel and 10 percent gravel; strongly calcareous, carbonates are disseminated; moderately alkaline (pH 8.4); abrupt broken boundary.

IIC4--17 to 40 inches (43.2 to 101.6cm); yellowish brown (10YR 5/4) extremely stony loamy sand, dark yellowish brown (10YR 3/4) moist; massive; loose, nonsticky, and nonplastic; few very fine and medium roots; 30 percent gravel, 15 percent cobbles, and 25 percent stones; strongly calcareous, carbonates are disseminated,; moderately alkaline (pH 8.4); abrupt smooth boundary.

IIIC5--40 to 60 inches (101.6 to 152cm); brown (10YR 5/3) extremely gravelly sandy loam, dark brown (10YR 3/3) moist; massive; loose; nonsticky, and nonplastic; few very fine, fine, and medium roots; 60 percent gravel and 5 percent boulders; strongly calcareous, carbonates are disseminated; moderately alkaline (pH 8.4).

The range in characteristics has not been determined for this soil.

RIVRA VARIANT

These soils are classified as sandy-skeletal, mixed, mesic Ustic Torrifluvents.

The Rivra Variant, consists of very deep, somewhat excessively drained and moderately rapid permeable soils that formed in alluvium derived dominantly from mixed sedimentary rocks.

These soils are on alluvial bottoms at elevations of 4,300 to 5,200 feet (1,311 to 1,585m). Slope ranges from 1 to 8 percent. The average annual precipitation ranges from 10 to 12 inches (25.4 to 30.5cm), and the mean annual air temperature ranges from 45° to 47°F (7.2° to 8.3°C).

They are near the Green River, Glenberg, and Havre soils. Green River, Glenberg, and Havre soils are finer than fine sandy loam or coarse sand. Havre and Rivra soils are colder.

A typical pedon of Rivra Variant cobbly fine sandy loam, 0 to 8 percent slopes; located at the mouth of Jack Creek on Green River. (No general land office survey made).

A1--0 to 3 inches (0 to 7.6cm); pale brown (10YR 6/3) cobbly fine sandy loam, brown (10YR 4/3) moist; weak medium subangular blocky structure; soft, very friable, slightly sticky, and slightly plastic; few very fine roots; few very fine pores; moderately calcareous, carbonates are disseminated; very strongly alkaline (pH 9.4); abrupt smooth boundary.

C1--3 to 8 inches (7.6 to 20.3cm); pale brown (10YR 6/3) fine sandy loam, brown (10YR 4/3) moist; massive; hard, friable, nonsticky, and nonplastic; few very fine roots; few very fine and fine pores; moderately calcareous, carbonates are disseminated; very strongly alkaline (pH 9.6); abrupt smooth boundary.

C2--8 to 13 inches (20.3 to 33cm); pale brown (10YR 6/3) sand, brown (10YR 4/3) moist; massive; soft, very friable, nonsticky, and nonplastic; few very fine roots; few very fine, few and medium pores; moderately calcareous, carbonates are disseminated; very strongly alkaline (pH 9.2); abrupt smooth boundary.

C3--13 to 18 inches (33 to 45.7cm); pale brown (10YR 6/3) sandy loam, brown (10YR 5/3) moist; massive; soft, very friable, nonsticky and nonplastic; few very fine and fine roots; few very fine, fine and medium pores; moderately calcareous, carbonates are disseminated; very strongly alkaline (pH 9.0); clear smooth boundary.

C4--18 to 53 inches (45.7 to 134.6cm); pale brown (10YR 6/3) extremely gravelly sand, brown (10YR 4/3) moist; massive; loose, nonsticky, and nonplastic; few very fine and many very coarse roots; 50 percent gravel, 10 percent cobbles, and 5 percent stones; moderately calcareous, carbonates are disseminated; moderately alkaline (pH 8.4); abrupt smooth boundary.

C5--53 to 60 inches (134.6 to 152cm); pale brown (10YR 6/3) fine sandy loam, brown (10YR 4/3) moist; massive; soft, very friable, nonsticky and nonplastic; few very fine roots; few very fine pores; moderately calcareous, carbonates are disseminated; moderately alkaline (pH 8.2).

The range in characteristics for this soil has not been determined.

Rivra Variant differs from the series because soils are warmer and have a lower rainfall.

SUNUP SERIES

Taxonomic classification is loamy-skeletal, mixed (calcareous), mesic Lithic Ustic Torriorthents.

Sunup is a very gravelly fine sandy loam, high rainfall; 3 to 15 percent slopes represent this soil.

A1--0 to 2 inches (0 to 5cm); brown (7.5YR 5/4) very gravelly fine sandy loam, dark brown (7.5YR 4/4) when moist; weak fine granular structure; soft, very friable, slightly sticky, slightly plastic; few very fine roots; few very fine pores; 60 percent gravel; moderately calcareous, carbonates are disseminated; moderately alkaline (pH 8.4); abrupt smooth boundary.

C1--2 to 6 inches (5 to 15.2cm); brown (7.5YR 5/4) gravelly very fine sandy loam, dark brown (7.5YR 4/4) when moist; weak fine subangular blocky structure; soft very friable, slightly sticky, slightly plastic; few very fine roots; few very fine pores; 30 percent gravel; moderately calcareous, carbonates are disseminated; moderately alkaline (pH 8.2).

R--6 inches (15.2cm); conglomerate.

Depth to conglomerate ranges from 5 to 20 inches (12.7 to 50.8cm).

8.3 Cont.

8.3.3 Present and Potential Productivity of Existing Soils

The potential vegetation production of the Permit Area is generally low because of the sparse vegetation and climatic characteristics. Ecological sites and the potential soils productivity within the mapping units are presented in Table VIII-1. The ecological site descriptions are preliminary and largely unavailable (SCS, BLM, personal communication). More accurate information concerning the actual productivity of the Permit Area is the site specific measurements presented in Table IX-6.

Table VIII-1 . Potential productivity of soils to be disturbed.

Soil Mapping Unit	Name	Relative % of Unit	Ecological Site	Potential Productivity #/A Dry Weight* Favorable Year	Normal Year	Unfavorable Year
BL	Badlands	90	Not rated	Vegetation Sparse		
BGC2	BG loam, eroded		Desert loam	800	700	500
BNE2	Chilton, extremely bouldery, fine sandy loam, eroded		Semi-desert bouldery loam	650	450	300
BWD2	Badlands - Chipeta complex, eroded	60 30	Desert shallow shale	200	150	100
CHC2	Chipeta silty clay loam, eroded		Desert shallow shale	200	100	100
EDF2	EA - Persayo - Badland complex, eroded	45 25 20	Desert loamy shale	400	300	150
EED2	EA - Badland complex, eroded	60 25	Desert loamy shale	400	300	150
GNA	Glenberg fine sandy loam		Upland loam	1400	1025	700
PEC2	Persayo loam, eroded		Desert loamy shale	400	300	100
RJA2	Ravola silt loam, saline, eroded		Desert salt flat	1200	750	300
RR	Rock outcrop - Rubble land - Badland complex	40 35 25	Not rated	Sparse Vegetation Grows Only in Rock Fissures		
RVD	Rock outcrop - Sunup complex	70 20	Semi-desert very shallow loam	700	500	250

*Range condition assumed to be excellent

8.4 Prime Farmland

The soil survey conducted by the SCS (Jensen, et al., 1980) indicates no prime farmland in the Mine Plan Area. Additional scrutiny of the proposed South Lease Permit Area maps by the State soil scientist assures the absence of prime farmland within the Permit Area (Figure VIII-1).

The land within the Mine Plan Area has not been historically used as cropland. Much of the soil surface is rocky and topsoil is generally thin. Large acreages are classified as Badland, Rock outcrop or Rubble land (Plate VIII-1).

Based on the above facts, this statement is a request for a negative determination of the presence of prime farmland within the Mine Plan Area.

United States Department of Agriculture

Soil Conservation Service

4012 Federal Building
125 South State Street
Salt Lake City, UT 84138

March 16, 1981

Marcia Wolfe
Kaiser Steel Corporation
P. O. Box 1107
Raton, New Mexico 87740

Dear Ms. Wolfe:

A review of the soils on your company's South Lease Permit Area as described on maps provided by John Huefner, March 6, 1981, indicates no prime farmland within the permit area.

These maps will remain on file in the SCS State Office for future reference.

Sincerely,

THERON B. HUTCHINGS
State Soil Scientist

cc:
Gary D. Moreau, DC, Price

Figure VIII-1. Prime Farmland Determination.

8.5 Physical and Chemical Properties of Soils and Results of Analyses, Tests and Trials

Samples were collected from each soil series scheduled for disturbance within the permit area. Each soil series was sampled at three locations. A soil bucket auger was used to sample each soil horizon. If the horizon was cobbly or bouldery, a spade was used to collect the horizon sample. To ascertain soil heterogeneity, samples were analyzed separately, rather than using a composite sample (Berg, 1978). All soil analyses were performed by the Colorado State Soil Testing Laboratory, Fort Collins, Colorado. Soil media was analyzed for the following parameters:

1. nitrate nitrogen
2. phosphorus
3. potassium
4. soluble calcium
5. soluble magnesium
6. soluble sodium
7. arsenic
8. boron
9. lead
10. molybdenum
11. selenium
12. lime
13. organic matter
14. electrical conductivity
15. SAR
16. ESP, if SAR $>$10
17. saturation percentage
18. particle size analysis

The methods of analysis used by the Colorado Soil Testing Laboratory are included in Table VIII-2. The results of these analyses are listed alphabetically by soil mapping unit in Table VIII-3. The parameter values are the average of the three samples taken for each horizon.

As it is planned to maintain the Mancos Shale badlands in the postmine landscape and revegetate them similarly to the pre-mine condition, samples of this material were also analyzed (Table VIII- 4).

8.5 Cont.

Table VIII-2. Methods of soil analysis. Colorado State Soil Testing Laboratory, Fort Collins, Colorado.

Symbol	Element	Unit	Method	Source
As	Arsenic	ppm	AB-DTPA extractable	(4)
B	Boron	μg/ml	Saturated extractable	(2)
Ca	Soluble Calcium	meq/l	Saturated extract	(2)
Ec	Electrical Conductivity	mmhos/cm	Standard wheatstone bridge	(1)
ESP	Exchangeable Sodium Percentage		Calculation	(1)
K	Potassium	ppm	AB-DTPA extractable	(4)
% Lime	$CaCO_3$		$CaCO_3$ equivalent 1%	(3)
Mg	Magnesium	meq/l	Saturated extract	(2)
Mo	Molybdenum	ppm	AB-DTPA extractable	(4)
Na	Sodium	meq/l	Saturated extract	(5)
NO_3-N	Nitrate-Nitrogen	ppm	AB-DTPA extractable	(5)
P	Phosphorus	ppm	AB-DTPA extractable	(5)
Pb	Lead	ppm	AB-DTPA extractable	(4)
pH			Paste pH	(1)
	Particle size analysis		Hydrometer analysis	(2)
OM	Organic Matter	%	Walkley-Black method	(2)
% Sat	Saturation Percentage	%	Water holding capacity	(1)
SAR	Sodium Absorption Ratio		Calculation	(1)

(1) Richards, L. A., 1969. Diagnosis and improvement of saline and alkali soils. USDA Agricultural Handbook No. 60. United States Department of Agriculture, Washington, D. C.

(2) Black, C. A., Editor, 1965. Methods of soil analysis. American Society of Agronomy No. 9. American Society of Agronomy, Madison, Wisconsin.

8.5 Cont.

Table VIII- 2. Cont.

(3) Colorado State University Soil Testing Laboratory. Undated. Lime Test. Colorado State University, Fort Collins, Colorado.

(4) Soltanpour, P. N., S. M. Workman, and A. P. Schwab, 1979. Use of inductively-coupled plasma spectrometry for the simultaneous determination of macro and micronutrients in NH_4HCO_3-DTPA extracts of soils. Soil Sci. Soc. Am. J., 43:75-78.

(5) ------, and A. P. Schwab, 1977. A new test for simultaneous extraction of macro and micronutrients in alkaline soil. Comm. in Soil Sci. and Plant Anal., 8:195-207.

8.5 Cont.

Table VIII-3 . Soil analyses for soils within South Lease permit boundary. Colorado Soil Testing Laboratory, Fort Collins, Colorado.

Mapping Unit	Soil Series	Horizon	Depth (in.)	OM %	NO_3-N ppm	P ppm	K ppm	Ca meg/l	Mg meg/l	Na meg/l	Pb ppm	Mo ppm	As ppm	Se ppm	B µg/ml	Saturation %	Cond. mmhos/cm	SAR	ESP meq/100g	Texture	$CaCO_3$ %
BGC2	BG Loam	A1	0-1	0.5	2	8	129	3.6	1.3	0.6	0.6	<0.01	0.02	0.02	0.41	25	0.7	0.4	-	SL	8.6
		B2	1-16	0.4	1	2	132	1.9	1.2	9.8	0.4	0.03	0.06	0.04	0.31	27	1.3	7.9	7.1	SCL	11.6
		C1ca	16-32	0.3	1	2	65	3.5	3.7	54.2	0.3	0.01	0.04	0.06	0.68	33	6.2	27.8	36.8	SCL	41.2
		C2ca	32-42	0.4	1	2	72	20.2	21.8	83.9	0.2	0.07	0.05	0.25	0.98	30	10.5	18.6	46.7	CL/SCL	17.8
		C3	42-60	0.3	1	1	54	22.4	22.8	71.5	0.2	0.04	0.03	0.22	1.49	25	9.4	15.0	41.9	SCL/SL	13.8
BNE2	Chilton	A1	0-3	0.6	4	9	160	4.0	0.9	0.3	0.7	<0.01	0.34	0.01	0.07	25	0.7	0.3	-	SCL/SL	12.0
		C1	3-24	0.7	5	5	169	2.8	0.9	0.3	0.5	<0.01	0.08	0.01	0.09	28	0.6	0.2	-	SCL/SL	17.3
BWD2	Badland	-	0-1	1.1	5	1	177	86	3.0	22.5	0.4	0.02	0.04	0.23	0.21	35	4.2	5.8	6.3	SiCL	14.7
		-	1-4	1.2	4	1	183	28	6.0	66.0	0.3	0.04	0.03	0.27	0.23	38	7.9	15.2	15.0	SiC	14.0
		-	4-18	1.2	2	1	152	24	8.4	66.0	0.3	0.04	0.02	0.13	0.16	36	7.4	15.4	12.7	SiC	14.0
		-	18-60	1.2	1	1	147	24	13.5	76.3	0.3	0.04	0.02	0.23	0.15	36	9.0	16.0	20.9	SiCL	14.4
BWD2	Chipeta	A1	0-1	0.7	1	4	135	24.8	2.2	0.3	0.6	0.01	0.06	0.03	0.18	31	2.4	0.1	-	SiL	13.0
		C1	1-4	0.6	2	3	128	28.5	2.4	0.8	0.4	0.02	0.04	0.05	0.20	34	2.8	0.1	-	L	12.6
		C2	4-7	0.5	1	2	163	26.2	7.0	4.8	0.4	0.09	0.03	0.06	0.94	33	3.3	1.2	-	L/CL	13.5
		C3	7-15	0.4	1	1	196	26.7	13.5	40.0	0.3	0.07	0.02	0.09	2.20	35	8.8	15.0	10.5	L	12.6
CHC2	Chipeta	A1	0-1	0.5	4	2	255	29.9	2.1	3.1	0.5	0.01	0.04	0.04	0.28	38	2.7	0.8	-	SiCL	12.6
		C1	1-4	0.4	3	1	216	22.6	5.2	58.3	0.3	0.02	0.03	0.11	0.43	45	6.8	16.3	16.8	SiC	14.6
		C2	4-7	0.5	3	1	192	20.2	5.5	152.1	0.3	0.17	0.05	0.11	0.39	50	14.0	41.4	38.0	SiC	11.8
		C3	7-15	0.5	2	1	143	24.7	8.5	298.0	0.3	0.03	0.03	0.30	0.23	50	23.2	73.2	43.9	SiC	11.7
EDF2	EA	A1	0-2	0.5	3	7	201	4.4	1.3	1.9	0.6	0.02	0.04	0.01	0.13	26	0.8	0.3	-	SCL	13.1
		C1	2-9	0.4	2	2	206	2.6	0.9	2.3	0.4	0.02	0.06	0.01	0.15	20	0.6	2.0	-	CL	18.0
		C2	1-22	0.5	1	1	93	2.5	1.5	13.6	0.2	0.02	0.05	0.02			1.7	7.7	7.2	SCL/CL	20.6
		C-3	22-28	0.4	2	2	39														

Table VIII-3. Cont.

Mapping Unit	Soil Series	Horizon	Depth (in.)	OM %	NO_3-N ppm	P ppm	K ppm	Ca meg/l	Mg meg/l	Na meg/l	Pb ppm	Mo ppm	As ppm	Se ppm	B µg/ml	Saturation %	Cond. mmhos/cm	SAR	ESP meq/100g	Texture	$CaCO_3$ %
EDF2	Badland	-	0-1	0.9	11	1	217	29.6	6.0	8.4	0.4	0.05	0.06	0.29	0.41	40	3.3	1.9	-	C	11.5
		-	1-12	0.8	33	1	187	25.1	18.6	91.6	0.4	0.08	0.05	0.89	0.31	40	10.0	19.3	16.4	C/SiC	11.1
EDF2	Persayo	A1	0-5	0.6	4	5	225	3.5	1.2	0.5	0.4	0.07	0.09	0.02	0.14	27	0.6	0.3	-	SCL	19.4
		C1	5-10	0.6	1	1	97	2.3	1.1	0.5	0.3	0.05	0.05	0.02	0.14	30	0.4	0.4	-	SCL	18.9
EED2	EA	A1	0-2	0.6	1	1	139	20.3	2.1	0.8	0.4	0.16	0.06	0.05	0.54	32	2.3	0.3	-	L/CL	14.7
		C1	2-9	0.8	2	1	172	27.4	2.8	0.9	0.3	0.04	0.05	0.02	0.19	33	2.5	0.3	-	L	15.4
		C2	9-22	0.7	0.7	1	188	27.8	11.0	2.6	0.2	0.04	0.03	0.04	0.31	34	3.4	0.6	-	CL/L	15.3
GNA	Glenberg	A1	0-2	0.6	6	6	138	3.3	0.8	0.4	0.6	0.01	0.04	0.01	0.06	31	0.5	0.3	-	LS	7.0
		C1	2-8	0.4	7	2	123	2.2	0.7	0.9	0.3	0.01	0.06	0.01	0.08	29	0.5	0.7	-	LS	7.7
		C2	8-20	0.3	1	1	76	1.6	0.7	0.9	0.2	0.02	0.04	0.01	0.09	29	0.3	0.9	-	S/SL	8.1
		C3	20-60	0.3	<1	1	80	1.8	1.1	0.8	0.2	0.02	0.04	<0.01	0.07	27	0.4	1.2	-	LS	9.3
PEC2	Persayo	A1	0-5	0.5	5	2	237	13.3	3.6	81.6	0.5	0.02	0.07	0.62	0.31	38	8.6	29.2	32.3	C/CL	17.1
		C1	5-10	0.4	1	1	141	25.0	7.8	162.2	0.4	0.04	0.05	1.03	0.25	38	15.0	40.3	48.6	CL	16.3
RJA2	Ravola	A1	0-2	0.4	2	10	82	3.7	1.6	5.0	0.5	<0.01	0.02	0.01	0.40	24	1.0	2.7	-	SL/LS	6.8
		C1	2-9	0.5	3	2	188	3.3	1.6	15.5	0.4	0.01	0.07	0.03	0.49	27	2.1	7.3	10.1	SCL/SL	9.0
		C2	9-60	0.5	2	1	90	9.9	8.5	78.4	0.3	0.03	0.03	0.07	0.24	26	9.2	16.2	23.3	SL	11.9
RR	Rock Rubble	A1	0-4	1.4	8	3	71	3.2	0.7	0.2	0.6	0.04	0.08	0.02	0.04	31	0.5	0.1	-	SL	4.8

8.5 Cont.

Table VIII- 4. Chemical analysis of Mancos Shale outcrops at base of Book Cliffs. South Lease, Utah. Colorado State Soil Testing Laboratory, Fort Collins, Colorado.

Mapping Unit	Soil Series	Horizon	Depth (in.)	OM %	NO_3-N ppm	P ppm	K ppm	Ca meg/l	Mg meg/l	Na meg/l	Pb ppm	Mo ppm	As ppm	Se ppm	B µg/ml	Saturation %	Cond. mmhos/cm	SAR	ESP meq/100g	Texture	$CaCO_3$ %
Mancos Shale	*	-	0-1	0.6	2	2	93	30.8	3.8	1.5	0.4	0.03	0.05	0.07	0.22	28	2.7	0.4	-	L	16.8
		-	1-4	0.5	2	1	105	30.4	6.7	2.3	0.3	0.05	0.04	0.10	0.28	30	3.0	0.5	-	L	16.9
		-	4-10	0.6	4	1	128	27.3	22.4	21.5	0.4	0.05	0.03	0.23	0.36	28	5.4	4.2	2.3	L	16.8

* Geologic material

8.6 Use of Selected Overburden Materials or Substitutes

The topsoil, or A horizons, found throughout the areas proposed for disturbance are very thin (Section 8.3.3). The topsoil (A horizon) will be removed separately from the substrata. Plans include removal of a 6 inch layer below the topsoil which, in most cases, is a C horizon (Section 3.5.2). This layer will be used as a strata below the topsoil in reclamation, but not as a substitute. If there is a B horizon present, the entire horizon will be removed and stockpiled. When this horizon is replaced, it will also be used as a separate layer below the A horizon.

In areas of Mancos Shale where there is no topsoil, the shale itself will be replaced without the addition of topsoil. Mancos Shale is inherently limiting to vegetation growth and establishment (Section 8.5). The use of native plant species adapted to growth on shale (Section 3.5.5.2) will help avoid revegetation problems. The results of chemical analyses of the Mancos Shale are presented in Table VIII-4. These samples were analyzed by the Soils Testing Laboratory at Colorado State University by the same methods used for the soil samples (Section 8.5).

There are no additional plans to use selected overburden or other soil substitutes.

8.7 Plans for Removal, Storage, and Protection of Soils

Kaiser Steel Corporation's South Lease Coal Properties, Emery County, Utah, are located at the base and on top of the Book Cliffs. The area's major landscape features are uplifted and eroded surfaces forming broad mesa tops, cuestas and mountain slopes of interbedded layers of sandstone and shale. Soil depth is generally shallow over sandstone, shallow or moderately deep over shale and deep in areas of local accumulation of alluvium and colluvium associated principally with old outwash plains (Jensen et al., 1980).

According to a 3rd order soil survey (Jensen, et al., 1980), twelve soil mapping units occur in the areas of proposed disturbance. Four soil units contain 60 percent or greater rock outcrop/rubble land/badland complexes; 2 contain 20 to 25 percent rock outcrop/rubble land/badland complexes; 1 contains 2 percent rock outcrop/rubble land complex (Table VIII-5).

The above mentioned complexes contain minimal topsoil volumes and the presence of steep, rocky and raw shale slopes limit practical and safe access for total topsoil removal within the proposed disturbed areas. For this reason, Kaiser Steel Corporation must obtain a variance for complete topsoil removal for reasons listed in UMC 817.22 (g)(1): Topsoil and subsoil removal under adverse conditions. The majority of the steep slopes (Slopes $>25^{\circ}$) are associated with badlands, therefore loss of topsoil resulting from this variance will be negligible as there is no topsoil on badlands. As postmine revegetation of badlands will occur on the Mancos Shale, borrowing of soil from other areas will not be necessary. The placement of borrowed topsoil on these steep, geologically eroding slopes would not be ecologically feasible.

8.7 Cont.

Table VIII-5. Disturbed soils within permit area.

Mapping Unit	Soil	Total Acre/ Soils Unit	% Included Soils	Acreage: Included Soils	% Known Rock Outcrop Rubble Land	% Known Badland	Known Acreage Rock Outcrop/ Rubble Land	Known Acreage Badland
BGC2	BG loam	76.3	13	9.9				
BL	Badland	85.3	*			100		85.3
BNE2	Chilton extremely bouldery fine sandy loam	37.7	15	5.6				
BWD2	Badland-Chipeta Complex	52.8	10	5.3		60		31.2
CHC2	Chipeta silty clay loam	35.2	20	7.0		2		.7
EDF2	EA-Persayo-Badland Complex	6.3	10	.6	2	20	.1	1.3
EED2	EA-Badland Complex	3.3	15	.5	2	25	.1	.8
GNA**	Glenberg fine sandy loam, high rainfall	18.3	15	2.7				
PEC2	Persayo loam	11.0	15	1.6				
RFA2	Ravola silt loam	57.8	20	11.6				

Table VIII-5. Cont.

Mapping Unit	Soil	Total Acre/ Soils Unit	% Included Soils	Acreage: Included Soils	% Known Rock Outcrop Rubble Land	% Known Badland	Known Acreage Rock Outcrop/ Rubble Land	Known Acreage Badland
RR	Rock Outcrop Rubble land Badland Complex	29.9			75	25	22.4	7.5
RVD#	Rock Outcrop Sunup Complex		10		70			
Total Acres:		413.9		44.8			22.6	126.8

* No recoverable inclusions

**Soil is included within the RVD mapping unit.

The 3rd order soil survey map designates the proposed disturbed areas on top of the Book Cliffs as RR and RVD mapping units. On site reconnaissance has found the project site to consist of the RR mapping unit and an inclusion of the GNA soil series.

8.7 Cont.

The following plan is designed to provide sufficient top-dressing for revegetating the habitat types characteristic of the mine area. A habitat type includes all those units of land which are capable of supporting the same plant association (Daubenmire, 1968).

Rock Removal - Any proposed disturbance areas which contain large amounts of rubble and boulders will be cleared using heavy machinery equipped with rock rakes or other appropriate attachments. The rock will be stockpiled for eventual redistribution.

Soil Removal - Prior to disturbance, topsoil (A horizons) will be removed by scrapers from all areas except those comprised of raw Mancos Shale where there is no soil and slopes are too steep or rocky for safe equipment operation. Topsoil removal exclusions may include small, relatively level areas if these areas are surrounded by steep or rocky slopes which are not safely accessible by heavy equipment. Soil removal will be conducted on those steep slopes which are safely accessible from the top and which present a transition to lesser grades or safe turning areas. Areas where topsoil will not be removed will be flagged in the field prior to disturbance.

Only one mapping unit in the proposed disturbed area contains a B horizon. Any recoverable B horizon will be handled in a manner similar to the A horizons. The B horizon will be stockpiled separately from the topsoil as sodium concentrations in these horizons are much greater than the A horizons and no benefit could be gained from mixing the A and B horizons.

Most soil types within the Permit Area contain shallow A horizons directly above C horizons. Covering proposed disturbed areas with a top-dressing suffici-

8.7 Cont.

ent to provide infiltration and good plant establishment will require collection of additional subsoil material. Removal of the top 6 inches of the C horizon is planned to supplement existing top-dressing volumes. The C horizons will be stockpiled separately from the A and B horizon stockpiles. General stockpile locations are marked on Plates VIII-2 and VIII-3. These stockpile locations are spaced according to convenient haul distances and soil types.

The removal of recoverable A, B, and C horizons could provide a minimum of 11.7 inches top-dressing for the entire disturbed acreage below the Book Cliffs and 8.6 inches top-dressing for the clifftop acreages (Tables VIII-6 and VIII-7). However, it is not planned to distribute the B horizon over the entire disturbed area. In order to maintain potential productivity, the B horizon will only be used on appropriate habitat types. Therefore, actual top-dressing depths will be approximately 7.8 inches of material to cover the non-B horizon acreage below the Book Cliffs and 20.8 inches material on those areas which originally contained B horizons. Appendix 8.13 presents the calculations used to determine recoverable topsoil and subsoil volumes for soil complexes containing rock outcrop, rubble land, and badland inclusions.

As the chemical analyses of the Mancos Shale (Table VIII-4) demonstrate the chemical characteristics of the shale to be reasonably consistent with depth, shale will not be removed and stockpiled for the life of the mine.

8.7 Cont.

Table VIII- 6. Total A horizon volumes summary sheet (adjusted for recoverable inclusions and unsuitable areas)

Mapping Unit	Acres	Horizon Volume (ft.^{3})	Slope (%)
BGC2	76.3	301,304	3-6
BNE2	37.7	268,042	3-20
BWD2	19.3	124,538	3-15
CHC2	34.5	147,785	3-8
EDF2	4.9	43,325	8-40
EED2	2.4	23,261	8-15
GNA*	18.3	172,288	1-3
PEC2	11.0	96,925	3-8
RJA2	57.8	420,467	0-3
Totals	262.2	1,597,935[1]	

* Soil type on top of Book Cliffs only

[1] Replaceable soil volume (see Appendix 8.13.4 for calculations)

A horizon

Below cliffs: 1.6" over 243.9 acres
Above cliffs: 2.6" over 18.3 acres

8.7 Cont.

Table VIII-7. Total B and C horizon volumes summary sheet (adjusted for recoverable inclusions and unsuitable areas)

Mapping Unit	Acres	Horizon Volume (ft.^{3})	Slope (%)
BGC2*	76.3	3,615,480[1]	3-6
BGC2	76.3	1,661,814	3-6
BNE2	37.7	821,106	3-20
BWD2	19.3	459,558	8-15
CHC2	34.5	751,410	3-8
EDF2	4.9	108,900	8-40
EED2	2.4	52,272	8-15
GNA**	18.3	398,574	1-3
PEC2	11.0	237,402	3-8
RJA2	57.8	1,258,884	0-3
Totals	262.2	5,749,920[1]	

* Only mapping unit with substantial B horizon

** Soil type on top of Book Cliffs only

[1] Replaceable soil volume (see Appendix 8.13.4 for calculations)

B horizon

Below cliffs: 13.2" over 76.3 acres

C horizon

Below cliffs: 6.0" over 243.9 acres
Above cliffs: 6.0" over 18.3 acres

8.8 Plans for Redistribution of Soils

Prior to topsoil placement the subsoil may be ripped to increase infiltration. Topsoil redistribution will take place immediately prior to final reclamation efforts. The intended top-dressing redistribution will not include areas which historically have no topsoil. Approximately 129 acres at the base of the Book Cliffs contain either raw shale, rock outcrops or rubble lands. The presence of these areas limit complete topsoil recovery and redistribution. However, the rock outcrop/rubble land/badland complexes are unique in terms of wildlife habitat and reclaiming the areas to their natural state will maintain these habitat type areas for specific wildlife species. Wildlife habitats created by geomorphic features comprise a small part of the total land base but concentrate a variety of wildlife into a relatively small area (Maser et al., 1979). Approximately 6 species of reptiles, 13 species of birds, and 21 species of mammals listed as occurring within the South Lease permit utilize cliffs and rocky areas (Dalton, 1978). Maintaining the rock outcrop/rubble land areas will preserve the natural pre-mine appearance of the landscape and reduce the total area where topsoil will be required. Rock outcrops will be comprised of remnant sandstone ledges while rubble land areas can be simulated by placing sandstone rocks, produced during mine site construction, at appropriate locations.

The collected horizons will be stockpiled separately at approved locations for the life of the mine unless specific areas not scheduled for future disturbance can be immediately retopsoiled.

8.8 Cont.

The B and C horizons will be replaced beneath the A horizon on those habitat types where all three occur. Generally the A horizon will be placed directly over the C horizon. Redistributed top-dressing depths will vary according to the locales from which they were initially recovered. Top-dressing at the cliff base will range from approximately 1 to 2 inches A horizon and 6 to 20 inches subsoil (B and C horizons). Redistributed top-dressing for the areas on the clifftop is approximately 2 inches A horizon and 6 inches subsoil (C horizon only).

Top-dressing will not be redistributed evenly over the disturbed areas with the onset of reclamation operations. Different habitat types require varying soil depths and monotypic reclaimed sites can be avoided by diversified top-dressing distribution. Topsoil will be spread more thickly on areas which previously consisted of deeper soils (mesa tops, outwash plains, etc.). Slopes soils, generally thinner and rockier, will be replaced similarly. This method of soil redistribution is not only appropriate for the plant communities the land must support but should reduce erosion problems.

In conclusion, heterogeneous top-dressing replacement combined with maintaining existing rock outcrop/rubble land/badland areas will help to: 1) ensure the successful re-establishment of plants typical of existing habitat types, 2) reduce erosion, and 3) prevent the formation of a monotypic postmine environment. The topsoil removal plan previously discussed will enable Kaiser Steel Corporation to fulfill legal requirements by providing sufficient top-dressing to revegetate a diverse vegetation cover which in turn will be able to support the postmine land uses.

8.9 Nutrients and Soil Amendments

Nutrients - The application of soil nutrients in the arid West is a moot question. The use of topsoil may not ensure adequate fertility for reclamation (Safaya, 1979). Many undisturbed western soils exhibit nutrient deficiencies compared to agricultural soils. All the soils to be disturbed at the South Lease typically show low values for phosphorous, organic matter and nitrogen (Table VIII- 3). Long term stockpiling and storage may further deteriorate some chemical and microbiological soil properties (Miller and Cameron, 1976). Safaya (1979) reports improvement of dry matter yield when fertility is restored to mined spoils. However, most of the species tested were either exotic or agronomic plant varieties.

The possibility that native plants are adapted to low fertility requirements seems intuitive because the unmined soils are low in fertility compared to agricultural soils. Phosphorous is often the most limiting nutrient to plant establishment (Berg, 1978). However, few correlations and calibrations have been made on disturbed soils for native plants (Berg, 1978). Recommendations for fertilizer applications are typically made from field calibrations. The fertilizer recommendations for the South Lease soils from the Colorado State Soils Testing Laboratory are presented in Table VIII- 8. However, these recommendations are based on agronomic calibrations, and will only be used as a guide in planning the actual treatment.

Clearly, many problems remain in the area of fertility of disturbed lands. Study of this matter is continuing at the time of permit submittal. Hodder of Montana State University, and Berg have been contacted concerning current work in this area. Should new information be obtained which would change the enclosed reclamation plans, DOGM will be informed.

Table VIII- 8 . Fertilizer recommendations for the soil series on the South Lease, Utah, as made by the Colorado State Soil Testing Laboratory, Fort Collins, Colorado. *

Mapping Unit	Soil Series	N (lbs/A)	P_2O_5 (lbs/A)
BGC2	BG Loam	40	30
BNE2	Chilton	33	0
BWD2	Badland	30	30
	Chipeta	40	20
CHC2	Chipeta	40	30
EDF2	Badland	27	30
	EA	40	10
	Persayo	40	10
EED2	EA	40	30
GNA	Glenberg	27	0
Mancos Shale	**	40	30
PEC2	Persayo	40	30
RJA2	Ravola	40	0
RR	Rock Rubble	13	20

* Recommendations are for the A horizon and, where applicable, the B horizon.

** Geologic Material

8.9 Cont.

Soil Amendments - Plans for mulching are presented in Section 3.5.5.3. Although most of the soils are not characteristically eroded by wind to any serious extent (SCS, 1980) (Section 8.3.2), the mine soils to be disturbed are currently and historically undergoing geologic and mass soil erosion. In fact, the soils descriptions often give the size and pattern of rills and gullies as well as describe the extent of pedestalling.

As the areas to be disturbed are relatively small compared to the vast, eroding areas by which they are surrounded, it will be extremely difficult, if not impossible, to hold soil erosion to the limits described by law. The mulching techniques described in Section 3.5.5.3 are generally capable of preventing erosion and aiding plant establishment under a low moisture regime. However, it is doubtful any mulching technique would be able to prevent the re-establishment of the natural rill and gully patterns which would surround a revegetated site.

At the end of mining it is also planned to use crushed rock from the road base as a mulch. This procedure will permanently increase the water harvesting capacity of the soil.

If sodium should accumulate in portions of the long term soil stockpiles, they may be leached with applications of gypsum or sulfuric acid (Miyamoto et al., 1975).

8.10 Effects of Mining Operations on Soils, Nutrients and Soil Amendments to be Used

The quality of the soils within the permit area reflects the origin of the materials from which they were derived. The soils typically have a high exchangeable sodium percentage. However, there is frequently a tremendous difference between the A and C horizons. The higher quality of the thin A horizon undoubtedly is important for the germination and resultant establishment of seeds. Therefore special care is to be taken in the removal and stockpiling of the A horizon. Scrapers, which have the capability to pick up thin layers of material will be used for soil removal. The use of this type of machine and trained operators will minimize the potential for inadvertently mixing horizons and will help maintain soil quality.

The removal and stockpiling of the soil material prior to mining or construction will protect the soil from potential sources of outside contamination such as coal and oil. Consequently, the mining and construction processes should not damage the chemical quality of the topsoil.

The soils to be disturbed are primarily Entisols or Aridisols and are in the early stages of soil genesis. Therefore the quantity of topsoil is limited as discussed in Section 8.7. Nor is there generally suitable material with which to supplement the topsoil or subsoil. Close adherence to the topsoil removal and stockpile plan is necessary to conserve the quantity of soil present for revegetation. There is a deep B horizon in the BGC2 mapping unit which could be used as a supplement if necessary. However, in order to best maintain potential productivity of the reclaimed habitat type, the B horizon should be replaced in the original BGC2 mapping unit.

8.10 Cont.

Mulch as described in Section 3.5 is planned. Gravel resulting from road construction may also be used as a mulch for final reclamation. As these soils are all low in organic matter, stockpiling will have little affect on this constituent and mulching with native hay may increase its value.

Soil nutrients are discussed in Section 8.9. The necessity for the use of nutrients requires further study. Many of the long term effects of stockpiling are unknown. Studies by Power et al., (1978) and Miller and Cameron (1976) concerning the effects of stockpiling soils have shown some soil properties deteriorate under storage. As these soils are poorly developed (SCS, 1980) there is little potential for structural loss during storage.

From an agronomic standpoint, the soils of the permit area typically have low productivity and are classified in low capability classes. However, when the topsoil handling plans are followed, the mining operation should have little, if any, affect on the soils to be disturbed.

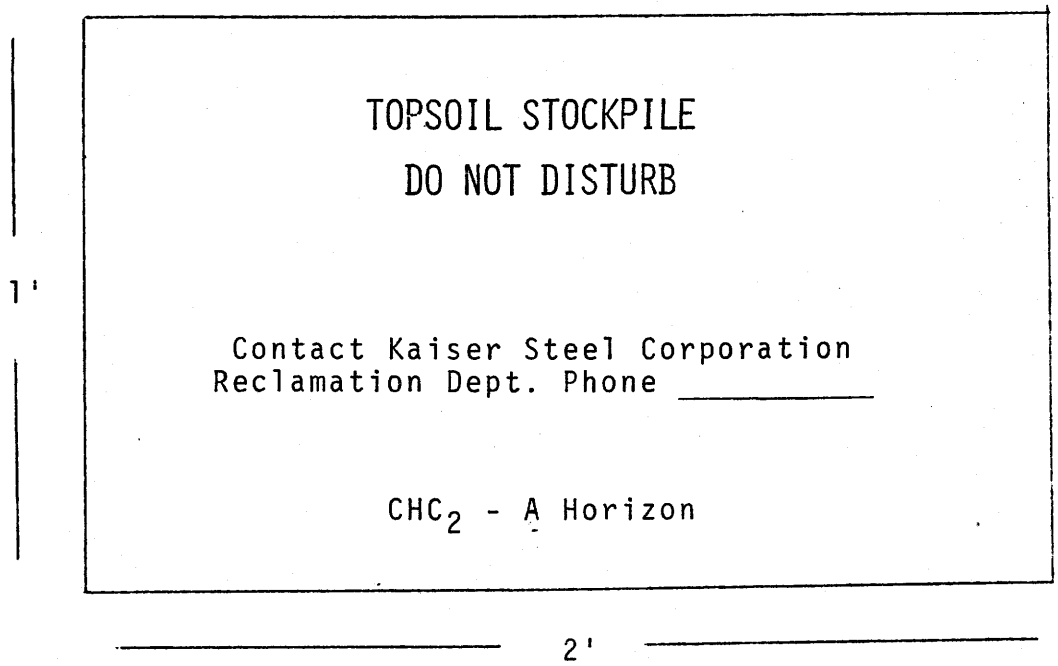
Revegetation with plant materials adapted to the qualities of the described soils (Sections 3.5, 8.5 and 8.9) will assure the capability of the reclaimed land to support the postmine land uses.

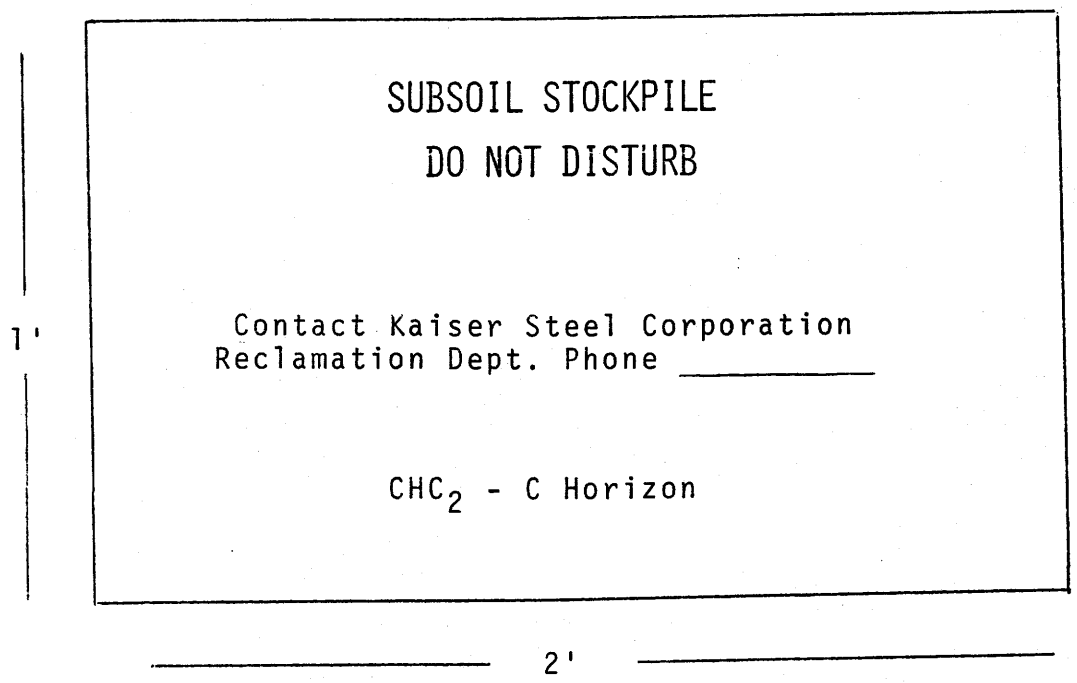
8.11 Mitigation and Control Plans

All disturbed areas will be minimized where possible. The soils are being analyzed and studied to best plan mitigation measures. A detailed topsoil removal plan (Section 8.7) has been developed to protect soils from potential damage or contamination which may result from mining, railroad tracks, and road construction and maintenance. Replacement of the present soil horizons will undoubtedly provide the most suitable substrata for revegetation. There is not sufficient soil or better material with which to dilute and consequently improve the current soil constituents. Therefore, mitigation of disturbance through revegetation will particularly depend upon the use of plant species adapted to the quality of the present soils.

Topsoil removal will be supervised by a reclamation engineer who will instruct the equipment operators in recognition of horizon depths and placement of the stockpiles. Stockpiles will be permanently marked with metal signs (Figure VIII-2) to assure their protection during the life of the mine and to aid in their identification at the time of reclamation.

Figure VIII-2 Typical Soil Stockpile Sign Specifications





SPECS: Metal Sign Plate 1' x 2'
Permanent Outdoor Enamel Paint - Black on White
Mounted on 6' Metal Fence Post w/Bolts

8.12 Bibliography

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8.13 Appendix

8.13.1 Inclusions of Disturbed Soils, South Lease Permit Area

8.13.2 A Horizon Volume Calculations: Rock Outcrop, Rubble Land, Badland Adjustments

8.13.3 C Horizon Volume Calculations: Rock Outcrop, Rubble Land, Badland Adjustments

8.13.4 Replaceable Soil Depth Calculations

8.13.1 Inclusions of Disturbed Soils, South Lease Permit Area

Mapping Unit	Inclusions Listed	Relative Percentage of Occurrence*
BGC2	Persayo very cobbly clay loam, 15 to 30% slopes	3
	Avalon loam, 1 to 5% slopes	5
	Glenton fine sandy loam, 1 to 6% slopes	5
BL	Chipeta silty clay loam, 8 to 15% slopes, eroded	**
BNE2	Persayo very cobbly clay loam, 15 to 30% slopes	5
	Avalon loam, 1 to 5% slopes	5
	Glenton fine sandy loam, 1 to 6% slopes	5
BWD2	Persayo loam, 8 to 15% slopes, eroded	5
	Bributte gravelly silty clay loam, 3 to 25% slopes	5
CHC2	Badland	2
	Greybull loam, 3 to 8% slopes, eroded	8
	Persayo extremely shaly loam, 8 to 30% slopes, eroded	10
EDF2	Ravola silt loam, 0 to 3% slopes, eroded	2
	EA very cobbly loam, 3 to 8% slopes, eroded	2
	EM cobbly loam, 3 to 20% slopes, eroded	2
	Persayo loam, 3 to 8% slopes, eroded	2
	Rubble land	2
EED2	Ravola silt loam, 0 to 3% slopes, eroded	7
	EA very cobbly loam, 3 to 8% slopes, eroded	6
	Rubble land	2
GNA	Haverson loam, high rainfall, 1 to 5% slopes	10
	Similar soils	5
PEC2	Killpack fine sandy loam, 1 to 8% slopes	5
	Persayo loam, 8 to 15% slopes, eroded	10
RJA2	Ravola silt loam, 0 to 3% slopes, eroded	10
	Ravola silt loam, saline, 0 to 3% slopes, severely eroded	10

*Information concerning soil inclusion relative percentage of occurrence was received through the SCS, Price, Utah (E. Jensen, telephone conversation, 1981).

**No figures given.

8.13.2 A Horizon Volume Calculations: Rock Outcrop, Rubble Land, Badland Adjustments*

Mapping Unit						
BWD2	52.8 acres					
	60% Badland (31.7 acres)					
	30% Chipeta silty clay loam (15.8 acres; 1" depth)					
	10% Inclusions (5.3 acres; 3.5" depth)					
	A horizons					
	Chipeta	(15.8 acres)	(.083)	(43,560)	=	57,124 ft.^{3}
	Inclusions	(5.3 acres)	(.292)	(43,560)	=	67,414 ft.^{3}
						124,538 ft.^{3}
CHC2	35.2 acres					
	80% Chipeta silty clay loam (28.2 acres; 1" depth)					
	18% Inclusions (6.3 acres; 2" depth)					
	2% Badland (.7 acres)					
	A horizons					
	Chipeta	(28.2)	(.083)	(43,560)	=	101,956 ft.^{3}
	Inclusions	(6.3)	(.167)	(43,560)	=	45,829 ft.^{3}
						147,785 ft.^{3}
EDF2	6.3 acres					
	45% EA extremely cobbly silty clay loam (2.8 acres; 2" depth)					
	25% Persayo loam (1.6 acres; 2" depth)					
	20% Badland, Rubble land (1.3 acres)					
	10% Inclusions (.6 acres; 5.2" depth)					
	A horizons					
	EA	(2.8 acres)	(.167)	(43,560)	=	20,369 ft.^{3}
	Persayo	(1.6 acres)	(.167)	(43,560)	=	11,639 ft.^{3}
	Inclusions	(.6 acres)	(.433)	(43,560)	=	11,317 ft.^{3}
						43,325 ft.^{3}
EED2	3.3 acres					
	60% EA extremely cobbly silty clay loam (2.0 acres; 2" depth)					
	27% Badland, Rubble land (.9 acres)					
	13% Inclusions (.4 acres; 6" depth)					
	A horizons					
	EA	(2.0 acres)	(.167)	(43,560)	=	14,549 ft.^{3}
	Inclusions	(.4 acres)	(.5)	(43,560)	=	8,712 ft.^{3}
						23,261 ft.^{3}

*Adjustments are based on soil depth information presented in the Carbon and Emery counties 3rd order soil survey (E. Jensen, et al., 1980). Volumes are calculated using minimum A horizon values for the major recoverable components of the mapping units. The depths of A horizons for the included soils are averaged.

8.13.3 C Horizon Volume Calculations: Rock Outcrop, Rubble Land, Badland Adjustments*

Mapping Unit						
BWD2	52.8 acres					
	60% Badland (31.7 acres)					
	30% Chipeta silty clay loam (15.8 acres; 6" depth)					
	10% Inclusions (5.3 acres; 6" depth)					
	C horizon					
		Chipeta	(15.8 acres) (.5) (43,560)	=	344,124 ft.^{3}	
		Inclusions	(5.3 acres) (.5) (43,560)	=	115,434 ft.^{3}	
					459,558 ft.^{3}	
CHC2	35.2 acres					
	80% Chipeta silty clay loam (28.2 acres; 6" depth)					
	18% Inclusions (6.3 acres; 6" depth)					
	2% Badland (.7 acres)					
	C horizon					
		Chipeta	(28.2 acres) (.5) (43,560)	=	614,196 ft.^{3}	
		Inclusions	(6.3 acres) (.5) (43,560)	=	137,214 ft.^{3}	
					751,410 ft.^{3}	
EDF2	6.3 acres					
	45% EA extremely cobbly silty clay loam (2.8 acres; 6" depth)					
	25% Persayo loam (1.6 acres; 6" depth)					
	20% Badland, Rubble land (1.3 acres)					
	10% Inclusions (.6 acres; 6" depth)					
	C horizon					
		EA	(2.8 acres) (.5) (43,560)	=	60,984 ft.^{3}	
		Persayo	(1.6 acres) (.5) (43,560)	=	34,848 ft.^{3}	
		Inclusions	(.6 acres) (.5) (43,560)	=	13,068 ft.^{3}	
					108,900 ft.^{3}	
EED2	3.3 acres					
	60% EA extremely cobbly silty clay loam (2.0 acres; 6" depth)					
	27% Badland, Rubble land (.9 acres)					
	13% Inclusions (.4 acres; 6" depth)					
	C horizon					
		EA	(2.0 acres) (.5) (43,560)	=	43,560 ft.^{3}	
		Inclusions	(.4 acres) (.5) (43,560)	=	8,712 ft.^{3}	
					52,272 ft.^{3}	

*Adjustments are based on soil depth information presented in the Carbon and Emery counties 3rd order soil survey (E. Jensen, et al., 1980). Volumes are calculated using a minimum C horizon depth of 6 inches for the major recoverable components and inclusions of the mapping unit.

8.13.4 Replaceable Soil Depth Calculations

Disturbed Area - Total	Below Book Cliffs	Above Book Cliffs
262.2 acres	243.9 acres (10,624,284 ft.^{2})	18.3 acres (797,148 ft.^{2})

A horizon

Below cliffs

$$\frac{1{,}425{,}647 \text{ ft.}^3 \text{ available topsoil}}{10{,}624{,}284 \text{ ft.}^2 \text{ disturbed area}} = .13 \text{ ft. } (12''/\text{ft.}) = 1.6'' \text{ topsoil}$$

Above cliffs

$$\frac{172{,}288 \text{ ft.}^3}{797{,}148 \text{ ft.}^2} = .22 \text{ ft. } (12''/\text{ft.}) = 2.6'' \text{ topsoil}$$

B horizon

Below cliff

$$\frac{3{,}615{,}480 \text{ ft.}^3}{3{,}323{,}628 \text{ ft.}^2} = 1.1 \text{ ft. } (12''/\text{ft.}) = 13.2'' \text{ subsoil (for unit BGC2)}$$

C horizon

Below cliffs

$$\frac{5{,}351{,}346 \text{ ft.}^3}{10{,}624{,}284 \text{ ft.}^2} = .5 \text{ ft. } (12''/\text{ft.}) = 6.0'' \text{ subsoil}$$

Above cliffs

$$\frac{398{,}574 \text{ ft.}^3}{797{,}148 \text{ ft.}^2} = .5 \text{ ft. } (12''/\text{ft.}) = 6.0'' \text{ subsoil}$$

8.14 Plates

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9.1 Scope

The objective of this study was to map and quantify the vegetation communities of the South Lease coal permit area. This report presents the information collected and is designed to satisfy the Utah Division of Oil, Gas and Mining (DOGM) and Office of Surface Mining (OSM) requirements.

The landscape of the South Lease permit area has been mapped to delineate the eight main vegetation communities present (Plate IX-1). The communities include:

1.	*Atriplex-Artemisia-Hilaria*	Saltbush-Sage-Galleta
2.	*Atriplex-Astragalus*	Saltbush-Milkvetch
3.	*Atriplex-* Badland	Saltbush-Badland
4.	*Juniperus* Savannah	Juniper Savannah
5.	*Pinus-Juniperus* Clifftop	Pinyon-Juniper Clifftop
6.	*Pinus-Juniperus* Cliffbottom	Pinyon-Juniper Cliffbottom
7.	*Artemisia tridentata*	Sagebrush
8.	Transition	

A cottonwood riparian type, small in extent, is found in the permit area adjacent to the developed stock water at the William's Draw Spring. No disturbance is scheduled near this spring.

Vegetation sampling was conducted from late June into September, 1982. All vegetation types scheduled for disturbance during this permit term were sampled. This information will be used as baseline data for evaluating reclamation success.

9.2 Methodology

Vegetation types were determined in the field by ocular reconnaissance and plotted on a 1:12000 topographic map, with the aid of color aerial photographs. Vegetation types were finalized on a 1:24000 topographic map and included all areas within and immediately adjacent to the permit area. The vegetation of planned disturbed areas was mapped on 1:4800 topographic maps (Plates IX-2 and IX-3).

The species list for each vegetation type was compiled from plants collected during reconnaissance and from plants collected during field measurements. All species were collected according to Harrington and Durrell (1957) and identified according to Welsh and Moore (1973) and Harrington (1964). Botanical nomenclature follows Welsh and Moore (1973). Difficult specimens were annotated by Dr. Stanley Welsh, Brigham Young University Herbarium, Provo, Utah. Some plants lacked structures needed for complete identification and were designated unknowns. The collected plants are retained in the Kaiser Steel Corporation Herbarium, Raton, New Mexico. All vegetation types were examined for threatened and endangered species according to Welsh (1977).

Vegetation measurements were collected from randomly located points determined from the Kaiser Steel Corporation mine coordinate grid; these points were stratified according to the vegetation type. From these random points, a random compass bearing and a random number of paces to be walked were selected to arrive at an unbiased sampling location.

Point-line transects to measure total first hit cover were laid out in all types with overstory cover. All transects were sampled on 0.5 meter intervals for the species first touched by a descending point. All transects were 30 meters long, unless vegetation distribution was very heterogeneous, then the length was extended.

9.2 Cont.

Herbaceous cover, by species, was estimated within a rectangular quadrat (Mueller-Dombois and Ellenberg, 1974). The 0.10 m^2 quadrat was used in the Sagebrush type, and a 0.25 m^2 in all others. Quadrats in all types were located randomly along 60 m line transects.

Tree and shrub cover, if present and over 12 inches in height, was measured along a 30, 50, or 60 m line-intercept transect. If less than 12 inches in height, trees and shrubs were included in herbaceous cover quadrat measurements. Different line lengths were used in different vegetation types to reduce between-stand variability. Thirty meter lines were appropriate in all types, except *Artemisia*, where a 50 m line was used and *Juniperus* Savannah, where a 60 m transect was necessary.

Shrub density for each species was measured by counting each shrub stem greater than 12 inches tall within either a 1 m^2, 0.02 ha, 0.04 ha, or 0.06 ha area. The 1 m^2 plot was used in the following communities: *Atriplex*-Badland, *Atriplex-Artemisia-Hilaria*, and *Atriplex-Astragalus*. The 0.02 ha was used in the Pinyon-Juniper Cliffbottom and Pinyon-Juniper Clifftop, the 0.06 ha in the *Juniperus* Savannah and the 0.04 ha in the Sagebrush. The plot size selected for use, best contained the between-stand variance.

Tree density was measured by the same technique used for shrub density, excluding the 1 m^2 plot size. Tree basal area was calculated from the basal stem diameter of all trees measured in the tree density plots. Tree seedling densities were counted to help determine population trends.

Productivity was measured by double sampling (Cook et al., 1974). The annual primary productivity, by lifeform for all vegetation types, was clipped in one 9.6 square foot quadrat for every five quadrats estimated. Clipped samples were air-

9.2 Cont.

dried for 5 days before weighing. Trees and perennial succulents were not clipped.

The sampling intensity was determined using the following formula which was recommended by DOGM (Mary Ann Wright, personal communication, 1981).

$$n_{min} = \frac{(t)^2 \quad (s^2)}{((.1)(\bar{x}))^2}$$

Where n_{min} = the minimum number of samples,

t = two-tailed t-value with appropriate alpha level and degrees of freedom,

s^2 = sample variance,

$\bar{x}$ = sample mean.

Sampling intensity information is contained in Table IX-1.

All techniques were discussed with DOGM personnel and were found to be appropriate and acceptable.

9.2 Cont.

Table IX-1 Sampling intensities for measured vegetation parameters. South Lease, Utah. June-September 1981.

Vegetation Type	Parameter	$n_{sampled}$	n_{min}
Atriplex-Artemisia-Hilaria	Cover quadrats	180	75
	Shrub density	195	173
	Production	40	86
Atriplex-Astragalus	Cover quadrats	200	196
	Shrub density	180	116
	Production	40	32
Atriplex-Badland	Cover quadrats	200	150
	Shrub density	160	100
	Production	40	2
Juniperus-Savannah	Cover quadrats	200	190
	Point-lines	20	15
	Shrub density	22	20
	Line intercept	11	9
	Tree intercept	24	201
	Production	40	108
Pinus-Juniperus Clifftop	Cover quadrats	480	463
	Point-lines	12	10
	Shrub density	26	24
	Line intercept	29	26
	Tree density	32	30
	Production	40	120
Pinus-Juniperus Cliffbottom	Cover quadrats	280	277
	Point-lines	23	20
	Shrub density	32	29
	Line intercept	10	7
	Tree density	28	28
	Production	40	380
Artemisia tridentata	Cover quadrats	260	545
	Point-lines	15	13
	Shrub density	6	6
	Line intercepts	13	12
	Production	40	19

9.3 Existing Resources

The Mine Plan Area is found in the Major Land Resource Area (MLRA) (34) of the Central Desertic Basins, Mountains and Plateaus which is found in the Northern and Central Intermountain Desertic Basins Plant Growth Region. This Plant Growth Region is similar to that described by Thornburg and Fuchs (1978), but it has been adjusted to the MLRAs as defined by the SCS (Thornburg 1981). The proposed Mine Plan Area (MPA) is primarily on Federal and State owned properties which are currently being used for wildlife habitat, livestock grazing and recreation (Chapter IV), although the area is also used as access to coal, oil and gas exploration sites by various companies.

In the summer of 1981, a study of the MPA was begun in order to define the characteristics of the existing vegetation and soil resources. The information obtained from on-site study will be used both in reclamation planning as well as in the determination of final reclamation success.

9.3.1 General Site Description

The Mine Plan Area rises from an elevation of 5000 feet (1523 m) on Marsh Flat Wash and Grassy Wash to about 8200 feet (2498 m) on the peaks northeast of Little Park Wash. The permit area is geologically divided by the Book Cliffs into two life zones, or provinces, strikingly different in vegetation and soils: the Shadscale or *Atriplex* Zone or Province and the *Agropyron spicatum* Province represented by an *Artemisia tridentata* shrub steppe (Daubenmire 1978). The cliffs have a vertical rise of 800 to 1000 feet (244 to 305 m). Differences in the moisture regime is one of the primary factors responsible for the contrasts in soil and vegetation development.

The cliffs themselves are extremely rugged. Only small microsites such as crevices are vegetated, and then only sparsely. The face of the cliffs is traversed

9.3 Cont.

by a primitive trail, however this appears to be only infrequently used by wildlife.

Although site specific records are unavailable, pinyon-juniper woodlands usually develop in areas where effective annual precipitation is near 12 inches (30cm) (Cronquist et al., 1972). Pinyon-juniper is found as an edpahic climax on the thin, rocky soils above the cliffs where the precipitation is greater. Other pinyon-juniper communities are found below the cliffs on specific microsites. *Juniperus osteosperma* is the common juniper of the proposed permit area on dry sites, while *J. scopulorum* may be found along more moist ravines or on north facing slopes elsewhere in the MPA. Above the cliffs, a sagebrush-grass community is ecotonal on deeper soils adjacent to the pinyon-juniper community. *Artemisia tridentata* is commonly found on non-saline uplands adjacent to ephemeral channels (Branson et al., 1976) such as Little Park Wash which bisects the plateau above the cliffs.

The area below the cliffs is geologically and edaphically young in terms of development. The area is an actively eroding region, highly dissected by numerous rills, gullies and arroyos. Soils are minimally developed and are being formed from interbedded shales and sandstone of Cretaceous marine origin. Badlands of exposed Mancos Shale are common. The vegetation is dominated by species of *Atriplex* and other salt tolerant ecotypes, one of the most salt tolerant being *A. corrugata*. This species has an unusual capacity to remove soil water at very high osmotic stresses and is commonly dominant on marine derived shale sites (Branson et al., 1976).

9.3 Cont.

The location of the plant communities is strongly dictated by the soil types and erosion patterns. In general, the plant communities tend to reflect the macroclimate in their structural simplicity, as well as in specific adaptations to drought such as found in the species of *Atriplex*, *Opuntia*, *Ephedra* and others.

9.3.2 Vegetation Types

9.3.2.1 Cover Data

9.3.2.2 Production Data

9.3.2.3 Tree Data

9.3.2.4 General Description

9.3.2.5 Species List

The general descriptions of each vegetation type to be disturbed are presented in the following pages. Cover data, production data, species lists, and tree data are given, when appropriate, as Tables within each description. For easy reference, each Table is listed in the index under the specific subject heading.

9.3 Cont.

Atriplex-Artemesia-Hilaria

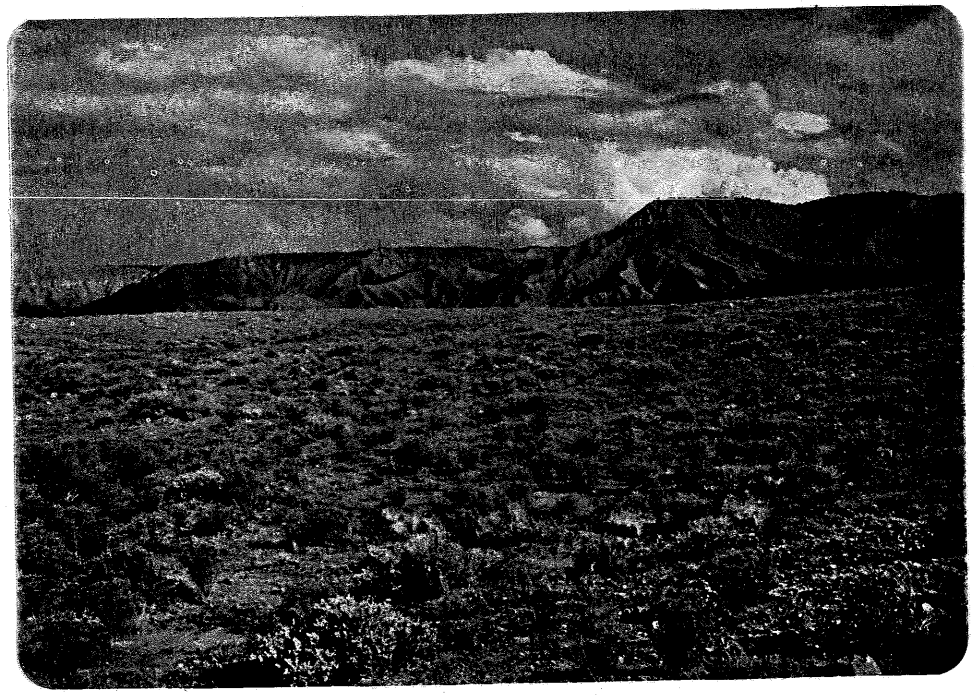
(Saltbush-Sagebrush-Galleta)

The *Atriplex-Artemisia-Hilaria* vegetation type is found from 5110 to 5230 feet (1567 to 1593 m) in elevation. Slopes vary from 1 to 3 percent. Aspect is typically south-facing (Photograph IX-1).

Stands occur on eroded BG loam, and eroded Ravola silt loam, saline soils. The BG soil averages greater than 60 inches (152 cm) in depth. Average surface layer (A1) thickness is one inch (2.5 cm) of loam, over 15 inches (38 cm) of loam subsoil (B2). Runoff is slow and erosion potential is moderate. The Ravola soil averages greater than 60 inches (152 cm) in depth. The surface layer (A1) averages 2 inches (5 cm) of silt loam atop C horizons to 60 inches (152 cm). Runoff is slow and erosion potential is moderate.

The *Atriplex-Artemisia-Hilaria* vegetation type displays some variability across different soils and aspects. To the west, near stock watering ponds where animals concentrate, broom snakeweed (*Xanthocephalum sarothrae*) is more prevalent. This is assumed to be the consequence of heavy livestock grazing. On the low eastern mesas where the rail loop is planned, broom snakeweed is a smaller part of the vegetation, and shadscale (*Atriplex confertifolia*) and bud sage (*Artemisia spinescens*) are the dominant shrubs. Galleta (*Hilaria jamesii*) is the dominant grass throughout, with sand dropseed (*Sporobolus cryptandrus*) common under light grazing pressure. Numerous annual and perennial forbs are present. Table IX-2 contains the species list for the *Atriplex-Artemisia-Hilaria* type. Cover and constancy information, by species, are included in Table IX-3.

9.3 Cont.



Photograph IX-1 *Atriplex-Artemisia-Hilaria.* Vegetation Type. September 1981.

9.3 Cont.

Table IX-2. Comprehensive species list for the *Atriplex-Artemisia-Hilaria* vegetation type. South Lease, Utah. June-August 1981.

Shrubs

Artemisia spinescens	ARSP	Bud sagebrush
Atriplex confertifolia	ATCON	Shadscale
A. cuneata	ATCU	Castle Valley clover
Chrysothamnus viscidiflorus	CHVI	Low rabbitbrush
Ephedra viridis	EPVI	Green ephedra
Eurotia lanata	EULA	Winterfat
Sarcobatus vermiculatus	SAVE	Greasewood
Tetradymia spinosa	TESP	Cottonthorn horsebrush
Xanthocephalum sarothrae	XASA	Broom snakeweed

Forbs

Aster spp.	ASTER	
Astragalus asclepiadoides	ASAS	Milkweed milkvetch
Brassicaceae spp.	BRASS	Mustard
Cryptantha crassisepala	CRCR	Plains hiddenflower
C. spp.	CRYPT	
Echinocereus spp.	ECHIN	
Eriogonum gordonii	ERGO	
E. inflatum	ERIN	Desert trumpet eriogonum
Halogeton glomeratus	HAGL	Halogeton
Lappula spp.	LAPPU	
Lepidium montanum	LEMO	Mountain pepperweed
L. spp.	LEPID	Pepperweed
Lygodesmia spp.	LYGO	Skeleton plant
Machaeranthera canescens	MACA	Hoary aster
Opuntia spp.	OPUNT	Prickly pear cactus
Phacelia spp.	PHACE	
Plantago patagonica	PLPA	Wooly Plantain
Salsola kali	SAKA	Russian thistle
Sphaeralcea coccinea	SPCO	Scarlet globemallow
S. leptophylla	SPLE	
S. parvifolia	SPPA	

9.3 Cont.

Table IX-2 Cont.

Grasses

Bouteloua gracilis	BOGR	Blue grama
Bromus tectorum	BRTE	Cheatgrass brome
Hilaria jamesii	HIJA	Galleta
Oryzopsis hymenoides	ORHY	Indian rice grass
Sporobolus cryptandrus	SPCR	Sand dropseed
Vulpia octoflora	VUOC	Sixweeks fescue

Table VIII-3. Cont.

9.3 Cont.

Table IX-3. Percent Cover and Constancy by Species for the *Atriplex-Artemisia-Hilaria* Vegetation Type. South Lease, Utah. July 1981.

STAND NUMBER	1	2	3	4	5	6	7	8	9	CONSTANCY
STATE AND COUNTY	UT EMERY	UT EMERY	UT EMERY	UT EMERY	UT EMERY	UT EMERY	UT EMERY	UT EMERY	UT EMERY	%
GRID NUMBER	11	11	11	11	11	11	11	11	11	
ELEVATION IN FEET	5220	5200	5185	5220	5150	5200	5220	5230	5110	
ASPECT	NE	S	S	S	S	S	SW	S	S	
SLOPE IN PERCENT	2	1	1	2	3	3	3	3	1	
SOIL MAPPING UNIT	BGC2	BGC2	BGC2	BGC2	BGC2	BGC2	BGC2	BGC2	BGC2	
SHRUBS:										
Artemisia spinescens	0.10	3.84	•	.33	•	.74	.06	•	•	56
Atriplex confertifolia	•*	•	•	0.15	•	•	•	•	•	11
A. corrugata	•	•	0.01	•	4.25	•	•	•	3.73	33
A. cuneata	3.86	7.06	1.03	2.65	1.8	5.05	7.23	5.6	1.39	100
Chrysothamnus viscidiflorus	•	•	.04	•	•	•	•	•	0.30	22
Ephedra torreyana	•	•	•	•	•	.95	•	•	•	11
Sarcobatus vermiculatus	•	•	•	•	•	•	•	•	1.45	11
Tetradymia spinosa	•	•	•	•	.44	•	2.4	•	•	22
Xanthocephalum sarothrae	0.78	.18	1.28	0.65	+#	•	0.20	.01	1.11	89
Unknown shrub	•	•	•	•	.01	•	•	•	0.05	22
FORBS:										
Aster spp.	•	•	•	+	•	•	•	•	•	11
Astragalus asclepiadoides	•	•	•	•	.09	•	•	•	•	11
Brassicaceae spp.	0.02	•	•	.01	•	•	.01	•	.5	44
Cryptantha crassisepala	0.01	•	•	.14	•	•	0.40	•	•	33
C. spp.	•	•	•	.05	•	•	•	•	•	11
Echinocereus spp.	•	•	•	.02	•	•	•	•	•	11
Eriogonum gordonii	+#	•	•	•	•	•	.01	0.10	•	33
E. inflatum	•	•	•	•	•	•	.01	•	•	11
Halogeton glomeratus	•	•	•	•	•	.01	•	•	•	11
Lappula spp.	•	0.01	•	•	.02	.01	•	0.02	•	44
Lepidium montanum	0.05	•	•	•	•	•	•	•	•	11
L. spp.	0.04	0.19	•	0.63	.01	.26	+	1.23	•	78
Lygodesmia spp.	•	•	.02	•	•	•	•	•	•	11
Machaeranthera canescens	•	•	.28	•	•	•	•	•	•	11
Opuntia spp.	0.20	0.5	0.45	0.10	0.20	0.40	1.25	1.78	0.51	100
Phacelia spp.	•	+	•	•	•	•	•	•	•	11
Plantago patagonica	1.41	0.45	2.34	2.71	1.98	1.86	1.7	1.55	1.01	100
Salsola kali	•	•	•	•	•	•	+	•	•	11
Sphaeralcea coccinia	•	•	.01	•	•	•	•	•	•	11
S. leptophylla	•	•	.04	•	•	•	•	•	0.10	22
S. parvifolia	1.05	1.35	.01	0.46	•	.41	1.36	1.71	0.15	89
Unknown forb	•	•	•	•	•	•	+	•	0.01	22
GRASSES:										
Bouteloua gracilis	0.05	•	•	•	•	•	•	•	•	11
Bromus tectorum	+	0.02	•	•	.14	•	0.01	•	.21	56
Hilaria jamesii	2.41	13.36	3.8	2.49	.14	2.18	1.96	1.1	1.74	100
Oryzopsis hymenoides	•	•	0.02	•	0.01	•	•	•	0.04	33
Sporobolus airoides	•	•	•	•	•	•	.02	•	•	11
S. cryptandrus	.21	.43	•	0.66	•	2.79	.30	.58	•	67
Vulpia octoflora	.55	.34	0.01	0.16	.09	.09	.04	+	•	89

•* = Species not present
+# = Species found as a trace in plot or present outside plots

9.3 Cont.

The low mesa tops are currently the least disturbed portion of this vegetation type, and were chosen as most representative of the potential plant community. All sample stands are on these low mesas.

Total vegetation cover averages more than 12 percent. Grasses account for 21 percent, forbs for 25 percent and shrubs for 54 percent of the total vegetation cover. Cover for rock, bareground, litter and life forms from quadrat measurements are contained in Table IX-4. Shrub stem density figures are included in Table IX-5.

Annual primary production for 1981 was estimated to be 297 pounds air dry per acre (333 kg/ha). Production by life form is presented in Table IX-6.

The principal disturbances planned in this type will be the road corridor and rail loadout. These disturbances will approximately equal 64.4 acres (26.1 ha).

9.3 Cont.

Table IX-4 Vegetation cover by life form from 0.25 m^2 quadrats, *Atriplex-Artemisia-Hilaria* vegetation type. South Lease, Utah, July 1981.

Life form or Feature	Total Cover %	Relative Vegetation Cover %
Tree	---*	
Shrub	6.74	53.66
Forb	3.16	25.16
Grass	2.66	21.18
Vegetative Cover	12.56	
Rock	1.11	
Bareground	81.64	
Litter	4.69	
Total	100.00	100.00

* No trees present

9.3 Cont.

Table IX-5 Shrub stem density by species for the *Atriplex-Artemisia-Hilaria* vegetation type. South Lease, Utah. August 1981.

Species	Common Name	Stem Density	
		per acre	per hectare
Artemisia spinescens	Bud sagebrush	5063	12500
Atriplex confertifolia	Shadscale	284	700
A. cuneata	Castle Valley clover	4637	11450
Eurotia lanata	Winterfat	304	750
Tetradymia spinosa	Cottonthorn horsebrush	952	2350
Xanthocephalum sarothrae	Broom snakeweed	20	50
Total		11260	27800

9.3 Cont.

Table IX-6. Annual primary production by life form as estimated through double-sampling, South Lease, Utah, September 1981.

Vegetation Type	Grass		Forbs		Shrubs		Total	
	lb/A	kg/ha	lb/A	kg/ha	lb/A	kg/ha	lb/A	kg/A
Atriplex-Astragalus-Hilaria	47	53	93	104	157	176	297	333
Atriplex-Astragalus	12	13	15	17	56	63	83	93
Atriplex- Badland	0	0	0	0	121	136	121	136
Juniperus Savannah	269	301	35	39	91	102	395	442
PJ Cliffbottom	29	33	11	12	45	50	85	95
PJ Clifftop	16	18	7	8	20	22	43	48
Artemisia tridentata	48	54	47	53	89	100	184	207

9.3 Cont.

Atriplex-Astragalus

(Saltbush-Milkvetch)

The *Atriplex-Astragalus* vegetation type is found from 5060 to 5115 feet (1542) to 1558 m) in elevation. Slopes vary from 1 to 6 percent. Aspect is variable from north to south-facing. Based on field reconnaissance, the aspect effect is small at these shallow slope angles (Photograph IX-2).

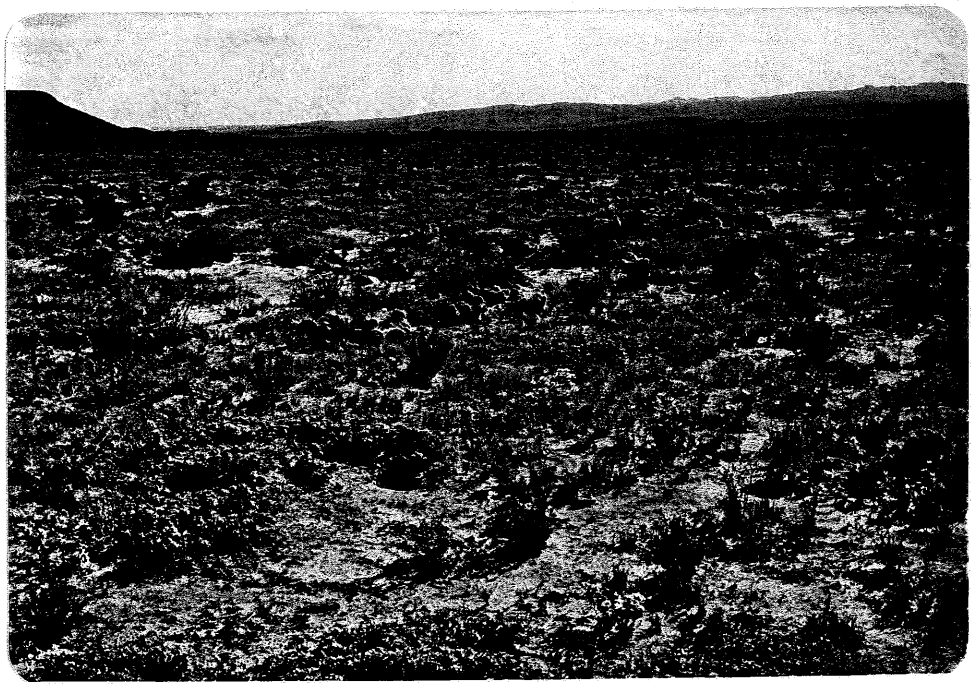
Atriplex-Astragalus stands occur on soils of the EA-Badland Complex. This complex consists of 60 percent EA extremely cobbly silty clay loam, 25 percent badland, and 15 percent other soils. The *Atriplex-Astragalus* type is primarily on the EA complex component. Average EA surface layer (A1) thickness is 2 inches (5 cm). It is underlain by 26 inches (66 cm) of C horizon to weathered shale. Runoff is rapid and erosion potential is high.

The *Atriplex-Astragalus* vegetation type to be disturbed is the least productive within the South Lease permit area. Cattle are attracted to this area by nearby watering ponds and use this type for grazing and standing.

Total vegetation cover of the *Atriplex-Astragalus* vegetation type is 7.5 percent; approximately half is contributed by shrubs (Table IX-7). The dominant shrubs are shadscale, Castle Valley clover (*Atriplex cuneata*), broom snakeweed, and bud sage. Most shrubs exhibit thick, truncated stems with small canopies protruding from the ground because erosion has removed the soil at the base. Shrub stem density information is contained in Table IX-8.

Milkweed milkvetch (*Astragalus asclepiadoides*) is the most conspicuous perennial forb species. It is accompanied by several less conspicuous annual and

9.3 Cont.



Photograph IX-2 *Atriplex-Astragalus* Vegetation Type. September, 1981.

9.3 Cont.

Table IX-7. Vegetation cover by life form from 0.25 m^2 quadrats, *Atriplex-Astragalus* vegetation type. South Lease, Utah, July 1981.

Life form or Feature	Total Cover %	Relative Vegetation Cover %
Tree	---*	
Shrub	3.35	45.45
Forb	1.90	25.78
Grass	2.12	28.77
Vegetation Cover	7.37	
Rock	1.66	
Bareground	86.94	
Litter	4.03	
Total	100.00	100.00

* No trees present

9.3 Cont.

Table IX-8 Shrub stem density by species for the *Atriplex-Astragalus* vegetation type. South Lease, Utah. July 1981.

Species	Common Name	Stem Density	
		per acre	per hectare
Artemisia spinescens	Bud sagebrush	1935	4778
A. confertifolia	Shadscale	630	1556
A. corrugata	Mat saltbush	180	444
A. cuneata	Castle Valley clover	3330	8222
A. gardneri	Gardner saltbush	45	111
Chrysothamnus nauseosus	Rubber rabbitbrush	23	56
C. viscidiflorus	Douglas rabbitbrush	45	111
Ephedra viridis	Green Mormon tea	23	56
Eriogonum spp.	Buckwheat	90	222
Eurotia lanata	Winterfat	428	1056
Xanthocephalum sarothrae	Broom snakeweed	5355	13222
Total		12084	29834

9.3 Cont.

perennial species of aster (*Aster spp.*), cryptantha (*Cryptantha spp.*), and wild buckwheat (*Eriogonum spp.*). Galleta is the dominant grass. Indian ricegrass (*Oryzopsis hymenoides*), sand dropseed and six weeks fescue (*Vulpia octoflora*) are also present. Table IX-9 contains the comprehensive species list for the *Atriplex-Astragalus* vegetation type. Cover and constancy by species are included in Table IX-10.

Annual primary production for 1981 was estimated to be 83 pounds air dry per acre (93 kg/ha). Production by life form is presented in Table IX-6.

The principal disturbance planned in the *Atriplex-Astragalus* type will be the road corridor. This disturbance will approximately equal 8.6 acres (3.5 hectares).

9.3 Cont.

Table IX-9. Comprehensive species list for the *Atriplex-Astragalus* vegetation type. South Lease, Utah. June-August 1981.

Shrubs

Artemisia spinescens	ARSP	Bud sagebush
Atriplex confertifolia	ATCON	Shadscale
A. corrugata	ATCOR	Mat saltbush
A. cuneata	ATCU	Castle Valley clover
A. gardneri	ATGA	Gardner saltbush
Cercocarpus intricatus	CEIN	Littleaf mountain mahogany
Chrysothamnus nauseosus	CHNA	Rubber rabbitbrush
Ephedra torreyana	EPTO	Green ephedra
Eriogonum spp.	ERIOG	Wild buckwheat
Eurotia lanata	EULA	Winterfat
Tetradymia spinosa	TESP	Cottonthorn horsebrush
Xanthocephalum sarothrae	XASA	Broom snakeweed
X. spp.	XANTH	Snakeweed

Forbs

Aster spp.	ASTER	
Astragalus asclepiadoides	ASAS	Milkweed milkvetch
A. spp.	ASTRA	Milkvetch
Brassicaceae spp.	BRASS	Mustard
Cryptantha crassisepala	CRCR	Plains hiddenflower
C. fulvocanescens	CRFU	Beggarlice hiddenflower
C. pterocarya	CRPT	Winged cryptantha
Eriogonum gordonii	ERGO	
E. inflatum	ERIN	Desert trumpet eriogonum
Hymenoxys acaulis	HYAC	Stemless hymenoxys
Lappula echinata	LAEC	European stickseed
L. occidentalis	LAOC	Annual stickseed
Leucelene eridoides	LEER	Heath aster
Opuntia spp.	OPUNT	Prickly pear cactus
Plantago patagonica	PLPA	Wooly plantain
Salsola kali	SAKA	Russian thistle

9.3 Cont.

Table IX-9 Cont.

<u>Forbs</u> - Continued		
Sphaeralcea coccinea	SPCO	Scarlet globemallow
S. spp.	SPHAE	Globemallow
Townsendia incana	TOIN	Hoary townsendia
<u>Grasses</u>		
Hilaria jamesii	HIJA	Galleta
Oryzopsis hymenoides	ORHY	Indian ricegrass
Sporobolus cryptandrus	SPCR	Sand dropseed
Vulpia octoflora	VUOC	Sixweeks fescue

Table VIII- 3. Cont.

9.3 Cont.

Table IX-10. Percent Cover and Constancy by Species for the Saltbush-Milkvetch Vegetation Type. South Lease, Utah. July 1981

STAND NUMBER	1	2	3	4	5	6	7	8	9	10	CONSTANCY
STATE AND COUNTY	UT EMERY	UT EMERY	UT EMERY	UT EMERY	UT EMERY	UT EMERY	UT EMERY	UT EMERY	UT EMERY	UT EMERY	%
GRID NUMBER	10	10	10	10	10	10	10	10	10	10	
ELEVATION IN FEET	5080	5115	5060	5120	5100	5110	5090	5110	5080	5085	
ASPECT	NE	NE	N	SE	E	SW	NE	S	SE	S	
SLOPE IN PERCENT	3	1	1	1	1	3	4	5	4	6	
SOIL MAPPING UNIT	EED2	EED2	EED2	EED2	EED2	EED2	EED2	EED2	EED2	EED2	
SHRUBS:											
Artemisia spinescens	.17	.03	.05	.05	.04	•*	.13	•	•	.03	70
Atriplex confertifolia	.05	2.30	.88	.90	.09	1.37	•	1.3	3.35	1.08	90
A. corrugata	•*	•	•	•	1.3	•	2.85	•	•	•	20
A. cuneata	1.25	1.97	1.08	•	.95	•	3.2	.05	1.0	1.23	80
A. gardneri	•	•	•	+	•	•	•	•	•	•	10
Chrysothamnus nauseosus	•	•	•	•	•	.80	•	+	•	•	20
Ephedra viridus	+#	•	•	•	•	•	•	•	•	•	10
Eriogonum microthecum	•	+	•	•	•	•	•	•	•	•	10
Eurotia lanata	•	•	•	•	.25	.08	•	•	.50	•	30
Tetradymia spinosa	•	•	•	•	•	•	•	•	•	+	10
Xanthocephalum sarothrae	.89	.80	1.13	.70	•	.32	.3	.07	.40	.58	90
Unknown shrub	•	•	•	•	•	.04	•	•	•	•	10
FORBS:											
Aster spp.	•	•	.02	.04	.05	.04	•	1.01	.63	•	60
Astragalus asclepiadoides	•	+	•	+	•	+	•	•	•	•	30
A. spp.	•	•	•	•	•	.14	1.29	•	•	•	20
Brassicaceae spp.	•	•	•	•	•	•	•	.19	•	•	10
Cryptantha crassisepala	.23	•	•	•	.19	+	•	•	•	•	30
C. fulvocanescens	•	•	•	•	•	•	•	•	+	•	10
C. pterocarya	•	+	+	.09	.03	•	•	+	•	•	50
Eriogonum gordonii	+	•	+	.17	1.02	•	•	•	•	•	40
E. inflatum	•	•	•	•	•	.02	•	•	•	•	10
Fabaceae spp.	+	1.32	.03	•	•	•	•	•	•	•	30
Hymenoxys acaulis	.03	•	.12	•	+	•	•	•	.30	•	40
Lappula occidentalis	+	•	+	.04	+	•	•	+	•	•	50
Lepidium spp.	•	•	•	•	.10	•	•	+	•	•	10
Leucelene ericoides	.03	•	•	•	•	•	•	•	•	•	10
Machaeranthera canescens	•	•	•	•	4.20	•	.02	•	•	•	20
Opuntia spp.	•	•	•	1.05	3.85	.20	•	•	•	•	30
Plantago patagonica	.10	.07	.50	1.72	•	.15	.17	.08	.32	+	90
Salsola kali	•	•	•	•	•	•	•	+	•	•	10
Sphaeralcea coccinia	.04	•	•	•	•	•	.05	•	.05	•	30
S. spp.	•	.07	•	•	•	•	•	.05	•	.05	30
Townsendia incana	.32	•	.02	•	+	•	.07	•	•	•	40
Unknown forb	.02	•	•	•	+	•	•	•	.02	•	30
GRASSES:											
Hilaria jamesii	1.69	1.59	1.63	4.5	1.98	3.03	.64	1.5	2.34	.83	100
Oryzopsis hymenoides	•	•	.05	.19	.05	.07	.05	•	.64	+	70
Sporobolus cryptandrus	•	•	•	•	.28	•	•	•	•	•	10
Vulpia octoflora	•	•	•	+	+	.15	•	•	•	•	30
OTHER:											
Cryptogams	•	•	•	•	+	•	•	•	•	•	10

•* = Species not present
+# = Species present as a trace in plot or present outside plots

9.3 Cont.

Atriplex-Badland

(Saltbush-Badland)

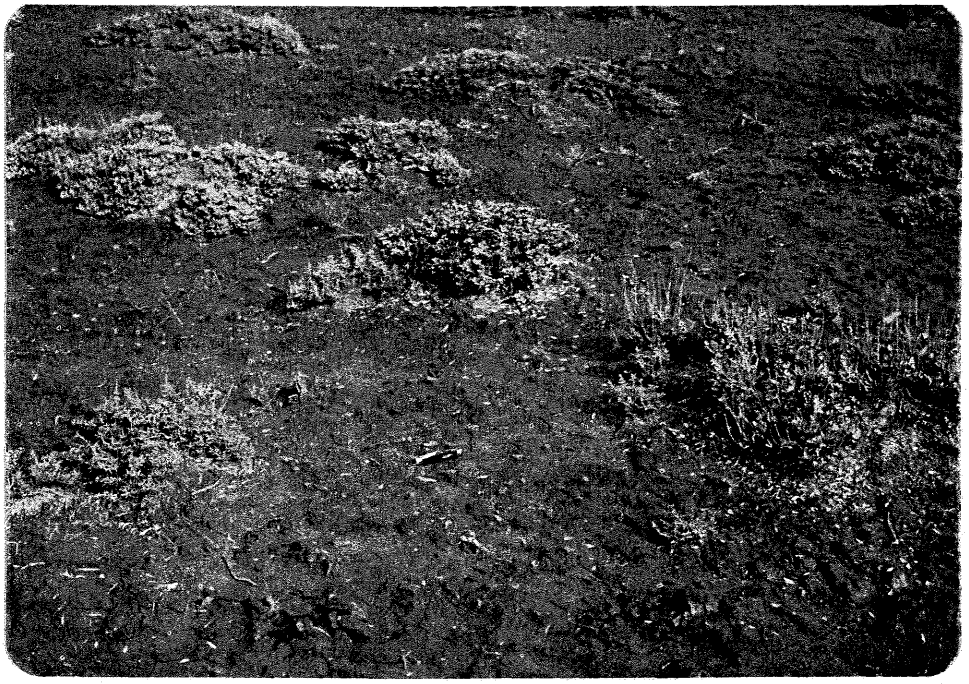
The *Atriplex*-Badland vegetation type is found from 4900 to 5300 feet (1493 to 1615 m) in elevation. Slopes range from 0 to 8 percent. Slope aspect is typically south to west-facing (Photographs IX-3 and IX-4).

The stands occur on soils of Chipeta silty clay loam. The Chipeta soil averages 15 inches (38 cm) deep over weathered shale. The average surface layer (A1) thickness is one inch (2.5 cm) of silty clay loam. Runoff is rapid and erosion potential is high.

The dominant species is mat saltbush *(Atriplex corrugata)*. Castle Valley clover and Gardner saltbush *(Atriplex gardneri)* are associated species. These shrub species are adapted to moderately salt-affected soils such as the Chipeta (Institute for Land Rehabilitation Staff, 1979). Life forms other than shrubs are not well-represented. Galleta and Indian ricegrass are present, with a complement of predominantly annual forbs. Rubber rabbitbrush *(Chrysothamnus nauseosus)* and winterfat *(Eurotia lanata)* are common in narrow drainage dissections. Total vegetation cover averages nine percent, with shrubs comprising 85 percent of the total cover. Vegetation cover by life form is included in Table IX-11. Shrub stem densities are contained in Table IX-12. Species cover and constancy data are summarized in Table IX-13, and a comprehensive species list is presented in Table IX-14.

The high frequency of annual forbs, together with the large amount of bare ground, is indicative of continuing disturbance. The disturbance results from natural erosion aggravated by the historically heavy grazing pressure.

9.3 Cont.



Photograph IX-3 *Atriplex*-Badland vegetation type, (close-up). South Lease, Utah. September 1981.

Photograph IX-4 *Atriplex*-Badland vegetation type. South Lease, Utah. September 1981.

9.3 Cont.

Table IX-11 Vegetation cover by life form from 0.25 m^2 quadrats, *Atriplex*-Badland vegetation type. South Lease, Utah, June 1981.

Life form or feature	Total Cover %	Relative Vegetation Cover %
Tree	---*	
Shrub	8.70	95.08
Forb	.25	2.73
Grass	.20	2.19
Vegetation Cover	9.15	
Rock	1.04	
Bareground	87.08	
Litter	2.73	
Total	100.00	100.00

*No trees present

9.3 Cont.

Table IX-12 Shrub stem density by species for the *Atriplex*-Badland vegetation type. South Lease, Utah. July 1981.

Species	Common Name	Stem Density	
		per acre	per hectare
Artemisia spinescens	Bud sagebrush	1367	3375
Atriplex corrugata	Mat saltbush	28072	69313
A. cuneata	Castle Valley clover	886	2188
A. gardneri	Gardner saltbush	1063	2625
Chrysothamnus nauseosus	Rubber rabbitbrush	51	125
Erotia lanata	Winterfat	304	750
Xanthocephalum sarothrae	Broom snakeweed	1190	2938
Total		32933	81314

9.3 Cont.

Table IX-13. Percent Cover and Constancy by Species for the Saltbush-Badland Vegetation Type. South Lease, Utah. July 1981.

STAND NUMBER	1	2	3	4	5	6	7	8	9	10	CONSTANCY
STATE AND COUNTY	UT EMERY	UT EMERY	UT EMERY	UT EMERY	UT EMERY	UT EMERY	UT EMERY	UT EMERY	UT EMERY	UT EMERY	%
GRID NUMBER	10	10	10	10	10	10	10	10	10	10	
ELEVATION IN FEET	4990	4980	4960	4925	4947	4935	4900	4925	4950	4965	
ASPECT	N	S	E	W	N	NW	NW	NW	NW	SE	
SLOPE IN PERCENT	8	1.5	2	4	2	5	1	6	5	4	
SOIL MAPPING UNIT	CHC2	CHC2	CHC2	PNE2	CHC2	CHC2	BNE2	CHC2	CHC2	CHC2	
SHRUBS:											
Artemisia spinescens	•*	•	•	•	•	•	•	.01	•	.01	20
Atriplex corrugata	6.9	4.96	.20	•	6.35	10.15	15.90	7.18	13.00	7.18	90
A. cuneata	•	2.06	1.25	•	•	•	•	.10	•	.10	40
A. gardneri	•	•	4.65	2.78	•	•	•	•	•	.03	30
Chrysothamnus viscidiflorus	•	•	•	.15	•	•	•	•	•	•	10
Ephedra torreyana	•	•	•	.10	•	•	•	•	•	•	10
Xanthocephalum sarothrae	•	•	•	•	•	•	•	.13	•	•	10
Unknown forb	•	.21	•	•	•	•	•	•	•	•	10
FORBS:											
Astragalus spp.	•	+	•	•	•	•	•	•	•	•	10
Brassicaeae spp.	•	•	•	•	•	•	•	+	•	+	20
Cryptantha spp.	•	•	•	•	•	•	.06	•	•	•	10
Eriogonum gordonii	•	•	.06	.10	.01	.20	•	•	•	•	40
E. inflatum	•	•	•	•	.01	.04	•	•	•	•	20
Happlopappus spp.	•	•	.73	.65	•	•	•	•	•	•	20
Lappula occidentalis	•	.03	•	.09	+	•	•	+#	•	+	50
Plantago patagonica	•	1.03	•	•	•	•	•	.04	•	.04	30
Opuntia spp.	•	.15	•	•	•	•	•	•	•	•	10
Sphaeralcea coccinea	•	.01	•	•	•	•	•	•	•	•	10
Unknown forb	•	.01	•	.01	•	•	•	•	•	•	20
GRASSES:											
Hilaria jamesii	•	.50	•	.38	•	•	•	.80	•	.80	40
Oryzopsis hymenoides	•	.04	•	.29	•	•	•	•	•	•	20

•* = Species not present
+# = Species found as a trace in plot or present outside plots

9.3 Cont.

Table IX-14 Comprehensive species list for the *Atriplex*-Badland vegetation type. South Lease, Utah. June-August 1981.

Shrubs

Artemisia spinescens	ARSP	Bud sagebrush
Atriplex canescens	ATCA	Fourwing saltbush
A. corrugata	ATCOR	Mat saltbush
A. cuneata	ATCU	Castle Valley clover
A. gardneri	ATGA	Gardner saltbush
Chrysothamnus nauseosus	CHNA	Rubber rabbitbrush
C. viscidiflorus	CHVI	Low rabbitbrush
Ephedra torreyana	EPTO	Torrey ephedra
Eurotia lanata	EULA	Winterfat
Xanthocephalum sarothrae	XASA	Broom snakeweed

Forbs

Asteraceae spp.	ASTER	
Astragalus asclepiadoides	ASAS	Milkweed milkvetch
Brassicaceae spp.	BRASS	Mustard
Cryptantha spp.	CRYPT	Cryptantha
Eriogonum gordonii	ERGO	
E. inflatum	ERIN	Desert trumpet eriogonum
Haplopappus spp.	HAPLO	Goldenweed
Lappula occidentalis	LAOC	Annual stickseed
Opuntia spp.	OPUNT	Prickly pear cactus
Plantago patagonica	PLPA	Wooly plantain
Sphaeralcea coccinea	SPCO	Scarlet globemallow

Grasses

Hilaria jamesii	HIJA	Galleta
Oryzopsis hymenoides	ORHY	Indian ricegrass

9.3 Cont.

Annual primary production for 1981 is estimated by double sampling to be 121 pounds air dry per acre (136 kg/ha) (Table IX-6).

The principal disturbances planned in this area will be a road corridor and a rock fill from the rotary breaker. These disturbances will equal approximately 239 acres (98 ha).

9.3 Cont.

Juniperus Savannah
(Juniper Savannah)

The *Juniperus* Savannah vegetation type is found from 5460 to 5520 feet (1663 to 1682 m) in elevation. Slopes vary from 4 to 12 percent. Aspect is typically north to east (Photograph IX-5).

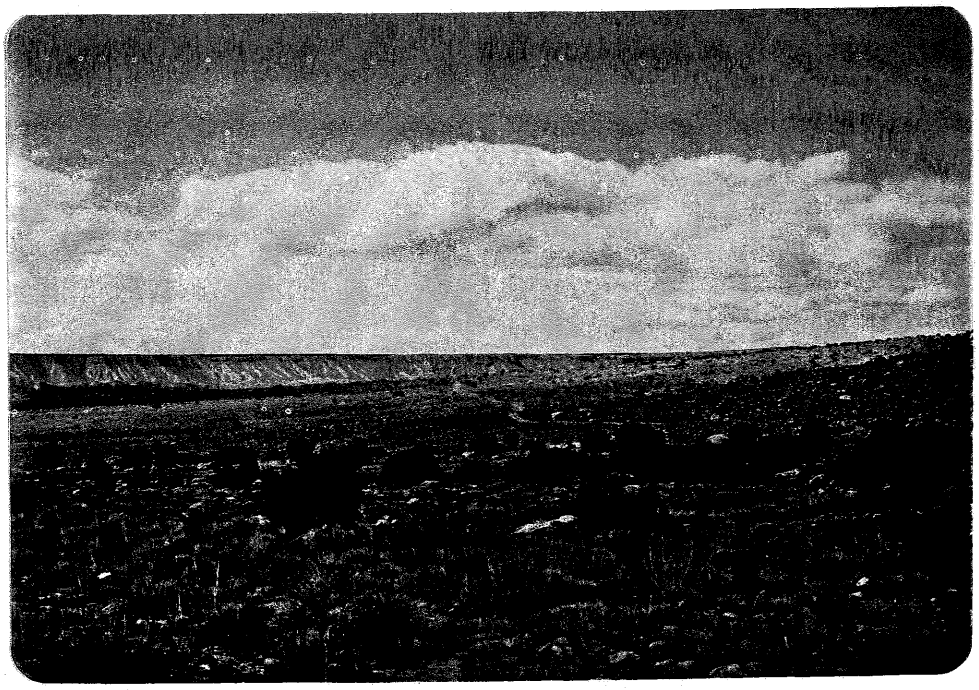
Soils underlying the *Juniperus* Savannah type are Chilton extremely bouldery fine sandy loam, low rainfall, 3 to 20 percent slopes eroded. The average surface layer (A1) is 3 inches (7.5 cm), extremely bouldery, of fine sandy loam and is underlain with 21 inches (53 cm) of very bouldery sandy clay loam (C1). Runoff is medium and erosion potential is high.

The *Juniperus* Savannah vegetation type lies on the toe of the Book Cliffs. The ground is strewn with boulders. Herbaceous and shrub vegetation dominate with occasional junipers *(Juniperus osteosperma)* giving the area a savannah appearance. The bouldery surface and remoteness from water has protected this area from intense cattle grazing.

Total vegetation cover of the *Juniperus* Savannah type is slightly less than 11 percent for herbaceous species, and woody species less than 12 inches (30 cm) in height. Tree canopy cover equals one percent. Cover by life form from quadrats is presented in Table IX-15. The dominant shrubs are shadscale, broom snakeweed, greasebush *(Forsellesia meionandra)*, and Mormon-tea *(Ephedra torreyana)*. Tree and shrub cover from line intercept information is contained in Table IX-16. Shrub stem and tree density data are summarized in Table IX-17 and Table IX-18, respectively. Tree basal areas are presented in Table IX-19.

Total canopy cover collected by point-line transects is 25 percent, including all strata. Cover by life form from the point-line method is reported in Table

9.3 Cont.



Photograph IX-5 *Juniperus* Savannah Vegetation Type.
South Lease, Utah. September, 1981.

9.3 Cont.

Table IX-15. Vegetation cover by life form from 0.25 m^2 quadrats. *Juniperus* Savannah vegetation type. South Lease, Utah, July 1981.

Life form or feature	Total Cover (%)	Relative Vegetative Cover (%)
Tree	-+	
Shrub	0.52	4.70
Forb	1.53	13.90
Grass	8.93	81.40
Vegetation Cover	10.98	
Rock	29.12	
Bareground	48.14	
Litter	11.76	
Total	100.00	100.00

+ Tree and shrub cover value is only for plants <12 inches in height. Complete shrub cover data is available in Table IX-16.

9.3 Cont.

Table IX-16. Vegetation cover from 60 m line-intercept transect, *Juniperus* Savannah vegetation type, South Lease, Utah, July 1981.

Species	Common Name	Cover (%)
Atriplex confertifolia	Shadscale	1.28
Chrysothamnus nauseosus	Rubber rabbitbrush	.40
Ephedra torreyana	Mormon tea	.97
E. viridis	Green Mormon tea	.05
Forsellesia meionandra	Greasebush	.39
Xanthocephalum sarothrae	Broom snakeweed	1.31
Juniperus osteosperma	Utah juniper	.98
Total		5.38

9.3 Cont.

Table IX-17 Shrub stem density by species for the *Juniperus* Savannah vegetation type. South Lease, Utah. July 1981.

Species	Common Name	Stem Density	
		per acre	per hectare
Artemisia nova	Black sagebrush	.31	.76
Atriplex confertifolia	Shadscale	247.26	609.88
Chrysothamnus nauseosus	Rubber rabbitbrush	11.98	29.55
C. viscidiflorus	Low rabbitbrush	31.64	78.03
Ephedra torreyana	Mormon tea	414.05	1021.26
Eriogonum microthecum	Slenderbush eriogonum	.61	1.52
Eurotia lanata	Winterfat	33.17	81.82
Forsellesia meionandra	Greasebush	203.95	503.06
Xanthocephalum sarothrae	Broom snakeweed	555.96	1371.28
Yucca spp.	Yucca	2.15	5.30
Total		1501.08	3702.46

9.3 Cont.

Table IX-18. Tree densities for the *Juniperus* Savannah vegetation type. South Lease, Utah. July 1981.

Species	Common Name	Tree Density	
		per acre	per hectare
Juniperus osteosperma	Utah Juniper	23.62	58.33
Pinus edulis	Pinyon pine	.84	2.08
Total		24.46	60.41

9.3 Cont.

Table IX-19. Tree basal areas by species for the *Juniperus* Savannah vegetation type. South Lease, Utah. July 1981.

Species	Common Name	Basal Area	
		ft^2/A	m^2/ha
Juniperus osteosperma	Utah juniper	1768	405.6
Pinus edulis	Pinyon pine	10	2.3
Total		1778	407.9

9.3 Cont.

IX-20. Cover and constancy by species is found in Table IX-21. A comprehensive species list is included in Table IX-22.

Annual primary production for 1981 was estimated to be 395 pounds air dry per acre (442 kg/ha). Production by life form is presented in Table IX-6.

The principal disturbance planned in *Juniperus* Savannah is a road corridor. Approximately 28.1 acres (11.4 ha) are scheduled for disturbance.

9.3 Cont.

Table IX-20. Vegetation cover by life form from 30 m point-line transects for the *Juniperus* Savannah vegetation type. South Lease, Utah. July 1981.

Life form or feature	Total Cover (%)	Relative Vegetation Cover (%)
Tree	1.20	4.88
Shrub	7.50	30.49
Forb	4.40	17.89
Grass	11.50	46.74
Vegetation Cover	24.60	
Rock	21.00	
Bareground	34.60	
Litter	19.80	
Total	100.00	100.00

9.3 Cont.

Table IX-21. Percent Cover and Constancy by Species for the *Juniperus* Savannah Vegetation Type. South Lease, Utah. July 1981.

STAND NUMBER	1	2	3	4	5	6	7	8	9	10	CONSTANCY
STATE AND COUNTY	UT EMERY	UT EMERY	UT EMERY	UT EMERY	UT EMERY	UT EMERY	UT EMERY	UT EMERY	UT EMERY	UT EMERY	%
GRID NUMBER	12	12	12	12	12	12	12	12	12	12	
ELEVATION IN FEET	5500	5480	5520	5510	5460	5490	5485	5515	5510	5490	
ASPECT	E	E	E	E	E	NE	NE	NE	N	N	
SLOPE IN PERCENT	4	4	10	10	12	11	4	4	11	11	
SOIL MAPPING UNIT	BNE2	BNE2	BNE2	BNE2	BNE2	BNE2	BNE2	BNE2	BNE2	BNE2	
SHRUBS:											
Artemisia nova	•*	+#	•	•	•	•	•	•	•	•	10
Atriplex confertifolia	•	2.35	2.50	•	•	•	.50	•	•	.90	40
Chrysothamnus nauseosus	.03	1.40	•	•	•	•	•	•	•	•	20
C. viscidiflorus	.20	.04	•	•	•	•	•	•	•	•	20
Ephedra torreyana	•	•	2.50	•	•	•	•	•	•	•	10
E. viridis	+	+	+	+	•	•	•	•	•	•	40
Eriogonum ovalifolium	•	•	•	•	•	•	.15	•	•	•	10
E. microthecum	.15	•	•	•	•	•	•	•	•	•	10
Eurotia lanata	.16	.01	•	.15	.06	•	•	•	•	•	40
Forsellesia meionandra	•	•	1.25	•	•	•	.08	0.03	.40	.69	50
Fraxinus anomala	.01	•	•	•	•	•	•	•	•	•	10
Xanthocephalum sarothrae	.13	.90	.05	•	•	+	.10	•	.15	•	60
Yucca spp.	•	•	•	+	•	•	•	•	•	•	10
FORBS:											
Astragalus mollissimus	•	•	•	•	+	•	•	•	•	•	10
A. spp.	•	.75	•	+	•	•	•	•	•	•	20
Brassicaceae spp.	+	•	•	+	•	•	•	•	•	•	20
Cryptantha pterocarya	.05	.06	•	•	.01	•	•	•	•	•	30
C. spp.	•	•	•	•	•	.04	•	•	•	•	10
Echinocereus spp.	•	•	•	+	+	•	•	•	•	•	20
Eriogonum bicolor	•	.01	•	•	•	•	•	•	•	•	10
E. ovalifolium	•	•	•	•	+	•	•	•	•	•	10
Euphorbia fendleri	•	•	•	•	•	.19	.23	.01	.08	.43	50
Hymenoxys richardsonii	•	•	.10	.08	.45	.28	.68	.15	.25	•	70
Lappula echinata	+	•	•	•	•	+	•	•	•	•	20
Lepidium lasiocarpum	•	•	•	•	•	•	.10	•	•	•	10
L. spp.	•	•	.10	+	+	.01	•	•	•	•	40
Leucelene ericoides	•	•	.03	•	.75	•	.84	1.00	.30	.81	60
Machaeranthera grindelioides	•	•	.05	•	.20	•	.50	.35	.41	.05	60
M. species	•	.14	.05	•	•	.43	.13	.11	•	•	50
Opuntia spp.	•	•	•	•	•	.03	•	.75	.65	.08	40
Plantago patigonica	+	.01	•	•	•	.01	.05	•	•	•	40
Phacelia spp.	•	•	•	+	•	•	•	•	•	•	10
Senecio spp.	•	•	+	•	•	•	•	•	•	•	10
Sphaeralcea munroana	.01	.03	•	•	•	•	•	•	•	•	20
S. parvifolia	•	•	•	+	•	•	•	•	•	•	10
Thelesperma subnudum	•	•	•	•	•	•	•	•	.28	.64	20
Townsendia incana	•	•	•	•	•	•	•	+	•	•	10
Unknown forb	.05	•	•	•	•	•	•	•	•	•	10
GRASSES:											
Aristida spp.	•	•	.15	•	•	.01	.65	•	•	•	30
Bromus tectorum	.01	.76	•	•	•	•	.01	•	•	•	30
Bouteloua gracilis	•	•	•	•	.10	.01	3.85	•	.54	.16	50
B. hirsuta	•	•	•	•	•	•	•	+	•	•	10
Elymus salina	2.75	4.59	14.65	5.10	2.19	5.34	4.45	5.90	3.46	4.68	100
Hilaria jamesii	3.95	3.01	4.40	1.80	2.58	.81	3.01	2.43	2.03	3.58	100
Oryzopsis hymenoides	•	•	.75	•	.25	•	•	•	.20	.05	40
Sporobolus cryptandrus	•	•	•	•	•	•	+	•	•	•	10
Stipa comata	•	.15	•	.55	.13	•	.08	•	•	•	40
Vulpia octoflora	+	.11	.03	+	+	+	.04	•	•	•	70

•* = Species not present
+# = Species found as a trace in plot or present outside plots

9.3 Cont.

Table IX-22. Comprehensive species list for the Pinyon-Juniper Savannah vegetation type. South Lease, Utah. June-August 1981.

Trees		
Juniperus communis	JUCO	Common juniper
J. osteosperma	JUOS	Utah juniper
Pinus edulis	PIED	Pinyon pine
Shrubs		
Artemisia nova	ARNO	Black sagebrush
Atriplex confertifolia	ATCON	Shadscale
Chrysothamnus nauseosus	CHNA	Rubber rabbitbrush
C. viscidiflorus	CHVI	Low rabbitbrush
Ephedra torreyana	EPTO	Torrey ephedra
E. viridis	EPVI	Green ephedra
Eriogonum ovalifolium	EROV	Cushion eriogonum
E. microthecum	ERMI	Slender eriogonum
Eurotia lanata	EULA	Winterfat
Forsellesia meionandra	FOME	Greasebush
Fraxinus anomala	FRAN	Singleleaf ash
Xanthocephalum sarothrae	XASA	Broom snakeweed
Yucca spp.	YUCCA	Yucca
Forbs		
Astragalus mollissimus	ASMO	Wooly milkvetch
A. spp.	ASTRA	Milkvetch
Brassicaceae spp.	BRASS	Mustard
Cryptantha spp.	CRYPT	Cryptantha
C. pterocarya	CRPT	Winged cryptantha
Echinocereus spp.	ECHIN	
Eriogonum bicolor	ERBI	
Euphorbia fendleri	EUFE	Fendler euphorbia
Hymenoxys richardsonii	HYRI	Pingue hymenoxys
Lappula echinata	LAEC	European stickseed

9.3 Cont.

Table IX-22 Continued

Forbs

Lepidium spp.	LEPID	Pepperweed
Leucelene ericoides	LEER	Heath aster
Machaeranthera grindellioides	MAGR	
M. spp.	MACHA	
Opuntia spp.	OPUNT	Prickly pear cactus
Plantago patagonica	PLPA	Wooly plantain
Phacelia spp.	PHACE	Phacelia
Senecio spp.	SENEC	Goundsel
Sphaeralcea munroana	SPMU	Munro globemallow
S. parvifolia	SPPA	
Thelesperma subnudum	THSU	Navajo-tea greenthread
Townsendia incana	TOIN	Hoary townsendia

Grasses

Aristida spp.	ARIST	Threeawn
Bromus tectorum	BRTE	Cheatgrass brome
Bouteloua gracilis	BOGR	Blue grama
B. hirsuta	BOHI	Hairy grama
Elymus salina	ELSA	Salina wildrye
Hilaria jamesii	HIJA	Galleta
Oryzopsis hymenoides	ORHY	Indian ricegrass
Sporobolus cryptandrus	SPCR	Sand dropseed
Stipa comata	STCO	Needle-and-thread
Vulpia octoflora	VUOC	Sixweeks fescue

9.3 Cont.

Pinus-Juniperus Cliffbottom
(Pinyon-Juniper Cliffbottom)

Pinyon-Juniper Cliffbottom vegetation type is found from 5525 to 5710 feet (1683 to 1740 m) in elevation. Slopes vary from 9 to 31 percent. Aspect is typically southwestern (Photograph IX-6).

Soils underlying this type are Chilton, extremely bouldery fine sandy loam (BNE2) and Rock Outcrop-Rubbleland-Badland Complex. The average surface layer (A1) of the Chilton soil is 3 inches (7.5 cm) of extremely bouldery fine sandy loam and is underlain with 21 inches (53 cm) of very bouldery sandy clay loam (C1). Runoff is medium and erosion potential is high.

The Rock Outcrop-Rubbleland-Badland Complex consists of about 40 percent Rock Outcrop, 35 percent Rubbleland, and 25 percent Badland. Rock Outcrop is exposed bedrock consisting of sandstone, conglomerate sandstone, and limestone. Rubbleland consists of areas covered by stones and boulders. Little soil is exposed at the surface. Badland consists of steep to very steep nearly barren beds of eroding shale. The Pinyon-Juniper Cliffbottom type lies on the Rubbleland in this complex.

The vegetation cover from quadrats of the herbaceous species and woody species less than 12 inches (30 cm) in height is 5.31 percent (Table IX-23). Line-intercept cover for trees and shrub is contained in Table IX-24. Using the point-line method, total first-hit vegetation cover is 22 percent, of which 12 percent is tree cover and 10 percent is cover contributed by herbaceous species and woody species less than 12 inches (30 cm) (Table IX-25).

9.3 Cont.

Photograph IX-6 Pinyon-Juniper Cliffbottom Vegetation Type. South Lease, Utah. September, 1981.

9.3 Cont.

Table IX-23. Vegetation cover by life form from 0.25 m^2 quadrats, Pinyon-Juniper Cliffbottom vegetation type. South Lease, Utah, July 1981.

Life form or feature	Total Cover %	Relative Vegetation Cover %
Tree	0	0
Shrub	1.30	30
Forb	.81	15
Grass	3.20	55
Vegetation Cover	5.31	
Rock	53.80	
Bareground	27.52	
Litter	13.37	
Total	100.00	100.00

9.3 Cont.

Table IX-24. Shrub and tree cover from 30 m line-intercept transects, Pinyon-Juniper Cliffbottom vegetation type. South Lease, Utah. July 1981.

Species	Common Name	Cover (%)
Artemisia nova	Black sagebrush	.07
Chrysothamnus nauseosus	Rubber rabbitbrush	.26
Cowania mexicana	Cliffrose	.21
Fraxinus anomala	Singleleaf ash	.42
Xanthocephalum sarothrae	Broom snakeweed	.27
Trees		
Juniperus osteosperma	Utah juniper	11.92
Pinus edulis	Pinyon pine	2.76
Total		15.91

9.3 Cont.

Table IX-25. Vegetation cover by life form from 30 m point-line transects, Pinyon-Juniper Cliffbottom vegetation type. South Lease, Utah. August 1971.

Life form or feature	Total Cover (%)	Relative Vegetation Cover (%)
Tree	11.91	54
Shrub	1.82	8
Forb	0.87	4
Grass	7.48	34
Vegetation Cover	22.08	
Rock	43.74	
Bareground	23.83	
Litter	10.35	
Total	100.00	100.00

9.3 Cont.

Tree cover is composed of Utah juniper and pinyon pine *(Pinus edulis)*. Density and basal area figures for trees are presented in Table IX-26 and Table IX-27, respectively. Seedling density information shows few seedlings present (Table IX-28). Cover and constancy data by species are summarized in Table IX-28a.

Rubber rabbitbrush, singleleaf ash *(Fraxinus anomala)*, black sage *(Artemisia nova)*, and broom snakeweed are the dominant shrubs. Shrub density data are included in Table IX-26.

Galleta, Salina wildrye *(Elymus salina)*, cheatgrass *(Bromus tectorum)*, and needle and thread *(Stipa comata)* are the most prevalant grasses. Table IX-29 contains the comprehensive species list for the Pinyon-Juniper Cliffbottom type. Annual primary production was estimated to be 85 pounds air dry per acre (95 kg/ha). Production by life form is presented in Table IX-6.

The disturbed areas planned in this type will be used for road corridor and surface facilities. These disturbances will comprise approximately 1.2 acres (.49 ha).

9.3 Cont.

Table IX-26. Tree and shrub stem density by species from the Pinyon-Juniper Cliffbottom vegetation type. South Lease, Utah. August 1981.

Species	Common Name	Stem Density per acre	Stem Density per hectare
Shrubs			
Artemisia nova	Black sagebrush	65	161
A. tridentata	Big sagebrush	2	5
Atriplex confertifolia	Shadscale	3	6
Chrysothamnus depressus	Little rabbitbrush	1	3
C. nauseosus	Rubber rabbitbrush	193	477
Cowania mexicana	Cliffrose	1	3
Ephedra torreyana	Mormon tea	64	158
E. viridis	Green Mormon tea	1	3
Eriogonum microthecum	Slenderbush eriogonum	60	148
Fraxinus anomala	Singleleaf ash	11	27
Xanthocephalum sarothrae	Broom snakeweed	111	275
Yucca spp.	Yucca	1	3
Total Shrubs		513	1269
Trees			
Juniperus osteosperma	Utah juniper	121	298
Pinus edulis	Pinyon pine	40	98
Total Trees		161	396

9.3 Cont.

Table IX-27. Tree basal area from the Pinyon-Juniper Cliffbottom vegetation type, South Lease, Utah. August 1981.

Species	Common Name	Basal Area	
		ft^2/A	m^2/ha
Juniperus osteosperma	Utah juniper	3657	834
Pinus edulis	Pinyon pine	441	101
Total		4098	935

9.3 Cont.

Table IX-28. Seedling density by species from the Pinyon-Juniper Cliffbottom vegetation type. South Lease, Utah. July 1981.

Species	Common Name	Seedling Density*	
		per acre	per hectare
Shrubs			
Artemisia nova	Black sagebrush	4	10
Eriogonum microthecum	Slenderbush eriogonum	1	3
Chrysothamnus nauseosus	Rubber rabbitbrush	1	3
Xanthocephalum sarothrae	Broom snakeweed	3	5
Shrub Total		9	21
Trees			
Juniperus osteosperma	Utah juniper	24	59
Pinus edulis	Pinyon pine	38	93
		62	152
Grand Total		71	173

* Plants less than one foot (33cm) in height

9.3 Cont.

Table IX-28a. Percent Cover and Constancy by Species for the Pinyon-Juniper Cliffbottom Vegetation Type. South Lease, Utah. July 1981

STAND NUMBER	1	2	3	4	5	6	7	8	9
STATE AND COUNTY	UT EMERY	UT EMERY	UT EMERY	UT EMERY	UT EMERY	UT EMERY	UT EMERY	UT EMERY	UT EMERY
GRID NUMBER	12	12	12	12	12	12	12	12	12
ELEVATION IN FEET	5670	5650	5590	5600	5695	5690	5620	5650	5645
ASPECT	SW	SW	SW	SW	SW	SW	SW	SW	SW
SLOPE IN PERCENT	27	27	27	27	9	24	24	31	31
SOIL MAPPING UNIT	RR	RR	RR	RR	BNE2	BNE2	BNE2	RR	RR
SHRUBS:									
Artemisia nova	•*	•	•	•	1.45	0.05	0.10	0.05	1.55
Chrysothamnus nauseosus	0.02	0.01	•	0.50	0.30	0.70	1.55	2.85	0.01
Cowania mexicana	•	0.05	•	•	•	•	•	•	•
Ephedra torreyana	•	•	•	0.55	•	•	•	•	•
Eriogonum microthecum	0.19	0.10	•	0.08	0.08	0.08	0.14	0.06	•
Eurotia lanata	•	•	•	0.01	•	•	•	0.01	•
Fraxinus anomala	•	•	0.35	•	•	•	•	•	•
Xanthocephalum sarothrae	•	•	•	•	0.02	0.80	0.05	•	0.12
FORBS:									
Aster spp.	•	•	•	+#	•	•	•	•	0.46
Astragalus spp.	0.08	•	•	•	•	0.01	0.04	0.26	•
Brassicaceae spp.	•	•	•	•	•	•	•	•	•
Commandra umbellatum	0.06	•	•	•	•	•	•	•	•
Cryptantha spp.	•	•	•	•	•	•	•	•	•
Erigeron spp.	•	•	•	•	•	•	•	•	•
Eriogonum bicolor	•	•	0.10	0.08	+	•	•	•	•
E. gordonii	•	•	•	•	•	•	•	•	•
Euphorbia fendleri	0.14	0.02	•	0.25	0.02	•	0.14	0.04	•
Hymenopappus filifolium	0.31	•	•	•	•	•	•	•	•
Hymenoxys acaulis	•	+	•	•	•	•	•	•	•
H. richardsonii	0.22	•	•	•	0.39	0.45	0.04	0.01	0.05
Lappula echinata	•	•	•	•	•	•	0.02	•	•
Leptodactylon pungens	0.06	•	•	0.02	•	•	0.25	0.08	0.10
Leucelene ericoides	•	•	•	•	0.02	0.08	•	0.02	•
Lygodesmia juncea	•	•	•	•	•	•	•	•	0.10
Machaeranthera grindelioides	0.45	•	0.05	•	0.10	•	•	0.35	0.35
Opuntia spp.	•	•	+	•	•	•	•	•	•
Penstemon palmerii	0.02	•	•	•	•	•	•	•	•
P. spp.	•	•	•	•	•	•	•	•	•
Sphaeralcea munroana	•	•	0.35	•	•	•	•	•	•
S. parvifolia	•	•	0.04	•	•	•	•	•	•
Unknown forb	0.02	0.21	+	0.05	0.06	•	+	0.02	0.02
GRASSES:									
Agropyron spp.	0.02	•	•	0.02	•	•	•	•	•
Aristida spp.	•	•	•	•	0.08	•	•	0.15	•
A. wrightii	•	•	0.36	•	•	•	•	•	•
Bouteloua gracilis	•	•	0.35	•	•	0.48	•	•	•
Bromus tectorum	•	•	•	•	•	+	+	+	•
Elymus salina	0.82	•	3.90	1.98	1.42	+	0.78	0.19	1.30
Hilaria jamesii	0.66	0.59	2.10	1.14	1.52	3.55	3.42	0.92	0.74
Oryzopsis hymenoides	•	•	•	•	•	0.61	0.05	•	•
Stipa comata	0.62	0.36	0.49	0.10	•	•	•	0.10	•
Vulpia octoflora	•	•	0.01	•	•	•	•	•	•

•* = Species not present
+# = Species found as a trace in plot or present outside plots

Table IX-28a Cont.

PINYON-JUNIPER CLIFFBOTTOM

STAND NUMBER	10	11	12	13	14	CONSTANCY
STATE AND COUNTY	UT EMERY	UT EMERY	UT EMERY	UT EMERY	UT EMERY	%
GRID NUMBER	12	12	12	12	12	
ELEVATION IN FEET	5710	5645	5635	5525	5615	
ASPECT	SW	SW	SW	SW	SW	
SLOPE IN PERCENT	19	19	23	23	29	
SOIL MAPPING UNIT	RR	RR	RR	RR	RR	
SHRUBS:						
Artemisia nova	•*	•	•	•	•	36
Chrysothamnus nauseosus	•	+	0.01	0.60	+	86
Cowania mexicana	•	•	•	•	•	7
Ephedra torreyana	•	•	•	•	•	7
Eriogonum microthecum	0.15	0.22	+	•	•	71
Eurotia lanata	•	•	•	•	•	14
Fraxinus anomala	•	•	0.15	•	0.05	21
Xanthocephalum sarothrae	•	+#	•	+	•	43
FORBS:						
Aster spp.	•	•	•	•	•	14
Astragalus spp.	0.18	1.32	0.05	•	•	50
Brassicaceae spp.	•	•	•	•	0.10	7
Commandra umbellatum	•	•	•	•	•	7
Cryptantha spp.	•	•	•	•	0.10	7
Erigeron spp.	•	0.01	•	•	•	7
Eriogonum bicolor	•	•	•	•	•	21
E. gordonii	+	•	•	•	•	7
Euphorbia fendleri	0.10	0.06	0.04	0.05	0.16	78
Hymenopappus filifolium	•	•	•	•	•	7
Hymenoxys acaulis	•	0.02	0.01	•	0.02	28
H. richardsonii	0.08	0.06	0.15	0.08	0.10	78
Lappula echinata	+	•	•	•	•	14
Leptodactylon pungens	•	0.09	•	•	•	43
Leucelene ericoides	•	•	0.10	•	0.06	36
Lygodesmia juncea	•	•	•	0.90	•	14
Machaeranthera grindelicoides	0.08	0.15	0.02	0.11	•	64
Opuntia spp.	•	•	•	•	•	7
Penstemon palmerii	•	•	•	•	•	7
P. spp.	•	0.02	•	•	•	7
Sphaeralcea munroana	•	•	•	•	•	7
S. parvifolia	•	•	•	•	•	7
Unknown forb	•	0.03	0.04	0.05	•	78
GRASSES:						
Agropyron spp.	•	•	•	•	•	14
Aristida spp.	0.15	•	•	•	0.20	28
A. wrightii	•	•	•	•	•	7
Bouteloua gracilis	•	•	•	•	•	14
Bromus tectorum	•	+	+	+	•	43
Elymus salina	2.75	0.76	0.65	0.41	1.42	93
Hilaria jamesii	2.96	2.42	0.88	1.48	1.82	100
Oryzopsis hymenoides	•	•	•	•	•	14
Stipa comata	•	•	0.05	•	•	36
Vulpia octoflora	•	•	•	•	•	7

•* = Species not present
+# = Species present as a trace in plot or present outside plots

9.3 Cont.

Table IX-29. Comprehensive species list for the Pinyon-Juniper Cliffbottom vegetation type. South Lease, Utah. June-August 1981.

Trees		
Juniper osteosperma	JUOS	Utah juniper
Pinus edulis	PIED	Pinyon pine
Shrubs		
Artemisia nova	ARNO	Black sagebrush
A. tridentata	ARTR	Big sagebrush
Atriplex confertifolia	ATCON	Shadscale
Cercocarpus intricatus	CEIN	Littleleaf mountain mahogany
Chrysothamnus nauseosus	CHNA	Rubber rabbitbrush
C. viscidiflorus	CHVI	Low rabbitbrush
Cowania mexicana	COME	Cliffrose
Ephedra viridis	EPVI	Green ephedra
Eriogonum bicolor	ERBI	
E. jamesii	ERJA	James eriogonum
Eurotia lanata	EULA	Winterfat
Fraxinus anomala	FRAN	Singleleaf ash
Xanthocephalum sarothrae	XASA	Broom snakeweed
Forbs		
Aster spp.	ASTER	
Astragalus spp.	ASTRA	
Brassicaceae spp.	BRASS	Mustard
Commandra umbellatum	COUM	Bastard toadflax
Cryptantha spp.	CRYPT	
Erigeron spp.	ERIGE	
Eriogonum gordonii	ERIOG	
Euphorbia fendleri	EUFE	Fendler euphorbia
Hymenopappus filifolium	HYFI	Fineleaf hymenopappus
Hymenoxys acaulis	HYAC	Stemless hymenoxys
H. richardsonii	HYRI	Pingue hymenoxys

9.3 Cont.

Table IX-29 Continued

Forbs - Continued

Lappula spp.	LAPPU	
Lepidium spp.	LEPID	Pepperweed
Leptodactylon pungens	LEPU	Prickly phlox
Leucelene ericoides	LEER	Heath aster
Lygodesmia juncea	LYJU	Rush skeletonplant
Machaeranthea grindelioides	MAGR	
Opuntia spp.	OPUNT	Prickly pear cactus
Penstemon palmerii	PEPA	Palmer penstemon
P. spp.	PENST	
Sphaeralcea munroana	SPMU	Munro globemallow
S. parvifolia	SPPA	

Grasses

Agropyron spp.	AGROP	Wheatgrass
Aristida spp.	ARIST	Threeawn
Bouteloua gracilis	BOGR	Blue grama
Bromus tectorum	BRTE	Cheatgrass brome
Elymus salina	ELSA	Salina wildrye
Hilaria jamesii	HIJA	Galleta
Oryzopsis hymenoides	ORHY	Indian ricegrass
Stipa comata	STCO	Needle-and-thread
Vulpia octoflora	VUOC	Sixweeks fescue

9.3 Cont.

Pinus-Juniperus Clifftop
(Pinyon-Juniper Clifftop)

The Pinyon-Juniper (PJ) Clifftop vegetation type is found from 6600 to 6900 feet (2011 to 2102 m) in elevation. Slopes vary from 12 to 52 percent. Slope aspect is typically east-facing (Photograph IX-7).

The PJ Clifftop vegetation type covers a large area of the permit above the Book Cliffs, and encompasses many similar soil mapping units. Vegetation sampling was conducted on the soil mapping units near planned disturbance locations. These soils include the Rock Outcrop-Sunup Complex, the Lazear Rock Outcrop Complex, and the Cabba-Podo-Patmos Complex. These complexes are located on steep slopes, are gravelly to stony at the surface and have minimal topsoil development. Complete mapping unit descriptions for these complexes are found in Chapter VIII.

The type is dominated by pinyon pine and Utah juniper. Understory dominants include black sage, rubber rabbitbrush, pingue (*Hymenoxys richardsonii*), Salina wildrye and Indian ricegrass. A comprehensive species list is presented in Table IX-30. Shrub and tree densities are summarized in Table IX-31 and Table IX-32, respectively.

Herbaceous and low (height less than 12 inches) woody vegetation cover collected by quadrats, averages 3.0 percent (Table IX-33). Tree and shrub cover from line intercept information averages 33 percent (Table IX-34). Point-line transect data indicates a total vegetation cover average of 36 percent (Table IX-35). Constancy and cover values from quadrat data is contained in Table IX-36.

9.3 Cont.

Photograph IX-7. Pinyon-Juniper Clifftop Vegetaion Type.
South Lease, Utah. February, 1982.

9.3 Cont.

Table IX-30. Comprehensive species list for Pinyon-Juniper Clifftop vegetation type. South Lease, Utah. June-August 1981.

Trees		
Juniperus communis	JUCO	Common juniper
J. osteosperma	JUOS	Utah juniper
Pinus edulis	PIED	Pinyon pine
Shrubs		
Artemisia nova	ARNO	Black sagebrush
A. tridentata	ARTR	Big sagebrush
Cercocarpus ledifolius	CELE	Curlleaf mountain mahogany
C. montanus	CEMO	True mountain mahogany
Chrysothamnus nauseosus	CHNA	Rubber rabbitbrush
C. vaseyi	CHVA	Vasey rabbitbrush
C. viscidiflorus	CHVI	Low rabbitbrush
Cowania mexicana	COME	Cliffrose
Ephedra torreyana	EPTO	Torrey ephedra
E. viridis	EPVI	Green ephedra
Eurotia lanata	EULA	Winterfat
Forsellesia meionandra	FOME	Greasebush
Symphoricarpos vaccinoides	SYVA	Snowberry
Xanthocephalum sarothrae	XASA	Broom snakeweed
Forbs		
Abronia spp.	ABRON	Sand verbena
Arabis perennans	ARPE	Rock cress
Caulanthus crassicaulus	CACR	Wildcabbage
Cryptantha spp.	CRYPT	Cryptantha
Echinocereus spp.	ECHIN	
Erigeron pumilis	ERUP	Low fleabane
Eriogonum jamesii	ERJA	James eriogonum
E. spp.	ERIOG	

9.3 Cont.

Table IX-30 Continued

Forbs - Continued

Euphorbia fendleri	EUFE	Fendler euphorbia
Gilia aggregata	GIAG	Skyrocket gilia
G. congesta	GICO	Ballhead gilia
Hedysarum boreale	HEBO	Northern sweetvetch
Hymenopappus filifolius	HYFI	Fineleaf hymenopappus
H. spp.	HYMEN	Hymenopappus
Hymenoxys richardsonii	HYRI	Pingue hymenoxys
Leptodactylon pungens	LEPU	Prickly phlox
Machaeranthera grindelioides	MAGR	
M. spp.	MACHA	Aster
M. tanacetifolia	MATA	Tansyleaf aster
Opuntia spp.	OPUNT	Prickly pear cactus
Penstemon subglaber	PESU	
P. spp.	PENST	Beardtongue
Senecio multilobatus	SEMU	Lobeleaf groundsel
Sphaeralcea spp.	SPHAE	Globemallow
Stanleya pinnata	STPI	Desert princeplume
Townsendia incana	TOIN	Hoary townsendia

Grasses

Agropyron spp.	AGROP	Wheatgrass
Aristida spp.	ARIST	Threeawn
Bouteloua gracilis	BOGR	Blue grama
B. hirsuta	BOHI	Hairy grama
Bromus tectorum	BRTE	Cheatgrass brome
Elymus salina	ELSA	Salina wildrye
Hordeum jubatum	HOJU	Foxtail barley
Koelaria cristata	KOCR	Prairie junegrass
Oryzopsis hymenoides	ORHY	Indian ricegrass
Poa secunda	POSE	Sandburg bluegrass
P. spp.	POA	Bluegrass
Sporobolus cryptandrus	SPCR	Sand dropseed
Stipa comata	STCO	Needle-and-thread

9.3 Cont.

Table IX-31 Shrub stem densities, Pinyon-Juniper Clifftop vegetation type. South Lease, Utah. July 1981.

Species	Common Name	Stem Density	
		per acre	per hectare
Artemisia nova	Black sagebrush	687.38	1698.08
A. tridentata	Big sagebrush	29.58	73.07
Cercocarpus ledifolius	Curlleaf mountain mahogany	12.46	30.77
C. montanus	True mountain mahogany	101.98	251.92
Chrysothamnus vaseyi	Vasey rabbitbrush	77.07	190.38
C. viscidiflorus	Low rabbitbrush	7.78	19.23
Cowania mexicana	Cliffrose	14.79	36.54
Ephidra torreyana	Mormon tea	70.84	175.00
Eriogonum microthecum	Slenderbush eriogonum	3.11	7.69
Eurotia lanata	Winterfat	10.12	25.00
Forsellesia meionandra	Greasebush	14.01	34.62
Philadelphus microphyllus	Mock orange	4.67	11.54
Symphoricarpos vaccinoides	Serviceberry	26.47	65.38
Xanthocephalum sarothrae	Broom snakeweed	104.31	257.69
Total		1164.57	2876.91

9.3 Cont.

Table IX-32. Tree densities, Pinyon-Juniper Clifftop vegetation type. South Lease, Utah· July-August 1981.

Species	Common Name	Tree Density	
		per acre	per hectare
Juniperus osteosperma	Utah juniper	149.27	368.75
Pinus edulis	Pinyon pine	98.67	243.75
Total		247.94	612.50

9.3 Cont.

Table IX-33. Vegetation cover by life form from 0.25 m^2 quadrats, Pinyon-Juniper Clifftop vegetation type. South Lease, Utah. July 1981.

Life form or feature	Total Cover (%)	Relative Vegetation Cover (%)
Tree	-*	
Shrub	0.80+	28.48
Forb	0.68	38.74
Grass	0.99	32.78
Cryptogam	.55	
Vegetation Cover	3.02	
Rock	47.46	
Bareground	19.40	
Litter	30.12	
Total	100.00	100.00

* Tree cover was not measured by quadrats. Tree cover data from line-intercept measurements appear in Table IX-34.

+ Shrub cover value is only for plants < 12 inches in height. Complete shrub cover data is available in Table IX-34.

9.3 Cont.

Table IX-34. Shrub and tree cover from 30 m line-intercept transects, Pinyon-Juniper Clifftop vegetation type. South Lease, Utah. July 1981.

Species	Common Name	Cover (%)
Shrub		
Artemisia nova	Black sagebrush	1.06
A. tridentata	Big sagebrush	.36
Cercocarpus ledifolius	Curlleaf mountain mahogany	.18
C. montanus	True mountain mahogany	1.39
Chrysothamnus vaseyi	Vasey rabbitbrush	.05
Cowania mexicana	Cliffrose	.30
Ephedra viridis	Green Mormon tea	.15
Eurotia lanata	Winterfat	.02
Symphoricarpos spp.	Snowberry	.09
Xanthocephalum sarothrae	Broom snakeweed	.39
Tree		
Juniperus osteosperma	Utah juniper	8.09
Pinus edulis	Pinyon pine	21.05
Total		33.13

9.3 Cont.

Table IX-35. Vegetation cover by life form from 30 m point-line transects, Pinyon-Juniper Clifftop vegetation type. South Lease, Utah. July 1981.

Life form or feature	Total Cover (%)	Relative Vegetation Cover (%)
Tree	29.83	80.59
Shrub	3.33	10.58
Forb	1.67	4.79
Grass	1.50	4.04
Vegetation Cover	36.33	
Rock	28.33	
Bareground	13.83	
Litter	21.51	
Total	100.00	100.00

9.3 Cont.

Table IX-36. Percent Cover and Constancy by Species for the Pinyon-Juniper Clifftop Vegetation Type. South Lease, Utah. July 1981.

STAND NUMBER	1	2	3	4	5	6	7	8	9
STATE AND COUNTY	UT EMERY	UT EMERY	UT EMERY	UT EMERY	UT EMERY	UT EMERY	UT EMERY	UT EMERY	UT EMERY
GRID NUMBER	12	12	12	12	12	12	12	12	12
ELEVATION IN FEET	6600	6600	6760	6760	6780	6780	6550	6550	6600
ASPECT	SW	SW	E	E	E	E	NE	NE	E
SLOPE IN PERCENT	37	37	14	14	12	12	15	15	19
SOIL MAPPING UNIT	NXC	NXC	NXC	NXC	NXC	NXC	RVD	RVD	RVD
TREES:									
Juniperus osteosperma	0.22	•*	•	0.01	•	•	•	•	•
Pinus edulis	0.05	•	0.35	•	0.01	•	•	•	•
SHRUBS:									
Artemisia nova	•	•	•	•	•	•	0.92	1.05	•
Cercocarpus montanus	•	•	•	•	•	•	•	•	0.20
Chrysothamnus nauseosus	•	•	•	0.02	•	•	•	•	•
C. viscidiflorus	•	•	0.50	•	•	•	0.04	•	•
Eurotia lanata	0.25	5.12	•	•	•	•	•	•	•
Philidelphus microphyllus	0.05	•	•	•	•	0.60	•	•	0.16
Symphoricarpos vaccinioides	•	•	•	•	•	•	•	•	•
Xanthocephalum sarothrae	•	•	•	•	•	•	•	•	•
FORBS:									
Arabis perennans	0.01	0.10	0.02	•	•	•	•	•	•
Aster spp.	•	•	•	•	•	•	•	•	•
Brassicaeae spp.	•	•	•	•	•	•	•	•	•
Caulanthus crassicaulis	•	•	0.10	•	•	•	•	•	•
Cryptantha spp.	0.46	0.19	0.16	•	•	0.11	•	1.02	0.26
Echinocereus spp.	•	•	•	0.10	0.28	•	•	•	•
Eriogonum jamesii	•	•	0.30	•	•	•	•	•	•
Euphorbia fendleri	•	•	•	•	0.04	•	•	•	0.06
Gilia congesta	•	•	•	•	•	•	0.25	•	•
Hedysarum boreale	0.25	•	•	•	•	•	•	•	•
Hymenopappus spp.	•	•	•	•	•	•	•	•	•
Hymenoxys richardsonii	1.05	0.02	0.15	0.02	•	•	0.08	0.25	0.08
Leptodactylon pungens	0.22	0.35	•	•	•	•	•	•	•
Machaerantha grindelioides	0.15	0.12	0.05	•	0.12	0.15	0.05	0.12	0.05
M. tanacetifolia	•	•	•	•	0.04	•	•	•	•
Opuntia spp.	•	•	0.88	0.08	0.10	0.50	•	•	0.05
Penstemon spp.	•	•	•	0.12	•	•	•	•	•
Physaria spp.	•	•	•	•	•	•	•	•	•
Senecio multilobatus	0.02	0.12	•	•	•	•	•	0.30	0.17
Sphaeralcea spp.	•	•	•	0.01	•	•	•	•	•
Townsendia incana	0.05	•	•	•	•	•	•	•	•
Unknown forb	0.15	0.04	•	0.01	0.04	0.20	+	•	•
GRASSES:									
Agropyron spp.	+#	0.65	•	•	•	•	•	•	•
Aristida spp.	•	•	0.09	•	0.16	•	•	•	0.10
Bouteloua hirsuta	•	•	•	0.05	•	•	•	•	•
Bromus tectorum	•	•	•	+	•	•	+	1.25	•
Elymus salina	2.71	2.12	0.25	0.02	•	•	0.11	1.10	0.25
Hordeum jubatum	•	•	0.05	•	•	•	•	•	•
Koeleria cristata	•	•	•	•	•	•	•	•	•
Oryzopsis hymenoides	0.54	0.92	•	0.01	0.09	0.05	•	•	0.85
Poa secunda	•	0.02	•	•	•	•	•	•	•
P. spp.	•	0.60	•	•	•	•	•	0.18	•
Sitanion hystrix	•	•	•	•	•	•	•	•	•
Stipa comata	0.05	•	•	•	•	•	•	•	•
Vulpia octoflora	•	•	•	•	•	•	•	•	•
Cryptogams	•	•	0.52	0.40	0.85	0.65	0.25	0.15	0.25

•* = Species not present
+# = Species present as a trace in plot or present outside plots.

Table IX-36 Cont.

PINYON-JUNIPER/CLIFFTOP

STAND NUMBER	10	11	12	13	14	15	16	17	18
STATE AND COUNTY	UT EMERY	UT EMERY	UT EMERY	UT EMERY	UT EMERY	UT EMERY	UT EMERY	UT EMERY	UT EMERY
GRID NUMBER	12	12	12	12	12	12	12	12	12
ELEVATION IN FEET	6600	6640	6640	6620	6620	6610	6420	6425	6430
ASPECT	E	E	E	E	E	E	NE	NE	NE
SLOPE IN PERCENT	19	21	21	26	26	52	52	52	52
SOIL MAPPING UNIT	RVD	MUE	MUE	MUE	MUE	MUE	MUE	MUE	MUE
TREES:									
Juniperus osteosperma	•*	•	•	•	•	•	•	0.25	•
Pinus edulis	•	•	0.35	•	0.11	•	•	•	•
SHRUBS:									
Artemisia nova	1.10	•	2.40	•	0.58	•	0.70	•	0.70
Cercocarpus montanus	•	•	•	•	•	•	•	•	•
Chrysothamnus nauseosus	•	•	•	•	0.08	•	0.65	•	•
C. viscidiflorus	•	•	•	0.02	•	•	•	•	•
Eurotia lanata	•	•	•	•	•	•	•	•	•
Philidelphus microphyllus	•	•	•	•	0.78	0.10	•	•	•
Symphoricarpos vaccinioides	•	•	•	•	•	•	•	•	•
Xanthocephalum sarothrae	•	0.25	0.30	•	•	•	•	•	•
FORBS:									
Arabis perennans	•	0.02	•	•	+	•	•	•	•
Aster spp.	•	•	•	•	•	•	•	•	•
Brassicaeae spp.	•	•	•	•	•	•	0.02	•	+
Caulanthus crassicaulis	•	•	•	•	•	•	•	•	•
Cryptantha spp.	0.16	0.02	•	0.25	+	•	•	•	•
Echinocereus spp.	•	•	•	•	•	•	•	•	•
Eriogonum jamesii	•	•	•	•	•	•	•	•	•
Euphorbia fendleri	•	•	•	0.02	0.05	•	0.05	•	0.05
Gilia congesta	•	•	•	•	0.15	•	•	•	0.05
Hedysarum boreale	•	•	•	•	•	•	•	•	0.80
Hymenopappus spp.	•	•	•	0.20	•	0.01	•	0.05	•
Hymenoxys richardsonii	0.01	0.27	0.08	0.32	•	•	0.05	•	•
Leptodactylon pungens	•	•	0.01	0.35	•	0.25	•	0.15	•
Machaerantha grindelioides	0.01	0.05	•	0.01	0.35	•	•	•	•
M. tanacetifolia	•	•	•	•	•	•	•	•	•
Opuntia spp.	0.30	0.40	•	•	•	•	•	•	•
Penstemon spp.	•	•	•	•	•	•	•	•	•
Physaria spp.	•	•	•	•	•	•	•	•	•
Senecio multilobatus	•	•	•	•	0.05	•	•	•	•
Sphaeralcea spp.	•	•	•	•	•	•	•	•	•
Townsendia incana	•	•	•	•	•	•	•	•	•
Unknown forb	0.01	•	•	0.20	•	0.01	+	+	•
GRASSES:									
Agropyron spp.	•	•	•	•	•	0.02	•	•	•
Aristida spp.	•	0.02	•	0.15	•	•	•	•	•
Bouteloua hirsuta	•	•	•	•	•	•	•	•	•
Bromus tectorum	+#	•	•	•	•	•	•	•	•
Elymus salina	0.16	•	•	•	2.10	•	•	0.05	0.50
Hordeum jubatum	•	•	•	•	•	•	•	•	•
Koeleria cristata	0.02	•	•	•	•	•	•	•	•
Oryzopsis hymenoides	•	•	•	•	0.30	•	0.05	0.02	0.25
Poa secunda	•	•	•	•	•	•	•	•	•
P. spp.	•	•	•	•	•	•	•	•	•
Sitanion hystrix	•	•	•	•	•	0.20	•	•	•
Stipa comata	•	•	•	•	•	•	•	•	•
Vulpia octoflora	•	•	•	•	•	•	•	•	+
Cryptogams	0.05	0.60	•	0.89	0.08	1.10	0.50	0.65	1.00

•* = Species not present
+# = Species present as a trace in plot or present outside plot

Table IX-36 Cont.

PINYON-JUNIPER/CLIFFTOP

STAND NUMBER	19	20	21	22	23	24	CONSTANCY
STATE AND COUNTY	UT EMERY	UT EMERY	UT EMERY	UT EMERY	UT EMERY	UT EMERY	%
GRID NUMBER	12	12	12	12	12	12	
ELEVATION IN FEET	6450	6485	6460	6490	6475	6480	
ASPECT	NE	NE	NE	NE	NE	NE	
SLOPE IN PERCENT	43	52	43	43	43	43	
SOIL MAPPING UNIT	MUE	MUE	MUE	MUE	MUE	MUE	
TREES:							
Juniperus osteosperma	•*	•	•	•	•	•	12
Pinus edulis	•	•	•	•	•	•	21
SHRUBS:							
Artemisia nova	•	0.70	2.40	0.40	•	•	42
Cercocarpus montanus	•	•	•	•	•	•	4
Chrysothamnus nauseosus	0.90	0.65	0.30	0.60	0.25	0.50	38
C. viscidiflorus	•	•	•	•	•	•	12
Eurotia lanata	•	•	•	•	•	•	8
Philidelphus microphyllus	•	•	•	0.35	0.27	0.25	33
Symphoricarpos vaccinioides	•	0.25	•	•	•	•	4
Xanthocephalum sarothrae	•	•	•	•	•	•	8
FORBS:							
Arabis perennans	•	•	•	•	•	•	21
Aster spp.	•	•	•	0.05	•	•	4
Brassicaceae spp.	•	•	•	•	•	•	8
Caulanthus crassicaulis	•	•	•	•	•	•	4
Cryptantha spp.	•	•	•	•	•	•	42
Echinocereus spp.	•	•	•	•	•	•	8
Eriogonum jamesii	•	•	•	•	•	•	4
Euphorbia fendleri	•	0.20	•	•	•	0.42	33
Gilia congesta	•	•	•	•	•	•	12
Hedysarum boreale	•	0.30	•	0.15	•	•	17
Hymenopappus spp.	0.10	•	•	0.05	•	•	21
Hymenoxys richardsonii	•	•	•	•	•	•	50
Leptodactylon pungens	•	•	0.05	•	0.10	•	33
Machaerantha grindelioides	•	•	•	•	•	•	50
M. tanacetifolia	•	•	•	•	•	•	4
Opuntia spp.	•	•	•	•	•	•	29
Penstemon spp.	•	•	•	•	•	•	4
Physaria spp.	0.10	•	•	•	•	•	4
Senecio multilobatus	•	•	•	•	•	•	21
Sphaeralcea spp.	•	•	•	•	•	•	4
Townsendia inoana	•	•	•	•	•	•	4
Unknown forb	•	•	•	•	•	+	50
GRASSES:							
Agropyron spp.	•	•	•	•	•	•	12
Aristida spp.	•	•	0.11	•	•	0.45	29
Bouteloua hirsuta	•	•	•	•	•	•	4
Bromus tectorum	•	•	•	•	•	•	17
Elymus salina	0.50	0.90	0.01	1.32	0.55	0.20	71
Hordeum jubatum	•	•	•	•	•	•	4
Koeleria cristata	•	•	•	•	•	•	4
Oryzopsis hymenoides	1.35	0.22	0.40	1.30	0.40	•	62
Poa secunda	•	•	•	•	•	•	4
P. spp.	•	•	•	•	•	•	8
Sitanion hystrix	0.10	•	•	•	•	•	8
Stipa comata	•	•	•	•	•	•	4
Vulpia octoflora	•	•	•	•	•	•	4
Cryptogams	0.30	0.80	0.15	0.40	0.40	1.90	88

•* = Species not present

9.3 Cont.

Annual primary production is estimated to be 43 pounds air dry per acre (48 kg/ha), reflecting the harsh, steep rock conditions beneath the PJ canopy. Primary production by life form is included in Table IX-6. Tree basal area per acre averages 8512 square feet (1953 m^2/ha) (Table IX-37). Planned disturbances in the PJ Clifftop type are ventilation shafts and less than one-half mile (0.8 km) of service road. These will be maintained for the life of the mine, and will occupy 15.5 acres (6.3 ha).

9.3 Cont.

Table IX-37. Tree basal area, Pinyon-Juniper Clifftop vegetation type. South Lease, Utah. July-August 1981.

Species	Common Name	Basal Area	
		ft^2/A	m^2/ha
Juniperus osteosperma	Utah juniper	4900	1124
Pinus edulis	Pinyon pine	3612	829
Total		8512	1953

9.3 Cont.

Artemisia tridentata
(Sagebrush)

The Sagebrush vegetation type in the South Lease properties lies between 6400 and 6500 feet (1950 to 1980 m) atop the Book Cliffs. Slopes are 0 to 6 percent. Aspect is typically eastern to southeastern (Photograph IX-8).

The soil underlying the sagebrush is Glenberg fine sandy loam. The Glenberg soil mapping unit is characterized by very deep, well-drained soils in intermittent stream bottoms. The average surface layer (A1) is 2 inches (5 cm) thick. The underlying C horizons extend to 60 inches (152 cm). Runoff is slow and erosion hazard is moderate.

The intermittent stream bottoms are standing and traveling areas for cattle and little vegetation remains in these bottoms, other than big sagebrush (*Artemisia tridentata*) and cheatgrass, with occasional forbs. Greasewood (*Sarcobatus vermiculatus*) individuals are found erratically within the Sagebrush. A comprehensive species list for Sagebrush is contained in Table IX-38.

Herbaceous and low (less than 12 inches) woody vegetation cover collected by quadrats, averages four percent (Table IX-39). Tree and shrub cover from line intercept information averages 24 percent; 89 percent of which is big sagebrush cover (Table IX-40). Point-line transect data indicates a total vegetation cover average of 30 percent (Table IX-41). Cover and constancy is contained in Table IX-42).

Shrub stem density information is summarized in Table IX-43. Annual primary productivity was estimated to be 184 pounds air dry per acre (207 kg/ha). Production by life form is presented in Table IX-6.

9.3 Cont.

Photograph IX-8 *Artemisia Tridextata* Vegetation Type.
South Lease, Utah. February, 1982.

9.3 Cont.

Table IX-38. Comprehensive species list for the Sagebrush vegetation type. South Lease, Utah. June-August 1981.

Trees		
Juniperus communis	JUCO	Common juniper
J. osteosperma	JUOS	Utah juniper
Pinus edulis	PIED	Pinyon pine
Shrubs		
Artemisia nova	ARNO	Black sagebrush
A. tridentata	ARTR	Big sagebrush
Atriplex canescens	ATCA	Fourwing saltbush
A. confertifolia	ATCON	Shadscale
Eurotia lanata	EULA	Winterfat
Sarcobatus vermiculatus	SAVE	Greasewood
Xanthocephalum sarothrae	XASA	Broom snakeweed
Forbs		
Aster spp.	ASTER	
Cryptantha spp.	CRYPT	Cryptantha
Euphorbia fendleri	EUFE	Fendler euphorbia
Lappula echinata	LAEC	European stickseed
Lepidium montanum	LEMO	Mountain pepperweed
L. spp.	LEPID	Pepperweed
Lupinus spp.	LUPIN	Lupine
Machaeranthera canescens	MACA	Hoary aster
Opuntia spp.	OPUNT	Prickly pear cactus
Plantago patagonica	PLPA	Wooly plantain
Sphaeralcea parvifolia	SPPA	
Grasses		
Agropyron smithii	AGSM	Western wheatgrass

9.3 Cont.

Table IX-38 Continued

Grasses - Continued

Agropyron spp.	AGROP	Wheatgrass
Bromus tectorum	BRTE	Cheatgrass brome
Oryzopsis hymenoides	ORHY	Indian ricegrass
Sitanion hystrix	SIHY	Bottlebrush squirreltail
Sporobolus cryptandrus	SPCR	Sand dropseed
Stipa comata	STCO	Needle-and-thread
Vulpia octoflora	VUOC	Sixweeks fescue

9.3 Cont.

Table IX-39. Vegetation cover by life form from 0.25 m^2 quadrats, Sagebrush vegetation type. South Lease, Utah. July 1981.

Life form or feature	Total Cover (%)	Relative Vegetation Cover (%)
Tree	*	
Shrub	+	
Forb	2.14	52
Grass	2.00	48
Vegetation Cover	4.14	
Rock	1.16	
Bareground	52.31	
Litter	42.39	
Total	100.00	100.00

* Not measured in quadrats unless <12 inches tall.

\+ Not measured in quadrats unless <12 inches tall.

9.3 Cont.

Table IX-40. Shrub and tree cover from 50 m line-intercept transects, Sagebrush vegetation type. South Lease, Utah. June 1981.

Species	Common Name	Cover (%)
Shrub		
Artemisia tridentata	Big sagebrush	21.22
Atriplex canescens	Fourwing saltbush	.45
Eurotia lanata	Winterfat	.76
Juniperus communis	Common juniper	.08
Sarcobatus vermiculatus	Greasewood	1.28
Tree		
Juniperus osteosperma	Utah juniper	.06
Pinus edulis	Pinyon pine	.09
Total		23.94

9.3 Cont.

Table IX-41. Vegetation cover by life form from 30 m point-line transects, Sagebrush vegetation type. South Lease, Utah. August 1981.

Life form or feature	Total Cover (%)	Relative Vegetation Cover (%)
Tree	.27	.90
Shrub	24.93	83.10
Forb	1.73	5.77
Grass	3.07	10.23
Vegetation Cover	30.00	
Rock	.93	
Bareground	39.74	
Litter	29.33	
Total	100.00	100.00

9.3 Cont.

Table IX-42. Percent Cover and Constancy by Species for the Sagebrush Vegetation Type. South Lease, Utah. July 1981.

STAND NUMBER	1	2	3	4	5	6	7	8	9
STATE AND COUNTY	UT EMERY	UT EMERY	UT EMERY	UT EMERY	UT EMERY	UT EMERY	UT EMERY	UT EMERY	UT EMERY
GRID NUMBER	12	12	12	12	12	12	12	12	12
ELEVATION IN FEET	6520	6520	6520	6520	6520	6520	6520	6520	6520
ASPECT	E	E	E	E	E	SE	SE	SE	SE
SLOPE IN PERCENT	2	2	5	6	3	3	3	2	2
SOIL MAPPING UNIT	GNA	GNA	GNA	GNA	GNA	GNA	GNA	GNA	GNA
FORBS:									
Aster spp.	•*	•	•	0.20	•	•	•	•	•
Cryptantha spp.	•	•	0.40	•	•	•	0.10	•	•
Euphorbia fendleri	•	•	•	•	•	•	•	•	•
Lappula echinata	•	•	•	•	•	1.10	•	•	•
Lepidium spp.	•	•	•	•	•	0.75	0.02	•	•
Lupinus spp.	•	•	•	•	•	•	•	•	•
Machaeranthera canescens	•	•	•	•	•	•	•	0.40	•
Opuntia spp.	•	•	0.20	•	•	•	•	•	0.40
Plantago patagonica	•	0.01	•	•	•	•	•	•	•
Sphaeralcea parvifolia	1.6	2.71	2.20	0.05	3.65	2.45	1.52	0.55	0.95
Unknown forb	•	•	•	0.01	0.04	•	•	•	•
GRASSES:									
Agropyron smithii	0.02	•	•	0.02	•	0.19	•	•	•
A. spp.	0.05	•	•	•	•	•	•	0.30	•
Bromus tectorum	0.72	0.10	•	•	0.12	0.10	2.25	0.05	0.9
Elymus salina	•	•	•	•	•	•	•	•	0.45
Oryzopsis hymenoides	0.95	0.85	1.91	1.25	•	•	0.75	1.20	•
Sitanion hystrix	0.25	•	•	•	•	•	•	•	•
Sporobolus cryptandrus	0.10	0.10	•	0.15	•	•	•	0.05	•
Stipa comata	1.35	1.70	0.75	0.30	0.35	•	0.45	1.55	0.22
Vulpia octoflora	•	0.35	•	•	•	•	0.20	•	•

•* = Species not present

Table IX-42 Cont.

				SAGEBRUSH	
STAND NUMBER	10	11	12	13	CONSTANCY %
STATE AND COUNTY	UT EMERY	UT EMERY	UT EMERY	UT EMERY	
GRID NUMBER	12	12	12	12	
ELEVATION IN FEET	6520	6520	6520	6520	
ASPECT	SE	SE	SE	SE	
SLOPE IN PERCENT	2	3	3	2	
SOIL MAPPING UNIT	GNA	GNA	GNA	GNA	
FORBS:					
Aster spp.	•*	•	•	•	8
Cryptantha spp.	•	•	0.15	•	23
Euphorbia fendleri	•	•	•	0.25	8
Lappula echinata	0.15	0.95	0.25	•	31
Lepidium spp.	•	•	0.40	•	23
Lupinus spp.	•	•	•	0.50	8
Machaeranthera canescens	•	•	•	•	8
Opuntia spp.	•	0.45	•	•	23
Plantago patagonica	•	•	•	•	8
Sphaeralcea parvifolia	0.15	1.10	3.65	0.45	100
Unknown forb	•	•	•	0.01	23
GRASSES:					
Agropyron smithii	0.25	•	•	•	23
A. spp.	•	•	•	•	15
Bromus tectorum	0.62	0.25	1.92	0.10	69
Elymus salina	•	•	•	•	8
Oryzopsis hymenoides	0.45	0.32	0.80	0.05	77
Sitanion hystrix	0.20	•	•	•	15
Sporobolus cryptandrus	0.08	•	•	•	38
Stipa comata	0.65	0.15	•	•	77
Vulpia octoflora	•	•	0.02	•	23

•* = Species not present

9.3 Cont.

Table IX-43. Shrub stem density by species for the Sagebrush vegetation type. South Lease, Utah. July 1981.

Species	Common Name	Stem Density	
		per acre	per hectare
Artemisia tridentata	Big sagebrush	2183	5391
Atriplex canescens	Fourwing saltbush	33	82
A. confertifolia	Shadscale	67	165
Sarcobatus vermiculatus	Greasewood	467	1152
Total Shrubs		2750	6790

9.3 Cont.

The planned disturbances for this area are a road, the surface facilities near the man shaft, and a temporary coal stockpile. These disturbances will comprise 13.5 acres (5.5 hectares).

9.3 Cont.

Transition

The Transition vegetation type occurs in the ecotonal area between the *Atriplex*-Badland and *Atriplex-Artemisia-Hilaria* vegetation types (Photograph IX-9). The transition between these two types if very gradual and covers a large area. Because of its large size in the lease area, the dominants of the adjoining vegetation types are common in the Transition type.

No intensive sampling was conducted in the Transition type because of its ecotonal nature. The area planned for disturbance comprises 14.2 acres (5.75 ha), in the permit area. For reclamation purposes, the materials and methods planned for the *Atriplex-Artemisia-Hilaria* vegetation type will be appropriate with slight site specific modifications.

9.3 Cont.

Photograph IX-9 Transition Vegetation type.
South Lease, Utah. Sepetmber, 1981.

9.3 Cont.

9.3.2.6 Total Acres in Plan Area

The total Mine Plan Area (MPA) covers 10,372 acres. This includes the approximate 4,000 acres within the Mine Permit Area under consideration for the current permit application, plus 6,411 acres of additional leased land.

9.3.2.7 Total Acres of Vegetation Types to be Disturbed

Vegetation Type	Acreage	Relative % of Permit Area
Atriplex-Artemisia-Hilaria	238.9	6.2
Atriplex-Badland	64.4	1.7
Atriplex-Astragalus	8.6	.2
Artemisia (Sagebrush)	13.5	.3
Juniperus (Savannah)	28.1	.7
Pinus-Juniperus (clifftop)	15.5	.4
Pinus-Juniperus (cliffbottom)	1.2	.03
Transition	14.2	.4
Total Acres to be Disturbed	384.4	9.93

The total acreages to be disturbed during this permit term represent a maximum number. The acreages were planimetered and are accurate to within the ±5% accuracy of the planimeter. The areas to be planimetered were selected based on the following assumptions:

1. The roadway and railroad track include a disturbed area of a 400-foot right-of-way.

9.3 Cont.

2. A 200-foot area was used for the future conveyor belt and proposed water line except where they are included in the road right-of-way.
3. A 200-foot buffer zone was included around a generalized area of the surface facilities below the cliffs (Plate IX-3).
4. A generalized potential area of surface disturbance was planimetered for the surface facilities above the cliffs (Plate IX-2).

As proposed for all mining activities, the extent of all areas planned for surface disturbance will be minimized whenever possible. A special orientation class will be presented to heavy equipment operators on the importance and methods of minimizing surface disturbances.

Also see Sections 9.5 and 9.6 for discussion of the effects of the mining operations on vegetation and mitigation plans.

9.3 Cont.

9.3.2.8 Reference Area Supporting Data

Reference areas will not be used for this mine. It is planned to use baseline data and the condition of the undisturbed vegetation types at the time of bond release for determining revegetation success. As the life of this mine is projected to be 40 years, it is difficult to know precisely what methods will be used for determination of revegetation success, therefore definitive baseline data were obtained during the summer of 1981 (Chapter IX). The baseline data will be used for evaluation of final reclamation success.

9.4 Threatened and Endangered Species

Every vegetation type was searched for rare and endangered plant species during the field mapping and intensive vegetation sampling. No threatened or endangered species (Welsh 1977) have been found to occur on the South Lease Coal Properties or from within the proposed permit area.

The nearest known population of a threatened or endangered species is that of *Hedysarum occidentale canoe* which is found within the Sunnyside, Utah, Mines permit area. However, its habitat does not occur on the South Lease Coal Properties.

9.5 Effects of Mining Operations on Vegetation

The area of surface disturbances will be minimized wherever possible. The potential acreages to be disturbed are given in Section 9.2.2.7. The *Atriplex-Artemisia-Hilaria* and *Atriplex*-Badland are those types which will incur the largest disturbance. Impacts of mining are also discussed in Section 3.4.5.1 and in Chapter X.

Conclusions of research and study instigated as a result of mine development will enhance the status of our knowledge of the affected vegetation types. The development of new seed varieties and resultant experience gained in revegetation can be expected to increase the potential for successful range improvement of similar habitat types.

9.6 Mitigation and Management Plans

Areas adjacent to construction sites which have been disturbed will be seeded for the life of the mine during the first appropriate season. All disturbed areas will be minimized.

If practical, the railroad tracks will not be sprayed annually with herbicides. The vegetation in this zone is sparse and generally will not carry a fire (Daubenmire, 1978), thus the use of herbicides should not be necessary.

If feasible, the *Artemisia* vegetation type will be interseeded with perennial grasses found adjacent to the disturbed area. Use of a specially designed seed mixture (Chapter III) should improve the range condition for wintering deer. *Agropyron smithii* is an excellent spring forage and *Bouteloua gracillis* is a good winter supplement. The livestock allotments should be slightly reduced to adjust for the decrease in available acreage for grazing, however, this is the responsibility of the land management agencies.

Dust control plans (Chapter III) should minimize any effect of increased dust and the potential for a reduction of the photosynthetic processes.

Management of wildlife, grazing and recreation by the appropriate agencies will continue for the life of the mine. Kaiser Steel Corporation will appropriately manage revegetated areas for establishment until bond release. Any necessary management practices, including accepted or experimental techniques, may be used to assure the establishment and development of the revegetated areas. At the time of bond release it will be the responsibility of the land owner or management agency to properly implement the postmine land uses.

9.6 Cont.

Plant species used for revegetation which are adapted to the permit area soils will help mitigate vegetation losses during the period of postmine succession. The use of species important for support of natural wildlife populations (Section 9.7) and others suitable for secondary plant succession will temper habitat losses and enhance the natural successional processes.

9.7 Revegetation Methods and Justifications

Areas disturbed by mining operations will be prepared for final revegetation as they are abandoned. Experience and site specific conditions may occasionally modify these methods.

Methods for revegetation at the South Lease Coal Properties follow established and proven techniques for critical area stabilization (Currier, 1973). The basic considerations are:

- Use adapted species considering the postmine land use
- Reduce plant competition and prepare a good seed bed
- Cover seed at proper depth
- Seed at proper time
- Provide sufficient plant nutrients
- Modify moisture regimen to supply adequate water

Revegetation is also discussed in Section 3.5.

(a) Use of Adapted Species

Plant species to be used were selected based on availability, adaptability to the site and usefulness for support of the mine land uses. Cattle, mule deer, antelope, the whitetailed prairie dog and the associated burrowing owl are the primary species for which forage and habitat requirements were selected. All factors which enhance habitat for the whitetailed prairie dog were assumed to simultaneously be suitable for the burrowing owl (Chapter X). Forage values for most plant species selected for revegetation are presented in Table IX-44.

(b) Seed Bed Preparation

Soil will be seeded while friable (Sections 3.5.4.4 and 8.8).

Table IX - 44 Importance of Revegetated Species as Forage[@]

Trees	Forage Values[#]	Most Important Season of Use
Juniperus communis *J. osteosperma*	many birds +, rock squirrel ++, antelope +++, mule deer +++	Su, F, W[&]
Pinus edulis	upland gamebirds ++, many songbirds +++, black bear ++, porcupine +++, mule deer +++, elk ++, antelope, ground squirrel ++	
Shrubs		
Artemisia nova	generally more palatable than big sage and is used by sheep and big game	
A. spinescens	important in early spring	S
A. tridentata	antelope ++++, mule deer +++, whitetailed prairie dog ++, cattle ++, horses +	Sp, F, W
Atriplex canescens *A. corrugata* *A. cuneata* *A. gardneri*	whitetailed prairie dog ++++, antelope ++, mule deer +, cattle +++, horses +	Sp, Su, F, W
Cercocarpus intricatus *C. montana*	* mule deer +++, antelope +, cattle ++	W, Sp, Su, F
Ephedra spp.	antelope +, cattle ++ (important emergency forage during drought, and poor winter range condition)	F
Eurotia lanata	mule deer ++++, all classes of livestock ++++	Sp, F, W
Opuntia spp.	antelope +++, whitetailed prairie dog +, mule deer +	F, W

Grasses	Forage Values#	Most Important Season of Use
Agropyron smithii	antelope ++, whitetailed prairie dog ++ excellent forage for cattle, sheep, mule deer ++, and elk	Su, F, W
Bouteloua gracilis	antelope +, mule deer +, whitetailed prairie dog	Sp, W
Elymus salina	generally ryes are moderately palatable to livestock	Sp, Su
Hilaria jamesii	whitetailed prairie dog +, cattle - excellent spring/summer forage for all classes of livestock	Sp, Su
Oryzopsis hymenoides	highly palatable to all classes of forage especially on winter range for cattle forage, sheep	F, W
Poa spp.	whitetailed prairie dog +, good spring and summer forage for all classes of livestock, mule deer ++	Sp, Su
Sporobolus cryptandrus	whitetailed prairie dog +, some songbirds (seeds)	F, W
Forbs		
Achillea lanulosa	sheep (flowerheads), fair to good forage for cattle; mule deer eat it sparingly	Su
Astragalus cicer	good forage for all classes of livestock, cattle, deer, and elk	Sp, Su

Table IX - 44 - Continued

Forbs	Forage Values#	Most Important Season of Use
Eriogonum spp.	forage (virtually useless), mule (flowerheads), seeds (many birds, especially sparrows and horned larks	F
Gilia aggregata	used by hummingbirds (Wolfe, personal observation)	Su
Hedysarum boreale	highly nutritional and palatable to wildlife	Sp, Su
Machaeranthera tanacetifolia	*	
Penstemon subglaber	fair to poor forage for cattle, antelope, and elk	Su, F, W
Sphaeralcea coccinea	minimal forage value	
Townsendia incana	*	

* Unknown
\# Key to Forage Values
+ 2-5% of diet
++ 5-10% of diet
+++ 10-25% of diet
++++ 25-50% of diet
+++++ 50% of diet
& Season Abbreviations
Sp Spring
Su Summer
F Fall
W Winter

@ Institute for Land Rehabilitation (1979); Martin, Zim, and Nelson (1951); Thornburg (1981); USDA (1937)

9.7 Cont.

(c) Cover Seed at Proper Depth (Seeding Methods)

Three different planting methods may be used: drilling, broadcasting and transplanting. Even though some consider the results less aesthetic, drilling has a proven higher rate of seeding success in the arid southwest (Valentine, 1977; Merkel and Herbel, 1973). A seed drill constructed for use with native seed will be used. Seed will be drilled to an appropriate depth. *Eurotia lanata*, a special case, will be broadcast on the soil surface.

A hydroseeder will be used on rocky areas or on slopes too small or too steep for a seed drill. Small areas of difficult access may be seeded with a hand broadcaster. Generally, broadcast seed will be covered by a surface manipulation or mulch.

Native trees, which normally take a very long time to grow from seed will be transplanted as seedlings. Transplants may either be containerized species ordered from nurseries or clumps of native materials moved at the site by front-end loader or other means. Transplanting is normally done during the early spring or late fall when trees and shrubs are dormant.

As wildlife habitat is also a land use of this native range, trees will be planted to create a good edge effect; that is, the planting should be made in patterns with irregular boundaries (Thomas et al., 1979). This process of revegetation will also create induced edge effects as described by Thomas et al., (1979).

(d) Time of Seeding

Areas shall be seeded in the season prior to major precipitation (Section

9.7 Cont.

3.5), as recommended by the SCS (Thornburg, 1981).

(e) Plant Nutrients

Phosphorous may be spread and disked into the subsoil prior to seeding. Phosphorous has been thought to be important for germination and establishment. Rates will be those recommended by soil fertility tests.

Nitrogen fertilization, if necessary, will be delayed until spring of the second growing season. This delay will minimize excessive growth of annual weeds. The application of nitrogen will be kept to a minimum whenever possible because it reduces species diversity (Sindelar, 1980).

The necessity of fertilizing for establishment of native species is a moot question at the present time. Few field calibrations and correlations have been computed for native plant varieties (Berg, 1978). Therefore, the practice of fertilizing will be closely monitored according to current scientific literature.

(f) Modify Moisture Regimen to Supply Adequate Water (Mulching Techniques)

All reseeded areas will be mulched to reduce erosion, increase germination, improve ground moisture and reduce soil surface temperatures. The primary method for mulching seeded areas will be an application of native hay, normally applied with a hay blower at the rate of about two tons per acre. The hay will either be crimped or sprayed with an application of wood fiber and Terra Tac II or J-Tac. Terra Tac II is a semi-refined seaweed extract. The rates to be used are those recommended by Terra Tac: a slurry of 2500 gallons of water, three cases of Terra Tac and 450 pounds of wood fiber for three acres. For slopes greater than 3:1, this mixture will be doubled.

9.7 Cont.

This method of mulching has proved successful at the Kaiser Steel Corporation York Canyon Mines, New Mexico, for obtaining germination and establishment without irrigation while preventing any major erosion (Wolfe, 1981). On other areas, Terra Tac II was found to be one of the best tackifiers on straw when compared to all other treatments, and Terra Tac II on straw or hay provided excellent germination (Kay, 1968). Plain wood fiber alone has not been sufficient in arid areas to provide good germination and erosion control. Jute matting or excelsior blankets may be used to treat localized trouble areas where the above method has failed. Testing of other mulch techniques may be done.

Surface manipulation for water harvesting is not planned, because it can be expected to create excessive salt problems in these types of soils (NAS, 1974).

Where rock occurs naturally in the topsoil, it will be retained as much as possible within the limitations of the equipment. The rockier soils will be replaced on slopes and in habitat types similar to their origin when possible. These rocks act as mulch, reducing the effect of wind and water erosion. Larger boulders may also be placed for use as wildlife cover.

9.8 Revegetation Monitoring

Monitoring of all reclaimed areas not planned for future mining disturbances will be instigated during the bonding period on an annual basis or at intervals recommended by DOGM, commencing with the end of the second growing season. Ground cover, i.e., vegetation, litter, rock and bareground, will be estimated. Sampling techniques to be used each year will be consistent and the samples will be statistically adequate. Productivity of the reclaimed sites will be determined during the last two years of the 10-year responsibility period required of areas with less than 26 inches of precipitation (Chapter XI). Other reports will be submitted as required by CFR 211.62. Revegetation monitoring is also discussed in Section 3.4.5.3.

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9.10 Plates

Plate IX-1 General Vegetation Map

Plate IX-2 Vegetation Map: Surface Plant and Facilities Area

Plate IX-3 Vegetation Map: Access/Haul Road and Rail Spur Area

10.8 Appendix

10.8.1 Vertebrate Species List for the South Lease Project Site

	Status	Population Trend
Amphibians		
Family Ambystomatidae		
Tiger Salamander (*Ambystoma tigrinum*)	C/P/H	Unknown
Family Pelobatidae		
Great Basin Spadefoot Toad (*Scaphiopus intermontanus*)	C/P/-[1]	Unknown
Family Bufonidae		
Woodhouse's Toad (*Bufo woodhousei*)	C/P/-	Unknown
Family Hylidae		
Chorus Frog (*Pseudacris triseriata*)	C/P/-	Unknown
Reptiles		
Family Iguanidae		
Collared Lizard (*Crotaphytus collaris*)	C/P/-	Unknown
Leopard Lizard (*Crotaphytus wislizenii*)	C/P/-	Unknown
*[2]Eastern Fence Lizard (*Sceloporus undulatus*)	C/P/-	Unknown
*Sagebrush Lizard (*Sceloporus graciosus*)	C/P/-	Unknown
Tree Lizard (*Urosaurus ornatus*)	C/P/-	Unknown
Side-blotched Lizard (*Uta stansburiana*)	C/P/-	Unknown
*Short-horned Lizard (*Phyrnosoma douglassi*)	C/P/-	Unknown
Family Colubridae		
Striped Whipsnake (*Masticophis taeniatus*)	C/P/-	Unknown
Racer (*Coluber constrictor*)	C/P/-	Unknown
Gopher Snake (*Pituophis melanoleucus*)	C/P/-	Unknown
Milk Snake (*Lampropeltis triangulum*)	L/P/H	Unknown
Western Terrestrial Garter Snake (*Thamnophis elegans*)	C/P/-	Unknown
*Night Snake (*Hypsiglena torquata*)	C/P/-	Unknown
Family Crotalidae		
*Midget Faded Rattlesnake (*Crotalus viridis concolor*)	C/P/-	Unknown

	Status	Population Trend
Birds (Continued)		
Order Galliformes		
Family Tetraonidae		
Blue Grouse (Dendragapus obscurus)	C/P/H,SG resident	Stable
Family Phasianidae		
*Chukar (Alectoris chukar)	C/P/H,SG resident	Stable
Order Charadriiformes		
Family Charadriidae		
Mountain Plover (Charadrius montanus)	R/P/- transient	Stable
*Killdeer (Charadrius vociferus)	C/P/- summer resident & transient	Stable
Family Scolopacidae		
Spotted Sandpiper (Tringa macularia)	C/P/-	Stable
*Solitary Sandpiper (Tringa solitaria)	U/P/- transient	Stable
Order Columbiformes		
Family Columbidae		
Rock Dove (Columba lavia)	C/N/-	Stable
*Mourning Dove (Zenaida macroura)	C/P/H,MG summer resident & transient	Stable
Order Strigiformes		
Family Tytonidae		
Barn Owl (Tyto alba)	K/P/H resident	Unknown
Family Strigidae		
Screech Owl (Otus asio)	U/P/H resident	Unknown
Flammulated Owl (Otus flammeolus)	K/P/H,X summer resident	Unknown
*Great Horned Owl (Bubo virginianus)	C/P/H resident	Stable
Pygmy Owl (Glaucidium gnoma)	K/P/H resident	Unknown
*Burrowing Owl (Speotyto cunicularia)	L/P/H,X resident	Decreasing

	Status	Population Trend
Birds		
Order Anseriformes		
Family Anatidae		
Mallard (Anas platyrhynchos)	C/P/H,MG resident & transient	Stable
Redhead (Aythya americana)	C/P/H,MG resident & transient	Stable
Order Falconiformes		
Family Cathartidae		
Turkey Vulture (Cathartes aura)	C/P/H	Stable
Family Accipitridae		
Goshawk (Accipiter gentilis)	U/P/H	Stable
Sharp-shinned Hawk (Accipiter striatus)	U/P/H resident & transient	Stable
Cooper's Hawk (Accipiter cooperii)	C/P/H,X summer resident & transient R/P/H,X winter resident	Stable
*Red-tailed Hawk (Buteo jamaicensis)	C/P/H resident	Stable
Swainson's Hawk (Buteo swainsoni)	U/P/H summer resident	Stable
Rough-legged Hawk (Buteo lagopus)	C/P/H winter resident	Stable
Ferruginous Hawk (Buteo regalis)	U/P/H,X summer resident R/P/H,X winter resident	Stable
*Golden Eagle (Aquila chrysaetos)	C/P/H,X resident	Stable
Bald Eagle (Haliaeetus leucocephalus)	R/P/H,X,E winter resident	Increasing
*Marsh Hawk (Circus cyaneus)	C/P/H	Stable
Family Falconidae		
Prairie Falcon (Falco mexicanus)	C/P/H,X resident	Stable
Peregrine Falcon (Falco peregrinus)	R/P/H,X,E resident	Unknown
Merlin (Falco columbarius)	K/P/H,X winter resident	Unknown
*American Kestrel (Falco sparverius)	C/P/H summer resident U/P/H winter resident	Stable

	Status	Population Trend
Birds (Continued)		
Family Strigidae (Continued)		
Long-eared Owl (*Asio otus*)	C/P/H resident	Stable
Short-eared Owl (*Asio flammeus*)	C/P/H resident	Stable
Saw-whet Owl (*Aegolius acadicus*)	K/P/H Resident	Stable
Order Caprimulgiformes		
Family Caprimulgidae		
*Common Nighthawk (*Chordeiles minor*)	C/P/- summer resident	Stable
Poor-will (*Phalaenoptilus nuttallii*)	C/P/- summer resident	Stable
Order Apodiformes		
Family Apodidae		
Black Swift (*Cypseloides niger*)	U/P/H,X summer resident	Unknown
White-throated Swift (*Aeronautes saxatalis*)	C/P/- summer resident	Unknown
Family Trochilidae		
Black-chinned Hummingbird (*Archilochus alexandri*)	C/P/- summer resident	Unknown
Broad-tailed Hummingbird (*Selasphorus platycercus*)	C/P/- summer resident	Unknown
Rufous Hummingbird (*Selasphorus rufus*)	C/P/- summer resident & transient	Unknown
Order Piciformes		
Family Picidae		
Common Flicker (*Colaptes auratus*)	C/P/- resident	Stable
Yellow-bellied Sapsucker (*Sphyrapicus varius*)	C/P/- resident	Unknown
Hairy Woodpecker (*Picoides villosus*)	C/P/- resident	Unknown
Downy Woodpecker (*Picoides pubescens*)	C/P/- resident	Unknown
Northern Three-toed Woodpecker (*Picoides tridactylus*)	U/P/- resident	Unknown

	Status	Population Trend
Birds (Continued)		
Order Passeriformes		
Family Tyrannidae		
Cassin's Kingbird (*Tyrannus vociferans*)	U/P/- summer resident	Unknown
Ash-throated Flycatcher (*Myiarchus cinerascens*)	C/P/- summer resident	Stable
*Says Phoebe (*Sayornis saya*)	C/P/- resident	Unknown
Dusky Flycatcher (*Empidonax oberholseri*)	C/P/- summer resident	Unknown
Gray Flycatcher (*Empidonax wrightii*)	K/P/- summer resident	Unknown
Western Wood Pewee (*Contopus sordidulus*)	C/P/- summer resident	Unknown
Olive-sided flycatcher (*Contopus borealis*)	U/P/- summer resident	Unknown
Family Alaudidae		
*Horned Lark (*Eremophila alpestris*)	C/P/- resident	Unknown
Family Hirundinidae		
*Violet-green Swallow (*Tachycineta thalassina*)	C/P/- summer resident	Unknown
*Cliff Swallow (*Petrochelidon pyrrhonota*)	C/P/- summer resident	Unknown
Family Corvidae		
Steller's Jay (*Cyanocitta stelleri*)	C/P/- resident	Unknown
Gray Jay (*Perisorius canadensis*)	R/P/- resident	Unknown
Scrub Jay (*Aphelocoma coerulescens*)	C/P/- resident	Unknown
*Black-billed Magpie (*Pica pica*)	C/P/- resident	Unknown
*Common Raven (*Corvus corax*)	C/P/- resident	Unknown
Common Crow (*Corvus brachyrhynchos*)	R/P/- transient	Unknown
*Pinion Jay (*Gymnorhinus cyanocephalus*)	C/P/- resident	Unknown
Family Paridae		
Mountain Chickadee (*Parus gambeli*)	C/P/- resident	Unknown

Birds (Continued)	Status	Population Trend
Family Paridae (Continued)		
Plain Titmouse (Parus inornatus)	C/P/- resident	Unknown
Bushtit (Psaltriparus minimus)	C/P/- resident	Unknown
Family Sittidae		
White-breasted Nuthatch (Sitta carolinensis)	C/P/- resident	Unknown
Red-breasted Nuthatch (Sitta canadensis)	C/P/- resident	Unknown
Pygmy Nuthatch (Sitta pusilla)	C/P/- resident	Unknown
Family Certidae		
Brown Creeper (Certhia familiaris)	C/P/- resident	Unknown
Family Troglodytidae		
House Wren (Troglodytes aedon)	C/P/- resident	Unknown
*Rock Wren (Salpinctes obsoletus)	C/P/- resident	Unknown
*Canyon Wren (Catherpes mexicanus)	C/P/- resident	Unknown
Bewick's Wren (Thryomanes bewickii)	C/P/- resident	Unknown
Family Mimidae		
Sage Thrasher (Oreoscoptes montanus)	C/P/- resident	Unknown
Family Muscicapidae		
*American Robin (Turdus migratorius)	C/P/- resident	Unknown
Hermit Thrush (Catharus guttatus)	C/P/- summer resident & transient	Unknown
Western Bluebird (Sialia mexicana)	U/P/H,X summer resident	Unknown
*Mountain Bluebird (Sialia currucoides)	K/P/H	Unknown
Townsend's Solitaire (Myadestes townsendi)	C/P/- resident	Unknown

Birds (Continued)	Status	Population Trend
Family Sylviidae		
Blue-gray Gnatcatcher (*Polioptila caerulea*)	C/P/- summer resident	Unknown
Golden-crowned Kinglet (*Regulus satrapa*)	U/P/- resident	Unknown
Ruby-crowned Kinglet (*Regulus calendula*)	C/P/- resident	Unknown
Family Bombycillidae		
Boehemian Waxwing (*Bombycilla garrulus*)	U/P/- winter resident	Unknown
Family Laniidae		
Northern Shrike (*Lanius excubitor*)	U/P/- winter resident	Unknown
*Loggerhead Shrike (*Lanius ludovicianus*)	C/P/- resident	Unknown
Family Vireonidae		
Solitary Vireo (*Vireo solitarius*)	U/P/- summer resident	Unknown
Family Parulidae		
Orange-crowned Warbler (*Vermivora celata*)	C/P/- summer resident & transient	Unknown
Nashville Warbler (*Vermivora ruficapilla*)	U/P/- transient	Unknown
Virginia's Warbler (*Vermivora virginiae*)	C/P/- summer resident	Unknown
Magnolia Warbler (*Dendroica magnolia*)	U/P/- transient	Unknown
Yellow-rumped Warbler (*Dendroica coronata*)	C/P/- summer resident	Unknown
Black-throated Gray Warbler (*Dendroica nigrescens*)	C/P/- summer resident	Unknown
Townsend's Warbler (*Dendroica townsendi*)	U/P/- transient	Unknown
Family Icteridae		
*Western Meadowlark (*Sturnella neglecta*)	C/P/- resident	Unknown
*Red-winged Blackbird (*Agelaius phoeniceus*)	C/P/- resident	Unknown

Birds (Continued)	Status	Population Trend
Family Thraupidae		
Western Tanager (*Piranga ludoviciana*)	C/P/- summer resident	Unknown
Family Embarizidae		
Black-headed Grosbeak (*Pheucticus melanocephalus*)	C/P/- summer resident	Unknown
Blue Grosbeak (*Guiraca caerulea*)	C/P/- summer resident	Unknown
Lapland Longspur (*Calcarius lapponicus*)	R/P/- winter resident	Unknown
Green-tailed Towhee (*Chlorura chlorura*)	C/P/- summer resident	Unknown
*Rufous-sided Towhee (*Pipilo erythrophthalmus*)	C/P/- resident	Unknown
Lark Bunting (*Calamospiza melanocorys*)	O/P/- transient	Unknown
*Savannah Sparrow (*Passercules sandwichensis*)	C/P/- summer resident	Unknown
Grasshopper Sparrow (*Ammodramus savannarum*)	K/P/H transient	Unknown
Vesper Sparrow (*Pooecetes gramineus*)	C/P/- summer resident	Unknown
*Lark Sparrow (*Chondestes grammacus*)	C/P/- summer resident	Unknown
Sage Sparrow (*Amphispiza belli*)	U/P/- summer resident	Unknown
Dark-eyed Junco (*Junco hyemalis*)	C/P/- resident	Unknown
Gray-headed Junco (*Junco caniceps*)	C/P/- summer resident	Unknown
Chipping Sparrow (*Spizella passerina*)	C/P/- summer resident	Unknown
Brewer's Sparrow (*Spizella breweri*)	C/P/- summer resident	Unknown
Harris Sparrow (*Zonotrichia querula*)	U/P/- winter resident	Unknown
*White-crowned Sparrow (*Zonotrichia leucophrys*)	C/P/- resident	Unknown
*Black-throated Sparrow (*Amphispiza bilineata*)	U/P/- summer resident	Unknown
Family Fringillidae		
Cassin's Finch (*Carpodacus cassinii*)	C/P/- summer resident U/P/- winter resident	Unknown

	Status	Population Trend
Birds (Continued)		
Family Fringillidae (Continued)		
House Finch (*Carpodacus mexicanus*)	C/P/- resident	Unknown
Pine Grosbeak (*Pinicola enucleator*)	U/P/- resident	Unknown
Rosy Finch (*Leucosticte arctoa*)	C/P/- resident	Unknown
Pine Siskin (*Carduelis pinus*)	C/P/- resident	Unknown
Lesser Goldfinch (*Carduelis psaltria*)	C/P/- resident	Unknown
Mammals		
Order Insectivora		
Family Soricidae		
Dwarf Shrew (*Sorex nanus*)	L/N/H	Unknown
Merriam Shrew (*Sorex merriami*)	U/N/-	Unknown
Dusky Shrew (*Sorex obscurus*)	C/N/-	Unknown
Order Chiroptera		
Family Vespertilionidae		
Little Brown Myotis (*Myotis lucifugus*)	C/N/-	Unknown
Fringed Myotis (*Myotis thysanodes*)	U/N/-	Unknown
Long-eared Myotis (*Myotis evotis*)	C/N/-	Unknown
Long-legged Myotis (*Myotis volans*)	C/N/-	Unknown
Yuma Myotis (*Myotis yumanensis*)	U/N/-	Unknown
California Myotis (*Myotis californicus*)	C/N/-	Unknown
Small-footed Myotis (*Myotis leibii*)	U/N/-	Unknown
Silver-haired Bat (*Lasionycteris noctivagans*)	C/N/-	
Western Pipistrelle (*Pipistrellus hesperus*)	C/N/-	Unknown
Big Brown Bat (*Eptesicus fuscus*)	C/N/-	Unknown
Red Bat (*Lasiurus borealis*)	L/N/H	Unknown
Hoary Bat (*Lasiurus cinereus*)	U/N/-	Unknown
Western Big-eared Bat (*Plecotus townsendii*)	C/N/H	Unknown
Spotted Bat (*Euderma maculata*)	L/N/H	Unknown
Pallid Bat (*Antrozous pallidus*)	C/N/-	Unknown

	Status	Population Trend
Mammals (Continued)		
Family Molossidae		
Mexican Free-tailed Bat (*Tadarida brasiliensis*)	C/N/-	Unknown
Order Lagomorpha		
Family Leporidae		
White-tailed Jackrabbit (*Lepus townsendii*)	C/N/-	Stable
Snowshoe Hare (*Lepus americanus*)	C/P/H,SG	Cyclic
*Black-tailed Jackrabbit (*Lepus californicus*)	C/N/-	Stable
Mountain Cottontail (*Sylvilagus nuttallii*)	C/P/H,SG	Stable
*Desert Cottontail (*Sylvilagus audubonii*)	C/P/H,SG	Stable
Order Rodentia		
Family Sciuridae		
*White-tailed Prairie Dog (*Cynomys leucurus*)	C/N/-	Stable
Red Squirrel (*Tamiasciurus hudsonicus*)	C/N/-	Stable
Rock Squirrel (*Spermophilus variegatus*)	C/N/-	Stable
Uintah Ground Squirrel (*Spermophilus armatus*)	C/N/-	Stable
Golden-mantled Ground Squirrel (*Spermophilus lateralis*)	C/N/-	Stable
Whitetail Antelope Squirrel (*Ammospermophilus leucurus*)	C/N/-	Stable
Yellow-bellied Marmot (*Marmota flaviventris*)	C/N/-	Stable
Northern Flying Squirrel (*Glaucomys sabrinus*)	C/N/H	Unknown
Least Chipmunk (*Eutamius minimus*)	C/N/-	Stable
Uintah Chipmunk (*Eutamius umbrinus*)	C/N/-	Stable
Cliff Chipmunk (*Eutamius dorsalis*)	U/N/-	Stable
Family Geomyidae		
Northern Pocket Gopher (*Thomomys talpoides*)	C/N/-	Unknown
Valley or Botta Pocket Gopher (*Thomomys bottae*)	C/N/-	Unknown
Family Heteromyidae		
Ord Kangaroo Rat (*Dipodomys ordii*)	C/N/-	Unknown

	Status	Population Trend
Mammals (Continued)		
Family Cricetidae		
Western Harvest Mouse (*Reithrodontomys megalotis*)	C/N/-	Unknown
Canyon Mouse (*Peromyscus crinitus*)	C/N/-	Unknown
Deer Mouse (*Peromyscus maniculatus*)	C/N/-	Unknown
Brush Mouse (*Peromyscus boylei*)	C/N/-	
Pinon Mouse (*Peromyscus truei*)	C/N/-	
Desert Wood Rat (*Neotoma lepida*)	C/N/-	Unknown
Bushy-tailed Wood Rat (*Neotoma cinerea*)	C/N/-	Unknown
Mountain Vole (*Microtus montanus*)	C/N/-	Unknown
Family Erethizontidae		
Porcupine (*Erethizon dorsatum*)	C/N/-	Stable
Order Carnivora		
Family Canidae		
*Coyote (*Canis latrans*)	C/N/-	Stable
Red Fox (*Vulpes fulva*)	C/N/H	Stable
Kit Fox (*Vulpes macrotis*)	U/N/H	Stable
Gray Fox (*Urocyan cinereoargenteus*)	C/N/-	Stable
Gray Wolf (*Canis lupus*)	R/P/H,E	Decreasing
Family Ursidae		
Black Bear (*Ursus americanus*)	C/P/H,BG	Increasing
Family Mustelidae		
Wolverine (*Gulo luscus*)	L/P/H	Unknown
Black-footed Ferret (*Mustela nigripes*)	R/P/H,E	Unknown
Badger (*Taxidea taxus*)	C/P/H,F	Stable
Family Felidae		
Bobcat (*Lynx rufus*)	C/P/H	Decreasing
Canada Lynx (*Lynx canadensis*)	L/P/H	Unknown
Cougar (*Felis concolor*)	C/P/H,BG	Stable
Order Artiodactyla		
Family Cervidae		
*Mule Deer (*Odocoileus hemionus*)	C/P/H,BG	Increasing
Rocky Mountain Elk (*Cervus canadensis*)	C/P/H,BG	Increasing

Mammals (Continued)	Status	Population Trend
Family Antilocapridae		
*Pronghorn Antelope (*Antilocapra americana*)	L/P/H,BG	Stable
Family Bovidae		
Desert Bighorn Sheep (*Ovis canadensis nelsoni*)	L/P/H,BG	Increasing
Rocky Mountain Bighorn Sheep (*Ovis canadensis canadensis*)	L/P/H,BG	Increasing

STATUS KEY:

The first block refers to abundance, the second to protection and the third to classification: abundance/protection/classification.

Abundance:

- K Unknown - It is believed that these species are present, but little is known of their population dynamics.
- C Common - These species are widespread and abundant.
- U Uncommon - These species are widespread, but not abundant.
- R Rare - These species are seldom identified during any one year.
- O Occasional - These species are periodically identified during a long term period - 10-50 years.
- L Limited - These species are common, but restricted to a particular use area or habitat type in Utah.

Protection:

- P Protected - These species are protected by state or federal law in Utah.
- N Nonprotected - These species are not protected by any laws in Utah.

Classification:

- E Endangered - These species are endangered with extinction or exterpation from wildlands in Utah.
- T Threatened - These species are threatened with becoming endangered in Utah.
- F Furbearers - These species are classified as furbearers by Utah.
- X High interest species - A migratory bird of high federal interest.
- H High interest species - A high interest species to the state.
- SG Small game - These species are classified as small game by Utah.
- BG Big game - These species are classified as big game by Utah.
- MG Migratory game birds - These species are classified as migratory game birds by Utah.

The following terminology is used to describe the seasonal status for avian species.

Transient - These species pass through southeastern Utah twice a year during their migratory travels.

Resident - These species occur yearlong in southeastern Utah.

Summer Resident - These species breed in southeastern Utah and migrate elsewhere for the winter.

Winter Resident - These species breed elsewhere but winter in southeastern Utah.

[1]A hyphen means no designation

[2]An asterisk means that the species has been observed on the project site.

Reference: Utah Division of Wildlife Resources (1978)

10.8.2 Agency Letters Regarding Site Specific Recommendations

(a) From William C. White, Acting Area Manager,
Fish and Wildlife Service, Colorado-Utah,
U. S. Department of the Interior,
dated February 25, 1981.

(b) From Area Manager,
Bureau of Land Management, Moab District,
U. S. Department of the Interior,
dated February 23, 1981.

(c) From John Livesay, Supervisor, Southeastern Region,
Division of Wildlife Resources, State of Utah,
dated February 23, 1981.

10.8 Cont
(a)

United States Department of the Interior
FISH AND WILDLIFE SERVICE
AREA OFFICE COLORADO—UTAH
1311 FEDERAL BUILDING
125 SOUTH STATE STREET
SALT LAKE CITY, UTAH 84138

IN REPLY REFER TO:

February 25, 1981

Cleon B. Feight, Director
Division of Oil, Gas and Mining
1588 West North Temple
Salt Lake City, Utah 84116

Attention: Mary Ann Wright

RE: Predesign Wildlife Consultation
Kaiser South Lease
PRO/015/008

Dear Mr. Feight:

We wish to express our appreciation in being invited to continue with the predesign wildlife consultation concept initiated by your Division. Your willingness to proceed with this open-mined approach will, in our opinion, certainly be a benefit to industry and you should be commended for this progressive attitude.

The following comments will be our response to the predesign consultation effort for the proposed mine plan for the Kaiser South Lease. Since this would be a new mining operation, all of the area that would be disturbed by mine development activities should have wildlife surveys conducted to identify those wildlife resources that may be impacted by the planned development activities. It would be our suggestion, that eagle and other raptor type survey's be conducted on the cliff front area within three-quarters of a mile of the planned disturbance. Also, that these types of surveys be conducted around the 40 acre area of disturbance planned for the Lilly Park Wash area. This later development area should also be examined for the presence of any migratory bird species of high federal interest.

A large part of the planned disturbance will occur at the base of the Book Cliffs. These are the areas in which the processing and transportation facilities would be located. Those areas considered for facility location and for rights-of-way for transportation facilities should be examined for the presence of prairie dog towns. Since this entire area is located in a zone in which black-footed ferret might occur, the absence of prairie dog towns would preclude the need for additional survey work.

These areas should also be examined for the presence of any migratory bird species of high federal interest. Should a positive determination be made, the Service would evaluate this occurrence to determine if these areas provide substantial value to the continued well-being of these species.

10.8 Cont.

The best available information that we currently have indicates that there are no threatened or endangered plant species occurring in the areas of the planned disturbance.

We will be more than happy to continue this consultation with you for this planned development. Again we thank you for the opportunity to provide these comments to you.

Sincerely yours,

William C. White
Acting Area Manager

cc: OSM, Shirley Lindsay
DWR, John Livesay

10.8 Cont.
(b)

IN REPLY REFER TO

3400
(U-601)

United States Department of the Interior

BUREAU OF LAND MANAGEMENT
Moab District
Price River Resource Area
P. O. Drawer AB
Price, Utah 84501

February 23, 1981

Mr. Cleon B. Feight, Director
Division of Oil, Gas and Mining
1988 West North Temple
Salt Lake City, Utah 84116

Attention: Mary Ann Wright

Dear Mr. Feight:

The Price office of the Bureau of Land Management is sending the enclosed recommendations in response to your request for consultation concerning the level of fish and wildlife information required for the proposed mine facility on Kaiser Steel's South Lease.

Thank you for the opportunity to provide input in this area of concern. We will be looking forward to working with you in the future.

Sincerely yours,

Area Manager

Enclosure:
Recommendations (3 pages)

CONSERVE AMERICA'S ENERGY

Save Energy and You Serve America!

GENERAL RECOMMENDATIONS

Habitat Mapping

Mapping of vegetative communities, seasonal use distributions for classified and high interest wildlife species and special habitat features is recommended on the South Lease Project Area. All mapping should be accomplished on a base map--overlay system on 1:24,000 scale topographic maps or (if available) same scale, orthophoto quads. The maps should be accompanied by descriptive narration describing the various mapping delineations involved in each series of overlays.

1. Vegetative Mapping

   All present vegetative types occurring on the mine plan area should be delineated on overlays. Included in narration or tabular form should be the following:

   A. Total acreage of each community
   B. Percent plant composition by dry weight for each community
   C. Canopy cover by species for each community
   D. Condition, successional stage and trend of all vegetative communities
   E. Present class, season, and amount of use of livestock

2. Wildlife Species Seasonal Use Distributions

   Classified and high interest wildlife species seasonal and or special use areas should be delineated on overlays. Included in narration or tabular form should be the following:

   A. List of all aquatic and terrestrial wildlife species occurring on the mine area.
   B. Status of all high interest or classified wildlife species which occur on the mine area should be provided.
   C. List acreage for each of the high interest and classified wildlife species.

3. Special Habitat Features

   All special habitat features (features which may significantly influence habitat for wildlife) should be identified and mapped. Below is a list covering the more common natural and man-made special habitat features.

Natural Special Features

- -Avalanche-Slide Area
- -Cave
- -Cliff
- -Overhang
- -Salting Area
- -Seep
- -Cold Springs
- -Sink Hole
- -Snag or Group of Snags
- -Talus, Slope
- -Talus, Field
- -Island (too small for habitat type)
- -Temporary Pond
- -Small Natural Ponds

Man-Made Special Features

- -Fence
- -Salting Area
- -Small Seedings
- -Buffer Strip
- -Building
- -Bird Ramp
- -Dredged Area
- -Exclosure, Study Area
- -Mining Activity
- -Poles (Electrical and Telephone)
- -Perches
- -Road
- -Trail
- -Stream Improvement Structure
- -Stream Crossing
- -Fire Break
- -Seismographic Trail
- -Oil Sump Pit
- -Irrigation Diversion and Ditch
- -Stock Water Tanks and Ponds
- -Artificial Wildlife Waters

Significance of special habitat features vary from one area to another. Professional judgment should be used to map special habitat features which indeed do influence wildlife habitat and its use.

Special emphasis should be placed in mapping all seeps, springs, wells, perennial, intermittent and ephemeral streams, lakes, reservoirs and ponds. Narration of special habitat features should include the following:

A. Significant influence the special habitat feature provides.
B. Total surface acres of all lakes, reservoirs, and ponds as well as miles of stream.
C. Stream velocity, gradient, width, depth, pool-riffle ratio and substrata type.
D. Seasonal water availability for intermittent ponds and stream flows.

SITE-SPECIFIC RECOMMENDATIONS

Fish and Wildlife Inventory Needs

1. Aquatic Wildlife

   No aquatic habitat is present on the South Lease, therefore, no studies are recommended.

2. Terrestrial Wildlife

A. Amphibians and Reptiles

Provide a review of amphibians and reptiles potentially occurring on the coal lease tract.

B. Birds

Provide a review of avian species potentially occurring on the coal lease tract.

Conduct breeding raptor inventories on the coal lease tract and delineate ½ mile radius buffer zones for all active nest sites for raptors of high federal interest (listed below).

Golden eagle	Spotted owl
Peregrine falcon	Burrowing owl
Prairie falcon	Flammulated owl
Ferruginous hawk	
Merlin	
Cooper's hawk	

Determine and delineate habitat use areas for upland game birds on the lease tract.

C. Mammals

Provide a review of mammal species potentially occurring on the coal lease tract.

Inventory the tract to determine the presence of prairie dog towns. If present, inventory towns for black-footed ferrets.

Identify special use areas for deer and elk within the coal lease tract. Examples include fawning and calving areas, watering areas and migration routes. All impacts to these identified areas should be completely mitigated.

10.8 Cont.
(c)

state of utah

DIVISION OF WILDLIFE RESOURCES
EQUAL OPPORTUNITY EMPLOYER
DOUGLAS F. DAY
Director
1596 West North Temple/Salt Lake City, Utah 84116/801-533-9333

February 23, 1981

Reply To SOUTHEASTERN REGIONAL OFFICE
455 West Railroad Avenue, Box 840, Price, Utah 84501
(801) 637-3310

Mr. Cleon B. Feight, Director
Division of Oil, Gas and Mining
1588 West North Temple
Salt Lake City, Utah 84116

Attention: Mary Ann Wright

Dear Mr. Feight:

In response to the request for consultation concerning the nature and level of detail for fish and wildlife resource information to be provided for the South Lease Project by Kaiser Steel Corporation, the following recommendations are offered. These recommendations parallel the "Guidelines for Fish and Wildlife Resource Information Required in Utah on Coal Mine Lands" suggested by our Division and provided earlier to Mary Ann Wright.

Mapping and Associated Narrative

1. The applicant should provide detailed topographic maps or aerial photographs of the mine plan and designated adjacent areas that display wildlife habitats or land cover. Unique habitats such as wetlands, bogs, seeps and riparian zones; flood plains; and cliffs with their associated tallus are of special importance to wildlife; they should be displayed on maps. The maps should be accompanied by sufficient descriptive narration describing the various wildlife habitats or land cover as follows:

    a. Total acreage for each habitat type.
    b. Floral composition of each wildlife habitat.
    c. Condition, successional stage and trend of all habitats.
    d. Present use by livestock.

It is probable that this information would have to be secured through a land management agency or a qualified, private consultant.

2. The applicant should provide detailed topographic maps of the mine plan and designated adjacent areas that display distributions and use areas for high interest species of terrestrial and aquatic vertebrate wildlife. The map display should also show the relationship of the project area to regional wildlife distributions. The mine plan area maps should be accompanied by sufficient descriptive narration describing the high interest Aquatic, Amphi-

bian, Reptilian, Avian and Mammalian forms of wildlife and the quality (ranking) and quantity (extent or acreage) of their use areas.

This information can be assimilated from a map overlay-display system available from Utah's Division of Wildlife Resources Southeastern Regional Office in Price, Utah.

3. The applicant should provide detailed topographic maps of the mine plan and designated adjacent areas that display locations of all seeps, springs, wells, perennial, intermittent and ephemeral streams, lakes, reservoirs and ponds. Such maps should be accompanied by sufficient descriptive narration and tabular data concerning quantity and quality of the various surface waters (e.g., miles of stream as classified by the state water plan to include stream velocity, gradient - width, depth, pool-riffle ratio, substrata type, acres of flat water and surface water information required for SMC, Part 779.16). Water sources and unique habitats are critical to the survival of many forms of wildlife.

It is probable that this information would have to be secured through a land management agency, State Department of Health (Bureau of Water Quality) or a qualified, private consultant.

Fish or Wildlife Studies

A. Aquatic Wildlife

1. Macrophytes - studies are not recommended.

2. Macroinvertebrates - studies are not recommended.

3. Fish - studies are not recommended.

B. Terrestrial Wildlife

1. Wildlife habitat types - within Southeastern Utah there are twelve basic wildlife habitat types (riparian and wetland, desert scrub, pasture and fields, urban or parks, cliffs and tallus, sagebrush, aspen forest, ponderosa forest, parkland and spruce-fir forest). These wildlife habitats are appropriately located within the cold desert (upper Sonoran life zone), submontane (Transition life zone) and montane (Canadian, Hudsonian and Alpine life zones) ecological associations. The applicant should identify these environs as they relate to the mine plan and adjacent areas.

Wetland and riparian habitats which are normally associated with drainage bottoms (ephemeral or intermittent), or perennial streams (SMC 700.5 and UMC 700.5), seeps and springs within the upper Sonoran, Transition and Canadian life zones are ranked as being of critical value to all wildlife. Cliffs and their associated tallus areas that lie within the upper Sonoran and Transition life zones are ranked as being of high-priority value to all wildlife. When compared to all other wildlife habitats the aforementioned situations are considered to represent unique habitat associations.

Riparian and wetland areas are highly productive in terms of herbage produced and use by wildlife as compared to surrounding areas. Experience has shown that as much as 70 percent of a local wildlife population are dependent upon riparian zones. Cliffs and tallus are of special importance to many high interest wildlife. These unique habitat types must be identified in the permit application and protected due to their high value for all wildlife.

Quantitative (acreage) and qualitative (condition, successional stage and trend) data concerning the wildlife habitats in each ecological association should be included as part of the mine permit application.

2. Amphibians - all amphibians in the state of Utah are protected; therefore, data from low levels of study for amphibians inhabiting the mine plan and adjacent areas are recommended to be included with the application for this mine project. Currently, no species of amphibian are recognized as being of high interest to the state of Utah and inhabiting the project area. Thus, high level studies of amphibians need not be considered.

3. Reptiles - all reptiles in the state of Utah are protected; therefore, data from low levels of study for reptiles inhabiting the mine plan and adjacent areas are recommended to be included with the application for this mine project. Currently, the Utah milk snake is the only species of reptile recognized as being of high interest to the state of Utah that inhabits the project area. It is not believed that the project will significantly impact this specie or its high value habitat use areas, thus, high level studies need not be considered.

   Low level studies should identify potential occurrence, relative abundance, status, population trend and preferred habitat use areas for all amphibians and reptiles inhabiting the mine plan and designated adjacent areas. Such studies concerning amphibians and reptiles have already been completed and are available from Utah's Division of Wildlife Resources Southeastern Regional Office in Price, Utah.

4. Birds - all birds in the state of Utah are protected; therefore, data from the low levels of study for avifauna inhabiting the mine plan and adjacent areas are recommended to be included with the application for this mine project. Low level studies should identify potential occurrence, season of use, relative abundance, status population trend and preferred habitat use areas for all birds inhabiting the mine plan and designated adjacent areas. These studies have already been completed and are available from Utah's Division of Wildlife Resources Southeastern Regional Office in Price, Utah.

An intensive survey to be provided by the applicant for breeding eagles, cliff nesting falcons, ferruginous hawks and "high priority" habitats--43 CFR 3461.1 (n-1)--for other birds that have high federal interest is recommended. The aforementioned raptors are extremely sensitive to man's disturbances. There exists a lack of significant site specific knowledge of aeries and other "high priority" habitats for avifauna on the mine project area. Such a survey would represent a high level of study and only needs to be conducted within a one kilometer radius of planned surface developments and activity centers. The results of such study should be included with the application for a mining permit.

If such surveys have already been completed, the Division requests an opportunity to review this work in order to make a determination of its adequacy.

High level studies relative to use of habitats on the mine plan and designated adjacent areas by migratory and upland game birds, federally listed endangered species of avifauna and potential use by migratory birds having high federal interest in the Uintah-Southwestern Utah coal leasing region should be included with the application for a mining permit. Such studies are ongoing or have been completed and are available from Utah's Division of Wildlife Resources Southeastern Regional Office in Price, Utah.

No other high level studies are recommended for avifauna.

5. Mammals - it is recommended that data from low levels of study for mammals inhabiting the mine plan and adjacent areas be included with the application for this mine project. Low level studies should identify potential habitat use areas for all mammals inhabiting the mine plan and designated adjacent areas. These studies have already been completed and are available from Utah's Division of Wildlife Resources Southeastern Regional Office in Price, Utah.

Additionally, high level studies relative to use of habitats on the mine plan and designated adjacent areas by protected species and federally listed endangered species of mammals should be included with the application for a mining permit. Such studies are ongoing or have been completed and are available from Utah's Division of Wildlife Resources Regional Office in Price, Utah.

No other high level studies are recommended for mammals since high interest species of limited distribution will not be severely impacted by the mining project.

6. Consultation Required for the Presence of Threatened or Endangered Species- it is recommended that the applicant and the Division of Oil, Gas and Mining contact the U.S. Fish and Wildlife Service for consultation required to determine the presence or non-presence of threatened or endangered biotic species on the project.

Thank you for an opportunity to provide input into this area of concern.

Sincerely,

John Livesay

John Livesay, Supervisor
Southeastern Region

JL:LBD:gp

cc: Darrell Nish
Clark Johnson
Leon Berggren

10.9 Plates

Plate X-1 Wildlife Map