VIA ELECTRONIC MAIL –

April 22, 2022

Jake Janicek
EH&S Specialist
Caerus Oil and Gas LLC
143 Diamond Avenue
Parachute, Colorado 81635

Subject: **Condition of Approval Response**
Dumpline Release
H7
Mamm Creek Field
Garfield County, Colorado

Dear Mr. Janicek:

WSP USA Inc. (WSP), on behalf of Caerus Oil and Gas LLC (Caerus), is planning to complete excavation oversight and soil land treatment activities to remediate previously delineated hydrocarbon and inorganic impacts to soils associated with production well KRK 7-7A dumpline release at the KRK-67S92W7SENE (H7) (Facility ID: 334864) pad location (Site). This document was prepared in response to the Colorado Oil and Gas Conservation Commission (COGCC) (Director) condition of approvals (COAs) (one and three) issued in COGCC Site Investigation and Remediation Workplan (Supplemental Form) Form 27 Document Number (DN) 402955802. The Site is in the Caerus Mamm Creek area of operation in Garfield County, Colorado (Figure 1).

CONDITION OF APPROVAL RESPONSES – H7 DUMPINE RELEASE

The Director's first COA in DN 402955802 directs the Operator (Caerus) "*to collect and analyze a minimum of one, 5-point composite sample per 100 cubic yards of excavated material to characterize impacts prior to land treatment. A sampling frequency of one sample per 100 cubic yards is also required for final demonstration of compliance of treated material with Table 915-1, unless a different sampling frequency is requested and approved in advance on a Form 27*."

Response to first COA (DN 402955802): The previous report of work completed (ROWC) submitted as DN 402986986 as an attachment to DN 402955802 proposed the sample collection of one, 5-point sample per every 1,000 cubic yards (yd^3) of land treated soil. Based on the estimated volume of soil to be land treated (1,500 yd^3), WSP recommends that Caerus request upon approval of the Director that all samples collected to characterize the land treated soils throughout the proposed remediation process be collected at a frequency of one, 5-point composite sample per 500 yd^3. Under this proposed sampling frequency, three, 5-point composite samples per sampling event would be collected. Based on this methodology, each "aliquot" of the 5-point sample will represent approximately 100 yd^3 of material. This requested sample volume will accurately demonstrate compliance of the land treated soil. All samples will continue to be submitted under the previously approved reduced suite (DN 402898845). This approved sampling suite will address previous identified contaminants of concern specific to the Site including both organic and inorganic contaminants.

The Director's third COA in DN 402955802, states: *Per Rule 913.b.(5).A, Remediation will be performed in a manner that reduces or removes contamination that exceedances the cleanup concentrations in Table 915-1. In addition to "excavation of hydrocarbon impacted soil" described in the attached report, doc #402986986, the Operator shall demonstrate remediation of documented Table 915-1 exceedances for SAR and pH.*

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820 MEGAN AVENUE, UNIT B
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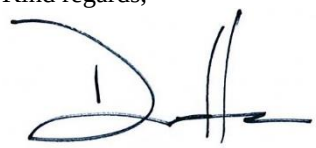
Response to third COA (DN 402955802): Based on the analytical data provided from the investigative assessment soil sampling completed at the Site, there are remaining COGCC Table 915-1 exceedances of sodium adsorption ratio (SAR) and pH in the soil. However, the exceedances of SAR and pH are documented within the delineated release extent are within background concentrations documented in background soil samples located at the nearby pad, D32NE (COGCC Facility ID: 335400). The geographic proximity of the two locations is depicted on the attached Figure 2 along with the associated background sample locations. A geographic proximity analytical map is depicted on Figure 3. The analytical data for the samples are summarized in the enclosed Table 1, and the analytical reports are included in Enclosure A.

Although the soil samples were collected from a geographical distance of 1.68 miles north of the Site, the soils at the D32NE are representative of the same soil complex (Potts) [Site (Potts Loam) and D32NE location (Potts-Ildefonso Complex)]. Based on the *COGCC GISOnline Soil Survey (NRCS)* website map layer these two soils are within the same soil complex but different classifications due to the difference of slope angles and aspects which subsequently categorizes them into different zones or "mapped areas". Per the *Soil Survey of Rifle Area, Colorado Parts of Garfield and Mesa Counties* publication included in Enclosure B, the Potts series is consistent of a deep, well drained soils, moderately sloping soils on mesas, benches, and sides of valleys. These soils formed in alluvium derived from sandstone, shale, and basalt.

Based on the information provided above WSP recommends that Caerus request the Director to allow for the reuse of all excavated and land treated material to be used to backfill the open excavation as these inorganic concentrations should be considered naturally occurring (not approved per Director Comment in DN 402955802). We also recommend that Caerus request to continue with the planned remediation as outlined in DN 402986986.

Please contact us at (970) 618-4514 or (970) 658-7025 if you have any questions regarding this report or require additional information.

Kind regards,





Dustin Held
Sr. Consultant, Environmental Geologist

Parker Coit, P.G.
Sr. Consultant, Geologist

Encl.

FIGURES

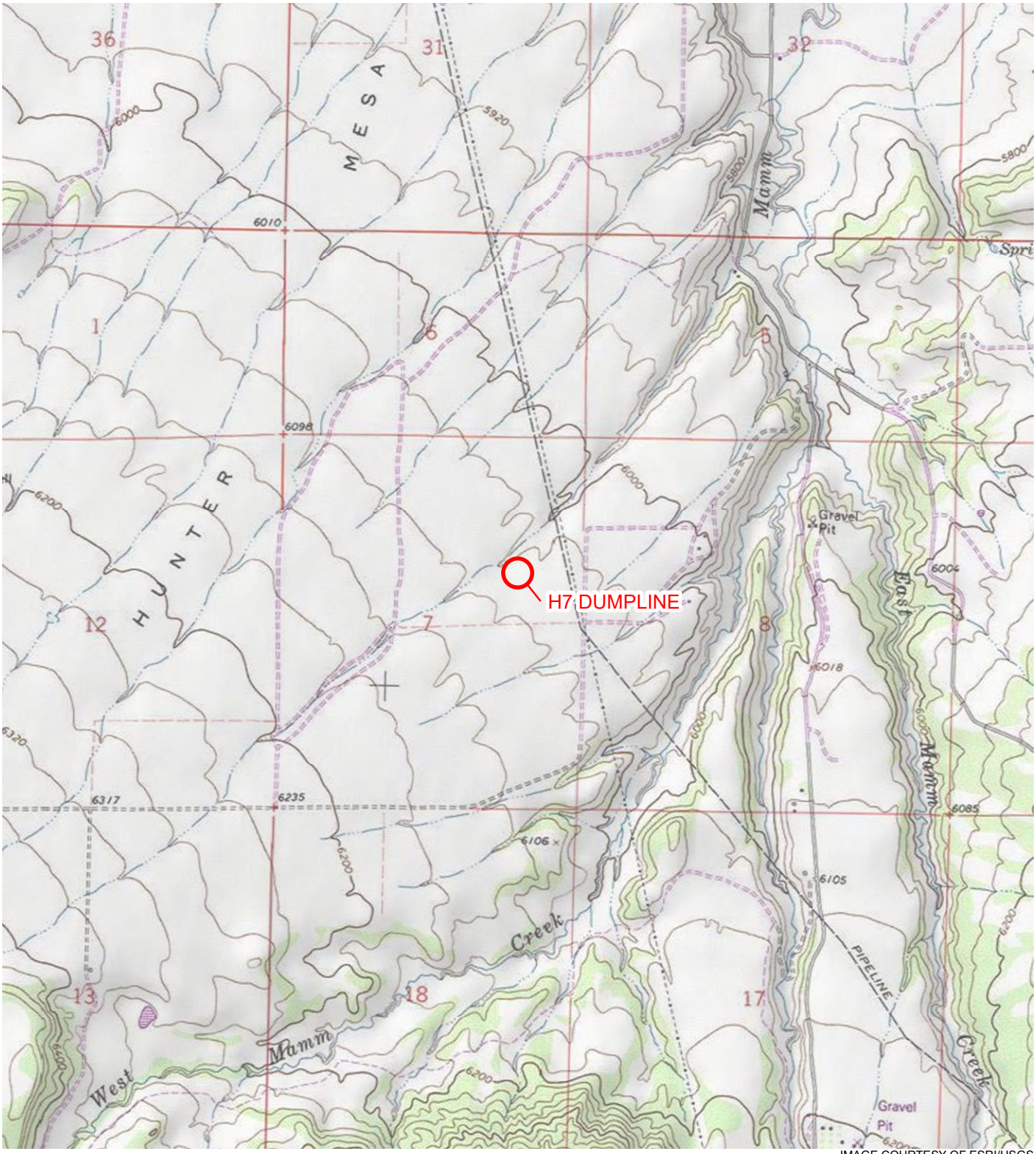


IMAGE COURTESY OF ESRI/USGS

LEGEND

SITE LOCATION

0 2,000 4,000

Feet

N

COLORADO

FIGURE 1
SITE LOCATION MAP
H7 DUMPLINE
SENE SEC 7-T7S-R92W
GARFIELD COUNTY, COLORADO
CAERUS OIL AND GAS LLC

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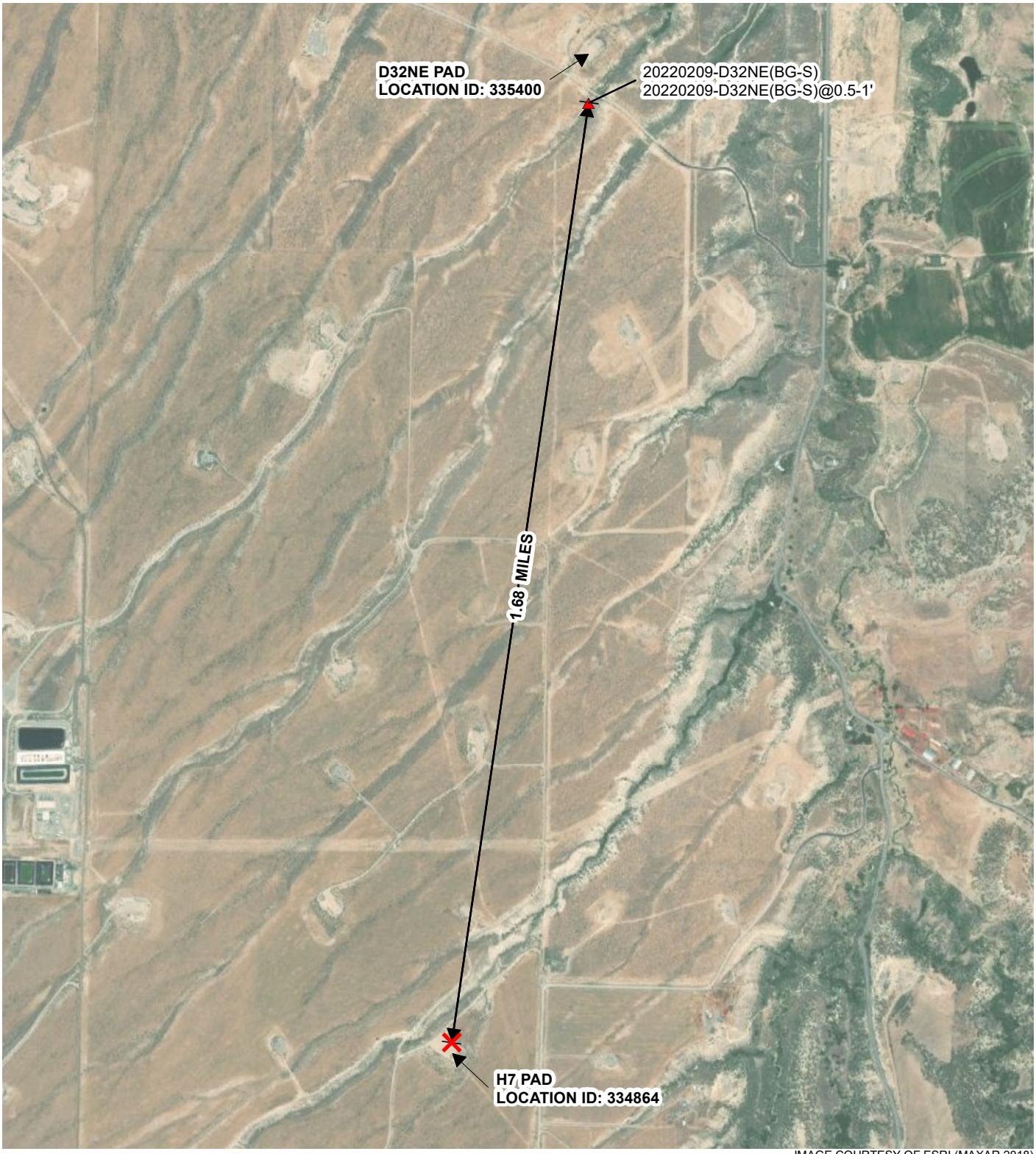


IMAGE COURTESY OF ESRI (MAXAR 2018)

LEGEND

- POINT OF RELEASE
- BACKGROUND SOIL SAMPLE

0 0.25 0.5
Miles

N

FIGURE 2
GEOGRAPHIC PROXIMITY MAP
H7 DUMPLINE
SENE SEC 7-T7S-R92W
GARFIELD COUNTY, COLORADO
CAERUS OIL AND GAS LLC

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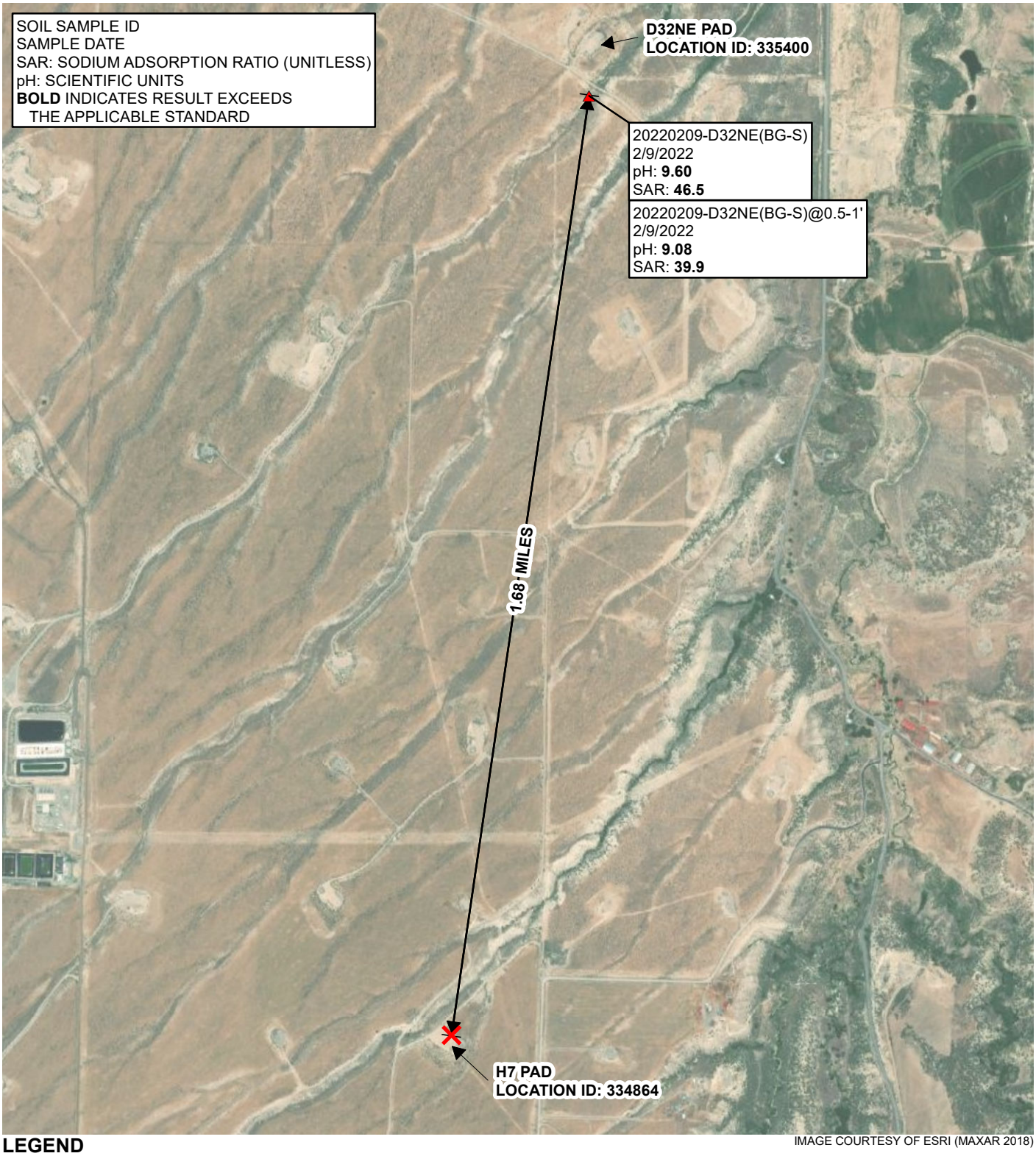


IMAGE COURTESY OF ESRI (MAXAR 2018)

LEGEND

- POINT OF RELEASE
- BACKGROUND SOIL SAMPLE

0 0.25 0.5
Miles

N

FIGURE 3
GEOGRAPHIC PROXIMITY
BACKGROUND ANALYTICAL MAP
H7 DUMPLINE
SENE SEC 7-T7S-R92W
GARFIELD COUNTY, COLORADO
CAERUS OIL AND GAS LLC

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TABLE

TABLE 1

SOIL ANALYTICAL RESULTS
H7 DUMPLINE
GARFIELD COUNTY, COLORADO
CAERUS OIL AND GAS LLC

PARAMETER	COGCC RESIDENTIAL SOIL SCREENING LEVEL CONCENTRATIONS	COGCC PROTECTION OF GROUNDWATER SOIL SCREENING LEVEL CONCENTRATIONS	UNITS	CONFIRMATION SOIL SAMPLE			
				20211005-H7(POR)@7.5'	**20211104-H7(POR)@9'**	**20211104-H7(POR)@12'**	**20211104-H7(POR)@15'**
Sample Date				10/5/2021	11/4/2021	11/4/2021	11/4/2021
Sample Depth (feet)				7.5	9	12	15
Sample Type				Confirmation Sample	Confirmation Sample	Confirmation Sample	Confirmation Sample
Arsenic	0.68	0.29 (M)	mg/kg	**3.54**	NA	NA	NA
Barium	15,000	82 (M)	mg/kg	**241**	**285**	**259**	**887**
Boron	2	2	mg/l	0.769	NA	NA	NA
Cadmium	71	0.38 (M)	mg/kg	0.236	NA	NA	NA
Chromium (VI)	0.3	0.00067 (R)	mg/kg	**0.277**	ND	ND	ND
Copper	3,100	46 (M)	mg/kg	10.6	NA	NA	NA
Lead	400	14 (M)	mg/kg	7.62	NA	NA	NA
Nickel	1,500	26 (R)	mg/kg	13.2	NA	NA	NA
Selenium	390	0.26 (M)	mg/kg	ND	NA	NA	NA
Silver	390	0.8 (R)	mg/kg	ND	NA	NA	NA
Zinc	23,000	370 (R)	mg/kg	27.9	NA	NA	NA
EC	<4	<4	mmhos/cm	0.252	NA	NA	NA
pH	6 - 8.3	6 - 8.3	SU	**8.38**	8.27	8.30	**8.64**
SAR	<6	<6	unitless	**18.3**	**21.9**	**10.7**	**10.5**
TPH-GRO			mg/kg	3,310	3,740	4,020	2,540
TPH-DRO			mg/kg	650	1,560	219	294
TPH-ORO			mg/kg	13.7	42.9	ND	36.9
TPH	500	500	mg/kg	**3,973.7**	**5,342.9**	**4,239**	**2,870.9**
Benzene	1.2	0.0026 (M)	mg/kg	**0.883**	**1.46**	**1.140**	**0.606**
Toluene	490	0.69 (M)	mg/kg	**22.4**	**41.6**	**26.1**	**13.7**
Ethylbenzene	5.8	0.78 (M)	mg/kg	**5.30**	**11.7**	**7.29**	**3.97**
Total Xylenes	58	9.9 (M)	mg/kg	**89.9**	**197**	**128**	**88.2**
1,2,4-trimethylbenzene	30	0.0081 (R)	mg/kg	**26.0**	**62.6**	**40.5**	**25.7**
1,3,5-trimethylbenzene	27	0.0087 (R)	mg/kg	**23.8**	**65.1**	**42.9**	**24.8**
Acenaphthene	360	5.8 (R)	mg/kg	0.0170	ND	ND	ND
Anthracene	1,800	0.55 (R)	mg/kg	ND	ND	ND	ND
Benzo(A)anthracene	1.1	0.011 (R)	mg/kg	ND	ND	ND	ND
Benzo(B)fluoranthene	1.1	0.3 (R)	mg/kg	ND	ND	ND	ND
Benzo(K)fluoranthene	11	2.9 (R)	mg/kg	ND	ND	ND	ND
Benzo(A)pyrene	0.11	0.24 (M)	mg/kg	ND	ND	ND	ND
Chrysene	110	9 (R)	mg/kg	ND	0.00449	ND	ND
Dibenzo(A,H)anthracen	0.11	0.11 (R)	mg/kg	ND	ND	ND	ND
Fluoranthene	240	0.096 (R)	mg/kg	ND	0.0026	ND	ND
Fluorene	240	0.54 (R)	mg/kg	0.0346	0.0801	0.0361	0.0163
Indeno(1,2,3,c-d)pyrene	1.1	0.98 (R)	mg/kg	ND	ND	ND	ND
1-methylnaphthalene	18	0.006 (R)	mg/kg	ND	**1.37**	**0.553**	**0.242**
2-methylnaphthalene	24	0.019 (R)	mg/kg	ND	**3.47**	**1.39**	**0.613**
Naphthalene	2	0.0038 (R)	mg/kg	**1.02**	**1.98**	**0.751**	**0.321**
Pyrene	180	1.3 (R)	mg/kg	0.00253	0.00369	0.00222	ND

NOTES:
ND - less than the stated reporting limit
BOLD - indicates result exceeds the COGCC concentration level
COGCC - Colorado Oil and Gas Conservation Commission
EC- electrical conductivity
mg/kg - milligrams per kilogram
mg/l - millgrams per liter
mmhos/cm - millimhos per centimeter
SAR - sodium adsorption ratio
SU - standard unit
TPH-ORO - total petroleum hydrcarbons- oil range orgainc
TPH-GRO - total petroleum hydrocarbons-gasoline range organics
TPH-DRO - total petroleum hydrocarbons-diesel range organics
TPH - combination of TPH-GRO, TPH-DRO, and TPH-ORO
NA - analyte not analyzed
ND - analyte not detected
R - risk based
MCL - maxium containment level (M)

TABLE 1

SOIL ANALYTICAL RESULTS
H7 DUMPLINE
GARFIELD COUNTY, COLORADO
CAERUS OIL AND GAS LLC

PARAMETER	COGCC RESIDENTIAL SOIL SCREENING LEVEL CONCENTRATIONS	COGCC PROTECTION OF GROUNDWATER SOIL SCREENING LEVEL CONCENTRATIONS	UNITS	CONFIRMATION SOIL SAMPLE			
				20211118-H7 (SB-POR) @ 10-12'	**20211118-H7 (SB-POR) @ 21-23'**	**20211118-H7 (SB-POR) @ 30-32'**	**20211118-H7 (SB-POR) @ 40-41.5'**
Sample Date				11/18/2021	11/18/2021	11/18/2021	11/18/2021
Sample Depth (feet)				10-12	21-23	30-32	40-41.5
Sample Type				Confirmation Sample	Confirmation Sample	Confirmation Sample	Confirmation Sample
Arsenic	0.68	0.29 (M)	mg/kg	NA	NA	NA	NA
Barium	15,000	82 (M)	mg/kg	**267**	**164**	**145**	**293**
Boron	2	2	mg/l	NA	NA	NA	NA
Cadmium	71	0.38 (M)	mg/kg	NA	NA	NA	NA
Chromium (VI)	0.3	0.00067 (R)	mg/kg	ND	ND	ND	ND
Copper	3,100	46 (M)	mg/kg	NA	NA	NA	NA
Lead	400	14 (M)	mg/kg	NA	NA	NA	NA
Nickel	1,500	26 (R)	mg/kg	NA	NA	NA	NA
Selenium	390	0.26 (M)	mg/kg	NA	NA	NA	NA
Silver	390	0.8 (R)	mg/kg	NA	NA	NA	NA
Zinc	23,000	370 (R)	mg/kg	NA	NA	NA	NA
EC	<4	<4	mmhos/cm	NA	NA	NA	NA
pH	6 - 8.3	6 - 8.3	SU	**8.58**	**8.57**	**8.63**	**8.31**
SAR	<6	<6	unitless	**9.71**	**6.55**	**6.10**	**6.61**
TPH-GRO			mg/kg	4,310	2,730	8.38	0.316
TPH-DRO			mg/kg	1,500	1,430	101	38.4
TPH-ORO			mg/kg	102	88.8	63.5	146
TPH	500	500	mg/kg	**5,912**	**4,248.8**	172.9	184.7
Benzene	1.2	0.0026 (M)	mg/kg	**1.46**	**0.704**	ND	0.00238
Toluene	490	0.69 (M)	mg/kg	**75.0**	**9.99**	0.203	0.0372
Ethylbenzene	5.8	0.78 (M)	mg/kg	**8.83**	**6.06**	0.140	0.00983
Total Xylenes	58	9.9 (M)	mg/kg	**320.0**	**49.4**	2.74	0.175
1,2,4-trimethylbenzene	30	0.0081 (R)	mg/kg	**82.4**	**15.1**	**1.09**	**0.0423**
1,3,5-trimethylbenzene	27	0.0087 (R)	mg/kg	**80.3**	**14.8**	**1.08**	**0.0459**
Acenaphthene	360	5.8 (R)	mg/kg	NA	NA	NA	NA
Anthracene	1,800	0.55 (R)	mg/kg	NA	NA	NA	NA
Benzo(A)anthracene	1.1	0.011 (R)	mg/kg	NA	NA	NA	NA
Benzo(B)fluoranthene	1.1	0.3 (R)	mg/kg	NA	NA	NA	NA
Benzo(K)fluoranthene	11	2.9 (R)	mg/kg	NA	NA	NA	NA
Benzo(A)pyrene	0.11	0.24 (M)	mg/kg	NA	NA	NA	NA
Chrysene	110	9 (R)	mg/kg	NA	NA	NA	NA
Dibenzo(A,H)anthracen	0.11	0.11 (R)	mg/kg	NA	NA	NA	NA
Fluoranthene	240	0.096 (R)	mg/kg	NA	NA	NA	NA
Fluorene	240	0.54 (R)	mg/kg	NA	NA	NA	NA
Indeno(1,2,3,c-d)pyrene	1.1	0.98 (R)	mg/kg	NA	NA	NA	NA
1-methylnaphthalene	18	0.006 (R)	mg/kg	**1.06**	**1.01**	ND	ND
2-methylnaphthalene	24	0.019 (R)	mg/kg	**2.64**	**2.55**	**0.0399**	ND
Naphthalene	2	0.0038 (R)	mg/kg	**1.37**	**1.45**	**0.0226**	ND
Pyrene	180	1.3 (R)	mg/kg	NA	NA	NA	NA

NOTES:
ND - less than the stated reporting limit
BOLD - indicates result exceeds the COGCC concentration level
COGCC - Colorado Oil and Gas Conservation Commission
EC- electrical conductivity
mg/kg - milligrams per kilogram
mg/l - millgrams per liter
mmhos/cm - millimhos per centimeter
SAR - sodium adsorption ratio
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TPH-ORO - total petroleum hydrcarbons- oil range orgainc
TPH-GRO - total petroleum hydrocarbons-gasoline range organics
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NA - analyte not analyzed
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MCL - maxium containment level (M)

TABLE 1

SOIL ANALYTICAL RESULTS
H7 DUMPLINE
GARFIELD COUNTY, COLORADO
CAERUS OIL AND GAS LLC

PARAMETER	COGCC RESIDENTIAL SOIL SCREENING LEVEL CONCENTRATIONS	COGCC PROTECTION OF GROUNDWATER SOIL SCREENING LEVEL CONCENTRATIONS	UNITS	CONFIRMATION SOIL SAMPLE			
				20211118-H7 (SB-N) @ 10-12'	**20211118-H7 (SB-N) @ 20-22'**	**20211118-H7 (SB-N) @ 30-31.5'**	**20211119-H7 (SB-N) @ 40-41'**
Sample Date				11/18/2021	11/18/2021	11/18/2021	11/19/2021
Sample Depth (feet)				10-12	20-22	30-31.5	40-41
Sample Type				Confirmation Sample	Confirmation Sample	Confirmation Sample	Confirmation Sample
Arsenic	0.68	0.29 (M)	mg/kg	NA	NA	NA	NA
Barium	15,000	82 (M)	mg/kg	**278**	**240**	**135**	**301**
Boron	2	2	mg/l	NA	NA	NA	NA
Cadmium	71	0.38 (M)	mg/kg	NA	NA	NA	NA
Chromium (VI)	0.3	0.00067 (R)	mg/kg	ND	ND	ND	ND
Copper	3,100	46 (M)	mg/kg	NA	NA	NA	NA
Lead	400	14 (M)	mg/kg	NA	NA	NA	NA
Nickel	1,500	26 (R)	mg/kg	NA	NA	NA	NA
Selenium	390	0.26 (M)	mg/kg	NA	NA	NA	NA
Silver	390	0.8 (R)	mg/kg	NA	NA	NA	NA
Zinc	23,000	370 (R)	mg/kg	NA	NA	NA	NA
EC	<4	<4	mmhos/cm	NA	NA	NA	NA
pH	6 - 8.3	6 - 8.3	SU	**8.82**	**8.36**	8.25	**8.42**
SAR	<6	<6	unitless	3.40	3.17	3.00	3.05
TPH-GRO			mg/kg	ND	0.183	ND	0.210
TPH-DRO			mg/kg	12.8	10.2	16.6	25
TPH-ORO			mg/kg	36.9	51.2	77.5	90.5
TPH	500	500	mg/kg	49.7	61.6	94.1	115.7
Benzene	1.2	0.0026 (M)	mg/kg	0.00115	0.00230	ND	0.00176
Toluene	490	0.69 (M)	mg/kg	0.0114	0.0105	ND	0.0394
Ethylbenzene	5.8	0.78 (M)	mg/kg	ND	ND	ND	ND
Total Xylenes	58	9.9 (M)	mg/kg	0.0194	0.0258	ND	0.0495
1,2,4-trimethylbenzene	30	0.0081 (R)	mg/kg	ND	**0.00950**	ND	ND
1,3,5-trimethylbenzene	27	0.0087 (R)	mg/kg	ND	**0.00960**	ND	ND
Acenaphthene	360	5.8 (R)	mg/kg	NA	NA	NA	NA
Anthracene	1,800	0.55 (R)	mg/kg	NA	NA	NA	NA
Benzo(A)anthracene	1.1	0.011 (R)	mg/kg	NA	NA	NA	NA
Benzo(B)fluoranthene	1.1	0.3 (R)	mg/kg	NA	NA	NA	NA
Benzo(K)fluoranthene	11	2.9 (R)	mg/kg	NA	NA	NA	NA
Benzo(A)pyrene	0.11	0.24 (M)	mg/kg	NA	NA	NA	NA
Chrysene	110	9 (R)	mg/kg	NA	NA	NA	NA
Dibenzo(A,H)anthracen	0.11	0.11 (R)	mg/kg	NA	NA	NA	NA
Fluoranthene	240	0.096 (R)	mg/kg	NA	NA	NA	NA
Fluorene	240	0.54 (R)	mg/kg	NA	NA	NA	NA
Indeno(1,2,3,c-d)pyrene	1.1	0.98 (R)	mg/kg	NA	NA	NA	NA
1-methylnaphthalene	18	0.006 (R)	mg/kg	ND	ND	ND	ND
2-methylnaphthalene	24	0.019 (R)	mg/kg	ND	ND	ND	ND
Naphthalene	2	0.0038 (R)	mg/kg	ND	ND	ND	ND
Pyrene	180	1.3 (R)	mg/kg	NA	NA	NA	NA

NOTES:
ND - less than the stated reporting limit
BOLD - indicates result exceeds the COGCC concentration level
COGCC - Colorado Oil and Gas Conservation Commission
EC- electrical conductivity
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H7 DUMPLINE
GARFIELD COUNTY, COLORADO
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				20211119-H7 (SB-W) @ 10-12'	**20211119-H7 (SB-W) @ 20-21.5'**	**20211119-H7 (SB-W) @ 30.5-32'**	**20211119-H7 (SB-W) @ 40-41.5'**
Sample Date				11/19/2021	11/19/2021	11/19/2021	11/19/2021
Sample Depth (feet)				10-12	20-21.5	30.5-32	40-41.5
Sample Type				Confirmation Sample	Confirmation Sample	Confirmation Sample	Confirmation Sample
Arsenic	0.68	0.29 (M)	mg/kg	NA	NA	NA	NA
Barium	15,000	82 (M)	mg/kg	**217**	**235**	**284**	**155**
Boron	2	2	mg/l	NA	NA	NA	NA
Cadmium	71	0.38 (M)	mg/kg	NA	NA	NA	NA
Chromium (VI)	0.3	0.00067 (R)	mg/kg	ND	ND	ND	ND
Copper	3,100	46 (M)	mg/kg	NA	NA	NA	NA
Lead	400	14 (M)	mg/kg	NA	NA	NA	NA
Nickel	1,500	26 (R)	mg/kg	NA	NA	NA	NA
Selenium	390	0.26 (M)	mg/kg	NA	NA	NA	NA
Silver	390	0.8 (R)	mg/kg	NA	NA	NA	NA
Zinc	23,000	370 (R)	mg/kg	NA	NA	NA	NA
EC	<4	<4	mmhos/cm	NA	NA	NA	NA
pH	6 - 8.3	6 - 8.3	SU	8.07	**8.59**	**9.00**	**8.61**
SAR	<6	<6	unitless	5.54	5.92	4.89	3.46
TPH-GRO			mg/kg	4,240	0.806	0.269	0.168
TPH-DRO			mg/kg	2,630	17	23	35.2
TPH-ORO			mg/kg	166	52.9	103	128
TPH	500	500	mg/kg	**7,036**	70.7	126.3	163.4
Benzene	1.2	0.0026 (M)	mg/kg	**1.4**	ND	**0.00337**	0.00193
Toluene	490	0.69 (M)	mg/kg	**46.4**	0.0186	0.0603	0.0265
Ethylbenzene	5.8	0.78 (M)	mg/kg	**11.2**	0.00715	0.00540	ND
Total Xylenes	58	9.9 (M)	mg/kg	**205**	0.181	0.109	0.0340
1,2,4-trimethylbenzene	30	0.0081 (R)	mg/kg	**58.5**	**0.0656**	**0.0132**	ND
1,3,5-trimethylbenzene	27	0.0087 (R)	mg/kg	**54.7**	**0.0481**	**0.00980**	ND
Acenaphthene	360	5.8 (R)	mg/kg	NA	NA	NA	NA
Anthracene	1,800	0.55 (R)	mg/kg	NA	NA	NA	NA
Benzo(A)anthracene	1.1	0.011 (R)	mg/kg	NA	NA	NA	NA
Benzo(B)fluoranthene	1.1	0.3 (R)	mg/kg	NA	NA	NA	NA
Benzo(K)fluoranthene	11	2.9 (R)	mg/kg	NA	NA	NA	NA
Benzo(A)pyrene	0.11	0.24 (M)	mg/kg	NA	NA	NA	NA
Chrysene	110	9 (R)	mg/kg	NA	NA	NA	NA
Dibenzo(A,H)anthracen	0.11	0.11 (R)	mg/kg	NA	NA	NA	NA
Fluoranthene	240	0.096 (R)	mg/kg	NA	NA	NA	NA
Fluorene	240	0.54 (R)	mg/kg	NA	NA	NA	NA
Indeno(1,2,3,c-d)pyrene	1.1	0.98 (R)	mg/kg	NA	NA	NA	NA
1-methylnaphthalene	18	0.006 (R)	mg/kg	**1.51**	ND	ND	ND
2-methylnaphthalene	24	0.019 (R)	mg/kg	**3.75**	ND	ND	ND
Naphthalene	2	0.0038 (R)	mg/kg	**1.89**	ND	ND	ND
Pyrene	180	1.3 (R)	mg/kg	NA	NA	NA	NA

NOTES:
ND - less than the stated reporting limit
BOLD - indicates result exceeds the COGCC concentration level
COGCC - Colorado Oil and Gas Conservation Commission
EC- electrical conductivity
mg/kg - milligrams per kilogram
mg/l - millgrams per liter
mmhos/cm - millimhos per centimeter
SAR - sodium adsorption ratio
SU - standard unit
TPH-ORO - total petroleum hydrcarbons- oil range orgainc
TPH-GRO - total petroleum hydrocarbons-gasoline range organics
TPH-DRO - total petroleum hydrocarbons-diesel range organics
TPH - combination of TPH-GRO, TPH-DRO, and TPH-ORO
NA - analyte not analyzed
ND - analyte not detected
R - risk based
MCL - maxium containment level (M)

TABLE 1

SOIL ANALYTICAL RESULTS
H7 DUMPLINE
GARFIELD COUNTY, COLORADO
CAERUS OIL AND GAS LLC

PARAMETER	COGCC RESIDENTIAL SOIL SCREENING LEVEL CONCENTRATIONS	COGCC PROTECTION OF GROUNDWATER SOIL SCREENING LEVEL CONCENTRATIONS	UNITS	CONFIRMATION SOIL SAMPLE			
				20211119-H7 (SB-E) @ 10-12'	**20211119-H7 (SB-E) @ 20-22'**	**20211122-H7 (SB-E) @ 30-32'**	**20211122-H7 (SB-E) @ 40.5-42.5'**
Sample Date				11/19/2021	11/19/2021	11/22/2021	11/22/2021
Sample Depth (feet)				10-12	20-22	30-32	40.5-42.5
Sample Type				Confirmation Sample	Confirmation Sample	Confirmation Sample	Confirmation Sample
Arsenic	0.68	0.29 (M)	mg/kg	NA	NA	NA	NA
Barium	15,000	82 (M)	mg/kg	**203**	**171**	**266**	**267**
Boron	2	2	mg/l	NA	NA	NA	NA
Cadmium	71	0.38 (M)	mg/kg	NA	NA	NA	NA
Chromium (VI)	0.3	0.00067 (R)	mg/kg	ND	ND	ND	ND
Copper	3,100	46 (M)	mg/kg	NA	NA	NA	NA
Lead	400	14 (M)	mg/kg	NA	NA	NA	NA
Nickel	1,500	26 (R)	mg/kg	NA	NA	NA	NA
Selenium	390	0.26 (M)	mg/kg	NA	NA	NA	NA
Silver	390	0.8 (R)	mg/kg	NA	NA	NA	NA
Zinc	23,000	370 (R)	mg/kg	NA	NA	NA	NA
EC	<4	<4	mmhos/cm	NA	NA	NA	NA
pH	6 - 8.3	6 - 8.3	SU	**8.99**	**9.46**	**8.90**	**8.37**
SAR	<6	<6	unitless	1.08	**8.38**	**8.92**	**6.33**
TPH-GRO			mg/kg	0.134	0.202	0.141	0.115
TPH-DRO			mg/kg	ND	9.31	15.8	12.9
TPH-ORO			mg/kg	6.16	53.1	82.9	82.7
TPH	500	500	mg/kg	6.29	62.6	98.8	95.7
Benzene	1.2	0.0026 (M)	mg/kg	ND	ND	ND	ND
Toluene	490	0.69 (M)	mg/kg	ND	0.0172	0.00633	0.00615
Ethylbenzene	5.8	0.78 (M)	mg/kg	ND	ND	ND	ND
Total Xylenes	58	9.9 (M)	mg/kg	ND	0.0177	ND	ND
1,2,4-trimethylbenzene	30	0.0081 (R)	mg/kg	ND	ND	ND	ND
1,3,5-trimethylbenzene	27	0.0087 (R)	mg/kg	ND	ND	ND	ND
Acenaphthene	360	5.8 (R)	mg/kg	NA	NA	NA	NA
Anthracene	1,800	0.55 (R)	mg/kg	NA	NA	NA	NA
Benzo(A)anthracene	1.1	0.011 (R)	mg/kg	NA	NA	NA	NA
Benzo(B)fluoranthene	1.1	0.3 (R)	mg/kg	NA	NA	NA	NA
Benzo(K)fluoranthene	11	2.9 (R)	mg/kg	NA	NA	NA	NA
Benzo(A)pyrene	0.11	0.24 (M)	mg/kg	NA	NA	NA	NA
Chrysene	110	9 (R)	mg/kg	NA	NA	NA	NA
Dibenzo(A,H)anthracen	0.11	0.11 (R)	mg/kg	NA	NA	NA	NA
Fluoranthene	240	0.096 (R)	mg/kg	NA	NA	NA	NA
Fluorene	240	0.54 (R)	mg/kg	NA	NA	NA	NA
Indeno(1,2,3,c-d)pyrene	1.1	0.98 (R)	mg/kg	NA	NA	NA	NA
1-methylnaphthalene	18	0.006 (R)	mg/kg	ND	ND	ND	ND
2-methylnaphthalene	24	0.019 (R)	mg/kg	ND	ND	ND	ND
Naphthalene	2	0.0038 (R)	mg/kg	ND	ND	ND	ND
Pyrene	180	1.3 (R)	mg/kg	NA	NA	NA	NA

NOTES:
ND - less than the stated reporting limit
BOLD - indicates result exceeds the COGCC concentration level
COGCC - Colorado Oil and Gas Conservation Commission
EC- electrical conductivity
mg/kg - milligrams per kilogram
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TPH-GRO - total petroleum hydrocarbons-gasoline range organics
TPH-DRO - total petroleum hydrocarbons-diesel range organics
TPH - combination of TPH-GRO, TPH-DRO, and TPH-ORO
NA - analyte not analyzed
ND - analyte not detected
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MCL - maxium containment level (M)

TABLE 1

SOIL ANALYTICAL RESULTS
H7 DUMPLINE
GARFIELD COUNTY, COLORADO
CAERUS OIL AND GAS LLC

PARAMETER	COGCC RESIDENTIAL SOIL SCREENING LEVEL CONCENTRATIONS	COGCC PROTECTION OF GROUNDWATER SOIL SCREENING LEVEL CONCENTRATIONS	UNITS	CONFIRMATION SOIL SAMPLE			
				20211122-H7 (SB-S) @ 10-12'	**20211122-H7 (SB-S) @ 20-22'**	**20211122-H7 (SB-S) @ 30-32'**	**20211122-H7 (SB-S) @ 40-42'**
Sample Date				11/22/2021	11/22/2021	11/22/2021	11/22/2021
Sample Depth (feet)				10-12	20-22	30-32	40-42
Sample Type				Confirmation Sample	Confirmation Sample	Confirmation Sample	Confirmation Sample
Arsenic	0.68	0.29 (M)	mg/kg	NA	NA	NA	NA
Barium	15,000	82 (M)	mg/kg	**255**	**364**	**219**	**222**
Boron	2	2	mg/l	NA	NA	NA	NA
Cadmium	71	0.38 (M)	mg/kg	NA	NA	NA	NA
Chromium (VI)	0.3	0.00067 (R)	mg/kg	ND	ND	ND	ND
Copper	3,100	46 (M)	mg/kg	NA	NA	NA	NA
Lead	400	14 (M)	mg/kg	NA	NA	NA	NA
Nickel	1,500	26 (R)	mg/kg	NA	NA	NA	NA
Selenium	390	0.26 (M)	mg/kg	NA	NA	NA	NA
Silver	390	0.8 (R)	mg/kg	NA	NA	NA	NA
Zinc	23,000	370 (R)	mg/kg	NA	NA	NA	NA
EC	<4	<4	mmhos/cm	NA	NA	NA	NA
pH	6 - 8.3	6 - 8.3	SU	**8.83**	**9.29**	**8.46**	**8.85**
SAR	<6	<6	unitless	1.78	**8.24**	**7.07**	4.34
TPH-GRO			mg/kg	0.104	0.216	0.118	0.120
TPH-DRO			mg/kg	5.91	6.62	13.9	31.7
TPH-ORO			mg/kg	18.7	37.1	72.4	143
TPH	500	500	mg/kg	24.7	43.9	86.4	174.8
Benzene	1.2	0.0026 (M)	mg/kg	ND	ND	ND	ND
Toluene	490	0.69 (M)	mg/kg	ND	0.00638	0.00560	0.00695
Ethylbenzene	5.8	0.78 (M)	mg/kg	ND	ND	ND	ND
Total Xylenes	58	9.9 (M)	mg/kg	ND	ND	ND	ND
1,2,4-trimethylbenzene	30	0.0081 (R)	mg/kg	ND	ND	ND	ND
1,3,5-trimethylbenzene	27	0.0087 (R)	mg/kg	ND	ND	ND	ND
Acenaphthene	360	5.8 (R)	mg/kg	NA	NA	NA	NA
Anthracene	1,800	0.55 (R)	mg/kg	NA	NA	NA	NA
Benzo(A)anthracene	1.1	0.011 (R)	mg/kg	NA	NA	NA	NA
Benzo(B)fluoranthene	1.1	0.3 (R)	mg/kg	NA	NA	NA	NA
Benzo(K)fluoranthene	11	2.9 (R)	mg/kg	NA	NA	NA	NA
Benzo(A)pyrene	0.11	0.24 (M)	mg/kg	NA	NA	NA	NA
Chrysene	110	9 (R)	mg/kg	NA	NA	NA	NA
Dibenzo(A,H)anthracen	0.11	0.11 (R)	mg/kg	NA	NA	NA	NA
Fluoranthene	240	0.096 (R)	mg/kg	NA	NA	NA	NA
Fluorene	240	0.54 (R)	mg/kg	NA	NA	NA	NA
Indeno(1,2,3,c-d)pyrene	1.1	0.98 (R)	mg/kg	NA	NA	NA	NA
1-methylnaphthalene	18	0.006 (R)	mg/kg	ND	ND	ND	ND
2-methylnaphthalene	24	0.019 (R)	mg/kg	ND	ND	ND	ND
Naphthalene	2	0.0038 (R)	mg/kg	ND	ND	ND	ND
Pyrene	180	1.3 (R)	mg/kg	NA	NA	NA	NA

NOTES:
ND - less than the stated reporting limit
BOLD - indicates result exceeds the COGCC concentration level
COGCC - Colorado Oil and Gas Conservation Commission
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TPH - combination of TPH-GRO, TPH-DRO, and TPH-ORO
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ND - analyte not detected
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TABLE 1

SOIL ANALYTICAL RESULTS
H7 DUMPLINE
GARFIELD COUNTY, COLORADO
CAERUS OIL AND GAS LLC

PARAMETER	COGCC RESIDENTIAL SOIL SCREENING LEVEL CONCENTRATIONS	COGCC PROTECTION OF GROUNDWATER SOIL SCREENING LEVEL CONCENTRATIONS	UNITS	CONFIRMATION SOIL SAMPLE		
				20220106-H7 (PH01) @ 11.5-13.5'	**20220106-H7 (PH01) @ 16-16.5'**	**20220106-H7 (PH01) @ 16-16.5'**
Sample Date				1/6/2022	1/6/2022	1/6/2022
Sample Depth (feet)				11.5-13.5	16-16.5	16-16.5
Sample Type				Confirmation Sample	Confirmation Sample	Confirmation Sample
Arsenic	0.68	0.29 (M)	mg/kg	NA	NA	NA
Barium	15,000	82 (M)	mg/kg	154	190	NA
Boron	2	2	mg/l	NA	NA	NA
Cadmium	71	0.38 (M)	mg/kg	NA	NA	NA
Chromium (VI)	0.3	0.00067 (R)	mg/kg	ND	**1.88**	ND
Copper	3,100	46 (M)	mg/kg	NA	NA	NA
Lead	400	14 (M)	mg/kg	NA	NA	NA
Nickel	1,500	26 (R)	mg/kg	NA	NA	NA
Selenium	390	0.26 (M)	mg/kg	NA	NA	NA
Silver	390	0.8 (R)	mg/kg	NA	NA	NA
Zinc	23,000	370 (R)	mg/kg	NA	NA	NA
EC	<4	<4	mmhos/cm	NA	NA	NA
pH	6 - 8.3	6 - 8.3	SU	**8.72**	**8.94**	NA
SAR	<6	<6	unitless	3.66	5.07	NA
TPH-GRO			mg/kg	ND	0.109	NA
TPH-DRO			mg/kg	ND	ND	NA
TPH-ORO			mg/kg	8.30	6.53	NA
TPH	500	500	mg/kg	8.30	6.639	NA
Benzene	1.2	0.0026 (M)	mg/kg	ND	ND	NA
Toluene	490	0.69 (M)	mg/kg	ND	ND	NA
Ethylbenzene	5.8	0.78 (M)	mg/kg	ND	ND	NA
Total Xylenes	58	9.9 (M)	mg/kg	ND	ND	NA
1,2,4-trimethylbenzene	30	0.0081 (R)	mg/kg	ND	ND	NA
1,3,5-trimethylbenzene	27	0.0087 (R)	mg/kg	ND	ND	NA
Acenaphthene	360	5.8 (R)	mg/kg	NA	NA	NA
Anthracene	1,800	0.55 (R)	mg/kg	NA	NA	NA
Benzo(A)anthracene	1.1	0.011 (R)	mg/kg	NA	NA	NA
Benzo(B)fluoranthene	1.1	0.3 (R)	mg/kg	NA	NA	NA
Benzo(K)fluoranthene	11	2.9 (R)	mg/kg	NA	NA	NA
Benzo(A)pyrene	0.11	0.24 (M)	mg/kg	NA	NA	NA
Chrysene	110	9 (R)	mg/kg	NA	NA	NA
Dibenzo(A,H)anthracen	0.11	0.11 (R)	mg/kg	NA	NA	NA
Fluoranthene	240	0.096 (R)	mg/kg	NA	NA	NA
Fluorene	240	0.54 (R)	mg/kg	NA	NA	NA
Indeno(1,2,3,c-d)pyrene	1.1	0.98 (R)	mg/kg	NA	NA	NA
1-methylnaphthalene	18	0.006 (R)	mg/kg	ND	ND	ND
2-methylnaphthalene	24	0.019 (R)	mg/kg	ND	ND	ND
Naphthalene	2	0.0038 (R)	mg/kg	ND	ND	ND
Pyrene	180	1.3 (R)	mg/kg	NA	NA	NA

NOTES:
ND - less than the stated reporting limit
BOLD - indicates result exceeds the COGCC concentration level
COGCC - Colorado Oil and Gas Conservation Commission
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mg/kg - milligrams per kilogram
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TPH-ORO - total petroleum hydrcarbons- oil range orgainc s
TPH-GRO - total petroleum hydrocarbons-gasoline range organics
TPH-DRO - total petroleum hydrocarbons-diesel range organics
TPH - combination of TPH-GRO, TPH-DRO, and TPH-ORO
NA - analyte not analyzed
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TABLE 1

SOIL ANALYTICAL RESULTS
H7 DUMPLINE
GARFIELD COUNTY, COLORADO
CAERUS OIL AND GAS LLC

PARAMETER	COGCC RESIDENTIAL SOIL SCREENING LEVEL CONCENTRATIONS	COGCC PROTECTION OF GROUNDWATER SOIL SCREENING LEVEL CONCENTRATIONS	UNITS	BACKGROUND SOIL SAMPLES					
				20211005-H7(BGS)	**20211005-H7(BGE)**	**20211005-H7(BGN)**	**20211005-H7(BGW)**	**20220209-D32NE(BG-S)**	**20220209-D32NE(BG-S) 0.5-1**
Sample Date				10/5/2021	10/5/2021	10/5/2021	10/5/2021	2/9/2022	2/9/2022
Sample Depth (feet)				0.5	0.5	0.5	0.5	0.5	0.5-1
Sample Type				Background Sample	Background Sample	Background Sample	Background Sample	Background Sample	Background Sample
Arsenic	0.68	0.29 (M)	mg/kg	**1.72**	**2.03**	**4.11**	**4.47**	**4.55**	**5.82**
Barium	15,000	82 (M)	mg/kg	**129**	**141**	**173**	**169**	167	167
Boron	2	2	mg/l	0.358	0.311	0.402	0.406	0.770	**2.69**
Cadmium	71	0.38 (M)	mg/kg	0.259	0.203	0.246	**0.396**	ND	ND
Chromium (VI)	0.3	0.00067 (R)	mg/kg	ND	ND	ND	ND	ND	ND
Copper	3,100	46 (M)	mg/kg	11.0	11.8	12.8	13.9	10.1	12.3
Lead	400	14 (M)	mg/kg	10.3	9.9	9.24	9.38	7.56	8.11
Nickel	1,500	26 (R)	mg/kg	9.89	11.5	13.5	11.8	9.95	11.8
Selenium	390	0.26 (M)	mg/kg	ND	**1.37**	**1.19**	ND	ND	2.15
Silver	390	0.8 (R)	mg/kg	ND	ND	ND	ND	ND	ND
Zinc	23,000	370 (R)	mg/kg	21.4	22.5	28.99	28.6	28.6	31.8
EC	<4	<4	mmhos/cm	0.160	0.109	**0.354**	0.153	**7.040**	**9.090**
pH	6 - 8.3	6 - 8.3	SU	7.88	7.60	7.80	8.09	**9.60**	**9.08**
SAR	<6	<6	unitless	0.271	0.191	0.0826	0.148	**46.5**	**39.9**
TPH-GRO			mg/kg	0.0613	0.0559	0.0550	0.0863	NA	NA
TPH-DRO			mg/kg	ND	ND	ND	ND	NA	NA
TPH-ORO			mg/kg	0.45	ND	ND	0.955	NA	NA
TPH	500	500	mg/kg	0.5143	0.0559	0.0550	1.0413	ND	ND
Benzene	1.2	0.0026 (M)	mg/kg	NA	NA	NA	NA	ND	ND
Toluene	490	0.69 (M)	mg/kg	NA	NA	NA	NA	ND	ND
Ethylbenzene	5.8	0.78 (M)	mg/kg	NA	NA	NA	NA	ND	ND
Total Xylenes	58	9.9 (M)	mg/kg	NA	NA	NA	NA	ND	ND
1,2,4-trimethylbenzene	30	0.0081 (R)	mg/kg	NA	NA	NA	NA	ND	ND
1,3,5-trimethylbenzene	27	0.0087 (R)	mg/kg	NA	NA	NA	NA	ND	ND
Acenaphthene	360	5.8 (R)	mg/kg	ND	ND	ND	ND	ND	ND
Anthracene	1,800	0.55 (R)	mg/kg	ND	ND	ND	ND	ND	ND
Benzo(A)anthracene	1.1	0.011 (R)	mg/kg	ND	ND	ND	ND	ND	ND
Benzo(B)fluoranthene	1.1	0.3 (R)	mg/kg	ND	ND	ND	ND	ND	ND
Benzo(K)fluoranthene	11	2.9 (R)	mg/kg	ND	ND	ND	ND	ND	ND
Benzo(A)pyrene	0.11	0.24 (M)	mg/kg	ND	ND	ND	ND	ND	ND
Chrysene	110	9 (R)	mg/kg	ND	ND	ND	ND	ND	ND
Dibenzo(A,H)anthracen	0.11	0.11 (R)	mg/kg	ND	ND	ND	ND	ND	ND
Fluoranthene	240	0.096 (R)	mg/kg	ND	ND	ND	ND	ND	ND
Fluorene	240	0.54 (R)	mg/kg	ND	ND	ND	ND	ND	ND
Indeno(1,2,3,c-d)pyrene	1.1	0.98 (R)	mg/kg	ND	ND	ND	ND	ND	ND
1-methylnaphthalene	18	0.006 (R)	mg/kg	ND	ND	ND	ND	ND	ND
2-methylnaphthalene	24	0.019 (R)	mg/kg	ND	ND	ND	ND	ND	ND
Naphthalene	2	0.0038 (R)	mg/kg	ND	ND	ND	ND	ND	ND
Pyrene	180	1.3 (R)	mg/kg	ND	ND	ND	ND	ND	ND

NOTES:
ND - less than the stated reporting limit
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ENCLOSURE A – LABORATORY ANALYTICAL REPORTS

ANALYTICAL REPORT

February 18, 2022

1 Cp
2 Tc
3 Ss
4 Cn
5 Sr
6 Qc
7 Gl
8 Al
9 Sc

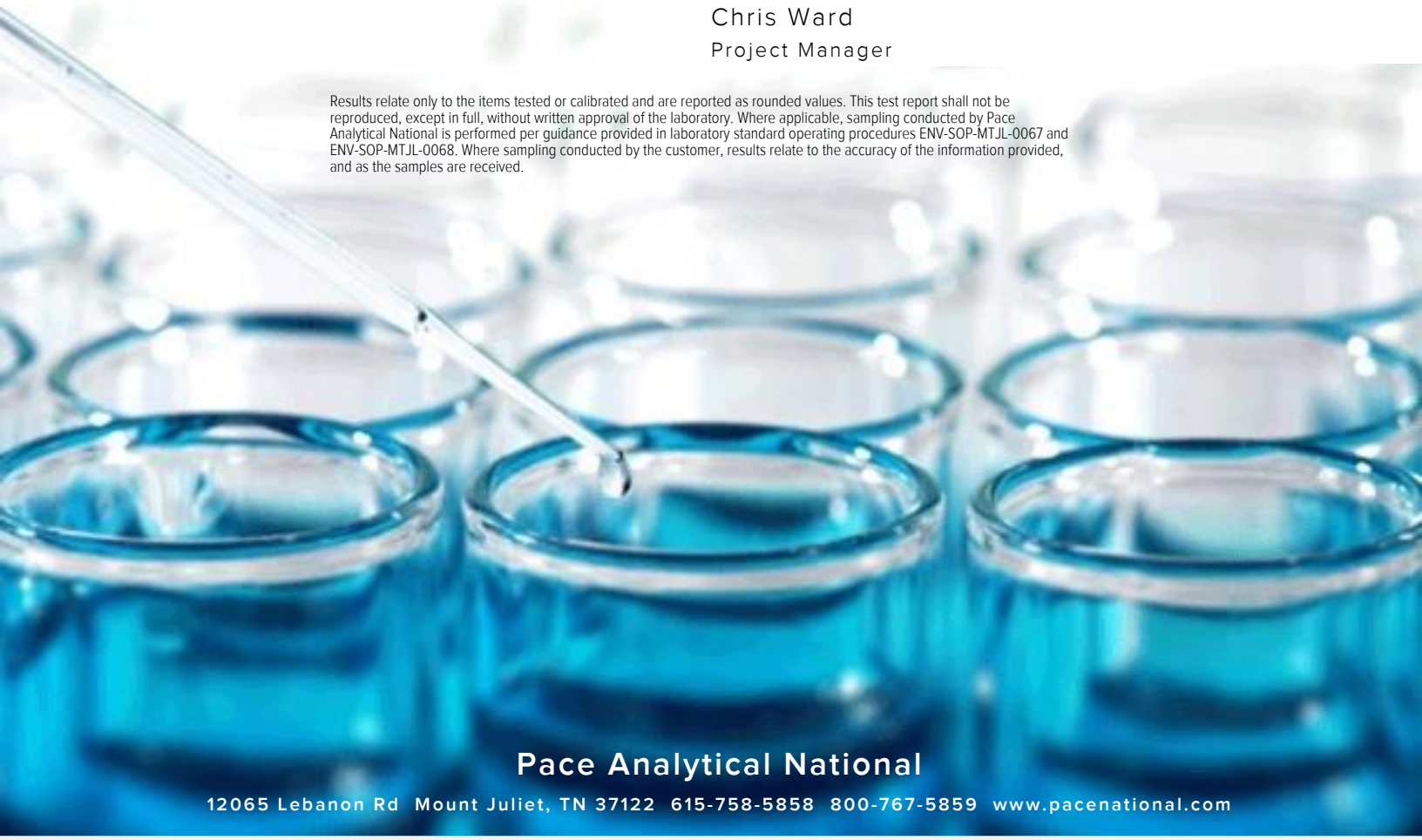
Caerus Oil and Gas

Sample Delivery Group:	L1460109
Samples Received:	02/10/2022
Project Number:	D32NE
Description:	D32NE
Site:	D32NE
Report To:	Blair Rollins 143 Diamond Avenue Parachute, CO 81635

Entire Report Reviewed By: Chris Ward

Chris Ward
Project Manager

Results relate only to the items tested or calibrated and are reported as rounded values. This test report shall not be reproduced, except in full, without written approval of the laboratory. Where applicable, sampling conducted by Pace Analytical National is performed per guidance provided in laboratory standard operating procedures ENV-SOP-MTJL-0067 and ENV-SOP-MTJL-0068. Where sampling conducted by the customer, results relate to the accuracy of the information provided, and as the samples are received.



Pace Analytical National
12065 Lebanon Rd Mount Juliet, TN 37122 615-758-5858 800-767-5859 www.pacenational.com

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20220209-D32NE(BGW) L1460109-04 12

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20220209-D32NE(BG-N) L1460109-01 Solid

Collected by: DH | Collected date/time: 02/09/22 08:50 | Received date/time: 02/10/22 09:30

Method	Batch	Dilution	Preparation date/time	Analysis date/time	Analyst	Location
Calculated Results	WG1817292	1	02/16/22 00:31	02/16/22 00:31	CCE	Mt. Juliet, TN
Wet Chemistry by Method 7199	WG1817473	1	02/16/22 01:00	02/17/22 12:00	JER	Mt. Juliet, TN
Wet Chemistry by Method 9045D	WG1816500	1	02/11/22 09:00	02/11/22 12:00	GI	Mt. Juliet, TN
Wet Chemistry by Method 9050AMod	WG1817278	1	02/13/22 02:05	02/13/22 07:58	ARD	Mt. Juliet, TN
Metals (ICP) by Method 6010B	WG1817139	1	02/14/22 15:58	02/16/22 00:10	CCE	Mt. Juliet, TN
Metals (ICP) by Method 6010B-NE493 Ch 2	WG1817290	1	02/14/22 17:10	02/16/22 01:41	CCE	Mt. Juliet, TN
Metals (ICPMS) by Method 6020	WG1817141	5	02/14/22 16:04	02/15/22 03:06	JPD	Mt. Juliet, TN
Volatile Organic Compounds (GC/MS) by Method 8260B	WG1816372	1	02/10/22 16:49	02/11/22 01:05	JHH	Mt. Juliet, TN
Semi Volatile Organic Compounds (GC/MS) by Method 8270C-SIM	WG1818233	1	02/15/22 20:05	02/16/22 13:13	BJP	Mt. Juliet, TN

20220209-D32NE(BG-E) L1460109-02 Solid

Collected by: DH | Collected date/time: 02/09/22 09:40 | Received date/time: 02/10/22 09:30

Method	Batch	Dilution	Preparation date/time	Analysis date/time	Analyst	Location
Calculated Results	WG1817292	1	02/16/22 00:34	02/16/22 00:34	CCE	Mt. Juliet, TN
Wet Chemistry by Method 7199	WG1817473	1	02/16/22 01:00	02/17/22 12:05	JER	Mt. Juliet, TN
Wet Chemistry by Method 9045D	WG1816500	1	02/11/22 09:00	02/11/22 12:00	GI	Mt. Juliet, TN
Wet Chemistry by Method 9050AMod	WG1817278	1	02/13/22 02:05	02/13/22 07:58	ARD	Mt. Juliet, TN
Metals (ICP) by Method 6010B	WG1817139	1	02/14/22 15:58	02/15/22 23:55	CCE	Mt. Juliet, TN
Metals (ICP) by Method 6010B-NE493 Ch 2	WG1817290	1	02/14/22 17:10	02/16/22 01:44	CCE	Mt. Juliet, TN
Metals (ICPMS) by Method 6020	WG1817141	5	02/14/22 16:04	02/15/22 02:49	JPD	Mt. Juliet, TN
Volatile Organic Compounds (GC/MS) by Method 8260B	WG1816372	1	02/10/22 16:49	02/11/22 01:25	JHH	Mt. Juliet, TN
Semi Volatile Organic Compounds (GC/MS) by Method 8270C-SIM	WG1818233	1	02/15/22 20:05	02/16/22 14:12	BJP	Mt. Juliet, TN

20220209-D32NE(BG-E) 0.5-1 L1460109-03 Solid

Collected by: DH | Collected date/time: 02/09/22 09:50 | Received date/time: 02/10/22 09:30

Method	Batch	Dilution	Preparation date/time	Analysis date/time	Analyst	Location
Calculated Results	WG1817292	1	02/16/22 00:37	02/16/22 00:37	CCE	Mt. Juliet, TN
Wet Chemistry by Method 7199	WG1817473	1	02/16/22 01:00	02/17/22 12:10	JER	Mt. Juliet, TN
Wet Chemistry by Method 9045D	WG1816500	1	02/11/22 09:00	02/11/22 12:00	GI	Mt. Juliet, TN
Wet Chemistry by Method 9050AMod	WG1817278	1	02/13/22 02:05	02/13/22 07:58	ARD	Mt. Juliet, TN
Metals (ICP) by Method 6010B	WG1817139	1	02/14/22 15:58	02/16/22 00:13	CCE	Mt. Juliet, TN
Metals (ICP) by Method 6010B-NE493 Ch 2	WG1817290	1	02/14/22 17:10	02/16/22 01:47	CCE	Mt. Juliet, TN
Metals (ICPMS) by Method 6020	WG1817141	5	02/14/22 16:04	02/15/22 03:09	JPD	Mt. Juliet, TN
Volatile Organic Compounds (GC/MS) by Method 8260B	WG1816372	1	02/10/22 16:49	02/11/22 01:44	JHH	Mt. Juliet, TN
Semi Volatile Organic Compounds (GC/MS) by Method 8270C-SIM	WG1818233	1	02/15/22 20:05	02/16/22 14:32	BJP	Mt. Juliet, TN

20220209-D32NE(BGW) L1460109-04 Solid

Collected by: DH | Collected date/time: 02/09/22 10:00 | Received date/time: 02/10/22 09:30

Method	Batch	Dilution	Preparation date/time	Analysis date/time	Analyst	Location
Calculated Results	WG1817292	1	02/16/22 00:39	02/16/22 00:39	CCE	Mt. Juliet, TN
Wet Chemistry by Method 7199	WG1817473	1	02/16/22 01:00	02/17/22 13:15	JER	Mt. Juliet, TN
Wet Chemistry by Method 9045D	WG1816500	1	02/11/22 09:00	02/11/22 12:00	GI	Mt. Juliet, TN
Wet Chemistry by Method 9050AMod	WG1817278	1	02/13/22 02:05	02/13/22 07:58	ARD	Mt. Juliet, TN
Metals (ICP) by Method 6010B	WG1817139	1	02/14/22 15:58	02/16/22 00:16	CCE	Mt. Juliet, TN
Metals (ICP) by Method 6010B-NE493 Ch 2	WG1817290	1	02/14/22 17:10	02/16/22 01:50	CCE	Mt. Juliet, TN
Metals (ICPMS) by Method 6020	WG1817141	5	02/14/22 16:04	02/15/22 03:12	JPD	Mt. Juliet, TN
Volatile Organic Compounds (GC/MS) by Method 8260B	WG1816372	1	02/10/22 16:49	02/11/22 02:03	JHH	Mt. Juliet, TN
Semi Volatile Organic Compounds (GC/MS) by Method 8270C-SIM	WG1818233	1	02/15/22 20:05	02/16/22 14:52	BJP	Mt. Juliet, TN

20220209-D32NE(BG-S) L1460109-05 Solid

Collected by: DH
Collected date/time: 02/09/22 10:30
Received date/time: 02/10/22 09:30

Method	Batch	Dilution	Preparation date/time	Analysis date/time	Analyst	Location
Calculated Results	WG1817292	1	02/16/22 00:42	02/16/22 00:42	CCE	Mt. Juliet, TN
Wet Chemistry by Method 7199	WG1817473	1	02/16/22 01:00	02/17/22 13:22	JER	Mt. Juliet, TN
Wet Chemistry by Method 9045D	WG1816500	1	02/11/22 09:00	02/11/22 12:00	GI	Mt. Juliet, TN
Wet Chemistry by Method 9050AMod	WG1817278	1	02/13/22 02:05	02/13/22 07:58	ARD	Mt. Juliet, TN
Metals (ICP) by Method 6010B	WG1817139	1	02/14/22 15:58	02/15/22 23:28	CCE	Mt. Juliet, TN
Metals (ICP) by Method 6010B-NE493 Ch 2	WG1817290	2	02/14/22 17:10	02/16/22 01:53	CCE	Mt. Juliet, TN
Metals (ICPMS) by Method 6020	WG1817141	5	02/14/22 16:04	02/15/22 02:20	JPD	Mt. Juliet, TN
Volatile Organic Compounds (GC/MS) by Method 8260B	WG1816372	1	02/10/22 16:49	02/11/22 02:22	JHH	Mt. Juliet, TN
Semi Volatile Organic Compounds (GC/MS) by Method 8270C-SIM	WG1818233	1	02/15/22 20:05	02/16/22 15:12	BJP	Mt. Juliet, TN

20220209-D32NE(BG-S) 0.5-1 L1460109-06 Solid

Collected by: DH
Collected date/time: 02/09/22 10:40
Received date/time: 02/10/22 09:30

Method	Batch	Dilution	Preparation date/time	Analysis date/time	Analyst	Location
Calculated Results	WG1817292	1	02/16/22 00:45	02/16/22 00:45	CCE	Mt. Juliet, TN
Wet Chemistry by Method 7199	WG1817473	1	02/16/22 01:00	02/17/22 13:28	JER	Mt. Juliet, TN
Wet Chemistry by Method 9045D	WG1816500	1	02/11/22 09:00	02/11/22 12:00	GI	Mt. Juliet, TN
Wet Chemistry by Method 9050AMod	WG1817278	1	02/13/22 02:05	02/13/22 07:58	ARD	Mt. Juliet, TN
Metals (ICP) by Method 6010B	WG1817139	1	02/14/22 15:58	02/15/22 23:31	CCE	Mt. Juliet, TN
Metals (ICP) by Method 6010B-NE493 Ch 2	WG1817290	1	02/14/22 17:10	02/16/22 01:56	CCE	Mt. Juliet, TN
Metals (ICPMS) by Method 6020	WG1817141	5	02/14/22 16:04	02/15/22 02:23	JPD	Mt. Juliet, TN
Volatile Organic Compounds (GC/MS) by Method 8260B	WG1816372	1	02/10/22 16:49	02/11/22 02:41	JHH	Mt. Juliet, TN
Semi Volatile Organic Compounds (GC/MS) by Method 8270C-SIM	WG1818233	1	02/15/22 20:05	02/16/22 15:32	BJP	Mt. Juliet, TN

CASE NARRATIVE

All sample aliquots were received at the correct temperature, in the proper containers, with the appropriate preservatives, and within method specified holding times, unless qualified or notated within the report. Where applicable, all MDL (LOD) and RDL (LOQ) values reported for environmental samples have been corrected for the dilution factor used in the analysis. All Method and Batch Quality Control are within established criteria except where addressed in this case narrative, a non-conformance form or properly qualified within the sample results. By my digital signature below, I affirm to the best of my knowledge, all problems/anomalies observed by the laboratory as having the potential to affect the quality of the data have been identified by the laboratory, and no information or data have been knowingly withheld that would affect the quality of the data.



Chris Ward
Project Manager

Calculated Results

Analyte	Result	Qualifier	Dilution	Analysis date / time	Batch
	SAR				
Sodium Adsorption Ratio	3.82		1	02/16/2022 00:31	WG1817292

Wet Chemistry by Method 7199

Analyte	Result	Qualifier	RDL	Dilution	Analysis date / time	Batch
	mg/kg		mg/kg			
Hexavalent Chromium	ND		1.00	1	02/17/2022 12:00	WG1817473

Wet Chemistry by Method 9045D

Analyte	Result	Qualifier	Dilution	Analysis date / time	Batch
	pH				
pH	9.29	T8	1	02/11/2022 12:00	WG1816500

Sample Narrative:

L1460109-01 WG1816500: 9.29 at 19.6C

Wet Chemistry by Method 9050AMod

Analyte	Result	Qualifier	RDL	Dilution	Analysis date / time	Batch
	umhos/cm		umhos/cm			
Specific Conductance	328		10.0	1	02/13/2022 07:58	WG1817278

Sample Narrative:

L1460109-01 WG1817278: at 25C

Metals (ICP) by Method 6010B

Analyte	Result	Qualifier	RDL	Dilution	Analysis date / time	Batch
	mg/kg		mg/kg			
Barium	238		0.500	1	02/16/2022 00:10	WG1817139
Cadmium	ND		0.500	1	02/16/2022 00:10	WG1817139
Copper	10.8		2.00	1	02/16/2022 00:10	WG1817139
Lead	8.45		0.500	1	02/16/2022 00:10	WG1817139
Nickel	13.0		2.00	1	02/16/2022 00:10	WG1817139
Selenium	2.48		2.00	1	02/16/2022 00:10	WG1817139
Silver	ND		1.00	1	02/16/2022 00:10	WG1817139
Zinc	25.8		5.00	1	02/16/2022 00:10	WG1817139

Metals (ICP) by Method 6010B-NE493 Ch 2

Analyte	Result	Qualifier	RDL	Dilution	Analysis date / time	Batch
	mg/l		mg/l			
Hot Water Sol. Boron	0.469		0.200	1	02/16/2022 01:41	WG1817290

Metals (ICPMS) by Method 6020

Analyte	Result	Qualifier	RDL	Dilution	Analysis date / time	Batch
	mg/kg		mg/kg			
Arsenic	6.38		1.00	5	02/15/2022 03:06	WG1817141

Volatile Organic Compounds (GC/MS) by Method 8260B

Analyte	Result	Qualifier	RDL	Dilution	Analysis date / time	Batch
	mg/kg		mg/kg			
Benzene	ND		0.00100	1	02/11/2022 01:05	WG1816372
Toluene	ND		0.00500	1	02/11/2022 01:05	WG1816372
Ethylbenzene	ND		0.00250	1	02/11/2022 01:05	WG1816372
Xylenes, Total	ND		0.00650	1	02/11/2022 01:05	WG1816372

Volatile Organic Compounds (GC/MS) by Method 8260B

Analyte	Result mg/kg	Qualifier	RDL mg/kg	Dilution	Analysis date / time	Batch
1,2,4-Trimethylbenzene	ND		0.00500	1	02/11/2022 01:05	WG1816372
1,3,5-Trimethylbenzene	ND		0.00500	1	02/11/2022 01:05	WG1816372
(S) Toluene-d8	*100*		*75.0-131*		*02/11/2022 01:05*	WG1816372
(S) 4-Bromofluorobenzene	*92.1*		*67.0-138*		*02/11/2022 01:05*	WG1816372
(S) 1,2-Dichloroethane-d4	*93.0*		*70.0-130*		*02/11/2022 01:05*	WG1816372

Semi Volatile Organic Compounds (GC/MS) by Method 8270C-SIM

Analyte	Result mg/kg	Qualifier	RDL mg/kg	Dilution	Analysis date / time	Batch
Acenaphthene	ND		0.00600	1	02/16/2022 13:13	WG1818233
Anthracene	ND		0.00600	1	02/16/2022 13:13	WG1818233
Benzo(a)anthracene	ND		0.00600	1	02/16/2022 13:13	WG1818233
Benzo(b)fluoranthene	ND		0.00600	1	02/16/2022 13:13	WG1818233
Benzo(k)fluoranthene	ND		0.00600	1	02/16/2022 13:13	WG1818233
Benzo(a)pyrene	ND		0.00600	1	02/16/2022 13:13	WG1818233
Chrysene	ND		0.00600	1	02/16/2022 13:13	WG1818233
Dibenz(a,h)anthracene	ND		0.00600	1	02/16/2022 13:13	WG1818233
Fluoranthene	ND		0.00600	1	02/16/2022 13:13	WG1818233
Fluorene	ND		0.00600	1	02/16/2022 13:13	WG1818233
Indeno(1,2,3-cd)pyrene	ND		0.00600	1	02/16/2022 13:13	WG1818233
1-Methylnaphthalene	ND		0.0200	1	02/16/2022 13:13	WG1818233
2-Methylnaphthalene	ND		0.0200	1	02/16/2022 13:13	WG1818233
Naphthalene	ND		0.0200	1	02/16/2022 13:13	WG1818233
Pyrene	ND		0.00600	1	02/16/2022 13:13	WG1818233
(S) p-Terphenyl-d14	*87.5*		*23.0-120*		*02/16/2022 13:13*	WG1818233
(S) Nitrobenzene-d5	*87.8*		*14.0-149*		*02/16/2022 13:13*	WG1818233
(S) 2-Fluorobiphenyl	*79.7*		*34.0-125*		*02/16/2022 13:13*	WG1818233

Calculated Results

Analyte	Result	Qualifier	Dilution	Analysis date / time	Batch
	SAR				
Sodium Adsorption Ratio	0.131		1	02/16/2022 00:34	WG1817292

Wet Chemistry by Method 7199

Analyte	Result	Qualifier	RDL	Dilution	Analysis date / time	Batch
	mg/kg		mg/kg			
Hexavalent Chromium	ND		1.00	1	02/17/2022 12:05	WG1817473

Wet Chemistry by Method 9045D

Analyte	Result	Qualifier	Dilution	Analysis date / time	Batch
	pH				
pH	8.70	T8	1	02/11/2022 12:00	WG1816500

Sample Narrative:

L1460109-02 WG1816500: 8.7 at 19.6C

Wet Chemistry by Method 9050AMod

Analyte	Result	Qualifier	RDL	Dilution	Analysis date / time	Batch
	umhos/cm		umhos/cm			
Specific Conductance	176		10.0	1	02/13/2022 07:58	WG1817278

Sample Narrative:

L1460109-02 WG1817278: at 25C

Metals (ICP) by Method 6010B

Analyte	Result	Qualifier	RDL	Dilution	Analysis date / time	Batch
	mg/kg		mg/kg			
Barium	153		0.500	1	02/15/2022 23:55	WG1817139
Cadmium	ND		0.500	1	02/15/2022 23:55	WG1817139
Copper	11.3		2.00	1	02/15/2022 23:55	WG1817139
Lead	9.32		0.500	1	02/15/2022 23:55	WG1817139
Nickel	12.6		2.00	1	02/15/2022 23:55	WG1817139
Selenium	ND		2.00	1	02/15/2022 23:55	WG1817139
Silver	ND		1.00	1	02/15/2022 23:55	WG1817139
Zinc	31.3		5.00	1	02/15/2022 23:55	WG1817139

Metals (ICP) by Method 6010B-NE493 Ch 2

Analyte	Result	Qualifier	RDL	Dilution	Analysis date / time	Batch
	mg/l		mg/l			
Hot Water Sol. Boron	0.959		0.200	1	02/16/2022 01:44	WG1817290

Metals (ICPMS) by Method 6020

Analyte	Result	Qualifier	RDL	Dilution	Analysis date / time	Batch
	mg/kg		mg/kg			
Arsenic	4.07		1.00	5	02/15/2022 02:49	WG1817141

Volatile Organic Compounds (GC/MS) by Method 8260B

Analyte	Result	Qualifier	RDL	Dilution	Analysis date / time	Batch
	mg/kg		mg/kg			
Benzene	ND		0.00100	1	02/11/2022 01:25	WG1816372
Toluene	ND		0.00500	1	02/11/2022 01:25	WG1816372
Ethylbenzene	ND		0.00250	1	02/11/2022 01:25	WG1816372
Xylenes, Total	ND		0.00650	1	02/11/2022 01:25	WG1816372

Volatile Organic Compounds (GC/MS) by Method 8260B

Analyte	Result mg/kg	Qualifier	RDL mg/kg	Dilution	Analysis date / time	Batch
1,2,4-Trimethylbenzene	ND		0.00500	1	02/11/2022 01:25	WG1816372
1,3,5-Trimethylbenzene	ND		0.00500	1	02/11/2022 01:25	WG1816372
(S) Toluene-d8	*101*		*75.0-131*		*02/11/2022 01:25*	WG1816372
(S) 4-Bromofluorobenzene	*93.6*		*67.0-138*		*02/11/2022 01:25*	WG1816372
(S) 1,2-Dichloroethane-d4	*94.8*		*70.0-130*		*02/11/2022 01:25*	WG1816372

Semi Volatile Organic Compounds (GC/MS) by Method 8270C-SIM

Analyte	Result mg/kg	Qualifier	RDL mg/kg	Dilution	Analysis date / time	Batch
Acenaphthene	ND		0.00600	1	02/16/2022 14:12	WG1818233
Anthracene	ND		0.00600	1	02/16/2022 14:12	WG1818233
Benzo(a)anthracene	ND		0.00600	1	02/16/2022 14:12	WG1818233
Benzo(b)fluoranthene	ND		0.00600	1	02/16/2022 14:12	WG1818233
Benzo(k)fluoranthene	ND		0.00600	1	02/16/2022 14:12	WG1818233
Benzo(a)pyrene	ND		0.00600	1	02/16/2022 14:12	WG1818233
Chrysene	ND		0.00600	1	02/16/2022 14:12	WG1818233
Dibenz(a,h)anthracene	ND		0.00600	1	02/16/2022 14:12	WG1818233
Fluoranthene	ND		0.00600	1	02/16/2022 14:12	WG1818233
Fluorene	ND		0.00600	1	02/16/2022 14:12	WG1818233
Indeno(1,2,3-cd)pyrene	ND		0.00600	1	02/16/2022 14:12	WG1818233
1-Methylnaphthalene	ND		0.0200	1	02/16/2022 14:12	WG1818233
2-Methylnaphthalene	ND		0.0200	1	02/16/2022 14:12	WG1818233
Naphthalene	ND		0.0200	1	02/16/2022 14:12	WG1818233
Pyrene	ND		0.00600	1	02/16/2022 14:12	WG1818233
(S) p-Terphenyl-d14	*83.8*		*23.0-120*		*02/16/2022 14:12*	WG1818233
(S) Nitrobenzene-d5	*81.7*		*14.0-149*		*02/16/2022 14:12*	WG1818233
(S) 2-Fluorobiphenyl	*75.5*		*34.0-125*		*02/16/2022 14:12*	WG1818233

Calculated Results

Analyte	Result	Qualifier	Dilution	Analysis date / time	Batch
	SAR				
Sodium Adsorption Ratio	0.506		1	02/16/2022 00:37	WG1817292

Wet Chemistry by Method 7199

Analyte	Result	Qualifier	RDL	Dilution	Analysis date / time	Batch
	mg/kg		mg/kg			
Hexavalent Chromium	ND		1.00	1	02/17/2022 12:10	WG1817473

Wet Chemistry by Method 9045D

Analyte	Result	Qualifier	Dilution	Analysis date / time	Batch
	pH				
pH	8.56	T8	1	02/11/2022 12:00	WG1816500

Sample Narrative:

L1460109-03 WG1816500: 8.56 at 19.4C

Wet Chemistry by Method 9050AMod

Analyte	Result	Qualifier	RDL	Dilution	Analysis date / time	Batch
	umhos/cm		umhos/cm			
Specific Conductance	200		10.0	1	02/13/2022 07:58	WG1817278

Sample Narrative:

L1460109-03 WG1817278: at 25C

Metals (ICP) by Method 6010B

Analyte	Result	Qualifier	RDL	Dilution	Analysis date / time	Batch
	mg/kg		mg/kg			
Barium	133		0.500	1	02/16/2022 00:13	WG1817139
Cadmium	ND		0.500	1	02/16/2022 00:13	WG1817139
Copper	9.92		2.00	1	02/16/2022 00:13	WG1817139
Lead	7.67		0.500	1	02/16/2022 00:13	WG1817139
Nickel	11.6		2.00	1	02/16/2022 00:13	WG1817139
Selenium	ND		2.00	1	02/16/2022 00:13	WG1817139
Silver	ND		1.00	1	02/16/2022 00:13	WG1817139
Zinc	27.8		5.00	1	02/16/2022 00:13	WG1817139

Metals (ICP) by Method 6010B-NE493 Ch 2

Analyte	Result	Qualifier	RDL	Dilution	Analysis date / time	Batch
	mg/l		mg/l			
Hot Water Sol. Boron	0.834		0.200	1	02/16/2022 01:47	WG1817290

Metals (ICPMS) by Method 6020

Analyte	Result	Qualifier	RDL	Dilution	Analysis date / time	Batch
	mg/kg		mg/kg			
Arsenic	3.92		1.00	5	02/15/2022 03:09	WG1817141

Volatile Organic Compounds (GC/MS) by Method 8260B

Analyte	Result	Qualifier	RDL	Dilution	Analysis date / time	Batch
	mg/kg		mg/kg			
Benzene	ND		0.00100	1	02/11/2022 01:44	WG1816372
Toluene	ND		0.00500	1	02/11/2022 01:44	WG1816372
Ethylbenzene	ND		0.00250	1	02/11/2022 01:44	WG1816372
Xylenes, Total	ND		0.00650	1	02/11/2022 01:44	WG1816372

Volatile Organic Compounds (GC/MS) by Method 8260B

Analyte	Result mg/kg	Qualifier	RDL mg/kg	Dilution	Analysis date / time	Batch
1,2,4-Trimethylbenzene	ND		0.00500	1	02/11/2022 01:44	WG1816372
1,3,5-Trimethylbenzene	ND		0.00500	1	02/11/2022 01:44	WG1816372
(S) Toluene-d8	*100*		*75.0-131*		*02/11/2022 01:44*	WG1816372
(S) 4-Bromofluorobenzene	*95.1*		*67.0-138*		*02/11/2022 01:44*	WG1816372
(S) 1,2-Dichloroethane-d4	*87.7*		*70.0-130*		*02/11/2022 01:44*	WG1816372

Semi Volatile Organic Compounds (GC/MS) by Method 8270C-SIM

Analyte	Result mg/kg	Qualifier	RDL mg/kg	Dilution	Analysis date / time	Batch
Acenaphthene	ND		0.00600	1	02/16/2022 14:32	WG1818233
Anthracene	ND		0.00600	1	02/16/2022 14:32	WG1818233
Benzo(a)anthracene	ND		0.00600	1	02/16/2022 14:32	WG1818233
Benzo(b)fluoranthene	ND		0.00600	1	02/16/2022 14:32	WG1818233
Benzo(k)fluoranthene	ND		0.00600	1	02/16/2022 14:32	WG1818233
Benzo(a)pyrene	ND		0.00600	1	02/16/2022 14:32	WG1818233
Chrysene	ND		0.00600	1	02/16/2022 14:32	WG1818233
Dibenz(a,h)anthracene	ND		0.00600	1	02/16/2022 14:32	WG1818233
Fluoranthene	ND		0.00600	1	02/16/2022 14:32	WG1818233
Fluorene	ND		0.00600	1	02/16/2022 14:32	WG1818233
Indeno(1,2,3-cd)pyrene	ND		0.00600	1	02/16/2022 14:32	WG1818233
1-Methylnaphthalene	ND		0.0200	1	02/16/2022 14:32	WG1818233
2-Methylnaphthalene	ND		0.0200	1	02/16/2022 14:32	WG1818233
Naphthalene	ND		0.0200	1	02/16/2022 14:32	WG1818233
Pyrene	ND		0.00600	1	02/16/2022 14:32	WG1818233
(S) p-Terphenyl-d14	*77.1*		*23.0-120*		*02/16/2022 14:32*	WG1818233
(S) Nitrobenzene-d5	*79.7*		*14.0-149*		*02/16/2022 14:32*	WG1818233
(S) 2-Fluorobiphenyl	*72.4*		*34.0-125*		*02/16/2022 14:32*	WG1818233

Calculated Results

Analyte	Result	Qualifier	Dilution	Analysis date / time	Batch
	SAR				
Sodium Adsorption Ratio	2.09		1	02/16/2022 00:39	WG1817292

Wet Chemistry by Method 7199

Analyte	Result	Qualifier	RDL	Dilution	Analysis date / time	Batch
	mg/kg		mg/kg			
Hexavalent Chromium	ND		1.00	1	02/17/2022 13:15	WG1817473

Wet Chemistry by Method 9045D

Analyte	Result	Qualifier	Dilution	Analysis date / time	Batch
	pH				
pH	8.40	T8	1	02/11/2022 12:00	WG1816500

Sample Narrative:

L1460109-04 WG1816500: 8.4 at 19.7C

Wet Chemistry by Method 9050AMod

Analyte	Result	Qualifier	RDL	Dilution	Analysis date / time	Batch
	umhos/cm		umhos/cm			
Specific Conductance	218		10.0	1	02/13/2022 07:58	WG1817278

Sample Narrative:

L1460109-04 WG1817278: at 25C

Metals (ICP) by Method 6010B

Analyte	Result	Qualifier	RDL	Dilution	Analysis date / time	Batch
	mg/kg		mg/kg			
Barium	114		0.500	1	02/16/2022 00:16	WG1817139
Cadmium	ND		0.500	1	02/16/2022 00:16	WG1817139
Copper	11.8		2.00	1	02/16/2022 00:16	WG1817139
Lead	9.13		0.500	1	02/16/2022 00:16	WG1817139
Nickel	11.4		2.00	1	02/16/2022 00:16	WG1817139
Selenium	ND		2.00	1	02/16/2022 00:16	WG1817139
Silver	ND		1.00	1	02/16/2022 00:16	WG1817139
Zinc	28.5		5.00	1	02/16/2022 00:16	WG1817139

Metals (ICP) by Method 6010B-NE493 Ch 2

Analyte	Result	Qualifier	RDL	Dilution	Analysis date / time	Batch
	mg/l		mg/l			
Hot Water Sol. Boron	0.394		0.200	1	02/16/2022 01:50	WG1817290

Metals (ICPMS) by Method 6020

Analyte	Result	Qualifier	RDL	Dilution	Analysis date / time	Batch
	mg/kg		mg/kg			
Arsenic	2.27		1.00	5	02/15/2022 03:12	WG1817141

Volatile Organic Compounds (GC/MS) by Method 8260B

Analyte	Result	Qualifier	RDL	Dilution	Analysis date / time	Batch
	mg/kg		mg/kg			
Benzene	ND		0.00100	1	02/11/2022 02:03	WG1816372
Toluene	ND		0.00500	1	02/11/2022 02:03	WG1816372
Ethylbenzene	ND		0.00250	1	02/11/2022 02:03	WG1816372
Xylenes, Total	ND		0.00650	1	02/11/2022 02:03	WG1816372

Volatile Organic Compounds (GC/MS) by Method 8260B

Analyte	Result mg/kg	Qualifier	RDL mg/kg	Dilution	Analysis date / time	Batch
1,2,4-Trimethylbenzene	ND		0.00500	1	02/11/2022 02:03	WG1816372
1,3,5-Trimethylbenzene	ND		0.00500	1	02/11/2022 02:03	WG1816372
(S) Toluene-d8	*102*		*75.0-131*		*02/11/2022 02:03*	WG1816372
(S) 4-Bromofluorobenzene	*95.0*		*67.0-138*		*02/11/2022 02:03*	WG1816372
(S) 1,2-Dichloroethane-d4	*97.0*		*70.0-130*		*02/11/2022 02:03*	WG1816372

Semi Volatile Organic Compounds (GC/MS) by Method 8270C-SIM

Analyte	Result mg/kg	Qualifier	RDL mg/kg	Dilution	Analysis date / time	Batch
Acenaphthene	ND		0.00600	1	02/16/2022 14:52	WG1818233
Anthracene	ND		0.00600	1	02/16/2022 14:52	WG1818233
Benzo(a)anthracene	ND		0.00600	1	02/16/2022 14:52	WG1818233
Benzo(b)fluoranthene	ND		0.00600	1	02/16/2022 14:52	WG1818233
Benzo(k)fluoranthene	ND		0.00600	1	02/16/2022 14:52	WG1818233
Benzo(a)pyrene	ND		0.00600	1	02/16/2022 14:52	WG1818233
Chrysene	ND		0.00600	1	02/16/2022 14:52	WG1818233
Dibenz(a,h)anthracene	ND		0.00600	1	02/16/2022 14:52	WG1818233
Fluoranthene	ND		0.00600	1	02/16/2022 14:52	WG1818233
Fluorene	ND		0.00600	1	02/16/2022 14:52	WG1818233
Indeno(1,2,3-cd)pyrene	ND		0.00600	1	02/16/2022 14:52	WG1818233
1-Methylnaphthalene	ND		0.0200	1	02/16/2022 14:52	WG1818233
2-Methylnaphthalene	ND		0.0200	1	02/16/2022 14:52	WG1818233
Naphthalene	ND		0.0200	1	02/16/2022 14:52	WG1818233
Pyrene	ND		0.00600	1	02/16/2022 14:52	WG1818233
(S) p-Terphenyl-d14	*74.6*		*23.0-120*		*02/16/2022 14:52*	WG1818233
(S) Nitrobenzene-d5	*73.1*		*14.0-149*		*02/16/2022 14:52*	WG1818233
(S) 2-Fluorobiphenyl	*68.3*		*34.0-125*		*02/16/2022 14:52*	WG1818233

Calculated Results

Analyte	Result	Qualifier	Dilution	Analysis date / time	Batch
	SAR				
Sodium Adsorption Ratio	46.5		1	02/16/2022 00:42	WG1817292

Wet Chemistry by Method 7199

Analyte	Result	Qualifier	RDL	Dilution	Analysis date / time	Batch
	mg/kg		mg/kg			
Hexavalent Chromium	ND		1.00	1	02/17/2022 13:22	WG1817473

Wet Chemistry by Method 9045D

Analyte	Result	Qualifier	Dilution	Analysis date / time	Batch
	pH				
pH	9.60	T8	1	02/11/2022 12:00	WG1816500

Sample Narrative:

L1460109-05 WG1816500: 9.6 at 19.5C

Wet Chemistry by Method 9050AMod

Analyte	Result	Qualifier	RDL	Dilution	Analysis date / time	Batch
	umhos/cm		umhos/cm			
Specific Conductance	7040		10.0	1	02/13/2022 07:58	WG1817278

Sample Narrative:

L1460109-05 WG1817278: at 25C

Metals (ICP) by Method 6010B

Analyte	Result	Qualifier	RDL	Dilution	Analysis date / time	Batch
	mg/kg		mg/kg			
Barium	167		0.500	1	02/15/2022 23:28	WG1817139
Cadmium	ND		0.500	1	02/15/2022 23:28	WG1817139
Copper	10.1		2.00	1	02/15/2022 23:28	WG1817139
Lead	7.56		0.500	1	02/15/2022 23:28	WG1817139
Nickel	9.95		2.00	1	02/15/2022 23:28	WG1817139
Selenium	ND		2.00	1	02/15/2022 23:28	WG1817139
Silver	ND		1.00	1	02/15/2022 23:28	WG1817139
Zinc	28.6		5.00	1	02/15/2022 23:28	WG1817139

Metals (ICP) by Method 6010B-NE493 Ch 2

Analyte	Result	Qualifier	RDL	Dilution	Analysis date / time	Batch
	mg/l		mg/l			
Hot Water Sol. Boron	0.770		0.400	2	02/16/2022 01:53	WG1817290

Metals (ICPMS) by Method 6020

Analyte	Result	Qualifier	RDL	Dilution	Analysis date / time	Batch
	mg/kg		mg/kg			
Arsenic	4.55		1.00	5	02/15/2022 02:20	WG1817141

Volatile Organic Compounds (GC/MS) by Method 8260B

Analyte	Result	Qualifier	RDL	Dilution	Analysis date / time	Batch
	mg/kg		mg/kg			
Benzene	ND		0.00100	1	02/11/2022 02:22	WG1816372
Toluene	ND		0.00500	1	02/11/2022 02:22	WG1816372
Ethylbenzene	ND		0.00250	1	02/11/2022 02:22	WG1816372
Xylenes, Total	ND		0.00650	1	02/11/2022 02:22	WG1816372

Volatile Organic Compounds (GC/MS) by Method 8260B

Analyte	Result mg/kg	Qualifier	RDL mg/kg	Dilution	Analysis date / time	Batch
1,2,4-Trimethylbenzene	ND		0.00500	1	02/11/2022 02:22	WG1816372
1,3,5-Trimethylbenzene	ND		0.00500	1	02/11/2022 02:22	WG1816372
(S) Toluene-d8	*101*		*75.0-131*		*02/11/2022 02:22*	WG1816372
(S) 4-Bromofluorobenzene	*92.1*		*67.0-138*		*02/11/2022 02:22*	WG1816372
(S) 1,2-Dichloroethane-d4	*93.8*		*70.0-130*		*02/11/2022 02:22*	WG1816372

Semi Volatile Organic Compounds (GC/MS) by Method 8270C-SIM

Analyte	Result mg/kg	Qualifier	RDL mg/kg	Dilution	Analysis date / time	Batch
Acenaphthene	ND		0.00600	1	02/16/2022 15:12	WG1818233
Anthracene	ND		0.00600	1	02/16/2022 15:12	WG1818233
Benzo(a)anthracene	ND		0.00600	1	02/16/2022 15:12	WG1818233
Benzo(b)fluoranthene	ND		0.00600	1	02/16/2022 15:12	WG1818233
Benzo(k)fluoranthene	ND		0.00600	1	02/16/2022 15:12	WG1818233
Benzo(a)pyrene	ND		0.00600	1	02/16/2022 15:12	WG1818233
Chrysene	ND		0.00600	1	02/16/2022 15:12	WG1818233
Dibenz(a,h)anthracene	ND		0.00600	1	02/16/2022 15:12	WG1818233
Fluoranthene	ND		0.00600	1	02/16/2022 15:12	WG1818233
Fluorene	ND		0.00600	1	02/16/2022 15:12	WG1818233
Indeno(1,2,3-cd)pyrene	ND		0.00600	1	02/16/2022 15:12	WG1818233
1-Methylnaphthalene	ND		0.0200	1	02/16/2022 15:12	WG1818233
2-Methylnaphthalene	ND		0.0200	1	02/16/2022 15:12	WG1818233
Naphthalene	ND		0.0200	1	02/16/2022 15:12	WG1818233
Pyrene	ND		0.00600	1	02/16/2022 15:12	WG1818233
(S) p-Terphenyl-d14	*76.9*		*23.0-120*		*02/16/2022 15:12*	WG1818233
(S) Nitrobenzene-d5	*71.7*		*14.0-149*		*02/16/2022 15:12*	WG1818233
(S) 2-Fluorobiphenyl	*69.3*		*34.0-125*		*02/16/2022 15:12*	WG1818233

Calculated Results

Analyte	Result	Qualifier	Dilution	Analysis date / time	Batch
	SAR				
Sodium Adsorption Ratio	39.9		1	02/16/2022 00:45	WG1817292

Wet Chemistry by Method 7199

Analyte	Result	Qualifier	RDL	Dilution	Analysis date / time	Batch
	mg/kg		mg/kg			
Hexavalent Chromium	ND		1.00	1	02/17/2022 13:28	WG1817473

Wet Chemistry by Method 9045D

Analyte	Result	Qualifier	Dilution	Analysis date / time	Batch
	pH				
pH	9.08	T8	1	02/11/2022 12:00	WG1816500

Sample Narrative:

L1460109-06 WG1816500: 9.08 at 19.5C

Wet Chemistry by Method 9050AMod

Analyte	Result	Qualifier	RDL	Dilution	Analysis date / time	Batch
	umhos/cm		umhos/cm			
Specific Conductance	9090		10.0	1	02/13/2022 07:58	WG1817278

Sample Narrative:

L1460109-06 WG1817278: at 25C

Metals (ICP) by Method 6010B

Analyte	Result	Qualifier	RDL	Dilution	Analysis date / time	Batch
	mg/kg		mg/kg			
Barium	167		0.500	1	02/15/2022 23:31	WG1817139
Cadmium	ND		0.500	1	02/15/2022 23:31	WG1817139
Copper	12.3		2.00	1	02/15/2022 23:31	WG1817139
Lead	8.11		0.500	1	02/15/2022 23:31	WG1817139
Nickel	11.8		2.00	1	02/15/2022 23:31	WG1817139
Selenium	2.15		2.00	1	02/15/2022 23:31	WG1817139
Silver	ND		1.00	1	02/15/2022 23:31	WG1817139
Zinc	31.8		5.00	1	02/15/2022 23:31	WG1817139

Metals (ICP) by Method 6010B-NE493 Ch 2

Analyte	Result	Qualifier	RDL	Dilution	Analysis date / time	Batch
	mg/l		mg/l			
Hot Water Sol. Boron	2.69		0.200	1	02/16/2022 01:56	WG1817290

Metals (ICPMS) by Method 6020

Analyte	Result	Qualifier	RDL	Dilution	Analysis date / time	Batch
	mg/kg		mg/kg			
Arsenic	5.82		1.00	5	02/15/2022 02:23	WG1817141

Volatile Organic Compounds (GC/MS) by Method 8260B

Analyte	Result	Qualifier	RDL	Dilution	Analysis date / time	Batch
	mg/kg		mg/kg			
Benzene	ND		0.00100	1	02/11/2022 02:41	WG1816372
Toluene	ND		0.00500	1	02/11/2022 02:41	WG1816372
Ethylbenzene	ND		0.00250	1	02/11/2022 02:41	WG1816372
Xylenes, Total	ND		0.00650	1	02/11/2022 02:41	WG1816372

Volatile Organic Compounds (GC/MS) by Method 8260B

Analyte	Result mg/kg	Qualifier	RDL mg/kg	Dilution	Analysis date / time	Batch
1,2,4-Trimethylbenzene	ND		0.00500	1	02/11/2022 02:41	WG1816372
1,3,5-Trimethylbenzene	ND		0.00500	1	02/11/2022 02:41	WG1816372
(S) Toluene-d8	*101*		*75.0-131*		*02/11/2022 02:41*	WG1816372
(S) 4-Bromofluorobenzene	*95.3*		*67.0-138*		*02/11/2022 02:41*	WG1816372
(S) 1,2-Dichloroethane-d4	*94.3*		*70.0-130*		*02/11/2022 02:41*	WG1816372

Semi Volatile Organic Compounds (GC/MS) by Method 8270C-SIM

Analyte	Result mg/kg	Qualifier	RDL mg/kg	Dilution	Analysis date / time	Batch
Acenaphthene	ND		0.00600	1	02/16/2022 15:32	WG1818233
Anthracene	ND		0.00600	1	02/16/2022 15:32	WG1818233
Benzo(a)anthracene	ND		0.00600	1	02/16/2022 15:32	WG1818233
Benzo(b)fluoranthene	ND		0.00600	1	02/16/2022 15:32	WG1818233
Benzo(k)fluoranthene	ND		0.00600	1	02/16/2022 15:32	WG1818233
Benzo(a)pyrene	ND		0.00600	1	02/16/2022 15:32	WG1818233
Chrysene	ND		0.00600	1	02/16/2022 15:32	WG1818233
Dibenz(a,h)anthracene	ND		0.00600	1	02/16/2022 15:32	WG1818233
Fluoranthene	ND		0.00600	1	02/16/2022 15:32	WG1818233
Fluorene	ND		0.00600	1	02/16/2022 15:32	WG1818233
Indeno(1,2,3-cd)pyrene	ND		0.00600	1	02/16/2022 15:32	WG1818233
1-Methylnaphthalene	ND		0.0200	1	02/16/2022 15:32	WG1818233
2-Methylnaphthalene	ND		0.0200	1	02/16/2022 15:32	WG1818233
Naphthalene	ND		0.0200	1	02/16/2022 15:32	WG1818233
Pyrene	ND		0.00600	1	02/16/2022 15:32	WG1818233
(S) p-Terphenyl-d14	*91.0*		*23.0-120*		*02/16/2022 15:32*	WG1818233
(S) Nitrobenzene-d5	*82.7*		*14.0-149*		*02/16/2022 15:32*	WG1818233
(S) 2-Fluorobiphenyl	*80.6*		*34.0-125*		*02/16/2022 15:32*	WG1818233

Method Blank (MB)

(MB) R3761205-1 02/17/22 11:47

Analyte	MB Result mg/kg	MB Qualifier	MB MDL mg/kg	MB RDL mg/kg
Hexavalent Chromium	U		0.255	1.00

L1460109-03 Original Sample (OS) • Duplicate (DUP)

(OS) L1460109-03 02/17/22 12:10 • (DUP) R3761205-3 02/17/22 12:15

Analyte	Original Result mg/kg	DUP Result mg/kg	Dilution	DUP RPD %	DUP Qualifier	DUP RPD Limits %
Hexavalent Chromium	ND	ND	1	0.000		20

L1460758-04 Original Sample (OS) • Duplicate (DUP)

(OS) L1460758-04 02/17/22 14:56 • (DUP) R3761205-8 02/17/22 15:01

Analyte	Original Result mg/kg	DUP Result mg/kg	Dilution	DUP RPD %	DUP Qualifier	DUP RPD Limits %
Hexavalent Chromium	ND	ND	1	0.000		20

Laboratory Control Sample (LCS)

(LCS) R3761205-2 02/17/22 11:54

Analyte	Spike Amount mg/kg	LCS Result mg/kg	LCS Rec. %	Rec. Limits %	LCS Qualifier
Hexavalent Chromium	10.0	9.87	98.7	80.0-120	

L1460758-02 Original Sample (OS) • Matrix Spike (MS) • Matrix Spike Duplicate (MSD)

(OS) L1460758-02 02/17/22 14:14 • (MS) R3761205-4 02/17/22 14:20 • (MSD) R3761205-5 02/17/22 14:25

Analyte	Spike Amount mg/kg	Original Result mg/kg	MS Result mg/kg	MSD Result mg/kg	MS Rec. %	MSD Rec. %	Dilution	Rec. Limits %	MS Qualifier	MSD Qualifier	RPD %	RPD Limits %
Hexavalent Chromium	20.0	ND	14.5	6.84	72.5	34.2	1	75.0-125	J6	J3 J6	71.7	20

L1460758-02 Original Sample (OS) • Matrix Spike (MS)

(OS) L1460758-02 02/17/22 14:14 • (MS) R3761205-6 02/17/22 14:30

Analyte	Spike Amount mg/kg	Original Result mg/kg	MS Result mg/kg	MS Rec. %	Dilution	Rec. Limits %	MS Qualifier
Hexavalent Chromium	638	ND	588	92.1	50	75.0-125	

L1460073-01 Original Sample (OS) • Duplicate (DUP)

(OS) L1460073-01 02/11/22 12:00 • (DUP) R3759267-2 02/11/22 12:00

Analyte	Original Result	DUP Result	Dilution	DUP RPD	DUP Qualifier	DUP RPD Limits
	pH	su		%		%
pH	8.47	8.44	1	0.355		1

Sample Narrative:

OS: 8.47 at 19.9C

DUP: 8.44 at 20.2C

L1460109-03 Original Sample (OS) • Duplicate (DUP)

(OS) L1460109-03 02/11/22 12:00 • (DUP) R3759267-3 02/11/22 12:00

Analyte	Original Result	DUP Result	Dilution	DUP RPD	DUP Qualifier	DUP RPD Limits
	pH	su		%		%
pH	8.56	8.56	1	0.000		1

Sample Narrative:

OS: 8.56 at 19.4C

DUP: 8.56 at 19.4C

Laboratory Control Sample (LCS)

(LCS) R3759267-1 02/11/22 12:00

Analyte	Spike Amount	LCS Result	LCS Rec.	Rec. Limits	LCS Qualifier
	su	su	%	%	
pH	10.0	10.0	100	99.0-101	

Sample Narrative:

LCS: 10 at 18.6C

Method Blank (MB)

(MB) R3759549-1 02/13/22 07:58

Analyte	MB Result umhos/cm	MB Qualifier	MB MDL umhos/cm	MB RDL umhos/cm
Specific Conductance	U		10.0	10.0

Sample Narrative:
BLANK: at 25C

L1459230-04 Original Sample (OS) • Duplicate (DUP)

(OS) L1459230-04 02/13/22 07:58 • (DUP) R3759549-3 02/13/22 07:58

Analyte	Original Result umhos/cm	DUP Result umhos/cm	Dilution	DUP RPD %	DUP Qualifier	DUP RPD Limits %
Specific Conductance	466	437	1	6.42		20

Sample Narrative:
OS: at 25C
DUP: at 25C

L1460440-02 Original Sample (OS) • Duplicate (DUP)

(OS) L1460440-02 02/13/22 07:58 • (DUP) R3759549-4 02/13/22 07:58

Analyte	Original Result umhos/cm	DUP Result umhos/cm	Dilution	DUP RPD %	DUP Qualifier	DUP RPD Limits %
Specific Conductance	4780	4870	1	1.87		20

Sample Narrative:
OS: at 25C
DUP: at 25C

Laboratory Control Sample (LCS)

(LCS) R3759549-2 02/13/22 07:58

Analyte	Spike Amount umhos/cm	LCS Result umhos/cm	LCS Rec. %	Rec. Limits %	LCS Qualifier
Specific Conductance	268	275	103	85.0-115	

Sample Narrative:
LCS: at 25C

QUALITY CONTROL SUMMARY

L1460109-01,02,03,04,05,06

Method Blank (MB)

(MB) R3760407-1 02/15/22 23:50

Analyte	MB Result mg/kg	MB Qualifier	MB MDL mg/kg	MB RDL mg/kg
Barium	U		0.0852	0.500
Cadmium	U		0.0471	0.500
Copper	U		0.400	2.00
Lead	U		0.208	0.500
Nickel	U		0.132	2.00
Selenium	U		0.764	2.00
Silver	U		0.127	1.00
Zinc	U		0.832	5.00

Laboratory Control Sample (LCS)

(LCS) R3760407-2 02/15/22 23:52

Analyte	Spike Amount mg/kg	LCS Result mg/kg	LCS Rec. %	Rec. Limits %	LCS Qualifier
Barium	100	95.4	95.4	80.0-120	
Cadmium	100	91.3	91.3	80.0-120	
Copper	100	93.8	93.8	80.0-120	
Lead	100	92.1	92.1	80.0-120	
Nickel	100	94.8	94.8	80.0-120	
Selenium	100	91.4	91.4	80.0-120	
Silver	20.0	16.8	83.8	80.0-120	
Zinc	100	91.5	91.5	80.0-120	

L1460109-02 Original Sample (OS) • Matrix Spike (MS) • Matrix Spike Duplicate (MSD)

(OS) L1460109-02 02/15/22 23:55 • (MS) R3760407-5 02/16/22 00:04 • (MSD) R3760407-6 02/16/22 00:07

Analyte	Spike Amount mg/kg	Original Result mg/kg	MS Result mg/kg	MSD Result mg/kg	MS Rec. %	MSD Rec. %	Dilution	Rec. Limits %	MS Qualifier	MSD Qualifier	RPD %	RPD Limits %
Barium	100	153	247	237	94.5	84.7	1	75.0-125			4.06	20
Cadmium	100	ND	98.7	91.9	98.5	91.7	1	75.0-125			7.11	20
Copper	100	11.3	112	105	101	93.7	1	75.0-125			6.25	20
Lead	100	9.32	110	103	101	93.9	1	75.0-125			6.47	20
Nickel	100	12.6	117	110	104	97.1	1	75.0-125			6.18	20
Selenium	100	ND	91.8	87.2	90.8	86.1	1	75.0-125			5.23	20
Silver	20.0	ND	18.5	17.2	92.4	85.9	1	75.0-125			7.27	20
Zinc	100	31.3	121	114	90.1	82.4	1	75.0-125			6.50	20

Method Blank (MB)

(MB) R3760410-1 02/16/22 01:30

Analyte	MB Result mg/l	MB Qualifier	MB MDL mg/l	MB RDL mg/l
Hot Water Sol. Boron	U		0.0167	0.200

Laboratory Control Sample (LCS) • Laboratory Control Sample Duplicate (LCSD)

(LCS) R3760410-2 02/16/22 01:33 • (LCSD) R3760410-3 02/16/22 01:35

Analyte	Spike Amount mg/l	LCS Result mg/l	LCSD Result mg/l	LCS Rec. %	LCSD Rec. %	Rec. Limits %	LCS Qualifier	LCSD Qualifier	RPD %	RPD Limits %
Hot Water Sol. Boron	1.00	1.07	1.09	107	109	80.0-120			1.95	20

Method Blank (MB)

(MB) R3760069-1 02/15/22 02:43

Analyte	MB Result mg/kg	MB Qualifier	MB MDL mg/kg	MB RDL mg/kg
Arsenic	U		0.100	1.00

Laboratory Control Sample (LCS)

(LCS) R3760069-2 02/15/22 02:46

Analyte	Spike Amount mg/kg	LCS Result mg/kg	LCS Rec. %	Rec. Limits %	LCS Qualifier
Arsenic	100	85.7	85.7	80.0-120	

L1460109-02 Original Sample (OS) • Matrix Spike (MS) • Matrix Spike Duplicate (MSD)

(OS) L1460109-02 02/15/22 02:49 • (MS) R3760069-5 02/15/22 02:59 • (MSD) R3760069-6 02/15/22 03:02

Analyte	Spike Amount mg/kg	Original Result mg/kg	MS Result mg/kg	MSD Result mg/kg	MS Rec. %	MSD Rec. %	Dilution	Rec. Limits %	MS Qualifier	MSD Qualifier	RPD %	RPD Limits %
Arsenic	100	4.07	89.3	85.5	85.3	81.5	5	75.0-125			4.35	20

Method Blank (MB)

(MB) R3759799-3 02/10/22 22:34

Analyte	MB Result mg/kg	MB Qualifier	MB MDL mg/kg	MB RDL mg/kg
Benzene	U		0.000467	0.00100
Ethylbenzene	U		0.000737	0.00250
Toluene	U		0.00130	0.00500
1,2,4-Trimethylbenzene	U		0.00158	0.00500
1,3,5-Trimethylbenzene	U		0.00200	0.00500
Xylenes, Total	U		0.000880	0.00650
(S) Toluene-d8	*99.4*			*75.0-131*
(S) 4-Bromofluorobenzene	*89.8*			*67.0-138*
(S) 1,2-Dichloroethane-d4	*95.4*			*70.0-130*

Laboratory Control Sample (LCS) • Laboratory Control Sample Duplicate (LCSD)

(LCS) R3759799-1 02/10/22 21:18 • (LCSD) R3759799-2 02/10/22 21:37

Analyte	Spike Amount mg/kg	LCS Result mg/kg	LCSD Result mg/kg	LCS Rec. %	LCSD Rec. %	Rec. Limits %	LCS Qualifier	LCSD Qualifier	RPD %	RPD Limits %
Benzene	0.125	0.121	0.120	96.8	96.0	70.0-123			0.830	20
Ethylbenzene	0.125	0.133	0.131	106	105	74.0-126			1.52	20
Toluene	0.125	0.115	0.114	92.0	91.2	75.0-121			0.873	20
1,2,4-Trimethylbenzene	0.125	0.141	0.137	113	110	70.0-126			2.88	20
1,3,5-Trimethylbenzene	0.125	0.134	0.132	107	106	73.0-127			1.50	20
Xylenes, Total	0.375	0.387	0.399	103	106	72.0-127			3.05	20
(S) Toluene-d8				*96.6*	*94.0*	*75.0-131*				
(S) 4-Bromofluorobenzene				*101*	*103*	*67.0-138*				
(S) 1,2-Dichloroethane-d4				*102*	*104*	*70.0-130*				

L1459768-02 Original Sample (OS) • Matrix Spike (MS) • Matrix Spike Duplicate (MSD)

(OS) L1459768-02 02/11/22 03:58 • (MS) R3759799-4 02/11/22 05:14 • (MSD) R3759799-5 02/11/22 05:33

Analyte	Spike Amount mg/kg	Original Result mg/kg	MS Result mg/kg	MSD Result mg/kg	MS Rec. %	MSD Rec. %	Dilution	Rec. Limits %	MS Qualifier	MSD Qualifier	RPD %	RPD Limits %
Benzene	1.00	ND	1.05	1.05	105	105	8	10.0-149			0.000	37
Ethylbenzene	1.00	ND	1.17	1.17	117	117	8	10.0-160			0.000	38
Toluene	1.00	ND	1.04	1.07	104	107	8	10.0-156			2.84	38
1,2,4-Trimethylbenzene	1.00	ND	1.23	1.24	123	124	8	10.0-160			0.810	36
1,3,5-Trimethylbenzene	1.00	ND	1.24	1.20	124	120	8	10.0-160			3.28	38
Xylenes, Total	3.00	ND	3.55	3.50	118	117	8	10.0-160			1.42	38
(S) Toluene-d8					*97.9*	*98.5*		*75.0-131*				
(S) 4-Bromofluorobenzene					*97.5*	*97.3*		*67.0-138*				
(S) 1,2-Dichloroethane-d4					*103*	*103*		*70.0-130*				

Method Blank (MB)

(MB) R3760648-2 02/16/22 09:35

Analyte	MB Result mg/kg	MB Qualifier	MB MDL mg/kg	MB RDL mg/kg
Anthracene	U		0.00230	0.00600
Acenaphthene	U		0.00209	0.00600
Benzo(a)anthracene	U		0.00173	0.00600
Benzo(a)pyrene	U		0.00179	0.00600
Benzo(b)fluoranthene	U		0.00153	0.00600
Benzo(k)fluoranthene	U		0.00215	0.00600
Chrysene	U		0.00232	0.00600
Dibenz(a,h)anthracene	U		0.00172	0.00600
Fluoranthene	U		0.00227	0.00600
Fluorene	U		0.00205	0.00600
Indeno(1,2,3-cd)pyrene	U		0.00181	0.00600
Naphthalene	U		0.00408	0.0200
Pyrene	U		0.00200	0.00600
1-Methylnaphthalene	U		0.00449	0.0200
2-Methylnaphthalene	U		0.00427	0.0200
(S) Nitrobenzene-d5	*84.8*			*14.0-149*
(S) 2-Fluorobiphenyl	*91.2*			*34.0-125*
(S) p-Terphenyl-d14	*106*			*23.0-120*

Laboratory Control Sample (LCS)

(LCS) R3760648-1 02/16/22 09:15

Analyte	Spike Amount mg/kg	LCS Result mg/kg	LCS Rec. %	Rec. Limits %	LCS Qualifier
Anthracene	0.0800	0.0608	76.0	50.0-126	
Acenaphthene	0.0800	0.0656	82.0	50.0-120	
Benzo(a)anthracene	0.0800	0.0636	79.5	45.0-120	
Benzo(a)pyrene	0.0800	0.0476	59.5	42.0-120	
Benzo(b)fluoranthene	0.0800	0.0650	81.3	42.0-121	
Benzo(k)fluoranthene	0.0800	0.0646	80.7	49.0-125	
Chrysene	0.0800	0.0667	83.4	49.0-122	
Dibenz(a,h)anthracene	0.0800	0.0618	77.3	47.0-125	
Fluoranthene	0.0800	0.0625	78.1	49.0-129	
Fluorene	0.0800	0.0675	84.4	49.0-120	
Indeno(1,2,3-cd)pyrene	0.0800	0.0606	75.8	46.0-125	
Naphthalene	0.0800	0.0676	84.5	50.0-120	
Pyrene	0.0800	0.0626	78.3	43.0-123	
1-Methylnaphthalene	0.0800	0.0686	85.8	51.0-121	
2-Methylnaphthalene	0.0800	0.0661	82.6	50.0-120	

Laboratory Control Sample (LCS)

(LCS) R3760648-1 02/16/22 09:15

Analyte	Spike Amount mg/kg	LCS Result mg/kg	LCS Rec. %	Rec. Limits %	LCS Qualifier
(S) Nitrobenzene-d5			*84.4*	*14.0-149*	
(S) 2-Fluorobiphenyl			*90.3*	*34.0-125*	
(S) p-Terphenyl-d14			*104*	*23.0-120*	

L1460109-01 Original Sample (OS) • Matrix Spike (MS) • Matrix Spike Duplicate (MSD)

(OS) L1460109-01 02/16/22 13:13 • (MS) R3760648-3 02/16/22 13:33 • (MSD) R3760648-4 02/16/22 13:52

Analyte	Spike Amount mg/kg	Original Result mg/kg	MS Result mg/kg	MSD Result mg/kg	MS Rec. %	MSD Rec. %	Dilution	Rec. Limits %	MS Qualifier	MSD Qualifier	RPD %	RPD Limits %
Anthracene	0.0792	ND	0.0659	0.0619	83.2	78.2	1	10.0-145			6.26	30
Acenaphthene	0.0792	ND	0.0628	0.0597	79.3	75.4	1	14.0-127			5.06	27
Benzo(a)anthracene	0.0792	ND	0.0673	0.0626	85.0	79.0	1	10.0-139			7.24	30
Benzo(a)pyrene	0.0792	ND	0.0593	0.0557	74.9	70.3	1	10.0-141			6.26	31
Benzo(b)fluoranthene	0.0792	ND	0.0542	0.0517	68.4	65.3	1	10.0-140			4.72	36
Benzo(k)fluoranthene	0.0792	ND	0.0553	0.0525	69.8	66.3	1	10.0-137			5.19	31
Chrysene	0.0792	ND	0.0623	0.0592	78.7	74.7	1	10.0-145			5.10	30
Dibenz(a,h)anthracene	0.0792	ND	0.0557	0.0530	70.3	66.9	1	10.0-132			4.97	31
Fluoranthene	0.0792	ND	0.0635	0.0594	80.2	75.0	1	10.0-153			6.67	33
Fluorene	0.0792	ND	0.0649	0.0614	81.9	77.5	1	11.0-130			5.54	29
Indeno(1,2,3-cd)pyrene	0.0792	ND	0.0584	0.0554	73.7	69.9	1	10.0-137			5.27	32
Naphthalene	0.0792	ND	0.0642	0.0618	81.1	78.0	1	10.0-135			3.81	27
Pyrene	0.0792	ND	0.0586	0.0549	74.0	69.3	1	10.0-148			6.52	35
1-Methylnaphthalene	0.0792	ND	0.0664	0.0639	83.8	80.7	1	10.0-142			3.84	28
2-Methylnaphthalene	0.0792	ND	0.0637	0.0613	80.4	77.4	1	10.0-137			3.84	28
(S) Nitrobenzene-d5					*92.1*	*85.8*		*14.0-149*				
(S) 2-Fluorobiphenyl					*85.1*	*79.3*		*34.0-125*				
(S) p-Terphenyl-d14					*93.8*	*86.3*		*23.0-120*				

GLOSSARY OF TERMS

Guide to Reading and Understanding Your Laboratory Report

The information below is designed to better explain the various terms used in your report of analytical results from the Laboratory. This is not intended as a comprehensive explanation, and if you have additional questions please contact your project representative.

Results Disclaimer - Information that may be provided by the customer, and contained within this report, include Permit Limits, Project Name, Sample ID, Sample Matrix, Sample Preservation, Field Blanks, Field Spikes, Field Duplicates, On-Site Data, Sampling Collection Dates/Times, and Sampling Location. Results relate to the accuracy of this information provided, and as the samples are received.

Abbreviations and Definitions

MDL	Method Detection Limit.
ND	Not detected at the Reporting Limit (or MDL where applicable).
RDL	Reported Detection Limit.
Rec.	Recovery.
RPD	Relative Percent Difference.
SDG	Sample Delivery Group.
(S)	Surrogate (Surrogate Standard) - Analytes added to every blank, sample, Laboratory Control Sample/Duplicate and Matrix Spike/Duplicate; used to evaluate analytical efficiency by measuring recovery. Surrogates are not expected to be detected in all environmental media.
U	Not detected at the Reporting Limit (or MDL where applicable).
Analyte	The name of the particular compound or analysis performed. Some Analyses and Methods will have multiple analytes reported.
Dilution	If the sample matrix contains an interfering material, the sample preparation volume or weight values differ from the standard, or if concentrations of analytes in the sample are higher than the highest limit of concentration that the laboratory can accurately report, the sample may be diluted for analysis. If a value different than 1 is used in this field, the result reported has already been corrected for this factor.
Limits	These are the target % recovery ranges or % difference value that the laboratory has historically determined as normal for the method and analyte being reported. Successful QC Sample analysis will target all analytes recovered or duplicated within these ranges.
Original Sample	The non-spiked sample in the prep batch used to determine the Relative Percent Difference (RPD) from a quality control sample. The Original Sample may not be included within the reported SDG.
Qualifier	This column provides a letter and/or number designation that corresponds to additional information concerning the result reported. If a Qualifier is present, a definition per Qualifier is provided within the Glossary and Definitions page and potentially a discussion of possible implications of the Qualifier in the Case Narrative if applicable.
Result	The actual analytical final result (corrected for any sample specific characteristics) reported for your sample. If there was no measurable result returned for a specific analyte, the result in this column may state “ND” (Not Detected) or “BDL” (Below Detectable Levels). The information in the results column should always be accompanied by either an MDL (Method Detection Limit) or RDL (Reporting Detection Limit) that defines the lowest value that the laboratory could detect or report for this analyte.
Uncertainty (Radiochemistry)	Confidence level of 2 sigma.
Case Narrative (Cn)	A brief discussion about the included sample results, including a discussion of any non-conformances to protocol observed either at sample receipt by the laboratory from the field or during the analytical process. If present, there will be a section in the Case Narrative to discuss the meaning of any data qualifiers used in the report.
Quality Control Summary (Qc)	This section of the report includes the results of the laboratory quality control analyses required by procedure or analytical methods to assist in evaluating the validity of the results reported for your samples. These analyses are not being performed on your samples typically, but on laboratory generated material.
Sample Chain of Custody (Sc)	This is the document created in the field when your samples were initially collected. This is used to verify the time and date of collection, the person collecting the samples, and the analyses that the laboratory is requested to perform. This chain of custody also documents all persons (excluding commercial shippers) that have had control or possession of the samples from the time of collection until delivery to the laboratory for analysis.
Sample Results (Sr)	This section of your report will provide the results of all testing performed on your samples. These results are provided by sample ID and are separated by the analyses performed on each sample. The header line of each analysis section for each sample will provide the name and method number for the analysis reported.
Sample Summary (Ss)	This section of the Analytical Report defines the specific analyses performed for each sample ID, including the dates and times of preparation and/or analysis.

Qualifier	Description
J3	The associated batch QC was outside the established quality control range for precision.
J6	The sample matrix interfered with the ability to make any accurate determination; spike value is low.
T8	Sample(s) received past/too close to holding time expiration.

ACCREDITATIONS & LOCATIONS

Pace Analytical National 12065 Lebanon Rd Mount Juliet, TN 37122

Alabama	40660	Nebraska	NE-OS-15-05
Alaska	17-026	Nevada	TN000032021-1
Arizona	AZ0612	New Hampshire	2975
Arkansas	88-0469	New Jersey–NELAP	TN002
California	2932	New Mexico [1]	TN00003
Colorado	TN00003	New York	11742
Connecticut	PH-0197	North Carolina	Env375
Florida	E87487	North Carolina [1]	DW21704
Georgia	NELAP	North Carolina [3]	41
Georgia [1]	923	North Dakota	R-140
Idaho	TN00003	Ohio–VAP	CL0069
Illinois	200008	Oklahoma	9915
Indiana	C-TN-01	Oregon	TN200002
Iowa	364	Pennsylvania	68-02979
Kansas	E-10277	Rhode Island	LA000356
Kentucky [1 6]	KY90010	South Carolina	84004002
Kentucky [2]	16	South Dakota	n/a
Louisiana	AI30792	Tennessee [1 4]	2006
Louisiana	LA018	Texas	T104704245-20-18
Maine	TN00003	Texas [5]	LAB0152
Maryland	324	Utah	TN000032021-11
Massachusetts	M-TN003	Vermont	VT2006
Michigan	9958	Virginia	110033
Minnesota	047-999-395	Washington	C847
Mississippi	TN00003	West Virginia	233
Missouri	340	Wisconsin	998093910
Montana	CERT0086	Wyoming	A2LA
A2LA – ISO 17025	1461.01	AIHA-LAP,LLC EMLAP	100789
A2LA – ISO 17025 [5]	1461.02	DOD	1461.01
Canada	1461.01	USDA	P330-15-00234
EPA–Crypto	TN00003		

[1] Drinking Water [2] Underground Storage Tanks [3] Aquatic Toxicity [4] Chemical/Microbiological [5] Mold [6] Wastewater n/a Accreditation not applicable

* Not all certifications held by the laboratory are applicable to the results reported in the attached report.

* Accreditation is only applicable to the test methods specified on each scope of accreditation held by Pace Analytical.

Caerus Oil & Gas LLC
143 Diamond Avenue
Parachute, CO 81635
970-285-9606

Billing Information: **Same as above**

Report to: **bmiddleton@caerusoilandgas.com**

Email To: **bmiddleton@caerusoilandgas.com**

Project Description: **D32NE**

City/State Collected: **Mamm Creek, CO**

Phone:
Fax:

Client Project # **D32NE**

Lab Project # **D32NE**

Collected by (print):

Site/Facility ID # **D32NE**

P.O. # **D32NE**

Collected by (signature):

Immediately Packed on Ice N ____ Y X

Rush? (Lab MUST Be Notified)
___ Same Day ___ Five Day
___ Next Day ___ 5 Day (Rad Only)
___ Two Day ___ 10 Day (Rad Only)
___ Three Day

Quote #

Date Results Needed: **Standard TAT**

Pres Chk

Analysis / Container / Preservative

Sample ID	Comp/Grab	Matrix *	Depth	Date	Time	No. of Cntrs	TPH- GRO,DRO,ORO	BTEX	TABLE 915-1- PAH's	SAR , EC, pH, Boron	TABLE 915-1- Metals	Remarks	Sample # (lab only)
20220209-D32NE(BG-N)	Grab	SS	NA	2/9/22	950	3		+	+	+	+		01
20220209-D32NE(BG-E)					940								02
20220209-D32NE(BG-E)@0.5'-1'					950								03
20220209-D32NE(BG-W)					1000	2							04
20220209-D32NE(BG-S)					1030	3							05
20220209-D32NE(BG-S)@0.5'-1'					1040	3							06

Chain of Custody Page 1 of 1

Pace Analytical®
National Center for Testing & Innovation

12065 Lebanon Rd
Mount Juliet, TN 37122
Phone: 615-758-5858
Phone: 800-767-5859
Fax: 615-758-5859

L # L460108
F208

Acctnum:
Template:
Prelogin:
TSR:
PB:
Shipped Via:

* Matrix:
SS - Soil **AIR** - Air **F** - Filter
GW - Groundwater **B** - Bioassay
WW - WasteWater
DW - Drinking Water
OT - Other_____

Remarks:

pH _____ Temp _____
Flow _____ Other _____

Samples returned via:
__ UPS __ FedEx __ Courier __ _____

Tracking #

Sample Receipt Checklist
COC Seal Present/Intact: NP Y N
COC Signed/Accurate: Y N
Bottles arrive intact: Y N
Correct bottles used: Y N
Sufficient volume sent: Y N
If Applicable
VOA Zero Headspace: Y N
Preservation Correct/Checked: Y N

Relinquished by: (Signature)	Date:	Time:	Received by: (Signature)	Trip Blank Received: Yes / No HCL / MeoH TBR
	2/9/22	1300		
Relinquished by: (Signature)	Date:	Time:	Received by: (Signature)	Temp: NSA °C Bottles Received:
	2/9/22	1500		2.2+.1=2.3 17
Relinquished by: (Signature)	Date:	Time:	Received for lab by: (Signature)	Date: Time:
				2/10/22 930

If preservation required by Login: Date/Time

Hold:

Condition: NCF / ~~OK~~

ENCLOSURE B – SOIL SURVEY OF RIFLE AREA, COLORADO

United States Department of Agriculture

Soil Conservation Service

In Cooperation with the Colorado Agricultural Experiment Station

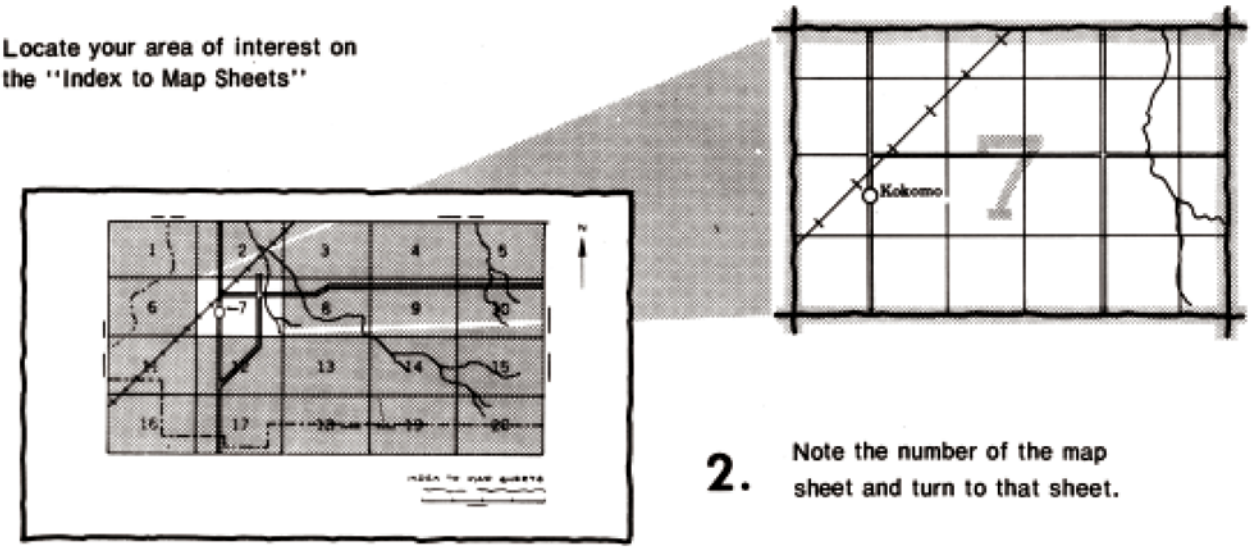
Soil Survey of Rifle Area, Colorado

Parts of Garfield and Mesa Counties



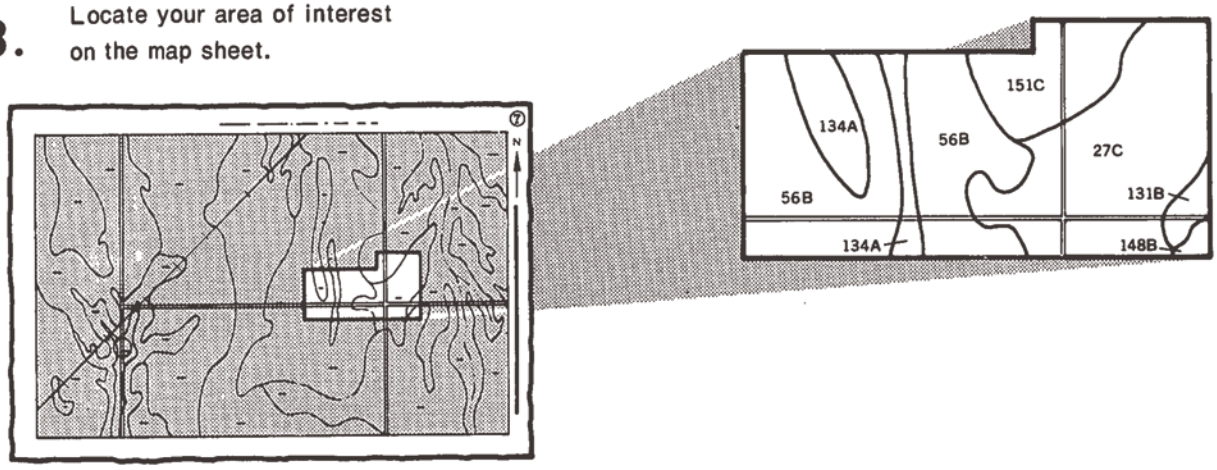
HOW TO USE

1. Locate your area of interest on the "Index to Map Sheets"

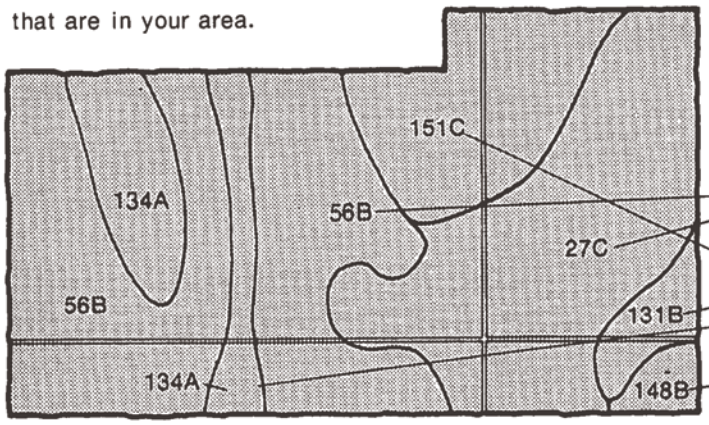


2. Note the number of the map sheet and turn to that sheet.

3. Locate your area of interest on the map sheet.



4. List the map unit symbols that are in your area.

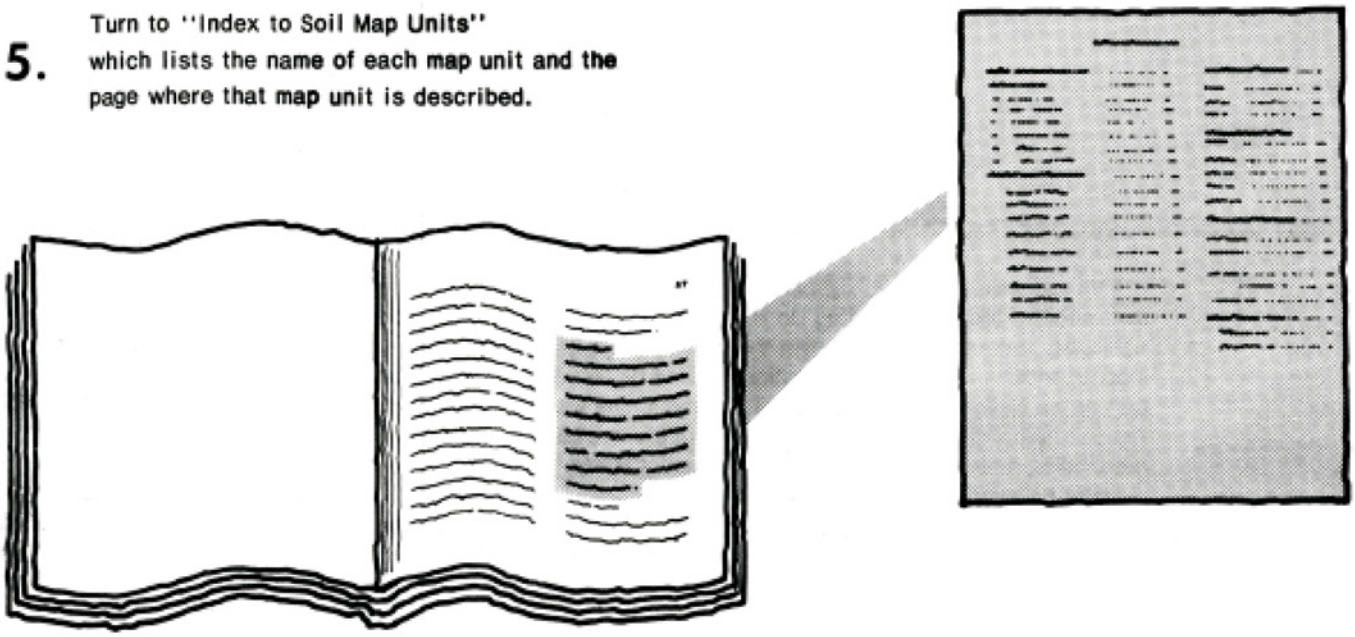


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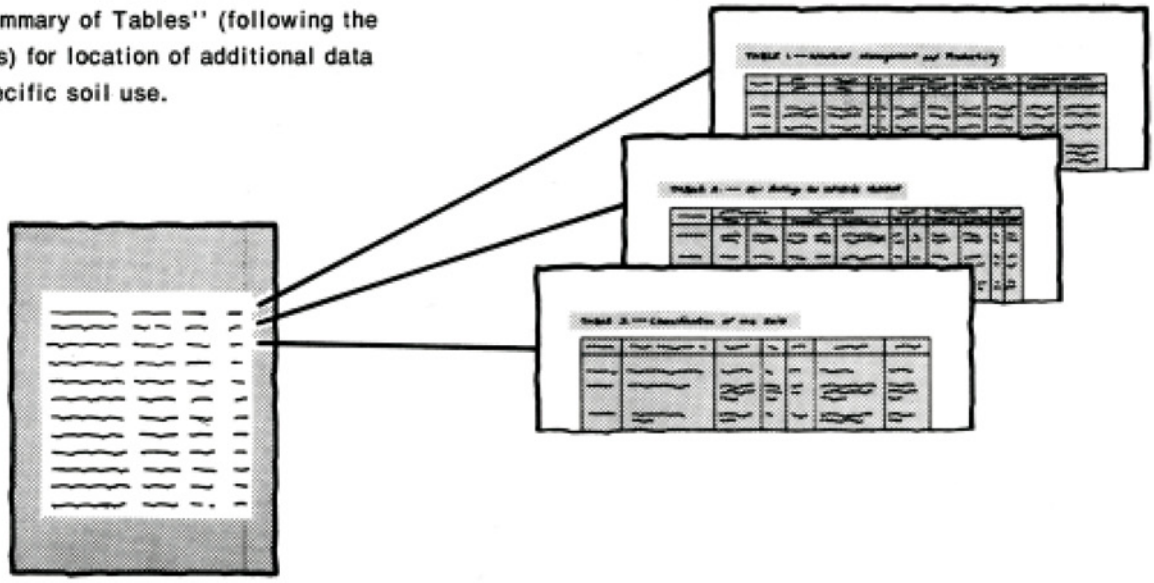
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- 151C

THIS SOIL SURVEY

5. Turn to "Index to Soil Map Units" which lists the name of each map unit and the page where that map unit is described.



6. See "Summary of Tables" (following the Contents) for location of additional data on a specific soil use.



7. Consult "Contents" for parts of the publication that will meet your specific needs. This survey contains useful information for farmers or ranchers, foresters or agronomists; for planners, community decision makers, engineers, developers, builders, or homebuyers; for conservationists, recreationists, teachers, or students; to specialists in wildlife management, waste disposal, or pollution control.

This is a publication of the National Cooperative Soil Survey, a joint effort of the United States Department of Agriculture and agencies of the States, usually the Agricultural Experiment Stations. In some surveys, other Federal and local agencies also contribute. The Soil Conservation Service has leadership for the Federal part of the National Cooperative Soil Survey. In line with Department of Agriculture policies, benefits of this program are available to all, regardless of race, color, national origin, sex, religion, marital status, or age.

Major fieldwork for this soil survey was completed in the period 1970-76. Soil names and descriptions were approved in 1977. Unless otherwise indicated, statements in the publication refer to conditions in the survey area in 1977. This survey was made cooperatively by the Soil Conservation Service and the Colorado Agricultural Experiment Station. It is part of the technical assistance furnished to the Bookcliff, Mt. Sopris, and South Side Soil Conservation Districts. Assistance was provided by the Garfield County Board of Commissioners.

Soil maps in this survey may be copied without permission, but any enlargement of these maps can cause misunderstanding of the detail of mapping and result in erroneous interpretations. Enlarged maps do not show small areas of contrasting soils that could have been shown at a larger mapping scale.

Cover: Rangeland in Rifle Area. The soil in the foreground is Potts loam, 3 to 6 percent slopes. In the background are the Roan Cliffs and Roan Plateau.

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Foreword

The Soil Survey of Rifle Area, Colorado, contains much information useful in any land-planning program. Of prime importance are the predictions of soil behavior for selected land uses. Also highlighted are limitations or hazards to land uses that are inherent in the soil, improvements needed to overcome these limitations, and the impact that selected land uses will have on the environment.

This soil survey has been prepared for many different users. Farmers, ranchers, foresters, and agronomists can use it to determine the potential of the soil and the management practices required for food and fiber production. Planners, community officials, engineers, developers, builders, and homebuyers can use it to plan land use, select sites for construction, develop soil resources, or identify any special practices that may be needed to insure proper performance. Conservationists, teachers, students, and specialists in recreation, wildlife management, waste disposal, and pollution control can use the soil survey to help them understand, protect, and enhance the environment.

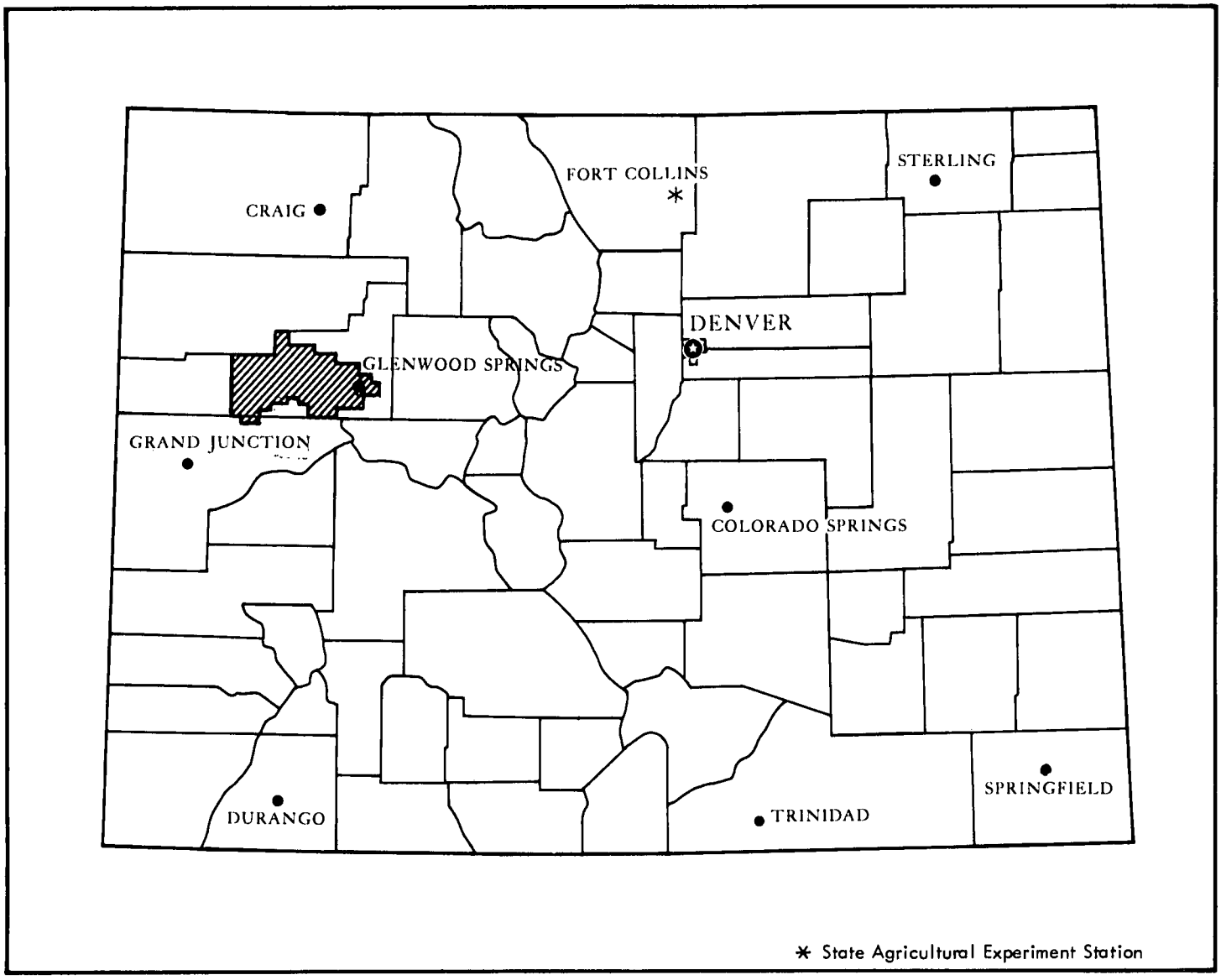
Great differences in soil properties can occur even within short distances. Soils may be seasonally wet or subject to flooding. They may be shallow to bedrock. They may be too unstable to be used as a foundation for buildings or roads. Very clayey or wet soils are poorly suited to septic tank absorption fields. A high water table makes a soil poorly suited to basements or underground installations.

These and many other soil properties that affect land use are described in this soil survey. Broad areas of soils are shown on the general soil map; the location of each kind of soil is shown on detailed soil maps. Each kind of soil in the survey area is described, and much information is given about each soil for specific uses. Additional information or assistance in using this publication can be obtained from the local office of the Soil Conservation Service or the Cooperative Extension Service.

This soil survey can be useful in the conservation, development, and productive use of soil, water, and other resources.



Robert G. Halstead
State Conservationist
Soil Conservation Service



Location of Rifle Area in Colorado.

SOIL SURVEY OF RIFLE AREA, COLORADO

PARTS OF GARFIELD AND MESA COUNTIES

By Jerry B. Harman and Donald J. Murray

Soils surveyed by Jerry B. Harman, Donald J. Murray, Tom S. Bargsten, Steve C. McWilliams, Michael L. Petersen, and William P. Tripp, Soil Conservation Service

United States Department of Agriculture, Soil Conservation Service, in cooperation with the Colorado Agricultural Experiment Station

RIFLE AREA, parts of Garfield and Mesa Counties, is along the Colorado River in northwestern Colorado (see map on facing page). Approximately 99 percent of the survey area is in Garfield County, and the rest is in north-central Mesa County. The survey area covers 629,860 acres, or 984 square miles.

General nature of the area

Rifle Area consists of broad foothill valleys, narrow mountain valleys, high rolling plateaus dissected by steep canyons, and high mountains. Elevation ranges from 4,950 feet near Grand Valley in the western part of the survey area to 10,600 feet on the top of Sunlight Peak in the southeastern part. The survey area extends approximately 48 miles east and west and varies in width from 6 to 27 miles.

The Rifle Area and its principal cities of Glenwood Springs and Rifle are known for year-round outdoor recreation and related services and trade. Important among the other economic resources of the area are crops, livestock, and minerals.

History and development

The Rifle Area was one of the oldest gathering places for the Ute Indian tribe. They hunted in the valley and surrounding mountains and camped at the east end of the area near Yampah Hot Springs.

The first explorers to enter the Rifle Area were Friars Escalante and Dominquez in 1776. In 1860, Captain Richard Sopris and his party entered the valley from the east (*10*).

In 1881, the Ute Indians were placed on reservations and the United States Government opened western Colorado to development. Emigrants chose most of this area as a good location for farming and ranching (*4*). The first homestead of 160 acres was filed for in 1880, near the present site of the city of Rifle.

In 1883, Garfield County was established. Grand Springs, which was established and renamed Glenwood Springs in 1885, was the permanent county seat. Settlement of the area proceeded rapidly. New Castle, Silt, Rifle, and Grand Valley were established within a few years.

Agriculture was the main factor in development and settlement in Silt, Rifle, and Grand Valley. Fruit crops, small grains, a variety of vegetable crops, and hay were grown initially in the area. With the coming of the railroad in 1890, Rifle became a major livestock shipping center. Although very little livestock is shipped by rail now, this area still depends largely on livestock production.

Mineral production and speculation has influenced the development of the Rifle Area. Coal, vanadium, and uranium were mined. A very productive natural gas field was developed in the south-central part of the Area. Oil shale deposits were first examined and reported to be a potential source of oil about 1915.

Excellent hunting, fishing, hiking, swimming, and skiing make this area a year-round recreation center. In 1890, the waters of the Yampah Hot Springs were harnessed and developed into a swimming pool and vapor cave. The Glenwood Springs area has been a major tourist attraction since.

Glenwood Springs and Rifle are the largest cities in the Area. Glenwood Springs (fig. 1) has a population of 5,688, and Rifle has a population of 2,600. West Glenwood, an unincorporated area just west of Glenwood Springs, has a population of 1,840. Grand Valley has a population of 525, New Castle has a population of 656, and Silt has a population of 966. The rural population of the Rifle Area is 5,254.

Physiography, drainage, and relief

The Rifle Area is in the central part of the Southern Rocky Mountains. In general, the greater part of the area consists of high mountains, plateaus, foothills, and narrow valleys. There are some relatively broad flood plains and valleys. Some small mesas have a deposit of silty loess over old river terrace cobbles and stony basaltic outwash.

Elevation within the Rifle Area varies from approximately 4,950 feet above sea level along the Colorado River in the western part of the Area to 10,600 feet on the high mountains in the southeastern part. The elevation of Rifle, along the Colorado River in the central part, is 5,345 feet. Glenwood Springs, along the Colorado River in the eastern part, is at 5,763 feet. Elevations increase sharply on either side of the Colorado River valley.

The Colorado River flows in a westerly to southwesterly direction through the Area. The Roaring Fork River drains the eastern part of the Area, and many creeks drain the western part (fig. 2). The most important creeks are South Canon Creek, Divide Creek, Mamm Creek, Beaver Creek, Porcupine Creek, Battlement Creek, and Alkali Creek, all on the south side of the Colorado River and Oasis Creek, Mitchell Creek, Canon Creek, Elk Creek, Government Creek, and Parachute Creek on the north. Many intermittent drainageways also flow into the Colorado River. The tributaries on the north side of the river drain the high mountains and plateaus. The Flat Tops in the northeastern part of the Area are primarily sandstone and limestone. They are high, rolling mountains cut by narrow, steep canyons and well defined drainageways. The Roan Plateau dominates the landscape in the northwestern part of the area. The plateau consists of rolling to steep mountainsides and well defined narrow mountain valleys and drainageways. Extremely steep canyons and cliffs exposing the Green River Formation are along Parachute Creek and its tributaries. Underlying the Green River shale are exposures of multicolored, silty Wasatch shale.

The major creeks on the south side of the Colorado River drain the Battlement Mountains, the Divide Creek Valley, and the high mountains south of Glenwood Springs. The Battlement Mountains consist primarily of Green River shale and the underlying Wasatch shale. The Divide Creek Valley is an area of low lying fans, ridges, and mesas of mixed shale, sandstone, and basaltic alluvium. Reddish silty loess has been deposited over most of this valley. The mountains south of Glenwood Springs are mixed sandstone and shale with a basalt cap in many areas. The mountains are steep and have narrow valleys and well defined drainageways.

The Colorado River Valley varies in width from 1/2 to 2 miles. It consists of nearly level flood plains and low terraces. The water table fluctuates between depths of less than 10 inches and more than 60 inches.

Adjacent to the valley are higher lying terraces and mesas. The best irrigated soils in the area are on these terraces. The terrace soils are normally well drained, and deep over cobbles and gravel. The mesas normally have a deep deposit of reddish silty loess over cobbles and gravel. Slope on these terraces and mesas ranges from nearly level to gently sloping and rolling.

Climate

In Garfield County, summer is warm or hot in most valleys and much cooler in the mountains. Winter is cold in the mountains. Valleys are colder than the lower parts of adjacent mountains because of cold air drainage. Precipitation falls in the mountains throughout the year, and a deep snowpack accumulates during winter. Snowmelt usually supplies much more water than can be used for farming.

In valleys precipitation in summer falls as showers; some thunderstorms occur. In winter the ground is covered with snow much of the time. Chinook winds, which blow downslope and are warm and dry, often melt and evaporate the snow.

Table 1 gives data on temperature and precipitation in the survey area, as recorded at Rifle, from 1951 to 1974. Table 2 shows probable dates of the first freeze in fall and the last freeze in spring. Table 3 provides data on length of the growing season.

In winter the average temperature is 25.5 degrees F, and the average daily low is 12.0 degrees. The lowest temperature on record, -38 degrees, occurred at Rifle on January 12, 1963. In summer the average temperature is 67.3 degrees, and the average daily high is 86.6 degrees. The highest temperature, 101 degrees, was recorded on July 11, 1954.

Growing degree days, shown in table 1, are equivalent to "heat units." Beginning in spring, growing degree days accumulate by the amount that the average temperature each day exceeds a base temperature (40 degrees F). The normal monthly accumulation is used to schedule single or successive plantings of a crop between the last freeze in spring and the first freeze in fall.

Of the total annual precipitation, 5.69 inches, or 51 percent, usually falls from April to September, which includes the growing season for most crops. Two years in ten, the April-September rainfall is less than 3.84 inches. The heaviest 1-day rainfall during the period of record was 1.95 inches at Rifle on October 13, 1957. Thunderstorms number about 35 each year, 21 of which occur in summer.

Average seasonal snowfall is 50 inches. The greatest snow depth at any one time during the period of record was 29 inches. On the average, 24 days have at least one inch of snow on the ground, but the number of days varies greatly from year to year.

The average relative humidity in midafternoon is less than 33 percent in spring; during the rest of the year it is

about 44 percent. Humidity is higher at night in all seasons, and the average at dawn is about 59 percent. The percentage of possible sunshine is 77 percent in summer and 61 percent in winter. The prevailing wind is from the east-southeast. Average windspeed is highest, 10 miles per hour, in June.

Much of the Rifle Area is higher than Rifle and is somewhat cooler and receives more precipitation. Glenwood Springs, near the eastern edge of the Area, averages about one degree cooler than Rifle and receives about 5 inches more precipitation per year.

Farming and ranching

The first settlers in the Rifle Area were homesteaders who came to develop the land for farming and ranching. Irrigation systems were soon constructed and a wide variety of small grains, hay, and vegetables were successfully grown. Sugar beets were introduced about 1910 and were a major cash crop until the early 1950's, when transportation and field labor shortages forced the producers to grow other crops.

Farming today is primarily concerned with forage for livestock. There is about 62,000 acres, or about 10 percent of the Rifle Area, in crops and pasture. About 18,000 acres is used for irrigated pasture, and approximately 44,000 acres is used for harvested crops. Of this, approximately 40,000 acres is irrigated, and the remaining 4,000 acres is dryfarmed. Approximately 80 percent, or 32,000 acres, of the irrigated crops is used for alfalfa and alfalfa-grass mixtures for hay. Other irrigated crops include corn for ensilage, oats, and barley. Wheat is the main dryfarmed crop, and a small acreage of oats and barley is grown (*9*).

Livestock is the most important part of the Area's agriculture. Most livestock operations are cow-calf. A few ranchers raise feeder calves and sell them to commercial feedlots elsewhere. About 65 percent of the Rifle Area is native rangeland. About 20 percent of the Area is woodland with considerable grazing value.

The Rifle Area is surrounded by land administered by the Bureau of Land Management and the Forest Service. Most ranchers in the area lease grazing allotments on these lands for summer grazing. Hay, grain, and forage for ensilage are grown under irrigation and fed to the livestock in winter.

Farms and ranches in the Rifle Area have become fewer and larger over the last 10 years. A considerable amount of land has been sold to land development companies for housing projects. Other land has been sold to neighboring ranchers. In 1974, there were 41 fewer farms and ranches in Garfield County than in 1969.

Natural resources

Soil, water, vanandium, uranium, natural gas, coal, oil shale, sand and gravel, and wildlife are the major natural resources of the Rifle Area.

Soil is the most widely used of the Area's resources and can yield benefits without depletion if managed and used properly. The purpose of this report is to aid in maintaining and improving the value of the soil resource. The soil in the Rifle Area has a multitude of uses, including irrigated crops, trees, rangeland, and urban development.

The main source of surface water in the Rifle Area is the Colorado River. Many tributaries to the Colorado River contribute to the quality and quantity of water. Irrigation and domestic water supplies are obtained from these sources.

Vanadium and uranium are mined in the Area and extracted from the ore at the mill at Rifle. Natural gas fields are in the southern part of the survey area. They are not too concentrated in any one area but are considered to be high producers. Coal is a potential major resource in the Rifle Area. It was once intensively mined along the Grand Hogback near New Castle and Rifle. Reportedly, huge beds of coal are in the Grand Hogback. Oil shale is another resource with enormous potential. The northwestern part of the Area contains the thickest, richest, and most easily mined oil shale (actually marlstone rather than shale) deposits in the Green River Formation of Colorado, Utah, and Wyoming (*5*). The Green River Formation is the largest oil shale deposit in the world (fig. 3). Sand and gravel deposits are abundant along the terraces adjacent to the Colorado River. These deposits have been developed and used to some extent for construction of an interstate highway and for local building.

The Rifle Area has some of the best hunting and fishing in the State of Colorado. Well managed fish and game programs are responsible for the development of this resource.

Recreation and tourism

The natural beauty of the Rifle Area with high mountains on either side of the Colorado River Valley and the abundance of recreational facilities has created a large tourist trade, especially in the eastern part of the Area.

The Yampah Hot Springs at Glenwood Springs was developed as a health and recreation center soon after the area was settled. It achieved world-wide fame as a health resort and today is a major attraction. The Hot Springs pool is the largest outdoor swimming pool in Colorado and is open all year.

Hiking and camping are also favorite recreations in the Rifle Area. The White River National Forest borders the Area. It has many four-wheel-drive roads, horseback trails, and foot trails.

The White River National Forest supports the largest elk and deer populations in Colorado. The lakes, streams, and rivers of the White River National Forest and the Rifle Area are well stocked with trout and provide excellent fishing. Local fish hatcheries supply trout for restocking these waters. The Rifle Falls Fish Hatchery is the largest State hatchery in Colorado and one of the largest in the world.

Cross-country and downhill skiing and snowmobiling are also popular.

The Rifle Area is accessible by Interstate 70 and the Rio Grande Western Railroad. Regularly scheduled commercial airline flights fly into Aspen, 45 miles southeast of Glenwood Springs, and Grand Junction, 64 miles southwest of Rifle.

How this survey was made

Soil scientists made this survey to learn what kinds of soil are in the survey area, where they are, and how they can be used. The soil scientists went into the area knowing they likely would locate many soils they already knew something about and perhaps identify some they had never seen before. They observed the steepness, length, and shape of slopes; the size of streams and the general pattern of drainage; the kinds of native plants or crops; the kinds of rock; and many facts about the soils. They dug many holes to expose soil profiles. A profile is the sequence of natural layers, or horizons, in a soil; it extends from the surface down into the parent material, which has been changed very little by leaching or by the action of plant roots.

The soil scientists recorded the characteristics of the profiles they studied, and they compared those profiles with others in counties nearby and in places more distant. Thus, through correlation, they classified and named the soils according to nationwide, uniform procedures.

After a guide for classifying and naming the soils was worked out, the soil scientists drew the boundaries of the soils on aerial photographs. These photographs show woodlands, buildings, field borders, roads, and other details that help in drawing boundaries accurately. The soil map at the back of this publication was prepared from aerial photographs.

The areas shown on a soil map are called soil map units. Some map units are made up of one kind of soil, others are made up of two or more kinds of soil, and a few have little or no soil material at all. Map units are discussed in the sections "General soil map for broad land use planning" and "Soil maps for detailed planning."

While a soil survey is in progress, samples of soils are taken as needed for laboratory measurements and for engineering tests. The soils are field tested, and interpretations of their behavior are modified as necessary during the course of the survey. New interpretations are added to meet local needs, mainly through field observations of different kinds of soil in different uses under different levels of management. Also, data are assembled from other sources, such as test results, records, field experience, and information available from state and local specialists. For example, data on crop yields under defined practices are assembled from farm records and from field or plot experiments on the same kinds of soil.

But only part of a soil survey is done when the soils have been named, described, interpreted, and delineated on aerial photographs and when the laboratory data and other data have been assembled. The mass of detailed information then needs to be organized so that it is readily available to different groups of users, among them farmers, managers of rangeland and woodland, engineers, planners, developers and builders, homebuyers, and those seeking recreation.

General soil map for broad land use planning

The general soil map at the back of this publication shows, in color, map units that have a distinct pattern of soils and of relief and drainage. Each map unit is a unique natural landscape. Typically, a map unit consists of one or more major soils and some minor soils. It is named for the major soils. The soils making up one unit can occur in other units but in a different pattern.

The general soil map provides a broad perspective of the soils and landscapes in the survey area. It provides a basis for comparing the potential of large areas for general kinds of land use. Areas that are, for the most part, suited to certain kinds of farming or to other land uses can be identified on the map. Likewise, areas of soils having properties that are distinctly unfavorable for certain land uses can be located.

Because of its small scale, the map does not show the kind of soil at a specific site. Thus, it is not suitable for planning the management of a farm or field or for selecting a site for a road or building or other structure. The kinds of soil in any one map unit differ from place to place in slope, depth, stoniness, drainage, or other characteristics that affect their management.

The soils in the survey area vary widely in their potential for major land uses.

Descriptions of the general soil map units

1. Parachute-Rhone-Irigul

Deep to shallow, well drained, moderately sloping to steep soils on mountains and ridges

This map unit is in the northwestern part of the survey area. Elevation is 7,500 to 8,700 feet. The soils are

underlain by and formed in material weathered from Green River shale and Uinta sandstone. Annual precipitation is about 20 inches, and average annual temperature is about 40 degrees F.

This map unit covers about 16 percent of the survey area, or approximately 100,000 acres. The unit is about 30 percent Parachute soils, 30 percent Rhone soils, 20 percent Irigul soils, 15 percent Northwater soils, and 5 percent soils of minor extent.

Parachute soils are on ridges and mountainsides. They are moderately deep and well drained. The surface layer is loam, and the subsoil is loam that grades to extremely channery loam. Bedrock is sandstone.

Rhone soils are on mountainsides. They are deep and well drained. The surface layer is loam in the upper part and sandy clay loam in the lower part. The substratum is very channery sandy clay loam.

Irigul soils are on crests and sides of ridges. They are shallow and well drained. The surface layer is channery loam, and the substratum is extremely channery sandy clay loam. Bedrock is sandstone.

This unit is used entirely for grazing and wildlife habitat. It is poorly suited to other uses. It is grazed mainly from early summer to early fall. This unit is well suited to wildlife habitat. Deer, elk, mountain lion, grouse, rabbits, and squirrels are common.

2. Rock outcrop-Torriorthents

Rock outcrop and moderately deep and shallow, well drained, very steep and extremely steep soils on escarpments and mountains

This map unit is in the northwestern part of the survey area below the Roan Plateau from the escarpment edges down to the toe slope. Average annual precipitation is about 14 inches, and average annual temperature is about 46 degrees F.

This map unit covers about 5 percent of the survey area, or approximately 30,000 acres. This unit is about 45 percent Rock outcrop, 40 percent Torriorthents, and 15 percent soils of minor extent.

Rock outcrop is on the nearly vertical cliffs from the rim of the Roan Plateau to the talus slopes below. It consists of exposures of shale of the Green River Formation. This shale is locally known as "oil shale."

Torriorthents are on the colluvial slopes below the Rock outcrop. They are moderately deep and shallow and are well drained. They are clayey to loamy and contain variable amounts of gravel, cobbles, and stones.

This unit is used primarily for grazing and wildlife habitat, mainly on the toe slopes where browse plants and some grasses grow. The deer and elk feed at the lower elevations in winter. Sage grouse, mountain lion, rabbits, and coyotes also find habitat on this unit. There has been limited mining of "oil shale" from the Rock outcrop. Commercial development is extremely limited.

3. Arvada-Torrifluvents-Heldt

Deep, well drained to somewhat poorly drained, nearly level to gently sloping soils on benches, terraces, alluvial fans, and flood plains

This map unit is in the central part of the survey area. The soils formed in mixed alluvium. Average annual precipitation is about 13 inches, and average annual temperature is about 48 degrees F.

This map unit covers about 6 percent of the survey area, or approximately 41,000 acres. This unit is about 40 percent Arvada soils, 20 percent Torrifluvents, 20 percent Heldt soils, and 20 percent soils of minor extent.

Arvada soils are on benches, terraces, and fans. They are deep, well drained, and alkali affected. The surface layer is loam, the subsoil is strongly alkaline silty clay loam, and the substratum is silty clay loam.

Torrifluvents are on flood plains and low terraces. They are deep and well drained to somewhat poorly drained. They are sandy loam or loam stratified with sand, gravel, or cobbles.

Heldt soils are on alluvial fans. They are deep and well drained. The surface layer and subsoil are clay loam, and the substratum is clay.

Minor in this unit are Nihill, Kim, and Olney soils. These soils are deep and well drained.

This unit is used for irrigated crops, grazing, and wildlife habitat. Most of the irrigated crops are on the Heldt soils. The major crops are alfalfa, small grains, and irrigated pasture. The suitability of the Arvada soils for irrigated crops is poor because of the strongly saline-alkali condition and slow permeability. The suitability of Torrifluvents for irrigation and most other uses is poor because of flooding and a high water table. This unit has poor suitability for community development because of flooding, high shrink-swell potential, and salinity and alkalinity. It has fair suitability for upland wildlife habitat. Torrifluvents have fair suitability for wetland wildlife habitat.

4. Torriorthents-Rock outcrop-Camborthids

Dominantly shallow to deep, well drained, steep to extremely steep soils, and Rock outcrop, on mountains, fans, and ridges

This map unit is throughout the survey area. The soils formed in sandstone and shale. Average annual precipitation is about 14 inches, and average annual temperature is about 47 degrees F.

This map unit covers about 20 percent of the survey area, or approximately 130,000 acres. This unit is about 50 percent Torriorthents, 20 percent Rock outcrop, 20 percent Camborthids, and 10 percent soils of minor extent.

Torriorthents are on steep and very steep mountainsides and steep fans. They are shallow and moderately

deep and are well drained. They are clayey to loamy and contain variable amounts of gravel, cobbles, and stones.

Rock outcrop is on steep and very steep mountainsides and escarpments. It is mostly sandstone and shale.

Camborthids are on steep fans and mountainsides. They are shallow to deep and are generally clayey to loamy throughout.

Minor in this unit are Lazear, Dollard, and Ansari soils. These soils are on steep mountainsides.

This unit is used almost entirely for wildlife habitat and limited grazing. It is well suited to wildlife habitat and is important winter feeding areas for deer and elk. Grouse, mountain lion, rabbits, and coyotes also use these areas. This unit is poorly suited to community development because of depth to rock, steep slopes, and Rock outcrop.

5. Potts-Ildefonso-Vale

Deep, well drained, gently sloping to steep soils on mesas, alluvial fans, terraces, and benches

This map unit is in the central and south-central parts of the survey area. The soils formed in loess caps over gravelly material on mesas and in a mixture of basalt and sandstone outwash. Average annual precipitation is about 14 inches, and average annual temperature is about 47 degrees F.

This map unit covers about 16 percent of the survey area, or approximately 100,000 acres. This unit is about 40 percent Potts soils, 20 percent Ildefonso soils, 15 percent Vale soils, 10 percent Olney soils, and 15 percent soils of minor extent.

Potts and Vale soils are on mesas and gently sloping fans. They are deep and well drained. The surface layer is loam or silt loam, the subsoil is clay loam or silty clay loam, and the substratum is loam and silt loam.

Ildefonso soils are on moderately sloping to steep fans. They are deep and well drained. The surface layer is stony loam, and the substratum is very stony loam.

Olney soils are on gently sloping fans.

Minor in this unit are Heldt and Pena soils, Torriorthents, Camborthids, and Rock outcrop.

About 60 percent of this unit is used for dryfarmed and irrigated crops. Most irrigated crops are hay and pasture. A very small acreage is dryfarmed. The rest of the unit is used for grazing and nonirrigated pasture. Wildlife such as deer, elk, rabbits, grouse, and doves find food and cover on this unit. Deer and elk use this unit as a prime winter feeding area. A few pheasant and chukar live near areas where cereal crops are grown.

6. Morval-Villa Grove

Deep, well drained, moderately sloping to moderately steep soils on mesas, mountainsides, and alluvial fans

This map unit is in the south-central and extreme eastern parts of the survey area. The soils formed in alluvium and outwash derived from mixed basalt and sandstone from mountainous areas. Average annual precipitation is about 16 inches, and average annual temperature is about 44 degrees F.

This map unit covers about 8 percent of the survey area, or approximately 50,000 acres. The unit is about 15 percent Morval soils, 15 percent Villa Grove soils, 10 percent Tridell soils, 10 percent Zoltay soils, and 50 percent soils of minor extent.

Morval soils are on moderately sloping mesas and sides of valleys. They are deep and well drained. The surface layer is loam, the subsoil is clay loam, and the substratum is stony loam.

Villa Grove soils are on mountainsides and fans. They are deep and well drained. The surface layer is loam, the subsoil is clay loam, and the substratum is loam.

Tridell soils are on strongly sloping to moderately steep mesa sides and fans. They are deep and well drained. The surface layer is stony loam, and the substratum is very stony loam. Zoltay soils are on moderately steep mountainsides and fans. They are deep and well drained. The surface layer is loam, and the subsoil and substratum are cobbly clay.

Minor in this unit are Ansari, Dollard, Detra, and Jerry soils and Torriorthents, Camborthids, and Rock outcrop.

Nearly all of this unit is used for grazing and wildlife habitat. It produces good stands of grasses, forbs, and browse shrubs. This unit is used extensively by wildlife and is a wintering area for deer and elk. Upland wildlife such as grouse and dove also fine cover and food on this unit. Nearly all of the soils in this unit are poorly suited to community development. Steep slopes, stones, and high shrink-swell potential are the main limitations.

7. Lazear-Cushman-Ascalon

Shallow to deep, well drained, moderately sloping to very steep soils on mountains, mesa breaks, and alluvial fans

This map unit is in the central and north-central parts of the survey area. The soils formed in material weathered from sandstone, limestone, and shale and in mixed alluvium. Average annual precipitation ranges from 12 to 15 inches, and average annual temperature is about 48 degrees F.

This map unit covers about 6 percent of the survey area, or approximately 35,000 acres. The unit is about 30 percent Lazear soils, 30 percent Cushman soils, 15 percent Ascalon soils, and 25 percent soils of minor extent.

Lazear soils are on moderately sloping to very steep mountainsides and mesa breaks. They are shallow and well drained. The surface layer is gravelly loam, and the substratum is cobbly loam. Bedrock is sandstone.

Cushman soils are on moderately sloping to steep mesa breaks and side slopes. They are moderately deep and well drained. The surface layer is stony loam, the

subsoil is sandy clay loam, and the substratum is loam and very gravelly loam. Bedrock is shale and sandstone.

Ascalon soils are on moderately sloping to strongly sloping alluvial fans and mesas. They are deep and well drained. The surface layer is fine sandy loam, and the subsoil and substratum are sandy clay loam.

Minor in this unit are Tanna soils, Torriorthents, Camborthids, Badland, and Rock outcrop. Tanna soils are on the strongly sloping to very steep mountainsides. Badland is on the very steep mountainsides and hills. Torriorthents, Camborthids, and Rock outcrop are on the steep to very steep hills and mesa breaks.

This unit is used for grazing and wildlife habitat. It provides cover and food for deer, elk, rabbits, grouse, doves, and chukars. The understory vegetation is sparse in most areas and is dominated by pinyon and juniper. Livestock grazing must be carefully managed to prevent deterioration of the desirable understory vegetation. Deer and elk feed in these areas of sparse vegetation in winter. Community development is limited to a small part of this map unit. Steep slopes and stoniness are the main limitations.

8. Bucklon-Inchau-Cochetopa

Shallow to deep, well drained, moderately sloping to steep soils on mountains and alluvial fans

This map unit is mainly in the southwestern part of the survey area. The soils formed in alluvium derived from sandstone, shale, and basalt. Average annual precipitation is 18 inches, and average annual temperature is about 40 degrees F.

This map unit covers about 5 percent of the survey area, or approximately 30,000 acres. This unit is about 40 percent Bucklon soils, 25 percent Inchau soils, 20 percent Cochetopa soils, and 15 percent soils of minor extent.

Bucklon soils are on ridges and mountainsides. They are shallow and well drained. The surface layer is loam, and the substratum is clay loam and loam. Bedrock is sandstone.

Inchau soils are on mountainsides and ridges. They are moderately deep and well drained. The surface layer is loam, and the subsoil is clay loam. Bedrock is sandstone or shale.

Cochetopa soils are on mountainsides and alluvial fans. They are deep and well drained. The surface layer is loam, the subsoil is stony clay loam or stony clay, and the substratum is stony clay.

Minor in this unit are Jerry, Morval, and Tanna soils. Jerry and Morval soils are on mountainsides and mesas. They are deep, well drained, and loamy. Tanna soils are on mountainsides. They are moderately deep and well drained.

Almost all of this unit is used for grazing and wildlife habitat. Bucklon soils have fair potential for grazing and wildlife habitat. Inchau and Cochetopa soils have good potential for grazing. All of the soils in this unit are poorly suited to community development. Steep slopes, depth to bedrock, and high shrink-swell potential are the main limitations.

9. Jerry-Lamphier-Cochetopa

Deep, well drained, moderately sloping to steep soils on mountains and fans

This map unit is in the north-central and northeastern parts of the survey area. The soils formed in mixed alluvial and colluvial material derived from sandstone, shale, and basalt. Average annual precipitation is about 18 inches, and average annual temperature is about 40 degrees F.

This map unit covers about 18 percent of the survey area, or approximately 114,000 acres. This unit is about 30 percent Jerry soils, 20 percent Lamphier soils, 15 percent Cochetopa soils, 20 percent Dateman, Farlow, and Etoe soils, and 15 percent soils of minor extent.

Jerry soils are on fans and mountainsides. They are deep and well drained. The surface layer is loam, the subsoil is cobbly clay loam, and the substratum is cobbly clay.

Lamphier soils are on fans and mountainsides. They are deep and well drained. The surface layer and substratum are loam.

Cochetopa soils are on fans and mountainsides. They are deep and well drained. The surface layer is loam, the subsoil is stony clay loam and stony loam, and the substratum is stony clay.

Dateman, Farlow, and Etoe soils are on mountainsides. Dateman soils are moderately deep and well drained. Farlow and Etoe soils are deep and well drained.

Minor in this unit are Detra and Bucklon soils. Detra soils are on mountainsides. They are deep and well drained. Bucklon soils are on ridges and mountainsides. They are shallow and well drained.

This unit is used almost entirely for grazing and wildlife habitat. A few small areas of gentle sloping soils are irrigated. The main crop is native hay. This unit has good potential for grazing and wildlife habitat. The main concerns in management are proper control of grazing, fencing, range reseeding, and brush control. The unit is poorly suited to community development. Steep slopes and high shrink-swell potential are the major limitations. The unit has good potential for wildlife habitat. Deer, elk, mountain lion, grouse, rabbits, and squirrels are common.

Broad land use considerations

The Rifle Area covers approximately 630,000 acres in Garfield and Mesa Counties, Colorado. Nearly all of this land is privately owned. It is used mainly for range, wildlife habitat, irrigated pasture, and irrigated crops.

Land use is remaining relatively stable. The general soil map is helpful in planning major land use changes in the survey area.

The main change in land use is development of small areas around Glenwood Springs and Rifle for housing. The potential for this type of development is increasing. Nearly 11,000 acres of agricultural land has been plotted and approved for future housing development. The main consideration at the present is development of the oil shale industry. Oil shale plant sites are planned for the west end of the survey area. A large part of the projected land use change is for housing for the oil shale industry employees.

An irrigation project to supply additional water to land users within the Area has been proposed. The "West Divide Project" would permit some small areas of range to be converted to irrigated pasture or crops.

The Potts-Ildefonso-Vale map unit has most of the irrigated pasture and irrigated crops in the survey area. The Potts, Vale, Ascalon, Heldt, and Olney soils all have good potential for irrigated crops if additional irrigation water becomes available. In this area, the most limiting factors on these soils are steep slopes and a short growing season. Ildefonso soils, Torriorthents, Camborthids, and Rock outcrop make up the rest of this map unit. They are either too steep or too stony to be irrigated. The Arvada-Torrifluvents-Heldt map unit has some potential for irrigated crops and pasture if additional irrigation water could be supplied. A small percentage of this unit is being irrigated successfully. Arvada and Heldt soils generally have a high concentration of sodium salts. The irrigation water is normally insufficient in quantity to leach out these salts; therefore, the unit is unproductive. Torrifluvents are regularly flooded and have a high water table. The minor Olney, Kim, Holderness, Atencio, and Azeltine soils are deep and well drained. They have good potential for irrigation.

The Morval-Villa Grove map unit has some potential for irrigated pasture. This map unit has too short a growing season to be used for crops. The Lazear-Cushman-Ascalon map unit has small isolated areas that are suitable for irrigation. These are areas of Ascalon soils that are not too steep. Lazear and Cushman soils are too steep and too stony to be irrigated.

The most extensive acreage of nonirrigated crops is in the Potts-Ildefonso-Vale map unit. The Morval-Villa Grove map unit has a few very small areas of nonirrigated crops. The potential for additional nonirrigated farming in the survey area is limited to small isolated tracts of deep, gently sloping soils in these map units. Most of the soils in the survey area are steep and stony and have a short growing season.

Grazing is the main land use in this survey area. All of the map units have substantial acreage of rangeland. The Parachute-Rhone-Irigul, Jerry-Lamphier-Cochetopa, and Bucklon-Inchau-Cochetopa map units are used exclusively for summer grazing. These units are very valuable for grazing cattle and sheep. The higher elevations have more precipitation and support good stands of native grasses, forbs, and browse plants. The other map units are at lower elevations and have a longer grazing season. Ranchers winter their cattle and sheep on these units and use these units for grazing early in spring and late in fall.

Nearly all of the soils are suited to grazing. The potential for continued productive grazing can be maintained and improved by effective range management.

The potential for wildlife habitat is fair to good throughout the survey area. The potential varies with changes in vegetation and elevation. In general, cropped soils of the Potts-Ildefonso-Vale and Arvada-Torrifluvents-Heldt map units have good potential for openland wildlife habitat. The scattered areas of crops on the Lazear-Cushman-Ascalon map unit have fair potential for openland wildlife habitat. Near major streams and their tributaries on the Arvada-Torrifluvents-Heldt map unit, the potential for wetland wildlife habitat is good. The potential for woodland and rangeland wildlife habitat is good throughout the survey area. Areas at high elevation, such as the Parachute-Rhone-Irigul, Bucklon-Inchau-Cochetopa, and Jerry-Lamphier-Cochetopa map units, provide excellent summer wildlife habitat. Migratory big game spend about 7 to 8 months of the year in these areas. The Morval-Villa Grove, Lazear-Cushman-Ascalon, Arvada-Torrifluvents-Heldt, and Torriorthents-Rock outcrop-Camborthids map units support woodland and rangeland wildlife in late fall, winter, and early spring.

Wildlife habitat development should not be overlooked in any area. It is an important use of land, especially in small, isolated areas that are not well suited to other uses.

The potential for recreation is good throughout the survey area. Areas at higher elevation provide excellent summer recreation and fair to good winter recreation. Areas at lower elevation have good potential for development of summer and winter recreational areas.

Extensive areas are unfavorable for urban development. The areas especially well suited to urban development are in crops. Most of the desirable development areas are in the Potts-Ildefonso-Vale map unit. The Arvada-Torrifluvents-Heldt map unit has some development potential if special measures are taken to overcome limiting factors such as high shrink-swell potential, flooding, and saline conditions. The Parachute-Rhone-Irigul, Bucklon-Inchau-Cochetopa, and Jerry-Lamphier-Cochetopa map units have very limited potential for development because of inaccessability in winter, steep slopes, and extreme stoniness. The potential for urban development on the Morval-Villa Grove and Lazear-Cushman-Ascalon map units is poor except in small isolated areas. Most of these map units have steep slopes and stony soils. Extensive measures would be needed to make these areas suitable for urban development. The Rock outcrop-Torriorthents and Torriorthents-Rock out-

crop-Camborthids map units have little potential for urban development. Extremely steep slopes, Rock outcrop, stony soils, high shrink-swell potential, and highly saline conditions require very extensive measures to make urban development practical.

Soil maps for detailed planning

The map units shown on the detailed soil maps at the back of this publication represent the kinds of soil in the survey area. They are described in this section. The descriptions together with the soil maps can be useful in determining the potential of a soil and in managing it for food and fiber production; in planning land use and developing soil resources; and in enhancing, protecting, and preserving the environment. More information for each map unit, or soil, is given in the section "Use and management of the soils."

Preceding the name of each map unit is the symbol that identifies the soil on the detailed soil maps. Each soil description includes general facts about the soil and a brief description of the soil profile. In each description, the principal hazards and limitations are indicated, and the management concerns and practices needed are discussed.

The map units on the detailed soil maps represent an area on the landscape made up mostly of the soil or soils for which the unit is named. Most of the delineations shown on the detailed soil map are phases of soil series.

Soils that have a profile that is almost alike make up a *soil series*. Except for allowable differences in texture of the surface layer or of the underlying substratum, all the soils of a series have major horizons that are similar in composition, thickness, and arrangement in the profile. A soil series commonly is named for a town or geographic feature near the place where a soil of that series was first observed and mapped.

Soils of one series can differ in texture of the surface layer or in the underlying substratum and in slope, erosion, stoniness, salinity, wetness, or other characteristics that affect their use. On the basis of such differences, a soil series is divided into phases. The name of a *soil phase* commonly indicates a feature that affects use or management. For example, Ascalon fine sandy loam, 1 to 6 percent slopes, is one of several phases within the Ascalon series.

Some map units are made up of two or more dominant kinds of soil. Such map units are called soil complexes and soil associations.

A *soil complex* consists of areas of two or more soils that are so intricately mixed or so small in size that they cannot be shown separately on the soil map. Each area includes some of each of the two or more dominant soils, and the pattern and proportion are somewhat similar in all areas. Ascalon-Pena complex, 6 to 25 percent slopes, is an example.

A *soil association* is made up of soils that are geographically associated and are shown as one unit on the map because it is not practical to separate them. A soil association has considerable regularity in geographic pattern and in the kinds of soil that are a part of it. The extent of the soils can differ appreciably from one delineation to another; nevertheless, interpretations can be made for use and management of the soils. Farlow-Rock outcrop association, steep, is an example.

This survey was mapped at two levels of detail. At the most detailed level, map units are narrowly defined. This means that soil boundaries were plotted and verified at closely spaced intervals. At the less detailed level, map units are broadly defined. Soil boundaries were plotted and verified at wider intervals. The broadly defined units are indicated by an asterisk in the soil map legend. The detail of mapping was selected to meet the anticipated long-term use of the survey, and the map units were designed to meet the needs for that use.

Most map units include small, scattered areas of soils other than those that appear in the name of the map unit. Some of these soils have properties that differ substantially from those of the dominant soil or soils and thus could significantly affect use and management of the map unit. These soils are described in the description of each map unit. Some of the more unusual or strongly contrasting soils that are included are identified by a special symbol on the soil map.

Most mapped areas include places that have little or no soil material and support little or no vegetation. Such places are called *miscellaneous areas*; they are delineated on the soil map and given descriptive names. Badland is an example. Some of these areas are too small to be delineated and are identified by a special symbol on the soil map.

The acreage and proportionate extent of each map unit are given in table 4, and additional information on properties, limitations, capabilities, and potentials for many soil uses is given for each kind of soil in other tables in this survey. (See "Summary of tables.") Many of the terms used in describing soils are defined in the Glossary.

1—Almy Variant loam, 25 to 65 percent slopes. This deep, well drained, hilly to very steep soil is on mountainsides. Elevation ranges from 6,500 to 8,000 feet. This soil formed in sandstone and shale residuum. The average annual precipitation is about 18 inches, the average annual air temperature is about 40 degrees F, and the frost-free period is about 85 days.

Typically, the surface layer is reddish brown loam about 8 inches thick. The subsoil is reddish brown and red clay loam about 26 inches thick. The substratum is red flaggy clay loam to a depth of 60 inches.

Included with this soil in mapping are small areas of Detra soils and Rock outcrop. These areas make up about 5 to 10 percent of the map unit.

Permeability is moderately slow, and available water capacity is high. The effective rooting depth is 60 inches or more. Surface runoff is medium, and the erosion hazard is moderate.

This soil is used mainly for wildlife habitat and limited grazing.

The native vegetation on this soil is mainly Gambel oak, serviceberry, elk sedge, and bromes.

When range condition deteriorates, forbs and woody shrubs increase. When the range is in poor condition, Kentucky bluegrass, undesirable weeds, and annual plants are abundant. Properly managing grazing maintains and improves range condition.

Mule deer, elk, cottontail rabbit, wild turkey, and blue grouse find habitat on this soil.

Community development and sanitary facilities are limited by steep slopes and low strength.

This soil is in capability subclass VIIe, nonirrigated.

2—Arle-Ansari-Rock outcrop complex, 12 to 65 percent slopes. This complex consists of strongly sloping to steep soils and Rock outcrop on mountainsides and sloping alluvial fans. Elevation ranges from 5,500 to 7,500 feet. The soils formed in alluvium derived from red-bed shale and sandstone. The average annual precipitation is about 16 inches, the average annual air temperature is about 42 degrees F, and the average frost-free period is about 100 days.

The Arle soil makes up about 45 percent of the complex, the Ansari soil makes up about 35 percent, and Rock outcrop makes up about 20 percent.

The Arle soil is moderately deep and well drained. Typically, the surface layer is reddish brown very stony loam about 10 inches thick. The subsoil and substratum are reddish brown very stony loam about 22 inches thick. Soft reddish brown sandstone and shale are at a depth of 32 inches.

Permeability of the Arle soil is moderate, and available water capacity is low. Effective rooting depth is about 20 to 40 inches. Surface runoff is medium, and the erosion hazard is severe.

The Ansari soil is shallow and well drained. Typically, the surface layer is reddish brown loam about 10 inches thick. The substratum is reddish brown stony loam. Bedrock is hard, reddish brown sandstone.

Permeability of the Ansari soil is moderate, and available water capacity is low. Effective rooting depth is about 10 to 20 inches. Surface runoff is rapid, and the erosion hazard is severe.

Rock outcrop is mainly red sandstone.

This complex is used mainly for grazing and wildlife habitat.

The native vegetation on the Arle soil is mainly wheatgrass, Indian ricegrass, mountainmahogany, and sagebrush. The native vegetation on the Ansari soil is mainly Indian ricegrass, wheatgrass, and sagebrush.

When range condition deteriorates, forbs and shrubs increase. When the range is in poor condition, undesirable weeds and annual plants are numerous. Properly managing grazing maintains and improves range condition.

Mule deer, rabbit, and grouse find habitat on these soils.

Use of this complex for community development or as a source of construction material is limited mainly by depth to rock, steep slopes, thin layers of borrow material, and large stones. Special design can overcome these limitations. Drainage and structures to control runoff from snowmelt reduce erosion around construction sites and roads.

This complex is in capability subclass VIIe, nonirrigated.

3—Arvada loam, 1 to 6 percent slopes. This deep, well drained, sloping soil is on fans and high terraces (fig. 4). Elevation ranges from 5,100 to 6,200 feet. This soil formed in highly saline alluvium derived from sandstone and shale. The average annual precipitation is about 12 inches, the average annual air temperature is about 48 degrees F, and the average frost-free period is about 120 days.

Typically, the surface layer is strongly alkaline or very strongly alkaline, pale brown loam about 3 inches thick. The subsoil is brown silty clay loam about 14 inches thick. The substratum is light brown or brown silty clay loam to a depth of 60 inches.

Included with this soil in mapping are small areas of Limon, Kim, Heldt, and Wann soils. Also included are some soils that are high in silt.

Permeability is very slow, and available water capacity is moderate. Effective rooting depth is 60 inches or more. Organic matter content of the surface layer is low. Surface runoff is medium, and the erosion hazard is moderate.

This soil is used mainly for wildlife habitat, limited grazing, and some irrigated farming.

Irrigated crops produce very poorly because the soil takes water in very slowly and is droughty. Leaching is needed to remove excess salts if this soil is to be irrigated. Soil amendments containing sulphur are helpful in leaching the salt.

The native vegetation on this soil is mainly saltgrass, alkali sacaton, and greasewood.

When range condition deteriorates, forbs and shrubs increase. Properly managing grazing maintains and improves range condition. Seeding improves range in poor condition. Western wheatgrass, alkali sacaton, and tall wheatgrass are suitable for seeding. Preparing a seedbed and drilling the seed are good practices. Irrigating new seedings is necessary for successful establish-

ment. Reducing brush improves the range if the grass understory is adequate.

Cottontail rabbit and pheasant find shelter on this soil if they can obtain food in surrounding areas.

Use of this soil for sanitary facilities, for community development, and as a source of construction material is limited by the high shrink-swell potential, slow permeability, clayey textures, and salinity.

This soil is in capability subclass VIIs, irrigated and nonirrigated.

4—Arvada loam, 6 to 20 percent slopes. This deep, well drained, sloping soil is on fans and high terraces. Elevation ranges from 5,100 to 6,200 feet. This soil formed in highly saline alluvium derived from sandstone and shale. The average annual precipitation is about 12 inches, average annual air temperature is about 48 degrees F, and the average frost-free period is about 120 days.

Typically, the surface layer is moderately alkaline, pale brown loam about 3 inches thick. The subsoil is brown silty clay loam about 14 inches thick. The substratum is light brown or brown silty clay loam to a depth of 60 inches.

Included with this soil in mapping are small areas of Limon, Kim, and Heldt soils.

Permeability is very slow, and available water capacity is high. Effective rooting depth is 60 inches or more. Organic matter content of the surface layer is low. Surface runoff is moderately rapid, and the erosion hazard is severe.

This soil is used mainly for wildlife habitat and limited grazing.

The native vegetation on this soil is mainly sagebrush, greasewood, and wheatgrass.

When range condition deteriorates, grasses decrease and weedy forbs, cheatgrass, big sagebrush, and greasewood increase. Properly managing grazing maintains and improves range condition. Seeding improves range in poor condition. Western wheatgrass and tall wheatgrass are suitable for seeding. Preparing a seedbed and drilling the seed are good practices. Irrigating new seedings is necessary for successful establishment. Brush should not be reduced because grass production is low and some desirable native shrubs could be destroyed.

Cottontail and pheasants find shelter on this soil if they can obtain food in surrounding areas.

Use of this soil for sanitary facilities and as a source of construction material is limited by the large amounts of clay and salts. This soil is corrosive to steel and concrete. Community development is limited by high shrink-swell potential, salinity, and steep slopes.

This soil is in capability subclass VIIs, nonirrigated.

5—Ascalon fine sandy loam, 1 to 6 percent slopes. This deep, well drained, nearly level to gently sloping soil is on mesas, alluvial fans, and terraces. Elevation ranges from 5,000 to 6,500 feet. The soil formed in alluvium derived from sandstone and shale. The average annual precipitation is about 14 inches, the average annual air temperature is about 48 degrees F, and the average frost-free period is about 120 days.

Typically, the surface layer is brown fine sandy loam about 5 inches thick. The subsoil is brown and yellowish brown sandy clay loam about 30 inches thick. The substratum is very pale brown sandy clay loam to a depth of 60 inches.

Included with this soil in mapping are small areas of Olney and Potts soils that have slopes of 1 to 6 percent.

Permeability is moderate, and available water capacity is moderate. Effective rooting depth is 60 inches. Surface runoff is slow, and the erosion hazard is moderate.

This soil is used mainly for irrigated crops, hay, and pasture. Some areas are used for grazing and wildlife habitat.

This soil is irrigated mainly by corrugations. Sprinklers are also suitable. This soil erodes easily. Such practices as minimum tillage, grassed waterways, and tail water control reduce the danger of excessive erosion. Drop structures in irrigation ditches control water and prevent excessive ditch erosion.

The native vegetation on this soil is mainly needleandthread, wheatgrasses, and sagebrush.

When range condition deteriorates, forbs and shrubs increase. When the range is in poor condition, undesirable weeds and annual plants are numerous. Properly managing grazing maintains and improves range condition. Reducing brush also improves the range. Seeding improves range in poor condition. Pubescent wheatgrass, western wheatgrass, and big bluegrass are suitable for seeding. Preparing a seedbed and drilling the seed are good practices.

This soil has potential as habitat for pheasant, cottontail rabbit, mourning dove, and squirrel. These animals mostly obtain food and shelter in areas of crops and hay.

This soil has few limitations for community development. Low strength and frost action affect structures and roads. Community sewage systems will be needed if the population density increases.

This soil is in capability subclasses IIIe, irrigated, and IVe, nonirrigated.

6—Ascalon fine sandy loam, 6 to 12 percent slopes. This deep, well drained, moderately sloping to rolling soil is on mesas, terraces, sides of valleys, and alluvial fans. Elevation ranges from 5,000 to 6,500 feet. The soil formed in alluvium derived from sandstone and shale. The average annual precipitation is about 14 inches, the average annual air temperature is about 48 degrees F, and the average frost-free period is about 120 days.

Typically, the surface layer is brown fine sandy loam about 5 inches thick. The subsoil is brown and yellowish

brown sandy clay loam about 30 inches thick. The substratum is very pale brown sandy clay loam to a depth of 60 inches.

Included with this soil in mapping are small areas of Olney and Potts soils that have slopes of 1 to 6 percent.

Permeability is moderate, and available water capacity is moderate. Effective rooting depth is 60 inches. Surface runoff is medium, and the erosion hazard is moderate.

This soil is used mainly for irrigated hay and pasture and some crops. Some areas are used for grazing and wildlife habitat.

Corrugations are the main method of applying irrigation water. Sprinklers are also suitable. Steep slopes cause erosion to be more rapid on this soil than on less sloping Ascalon soils. Minimum tillage, cover crops, contour tillage, and grassed waterways help to control erosion. Drop structures are needed in irrigation ditches.

The native vegetation on this soil is mainly needleandthread, wheatgrasses, and sagebrush.

When range condition deteriorates, forbs and shrubs increase. When the range is in poor condition, undesirable weeds and annual plants are numerous. Properly managing grazing maintains and improves range condition. Reducing brush also improves the range. Seeding improves range in poor condition. Pubescent wheatgrass, western wheatgrass, and big bluegrass are suitable for seeding. Preparing a seedbed and drilling the seed are good practices.

This soil has potential as habitat for cottontail rabbit, squirrel, pheasant, mourning dove, and wild turkey.

Steep slopes and frost action limit community development. Cuts and fills should be minimal, and drainage is needed for roads and structures.

This soil is in capability subclasses IVe, irrigated, and VIe, nonirrigated.

7—Ascalon-Pena complex, 6 to 25 percent slopes. These moderately sloping to hilly soils are on sides of valleys and alluvial fans. Elevation ranges from 5,000 to 6,500 feet. The soils formed in alluvium derived from sandstone and shale. The average annual precipitation is about 14 inches, the average annual air temperature is about 48 degrees F, and the average frost-free period is about 120 days.

The Ascalon soil makes up about 65 percent of the complex, and the Pena soil makes up about 25 percent. The Ascalon soil is on the less sloping, somewhat concave parts of the landscape, and the Pena soil is on the steeper, convex parts.

The Ascalon soil is deep and well drained. Typically, the surface layer is brown fine sandy loam about 5 inches thick. The subsoil is brown and yellowish brown sandy clay loam about 30 inches thick. The substratum is very pale brown sandy clay loam to a depth of 60 inches.

Permeability of the Ascalon soil is moderate, and available water capacity is moderate. Effective rooting depth is 60 inches. Surface runoff is medium, and the erosion hazard is moderate.

The Pena soil is deep and well drained. Typically, the surface layer is about 12 inches thick. The upper part of the surface layer is dark grayish brown stony loam, and the lower part is dark grayish brown very stony loam. The substratum is very pale brown very stony sandy loam to a depth of 60 inches.

Permeability of the Pena soil is moderate, and available water capacity is low. Effective rooting depth is 60 inches. Runoff is slow, and the erosion hazard is moderate.

Included with these soils in mapping are small areas of Olney and Potts soils that have slopes of 6 to 12 percent. These areas are on small, isolated mesas and make up 5 to 10 percent of the complex.

This complex is used mainly for wildlife habitat and limited grazing.

The native vegetation is mainly needleandthread, wheatgrasses, mountainmahogany, and sagebrush.

When range condition deteriorates, forbs and shrubs increase. Properly managing grazing maintains and improves range condition. When the range is in poor condition, seeding is practical. Areas must be carefully selected to avoid the concentration of stones. Pubescent wheatgrass, western wheatgrass, and big bluegrass are suitable for seeding. Preparing a seedbed and drilling the seed are good practices. Controlling brush improves areas that are producing more woody shrubs than are normally found in the potential plant community, but controlling brush may damage deer habitat.

Cottontail rabbit, squirrel, pheasant, mourning dove, wild turkey, and some mule deer find habitat on these soils.

Community development is limited by the steep slopes and frost action in the Ascalon soil and by steep slopes and stones in the Pena soil.

This complex is in capability subclass VIe, nonirrigated.

8—Atencio-Azeltine complex, 1 to 3 percent slopes. These nearly level to gently sloping soils are on alluvial fans and terraces. Elevation ranges from 5,000 to 7,000 feet. The soils formed in mixed alluvium derived from red-bed shale and sandstone. The average annual precipitation is about 14 inches, the average annual air temperature is about 47 degrees F, and the average annual frost-free period is about 110 days.

The Atencio soil makes up about 45 percent of the map unit, and the Azeltine soil makes up about 45 percent. Exposed areas of gravel make up about 10 percent of the unit.

The Atencio soil is deep and well drained. Typically, the surface layer is dark reddish gray sandy loam about 11 inches thick. The upper part of the subsoil is reddish brown gravelly sandy clay loam about 12 inches thick,

and the lower part is brown gravelly sandy loam about 5 inches thick. The substratum is sand, cobbles, and gravel to a depth of 60 inches.

Permeability of the Atencio soil is moderate, and available water capacity is low. Effective rooting depth is 60 inches or more. Surface runoff is slow, and the erosion hazard is slight.

The Azeltine soil is deep and well drained. Typically, the surface layer is reddish gray gravelly sandy loam about 8 inches thick. The underlying layer is reddish brown gravelly sandy loam about 10 inches thick. The substratum is calcareous sand, gravel, and cobbles to a depth of 60 inches or more.

Permeability of the Azeltine soil is moderately rapid, and water capacity is very low. Effective rooting depth is about 60 inches or more. Surface runoff is slow, and the erosion hazard is slight.

These soils are used mainly for grazing and crops. Alfalfa, small grains, potatoes, and grass-legume hay are the main crops.

This soil is irrigated mainly by flooding. Grassed waterways and minimum tillage prevent serious erosion. Cover crops or stubble mulching in dryfarmed areas also reduce erosion.

The native vegetation on these soils is mainly wheatgrass, sagebrush, and needleandthread.

When range condition deteriorates, forbs and shrubs increase. When the range is in poor condition, undesirable weeds and annual plants are numerous. Properly managing grazing maintains and improves range condition. Seeding improves range in poor condition. Crested wheatgrass, western wheatgrass, and Russian wildrye are suitable for seeding. Preparing a seedbed and drilling the seed are good practices. Reducing brush improves the range.

Pheasant, dove, rabbit, squirrel, and some deer find food and shelter on these soils, mainly in areas of crops.

Use of this soil for community development or as a source of construction material is limited by the large stones. Special design is needed for septic tank absorption fields because of seepage and the possibility of polluting ground water.

This complex is in capability subclass IVs, irrigated, and VIs, nonirrigated.

9—Badland. This broadly defined unit consists of steep and very steep, nearly barren land dissected by many intermittent drainage channels that have cut into the soft shale and sandstone of the Green River Formation and into the soft shale and siltstone of the Wasatch, Mancos, and Mesa Verde Formations. Badland occurs throughout the survey area, mainly on steep foothills and mountainsides that have outcrops of shale or sandstone.

About 85 percent or more of the area is unvegetated. The water erosion hazard is very severe, and erosion is active.

About 15 percent of this map unit is small, isolated areas of Lazear, Tanna, and Dollard soils. These soils have only a sparse plant cover, mainly scattered pinyon and juniper. The value for grazing is very limited. The trees provide a little protection and cover for livestock and wildlife.

Badland is unsuitable for community development.

Badland is in capability subclass VIIIe, nonirrigated.

10—Begay sandy loam, 1 to 6 percent slopes. This deep, well drained, nearly level to gently rolling soil is on alluvial fans and sides of valleys. Elevation ranges from 5,000 to 6,500 feet. This soil formed in alluvium derived from red-bed sandstone and shale. The average annual precipitation is about 14 inches, the average annual air temperature is about 48 degrees F, and the average frost-free period is about 120 days.

Typically, the surface layer is red or yellowish red sandy loam about 14 inches thick. The subsoil is yellowish red fine sandy loam about 10 inches thick. The substratum is yellowish red stony sandy loam to a depth of 60 inches.

Included with this soil in mapping are small areas of Olney and Ascalon soils that have slopes of 6 to 12 percent. These areas make up about 5 to 10 percent of the map unit.

Permeability is moderately rapid, and available water capacity is low. Effective rooting depth is 60 inches. Surface runoff is slow, and the erosion hazard is moderate.

This soil is used mainly for some irrigated pasture and hay and for grazing. Small acreages of wheat, barley, and oats are grown.

Flooding and sprinklers are suitable for irrigating this soil. This soil is droughty and needs frequent irrigation to mature crops. Controlling the rate of water application reduces piping and erosion.

The native vegetation on this soil is mainly wheatgrass, needleandthread, and sagebrush.

When range condition deteriorates, forbs and shrubs increase. When the range is in poor condition, undesirable weeds and annual plants are numerous. Properly managing grazing maintains and improves range condition. Seeding improves range in poor condition. Crested wheatgrass, western wheatgrass, and Russian wildrye are suitable for seeding. Preparing a seedbed and drilling the seed are good practices.

Cottontail rabbit, squirrel, mourning dove, chukar, and some mule deer find habitat on this soil.

Use of this soil for community development and as a source of construction material is limited by seepage, large stones, and excess fines.

This soil is in capability subclasses IIIe, irrigated, and IVe, nonirrigated.

11—Begay sandy loam, 6 to 12 percent slopes. This deep, well drained, moderately sloping to rolling soil

is on alluvial fans and sides of valleys. Elevation ranges from 5,000 to 6,500 feet. This soil formed in alluvium derived from red-bed sandstone and shale. The average annual precipitation is about 15 inches, the average annual air temperature is about 48 degrees F, and the average frost-free period is about 120 days.

Typically, the surface layer is red or yellowish red sandy loam about 10 inches thick. The substratum is yellowish red stony sandy loam to a depth of 60 inches.

Included with this soil in mapping are small areas of Olney and Ascalon soils that have slopes of 6 to 12 percent. These areas make up about 5 to 10 percent of the map unit.

Permeability is moderately rapid, and available water capacity is low. Effective rooting depth is 60 inches. Surface runoff is moderate, and the erosion hazard is severe.

This soil is used mainly for irrigated pasture and hay and for grazing.

Flooding and sprinklers are suitable for irrigating this soil. This soil is droughty and needs frequent irrigation to mature crops. Controlling the rate of water application reduces piping and erosion.

The native vegetation on this soil is mainly wheatgrass, needleandthread, and sagebrush.

When range condition deteriorates, forbs and shrubs increase. When the range is in poor condition, undesirable weeds and annual plants are numerous. Properly managing grazing maintains and improves range condition. Reducing brush is often necessary to improve deteriorated range. Seeding improves range in poor condition. Crested wheatgrass, western wheatgrass, and Russian wildrye are suitable for seeding. Preparing a seedbed and drilling the seed are good practices.

Cottontail rabbit, squirrel, mourning dove, chukar, and some mule deer find habitat on this soil.

Use of this soil for community development and as a source of construction material is limited by large stones, seepage, and steep slopes.

This soil is in capability subclass IVe, irrigated and nonirrigated.

12—Bucklon-Inchau loams, 25 to 50 percent slopes. These moderately sloping to very steep soils are on ridges and mountainsides. Elevation ranges from 7,000 to 9,500 feet. These soils formed in sandstone and shale residuum. The average annual precipitation is about 18 inches, the average annual air temperature is about 40 degrees F, and the average frost-free period is less than 75 days.

The Bucklon soil makes up about 55 percent of the map unit, and the Inchau soil makes up about 35 percent. The Bucklon soil is on the more steep, convex parts of the landscape, and the Inchau soil is on the slightly concave parts.

The Bucklon soil is shallow and well drained. An organic layer is on the surface in some areas. Typically, the surface layer is dark grayish brown loam about 5 inches thick. The underlying material is dark grayish brown clay loam and grayish brown loam about 10 inches thick. Shale and sandstone bedrock is at a depth of 15 inches.

Permeability of the Bucklon soil is slow above bedrock. Available water capacity is very low. Effective rooting depth is about 10 to 20 inches. Surface runoff is medium, and the erosion hazard is severe.

The Inchau soil is moderately deep and well drained. An organic layer is on the surface in some areas. Typically, the surface layer is grayish brown loam about 3 inches thick. The upper part of the subsoil is dark grayish brown and yellowish brown clay loam about 15 inches thick, and the lower part is yellowish brown gravelly clay loam about 18 inches thick. Sandstone and shale bedrock is at a depth of 36 inches.

Permeability of the Inchau soil is moderate above bedrock, and available water capacity is moderate. Effective rooting depth is 20 to 40 inches. Surface runoff is medium, and the erosion hazard is severe.

Included with these soils in mapping are small areas of Cochetopa, Cimarron, and Jerry soils. The Cochetopa and Jerry soils have slopes of 25 to 50 percent. The Cimarron soils are in small drainageways and have slopes of 2 to 12 percent. These areas make up 5 to 10 percent of the map unit.

These soils are used mainly for wildlife habitat and limited grazing.

The native vegetation on these soils is mainly Gambel oak, elk sedge, and bromes.

When range condition deteriorates, forbs and shrubs increase. When the range is in poor condition, Kentucky bluegrass, undesirable weeds, and annual plants are numerous. Properly managing grazing maintains and improves range condition.

Mule deer, elk, snowshoe rabbit, squirrel, and blue grouse find habitat on these soils.

Community development is limited by steep slopes, depth to rock, and low strength.

This complex is in capability subclass VIIs, nonirrigated.

13—Chilton channery loam, 3 to 6 percent slopes. This deep, well drained, gently sloping soil is on alluvial fans and sides of valleys. Elevation ranges from 5,000 to 6,500 feet. This soil formed in alluvium derived from red-bed shale and sandstone. The average annual precipitation is about 14 inches, the average annual air temperature is about 46 degrees F, and the average frost-free period is about 120 days.

Typically, the surface layer is reddish brown channery loam about 13 inches thick. The substratum is reddish brown, light brown, and pink very channery sandy loam and very cobbly sandy loam to a depth of 60 inches.

Included with this soil in mapping are small areas of Begay and Morval soils. The Begay soils have slopes of

1 to 6 percent. The Morval soils are in higher lying areas and have slopes of 3 to 12 percent. These areas make up 10 to 15 percent of the map unit.

Permeability is moderately rapid, and available water capacity is moderate. Effective rooting depth is 60 inches or more. Surface runoff is slow, and the erosion hazard is moderate.

This soil is used mainly for wildlife habitat, limited grazing, and some irrigated hay and pasture.

The native vegetation on this soil is mainly wheatgrass, needleandthread, and sagebrush.

When range condition deteriorates, forbs and shrubs increase. When the range is in poor condition, undesirable weeds and annual plants are numerous. Properly managing grazing maintains and improves range condition. Reducing brush improves the range. Seeding improves range in poor condition. Crested wheatgrass, western wheatgrass, and Russian wildrye are suitable for seeding. Preparing a seedbed and drilling the seed are good practices.

Mule deer, cottontail rabbit, squirrel, and wild turkey find habitat on this soil.

Community development is limited by the large stones.

This soil is in capability subclass IVe, nonirrigated.

14—Chilton channery loam, 6 to 12 percent slopes. This deep, well drained, rolling soil is on alluvial fans and sides of valleys. Elevation ranges from 5,000 to 6,500 feet. This soil formed in alluvium derived from red-bed shale and sandstone. The average annual precipitation is about 14 inches, the average annual air temperature is about 46 degrees F, and the average frost-free period is about 120 days.

Typically, the surface layer is reddish brown channery loam about 13 inches thick. The substratum is reddish brown, light brown, and pink very channery sandy loam and very cobbly sandy loam to a depth of 60 inches.

Included with this soil in mapping are small areas of Begay and Morval soils. The Begay soils have slopes of 6 to 12 percent. The Morval soils are in higher lying areas and have slopes of 3 to 12 percent. These areas make up 10 to 15 percent of the map unit.

Permeability is moderately rapid, and available water capacity is moderate. Effective rooting depth is 60 inches or more. Surface runoff is slow, and the erosion hazard is moderate.

This soil is used mainly for wildlife habitat and grazing.

The native vegetation on this soil is mainly wheatgrass, needleandthread, and sagebrush.

When range condition deteriorates, forbs and shrubs increase. When the range is in poor condition, undesirable weeds and annual plants are numerous. Properly managing grazing maintains and improves range condition. Reducing brush improves the range. Seeding improves range in poor condition. Crested wheatgrass, western wheatgrass, and Russian wildrye are suitable for seeding. Preparing a seedbed and drilling the seed are good practices.

Mule deer, cottontail rabbit, squirrel, and wild turkey find habitat on this soil.

Community development is limited by slope and large stones.

This soil is in capability subclass VIe, nonirrigated.

15—Chilton channery loam, 12 to 25 percent slopes. This deep, well drained, moderately steep to hilly soil is on alluvial fans and sides of valleys. Elevation ranges from 5,000 to 6,500 feet. This soil formed in alluvium derived from red-bed shale and sandstone. The average annual precipitation is about 14 inches, the average annual air temperature is about 46 degrees F, and the average frost-free period is about 120 days.

Typically, the surface layer is reddish brown channery loam about 13 inches thick. The substratum is reddish brown, light brown, and pink very channery sandy loam and very cobbly sandy loam to a depth of 60 inches.

Included with this soil in mapping are small areas of Begay and Morval soils that have slopes of less than 12 percent. These areas make up 10 to 15 percent of the map unit.

Permeability is moderately rapid, and available water capacity is moderate. Effective rooting depth is 60 inches or more. Surface runoff is medium, and the erosion hazard is severe.

This soil is used mainly for wildlife habitat and grazing.

The native vegetation on this soil is mainly wheatgrass, needleandthread, and sagebrush.

When range condition deteriorates, forbs and shrubs increase. When the range is in poor condition, undesirable weeds and annual plants are numerous. Properly managing grazing maintains and improves range condition. Reducing brush improves the range. Seeding improves range in poor condition in the less sloping areas. Crested wheatgrass, western wheatgrass, and Russian wildrye are suitable for seeding. Preparing a seedbed and drilling the seed are good practices.

Mule deer, cottontail rabbit, squirrel, and wild turkey find habitat on this soil.

Community development is limited by steep slopes and large stones. Cut slopes should be revegetated immediately to reduce erosion and prevent gullying.

This soil is in capability subclass VIe, nonirrigated.

16—Cimarron loam, 2 to 12 percent slopes. This deep, well drained, nearly level to undulating soil is in narrow mountain valleys and drainageways. Elevation ranges from 7,500 to 9,000 feet. This soil formed in alluvium derived from basalt. The average annual precipitation is about 18 inches, the average annual air temperature is 39 degrees F, and the frost-free period is less than 75 days.

Typically, the surface layer is dark grayish brown loam about 4 inches thick. The subsoil is grayish brown silty

clay loam and silty clay about 29 inches thick. The substratum is dark gray silty clay to a depth of 60 inches.

Included with this soil in mapping are small areas of Cochetopa and Jerry soils on small hilly undulations within the drainageways. Slopes are more than 12 percent. These areas make up 5 to 10 percent of the map unit.

Permeability is slow, and available water capacity is high. Effective rooting depth is about 60 inches or more. Primary roots that reach below a depth of 16 inches follow cracks in the soil. Surface runoff is medium, and the erosion hazard is moderate.

This soil is used mainly for limited grazing and wildlife habitat.

The native vegetation on this soil is mainly Idaho fescue, bromes, wheatgrasses, and sagebrush.

When range condition deteriorates, forbs and shrubs increase. When the range is in poor condition, undesirable weeds and annual plants are numerous. Reducing brush improves the range. Properly managing grazing maintains and improves range condition. Seeding improves range in poor condition. Preparing a seedbed and drilling the seed are good practices. Mountain or smooth brome, intermediate wheatgrass, and pubescent wheatgrass are suitable for seeding.

Elk, deer, black bear, and grouse find habitat on this soil.

Use of this soil for community development, for sanitary facilities, and as a source of construction material is limited by the high clay content, which causes a high shrink-swell potential, slow permeability, and low strength. Special designs for foundations and septic tank absorption fields overcome these problems.

This soil is in capability subclass VIe, nonirrigated.

17—Cochetopa loam, 9 to 50 percent slopes. This deep, well drained, rolling to steep soil is on mountainsides and alluvial fans. Elevation ranges from 7,000 to 9,500 feet. This soil formed in basaltic alluvium. The average annual precipitation is about 20 inches, the average annual air temperature is about 38 degrees F, and the average frost-free period is less than 75 days.

Typically, the surface layer is dark grayish brown loam about 21 inches thick. In some areas an organic layer as much as 4 inches thick is on the surface. The subsoil is brown stony clay loam and stony clay about 24 inches thick. The substratum is pinkish gray stony clay to a depth of 60 inches.

Included with this soil in mapping are small areas of Jerry and Lamphier soils. The Jerry soils are stony on the surface and make up 10 to 15 percent of the unit. The Lamphier soil is stone-free and has a cover of aspen.

Permeability is slow, and available water capacity is high. Effective rooting depth is 60 inches or more. Surface runoff is slow, and the erosion hazard is severe.

This soil is used mainly for limited grazing and wildlife habitat.

The native vegetation on this soil is mainly Gambel oak, bromes, and elk sedge.

When the range condition deteriorates, forbs and shrubs increase. When the range is in poor condition, Kentucky bluegrass, undesirable weeds, and annual plants are numerous. Properly managing grazing maintains and improves range condition.

Elk, mule deer, blue grouse, and snowshoe hare find habitat on this soil.

Community development is limited by the shrink-swell potential caused by high clay content, low strength, and steep slopes. Building foundations, roads, and sanitary facilities can be designed to overcome these limitations. Keeping cuts to a minimum and placing them carefully help to lessen soil slumping. Drainage and structures to control runoff from snowmelt help to avoid deep saturation of the soil around construction sites and roads.

This soil is in capability subclass VIIe, nonirrigated.

18—Cochetopa-Jerry complex, 12 to 25 percent slopes. These moderately steep to hilly soils are on mountainsides. Elevation ranges from 7,000 to 9,500 feet. The soils formed in alluvium derived from sandstone, shale, and basalt. The average annual precipitation is about 20 inches, the average annual air temperature is about 40 degrees F, and the frost-free period is less than 75 days.

The Cochetopa soil makes up about 50 percent of the map unit, and the Jerry soil makes up about 40 percent.

The Cochetopa soil is deep and well drained. Typically, the surface layer is dark grayish brown loam about 21 inches thick. The subsoil is brown stony clay and clay loam about 24 inches thick. The substratum is pinkish gray stony clay to a depth of 60 inches.

Permeability of the Cochetopa soil is slow, and available water capacity is high. Effective rooting depth is 60 inches or more. Surface runoff is slow, and the erosion hazard is moderate.

The Jerry soil is deep and well drained. Typically, the surface layer is dark grayish brown stony loam about 3 inches thick. The subsoil is yellowish brown and light brown cobbly clay loam about 37 inches thick. The substratum is light brown cobbly clay to a depth of 60 inches.

Permeability of the Jerry soil is slow, and available water capacity is high. Effective rooting depth is 60 inches or more. Surface runoff is slow, and the erosion hazard is moderate.

Included with these soils in mapping are small areas of Lamphier, Bucklon, and Inchau soils that have slopes of more than 25 percent. These areas make up about 10 percent of the map unit.

This complex is used mainly for grazing and wildlife habitat.

The native vegetation on these soils is mainly Gambel oak, elk sedge, and bromes.

When range condition deteriorates, forbs and shrubs increase. When the range is in poor condition, Kentucky bluegrass, undesirable weeds, and annual plants are numerous. Properly managing grazing maintains and improves range condition. Seeding improves some less sloping areas of range in poor condition. Preparing a seedbed and drilling the seed are good practices. Mountain or smooth brome, orchardgrass, and intermediate wheatgrass are suitable for seeding.

Elk, deer, black bear, and grouse find habitat on these soils.

Community development is limited by the high clay content, low strength, and steep slopes. Building foundations, roads, and sanitary facilities can be designed to overcome these limitations. Drainage and structures to control runoff from snowmelt are needed to avoid deep saturation of the soil around construction sites and roads.

This complex is in capability subclass VIe, nonirrigated.

19—Cochetopa-Jerry complex, 25 to 50 percent slopes. These moderately steep soils are on mountainsides. Elevation ranges from 7,000 to 9,500 feet. The soils formed in alluvium derived from sandstone, shale, and basalt. The average annual precipitation is about 20 inches, the average annual air temperature is about 40 degrees F, and the frost-free period is less than 75 days.

The Cochetopa soil makes up about 50 percent of the map unit, and the Jerry soil makes up about 40 percent.

The Cochetopa soil is deep and well drained. Typically, the surface layer is dark grayish brown loam about 21 inches thick. The subsoil is brown stony clay and stony clay loam about 24 inches thick. The substratum is pinkish gray stony clay to a depth of 60 inches.

Permeability of the Cochetopa soil is slow, and available water capacity is high. Effective rooting depth is 60 inches or more. Surface runoff is slow, and the erosion hazard is moderate.

The Jerry soil is deep and well drained. Typically, the surface layer is dark grayish brown stony loam about 3 inches thick. The subsoil is yellowish brown and light brown cobbly clay loam about 37 inches thick. The substratum is light brown cobbly clay to a depth of 60 inches.

Permeability of the Jerry soil is slow, and available water capacity is high. Effective rooting depth is 60 inches or more. Surface runoff is slow, and the erosion hazard is moderate.

Included with this soil in mapping are small areas of Lamphier, Bucklon, and Inchau soils that have slopes of 25 to 65 percent. These areas make up about 5 to 10 percent of the map unit.

These soils are used mainly for grazing and wildlife habitat.

The native vegetation on these soils is mainly Gambel oak, elk sedge, and bromes.

When range condition deteriorates, forbs and shrubs increase. When the range is in poor condition, Kentucky bluegrass, undesirable weeds, and annual plants are numerous. Properly managing grazing maintains and improves range condition.

Elk, deer, black bear, and grouse find habitat on these soils.

Community development is limited by slope, high clay content, and low strength. Building foundations, roads, and sanitary facilities can be designed to overcome these limitations. Drainage and structures to control runoff from snowmelt help to avoid deep saturation of the soil around construction sites and roads.

This complex is in capability subclass VIIe, nonirrigated.

20—Cryaquolls, nearly level. This broadly defined unit consists of poorly drained soils in swales and on bottom land of valleys. Elevation ranges from 7,000 to 9,500 feet. The average annual precipitation is about 18 inches, the average annual air temperature is about 39 degrees F, and the average frost-free period is less than 75 days.

These soils range from sandy loam to clay throughout and are commonly stratified. The surface layer is black to very dark brown. In places an organic mat is on the surface. Sand and gravel is at a depth of 2 to 4 feet in some places.

Permeability is moderate. Surface runoff is slow, and the erosion hazard is slight. The water table is at a depth of 10 to 24 inches at some time during the growing season. These soils are subject to annual flooding.

Included in mapping are small areas of peat and marsh.

These soils are used mainly for wildlife habitat. Some areas are used for irrigated hay and pasture.

The cold climate and short growing season limit production of introduced grasses. Irrigation water should be managed to prevent ponding. Subsurface drainage and fertilizer are needed to maintain production of hay. Slender wheatgrass, smooth brome, and creeping meadow foxtail are suitable for seeding.

The native vegetation includes tufted hairgrass, slender wheatgrass, sedges, rushes, reedgrass, willows, shrubby cinquefoil, and numerous forbs.

The total annual production of air-dry forage averages 2,500 pounds per acre. Nitrogen and phosphorus fertilizer is needed late in spring to replace nutrients lost during spring snowmelt.

These soils are typically wet and produce abundant wetland vegetation. Mallard, teal, shorebirds, beaver, mink, and muskrat find habitat on these soils. Shallow water developments increase the use of the areas by wetland wildlife. To manage these soils for wetland wildlife, grazing by livestock should be controlled and fences

should be put up to keep livestock out, unwanted burning should be prevented, and the wetlands should not be drained. Natural wetland plants should be allowed to grow. These soils also provide valuable summer range for big game.

Seasonal flooding and depth to the water table limit community development and recreation. Adequate drainage and protection from floods would be necessary before development could be attempted. These soils can be reserved as greenbelts or for other restricted uses.

These soils are in capability subclass VIw, nonirrigated.

21—Cushman-Lazear stony loams, 15 to 65 percent slopes. These hilly to very steep soils are on mountainsides and mesa breaks. Elevation ranges from 5,000 to 7,000 feet. The soils formed in sandstone and shale residuum. The average annual precipitation is about 13 inches, the average annual air temperature is about 48 degrees F, and the average frost-free period is about 125 days.

The Cushman soil makes up about 45 percent of the map unit, and the Lazear soil makes up about 40 percent. The Cushman soil is on the landscape where alluvium has accumulated to a greater depth over bedrock, and the Lazear soil is on the more steep areas.

The Cushman soil is moderately deep and well drained. Typically, the surface layer is grayish brown stony loam about 3 inches thick. The subsoil is dark grayish brown sandy loam about 8 inches thick. The substratum is light brownish gray loam and very gravelly loam. Shale and sandstone is at a depth of 32 inches.

Permeability of the Cushman soil is moderate above bedrock, and available water capacity is low. Effective rooting depth is 20 to 40 inches. Surface runoff is medium, and the erosion hazard is severe.

The Lazear soil is shallow over bedrock and is well drained. Typically, the surface layer is grayish brown stony loam about 4 inches thick. The underlying material is light brownish gray stony loam. Calcareous shale and sandstone is at a depth of 16 inches.

Permeability of the Lazear soil is moderate above bedrock, and available water capacity is low. Effective rooting depth is 10 to 20 inches. Surface runoff is moderately rapid, and the erosion hazard is severe.

Included with these soils in mapping are small areas of shale and sandstone outcrop and of Ildefonso soils. The Ildefonso soils are deep and very stony and have large accumulations of calcium carbonate. They are on very steep mesa breaks. These areas make up about 15 percent of the map unit.

These soils are used mainly for wildlife habitat and grazing.

The native vegetation on these soils is mainly Utah juniper and pinyon. The understory consists of Salina wildrye, Indian ricegrass, beardless wheatgrass, galleta, low phlox, stemless goldenweed, fourwing saltbush, serviceberry, shadscale, bitterbrush, and big sagebrush.

When the understory vegetation deteriorates, only a few forbs and shrubs remain. Properly managing the vegetation maintains wood production and grazing. Selectively thinning the pinyon and juniper improves grazing and provides firewood and posts. Steep slopes and the erosion hazard affect harvesting.

These soils can produce about 6 cords of wood per acre when trees more than 4.5 feet tall reach an average diameter of 5 inches.

Mule deer, gray squirrel, and cottontail rabbit find habitat on these soils.

Use of these soils for community development and as a source of construction materials is limited by depth to bedrock and steep slopes.

This complex is in capability subclass VIIs, nonirrigated.

22—Dateman gravelly loam, 30 to 50 percent slopes. This moderately deep, well drained, steep soil is on mountainsides. Elevation ranges from 7,000 to 9,500 feet. This soil formed in sandstone and limestone residuum. The average annual precipitation is about 20 inches, the average annual air temperature is about 38 degrees F, and the average frost-free period is less than 75 days.

Typically, the upper part of the surface layer is very dark grayish brown gravelly loam about 3 inches thick, and the lower part is very dark grayish brown gravelly sandy loam about 6 inches thick. The substratum is dark yellowish brown very gravelly sandy loam. Limestone or sandstone bedrock is at a depth of 34 inches.

Included with this soil in mapping are small areas of Farlow, Cochetopa, and Lamphier soils on the steeper parts of the landscape. They make up about 5 to 15 percent of the map unit.

Permeability is moderate, and available water capacity is low. Effective rooting depth is 20 to 40 inches. Surface runoff is medium, and the erosion hazard is moderate.

This soil is used mainly for wildlife habitat and grazing.

The native vegetation on this soil is mainly Gambel oak, serviceberry, and mountain brome. A few small areas have some Douglas-fir.

When range condition deteriorates, forbs and shrubs increase. When the range is in poor condition, Kentucky bluegrass, undesirable weeds, and annual plants are numerous. Properly managing grazing maintains and improves range condition. Seeding and controlling brush are generally unsuitable because of the steep slopes.

Elk, mule deer, blue grouse, snowshoe rabbit, and squirrel find habitat on this soil.

Use of this soil for community development and as a source of construction material is limited by steep slopes and depth to rock.

This soil is in capability subclass VIIe, nonirrigated.

23—Detra fine sandy loam, 12 to 25 percent slopes. This deep, well drained, strongly sloping to moderately steep soil is on mountainsides. Elevation ranges from 6,500 to 8,000 feet. This soil formed in residuum from red-bed shale and sandstone. The average annual precipitation is about 16 inches, the average annual air temperature is about 44 degrees F, and the frost-free period is about 85 days.

Typically, the surface layer is brown fine sandy loam about 12 inches thick. The subsoil is reddish brown sandy clay loam about 21 inches thick. The substratum is yellowish red sandy clay loam. Weathered red sandstone and shale is at a depth of 57 inches.

Included with this soil in mapping are small areas of Morval, Ansari, and Arle soils on the steeper parts of the landscape. They make up about 5 to 15 percent of the map unit.

Permeability is moderate, and available water capacity is moderate. Effective rooting depth is 40 to 60 inches. Surface runoff is slow, and the erosion hazard is slight.

This soil is used mainly for grazing and wildlife habitat.

The native vegetation on this soil is mainly needlegrasses, fescues, and sagebrush.

When range condition deteriorates, forbs and shrubs increase. When the range is in poor condition, undesirable weeds and annual plants are numerous. Properly managing grazing maintains and improves range condition. Reducing brush improves the range. Seeding improves range in poor condition if slope is not so steep that drilling is impossible. Preparing a seedbed and drilling the seed are good practices. Mountain or smooth brome, intermediate wheatgrass, and pubescent wheatgrass are suitable for seeding.

Elk, deer, and grouse find habitat on this soil.

Use of this soil for community development, for sanitary facilities, and as a source of construction material is limited by slope, low strength, and depth to bedrock. Special design and engineering practices overcome many of these limitations.

This soil is in capability subclass VIe, nonirrigated.

24—Dollard-Rock outcrop, shale, complex, 25 to 65 percent slopes. This complex consists of moderately steep to steep Dollard soil and shale outcrop on hills and mountainsides. Elevation ranges from 6,000 to 7,500 feet. The soil formed in shale residuum. The average annual precipitation is about 17 inches, the average annual air temperature is about 43 degrees F, and the average frost-free period is about 95 days.

The Dollard soil makes up about 60 percent of the map unit, shale outcrops make up about 20 percent, and soils of minor extent make up 20 percent. The Dollard soil is on the less steep parts of the landscape, and the shale outcrops are throughout the mapped areas.

The Dollard soil is moderately deep and well drained. Typically, the surface layer is light brownish gray clay about 5 inches thick. The substratum is light gray clay and shaly clay. Weathered shale bedrock is at a depth of 25 inches.

Permeability of the Dollard soil is slow, and available water capacity is moderate. Effective rooting depth is about 20 to 40 inches. Surface runoff is rapid, and the erosion hazard is severe.

The Rock outcrop is soft, weathered shale.

Permeability of Rock outcrop is very slow. Rooting depth is very shallow. Surface runoff is rapid, and the erosion hazard is very severe.

Included with this complex in mapping are small areas of Tanna soils in depressions.

This complex is used for limited grazing and wildlife habitat.

The native vegetation on this soil is mainly wheatgrass and sagebrush.

When range condition deteriorates, forbs and shrubs increase. When the range is in poor condition, undesirable weeds and annual plants are numerous. Properly managing grazing maintains and improves range condition. Reducing brush is not practical because of steep slopes and because of the erosion hazard if plant cover is removed.

Mule deer, cottontail rabbit, and squirrel find habitat on this soil.

Community development is limited by steep slopes, depth to rock, high shrink-swell potential, and low strength. The soil slumps easily in deep cuts.

This complex is in capability subclass VIIe, nonirrigated.

25—Etoe loam, 15 to 50 percent slopes. This deep, well drained, sloping to steep soil is on mountainsides. Elevation ranges from 8,000 to 10,500 feet. This soil formed in outwash derived from basalt and sandstone. The average annual precipitation is about 20 inches, the average annual air temperature is about 38 degrees F, and the frost-free period is less than 75 days.

Typically, the surface layer is pinkish gray loam about 8 inches thick. The subsurface layer is light brownish gray loam about 7 inches thick. The next layer is about 20 inches thick. It is mixed light brownish gray extremely cobbly sandy loam and brown extremely cobbly sandy loam and extremely cobbly sandy clay loam.

Included with this soil in mapping are small areas of Cochetopa and Jerry soils in open brush. These areas make up 10 to 15 percent of the map unit.

Permeability is moderate, and available water capacity is low. Effective rooting depth is greater than 60 inches. Surface runoff is medium, and the erosion hazard is slight.

This soil is used for timber, limited grazing, and wildlife habitat.

The understory is sparse. It consists of elk sedge, some grasses, boxleaf myrtle, and low growing woody plants.

This soil is suited to production of Engelmann spruce and Douglas-fir. This soil can produce 3,850 cubic feet of wood per acre every 10 years from a fully stocked, even-aged stand of 100-year-old trees. Steep slopes affect timber harvest, and special care is needed to prevent erosion.

Elk, deer, black bear, and grouse find habitat on this soil.

Slope and large stones limit community development. Special design overcomes these limitations.

This soil is in capability subclass VIIe, nonirrigated.

26—Farlow-Rock outcrop association, steep. This broadly defined map unit consists of moderately steep to steep Farlow soils and Rock outcrop on mountainsides. Elevation ranges from 8,000 to 10,500 feet. The Farlow soil formed in residuum from limestone. The average annual precipitation is about 19 inches, the average annual air temperature is about 38 degrees F, and the frost-free period is less than 75 days.

The Farlow soil makes up about 65 percent of the association, and Rock outcrop makes up about 25 percent.

The Farlow soil is deep and well drained. Typically, the surface layer is dark grayish brown channery loam about 10 inches thick. The substratum is light gray and pale brown very channery loam and extremely flaggy loam about 32 inches thick. Weathered limestone is at a depth of 42 inches.

Permeability of the Farlow soil is moderate, and available water capacity is low. Effective rooting depth is about 40 to 60 inches. Surface runoff is rapid, and the erosion hazard is moderate.

The Rock outcrop is limestone.

Included in mapping are small areas of Dateman soils, generally in depressions. These areas make up 5 to 15 percent of the map unit.

This association is used mainly for limited grazing and wildlife habitat.

The native vegetation is mainly needlegrasses, wheatgrasses, and serviceberry.

When range condition deteriorates, forbs and shrubs increase. When the range is in poor condition, undesirable weeds and annual plants are numerous. Properly managing grazing maintains and improves range condition.

Elk, deer, black bear, and grouse find habitat on this soil.

Community development and sanitary facilities are limited by slope and depth to rock. Special design is needed to overcome these limitations.

This association is in capability subclass VIIe, nonirrigated.

27—Halaquepts, nearly level. This broadly defined unit consists of deep, somewhat poorly drained to poorly drained, nearly level and gently sloping, salt-affected soils in narrow foothill valleys, on fans, and on low terraces. Slopes are 0 to 6 percent. These soils formed in alluvium.

The soils are extremely variable. The upper 24 inches ranges from loam to clay, and the underlying layers are generally gravelly. The soils are commonly gleyed from the surface down. Stratified sand, gravel, and cobbles are at a depth of 24 to 40 inches. In some areas, gravel and cobbles are at or near the surface.

Included with these soils in mapping are small, isolated areas of Arvada, Limon, and Heldt soils that have slopes of 1 to 6 percent. Small areas of severely alkali-affected soils are identified by an alkali spot symbol. These areas make up 10 to 15 percent of the map unit.

The water table is at or near the surface at times, mainly during spring and summer. The level of the water table is strongly influenced by the seasonal water level in nearby streams and rivers and higher lying irrigation ditches. Water seeps from the ditches into these soils. These soils are subject to rare or occasional flooding.

This unit is used mainly for grazing.

Some hay is grown in areas drained by ditches. Yields are low because of saline condition. Alkali-tolerant grasses and legumes must be grown for productive hay and pasture.

The native vegetation consists of willows, tamarisk, cottonwoods, and alkali- and water-tolerant grasses.

Game birds, rabbits, deer, and other wildlife find habitat on these soils. Ducks and geese nest in the more swampy areas. Mourning doves nest in the cottonwoods and tamarisk. Rabbits and deer find adequate food and cover on these soils. Where the soil has been drained and is suitable for hay and pasture, planting food plots, trees and shrubs, and nesting cover enhances habitat for upland wildlife. Where the water table is high, open water for waterfowl can be developed by blasting or excavating.

Community development is limited by flooding and depth to water table. Onsite investigation is necessary for appropriate design and construction to overcome these limitations.

These soils are in capability subclass VIw, nonirrigated.

28—Heldt clay loam, 1 to 3 percent slopes. This deep, well drained, nearly level soil is on alluvial fans and sides of valleys. Elevation ranges from 5,000 to 6,000 feet. This soil formed in fine textured alluvium derived from shale and sandstone. The average annual precipitation is about 14 inches, the average annual air temperature is about 48 degrees F, and the average frost-free period is about 120 days.

Typically, the surface layer is grayish brown clay loam about 8 inches thick. The subsoil is light brownish gray clay loam about 13 inches thick. The substratum is light gray clay to a depth of 60 inches.

Included with this soil in mapping are small areas of Olney, Arvada, and Kim soils that have slopes of 1 to 3 percent. These areas make up 5 to 10 percent of the map unit.

Permeability is slow, and available water capacity is moderate. Effective rooting depth is 60 inches or more. Surface runoff is medium, and the erosion hazard is slight.

This soil is used for irrigated crops and hay (fig. 5). Alfalfa, small grains, some corn for silage, and grass or grass-legume mixtures are grown.

Flooding is suitable for irrigating this soil. Intake rate is slow. Wide, deep cracks form when the soil dries. Irrigation rates and tillage practices should be carefully planned to overcome soil conditions. Green manure crops and commercial fertilizer are generally needed to maintain or improve tilth and fertility.

The native vegetation on this soil was mainly wheatgrass, sagebrush, and rabbitbrush; however, all areas of this soil are now in irrigated crops.

Cottontail rabbit, squirrel, mourning dove, and pheasant find habitat on this soil.

Community development and recreation are limited by slow permeability, high clay content, and shrink-swell potential. Dwellings and roads can be designed to compensate for the low strength and shrink-swell potential. Septic tank absorption fields are severely limited by slow permeability. Community sewage disposal systems will be needed if population density increases.

This soil is in capability subclasses IIIe, irrigated, and IVc, nonirrigated.

29—Heldt clay loam, 3 to 6 percent slopes. This deep, well drained, gently sloping soil is on alluvial fans and sides of valleys. Elevation ranges from 5,000 to 6,000 feet. This soil formed in fine textured alluvium derived from shale and sandstone. The average annual precipitation is about 14 inches, the average annual air temperature is about 48 degrees F, and the average frost-free period is about 120 days.

Typically, the surface layer is grayish brown clay loam about 8 inches thick. The subsoil is light brownish gray clay loam about 13 inches thick. The substratum is light gray clay to a depth of 60 inches.

Included with this soil in mapping are small areas of Olney, Arvada, and Kim soils that have slopes of 3 to 6 percent. These areas make up 5 to 10 percent of the map unit.

Permeability is slow, and available water capacity is moderate. Effective rooting depth is 60 inches or more. Surface runoff is medium, and the erosion hazard is moderate.

This soil is used for irrigated crops and hay. Some areas are used for grazing. Alfalfa, small grains, some corn for silage, and grass or grass-legume mixtures are grown.

Flooding is suitable for irrigating this soil. Intake rate is slow. Wide, deep cracks form when the soil dries. Irrigation rates and tillage practices should be carefully planned to overcome limiting soil conditions. Green manure crops and commercial fertilizer are generally needed to maintain or improve tilth and fertility.

The native vegetation on this soil is mainly wheatgrass, sagebrush, and low rabbitbrush; however, all areas of this soil are now in irrigated crops.

Cottontail rabbit, squirrel, mourning dove, and pheasant find habitat on this soil.

Community development and recreation are limited by slow permeability, high clay content, and shrink-swell potential. Dwellings and roads can be designed to compensate for the low strength and shrink-swell potential. Septic tank absorption fields are severely limited by slow permeability. Community sewage disposal systems will be needed if population density increases.

This soil is in capability subclasses IIIe, irrigated, and IVc, nonirrigated.

30—Heldt clay loam, 6 to 12 percent slopes. This deep, well drained, moderately sloping to rolling soil is on alluvial fans and sides of valleys. Elevation ranges from 5,000 to 6,000 feet. This soil formed in fine textured alluvium derived from shale and sandstone. The average annual precipitation is about 14 inches, the average annual air temperature is about 48 degrees F, and the average frost-free period is about 120 days.

Typically, the surface layer is grayish brown clay loam about 8 inches thick. The subsoil is light brownish gray clay loam about 13 inches thick. The substratum is light gray clay to a depth of 60 inches.

Included with this soil in mapping are small areas of Olney, Arvada, and Kim soils that have slopes of 6 to 12 percent. These areas make up about 5 to 10 percent of the map unit.

Permeability is slow, and available water capacity is moderate. Effective rooting depth is 60 inches or more. Surface runoff is medium, and the erosion hazard is moderate.

This soil is used mainly for irrigated hay (fig. 6) and grazing. Some small areas are in irrigated crops. Alfalfa, small grains, and grass or grass-legume mixtures are grown.

Flooding is suitable for irrigating this soil. The intake rate is slow. Wide, deep cracks form when the soil dries. Irrigation and tillage practices should be carefully planned to overcome soil conditions and to control erosion. Erosion can be controlled by keeping the soil in hay or pasture for at least three-fourths of the time. Green manure crops and fertilizer are generally needed to maintain or improve tilth and fertility.

The native vegetation on this soil is mainly wheatgrass, sagebrush, and rabbitbrush.

When range condition deteriorates, forbs and shrubs increase. When the range is in poor condition, undesira-

ble weeds and annual plants are numerous. Properly managing grazing maintains and improves range condition. Reducing brush improves the range. Seeding improves range in poor condition. Western wheatgrass, streambank wheatgrass, and crested wheatgrass are suitable for seeding. Preparing a seedbed and drilling the seed are good practices.

Cottontail rabbit, squirrel, mourning dove, and pheasant find habitat on this soil.

Community development and recreation are limited by slope, slow permeability, high clay content, and shrink-swell potential. Dwellings and roads can be designed to compensate for the low strength and shrink-swell potential. Septic tank absorption fields are severely limited by slow permeability. Community sewage disposal systems will be needed if population density increases.

This soil is in capability subclass IVe, irrigated and nonirrigated.

31—Heldt clay loam, 12 to 25 percent slopes. This deep, well drained, moderately steep to hilly soil is on alluvial fans and sides of valleys. Elevation ranges from 5,000 to 6,000 feet. This soil formed in fine textured alluvium derived from shale and sandstone. The average annual precipitation is about 14 inches, the average annual air temperature is about 48 degrees F, and the average frost-free period is about 120 days.

Typically, the surface layer is grayish brown clay loam about 8 inches thick. The subsoil is light brownish gray clay loam about 13 inches thick. The substratum is light gray clay to a depth of 60 inches.

Included with this soil in mapping are small areas of Olney, Arvada, and Kim soils that have slopes of 12 to 25 percent. These areas make up about 5 to 10 percent of the map unit.

Permeability is slow, and available water capacity is moderate. Effective rooting depth is 60 inches or more. Surface runoff is medium, and the erosion hazard is moderate.

This soil is used mainly for grazing and wildlife habitat. Small areas are used for grass hay or irrigated pasture.

The native vegetation on this soil is mainly wheatgrass, sagebrush, and rabbitbrush.

When range condition deteriorates, forbs and woody shrubs increase. When the range is in poor condition, undesirable weeds and annual plants are numerous. Properly managing grazing maintains and improves range condition. Reducing brush improves the range. Seeding improves the range in the more gently sloping areas if it is in poor condition. Western wheatgrass, streambank wheatgrass, and crested wheatgrass are suitable for seeding. Preparing a seedbed and drilling the seed are good practices.

Cottontail rabbit, squirrel, mourning dove, and pheasant find habitat on this soil.

Community development and recreation are limited by slope, slow permeability, high clay content, and shrink-swell potential. Dwellings and roads can be designed to compensate for the low strength and shrink-swell potential. Septic tank absorption fields are severely limited by slow permeability. Community sewage disposal systems will be needed if population density increases.

This soil is in capability subclass VIe, nonirrigated.

32—Holderness Variant clay loam, 6 to 25 percent slopes. This deep, well drained, moderately sloping to hilly soil is on alluvial fans and sides of valleys (fig. 7). Elevation ranges from 6,500 to 7,500 feet. This soil formed in fine textured sediment derived from shale and sandstone. The average annual precipitation is about 17 inches, the average annual air temperature is about 43 degrees F, and the average frost-free period is about 95 days.

Typically, the surface layer is grayish brown clay loam about 11 inches thick. The subsoil is grayish brown or light brownish gray clay about 41 inches thick. The substratum is light brownish gray, calcareous clay loam to a depth of 60 inches.

Included with this soil in mapping are small areas of Dollard and Tanna soils that have slopes of more than 25 percent. These areas make up about 5 to 10 percent of the map unit.

Permeability is slow, and available water capacity is high. Effective rooting depth is 60 inches or more. Surface runoff is medium, and the erosion hazard is slight.

This soil is used mainly for grazing. Some small areas are in irrigated pasture and hay.

Flooding is the usual method of irrigation. This soil is easily compacted by machinery or livestock. It takes in water slowly.

The native vegetation on this soil is mainly wheatgrass, needlegrass, and sagebrush.

When range condition deteriorates, forbs and shrubs increase. When the range is in poor condition, undesirable weeds and annual plants are numerous. Properly managing grazing maintains and improves the range. Reducing brush improves the range. Seeding improves range in poor condition. Western wheatgrass, pubescent wheatgrass, and big bluegrass are suitable for seeding. Preparing a seedbed and drilling the seed are good practices.

Mule deer, cottontail rabbit, and gray squirrel find habitat on this soil.

Use of this soil for community development and as a source of construction material is limited by high clay content, high shrink-swell potential, low strength, and steep slopes. Roads and dwellings need good drainage to reduce shrinking and swelling and soil slumping.

This soil is in capability subclasses IVe, irrigated, and VIe, nonirrigated.

33—Ildefonso stony loam, 6 to 25 percent slopes. This deep, well drained, moderately sloping to hilly soil is on mesas, benches, and sides of valleys. Elevation

ranges from 5,000 to 6,500 feet. This soil formed in mixed alluvium derived primarily from basalt. This soil has a thin intermittent cap of reddish eolian material. The average annual precipitation is about 14 inches, the average annual air temperature is 46 degrees F, and the average frost-free period is about 125 days.

Typically, the surface layer is brown stony loam about 8 inches thick. The underlying material is white, very strongly calcareous very stony loam to a depth of 60 inches.

Included with this soil in mapping are small areas of Potts and Ascalon soils on less sloping positions. These areas make up 5 to 15 percent of the map unit.

Permeability is moderately rapid, and available water capacity is low. Effective rooting depth is more than 60 inches. Surface runoff is medium, and the erosion hazard is moderate.

This soil is used mainly for grazing and wildlife habitat.

The native vegetation on this soil is mainly pinyon and Utah juniper. The understory consists mostly of Indian ricegrass, wheatgrass, junegrass, serviceberry, bitterbrush, and big sagebrush.

When the understory vegetation deteriorates, grasses almost disappear and forbs and shrubs increase. Properly managing the vegetation maintains wood production and grazing. Selectively thinning the pinyon and juniper improves understory grazing and provides firewood, posts, and Christmas trees.

This soil is suited to production of pinyon and Utah juniper. It can produce 9 cords of wood per acre when trees more than 4.5 feet tall reach an average diameter (at one foot) of 5 inches. The low available water capacity affects survival of tree seedlings.

Mule deer, chukar, wild turkey, gray squirrel, and cottontail rabbit find habitat on this soil.

Community development is limited by large stones and steep slopes. Structures to divert runoff are needed for roads.

This soil is in capability subclass VIs, nonirrigated.

34—Ildefonso stony loam, 25 to 45 percent slopes. This deep, well drained, hilly to steep soil is on mesa breaks, sides of valleys, and alluvial fans. A small portion of this unit is on very steep to extremely steep mesa escarpments. Elevation ranges from 5,000 to 6,500 feet. This soil formed in mixed alluvium derived primarily from basalt. This soil has a thin intermittent cap of reddish eolian material. The average annual precipitation is about 14 inches, the average annual air temperature is about 46 degrees F, and the average frost-free period is about 125 days.

Typically, the surface layer is brown stony loam about 8 inches thick. The underlying material is white, very strongly calcareous very stony loam to a depth of 60 inches.

Included with this soil in mapping are small areas of Potts and Ascalon soils on less steep and depressional positions. These areas make up about 5 to 15 percent of the map unit.

Permeability is moderately rapid, and available water capacity is low. Effective rooting depth is more than 60 inches. Surface runoff is medium, and the erosion hazard is severe.

Ildefonso soil is used mainly for grazing and wildlife habitat.

The native vegetation on this soil is mainly pinyon and Utah juniper. The understory consists of Indian ricegrass, wheatgrass, junegrass, serviceberry, bitterbrush, and big sagebrush.

When the understory vegetation deteriorates, grasses almost disappear and forbs and shrubs increase. Properly managing the vegetation maintains wood production and ground cover. The value for grazing is low because of steep slopes and tree cover. Firewood, posts, and Christmas trees can be harvested on the more gently sloping areas.

This soil is suited to production of pinyon and Utah juniper. It can produce 9 cords of wood per acre when trees more than 4.5 feet tall reach an average diameter (at one foot) of 5 inches. The low available water capacity affects survival of tree seedlings. Steep slopes and severe erosion hazard affect harvesting.

Mule deer, chukar, wild turkey, gray squirrel, and cottontail rabbit find habitat on this soil.

Community development is limited by large stones and steep slopes. Structures to divert runoff are needed for roads.

This soil is in capability subclass VIIe, nonirrigated.

35—Ildefonso-Lazear complex, 6 to 65 percent slopes. Moderately sloping to very steep soils are on hillsides and mesa breaks. Elevation ranges from 5,000 to 6,500 feet. The Ildefonso soil formed in very calcareous, mixed, stony alluvium derived mainly from basalt, and the Lazear soil formed in shale and sandstone residuum. The average annual precipitation is about 14 inches, the average annual air temperature is about 48 degrees F, and the average frost-free period is about 125 days.

The Ildefonso soil makes up about 50 percent of the unit, the Lazear soil makes up about 30 percent, and soils of minor extent make up 20 percent.

The Ildefonso soil is deep and well drained. Typically, the surface layer is brown stony loam about 8 inches thick. The underlying material is white, very strongly calcareous very stony loam to a depth of 60 inches.

Permeability of the Ildefonso soil is moderately rapid, and available water capacity is low. Effective rooting depth is more than 60 inches. Surface runoff is medium, and the erosion hazard is moderate.

The Lazear soil is shallow over shale bedrock and is well drained. Typically, the surface layer is grayish brown gravelly loam about 4 inches thick. The underlying mate-

rial is light brownish gray cobbly loam. Calcareous shale and sandstone is at a depth of 16 inches.

Permeability of the Lazear soil is moderate, and available water capacity is very low. Effective rooting depth is 10 to 20 inches. Surface runoff is rapid, and the erosion hazard is severe.

Included with these soils in mapping are small areas of shale outcrops and Potts soils. The Potts soils are in depressions. These areas make up about 5 to 10 percent of the map unit.

These soils are used for wildlife habitat and grazing.

The native vegetation on these soils is mainly pinyon and juniper. The understory is junegrass, serviceberry, bitterbrush, wheatgrass, and sagebrush.

When the understory vegetation deteriorates, forbs and shrubs increase and grasses almost disappear. Properly managing grazing maintains and improves the vegetation. Reducing brush improves grazing on the Ildefonso soil where slope is less than 15 percent if the grass understory is adequate and desirable shrubs are not destroyed. Properly managing grazing maintains and improves the understory vegetation. Reducing brush on the Ildefonso soil where slope is less than 15 percent improves deteriorated vegetation if the grass understory is adequate and if desirable shrubs are not destroyed. Selectively thinning pinyon and juniper on the Lazear soil improves grazing and provides firewood and posts. Steep slopes and the severe erosion hazard affect harvesting.

These soils can produce about 6 cords of wood per acre when trees more than 4.5 feet tall reach an average diameter of 5 inches.

Mule deer, gray squirrel, and cottontail rabbit find habitat on these soils.

Use of these soils for community development and as a source of construction material is limited by depth to bedrock, steep slopes, and large stones.

This complex is in capability subclass VIIe, nonirrigated.

36—Irigul channery loam, 9 to 50 percent slopes. This shallow, well drained, rolling to steep, soil is on upland ridges and mountainsides. Elevation ranges from 7,800 to 8,700 feet. This soil formed in residuum from sandstone and marlstone. The average annual precipitation is about 20 inches and comes mostly as snow. The average annual air temperature is about 40 degrees F, and the average frost-free period is less than 75 days.

Typically, the surface layer is grayish brown channery loam about 6 inches thick. The underlying material is yellowish brown extremely channery sandy clay loam about 11 inches thick. Hard, fractured sandstone is at a depth of 17 inches.

Included with this soil in mapping are small areas of soils that are more than 20 inches deep to bedrock, some small areas of soils that have a light colored surface layer, and some small areas of Rock outcrop.

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

This soil is used for wildlife habitat and limited grazing.

The native vegetation on this soil is mainly wheatgrass, bluegrass, mountainmahogany, and serviceberry.

When range condition deteriorates, forbs and shrubs increase. When the range is in poor condition, undesirable weeds and annual plants are numerous. Properly managing grazing maintains and improves range condition. Reducing brush where slope is less than 15 percent improves the range, but desirable shrubs should not be destroyed.

Mule deer, snowshoe hare, and blue grouse find habitat on this soil.

Use of this soil for septic tank absorption fields, community development, and roads and as a source of construction material is limited by shallow depth to bedrock and steep slopes.

This soil is in capability subclass VIIe, nonirrigated.

37—Irigul channery loam, 50 to 75 percent slopes. This shallow, well drained, steep soil is on north-facing ridges and mountainsides. Elevation ranges from 7,800 to 8,700 feet. This soil formed in residuum from sandstone and marlstone. The average annual precipitation is about 20 inches and comes mostly as snow. The average annual air temperature is about 40 degrees F, and the average frost-free period is less than 75 days.

Typically, an organic layer 2 or 3 inches thick is on the surface. The surface layer is grayish brown channery loam about 6 inches thick. The underlying material is yellowish brown extremely channery sandy clay loam about 11 inches thick. Hard, fractured sandstone is at a depth of 17 inches.

Included with this soil in mapping are small areas of soils that are more than 20 inches deep to bedrock, some small areas of soils that have a light colored surface layer, and some small areas of Rock outcrop.

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

This soil is used mainly for wildlife habitat.

The native vegetation on this soil is mainly Douglas-fir and an understory of grasses, forbs, and shrubs. The major understory plants are elk sedge, wildrye, Oregongrape, snowberry, serviceberry, rose, and chokecherry.

Properly managing the vegetation maintains good wildlife habitat, aesthetic value, and watershed.

This soil is suited to production of Douglas-fir. It can produce 3,350 cubic feet of wood per acre or 13,760 board feet (International rule) of merchantable timber from a fully stocked, even-aged stand of 80-year-old trees. The very steep slopes affect timber harvest, and special attention is needed to reduce soil loss during

harvesting. The low available water capacity affects survival of seedlings.

Mule deer, snowshoe hare, and some blue grouse find habitat on this soil.

Community development is severely limited by shallow depth to bedrock and very steep slopes.

This soil is in capability subclass VIIe, nonirrigated.

38—Irigul-Starman channery loams, 5 to 50 percent slopes. This complex is on ridge crests and mountainsides. Elevation ranges from 7,800 to 9,000 feet. The soils formed in residuum from sandstone and marlstone. The average annual precipitation is about 20 inches, the average annual air temperature is about 40 degrees F, and the average frost-free period is less than 75 days.

The Irigul soil makes up about 55 percent of the unit, and the Starman soil makes up about 30 percent. The Irigul soil is on mountainsides and the less windswept parts of the landscape, and the Starman soil is on ridge crests.

The Irigul soil is shallow and well drained. Typically, the surface layer is grayish brown channery loam about 6 inches thick. The underlying material is yellowish brown extremely channery sandy clay loam about 11 inches thick. Hard, fractured sandstone is at a depth of 17 inches.

Permeability of the Irigul soil is moderate, and available water capacity is very low. Effective rooting depth is 10 to 20 inches. Surface runoff is medium, and the erosion hazard is slight.

The Starman soil is shallow and well drained. Typically, the surface layer is brown, calcareous channery loam about 3 inches thick. The underlying material is very pale brown, strongly calcareous extremely channery loam. Bedrock is at a depth of 13 inches.

Permeability of the Starman soil is moderate, and available water capacity is very low. Effective rooting depth is about 10 to 20 inches. Surface runoff is medium, and the erosion hazard is slight.

Included with these soils in mapping are small areas of Parachute soils in small depressions. These areas make up about 5 to 15 percent of the map unit.

These soils are used mainly for limited grazing and wildlife habitat.

The native vegetation on the Irigul soil is mainly wheatgrass, bluegrass, mountainmahogany, and serviceberry. The native vegetation on the Starman soil is mainly wheatgrass, penstemon, goldenweed, and buckwheat.

When range condition deteriorates, forbs and low growing shrubs increase. Properly managing grazing maintains and improves range condition.

Mule deer, wild horses, snowshoe hare, and blue grouse find habitat on these soils.

Community development is limited by steep slopes and shallow depth to rock.

This complex is in capability subclass VIIe, nonirrigated.

39—Jerry loam, 12 to 50 percent slopes. This deep, well drained, strongly sloping to steep soil is on mountainsides. Elevation ranges from 7,000 to 9,500 feet. This soil formed in alluvium derived from sandstone, shale, and basalt. The average annual precipitation is about 20 inches, the average annual air temperature is about 41 degrees F, and the average frost-free period is less than 75 days.

Typically, the surface layer is dark grayish brown loam about 3 inches thick. The subsoil is yellowish brown and light brown cobbly clay loam about 37 inches thick. The substratum is light brown cobbly clay to a depth of 60 inches.

Included with this soil in mapping are small areas of Tanna and Dollard soils at lower elevations. These areas make up 5 to 10 percent of the map unit.

Permeability is slow, and available water capacity is high. Effective rooting depth is 60 inches or more. Surface runoff is slow, and the erosion hazard is moderate.

This soil is used mainly for limited grazing and wildlife habitat.

The native vegetation on this soil is mainly Gambel oak, bromes, and elk sedge.

When range is in poor condition, Kentucky bluegrass, undesirable weeds, and annual plants are numerous. Properly managing grazing maintains and improves range condition.

Mule deer, elk, blue grouse, gray squirrel, and wild turkey find habitat on these soils.

Community development is limited by high shrink-swell potential, steep slopes, and low strength. Building sites and roads need good drainage. This soil slumps when saturated or if cut deep.

This soil is in capability subclass VIIe, nonirrigated.

40—Kim loam, 3 to 6 percent slopes. This deep, well drained, gently to sloping soil is on alluvial fans and benches. Elevation ranges from 5,000 to 6,000 feet. This soil formed in alluvium derived from shale and sandstone. The average annual precipitation is about 12 inches, the average annual air temperature is about 46 degrees F, and the average frost-free period is about 125 days.

Typically, the surface layer is yellowish brown or light yellowish brown loam about 17 inches thick. The underlying material is light brownish gray loam to a depth of 60 inches. In places the underlying material is stratified with fine sandy loam.

Included with this soil in mapping are small areas of Arvada and Olney soils that have slopes of 3 to 6 percent. These areas make up 5 to 15 percent of the map unit.

Permeability is moderate, and available water capacity is high. Effective rooting depth is 60 inches or more.

Surface runoff is slow, and the erosion hazard is moderate.

This soil is used mainly for crops, hay, and pasture. Alfalfa, small grains, and grass or grass-legume mixtures are grown.

This soil is irrigated by flooding or furrows. Sprinklers are also suitable. Drop structures in ditches control water and prevent excessive ditch erosion.

The native vegetation on this soil is mainly wheatgrasses, needleandthread, and sagebrush.

When range condition deteriorates, forbs and shrubs increase. When the range is in poor condition, undesirable weeds and annual plants are numerous. Properly managing grazing maintains and improves range condition. Reducing brush improves the range. Seeding improves range in poor condition. Crested wheatgrass, western wheatgrass, and Russian wildrye are suitable for seeding. Preparing a seedbed and drilling the seed are good practices.

Cottontail rabbit, ground squirrel, and pheasant find habitat on this soil.

Use of this soil for community development and as a source of construction material is limited by low strength.

This soil is in capability subclasses IIIe, irrigated, and IVc, nonirrigated.

41—Kim loam, 6 to 12 percent slopes. This deep, well drained, moderately sloping to rolling soil is on alluvial fans and benches. Elevation ranges from 5,000 to 6,000 feet. This soil formed in alluvium derived from shale and sandstone. The average annual precipitation is about 12 inches, the average annual air temperature is about 48 degrees F, and the average frost-free period is about 125 days.

Typically, the surface layer is yellowish brown or light yellowish brown loam about 17 inches thick. The underlying material is light brownish gray loam to a depth of 60 inches. In places the underlying material is stratified with fine sandy loam.

Included with this soil in mapping are small areas of Arvada and Potts soils that have slopes of 6 to 12 percent. These areas make up 5 to 15 percent of the map unit.

Permeability is moderate, and available water capacity is high. Effective rooting depth is 60 inches or more. Surface runoff is slow, and the erosion hazard is moderate.

This soil is used mainly for crops, hay, and pasture. Alfalfa, small grains, and grass or grass-legume mixtures are grown.

This soil is irrigated by flooding and furrows. Sprinklers are also suitable. Drop structures in irrigation ditches control water and prevent excessive ditch erosion. Keeping the soil in hay or pasture at least three-fourths of the time helps to control erosion.

The native vegetation on this soil is mainly wheatgrass, needleandthread, and sagebrush.

When range condition deteriorates, forbs and shrubs increase. When the range is in poor condition, undesirable weeds and annual plants are numerous. Properly managing grazing maintains and improves range condition. Reducing brush improves the range. Seeding improves range in poor condition. Crested wheatgrass, western wheatgrass, and Russian wildrye are suitable for seeding. Preparing a seedbed and drilling the seed are good practices.

Cottontail rabbit, ground squirrel, and pheasant find habitat on this soil.

Use of this soil for community development and as a source of construction material is limited by low strength and steep slopes.

This soil is in capability subclasses IVe, irrigated, and VIe, nonirrigated.

42—Lamphier loam, 15 to 50 percent slopes. This deep, well drained, steep soil is on fans and mountainsides. Elevation ranges from 7,500 to 10,000 feet. This soil formed in residuum from sandstone and shale. The average annual precipitation is about 21 inches, the average annual air temperature is about 40 degrees F, and the frost-free period is less than 75 days.

Typically, the surface layer is dark brown loam about 30 inches thick. The underlying material is reddish brown and dark reddish brown loam to a depth of 60 inches.

Included with this soil in mapping are small areas of Almy soils and Rock outcrop. The Almy soils are at lower elevations. These areas make up 5 to 10 percent of the map unit.

Permeability is moderate, and available water capacity is high. Effective rooting depth is 60 inches or more. Surface runoff is slow, and the erosion hazard is slight.

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

The native vegetation is aspen and an understory of bromes, elk sedge, wildrye, wheatgrass, peavine, columbine, snowberry, serviceberry, and chokecherry.

When the understory vegetation deteriorates, forbs, shrubs, and Kentucky bluegrass increase. Properly managing grazing maintains and improves the understory vegetation.

This soil is suited to production of quaking aspen. It can produce 4,050 cubic feet of wood per acre or 6,800 board feet of timber from a fully stocked, even-aged stand of 80-year-old trees. At the present there is no commercial harvest of the aspen. Steep slopes affect harvesting, and special attention is needed to reduce soil loss during harvest.

Mule deer, elk, blue grouse, and snowshoe rabbit find habitat on this soil.

Septic tank filter fields, community development, and roads are limited by steep slopes. Surface runoff from snowmelt increases the erosion hazard on cuts and fills. Seeding reduces the erosion hazard. Roads can be de-

signed to provide surface drainage outlets for large amounts of snowmelt.

This soil is in capability subclass VIIe, nonirrigated.

43—Limon silty clay loam, 3 to 12 percent slopes. This deep, well drained, gently sloping to strongly sloping soil is on alluvial fans and sides of valleys. Elevation ranges from 5,000 to 6,500 feet. This soil formed in fine textured, calcareous sediment derived from shale. The average annual precipitation is about 14 inches, the average annual air temperature is about 48 degrees F, and the average frost-free period is about 125 days.

Typically, the surface layer is light brownish gray silty clay loam about 11 inches thick. The underlying material is light brownish gray and light gray silty clay loam to a depth of 60 inches.

Included with this soil in mapping are small areas of Arvada and Heldt soils that have slopes of 3 to 12 percent. These soils make up 10 to 15 percent of the map unit.

Permeability is slow, and available water capacity is moderate. Effective rooting depth is 60 inches or more. Surface runoff is medium, and the erosion hazard is moderate.

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

This soil is usually irrigated by flooding. This soil takes in water slowly. Length of run and slope should be carefully determined. This soil compacts easily when wet. Green manure crops and tillage help to maintain tilth.

The native vegetation on this soil is mainly wheatgrass, sagebrush, and rabbitbrush.

When range condition deteriorates, forbs and shrubs increase. When the range is in poor condition, undesirable weeds and annual plants are numerous. Properly managing grazing maintains and improves range condition. Reducing brush improves the range. Seeding improves range in poor condition. Western wheatgrass, streambank wheatgrass, and crested wheatgrass are suitable for seeding. Preparing a seedbed and drilling the seed are good practices.

Cottontail rabbit, pheasant, and squirrel find habitat on this soil.

Use of this soil for community development, for sanitary facilities, and as a source of construction material is limited by the high clay content, shrink-swell potential, and low strength. Dwellings and roads can be designed to reduce these limitations.

This soil is in capability subclasses IVs, irrigated, and VIe, nonirrigated.

44—Morval loam, 3 to 12 percent slopes. This deep, well drained, gently sloping to rolling soil is on mesas and sides of valleys. Elevation ranges from 6,500 to 8,000 feet. This soil formed in reworked alluvium derived from basalt and sandstone. The average annual precipitation is about 15 inches, the average annual air temperature is about 44 degrees F, and the average frost-free period is about 100 days.

Typically, the surface layer is brown loam about 5 inches thick. The upper part of the subsoil is brown or light brown clay loam about 12 inches thick, and the lower part is light brown stony clay loam about 10 inches thick. The substratum is pink stony loam.

Included with this soil in mapping are small areas of Villa Grove, Zoltay, and Tridell soils. Villa Grove and Zoltay soils are on the steeper parts of the landscape. Tridell soils have accumulations of calcium carbonate. These areas make up about 15 percent of the map unit.

Permeability is moderate, and available water capacity is moderate. Effective rooting depth is 60 inches. Surface runoff is slow, and the erosion hazard is slight.

This soil is used mainly for grazing. A small acreage is used for hay and pasture (fig. 8). Irrigated areas are used for alfalfa, grass-legume mixtures, and oats or barley.

Flooding, furrows, and sprinklers are suitable for irrigating this soil. Flooding is well suited to alfalfa, pasture, hay, and small grains. Sprinklers minimize soil loss.

The native vegetation on this soil is mainly needleandthread, wheatgrass, and sagebrush.

When range condition deteriorates, forbs and shrubs increase. When the range is in poor condition, undesirable weeds and annual plants are numerous. Properly managing grazing maintains and improves range condition. Reducing brush improves the range. Seeding improves range in poor condition. Pubescent wheatgrass, western wheatgrass, and big bluegrass are suitable for seeding. Preparing a seedbed and drilling the seed are good practices.

Cottontail rabbit, mule deer, and grouse find habitat on this soil.

Community development and recreation are limited by shrink-swell potential, frost action, and low strength.

This soil is in capability subclass IVe, irrigated and nonirrigated.

45—Morval-Tridell complex, 6 to 25 percent slopes. These moderately sloping to hilly soils are on alluvial fans and sides of mesas. Elevation ranges from 6,500 to 8,000 feet. The soils formed in reworked alluvium derived from basalt and sandstone. The average annual precipitation is about 15 inches, the average annual air temperature is about 44 degrees F, and the average frost-free period is about 100 days.

The Morval soil makes up about 55 percent of the unit, and the Tridell soil makes up about 30 percent. The Morval soil is on the less sloping parts of the landscape, and the Tridell soil is on the sides of mesas.

The Morval soil is deep and well drained. Typically, the surface layer is brown loam about 5 inches thick. The upper part of the subsoil is brown and light brown clay loam and stony clay loam about 12 inches thick, and the lower part is light brown stony clay loam about 10 inches thick. The substratum is pink stony loam.

Permeability of the Morval soil is moderate, and available water capacity is moderate. Effective rooting depth is 60 inches. Surface runoff is medium, and the erosion hazard is moderate.

The Tridell soil is deep and well drained. Typically, the surface layer is brown stony loam 10 inches thick. The upper part of the underlying material is brown very stony loam 11 inches thick, and the lower part is pinkish white very stony loam to a depth of 60 inches.

Permeability of the Tridell soil is moderately rapid, and available water capacity is low. Effective rooting depth is 60 inches. Surface runoff is medium, and the erosion hazard is moderate.

Included with these soils in mapping are small areas of Villa Grove and Zoltay soils on the steeper parts of the landscape. These areas make up about 15 percent of the map unit.

These soils are used mainly for grazing.

The native vegetation on the Morval soil is mainly needleandthread, wheatgrass, and sagebrush. The native vegetation on the Tridell soil is mainly pinyon, Utah juniper, and some Rocky Mountain juniper and an understory mostly of wheatgrass, Indian ricegrass, needleandthread, junegrass, serviceberry, bitterbrush, mountainmahogany, and big sagebrush.

When range condition deteriorates, forbs and shrubs increase. Properly managing grazing maintains and improves range condition. Seeding improves range in poor condition on gently sloping Morval soils. Bluebunch wheatgrass, western wheatgrass, and needleandthread are suitable for seeding. Preparing a seedbed and drilling the seed are good practices. Reducing brush improves range that is producing more shrubs than are normally found in the potential plant community. Properly managing the vegetation on the Tridell soil maintains wood production and grazing. Selectively thinning pinyon and juniper improves grazing and provides firewood, posts, and Christmas trees.

The Tridell soil is suited to production of pinyon and Utah juniper. It can produce 8 cords of wood per acre when trees more than 4.5 feet tall reach an average diameter (at one foot) of 5 inches. Special care is needed to prevent erosion during harvest. The low available water capacity affects survival of seedlings.

Mule deer, wild turkey, and squirrel find habitat on these soils.

Community development is limited by large stones. Cut slopes are difficult to revegetate because of the stones and because of the shrink-swell potential and frost action of the Morval soil.

This complex is in capability subclass VIe, nonirrigated.

46—Nihill channery loam, 1 to 6 percent slopes. This deep, well drained, nearly level to gently sloping soil is on alluvial fans and sides of valleys. Elevation ranges from 5,000 to 6,500 feet. The soil formed in alluvium derived from Green River shale and sandstone. The average annual precipitation is about 13 inches, the average annual air temperature is about 48 degrees F, and the average frost-free period is about 125 days.

Typically, the surface layer is light gray and very pale brown channery loam about 11 inches thick. The upper part of the underlying material is very pale brown very channery loam about 14 inches thick, and the lower part is very pale brown extremely channery sandy loam and extremely channery loam to a depth of 60 inches.

Included with this soil in mapping are small areas of Arvada and Ildefonso soils. The Arvada soils are nearly level, and Ildefonso soils are steeper. These areas make up 10 to 15 percent of the map unit.

Permeability is moderately rapid, and available water capacity is low. Effective rooting depth is 60 inches. Surface runoff is slow, and the erosion hazard is moderate.

This soil is used mainly for grazing and wildlife habitat. Some small areas are in irrigated hay and pasture.

This soil is usually irrigated by flooding. Sprinklers are also suitable. Since this soil is droughty, frequent irrigation is needed to grow hay or pasture. Drop structures in irrigation ditches prevent ditch erosion. Keeping the irrigation run short prevents too deep percolation.

The native vegetation on this soil is mainly wheatgrass, needleandthread, and sagebrush.

When range condition deteriorates, forbs and shrubs increase. When the range is in poor condition, undesirable weeds and annual plants are numerous. Properly managing grazing maintains and improves range condition. Reducing brush improves the range. Seeding improves range in poor condition. Crested wheatgrass, western wheatgrass, and Russian wildrye are suitable for seeding. Preparing a seedbed and drilling the seed are good practices.

Mule deer, cottontail rabbit, chukar, and squirrel find habitat on this soil.

This soil has few limitations for community development. Community sewage facilities will be needed if population density increases.

This soil is in capability subclasses IVe, irrigated, and VIe, nonirrigated.

47—Nihill channery loam, 6 to 25 percent slopes. This deep, well drained, moderately sloping to hilly soil is on alluvial fans and sides of valleys. Elevation ranges from 5,000 to 6,500 feet. This soil formed in alluvium derived from Green River shale and sandstone. The average annual precipitation is about 13 inches, the average annual air temperature is about 48 degrees F, and the average frost-free period is about 125 days.

Typically, the surface layer is light gray and very pale brown channery loam about 11 inches thick. The upper part of the underlying material is very pale brown very channery loam about 7 inches thick, and the lower part is very pale brown extremely channery sandy loam and extremely channery loam to a depth of 60 inches.

Included with this soil in mapping are small areas of Arvada and Ildefonso soils. The Arvada soils are moderately sloping, and the Ildefonso soils are steeper. These areas make up 10 to 15 percent of the map unit.

Permeability is moderately rapid, and available water capacity is low. Effective rooting depth is 60 inches. Surface runoff is slow, and the erosion hazard is severe.

This soil is used mainly for grazing and wildlife habitat.

The native vegetation on this soil is mainly wheatgrass, needleandthread, and sagebrush.

When range condition deteriorates, forbs and shrubs increase. When the range is in poor condition, undesirable weeds and annual plants are numerous. Properly managing grazing maintains and improves range condition. Reducing brush improves range, but desirable shrubs should not be destroyed.

Mule deer, cottontail rabbit, chukar, and squirrel find habitat on this soil.

Community development is limited by steep slopes. Community sewage facilities will be needed if population density increases.

This soil is in capability subclass VIIe, nonirrigated.

48—Northwater loam, 15 to 65 percent slopes. This deep, well drained, hilly to very steep soil is on mountainsides. Elevation ranges from 7,600 to 8,400 feet. This soil formed in residuum from sedimentary rocks. The average annual precipitation is about 20 inches, the average air temperature is about 40 degrees F, and the average frost-free period is less than 75 days.

Typically, the upper part of the surface layer is brown loam about 10 inches thick. In most places 2 inches of organic material is on the surface. The lower part of the surface layer is dark grayish brown loam about 15 inches thick. The subsoil is light brown very channery clay loam about 25 inches thick. Fractured sandstone is at a depth of 50 inches.

Included with this soil in mapping are small areas of Parachute, Rhone, and Irigul soils. The Rhone soils are on the north-facing side slopes, and the Parachute and Irigul soils are near ridge crests. These areas make up 10 to 15 percent of the map unit.

Permeability is moderate, and available water capacity is moderate. Effective rooting depth is 40 to 60 inches. Surface runoff is slow, and the erosion hazard is slight.

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

The native vegetation is aspen and an understory mostly of mountain brome, elk sedge, slender wheatgrass, aspen peavine, aspen fleabane, snowberry, serviceberry, and chokecherry.

When the understory vegetation deteriorates, forbs, shrubs, and Kentucky bluegrass increase.

This soil is suited to production of quaking aspen. It can produce 4,050 cubic feet of wood or 6,800 board feet of timber per acre from a fully stocked, even-aged stand of 80-year-old trees. At the present there is no commercial harvest of aspen. Steep slopes affect harvesting, and special attention is needed to reduce soil loss during harvest.

Elk, mule deer, coyote, and grouse find habitat on this soil.

Use of this soil for community development, for sanitary facilities, and as a source of construction material is limited by slope and depth to rock.

This soil is in capability subclass VIIe, nonirrigated.

49—Olney loam, 1 to 3 percent slopes. This deep, well drained, nearly level soil is on alluvial fans and sides of valleys. Elevation ranges from 5,000 to 6,500 feet. This soil formed in alluvium derived from sandstone and shale. The average annual precipitation is about 14 inches, the average annual air temperature is about 48 degrees F, and the average frost-free period is about 125 days.

Typically, the surface layer is grayish brown loam about 12 inches thick. The subsoil is grayish brown and light gray sandy clay loam about 21 inches thick. The substratum is light gray gravelly sandy clay loam or very gravelly sandy loam to a depth of 60 inches.

Included with this soil in mapping are small areas of Heldt, Potts, and Kim soils that have slopes of 2 to 3 percent. These areas make up 5 to 15 percent of the map unit.

Permeability is moderate, and available water capacity is moderate. Effective rooting depth is 60 inches or more. Surface runoff is slow, and the erosion hazard is slight.

This soil is mainly used for irrigated crops and hay. Alfalfa, small grains, corn for silage, and grass or grass-legume mixtures are grown. Small acreages are in fruits, including apples, peaches, and apricots.

This soil is irrigated by furrows and flooding. Sprinklers are also suitable. Drop structures in irrigation ditches help to control water and prevent excessive ditch erosion.

The native vegetation on this soil was mainly wheatgrass, needleandthread, and sagebrush.

When range condition deteriorates, forbs and shrubs increase. When the range is in poor condition, undesirable weeds and annual plants are numerous.

Cottontail rabbit, squirrel, pheasant, and some mule deer find habitat on this soil.

Community development and recreation are limited by low strength.

This soil is in capability subclass IIIe, irrigated.

50—Olney loam, 3 to 6 percent slopes. This deep, well drained, gently sloping soil is on alluvial fans and sides of valleys. Elevation ranges from 5,000 to 6,500 feet. This soil formed in alluvium derived from sandstone and shale. The average annual precipitation is about 14 inches, the average annual air temperature is about 48

degrees F, and the average frost-free period is about 125 days.

Typically, the surface layer is grayish brown loam about 12 inches thick. The subsoil is grayish brown and light gray sandy clay loam about 21 inches thick. The substratum is light gray gravelly sandy clay loam or very gravelly sandy loam to a depth of 60 inches.

Included with this soil in mapping are small areas of Heldt, Potts, and Kim soils that have slopes of 3 to 6 percent. These areas make up 5 to 15 percent of the map unit.

Permeability is moderate, and available water capacity is moderate. Effective rooting depth is 60 inches or more. Surface runoff is slow, and the erosion hazard is moderate.

This soil is used mainly for irrigated crops and hay. Alfalfa, small grains, corn for silage, and grass or grass-legume mixtures are grown. Small acreages are in fruits, including apples, peaches, and apricots. Isolated areas are used for grazing.

This soil is irrigated by furrows and flooding. Sprinklers are also suitable. Drop structures in irrigation ditches help to control water and prevent excessive ditch erosion.

The native vegetation on this soil is mainly wheatgrass, needleandthread, and sagebrush.

When range condition deteriorates, forbs and shrubs increase. When the range is in poor condition, undesirable weeds and annual plants are numerous. Properly managing grazing maintains and improves range condition. Reducing brush improves deteriorated range. Seeding improves range in poor condition. Crested wheatgrass, western wheatgrass, and Russian wildrye are suitable for seeding. Preparing a seedbed and drilling the seed are good practices.

Cottontail rabbit, squirrel, pheasant, and some mule deer find habitat on this soil.

Community development and recreation are limited by low strength.

This soil is in capability subclasses IIIe, irrigated, and IVe, nonirrigated.

51—Olney loam, 6 to 12 percent slopes. This deep, well drained, moderately sloping to rolling soil is on alluvial fans and sides of valleys. Elevation ranges from 5,000 to 6,500 feet. This soil formed in alluvium derived from sandstone and shale. The average annual precipitation is about 14 inches, the average annual air temperature is about 48 degrees F, and the frost-free period is about 125 days.

Typically, the surface layer is grayish brown loam about 12 inches thick. The subsoil is grayish brown and light gray sandy clay loam about 21 inches thick. The substratum is light gray gravelly sandy clay loam and very gravelly sandy loam to a depth of 60 inches.

Included with this soil in mapping are small areas of Heldt, Potts, and Kim soils that have slopes of 6 to 12 percent. These areas make up 5 to 15 percent of the map unit.

Permeability is moderate, and available water capacity is moderate. Effective rooting depth is 60 inches or more. Surface runoff is medium, and the erosion hazard is moderate.

This soil is used mainly for irrigated hay, fruits, and grazing. Grass-legume mixtures and apples, peaches, and apricots are grown.

This soil is irrigated by furrows and flooding. Sprinklers are also suitable. Drop structures in irrigation ditches help to control water and prevent excessive ditch erosion. Keeping a grass or legume cover on this soil at least three-fourths of the time controls erosion.

The native vegetation on this soil is mainly wheatgrass, needleandthread, and sagebrush.

When range condition deteriorates, forbs and shrubs increase. When the range is in poor condition, undesirable weeds and annual plants are numerous. Properly managing grazing maintains and improves range condition. Reducing brush improves the range. Seeding improves range in poor condition. Crested wheatgrass, western wheatgrass, and Russian wildrye are suitable for seeding. Preparing a seedbed and drilling the seed are good practices.

Cottontail rabbit, squirrel, pheasant, and some mule deer find habitat on this soil.

Community development and recreation are limited by steep slopes and low strength.

This soil is in capability subclass IVe, irrigated and nonirrigated.

52—Parachute loam, 25 to 65 percent slopes. This moderately deep, well drained, hilly to very steep soil is on north- and east-facing mountainsides. Elevation ranges from 7,500 to 8,700 feet. This soil formed in residuum from sandstone. The average annual precipitation is 20 inches, the average annual air temperature is about 40 degrees F, and the average frost-free period is less than 75 days.

Typically, the surface layer is grayish brown loam about 5 inches thick. The upper part of the subsoil is very dark grayish brown and brown loam about 13 inches thick, and the lower part is light yellowish brown extremely channery loam about 11 inches thick. Hard, fractured sandstone bedrock is at a depth of 29 inches.

Included with this soil in mapping are small areas of Rhone and Irigul soils. The Rhone soils are in concave positions. These areas make up 10 to 15 percent of the map unit. Irigul soils are on ridge crests.

Permeability is moderate, and available water capacity is low. Effective rooting depth is 20 to 40 inches. Surface runoff is medium, and the erosion hazard is moderate.

This soil is used mainly for wildlife habitat and limited grazing.

The native vegetation on this soil, because it faces north and east, is mainly Gambel oak, serviceberry, snowberry, and elk sedge.

When range condition deteriorates, shrubs increase. Properly managing grazing maintains and improves range condition.

Elk, mule deer, coyote, and grouse find habitat on this soil.

Use of this soil for community development and as a source of construction material is limited by depth to rock and steep slopes.

This soil is in capability subclass VIIe, nonirrigated.

53—Parachute-Rhone loams, 5 to 30 percent slopes. These gently sloping to steep soils are on ridge crests and mountainsides. Elevation ranges from 7,600 to 8,600 feet. The Parachute soil formed in residuum from sandstone or marlstone, and the Rhone soil formed in residuum from hard, fine-grained sandstone. The average annual precipitation is about 20 inches, the average annual air temperature is about 40 degrees F, and the frost-free period is less than 75 days.

The Parachute soil makes up about 55 percent of the map unit, the Rhone soil makes up about 30 percent, and soils of minor extent make up 15 percent. The Parachute soil is mostly on ridge crests, and the Rhone soil is in gently sloping to moderately sloping areas on mountainsides.

The Parachute soil is moderately deep and well drained. Typically, the surface layer is grayish brown loam about 5 inches thick. The upper part of the subsoil is very dark grayish brown and brown loam about 13 inches thick, and the lower part is light yellowish brown extremely channery loam about 11 inches thick. Hard, fractured sandstone is at a depth of 29 inches (fig. 9).

Permeability of the Parachute soil is moderate, and available water capacity is low. Effective rooting depth is 20 to 40 inches. Surface runoff is medium, and the erosion hazard is moderate.

The Rhone soil is deep and well drained. Typically, the upper part of the surface layer is brown loam about 8 inches thick, and the lower part is brown sandy clay loam about 20 inches thick. The underlying material is brown very channery sandy clay loam about 24 inches thick. Fractured sandstone is at a depth of 52 inches.

Permeability of the Rhone soil is moderate, and available water capacity is moderate to high. Effective rooting depth is 40 to 60 inches. Surface runoff is slow, and the erosion hazard is slight.

Included with these soils in mapping are areas of Irigul soils on ridge crests. These areas make up about 10 percent of the map unit.

These soils are used mainly for grazing and wildlife habitat.

The native vegetation on these soils is mainly needlegrass, elk sedge, and sagebrush.

When range condition deteriorates, forbs and shrubs increase. Properly managing grazing maintains and improves range condition. Seeding improves range in poor condition where slope is less than 15 percent. Intermediate wheatgrass, slender wheatgrass, and mountain and smooth brome are suitable for seeding. Preparing a seedbed and drilling the seed are good practices. Reducing brush on slopes of less than 15 percent improves deteriorated range, but removing brush may damage deer habitat.

Many deer and some snowshoe hare and blue grouse find habitat on these soils.

Use of this soil for community development or as a source of construction material is limited by depth to rock and steep slopes.

This complex is in capability subclass VIe, nonirrigated.

54—Potts loam, 1 to 3 percent slopes. This deep, well drained soil is on mesas, benches, and sides of valleys. Elevation ranges from 5,000 to 7,000 feet. This soil formed in alluvium derived from sandstone, shale, or basalt. The average annual precipitation is about 14 inches, the average annual air temperature is about 46 degrees F, and the average frost-free period is about 120 days.

Typically, the surface layer is brown loam about 4 inches thick. The subsoil is reddish brown clay loam about 24 inches thick. The substratum is pinkish white loam to a depth of 60 inches.

Included with this soil in mapping are small areas of Olney, Kim, and Ildefonso soils that have slopes of 1 to 3 percent. These areas make up 10 to 15 percent of the map unit.

Permeability is moderate, and available water capacity is high. Effective rooting depth is 60 inches or more. Surface runoff is slow, and the erosion hazard is slight.

This soil is used mainly for irrigated crops and hay and for dryland farming. Alfalfa, small grains, and grass-legume hay are grown.

This soil is usually irrigated by flooding. Drop structures in irrigation ditches, grassed waterways, and minimum tillage control erosion. Irrigation water should be carefully managed to avoid piping. Cover crops or stubble mulching also help to limit erosion losses in dry-farmed areas.

The native vegetation on this soil is mainly wheatgrass, needleandthread, and sagebrush.

Pheasant, mourning dove, cottontail rabbit, some mule deer, and squirrel find habitat on this soil.

Community development and recreation are limited by low strength and shrink-swell potential. Dwellings and roads can be designed to compensate for these limitations. Community sewage systems will be needed if the population density increases.

This soil is in capability subclasses IIIe, irrigated, and IIIc, nonirrigated.

55—Potts loam, 3 to 6 percent slopes. This deep, well drained, moderately sloping soil is on mesas, benches, and sides of valleys. Elevation ranges from 5,000 to 7,000 feet. This soil formed in alluvium derived from sandstone, shale, or basalt. The average annual precipitation is about 14 inches, the average annual air temperature is about 46 degrees F, and the average frost-free period is about 120 days.

Typically, the surface layer is brown loam about 4 inches thick. The subsoil is reddish brown clay loam about 24 inches thick. The substratum is pinkish white loam to a depth of 60 inches.

Included with this soil in mapping are small areas of Olney, Kim, and Ildefonso soils that have slopes of 3 to 6 percent. These areas make up 10 to 15 percent of the map unit.

Permeability is moderate, and available water capacity is high. Effective rooting depth is 60 inches or more. Surface runoff is slow, and the erosion hazard is moderate.

This soil is used mainly for irrigated crops and hay and for dryland farming (fig. 10). Alfalfa, small grains, and grass-legume hay are grown. Small areas are used for grazing.

These soils are usually irrigated by flooding. Drop structures in irrigation ditches, grassed waterways, and minimum tillage prevent serious erosion. Irrigation water should be carefully managed to avoid piping and erosion. Cover crops or stubble mulching also help to limit erosion in dryfarmed areas.

The native vegetation on this soil is mainly wheatgrass, needleandthread, and sagebrush.

When range condition deteriorates, forbs and shrubs increase. When the range is in poor condition, undesirable weeds and annual plants are numerous. Properly managing grazing maintains and improves range condition. Reducing brush improves the range. Seeding improves range in poor condition. Crested wheatgrass, western wheatgrass, and Russian wildrye are suitable for seeding. Preparing a seedbed and drilling the seed are good practices.

Pheasant, mourning dove, cottontail rabbit, some mule deer, and squirrel find habitat on this soil.

Community development and recreation are limited by low strength and the shrink-swell potential. Dwellings and roads can be designed to overcome these limitations. Community sewage systems will be needed if the population density increases.

This soil is in capability subclasses IIIe, irrigated, and IVe, nonirrigated.

56—Potts loam, 6 to 12 percent slopes. This deep, well drained, moderately sloping to rolling soil is on mesas, benches, and sides of valleys. Elevation ranges from 5,000 to 7,000 feet. This soil formed in alluvium derived from sandstone, shale, or basalt. The average annual precipitation is about 14 inches, the average annual air temperature is about 46 degrees F, and the average frost-free period is about 120 days.

Typically, the surface layer is brown loam about 4 inches thick. The subsoil is reddish brown clay loam about 24 inches thick. The substratum is pinkish white loam to a depth of 60 inches.

Included with this soil in mapping are small areas of Kim, Olney, and Ildefonso soils that have slopes of 6 to 12 percent. These areas make up 10 to 15 percent of the map unit.

Permeability is moderate, and available water capacity is high. Effective rooting depth is 60 inches or more. Surface runoff is medium, and the erosion hazard is severe.

This soil is used mainly for grazing, wildlife habitat, and some dryland farming (fig. 10). Wheat, barley, and oats are grown.

Minimum contour tillage and stubble mulching help to prevent excessive erosion.

The native vegetation on this soil is mainly wheatgrass, needleandthread, and sagebrush.

When range condition deteriorates, forbs and shrubs increase. When the range is in poor condition, undesirable weeds and annual plants are numerous. Properly managing grazing improves and maintains range condition. Reducing brush improves range. Seeding improves range in poor condition. Crested wheatgrass, western wheatgrass, and Russian wildrye are suitable for seeding. Preparing a seedbed and drilling the seed are good practices.

Community development and recreation are limited by low strength, shrink-swell potential, and slope. Dwellings and roads can be designed to overcome these limitations. Community sewage systems will be needed if the population density increases.

This soil is in capability subclass IVe, irrigated and nonirrigated.

57—Potts-Ildefonso complex, 3 to 12 percent slopes. These gently sloping to rolling soils are on mesas and sides of valleys. Elevation ranges from 5,000 to 6,500 feet. The Potts soil formed in alluvium derived from sandstone, shale, or basalt. The Ildefonso soil formed in very strongly calcareous, basaltic alluvium and small amounts of eolian material. The average annual precipitation is about 14 inches, the average annual air temperature is about 46 degrees F, and the average frost-free period is about 120 days.

The Potts soil makes up about 60 percent of the map unit, and the Ildefonso soils makes up about 30 percent. The Potts soil is on slightly concave positions, and the Ildefonso soil is on the breaks of steeper slopes.

The Potts soil is deep and well drained. Typically, the surface layer is brown loam about 4 inches thick. The subsoil is reddish brown clay loam about 24 inches thick. The substratum is pinkish white loam that extends to a depth of 60 inches.

Permeability of the Potts soil is moderate, and available water capacity is high. Effective rooting depth is 60 inches or more. Surface runoff is slow, and the erosion hazard is moderate.

The Ildefonso soil is deep and well drained. Typically, the surface layer is brown stony loam about 8 inches thick. The underlying material is white, calcareous very stony loam that extends to a depth of 60 inches.

Permeability of the Ildefonso soil is moderately rapid, and available water capacity is low. Effective rooting depth is about 60 inches. Surface runoff is slow, and the erosion hazard is moderate.

Included with this soil in mapping are small areas of Olney and Kim soils that have slopes of 3 to 12 percent. These areas make up 5 to 15 percent of the map unit.

These soils are used mainly for limited grazing and wildlife habitat.

The native vegetation on the Potts soil is mainly wheatgrass, needleandthread, and sagebrush. The native vegetation on the Ildefonso soil is mainly pinyon and Utah juniper and an understory of Indian ricegrass, wheatgrass, junegrass, serviceberry, bitterbrush, and sagebrush.

When the understory vegetation deteriorates, grasses almost disappear and forbs and shrubs increase. Properly managing grazing maintains and improves range condition on both soils. Seeding improves range on the Potts soil if it is in poor condition. Crested wheatgrass, western wheatgrass, and Russian wildrye are suitable for seeding. Preparing a seedbed and drilling the seed are good practices. Reducing brush on the Potts soil improves the range. Properly managing the vegetation on the Ildefonso soil maintains wood production and grazing. Selectively thinning pinyon and juniper improves grazing and provides firewood, posts, and Christmas trees.

The Ildefonso soil is suited to production of pinyon and Utah juniper. It can produce 9 cords of wood per acre when trees more than 4.5 feet tall reach an average diameter (at one foot) of 5 inches. The low available water capacity affects survival of tree seedlings.

Mule deer, wild turkey, chukar, gray squirrel, cottontail rabbit, and some pheasant find habitat on these soils.

Community development is limited on the Potts soil by low strength, shrink-swell potential, and slope. Community development is limited on the Ildefonso soil by steep slopes.

This complex is in capability subclass VIe, nonirrigated.

58—Potts-Ildefonso complex, 12 to 25 percent slopes. These strongly sloping to hilly soils are on mesas, alluvial fans, and sides of valleys. Elevation ranges from 5,000 to 6,500 feet. The Potts soil formed in alluvium derived from sandstone, shale, or basalt. The Ildefonso soil formed in very strongly calcareous, basaltic alluvium and small amounts of eolian material. The average annual precipitation is about 14 inches, the average annual air temperature is about 46 degrees F, and the average frost-free period is about 120 days.

The Potts soil makes up about 60 percent of this unit, and the Ildefonso soil makes up about 30 percent. The Potts soil is in slightly concave positions, and the Ildefonso soil is on the breaks of steeper slopes.

The Potts soil is deep and well drained. Typically, the surface layer is brown loam about 4 inches thick. The subsoil is reddish brown clay loam about 24 inches thick. The substratum is pinkish white loam to a depth of 60 inches.

Permeability of the Potts soil is moderate, and available water capacity is high. Effective rooting depth is 60 inches or more. Surface runoff is medium, and the erosion hazard is moderate.

The Ildefonso soil is deep and well drained. Typically, the surface layer is brown stony loam about 8 inches thick. The underlying material is white, calcareous very stony loam to a depth of 60 inches.

Permeability of the Ildefonso soil is moderately rapid, and available water capacity is low. Effective rooting depth is about 60 inches. Surface runoff is medium, and the erosion hazard is moderate.

Included with this soil in mapping are small areas of Morval and Lazear soils. The Morval soils are at the higher elevations. The Lazear soils are shallow and are on ridge crests and steep mountainsides. These areas make up 10 to 18 percent of the map unit.

These soils are used mainly for limited grazing and wildlife habitat.

The native vegetation on the Potts soil is mainly wheatgrass, needleandthread, and sagebrush. The native vegetation on the Ildefonso soil is mainly pinyon and Utah juniper and an understory of Indian ricegrass, wheatgrass, junegrass, serviceberry, bitterbrush, and sagebrush.

When the understory vegetation deteriorates, grasses almost disappear and forbs and shrubs increase. Properly managing grazing maintains and improves range condition on both soils. Seeding improves range in poor condition in less sloping areas of the Potts soil. Bluebunch wheatgrass, western wheatgrass, and needleandthread are suitable for seeding. Preparing the seedbed and drilling the seed are good practices. Controlling brush on the Potts soil improves range that is producing more shrubs than are normally found in the potential plant community. Properly managing the understory vegetation on the Ildefonso soil maintains wood production and grazing. Selectively thinning pinyon and juniper improves grazing and provides firewood, posts, and Christmas trees.

The Ildefonso soil is suited to production of pinyon and Utah juniper. It can produce 9 cords of wood per acre when trees more than 4.5 feet tall reach an average diameter (at one foot) of 5 inches. The low available water capacity affects survival of tree seedlings.

Mule deer, wild turkey, chukar, gray squirrel, cottontail rabbit, and some pheasant find habitat on these soils.

The steep slopes limit community development. Structures are needed to divert runoff to minimize gullying and erosion.

This complex is in capability subclass VIe, nonirrigated.

59—Potts-Ildefonso complex, 25 to 45 percent slopes. These hilly to very steep soils are on alluvial fans and sides of valleys. Elevation ranges from 5,000 to 6,500 feet. The Potts soil formed in alluvium derived from sandstone, shale, or basalt. The Ildefonso soil formed in very strongly calcareous, basaltic alluvium and small amounts of eolian material. The average annual precipitation is about 14 inches, the average annual air temperature is about 46 degrees F, and the average frost-free period is about 120 days.

The Potts soil makes up about 60 percent of the map unit, and the Ildefonso soil makes up about 30 percent. The Potts soil is in slightly concave positions, and the Ildefonso soil is in the steeper, breaklike areas.

The Potts soil is deep and well drained. Typically, the surface layer is brown loam about 4 inches thick. The subsoil is reddish brown clay loam about 24 inches thick. The substratum is pinkish white loam to a depth of 60 inches.

Permeability of the Potts soil is moderate, and available water capacity is high. Effective rooting depth is 60 inches or more. Surface runoff is medium, and the erosion hazard is severe.

The Ildefonso soil is deep and well drained. Typically, the surface layer is brown stony loam about 8 inches thick. The underlying material is white, very strongly calcareous very stony loam to a depth of 60 inches.

Permeability of the Ildefonso soil is moderately rapid, and available water capacity is low. Effective rooting depth is about 60 inches. Surface runoff is medium to rapid, and the erosion hazard is severe.

Included with this soil in mapping are small areas of Morval and Lazear soils. The Morval soils are at the higher elevations. The Lazear soils are shallow and are on ridge crests and steep mountainsides. These areas make up 10 to 18 percent of the map unit.

These soils are used mainly for limited grazing and wildlife habitat.

The native vegetation on the Potts soil is mainly wheatgrass, needleandthread, and sagebrush. The native vegetation on the Ildefonso soil is mainly pinyon and Utah juniper and an understory of Indian ricegrass, wheatgrass, junegrass, serviceberry, bitterbrush, and sagebrush.

When the understory vegetation deteriorates, grasses almost disappear and forbs and shrubs increase. Properly managing grazing on the Potts soil maintains and improves the range condition. Properly managing the vegetation on the Ildefonso soil maintains wood production and ground cover. The value for grazing is low because of steep slopes and the tree canopy. Firewood, posts, and Christmas trees can be harvested from the more gently sloping areas.

The Ildefonso soil is suited to production of pinyon and Utah juniper. It can produce 9 cords of wood per acre when trees more than 4.5 feet tall reach an average diameter (at one foot) of 5 inches. The low available water capacity affects survival of tree seedlings. Steep slopes and the severe erosion affect harvesting.

Mule deer, wild turkey, chukar, gray squirrel, cottontail rabbit, and some pheasant find habitat on these soils.

Community development is limited by very steep slopes.

This complex is in capability subclass VIIe, nonirrigated.

60—Rhone loam, 5 to 30 percent slopes. This deep, well drained, gently sloping to steep soil is on mountainsides and ridges. Elevation ranges from 7,600 to 8,600 feet. This soil formed in residuum from sandstone and marlstone. The average annual precipitation is about 20 inches, the average annual air temperature is about 40 degrees F, and the average frost-free period is less than 75 days.

Typically, the upper part of the surface layer is brown loam about 8 inches thick, and the lower part is brown sandy clay loam about 20 inches thick. The underlying material is brown extremely channery sandy clay loam about 24 inches thick. Sandstone is at a depth of 52 inches.

Included with this soil in mapping are small areas of Parachute and Northwater soils. The moderately deep Parachute soils are on smooth ridge crests and west- and south-facing side slopes. The Northwater soils are on north-facing side slopes. These areas make up about 10 to 15 percent of the map unit.

Permeability is moderate, and available water capacity is moderate. Effective rooting depth is 40 to 60 inches. Surface runoff is slow, and the erosion hazard is slight.

This soil is used mainly for wildlife habitat and limited grazing.

The native vegetation is mainly brome, needlegrass, and sagebrush. There are small areas of dwarfed aspen, but they are of little or no commercial value.

When range condition deteriorates, forbs, shrubs, and Kentucky bluegrass increase. Properly managing grazing maintains and improves range condition. Seeding and removing brush improve range on less sloping areas if it is in poor condition. Intermediate wheatgrass, slender wheatgrass, and mountain or smooth brome are suitable for seeding. Preparing the seedbed and drilling the seed are good practices.

Elk, mule deer, coyote, grouse, and rabbit find habitat on this soil.

Use of this soil for community development or as a source of construction material is limited by steep slopes.

This soil is in capability subclass VIe, nonirrigated.

61—Rhone loam, 30 to 70 percent slopes. This deep, well drained, hilly to very steep soil is on north- and east-facing mountainsides and ridges. Elevation ranges from 7,600 to 8,600 feet. This soil formed in residuum from sandstone and marlstone. The average annual precipitation is about 20 inches, the average annual air temperature is about 40 degrees F, and the average frost-free period is less than 75 days.

Typically, the upper part of the surface layer is brown loam about 8 inches thick, and the lower part is brown sandy clay loam about 20 inches thick. The underlying material is brown extremely channery sandy clay loam about 24 inches thick. Sandstone is at a depth of 52 inches.

Included with this soil in mapping are small areas of Parachute and Northwater soils. The moderately deep Parachute soils are on smooth ridge crests and west- and south-facing side slopes. The Northwater soils are on north-facing side slopes. These areas make up 10 to 15 percent of the map unit.

Permeability is moderate, and available water capacity is moderate. Effective rooting depth is 40 to 60 inches. Surface runoff is slow, and the erosion hazard is slight.

This soil is used mainly for wildlife habitat and limited grazing.

The native vegetation on this soil, because it faces north and east, is mainly Gambel oak, elk sedge, serviceberry, and snowberry. There are small areas of dwarfed aspen, but they are of little or no commercial value.

When range condition deteriorates, forbs, shrubs, and Kentucky bluegrass increase. Properly managing grazing maintains and improves range condition.

Many deer and some snowshoe hare and blue grouse find habitat on this soil.

Use of this soil for community development or as a source of construction material is limited by steep slopes. Areas from which construction material has been removed are difficult to reclaim.

This soil is in capability subclass VIIe, nonirrigated.

62—Rock outcrop-Torriorthents complex, very steep. This broadly defined unit consists of exposed bedrock, very stony areas, soils that are shallow to moderately deep over bedrock and small pockets of deep soils. This complex is in the northwestern and north-central parts of the Area. The complex is on the rock escarpment and colluvial slopes along the edge of Roan Plateau. The outcrops and soils are very steep to extremely steep (fig. 3). Slope ranges from 50 to 80 percent.

Rock outcrop makes up about 50 to 80 percent of the complex, and Torriorthents make up 20 to 50 percent. Rock escarpments are along the upper edge of the areas, and the Torriorthents are between the toe slopes and the higher-lying exposed bedrock. Commonly, the top of the escarpment is 2,000 to 2,500 feet higher than the toe slopes.

Rock outcrop is mainly Green River shale. The loose stones are fragments of bedrock broken from the escarpments. The stones are generally flagstones, 6 to 24 inches wide and 2 to 6 inches thick.

Torriorthents are shallow to moderately deep. They generally are clayey to loamy and contain variable amounts of gravel, cobbles, and stones.

At the lower elevations of this complex, surface runoff is rapid and the erosion hazard is moderate. Surface runoff is very rapid and the erosion hazard is severe on the exposed bedrock and shallow stony soils at the higher elevations.

Included in mapping are small, isolated areas of Nihill soils at lower elevations in concave pockets near the toe slopes. These areas make up about 5 percent of the unit.

The native vegetation is mainly serviceberry, bitterbrush, mountainmahogany, big sagebrush, and western wheatgrasses at the lower elevations in north-facing areas. The native vegetation is bitterbrush, shadscale, Indian ricegrass, big sagebrush, and western wheatgrass at the lower elevations in south-facing areas. At the higher elevations, vegetation is sparse or nonexistant on the exposed bedrock and rocky colluvial slopes.

This complex has only limited value for grazing. Some sheep can use the browse plants at the lower elevations.

Deer, rabbits, and grouse find food and cover at the lower elevations. The south-facing lower areas are an important wintering area for deer.

Green River shale is locally known as "oil shale." Exposures of oil shale are at higher elevations in this unit.

Extremely steep slopes and rockiness limit development. These limitations can be overcome by appropriate design and constructon.

This complex is in capability subclass VIIIe, nonirrigated.

63—Silas loam, 3 to 12 percent slopes. This deep, moderately well drained soil is on bottom land of mountain valleys. Elevation ranges from 7,600 to 8,300 feet. This soil formed in alluvium derived mainly from sandstone and marlstone. The average annual precipitation is about 20 inches, the average annual air temperature is about 40 degrees F, and the average frost-free period is less than 75 days.

Typically, the surface layer is very dark grayish brown loam about 14 inches thick. The underlying material is very dark gray and very dark grayish brown loam to a depth of 60 inches.

Included with this soil in mapping are small areas of coarse loamy soils and of soils that have a light colored surface layer.

Permeability is moderate, and available water capacity is moderate. Effective rooting depth is 60 inches or

more. Organic matter content is high. Surface runoff is slow, and the erosion hazard is slight. This soil is occasionally flooded for brief periods between April and September.

This soil is used mainly for grazing, wildlife habitat, and limited irrigated hay. Good management of water and fertilizer maintains or improves the production of native hay.

The native vegetation on this soil is mainly wildrye, wheatgrass, needlegrass, and small amounts of forbs and shrubs.

When range condition deteriorates, dandelion, yarrow, rabbitbrush, big sagebrush, and Kentucky bluegrass increase. Properly managing grazing maintains and improves range condition. Basin wildrye, slender wheatgrass, and western wheatgrass are suitable for seeding. Preparing a seedbed and drilling the seed are good practices. Fencing protects this more productive soil. This soil is lower than surrounding soils and usually contains the water supply for livestock. Reducing brush improves the range.

Mule deer, snowshoe hare, elk, coyote, and blue grouse find habitat on this soil.

Community development is limited by flooding. This soil is a good source of topsoil.

This soil is in capability subclass VIe, nonirrigated.

64—Tanna silty clay loam, 25 to 45 percent slopes. This moderately deep, well drained soil is on mountainsides. Elevation ranges from 6,500 to 7,600 feet. This soil formed in material weathered from shale. The average annual precipitation is about 17 inches, the average annual air temperature is about 43 degrees F, and the average frost-free period is about 100 days.

Typically, the surface layer is grayish brown silty clay loam about 9 inches thick. The subsoil is light brownish gray clay and light gray silty clay about 15 inches thick. The substratum is light gray channery clay loam about 6 inches thick. Weathered shale is at a depth of 30 inches.

Included with this soil in mapping are small areas of Dollard clay and shale outcrop on steep and very steep mountainsides. These areas make up 10 to 15 percent of the map unit.

Permeability is slow, and available water capacity is low. Effective rooting depth is 20 to 40 inches. Surface runoff is rapid, and the erosion hazard is severe.

This soil is used mainly for wildlife habitat and limited grazing.

The native vegetation on this soil is mainly Gambel oak, serviceberry, snowberry, and elk sedge.

When range condition deteriorates, forbs and shrubs increase. When the range is in poor condition, Kentucky bluegrass, weeds, and annual plants are numerous. Properly managing grazing maintains and improves range condition.

Mule deer, wild turkey, and cottontail rabbit find habitat on this soil.

Use of this soil for community development, for sanitary facilities, and as a source of construction material is limited by steep slopes, high clay content, low strength, depth to bedrock and shrink-swell potential. Road construction and building foundations can be designed to reduce the effects of shrinking and swelling. A good drainage system reduces soil slumping.

This soil is in capability subclass VIIe, nonirrigated.

65—Torrifluvents, nearly level. This broadly defined unit consists of deep, well drained to somewhat poorly drained, nearly level soils on flood plains adjacent to the Colorado and Roaring Fork Rivers and their major tributaries. Slope is 0 to 6 percent. The soils formed in alluvium.

These soils are stratified and vary widely in texture and depth. The surface layer ranges from loamy sand and fine sandy loam to silty loam and clay loam. The underlying layers are generally sandy loam or loam stratified with sand, gravel, and cobbles. In some areas gravel and cobbles are on or near the surface.

The water table fluctuates between depths of 2 and 4 feet and in some years is near the surface during spring runoff from snowmelt. These soils are subject to brief, occasional flooding late in spring and early in summer.

Included in mapping are small isolated areas of Wann soils that have slopes of 1 to 3 percent. Small areas of soils that are moderately to severely affected by alkali are identified by an alkali spot symbol. Small, isolated areas where water stands at or near the surface all year are identified by wet spot and marsh spot symbols. These areas make up 15 percent of the map unit.

These soils are used for wildlife habitat, recreation, and some grazing.

The native vegetation is mainly cottonwood, willow, tamarisk and water-tolerant grasses, sedges, and rushes.

In many areas these soils are suited to production of Fremont cottonwood. The soils are capable of producing 230 board feet of timber per acre from a fully stocked, even-aged stand of 40-year-old trees.

Where these soils are accessible, they provide shelter and forage for livestock.

Mule deer, cottontail rabbit, coyote, bobcat, ducks, geese, and other native birds find food and shelter on these soils. Where feasible, planting food plots, trees and shrubs, and nesting cover enhances the habitat for upland wildlife. Where the water table is high, open water for waterfowl and fish can be developed by blasting or by excavating.

These soils have potential for recreation. Wildlife is abundant, and the nearby rivers can be used for rafting and canoeing. Community development is very limited by flooding, the seasonal high water table, and variable texture. Onsite investigation is necessary.

These soils are in capability subclass VIIw, nonirrigated.

66—Torriorthents-Camborthids-Rock outcrop complex, steep. This broadly defined unit consists of exposed sandstone and shale bedrock, loose stones, and soils that are shallow to deep over sandstone and shale bedrock and stony basaltic alluvium. This complex occurs throughout the survey area. The soils and outcrops are moderately steep to very steep. Slope ranges from 15 to 70 percent.

Torriorthents make up about 45 percent of the complex, Camborthids make up 20 percent, and Rock outcrop makes up 15 percent. The Torriorthents are on foothills and mountainsides below Rock outcrop. The moderately steep Camborthids are on lower toe slopes and concave open areas on foothills and mountainsides.

Torriorthents are shallow to moderately deep. They are generally clayey to loamy and contain variable amounts of gravel, cobbles, and stones. The surface is normally covered with stones weathered from the higher-lying Rock outcrop. South of the Colorado River, basaltic stones and cobbles are on the surface.

Camborthids are shallow to deep. They are generally clayey to loamy and have slightly more clay in the subsoil than in the surface layer. The surface layer is light colored. The profile is normally free of stones, but scattered basalt stones, cobbles, and sandstone fragments are on the surface.

The Rock outcrop is mainly Mesa Verde sandstone and Wasatch shale. Some areas are covered with basaltic boulders and stones. Small areas of limestone outcrops and exposed gypsum are in the eastern part of the survey area.

Included in mapping are small, isolated areas of Ildefonso, Lazear, Ansari, Begay, Heldt, and Dollard soils. These intermittent areas make up 10 to 20 percent of this map unit.

This complex is used for grazing, wildlife habitat, and recreation.

The stones on the surface and the steep slopes make this complex unsuitable for crops. Some areas can be reseeded to pasture by broadcast seeding. Other planting methods are made difficult by the stones and slopes.

The native vegetation includes wheatgrasses, bluegrasses, Indian ricegrass, needlegrasses, bitterbrush, mountainmahogany, sagebrush, and an overstory of pinyon and juniper.

The value of grazing is fair. The vegetation should be managed to maintain wood production and limited grazing. Selectively thinning the pinyon and juniper improves grazing and provides firewood and posts. Steep slopes, moderate to severe erosion hazard, and slow regrowth of trees affect harvesting and management.

Most of this complex is a prime wintering area for deer. Rabbits, coyote, and a few elk also find food and cover on this complex.

Building is limited by steep slopes and stoniness. These limitations can be overcome by appropriate design and construction.

This complex is in capability subclass VIIe, nonirrigated.

67—Torriorthents-Rock outcrop complex, steep. This broadly defined unit consists of exposed sandstone and shale bedrock and stony soils that are shallow to moderately deep over sandstone and shale and stony basaltic alluvium. Areas of this complex occur throughout the survey area. The soils and outcrops are moderately steep to very steep. Slope ranges from 15 to 70 percent.

Torriorthents make up about 60 percent of this complex, and Rock outcrop makes up 25 percent. The Torriorthents are on foothills and mountainsides below the Rock outcrop.

Torriorthents are generally clayey to loamy and contain variable amounts of gravel, cobbles, and stones. The surface is normally covered with stones weathered from the higher-lying Rock outcrop. South of the Colorado River, stones and cobbles of basalt are on the surface.

The Rock outcrop is mainly Mesa Verde sandstone and Wasatch shale. Some areas are covered with basaltic boulders and stones. Small areas of limestone outcrops and exposed gypsum are in the eastern part of the survey area.

Included in mapping are small isolated areas of Ildefonso, Lazear, Ansari, Gaynor, Tridell, and Nihill soils. These intermittent areas make up 10 to 15 percent of this map unit.

This complex is used for limited grazing, wildlife habitat, and recreation.

Because of the stones on the surface, the Rock outcrop, and the steep slope, this complex is unsuited to crops.

The native vegetation includes wheatgrass, bluegrass, Indian ricegrass, needlegrass, bitterbrush, sagebrush, mountainmahogany and an overstory of pinyon and juniper.

The vegetation should be managed to maintain wood production and limited grazing. Selectively thinning the pinyon and juniper improves grazing and provides firewood and posts. Steep slopes, moderate to severe erosion hazard, and slow regrowth of trees affect harvesting and management.

Most of this complex is a prime wintering area for deer. Rabbits, coyote, and a few elk also find food and cover on this complex.

Community development is limited by the Rock outcrop, steep slopes, and stoniness. These limitations can be overcome by appropriate design and construction.

This complex is in capability subclass VIIe, nonirrigated.

68—Vale silt loam, 3 to 6 percent slopes. This deep, well drained, gently sloping soil is on mesas, terraces, and alluvial fans. Elevation ranges from 5,000 to 7,200 feet. This soil formed in calcareous eolian material. The

average annual precipitation is about 14 inches, the average annual air temperature is about 48 degrees F, and the average frost-free period is about 120 days.

Typically, the surface layer is brown silt loam about 7 inches thick. The subsoil is brown silt loam and silty clay loam about 19 inches thick. The substratum is pink silt loam to a depth of 60 inches.

Included with this soil in mapping are small areas of Morval soils that have slopes of 3 to 6 percent. These areas make up 5 to 10 percent of the map unit.

Permeability is moderate, and available water capacity is high. Effective rooting depth is more than 60 inches. Surface runoff is medium, and the erosion hazard is moderate.

This soil is used mainly for irrigated crops and hay. Small grains, corn, potatoes, alfalfa, and grass hay are grown. Small areas are used for grazing.

This soil is usually irrigated by flooding, but furrows or sprinklers are also used.

The native vegetation on this soil is mainly needleandthread, wheatgrass, muttongrass, and sagebrush.

When range condition deteriorates, forbs and shrubs increase. When the range is in poor condition, undesirable weeds and annual plants are numerous. Properly managing grazing maintains and improves range condition. Reducing brush improves the range. Seeding improves range in poor condition. Pubescent wheatgrass, western wheatgrass, and big bluegrass are suitable for seeding. Preparing a seedbed and drilling the seed are good practices.

Cottontail rabbit, mourning dove, wild turkey, and mule deer find habitat on this soil.

Community development and recreation are limited by low strength and clayey texture. Roads, ditches, and building foundations can be designed to compensate for these limitations.

This soil is in capability subclass IIIe, irrigated and nonirrigated.

69—Vale silt loam, 6 to 12 percent slopes. This deep, well drained, moderately sloping to rolling soil is on mesas, benches, and alluvial fans. Elevation ranges from 5,000 to 7,200 feet. This soil formed in calcareous eolian material. The average annual precipitation is about 14 inches, the average annual air temperature is about 48 degrees F, and average frost-free period is about 120 days.

Typically, the surface layer is brown silt loam about 7 inches thick. The subsoil is brown silt loam and silty clay loam about 19 inches thick. The substratum is pink silt loam to a depth of 60 inches.

Included with this soil in mapping are small areas of Morval soils that have slopes of 6 to 12 percent. These areas make up 5 to 10 percent of the map unit.

Permeability is moderate, and available water capacity is high. Effective rooting depth is more than 60 inches. Surface runoff is medium, and the erosion hazard is moderate.

This soil is used mainly for irrigated crops and hay. Small grains, corn, potatoes, alfalfa, and grass hay are grown. Some areas are used for grazing.

This soil is usually irrigated by flooding, but furrows or sprinklers are also used.

The native vegetation on this soil is mainly needleandthread, wheatgrass, muttongrass, and sagebrush.

When range condition deteriorates, forbs and shrubs increase. When the range is in poor condition, undesirable weeds and annual plants are numerous. Properly managing grazing maintains and improves range condition. Reducing brush improves the range. Seeding improves range in poor condition. Pubescent wheatgrass, western wheatgrass, and big bluegrass are suitable for seeding. Preparing a seedbed and drilling the seed are good practices.

Cottontail rabbit, mourning dove, wild turkey, and mule deer find habitat on this soil.

Community development and recreation are limited by low strength, clayey texture, and slope. Roads, ditches, and building foundations can be designed to compensate for these limitations.

This soil is in capability subclass IVe, irrigated and nonirrigated.

70—Vale silt loam, 12 to 25 percent slopes. This deep, well drained, strongly sloping to hilly soil is on mesas, mesa sides, and alluvial fans. Elevation ranges from 5,000 to 7,200 feet. This soil formed in calcareous eolian material. The average annual precipitation is about 14 inches, the average annual air temperature is about 48 degrees F, and the average frost-free period is about 120 days.

Typically, the surface layer is brown silt loam about 7 inches thick. The subsoil is brown silt loam and silty clay loam about 19 inches thick. The substratum is pink silt loam to a depth of 60 inches.

Included with this soil in mapping are small areas of Morval soils that have slopes of 12 to 25 percent. These areas make up 10 to 18 percent of the map unit.

Permeability is moderate, and available water capacity is high. Effective rooting depth is more than 60 inches. Surface runoff is medium, and the erosion hazard is severe.

This soil is used mainly for wildlife habitat, recreation, some hay, and grazing.

The native vegetation on this soil is mainly needleandthread, wheatgrass, muttongrass, and sagebrush.

When the range is in poor condition, undesirable weeds and annual plants are numerous. Properly managing grazing maintains and improves range condition. Reducing brush improves the range. Seeding improves range on the more gently sloping areas, if it is in poor condition. Pubescent wheatgrass, western wheatgrass,

and big bluegrass are suitable for seeding. Preparing a seedbed and drilling the seed are good practices.

Cottontail rabbit, mourning dove, wild turkey, and mule deer find habitat on this soil.

Community development and recreation are limited by steep slopes, low strength, and clayey texture.

This soil is in capability subclass VIe, nonirrigated.

71—Villa Grove-Zoltay loams, 15 to 30 percent slopes. These moderately steep to hilly soils are on mountainsides and alluvial fans. Elevation ranges from 7,500 to 7,600 feet. The Villa Grove soil formed in mixed alluvium, and the Zoltay soil formed in basaltic alluvium. The average annual precipitation is about 16 inches, the average annual air temperature is about 43 degrees F, and the average frost-free period is about 100 days.

The Villa Grove soil makes up about 50 percent of the map unit, and the Zoltay soil makes up about 40 percent. The Villa Grove soil is in the steeper areas, and the Zoltay soil is in the less sloping areas.

The Villa Grove soil is deep and well drained. Typically, the surface layer is dark grayish brown loam about 4 inches thick. The upper part of the subsoil is brown clay loam about 11 inches thick, and the lower part is brown loam about 33 inches thick. The substratum is pale brown loam to a depth of 60 inches.

Permeability of the Villa Grove soil is moderately slow, and available water capacity is high. Effective rooting depth is 60 inches or more. Surface runoff is slow, and the erosion hazard is slight.

The Zoltay soil is deep and well drained. Typically, the surface layer is dark grayish brown loam about 19 inches thick. The subsoil is brown cobbly clay or cobbly clay loam about 35 inches thick. The substratum is pinkish gray cobbly clay to a depth of 60 inches.

Permeability of the Zoltay soil is slow, and available water capacity is high. Effective rooting depth is 60 inches or more. Surface runoff is medium, and the erosion hazard is moderate.

Included with these soils in mapping are small areas of Vale, Potts, and Morval soils. The Vale and Potts soils are on small, isolated remnants of mesas. The Morval soils are on small undulations that have slopes of 3 to 12 percent. These areas make up 10 percent of the map unit.

These soils are used mainly for grazing, wildlife habitat, and some irrigated pasture.

The native vegetation on these soils is mainly Gambel oak, serviceberry, snowberry, and elk sedge.

When range condition deteriorates, forbs and shrubs increase. When the range is in poor condition, Kentucky bluegrass, undesirable weeds, and annual plants are numerous. Properly managing grazing maintains and improves range condition. Controlling brush and seeding improve forage production in the less sloping areas. Pubescent wheatgrass, western wheatgrass, and big bluegrass are suitable for seeding. Preparing a seedbed and drilling the seed are good practices.

Many deer and some cottontail rabbit, squirrel, and grouse find habitat on this soil.

Community development and recreation are limited by moderately steep slopes, shrink-swell potential, and low strength.

This complex is in capability subclass VIe, nonirrigated.

72—Wann sandy loam, 1 to 3 percent slopes. This deep, somewhat poorly drained, nearly level to gently sloping, low-lying soil is on terraces and bottom land in valleys. Elevation ranges from 5,000 to 6,500 feet. The soil formed in alluvium derived primarily from sandstone and shale. The average annual precipitation is about 12 inches, the average annual air temperature is about 48 degrees F, and the average frost-free period is about 120 days.

Typically, the upper part of the surface layer is dark grayish brown sandy loam about 8 inches thick, and the lower part is dark grayish brown fine sandy loam about 4 inches thick. The upper part of the underlying material is mottled, light brownish gray fine sandy loam and sandy loam about 24 inches thick, and the lower part is mottled light brownish gray coarse sandy loam to a depth of 60 inches.

Included with this soil in mapping are small areas of Kim and Arvada soils and Torrifluvents. These soils have slopes of 1 to 3 percent. These areas make up 5 to 18 percent of the map unit.

Permeability is moderately rapid, and available water capacity is high. Effective rooting depth varies with the level of the water table but is usually about 2 feet. Surface runoff is slow, and the erosion hazard is moderate. Depth to the water table ranges from 2 to 3 feet. The level of the water table varies with the amount of irrigation water applied to this soil and surrounding soils. Water ponds in spring. This soil is occasionally flooded for brief periods between April and July.

This soil is used mainly for grazing, grass or legume hay, and pasture.

Tile drains and improved water management increase the potential for crops. This soil is usually irrigated by furrows or flooding. Sprinklers are also well suited.

The native vegetation on this soil is mainly alkali sacaton, saltgrass, wheatgrass, sedges, and rabbitbrush.

When range condition deteriorates, shrubs and saltgrass increase. When the range is in poor condition, undesirable weeds and annual plants are abundant. Properly managing grazing maintains and improves range condition. Alkali sacaton and western wheatgrass are suitable for seeding. Preparing a seedbed and drilling the seed are good practices. Controlling brush improves range that is producing more woody shrubs than is normally found in the potential plant community, but care should be taken to leave stands of fourwing saltbush.

Mourning dove, ground squirrel, cottontail rabbit, and some pheasant find habitat on this soil.

Community development is limited by a high water table, seasonal flooding, seepage, and frost heaving. Drainage increases potential for various uses.

This soil is in capability subclasses IVw, irrigated, and VIw, nonirrigated.

Use and management of the soils

The soil survey is a detailed inventory and evaluation of the most basic resource of the survey area—the soil. It is useful in adjusting land use, including urbanization, to the limitations and potentials of natural resources and the environment. Also, it can help avoid soil-related failures in uses of the land.

While a soil survey is in progress, soil scientists, conservationists, engineers, and others keep extensive notes about the nature of the soils and about unique aspects of behavior of the soils. These notes include data on erosion, drought damage to specific crops, yield estimates, flooding, the functioning of septic tank disposal systems, and other factors affecting the productivity, potential, and limitations of the soils under various uses and management. In this way, field experience and measured data on soil properties and performance are used as a basis for predicting soil behavior.

Information in this section is useful in planning use and management of soils for crops and pasture, rangeland, and woodland, as sites for buildings, highways and other transportation systems, sanitary facilities, and parks and other recreation facilities, and for wildlife habitat. From the data presented, the potential of each soil for specified land uses can be determined, soil limitations to these land uses can be identified, and costly failures in houses and other structures, caused by unfavorable soil properties, can be avoided. A site where soil properties are favorable can be selected, or practices that will overcome the soil limitations can be planned.

Planners and others using the soil survey can evaluate the impact of specific land uses on the overall productivity of the survey area or other broad planning area and on the environment. Productivity and the environment are closely related to the nature of the soil. Plans should maintain or create a land-use pattern in harmony with the natural soil.

Contractors can find information that is useful in locating sources of sand and gravel, roadfill, and topsoil. Other information indicates the presence of bedrock, wetness, or very firm soil horizons that cause difficulty in excavation.

Health officials, highway officials, engineers, and many other specialists also can find useful information in this soil survey. The safe disposal of wastes, for example, is closely related to properties of the soil. Pavements, sidewalks, campsites, playgrounds, lawns, and trees and shrubs are influenced by the nature of the soil.

Crops and pasture

The major management concerns in the use of the soils for crops and pasture are described in this section. In addition, the crops or pasture plants best suited to the soil, including some not commonly grown in the survey area, are discussed; the system of land capability classification used by the Soil Conservation Service is explained; and the estimated yields of the main crops and hay and pasture plants are presented for each soil.

This section provides information about the overall agricultural potential of the survey area and about the management practices that are needed. The information is useful to equipment dealers, land improvement contractors, fertilizer companies, processing companies, planners, conservationists, and others. For each kind of soil, information about management is presented in the section "Soil maps for detailed planning." Planners of management systems for individual fields or farms should also consider the detailed information given in the description of each soil.

About 10 percent, or approximately 62,000 acres, of the Rifle Area is used for crops. Of this, about 58,000 acres is in irrigated crops and pasture; the remaining 4,000 acres is in nonirrigated crops. Approximately 80 percent, or 32,000 acres, of the irrigated crops is alfalfa and legume-grass mixtures for hay. Eighteen thousand acres is irrigated pasture. Most of the remaining 8,000 acres of irrigated land is used for oats, barley, and ensilage corn. Very small acreages of orchards, wheat, and potatoes are irrigated. The 4,000 acres of nonirrigated crops is mainly wheat and small areas of barley, oats, and grasses for seed.

The soils used for crops and pasture are along and adjacent to the Colorado River and its major tributaries. Most of these soils are on terraces, mesas, alluvial fans, and foothills. This is an area of diverse topography and soils. Annual precipitation ranges from about 10 inches in the western part of the Area to approximately 18 inches in the eastern part.

The main concerns in managing the soils for crops and pasture are maintaining or improving production and controlling water erosion. On irrigated land, efficient use of water and uniform distribution of water protect the soil from erosion and help to maintain productivity. Slope of the irrigation run, length of run, amount of water applied, and length of time of application, and frequency of irrigation are all considerations. Land leveling permits more uniform distribution of water and reduces runoff and erosion. Furrow and sprinkler irrigation are suitable for most irrigated soils in the Rifle Area. Corrugations and controlled flooding are used on the steeper soils in pasture and hay.

Except when establishing new seedings, erosion is not a major concern in areas of irrigated pasture and hay. The density of vegetation and limited area of bare soil minimize water erosion.

Manure and commercial fertilizer containing nitrogen and phosphorus help to maintain soil fertility on all irrigated soils. Legume-grass mixtures used for hay need a balanced fertilizer. A fertilizer high in nitrogen is recommended for grass pastures and for crops such as corn and small grains. A fertilizer high in phosphorus is recommended for alfalfa and legumes.

Some small areas of soils are affected by wetness and salinity. This is caused by seepage from irrigation ditches and a fluctuating water table in areas adjacent to major drainageways. These areas can be reclaimed by open or closed drainage systems. Soil salinity can be reduced by incorporating calcium sulfate (gypsum) into the soil, then leaching the soil with good quality irrigation water. Since supplies of irrigation water are limited and no high value cash crops are grown in the Rifle Area, reclamation of these soils by drainage and leaching may not be feasible. Examples of soils that have wet and saline areas are Arvada loam, Cryaquolls, Halaquepts, Torrifluvents, and Wann sandy loam.

Irrigated pasture consists mainly of mixtures of grasses such as brome or orchardgrass. Alfalfa and intermediate wheatgrass are often included in these mixtures. Management practices applicable on irrigated pasture include the deferment of grazing until plants have become firmly established and provide adequate cover to ensure optimum production and protection from erosion. Timely application of irrigation water is important to supply water to the plants while they are growing. Controlled grazing, cross-fencing, and properly distributing stock water facilities and salt help to maintain production on irrigated pasture.

Wheat is the main nonirrigated crop. There are small acreages of oats, barley, and grass for seed. Potts loam and Vale silt loam are the main soils used for nonirrigated crops.

Controlling wind and water erosion and conserving soil moisture are the major managment concerns in nonirrigated farming. Because of limited precipitation, a crop-fallow system is used in which crops are grown only in alternate years. Stubble mulch tillage and incorporation of crop residue into and on the surface layer in adequate amounts protect fallowed soils from wind and water erosion and allow them to readily absorb and retain moisture. In the Rifle Area, soils that have a fine or very fine sandy loam or light loam surface layer are susceptible to wind erosion in spring. Winds are negligible during the rest of the year. The more sloping loamy soils are susceptible to water erosion because of surface runoff, especially during intense rainstorms and rapid snowmelt in spring. Crop residue managment and diversions or water interceptor ditches minimize loss from soils used for nonirrigated crops.

Yields per acre

The average yields per acre that can be expected of the principal crops under a high level of management are shown in table 5. In any given year, yields may be higher or lower than those indicated in the table because of variations in rainfall and other climatic factors. Absence of an estimated yield indicates that the crop is not suited to or not commonly grown on the soil or that a given crop is not commonly irrigated.

The estimated yields were based mainly on the experience and records of farmers, conservationists, and extension agents. Results of field trials and demonstrations and available yield data from nearby counties were also considered.

The yields were estimated assuming that the latest soil and crop management practices were used. Hay and pasture yields were estimated for the most productive varieties of grasses and legumes suited to the climate and the soil. A few farmers may be obtaining average yields higher than those shown in table 5.

The management needed to achieve the indicated yields of the various crops depends on the kind of soil and the crop. Such management provides drainage, erosion control, and protection from flooding; the proper planting and seeding rates; suitable high-yielding crop varieties; appropriate tillage practices, including time of tillage and seedbed preparation and tilling when soil moisture is favorable; control of weeds, plant diseases, and harmful insects; favorable soil reaction and optimum levels of nitrogen, phosphorus, potassium, and trace elements for each crop; effective use of crop residues, barnyard manure, and green-manure crops; harvesting crops with the smallest possible loss; and timeliness of all fieldwork.

For yields of irrigated crops, it is assumed that the irrigation system is adapted to the soils and to the crops grown; that good quality irrigation water is uniformly applied in proper amounts as needed; and that tillage is kept to a minimum.

The estimated yields reflect the productive capacity of the soils for each of the principal crops. Yields are likely to increase as new production technology is developed. The productivity of a given soil compared with that of other soils, however, is not likely to change.

Crops other than those shown in table 5 are grown in the survey area, but estimated yields are not included because the acreage of these crops is small. The local offices of the Soil Conservation Service and the Cooperative Extension Service can provide information about the management concerns and productivity of the soils for these crops.

Capability classes and subclasses

Capability classes and subclasses show, in a general way, the suitability of soils for most kinds of field crops (*7*). The soils are classed according to their limitations

when they are used for field crops, the risk of damage when they are used, and the way they respond to treatment. The grouping does not take into account major and generally expensive landforming that would change slope, depth, or other characteristics of the soils; does not take into consideration possible but unlikely major reclamation projects; and does not apply to rice, cranberries, horticultural crops, or other crops that require special management. Capability classification is not a substitute for interpretations designed to show suitability and limitations of groups of soils for rangeland, for forest trees, or for engineering purposes.

In the Rifle area, all kinds of soil are grouped at two levels: capability class and subclass. These levels are defined in the following paragraphs. A survey area may not have soils of all classes.

Capability classes, the broadest groups, are designated by Roman numerals I through VIII. The numerals indicate progressively greater limitations and narrower choices for practical use. The classes are defined as follows:

Class I soils have few limitations that restrict their use.

Class II soils have moderate limitations that reduce the choice of plants or that require moderate conservation practices.

Class III soils have severe limitations that reduce the choice of plants, or that require special conservation practices, or both.

Class IV soils have very severe limitations that reduce the choice of plants, or that require very careful management, or both.

Class V soils are not likely to erode but have other limitations, impractical to remove, that limit their use.

Class VI soils have severe limitations that make them generally unsuitable for cultivation.

Class VII soils have very severe limitations that make them unsuitable for cultivation.

Class VIII soils and landforms have limitations that nearly preclude their use for commercial crop production.

Capability subclasses are soil groups within one class; they are designated by adding a small letter, *e, w, s,* or *c,* to the class numeral, for example, IIe. The letter *e* shows that the main limitation is risk of erosion unless close-growing plant cover is maintained; *w* shows that water in or on the soil interferes with plant growth or cultivation (in some soils the wetness can be partly corrected by artificial drainage); *s* shows that the soil is limited mainly because it is shallow, droughty, or stony; and *c*, used in only some parts of the United States, shows that the chief limitation is climate that is too cold or too dry.

In class I there are no subclasses because the soils of this class have few limitations. Class V contains only the subclasses indicated by *w, s,* or *c* because the soils in class V are subject to little or no erosion, though they have other limitations that restrict their use to pasture, rangeland, woodland, wildlife habitat, or recreation.

Rangeland

By Harmon Hodgkinson, range conservationist, Soil Conservation Service.

About 65 percent of the Rifle Area is rangeland. More than half of the farm income is derived from livestock. Most of the ranches are cow-calf operations. Some ranchers keep the calves and market them as yearlings.

The average ranch in the survey area consists of 1,200 acres of privately owned land plus Forest Service and Bureau of Land Management leases. Many ranches have some woodland and nearly all have some irrigated land in addition to rangeland.

Livestock graze on the privately owned rangeland and woodland during spring and late fall. Leased lands are grazed in summer. Irrigated land is grazed in the fall to harvest the regrowth and aftermath of hay and small grains. During winter the cattle are fed hay on the irrigated land or in corral areas.

Soils strongly influence the natural vegetation. However, exposure, topography, temperature, precipitation, and elevation all interrelate with the soils to produce a variety of vegetation in the survey area.

Where climate and topography are about the same, differences in the kind and amount of vegetation that rangeland can produce are related closely to the kind of soil. Effective management is based on the relationships among soils, vegetation, and water.

Table 6 shows, for each kind of soil, the name of the range site; the total annual production of vegetation in favorable, normal, and unfavorable years; the characteristic vegetation; and the expected percentage of each species in the composition of the potential natural plant community. Soils not listed either are used entirely for crops or other uses or cannot support a natural plant community of predominately grasses, grasslike plants, forbs, or shrubs suitable for grazing or browsing. The following are explanations of column headings in table 6.

A *range site* is a distinctive kind of rangeland that differs from other kinds of rangeland in its ability to produce a characteristic natural plant community. Soils that produce a similar kind, amount, and proportion of range plants are grouped into range sites. For those areas where the relationship between soils and vegetation has been established, range sites can be interpreted directly from the soil map. Properties that determine the capacity of the soil to supply moisture and plant nutrients have the greatest influence on the productivity of range plants. Soil reaction, salt content, and a seasonal high water table are also important.

Total production refers to the amount of vegetation that can be expected to grow annually on well managed rangeland that is supporting the potential natural plant community. It is expressed in pounds per acre of air-dry vegetation for favorable, normal, and unfavorable years. In a favorable year the amount and distribution of pre-

cipitation and the temperatures are such that growing conditions are substantially better than average; in a normal year these conditions are about average for the area; in an unfavorable year, growing conditions are well below average, generally because of low available soil moisture.

Dry weight refers to the total air-dry vegetation produced per acre each year by the potential natural plant community. Vegetation that is highly palatable to livestock and vegetation that is unpalatable are included. Some of the vegetation can also be grazed extensively by wildlife.

Characteristic vegetation is grasses, grasslike plants, forbs, and shrubs that make up most of the potential natural plant community on each soil. They are listed by common name. Under *Composition*, the expected proportion of each species is presented as the percentage, in air-dry weight, of the total annual production of herbaceous and woody plants. The amount that can be used as forage depends on the kinds of grazing animals and on the grazing season. Generally all of the vegetation produced is not used.

Range management requires, in addition to knowledge of the kinds of soil and the potential natural plant community, an evaluation of the present condition of the range vegetation in relation to its potential. Range condition is determined by comparing the present plant community with the potential natural plant community on a particular range site. The more closely the existing community resembles the potential community, the better the range condition. The objective in range management is to control grazing so that the plants growing on a site are about the same in kind and amount as the potential natural plant community for that site. Such management generally results in the maximum production of vegetation, conservation of water, and control of erosion. Sometimes, however, a range condition somewhat below the potential meets grazing needs, provides wildlife habitat, and protects soil and water resources.

Several conservation practices can be used in the management and treatment of rangeland. These include proper management of grazing, planned grazing systems, brush control, and seeding.

Proper management of grazing is grazing at an intensity that maintains enough cover to protect the soil and maintain or improve the quality and quantity of desirable vegetation. At least 50 percent of the annual production, by weight, remains at the end of the grazing season.

If proper grazing alone does not maintain or improve the vegetation, a planned grazing system will help. In a planned grazing system, two or more grazing units are alternately rested from grazing in a planned sequence over a period of years. The rest period can be throughout the year or during the growing season of the important plants. Such a system improves efficiency of grazing by uniformly using all parts of the range. Distribution of livestock in the grazing units can be controlled by fencing, developing water facilities, and salting.

If undesirable shrubs dominate the plant community to a point that forage plants are suppressed, brush should be reduced. Caution should be exercised in reducing brush. Critical winter wildlife habitat should not be destroyed. If slope is too steep, erosion will accelerate. There must be enough grass present to reestablish in the area.

When the range has deteriorated to an unproductive, eroding condition, seeding is often the most economical and fastest method to restore production and protect the soil. Care must be taken in selecting areas for seeding. Soils that are too steep, too shallow, or too rocky are generally not suitable for successful seeding.

Engineering

This section provides information about the use of soils for building sites, sanitary facilities, construction material, and water management. Among those who can benefit from this information are engineers, landowners, community planners, town and city managers, land developers, builders, contractors, and farmers and ranchers.

The ratings in the engineering tables are based on test data and estimated data in the "Soil properties" section. The ratings were determined jointly by soil scientists and engineers of the Soil Conservation Service using known relationships between the soil properties and the behavior of soils in various engineering uses.

Among the soil properties and site conditions identified by a soil survey and used in determining the ratings in this section were grain-size distribution, liquid limit, plasticity index, soil reaction, depth to bedrock, hardness of bedrock that is within 5 or 6 feet of the surface, soil wetness, depth to a seasonal high water table, slope, likelihood of flooding, natural soil structure or aggregation, in-place soil density, and geologic origin of the soil material. Where pertinent, data about kinds of clay minerals, mineralogy of the sand and silt fractions, and the kind of absorbed cations were also considered.

On the basis of information assembled about soil properties, ranges of values can be estimated for erodibility, permeability, corrosivity, shrink-swell potential, available water capacity, shear strength, compressibility, slope stability, and other factors of expected soil behavior in engineering uses. As appropriate, these values can be applied to each major horizon of each soil or to the entire profile.

These factors of soil behavior affect construction and maintenance of roads, airport runways, pipelines, foundations for small buildings, ponds and small dams, irrigation projects, drainage systems, sewage and refuse disposal systems, and other engineering works. The ranges of values can be used to (1) select potential residential, commercial, industrial, and recreational uses; (2) make

preliminary estimates pertinent to construction in a particular area; (3) evaluate alternative routes for roads, streets, highways, pipelines, and underground cables; (4) evaluate alternative sites for location of sanitary landfills, onsite sewage disposal systems, and other waste disposal facilities; (5) plan detailed onsite investigations of soils and geology; (6) find sources of gravel, sand, clay, and topsoil; (7) plan farm drainage systems, irrigation systems, ponds, terraces, and other structures for soil and water conservation; (8) relate performance of structures already built to the properties of the kinds of soil on which they are built so that performance of similar structures on the same or a similar soil in other locations can be predicted; and (9) predict the trafficability of soils for cross-country movement of vehicles and construction equipment.

Data presented in this section are useful for land-use planning and for choosing alternative practices or general designs that will overcome unfavorable soil properties and minimize soil-related failures. Limitations to the use of these data, however, should be well understood. First, the data are generally not presented for soil material below a depth of 5 or 6 feet. Also, because of the scale of the detailed map in this soil survey, small areas of soils that differ from the dominant soil may be included in mapping. Thus, these data do not eliminate the need for onsite investigations, testing, and analysis by personnel having expertise in the specific use contemplated.

The information is presented mainly in tables. Table 7 shows, for each kind of soil, the degree and kind of limitations for building site development; table 8, for sanitary facilities; and table 10, for water management. Table 9 shows the suitability of each kind of soil as a source of construction materials.

The information in the tables, along with the soil map, the soil descriptions, and other data provided in this survey, can be used to make additional interpretations and to construct interpretive maps for specific uses of land.

Some of the terms used in this soil survey have a special meaning in soil science. Many of these terms are defined in the Glossary.

Building site development

The degree and kind of soil limitations that affect shallow excavations, dwellings with and without basements, small commercial buildings, and local roads and streets are indicated in table 7. A *slight* limitation indicates that soil properties generally are favorable for the specified use; any limitation is minor and easily overcome. A *moderate* limitation indicates that soil properties and site features are unfavorable for the specified use, but the limitations can be overcome or minimized by special planning and design. A *severe* limitation indicates that one or more soil properties or site features are so unfavorable or difficult to overcome that a major increase in construction effort, special design, or intensive maintenance is required. For some soils rated severe, such costly measures may not be feasible.

Shallow excavations are made for pipelines, sewerlines, communications and power transmission lines, basements, open ditches, and cemeteries. Such digging or trenching is influenced by soil wetness caused by a seasonal high water table; the texture and consistence of soils; the tendency of soils to cave in or slough; and the presence of very firm, dense soil layers, bedrock, or large stones. In addition, excavations are affected by slope of the soil and the probability of flooding. Ratings do not apply to soil horizons below a depth of 6 feet unless otherwise noted.

In the soil series descriptions, the consistence of each soil horizon is given, and the presence of very firm or extremely firm horizons, usually difficult to excavate, is indicated.

Dwellings and *small commercial buildings* referred to in table 7 are built on undisturbed soil and have foundation loads of a dwelling no more than three stories high. Separate ratings are made for small commercial buildings without basements and for dwellings with and without basements. For such structures, soils should be sufficiently stable that cracking or subsidence of the structure from settling or shear failure of the foundation does not occur. These ratings were determined from estimates of the shear strength, compressibility, and shrink-swell potential of the soil. Soil texture, plasticity and in-place density, potential frost action, soil wetness, and depth to a seasonal high water table were also considered. Soil wetness and depth to a seasonal high water table indicate potential difficulty in providing adequate drainage for basements, lawns, and gardens. Depth to bedrock, slope, and large stones in or on the soil are also important considerations in the choice of sites for these structures and were considered in determining the ratings. Susceptibility to flooding is a serious hazard.

Local roads and streets referred to in table 7 have an all-weather surface that can carry light to medium traffic all year. They consist of a subgrade of the underlying soil material; a base of gravel, crushed rock fragments, or soil material stabilized with lime or cement; and a flexible or rigid surface, commonly asphalt or concrete. The roads are graded with soil material at hand, and most cuts and fills are less than 6 feet deep.

The load supporting capacity and the stability of the soil as well as the quantity and workability of fill material available are important in design and construction of roads and streets. The classifications of the soil and the soil texture, density, shrink-swell potential, and potential frost action are indicators of the traffic supporting capacity used in making the ratings. Soil wetness, flooding, slope, depth to hard rock or very compact layers, and content of large stones affect stability and ease of excavation.

Sanitary facilities

Favorable soil properties and site features are needed for proper functioning of septic tank absorption fields, sewage lagoons, and sanitary landfills. The nature of the soil is important in selecting sites for these facilities and in identifying limiting soil properties and site features to be considered in design and installation. Also, those soil properties that affect ease of excavation or installation of these facilities will be of interest to contractors and local officials. Table 8 shows the degree and kind of limitations of each soil for such uses and for use of the soil as daily cover for landfills. It is important to observe local ordinances and regulations.

If the degree of soil limitation is expressed as *slight*, soils are generally favorable for the specified use and limitations are minor and easily overcome; if *moderate*, soil properties or site features are unfavorable for the specified use, but limitations can be overcome by special planning and design; and if *severe*, soil properties or site features are so unfavorable or difficult to overcome that major soil reclamation, special designs, or intensive maintenance is required. Soil suitability is rated by the terms *good*, *fair*, or *poor*, which, respectively, mean about the same as the terms *slight*, *moderate*, and *severe*.

Septic tank absorption fields are subsurface systems of tile or perforated pipe that distribute effluent from a septic tank into the natural soil. Only the soil horizons between depths of 18 and 72 inches are evaluated for this use. The soil properties and site features considered are those that affect the absorption of the effluent and those that affect the construction of the system.

Properties and features that affect absorption of the effluent are permeability, depth to seasonal high water table, depth to bedrock, and susceptibility to flooding. Stones, boulders, and shallowness to bedrock interfere with installation. Excessive slope can cause lateral seepage and surfacing of the effluent. Also, soil erosion and soil slippage are hazards if absorption fields are installed on sloping soils.

In some soils, loose sand and gravel or fractured bedrock is less than 4 feet below the tile lines. In these soils the absorption field does not adequately filter the effluent, and ground water in the area may be contaminated.

On many of the soils that have moderate or severe limitations for use as septic tank absorption fields, a system to lower the seasonal water table can be installed or the size of the absorption field can be increased so that performance is satisfactory.

Sewage lagoons are shallow ponds constructed to hold sewage while aerobic bacteria decompose the solid and liquid wastes. Lagoons have a nearly level floor and cut slopes or embankments of compacted soil material. Aerobic lagoons generally are designed to hold sewage within a depth of 2 to 5 feet. Nearly impervious soil material for the lagoon floor and sides is required to minimize seepage and contamination of ground water. Soils that are very high in content of organic matter and those that have cobbles, stones, or boulders are not suitable. Unless the soil has very slow permeability, contamination of ground water is a hazard where the seasonal high water table is above the level of the lagoon floor. In soils where the water table is seasonally high, seepage of ground water into the lagoon can seriously reduce the lagoon's capacity for liquid waste. Slope, depth to bedrock, and susceptibility to flooding also affect the suitability of sites for sewage lagoons or the cost of construction. Shear strength and permeability of compacted soil material affect the performance of embankments.

Sanitary landfill is a method of disposing of solid waste by placing refuse in successive layers either in excavated trenches or on the surface of the soil. The waste is spread, compacted, and covered daily with a thin layer of soil material. Landfill areas are subject to heavy vehicular traffic. Risk of polluting ground water and trafficability affect the suitability of a soil for this use. The best soils have a loamy or silty texture, have moderate to slow permeability, are deep to a seasonal water table, and are not subject to flooding. Clayey soils are likely to be sticky and difficult to spread. Sandy or gravelly soils generally have rapid permeability, which might allow noxious liquids to contaminate ground water. Soil wetness can be a limitation, because operating heavy equipment on a wet soil is difficult. Seepage into the refuse increases the risk of pollution of ground water.

Ease of excavation affects the suitability of a soil for the trench type of landfill. A suitable soil is deep to bedrock and free of large stones and boulders. If the seasonal water table is high, water will seep into trenches.

Unless otherwise stated, the limitations in table 8 apply only to the soil material within a depth of about 6 feet. If the trench is deeper, a limitation of slight or moderate may not be valid. Site investigation is needed before a site is selected.

Daily cover for landfill should be soil that is easy to excavate and spread over the compacted fill in wet and dry periods. Soils that are loamy or silty and free of stones or boulders are better than other soils. Clayey soils may be sticky and difficult to spread; sandy soils may be subject to soil blowing.

The soils selected for final cover of landfills should be suitable for growing plants. Of all the horizons, the A horizon in most soils has the best workability, more organic matter, and the best potential for growing plants. Thus, for either the area- or trench-type landfill, stockpiling material from the A horizon for use as the surface layer of the final cover is desirable.

Where it is necessary to bring in soil material for daily or final cover, thickness of suitable soil material available and depth to a seasonal high water table in soils surrounding the sites should be evaluated. Other factors to

be evaluated are those that affect reclamation of the borrow areas. These factors include slope, erodibility, and potential for plant growth.

Construction materials

The suitability of each soil as a source of roadfill, sand, gravel, and topsoil is indicated in table 9 by ratings of good, fair, or poor. The texture, thickness, and organic-matter content of each soil horizon are important factors in rating soils for use as construction materials. Each soil is evaluated to the depth observed, generally about 6 feet.

Roadfill is soil material used in embankments for roads. Soils are evaluated as a source of roadfill for low embankments, which generally are less than 6 feet high and less exacting in design than high embankments. The ratings reflect the ease of excavating and working the material and the expected performance of the material where it has been compacted and adequately drained. The performance of soil after it is stabilized with lime or cement is not considered in the ratings, but information about some of the soil properties that influence such performance is given in the descriptions of the soil series.

The ratings apply to the soil material between the A horizon and a depth of 5 to 6 feet. It is assumed that soil horizons will be mixed during excavation and spreading. Many soils have horizons of contrasting suitability within their profile. The estimated engineering properties in table 13 provide specific information about the nature of each horizon. This information can help determine the suitability of each horizon for roadfill.

Soils rated *good* are coarse grained. They have low shrink-swell potential, low potential frost action, and few cobbles and stones. They are at least moderately well drained and have slopes of 15 percent or less. Soils rated *fair* have a plasticity index of less than 15 and have other limiting features, such as moderate shrink-swell potential, moderately steep slopes, wetness, or many stones. If the thickness of suitable material is less than 3 feet, the entire soil is rated *poor*.

Sand and *gravel* are used in great quantities in many kinds of construction. The ratings in table 9 provide guidance as to where to look for probable sources and are based on the probability that soils in a given area contain sizable quantities of sand or gravel. A soil rated *good* or *fair* has a layer of suitable material at least 3 feet thick, the top of which is within a depth of 6 feet. Coarse fragments of soft bedrock material, such as shale and siltstone, are not considered to be sand and gravel. Fine-grained soils are not suitable sources of sand and gravel.

The ratings do not take into account depth to the water table or other factors that affect excavation of the material. Descriptions of grain size, kinds of minerals, reaction, and stratification are given in the soil series descriptions and in table 13.

Topsoil is used in areas where vegetation is to be established and maintained. Suitability is affected mainly by the ease of working and spreading the soil material in preparing a seedbed and by the ability of the soil material to support plantlife. Also considered is the damage that can result at the area from which the topsoil is taken.

The ease of excavation is influenced by the thickness of suitable material, wetness, slope, and amount of stones. The ability of the soil to support plantlife is determined by texture, structure, and the amount of soluble salts or toxic substances. Organic matter in the A1 or Ap horizon greatly increases the absorption and retention of moisture and nutrients. Therefore, the soil material from these horizons should be carefully preserved for later use.

Soils rated *good* have at least 16 inches of friable loamy material at their surface. They are free of stones and cobbles, are low in content of gravel, and have gentle slopes. They are low in soluble salts that can limit or prevent plant growth. They are naturally fertile or respond well to fertilizer. They are not so wet that excavation is difficult during most of the year.

Soils rated *fair* are loose sandy soils or firm loamy or clayey soils in which the suitable material is only 8 to 16 inches thick or soils that have appreciable amounts of gravel, stones, or soluble salt.

Soils rated *poor* are very sandy soils and very firm clayey soils; soils with suitable layers less than 8 inches thick; soils having large amounts of gravel, stones, or soluble salt; steep soils; and poorly drained soils.

Although a rating of *good* is not based entirely on high content of organic matter, a surface horizon is generally preferred for topsoil because of its organic-matter content. This horizon is designated as A1 or Ap in the soil series descriptions. The absorption and retention of moisture and nutrients for plant growth are greatly increased by organic matter.

Water management

Many soil properties and site features that affect water management practices have been identified in this soil survey. In table 10 the degree of soil limitation and soil and site features that affect use are indicated for each kind of soil. This information is significant in planning, installing, and maintaining water control structures.

Pond reservoir areas hold water behind a dam or embankment. Soils best suited to this use have a low seepage potential, which is determined by permeability and the depth to fractured or permeable bedrock or other permeable material.

Embankments, dikes, and levees require soil material that is resistant to seepage, erosion, and piping and has favorable stability, shrink-swell potential, shear strength,

and compaction characteristics. Large stones and organic matter in a soil downgrade the suitability of a soil for use in embankments, dikes, and levees.

Drainage of soil is affected by such soil properties as permeability; texture; depth to bedrock, hardpan, or other layers that affect the rate of water movement; depth to the water table; slope; stability of ditchbanks; susceptibility to flooding; salinity and alkalinity; and availability of outlets for drainage.

Irrigation is affected by such features as slope, susceptibility to flooding, hazards of water erosion and soil blowing, texture, presence of salts and alkali, depth of root zone, rate of water intake at the surface, permeability of the soil below the surface layer, available water capacity, need for drainage, and depth to the water table.

Terraces and diversions are embankments or a combination of channels and ridges constructed across a slope to intercept runoff. They allow water to soak into the soil or flow slowly to an outlet. Features that affect suitability of a soil for terraces are uniformity and steepness of slope; depth to bedrock, hardpan, or other unfavorable material; large stones; permeability; ease of establishing vegetation; and resistance to water erosion, soil blowing, soil slipping, and piping.

Grassed waterways are constructed to channel runoff to outlets at a nonerosive velocity. Features that affect the use of soils for waterways are slope, permeability, erodibility, wetness, and suitability for permanent vegetation.

Recreation

The soils of the survey area are rated in table 11 according to limitations that affect their suitability for recreation uses. The ratings are based on such restrictive soil features as flooding, wetness, slope, and texture of the surface layer. Not considered in these ratings, but important in evaluating a site, are location and accessibility of the area, size and shape of the area and its scenic quality, the ability of the soil to support vegetation, access to water, potential water impoundment sites available, and either access to public sewerlines or capacity of the soil to absorb septic tank effluent. Soils subject to flooding are limited, in varying degree, for recreation use by the duration and intensity of flooding and the season when flooding occurs. Onsite assessment of height, duration, intensity, and frequency of flooding is essential in planning recreation facilities.

The degree of the limitation of the soils is expressed as slight, moderate, or severe. *Slight* means that the soil properties are generally favorable and that the limitations are minor and easily overcome. *Moderate* means that the limitations can be overcome or alleviated by planning, design, or special maintenance. *Severe* means that soil properties are unfavorable and that limitations can be offset only by costly soil reclamation, special design, intensive maintenance, limited use, or by a combination of these measures.

The information in table 11 can be supplemented by information in other parts of this survey. Especially helpful are interpretations for septic tank absorption fields, given in table 8, and interpretations for dwellings without basements and for local roads and streets, given in table 7.

Camp areas require such site preparation as shaping and leveling for tent and parking areas, stabilizing roads and intensively used areas, and installing sanitary facilities and utility lines. Camp areas are subject to heavy foot traffic and some vehicular traffic. The best soils for this use have mild slopes and are not wet or subject to flooding during the period of use. The surface has few or no stones or boulders, absorbs rainfall readily but remains firm, and is not dusty when dry. Strong slopes and stones or boulders can greatly increase the cost of constructing camping sites.

Picnic areas are subject to heavy foot traffic. Most vehicular traffic is confined to access roads and parking areas. The best soils for use as picnic areas are firm when wet, are not dusty when dry, are not subject to flooding during the period of use, and do not have slopes or stones or boulders that will increase the cost of shaping sites or of building access roads and parking areas.

Playgrounds require soils that can withstand intensive foot traffic. The best soils are almost level and are not wet or subject to flooding during the season of use. The surface is free of stones or boulders, is firm after rains, and is not dusty when dry. If shaping is required to obtain a uniform grade, the depth of the soil over bedrock or hardpan should be enough to allow necessary grading.

Paths and trails for walking, horseback riding, bicycling, and other uses should require little or no cutting and filling. The best soils for this use are those that are not wet, are firm after rains, are not dusty when dry, and are not subject to flooding more than once during the annual period of use. They should have moderate slopes and have few or no stones or boulders on the surface.

Wildlife habitat

Soils directly affect the kind and amount of vegetation that is available to wildlife as food and cover, and they affect the construction of water impoundments. The kind and abundance of wildlife that populate an area depend largely on the amount and distribution of food, cover, and water. If any one of these elements is missing, is inadequate, or is inaccessible, wildlife either are scarce or do not inhabit the area.

If the soils have the potential, wildlife habitat can be created or improved by planting appropriate vegetation, by maintaining the existing plant cover, or by helping the natural establishment of desirable plants.

In table 12, the soils in the survey area are rated according to their potential to support the main kinds of wildlife habitat in the area. This information can be used in planning for parks, wildlife refuges, nature study areas, and other developments for wildlife; selecting areas that are suitable for wildlife; selecting soils that are suitable for creating, improving, or maintaining specific elements of wildlife habitat; and determining the intensity of management needed for each element of the habitat.

The potential of the soil is rated good, fair, poor, or very poor. A rating of *good* means that the element of wildlife habitat or the kind of habitat is easily created, improved, or maintained. Few or no limitations affect management, and satisfactory results can be expected if the soil is used for the designated purpose. A rating of *fair* means that the element of wildlife habitat or kind of habitat can be created, improved, or maintained in most places. Moderately intensive management is required for satisfactory results. A rating of *poor* means that limitations are severe for the designated element or kind of wildlife habitat. Habitat can be created, improved, or maintained in most places, but management is difficult and must be intensive. A rating of *very poor* means that restrictions for the element of wildlife habitat or kind of wildlife are very severe, and that unsatisfactory results can be expected. Wildlife habitat is impractical or even impossible to create, improve, or maintain on soils having such a rating.

The elements of wildlife habitat are briefly described in the following paragraphs.

Grain and seed crops are seed-producing annuals used by wildlife. The major soil properties that affect the growth of grain and seed crops are depth of the root zone, texture of the surface layer, available water capacity, wetness, slope, surface stoniness, and flood hazard. Soil temperature and soil moisture are also considerations. Examples of grain and seed crops are corn, wheat, oats, and barley.

Grasses and legumes are domestic perennial grasses and herbaceous legumes that are planted for wildlife food and cover. Major soil properties that affect the growth of grasses and legumes are depth of the root zone, texture of the surface layer, available water capacity, wetness, surface stoniness, flood hazard, and slope. Soil temperature and soil moisture are also considerations. Examples of grasses and legumes are fescue, orchardgrass, bromegrass, clover, and alfalfa.

Wild herbaceous plants are native or naturally established grasses and forbs, including weeds, that provide food and cover for wildlife. Major soil properties that affect the growth of these plants are depth of the root zone, texture of the surface layer, available water capacity, wetness, surface stoniness, and flood hazard. Soil temperature and soil moisture are also considerations. Examples of wild herbaceous plants are needlegrass, goldenrod, beggarweed, wheatgrass, and fescues.

Hardwood trees and the associated woody understory provide cover for wildlife and produce nuts or other fruit, buds, catkins, twigs, bark, or foliage that wildlife eat. Major soil properties that affect growth of hardwood trees and shrubs are depth of the root zone, available water capacity, and wetness. Examples of native plants are oak, poplar, cherry, sweetgum, apple, hawthorn, dogwood, hickory, blackberry, and blueberry. Examples of fruit-producing shrubs that are commercially available and suitable for planting on soils rated *good* are Russian-olive, autumn-olive, and crabapple.

Coniferous plants are cone-bearing trees, shrubs, or ground cover plants that furnish habitat or supply food in the form of browse, seeds, or fruitlike cones. Soil properties that have a major effect on the growth of coniferous plants are depth of the root zone, available water capacity, and wetness. Examples of coniferous plants are pine, spruce, fir, cedar, and juniper.

Shrubs are bushy woody plants that produce fruit, buds, twigs, bark, or foliage used by wildlife or that provide cover and shade for some species of wildlife. Major soil properties that affect the growth of shrubs are depth of the root zone, available water capacity, salinity, and moisture. Examples of shrubs are serviceberry, mountain-mahogany, bitterbrush, snowberry, and big sagebrush.

Wetland plants are annual and perennial wild herbaceous plants that grow on moist or wet sites, exclusive of submerged or floating aquatics. They produce food or cover for wildlife that use wetland as habitat. Major soil properties affecting wetland plants are texture of the surface layer, wetness, reaction, salinity, slope, and surface stoniness. Examples of wetland plants are cattail, wild millet, saltgrass, and cordgrass and rushes, sedges, and reeds.

Shallow water areas are bodies of water that have an average depth of less than 5 feet and that are useful to wildlife. They can be naturally wet areas, or they can be created by dams or levees or by water-control structures in marshes or streams. Major soil properties affecting shallow water areas are depth to bedrock, wetness, surface stoniness, slope, and permeability. The availability of a dependable water supply is important if water areas are to be developed. Examples of shallow water areas are marshes, waterfowl feeding areas, and ponds.

The kinds of wildlife habitat are briefly described in the following paragraphs.

Openland habitat consists of cropland, pasture, meadows, and areas that are overgrown with grasses, herbs, shrubs, and vines. These areas produce grain and seed crops, grasses and legumes, and wild herbaceous plants. The kinds of wildlife attracted to these areas include Gambel's quail, pheasant, meadowlark, field sparrow, cottontail rabbit, and coyote.

Woodland habitat consists of areas of hardwoods or conifers, or a mixture of both, and associated grasses, legumes, and wild herbaceous plants. Wildlife attracted

to these areas include wild turkey, blue grouse, jays, thrushes, woodpeckers, squirrels, coyote, snowshoe hare, deer, bear, elk, and mountain lion.

Wetland habitat consists of open, marshy or swampy, shallow water areas where water-tolerant plants grow. Some of the wildlife attracted to such areas are ducks, geese, herons, shore birds, muskrat, mink, beaver, and raccoon.

Rangeland habitat consists of areas of wild herbaceous plants and shrubs. Wildlife attracted to rangeland include elk, cottontail rabbit, mule deer, sage grouse, meadowlark, and lark bunting.

Soil properties

Extensive data about soil properties are summarized on the following pages. The two main sources of these data are the many thousands of soil borings made during the course of the survey and the laboratory analyses of selected soil samples from typical profiles.

In making soil borings during field mapping, soil scientists can identify several important soil properties. They note the seasonal soil moisture condition or the presence of free water and its depth. For each horizon in the profile, they note the thickness and color of the soil material; the texture, or amount of clay, silt, sand, and gravel or other coarse fragments; the structure, or the natural pattern of cracks and pores in the undisturbed soil; and the consistence of the soil material in place under the existing soil moisture conditions. They record the depth of plant roots, determine the pH or reaction of the soil, and identify any free carbonates.

Samples of soil material are analyzed in the laboratory to verify the field estimates of soil properties and to determine all major properties of key soils, especially properties that cannot be estimated accurately by field observation. Laboratory analyses are not conducted for all soil series in the survey area, but laboratory data for many soil series not tested are available from nearby survey areas.

The available field and laboratory data are summarized in tables. The tables give the estimated range of engineering properties, the engineering classifications, and the physical and chemical properties of each major horizon of each soil in the survey area. They also present data about pertinent soil and water features, engineering test data, and data obtained from physical and chemical laboratory analyses of soils.

Engineering properties

Table 13 gives estimates of engineering properties and classifications for the major horizons of each soil in the survey area.

Most soils have, within the upper 5 or 6 feet, horizons of contrasting properties. Table 13 gives information for each of these contrasting horizons in a typical profile. *Depth* to the upper and lower boundaries of each horizon is indicated. More information about the range in depth and about other properties in each horizon is given for each soil series in the section "Soil series and morphology."

Texture is described in table 13 in the standard terms used by the U.S. Department of Agriculture. These terms are defined according to percentages of sand, silt, and clay in soil material that is less than 2 millimeters in diameter. "Loam," for example, is soil material that is 7 to 27 percent clay, 28 to 50 percent silt, and less than 52 percent sand. If a soil contains gravel or other particles coarser than sand, an appropriate modifier is added, for example, "gravelly loam." Other texture terms are defined in the Glossary.

The two systems commonly used in classifying soils for engineering use (*3*) are the Unified Soil Classification System (Unified) (*2*) and the system adopted by the American Association of State Highway and Transportation Officials (AASHTO) (*1*).

The *Unified* system classifies soils according to properties that affect their use as construction material. Soils are classified according to grain-size distribution of the fraction less than 3 inches in diameter, plasticity index, liquid limit, and organic-matter content. Soils are grouped into 15 classes—eight classes of coarse-grained soils, identified as GW, GP, GM, GC, SW, SP, SM, and SC; six classes of fine-grained soils, identified as ML, CL, OL, MH, CH, and OH; and one class of highly organic soils, identified as Pt. Soils on the borderline between two classes have a dual classification symbol, for example, CL-ML.

The *AASHTO* system classifies soils according to those properties that affect their use in highway construction and maintenance. In this system a mineral soil is classified in one of seven basic groups ranging from A-1 through A-7 on the basis of grain-size distribution, liquid limit, and plasticity index. Soils in group A-1 are coarse grained and low in content of fines. At the other extreme, in group A-7, are fine-grained soils. Highly organic soils are classified in group A-8 on the basis of visual inspection.

Also in table 13 the percentage, by weight, of rock fragments more than 3 inches in diameter is estimated for each major horizon. These estimates are determined mainly by observing volume percentage in the field and then converting that, by formula, to weight percentage.

Percentage of the soil material less than 3 inches in diameter that passes each of four sieves (U.S. standard) is estimated for each major horizon. The estimates are based on tests of soils that were sampled in the survey area and in nearby areas and on field estimates from many borings made during the survey.

Liquid limit and *plasticity index* indicate the effect of water on the strength and consistence of soil. These indexes are used in both the Unified and AASHTO soil

classification systems. They are also used as indicators in making general predictions of soil behavior. Range in liquid limit and plasticity index are estimated on the basis of test data from the survey area or from nearby areas and on observations of the many soil borings made during the survey.

In some surveys, the estimates are rounded to the nearest 5 percent. Thus, if the ranges of gradation and Atterburg limits extend a marginal amount across classification boundaries (1 or 2 percent), the classification in the marginal zone is omitted.

Physical and chemical properties

Table 14 shows estimated values for several soil characteristics and features that affect behavior of soils in engineering uses. These estimates are given for each major horizon, at the depths indicated, in the typical pedon of each soil. The estimates are based on field observations and on test data for these and similar soils.

Clay is a mineral soil particle that is less than 0.002 millimeters in diameter.

In table 14, the estimated clay content of each major soil horizon is given as a percent, by weight, of the soil material that is less than 2 millimeters in diameter.

The amount and kind of clay greatly affect the fertility and physical condition of the soil. They determine the ability of the soil to absorb cations and to retain moisture. They influence the soil's shrink-swell potential, permeability, and plasticity; the ease of soil dispersion; and other soil properties. The amount and kind of clay in a soil also affect tillage and earth-moving operations.

Permeability is estimated on the basis of known relationships among the soil characteristics observed in the field—particularly soil structure, porosity, and gradation or texture—that influence the downward movement of water in the soil. The estimates are for vertical water movement when the soil is saturated. Not considered in the estimates is lateral seepage or such transient soil features as plowpans and surface crusts. Permeability of the soil is an important factor to be considered in planning and designing drainage systems, in evaluating the potential of soils for septic tank systems and other waste disposal systems, and in many other aspects of land use and management.

Available water capacity is rated on the basis of soil characteristics that influence the ability of the soil to hold water and make it available to plants. Important characteristics are content of organic matter, soil texture, and soil structure. Shallow-rooted plants are not likely to use the available water from the deeper soil horizons. Available water capacity is an important factor in the choice of plants or crops to be grown and in the design of irrigation systems.

Soil reaction is expressed as range in pH values. The range in pH of each major horizon is based on many field checks. For many soils, the values have been verified by laboratory analyses. Soil reaction is important in selecting the crops, ornamental plants, or other plants to be grown; in evaluating soil amendments for fertility and stabilization; and in evaluating the corrosivity of soils.

Salinity is expressed as the electrical conductivity of the saturation extract, in millimhos per centimeter at 25 degrees C. Estimates are based on field and laboratory measurements at representative sites of the nonirrigated soils. The salinity of individual irrigated fields is affected by the quality of the irrigation water and by the frequency of water application. Hence, the salinity of individual fields can differ greatly from the value given in table 14. Salinity affects the suitability of a soil for crop production, its stability when used as a construction material, and its potential to corrode metal and concrete.

Shrink-swell potential depends mainly on the amount and kind of clay in the soil. Laboratory measurements of the swelling of undisturbed clods were made for many soils. For others the swelling was estimated on the basis of the kind and amount of clay in the soil and on measurements of similar soils. The size of the load and the magnitude of the change in soil moisture content also influence the swelling of soils. Shrinking and swelling of some soils can cause damage to building foundations, basement walls, roads, and other structures unless special designs are used. A high shrink-swell potential indicates that special design and added expense may be required if the planned use of the soil will not tolerate large volume changes.

Erosion factors are used to predict the erodibility of a soil and its tolerance to erosion in relation to specific kinds of land use and treatment. The soil erodibility factor (K) is a measure of the susceptibility of the soil to erosion by water. Soils having the highest K values are the most erodible. K values range from 0.10 to 0.64. To estimate annual soil loss per acre, the K value of a soil is modified by factors representing plant cover, grade and length of slope, management practices, and climate. The soil-loss tolerance factor (T) is the maximum rate of soil erosion, whether from rainfall or soil blowing, that can occur without reducing crop production or environmental quality. The rate is expressed in tons of soil loss per acre per year.

Organic matter is the plant and animal residue in the soil at various stages of decomposition.

In table 14, the estimated content of organic matter of the plow layer is expressed as a percent, by weight, of the soil material that is less than 2 millimeters in diameter.

The content of organic matter of a soil can be maintained or increased by returning crop residue to the soil. Organic matter affects the available water capacity, infiltration rate, and tilth of the soil. It is a source of nitrogen and other nutrients for crops.

Soil and water features

Table 15 contains information helpful in planning land uses and engineering projects that are likely to be affected by soil and water features.

Hydrologic soil groups are used to estimate runoff from precipitation. Soils not protected by vegetation are placed in one of four groups on the basis of the intake of water after the soils have been wetted and have received precipitation from long-duration storms.

The four hydrologic soil groups are:

Group A. Soils having a high infiltration rate (low runoff potential) when thoroughly wet. These consist chiefly of deep, well drained to excessively drained sands or gravels. These soils have a high rate of water transmission.

Group B. Soils having a moderate infiltration rate when thoroughly wet. These consist chiefly of moderately deep or deep, moderately well drained or well drained soils that have moderately fine texture to moderately coarse texture. These soils have a moderate rate of water transmission.

Group C. Soils having a slow infiltration rate when thoroughly wet. These consist chiefly of soils that have a layer that impedes the downward movement of water or soils that have moderately fine texture or fine texture. These soils have a slow rate of water transmission.

Group D. Soils having a very slow infiltration rate (high runoff potential) when thoroughly wet. These consist chiefly of clay soils that have a high shrink-swell potential, soils that have a permanent high water table, soils that have a claypan or clay layer at or near the surface, and soils that are shallow over nearly impervious material. These soils have a very slow rate of water transmission.

Flooding is the temporary covering of soil with water from overflowing streams, with runoff from adjacent slopes, and by tides. Water standing for short periods after rains or after snow melts is not considered flooding, nor is water in swamps and marshes. Flooding is rated in general terms that describe the frequency and duration of flooding and the time of year when flooding is most likely. The ratings are based on evidence in the soil profile of the effects of flooding, namely thin strata of gravel, sand, silt, or, in places, clay deposited by floodwater; irregular decrease in organic-matter content with increasing depth; and absence of distinctive soil horizons that form in soils of the area that are not subject to flooding. The ratings are also based on local information about floodwater levels in the area and the extent of flooding and on information that relates the position of each soil on the landscape to historic floods.

The generalized description of flood hazards is of value in land-use planning and provides a valid basis for land-use restrictions. The soil data are less specific, however, than those provided by detailed engineering surveys that delineate flood-prone areas at specific flood frequency levels.

High water table is the highest level of a saturated zone more than 6 inches thick for a continuous period of more than 2 weeks during most years. The depth to a seasonal high water table applies to undrained soils. Estimates are based mainly on the relationship between grayish colors or mottles in the soil and the depth to free water observed in many borings made during the course of the soil survey. Indicated in table 15 are the depth to the seasonal high water table; the kind of water table, that is, perched, artesian, or apparent; and the months of the year that the water table commonly is high. Only saturated zones above a depth of 5 or 6 feet are indicated.

Information about the seasonal high water table helps in assessing the need for specially designed foundations, the need for specific kinds of drainage systems, and the need for footing drains to insure dry basements. Such information is also needed to decide whether or not construction of basements is feasible and to determine how septic tank absorption fields and other underground installations will function. Also, a seasonal high water table affects ease of excavation.

Depth to bedrock is shown for all soils that are underlain by bedrock at a depth of 5 to 6 feet or less. For many soils, the limited depth to bedrock is a part of the definition of the soil series. The depths shown are based on measurements made in many soil borings and on other observations during the mapping of the soils. The kind of bedrock and its hardness as related to ease of excavation is also shown. Rippable bedrock can be excavated with a single-tooth ripping attachment on a 200-horsepower tractor, but hard bedrock generally requires blasting.

Potential frost action refers to the likelihood of damage to pavements and other structures by frost heaving and low soil strength after thawing. Frost action results from the movement of soil moisture into the freezing temperature zone in the soil, which causes ice lenses to form. Soil texture, temperature, moisture content, porosity, permeability, and content of organic matter are the most important soil properties that affect frost action. It is assumed that the soil is not covered by insulating vegetation or snow and is not artificially drained. Silty and clayey soils that have a high water table in winter are most susceptible to frost action. Well drained very gravelly or sandy soils are the least susceptible.

Risk of corrosion pertains to potential soil-induced chemical action that dissolves or weakens uncoated steel or concrete. The rate of corrosion of uncoated steel is related to soil moisture, particle-size distribution, total acidity, and electrical conductivity of the soil material. The rate of corrosion of concrete is based mainly on the sulfate content, texture, and acidity of the soil. Protective measures for steel or more resistant concrete help to avoid or minimize damage resulting from the corrosion. Uncoated steel intersecting soil boundaries or

soil horizons is more susceptible to corrosion than an installation that is entirely within one kind of soil or within one soil horizon.

Soil series and morphology

In this section, each soil series recognized in the survey area is described in detail. The descriptions are arranged in alphabetic order by series name.

Characteristics of the soil and the material in which it formed are discussed for each series. The soil is then compared to similar soils of other series. Then a pedon, a small three-dimensional area of soil that is typical of the soil series in the survey area, is described. The detailed descriptions of each soil horizon follow standards in the Soil Survey Manual (*6*). Unless otherwise noted, colors described are for dry soil.

Following the pedon description is the range of important characteristics of the soil series in this survey area. Phases, or map units, of each soil series are described in the section "Soil maps for detailed planning."

Almy Variant

The Almy Variant consists of deep, well drained soils that formed in residuum from red sandstone and shale. Almy soils are on sides of mountains. Slopes are 25 to 65 percent. The average annual precipitation is about 18 inches, and the average annual air temperature is about 40 degrees F.

Almy Variant soils are similar to Cushman and Olney soils. Cushman and Olney soils have a mesic temperature regime and have hue of 7.5YR to 2.5Y.

Typical pedon of Almy Variant loam, 25 to 65 percent slopes, about 400 feet north and 300 feet west of the southeast corner of section 11, T. 6 S., R. 89 W.:

A1—0 to 8 inches; reddish brown (5YR 4/3) loam, dark reddish brown (5YR 3/3) moist; weak fine granular structure; soft, very friable, slightly sticky and slightly plastic; mildly alkaline; clear smooth boundary.

B21t—8 to 15 inches; reddish brown (2.5YR 4/4) clay loam, dark reddish brown (2.5YR 3/4) moist; moderate medium subangular blocky structure parting to moderate fine subangular blocky; hard, firm, sticky and plastic; thin nearly continuous clay films on faces of peds; 8 percent small flagstones; mildly alkaline; gradual smooth boundary.

B22t—15 to 34 inches; red (2.5YR 4/6) clay loam, dark red (2.5YR 3/6) moist; moderate medium subangular blocky structure parting to moderate fine subangular blocky; hard, firm, sticky and plastic; thin nearly continuous clay films on peds; 10 percent small flagstones; mildly alkaline; gradual wavy boundary.

Cca—34 to 60 inches; red (2.5YR 5/6) flaggy clay loam, red (2.5YR 4/6) moist; massive; slightly hard, friable, slightly sticky and slightly plastic; 20 percent flagstones and cobbles; visible secondary calcium carbonate as thin crusts on the bottoms of rock fragments and as thin filaments in soil material; calcareous; moderately alkaline.

The A horizon has hue of 7.5YR or 5YR, value of 4 or 5 dry and 3 or 4 moist, and chroma of 3 or 4. The Bt horizon has hue of 5YR or 2.5YR, value of 4 or 5 dry and 3 or 4 moist, and chroma of 4 to 6. The C horizon has hue of 5YR or 2.5YR, value of 5 or 6 dry and 4 or 5 moist, and chroma of 6 to 8.

Ansari series

The Ansari series consists of shallow, well drained soils that formed in a thin layer of alluvium derived from red-bed sandstone and shale. Ansari soils are on ridge crests and shoulders. Slopes range from 2 to 40 percent. The average annual precipitation is about 15 inches, and the average annual air temperature is about 43 degrees F.

Ansari soils are similar to Arle and Starman soils. Arle soils contain more than 35 percent coarse fragments and do not have lithic contact. Starman soils contain 55 percent coarse fragments in the profile, are calcareous, and have the colder cryic temperature regime.

Typical pedon of Ansari loam, 12 to 40 percent slopes, about 1,450 feet west and 620 feet north of the southeast corner of section 13, T. 6 S., R. 89 W.:

A1—0 to 10 inches; reddish brown (5YR 4/3) loam, dark reddish brown (5YR 3/3) moist; moderate fine granular structure; soft, very friable; 10 percent flagstones; calcareous; moderately alkaline; gradual wavy boundary.

Cca—10 to 18 inches; reddish brown (2.5YR 5/4) stony loam, reddish brown (2.5YR 4/4) moist; massive; hard, friable; 25 percent angular rock fragments and flagstones; weak and inconsistent accumulation of secondary carbonate as small soft concretions and crusts on underside of rock fragments; calcareous; moderately alkaline; abrupt wavy boundary.

R—18 inches; hard reddish brown calcareous sandstone.

The mollic epipedon ranges from 7 to 16 inches in thickness. Depth to sandstone bedrock ranges from 10 to 20 inches. The soil is calcareous throughout.

The A horizon has hue of 5YR to 10R, value of 4 or 5 dry and 2 or 3 moist, and chroma of 2 or 3. The C horizon has hue of 5YR to 10R, value of 5 or 6 dry and 4 or 5 moist, and chroma of 4 to 6.

Arle series

The Arle series consists of moderately deep, well drained soils that formed in residuum from red shale and sandstone. Arle soils are on ridges and hills in the uplands. Slopes are 12 to 65 percent. The average annual precipitation is about 18 inches, and the average annual air temperature is about 43 degrees F.

Arle soils are similar to Tridell soils. Tridell soils contain a calcic horizon and are calcareous throughout the profile.

Typical pedon of Arle very stony loam, 12 to 65 percent slopes, about 2,450 feet north and 400 feet east of the southwest corner, section 24, T. 6 S., R. 88 W.:

A1—0 to 10 inches; reddish brown (5YR 4/3) very stony loam, dark reddish brown (5YR 3/3) moist; moderate medium granular structure; soft, very friable; 40 percent flagstones; mildly alkaline; gradual smooth boundary.

B2—10 to 19 inches; reddish brown (5YR 4/4) very stony loam, reddish brown (5YR 3/4) moist; moderate medium subangular blocky structure parting to moderate medium granular; slightly hard, very friable; 40 percent flagstones; slightly calcareous; moderately alkaline; clear wavy boundary.

Cca—19 to 32 inches; reddish brown (5YR 5/4) very stony loam, reddish brown (5YR 4/4) moist; massive; hard, very friable; 60 percent flagstones; visible accumulations of secondary calcium carbonate as small lime concretions and as coatings on undersides of coarse fragments; strongly calcareous; moderately alkaline; clear wavy boundary.

Cr—32 to 60 inches; soft reddish brown sandstone and shale.

The mollic epipedon ranges from 7 to 15 inches in thickness. Depth to the paralithic contact ranges from 20 to 40 inches. In places this soil is leached to a depth of 7 to 15 inches. Coarse fragments make up 35 to 80 percent, by volume, of the soil.

The A horizon has hue of 2.5YR to 5YR, value of 4 or 5 dry and 2 or 3 moist, and chroma of 3 to 6. The B horizon has hue of 2.5YR to 5YR, value of 4 to 6 dry and 3 to 5 moist, and chroma of 3 to 6. The C horizon has hue of 5YR to 10R.

Arvada series

The Arvada series consists of deep, well drained soils that formed in alluvium derived from shale. Arvadas soil are on benches, terraces, and outwash fans. Slopes are 1 to 20 percent. The average annual precipitation is 12 inches, and the average annual air temperature is 48 degrees F.

Arvada soils are similar to Heldt and Potts soils. Heldt soils do not have a natric horizon or an argillic horizon. Potts soils are less than 35 percent clay in the control section and do not have a natric horizon.

Typical pedon of Arvada loam, 1 to 6 percent slopes, about 2,640 feet south and 200 feet east of the northwest corner of section 34, T. 7 S., R. 96 W.:

A2—0 to 3 inches; pale brown (10YR 6/3) loam, brown (10YR 5/3) moist; moderate medium platy structure parting to weak fine granular; soft, friable, calcareous; strongly alkaline; abrupt smooth boundary.

B21t—3 to 7 inches; brown (7.5YR 5/2) silty clay loam, dark brown (7.5YR 4/2) moist; weak coarse columnar structure parting to moderate medium subangular blocky; hard, firm, slightly sticky and slightly plastic; thin patchy clay films on peds; calcareous; strongly alkaline; clear smooth boundary.

B22t—7 to 17 inches; brown (7.5YR 5/2) silty clay loam, dark brown (7.5YR 4/2) moist; moderate medium subangular blocky structure; hard, firm, sticky and plastic; thin, nearly continuous clay films on peds; 15 percent white (10YR 8/2) salt accumulations; calcareous; strongly alkaline; clear smooth boundary.

Ccasa—17 to 40 inches; light brown (7.5YR 6/4) silty clay loam, dark brown (7.5YR 4/2) moist; massive; very hard, firm, sticky and plastic; calcium carbonate accumulations as seams and mycelia; some gypsum crystals on peds; 30 percent white (10YR 8/2) salt accumulations; calcareous; strongly alkaline; gradual smooth boundary.

C—40 to 60 inches; brown (7.5YR 5/3) silty clay loam, dark brown (7.5YR 4/2) moist; few fine yellowish brown mottles (10YR 5/8); massive; very hard, firm, slightly sticky and slightly plastic; 15 percent white (10YR 8/2) salt accumulations; calcareous; moderately alkaline.

The solum ranges from 15 to 25 inches in thickness. Depth to calcareous material ranges from 0 to 8 inches. A thin A1 horizon is present in some pedons. The light colored, platy A2 horizon is absent in some pedons.

The A horizon has hue of 2.5Y or 10YR, value of 5 or 6 dry and 4 or 5 moist, and chroma of 2 to 4. The A horizon ranges from moderately alkaline to very strongly alkaline. The B horizon has hue of 10YR or 7.5YR, value of 5 or 6 dry and 4 or 5 moist, and chroma of 2 to 4. The C horizon has hue of 10YR or 7.5YR, value of 5 to 7 dry and 4 or 5 moist, and chroma of 2 to 4.

Ascalon series

The Ascalon series consists of deep, well drained soils that formed in alluvium derived from sandstone and shale. Ascalon soils are on alluvial fans and sloping mesas. Slopes are 1 to 12 percent. The average annual precipitation is about 15 inches, and the average annual air temperature is about 48 degrees F.

Ascalon soils are similar to Morval and Vale soils. Morval soils have a loamy skeletal substratum above a depth of 40 inches. Vale soils have a fine silty control section.

Typical pedon of Ascalon fine sandy loam, 1 to 6 percent slopes, about 1,000 feet north of the south quarter-corner of section 1, T. 5 S., R. 93 W.:

A1—0 to 5 inches; brown (10YR 5/3) fine sandy loam, dark brown (10YR 3/3) moist; fine granular structure; soft, very friable, mildly alkaline; gradual wavy boundary.

B1—5 to 13 inches; brown (10YR 5/3) sandy clay loam, dark brown (10YR 3/3) moist; moderate fine subangular blocky structure parting to strong fine granular; slightly hard, very friable, slightly sticky and slightly plastic; mildly alkaline; clear smooth boundary.

B2t—13 to 30 inches; yellowish brown (10YR 5/4) sandy clay loam, dark yellowish brown (10YR 3/4) moist; moderate fine and medium subangular blocky structure; thin clay films on some faces of the peds; slightly hard, very friable, sticky and plastic; mildly alkaline; clear smooth boundary.

B3ca—30 to 35 inches; yellowish brown (10YR 5/4) sandy clay loam, dark yellowish brown (10YR 4/4) moist; weak fine subangular blocky structure; slightly hard, very friable, sticky and plastic; visible carbonates in seams and as concretions; calcareous; moderately alkaline; clear wavy boundary.

Cca—35 to 60 inches; very pale brown (10YR 8/4) sandy clay loam, very pale brown (10YR 7/4) moist; massive; slightly hard, very friable, sticky and plastic; finely disseminated carbonates throughout horizon; calcareous; moderately alkaline.

The mollic epipedon ranges from 9 to 16 inches in thickness. The profile is mildly alkaline to moderately alkaline throughout.

The A horizon has hue of 2.5Y or 10YR, value of 4 or 5 dry and 2 or 3 moist, and chroma of 2 or 3. The B horizon has hue of 7.5YR or 10YR, value of 5 or 6 dry and 3 or 4 moist, and chroma of 2 to 4. The Cca horizon has hue of 2.5Y or 10YR, value of 7 or 8 dry and 6 or 7 moist, and chroma of 1 to 4. Calcium carbonate equivalent is less than 15 percent in the Cca horizon.

Atencio series

The Atencio series consists of deep, well drained soils that formed in alluvium derived from red sandstone and shale. Atencio soils are on sloping fans and terraces. Slopes are 1 to 3 percent. The average annual precipitation is about 16 inches, and the average annual air temperature is about 48 degrees F.

Atencio soils are similar to Vale soils. Vale soils have more silt, and they do not have gravel in the upper part of the profile.

Typical pedon of Atencio sandy loam, 1 to 3 percent slopes, about 320 feet north and 150 feet west of the southeast corner of section 35, T. 6 S., R. 89 W.:

A1—0 to 5 inches; dark reddish gray (5YR 4/2) sandy loam, dark reddish brown (5YR 3/2) moist; moderate medium granular structure; soft, loose; 5 percent gravel; mildly alkaline; clear smooth boundary.

B1—5 to 11 inches; reddish brown (5YR 4/3) sandy loam, dark reddish brown (5YR 3/3) moist; weak medium subangular blocky structure; slightly hard, very friable; 5 percent gravel; mildly alkaline; clear smooth boundary.

B2t—11 to 23 inches; reddish brown (5YR 4/4) gravelly sandy clay loam, reddish brown (5YR 5/4) moist; moderate medium prismatic structure parting to weak medium subangular blocky; hard, friable, slightly sticky and slightly plastic; 15 percent gravel; calcareous; mildly alkaline; clear smooth boundary.

B3ca—23 to 28 inches; brown (7.5YR 5/4) gravelly sandy loam, dark brown (7.5YR 4/4) moist; weak medium subangular blocky structure; slightly hard, friable; 20 percent gravel; calcium carbonate as coatings on underside of gravel and as soft concretions; calcareous; mildly alkaline; clear smooth boundary.

IICca—28 to 54 inches; sand, gravel, and cobbles; calcareous; some visible calcium carbonate as coatings on coarse fragments; 30 percent cobbles, 30 percent sand, 40 percent gravel.

The mollic epipedon ranges from 9 to 15 inches in thickness. Depth to the underlying sandy material ranges from 23 to 38 inches. Reaction is mildly alkaline to moderately alkaline throughout.

The A horizon has hue of 2.5YR to 7.5YR, value of 4 or 5 dry and 2 or 3 moist, and chroma of 3 to 5. Gravel or cobbles make up less than 10 percent of the A horizon. The B2t horizon has hue of 10R to 5YR, value of 4 to 6 dry and 3 to 5 moist, and chroma of 3 to 5. Content of coarse fragments ranges from 5 to 35 percent. The IICca horizon is 20 to 40 percent cobbles and 35 to 50 percent gravel.

Azeltine series

The Azeltine series consists of deep, well drained soils that formed in gravelly and cobbly alluvium derived from mixed sedimentary and igneous rocks. Azeltine soils are on terraces, benches, and fans adjacent to major drainageways. Slopes are 1 to 3 percent. The average annual precipitation is about 16 inches, and the average annual air temperature is about 48 degrees F.

Azeltine soils are similar to Kim soils. Kim soils do not have a mollic epipedon and do not contain coarse fragments in the lower part of the control section.

Typical pedon of Azeltine gravelly sandy loam, 1 to 3 percent slopes, about 380 feet north and 155 feet west of the southeast corner of section 35, T. 6 S., R. 89 W.:

A1—0 to 8 inches; reddish gray (5YR 5/2) gravelly sandy loam, dark reddish brown (5YR 3/2) moist; moderate fine and medium granular structure; soft, very friable; 20 percent gravel; calcareous; mildly alkaline; clear smooth boundary.

C1—8 to 18 inches; reddish brown (5YR 4/4) gravelly sandy loam, reddish brown (5YR 4/3) moist; weak medium subangular blocky structure; soft, very friable; 25 percent gravel, 3 percent cobbles; calcareous; mildly alkaline; clear smooth boundary.

IIC2ca—18 to 60 inches; stratified calcareous sand, gravel, and cobbles; 30 percent cobbles, 30 percent gravel, and 40 percent sand; calcium carbonate coatings on coarse fragments; calcareous; mildly alkaline.

The mollic epipedon ranges from 6 to 14 inches in thickness. This soil is generally calcareous throughout but in places is leached to a depth of 6 to 14 inches.

The A horizon has hue of 2.5YR to 7.5YR, value of 4 or 5 dry and 2 or 3 moist, and chroma of 2 or 3. The C horizon has hue of 2.5YR to 7.5YR. The gravel content ranges from 15 to 35 percent, by volume, and the content of cobbles ranges from 3 to 7 percent, by volume.

Begay series

The Begay series consists of deep, well drained soils that formed in alluvium derived from red-bed sandstone and shale. Begay soils are on alluvial fans and sides of valleys. Slopes are 1 to 12 percent. The average annual precipitation is about 14 inches, and the average annual air temperature is about 48 degrees F.

Begay soils are similar to Ildefonso soils. Ildefonso soils do not have a cambic horizon, contain more than 35 percent coarse fragments in the control section, and have a calcium carbonate horizon.

Typical pedon of Begay sandy loam, 6 to 12 percent slopes, about 1,460 feet north of southeast corner of section 6, T. 6 S., R. 96 W.:

Ap—0 to 6 inches; red (2.5YR 4/6) sandy loam, dark red (2.5YR 3/6) moist; weak thick platy structure parting to weak medium or fine granular; soft, very friable; calcareous; mildly alkaline; abrupt smooth boundary.

A1—6 to 14 inches; yellowish red (5YR 5/6) sandy loam, yellowish red (5YR 4/6) moist; weak medium platy structure parting to weak medium subangular blocky; soft, very friable; calcareous; moderately alkaline; clear smooth boundary.

B2—14 to 24 inches; yellowish red (5YR 5/6) fine sandy loam, yellowish red (5YR 4/6) moist; moderate to weak fine subangular blocky structure; slightly hard, very friable; calcareous; moderately alkaline; gradual wavy boundary.

C—24 to 60 inches; yellowish red (5YR 5/6) stony sandy loam, yellowish red (5YR 4/6) moist; massive; soft, very friable; 20 percent sandstone fragments 7 to 10 inches long and about 5 inches thick; calcareous; moderately alkaline.

The A horizon has hue of 2.5YR or 5YR, value of 4 or 5 dry and 3 or 4 moist, and chroma of 4 to 6. The B horizon has hue of 5YR or 2.5YR, value of 5 or 6 dry and 4 or 5 moist, and chroma of 5 or 6. The C horizon has hue of 5YR or 2.5YR. The C horizon contains 15 to 25 percent sandstone fragments 6 to 12 inches long and 4 to 6 inches thick.

Bucklon series

The Bucklon series consists of shallow, well drained soils that formed in residuum from shale and sandstone. Bucklon soils are on sides of ridges and mountains. Slopes are 25 to 50 percent. The average annual precipitation is about 18 inches, and the average annual air temperature is about 40 degrees F.

Bucklon soils are similar to Farlow and Parachute soils. Farlow soils are deep, are calcareous, and contain more than 35 percent coarse fragments. Parachute soils are deep and contain more than 35 percent coarse fragments.

Typical pedon of Bucklon loam, 25 to 50 percent slopes, about 1,000 feet west and 300 feet south of the northeast corner of section 26, T. 7 S., R. 95 W.:

01—1 inch to 0; partially decomposed leaves, grass, and twigs.

A1—0 to 5 inches; dark grayish brown (10YR 4/2) loam, black (10YR 2/1) moist; moderate fine granular structure; slightly hard, very friable; neutral; clear wavy boundary.

C1—5 to 12 inches; dark grayish brown (10YR 4/2) clay loam, very dark grayish brown (10YR 3/2) moist; moderate medium subangular blocky structure parting to moderate fine subangular blocky; hard, friable, slightly sticky and slightly plastic; neutral; clear wavy boundary.

C2—12 to 15 inches; grayish brown (2.5Y 5/2) loam, dark grayish brown (2.5Y 4/2) moist; massive; slightly hard, friable; 10 percent channery fragments; calcareous; neutral; gradual wavy boundary.

C3r—15 inches; thin stratum of weathered sandstone overlying shale.

The mollic epipedon ranges from 8 to 14 inches in thickness. Depth to bedrock ranges from 10 to 20 inches.

The A horizon has hue of 10YR or 2.5Y, value of 3 or 4 dry and 2 or 3 moist, and chroma of 1 to 3. The C horizon has hue of 10YR or 2.5Y.

Chilton series

The Chilton series consists of deep, well drained soils that formed in alluvium derived from red-bed shale and sandstone. Chilton soils are on alluvial fans and sides of valleys. Slopes are 3 to 25 percent. The average annual precipitation is about 14 inches, and the average annual air temperature is about 46 degrees F.

Chilton soils are similar to Nihill and Kim soils. Nihill soils are more yellow. Kim soils contain less than 35 percent coarse fragments.

Typical pedon of Chilton channery loam, 12 to 25 percent slopes, about 300 feet west and 300 feet south of the northeast corner of section 22, T. 5 S., R. 92 W.:

Ap—0 to 9 inches; reddish brown (5YR 5/3) channery loam, dark reddish gray (5YR 4/2) moist; weak medium subangular blocky structure parting to weak fine granular; slightly hard, very friable; 20 percent channery fragments; calcareous; moderately alkaline; clear smooth boundary.

AC—9 to 13 inches; reddish brown (5YR 5/3) channery loam, dark reddish brown (5YR 4/3) moist; weak moderate subangular blocky structure parting to weak fine subangular blocky; slightly hard, very friable; 30 percent channery fragments; calcareous; moderately alkaline; clear smooth boundary.

C1—13 to 19 inches; reddish brown (5YR 5/4) very channery sandy loam, reddish brown (5YR 4/4) moist; massive; soft, very friable; 35 percent channery fragments; calcareous; moderately alkaline; clear wavy boundary.

C2ca—19 to 23 inches; light brown (7.5YR 6/4) very channery sandy loam, dark brown (7.5YR 4/4) moist; massive; soft, very friable; 40 percent coarse channery fragments; calcium carbonate accumulations on undersides of channery fragments; calcareous; moderately alkaline; clear wavy boundary.

C3—23 to 60 inches; pink (7.5YR 7/4) very cobbly sandy loam, brown (7.5YR 5/4) moist; massive; soft, very friable; 55 percent cobbles and channery fragments; calcareous; moderately alkaline.

The A horizon has hue of 5YR or 7.5YR, value of 4 or 5 dry and 3 or 4 moist, and chroma of 2 or 3. The C horizon has hue of 5YR or 7.5YR.

Cimarron series

The Cimarron series consists of deep, well drained soils that formed in alluvium derived from basalt. Cimarron soils are on uplands. Slopes are 2 to 12 percent. The average annual precipitation is about 18 inches, and the average annual air temperature is 39 degrees F.

Cimarron soils are similar to Jerry and Inchau soils. Jerry soils are calcareous and have secondary calcium carbonate accumulations in the lower part of the solum. Inchau soils are less than 35 percent clay in the control section.

Typical pedon of Cimarron loam, 2 to 12 percent slopes, about 720 feet east and 2,340 feet north of the southwest corner of section 8, T. 7 S., R. 93 W.:

A1—0 to 4 inches; dark grayish brown (10YR 4/2) loam, very dark brown (10YR 2/2) moist; moderate fine subangular blocky structure parting to strong fine granular; slightly hard, friable, slightly sticky and slightly plastic; mildly alkaline; clear smooth boundary.

B1—4 to 9 inches; dark grayish brown (10YR 4/2) silty clay loam, very dark grayish brown (10YR 3/2) moist; strong medium subangular blocky structure parting to strong very fine angular blocky; hard, friable, sticky and plastic; mildly alkaline; clear wavy boundary.

B21t—9 to 16 inches; grayish brown (10YR 5/2) silty clay loam, very dark grayish brown (10YR 3/2) moist; weak medium prismatic structure parting to strong fine angular blocky; hard, friable, very sticky and very plastic; many moderately thick clay films on peds; mildly alkaline; clear wavy boundary.

B22t—16 to 33 inches; grayish brown (10YR 5/2) silty clay, very dark grayish brown (10YR 3/2) moist; strong coarse prismatic blocky structure parting to strong medium angular blocky; very hard, firm, very sticky and very plastic; many moderately thick clay films on peds; mildly alkaline; clear wavy boundary.

C—33 to 60 inches; dark gray (10YR 4/1) silty clay, very dark gray (10YR 3/1) moist; moderate coarse prismatic blocky structure parting to moderate medium angular blocky; very hard, firm, very sticky and very plastic; mildly alkaline.

The A horizon has hue of 2.5Y or 10YR, value of 4 or 5 dry and 2 or 3 moist, and chroma of 1 or 2. The B horizon has hue of 2.5Y or 10YR, value of 5 or 6 dry and 3 or 4 moist, and chroma of 2 or 3. When dry, cracks 0.4 inch or more wide form between peds throughout the B horizon. The C horizon has hue of 2.5Y or 10YR, value of 4 to 6 dry and 3 to 5 moist, and chroma of 1 or 2. When dry, cracks form between peds in the upper part of this horizon in places.

Cochetopa series

The Cochetopa series consists of deep, well drained soils that formed in alluvium and residuum derived from basalt. Cochetopa soils are on mountainsides and alluvial fans. Slopes are 9 to 50 percent. The average

annual precipitation is about 18 inches, and the average annual air temperature is 40 degrees F.

The Cochetopa soils are similar to Jerry and Lamphier soils. Jerry soils do not have a mollic epipedon that extends to below a depth of 16 inches. Lamphier soils have less than 35 percent clay in the control section and do not have an argillic horizon.

Typical pedon of Cochetopa loam, 9 to 50 percent slopes, about 300 feet east and 800 feet north of the center of section 36, T. 7 S., R. 95 W.:

O1—4 inches to 0; grass, leaves, and twigs in various stages of decomposition.

A1—0 to 18 inches; dark grayish brown (10YR 4/2) loam, very dark brown (10YR 2/2) moist; moderate medium subangular blocky structure parting to moderate fine granular; slightly hard, very friable, nonsticky and nonplastic; neutral; clear wavy boundary.

A3—18 to 21 inches; grayish brown (10YR 5/2) loam, very dark grayish brown (10YR 3/2) moist; moderate medium subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; 5 percent stones; neutral; clear wavy boundary.

B21t—21 to 30 inches; brown (7.5YR 5/2) stony clay loam, dark brown (7.5YR 4/2) moist; moderate medium and fine subangular blocky structure; hard, friable, sticky and plastic; 15 percent stones; many moderately thick clay films on peds; neutral; clear wavy boundary.

B22t—30 to 45 inches; brown (7.5YR 5/2) stony clay, dark brown (7.5YR 4/2) moist; strong medium and fine subangular blocky structure; hard, firm, sticky and plastic; 15 percent stones; many moderately thick clay films on peds; neutral; clear wavy boundary.

C—45 to 60 inches; pinkish gray (7.5YR 6/2) stony light clay, brown (7.5YR 5/2) moist; massive; hard, firm, sticky and plastic; 25 percent stones; neutral.

The mollic epipedon ranges from 17 to 28 inches in thickness. Content of coarse fragments ranges from 0 to 30 percent, by volume. The fragments are mainly more than 10 inches in diameter. The A horizon has hue of 10YR or 7.5YR, value of 4 or 5 dry and 2 or 3 moist, and chroma of 1 to 3. The B horizon has hue of 10YR or 7.5YR, value of 4 to 6 dry and 2 to 5 moist, and chroma of 1 to 4. The C horizon has hue of 10YR or 7.5YR.

Cushman series

The Cushman series consists of moderately deep and well drained soils that formed in calcareous residuum from shale and sandstone. Cushman soils are on side slopes and mesa breaks. Slopes are 15 to 65 percent. The average annual precipitation is about 13 inches, and the average annual air temperature is about 48 degrees F.

Cushman soils are similar to Olney and Potts soils. Olney and Potts soils are deep.

Typical pedon of Cushman stony loam, 15 to 65 percent slopes, about 2,565 feet south and 45 feet west of the northwest corner of section 6, T. 5 S., R. 92 W.:

A1—0 to 3 inches; grayish brown (10YR 5/2) stony loam, very dark grayish brown (10YR 3/2) moist; weak medium granular structure; soft, very friable; mildly alkaline; clear wavy boundary.

B2t—3 to 6 inches; dark grayish brown (10YR 4/2) sandy clay loam, very dark grayish brown (10YR 3/2) moist; weak medium subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; few thin clay films on peds; mildly alkaline; clear wavy boundary.

B3ca—6 to 11 inches; grayish brown (10YR 5/2) loam, dark grayish brown (10YR 4/3) moist; weak fine subangular blocky structure; slightly hard, very friable, nonsticky and nonplastic; few thin clay films on peds; calcium carbonate accumulations as concretions and seams; calcareous; moderately alkaline; clear wavy boundary.

C1ca—11 to 17 inches; light brownish gray (10YR 6/2) loam, grayish brown (10YR 5/2) moist; weak coarse subangular blocky structure; slightly hard, friable, nonsticky and nonplastic; segregated lime as concretions and on gravel; calcareous; moderately alkaline; 10 percent gravel; clear wavy boundary.

C2ca—17 to 32 inches; light brownish gray (2.5Y 6/2) very gravelly loam, grayish brown (2.5Y 5/2) moist; massive; slightly hard, friable, nonsticky and nonplastic; 55 percent gravel; calcium carbonate as coatings on gravel and as small soft concretions; calcareous; moderately alkaline.

Cr—32 to 60 inches; weathered calcareous shale and sandstone; semiconsolidated.

Depth to bedrock ranges from 20 to 40 inches. The soil is usually leached to a depth of 6 to 10 inches.

Hue is 10YR or 2.5Y. The C horizon generally has hue of 2.5Y.

Dateman series

The Dateman series consists of moderately deep, well drained soils that formed in residuum from sandstone and limestone. Dateman soils are on side slopes. Slopes are 30 to 50 percent. The average annual precipitation is about 18 inches, and the average annual air temperature is about 40 degrees F.

Dateman soils are similar to Cochetopa and Farlow soils. Cochetopa soils are deep, have an argillic horizon, and contain more than 35 percent clay and less than 35 percent coarse fragments in the control section. Farlow soils do not have a mollic epipedon that extends to a depth of 16 inches and are deep.

Typical pedon of Dateman gravelly loam, 30 to 50 percent slopes, about 2,310 feet east and 375 feet south of the northeast corner of section 21, T. 5 S., R. 89 W.:

A11—0 to 3 inches; very dark grayish brown (10YR 3/2) gravelly loam, very dark brown (10YR 2/2) moist; weak fine granular; loose, very friable; 20 percent gravel; neutral; clear wavy boundary.

A12—3 to 16 inches; very dark grayish brown (10YR 3/2) gravelly sandy loam, very dark brown (10YR 2/2) moist; weak fine granular structure; slightly hard, friable; 25 percent gravel; neutral; clear wavy boundary.

B2—16 to 22 inches; brown (10YR 4/3) gravelly sandy clay loam, dark brown (10YR 3/3) moist; weak fine subangular blocky structure; slightly hard, friable, slightly sticky and nonplastic; 25 percent gravel; gradual wavy boundary.

C—22 to 34 inches; dark yellowish brown (10YR 4/4) very gravelly sandy loam, brown (10YR 4/3) moist; massive; slightly hard, friable; 50 percent gravel; neutral; gradual wavy boundary.

R—34 to 60 inches; consolidated sandstone and limestone.

The mollic epipedon is 16 to 24 inches thick. Depth to bedrock ranges from 20 to 40 inches. Hue is 7.5YR or 10YR. This soil is leached in most places. The C1 horizon is calcareous in places.

Detra series

The Detra series consists of deep, well drained soils that formed in residuum from red-bed shale and sandstone. Detra soils are on mountainsides. Slopes are 12 to 25 percent. The average annual precipitation is about 16 inches, and the average annual air temperature is about 44 degrees F.

Detra soils are similar to Villa Grove and Zoltay soils. Villa Grove soils have a mollic epipedon less than 16 inches thick. Zoltay soils have more than 35 percent clay in the control section.

Typical pedon of Detra fine sandy loam, 12 to 25 percent slopes, about 660 feet north and 200 feet east of the southwest corner of section 13, T. 6 S., R. 89 W.:

A11—0 to 7 inches; brown (7.5YR 4/2) fine sandy loam, dark brown (7.5YR 3/2) moist; weak fine granular structure; soft, very friable; neutral; clear smooth boundary.

A12—7 to 12 inches; brown (7.5YR 4/2) sandy loam, dark brown (7.5YR 3/2) moist; strong fine subangular blocky structure parting to moderate fine granular; slightly hard, friable; neutral; clear wavy boundary.

B21t—12 to 20 inches; reddish brown (5YR 4/3) sandy clay loam, dark reddish brown (5YR 3/3) moist; moderate medium subangular blocky structure; very hard, firm, slightly sticky and slightly plastic; thin nearly continuous clay films on peds; neutral; clear wavy boundary.

B22t—20 to 33 inches; yellowish red (5YR 4/6) sandy clay loam, dark reddish brown (5YR 3/4) moist; strong medium subangular blocky structure; very hard, firm, slightly sticky and slightly plastic; thin nearly continuous clay films on peds; neutral; clear smooth boundary.

C—33 to 57 inches; yellowish red (5YR 5/6) sandy clay loam, yellowish red (5YR 4/6) moist; massive; hard, friable, slightly sticky and slightly plastic; soft lime concretions on peds; calcareous; moderately alkaline; clear wavy boundary.

R—57 inches; weathered calcareous red-bed sandstone and shale.

The mollic epipedon ranges from 16 to 30 inches in thickness. Depth to bedrock ranges from 40 to 60 inches.

The A horizon ranges from 10YR to 7.5YR, value of 3 or 4 dry and 2 or 3 moist, and chroma of 1 to 3. The B horizon has hue of 7.5YR or 5YR, value of 4 or 5 dry and 3 or 4 moist, and chroma of 2 to 6. The C horizon has hue of 7.5YR or 5YR. This horizon is generally calcareous and is moderately alkaline or mildly alkaline.

Dollard series

The Dollard series consists of moderately deep, well drained soils that formed in shale residuum. Dollard soils are on hills and mountainsides. Slopes are 25 to 50 percent. The average annual precipitation is about 16 inches, and the average annual air temperature is about 43 degrees F.

Dollard soils are similar to Limon soils. Limon soils are warmer and are deep.

Typical pedon of Dollard clay, 25 to 50 percent slopes, about 2,500 feet west of the east quarter-corner of section 16, T. 5 S., R. 91 W.:

A1—0 to 5 inches; light brownish gray (2.5Y 6/2) clay, dark grayish brown (2.5Y 4/2) moist; weak medium platy structure parting to weak medium granular; hard, firm, sticky and plastic; calcareous; moderately alkaline; clear smooth boundary.

AC—5 to 12 inches; light gray (2.5Y 7/2) clay, grayish brown (2.5Y 5/2) moist; moderate medium subangular blocky structure parting to moderate fine subangular blocky; hard, very firm, sticky and plastic; calcareous; moderately alkaline; clear wavy boundary.

Cca—12 to 25 inches; light gray (2.5Y 7/2) shaly clay, grayish brown (2.5Y 5/2) moist; massive; hard, firm, sticky and plastic; 30 percent soft weathered shale fragments; calcium carbonate accumulations as

seams and as powdery masses on peds; calcareous; moderately alkaline; clear wavy boundary.
Cr—25 to 40 inches; weathered calcareous clay shale.

Depth to the paralithic contact ranges from 20 to 40 inches. Content of shale chips is generally less than 15 percent in the A horizon and is as much as 35 percent in the C horizon. Reaction ranges from mildly alkaline to strongly alkaline.

The A horizon has hue of 5Y to 10YR, value of 5 to 7 dry and 4 to 6 moist, and chroma of 2 or 3. The C horizon has hue of 5Y to 10YR.

Etoe series

The Etoe series consists of deep, well drained soils that formed in residuum from sandstone and shale. Etoe soils are on mountainsides. Slopes are 15 to 50 percent. The average annual precipitation is about 20 inches, and the average annual air temperature is about 38 degrees F.

Etoe soils are similar to Northwater soils. Northwater soils have a mollic epipedon more than 25 inches thick and do not have an A2 horizon.

Typical pedon of Etoe loam, 15 to 50 percent slopes, about 600 feet south and 200 feet west of section 22, T. 7 S., R. 90 W.:

O1—1 inch to 0; grasses, leaves, and twigs in various states of decomposition.
A21—0 to 8 inches; pinkish gray (7.5YR 6/2) loam, brown (7.5YR 4/2) moist; weak fine granular structure; soft, very friable; 10 percent gravel; slightly acid; clear wavy boundary.
A22—8 to 15 inches; light brownish gray (10YR 6/2) loam, brown (10YR 4/3) moist; weak, fine subangular blocky structure parting to weak fine granular; soft, very friable; 15 percent gravel; slightly acid; clear wavy boundary.
A&B—15 to 24 inches; (A) light brownish gray (10YR 6/2) extremely cobbly sandy loam, brown (10YR 5/3) moist; (B) brown (10YR 5/3) extremely cobbly heavy sandy loam, dark brown (10YR 4/3) moist; weak medium subangular blocky structure; slightly hard, very friable; 65 percent cobbles; slightly acid; clear wavy boundary.
B&A—24 to 35 inches; (B) brown (10YR 5/3) extremely cobbly light sandy clay loam, dark brown (10YR 4/3) moist; (A) light brownish gray (10YR 6/2) extremely cobbly sandy loam, brown (10YR 5/3) moist; weak medium subangular blocky structure; slightly hard, very friable; 65 percent cobbles; slightly acid; clear wavy boundary.
B2t—35 to 60 inches; brown (7.5YR 5/4) extremely stony sandy clay loam, dark brown (7.5YR 4/4) moist; moderate medium subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; 70 percent stones; thin nearly continuous clay films on sides of coarse fragments; slightly acid.

An A1 horizon is intermittent. Depth to the argillic horizon ranges from 30 to 40 inches.

The A horizon has hue of 7.5YR or 10YR, value of 6 or 7 dry and 3 or 4 moist, and chroma of 2 or 3. The mixed horizons have hue of 10YR or 7.5YR, value of 5 or 6 dry and 4 or 5 moist, and chroma of 3 to 6. The B horizon has hue of 7.5YR, value of 4 or 5 dry and moist, and chroma of 4 to 6.

Farlow series

The Farlow series consists of deep, well drained soils that formed in residuum from limestone. Farlow soils are on mountainsides. Slopes are 25 to 50 percent. The average annual precipitation is about 19 inches, and the average annual air temperature is about 38 degrees F.

Farlow soils are similar to Bucklon and Parachute soils. Bucklon soils are shallow. Parachute soils are moderately deep and noncalcareous.

Typical pedon of Farlow channery loam, 25 to 50 percent slopes, about 100 feet west and 175 feet south of the center of section 12, T. 5 S., R. 89 W.:

A1—0 to 10 inches; dark grayish brown (10YR 4/2) channery loam, very dark grayish brown (10YR 3/2) weak fine granular structure; soft, very friable; 15 percent channery fragments; calcareous; mildly alkaline; clear wavy boundary.
AC—10 to 24 inches; brown (10YR 4/3) very channery loam, dark grayish brown (10YR 4/2) moist; weak fine subangular blocky structure; slightly hard, friable; 40 percent channery fragments; calcareous; moderately alkaline; clear wavy boundary.
C1ca—24 to 35 inches; light gray (10YR 6/1) very channery loam, brown (10YR 5/3) moist; weak fine subangular blocky structure; slightly hard, very friable; 60 percent channery fragments; lime coatings on some of the channery fragments; calcareous; moderately alkaline; clear wavy boundary.
C2—35 to 42 inches; pale brown (10YR 6/3) extremely flaggy loam, light brownish gray (10YR 6/2) moist; weak fine subangular blocky structure; slightly hard, friable; 80 percent flagstones; calcareous; moderately alkaline; gradual wavy boundary.
R—42 inches; weathered limestone.

Depth to bedrock is 40 to 60 inches. The mollic epipedon is 8 to 12 inches thick.

The A horizon has hue of 2.5Y or 10YR, value of 4 or 5 dry and 2 or 3 moist, and chroma of 2 or 3. The C horizon has hue of 2.5Y or 10YR.

Heldt series

The Heldt series consists of deep, well drained soils that formed in alluvium. Heldt soils are on alluvial fans. Slopes are 1 to 25 percent. The average annual precipitation is about 14 inches, and the average annual air temperature is about 48 degrees F.

Heldt soils are similar to Limon soils. Limon soils do not have a B2 horizon.

Typical pedon of Heldt clay loam, 6 to 12 percent slopes, about 1,000 feet east and 1,000 feet north of the southwest corner of section 32, T. 5 S., R. 90 W.:

A1—0 to 8 inches; grayish brown (2.5Y 5/2) clay loam, dark grayish brown (2.5Y 4/2) moist; moderate medium granular structure; hard, firm, sticky and plastic; calcareous; mildly alkaline; clear smooth boundary.

B2—8 to 21 inches; light brownish gray (2.5Y 6/2) heavy clay loam, grayish brown (2.5Y 5/2) moist; weak medium prismatic structure parting to moderate medium angular blocky; very hard, very firm, very sticky and very plastic; few glossy patches on peds and in root channels; common shiny slickensides; calcareous; moderately alkaline; clear smooth boundary.

C1—21 to 30 inches; light gray (2.5Y 7/2) clay, grayish brown (2.5Y 5/2) moist; weak coarse angular blocky structure; very hard, very firm, very sticky and very plastic; calcareous; moderately alkaline; clear smooth boundary.

C2ca—30 to 39 inches; light gray (2.5Y 7/2) clay, grayish brown (2.5Y 5/2) moist; massive; very hard, very firm, very sticky and very plastic; calcium carbonate accumulations as lime concretions and seams; calcareous; moderately alkaline; clear smooth boundary.

C3—39 to 60 inches; light gray (2.5Y 7/2) clay, grayish brown (2.5Y 5/2) moist; massive; very hard, very firm, very sticky and very plastic; calcareous; moderately alkaline.

When dry, the soil cracks. The cracks are normally 3 to 5 feet apart on the surface, 0.5 to 1 inch wide at the surface, and 1 to 2 feet deep.

The A horizon has hue of 2.5Y or 10YR, value of 5 to 7 dry and 3 to 5 moist, and chroma of 2 or 3. The B horizon has hue of 2.5Y or 10YR, value of 5 or 6 dry and 4 or 5 moist, and chroma of 2 or 3. The C horizon has hue of 2.5Y or 10YR, value of 6 or 7 dry and 5 or 6 moist, and chroma of 2 or 3.

Holderness Variant

The Holderness Variant consists of deep, well drained soils that formed in alluvium derived from shale and sandstone. Holderness Variant soils are on fans and valley sides. Slopes are 6 to 25 percent. The average annual precipitation is about 17 inches, and the average annual temperature is about 44 degrees F.

Holderness Variant soils are similar to Morval and Tanna soils. Morval soils have less than 35 percent clay in the solum. Tanna soils have a paralithic contact above a depth of 40 inches.

Typical pedon of Holderness Variant clay loam, 6 to 25 percent slopes, about 1,320 feet south of the northeast corner of section 7, T. 5 S., R. 91 W.:

A11—0 to 2 inches; grayish brown (10YR 5/2) clay loam, very dark grayish brown (10YR 3/2) moist; weak medium granular structure; slightly hard, friable, slightly sticky and slightly plastic; calcareous; moderately alkaline; clear smooth boundary.

A12—2 to 11 inches; grayish brown (10YR 5/2) clay loam, very dark grayish brown (10YR 3/2) moist; moderate medium granular structure; hard, firm, sticky and plastic; calcareous; moderately alkaline; clear smooth boundary.

B21—11 to 20 inches; grayish brown (10YR 5/2) clay, dark grayish brown (10YR 4/2) moist; weak medium prismatic structure parting to weak fine angular blocky; hard, firm, sticky and plastic; few glossy patches on peds and in root channels; calcareous; moderately alkaline; clear smooth boundary.

B22—20 to 30 inches; light brownish gray (10YR 6/2) clay, dark grayish brown (10YR 4/3) moist; weak medium prismatic structure parting to moderate medium angular blocky; very hard, very firm, very sticky and very plastic; common slickensides and glossy patches on ped faces; calcareous; moderately alkaline; clear smooth boundary.

B3—30 to 52 inches; light brownish gray (10YR 6/2) clay loam, dark grayish brown (10YR 4/2) moist; weak fine angular blocky structure; very hard, firm, sticky and plastic; calcareous; moderately alkaline; gradual smooth boundary.

Cca—52 to 60 inches; light brownish gray (10YR 6/2) clay loam, dark grayish brown (10YR 4/2) moist; massive; hard, firm, sticky and plastic; visible secondary accumulations of carbonates as seams and mycelia; calcareous; moderately alkaline.

This soil is a variant of the Holderness series because it is calcareous to the surface, has a Cca horizon that extends to below a depth of 40 inches, and does not have an argillic horizon.

The mollic epipedon ranges from 8 to 14 inches in thickness.

The A horizon has hue of 10YR or 2.5Y, value of 4 or 5 dry and 2 or 3 moist, and chroma of 2 or 3. The B horizon has hue of 10YR or 2.5Y, value of 5 or 6 dry and 4 or 5 moist, and chroma of 2 or 3. The C horizon has hue of 10YR or 2.5Y.

Ildefonso series

The Ildefonso series consists of deep, well drained soils that formed in basaltic alluvium and eolian material. Ildefonso soils are on valley sides, hilly mesas, and benches. Slopes are 6 to 45 percent. The average annual precipitation is about 14 inches, and the average annual air temperature is about 46 degrees F.

Ildefonso soils are similar to Tridell and Begay soils. Tridell soils are at higher elevations and have a frigid temperature regime. Begay soils do not have a Cca horizon, have less than 35 percent coarse fragments in the control section, and have a cambic horizon.

Typical pedon of Ildefonso stony loam, 6 to 25 percent slopes, about 2,490 feet east and 300 feet north of the southwest corner of section 35, T. 7 S., R. 96 W.:

A1—0 to 2 inches; brown (10YR 5/3) stony loam, dark brown (7.5YR 3/2) moist; weak very fine to medium granular structure; soft, friable; 20 percent rock fragments (10 percent stones, 5 percent cobbles, and 5 percent gravel); calcareous; mildly alkaline; clear smooth boundary.

AC—2 to 8 inches; brown (10YR 5/3) stony loam, dark brown (10YR 4/3) moist; moderate medium subangular blocky structure; slightly hard, friable; 20 percent rock fragments (10 percent stones, 5 percent cobbles, and 5 percent gravel); calcareous; moderately alkaline; clear smooth boundary.

C1ca—8 to 15 inches; white (10YR 8/2) very stony loam, light gray (10YR 7/2) moist; moderate coarse subangular blocky structure; slightly hard, friable; 35 percent rock fragments (20 percent stones, 10 percent cobbles, and 5 percent gravel); visible secondary calcium carbonate as disseminated lime, lime nodules, and crusts on bottom of stones; calcareous; moderately alkaline; gradual smooth boundary.

C2ca—15 to 60 inches; white (10YR 8/2) very stony loam, light gray (10YR 7/2) moist; massive; slightly hard, friable; 50 percent rock fragments (30 percent stones, 10 percent cobbles, and 10 percent gravel); calcium carbonate accumulations as disseminated lime, lime nodules, and crusts on bottom of rock fragments; calcareous; moderately alkaline.

Cobbles and gravel cover 10 to 20 percent of the surface, and stones cover 5 to 10 percent.

The A horizon has hue of 10YR or 7.5YR, value of 5 or 6 dry and 3 or 4 moist, and chroma of 2 or 3. The A horizon contains 15 to 30 percent rock fragments, of which more than one-half, by volume, is stones. The C horizon has hue of 10YR or 7.5YR, value of 7 or 8 dry and 6 or 7 moist, and chroma of 1 to 3 dry and 1 to 4 moist. The C horizon contains 35 to 60 percent rock fragments. The content of stones increases with depth. Small lime nodules are common in the Cca horizon.

Inchau series

The Inchau series consists of moderately deep, well drained soils that formed in residuum from shale and sandstone. Inchau soils are on moderately sloping to very steep ridges and mountainsides. Slopes are 25 to 40 percent. The average annual precipitation is 18 inches, and the average annual air temperature is about 40 degrees F.

Inchau soils are similar to Jerry and Dateman soils. Jerry soils contain more than 35 percent clay in the control section. Dateman soils have a mollic epipedon more than 17 inches thick and contain more than 35 percent stones in the control section.

Typical pedon of Inchau loam, 25 to 40 percent slopes, located along the Battlement Creek access road, about 1,000 feet south and 200 feet west of the northeast corner of section 26, T. 7 S., R. 95 W.:

O1—1 inch to 0; leaves, twigs, and decomposed grasses.

A1—0 to 3 inches; grayish brown (10YR 5/2) loam, very dark brown (10YR 2/2) moist; weak thin platy structure parting to moderate fine granular; soft, very friable, neutral; clear smooth boundary.

B1—3 to 11 inches; dark grayish brown (10YR 4/2) light clay loam, very dark brown (10YR 2/2) moist; moderate fine and medium subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; few thin patchy clay films on peds; neutral; clear smooth boundary.

B2t—11 to 18 inches; yellowish brown (10YR 5/4) clay loam, dark yellowish brown (10YR 4/4) moist; moderate medium subangular blocky structure; hard, friable, sticky and plastic; thin, nearly continuous clay films; 10 percent shale fragments; neutral; clear wavy boundary.

B3—18 to 36 inches; yellowish brown (10YR 5/4) gravelly clay loam, dark yellowish brown (10YR 4/4) moist; weak medium subangular blocky structure; hard, friable, sticky and plastic; few thin patchy clay films; 20 percent small shale fragments; neutral; clear wavy boundary.

Cr—36 inches; weathered sandstone and shale.

The mollic epipedon generally ranges from 8 to 14 inches in thickness. Depth to paralithic contact ranges from 21 to 38 inches. These soils are generally leached throughout.

The A horizon has hue of 2.5Y to 7.5YR, value of 4 or 5 dry and 2 or 3 moist, and chroma of 2 or 3. The B2 horizon has hue of 7.5YR or 10YR, value of 5 or 6 dry and 4 or 5 moist, and chroma of 2 to 5.

Irigul series

The Irigul series consists of shallow, well drained soils that formed in residuum from sandstone and marlstone. Irigul soils are on upland ridges and mountainsides. Slopes are 9 to 75 percent. The average annual precipitation is about 20 inches, and the average annual air temperature is about 40 degrees F.

Irigul soils are similar to Parachute and Starman soils and are near Rhone, Northwater, Parachute, and Starman soils. Parachute soils are 30 to 40 inches deep over bedrock. Starman soils have a lighter colored surface layer.

Typical pedon of Irigul channery loam, 9 to 50 percent slopes, about 1,500 feet north and 850 feet east of the southwest corner of section 13, T. 5 S., R. 96 W.:

A1—0 to 6 inches; grayish brown (10YR 5/2) channery loam, dark brown (10YR 3/3) moist; weak medium platy structure parting to moderate fine granular; slightly hard, very friable, slightly sticky and slightly plastic; 20 percent channery rock fragments; neutral; clear wavy boundary.

C—6 to 17 inches; yellowish brown (10YR 5/4) extremely channery sandy clay loam, dark yellowish brown (10YR 4/4) moist; weak medium and fine subangular blocky structure; slightly hard, friable, sticky and plastic; 70 percent channery rock fragments; mildly alkaline; clear wavy boundary.

R—17 to 40 inches; hard fractured sandstone.

Depth to bedrock ranges from 10 to 20 inches. Channery fragments make up 15 to 35 percent of the surface layer and as much as 85 percent or more of the underlying material. Reaction is slightly acid to moderately alkaline.

The A horizon has hue of 2.5Y or 10YR, value of 4 or 5 dry and 2 or 3 moist, and chroma of 2 or 3. The C horizon has hue of 2.5Y or 10YR.

Jerry series

The Jerry series consists of deep, well drained soils that formed in alluvium derived from sandstone and shale. Jerry soils are on mountainsides. Slopes are 12 to 50 percent. The average annual precipitation is about 18 inches, and the average annual temperature is about 40 degrees F.

Jerry soils are similar to Inchau and Rhone soils. Inchau soils have less than 35 percent clay in the solum. Rhone soils have less than 35 percent clay in the solum and have a mollic epipedon more than 17 inches thick.

Typical pedon of Jerry loam, 12 to 50 percent slopes, about 450 feet south and 800 feet west of the northeast corner of section 17, T. 5 S., R. 89 W.:

O1—1 inch to 0; grass, leaves, and twigs in various stages of decomposition.

A11—0 to 3 inches; dark grayish brown (10YR 4/2) loam, very dark grayish brown (10YR 3/2) moist; weak fine granular blocky structure; soft, very friable; neutral; gradual smooth boundary.

B1—3 to 10 inches; dark grayish brown (10YR 4/2) clay loam, very dark grayish brown (10YR 3/2) moist; moderate fine granular structure; slightly hard, friable; slightly sticky and slightly plastic; 5 percent gravel; mildly alkaline; abrupt wavy boundary.

B2t—10 to 18 inches; yellowish brown (10YR 5/4) cobbly heavy clay loam, dark yellowish brown (10YR 4/4) moist; strong medium subangular blocky structure; very hard, firm, sticky and plastic; 15 percent cobbles, 5 percent gravel; thick nearly continuous clay films on peds; mildly alkaline; gradual wavy boundary.

B3ca—18 to 40 inches; light brown (7.5YR 6/4) cobbly clay loam, brown (7.5YR 4/4) moist; moderate medium subangular blocky structure; very hard, firm, sticky and plastic; few thin patchy clay films on ped faces; 20 percent cobbles, 5 percent gravel; visible calcium carbonate accumulations as concretions and seams; calcareous; moderately alkaline; gradual wavy boundary.

Cca—40 to 60 inches; light brown (7.5YR 6/4) cobbly clay, brown (7.5YR 5/4) moist; massive; very hard, firm, very sticky and very plastic; 30 percent cobbles; secondary calcium carbonate deposits as thin streaks and small soft concretions; calcareous; moderately alkaline.

The mollic epipedon ranges from 9 to 15 inches in thickness. Depth to calcareous material ranges from 17 to 30 inches.

The A horizon has hue of 2.5Y to 7.5YR, value of 4 or 5 dry and 2 or 3 moist, and chroma of 1 or 2. It is loam or stony loam. The B horizon has hue of 10YR or 7.5YR, value of 5 or 6 dry and 3 to 5 moist, and chroma of 3 or 4. Texture ranges from cobbly clay loam to cobbly clay.

Kim series

The Kim series consists of deep, well drained soils that formed in colluvial alluvial outwash from mixed shale and sandstone. Kim soils are on sloping terraces. Slopes are 3 to 12 percent. The average annual precipitation is 12 inches, and the average annual air temperature is 46 degrees F.

Kim soils are similar to Nihill and Chilton soils. Nihill and Chilton soils have more than 35 percent rock fragments in the control section.

Typical pedon of Kim loam, 3 to 12 percent slopes, about 150 feet west and 150 feet south of the northeast corner of section 36, T. 5 S., R. 92 W.:

Ap—0 to 7 inches; yellowish brown (10YR 5/4) loam, dark yellowish brown (10YR 3/4) moist; weak fine platy structure; soft, very friable; calcareous; mildly alkaline; gradual wavy boundary.
A12—7 to 17 inches; light yellowish brown (10YR 6/4) loam, dark yellowish brown (10YR 3/4) moist; weak very fine granular structure; soft, friable, slightly sticky and slightly plastic; calcareous; moderately alkaline; clear wavy boundary.
AC—17 to 26 inches; light brownish gray (10YR 6/2) loam, dark grayish brown (10YR 5/2) moist; weak medium subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; calcareous; moderately alkaline; clear wavy boundary.
C1—26 to 36 inches; light brownish gray (10YR 6/2) loam, grayish brown (10YR 5/3) moist; weak fine subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; 10 percent cobbles and sandstone fragments; calcareous; moderately alkaline; clear wavy boundary.
C2—36 to 60 inches; light brownish gray (10YR 6/2) loam, grayish brown (10YR 5/2) moist; massive; slightly hard, friable; 10 percent cobbles and sandstone fragments; calcareous; moderately alkaline.

The A horizon has hue of 10YR or 7.5YR, value of 5 to 6 dry and 3 to 5 moist, and chroma of 2 to 4. The C horizon has hue of 10YR or 7.5YR, value of 5 to 7 dry and 4 to 6 moist, and chroma of 2 to 4. Some visible lime concretions are found intermittently throughout this horizon in many places.

Lamphier series

The Lamphier series consists of deep, well drained soils that formed in residuum from sandstone and shale. Lamphier soils are on fans and mountainsides. Slopes are 15 to 50 percent. The average annual precipitation is 20 inches, and the average annual air temperature is 40 degrees F.

Lamphier soils are similar to Dateman and Detra soils. Dateman soils contain more than 35 percent coarse fragments in the solum. Detra soils have a frigid temperature regime.

Typical pedon of Lamphier loam, 15 to 50 percent slopes, about 2,500 feet north and 1,000 feet east of the southwest corner of section 21, T. 5 S., R. 89 W.:

O1—1 inch to 0; grasses, leaves, and twigs in various stages of decomposition.
A11—0 to 4 inches; dark reddish brown (5YR 3/2) loam, dark reddish brown (5YR 2/2) moist; weak fine granular structure; soft, very friable, slightly sticky and slightly plastic; slightly acid; gradual smooth boundary.
A12—4 to 12 inches; dark reddish brown (5YR 3/2) loam, dark reddish brown (5YR 2/2) moist; weak fine subangular blocky structure; soft, very friable, slightly sticky and slightly plastic; 5 to 10 percent gravel; neutral; clear wavy boundary.
AC—12 to 30 inches; dark reddish brown (5YR 3/2) loam, dark reddish brown (5YR 2/2) moist; moderate medium subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; 10 percent gravel; neutral; clear smooth boundary.
C2—30 to 45 inches; dark reddish brown (5YR 4/2) loam, dark reddish brown (5YR 3/2) moist; weak medium subangular blocky structure; slightly hard, very friable, slightly sticky and slightly plastic; 10 percent gravel; neutral; gradual smooth boundary.
C3—45 to 60 inches; reddish brown (5YR 4/2) loam, dark reddish brown (5YR 3/2) moist; massive; slightly hard, very friable, slightly sticky and slightly plastic; 15 percent gravel; neutral.

The mollic epipedon ranges from 16 to more than 40 inches in thickness.

This soil has hue of 5YR or 7.5YR, value of 3 to 5 dry and 2 or 3 moist, and chroma of 2 or 3.

Lazear series

The Lazear series consists of shallow, well drained soils that formed in residuum from sandstone and shale. Lazear soils are on moderately sloping to very steep hillsides and mesa breaks. Slopes are 6 to 65 percent. The average annual precipitation is 12 inches, and the average annual air temperature is 48 degrees F.

Lazear soils are similar to Chilton and Nihill soils. Chilton and Nihill soils contain more than 35 percent coarse fragments in the control section and are deep.

Typical pedon of Lazear gravelly loam, 6 to 65 percent slopes, about 1,640 feet east of the center of section 25, T. 6 S., R. 92 W.:

A1—0 to 4 inches; grayish brown (10YR 5/2) gravelly loam, dark grayish brown (10YR 4/2) moist; moderate fine granular structure; soft, friable; 20 percent gravel, 5 percent cobbles; calcareous; strongly alkaline; clear smooth boundary.
C—4 to 16 inches; light brownish gray (10YR 6/2) cobbly loam, dark grayish brown (10YR 4/2) moist; massive; slightly hard, friable; 20 percent cobbles, 10 percent gravel; calcareous; strongly alkaline; abrupt wavy boundary.
R—16 inches; calcareous shale and sandstone bedrock.

The A horizon has hue of 7.5YR or 10YR, value of 5 or 6 dry and 4 or 5 moist, and chroma of 2 or 3. It ranges from gravelly loam to stony loam. The C horizon has hue of 7.5YR or 10YR, value of 6 or 7 dry and 4 or 5 moist, and chroma of 2 or 3. In places, lime forms small concretions and filaments in the C horizon.

Limon series

The Limon series consists of deep, well drained soils that formed in alluvium derived from shale. Limon soils are on alluvial fans. Slopes are 3 to 12 percent. The average annual precipitation is about 14 inches, and the average annual air temperature is about 48 degrees F.

Limon soils are similar to the Dollard and Heldt soils. Dollard soils have a frigid temperature regime. Heldt soils have an argillic horizon.

Typical pedon of Limon silty clay loam, 3 to 12 percent slopes, 2,900 feet west and 550 feet south of the northeast corner of section 10, T. 5 S., R. 92 W.:

A1—0 to 5 inches; light brownish gray (2.5Y 6/2) light silty clay loam, dark grayish brown (2.5Y 4/2) moist; weak fine granular structure; slightly hard, friable, slightly sticky and slightly plastic; calcareous; moderately alkaline; clear smooth boundary.

AC—5 to 11 inches; light brownish gray (2.5Y 6/2) heavy silty clay loam, dark grayish brown (2.5Y 4/2) moist; weak medium subangular blocky structure parting to weak fine granular; hard, friable, slightly sticky and slightly plastic; calcareous; moderately alkaline; clear smooth boundary.

C1—11 to 22 inches; light brownish gray (2.5Y 6/2) heavy silty clay loam, grayish brown (2.5Y 5/2) moist; weak coarse subangular blocky structure; hard, firm, sticky and plastic; calcareous; moderately alkaline; gradual smooth boundary.

Cca—22 to 60 inches; light gray (2.5Y 7/2) heavy silty clay loam, light brownish gray (2.5Y 6/2) moist; massive; hard, friable, sticky and plastic; visible calcium carbonate accumulations as concretions and mycelia; calcareous; moderately alkaline.

Cracks more than 0.4 inches wide and 12 inches deep normally form when soil is dry.

The A horizon has hue of 2.5Y or 5Y, value of 5 or 6 dry and 4 or 5 moist, and chroma of 2 or 3. The C horizon has hue of 2.5Y or 10YR and value of 6 or 7 dry and 5 or 6 moist. Calcium sulfate crystals often occur in the lower portion of this horizon.

Morval series

The Morval series consists of deep, well drained soils that formed in alluvium derived from basalt and sandstone. Morval soils are on mesas and valley sides. Slopes are 3 to 12 percent. The average annual precipitation is about 15 inches, and the average annual air temperature is about 44 degrees F.

Morval soils are similar to Detra and Villa Grove soils. Detra soils have a mollic epipedon more than 17 inches thick. Villa Grove soils have a calcium carbonate content of less than 15 percent.

Typical pedon of Morval loam, 3 to 12 percent slopes, about 500 feet south of the northeast corner of section 4, T. 7 S., R. 93 W.:

A1—0 to 2 inches; brown (7.5YR 5/2) loam, dark brown (7.5YR 3/2) moist; weak medium platy structure parting to moderate fine granular; slightly hard, friable; calcareous; mildly alkaline; clear wavy boundary.

A3—2 to 5 inches; brown (7.5YR 5/2) loam, dark brown (7.5YR 3/2) moist; moderate fine subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; 10 percent gravel; calcareous; moderately alkaline; clear wavy boundary.

B21t—5 to 10 inches; brown (7.5YR 5/2) clay loam, dark brown (7.5YR 3/2) moist; moderate medium subangular blocky structure; hard, firm, sticky and plastic; 10 percent gravel; common thin clay films on peds; calcareous; moderately alkaline; clear wavy boundary.

B22tca—10 to 17 inches; light brown (7.5YR 6/4) clay loam, brown (7.5YR 5/4) moist; moderate medium subangular blocky structure; hard, firm, sticky and plastic; 10 percent gravel; common thin clay films on peds; calcareous; fine irregular lime filaments; moderately alkaline; clear wavy boundary.

B3ca—17 to 27 inches; light brown (7.5YR 6/4) stony clay loam, brown (7.5YR 5/4) moist; weak moderate subangular blocky structure; hard, firm, slightly sticky and slightly plastic; 20 percent stones; calcareous; medium soft lime concretions; moderately alkaline; gradual wavy boundary.

Cca—27 to 60 inches; pink (7.5YR 7/4) stony loam, light brown (7.5YR 6/4) moist; massive; slightly hard, friable, nonsticky and nonplastic; 20 percent stones; calcareous; medium soft lime concretions; moderately alkaline.

The A horizon has hue of 7.5YR or 10YR, value of 4 or 5 dry and 2 or 3 moist, and chroma of 2 or 3. The B horizon has hue of 7.5YR or 10YR, value of 5 or 6 dry and 3 to 5 moist, and chroma of 2 to 4. The C horizon has hue of 7.5YR or 10YR. Calcium carbonate content ranges from 15 to 25 percent.

Nihill series

The Nihill series consists of deep, well drained soils that formed in channery calcareous alluvium. Nihill soils are on alluvial fans and valley sides. Slopes are 1 to 25 percent. The average annual precipitation is about 13 inches, and the average annual air temperature is about 48 degrees F.

Nihill soils are similar to Chilton soils. Chilton soils are redder in hue.

Typical pedon of Nihill channery loam, 6 to 25 percent slopes, about 1,200 feet south of the northwest corner of section 21, T. 6 S., R. 96 W.:

A1—0 to 4 inches; light gray (10YR 7/2) channery loam, grayish brown (10YR 5/2) moist; weak medium granular structure; soft, friable, slightly sticky and slightly plastic; 20 percent channery fragments; calcareous; moderately alkaline; clear smooth boundary.

AC—4 to 11 inches; very pale brown (10YR 7/2) channery loam, brown (10YR 5/3) moist; moderate medium granular structure; slightly hard, friable, sticky and plastic; 30 percent channery fragments; calcareous; moderately alkaline; gradual smooth boundary.

C1ca—11 to 18 inches; very pale brown (10YR 7/3) very channery loam, brown (10YR 5/3) moist; massive; slightly hard, friable; 40 percent channery fragments; common visible calcium carbonate nodules and occasionally scattered gypsum crystals in lower part of horizon; moderately alkaline; gradual wavy boundary.

C2ca—18 to 60 inches; very pale brown (10YR 7/3) stratified extremely channery sandy loam and loam, pale brown (10YR 6/3) moist; massive; slightly hard, friable; 75 percent channery fragments; calcareous; moderately alkaline.

Channery fragments cover 20 to 50 percent of the surface. Most coarse fragments in the C1ca and C2ca horizons have thin coatings of calcium carbonate on the underside and are fragments of sandstone less than 3 inches long and 1/2 to 1 1/2 inches thick; they make up more than 35 percent of the profile. Reaction is mildly alkaline to moderately alkaline throughout.

The A and C horizons have hue of 2.5Y to 7.5YR, value of 5 to 7 dry and 4 to 6 moist, and chroma of 2 to 4 dry and moist.

Northwater series

The Northwater series consists of deep, well drained soils formed in residuum from sedimentary rock. Northwater soils are on mountainsides. Slopes are 15 to 65 percent. The average annual precipitation is about 20 inches, and the average annual air temperature is about 40 degrees F.

Northwater soils are similar to Rhone soils. Rhone soils do not have a skeletal control section.

Typical pedon of Northwater loam, 15 to 65 percent slopes, about 1,000 feet east and 75 feet north of the southwest corner of section 12, T. 5 S., R. 96 W.:

O2—2 inches to 0; organic material.

A11—0 to 10 inches; brown (10YR 4/3) loam, very dark grayish brown (10YR 3/2) moist; moderate fine granular structure; soft, very friable, slightly sticky and slightly plastic; many fine and very fine roots; neutral; clear smooth boundary.

A12—10 to 25 inches; dark grayish brown (10YR 4/2) loam, very dark brown (10YR 2/2) moist; moderate fine granular structure; slightly hard, very friable, slightly sticky and slightly plastic; many fine and very fine roots; 10 percent fragments which are mainly less than 1 inch in diameter; clear wavy boundary.

B2t—25 to 50 inches; light brown (7.5YR 6/4) very channery clay loam, dark brown (7.5YR 4/4) moist; moderate medium subangular blocky structure that parts to moderate fine subangular blocky; hard, friable, sticky and plastic; common medium and large roots; common thin clay films and organic coats on peds and along root channels; 50 percent channery fragments, mostly 3/4 inch to 3 inches long; neutral; clear wavy boundary.

R—50 inches; fractured sandstone.

Depth to bedrock is more than 40 inches but generally is less than 60 inches. The mollic epipedon ranges from 20 to 35 inches in thickness. Depth to the top of the argillic horizon is 24 inches or more. Reaction is slightly acid to mildly alkaline throughout.

The A horizon has hue of 7.5YR to 2.5Y, value of 4 or 5 dry and 2 or 3 moist, and chroma of 2 or 3. Content of rock fragments is generally less than 15 percent. The B horizon has hue of 7.5YR to 2.5Y, value of 6 or 7 dry and 4 or 5 moist, and chroma of 3 or 4. Content of rock fragments, which are mostly thin and flat and mainly 3/4 to 3 inches long, ranges from 35 to 65 percent. The C horizon, where present, has hue of 7.5YR to 2.5Y and contains as much as 85 percent rock fragments.

Olney series

The Olney series consists of deep, well drained soils that formed in alluvium derived from sandstone and shale. Olney soils are on nearly level alluvial fans and valley sides. Slopes are 1 to 12 percent. The average annual precipitation is about 14 inches, and the average annual air temperature is about 48 degrees F.

Olney soils are similar to Potts soils. Potts soils are less than 35 percent fine and coarser sand in the control section.

Typical pedon of Olney loam, 3 to 6 percent slopes, about 1,400 feet north and 100 feet west of the southeast corner of section 6, T. 6 S., R. 91 W.:

Ap—0 to 12 inches; grayish brown (10YR 5/2) loam, dark grayish brown (10YR 4/2) moist; weak medium subangular blocky structure parting to weak medium granular; slightly hard, very friable; neutral; clear smooth boundary.

B2t—12 to 18 inches; grayish brown (10YR 5/2) sandy clay loam, dark grayish brown (10YR 4/2) moist; weak medium prismatic structure parting to moder-

ate medium subangular blocky; slightly hard, very friable; common clay films on peds; calcareous; mildly alkaline; clear smooth boundary.

B3ca—18 to 33 inches; light gray (10YR 7/2) sandy clay loam, dark grayish brown (10YR 4/2) moist; weak coarse subangular blocky structure parting to weak medium subangular blocky; slightly hard, very friable, visible calcium carbonate as concretions, seams, and streaks; calcareous; moderately alkaline; clear wavy boundary.

C1ca—33 to 43 inches; light gray (10YR 7/2) gravelly sandy clay loam, grayish brown (10YR 5/2) moist; massive; hard, very friable; 25 percent gravel and cobbles; visible calcium carbonate as concretions, seams, and streaks; calcareous; moderately alkaline; clear wavy boundary.

C2ca—43 to 60 inches; light gray (10YR 7/2) very gravelly sandy loam, grayish brown (10YR 5/2) moist; massive; slightly hard, friable; 30 percent gravel and 10 percent cobbles; visible calcium carbonate as concretions, seams, and streaks and as coatings on gravel and cobbles; calcareous; moderately alkaline.

Depth to calcareous material ranges from 10 to 20 inches. The solum ranges from 20 to 35 inches in thickness. The control section averages more than 35 percent fine and coarser sand.

The A horizon has hue of 2.5Y or 10YR, value of 5 or 6 dry and 3 or 4 moist, and chroma of 2 or 3. The B horizon has hue of 2.5Y or 10YR, value of 5 or 6 dry and 4 or 5 moist, and chroma of 2 to 4. The Cca horizon has hue of 10YR, value of 7 or 8 dry and 5 or 6 moist, and chroma of 2 or 3.

Parachute series

The Parachute series consists of moderately deep, well drained soils that formed in residuum from sandstone or marlstone. Parachute soils are on mountainsides. Slopes are 5 to 65 percent. The average annual precipitation is about 20 inches, and the average annual air temperature is about 40 degrees F.

Parachute soils are similar to Northwater and Rhone soils. Northwater and Rhone soils are deep.

Typical pedon of Parachute loam, 5 to 30 percent slopes, 75 feet north and 150 feet west of the southeast corner of section 25, T. 4 S., R. 96 W. (fig. 9):

A1—0 to 5 inches; grayish brown (10YR 5/2) loam, dark brown (10YR 3/3) moist; weak fine subangular blocky structure parting to moderate fine granular; slightly hard, very friable, slightly sticky and slightly plastic; many fine roots; neutral; clear smooth boundary.

B21—5 to 13 inches; very dark grayish brown (10YR 3/2) loam, very dark brown (10YR 2/2) moist; moderate medium subangular blocky structure; slightly hard, very friable, slightly sticky and slightly plastic; 10 percent fine channery fragments; many fine roots; neutral; clear smooth boundary.

B22—13 to 18 inches; brown (10YR 5/3) loam, brown (10YR 4/3) moist; weak medium subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; 10 percent fine and medium channery fragments; common fine and medium roots; neutral; clear wavy boundary.

B3—18 to 29 inches; light yellowish brown (10YR 6/4) extremely channery loam, yellowish brown (10YR 5/4) moist; weak coarse subangular blocky structure; hard, friable, sticky and plastic; 80 percent channery fragments mostly 3/4 inch to 3 inches in size; few medium and fine roots; neutral; clear wavy boundary.

R—29 inches; hard slightly fractured sandstone and marlstone.

The mollic epipedon ranges from 10 to 15 inches in thickness. Depth to the lithic contact ranges from 20 to 40 inches. Texture of the control section is typically loam, but clay content ranges from 18 to 35 percent. Content of rock fragments, most of which are 3/4 to 3 inches long, range from 35 to 85 percent, by volume.

The A1 and B2 horizons have hue of 7.5YR to 2.5Y, value of 4 or 5 dry and 2 or 3 moist, and chroma of 2 or 3. The B3 and C horizons, where present, have hue of 7.5YR to 2.5Y, value of 6 or 7 dry and 4 or 5 moist, and chroma of 3 or 4.

Pena series

The Pena series consists of deep, well drained soils that formed in calcareous alluvium derived from sandstone and shale. Pena soils are on valley sides. Slopes are 6 to 25 percent. The average annual precipitation is about 12 inches, and the average annual air temperature is about 48 degrees F.

The Pena soils are similar to Tridell soils. Tridell soils have a frigid temperature regime.

Typical pedon of Pena stony loam, 6 to 25 percent slopes, about 1,300 feet east and 200 feet north of the southwest corner of section 13, T. 5 S., R. 90 W.:

A1—0 to 6 inches; dark grayish brown (10YR 4/2) stony loam, very dark grayish brown (10YR 3/2) moist; weak fine granular structure; loose, very friable; 30 percent large stones and cobbles; mildly alkaline; clear smooth boundary.

AC—6 to 12 inches; dark grayish brown (10YR 4/2) very stony loam, very dark grayish brown (10YR 3/2) moist; weak, fine subangular blocky structure; slightly hard, friable; 40 percent large stones and cobbles; calcareous; mildly alkaline; gradual smooth boundary.

C1—12 to 30 inches; very pale brown (10YR 7/3) very stony sandy loam, brown (10YR 5/3) moist; weak fine subangular blocky structure; slightly hard, very friable; 45 percent large stones; calcareous; moderately alkaline; gradual wavy boundary.

C2ca—30 to 60 inches; very pale brown (10YR 8/3) very stony sandy loam, pale brown (10YR 6/3) moist; massive; slightly hard, friable; 45 percent large stones; visible secondary calcium carbonate as fine seams and soft concretions; calcareous; moderately alkaline.

Depth to the Cca horizon is 15 to 30 inches. Content of rock fragments ranges from 35 to 55 percent. The mollic epipedon ranges from 8 to 16 inches in thickness.

The A horizon has hue of 10YR or 7.5YR, value of 3 or 4 dry and 2 or 3 moist, and chroma of 2 or 3. The AC horizon has hue of 10YR or 7.5YR, value of 4 or 5 dry and 3 or 4 moist, and chroma of 2 to 4. The C horizon has hue of 10YR or 7.5YR and has more than 15 percent calcium carbonate equivalent.

Potts series

The Potts series consists of deep, well drained soils that formed in alluvium derived from sandstone, shale, or basalt. Potts soils are on moderately sloping mesas, benches, and valley sides. Slopes are 1 to 12 percent. The average annual precipitation is about 14 inches, and the average annual air temperature is about 45 degrees F.

Potts soils are similar to Olney soils. Olney soils have more than 35 percent fine and coarser sand in the control section.

Typical pedon of Potts loam, 3 to 6 percent slopes, 1,300 feet north and 1,300 feet west of the southwest corner of section 3, T. 7 S., R. 92 W.:

A1—0 to 4 inches; brown (7.5YR 5/4) loam, dark brown (7.5YR 3/2) moist; weak medium platy structure parting to moderate fine granular; slightly hard, friable; mildly alkaline; clear smooth boundary.

B1—4 to 11 inches; reddish brown (5YR 5/4) heavy loam, dark reddish brown (5YR 3/4) moist; weak medium prismatic structure parting to moderate fine subangular blocky; hard, firm, slightly sticky and nonplastic; mildly alkaline; clear smooth boundary.

B2t—11 to 20 inches; reddish brown (5YR 5/4) light clay loam, reddish brown (5YR 4/3) moist; moderate medium subangular blocky structure parting to moderate fine subangular blocky; very hard, firm, slightly sticky and slightly plastic; calcareous; moderately alkaline; gradual smooth boundary.

B3ca—20 to 28 inches; reddish brown (5YR 5/4) light clay loam, reddish brown (5YR 4/4) moist; weak medium subangular blocky structure parting to moderate fine subangular blocky; hard, firm, slightly sticky and nonplastic; common fine round lime concretions; calcareous; strongly alkaline; clear smooth boundary.

Cca—28 to 60 inches; pinkish white (5YR 8/2) loam, light reddish brown (5YR 6/4) moist; massive; hard, firm; visible disseminated calcium carbonate; calcareous; strongly alkaline.

Depth to calcareous material ranges from 9 to 18 inches. In many places, the lower part of the C horizon has 10 to 15 percent gravel and cobbles. These fragments increase in quantity with depth.

The A horizon has hue of 7.5YR or 5YR, value of 5 or 6 dry and 3 or 4 moist, and chroma of 2 to 4. The B horizon has hue of 5YR or 2.5YR, value of 5 or 6 dry and 4 or 5 moist, and chroma of 3 to 5.

Rhone series

The Rhone series consists of deep, well drained soils that formed in residuum from sandstone and marlstone. Rhone soils are on mountainsides and ridges. Slopes are 5 to 70 percent. The average annual precipitation is about 20 inches, and the average annual air temperature is about 40 degrees F.

Rhone soils are similar to Silas, Northwater, and Parachute soils. Silas soils contain 0 to 15 percent rock fragments throughout. Parachute soils have lithic contact at a depth of 20 to 40 inches. Northwater soils have an argillic horizon.

Typical pedon of Rhone loam, 5 to 30 percent slopes, about 300 feet south and 200 feet east of the northwest corner of section 13, T. 5 S., R. 96 W.:

A11—0 to 8 inches; brown (10YR 4/3) loam, very dark grayish brown (10YR 3/2) moist; weak fine granular structure; soft, very friable, slightly sticky and slightly plastic; many fine and very fine roots; neutral; clear wavy boundary.

A12—8 to 15 inches; brown (7.5YR 5/2) sandy clay loam, dark brown (7.5YR 3/2) moist; moderate medium subangular blocky structure parting to moderate fine subangular blocky; slightly hard, friable, slightly sticky and slightly plastic; neutral; clear wavy boundary.

A13—15 to 28 inches; brown (7.5YR 5/2) sandy clay loam, dark brown (7.5YR 3/2) moist; moderate medium subangular blocky structure parting to weak fine subangular blocky; slightly hard, friable, slightly sticky and slightly plastic; neutral; clear wavy boundary.

IIC—28 to 52 inches; brown (7.5YR 5/4) very channery sandy clay loam, dark brown (7.5YR 4/2) moist; massive; slightly hard, friable, slightly sticky and slightly plastic; 40 percent channery fragments; neutral; abrupt wavy boundary.

R—52 inches; fractured sandstone bedrock.

The mollic epipedon is 17 to 40 inches thick. Depth to bedrock is more than 40 inches but is generally less than 60 inches. The soil is generally noncalcareous and neutral, but reaction ranges from slightly acid to mildly alkaline in the 10- to 40-inch control section. Content of coarse fragments is up as much as 60 percent in the lower part of some pedons.

The A horizon has hue of 10YR or 7.5YR, value of 3 to 5 dry and 2 or 3 moist, and chroma of 2 or 3. The C horizon has hue of 10YR or 7.5YR, value of 4 to 6 dry and 4 or 5 moist, and chroma of 2 to 4. The IIC horizon is at a depth of 20 to 40 inches. It is generally very channery sandy clay loam that is 35 to 50 percent channery fragments.

Silas series

The Silas series consists of deep, moderately well drained soils that formed in alluvium derived mainly from sedimentary bedrock. Silas soils are in mountain valley bottomland. Slopes are 3 to 12 percent. The average annual precipitation is about 20 inches, and the average annual air temperature is about 40 degrees F.

Silas soils are similar to Rhone soils. Rhone soils are on uplands and contain as much as 60 percent channery fragments in the lower part of some pedons.

Typical pedon of Silas loam, 3 to 12 percent slopes, NE1/4SW1/4, section 35, T. 4 S., R. 96 W.:

A11—0 to 14 inches; very dark grayish brown (10YR 3/2) loam, very dark brown (10YR 2/2) moist; weak medium platy structure parting to moderate fine granular; soft, very friable, slightly sticky and slightly plastic; mildly alkaline; clear smooth boundary.

A12—14 to 41 inches; very dark gray (10YR 3/1) loam, black (10YR 2/1) moist; weak coarse subangular blocky structure parting to moderate fine granular; slightly hard, friable, slightly sticky and slightly plastic; mildly alkaline; gradual smooth boundary.

C—41 to 60 inches; very dark grayish brown (10YR 3/2) loam, very dark brown (10YR 2/2) moist; weak coarse subangular blocky structure parting to moderate medium granular; slightly hard, very friable, slightly sticky and slightly plastic; mildly alkaline.

Content of coarse fragments ranges from 5 to 15 percent throughout; they are fine channery fragments. Reaction is neutral to mildly alkaline throughout. Stratified lenses of fine sandy loam, silt loam, and clay loam are common throughout.

The A and C horizons have hue of 10YR or 2.5Y, value of 3 to 5 dry and 2 or 3 moist, and chroma of 1 or 2.

Starman series

The Starman series consists of shallow, well drained soils that formed in residuum from sandstone and marlstone. Starman soils are on ridge crests and mountainsides. Slopes are 5 to 50 percent. The average annual precipitation is about 20 inches; however, prevailing winds sweep most of the snow cover off these areas in the winter. The effective precipitation comes as showers in summer and fall and amounts to about 10 inches. The average annual air temperature is about 40 degrees F.

Starman soils are similar to Irigul soils. Irigul soils have a mollic epipedon.

Typical pedon of Starman channery loam, 5 to 50 percent slopes, about 50 feet west and 1,600 feet north of the southeast corner of section 35, T. 5 S., R. 94 W.:

A1—0 to 3 inches; brown (10YR 5/3) channery loam, dark brown (10YR 4/3) moist; weak medium granular structure; soft, friable, slightly sticky and slightly plastic; 30 percent channery fragments; calcareous; moderately alkaline; clear wavy boundary.

AC—3 to 7 inches; pale brown (10YR 6/3) extremely channery loam, brown (10YR 4/3) moist; weak medium granular structure; slightly hard, friable, slightly sticky and slightly plastic; 70 percent channery fragments; calcareous; moderately alkaline; clear wavy boundary.

Cca—7 to 13 inches; very pale brown (10YR 7/3) extremely channery loam, pale brown (10YR 6/3) moist; massive; slightly hard, friable, slightly sticky and slightly plastic; 75 percent channery fragments and flagstones that are thinly crusted with secondary lime; calcareous; strongly alkaline; abrupt wavy boundary.

R—13 inches; hard Green River shale.

Depth to lithic contact is 10 to 20 inches. Reaction ranges from moderately alkaline to strongly alkaline. Rock fragments make up 20 to 35 percent of the A horizon and are mostly fine channery fragments. Rock fragments make up 65 to 75 percent of the AC and Cca horizons and are mostly 3/4 to 3 inches long. The percentage of coarse fragments larger than 3 inches increases near the lithic contact.

The A horizon has hue of 7.5YR to 2.5Y, value of 5 or 6 dry and 3 or 4 moist, and chroma of 2 or 3 dry and moist. The AC horizon has hue of 7.5YR to 2.5Y, value of 5 or 7 dry and 4 to 6 moist, and chroma of 2 or 3 dry and moist. The Cca horizon has hue of 7.5YR to 2.5Y, value of 6 or 7 dry and 4 to 6 moist, and chroma of 3 or 4 dry and moist. The Cca horizon has lime coatings on rock fragments.

Tanna series

The Tanna series consists of moderately deep, well drained soils that formed in weathered shale. Tanna soils are on mountainsides. Slopes are 25 to 45 percent. The average annual precipitation is about 17 inches, and the average annual air temperature is about 43 degrees F.

Tanna soils are similar to Holderness Variant and Morval soils. Holderness Variant soils are deep. Morval soils have less than 35 percent clay in the solum and are deep.

Typical pedon of Tanna silty clay loam, 25 to 45 percent slopes, about 700 feet north and 300 feet east of the southwest corner of section 12, T. 4 S., R. 94 W.:

A1—0 to 5 inches; grayish brown (10YR 5/2) light silty clay loam, very dark grayish brown (10YR 3/2) moist; moderate fine granular structure; slightly hard, friable, slightly sticky and slightly plastic; neutral; clear smooth boundary.

A3—5 to 9 inches; grayish brown (2.5Y 5/2) heavy silty clay loam, very dark grayish brown (2.5Y 3/2) moist; moderate fine subangular blocky structure; hard, friable, sticky and slightly plastic; calcareous; mildly alkaline; clear smooth boundary.

B2t—9 to 16 inches; light grayish brown (2.5Y 6/2) clay, dark grayish brown (2.5Y 4/2) moist; moderate medium prismatic structure parting to moderate fine angular blocky; hard, firm, sticky and plastic; common moderately thick clay films on ped faces; calcareous; moderately alkaline; clear wavy boundary.

B3ca—16 to 24 inches; light gray (2.5Y 7/2) heavy silty clay loam, grayish brown (2.5Y 5/2) moist; moderate to weak subangular blocky structure; hard, firm, sticky and plastic; few thin clay films on ped faces; calcareous; secondary calcium carbonate accumulations as seams; moderately alkaline; clear wavy boundary.

C1—24 to 30 inches; light gray (2.5Y 7/2) channery clay loam, grayish brown (2.5Y 5/2) moist; massive; hard, firm, sticky and slightly plastic; 20 percent channery fragments; calcareous; moderately alkaline; clear wavy boundary.

C2r—30 to 50 inches; weathered shale and fine grained sandstone.

Depth to paralithic contact ranges from 20 to 40 inches. The mollic epipedon ranges from 7 to 16 inches in thickness.

The A horizon has hue of 10YR or 2.5Y, value of 4 or 5 dry and 2 or 3 moist, and chroma of 2 or 3. The B horizon has hue of 2.5Y or 10YR, value of 5 to 7 dry and 3 to 5 moist, and chroma of 2 to 4. The C horizon has hue of 2.5Y or 10YR.

Tridell series

The Tridell series consists of deep, well drained soils that formed in alluvium derived from basalt and sandstone. Tridell soils are on sides of mesas and on fans. Slopes are 6 to 25 percent. The average annual precipitation is about 15 inches, and the average annual air temperature is about 44 degrees F.

Tridell soils are similar to Pena soils. Pena soils have a mesic temperature regime.

Typical pedon of Tridell stony loam, 6 to 25 percent slopes, about 2,440 feet west and 875 feet north of the southeast corner of section 8, T. 7 S., R. 91 W.:

A1—0 to 10 inches; brown (7.5YR 4/2) stony loam, dark brown (7.5YR 3/2) moist; weak fine granular structure; soft, very friable, slightly sticky and slightly plastic; 10 percent stones; calcareous; moderately alkaline; clear wavy boundary.

ACca—10 to 21 inches; brown (7.5YR 4/4) very stony loam, brown (7.5YR 4/2) moist; weak medium granular structure; slightly hard, very friable, slightly sticky and slightly plastic; 45 percent stones; soft rounded concretions of secondary calcium carbonate; calcareous; moderately alkaline; clear wavy boundary.

Cca—21 to 60 inches; pinkish white (7.5YR 8/2) very stony loam, pinkish gray (7.5YR 6/2) moist; massive; soft, very friable; 50 percent stones; well disseminated secondary calcium carbonate throughout horizon and common soft rounded concretions of secondary lime; calcareous; moderately alkaline.

The mollic epipedon ranges from 10 to 14 inches in thickness.

The A horizon has hue of 7.5YR or 10YR, value of 4 or 5 dry and 2 or 3 moist, and chroma of 2 or 3. The AC horizon has hue of 7.5YR or 10YR, value of 4 or 5 dry and 3 or 4 moist, and chroma of 2 to 4. The C horizon has hue of 7.5YR or 10YR. Calcium carbonate equivalent of the Cca horizon ranges from 15 to 30 percent.

Vale series

The Vale series consists of deep, well drained soils that formed in calcareous eolian material. Vale soils are on gently sloping mesas, terraces, and alluvial fans. Slopes are 3 to 25 percent. The average annual precipitation is about 14 inches, and the average annual air temperature is about 48 degrees F.

Vale soils are similar to Ascalon soils. Ascalon soils contain less silt in the control section.

Typical pedon of Vale silt loam, 3 to 25 percent slopes, near the southwest corner of section 8, T. 6 S., R. 91 W.:

Ap—0 to 7 inches; brown (7.5YR 4/2) silt loam, dark brown (7.5YR 3/2) moist; weak medium platy structure parting to moderate fine granular; slightly hard, very friable, slightly sticky and nonplastic; neutral; clear smooth boundary.

B1—7 to 11 inches; brown (7.5YR 4/2) silt loam, dark brown (7.5YR 3/2) moist; weak medium prismatic structure parting to moderate fine subangular blocky; hard, friable, slightly sticky and slightly plastic; neutral; clear wavy boundary.

B21t—11 to 18 inches; brown (7.5YR 5/2) silty clay loam, brown (7.5YR 4/2) moist; moderate to coarse subangular blocky structure; hard, firm, sticky and slightly plastic; thin nearly continuous clay films; neutral; clear wavy boundary.

B22t—18 to 26 inches; brown (7.5YR 5/4) silty clay loam, brown (7.5YR 4/4) moist; moderate medium prismatic structure parting to moderate medium subangular blocky; hard, firm, sticky and slightly plastic; thin continous clay films; calcareous; mildly alkaline; clear wavy boundary.

B3ca—26 to 40 inches; pink (7.5YR 7/4) silt loam, brown (7.5YR 5/4) moist; weak medium subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; thin patchy clay films on vertical faces of peds; calcium carbonate accumulations as thin seams and a few medium lime concretions; calcareous; moderately alkaline; clear wavy boundary.

Cca—40 to 60 inches; pink (7.5YR 8/4) silt loam, light brown (7.5YR 6/4) moist; massive; slightly hard, very friable, slightly sticky and nonplastic; few medium concretions of lime; calcareous; moderately alkaline.

The mollic epipedon ranges from 10 to 15 inches in thickness. This soil is usually leached to a depth of 10 to 20 inches.

The A horizon has hue of 7.5YR or 10YR, value of 3 or 4 dry and 2 or 3 moist, and chroma of 2 or 3. The B horizon has hue of 5YR or 7.5YR, value of 4 to 6 dry and 3 to 4 moist, and chroma of 2 to 4. The C horizon has hue of 5YR or 7.5YR. It commonly has small lime concretions throughout the horizon.

Villa Grove series

The Villa Grove series consists of deep, well drained soils that formed in mixed alluvium derived from sandstone, shale, and basalt. Villa Grove soils are on alluvial fans and mountainsides. Slopes are 15 to 30 percent. The average annual precipitation is about 16 inches, and the average annual air temperature is about 44 degrees F.

Villa Grove soils are similar to Holderness and Morval soils. Holderness soils have more than 35 percent clay in the solum. Morval soils have 15 to 25 percent calcium carbonate equivalent.

Typical pedon of Villa Grove loam, 15 to 30 percent slopes, about 1,000 feet east and 200 feet south of center of section 15, T. 7 S., R. 95 W.:

A1—0 to 4 inches; dark grayish brown (10YR 4/2) loam, very dark grayish brown (10YR 3/2) moist; moderate fine subangular blocky structure; slightly hard, friable; 5 percent gravel and cobbles; mildly alkaline; clear smooth boundary.

B2t—4 to 15 inches; brown (10YR 4/3) clay loam, very dark grayish brown (10YR 3/2) moist; moderate medium subangular blocky structure; hard, friable, slightly sticky and slightly plastic; thin, nearly continuous clay films on peds; 5 percent gravel and cobbles; calcareous; mildly alkaline; clear smooth boundary.

B3ca—15 to 48 inches; brown (10YR 5/3) loam, brown (10YR 4/3) moist; moderate medium subangular blocky structure; hard, friable; 5 to 10 percent gravel and cobbles; calcium carbonate accumulations as soft seams; calcareous; moderately alkaline; gradual smooth boundary.

Cca—48 to 60 inches; pale brown (10YR 6/3) loam, brown (10YR 5/3) moist; massive; slightly hard, very friable; 5 to 10 percent gravel and cobbles; calcium carbonate accumulations as soft concretions; calcareous; moderately alkaline.

Calcium carbonate equivalent is less than 15 percent.

The A horizon has hue of 10YR or 7.5YR, value of 4 or 5 dry and 2 or 3 moist, and chroma of 2 or 3. The B horizon has hue of 10YR or 7.5YR, value of 4 or 5 dry and 3 or 4 moist, and chroma of 2 or 3. The C horizon has hue of 10YR or 7.5YR.

Wann series

The Wann series consists of deep, somewhat poorly drained soils that formed in alluvium derived from sandstone and shale. Wann soils are on low terraces and valley bottom land. Slopes are 1 to 3 percent. The average annual precipitation is about 12 inches, and the average annual air temperature is about 48 degrees F.

Wann soils are not similar to any other soils in this survey area.

Typical pedon of Wann sandy loam, 1 to 3 percent slopes, about 1,320 feet west and 2,640 feet south of the northeast corner of section 11, T. 6 S., R. 93 W.:

Ap—0 to 8 inches; dark grayish brown (10YR 4/2) sandy loam, very dark grayish brown (10YR 3/2) moist; weak medium subangular blocky structure parting to moderate fine granular; soft, very friable; few very fine white (10YR 8/2) salt accumulations; calcareous; mildly alkaline; clear smooth boundary.

A12—8 to 12 inches; dark grayish brown (10YR 4/2) fine sandy loam, very dark grayish brown (10YR 3/2) moist; few fine distinct yellowish brown (10YR 5/8) mottles; weak medium subangular blocky structure parting to moderate fine granular; slightly hard, friable; calcareous; moderately alkaline; clear smooth boundary.

C1—12 to 17 inches; light brownish gray (10YR 6/2) fine sandy loam, dark grayish brown (10YR 4/2) moist; few fine distinct yellowish brown (10YR 5/8) mottles; massive; soft, very friable; calcareous; moderately alkaline; clear smooth boundary.

C2—17 to 36 inches; light brownish gray (10YR 6/2) sandy loam, dark grayish brown (10YR 4/2) moist; many distinct yellowish brown (10YR 5/8) mottles; massive; soft, very friable; calcareous; moderately alkaline; gradual smooth boundary.

C3—36 to 60 inches; light brownish gray (10YR 6/2) coarse sandy loam, dark grayish brown (10YR 4/2) moist; many distinct yellowish brown (10YR 5/8) mottles; massive; loose, very friable; calcareous; moderately alkaline.

The A horizon has hue of 10YR, value of 4 or 5 dry and 2 or 3 moist, and chroma of 1 or 2. The C horizon has hue of 10YR or 2.5Y, value of 6 or 7 dry and 4 or 5 moist, and chroma of 2 or 3. Thin lenses of stratified sand and silts occur intermittently in the C horizon.

Zoltay series

The Zoltay series consists of deep, well drained soils that formed in alluvium derived from sandstone and shale. Zoltay soils are on fans and mountainsides. Slopes are 15 to 30 percent. The average annual precipitation is about 16 inches, and the average annual temperature is about 44 degrees F.

Zoltay soils are similar to Detra, Holderness Variant, and Tanna soils. Detra soils have less than 35 percent clay in the solum. Holderness Variant and Tanna soils have a mollic epipedon less than 17 inches thick.

Typical pedon of Zoltay loam, 15 to 30 percent slopes, about 500 feet north and 300 feet east of section 15, T. 7 S., R. 95 W.:

A11—0 to 3 inches; dark grayish brown (10YR 4/2) loam, very dark brown (10YR 2/2) moist; weak fine granular structure; slightly hard, very friable; neutral; clear smooth boundary.

A12—3 to 19 inches; dark grayish brown (10YR 4/2) loam, very dark brown (10YR 2/2) moist; weak fine subangular blocky structure; slightly hard, friable; 10 percent gravel and cobbles; neutral; clear smooth boundary.

B21t—19 to 23 inches; brown (7.5YR 4/2) cobbly clay loam, dark brown (7.5YR 3/2) moist; moderate medium subangular blocky structure; hard, firm, slightly sticky and slightly plastic; 20 percent cobbles; common thin clay films on peds; neutral; gradual smooth boundary.

B22t—23 to 36 inches; brown (7.5YR 5/2) cobbly clay, brown (7.5YR 4/2) moist; strong medium angular blocky structure; hard, firm, sticky and plastic; 20 percent cobbles; common moderately thick clay films on peds; mildly alkaline; gradual wavy boundary.

B3ca—36 to 54 inches; pinkish gray (7.5YR 6/2) cobbly clay, brown (7.5YR 4/2) moist; moderate medium angular blocky structure; very hard, firm, sticky and plastic; 20 percent cobbles; common moderately thick clay films on peds; few fine irregular rounded filaments of lime; calcareous; mildly alkaline; gradual wavy boundary.

Cca—54 to 60 inches; pinkish gray (7.5YR 6/2) cobbly clay, brown (7.5YR 5/2) moist; massive; hard, firm, slightly sticky and slightly plastic; 25 percent cobbles; common medium rounded lime concretions; calcareous; moderately alkaline.

The mollic epipedon ranges from 16 to 40 inches in thickness. Rock fragments range from 2 to 10 inches in diameter.

The A horizon has hue of 10YR or 7.5YR, value of 4 or 5 dry and 2 or 3 moist, and chroma of 2 or 3. The B horizon has hue of 10YR or 7.5YR, value of 4 to 6 dry and 3 or 4 moist, and chroma of 2 or 3. The C horizon has hue of 10YR or 7.5YR. Calcium carbonate content is less than 15 percent in the C horizon.

Classification of the soils

The system of soil classification currently used was adopted by the National Cooperative Soil Survey in 1965. Readers interested in further details about the system should refer to "Soil taxonomy" (*8*).

The system of classification has six categories. Beginning with the broadest, these categories are the order, suborder, great group, subgroup, family, and series. In this system the classification is based on the different soil properties that can be observed in the field or those that can be inferred either from other properties that are observable in the field or from the combined data of soil science and other disciplines. The properties selected for the higher categories are the result of soil genesis or of factors that affect soil genesis. In table 16, the soils of the survey area are classified according to the system. Categories of the system are discussed in the following paragraphs.

ORDER. Ten soil orders are recognized as classes in the system. The properties used to differentiate among orders are those that reflect the kind and degree of dominant soil-forming processes that have taken place.

Each order is identified by a word ending in *sol*. An example is Entisol.

SUBORDER. Each order is divided into suborders based primarily on properties that influence soil genesis and are important to plant growth or that are selected to reflect the most important variables within the orders. The last syllable in the name of a suborder indicates the order. An example is Aquent (*Aqu*, meaning water, plus *ent*, from Entisol).

GREAT GROUP. Each suborder is divided into great groups on the basis of close similarities in kind, arrangement, and degree of expression of pedogenic horizons; soil moisture and temperature regimes; and base status. Each great group is identified by the name of a suborder and a prefix that suggests something about the properties of the soil. An example is Haplaquents (*Hapl*, meaning simple horizons, plus *aquent*, the suborder of Entisols that have an aquic moisture regime).

SUBGROUP. Each great group may be divided into three subgroups: the central (typic) concept of the great groups, which is not necessarily the most extensive subgroup; the intergrades, or transitional forms to other orders, suborders, or great groups; and the extragrades, which have some properties that are representative of the great groups but do not indicate transitions to any other known kind of soil. Each subgroup is identified by one or more adjectives preceding the name of the great group. The adjective *Typic* identifies the subgroup that is thought to typify the great group. An example is Typic Haplaquents.

FAMILY. Families are established within a subgroup on the basis of similar physical and chemical properties that affect management. Among the properties considered in horizons of major biological activity below plow depth are particle-size distribution, mineral content, temperature regime, thickness of the soil penetrable by roots, consistence, moisture equivalent, soil slope, and permanent cracks. A family name consists of the name of a subgroup and a series of adjectives. The adjectives are the class names for the soil properties used as family differentiae. An example is fine-loamy, mixed, nonacid, mesic, Typic Haplaquents.

SERIES. The series consists of soils that formed in a particular kind of material and have horizons that, except for texture of the surface soil or of the underlying substratum, are similar in differentiating characteristics and in arrangement in the soil profile. Among these characteristics are color, texture, structure, reaction, consistence, and mineral and chemical composition.

Soil formation

By Donald J. Murray, soil scientist, Soil Conservation Service.

This section describes the five major factors of soil formation and explains how these factors affect the soils of the Rifle Area.

Soil is a naturally occuring body at the surface of the earth. Its characteristics result from action of the environment on geologic parent material. The characteristics of the soil at any given point are determined by the interaction of parent material, climate, relief, living organisms, and time. The soil differs from place to place, depending on the maturity and intensity of the factors that controlled its development.

Parent material

The soils of the Rifle Area formed in many types of parent material. The area is part of the White River uplift with a major reverse fault (the Grand Hogback) bisecting the area in a northwesterly direction. The combination of faulting, thrusting, and normal erosion has profoundly affected the materials available for soil formation. Several different geologic formations are exposed in the Rifle Area.

The northwestern part of the survey area is dominated by the Roan Plateau. This plateau consists of the Uinta Formation of the Eocene period. This formation consists of semiconsolidated shales that contain significant amounts of oil shale. These shales are easily weathered and produce loamy soils. Northwater and Roan soils are deep and contain many channery fragments in the subsoil. Both soils are on ridges and mountainsides. Parachute soils are moderately deep and are on ridges and concave mountainsides. Irigul and Starman soils are very channery throughout, are shallow to bedrock, and are on ridge crests. Silas soils are on bottom land in narrow mountain valleys and are deep, dark colored and generally loamy.

South of the Roan Plateau and west of the Grand Hogback, the Wasatch Formation of Paleocene age dominates the landscape. This formation underlies the Uinta Formation. The area is characterized by gently to moderately sloping valleys and fans draining into the Colorado River. Near Battlement Mesa, in the southwest corner of the survey area, are many small mesa remnants underlain by basaltic cobbles that are commonly covered by eolian material. Soils that formed from Wasatch shale are generally loamy to silty or clayey. Arvada and Heldt soils are generally clay to silty clay and are on gently sloping to strongly sloping alluvial fans and terraces. Cushman and Lazear soils are on hilly to very steep mountainsides and are generally loam to stony loam. Cushman soils are moderately deep and concave. Lazear soils are shallow and are on the more convex parts of the landscape and mesa breaks. Dollard soils are associated with Rock outcrop and formed in clayey residuum. They are moderately deep and are on moderately steep to steep hills and mountainsides. Ildefonso soils are deep and formed in basaltic alluvium on sides of foothills and mesas. Typically, they range from stony loam to very stony loam. On the mesa tops, eolian deposits of calcareous loess are common. Vale and Potts

soils formed in these deposits and are generally loam to silty clay loam or silt loam.

In the southwestern part of the survey area are the remnants of a basalt flow from the Battlement Mesa area. In this area, a basalt cap covered or covers the Wasatch shale. Cochetopa and Jerry soils formed in alluvium derived from basalt and shale and range from stony loam to stony clay loam and stony clay. Bucklon and Inchau soils formed in shale residuum, are shallow and moderately deep over shale, and range from channery loam to clay loam or gravelly clay loam.

The Grand Hogback is composed primarily of Mesa Verde sandstone and shale of the Upper Cretaceous period. The Williams Fork and Iles members of this formation are dominant, along with some of the lower part of the Mesa Verde group such as Mancos shale. Ascalon and Pena soils are deep and formed in alluvium derived from sandstone on sloping fans and valley sides. They range from fine sandy loam or stony loam to sandy clay loam or stony sandy loam. Lamphier soils are deep, dark soils that formed in residuum from sandstone and shale on steep fans and mountainsides. Typically, they are loamy throughout. Cimarron and Tanna soils are deep and moderately deep and formed in dark shale on mountainsides. They range from loam or silty clay loam to silty clay loam or silty clay.

East of the Grand Hogback around Glenwood Springs, the area is dominated by Maroon sandstone of the Permian epoch. Arle and Ansari soils are moderately deep and shallow and formed in red sandstone on sloping fans and mountainsides. They range from loam or stony loam to very stony loam. Detra and Chilton soils are deep and formed in red sandstone on rolling fans and valley sides. They range from fine sandy loam or channery loam to fine sandy clay loam or channery sandy loam.

The Colorado and Roaring Fork Rivers are the major drainageways in the Area and the chief sources of alluvium. Atencio and Azeltine soils formed in red alluvium along the Roaring Fork River. They are deep and are sandy loam or gravelly sandy clay loam over gravel and cobbles. Olney and Kim soils formed in alluvium from the Colorado River around Rifle and Silt. These soils are deep and range from loam to sandy clay loam or fine sandy loam.

Climate

The climate of the Rifle Area varies widely with the difference in elevation. As elevation increases, precipitation increases and temperature decreases.

Through its influence on vegetation, the rate of biological activity, and the physical and chemical weathering of parent material, climate has been very important in the development of soils of this area. The amount of precipitation and the variation in temperature contribute to the accumulation of organic matter, the physical movement of substances, and rates of chemical processes.

Grand Valley, in the western part of the survey area, is along the Colorado River at an elevation of 4,950 feet. The average annual precipitation there ranges from 10 to 12 inches, and the average annual air temperature is about 48 degrees F. Because of the warm temperatures and the small amount of moisture, the soils of this area tend to have small amounts of organic matter, light color, and a high concentration of salts and calcium carbonate at or near the surface.

Sunlight Peak is the highest point in the survey area, 10,600 feet. Precipitation ranges from 20 to 24 inches, and the average annual air temperature is about 36 degrees F. The soils of this area are characterized by large amounts of organic matter, dark color, and a generally leached condition of salts and carbonates.

Plants and animals

Plants, micro-organisms, and earthworms and other animals on or in the soil influence soil formation. The kinds of plants and animals at any place are controlled by temperature and moisture and by the physical and chemical characteristics of the soil.

The native vegetation on this area ranges from salt-tolerant grasses and shrubs along the Colorado River to mixed grasses and shrubs on the uplands and mesas to deciduous and coniferous woodland in the high mountains. Communities of grasses and shrubs are the most extensive types and have had the greatest affect on soil formation. Plant roots provide aeration and permeability to the soil. When organic matter decays, it supplies nutrients to the soil and further enhances plant growth.

Soils under conifers at the higher elevations tend to be more acid than those under deciduous trees. There also has been some translocation of clays and organic compounds.

Animals affect the soils of this area somewhat less than plants do. Some mixing by rodents and earthworms is common in all soils but has not resulted in any drastic changes in soil characteristics. Worm casts are common in more moist soils, and ants have caused some mounding. Overgrazing by livestock and wildlife is currently affecting soil formation.

Relief

Major differences in elevation cause differences in climate which account for significant variations in soil formation. Relief also influences soil formation by its control of runoff. Distinct differences in relief are associated with relatively minor differences in slope, landform, and aspect within a given landscape.

In dry areas, a slight difference in moisture supply will mean a difference in vegetation and changes in the soil formation process. A soil that formed in depressions,

where runoff concentrates, is usually darker colored and has a better developed profile than convex soils.

On steeper slopes, aspect has a very pronounced affect on soil formation. Generally, north-facing soils are darker colored, cooler, more deeply leached, and drastically different in vegetation than south-facing soils in the same area.

Low-lying soils are greatly influenced by runoff from surrounding steeper soils and by material deposited by nearby streams and rivers. Occasional flooding has also influenced parent material.

Time

The formation of a soil requires time. The length of time depends on the other soil forming factors. The degree of development is evaluated on the basis of soil characteristics rather than the length of time the soil has been forming. Characteristics used to determine the degree of development are structure in the subsoil, evidence of downward clay movement, and thickness of the solum.

The horizons of older soils are normally more distinct than those of younger soils. In the Rifle Area, Etoe and Northwater soils show distinct horizons and a zone of clay accumulation. Potts soils show leaching of calcium carbonate from the surface layer.

Younger soils such as Silas and Irigul may be leached but show very little other horizon development.

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Glossary

Aggregate, soil. Many fine particles held in a single mass or cluster. Natural soil aggregates, such as granules, blocks, or prisms, are called peds. Clods are aggregates produced by tillage or logging.

Alkali (sodic) soil. A soil having so high a degree of alkalinity (pH 8.5 or higher), or so high a percentage of exchangeable sodium (15 percent or more of the total exchangeable bases), or both, that plant growth is restricted.

Alluvium. Material, such as sand, silt, or clay, deposited on land by streams.

Area reclaim. An area difficult to reclaim after the removal of soil for construction and other uses. Revegetation and erosion control are extremely difficult.

Available water capacity (available moisture capacity). The capacity of soils to hold water available for use by most plants. It is commonly defined as the difference between the amount of soil water at field moisture capacity and the amount at wilting point. It is commonly expressed as inches of water per inch of soil. The capacity, in inches, in a 60-inch profile or to a limiting layer is expressed as—

	Inches
Very low	0 to 3
Low	3 to 6
Moderate	6 to 9
High	More than 9

Bedrock. The solid rock that underlies the soil and other unconsolidated material or that is exposed at the surface.

Bottom land. The normal flood plain of a stream, subject to frequent flooding.

Boulders. Rock fragments larger than 2 feet (60 centimeters) in diameter.

Calcareous soil. A soil containing enough calcium carbonate (commonly with magnesium carbonate) to effervesce (fizz) visibly when treated with cold, dilute hydrochloric acid. A soil having measurable amounts of calcium carbonate or magnesium carbonate.

Channery soil. A soil that is, by volume, more than 15 percent thin, flat fragments of sandstone, shale, slate, limestone, or schist as much as 6 inches along the longest axis. A single piece is called a fragment.

Clay. As a soil separate, the mineral soil particles less than 0.002 millimeter in diameter. As a soil textural

class, soil material that is 40 percent or more clay, less than 45 percent sand, and less than 40 percent silt.

Clay film. A thin coating of oriented clay on the surface of a soil aggregate or lining pores or root channels. Synonyms: clay coat, clay skin.

Climax vegetation. The stabilized plant community on a particular site. The plant cover reproduces itself and does not change so long as the environment remains the same.

Coarse fragments. Mineral or rock particles up to 3 inches (2 millimeters to 7.5 centimeters) in diameter.

Cobblestone (or cobble). A rounded or partly rounded fragment of rock 3 to 10 inches (7.5 to 25 centimeters) in diameter.

Colluvium. Soil material, rock fragments, or both moved by creep, slide, or local wash and deposited at the bases of steep slopes.

Compressible. Excessive decrease in volume of soft soil under load.

Concretions. Grains, pellets, or nodules of various sizes, shapes, and colors consisting of concentrated compounds or cemented soil grains. The composition of most concretions is unlike that of the surrounding soil. Calcium carbonate and iron oxide are common compounds in concretions.

Consistence, soil. The feel of the soil and the ease with which a lump can be crushed by the fingers. Terms commonly used to describe consistence are—

Loose.—Noncoherent when dry or moist; does not hold together in a mass.

Friable.—When moist, crushes easily under gentle pressure between thumb and forefinger and can be pressed together into a lump.

Firm.—When moist, crushes under moderate pressure between thumb and forefinger, but resistance is distinctly noticeable.

Plastic.—When wet, readily deformed by moderate pressure but can be pressed into a lump; will form a "wire" when rolled between thumb and forefinger.

Sticky.—When wet, adheres to other material and tends to stretch somewhat and pull apart rather than to pull free from other material.

Hard.—When dry, moderately resistant to pressure; can be broken with difficulty between thumb and forefinger.

Soft.—When dry, breaks into powder or individual grains under very slight pressure.

Cemented.—Hard; little affected by moistening.

Control section. The part of the soil on which classification is based. The thickness varies among different kinds of soil, but for many it is 40 or 80 inches (1 or 2 meters).

Corrosive. High risk of corrosion to uncoated steel or deterioration of concrete.

Cover crop. A close-growing crop grown primarily to improve and protect the soil between periods of regular crop production, or a crop grown between trees and vines in orchards and vineyards.

Cutbanks cave. Unstable walls of cuts made by earth-moving equipment. The soil sloughs easily.

Decreasers. The most heavily grazed climax range plants. Because they are the most palatable, they are the first to be destroyed by overgrazing.

Deferred grazing. A delay in grazing until range plants have reached a specified stage of growth. Grazing is deferred in order to increase the vigor of forage and to allow desirable plants to produce seed. Contrasts with continuous grazing and rotation grazing.

Depth to rock. Bedrock at a depth that adversely affects the specified use.

Diversion (or diversion terrace). A ridge of earth, generally a terrace, built to protect downslope areas by diverting runoff from its natural course.

Drainage class (natural). Refers to the frequency and duration of periods of saturation or partial saturation during soil formation, as opposed to altered drainage, which is commonly the result of artificial drainage or irrigation but may be caused by the sudden deepening of channels or the blocking of drainage outlets. Seven classes of natural soil drainage are recognized:

Excessively drained.—Water is removed from the soil very rapidly. Excessively drained soils are commonly very coarse textured, rocky, or shallow. Some are steep. All are free of the mottling related to wetness.

Somewhat excessively drained.—Water is removed from the soil rapidly. Many somewhat excessively drained soils are sandy and rapidly pervious. Some are shallow. Some are so steep that much of the water they receive is lost as runoff. All are free of the mottling related to wetness.

Well drained.—Water is removed from the soil readily, but not rapidly. It is available to plants throughout most of the growing season, and wetness does not inhibit growth of roots for significant periods during most growing seasons. Well drained soils are commonly medium textured. They are mainly free of mottling.

Moderately well drained.—Water is removed from the soil somewhat slowly during some periods. Moderately well drained soils are wet for only a short time during the growing season, but periodically for long enough that most mesophytic crops are affected. They commonly have a slowly pervious layer within or directly below the solum, or periodically receive high rainfall, or both.

Somewhat poorly drained.—Water is removed slowly enough that the soil is wet for significant periods during the growing season. Wetness markedly restricts the growth of mesophytic crops unless artificial drainage is provided. Somewhat poorly drained soils commonly have a slowly pervious layer, a high

water table, additional water from seepage, nearly continuous rainfall, or a combination of these.

Poorly drained.—Water is removed so slowly that the soil is saturated periodically during the growing season or remains wet for long periods. Free water is commonly at or near the surface for long enough during the growing season that most mesophytic crops cannot be grown unless the soil is artificially drained. The soil is not continuously saturated in layers directly below plow depth. Poor drainage results from a high water table, a slowly pervious layer within the profile, seepage, nearly continuous rainfall, or a combination of these.

Very poorly drained.—Water is removed from the soil so slowly that free water remains at or on the surface during most of the growing season. Unless the soil is artificially drained, most mesophytic crops cannot be grown. Very poorly drained soils are commonly level or depressed and are frequently ponded. Yet, where rainfall is high and nearly continuous, they can have moderate or high slope gradients, as for example in "hillpeats" and "climatic moors."

Eolian soil material. Earthy parent material accumulated through wind action; commonly refers to sandy material in dunes or to loess in blankets on the surface.

Erosion. The wearing away of the land surface by running water, wind, ice, or other geologic agents and by such processes as gravitational creep.

Erosion (geologic). Erosion caused by geologic processes acting over long geologic periods and resulting in the wearing away of mountains and the building up of such landscape features as flood plains and coastal plains. Synonym: natural erosion.

Erosion (accelerated). Erosion much more rapid than geologic erosion, mainly as a result of the activities of man or other animals or of a catastrophe in nature, for example, fire, that exposes a bare surface.

Excess salts. Excess water soluble salts. Excessive salts restrict the growth of most plants.

Fallow. Cropland left idle in order to restore productivity through accumulation of moisture. Summer fallow is common in regions of limited rainfall where cereal grains are grown. The soil is tilled for at least one growing season for weed control and decomposition of plant residue.

Fertility, soil. The quality that enables a soil to provide plant nutrients, in adequate amounts and in proper balance, for the growth of specified plants when light, moisture, temperature, tilth, and other growth factors are favorable.

Fine textured (heavy textured) soil. Sandy clay, silty clay, and clay.

Flagstone. A thin fragment of sandstone, limestone, slate, shale, or (rarely) schist, 6 to 15 inches (15 to 37.5 centimeters) long.

Flooding. The temporary covering of soil with water from overflowing streams, runoff from adjacent slopes, and tides. Frequency, duration, and probable dates of occurrence are estimated. Frequency is expressed as none, rare, occasional, and frequent. *None* means that flooding is not probable; *rare* that it is unlikely but possible under unusual weather conditions; *occasional* that it occurs on an average of once or less in 2 years; and *frequent* that it occurs on an average of more than once in 2 years. Duration is expressed as *very brief* if less than 2 days, *brief* if 2 to 7 days, and *long* if more than 7 days. Probable dates are expressed in months; *November-May*, for example, means that flooding can occur during the period November through May. Water standing for short periods after rainfall or commonly covering swamps and marshes is not considered flooding.

Flood plain. A nearly level alluvial plain that borders a stream and is subject to flooding unless protected artificially.

Forage. Plant material used as feed by domestic animals. Forage can be grazed or cut for hay.

Forb. Any herbaceous plant not a grass or a sedge.

Frost action. Freezing and thawing of soil moisture. Frost action can damage structures and plant roots.

Gleyed soil. A soil having one or more neutral gray horizons as a result of waterlogging and lack of oxygen. The term "gleyed" also designates gray horizons and horizons having yellow and gray mottles as a result of intermittent waterlogging.

Grassed waterway. A natural or constructed waterway, typically broad and shallow, seeded to grass as protection against erosion. Conducts surface water away from cropland.

Gravel. Rounded or angular fragments of rock up to 3 inches (2 millimeters to 7.5 centimeters) in diameter. An individual piece is a pebble.

Gravelly soil material. Material from 15 to 50 percent, by volume, rounded or angular rock fragments, not prominently flattened, up to 3 inches (7.5 centimeters) in diameter.

Green manure (agronomy). A soil-improving crop grown to be plowed under in an early stage of maturity or soon after maturity.

Ground water (geology). Water filling all the unblocked pores of underlying material below the water table, which is the upper limit of saturation.

Gully. A miniature valley with steep sides cut by running water and through which water ordinarily runs only after rainfall. The distinction between a gully and a rill is one of depth. A gully generally is an obstacle to farm machinery and is too deep to be obliterated by ordinary tillage; a rill is of lesser depth and can be smoothed over by ordinary tillage.

Gypsum. Hydrous calcium sulphate.

Habitat. The natural abode of a plant or animal; refers to the kind of environment in which a plant or animal normally lives, as opposed to the range or geographical distribution.

Horizon, soil. A layer of soil, approximately parallel to the surface, having distinct characteristics produced by soil-forming processes. The major horizons of mineral soil are as follows:

O horizon.—An organic layer, fresh and decaying plant residue, at the surface of a mineral soil.

A horizon.—The mineral horizon, formed or forming at or near the surface, in which an accumulation of humified organic matter is mixed with the mineral material. Also, a plowed surface horizon most of which was originally part of a B horizon.

A2 horizon.—A mineral horizon, mainly a residual concentration of sand and silt high in content of resistant minerals as a result of the loss of silicate clay, iron, aluminum, or a combination of these.

B horizon.—The mineral horizon below an A horizon. The B horizon is in part a layer of change from the overlying A to the underlying C horizon. The B horizon also has distinctive characteristics caused (1) by accumulation of clay, sesquioxides, humus, or a combination of these; (2) by prismatic or blocky structure; (3) by redder or browner colors than those in the A horizon; or (4) by a combination of these. The combined A and B horizons are generally called the solum, or true soil. If a soil lacks a B horizon, the A horizon alone is the solum.

C horizon.—The mineral horizon or layer, excluding indurated bedrock, that is little affected by soil-forming processes and does not have the properties typical of the A or B horizon. The material of a C horizon may be either like or unlike that from which the solum is presumed to have formed. If the material is known to differ from that in the solum the Roman numeral II precedes the letter C.

R layer.—Consolidated rock beneath the soil. The rock commonly underlies a C horizon, but can be directly below an A or a B horizon.

Humus. The well decomposed, more or less stable part of the organic matter in mineral soils.

Hydrologic soil groups. Refers to soils grouped according to their runoff-producing characteristics. The chief consideration is the inherent capacity of soil bare of vegetation to permit infiltration. The slope and the kind of plant cover are not considered, but are separate factors in predicting runoff. Soils are assigned to four groups. In group A are soils having a high infiltration rate when thoroughly wet and having a low runoff potential. They are mainly deep, well drained, and sandy or gravelly. In group D, at the other extreme, are soils having a very slow infiltration rate and thus a high runoff potential. They have a claypan or clay layer at or near the surface, have a permanent high water table, or are shallow over nearly impervious bedrock or other material. A soil is assigned to two hydrologic groups if part of the acreage is artificially drained and part is undrained.

Increasers. Species in the climax vegetation that increase in amount as the more desirable plants are reduced by close grazing. Increasers commonly are the shorter plants and the less palatable to livestock.

Infiltration. The downward entry of water into the immediate surface of soil or other material, as contrasted with percolation, which is movement of water through soil layers or material.

Infiltration rate. The rate at which water penetrates the surface of the soil at any given instant, usually expressed in inches per hour. The rate can be limited by the infiltration capacity of the soil or the rate at which water is applied at the surface.

Invaders. On range, plants that encroach into an area and grow after the climax vegetation has been reduced by grazing. Generally, invader plants are those that follow disturbance of the surface.

Irrigation. Application of water to soils to assist in production of crops. Methods of irrigation are—

Border.—Water is applied at the upper end of a strip in which the lateral flow of water is controlled by small earth ridges called border dikes, or borders.

Basin.—Water is applied rapidly to nearly level plains surrounded by levees or dikes.

Controlled flooding.—Water is released at intervals from closely spaced field ditches and distributed uniformly over the field.

Corrugation.—Water is applied to small, closely spaced furrows or ditches in fields of close-growing crops or in orchards so that it flows in only one direction.

Furrow.—Water is applied in small ditches made by cultivation implements. Furrows are used for tree and row crops.

Sprinkler.—Water is sprayed over the soil surface through pipes or nozzles from a pressure system.

Subirrigation.—Water is applied in open ditches or tile lines until the water table is raised enough to wet the soil.

Wild flooding.—Water, released at high points, is allowed to flow onto an area without controlled distribution.

Landslide. The rapid downhill movement of a mass of soil and loose rock generally when wet or saturated. The speed and distance of movement, as well as the amount of soil and rock material, vary greatly.

Large stones. Rock fragments 10 inches (25 centimeters) or more across. Large stones adversely affect the specified use.

Leaching. The removal of soluble material from soil or other material by percolating water.

Light textured soil. Sand and loamy sand.

Loam. Soil material that is 7 to 27 percent clay particles, 28 to 50 percent silt particles, and less than 52 percent sand particles.

Loess. Fine grained material, dominantly of silt-sized particles, deposited by wind.

Low strength. Inadequate strength for supporting loads.

Medium textured soil. Very fine sandy loam, loam, silt loam, or silt.

Mineral soil. Soil that is mainly mineral material and low in organic material. Its bulk density is greater than that of organic soil.

Moderately coarse textured (moderately light textured) soil. Sandy loam and fine sandy loam.

Moderately fine textured (moderately heavy textured) soil. Clay loam, sandy clay loam, and silty clay loam.

Mottling, soil. Irregular spots of different colors that vary in number and size. Mottling generally indicates poor aeration and impeded drainage. Descriptive terms are as follows: abundance—*few, common,* and *many*; size—*fine, medium,* and *coarse*; and contrast—*faint, distinct,* and *prominent*. The size measurements are of the diameter along the greatest dimension. *Fine* indicates less than 5 millimeters (about 0.2 inch); *medium*, from 5 to 15 millimeters (about 0.2 to 0.6 inch); and *coarse*, more than 15 millimeters (about 0.6 inch).

Munsell notation. A designation of color by degrees of the three single variables—hue, value, and chroma. For example, a notation of 10YR 6/4 is a color of 10YR hue, value of 6, and chroma of 4.

Neutral soil. A soil having a pH value between 6.6 and 7.3.

Nutrient, plant. Any element taken in by a plant, essential to its growth, and used by it in the production of food and tissue. Plant nutrients are nitrogen, phosphorus, potassium, calcium, magnesium, sulfur, iron, manganese, copper, boron, zinc, and perhaps other elements obtained from the soil; and carbon, hydrogen, and oxygen obtained largely from the air and water.

Outwash plain. A land form of mainly sandy or coarse textured material of glaciofluvial origin. An outwash plain is commonly smooth; where pitted, it is generally low in relief.

Parent material. The great variety of unconsolidated organic and mineral material in which soil forms. Consolidated bedrock is not yet parent material by this concept.

Ped. An individual natural soil aggregate, such as a granule, a prism, or a block.

Pedon. The smallest volume that can be called "a soil." A pedon is three dimensional and large enough to permit study of all horizons. Its area ranges from about 10 to 100 square feet (1 square meter to 10 square meters), depending on the variability of the soil.

Percolation. The downward movement of water through the soil.

Percs slowly. The slow movement of water through the soil adversely affecting the specified use.

Permeability. The quality that enables the soil to transmit water or air, measured as the number of inches per hour that water moves through the soil. Terms describing permeability are *very slow* (less than 0.06 inch), *slow* (0.06 to 0.20 inch), *moderately slow* (0.2 to 0.6 inch), *moderate* (0.6 to 2.0 inches), *moderately rapid* (2.0 to 6.0 inches), *rapid* (6.0 to 20 inches), and *very rapid* (more than 20 inches).

pH value. (See Reaction, soil). A numerical designation of acidity and alkalinity in soil.

Piping. Moving water in subsurface tunnels or pipelike cavities in the soil.

Poorly graded. Refers to soil material consisting mainly of particles of nearly the same size. Because there is little difference in size of the particles, density can be increased only slightly by compaction.

Productivity (soil). The capability of a soil for producing a specified plant or sequence of plants under a specified system of management. Productivity is measured in terms of output, or harvest, in relation to input.

Range (or rangeland). Land that, for the most part, produces native plants suitable for grazing by livestock; includes land supporting some forest trees.

Range condition. The health or productivity of forage plants on a given range, in terms of the potential productivity under normal climate and the best practical management. Condition classes generally recognized are—*excellent, good, fair,* and *poor*. The classification is based on the percentage of original, or assumed climax vegetation on a site, as compared to what has been observed to grow on it when well managed.

Reaction, soil. The degree of acidity or alkalinity of a soil, expressed in pH values. A soil that tests to pH 7.0 is described as precisely neutral in reaction because it is neither acid nor alkaline. The degree of acidity or alkalinity is expressed as—

	pH
Extremely acid	Below 4.5
Very strongly acid	4.5 to 5.0
Strongly acid	5.1 to 5.5
Medium acid	5.6 to 6.0
Slightly acid	6.1 to 6.5
Neutral	6.6 to 7.3
Mildly alkaline	7.4 to 7.8
Moderately alkaline	7.9 to 8.4
Strongly alkaline	8.5 to 9.0
Very strongly alkaline	9.1 and higher

Relief. The elevations or inequalities of a land surface, considered collectively.

Residuum (residual soil material). Unconsolidated, weathered, or partly weathered mineral material that accumulates over disintegrating rock.

Rock fragments. Rock or mineral fragments having a diameter of 2 millimeters or more; for example, pebbles, cobbles, stones, and boulders.

Rooting depth. Shallow root zone. The soil is shallow over a layer that greatly restricts roots. See Root zone.

Root zone. The part of the soil that can be penetrated by plant roots.

Runoff. The precipitation discharged in stream channels from a drainage area. The water that flows off the land surface without sinking in is called surface runoff; that which enters the ground before reaching surface streams is called ground-water runoff or seepage flow from ground water.

Saline soil. A soil containing soluble salts in an amount that impairs growth of plants. A saline soil does not contain excess exchangeable sodium.

Sand. As a soil separate, individual rock or mineral fragments from 0.05 millimeter to 2.0 millimeters in diameter. Most sand grains consist of quartz. As a soil textural class, a soil that is 85 percent or more sand and not more than 10 percent clay.

Sandstone. Sedimentary rock containing dominantly sand-size particles.

Sedimentary rock. Rock made up of particles deposited from suspension in water. The chief kinds of sedimentary rock are conglomerate, formed from gravel; sandstone, formed from sand; shale, formed from clay; and limestone, formed from soft masses of calcium carbonate. There are many intermediate types. Some wind-deposited sand is consolidated into sandstone.

Seepage. The rapid movement of water through the soil. Seepage adversely affects the specified use.

Shale. Sedimentary rock formed by the hardening of a clay deposit.

Sheet erosion. The removal of a fairly uniform layer of soil material from the land surface by the action of rainfall and runoff water.

Shrink-swell. The shrinking of soil when dry and the swelling when wet. Shrinking and swelling can damage roads, dams, building foundations, and other structures. It can also damage plant roots.

Silt. As a soil separate, individual mineral particles that range in diameter from the upper limit of clay (0.002 millimeter) to the lower limit of very fine sand (0.05 millimeter). As a soil textural class, soil that is 80 percent or more silt and less than 12 percent clay.

Siltstone. Sedimentary rock made up of dominantly silt-sized particles.

Site index. A designation of the quality of a forest site based on the height of the dominant stand at an arbitrarily chosen age. For example, if the average height attained by dominant and codominant trees in a fully stocked stand at the age of 50 years is 75 feet, the site index is 75 feet.

Slickensides. Polished and grooved surfaces produced by one mass sliding past another. In soils, slickensides may occur at the bases of slip surfaces on the steeper slopes; on faces of blocks, prisms, and columns; and in swelling clayey soils, where there is marked change in moisture content.

Slick spot. Locally, a small area of soil having a puddled, crusted, or smooth surface and an excess of exchangeable sodium. The soil is generally silty or clayey, is slippery when wet, and is low in productivity.

Slope. The inclination of the land surface from the horizontal. Percentage of slope is the vertical distance divided by horizontal distance, then multiplied by 100. Thus, a slope of 20 percent is a drop of 20 feet in 100 feet of horizontal distance.

Slow intake. The slow movement of water into the soil.

Small stones. Rock fragments 3 to 10 inches (7.5 to 25 centimeters) in diameter. Small stones adversely affect the specified use.

Soil. A natural, three-dimensional body at the earth's surface that is capable of supporting plants and has properties resulting from the integrated effect of climate and living matter acting on earthy parent material, as conditioned by relief over periods of time.

Soil separates. Mineral particles less than 2 millimeters in equivalent diameter and ranging between specified size limits. The names and sizes of separates recognized in the United States are as follows: *very coarse sand* (2.0 millimeters to 1.0 millimeter); *coarse sand* (1.0 to 0.5 millimeter); *medium sand* (0.5 to 0.25 millimeter); *fine sand* (0.25 to 0.10 millimeter); *very fine sand* (0.10 to 0.05 millimeter); *silt* (0.05 to 0.002 millimeter); and *clay* (less than 0.002 millimeter).

Solum. The upper part of a soil profile, above the C horizon, in which the processes of soil formation are active. The solum in mature soil consists of the A and B horizons. Generally, the characteristics of the material in these horizons are unlike those of the underlying material. The living roots and other plant and animal life characteristics of the soil are largely confined to the solum.

Stones. Rock fragments 10 to 24 inches (25 to 60 centimeters) in diameter.

Stony. Refers to a soil containing stones in numbers that interfere with or prevent tillage.

Stratified. Arranged in strata, or layers. The term refers to geologic material. Layers in soils that result from the processes of soil formation are called horizons; those inherited from the parent material are called strata.

Structure, soil. The arrangement of primary soil particles into compound particles or aggregates that are separated from adjoining aggregates. The principal forms of soil structure are—*platy* (laminated), *prismatic* (vertical axis of aggregates longer than hori-

zontal), *columnar* (prisms with rounded tops), *blocky* (angular or subangular), and *granular. Structureless* soils are either *single grained* (each grain by itself, as in dune sand) or *massive* (the particles adhering without any regular cleavage, as in many hardpans).

Subsoil. Technically, the B horizon; roughly, the part of the solum below plow depth.

Substratum. The part of the soil below the solum.

Subsurface layer. Technically, the A2 horizon. Generally refers to a leached horizon lighter in color and lower in content of organic matter than the overlying surface layer.

Surface soil. The soil ordinarily moved in tillage, or its equivalent in uncultivated soil, ranging in depth from 4 to 10 inches (10 to 25 centimeters). Frequently designated as the "plow layer," or the "Ap horizon."

Taxadjuncts. Soils that cannot be classified in a series recognized in the classification system. Such soils are named for a series they strongly resemble and are designated as taxadjuncts to that series because they differ in ways too small to be of consequence in interpreting their use or management.

Terrace (geologic). An old alluvial plain, ordinarily flat or undulating, bordering a river, a lake, or the sea. A stream terrace is frequently called a second bottom, in contrast with a flood plain, and is seldom subject to overflow. A marine terrace, generally wide, was deposited by the sea.

Texture, soil. The relative proportions of sand, silt, and clay particles in a mass of soil. The basic textural classes, in order of increasing proportion of fine particles, are *sand, loamy sand, sandy loam, loam, silt, silt loam, sandy clay loam, clay loam, silty clay loam, sandy clay, silty clay,* and *clay.* The sand, loamy sand, and sandy loam classes may be further divided by specifying "coarse," "fine," or "very fine."

Thin layer. Otherwise suitable soil material too thin for the specified use.

Toe slope. The outermost inclined surface at the base of a hill; part of a foot slope.

Topsoil (engineering). Presumably a fertile soil or soil material, or one that responds to fertilization, ordinarily rich in organic matter, used to topdress roadbanks, lawns, and gardens.

Upland (geology). Land at a higher elevation, in general, than the alluvial plain or stream terrace; land above the lowlands along streams.

Variant, soil. A soil having properties sufficiently different from those of other known soils to justify a new series name, but the limited geographic soil area does not justify creation of a new series.

Water table. The upper limit of the soil or underlying rock material that is wholly saturated with water.
Water table, apparent. A thick zone of free water in the soil. An apparent water table is indicated by the level at which water stands in an uncased borehole after adequate time is allowed for adjustment in the surrounding soil.
Water table, artesian. A water table under hydrostatic head, generally beneath an impermeable layer. When this layer is penetrated, the water level rises in an uncased borehole.
Water table, perched. A water table standing above an unsaturated zone. In places an upper, or perched, water table is separated from a lower one by a dry zone.

Weathering. All physical and chemical changes produced in rocks or other deposits at or near the earth's surface by atmospheric agents. These changes result in disintegration and decomposition of the material.

Well graded. Refers to a soil or soil material consisting of particles well distributed over a wide range in size or diameter. Such a soil normally can be easily increased in density and bearing properties by compaction. Contrasts with poorly graded soil.

ILLUSTRATIONS

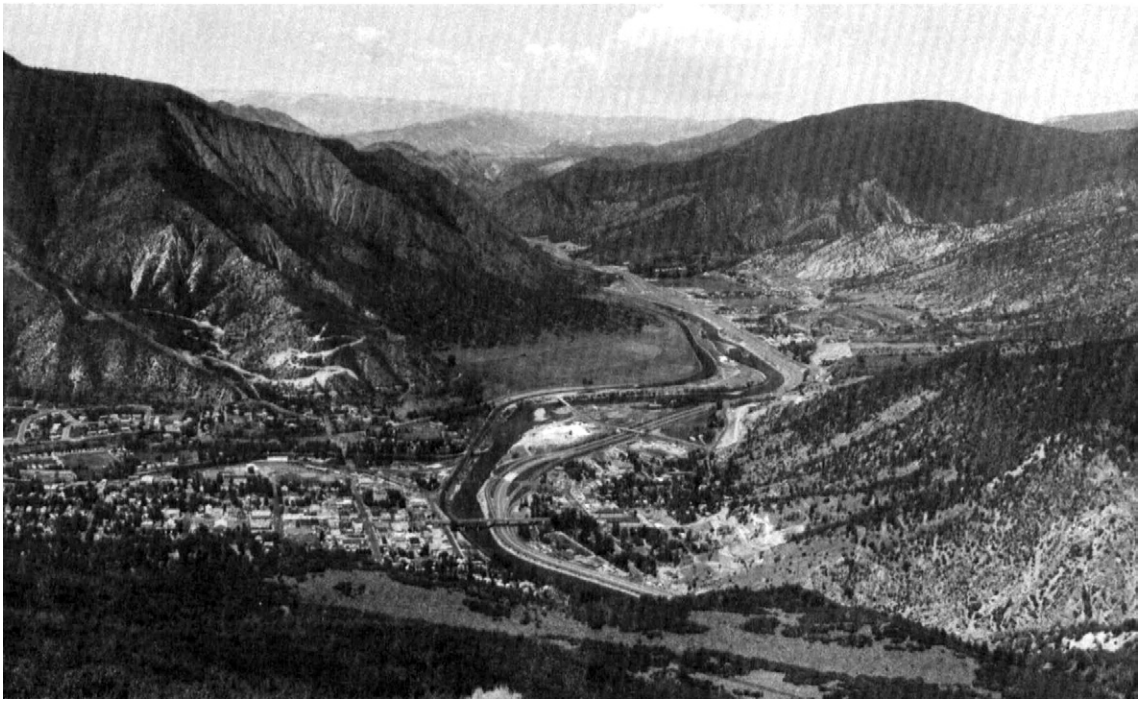


Figure 1.—Glenwood Springs is a center for tourism and year-round recreation.

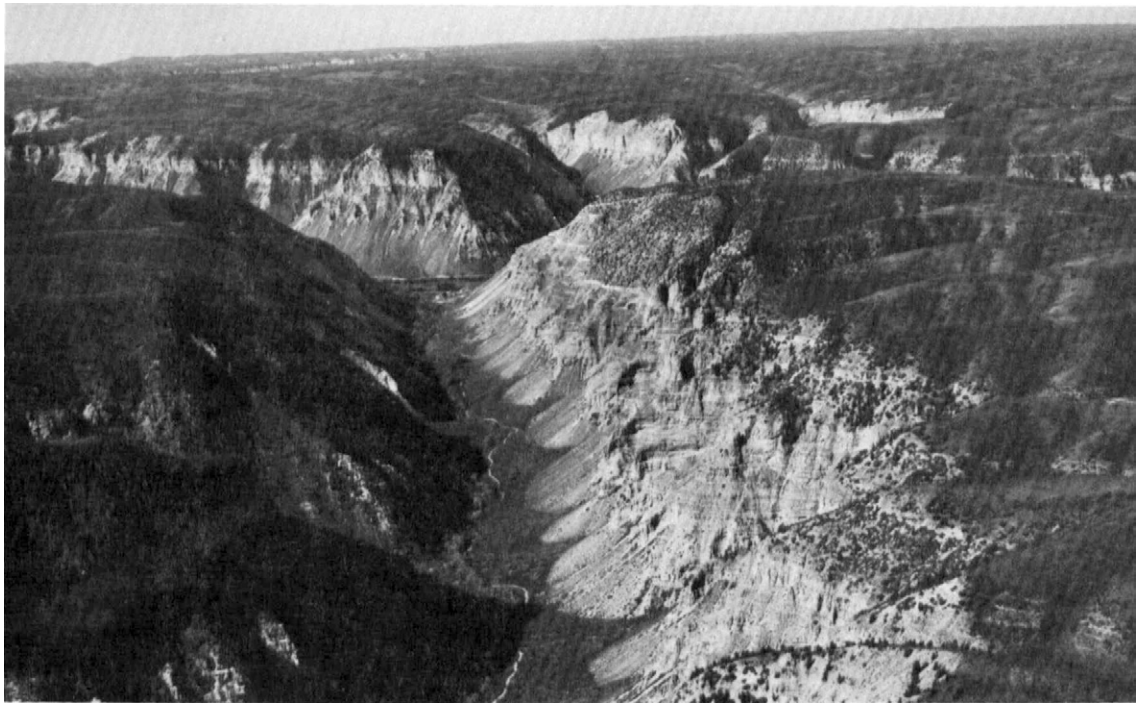


Figure 2.—East fork of Parachute Creek on the Roan Plateau.

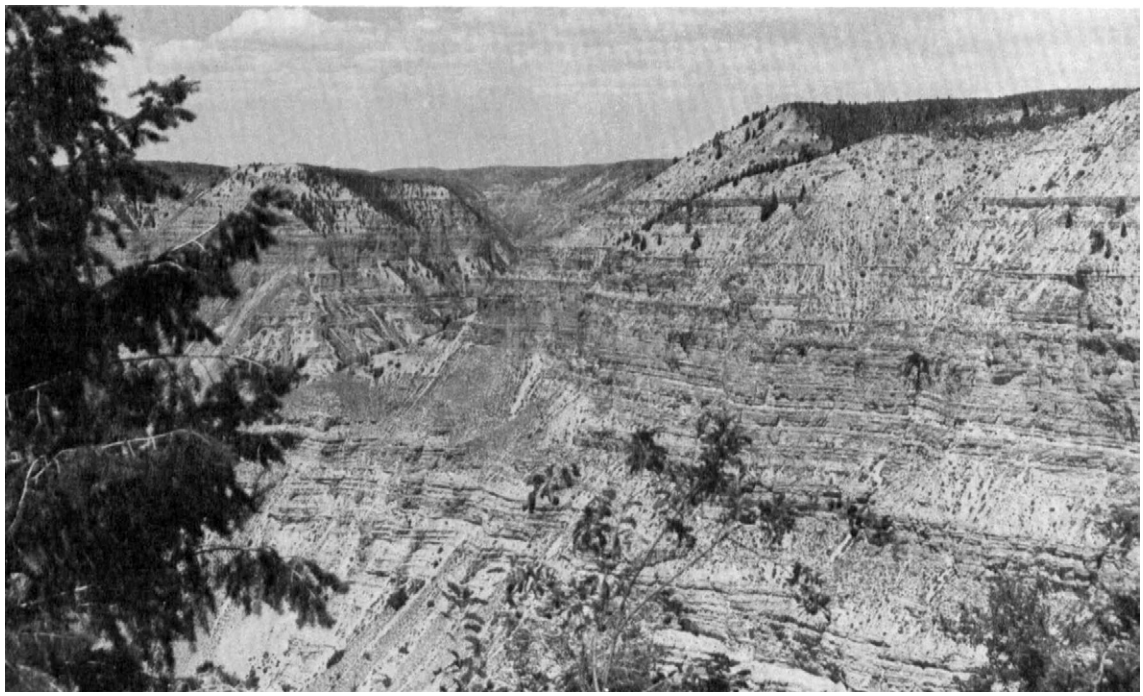


Figure 3.—Exposures of the Green River Formation oil shale in Rock outcrop-Torriorthents complex, very steep.

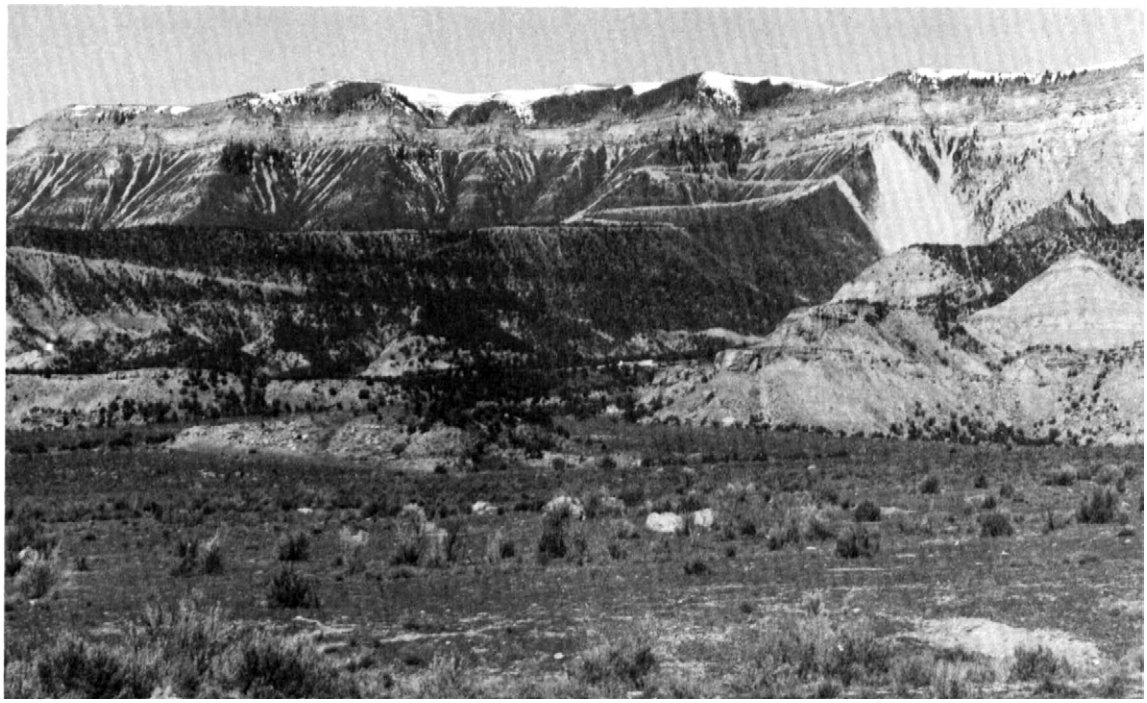


Figure 4.—Area of Arvada loam, 1 to 6 percent slopes, in foreground.



Figure 5.—Irrigated alfalfa on Heldt clay loam, 1 to 3 percent slopes, in foreground.

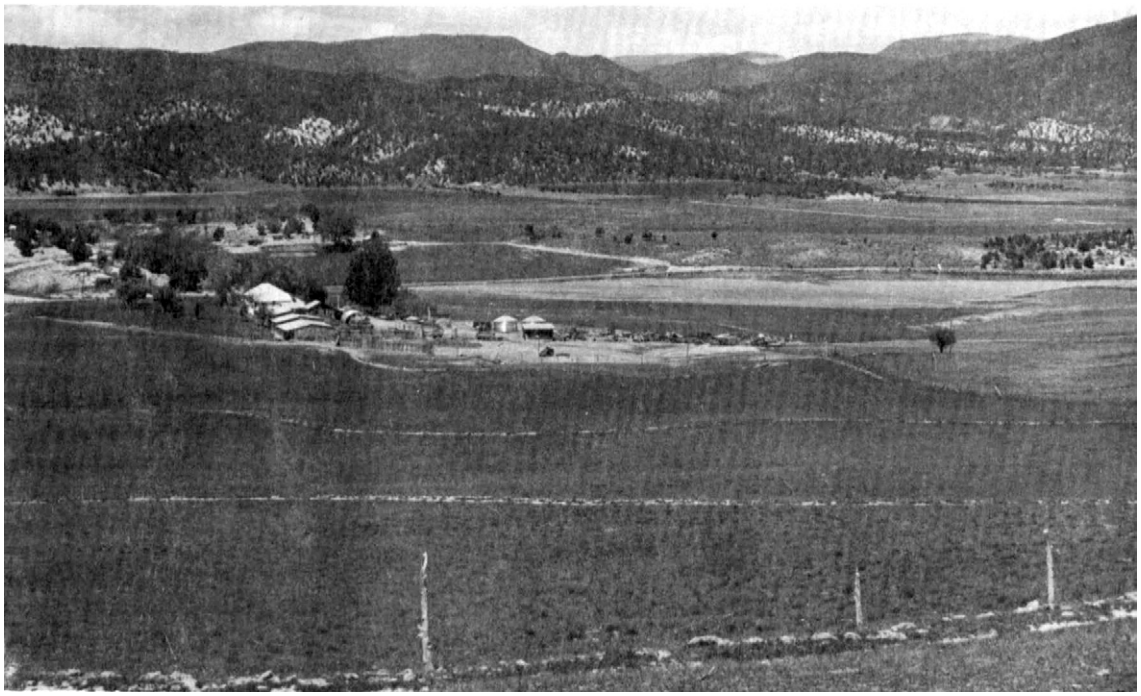


Figure 6.—Irrigated alfalfa on Heldt clay loam, 6 to 12 percent slopes, in foreground.



Figure 7.—Irrigated hay on Holderness Variant clay loam, 6 to 25 percent slopes, in center.



Figure 8.—Highly productive pasture on Morval loam, 3 to 12 percent slopes.

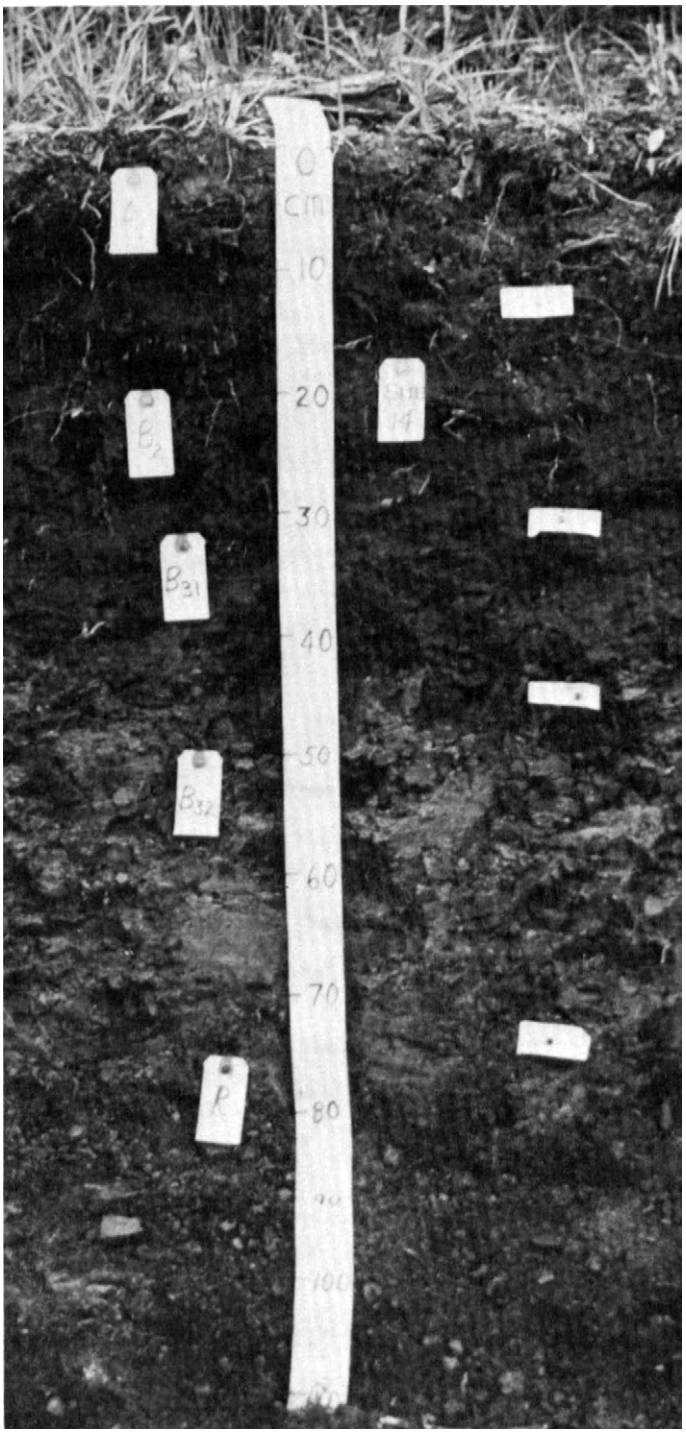


Figure 9.—Typical profile of Parachute loam.



Figure 10.—Orchards and pasture on Potts loam, 3 to 6 percent slopes, and Potts loam, 6 to 12 percent slopes.

TABLES

TABLE 1.--TEMPERATURE AND PRECIPITATION DATA*

Month	Temperature*						Precipitation*				
	Average daily maximum	Average daily minimum	Average daily	2 years in 10 will have-- Maximum temperature higher than--	2 years in 10 will have-- Minimum temperature lower than--	Average number of growing degree days**	Average	2 years in 10 will have-- Less than--	2 years in 10 will have-- More than--	Average number of days with 0.10 inch or more	Average snowfall
	°F	°F	°F	°F	°F		In	In	In		In
January----	36.2	9.2	22.7	53	-18	16	0.90	0.31	1.36	3	13.5
February---	42.9	15.4	29.2	61	-12	33	0.73	0.25	1.11	2	8.5
March------	52.2	22.6	37.4	73	3	69	0.70	0.28	1.04	3	4.6
April------	62.9	29.9	46.4	80	14	201	0.83	0.50	1.11	3	1.8
May--------	73.9	37.7	55.8	89	23	490	0.82	0.19	1.31	3	.0
June-------	83.3	44.0	63.7	96	31	711	0.88	0.21	1.41	2	.0
July-------	89.6	50.5	70.1	98	38	933	0.82	0.27	1.25	3	.0
August-----	86.8	49.4	68.1	96	36	871	1.32	0.55	1.93	4	.0
September--	78.9	39.8	59.4	93	25	582	1.03	0.28	1.62	3	.3
October----	67.5	30.5	49.0	84	15	285	1.27	0.40	1.96	3	.8
November---	50.6	21.2	35.9	69	1	40	0.85	0.45	1.17	3	5.9
December---	37.9	11.4	24.7	61	-13	11	1.10	0.43	1.57	4	14.5
Year-----	63.6	30.1	46.9	98	-23	4,242	11.25	8.61	13.62	36	49.9

*Recorded in the period 1951-74 at Rifle, CO.

**A growing degree day is an index of the amount of heat available for plant growth. It can be calculated by adding the maximum and minimum daily temperatures, dividing the sum by 2, and subtracting the temperature below which growth is minimal for the principal crops in the area (40° F).

TABLE 2.--FREEZE DATES IN SPRING AND FALL

Probability	Minimum temperature*		
	24° F. or lower	28° F or lower	32° F or lower
Last freezing temperature in spring:			
1 year in 10 later than--	May 15	May 26	June 14
2 years in 10 later than--	May 9	May 21	June 8
5 years in 10 later than--	April 29	May 11	May 27
First freezing temperature in fall:			
1 year in 10 earlier than--	September 28	September 14	September 1
2 years in 10 earlier than--	October 4	September 20	September 7
5 years in 10 earlier than--	October 14	September 30	September 18

*Recorded in the period 1951-74 at Rifle, CO.

TABLE 3.--GROWING SEASON LENGTH

Probability	Daily minimum temperature during growing season*		
	Higher than 24° F	Higher than 28° F	Higher than 32° F
	Days	Days	Days
9 years in 10	148	119	84
8 years in 10	155	126	94
5 years in 10	168	141	113
2 years in 10	181	156	133
1 year in 10	188	164	143

*Recorded in the period 1951-74 at Rifle, CO.

TABLE 4.--ACREAGE AND PROPORTIONATE EXTENT OF THE SOILS

Map symbol	Soil name	Garfield County	Mesa County	Total-- Area	Total-- Extent
		Acres	Acres	Acres	Pct
1	Almy Variant loam, 25 to 65 percent slopes	2,000	0	2,000	0.3
2	Arle-Ansari-Rock outcrop complex, 12 to 65 percent slopes	10,200	0	10,200	1.6
3	Arvada loam, 1 to 6 percent slopes	10,000	0	10,000	1.6
4	Arvada loam, 6 to 20 percent slopes	5,300	0	5,300	0.8
5	Ascalon fine sandy loam, 1 to 6 percent slopes	1,200	0	1,200	0.2
6	Ascalon fine sandy loam, 6 to 12 percent slopes	2,800	0	2,800	0.5
7	Ascalon-Pena complex, 6 to 25 percent slopes	6,300	0	6,300	1.0
8	Atencio-Azeltine complex, 1 to 3 percent slopes	1,700	0	1,700	0.3
9	Badland	9,500	0	9,500	1.5
10	Begay sandy loam, 1 to 6 percent slopes	600	0	600	0.1
11	Begay sandy loam, 6 to 12 percent slopes	900	0	900	0.1
12	Bucklon-Inchau loams, 25 to 50 percent slopes	25,150	2,350	27,500	4.4
13	Chilton channery loam, 3 to 6 percent slopes	900	0	900	0.1
14	Chilton channery loam, 6 to 12 percent slopes	700	0	700	0.1
15	Chilton channery loam, 12 to 25 percent slopes	600	0	600	0.1
16	Cimarron loam, 2 to 12 percent slopes	1,600	0	1,600	0.3
17	Cochetopa loam, 9 to 50 percent slopes	16,600	500	17,100	2.7
18	Cochetopa-Jerry complex, 12 to 25 percent slopes	1,200	0	1,200	0.2
19	Cochetopa-Jerry complex, 25 to 50 percent slopes	14,700	0	14,700	2.3
20	Cryaquolls, nearly level	300	0	300	*
21	Cushman-Lazear stony loams, 15 to 65 percent slopes	22,000	0	22,000	3.5
22	Dateman gravelly loam, 30 to 50 percent slopes	9,600	0	9,600	1.5
23	Detra fine sandy loam, 12 to 25 percent slopes	3,800	0	3,800	0.6
24	Dollard-Rock outcrop, shale, complex, 25 to 65 percent slopes	7,400	0	7,400	1.2
25	Etoe loam, 15 to 50 percent slopes	6,300	0	6,300	1.0
26	Farlow-Rock outcrop association, steep	7,600	0	7,600	1.2
27	Halaquepts, nearly level	2,000	0	2,000	0.3
28	Heldt clay loam, 1 to 3 percent slopes	900	0	900	0.1
29	Heldt clay loam, 3 to 6 percent slopes	2,000	0	2,000	0.3
30	Heldt clay loam, 6 to 12 percent slopes	3,700	0	3,700	0.6
31	Heldt clay loam, 12 to 25 percent slopes	2,160	0	2,160	0.3
32	Holderness Variant clay loam, 6 to 25 percent slopes	2,100	0	2,100	0.3
33	Ildefonso stony loam, 6 to 25 percent slopes	2,000	500	2,500	0.4
34	Ildefonso stony loam, 25 to 45 percent slopes	10,150	850	11,000	1.7
35	Ildefonso-Lazear complex, 6 to 65 percent slopes	6,700	0	6,700	1.1
36	Irigul channery loam, 9 to 50 percent slopes	14,800	0	14,800	2.4
37	Irigul channery loam, 50 to 75 percent slopes	2,800	0	2,800	0.5
38	Irigul-Starman channery loams, 5 to 50 percent slopes	4,700	0	4,700	0.8
39	Jerry loam, 12 to 50 percent slopes	28,700	0	28,700	4.6
40	Kim loam, 3 to 6 percent slopes	2,100	0	2,100	0.3
41	Kim loam, 6 to 12 percent slopes	1,200	0	1,200	0.2
42	Lamphier loam, 15 to 50 percent slopes	21,800	0	21,800	3.5
43	Limon silty clay loam, 3 to 12 percent slopes	600	0	600	0.1
44	Morval loam, 3 to 12 percent slopes	2,100	0	2,100	0.3
45	Morval-Tridell complex, 6 to 25 percent slopes	15,200	0	15,200	2.4
46	Nihill channery loam, 1 to 6 percent slopes	2,500	200	2,700	0.4
47	Nihill channery loam, 6 to 25 percent slopes	6,300	0	6,300	1.0
48	Northwater loam, 15 to 65 percent slopes	16,100	0	16,100	2.6
49	Olney loam, 1 to 3 percent slopes	800	0	800	0.1
50	Olney loam, 3 to 6 percent slopes	2,600	0	2,600	0.4
51	Olney loam, 6 to 12 percent slopes	5,300	0	5,300	0.8
52	Parachute loam, 25 to 65 percent slopes	8,700	0	8,700	1.4
53	Parachute-Rhone loams, 5 to 30 percent slopes	38,100	0	38,100	6.1
54	Potts loam, 1 to 3 percent slopes	1,900	0	1,900	0.3
55	Potts loam, 3 to 6 percent slopes	15,800	200	16,000	2.5
56	Potts loam, 6 to 12 percent slopes	15,150	550	15,700	2.5
57	Potts-Ildefonso complex, 3 to 12 percent slopes	3,800	0	3,800	0.6
58	Potts-Ildefonso complex, 12 to 25 percent slopes	7,300	100	7,400	1.2
59	Potts-Ildefonso complex, 25 to 45 percent slopes	2,750	50	2,800	0.4
60	Rhone loam, 5 to 30 percent slopes	7,800	0	7,800	1.2
61	Rhone loam, 30 to 70 percent slopes	5,300	0	5,300	0.8
62	Rock outcrop-Torriorthents complex, very steep	25,700	0	25,700	4.1
63	Silas loam, 3 to 12 percent slopes	2,800	0	2,800	0.5
64	Tanna silty clay loam, 25 to 45 percent slopes	3,700	0	3,700	0.6
65	Torrifluvents, nearly level	7,600	0	7,600	1.2
66	Torriorthents-Camborthids-Rock outcrop complex, steep	51,600	200	51,800	8.3
67	Torriorthents-Rock outcrop complex, steep	66,850	950	67,700	10.8
68	Vale silt loam, 3 to 6 percent slopes	4,000	0	4,000	0.6

See footnote at end of table.

TABLE 4.--ACREAGE AND PROPORTIONATE EXTENT OF THE SOILS--Continued

Map symbol	Soil name	Garfield County	Mesa County	Total-- Area	Total-- Extent
		Acres	Acres	Acres	Pct
69	Vale silt loam, 6 to 12 percent slopes	7,500	0	7,500	1.2
70	Vale silt loam, 12 to 25 percent slopes	2,000	0	2,000	0.3
71	Villa Grove-Zoltay loams, 15 to 30 percent slopes	12,650	450	13,100	2.1
72	Wann sandy loam, 1 to 3 percent slopes	2,000	0	2,000	0.3
	Water	1,700	0	1,700	0.3
	Total	622,928	6,932	629,860	100.0

* Less than 0.1 percent.

TABLE 5.--YIELDS PER ACRE OF CROPS AND PASTURE

[Yields in the N columns are for nonirrigated soils; those in the I columns are for irrigated soils. Yields are those that can be expected under a high level of management. Absence of a yield indicates that the soil is not suited to the crop or the crop generally is not grown on the soil]

Soil name and map symbol	Wheat		Barley		Oats		Alfalfa hay		Corn silage	
	N	I	N	I	N	I	N	I	N	I
	Bu	Bu	Bu	Bu	Bu	Bu	Ton	Ton	Ton	Ton
1---------- Almy Variant	---	---	---	---	---	---	---	---	---	---
2---------- Arle-Ansari-Rock outcrop	---	---	---	---	---	---	---	---	---	---
3---------- Arvada	---	40	---	60	---	80	---	3.0	---	---
4---------- Arvada	---	---	---	---	---	---	---	---	---	---
5---------- Ascalon	19	55	30	80	40	100	---	4.0	---	25
6---------- Ascalon	17	45	25	60	30	80	---	3.0	---	---
7---------- Ascalon-Pena	---	---	---	---	---	---	---	---	---	---
8---------- Atencio-Azeltine	---	55	---	65	---	80	---	3.0	---	---
9*. Badland										
10---------- Begay	18	60	20	80	40	75	---	4.0	---	---
11---------- Begay	15	50	---	65	30	60	---	2.5	---	---
12---------- Bucklon-Inchau	---	---	---	---	---	---	---	---	---	---
13, 14, 15---------- Chilton	---	---	---	---	---	---	---	---	---	---
16---------- Cimarron	---	---	---	---	---	---	---	---	---	---
17---------- Cochetopa	---	---	---	---	---	---	---	---	---	---
18, 19---------- Cochetopa-Jerry	---	---	---	---	---	---	---	---	---	---
20*. Cryaquolls										
21---------- Cushman-Lazear	---	---	---	---	---	---	---	---	---	---
22---------- Dateman	---	---	---	---	---	---	---	---	---	---
23---------- Detra	---	---	---	---	---	---	---	---	---	---
24---------- Dollard-Rock outcrop	---	---	---	---	---	---	---	---	---	---

See footnote at end of table.

TABLE 5.--YIELDS PER ACRE OF CROPS AND PASTURE--Continued

Soil name and map symbol	Wheat		Barley		Oats		Alfalfa hay		Corn silage	
	N	I	N	I	N	I	N	I	N	I
	Bu	Bu	Bu	Bu	Bu	Bu	Ton	Ton	Ton	Ton
25---------- Etoe	---	---	---	---	---	---	---	---	---	---
26*: Farlow----------	---	---	---	---	---	---	---	---	---	---
Rock outcrop.										
27*. Halaquepts										
28---------- Heldt	---	55	---	85	---	90	---	4.5	---	25
29---------- Heldt	---	55	---	80	---	85	---	4.0	---	---
30, 31---------- Heldt	---	50	---	70	---	75	---	3.0	---	---
32---------- Holderness Variant	---	---	---	---	---	30	---	2.5	---	---
33---------- Ildefonso	---	---	---	---	---	---	---	---	---	---
34---------- Ildefonso	---	---	---	---	---	---	---	---	---	---
35---------- Ildefonso-Lazear	---	---	---	---	---	---	---	---	---	---
36, 37---------- Irigul	---	---	---	---	---	---	---	---	---	---
38---------- Irigul-Starman	---	---	---	---	---	---	---	---	---	---
39---------- Jerry	---	---	---	---	---	---	---	---	---	---
40---------- Kim	---	50	---	80	---	100	---	4.5	---	25
41---------- Kim	---	40	---	60	---	80	---	3.0	---	---
42---------- Lamphier	---	---	---	---	---	---	---	---	---	---
43---------- Limon	---	40	---	60	---	---	---	3.5	---	---
44---------- Morval	---	25	---	30	---	---	---	---	---	---
45---------- Morval-Tridell	---	---	---	---	---	---	---	---	---	---
46. Nihill										
47---------- Nihill	---	---	---	---	---	---	---	2.0	---	---
48---------- Northwater	---	---	---	---	---	---	---	---	---	---

See footnote at end of table.

TABLE 5.--YIELDS PER ACRE OF CROPS AND PASTURE--Continued

Soil name and map symbol	Wheat		Barley		Oats		Alfalfa hay		Corn silage	
	N	I	N	I	N	I	N	I	N	I
	Bu	Bu	Bu	Bu	Bu	Bu	Ton	Ton	Ton	Ton
49---------- Olney	---	55	---	85	---	100	---	4.5	---	25
50---------- Olney	---	45	---	80	---	90	---	4.0	---	20
51---------- Olney	---	35	---	60	---	80	---	3.5	---	15
52---------- Parachute	---	---	---	---	---	---	---	---	---	---
53---------- Parachute-Rhone	---	---	---	---	---	---	---	---	---	---
54---------- Potts	25	55	40	80	40	100	---	5.0	---	25
55---------- Potts	20	45	30	60	30	70	---	4.0	---	---
56---------- Potts	18	40	25	55	25	65	---	3.5	---	---
57, 58---------- Potts-Ildefonso	---	---	---	---	---	---	---	---	---	---
59---------- Potts-Ildefonso	---	---	---	---	---	---	---	---	---	---
60---------- Rhone	---	---	---	---	---	---	---	---	---	---
61---------- Rhone	---	---	---	---	---	---	---	---	---	---
62---------- Rock outcrop-Torriorthents	---	---	---	---	---	---	---	---	---	---
63---------- Silas	---	---	---	---	---	---	---	---	---	---
64---------- Tanna	---	---	---	---	---	---	---	---	---	---
65*. Torrifluvents										
66---------- Torriorthents-Camborthids-Rock outcrop	---	---	---	---	---	---	---	---	---	---
67---------- Torriorthents-Rock outcrop	---	---	---	---	---	---	---	---	---	---
68---------- Vale	25	55	40	80	35	100	2.0	5.0	---	---
69, 70---------- Vale	20	45	30	60	30	70	1.5	4.0	---	---
71---------- Villa Grove-Zoltay	---	---	---	---	---	---	---	---	---	---
72---------- Wann	---	---	---	---	---	70	---	3.5	---	---

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 6.--RANGELAND PRODUCTIVITY AND CHARACTERISTIC PLANT COMMUNITIES

[Only the soils that support rangeland vegetation suitable for grazing are listed]

Soil name and map symbol	Range site name	Total production		Characteristic vegetation	Composition
		Kind of year	Dry weight		
			Lb/acre		Pct
1----------	Brushy Loam----------	Favorable	3,000	Mountain brome----------	20
Almy Variant		Normal	2,000	Gambel oak----------	20
		Unfavorable	1,500	Elk sedge----------	10
				Slender wheatgrass----------	5
				Western wheatgrass----------	5
				Mountain snowberry----------	5
				Nodding bromegrass----------	5
				Utah serviceberry----------	5
				Aspen peavine----------	5
				Big sagebrush----------	5
				Mountain snowberry----------	5
				Saskatoon serviceberry--------	5
2*:					
Arle----------	Loamy Slopes----------	Favorable	1,200	Western wheatgrass----------	20
		Normal	900	Indian ricegrass----------	15
		Unfavorable	500	Bluebunch wheatgrass----------	15
				Gambel oak----------	10
				Needleandthread----------	8
				Utah serviceberry----------	7
				True mountainmahogany---------	7
				Big sagebrush----------	5
Ansari----------	Loamy Breaks----------	Favorable	850	Indian ricegrass----------	20
		Normal	700	Western wheatgrass----------	15
		Unfavorable	500	Pinyon----------	15
				Juniper----------	5
				Big sagebrush----------	5
				Utah serviceberry----------	5
				Needleandthread----------	5
Rock outcrop.					
3----------	Salt Flats----------	Favorable	900	Western wheatgrass----------	10
Arvada		Normal	650	Alkali sacaton----------	10
		Unfavorable	500	Inland saltgrass----------	10
				Winterfat----------	5
				Bottlebrush squirreltail------	5
				Gardner saltbush----------	5
				Greasewood----------	5
4----------	Alkaline Slopes----------	Favorable	700	Big sagebrush----------	20
Arvada		Normal	500	Greasewood----------	20
		Unfavorable	400	Galleta----------	10
				Shadscale----------	10
				Bottlebrush squirreltail------	5
				Western wheatgrass----------	5
5, 6----------	Deep Loam----------	Favorable	1,800	Needleandthread----------	20
Ascalon		Normal	1,500	Western wheatgrass----------	15
		Unfavorable	700	Bluebunch wheatgrass----------	10
				Big sagebrush----------	10
				Utah serviceberry----------	5
7*:					
Ascalon----------	Deep Loam----------	Favorable	1,800	Needleandthread----------	20
		Normal	1,500	Western wheatgrass----------	15
		Unfavorable	700	Bluebunch wheatgrass----------	10
				Big sagebrush----------	10
				Utah serviceberry----------	5

See footnote at end of table.

TABLE 6.--RANGELAND PRODUCTIVITY AND CHARACTERISTIC PLANT COMMUNITIES--Continued

Soil name and map symbol	Range site name	Total production		Characteristic vegetation	Composition
		Kind of year	Dry weight		
			Lb/acre		Pct
7*:					
Pena	Loamy Slopes	Favorable	1,200	True mountainmahogany	15
		Normal	900	Big sagebrush	10
		Unfavorable	500	Utah serviceberry	10
				Bluebunch wheatgrass	10
				Western wheatgrass	10
				Indian ricegrass	10
				Bottlebrush squirreltail	5
8*:					
Atencio	Rolling Loam	Favorable	1,000	Western wheatgrass	20
		Normal	800	Needleandthread	15
		Unfavorable	500	Big sagebrush	15
				Indian ricegrass	10
				Prairie junegrass	5
				Bottlebrush squirreltail	5
				Rabbitbrush	5
Azeltine	Rolling Loam	Favorable	1,000	Western wheatgrass	20
		Normal	800	Needleandthread	15
		Unfavorable	600	Big sagebrush	15
				Indian ricegrass	10
				Prairie junegrass	5
				Bottlebrush squirreltail	5
				Rabbitbrush	5
10, 11 Begay	Rolling Loam	Favorable	1,000	Bluebunch wheatgrass	15
		Normal	800	Western wheatgrass	15
		Unfavorable	500	Needleandthread	10
				Big sagebrush	10
				Sand dropseed	5
				Indian ricegrass	5
				Rubber rabbitbrush	5
				Prairie junegrass	5
				Muttongrass	5
12*:					
Bucklon	Brushy Loam	Favorable	3,000	Gambel oak	20
		Normal	2,000	Elk sedge	10
		Unfavorable	1,500	Mountain brome	10
				Utah serviceberry	10
				Western wheatgrass	5
				Slender wheatgrass	5
				Common snowberry	5
Inchau	Brushy Loam	Favorable	3,000	Gambel oak	20
		Normal	2,000	Elk sedge	10
		Unfavorable	1,500	Mountain brome	10
				Utah serviceberry	10
				Western wheatgrass	5
				Slender wheatgrass	5
				Common snowberry	5
13, 14, 15 Chilton	Rolling Loam	Favorable	1,000	Bluebunch wheatgrass	25
		Normal	800	Western wheatgrass	15
		Unfavorable	500	Needleandthread	10
				Sandberg bluegrass	10
				Indian ricegrass	10
				Big sagebrush	10
				Low rabbitbrush	5
16 Cimarron	Mountain Loam	Favorable	1,500	Idaho fescue	25
		Normal	1,300	Bearded wheatgrass	15
		Unfavorable	1,000	Western wheatgrass	10
				Mountain brome	10
				Big sagebrush	10
				Muttongrass	10
				Slender wheatgrass	5
				Needlegrass	5
				Nodding bromegrass	5

See footnote at end of table.

TABLE 6.--RANGELAND PRODUCTIVITY AND CHARACTERISTIC PLANT COMMUNITIES--Continued

Soil name and map symbol	Range site name	Total production		Characteristic vegetation	Composition
		Kind of year	Dry weight		
			Lb/acre		Pct
17---------- Cochetopa	Brushy Loam----------	Favorable	3,000	Gambel oak----------	20
		Normal	2,000	Mountain brome----------	20
		Unfavorable	1,500	Utah serviceberry----------	10
				Elk sedge----------	10
				Bearded wheatgrass----------	5
				Columbia needlegrass----------	5
				Mountain snowberry----------	5
18*, 19*:					
Cochetopa----------	Brushy Loam----------	Favorable	3,000	Gambel oak----------	20
		Normal	2,000	Mountain brome----------	20
		Unfavorable	1,500	Utah serviceberry----------	10
				Elk sedge----------	10
				Bearded wheatgrass----------	5
				Columbia needlegrass----------	5
				Mountain snowberry----------	5
Jerry----------	Brushy Loam----------	Favorable	3,000	Gambel oak----------	20
		Normal	2,000	Mountain brome----------	10
		Unfavorable	1,500	Elk sedge----------	10
				Utah serviceberry----------	10
				Slender wheatgrass----------	5
				Western wheatgrass----------	5
				Mountain snowberry----------	5
				Big sagebrush----------	5
22---------- Dateman	Brushy Loam----------	Favorable	3,000	Utah serviceberry----------	20
		Normal	2,000	Mountain brome----------	20
		Unfavorable	1,500	Gambel oak----------	10
				Elk sedge----------	10
				Bluegrass----------	10
				Mountain snowberry----------	5
23---------- Detra	Mountain Loam----------	Favorable	1,800	Needleandthread----------	20
		Normal	1,500	Mountain brome----------	10
		Unfavorable	1,300	Big sagebrush----------	10
				Western wheatgrass----------	5
				Antelope bitterbrush----------	5
24*:					
Dollard----------	Mountain Shale----------	Favorable	1,000	Western wheatgrass----------	30
		Normal	600	Muttongrass----------	10
		Unfavorable	300	Big sagebrush----------	10
				Utah serviceberry----------	10
				Arizona fescue----------	5
				True mountainmahogany----------	5
Rock outcrop.					
26*:					
Farlow----------	Shallow Subalpine----------	Favorable	1,500	Columbia needlegrass----------	15
		Normal	1,000	Letterman needlegrass----------	10
		Unfavorable	775	Idaho fescue----------	10
				Mountain brome----------	10
				Slender wheatgrass----------	10
				Utah serviceberry----------	10
				Big sagebrush----------	10
				Western wheatgrass----------	5
Rock outcrop.					
28, 29, 30, 31----- Heldt	Clayey Foothills----------	Favorable	1,200	Western wheatgrass----------	45
		Normal	900	Big sagebrush----------	15
		Unfavorable	600	Green needlegrass----------	5
				Squirreltail----------	5
				Winterfat----------	5
				Prairie junegrass----------	5
				Low rabbitbrush----------	5
				Sandberg bluegrass----------	5

See footnote at end of table.

TABLE 6.--RANGELAND PRODUCTIVITY AND CHARACTERISTIC PLANT COMMUNITIES--Continued

Soil name and map symbol	Range site name	Total production		Characteristic vegetation	Composition
		Kind of year	Dry weight		
			Lb/acre		Pct
32---------- Holderness Variant	Deep Clay Loam----------	Favorable	2,500	Western wheatgrass----------	25
		Normal	2,000	Letterman needlegrass----------	20
		Unfavorable	1,500	Muttongrass----------	10
				Slender wheatgrass----------	10
				Prairie junegrass----------	8
				Big sagebrush----------	5
				Utah serviceberry----------	5
36---------- Irigul	Loamy Slopes----------	Favorable	1,200	Western wheatgrass----------	10
		Normal	900	Bluebunch wheatgrass----------	10
		Unfavorable	500	Mutton bluegrass----------	10
				Prairie junegrass----------	10
				Utah serviceberry----------	10
				Antelope bitterbrush----------	10
				Threetip sagebrush----------	10
38*:					
Irigul----------	Loamy Slopes----------	Favorable	1,200	Western wheatgrass----------	10
		Normal	900	Bluebunch wheatgrass----------	10
		Unfavorable	500	Mutton bluegrass----------	10
				Prairie junegrass----------	10
				Utah serviceberry----------	10
				Antelope bitterbrush----------	10
				Threetip sagebrush----------	10
Starman----------	Dry Exposure----------	Favorable	600	Beardless wheatgrass----------	20
		Normal	500	Needleandthread----------	15
		Unfavorable	300	Indian ricegrass----------	10
				Colorado buckwheat----------	5
				Stemless goldenweed----------	5
				Low rabbitbrush----------	5
39---------- Jerry	Brushy Loam----------	Favorable	3,000	Gambel oak----------	20
		Normal	2,000	Sedge----------	10
		Unfavorable	1,500	Big sagebrush----------	10
				Utah serviceberry----------	10
				Nodding bromegrass----------	5
				Big bluegrass----------	5
				Slender wheatgrass----------	5
				Western wheatgrass----------	5
				Common snowberry----------	5
40, 41---------- Kim	Rolling Loam----------	Favorable	1,000	Indian ricegrass----------	15
		Normal	800	Bluebunch wheatgrass----------	15
		Unfavorable	500	Prairie junegrass----------	10
				Muttongrass----------	10
				Western wheatgrass----------	10
				Big sagebrush----------	10
				Needleandthread----------	5
				Low rabbitbrush----------	5
43---------- Limon	Clayey Foothills----------	Favorable	1,200	Western wheatgrass----------	45
		Normal	900	Big sagebrush----------	20
		Unfavorable	600	Low rabbitbrush----------	5
				Muttongrass----------	5
				Bottlebrush squirreltail------	5
44---------- Morval	Deep Loam----------	Favorable	1,800	Western wheatgrass----------	20
		Normal	1,500	Needleandthread----------	15
		Unfavorable	700	Big sagebrush----------	10
				Bluebunch wheatgrass----------	10
				Utah serviceberry----------	5

See footnote at end of table.

TABLE 6.--RANGELAND PRODUCTIVITY AND CHARACTERISTIC PLANT COMMUNITIES--Continued

Soil name and map symbol	Range site name	Total production		Characteristic vegetation	Composition
		Kind of year	Dry weight		
			Lb/acre		Pct
45*:					
Morval	Deep Loam	Favorable	1,800	Western wheatgrass	20
		Normal	1,500	Needleandthread	15
		Unfavorable	700	Big sagebrush	10
				Bluebunch wheatgrass	10
				Utah serviceberry	5
46, 47	Rolling Loam	Favorable	1,000	Western wheatgrass	20
Nihill		Normal	800	Bluebunch wheatgrass	15
		Unfavorable	500	Big sagebrush	15
				Needleandthread	10
				Indian ricegrass	10
				Low rabbitbrush	5
49, 50, 51	Rolling Loam	Favorable	1,000	Western wheatgrass	20
Olney		Normal	800	Bluebunch wheatgrass	15
		Unfavorable	500	Big sagebrush	15
				Needleandthread	10
				Indian ricegrass	10
				Rabbitbrush	5
52	Brushy Loam	Favorable	3,000	Utah serviceberry	15
Parachute		Normal	2,000	Gambel oak	15
		Unfavorable	1,500	Elk sedge	10
				Mountain brome	10
				Columbia needlegrass	5
				Letterman needlegrass	5
				Idaho fescue	5
				Mountain snowberry	5
				Big sagebrush	5
53*:					
Parachute	Mountain Loam	Favorable	1,800	Letterman needlegrass	15
		Normal	1,500	Columbia needlegrass	10
		Unfavorable	1,200	Elk sedge	10
				Big sagebrush	10
				Idaho fescue	5
				Bluebunch wheatgrass	5
				Big bluegrass	5
				Utah serviceberry	5
				Mountain snowberry	5
				Douglas rabbitbrush	5
Rhone	Mountain Loam	Favorable	1,800	Letterman needlegrass	15
		Normal	1,500	Columbia needlegrass	10
		Unfavorable	1,200	Big sagebrush	10
				Elk sedge	10
				Bluebunch wheatgrass	5
				Idaho fescue	5
				Big bluegrass	5
				Utah serviceberry	5
				Mountain snowberry	5
				Douglas rabbitbrush	5
54, 55, 56	Rolling Loam	Favorable	1,000	Western wheatgrass	25
Potts		Normal	800	Needleandthread	15
		Unfavorable	500	Bluebunch wheatgrass	15
				Big sagebrush	10
				Indian ricegrass	10
				Low rabbitbrush	5
				Squirreltail	5
57*, 58*, 59*:					
Potts	Rolling Loam	Favorable	1,000	Western wheatgrass	25
		Normal	800	Needleandthread	15
		Unfavorable	500	Bluebunch wheatgrass	10
				Big sagebrush	10
				Indian ricegrass	10
				Low rabbitbrush	5
				Squirreltail	5

See footnote at end of table.

TABLE 6.--RANGELAND PRODUCTIVITY AND CHARACTERISTIC PLANT COMMUNITIES--Continued

Soil name and map symbol	Range site name	Total production		Characteristic vegetation	Composition
		Kind of year	Dry weight		
			Lb/acre		Pct
60---------- Rhone	Mountain Loam----------	Favorable Normal Unfavorable	1,800 1,500 1,200	Letterman needlegrass--------- Mountain brome---------- Big sagebrush---------- Columbia needlegrass---------- Big bluegrass---------- Elk sedge---------- Idaho fescue---------- Rabbitbrush---------- Utah serviceberry---------- Mountain snowberry----------	10 10 10 10 5 5 5 5 5 5
61---------- Rhone	Brushy Loam----------	Favorable Normal Unfavorable	3,000 2,000 1,500	Gambel oak---------- Utah serviceberry---------- Elk sedge---------- Mountain brome---------- Letterman needlegrass--------- Columbia needlegrass---------- Idaho fescue---------- Mountain snowberry----------	15 15 10 10 5 5 5 5
63---------- Silas	Mountain Swale----------	Favorable Normal Unfavorable	3,000 2,500 2,000	Basin wildrye---------- Western wheatgrass---------- Slender wheatgrass---------- Columbia needlegrass---------- Sedge---------- Big sagebrush---------- Mountain snowberry----------	25 15 10 10 10 5 5
64---------- Tanna	Brushy Loam----------	Favorable Normal Unfavorable	3,000 2,000 1,500	Mountain brome---------- Gambel oak---------- Elk sedge---------- Utah serviceberry---------- Western wheatgrass---------- Slender wheatgrass----------	20 15 10 10 5 5
68, 69, 70--------- Vale	Deep Loam----------	Favorable Normal Unfavorable	1,800 1,500 900	Western wheatgrass---------- Prairie sandreed---------- Needleandthread---------- Blue grama---------- Green needlegrass---------- Rabbitbrush---------- Utah serviceberry----------	20 15 10 10 10 5 5
71*: Villa Grove--------	Brushy Loam----------	Favorable Normal Unfavorable	3,000 2,000 1,500	Gambel oak---------- Utah serviceberry---------- Western wheatgrass---------- Elk sedge---------- Mountain brome---------- Mountain snowberry----------	15 15 10 10 10 5
Zoltay----------	Brushy Loam----------	Favorable Normal Unfavorable	3,000 2,000 1,500	Gambel oak---------- Utah serviceberry---------- Mountain brome---------- Elk sedge---------- Western wheatgrass---------- Mountain snowberry----------	20 15 10 10 5 5
72---------- Wann	Salt Meadow----------	Favorable Normal Unfavorable	2,500 2,000 1,500	Alkali sacaton---------- Saltgrass---------- Baltic rush---------- Low rabbitbrush---------- Skunkbush shumac---------- Sedge----------	35 10 10 10 10 10

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 7.--BUILDING SITE DEVELOPMENT

[Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "slight," "moderate," and "severe." Absence of an entry indicates that the soil was not rated]

Soil name and map symbol	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets
1 Almy Variant	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope, low strength.
2*: Arle	Severe: slope, large stones.	Severe: slope, large stones.	Severe: slope, large stones.	Severe: slope, large stones.	Severe: slope, large stones.
Ansari	Severe: slope, depth to rock.	Severe: slope, depth to rock.	Severe: slope, depth to rock.	Severe: slope, depth to rock.	Severe: slope, depth to rock.
Rock outcrop.					
3 Arvada	Moderate: too clayey.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: shrink-swell, low strength.
4 Arvada	Moderate: slope, too clayey.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: slope, shrink-swell.	Severe: shrink-swell, low strength.
5 Ascalon	Slight	Moderate: low strength.	Moderate: low strength.	Moderate: low strength.	Moderate: frost action, low strength.
6 Ascalon	Moderate: slope.	Moderate: slope, low strength.	Moderate: slope, low strength.	Severe: slope.	Moderate: slope, frost action, low strength.
7*: Ascalon	Moderate: slope.	Moderate: slope, low strength.	Moderate: slope, low strength.	Severe: slope.	Moderate: slope, frost action, low strength.
Pena	Severe: slope, large stones.	Severe: slope, large stones.	Severe: slope, large stones.	Severe: slope, large stones.	Severe: slope, large stones.
8*: Atencio	Severe: cutbanks cave.	Slight	Slight	Slight	Slight.
Azeltine	Severe: cutbanks cave, large stones.	Moderate: large stones.	Moderate: large stones.	Moderate: large stones.	Moderate: large stones.
9*. Badland					
10 Begay	Moderate: large stones.	Slight	Moderate: large stones.	Slight	Slight.
11 Begay	Moderate: slope, large stones.	Moderate: slope.	Moderate: slope, large stones.	Severe: slope.	Moderate: slope.
12*: Bucklon	Severe: depth to rock, slope.	Severe: depth to rock, slope.	Severe: depth to rock, slope.	Severe: depth to rock, slope.	Severe: depth to rock, slope, low strength.

See footnote at end of table.

TABLE 7.--BUILDING SITE DEVELOPMENT--Continued

Soil name and map symbol	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets
12*: Inchau	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
13-- Chilton	Slight	Slight	Slight	Moderate: slope.	Slight.
14-- Chilton	Moderate: slope.	Moderate: slope.	Moderate: slope.	Severe: slope.	Moderate: slope.
15-- Chilton	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
16-- Cimarron	Moderate: too clayey.	Severe: shrink-swell, low strength.	Severe: shrink-swell, low strength.	Severe: shrink-swell, low strength.	Severe: shrink-swell, low strength.
17-- Cochetopa	Severe: slope.	Severe: shrink-swell, slope, low strength.	Severe: shrink-swell, slope, low strength.	Severe: shrink-swell, slope, low strength.	Severe: shrink-swell, slope, low strength.
18*, 19*: Cochetopa	Severe: slope.	Severe: shrink-swell, slope, low strength.	Severe: shrink-swell, slope, low strength.	Severe: shrink-swell, slope, low strength.	Severe: shrink-swell, slope, low strength.
Jerry	Severe: slope.	Severe: slope, shrink-swell, low strength.	Severe: slope, shrink-swell, low strength.	Severe: slope, shrink-swell, low strength.	Severe: slope, shrink-swell, low strength.
20*. Cryaquolls					
21*: Cushman	Severe: slope, cutbanks cave.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
Lazear	Severe: depth to rock, slope.	Severe: slope, depth to rock.	Severe: depth to rock, slope.	Severe: slope, depth to rock.	Severe: depth to rock, slope.
22-- Dateman	Severe: slope, depth to rock.	Severe: slope.	Severe: slope, depth to rock.	Severe: slope.	Severe: slope.
23-- Detra	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
24*: Dollard	Severe: slope.	Severe: slope, shrink-swell, low strength.	Severe: slope, shrink-swell, depth to rock.	Severe: slope, shrink-swell, low strength.	Severe: slope, shrink-swell, low strength.
Rock outcrop.					
25-- Etoe	Severe: slope, large stones.	Severe: slope, large stones.	Severe: slope, large stones.	Severe: slope, large stones.	Severe: slope, large stones.
26*: Farlow	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.

See footnote at end of table.

TABLE 7.--BUILDING SITE DEVELOPMENT--Continued

Soil name and map symbol	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets
26*: Rock outcrop.					
27*. Halaquepts					
28, 29---- Heldt	Moderate: too clayey.	Severe: shrink-swell, low strength.	Severe: shrink-swell, low strength.	Severe: shrink-swell, low strength.	Severe: shrink-swell, low strength.
30---- Heldt	Moderate: too clayey, slope.	Severe: shrink-swell, low strength.	Severe: shrink-swell, low strength.	Severe: slope, shrink-swell, low strength.	Severe: shrink-swell, low strength.
31---- Heldt	Severe: slope, too clayey.	Severe: slope, shrink-swell, low strength.	Severe: slope, shrink-swell, low strength.	Severe: slope, shrink-swell, low strength.	Severe: slope, shrink-swell, low strength.
32---- Holderness Variant	Severe: slope.	Severe: slope, shrink-swell, low strength.	Severe: slope, shrink-swell, low strength.	Severe: slope, shrink-swell, low strength.	Severe: slope, shrink-swell, low strength.
33, 34---- Ildefonso	Severe: slope, large stones.	Severe: slope, large stones.	Severe: slope, large stones.	Severe: slope, large stones.	Severe: slope, large stones.
35*: Ildefonso----	Severe: slope, large stones.	Severe: slope, large stones.	Severe: slope, large stones.	Severe: slope, large stones.	Severe: slope, large stones.
Lazear----	Severe: depth to rock, slope.	Severe: depth to rock, slope.	Severe: depth to rock, slope.	Severe: depth to rock, slope.	Severe: depth to rock, slope.
36, 37---- Irigul	Severe: slope, depth to rock.	Severe: slope, depth to rock.	Severe: slope, depth to rock.	Severe: slope, depth to rock.	Severe: slope, depth to rock.
38*: Irigul----	Severe: slope, depth to rock.	Severe: slope, depth to rock.	Severe: slope, depth to rock.	Severe: slope, depth to rock.	Severe: slope, depth to rock.
Starman----	Severe: slope, depth to rock.	Severe: slope, depth to rock.	Severe: slope, depth to rock.	Severe: slope, depth to rock.	Severe: slope, depth to rock.
39---- Jerry	Severe: slope.	Severe: shrink-swell, slope.	Severe: slope, shrink-swell.	Severe: shrink-swell, slope.	Severe: shrink-swell, slope, low strength.
40---- Kim	Slight----	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: shrink-swell, slope.	Moderate: shrink-swell, low strength.
41---- Kim	Moderate: slope.	Moderate: shrink-swell, slope.	Moderate: shrink-swell, slope.	Severe: slope.	Moderate: slope, shrink-swell, low strength.
42---- Lamphier	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.

See footnote at end of table.

TABLE 7.--BUILDING SITE DEVELOPMENT--Continued

Soil name and map symbol	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets
43---- Limon	Moderate: too clayey.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: low strength, shrink-swell.
44---- Morval	Slight----	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: slope, shrink-swell.	Moderate: low strength, shrink-swell, frost action.
45*: Morval----	Moderate: slope.	Moderate: shrink-swell, slope.	Moderate: shrink-swell, slope.	Severe: slope.	Moderate: low strength, shrink-swell, slope.
Tridell----	Severe: slope, large stones.	Severe: slope, large stones.	Severe: slope, large stones.	Severe: slope, large stones.	Severe: slope, large stones.
46---- Nihill	Severe: cutbanks cave.	Slight----	Slight----	Slight----	Slight.
47---- Nihill	Severe: slope, cutbanks cave.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
48---- Northwater	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
49---- Olney	Slight----	Slight----	Slight----	Slight----	Slight.
50---- Olney	Slight----	Slight----	Slight----	Slight----	Slight.
51---- Olney	Moderate: slope.	Moderate: slope.	Moderate: slope.	Severe: slope.	Moderate: slope.
52---- Parachute	Severe: slope, depth to rock.	Severe: slope.	Severe: slope, depth to rock.	Severe: slope.	Severe: slope.
53*: Parachute----	Severe: slope, depth to rock.	Severe: slope.	Severe: slope, depth to rock.	Severe: slope.	Severe: slope.
Rhone----	Moderate: slope, depth to rock.	Moderate: slope, shrink-swell.	Moderate: slope, depth to rock, shrink-swell.	Severe: slope.	Moderate: slope, frost action, shrink-swell.
54---- Potts	Slight----	Slight----	Slight----	Slight----	Slight.
55---- Potts	Slight----	Slight----	Slight----	Moderate: slope.	Slight.
56---- Potts	Moderate: slope.	Moderate: slope.	Moderate: slope.	Severe: slope.	Moderate: slope.
57*: Potts----	Slight----	Slight----	Slight----	Moderate: slope.	Slight.
Ildefonso----	Severe: large stones.	Severe: large stones.	Severe: large stones.	Severe: slope, large stones.	Severe: large stones.

See footnote at end of table.

TABLE 7.--BUILDING SITE DEVELOPMENT--Continued

Soil name and map symbol	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets
58*, 59*:					
Potts	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
Ildefonso	Severe: slope, large stones.	Severe: slope, large stones.	Severe: slope, large stones.	Severe: slope, large stones.	Severe: slope, large stones.
60, 61 Rhone	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
62*:					
Rock outcrop.					
Torriorthents.					
63 Silas	Moderate: floods.	Severe: floods.	Severe: floods.	Severe: floods.	Severe: floods.
64 Tanna	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope, low strength.
65*.					
Torrifluvents					
66*:					
Torriorthents.					
Camborthids.					
Rock outcrop.					
67*:					
Torriorthents.					
Rock outcrop.					
68 Vale	Slight	Slight	Slight	Moderate: slope.	Moderate: low strength.
69 Vale	Moderate: slope.	Moderate: slope.	Moderate: slope.	Severe: slope.	Moderate: slope, low strength.
70 Vale	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
71*:					
Villa Grove	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope, low strength.
Zoltay	Severe: slope.	Severe: slope, shrink-swell.	Severe: slope, shrink-swell.	Severe: slope, shrink-swell.	Severe: slope, low strength, shrink-swell.
72 Wann	Severe: wetness.	Severe: floods.	Severe: floods, wetness.	Severe: floods.	Severe: floods, frost action.

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 8.--SANITARY FACILITIES

[Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "slight," "moderate," "good," "fair," and other terms. Absence of an entry indicates that the soil was not rated]

Soil name and map symbol	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
1---------- Almy Variant	Severe: slope, percs slowly.	Severe: slope.	Severe: slope.	Severe: slope.	Poor: slope.
2*: Arle----------	Severe: slope, depth to rock.	Severe: slope, large stones.	Severe: slope, depth to rock.	Severe: slope.	Poor: slope, large stones, area reclaim.
Ansari---------- Rock outcrop.	Severe: slope, depth to rock.	Severe: slope, depth to rock.	Severe: slope, depth to rock.	Severe: slope.	Poor: slope, thin layer, area reclaim.
3---------- Arvada	Severe: percs slowly.	Moderate: slope.	Moderate: too clayey.	Slight----------	Fair: too clayey.
4---------- Arvada	Severe: percs slowly.	Severe: slope.	Moderate: too clayey.	Moderate: slope.	Fair: slope, too clayey.
5---------- Ascalon	Slight----------	Severe: seepage.	Severe: seepage.	Severe: seepage.	Good.
6---------- Ascalon	Moderate: slope.	Severe: slope, seepage.	Severe: seepage.	Severe: seepage.	Fair: slope.
7*: Ascalon----------	Moderate: slope.	Severe: slope, seepage.	Severe: seepage.	Severe: seepage.	Fair: slope.
Pena----------	Severe: slope, large stones.	Severe: slope, large stones.	Severe: large stones.	Severe: slope.	Poor: slope, large stones.
8*: Atencio----------	Slight----------	Severe: seepage.	Severe: seepage.	Slight----------	Severe: large stones.
Azeltine----------	Severe: large stones.	Severe: seepage, large stones.	Severe: seepage, large stones.	Severe: seepage.	Poor: seepage, large stones.
9*. Badland					
10---------- Begay	Moderate: large stones.	Severe: seepage.	Severe: seepage.	Severe: seepage.	Fair: large stones.
11---------- Begay	Moderate: slope, large stones.	Severe: slope, seepage.	Severe: seepage.	Severe: seepage.	Fair: slope, large stones.
12*: Bucklon----------	Severe: depth to rock, slope, percs slowly.	Severe: depth to rock, slope.	Severe: depth to rock, slope.	Severe: slope.	Poor: thin layer, slope, area reclaim.

See footnote at end of table.

TABLE 8.--SANITARY FACILITIES--Continued

Soil name and map symbol	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
12*: Inchau	Severe: slope, depth to rock.	Severe: slope, depth to rock.	Severe: slope, depth to rock.	Severe: slope.	Poor: slope, thin layer, area reclaim.
13--- Chilton	Slight	Severe: seepage.	Severe: seepage.	Severe: seepage.	Poor: small stones.
14--- Chilton	Moderate: slope.	Severe: seepage, slope.	Severe: seepage.	Severe: seepage.	Poor: small stones.
15--- Chilton	Severe: slope.	Severe: seepage, slope.	Severe: seepage.	Severe: slope, seepage.	Poor: small stones, slope.
16--- Cimarron	Severe: percs slowly.	Severe: slope.	Severe: too clayey.	Slight	Poor: too clayey.
17--- Cochetopa	Severe: percs slowly, slope.	Severe: slope.	Severe: too clayey, slope.	Severe: slope.	Poor: slope, too clayey.
18*: Cochetopa	Severe: percs slowly, slope.	Severe: slope.	Severe: too clayey.	Severe: slope.	Poor: slope, too clayey.
Jerry	Severe: slope, percs slowly.	Severe: slope.	Severe: too clayey.	Severe: slope.	Poor: slope, too clayey.
19*: Cochetopa	Severe: percs slowly, slope.	Severe: slope.	Severe: too clayey, slope.	Severe: slope.	Poor: slope, too clayey.
Jerry	Severe: slope, percs slowly.	Severe: slope.	Severe: slope, too clayey.	Severe: slope.	Poor: slope, too clayey.
20*. Cryaquolls					
21*: Cushman	Severe: depth to rock, slope.	Severe: depth to rock, slope.	Severe: depth to rock, slope.	Severe: slope.	Poor: slope, thin layer.
Lazear	Severe: depth to rock, slope.	Severe: depth to rock, slope.	Severe: depth to rock, slope.	Severe: slope.	Poor: slope, thin layer, area reclaim.
22--- Dateman	Severe: slope, depth to rock.	Severe: slope, depth to rock.	Severe: slope, depth to rock.	Severe: slope.	Poor: slope, small stones, area reclaim.
23--- Detra	Severe: slope.	Severe: slope.	Severe: depth to rock.	Severe: slope.	Poor: slope.
24*: Dollard	Severe: slope, percs slowly, depth to rock.	Severe: depth to rock, slope.	Severe: slope, too clayey, depth to rock.	Severe: slope.	Poor: slope, too clayey, thin layer.

See footnote at end of table.

TABLE 8.--SANITARY FACILITIES--Continued

Soil name and map symbol	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
24*: Rock outcrop.					
25---------- Etoe	Severe: slope, large stones.	Severe: slope, large stones.	Severe: slope, large stones.	Severe: slope.	Poor: slope, large stones.
26*: Farlow----------	Severe: slope, depth to rock.	Severe: slope, depth to rock.	Severe: slope, depth to rock.	Severe: slope.	Poor: slope, small stones.
Rock outcrop.					
27*. Halaquepts					
28, 29---------- Heldt	Severe: percs slowly.	Moderate: slope.	Severe: too clayey.	Slight----------	Poor: too clayey.
30---------- Heldt	Severe: percs slowly.	Severe: slope.	Severe: too clayey.	Moderate: slope.	Poor: too clayey.
31---------- Heldt	Severe: slope, percs slowly.	Severe: slope.	Severe: too clayey.	Severe: slope.	Poor: slope, too clayey.
32---------- Holderness Variant	Severe: slope, percs slowly.	Severe: slope.	Severe: too clayey.	Severe: slope.	Poor: slope, too clayey.
33---------- Ildefonso	Severe: slope, large stones.	Severe: slope, seepage.	Severe: large stones, seepage.	Severe: slope, seepage.	Poor: slope, large stones.
34---------- Ildefonso	Severe: slope, large stones.	Severe: slope, seepage.	Severe: slope, large stones, seepage.	Severe: slope, seepage.	Poor: slope, large stones.
35*: Ildefonso----------	Severe: slope, large stones.	Severe: slope, seepage.	Severe: slope, large stones, seepage.	Severe: slope, seepage.	Poor: slope, large stones.
Lazear----------	Severe: depth to rock, slope.	Severe: depth to rock, slope.	Severe: slope, depth to rock.	Severe: slope.	Poor: thin layer, slope, area reclaim.
36, 37---------- Irigul	Severe: slope, depth to rock.	Severe: slope, depth to rock.	Severe: slope, depth to rock.	Severe: slope.	Poor: slope, thin layer, area reclaim.
38*: Irigul----------	Severe: slope, depth to rock.	Severe: slope, depth to rock.	Severe: slope, depth to rock.	Severe: slope.	Poor: slope, thin layer, area reclaim.
Starman----------	Severe: slope, depth to rock.	Severe: slope, depth to rock, small stones.	Severe: slope, depth to rock.	Severe: slope.	Poor: slope, thin layer, area reclaim.

See footnote at end of table.

TABLE 8.--SANITARY FACILITIES--Continued

Soil name and map symbol	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
39---------- Jerry	Severe: percs slowly, slope.	Severe: slope.	Severe: slope.	Severe: slope.	Poor: slope.
40---------- Kim	Moderate: percs slowly.	Moderate: slope, seepage.	Slight----------	Slight----------	Good.
41---------- Kim	Moderate: slope, percs slowly.	Severe: slope.	Slight----------	Moderate: slope.	Fair: slope.
42---------- Lamphier	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Poor: slope.
43---------- Limon	Severe: percs slowly, slope.	Moderate: slope.	Severe: too clayey.	Slight----------	Poor: too clayey.
44---------- Morval	Moderate: percs slowly, slope.	Severe: slope.	Moderate: too clayey.	Slight----------	Fair: too clayey.
45*: Morval----------	Moderate: percs slowly, slope.	Severe: slope.	Moderate: too clayey.	Moderate: slope.	Fair: slope, too clayey.
Tridell----------	Severe: slope, large stones.	Severe: seepage, slope, large stones.	Severe: seepage, large stones.	Severe: slope, seepage.	Poor: slope, large stones.
46---------- Nihill	Slight----------	Severe: seepage.	Severe: seepage.	Severe: seepage.	Poor: small stones.
47---------- Nihill	Severe: slope.	Severe: slope, seepage.	Severe: seepage.	Severe: slope, seepage.	Poor: slope, small stones.
48---------- Northwater	Severe: slope, depth to rock.	Severe: slope.	Severe: slope, depth to rock.	Severe: slope.	Poor: slope.
49, 50---------- Olney	Moderate: percs slowly.	Moderate: seepage, slope.	Slight----------	Slight----------	Fair: small stones.
51---------- Olney	Moderate: percs slowly, slope.	Severe: slope.	Slight----------	Moderate: slope.	Fair: small stones, slope.
52---------- Parachute	Severe: slope, depth to rock.	Severe: slope, depth to rock, seepage.	Severe: slope, depth to rock, seepage.	Severe: slope, seepage.	Poor: slope, small stones, area reclaim.
53*: Parachute----------	Severe: slope, depth to rock.	Severe: slope, depth to rock, seepage.	Severe: depth to rock, seepage.	Severe: slope, seepage.	Poor: slope, small stones, area reclaim.
Rhone----------	Severe: depth to rock.	Severe: slope.	Severe: depth to rock.	Moderate: slope.	Fair: small stones, thin layer, slope.

See footnote at end of table.

TABLE 8.--SANITARY FACILITIES--Continued

Soil name and map symbol	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
54, 55---------- Potts	Moderate: percs slowly.	Moderate: slope, seepage.	Slight----------	Slight----------	Good.
56---------- Potts	Moderate: slope, percs slowly.	Severe: slope.	Slight----------	Moderate: slope.	Fair: slope.
57*: Potts----------	Moderate: percs slowly.	Severe: slope.	Slight----------	Slight----------	Good.
Ildefonso----------	Severe: slope, large stones.	Severe: slope, seepage.	Severe: large stones.	Moderate: slope.	Poor: large stones.
58*: Potts----------	Severe: slope.	Severe: slope.	Moderate: slope.	Severe: slope.	Poor: slope.
Ildefonso----------	Severe: slope, large stones.	Severe: slope, seepage.	Severe: large stones, seepage.	Severe: slope, seepage.	Poor: slope, large stones.
59*: Potts----------	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Poor: slope.
Ildefonso----------	Severe: slope, large stones.	Severe: slope, seepage.	Severe: slope, large stones, seepage.	Severe: slope, seepage.	Poor: slope, large stones.
60---------- Rhone	Severe: depth to rock, slope.	Severe: slope.	Severe: depth to rock.	Severe: slope.	Poor: slope.
61---------- Rhone	Severe: depth to rock, slope.	Severe: slope.	Severe: slope, depth to rock.	Severe: slope.	Poor: slope.
62*: Rock outcrop.					
Torriorthents.					
63---------- Silas	Severe: floods.	Severe: floods.	Severe: floods.	Severe: floods.	Good.
64---------- Tanna	Severe: depth to rock, percs slowly, slope.	Severe: depth to rock, slope.	Severe: depth to rock, slope.	Severe: slope.	Poor: slope, thin layer, area reclaim.
65*. Torrifluvents					
66*: Torriorthents.					
Camborthids.					
Rock outcrop.					
67*: Torriorthents.					
Rock outcrop.					

See footnote at end of table.

TABLE 8.--SANITARY FACILITIES--Continued

Soil name and map symbol	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
68---------- Vale	Moderate: percs slowly.	Moderate: seepage, slope.	Moderate: too clayey.	Slight----------	Fair: too clayey.
69---------- Vale	Moderate: slope, percs slowly.	Severe: slope.	Moderate: too clayey.	Moderate: slope.	Fair: slope, too clayey.
70---------- Vale	Severe: slope.	Severe: slope.	Moderate: slope, too clayey.	Severe: slope.	Poor: slope.
71*: Villa Grove--------	Severe: slope.	Severe: slope, seepage.	Severe: seepage.	Severe: slope, seepage.	Poor: slope.
Zoltay----------	Severe: slope, percs slowly.	Severe: slope.	Severe: too clayey.	Severe: slope.	Poor: slope, too clayey.
72---------- Wann	Severe: wetness, floods.	Severe: seepage, wetness, floods.	Severe: floods, wetness, seepage.	Severe: floods, wetness, seepage.	Good.

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 9.--CONSTRUCTION MATERIALS

[Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "good," "fair," and "poor." Absence of an entry indicates that the soil was not rated]

Soil name and map symbol	Roadfill	Sand	Gravel	Topsoil
1--- Almy Variant	Poor: slope, low strength.	Unsuited---	Unsuited---	Poor: slope.
2*: Arle---	Poor: slope, thin layer, area reclaim.	Unsuited: thin layer.	Unsuited: thin layer.	Poor: slope, large stones.
Ansari---	Poor: slope, thin layer, area reclaim.	Unsuited---	Unsuited---	Poor: slope, large stones, area reclaim.
Rock outcrop.				
3, 4--- Arvada	Poor: shrink-swell, low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Poor: too clayey, excess sodium.
5--- Ascalon	Poor: low strength.	Poor: excess fines.	Unsuited---	Fair: too clayey.
6--- Ascalon	Poor: low strength.	Poor: excess fines.	Unsuited---	Fair: slope, too clayey.
7*: Ascalon---	Poor: low strength.	Poor: excess fines.	Unsuited---	Fair: slope, too clayey.
Pena---	Poor: large stones.	Unsuited---	Unsuited---	Poor: slope, large stones.
8*: Atencio---	Good---	Poor: large stones.	Poor: large stones.	Fair: small stones.
Azeltine---	Fair: large stones.	Poor: large stones.	Poor: large stones.	Poor: small stones.
9*. Badland				
10--- Begay	Fair: large stones.	Poor: excess fines, large stones.	Unsuited---	Good.
11--- Begay	Fair: large stones.	Poor: excess fines.	Unsuited---	Fair: slope.
12*: Bucklon---	Poor: thin layer, slope, area reclaim.	Unsuited---	Unsuited---	Poor: slope, area reclaim, thin layer.

See footnote at end of table.

TABLE 9.--CONSTRUCTION MATERIALS--Continued

Soil name and map symbol	Roadfill	Sand	Gravel	Topsoil
12*: Inchau	Poor: slope, thin layer, area reclaim.	Unsuited: thin layer.	Unsuited: thin layer.	Poor: slope, small stones, area reclaim.
13, 14---- Chilton	Fair: low strength.	Unsuited----	Unsuited----	Poor: small stones.
15---- Chilton	Fair: slope, low strength.	Unsuited----	Unsuited----	Poor: small stones, slope.
16---- Cimarron	Poor: shrink-swell, low strength.	Unsuited----	Unsuited----	Poor: too clayey.
17---- Cochetopa	Poor: shrink-swell, slope, low strength.	Unsuited----	Unsuited----	Poor: slope, small stones.
18*: Cochetopa----	Poor: shrink-swell, low strength.	Unsuited----	Unsuited----	Poor: slope, small stones.
Jerry----	Poor: slope, shrink-swell, low strength.	Unsuited----	Unsuited----	Poor: slope, large stones, too clayey.
19*: Cochetopa----	Poor: shrink-swell, slope, low strength.	Unsuited----	Unsuited----	Poor: slope, small stones.
Jerry----	Poor: slope, shrink-swell, low strength.	Unsuited----	Unsuited----	Poor: slope, large stones, too clayey.
20*. Cryaquolls				
21*: Cushman----	Poor: thin layer, area reclaim.	Unsuited: excess fines.	Unsuited: excess fines.	Poor: slope, small stones.
Lazear----	Poor: thin layer, slope, area reclaim.	Unsuited----	Unsuited----	Poor: large stones, slope.
22---- Dateman	Poor: slope, thin layer, area reclaim.	Unsuited----	Unsuited: excess fines.	Poor: slope, small stones, area reclaim.
23---- Detra	Poor: low strength.	Unsuited----	Unsuited----	Poor: slope.

See footnote at end of table.

TABLE 9.--CONSTRUCTION MATERIALS--Continued

Soil name and map symbol	Roadfill	Sand	Gravel	Topsoil
24*:				
Dollard	Poor: thin layer, slope, low strength.	Unsuited	Unsuited	Poor: slope, too clayey.
Rock outcrop.				
25--- Etoe	Poor: slope, large stones.	Unsuited	Unsuited: large stones.	Poor: slope, small stones.
26*:				
Farlow	Poor: slope.	Unsuited	Unsuited	Poor: slope, small stones.
Rock outcrop.				
27*. Halaquepts				
28, 29, 30--- Heldt	Poor: shrink-swell, low strength.	Unsuited	Unsuited	Poor: too clayey.
31--- Heldt	Poor: shrink-swell, low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Poor: slope, too clayey.
32--- Holderness Variant	Poor: low strength, shrink-swell.	Unsuited	Unsuited	Poor: slope.
33--- Ildefonso	Poor: large stones.	Unsuited	Unsuited	Poor: slope, large stones.
34--- Ildefonso	Poor: slope, large stones.	Unsuited	Unsuited	Poor: slope, large stones.
35*:				
Ildefonso	Poor: slope, large stones.	Unsuited	Unsuited	Poor: slope, large stones.
Lazear	Poor: slope, thin layer, area reclaim.	Unsuited	Unsuited	Poor: slope, small stones, area reclaim.
36, 37--- Irigul	Poor: slope, thin layer, area reclaim.	Unsuited	Unsuited	Poor: slope, small stones, area reclaim.
38*:				
Irigul	Poor: slope, thin layer, area reclaim.	Unsuited	Unsuited	Poor: slope, small stones, area reclaim.
Starman	Poor: slope, thin layer, area reclaim.	Unsuited: thin layer.	Unsuited: thin layer.	Poor: slope, area reclaim, small stones.

See footnote at end of table.

TABLE 9.--CONSTRUCTION MATERIALS--Continued

Soil name and map symbol	Roadfill	Sand	Gravel	Topsoil
39--- Jerry	Poor: shrink-swell, slope, low strength.	Unsuited---	Unsuited---	Poor: slope, too clayey, large stones.
40--- Kim	Fair: low strength.	Unsuited---	Unsuited---	Good.
41--- Kim	Fair: low strength.	Unsuited---	Unsuited---	Fair: slope.
42--- Lamphier	Poor: slope.	Unsuited---	Unsuited---	Poor: slope.
43--- Limon	Poor: low strength, shrink-swell.	Unsuited---	Unsuited---	Poor: too clayey.
44--- Morval	Fair: low strength, shrink-swell, frost action.	Unsuited---	Unsuited---	Good.
45*: Morval---	Fair: low strength, shrink-swell, frost action.	Unsuited---	Unsuited---	Fair: slope.
Tridell---	Poor: large stones.	Unsuited---	Unsuited---	Poor: slope, large stones.
46--- Nihill	Good---	Unsuited---	Unsuited---	Poor: small stones, area reclaim.
47--- Nihill	Fair: slope.	Unsuited---	Unsuited---	Poor: slope, small stones, area reclaim.
48--- Northwater	Poor: slope.	Unsuited---	Unsuited---	Poor: slope.
49, 50--- Olney	Fair: low strength.	Unsuited---	Unsuited---	Fair: small stones.
51--- Olney	Fair: low strength.	Unsuited---	Unsuited---	Fair: small stones, slope.
52--- Parachute	Poor: slope, thin layer, area reclaim.	Unsuited---	Unsuited---	Poor: slope, area reclaim.
53*: Parachute---	Poor: thin layer, area reclaim.	Unsuited---	Unsuited---	Poor: slope, area reclaim.
Rhone---	Fair: thin layer, low strength.	Unsuited---	Unsuited---	Fair: slope, small stones.

See footnote at end of table.

TABLE 9.--CONSTRUCTION MATERIALS--Continued

Soil name and map symbol	Roadfill	Sand	Gravel	Topsoil
54, 55---------- Potts	Fair: low strength.	Unsuited----------	Unsuited----------	Fair: small stones.
56---------- Potts	Fair: low strength.	Unsuited----------	Unsuited----------	Fair: slope, small stones.
57*: Potts----------	Fair: low strength.	Unsuited----------	Unsuited----------	Fair: small stones.
Ildefonso----------	Poor: large stones.	Unsuited----------	Unsuited----------	Poor: large stones.
58*: Potts----------	Fair: slope, low strength.	Unsuited----------	Unsuited----------	Poor: slope.
Ildefonso----------	Poor: large stones.	Unsuited----------	Unsuited----------	Poor: slope, large stones.
59*: Potts----------	Poor: slope.	Unsuited----------	Unsuited----------	Poor: slope.
Ildefonso----------	Poor: slope, large stones.	Unsuited----------	Unsuited----------	Poor: slope, large stones.
60---------- Rhone	Fair: slope, thin layer, low strength.	Unsuited----------	Unsuited----------	Poor: slope.
61---------- Rhone	Poor: slope.	Unsuited----------	Unsuited----------	Poor: slope.
62*: Rock outcrop. Torriorthents.				
63---------- Silas	Fair: low strength.	Unsuited----------	Unsuited----------	Good.
64---------- Tanna	Poor: slope, low strength, thin layer.	Unsuited----------	Unsuited----------	Poor: slope, too clayey.
65*. Torrifluvents				
66*: Torriorthents. Camborthids. Rock outcrop.				
67*: Torriorthents. Rock outcrop.				

See footnote at end of table.

TABLE 9.--CONSTRUCTION MATERIALS--Continued

Soil name and map symbol	Roadfill	Sand	Gravel	Topsoil
68--Vale	Poor: low strength.	Unsuited	Unsuited	Good.
69--Vale	Poor: low strength.	Unsuited	Unsuited	Fair: slope.
70--Vale	Fair: low strength, slope.	Unsuited	Unsuited	Poor: slope.
71*:				
Villa Grove	Poor: low strength.	Unsuited	Unsuited	Poor: slope.
Zoltay	Poor: low strength, shrink-swell.	Unsuited	Unsuited	Poor: slope, small stones.
72--Wann	Fair: low strength, wetness.	Unsuited	Unsuited	Good.

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 10.--WATER MANAGEMENT

[Some terms that describe restrictive soil features are defined in the Glossary. Absence of an entry indicates that the soil was not evaluated]

Soil name and map symbol	Pond reservoir areas	Embankments, dikes, and levees	Drainage	Irrigation	Terraces and diversions	Grassed waterways
1---------- Almy Variant	Slope----------	Favorable------	Slope----------	Slope----------	Slope----------	Slope.
2*: Arle----------	Slope, seepage, depth to rock.	Piping, thin layer, large stones.	Slope, depth to rock, large stones.	Large stones, slope, droughty.	Large stones, slope, depth to rock.	Large stones, slope, droughty.
Ansari----------	Slope, depth to rock.	Thin layer-----	Slope, depth to rock.	Droughty, slope, rooting depth.	Slope, depth to rock.	Slope, rooting depth, droughty.
Rock outcrop.						
3---------- Arvada	Favorable------	Excess sodium--	Percs slowly, excess sodium, slope.	Slope, percs slowly, excess sodium.	Percs slowly---	Percs slowly, excess sodium.
4---------- Arvada	Slope----------	Excess sodium--	Percs slowly, excess sodium, slope.	Slope, percs slowly, excess sodium.	Slope, percs slowly.	Slope, percs slowly, excess sodium.
5---------- Ascalon	Seepage, slope.	Favorable------	Slope----------	Slope----------	Slope----------	Slope.
6---------- Ascalon	Seepage, slope.	Favorable------	Slope----------	Slope----------	Slope----------	Slope.
7*: Ascalon----------	Seepage, slope.	Favorable------	Slope----------	Slope----------	Slope----------	Slope.
Pena----------	Slope, large stones.	Large stones---	Slope, large stones.	Slope, large stones, droughty.	Slope, large stones.	Slope, large stones, droughty.
8*: Atencio----------	Seepage, slope.	Seepage, large stones.	Slope, cutbanks cave, large stones.	Slope, droughty, soil blowing.	Large stones, soil blowing.	Droughty, large stones.
Azeltine---------	Slope, seepage.	Seepage, large stones.	Slope, large stones.	Slope, seepage, droughty.	Large stones, soil blowing.	Droughty, large stones.
9*. Badland						
10---------- Begay	Slope, seepage.	Piping, seepage.	Slope----------	Slope----------	Favorable------	Favorable.
11---------- Begay	Slope, seepage.	Piping, seepage.	Slope----------	Slope----------	Slope----------	Slope.
12*: Bucklon----------	Depth to rock, slope.	Thin layer-----	Depth to rock, slope.	Rooting depth, slope.	Slope, depth to rock.	Slope, rooting depth.
Inchau----------	Slope, depth to rock, seepage.	Thin layer-----	Slope, depth to rock.	Slope, rooting depth.	Slope, depth to rock.	Slope, rooting depth.
13---------- Chilton	Seepage, slope.	Seepage--------	Slope----------	Droughty, slope.	Favorable------	Droughty.

See footnote at end of table.

TABLE 10.--WATER MANAGEMENT--Continued

Soil name and map symbol	Pond reservoir areas	Embankments, dikes, and levees	Drainage	Irrigation	Terraces and diversions	Grassed waterways
14, 15---------- Chilton	Seepage, slope.	Seepage---------	Slope----------	Droughty, slope.	Slope----------	Droughty, slope.
16---------- Cimarron	Slope----------	Hard to pack---	Slope, percs slowly.	Percs slowly, slope.	Slope, percs slowly.	Slope, percs slowly.
17---------- Cochetopa	Slope----------	Hard to pack---	Percs slowly, slope.	Slope, percs slowly.	Percs slowly, slope.	Percs slowly, slope.
18*, 19*: Cochetopa--------	Slope----------	Hard to pack---	Percs slowly, slope.	Slope, percs slowly.	Percs slowly, slope.	Percs slowly, slope.
Jerry----------	Slope----------	Hard to pack---	Slope, percs slowly.	Slope, percs slowly.	Slope, percs slowly.	Slope, percs slowly.
20*. Cryaquolls						
21*: Cushman----------	Slope, depth to rock.	Thin layer-----	Slope, depth to rock.	Slope, rooting depth.	Slope, depth to rock.	Slope, depth to rock.
Lazear----------	Slope, depth to rock.	Thin layer, large stones.	Slope, depth to rock.	Large stones, droughty, rooting depth.	Large stones, slope, depth to rock.	Large stones, slope, rooting depth.
22---------- Dateman	Slope, depth to rock.	Thin layer-----	Slope----------	Slope----------	Slope, depth to rock.	Slope, rooting depth.
23---------- Detra	Slope, depth to rock.	Thin layer-----	Slope, depth to rock.	Slope----------	Slope----------	Slope.
24*: Dollard----------	Slope, depth to rock.	Thin layer, hard to pack.	Depth to rock, slope, percs slowly.	Slope, percs slowly, rooting depth.	Depth to rock, percs slowly, slope.	Percs slowly, slope, rooting depth.
Rock outcrop.						
25---------- Etoe	Slope, seepage.	Large stones---	Slope, large stones.	Droughty, slope, large stones.	Slope, large stones.	Droughty, large stones, slope.
26*: Farlow----------	Slope, depth to rock.	Thin layer, large stones.	Slope, large stones.	Slope, droughty, large stones.	Slope, large stones.	Slope, large stones, droughty.
Rock outcrop.						
27*. Halaquepts						
28, 29---------- Heldt	Slope----------	Hard to pack---	Percs slowly, slope.	Slope, percs slowly.	Percs slowly---	Percs slowly.
30---------- Heldt	Slope----------	Hard to pack---	Percs slowly, slope.	Slope, percs slowly.	Percs slowly, slope.	Slope, percs slowly.
31---------- Heldt	Slope----------	Hard to pack---	Percs slowly, slope.	Slope, percs slowly.	Slope, percs slowly.	Slope, percs slowly.
32---------- Holderness Variant	Slope----------	Hard to pack---	Slope, percs slowly.	Slope, percs slowly.	Slope, percs slowly.	Slope, percs slowly.

See footnote at end of table.

TABLE 10.--WATER MANAGEMENT--Continued

Soil name and map symbol	Pond reservoir areas	Embankments, dikes, and levees	Drainage	Irrigation	Terraces and diversions	Grassed waterways
33, 34---------- Ildefonso	Seepage, slope.	Large stones---	Slope, large stones.	Slope, large stones, droughty.	Large stones, slope.	Slope, large stones, droughty.
35*: Ildefonso--------	Seepage, slope.	Large stones---	Slope, large stones.	Slope, large stones, droughty.	Large stones, slope.	Slope, large stones, droughty.
Lazear----------	Depth to rock, slope.	Thin layer-----	Depth to rock, slope.	Rooting depth, slope.	Depth to rock, slope.	Slope, rooting depth.
36, 37---------- Irigul	Slope, depth to rock.	Thin layer-----	Depth to rock	Slope, rooting depth, droughty.	Depth to rock, slope.	Slope, rooting depth, droughty.
38*: Irigul----------	Slope, depth to rock.	Thin layer-----	Depth to rock	Slope, rooting depth, droughty.	Depth to rock, slope.	Slope, rooting depth, droughty.
Starman----------	Slope, depth to rock.	Thin layer-----	Depth to rock	Slope, rooting depth.	Slope, depth to rock.	Slope, rooting depth.
39---------- Jerry	Slope----------	Hard to pack---	Slope, percs slowly.	Slope, percs slowly.	Slope, percs slowly.	Slope, percs slowly.
40---------- Kim	Slope, seepage.	Piping---------	Slope----------	Slope----------	Favorable------	Favorable.
41---------- Kim	Slope, seepage.	Piping---------	Slope----------	Slope----------	Slope----------	Slope.
42---------- Lamphier	Slope, seepage.	Piping---------	Slope----------	Slope----------	Slope----------	Slope.
43---------- Limon	Slope----------	Hard to pack---	Percs slowly, slope.	Percs slowly, slope.	Percs slowly---	Percs slowly.
44---------- Morval	Slope, seepage.	Favorable------	Slope----------	Erodes easily, slope.	Erodes easily	Erodes easily.
45*: Morval----------	Slope, seepage.	Favorable------	Slope----------	Erodes easily, slope.	Erodes easily	Erodes easily.
Tridell----------	Slope, seepage.	Large stones, seepage.	Slope, large stones.	Slope, droughty, large stones.	Slope, large stones.	Slope, droughty, large stones.
46---------- Nihill	Seepage--------	Seepage--------	Slope----------	Slope, droughty.	Favorable------	Droughty.
47---------- Nihill	Seepage, slope.	Seepage--------	Slope----------	Slope, droughty.	Slope----------	Slope, droughty.
48---------- Northwater	Slope, seepage.	Thin layer-----	Slope----------	Slope----------	Slope----------	Slope.
49---------- Olney	Seepage--------	Favorable------	Favorable------	Favorable------	Favorable------	Favorable.
50, 51---------- Olney	Slope, seepage.	Favorable------	Slope----------	Slope----------	Slope----------	Slope.
52---------- Parachute	Depth to rock, slope, seepage.	Thin layer-----	Depth to rock, slope.	Slope, droughty, rooting depth.	Depth to rock, slope.	Slope, rooting depth, droughty.

See footnote at end of table.

TABLE 10.--WATER MANAGEMENT--Continued

Soil name and map symbol	Pond reservoir areas	Embankments, dikes, and levees	Drainage	Irrigation	Terraces and diversions	Grassed waterways
53*:						
Parachute	Depth to rock, slope, seepage.	Thin layer	Depth to rock, slope.	Slope, droughty, rooting depth.	Depth to rock, slope.	Slope, rooting depth, droughty.
Rhone	Slope, depth to rock.	Thin layer	Slope, depth to rock.	Slope, rooting depth.	Slope, depth to rock.	Slope, rooting depth.
54, 55 Potts	Seepage	Piping	Slope	Slope, erodes easily.	Erodes easily	Erodes easily.
56 Potts	Seepage	Piping	Slope	Slope, erodes easily.	Slope, erodes easily.	Slope, erodes easily.
57*:						
Potts	Seepage	Piping	Slope	Slope, erodes easily.	Erodes easily	Erodes easily.
Ildefonso	Seepage, slope.	Large stones	Slope, large stones.	Slope, large stones, droughty.	Large stones, slope.	Slope, large stones, droughty.
58*, 59*:						
Potts	Seepage	Piping	Slope	Slope, erodes easily.	Slope, erodes easily.	Slope, erodes easily.
Ildefonso	Seepage, slope.	Large stones	Slope, large stones.	Slope, large stones, droughty.	Large stones, slope.	Slope, large stones, droughty.
60, 61 Rhone	Slope, depth to rock.	Thin layer	Slope, depth to rock.	Slope, rooting depth.	Slope, depth to rock.	Slope, rooting depth.
62*:						
Rock outcrop.						
Torriorthents.						
63 Silas	Slope, seepage.	Piping	Slope, floods.	Slope, floods.	Favorable	Favorable.
64 Tanna	Slope, depth to rock.	Thin layer	Slope, percs slowly, depth to rock.	Slope, percs slowly, rooting depth.	Slope, depth to rock, percs slowly.	Slope, erodes easily, rooting depth.
65*.						
Torrifluvents						
66*:						
Torriorthents.						
Camborthids.						
Rock outcrop.						
67*:						
Torriorthents.						
Rock outcrop.						
68 Vale	Seepage	Piping	Favorable	Favorable	Erodes easily	Erodes easily.
69 Vale	Slope, seepage.	Piping	Slope	Slope	Erodes easily, slope.	Slope, erodes easily.
70 Vale	Slope, seepage.	Piping	Slope	Slope	Slope, erodes easily.	Slope, erodes easily.

See footnote at end of table.

TABLE 10.--WATER MANAGEMENT--Continued

Soil name and map symbol	Pond reservoir areas	Embankments, dikes, and levees	Drainage	Irrigation	Terraces and diversions	Grassed waterways
71*:						
Villa Grove	Slope, seepage.	Favorable	Slope, excess salt.	Slope, excess salt.	Favorable	Excess salt.
Zoltay	Slope	Favorable	Percs slowly, slope.	Slope, percs slowly.	Slope, percs slowly.	Slope, percs slowly.
72 Wann	Seepage	Seepage	Floods, frost action.	Floods	Favorable	Favorable.

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 11.--RECREATIONAL DEVELOPMENT

[Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "slight," "moderate," and "severe." Absence of an entry indicates that the soil was not rated]

Soil name and map symbol	Camp areas	Picnic areas	Playgrounds	Paths and trails
1 Almy Variant	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
2*: Arle	Severe: slope, large stones.	Severe: slope, large stones.	Severe: slope, large stones, small stones.	Severe: slope, large stones.
Ansari	Severe: slope, depth to rock.	Severe: slope.	Severe: slope, depth to rock, large stones.	Severe: slope.
Rock outcrop.				
3 Arvada	Moderate: percs slowly.	Slight	Moderate: percs slowly.	Slight.
4 Arvada	Moderate: percs slowly.	Moderate: slope.	Severe: slope.	Slight.
5 Ascalon	Slight	Slight	Moderate: slope.	Slight.
6 Ascalon	Moderate: slope.	Moderate: slope.	Severe: slope.	Slight.
7*: Ascalon	Moderate: slope.	Moderate: slope.	Severe: slope.	Slight.
Pena	Severe: slope, large stones.	Severe: slope.	Severe: slope, large stones.	Moderate: slope.
8*: Atencio	Slight	Slight	Moderate: slope, small stones.	Slight.
Azeltine	Moderate: small stones.	Moderate: small stones.	Severe: slope, small stones.	Moderate: small stones.
9*. Badland				
10 Begay	Slight	Slight	Moderate: slope.	Slight.
11 Begay	Moderate: slope.	Moderate: slope.	Severe: slope.	Slight.
12*: Bucklon	Severe: slope, depth to rock.	Severe: slope, depth to rock.	Severe: depth to rock, slope.	Severe: slope.
Inchau	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.

See footnote at end of table.

TABLE 11.--RECREATIONAL DEVELOPMENT--Continued

Soil name and map symbol	Camp areas	Picnic areas	Playgrounds	Paths and trails
13--- Chilton	Moderate: small stones.	Moderate: small stones.	Severe: small stones.	Moderate: small stones.
14--- Chilton	Moderate: slope, small stones.	Moderate: slope, small stones.	Severe: slope, small stones.	Moderate: small stones.
15--- Chilton	Severe: slope.	Severe: slope.	Severe: slope, small stones.	Moderate: slope, small stones.
16--- Cimarron	Moderate: percs slowly.	Moderate: percs slowly.	Severe: slope.	Slight.
17--- Cochetopa	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
18*: Cochetopa---	Severe: slope.	Severe: slope.	Severe: slope.	Moderate: slope, too clayey.
Jerry---	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
19*: Cochetopa---	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
Jerry---	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
20*. Cryaquolls				
21*: Cushman---	Severe: slope.	Severe: slope.	Severe: slope.	Moderate: slope.
Lazear---	Severe: slope, large stones.	Severe: slope.	Severe: slope, large stones, depth to rock.	Severe: slope.
22--- Dateman	Severe: slope.	Severe: slope.	Severe: slope, small stones.	Severe: slope.
23--- Detra	Severe: slope.	Severe: slope.	Severe: slope.	Moderate: slope.
24*: Dollard---	Severe: slope, too clayey.	Severe: slope, too clayey.	Severe: slope, too clayey.	Severe: slope, too clayey.
Rock outcrop.				
25--- Etoe	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
26*: Farlow---	Severe: slope.	Severe: slope.	Severe: slope, small stones.	Severe: slope.
Rock outcrop.				

See footnote at end of table.

TABLE 11.--RECREATIONAL DEVELOPMENT--Continued

Soil name and map symbol	Camp areas	Picnic areas	Playgrounds	Paths and trails
27*. Halaquepts				
28, 29---------- Heldt	Moderate: too clayey, percs slowly.	Moderate: too clayey, percs slowly.	Moderate: slope, too clayey, percs slowly.	Moderate: too clayey.
30---------- Heldt	Moderate: slope, too clayey, percs slowly.	Moderate: slope, too clayey, percs slowly.	Severe: slope.	Moderate: too clayey.
31---------- Heldt	Severe: slope.	Severe: slope.	Severe: slope.	Moderate: slope, too clayey.
32---------- Holderness Variant	Moderate: slope, percs slowly, too clayey.	Moderate: slope, percs slowly, too clayey.	Severe: slope.	Moderate: too clayey.
33---------- Ildefonso	Severe: slope, large stones.	Severe: slope, large stones.	Severe: slope, large stones.	Severe: large stones.
34---------- Ildefonso	Severe: slope, large stones.	Severe: slope, large stones.	Severe: slope, large stones.	Severe: slope, large stones.
35*: Ildefonso----------	Severe: slope, large stones.	Severe: slope, large stones.	Severe: slope, large stones.	Severe: slope, large stones.
Lazear----------	Severe: slope, depth to rock.	Severe: slope, depth to rock.	Severe: depth to rock, small stones, slope.	Moderate: small stones, slope.
36, 37---------- Irigul	Severe: slope, depth to rock.	Severe: slope, depth to rock.	Severe: slope, depth to rock.	Severe: slope.
38*: Irigul----------	Severe: slope, depth to rock.	Severe: slope, depth to rock.	Severe: slope, depth to rock.	Severe: slope.
Starman----------	Severe: slope, depth to rock.	Severe: slope, depth to rock.	Severe: slope, depth to rock, small stones.	Severe: slope.
39---------- Jerry	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
40---------- Kim	Moderate: dusty.	Moderate: dusty.	Moderate: slope, dusty.	Moderate: dusty.
41---------- Kim	Moderate: slope, dusty.	Moderate: slope, dusty.	Severe: slope.	Moderate: dusty.
42---------- Lamphier	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
43---------- Limon	Moderate: too clayey, percs slowly.	Moderate: too clayey, percs slowly.	Severe: slope.	Moderate: too clayey.

See footnote at end of table.

TABLE 11.--RECREATIONAL DEVELOPMENT--Continued

Soil name and map symbol	Camp areas	Picnic areas	Playgrounds	Paths and trails
44--Morval	Slight	Slight	Severe: slope.	Slight.
45*:				
Morval	Moderate: slope.	Moderate: slope.	Severe: slope.	Slight.
Tridell	Severe: slope.	Severe: slope.	Severe: slope, large stones.	Moderate: large stones.
46--Nihill	Moderate: small stones.	Moderate: small stones.	Severe: small stones.	Moderate: small stones.
47--Nihill	Severe: slope.	Severe: slope.	Severe: slope, small stones.	Moderate: slope, small stones.
48--Northwater	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
49, 50--Olney	Moderate: dusty.	Moderate: dusty.	Moderate: slope, dusty.	Moderate: dusty.
51--Olney	Moderate: slope, dusty.	Moderate: slope, dusty.	Severe: slope.	Moderate: dusty.
52--Parachute	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
53*:				
Parachute	Severe: slope.	Severe: slope.	Severe: slope.	Moderate: slope.
Rhone	Moderate: slope.	Moderate: slope.	Severe: slope.	Slight.
54, 55--Potts	Slight	Slight	Moderate: slope.	Slight.
56--Potts	Moderate: slope.	Moderate: slope.	Severe: slope.	Slight.
57*:				
Potts	Slight	Slight	Severe: slope.	Slight.
Ildefonso	Severe: large stones.	Severe: large stones.	Severe: slope, large stones.	Severe: large stones.
58*:				
Potts	Severe: slope.	Severe: slope.	Severe: slope.	Moderate: slope.
Ildefonso	Severe: slope, large stones.	Severe: slope, large stones.	Severe: slope, large stones.	Severe: large stones.
59*:				
Potts	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
Ildefonso	Severe: slope, large stones.	Severe: slope, large stones.	Severe: slope, large stones.	Severe: slope, large stones.

See footnote at end of table.

TABLE 11.--RECREATIONAL DEVELOPMENT--Continued

Soil name and map symbol	Camp areas	Picnic areas	Playgrounds	Paths and trails
60--- Rhone	Severe: slope.	Severe: slope.	Severe: slope.	Moderate: slope.
61--- Rhone	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
62*: Rock outcrop. Torriorthents.				
63--- Silas	Severe: floods.	Slight---	Severe: slope.	Slight.
64--- Tanna	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
65*. Torrifluvents				
66*: Torriorthents. Camborthids. Rock outcrop.				
67*: Torriorthents. Rock outcrop.				
68--- Vale	Moderate: dusty.	Moderate: dusty.	Moderate: slope, dusty.	Moderate: dusty.
69--- Vale	Moderate: slope, dusty.	Moderate: slope, dusty.	Severe: slope.	Moderate: dusty.
70--- Vale	Severe: slope.	Severe: slope.	Severe: slope.	Moderate: slope, dusty.
71*: Villa Grove---	Severe: slope.	Severe: slope.	Severe: slope.	Moderate: slope.
Zoltay---	Severe: slope.	Severe: slope.	Severe: slope.	Moderate: slope.
72--- Wann	Severe: floods.	Moderate: wetness.	Moderate: floods, wetness.	Slight.

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 12.--WILDLIFE HABITAT POTENTIALS

[See text for definitions of "good," "fair," "poor," and "very poor." Absence of an entry indicates that the soil was not rated]

Soil name and map symbol	Potential for habitat elements								Potential as habitat for--			
	Grain and seed crops	Grasses and legumes	Wild herbaceous plants	Hardwood trees	Coniferous plants	Shrubs	Wetland plants	Shallow water areas	Openland wildlife	Woodland wildlife	Wetland wildlife	Rangeland wildlife
1---------- Almy Variant	Very poor.	Very poor.	Fair	---	---	Fair	Very poor.	Very poor.	Poor	---	Very poor.	Fair.
2*: Arle----------	Very poor.	Very poor.	Fair	---	---	Fair	Very poor.	Very poor.	Poor	---	Very poor.	Fair.
Ansari----------	Very poor.	Very poor.	Poor	---	---	Poor	Very poor.	Very poor.	Very poor.	---	Very poor.	Poor.
Rock outcrop.												
3, 4---------- Arvada	Very poor.	Very poor.	Poor	---	---	Very poor.	Poor	Very poor.	Very poor.	---	Very poor.	Very poor.
5---------- Ascalon	Good	Good	Fair	---	---	Fair	Poor	Very poor.	Good	---	Very poor.	Fair.
6---------- Ascalon	Fair	Good	Fair	---	---	Fair	Poor	Very poor.	Fair	---	Very poor.	Fair.
7*: Ascalon----------	Poor	Fair	Fair	---	---	Fair	Poor	Very poor.	Fair	---	Very poor.	Fair.
Pena----------	Very poor.	Very poor.	Fair	---	---	Fair	Very poor.	Very poor.	Poor	---	Very poor.	Fair.
8*: Atencio----------	Fair	Good	Good	---	---	Fair	Poor	Very poor.	Fair	---	Very poor.	Fair.
Azeltine----------	Poor	Fair	Fair	---	---	Fair	Very poor.	Very poor.	Poor	---	Very poor.	Fair.
9*. Badland												
10, 11---------- Begay	Fair	Fair	Fair	---	---	Fair	Very poor.	Very poor.	Fair	---	Very poor.	Fair.
12*: Bucklon----------	Poor	Poor	Fair	---	---	Fair	Very poor.	Very poor.	Poor	---	Very poor.	Fair.
Inchau----------	Very poor.	Very poor.	Fair	---	---	Fair	Very poor.	Very poor.	Poor	---	Very poor.	Fair.
13, 14, 15---------- Chilton	Poor	Fair	Fair	---	Fair	Fair	Very poor.	Very poor.	Fair	Fair	Very poor.	Fair.
16---------- Cimarron	Poor	Poor	Fair	---	---	Fair	Very poor.	Very poor.	Poor	---	Very poor.	Fair.
17---------- Cochetopa	Poor	Poor	Good	---	---	Fair	Very poor.	Very poor.	Fair	---	Very poor.	Fair.
18*, 19*: Cochetopa----------	Poor	Poor	Good	---	---	Fair	Very poor.	Very poor.	Fair	---	Very poor.	Fair.
Jerry----------	Very poor.	Very poor.	Fair	---	---	Fair	Very poor.	Very poor.	Poor	---	Very poor.	Good.

See footnote at end of table.

TABLE 12.--WILDLIFE HABITAT POTENTIALS--Continued

Soil name and map symbol	Potential for habitat elements								Potential as habitat for--			
	Grain and seed crops	Grasses and legumes	Wild herbaceous plants	Hardwood trees	Coniferous plants	Shrubs	Wetland plants	Shallow water areas	Openland wildlife	Woodland wildlife	Wetland wildlife	Rangeland wildlife
20*. Cryaquolls												
21*: Cushman	Very poor.	Very poor.	Poor	---	Poor	Poor	---	---	Very poor.	Very poor.	Very poor.	Poor.
Lazear	Very poor.	Very poor.	Poor	---	Very poor.	Poor	---	---	Very poor.	Very poor.	Very poor.	Poor.
22---- Dateman	Very poor.	Very poor.	Good	---	Good	Good	Very poor.	Very poor.	Poor	Good	Very poor.	Good.
23---- Detra	Poor	Fair	Good	---	Good	Good	Very poor.	Very poor.	Fair	Good	Very poor.	Good.
24*: Dollard	Poor	Poor	Fair	---	---	Fair	Very poor.	Very poor.	Poor	---	Very poor.	Fair.
Rock outcrop.												
25---- Etoe	Very poor.	Very poor.	Good	---	Good	Good	Very poor.	Very poor.	Poor	Fair	Very poor.	---
26*: Farlow	Very poor.	Very poor.	Fair	---	---	Fair	Very poor.	Very poor.	Poor	---	Very poor.	Fair.
Rock outcrop.												
27*. Halaquepts												
28, 29---- Heldt	Fair	Fair	Poor	---	---	Poor	Poor	Very poor.	Fair	---	Very poor.	Poor.
30, 31---- Heldt	Poor	Fair	Poor	---	---	Poor	Very poor.	Very poor.	Poor	---	Very poor.	Poor.
32---- Holderness Variant	Fair	Fair	Fair	---	---	Fair	Poor	Very poor.	Fair	---	Very poor.	Fair.
33---- Ildefonso	Poor	Poor	Fair	---	---	Fair	Very poor.	Very poor.	Poor	---	Very poor.	Fair.
34---- Ildefonso	Very poor.	Very poor.	Fair	---	---	Fair	Very poor.	Very poor.	Poor	---	Very poor.	Fair.
35*: Ildefonso	Very poor.	Very poor.	Fair	---	---	Fair	Very poor.	Very poor.	Poor	---	Very poor.	Fair.
Lazear	Very poor.	Very poor.	Fair	---	---	Fair	Poor	Very poor.	Poor	---	Very poor.	Fair.
36, 37---- Irigul	Very poor.	Very poor.	Fair	---	---	Fair	Very poor.	Very poor.	Poor	---	Very poor.	Fair.
38*: Irigul	Very poor.	Very poor.	Fair	---	---	Fair	Very poor.	Very poor.	Poor	---	Very poor.	Fair.
Starman	Very poor.	Very poor.	Poor	---	---	Poor	Very poor.	Very poor.	Very poor.	---	Very poor.	Poor.
39---- Jerry	Very poor.	Very poor.	Fair	---	---	Fair	Very poor.	Very poor.	Poor	---	Very poor.	Good.

See footnote at end of table.

TABLE 12.--WILDLIFE HABITAT POTENTIALS--Continued

Soil name and map symbol	Potential for habitat elements								Potential as habitat for--			
	Grain and seed crops	Grasses and legumes	Wild herbaceous plants	Hardwood trees	Coniferous plants	Shrubs	Wetland plants	Shallow water areas	Openland wildlife	Woodland wildlife	Wetland wildlife	Rangeland wildlife
40, 41---------- Kim	Fair	Fair	Fair	---	---	Fair	Poor	Very poor.	Fair	---	Very poor.	Fair.
42---------- Lamphier	Poor	Poor	Good	---	---	Fair	Poor	Very poor.	Fair	---	Very poor.	Fair.
43---------- Limon	Poor	Poor	Fair	---	---	Fair	Poor	Very poor.	Poor	---	Very poor.	Fair.
44---------- Morval	Fair	Good	Good	---	---	Fair	Poor	Poor	Good	---	Poor	Fair.
45*: Morval----------	Fair	Good	Good	---	---	Fair	Poor	Poor	Good	---	Poor	Fair.
Tridell----------	Very poor.	Very poor.	Poor	---	---	Fair	Very poor.	Very poor.	Poor	---	Very poor.	Fair.
46---------- Nihill	Fair	Good	Fair	---	---	Fair	Very poor.	Very poor.	Fair	---	Very poor.	Fair.
47---------- Nihill	Poor	Fair	Fair	---	---	Fair	Very poor.	Very poor.	Fair	---	Very poor.	Fair.
48---------- Northwater	Poor	Poor	Good	---	---	Fair	Very poor.	Very poor.	Fair	---	Very poor.	Fair.
49, 50, 51--------- Olney	Poor	Fair	Fair	---	---	Fair	Poor	Very poor.	Fair	---	Very poor.	Fair.
52---------- Parachute	Very poor.	Very poor.	Good	---	---	Fair	Very poor.	Very poor.	Poor	---	Very poor.	Fair.
53*: Parachute---------	Poor	Poor	Good	---	---	Fair	Very poor.	Very poor.	Fair	---	Very poor.	Fair.
Rhone----------	Poor	Poor	Good	---	---	Fair	Very poor.	Very poor.	Fair	---	Very poor.	Good.
54, 55, 56--------- Potts	Poor	Poor	Fair	---	---	Fair	Very poor.	Very poor.	Poor	---	Very poor.	Fair.
57*, 58*: Potts----------	Poor	Poor	Fair	---	---	Fair	Very poor.	Very poor.	Poor	---	Very poor.	Fair.
Ildefonso---------	Poor	Poor	Fair	---	---	Fair	Very poor.	Very poor.	Poor	---	Very poor.	Fair.
59*: Potts----------	Poor	Poor	Fair	---	---	Fair	Very poor.	Very poor.	Poor	---	Very poor.	Fair.
Ildefonso---------	Very poor.	Very poor.	Fair	---	---	Fair	Very poor.	Very poor.	Poor	---	Very poor.	Fair.
60---------- Rhone	Poor	Poor	Good	---	---	Fair	Very poor.	Very poor.	Fair	---	Very poor.	Good.
61---------- Rhone	Very poor.	Very poor.	Good	---	---	Fair	Very poor.	Very poor.	Poor	---	Very poor.	Good.
62*: Rock outcrop.												
Torriorthents.												

See footnote at end of table.

TABLE 12.--WILDLIFE HABITAT POTENTIALS--Continued

Soil name and map symbol	Potential for habitat elements								Potential as habitat for--			
	Grain and seed crops	Grasses and legumes	Wild herbaceous plants	Hardwood trees	Coniferous plants	Shrubs	Wetland plants	Shallow water areas	Openland wildlife	Woodland wildlife	Wetland wildlife	Rangeland wildlife
63---------- Silas	Poor	Poor	Good	---	---	Good	Poor	Very poor.	Poor	---	Very poor.	Good.
64---------- Tanna	Poor	Fair	Fair	---	---	Fair	Very poor.	Very poor.	Fair	---	Very poor.	Fair.
65*. Torrifluvents												
66*: Torriorthents.												
Camborthids.												
Rock outcrop.												
67*: Torriorthents.												
Rock outcrop.												
68---------- Vale	Fair	Good	Good	Good	Very poor.	---	Very poor.	Very poor.	Good	Very poor.	Very poor.	Good.
69, 70---------- Vale	Very poor.	Very poor.	Good	Poor	Very poor.	---	Very poor.	Very poor.	Very poor.	Very poor.	Very poor.	Good.
71*: Villa Grove-------	Poor	Poor	Good	---	---	Good	Poor	Very poor.	Fair	---	Very poor.	Good.
Zoltay----------	Poor	Fair	Good	---	---	Good	Very poor.	Very poor.	Fair	---	Very poor.	Good.
72---------- Wann	Good	Good	Good	---	Fair	Good	Poor	Fair	Good	---	Fair	Good.

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 13.--ENGINEERING INDEX PROPERTIES

[The symbol < means less than; > means more than. Absence of an entry indicates that data were not estimated]

Soil name and map symbol	Depth	USDA texture	Classification		Fragments > 3 inches	Percentage passing sieve number--				Liquid limit	Plasticity index
			Unified	AASHTO		4	10	40	200		
	In				Pct					Pct	
1----------	0-8	Loam----------	CL-ML	A-4	0-5	90-100	90-100	80-95	50-75	10-20	5-10
Almy Variant	8-34	Clay loam-------	CL	A-6	0-5	85-100	85-100	75-95	65-85	30-40	10-20
	34-60	Flaggy clay loam, flaggy loam.	CL	A-6	25-35	75-90	75-90	60-80	50-70	20-30	10-15
2*:											
Arle----------	0-10	Very stony loam	SM, GM, ML	A-4	25-40	60-85	55-80	45-70	35-55	---	NP
	10-32	Very stony loam, very stony sandy loam.	GM, SM	A-2, A-1	30-60	40-70	40-70	35-55	20-35	---	NP
	32	Weathered bedrock.	---	---	---	---	---	---	---	---	---
Ansari----------	0-10	Loam----------	CL-ML, SM-SC	A-4	5-15	75-100	75-90	70-80	45-65	20-30	5-10
	10-18	Loam, stony loam	CL-ML, SM-SC	A-4	15-35	75-95	75-90	70-80	45-65	20-30	5-10
	18	Unweathered bedrock.	---	---	---	---	---	---	---	---	---
Rock outcrop.											
3, 4----------	0-3	Loam----------	CL-ML	A-4	0	90-100	90-100	85-95	60-75	15-25	5-10
Arvada	3-17	Clay, silty clay loam.	CL, CH	A-7	0	80-100	75-100	70-100	65-95	40-65	20-35
	17-60	Clay loam, silty clay loam.	CL	A-7	0	80-100	75-100	70-100	55-80	40-45	20-25
5, 6----------	0-5	Fine sandy loam	SM	A-2, A-4	0	95-100	90-100	70-95	25-50	15-25	NP-5
Ascalon	5-30	Sandy clay loam	SC, CL	A-6	0	95-100	90-100	80-100	40-55	20-40	10-20
	30-60	Sandy loam, sandy clay loam, fine sandy loam.	SC, SM-SC, CL, CL-ML	A-4, A-6	0	95-100	95-100	75-95	35-65	20-40	5-15
7*:											
Ascalon----------	0-5	Fine sandy loam	SM	A-2, A-4	0	95-100	90-100	70-95	25-50	15-25	NP-5
	5-30	Sandy clay loam	SC, CL	A-6	0	95-100	90-100	80-100	40-55	20-40	10-20
	30-60	Sandy loam, sandy clay loam, fine sandy loam.	SC, SM-SC, CL, CL-ML	A-4, A-6	0	95-100	95-100	75-95	35-65	20-40	5-15
Pena----------	0-12	Stony loam------	CL-ML	A-4	5-20	75-90	75-85	70-75	50-60	20-40	5-20
	12-60	Very stony loam, very stony sandy loam.	GM	A-1, A-2, A-4	35-75	40-75	35-70	30-65	20-50	20-30	NP-5
8*:											
Atencio----------	0-11	Sandy loam------	SM	A-2	0-5	75-100	75-100	50-65	20-30	15-20	NP-5
	11-23	Gravelly sandy clay loam, sandy clay loam.	SC	A-2, A-6	0-5	65-90	50-90	35-65	25-45	20-30	10-15
	23-28	Gravelly sandy clay loam, gravelly sandy loam.	SM-SC	A-2	5-10	50-80	50-75	40-65	15-30	15-25	5-10
	28-60	Sand, gravel, and cobbles.	SP, GP, SP-SM, GP-GM	A-1	30-60	40-60	35-55	10-35	0-10	---	NP

See footnote at end of table.

TABLE 13.--ENGINEERING INDEX PROPERTIES--Continued

Soil name and map symbol	Depth	USDA texture	Classification		Frag-ments > 3 inches	Percentage passing sieve number--				Liquid limit	Plas-ticity index
			Unified	AASHTO		4	10	40	200		
	In				Pct					Pct	
8*:											
Azeltine	0-18	Gravelly sandy loam.	SM	A-2, A-4	0-5	70-85	50-75	40-65	25-40	---	NP
	18-60	Sand, gravel, and cobbles.	GP, SP	A-1	35-60	25-70	20-65	10-30	0-5	---	NP
9*. Badland											
10, 11	0-14	Sandy loam	SM	A-2, A-4	0	95-100	95-100	65-80	30-50	---	NP
Begay	14-24	Fine sandy loam, very fine sandy loam.	SM, ML	A-4	0-5	95-100	95-100	70-95	40-65	15-25	NP-5
	24-60	Stony sandy loam, stony fine sandy loam.	SM	A-2, A-4	20-35	80-95	85-90	55-80	25-50	---	NP
12*:											
Bucklon	0-5	Loam	CL	A-6	0	95-100	95-100	80-100	60-80	25-35	10-15
	5-15	Clay loam, loam	CL	A-6, A-7	0	80-100	75-95	65-95	50-85	25-50	10-25
	15	Weathered bedrock.	---	---	---	---	---	---	---	---	---
Inchau	0-3	Loam	CL-ML, ML	A-4	0	75-100	75-100	70-90	50-70	25-35	5-10
	3-36	Gravelly loam, gravelly clay loam, clay loam.	GM-GC, GM, GC, CL	A-4, A-6	0-10	55-85	50-85	45-80	35-60	25-35	5-15
	36	Weathered bedrock.	---	---	---	---	---	---	---	---	---
13, 14, 15	0-13	Channery loam	SM	A-2, A-4	0-5	70-80	60-70	45-55	30-45	15-25	NP-5
Chilton	13-60	Very gravelly loam, very cobbly sandy loam, very channery sandy loam.	GM	A-2	5-30	40-60	30-60	25-40	15-35	---	NP-10
16	0-4	Loam	ML	A-4	0	90-100	90-100	85-95	60-75	20-30	NP-5
Cimarron	4-60	Clay, silty clay loam, silty clay.	CH, CL	A-7	0-10	95-100	95-100	90-100	75-90	45-70	30-45
17	0-21	Loam	ML	A-4	0-5	85-100	80-95	70-90	50-80	20-30	NP-5
Cochetopa	21-60	Clay, stony clay, stony clay loam.	CL, CH	A-7	5-30	70-90	60-90	55-85	50-80	40-60	20-40
18*, 19*:											
Cochetopa	0-21	Loam	ML	A-4	0-5	85-100	80-95	70-90	50-80	20-30	NP-5
	21-60	Clay, stony clay, stony clay loam.	CL, CH	A-7	5-30	70-90	60-90	55-85	50-80	40-60	20-40
Jerry	0-3	Stony loam	CL, CL-ML	A-4, A-6	5-15	75-100	75-100	70-90	55-70	20-35	5-15
	3-60	Stony clay, cobbly clay loam, cobbly clay.	CL, CH	A-7	20-30	70-90	70-80	60-70	50-60	40-60	25-45
20*. Cryaquolls											

See footnote at end of table.

TABLE 13.--ENGINEERING INDEX PROPERTIES--Continued

Soil name and map symbol	Depth	USDA texture	Classification		Frag-ments > 3 inches	Percentage passing sieve number--				Liquid limit	Plas-ticity index
			Unified	AASHTO		4	10	40	200		
	In				Pct					Pct	
21*:											
Cushman	0-3	Stony loam	CL-ML, ML	A-4	5-15	90-100	90-100	85-95	60-75	20-30	NP-10
	3-11	Clay loam, sandy clay loam, loam	CL	A-6	0-10	90-100	90-100	80-100	50-80	25-35	10-15
	11-32	Loam, gravelly loam, very gravelly loam.	CL-ML, GM-GC	A-4	0	50-90	45-85	40-80	25-60	20-30	5-10
	32	Weathered bedrock.	---	---	---	---	---	---	---	---	---
Lazear	0-4	Stony loam	GM-GC, SM-SC	A-2, A-4	10-20	50-80	50-80	40-60	30-50	20-30	5-10
	4-16	Stony loam	SM-SC	A-4	15-35	75-85	70-85	50-70	35-50	20-30	5-10
	16	Unweathered bedrock.	---	---	---	---	---	---	---	---	---
22	0-3	Gravelly loam	GM-GC	A-2, A-4	5-10	55-75	50-70	40-60	30-50	20-30	5-10
Dateman	3-22	Gravelly sandy loam, gravelly sandy clay loam	GC	A-2	5-15	50-65	50-60	30-45	20-35	20-35	10-15
	22-34	Very gravelly sandy loam.	GM	A-1, A-2	5-15	35-55	30-50	25-45	20-35	---	NP
	34	Unweathered bedrock.	---	---	---	---	---	---	---	---	---
23	0-12	Fine sandy loam	SM	A-4	0	100	100	95-100	35-50	15-25	NP-5
Detra	12-57	Sandy clay loam, clay loam.	CL	A-6	0	100	100	95-100	50-70	30-35	10-15
	57	Unweathered bedrock.	---	---	---	---	---	---	---	---	---
24*:											
Dollard	0-5	Clay	CL, CH	A-7, A-6	0	95-100	95-100	90-100	80-95	35-60	15-40
	5-25	Silty clay, silty clay loam, clay.	CH, CL	A-7	0	95-100	95-100	90-100	80-90	40-60	20-40
	25	Weathered bedrock.	---	---	---	---	---	---	---	---	---
Rock outcrop.											
25	0-15	Loam	ML	A-4	0-10	85-100	80-100	70-95	50-70	20-30	NP-5
Etoe	15-24	Cobbly loam, very cobbly sandy loam, very cobbly loam.	SM, GM	A-2, A-4	50-80	50-90	40-90	30-60	25-50	15-25	NP-5
	24-60	Very cobbly sandy clay loam, extremely stony sandy clay loam, very cobbly loam.	GM, GM-GC, ML, CL-ML	A-1, A-2, A-4, A-6	50-80	50-90	40-90	35-70	25-60	20-35	5-15
26*:											
Farlow	0-10	Channery loam	ML, GM	A-4	5-10	70-80	65-75	60-70	40-55	15-25	NP-5
	10-42	Very channery loam, very flaggy loam.	GM	A-1, A-2	5-45	35-50	30-40	25-40	20-35	15-25	NP-5
	42	Unweathered bedrock.	---	---	---	---	---	---	---	---	---
Rock outcrop.											
27*. Halaquepts											

See footnote at end of table.

TABLE 13.--ENGINEERING INDEX PROPERTIES--Continued

Soil name and map symbol	Depth	USDA texture	Classification		Frag-ments > 3 inches	Percentage passing sieve number--				Liquid limit	Plas-ticity index
			Unified	AASHTO		4	10	40	200		
	In				Pct					Pct	
28, 29, 30, 31----- Heldt	0-8	Clay loam-------	CH, CL	A-7	0	95-100	95-100	95-100	75-95	45-55	25-35
	8-60	Silty clay, clay, clay loam	CH, CL	A-7	0	95-100	95-100	95-100	75-95	45-55	25-35
32----------------- Holderness Variant	0-11	Clay loam-------	CL-ML, CL	A-4, A-6	0-5	95-100	90-100	70-95	50-80	20-35	5-15
	11-30	Clay------------	CL, CH	A-7, A-6	0-5	95-100	90-100	80-95	60-85	35-60	15-35
	30-60	Clay loam-------	CL	A-6, A-7	0-5	95-100	85-100	65-90	50-75	30-40	10-20
33, 34------------- Ildefonso	0-8	Stony loam------	SM, GM	A-1, A-2	5-25	50-75	45-60	30-45	20-35	20-25	NP-5
	8-60	Very stony loam, very gravelly sandy loam.	SM, GM	A-1, A-2	20-70	40-75	35-60	25-50	10-30	20-25	NP-5
35*: Ildefonso---------	0-8	Stony loam------	SM, GM	A-1, A-2	5-25	50-75	45-60	30-45	20-35	20-25	NP-5
	8-60	Very stony loam, very gravelly sandy loam.	SM, GM	A-1, A-2	20-70	40-75	35-60	25-50	10-30	20-25	NP-5
Lazear------------	0-4	Gravelly loam---	ML, GM	A-2, A-4	0-5	50-80	50-75	40-65	30-55	20-30	NP-5
	4-16	Gravelly loam, cobbly loam.	ML, GM	A-2, A-4	10-20	60-95	55-85	50-80	30-70	20-30	NP-5
	16	Unweathered bedrock.	---	---	---	---	---	---	---	---	---
36, 37------------- Irigul	0-6	Channery loam---	GM-GC, CL-ML	A-4	5-20	70-75	60-75	45-65	35-55	20-30	5-10
	6-17	Very channery sandy clay loam.	GM-GC	A-2	5-20	20-50	20-50	15-30	5-15	20-30	5-10
	17	Unweathered bedrock.	---	---	---	---	---	---	---	---	---
38*: Irigul------------	0-6	Channery loam---	GM-GC, CL-ML	A-4	5-20	70-75	60-75	45-65	35-55	20-30	5-10
	6-17	Very channery sandy clay loam.	GM-GC, GP-GC	A-2	5-20	20-50	20-50	15-30	5-15	20-30	5-10
	17	Unweathered bedrock.	---	---	---	---	---	---	---	---	---
Starman-----------	0-3	Channery loam---	GM, SM, GM-GC, GP-GC	A-1, A-2	0-15	60-80	50-75	40-60	30-50	30-40	5-10
	3-13	Very gravelly loam, channery loam, very channery loam.	GM	A-1, A-2	0-15	35-55	30-50	30-45	20-35	30-40	5-10
	13	Unweathered bedrock.	---	---	---	---	---	---	---	---	---
39----------------- Jerry	0-3	Loam------------	ML	A-4	0	80-100	75-100	70-95	55-70	20-35	NP-10
	3-40	Gravelly clay loam, cobbly clay loam, cobbly clay.	GC, CL, CH	A-6, A-7	5-30	60-90	60-80	45-70	35-70	35-60	20-35
	40-60	Gravelly loam, cobbly clay.	GC, CL, CL-ML, GM-GC	A-2, A-4, A-6, A-7	5-30	60-90	60-75	40-70	30-60	20-45	5-25
40, 41------------- Kim	0-60	Loam------------	ML	A-4	0-5	75-100	75-100	60-90	50-75	20-30	NP-5
42----------------- Lamphier	0-60	Loam------------	ML	A-4	0-10	80-100	75-100	70-95	50-75	25-35	NP-5

See footnote at end of table.

TABLE 13.--ENGINEERING INDEX PROPERTIES--Continued

Soil name and map symbol	Depth	USDA texture	Classification		Frag-ments > 3 inches	Percentage passing sieve number--				Liquid limit	Plas-ticity index
			Unified	AASHTO		4	10	40	200		
	In				Pct					Pct	
43---------- Limon	0-5 5-60	Silty clay loam Silty clay loam, silty clay, clay.	CL CH, CL	A-6 A-7	0 0	100 100	100 100	95-100 95-100	70-90 65-95	30-50 40-60	15-30 20-40
44---------- Morval	0-5 5-17 17-60	Loam---------- Silty clay loam, clay loam. Stony clay loam, stony loam.	CL CL CL, SC	A-6 A-6 A-6	0-5 0-10 15-35	90-100 85-100 75-85	85-100 80-100 70-80	80-95 65-95 55-70	60-75 60-80 40-60	30-40 30-40 25-35	10-15 10-15 10-15
45*: Morval---------- Tridell----------	0-5 5-17 17-60 0-10 10-60	Loam---------- Silty clay loam, clay loam. Stony clay loam, stony loam. Stony loam------ Very stony loam	CL CL CL, SC CL-ML, GM-GC, SM-SC ML	A-6 A-6 A-6 A-4 A-4	0-5 0-10 15-35 5-20 35-70	90-100 85-100 75-85 70-80 65-95	85-100 80-100 70-80 65-75 60-90	80-95 65-95 55-70 55-65 55-75	60-75 60-80 40-60 40-55 50-65	30-40 30-40 25-35 20-30 15-25	10-15 10-15 10-15 5-10 NP-5
46, 47---------- Nihill	0-11 11-60	Channery loam--- Very channery loam, very channery sandy loam.	GM, GM-GC, SM, ML GM, GM-GC	A-2, A-4 A-1, A-2	0-5 0-5	60-85 30-60	50-75 20-50	35-65 15-40	30-60 10-35	25-35 20-30	5-10 NP-10
48---------- Northwater	0-25 25-50 50	Loam---------- Very channery clay loam, very channery loam. Unweathered bedrock.	CL-ML, SM-SC GC, GM-GC ---	A-4 A-6, A-2, A-4 ---	0 25-30 ---	75-95 40-60 ---	75-90 40-50 ---	60-85 35-45 ---	45-65 30-40 ---	20-30 20-35 ---	5-10 5-15 ---
49, 50, 51--------- Olney	0-12 12-33 33-43 43-60	Loam---------- Sandy clay loam Gravelly sandy clay loam, gravelly sandy loam. Very gravelly sandy loam, very gravelly sandy clay loam.	CL-ML, ML SC, SM-SC SC, SM-SC, GC, GM-GC GM, GM-GC, GC	A-4 A-4, A-6 A-2 A-2, A-1	0 0 0 0	95-100 95-100 50-85 30-50	95-100 75-90 50-75 30-50	65-90 65-85 35-55 20-35	50-70 35-45 20-35 10-25	20-35 20-35 20-30 15-30	5-10 5-15 5-15 NP-15
52---------- Parachute	0-5 5-18 18-29 29	Loam---------- Loam---------- Very channery loam, very channery sandy loam. Unweathered bedrock.	CL-ML CL, CL-ML, SM-SC, SC GM-GC, GM ---	A-4 A-4, A-6 A-1, A-2 ---	0 0 5-30 ---	90-100 75-100 25-40 ---	90-100 75-95 20-30 ---	65-95 70-95 15-30 ---	50-75 35-75 10-20 ---	20-30 20-35 15-25 ---	5-10 5-15 NP-10 ---

See footnote at end of table.

TABLE 13.--ENGINEERING INDEX PROPERTIES--Continued

Soil name and map symbol	Depth	USDA texture	Classification		Frag-ments > 3 inches	Percentage passing sieve number--				Liquid limit	Plas-ticity index
			Unified	AASHTO		4	10	40	200		
	In				Pct					Pct	
53*:											
Parachute	0-5	Loam	CL-ML	A-4	0	90-100	90-100	65-95	50-75	20-30	5-10
	5-18	Loam	CL, CL-ML, SM-SC, SC	A-4, A-6	0	75-100	75-95	70-95	35-75	20-35	5-15
	18-29	Very channery loam, very channery sandy loam.	GM-GC, GM	A-1, A-2	5-30	25-40	20-30	15-30	10-20	15-25	NP-10
	29	Unweathered bedrock.	---	---	---	---	---	---	---	---	---
Rhone	0-8	Loam	CL, CL-ML	A-4, A-6	0	90-100	80-95	70-90	50-70	20-35	5-15
	8-28	Sandy clay loam, loam.	CL, CL-ML, SM-SC, SC	A-4, A-6	0-5	85-100	75-95	60-90	35-65	20-40	5-20
	28-52	Channery sandy clay loam, very channery sandy clay loam.	GM-GC	A-2	0-10	45-60	40-55	30-50	15-30	20-30	5-10
	52	Unweathered bedrock.	---	---	---	---	---	---	---	---	---
54, 55, 56	0-4	Loam	ML	A-4	0	75-100	75-100	65-90	50-70	25-35	NP-5
Potts	4-28	Clay loam	CL	A-6	0	75-100	75-100	70-100	55-80	25-35	10-15
	28-60	Loam	ML	A-4	0	75-100	75-100	65-90	50-70	25-35	NP-5
57*, 58*, 59*:											
Potts	0-4	Loam	ML	A-4	0	75-100	75-100	65-90	50-70	25-35	NP-5
	4-28	Clay loam	CL	A-6	0	75-100	75-100	70-100	55-80	25-35	10-15
	28-60	Loam	ML	A-4	0	75-100	75-100	65-90	50-70	25-35	NP-5
Ildefonso	0-8	Stony loam	SM, GM	A-1, A-2	5-25	50-75	40-60	30-45	20-35	20-25	NP-5
	8-60	Very stony loam, very gravelly sandy loam.	SM, GM	A-1, A-2	20-70	40-75	35-60	25-50	10-30	20-25	NP-5
60, 61	0-8	Loam	CL, CL-ML	A-4, A-6	0	90-100	80-95	70-90	50-70	20-35	5-15
Rhone	8-28	Sandy clay loam, loam.	CL, CL-ML, SM-SC, SC	A-4, A-6	0-5	85-100	75-95	60-90	35-65	20-40	5-20
	28-52	Channery sandy clay loam, very channery sandy clay loam.	GM-GC	A-2	0-10	45-60	40-55	30-50	15-30	20-30	5-10
	52	Unweathered bedrock.	---	---	---	---	---	---	---	---	---
62*:											
Rock outcrop.											
Torriorthents.											
63	0-60	Loam	ML	A-4	0-10	90-100	80-100	75-95	55-80	20-25	NP-5
Silas											
64	0-9	Silty clay loam	CL	A-6, A-7	0-5	90-100	90-100	90-100	85-95	35-45	15-20
Tanna	9-24	Clay loam, clay, silty clay loam	CL	A-6, A-7	0-5	90-100	90-100	80-95	75-90	35-45	15-25
	24-30	Very channery loam, channery clay loam, loam.	GM-GC, CL-ML	A-2	0-10	40-100	30-95	25-80	20-70	25-30	5-10
	30	Unweathered bedrock.	---	---	---	---	---	---	---	---	---

See footnote at end of table.

TABLE 13.--ENGINEERING INDEX PROPERTIES--Continued

Soil name and map symbol	Depth	USDA texture	Classification		Frag-ments > 3 inches	Percentage passing sieve number--				Liquid limit	Plas-ticity index
			Unified	AASHTO		4	10	40	200		
	In				Pct					Pct	
65*. Torrifluvents											
66*: Torriorthents.											
Camborthids.											
Rock outcrop.											
67*: Torriorthents.											
Rock outcrop.											
68, 69, 70---------- Vale	0-11	Silt loam-------	CL, CL-ML	A-4, A-6	0	100	100	90-100	70-90	25-40	5-15
	11-26	Silty clay loam, clay loam, silt loam.	CL	A-4, A-6, A-7	0	100	100	90-100	70-95	30-45	10-25
	26-60	Loam, silty clay loam, silt loam.	CL, CL-ML	A-4, A-6	0	100	100	85-100	60-95	25-40	5-15
71*: Villa Grove-------	0-4	Loam------------	CL	A-6	0	100	95-100	70-90	50-60	25-35	10-15
	4-15	Clay loam, sandy clay loam.	CL, SC	A-6	0	100	95-100	70-95	45-70	30-40	15-25
	15-60	Sandy loam, loam	SM-SC, CL-ML	A-2, A-4	0	100	95-100	60-70	3-55	20-30	5-10
Zoltay------------	0-19	Loam------------	CL	A-6	0-5	80-95	80-95	65-75	50-65	25-35	10-15
	19-60	Gravelly clay, cobbly clay, cobbly clay loam.	CL, GC, SC	A-6, A-7	5-30	65-85	60-80	50-75	45-70	30-50	15-30
72----------------- Wann	0-17	Sandy loam	SM, SM-SC	A-2, A-4	0	95-100	95-100	70-85	30-45	<25	NP-5
	17-60	Sandy loam, fine sandy loam, coarse sandy loam.	SM, SM-SC	A-2, A-4	0	95-100	95-100	70-80	30-45	0-26	NP-5

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 14.--PHYSICAL AND CHEMICAL PROPERTIES OF SOILS

[The symbol < means less than; > means more than. Entries under "Erosion factors--T" apply to the entire profile. Entries under "Organic matter" apply only to the surface layer. Absence of an entry indicates that data were not available or were not estimated]

Soil name and map symbol	Depth	Clay <2mm	Permeability	Available water capacity	Soil reaction	Salinity	Shrink-swell potential	Erosion factors		Organic matter
								K	T	
	In	Pct	In/hr	In/in	pH	mmhos/cm				Pct
1----------	0-8	20-25	0.6-2.0	0.16-0.19	7.4-7.8	<2	Low----------	0.28	5	3-5
Almy Variant	8-34	30-35	0.2-0.6	0.18-0.20	7.4-8.4	<2	Moderate------	0.32		
	34-60	20-35	0.6-2.0	0.13-0.15	7.9-8.4	<2	Low----------	0.32		
2*:										
Arle----------	0-10	15-25	0.6-2.0	0.07-0.09	7.4-8.4	<2	Low----------	0.10	2	2-4
	10-32	10-25	0.6-2.0	0.06-0.09	7.9-8.4	<2	Low----------	0.10		
	32	---	---	---	---	---	----------	----		
Ansari----------	0-10	18-25	0.6-2.0	0.10-0.13	7.9-8.4	<2	Low----------	0.15	1	2-4
	10-18	16-20	0.6-2.0	0.08-0.12	7.9-8.4	<2	Low----------	0.15		
	18	---	---	---	---	---	----------	----		
Rock outcrop.										
3, 4----------	0-3	15-27	0.6-2.0	0.16-0.18	>7.9	<4	Low----------	0.32	5	0.5-1
Arvada	3-17	35-45	0.06-0.2	0.07-0.09	>8.4	<4	High----------	0.32		
	17-60	28-40	0.06-0.2	0.09-0.11	>7.8	<8	High----------	0.32		
5, 6----------	0-5	10-20	0.6-6.0	0.11-0.16	6.6-7.8	<2	Low----------	0.17	5	1-3
Ascalon	5-30	20-30	0.6-2.0	0.13-0.15	6.6-7.8	<2	Moderate------	0.24		
	30-60	15-25	0.6-6.0	0.11-0.15	7.9-8.4	<2	Low----------	0.24		
7*:										
Ascalon---------	0-5	10-20	0.6-6.0	0.11-0.16	6.6-7.8	<2	Low----------	0.17	5	1-3
	5-30	20-30	0.6-2.0	0.13-0.15	6.6-7.8	<2	Moderate------	0.24		
	30-60	15-25	0.6-6.0	0.11-0.15	7.9-8.4	<2	Low----------	0.24		
Pena----------	0-12	15-25	0.6-2.0	0.12-0.15	7.4-7.9	<2	Low----------	0.28	3	1-3
	12-60	15-25	0.6-2.0	0.03-0.08	7.9-8.4	2-4	Low----------	0.24		
8*:										
Atencio---------	0-11	10-20	2.0-6.0	0.12-0.14	7.4-7.8	<2	Low----------	0.24	3	2-4
	11-23	20-30	0.6-2.0	0.11-0.13	7.4-7.8	<2	Moderate------	0.17		
	23-28	15-25	2.0-6.0	0.07-0.09	7.9-8.4	<2	Low----------	0.10		
	28-60	0-2	6.0-20	0.03-0.05	7.9-8.4	<2	Low----------	0.10		
Azeltine--------	0-18	10-20	2.0-6.0	0.08-0.12	7.9-8.4	<2	Low----------	0.10	2	2-4
	18-60	0-2	>6.0	0.03-0.05	7.4-8.4	<2	Low----------	0.10		
9*.										
Badland										
10, 11----------	0-14	10-18	2.0-6.0	0.12-0.14	6.6-8.4	<2	Low----------	0.24	5	0.5-1
Begay	14-24	10-20	2.0-6.0	0.12-0.15	7.4-8.4	<2	Low----------	0.32		
	24-60	10-15	2.0-6.0	0.08-0.11	7.4-8.4	<2	Low----------	0.32		
12*:										
Bucklon---------	0-5	20-27	0.06-0.2	0.17-0.20	6.1-7.3	<2	Moderate------	0.32	1	2-5
	5-15	20-35	0.06-0.2	0.16-0.18	6.1-7.3	<2	Moderate------	0.37		
	15	---	---	---	---	---	----------	----		
Inchau----------	0-3	15-27	0.6-2.0	0.16-0.18	6.1-7.8	<2	Low----------	0.32	3	2-5
	3-36	20-35	0.6-2.0	0.11-0.15	6.1-7.8	<2	Low----------	0.28		
	36	---	---	---	---	---	----------	----		
13, 14, 15-------	0-13	10-20	0.6-2.0	0.12-0.14	7.9-8.4	<2	Low----------	0.28	5	0.5-2
Chilton	13-60	10-18	2.0-6.0	0.07-0.09	7.9-8.4	<2	Low----------	0.15		
16----------	0-4	10-25	0.6-2.0	0.16-0.18	6.6-7.8	<2	Low----------	0.37	5	2-4
Cimarron	4-60	35-45	0.06-0.2	0.14-0.16	6.6-7.8	<2	High----------	0.32		

See footnote at end of table.

TABLE 14.--PHYSICAL AND CHEMICAL PROPERTIES OF SOILS--Continued

Soil name and map symbol	Depth	Clay <2mm	Permeability	Available water capacity	Soil reaction	Salinity	Shrink-swell potential	Erosion factors		Organic matter
								K	T	
	In	Pct	In/hr	In/in	pH	mmhos/cm				Pct
17----------	0-21	20-27	0.6-2.0	0.16-0.18	6.6-7.3	<2	Low----------	0.24	5	3-6
Cochetopa	21-60	35-50	0.06-0.2	0.11-0.14	6.6-7.8	<2	High----------	0.24		
18*, 19*:										
Cochetopa-------	0-21	20-27	0.6-2.0	0.16-0.18	6.6-7.3	<2	Low----------	0.24	5	3-6
	21-60	35-50	0.06-0.2	0.11-0.14	6.6-7.8	<2	High----------	0.24		
Jerry----------	0-3	20-25	0.6-2.0	0.16-0.18	6.6-7.3	<2	Low----------	0.28	5	3-5
	3-60	35-50	0.06-0.2	0.13-0.15	7.4-8.4	<2	High----------	0.32		
20*.										
Cryaquolls										
21*:										
Cushman---------	0-3	16-20	0.6-2.0	0.16-0.20	6.6-7.8	<2	Low----------	0.24	2	2-3
	3-11	25-35	0.6-2.0	0.14-0.18	7.4-8.4	<2	Moderate------	0.32		
	11-32	16-20	0.6-2.0	0.08-0.12	7.4-8.4	<2	Low----------	0.17		
	32	---	---	---	---	---	----------	---		
Lazear----------	0-4	15-20	0.6-2.0	0.08-0.11	7.9-9.0	<2	Low----------	0.20	1	0.5-1
	4-16	15-20	0.6-2.0	0.08-0.11	>7.9	<2	Low----------	0.20		
	16	---	---	---	---	---	----------	---		
22----------	0-3	15-25	0.6-2.0	0.11-0.13	6.1-7.3	<2	Low----------	0.24	3	3-6
Dateman	3-22	10-20	0.6-2.0	0.08-0.10	6.6-7.8	<2	Low----------	0.20		
	22-34	10-20	0.6-2.0	0.08-0.10	6.6-7.3	<2	Low----------	0.20		
	34	---	---	---	---	---	----------	---		
23----------	0-12	10-20	0.6-2.0	0.10-0.14	6.6-7.8	<2	Low----------	0.24	3	3-6
Detra	12-57	20-35	0.6-2.0	0.14-0.16	6.6-8.4	<2	Moderate------	0.20		
	57	---	---	---	---	---	----------	---		
24*:										
Dollard---------	0-5	35-45	0.06-0.2	0.17-0.19	7.4-9.0	<2	High----------	0.37	2	1-2
	5-25	35-50	0.06-0.2	0.13-0.18	7.4-9.0	<2	High----------	0.43		
	25	---	---	---	---	---	----------	---		
Rock outcrop.										
25----------	0-15	10-23	0.6-2.0	0.16-0.18	6.1-7.3	<2	Low----------	0.20	5	0.5-1
Etoe	15-24	10-25	0.6-2.0	0.12-0.14	6.1-6.5	<2	Low----------	0.15		
	24-60	20-25	0.6-2.0	0.05-0.11	6.1-7.3	<2	Low----------	0.15		
26*:										
Farlow----------	0-10	15-25	0.6-2.0	0.12-0.14	7.4-7.8	<2	Low----------	0.28	3	2-5
	10-42	18-27	0.6-2.0	0.05-0.07	7.9-8.4	<2	Low----------	0.28		
	42	---	---	---	---	---	----------	---		
Rock outcrop.										
27*.										
Halaquepts										
28, 29, 30, 31---	0-8	30-45	0.06-0.2	0.12-0.17	7.4-9.0	<8	High----------	0.28	5	1-2
Heldt	8-60	35-45	0.06-0.2	0.12-0.17	7.9-9.0	<8	High----------	0.28		
32----------	0-11	30-40	0.2-0.6	0.15-0.19	7.9-8.4	<2	Moderate------	0.24	5	2-4
Holderness	11-30	40-60	0.06-0.2	0.15-0.19	7.9-8.4	<2	High----------	0.28		
Variant	30-60	30-40	0.2-0.6	0.15-0.19	7.9-8.4	<2	High----------	0.32		
33, 34----------	0-8	15-25	2.0-6.0	0.08-0.10	7.4-8.4	<2	Low----------	0.15	3	0.5-1
Ildefonso	8-60	15-25	2.0-6.0	0.06-0.08	7.9-8.4	<4	Low----------	0.15		
35*:										
Ildefonso-------	0-8	15-25	2.0-6.0	0.08-0.10	7.4-8.4	<2	Low----------	0.15	3	0.5-1
	8-60	15-25	2.0-6.0	0.06-0.08	7.9-8.4	<4	Low----------	0.15		

See footnote at end of table.

TABLE 14.--PHYSICAL AND CHEMICAL PROPERTIES OF SOILS--Continued

Soil name and map symbol	Depth	Clay <2mm	Permeability	Available water capacity	Soil reaction	Salinity	Shrink-swell potential	Erosion factors		Organic matter
								K	T	
	In	Pct	In/hr	In/in	pH	mmhos/cm				Pct
35*:										
Lazear----------	0-4	15-25	0.6-2.0	0.14-0.16	7.9-9.0	<2	Low----------	0.20	1	0.5-1
	4-16	20-25	0.6-2.0	0.14-0.16	7.9-9.0	<2	Low----------	0.20		
	16	---	---	---	---	---	---	---		
36, 37----------	0-6	15-27	0.6-2.0	0.09-0.11	6.1-7.8	<2	Low----------	0.28	1	1-3
Irigul	6-17	20-35	0.6-2.0	0.05-0.07	7.4-8.4	<2	Low----------	0.20		
	17	---	---	---	---	---	---	---		
38*:										
Irigul----------	0-6	15-27	0.6-2.0	0.09-0.11	6.1-7.8	<2	Low----------	0.28	1	1-3
	6-17	20-35	0.6-2.0	0.05-0.07	7.4-8.4	<2	Low----------	0.20		
	17	---	---	---	---	---	---	---		
Starman---------	0-3	15-25	0.6-2.0	0.09-0.11	7.4-9.0	<2	Low----------	0.24	1	1-2
	3-13	18-25	0.6-2.0	0.09-0.11	7.4-9.0	<2	Low----------	0.28		
	13	---	---	---	---	---	---	---		
39----------	0-3	15-35	0.6-2.0	0.16-0.18	6.6-7.3	<2	Low----------	0.32	5	3-5
Jerry	3-40	35-45	0.06-0.2	0.13-0.15	6.6-8.4	<2	High----------	0.28		
	40-60	20-50	0.6-2.0	0.13-0.15	7.9-8.4	<2	Moderate------	0.20		
40, 41----------	0-60	15-25	0.6-2.0	0.15-0.18	7.4-8.4	<2	Low----------	0.32	5	0.5-1
Kim										
42----------	0-60	20-27	0.6-2.0	0.18-0.21	6.1-7.3	<2	Low----------	0.28	5	2-4
Lamphier										
43----------	0-5	30-40	0.2-0.6	0.14-0.17	7.4-8.4	2-8	High----------	0.28	5	0.5-1
Limon	5-60	35-60	0.06-0.2	0.12-0.16	7.9-9.0	2-8	High----------	0.32		
44----------	0-5	22-32	0.6-2.0	0.18-0.21	6.6-8.4	<2	Moderate------	0.37	5	1-2
Morval	5-17	28-35	0.6-2.0	0.14-0.21	7.4-8.4	<2	Moderate------	0.43		
	17-60	20-35	0.6-2.0	0.08-0.10	7.8-8.4	<2	Moderate------	0.24		
45*:										
Morval----------	0-5	22-32	0.6-2.0	0.18-0.21	6.6-8.4	<2	Moderate------	0.37	5	1-2
	5-17	28-35	0.6-2.0	0.14-0.21	7.4-8.4	<2	Moderate------	0.43		
	17-60	20-35	0.6-2.0	0.08-0.10	7.8-8.4	<2	Moderate------	0.24		
Tridell---------	0-10	15-27	0.6-2.0	0.11-0.13	7.4-8.4	<2	Low----------	0.28	3	2-4
	10-60	15-20	2.0-6.0	0.06-0.08	7.9-8.4	<2	Low----------	0.20		
46, 47----------	0-11	10-27	0.6-2.0	0.12-0.16	7.4-8,4	<2	Low----------	0.24	2	0-1
Nihill	11-60	15-27	2.0-6.0	0.06-0.09	7.9-9.0	<4	Low----------	0.20		
48----------	0-25	20-27	0.6-2.0	0.13-0.18	6.6-7.8	<2	Low----------	0.32	5	3-6
Northwater	25-50	20-35	0.6-2.0	0.08-0.10	6.6-7.8	<2	Low----------	0.20		
	50	---	---	---	---	---	---	---		
49, 50, 51-------	0-12	18-24	0.6-2.0	0.15-0.18	6.6-8.4	<2	Low----------	0.32	5	1-2
Olney	12-33	22-26	0.6-2.0	0.14-0.16	7.4-8.4	<2	Moderate------	0.24		
	33-43	18-22	0.6-2.0	0.10-0.15	7.9-8.4	<2	Low----------	0.20		
	43-60	16-22	0.6-2.0	0.07-0.10	7.9-8.4	<2	Low----------	0.10		
52----------	0-5	15-25	0.6-2.0	0.16-0.18	6.6-7.8	<2	Low----------	0.24	2	3-6
Parachute	5-18	15-25	0.6-2.0	0.14-0.16	6.6-7.8	<2	Low----------	0.24		
	18-29	15-25	2.0-6.0	0.03-0.06	6.6-7.8	<2	Low----------	0.10		
	29	---	---	---	---	---	---	---		
53*:										
Parachute-------	0-5	15-25	0.6-2.0	0.16-0.18	6.6-7.8	<2	Low----------	0.24	2	3-6
	5-18	15-25	0.6-2.0	0.14-0.16	6.6-7.8	<2	Low----------	0.24		
	18-29	15-25	2.0-6.0	0.03-0.06	6.6-7.8	<2	Low----------	0.10		
	29	---	---	---	---	---	---	---		

See footnote at end of table.

TABLE 14.--PHYSICAL AND CHEMICAL PROPERTIES OF SOILS--Continued

Soil name and map symbol	Depth	Clay <2mm	Permeability	Available water capacity	Soil reaction	Salinity	Shrink-swell potential	Erosion factors		Organic matter
								K	T	
	In	Pct	In/hr	In/in	pH	mmhos/cm				Pct
53*:										
Rhone	0-8	20-27	0.6-2.0	0.19-0.21	6.6-7.8	<2	Low	0.24	3	3-6
	8-28	20-30	0.6-2.0	0.15-0.17	6.6-7.8	<2	Moderate	0.24		
	28-52	20-30	0.6-2.0	0.08-0.10	6.6-7.8	<2	Low	0.15		
	52	---	---	---	---	---	---	---		
54, 55, 56	0-4	15-25	0.6-2.0	0.16-0.18	6.6-7.8	<2	Low	0.37	5	1-2
Potts	4-28	20-35	0.6-2.0	0.19-0.21	6.6-8.4	<2	Moderate	0.43		
	28-60	15-25	0.6-2.0	0.16-0.18	7.9-9.0	<2	Low	0.55		
57*, 58*, 59*:										
Potts	0-4	15-25	0.6-2.0	0.16-0.18	6.6-7.8	<2	Low	0.37	5	1-2
	4-28	20-35	0.6-2.0	0.19-0.21	6.6-8.4	<2	Moderate	0.43		
	28-60	15-25	0.6-2.0	0.16-0.18	7.9-9.0	<2	Low	0.55		
Ildefonso	0-8	15-25	2.0-6.0	0.08-0.10	7.4-8.4	<2	Low	0.15	3	0.5-1
	8-60	15-25	2.0-6.0	0.06-0.08	7.9-8.4	<4	Low	0.15		
60, 61	0-8	20-27	0.6-2.0	0.19-0.21	6.6-7.8	<2	Low	0.24	3	3-6
Rhone	8-28	20-30	0.6-2.0	0.15-0.17	6.6-7.8	<2	Moderate	0.24		
	28-52	20-30	0.6-2.0	0.08-0.10	6.6-7.8	<2	Low	0.15		
	52	---	---	---	---	---	---	---		
62*:										
Rock outcrop.										
Torriorthents.										
63	0-60	15-27	0.6-2.0	0.14-0.16	6.6-7.8	<2	Low	0.24	5	3-5
Silas										
64	0-9	27-35	0.06-0.2	0.14-0.20	6.6-7.8	<2	Moderate	0.37	2	20-40
Tanna	9-24	35-45	0.06-0.2	0.12-0.18	7.4-9.0	<4	Moderate	0.43		
	24-30	15-30	0.06-0.2	0.07-0.12	7.4-9.0	<4	Moderate	0.24		
	30	---	---	---	---	---	---	---		
65*.										
Torrifluvents										
66*:										
Torriorthents.										
Camborthids.										
Rock outcrop.										
67*:										
Torriorthents.										
Rock outcrop.										
68, 69, 70	0-11	20-27	0.6-2.0	0.19-0.22	6.1-7.8	<2	Moderate	0.32	5	2-4
Vale	11-26	25-35	0.6-2.0	0.17-0.22	6.6-8.4	<2	Moderate	0.43		
	26-60	15-30	0.6-2.0	0.13-0.20	7.4-9.0	<2	Low	0.43		
71*:										
Villa Grove	0-4	15-27	0.2-0.6	0.16-0.18	7.4-8.4	2-8	Moderate	0.24	5	2-4
	4-15	20-35	2.0-6.0	0.10-0.14	7.4-8.4	<8	Low	0.20		
	15-60	15-25	0.2-2.0	0.14-0.16	7.9-8.4	<8	Moderate	0.32		
Zoltay	0-19	20-27	0.6-2.0	0.17-0.19	6.6-7.8	<2	Moderate	0.28	5	2-4
	19-60	35-45	0.06-0.2	0.13-0.15	6.6-7.8	<2	High	0.24		
72	0-17	10-18	2.0-6.0	0.16-0.18	6.6-8.4	<2	Low	0.20	5	3-6
Wann	17-60	10-18	2.0-6.0	0.15-0.17	7.9-8.4	<2	Low	0.20		

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 15.--SOIL AND WATER FEATURES

[The definitions of "flooding" and "water table" in the Glossary explain terms such as "rare," "brief," "apparent," and "perched." The symbol < means less than; > means more than. Absence of an entry indicates that the feature is not a concern]

Soil name and map symbol	Hydrologic group	Flooding			High water table		Bedrock		Potential frost action	Risk of corrosion	
		Frequency	Duration	Months	Depth	Months	Depth	Hardness		Uncoated steel	Concrete
					Ft		In				
1---------- Almy Variant	C	None--------	---	---	>6.0	---	>60	---	Low--------	High-----	Low.
2*: Arle----------	C	None--------	---	---	>6.0	---	20-40	Rippable	Low--------	Moderate	Low.
Ansari----------	D	None--------	---	---	>6.0	---	10-20	Hard	Low--------	High-----	Low.
Rock outcrop.											
3, 4---------- Arvada	D	None--------	---	---	>6.0	---	>60	---	Low--------	High-----	Moderate.
5, 6---------- Ascalon	B	None--------	---	---	>6.0	---	>60	---	Moderate---	Moderate	Low.
7*: Ascalon----------	B	None--------	---	---	>6.0	---	>60	---	Moderate---	Moderate	Low.
Pena----------	B	None--------	---	---	>6.0	---	>60	---	Moderate---	High-----	Low.
8*: Atencio----------	B	None--------	---	---	>6.0	---	>60	---	Low--------	High-----	Low.
Azeltine---------	B	None--------	---	---	>6.0	---	>60	---	Low--------	High-----	Low.
9*. Badland											
10, 11---------- Begay	B	None--------	---	---	>6.0	---	>60	---	Low--------	High-----	Low.
12*: Bucklon----------	D	None--------	---	---	>6.0	---	10-20	Rippable	Moderate---	High-----	Low.
Inchau----------	C	None--------	---	---	>6.0	---	20-40	Rippable	Moderate---	High-----	Low.
13, 14, 15-------- Chilton	B	None--------	---	---	>6.0	---	>60	---	Low--------	Moderate	Low.
16---------- Cimarron	C	None--------	---	---	>6.0	---	>60	---	Moderate---	High-----	Low.
17---------- Cochetopa	C	None--------	---	---	>6.0	---	>60	---	Moderate---	High-----	Low.
18*, 19*: Cochetopa--------	C	None--------	---	---	>6.0	---	>60	---	Moderate---	High-----	Low.
Jerry----------	C	None--------	---	---	>6.0	---	>60	---	Moderate---	High-----	Low.

See footnote at end of table.

TABLE 15.--SOIL AND WATER FEATURES--Continued

Soil name and map symbol	Hydrologic group	Flooding			High water table		Bedrock		Potential frost action	Risk of corrosion	
		Frequency	Duration	Months	Depth	Months	Depth	Hardness		Uncoated steel	Concrete
					Ft		In				
20*. Cryaquolls											
21*: Cushman	C	None	---	---	>6.0	---	20-40	Rippable	Low	High	Low.
Lazear	D	None	---	---	>6.0	---	10-20	Hard	Low	High	Low.
22--- Dateman	C	None	---	---	>6.0	---	20-40	Hard	Moderate	High	Moderate.
23--- Detra	B	None	---	---	>6.0	---	40-60	Hard	Moderate	High	Low.
24*: Dollard	C	None	---	---	>6.0	---	20-40	Rippable	Low	High	Low.
Rock outcrop.											
25--- Etoe	B	None	---	---	>6.0	---	>60	---	Moderate	Low	Low.
26*: Farlow	B	None	---	---	>6.0	---	40-60	Hard	Low	High	Low.
Rock outcrop.											
27*. Halaquepts											
28, 29, 30, 31--- Heldt	C	None	---	---	>6.0	---	>60	---	Low	High	High.
32--- Holderness Variant	C	None	---	---	>6.0	---	>60	---	Moderate	High	Low.
33, 34--- Ildefonso	B	None	---	---	>6.0	---	>60	---	Low	High	Low.
35*: Ildefonso	B	None	---	---	>6.0	---	>60	---	Low	High	Low.
Lazear	D	None	---	---	>6.0	---	10-20	Hard	Low	High	Low.
36, 37--- Irigul	D	None	---	---	>6.0	---	10-20	Hard	Low	High	Low.
38*: Irigul	D	None	---	---	>6.0	---	10-20	Hard	Low	High	Low.
Starman	D	None	---	---	>6.0	---	10-20	Hard	Moderate	High	Low.

See footnote at end of table.

TABLE 15.--SOIL AND WATER FEATURES--Continued

Soil name and map symbol	Hydrologic group	Flooding			High water table		Bedrock		Potential frost action	Risk of corrosion	
		Frequency	Duration	Months	Depth	Months	Depth	Hardness		Uncoated steel	Concrete
					Ft		In				
39---------- Jerry	C	None---------	---	---	>6.0	---	>60	---	Moderate---	High-----	Moderate.
40, 41---------- Kim	B	None---------	---	---	>6.0	---	>60	---	Low--------	High-----	Low.
42---------- Lamphier	B	None---------	---	---	>6.0	---	>60	---	Moderate---	High-----	Low.
43---------- Limon	C	None---------	---	---	>6.0	---	>60	---	Low--------	High-----	Moderate.
44---------- Morval	B	None---------	---	---	>6.0	---	>60	---	Moderate---	Moderate	Low.
45*: Morval----------	B	None---------	---	---	>6.0	---	>60	---	Moderate---	Moderate	Low.
Tridell----------	B	None---------	---	---	>6.0	---	>60	---	Moderate---	High-----	Low.
46, 47---------- Nihill	B	None---------	---	---	>6.0	---	>60	---	Moderate---	High-----	Low.
48---------- Northwater	B	None---------	---	---	>6.0	---	40-60	Hard	Moderate---	Moderate	Low.
49, 50, 51-------- Olney	B	None---------	---	---	>6.0	---	>60	---	Low--------	Moderate	Low.
52---------- Parachute	B	None---------	---	---	>6.0	---	20-40	Rippable	Moderate---	Moderate	Low.
53*: Parachute--------	B	None---------	---	---	>6.0	---	20-40	Rippable	Moderate---	Moderate	Low.
Rhone----------	B	None---------	---	---	>6.0	---	40-60	Rippable	Moderate---	Moderate	Low.
54, 55, 56-------- Potts	B	None---------	---	---	>6.0	---	>60	---	Low--------	High-----	Moderate.
57*, 58*, 59*: Potts----------	B	None---------	---	---	>6.0	---	>60	---	Low--------	High-----	Moderate.
Ildefonso--------	B	None---------	---	---	>6.0	---	>60	---	Low--------	High-----	Low.
60, 61---------- Rhone	B	None---------	---	---	>6.0	---	40-60	Rippable	Moderate---	Moderate	Low.
62*: Rock outcrop.											
Torriorthents.											

See footnote at end of table.

TABLE 15.--SOIL AND WATER FEATURES--Continued

Soil name and map symbol	Hydrologic group	Flooding			High water table		Bedrock		Potential frost action	Risk of corrosion	
		Frequency	Duration	Months	Depth	Months	Depth	Hardness		Uncoated steel	Concrete
					Ft		In				
63---------- Silas	B	Occasional	Brief-----	Apr-Sep	>6.0	---	---	---	Moderate---	High-----	Low.
64---------- Tanna	C	None--------	---	---	>6.0	---	20-40	Rippable	Low--------	High-----	Low.
65*. Torrifluvents											
66*: Torriorthents.											
Camborthids.											
Rock outcrop.											
67*: Torriorthents.											
Rock outcrop.											
68, 69, 70-------- Vale	B	None--------	---	---	>6.0	---	>60	---	Moderate---	Moderate	Low.
71*: Villa Grove------	B	None--------	---	---	>6.0	---	>60	---	Moderate---	High-----	Low.
Zoltay----------	C	None--------	---	---	>6.0	---	>60	---	Moderate---	High-----	Low.
72---------- Wann	B	Occasional	Brief-----	Apr-Jul	2.0-3.0	Apr-Jul	>60	---	High-------	High-----	Low.

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 16.--CLASSIFICATION OF THE SOILS

Soil name	Family or higher taxonomic class
Almy Variant	Fine-loamy, mixed Borollic Haplargids
Ansari	Loamy, mixed Lithic Haploborolls
Arle	Loamy-skeletal, mixed, Aridic Haploborolls
Arvada	Fine, montmorillonitic, mesic Ustollic Natrargids
Ascalon	Fine-loamy, mixed, mesic Aridic Argiustolls
Atencio	Fine-loamy over sandy or sandy-skeletal, mixed, mesic Aridic Argiustolls
Azeltine	Fine-loamy over sandy or sandy-skeletal, mixed, mesic Torriorthentic Haplustolls
Begay	Coarse-loamy, mixed, mesic Ustollic Camborthids
Bucklon	Loamy, mixed, shallow Typic Cryoborolls
Chilton	Loamy-skeletal, mixed (calcareous), mesic Ustic Torriorthents
Cimarron	Fine, montmorillonitic Argic Vertic Cryoborolls
Cochetopa	Fine, montmorillonitic Argic Pachic Cryoborolls
Cushman	Fine-loamy, mixed, mesic Ustollic Haplargids
Dateman	Loamy-skeletal, mixed Pachic Cryoborolls
Detra	Fine-loamy, mixed Pachic Argiborolls
Dollard	Fine, montmorillonitic (calcareous), frigid Ustic Torriorthents
Etoe	Loamy-skeletal, mixed Typic Paleboralfs
Farlow	Loamy-skeletal, mixed Typic Cryoborolls
Heldt	Fine, montmorillonitic, mesic Ustertic Camborthids
Holderness Variant	Fine, montmorillonitic Aridic Haploborolls
Ildefonso	Loamy-skeletal, mixed, mesic Ustollic Calciorthids
Inchau	Fine-loamy, mixed Argic Cryoborolls
Irigul	Loamy-skeletal, mixed Lithic Cryoborolls
Jerry	Fine, montmorillonitic Argic Cryoborolls
Kim	Fine-loamy, mixed (calcareous), mesic Ustic Torriorthents
Lamphier	Fine-loamy, mixed Pachic Cryoborolls
Lazear	Loamy, mixed (calcareous), mesic Lithic Ustic Torriorthents
Limon	Fine, montmorillonitic (calcareous), mesic Ustertic Torriorthents
Morval	Fine-loamy, mixed Aridic Argiborolls
Nihill	Loamy-skeletal, mixed (calcareous), mesic Ustic Torriorthents
Northwater	Loamy-skeletal, mixed Cryic Pachic Paleborolls
Olney	Fine-loamy, mixed, mesic Ustollic Haplargids
Parachute	Loamy-skeletal, mixed Typic Cryoborolls
Pena	Loamy-skeletal, mixed, mesic Aridic Calciustolls
Potts	Fine-loamy, mixed, mesic Ustollic Haplargids
Rhone	Fine-loamy, mixed Pachic Cryoborolls
Silas	Fine-loamy, mixed Cumulic Cryoborolls
Starman	Loamy-skeletal, mixed (calcareous) Lithic Cryorthents
Tanna	Fine, montmorillonitic Aridic Argiborolls
Tridell	Loamy-skeletal, mixed Aridic Calciborolls
Vale	Fine-silty, mixed, mesic Aridic Argiustolls
Villa Grove	Fine-loamy, mixed Aridic Argiborolls
Wann	Coarse-loamy, mixed, mesic Fluvaquentic Haplustolls
Zoltay	Fine, montmorillonitic Pachic Argiborolls

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