

**Soil Survey of
Modoc National Forest Area,
California**



**United States Department of Agriculture
Forest Service and Soil Conservation Service**



*in cooperation with
The Regents of the University of California
(Agricultural Experiment Station)*

How To Use This Soil Survey

General Soil Map

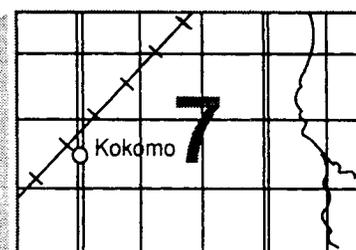
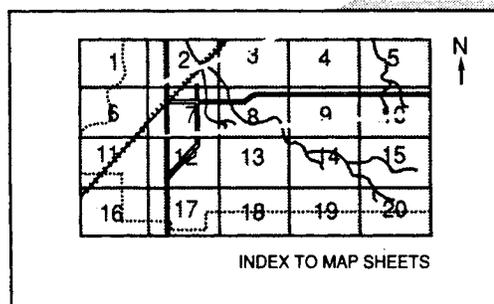
The general soil map, which is the small scale map preceding the detailed soil maps, shows the survey area divided into groups of associated soils called general soil map units. This map is useful in planning the use and management of large areas.

To find information about your area of interest, locate that area on the map, identify the name of the map unit in the area on the map legend, then refer to the section **General Soil Map Units** for a general description of the soils in your area.

Detailed Soil Maps

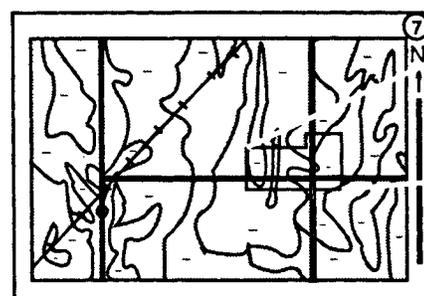
The detailed soil maps follow the general soil map. These maps can be useful in planning the use and management of small areas.

To find information about your area of interest, locate that area on the **Index to Map Sheets**, which precedes the soil maps. Note the number of the map sheet, and turn to that sheet.

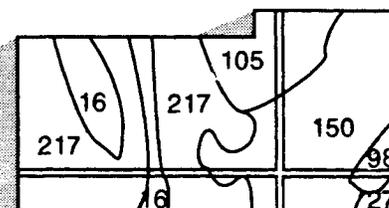


MAP SHEET

Locate your area of interest on the map sheet. Note the map unit symbols that are in that area. Turn to the **Index to Map Units** (see Contents), which lists the map units by symbol and name and shows the page where each map unit is described.



MAP SHEET



AREA OF INTEREST

NOTE: Map unit symbols in a soil survey may consist only of numbers or letters, or they may be a combination of numbers and letters.

The **Summary of Tables** shows which table has data on a specific land use for each detailed soil map unit. See **Contents** for sections of this publication that may address your specific needs.

Modoc National Forest Area, California

This soil survey is a publication of the National Cooperative Soil Survey, a joint effort of the United States Department of Agriculture and other federal agencies, and state agencies including the Agricultural Experiment Stations. The fieldwork and technical quality control for this survey were conducted by the Forest Service. The correlation of the soils was conducted by the Soil Conservation Service in consultation with the Forest Service. 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 performed in the period 1978-1982. Soil names and descriptions were approved in 1983. Unless otherwise indicated, statements in this publication refer to conditions in the survey area in 1982. This survey was made cooperatively by the Forest Service and the Soil Conservation Service. The soil survey area consists of most of the Modoc National Forest (except that area of the forest that was published in the Surprise Valley-Home Camp Soil Survey Area, and a few minor areas of the forest that will be published with the Big Valley Soil Survey and Butte Valley-Tule Lake Soil Surveys at a later date). The soil survey area also includes some private land holdings, the Lava Beds National Monument and the Clear Lake National Wildlife Refuge.

Soil maps in this survey may be copied without permission. Enlargement of these maps, however, could cause misunderstanding of the detail of mapping. If enlarged, maps do not show the small areas of contrasting soils that could have been shown at a larger scale.

Cover: Looking east towards Cedar Pass through Warner mountains. The mid section is the Modoc Plateau being the dominant landscape covered with juniper and sagebrush. Lower portion shows a road cut through Gwin family soils overlying volcanic tuff material.

Contents

Index to detailed soil map units	iv	Introduction to map unit descriptions, characteristics and interpretations for management	21
Summary of tables	x	Detailed map unit descriptions	37
Foreward	xi	Use and management of the soils	272
Acknowledgements	xii	Watershed	272
General nature of the survey area	1	Wildlife	272
Geomorphology	1	Recreation	273
Geology and geomorphic history	1	Classification of the soils	275
Climate	4	Taxonomic unit descriptions	284
Vegetation	5	Formation of the soils	411
How this survey was made	7	References	414
General soil map units for broad land use planning	9	Glossary	415
General soil map	19		

Taxonomic Unit Descriptions

Ahart family	296	Germany family	332
Aikman family	297	Ginser family	334
Alcot family	299	Gleason family	335
Alicel family	301	Gralic family	336
Anatone family	302	Gwin family	337
Aquolls	303	Hades family	338
Bakeoven family	304	Hiebner family	339
Barnard family	305	Holland family	340
Bearskin family	306	Indian Creek family	342
Behanin family	307	Inville family	342
Bertag family	308	Jacket family	345
Bieber family	309	Jacknife family	347
Cardon family	310	Keating family	349
Castlevale family	311	Kinzel family	350
Casuse family	312	Lamondi family	352
Cavanaugh family	313	Lapine family	353
Cheadle family	315	Lawyer family	355
Cowiche family	316	Lithic Cryochrepts	357
Cryoborolls, wet	317	Lithic Xerorthents	358
DeMasters family	318	Lithic Xerumbrepts	359
Deven family	320	Loberg family	360
Dishner family	321	Los Gatos family	361
Ditchcamp family	322	Manila family	362
Divers family	324	Mascamp family	364
Duncom family	326	Menzel family	365
Elmore family	327	Merkel family	367
Fordice family	328	Merlin family	368
Friana family	330	Neer family	369
Gallatin family	331	Pack wood family	371

Pass Canyon family	373	Stonewell family	392
Patio family	375	Stukel family	394
Puls family	376	Supan family	395
Ridd family	377	Supervisor family	395
Roval family	378	Vipont family	398
Ruckles family	379	Wapal family	400
Sadie family	380	Wenatchee family	401
Sapristis	382	Woodhurst family	403
Searles family	383	Wrentham family	405
Sheld family	384	Wuksi family	406
Simpson family	386	Xerofluvents	407
Skalan family	388	Yallani family	408
Smarts family	390	Zynbar family	410

Index to Detailed Soil Map Units

101 Aikman family, 0 to 2 percent slopes	37
102 Aikman-Cardon families complex, 0 to 2 percent slopes	38
103 Aikman-Barnard families association, 0 to 2 percent slopes	39
104 Alcot family, 20 to 40 inch pumice overburden,	40
1 to 10 percent slopes	
105 Alcot family, 40 to 60 inch pumice,	41
5 to 35 percent slopes	
106 Alcot-Neer families association, 10 to 20 inch pumice overburden,	42
5 to 30 percent slopes	
107 Alcot-Sadie families complex,	43
1 to 20 percent slopes	
108 Alcot-Menzel families complex, 10 to 20 inch pumice overburden,	44
1 to 10 percent slopes	
109 Alicel family,	45
5 to 25 percent slopes	
110 Anatone-Bearskin families-Rock outcrop association,	46
40 to 70 percent slopes	
111 Anatone-Bearskin-Smarts families association,	47
2 to 20 percent slopes	
112 Anatone-Bearskin-Smarts families association,	49
20 to 40 percent slopes	
113 Anatone-Merlin families-Rock outcrop association,	51
40 to 90 percent slopes	
114 Anatone-Patio families-Rubble land association	52
60 to 90 percent slopes	
115 Anatone-Smarts families association,	53
5 to 20 percent slopes	
116 Anatone-Smarts families association,	54
20 to 40 percent slopes	
117 Anatone-Smarts families-Rock outcrop association,	55
40 to 70 percent slopes	
118 Bakeoven family-Lava flow-Lithic Xerorthents, mesic association,	57
1 to 15 percent slopes	
120 Bakeoven family-Rock outcrop association,	58
20 to 60 percent slopes	

121	Bakeoven family-Rock outcrop-Wenatchee family association,	59
	1 to 20 percent slopes	
122	Bakeoven-Stukel families-Lava flow association,	61
	1 to 15 percent slopes	
123	Behanin-Cheadle families association,	62
	10 to 35 percent slopes	
124	Behanin-Cheadle families association,	63
	35 to 60 percent slopes	
125	Behanin deep-Gallatin families complex,	64
	10 to 35 percent slopes	
126	Behanin deep-Supervisor families complex,	65
	15 to 40 percent slopes	
127	Bertag deep-Cavanaugh-Mascamp families association,	66
	35 to 60 percent slopes	
128	Betag-Smarts families association,	68
	10 to 40 percent slopes	
129	Bertag-Smarts, deep-Cavanaugh families complex,	69
	35 to 60 percent slopes	
130	Bieber-Barnard families complex,	71
	1 to 20 percent slopes	
131	Bieber-Barnard-Simpson families complex,	72
	1 to 10 percent slopes	
132	Bieber-Deven-Roval families complex,	74
	1 to 10 percent slopes	
133	Bieber-Roval families complex,	75
	1 to 15 percent slopes	
134	Bieber-Roval-Barnard families complex,	76
	1 to 10 percent slopes	
135	Bieber-Roval -Puls families complex,	78
	1 to 15 percent slopes	
136	Cardon family,	79
	0 to 2 percent slopes	
137	Cardon-Jacket-Deven families association,	80
	5 to 25 percent slopes	
138	Saprists,	82
	0 to 2 percent slopes	
139	Castlevale-Bakeoven families complex, 2 to 8 inch pumice overburden	83
	1 to 10 percent slopes	
140	Castlevale-Wenatchee-Searles families complex, 2 to 12 inch pumice overburden,	84
	1 to 10 percent slopes	
141	Cavanaugh-Patio deep families association,	86
	35 to 65 percent slopes	
142	Cheadle-Gallatin families-Rock outcrop association,	87
	10 to 60 percent slopes	
144	Cowiche family,	88
	1 to 10 percent slopes	
145	Cowiche-Casuse families-Rock outcrop, tuff association,	89
	2 to 30 percent slopes	
146	Cowiche-Simpson families complex	90
	1 to 15 percent slopes	
147	DeMasters-Merlin-DeMasters deep families association,	91
	1 to 20 percent slopes	
148	DeMasters-Smarts families, deep complex,	93
	1 to 20 percent slopes	
149	DeMasters-Smarts families, deep complex,	94
	20 to 40 percent slopes	

150	Deven family,	95
	1 to 10 percent slopes	
151	Deven-Bieber-Barnard families complex,	96
	0 to 5 percent slopes	
152	Deven-Bieber-Lawyer families association,	98
	1 to 10 percent slopes	
153	Deven-Bieber-Pass Canyon families association,	99
	1 to 15 percent slopes	
154	Deven-Pass Canyon families complex,	100
	1 to 10 percent slopes	
155	Deven-Pass Canyon-Keating families complex,	101
	1 to 15 percent slopes	
156	Deven-Pass Canyon-Keating families complex,	102
	15 to 35 percent slopes	
157	Deven-Pass Canyon-Keating families complex,	103
	35 to 60 percent slopes	
158	Deven-Puls families association,	104
	1 to 15 percent slopes	
159	Deven family-Rock outcrop association,	105
	1 to 20 percent slopes	
161	Divers-Lapine-Kinzel families association,	106
	2 to 15 inch pumice overburden, 2 to 30 percent slopes	
162	Divers-Lapine-Kinzel families association,	108
	30 to 55 percent slopes	
163	Divers-Lapine families-Rock outcrop association,	110
	5 to 15 inch pumice overburden, 30 to 60 percent slopes	
164	Elmore deep family,	112
	1 to 15 percent slopes	
165	Elmore deep family,	113
	15 to 40 percent slopes	
166	Elmore-Deven-Elmore deep families association,	114
	1 to 20 percent slopes	
167	Elmore-Jacket, deep-Lawyer families association,	116
	1 to 20 percent slopes	
168	Elmore-Jacket, deep-Lawyer families association,	117
	20 to 40 percent slopes	
169	Elmore deep-Elmore family-Lava flow association,	119
	5 to 30 percent slopes	
170	Gallatin-Behanin deep-Duncom families complex,	120
	5 to 30 percent slopes	
171	Gallatin-Cheadle families-Cryoborolls, wet association,	121
	15 to 40 percent slopes	
173	Germany deep-Sadie families complex,	122
	1 to 5 percent slopes	
174	Germany family-Lithic Xerumbrepts-Lava flow association,	123
	1 to 20 percent slopes	
175	Gwin-Pass Canyon families-Lithic Xerorthents, mesic complex,	125
	1 to 20 percent slopes	
176	Gwin-pass Canyon families-Lithic Xerorthents, mesic complex,	127
	20 to 40 percent slopes	
177	Gwin-Pass Canyon families-Lithic Xerorthents, mesic complex,	129
	40 to 70 percent slopes	
178	Gwin-Ruckles families-Rock outcrop association,	131
	40 to 70 percent slopes	
179	Hades-Vipont-Anatone families association,	132
	10 to 30 percent slopes	

180	Hiibner-Deven-Keating families complex, 20 to 60 percent slopes	133
181	Hiibner-Ruckles families complex, 15 to 35 percent slopes	135
182	Holland family, 4 to 15 inch pumice overburden, 1 to 10 percent slopes	136
183	Holland deep-Skalan families complex, 8 to 20 inch pumice overburden, 1 to 10 percent slopes	137
184	Indian Creek family, 1 to 5 percent slopes	139
185	Indian Creek-Puls-Barnard families complex, 0 to 2 percent slopes	140
186	Inville-Yallani families complex, 10 to 20 inch pumice overburden, 2 to 20 percent slopes	142
187	Jacket-Deven-Hiibner families association, 1 to 15 percent slopes	144
188	Jacket-Deven-Hiibner families association, 15 to 35 percent slopes	146
189	Jacket-Deven-Hiibner families association, 35 to 60 percent slopes	148
190	Jackknife-Aikman families association, 0 to 5 percent slopes	150
191	Keating-Deven families association, 1 to 20 percent slopes	151
192	Keating-Deven families association, 20 to 40 percent slopes	152
193	Kinzel-Lapine-Divers families association, 2 to 12 inch pumice overburden, 1 to 15 percent slopes	153
194	Lamondi-Smarts deep families complex, 2 to 20 percent slopes	155
195	Lamondi-Smarts deep families complex, 20 to 40 percent slopes	156
196	Lamondi-Smarts deep families complex, 40 to 60 percent slopes	157
197	Lapine-Divers families association, 10 to 24 inch pumice overburden, 20 to 40 percent slopes	158
198	Lapine-Divers families association, 10 to 24 inch pumice overburden, 40 to 60 percent slopes	160
199	Lapine-Wuksi-Divers families association, 2 to 8 inch pumice overburden, 5 to 30 percent slopes	162
200	Lawyer deep-Lawyer family complex, 1 to 20 percent slopes	164
201	Lawyer-Elmore families, deep association, 1 to 20 percent slopes	165
202	Lawyer-Elmore families, deep association, 20 to 40 percent slopes	166
203	Lawyer-Elmore families, deep association, 40 to 60 percent slopes	167
204	Lawyer-Elmore-Gwin families association, 1 to 20 percent slopes	168
205	Lawyer-Elmore-Gwin families association, 20 to 40 percent slopes	170
206	Lawyer-Elmore-Gwin families association, 40 to 60 percent slopes	172
207	Lithic Cryochrepts-Cheadle family association, 10 to 40 percent slopes	174

208	Lithic Xerorthents, mesic-Deven family complex, 1 to 15 percent slopes	175
209	Lithic Xerorthents, mesic-Lava flow complex, 1 to 20 percent slopes	176
210	Lithic Xerorthents, mesic-Xerofluvents, mesic-Aquolls association, 0 to 20 percent slopes	177
211	Loberg-Friana-Cheadle families association, 30 to 65 percent slopes	179
212	Manila-Merlin-Mascamp families association, 10 to 35 percent slopes	181
213	Manila-Merlin-Mascamp families association, 35 to 60 percent slopes	182
214	Merlin family, 1 to 10 percent slopes	183
215	Gralic-Loberg families-Rubble land association, 35 to 80 percent slopes	184
216	Gralic-Supervisor families complex, 10 to 35 percent slopes	186
217	Gralic-Supervisor families complex, 35 to 60 percent slopes	187
218	Packwood-Bieber families complex, 1 to 10 percent slopes	188
219	Packwood-Ditchcamp families-Rock outcrop complex, 1 to 10 percent slopes	189
220	Packwood-Puls families complex, 1 to 5 percent slopes	190
221	Pass Canyon-Dishner-Deven families association, 1 to 20 percent slopes	191
222	Pass Canyon-Elmore families-Lava flow association, 1 to 20 percent slopes	192
223	Pass Canyon-Elmore-Packwood families association, 1 to 10 percent slopes	194
224	Pass Canyon-Fordice-Gwin families association, 1 to 20 percent slopes	196
225	Pass Canyon-Fordice-Gwin families association, 20 to 40 percent slopes	198
226	Pass Canyon-Gwin-Fordice families association, 40 to 70 percent slopes	200
227	Pass Canyon family-Lithic Xerorthents, mesic complex, 1 to 15 percent slopes	202
228	Pass Canyon-Los Gatos families complex, 1 to 20 percent slopes	203
229	Pass Canyon-Roval families complex, 1 to 15 percent slopes	204
230	Patio deep-Gleason-Merkel families complex, 10 to 40 percent slopes	205
231	Patio deep-Merkel families complex, 15 to 35 percent slopes	207
232	Patio deep-Merkel families complex, 35 to 60 percent slopes	208
233	Patio-Smarts-Anatone families association, 15 to 35 percent slopes	209
235	Puls-Packwood-Ditchcamp families complex, 1 to 10 percent slopes	211
236	Puls-Roval-Dishner families complex, 0 to 5 percent slopes	212

237	Ridd-Los Gatos-Gwin families association, 5 to 35 percent slopes	213
238	Ridd-Ruckles-Keating families complex, 1 to 20 percent slopes	214
239	Rock outcrop-Bakeoven-Wenatchee families association, 20 to 60 percent slopes	215
240	Rock outcrop-Rubble land-Bakeoven family association, 40 to 90 percent slopes	217
241	Rock out crop-Rubble land-Cheadle family association, 60 to 100 percent slopes	218
242	Roval-Deven families association, 1 to 10 percent slopes	219
243	Roval-Pass Canyon families complex, 1 to 15 percent slopes	220
244	Ruckles-Bieber families complex, 2 to 30 percent slopes	221
245	Ruckles-Gwin families-Rock outcrop association, 20 to 40 percent slopes	222
246	Menzel-Holland families, 4 to 15 inch pumice overburden-Rock outcrop association 15 to 40 percent slopes	223
247	Searles-Gwin families-Lava flow complex, 1 to 10 percent slopes	225
249	Sheld-Ahart families association, 2 to 20 percent slopes	227
250	Simpson family, 1 to 10 percent slopes	228
251	Simpson-Deven families association, 1 to 20 percent slopes	229
252	Smarts deep-Smarts family complex, 2 to 20 percent slopes	230
253	Smarts deep-Smarts family complex, 20 to 40 percent slopes	231
254	Smarts-Bertag-DeMasters families, deep association, 10 to 35 percent slopes	232
255	Smarts deep-Cavanaugh families complex, 10 to 35 percent slopes	234
256	Smarts deep-Cavanaugh families complex, 35 to 60 percent slopes	235
257	Smarts-Mascamp families association, 40 to 60 percent slopes	236
258	Smarts-Mascamp-DeMasters deep families association, 2 to 20 percent slopes	237
259	Smarts-Mascamp-DeMasters deep families association, 20 to 40 percent slopes	239
260	Stonewell family, 40 to 60 inch pumice, 15 to 40 percent slopes	241
261	Stonewell-Yallani families association, 6 to 20 inch pumice overburden, 5 to 30 percent slopes	242
262	Stonewell-Yallani families association, 35 to 70 percent slopes	244
263	Stonewell-Yallani families-Lithic Xerorthents, frigid association, 30 to 55 percent slopes	245
264	Stonewell-Yallani-Zynbar families association, 2 to 20 percent slopes	247
265	Stonewell-Zynbar families association, 15 to 35 percent slopes	249

266	Stukel family-Lava flow association,	250
	1 to 20 percent slopes	
267	Stukel-Los Gatos-Pass Canyon families complex,	251
	1 to 10 percent slopes	
268	Supan-Supan deep-Pass Canyon families association,	252
	1 to 20 percent slopes	
269	Supervisor-Cheadle families-Rock outcrop association,	254
	15 to 35 percent slopes	
270	Supervisor-Cheadle families-Rock outcrop association,	256
	35 to 60 percent slopes	
271	Supervisor-Cheadle families-Rock outcrop association,	257
	60 to 90 percent slopes	
272	Rock outcrop, tuff-Lithic Xerorthents, frigid complex,	258
	60 to 100 percent slopes	
273	Vipont-Ginser-Anatone families association,	259
	15 to 40 percent slopes	
274	Aquolls,	261
	0 to 5 percent slopes	
275	Woodhurst-Behanin deep families complex,	262
	10 to 35 percent slopes	
276	Wrentham-Bakeoven families association,	263
	10 to 40 percent slopes	
277	Yallani-Sheld families complex,	264
	5 to 30 percent slopes	
278	Yallani-Inville families complex, 8 to 20 inch pumice overburden,	265
	5 to 30 percent slopes	
279	Yallani-Stonewell families association,	267
	15 to 35 percent slopes	
280	Wapal-Anatone-Patio deep families association,	268
	60 to 90 percent slopes	
281	Wapal-Patio deep families association,	269
	15 to 35 percent slopes	
282	Wapal-Patio deep-Anatone families associtaion,	270
	35 to 60 percent slopes	
	V Lava flow rock	
	W Water	

Summary of Tables

Relationship between Forest Survey and Dunning Site Classes at Various Potential	
Crown Covers (table 1)	25
Classification by soil name (table 2)	276
Classification by taxonomic category (table 3)	281
Map unit legend, acreage and proportionate extent of the soils (table 4)	285
Soil components in map units (table 5)	293

Foreward

The Modoc National Forest (703) Soil Survey Area is in the extreme northeastern corner of California and encompasses parts of Modoc, Siskiyou, and Lassen counties. The total survey area is about 2,758 square miles or about 1,764,960 acres. This survey was designed to facilitate broad forestwide resource management planning and to increase the knowledge of our environment. It contains predictions of soil behavior for selected land uses. Also highlighted are limitations or hazards to land uses that are inherent in the soil.

This soil survey has been prepared primarily for forest and rangeland resource planners and managers. It is useful for preliminary project planning, for identifying general soil management considerations, and for evaluation of more intensive soil survey needs. The survey should be used for detailed resource management planning and project level planning and design only after field verification.

Great differences in soil properties can occur even within short distances. Soil may be shallow to bedrock and incapable of producing commercial timber. They may be seasonally wet or subject to flooding. A low available water capacity makes a soil poorly suited to reforestation. A high water table makes a soil suitable for use as summer range.

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 soil map unit is shown on detailed soil maps. Each kind of soil in the survey area is described, and information is given about each soil for specific uses.

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



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Acknowledgements

So many people have helped to bring this document to present form that I felt compelled to write an acknowledgement that is not the norm for Soil Resource Inventory Manuscripts. The hardest job of writing an acknowledgement is that you are bound to forget some of the names inspite of the best efforts to credit individuals who contributed.

Particular thanks are due to Kenneth Luckow, the senior author who would have liked to see it published in 1986 before his transfer to Arizona. His untiring field and correlation work made this manuscript a reality. Thanks are due Desiderio Zamudio, Thomas Sheehy, Kenneth Luckow, Richard Hanes and Suraj Ahuja who were reponsible to complete the field mapping. Chuck Goudey and Scott Miles from the Regional Office deserve to be recognised for reviewing and taking all the heat about soil correlation. Special thanks are due to Tom Ryan without whose coordinating efforts the manuscript would have stayed unpublished. La Wanda Forsythe helped to put this manuscript in desktop published format in a very short time frame that needs special recognition. Thanks are due to Susan Stokke for giving me extra time to edit, rewrite, and consolidate the manuscript inspite of work overload pressures from other functions. Thanks to Rebecca Prudhomme and Yvonne Studinski for typing corrections and for their help in tracking down information lying all over. Thanks are due Randy Sharp for his assistance in write up of the geology section.

Many individuals from the Soil Conservation Service and University of California helped in correlation and manuscript review. Naming these individuals would be a futile effort. Myriads of others gave me their precious time and knowledge in casual conversation. Thanks go to all of them.

SURAJ AHUJA
Forest Soil Scientist



Location of the Modoc National Forest Area, California

Soil Survey of Modoc National Forest Area, California

Parts of Modoc, Siskiyou, and Lassen Counties

By Kenneth R. Luckow and Suraj P. Ahuja, Forest Service

Soils surveyed by Suraj Ahuja, Richard O. Hanes, Kenneth R. Luckow,
Thomas Sheehy and Desiderio Zamudio

United States Department of Agriculture, Forest Service and Soil
Conservation Service, in cooperation with the Regents of the
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General Nature of the Survey Area

This section briefly discusses the geomorphology, geology, climate, and vegetation of the survey area.

Geomorphology

The Modoc National Forest Survey Area includes the major part of the Modoc Plateau geomorphic province and, to a lesser extent, areas of the Cascade Range and Great Basin geomorphic provinces (4, 7). It is characterized by several landforms consisting of northwest-to north-trending, block-faulted mountain ranges on the east and southwest areas of the survey; broad basalt lava flow plateaus throughout the center and most of the northern part; and the Medicine Lake Highlands which is a shield volcano on the west central edge of the survey area. Land areas of gentle slopes include the lava plains that were formed by extensive basalt outflows; the alluvial plains consisting of nearly level intermittent lake basins, sloping alluvial fans, and high alluvial terraces. The steeper areas include the dissected mountain ranges and the fault- or erosion- formed escarpments. Numerous escarpment faces drop from the Modoc plateau level to the Alturas area alluvial valley floor below, a difference in elevation of about 600 feet (Figure 1).

Eagle Peak in the southeastern part of the survey area has the highest elevation: almost 9900 feet. The lowest elevation of about 4200 feet is found on the northwestern area of the survey. The soils vary in any one of the different landforms, creating complex patterns of soils.

The survey area is drained by three main drainages. The headwaters of the Pit River are in the Warner Mountains on the eastern part of the survey area. The North Fork of the river starts east of the town of Davis Creek and flows south to join the South Fork near the town of Alturas where the two forks form the Pit River. The South Fork of the river flows west and turns south near the town of Likely. The Pit River flows through the Warm Springs Valley in a southwesterly direction that eventually leads into Lake Shasta, then into the Sacramento River, and finally into the Pacific Ocean. Goose Lake and its contributing watershed is considered part of the Pit River drainage system. This area is now a closed basin, but reportedly it drained into the Pit River twice since 1871.

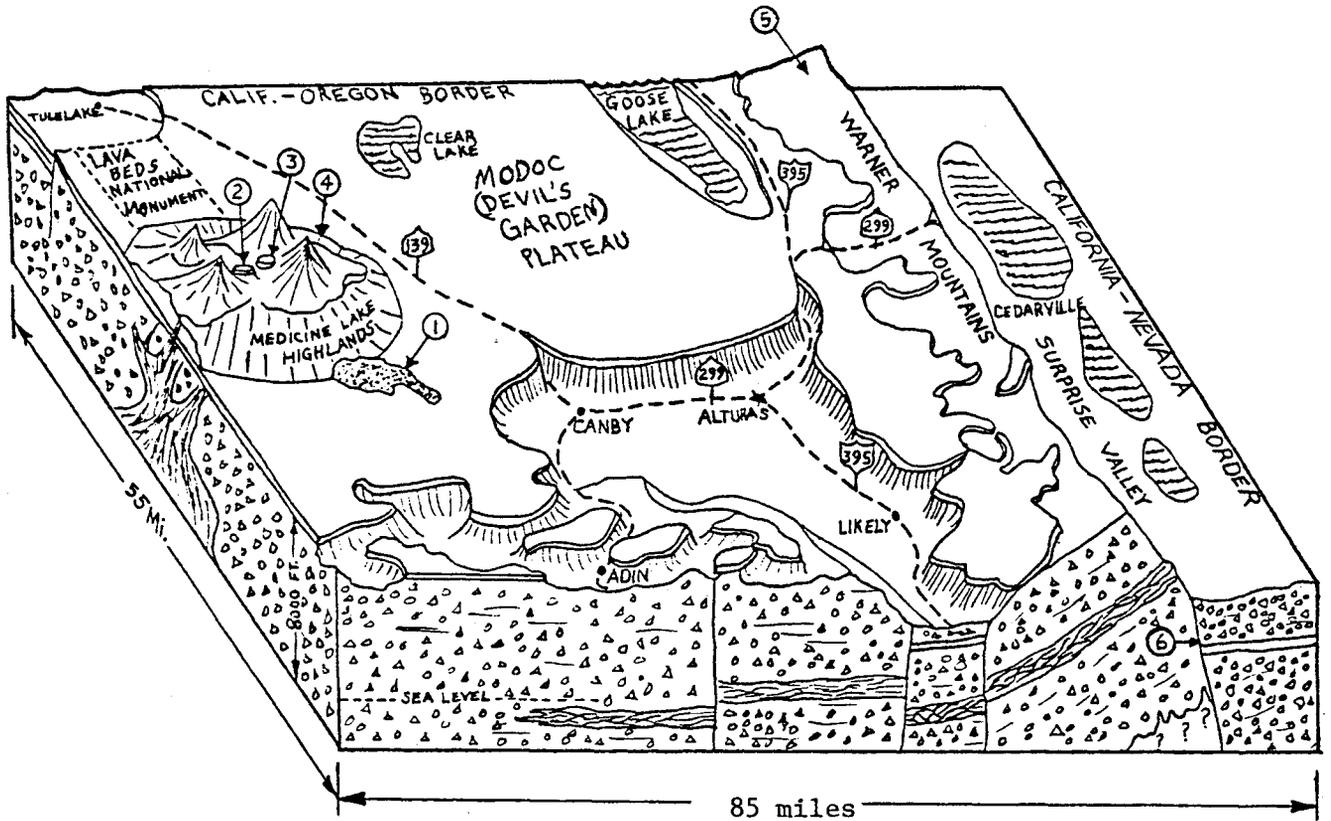
Most of the northcentral and northwestern area of the survey area drains into the Klamath River Basin near the headwaters of the Klamath River. This eventually ends up in the Pacific Ocean near Eureka, California. The third major drainage system occurs on the eastern slopes of the Warner Mountain range on the eastern edge of the survey area. This area drains into Upper, Middle and Lower Alkali Lakes which are considered closed basins within the Great Basin.

Geology and Geomorphic History

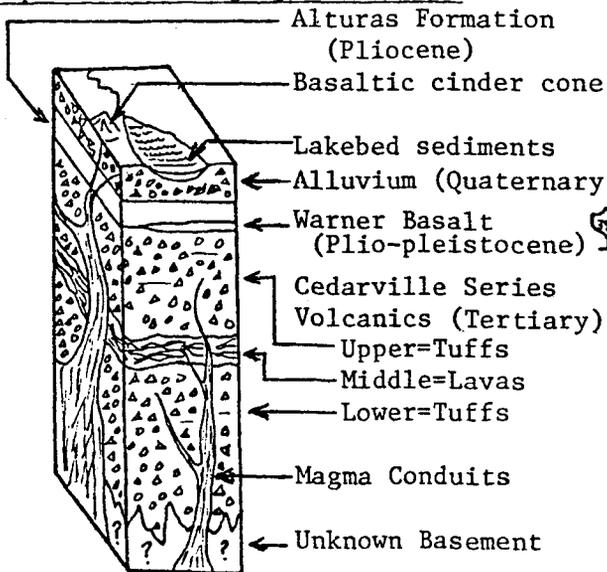
The geology of the survey area is strongly influenced by faulting and by volcanic and erosional activity. Tremendous volcanic activity has occurred here during the past 60 million years or so up to the present time. Vast quantities of lava, mainly of basaltic nature, and associated

Figure 1

Schematic Geology of the Modoc National Forest and Vicinity to the Lassen County line



Composite Stratigraphic Section



Legend and Points of Interest

1" ≈ 16.5 Miles (Horizontal Scale)
 1" ≈ 8700 Feet (Vertical Scale)
 Vertical Exaggeration ≈ 10X

- Towns
- U.S.F.S. Headquarters
- Major Highways
- Lakes
- ① Burnt Laval Flow
- ② Medicine Lake
- ③ Medicine Lake Glass Flow
- ④ Glass Mtn. Obsidian Flow
- ⑤ Highgrade Mining District
- ⑥ Surprise Valley Fault

pyroclastic materials flowed, or were deposited, over the landscape in almost continuous interbedded masses.

Three major geomorphic provinces evolved from these activities in this survey area. They are the Cascade Range, Great Basin and Modoc Plateau geomorphic provinces. The Cascade Range geomorphic province is characterized in this area by the Medicine Lake Highlands.

The Medicine Lake Highlands is a broad shield volcano approximately twenty miles in diameter which rises almost four thousand feet above the level of the surrounding plateau. It is composed primarily of andesitic lava flows of Tertiary age (between 3 million to 60 million years ago). The original peak of the volcano collapsed to form an elliptical caldera measuring about four by six miles. The caldera rim was subsequently surmounted and entirely obscured, still in the Tertiary period, by a rampart of small secondary parasitic volcanoes including Glass Mountain, Mount Hoffman, Medicine Mountain, Little Mount Hoffman, Red Shale Butte, and Lyons Peak. The parasitic volcanoes are also composed mainly of andesite flows. Some are apparently composite cones consisting of both flows and pyroclastics.

In recent geologic time eruptions on the floor of the caldera and from some of the secondary volcanoes have released an acidic suite of rocks including spectacular domes and flows of rhyolitic obsidian, rhyodacite, and dacite as well as a relatively thin to thick extensive mantle of rhyolitic pumice. Basalts of the Modoc Basalt series have erupted on the flanks of the volcano in recent geologic time. The Burnt Lava Basalt flow has been radiocarbon dated from charred wood found in it at about 1100 years old. The Black (Callaghan) and Point Pot Crater basalt flows are thought to be only slightly older. These recent flows correspond to similar recent basalt flows in the Lava Beds National Monument to the north. The Medicine Lake Highlands Shield volcano, the largest volcano in California, is considered still active and is currently among the top five candidates for potential future volcanism in California.

The Modoc Plateau geomorphic province comprises the relatively flat and monotonous central portion of the survey area, also known as the Devil's Garden. It is capped by fissure erupted basalts of Late Miocene to Late Pleistocene age (about 25,000 years to 20 million years ago) which resemble but cannot be correlated with the much thicker and older Columbia Plateau basalts. On the average, the basalt capping on the Devil's Garden, or Modoc Plateau, is about 400 feet thick. The maximum thickness known is about 1,000 feet. At the southern margin of the plateau the basalt may be as little as fifteen feet thick. A very thick sequence of

pyroclastics and minor intercalated lava flows of gross andesitic composition, which has been correlated with the Cedarville series of the Warner Mountains, underlies the basalt capping of the entire plateau.

Geologically recent basaltic cinder cones occur sporadically on the surface of the plateau, usually along the frequent northwest-southeast trending normal faults which regularly interrupt the otherwise level terrain. Apparently the faults acted as conduits for the magma. Fissure erupted basalts of the recent Modoc Basalt Series cover extensive areas of the Modoc Plateau in the vicinity of the Medicine Lake Highlands west of Highway 139. Some of these were "pahoehoe" (ropy) flows and contain lava tube ice-caves similar to those in the Lava Beds National Monument to the north. Generally speaking, faults, cinder cones, and Modoc series basalt flows are rare or non-existent in the eastern portion of the Modoc Plateau and common in the western portion.

The Modoc Plateau geomorphic province extends westward under the Medicine Lake Highlands Volcano and in the east phases gradually into the gentle west slope of the Warner Mountains and into the Adin Mountains to the south.

The Warner Mountains in the eastern portion of the survey area is an extreme western extension of the Basin and Range Geomorphic Province. The Warner Range is a westward tilting fault block bounded on the west by the Modoc Plateau and the Goose Lake and Warm Springs Valley depressions, and on the east by Surprise Valley, a graben, from which it is separated by the Surprise Valley Fault, a major normal fault. The range trends almost exactly north-south and is roughly eighty miles long and ten miles wide. Surprise Valley also trends north-south and has approximately the same areal dimensions. Probable vertical displacement on the Surprise Valley Fault is on the order of 5000 feet. Proven vertical displacement is slightly more than 3500 feet. The fault is not older than Late Miocene age (about 11 million to 20 million years old).

Lithologies in the Warner Mountains are almost entirely volcanic. Pyroclastics account for most of the mass of the range, intercalated flows of andesite and later overlying basalt over most of the remainder. Minor obsidian flows, rhyolitic intrusives, lahars (volcanic mud flows), ignimbrites (welded tuffs), and fluvial, alluvial, and lacustrine sediments of volcanic origin also occur. Glacial deposits probably occur but are difficult to identify positively. Rhyolitic intrusive bodies and breccias in the Warner Mountains north of Fandango Valley are gold bearing and form the basis of the old Highgrade gold mining district.

Stratigraphy in the Warners is quite simple. A thick sequence of andesitic pyroclastics and minor intercalated andesitic lava flows, known as the Cedarville Volcanic Series is overlain more or less conformably by a much thinner sequence of basaltic lava flows known as the Warner Basalt. The Alturas Formation, consisting of a Pliocene age (about 3 million to 11 million years old) lake bed composed of fluvial, and alluvial sediments, locally underlies the Pleistocene age (about 25,000 to 3 million years old) member of the Warner Basalt. Locally the basalt is overlain by rhyolite flows (possibly ignimbrites) which are in some areas overlain by later obsidian flows. The coarser grained rhyolitic intrusives are associated with the rhyolite flows.

The Cedarville Series is tremendously thick, and although it is very well displayed on east slopes of the Warner Range, its base is nowhere exposed. Thus its maximum age and thickness remain unknown. It is at least 3500 feet thick and over 30 million years old.

Strata in the Warners exhibit a consistent westward dip, that is, they have been elevated in the east and depressed in the west with the result that the western slope is gradual, culminating gently in the nearly 9900 foot high crest of the range. The eastern slope, however, is extremely precipitous, descending abruptly, within three or four miles into Surprise Valley which has a mean elevation of about 4500 feet. Refer to figure 1 for a schematic overview of the major geologic formations and their general locations.

The Adin Mountains¹ are a series of anticlines and synclines that have been block faulted. The axis of the synclines and anticlines trends north-northwest. The amount of displacement due to faulting is presently unknown but it is estimated to exceed one thousand feet.

Lithologically, the Adin Mountains are a sequence of non-marine deposits that are unconformably overlain by a thick sequence of pyroclastics, welded tuffs, ignimbrites and basaltic flows. This sequence is overlain by a Miocene age (about 11 million to 25 million years old) andesitic/basalt flow.

Climate

The Modoc National Forest Survey Area is more than 100 miles inland from the Pacific Ocean, and much of the topography within that distance consists of rugged mountain ranges. The north-south alignment of these mountain ranges cause orographic precipitation from moist pacific air on the western slopes and produces a rain shadow effect on the east slopes. Where the air is again lifted by the local mountains within the area, precipitation totals and intensities tend to increase.

While the average temperature normally decreases with elevation, this relation is not always so in the case of extreme temperatures. Both maximum and minimum temperatures are influenced by features of local topography. Low temperatures, especially, can change sharply within short distances because of drainage or blockage of cold air.

Winter in the survey area is marked by the frequent passage of low pressure systems and the predominance of maritime polar air. Precipitation is frequent but generally is light on the Modoc plateau and somewhat heavier in the mountains. High pressure areas between the storm centers are often associated with polar continental air.

Under clear skies there is rapid radiational cooling at night. This generally results in low minimum temperatures. Much of the winter precipitation falls as snow. Snow cover can last for long periods at the higher elevations. Snowfall is lighter and temperatures are higher at lower elevations, and the snow generally does not stay on the ground so long.

In spring, precipitation gradually decreases after February or March as the storm centers move northward. There is, however, a secondary maximum in May. This increase is associated with the passage of cold lows across the area.

In summer there are few storms except for occasional thundershowers. Precipitation is very light. Summers are usually warm.

The higher elevation mountain areas receive approximately 20 to 45 inches of precipitation while the surrounding lower elevation Modoc Plateau, foothills and valleys receive between 10 to 25 inches. During the winter months, the valleys and surrounding plateaus generally have mild temperatures and are relatively free of snow. Occasionally there are long severe winters, with deep snows and low temperatures at more than 30 degrees below zero.

Precipitation in the Warner Mountains ranges from about 16 to 35 inches annually and increases with elevation. The Modoc Plateau receives 10 to 25 inches annually, increasing from the low in the northwest and southern portion to the high in the northeast portion. The Medicine Lake Highlands receive the highest annual precipitation, ranging from about 25 to 45 inches. The Big Valley area has an annual precipitation ranging from about 14 inches in the lower elevations to 25 inches in the Adin Mountains.

¹ The above Geology section prepared by Randy Sharp, Geologist, Modoc National Forest.

Rainfall intensities range from low to moderate. Based on a two year 24 hour storm event, rainfall intensities range from 1.4 to 3.0 inches. The majority of the Modoc Plateau and Adin Mountains can expect 1.4 to 1.6 inches in 24 hours, the Warner Mountains from 1.4 to 1.8 inches and the Medicine Lake Highlands can expect between 2.0 to 3.0 inches from a two year 24 hour storm event.

The relative humidity in the area changes seasonally. Cool weather and frequent precipitation in winter result in fairly high relative humidity. In January, in the Alturas area, the average relative humidity is 75 percent. On the average, the relative humidity is 15 to 20 percent on a midsummer afternoon and about 40 percent at night. Dry northerly or easterly winds occasionally cause the humidity to drop below 10 percent. This can create a serious fire hazard.

Because of the broad, open topography of the plateaus, winds occasionally are strong. Although available data is limited, it is estimated that in areas of typical exposure, a wind of 55 miles or more per hour occurs every other year with even stronger winds on mountain ridges and crests.

The growing season, as defined by 32°F. temperatures in spring and fall, ranges from 80 to 110 days throughout most of the lower elevation Modoc Plateau tablelands and adjoining foothills. In the higher elevation mountains little data is available to accurately determine the length of the frost free growing seasons. Based on what data is available, and that normal air temperatures drop an average of about 3.5°F. for each 1000 feet rise in elevation, we can estimate that the frost free season is 30 days or less in the highest elevations to around 80 or 90 days in the lower mountain elevations approaching 5500 feet.

There is a 50 percent probability that the last freeze in spring will occur on June 9 and that the first freeze in fall will occur on August 30 at Alturas. When defined by 28° temperatures in spring and fall, the growing season ranges from 120 to 140 days. There is a 50 percent probability that the last 28° reading in spring will occur on May 26 and that the first freeze in fall will occur on September 23 at Alturas.

Potential evapotranspiration is defined as the amount of moisture that would be lost from the soil by evaporation and transpiration under existing conditions of temperature and solar radiation and with an adequate supply of soil moisture available. At Alturas solar radiation readings, as measured in Langleys per day, have been found to be among the highest in the state. The mean summer solar radiation, in Langleys per day, were 738 at Alturas as compared to an average of 675 in the Sierra Nevada

Mountains, 625 in the Coastal Mountain Ranges and 485 at Huntington Beach. The percentage of possible days of sunshine ranges from about 45 percent in winter to 90 percent in summer in Modoc County. Studies show that in the course of a year the potential evapotranspiration totals from 21 to 25 inches in Modoc County. During the growing season, as defined by 32° temperature values, the potential evapotranspiration amounts to 12 to 18 inches.

The only records of evaporation available near the area are from Tule Lake, and because of temperatures in winter, the record doesn't cover the entire year. Based on extrapolation from available records, it appears that the annual evaporation from a Class A pan in the survey area is between 60 and 65 inches, about 80 percent of which is lost during May through October. Lakes or reservoirs probably lose only 73 percent to 74 percent as much by evaporation as does a Class A pan, making the annual total loss for these larger bodies of water around 45 inches.

Vegetation

Vegetation throughout the survey area is highly variable and dependent on climatic and soil conditions. Generally speaking, the Rangeland vegetation found on the shallow soils in this survey area is composed of scattered western juniper, low sagebrush, various short season perennial bunchgrasses and a few forbs. The soil surface is also normally quite rocky where this type of vegetation occurs. Vegetation on the deeper, well-drained range soils normally consists of bitterbrush, big sagebrush and rabbitbrush along with short and intermediate season perennial bunchgrasses. In addition many of these deeper, well-drained rangeland soils may have an overstory of western juniper and/or mountain mahogany. The less than well drained soils found on flood plains, draingeways and intermittent shallow lake beds contain mainly water loving vegetation such as silver sagebrush, sedges, rushes, Timothy, Kentucky bluegrass, willows and Aspen in addition to the other short and intermediate season perennial bunch grasses and forbs.

Woodland vegetation in the low elevation mesic soils of about 4200 to 5500 feet elevation is mainly composed of ponderosa pine with less amounts of incense-cedar, western juniper, white fir and black oak. Normally there is a significant amount of browse type understory vegetation such as bitterbrush, big sagebrush, greenleaf manzanita, and various perennial grasses sand forbs and sedges. The mid-elevation (about 5500 to 7000 feet) frigid timbered soils are mainly composed of white fir stands or white fir and ponderosa pine stands. Understory vegetation is not as plentiful and in many cases is essentially non-

existant. The high elevation (about 7000 to 9900 feet) cryic soils contain such timber as red fir, lodgepole pine, white fir, western white pine, mountain hemlock, and white bark pine at the highest elevations.

Understory vegetation is typically prostrate manzanita plus a few forbs and grasses and sedges.

For an overview of the existing and/or potential vegetation by common names and where they are located

in the survey area refer to the General Soil Map Unit Descriptions found on pages 9 thru 18, their reference to Range Sites, if applicable, and the General Soil Map found near the back of this report. For more detailed descriptions of the existing or potential vegetative composition by common names by soil type and where they are located, refer to the detailed soil map unit descriptions under Physiographic Position; Slope; and Elevation, Typical Vegetation; and Precipitation, and Range Site (if applicable) and the SRI 3 Soil Maps.

How This Survey Was Made

This Order 3 soil survey (10) has followed the directives and guidelines in Forest Service Manuals and Handbooks. It has also followed the concepts, procedures, and guidelines of the National Cooperative Soil Survey as specified in the *Soil Survey Manual* (14, 15), the *National Soils Handbook* (13), and the soil classification system as stated in *Soil Taxonomy* (16).

Soil Scientists began the inventory by collecting, studying, and correlating all the existing data and information concerning the survey area that is related to soil genesis and morphology. This includes lithological, geomorphological, topographical, climatic, vegetative, and existing soil survey data both within and adjoining the survey area.

This data and information was assimilated and transferred to a single base map of suitable scale and accuracy forming a schematic map. With the schematic map and aerial photo field sheets (stereo-pair coverage) in hand, the soil scientist made a reconnaissance study of the survey area. At this time, the delineations on the schematic map were checked for accuracy of content and location. The aerial photos were studied stereoscopically and the photo images were compared to the conditions found on the ground to insure that later recognition by photo interpretation would be credible. Lithologic, geomorphic, soil, and vegetative characteristics were recognized and recorded in field notes, on the schematic map, and on the aerial photo field sheets.

Using the augmented and corrected schematic map, field notes, and an understanding of how the photo images relate to actual conditions on the ground, the soil scientist delineated map units on the aerial photographs. The map units corresponded to segments of the landscape having similar landform, vegetative cover, and soils as determined by a knowledge of ground conditions and by stereoscopic aerial photo interpretation. These aerial photos with the delineated map units and delineation symbols became the exploratory or preliminary soils map.

With the aerial photo (exploratory soil maps) and a field stereoscope in hand, the soil scientist examined on the ground as many delineations of each map unit as was feasibly possible, considering the access and time allowed to complete the survey. In this way, each different map unit was examined, studied, and described by aerial photo interpretations and on-the-ground investigation. However, because of the design of the survey, Order 3 in intensity, and the time and period allotted for its completion, every delineation of each different map unit was not visited and examined on the ground. Those

delineations with no easy access were rarely visited other than by aerial photo interpretation. In this way, possibly one-quarter to one-third of the delineations on the field sheets and maps would not have been entered and examined by an on-the-ground investigation. This is one of the main aspects of this survey that limits its reliability. It is one reason that the survey is not suitable for project planning without field verification.

As each map was visited and examined, individual soils were recognized, studied, described, classified, and enough data was collected to furnish the information needed to make interpretations and predictions concerning the use and management of each soil. However, due to the small photo mapping scale (approximately 1:60,000), the exact location of each soil type was normally not delineated. The map units usually consist of a group of soils that occupy a particular portion of the landscape which has been delineated on the aerial photo field sheets. Depending on the area location and extent of the individual soils that are components of the delineated map units, a map unit is usually called an association or complex of soil components. A few of the map units are consociations (i.e., the mapping unit being made up of only one named soil type). The soil scientist makes a field and aerial photo examination to estimate the soil component percentage composition for each map unit. These map units do not necessarily consist of similar soils. They consist of geographically associated soils that may be, and usually are, quite different in their characteristics and their suitability for use and management. These are other aspects of the survey that limits its suitability for project planning without field verification.

This field examination and study, and the associated correction and refinement when needed of the soil map unit line delineations on the aerial photo field sheets, produces the Order 3 intensity soil maps called for in this system of survey.

The interpretations and predictions concerning use and management found in this report are based on the soil scientist's knowledge and understanding of the conditions recognized and measured in the time and period allotted to this inventory. By classifying the soils, the soil scientist can also, with acceptable reliability, bring information concerning use and management of a particular soil from other survey areas where this same soil occurs and has been recognized and studied. Because of the time allocation for the completion of this survey, these use and management interpretations and predictions should be considered as first or second approximations due to the relatively few examinations and measurements that have been made. This is another aspect

of the survey that limits its reliability and suitability for project planning without field verification.

Despite the cautions that have been made in the above paragraphs concerning the use of this survey information for project level planning, it is adequate and reliable for its intended and designed purpose: a base for a Forest-wide system of land management planning, and for reconnaissance level use of project level planning.

Some of the boundaries on the soil maps of the Modoc National Forest Survey Area do not match those on the soil maps of adjacent soil surveys and/or many of the soil names do not agree. The differences are the result of the intensity of mapping, the very limited extent of some soils, and the use of soil family names

instead of series names where this survey joins with the Modoc County-Alturas Area survey, and the soon to be completed Susanville Area, Big Valley Area, Butte Valley-Tule Lake Areas in California and Lake County Area, Oregon surveys. Where this survey joins the Surprise Valley-Home Camp Area, California and Southern Klamath County Area, Oregon soil surveys, the differences are mainly the result of improvements in the classification of soils and the not-so-similar east-west mountain crest soils, slopes and miscellaneous land types. Soil classification names used are those described in Soil Taxonomy, Agriculture Handbook No. 436, December 1975. The manuscript does not refer to the order Andisols and new suborder and great groups added in the Vertisols in 1992 version.

General Soil Map Units

The general soil map shows 22 map units which consist of many individual soils and miscellaneous land types. Each map unit contains soils with similar parent rock material, soil temperature regimes and similar use and management. A map unit typically is made up of one or more soils of major extent and several soils of minor extent. Map units are named for the major soils occurring in the unit. The soils in one unit can occur in other units. The soils are classified at the family level, or at a higher taxonomic level.

The map furnishes a broad perspective of the soils in the survey area. It provides a basis for comparing the potential of large areas for general kinds of land use. General areas which are capable of timber production or for range can be identified on the map. Likewise, general areas of soils having properties that are distinctly unfavorable for certain land uses can be located.

Some of the boundaries on the general soil map of the Modoc National Forest Survey area do not match those on adjacent soil surveys, and most of the soil names do not agree. This is due mainly to the intensity of mapping and due to the use of soil family names rather than soil series names. All the Family names pertain to the "Soil Taxonomy" 1965 edition.

Because of the generalization of map units and the small scale of the map, the location of specific soils are not shown. The map and map unit information is not suitable for Forest or project level land management planning. They give a very general overview of soil conditions and are suitable for State or Regional planning.

The general map units in this survey have been grouped into seven general kinds of landscape and capabilities for broad interpretive purposes. Each of the broad groups and the map units in each group are described in the following pages.

Lower Elevation Predominantly Woodland Soils Mainly on 0 to 40 Percent Slopes.

The two map units in this group make up about 18 percent of the survey area. The soils are on undulating basalt plateaus and mountain uplands of volcanic origin. The soils are moderately deep (20 to 40 inches) and deep (greater than 40 inches), except Deven family soils which are shallow (less than 20 inches) over soft to hard volcanic tuff. The parent material is basalt and volcanic tuff derived mainly from basic igneous rocks.

The elevation ranges from 4300 to 6000 feet. The average annual precipitation is 16 to 25 inches. The mean annual air temperature is 44 to 48°F and the frost free period is 80 to 110 days. Vegetation is primarily commercial timber with ponderosa pine being the major species. The soils are used mostly for timber production and transitory range.

1. Lawyer-Elmore families

This soil unit is predominately on nearly level to undulating basalt plateaus, with lesser amounts on mountain uplands. These soils are moderately deep and deep over soft to hard basalt bedrock. Elevation ranges from 4,300 to 6,000 feet, and annual precipitation ranges from 16 to 25 inches. Slopes range from 1 to 60 percent, but are predominantly less than 20 percent. The frost-free season is 80 to 110 days.

These soils support ponderosa pine and Jeffrey pine forests and may include some incense cedar, white fir, black oak, and western juniper. The Forest survey site class is 5 or 6. Understory vegetation may consist of squawcarpet, big sagebrush, rabbitbrush, bitterbrush, greenleaf manzanita, muleears, and various perennial grasses and sedges.

This unit makes up approximately 16.0 percent of the survey area. It consists of approximately 55 percent Lawyer soils and 25 percent Elmore soils. The Jacket, Deven, Gwin, Pass Canyon, and Fordice families and rock outcrop make up most of the remaining 20 percent of this unit.

The Lawyer soils are moderately deep and deep to basalt bedrock. They are well drained and permeability is moderately slow. They have a thick, brown to reddish brown, stony loam or loam surface over a very cobbly clay loam to extremely cobbly clay loam subsoil.

The Elmore soils are moderately deep and deep to basalt bedrock. They are well drained, and permeability is moderately slow. They have a thick, dark brown to reddish brown loam or gravelly loam surface over a clay loam or gravelly clay loam subsoil.

2. Jacket-Deven-Hiibner families

This unit occurs in the Adin mountains on the southern portion of this survey area. It is on mountain uplands of 1 to 60 percent slopes, and elevation of 4,400 to 5,800 feet. The annual precipitation ranges from 16 to 20 inches, and the frost-free season is 80 to 110 days.

The Jacket and Hiibner soils support ponderosa and Jeffrey pine forests and may include some incense cedar, black oak and western juniper. The Forest survey site class is 5 and 6, for the Jacket and Hiibner soils respectively. Understory vegetation may consist of snowberry, service-berry, big sagebrush, greenleaf manzanita, mountain mahogany, bitterbrush, vetch, lupine, and various perennial grasses and sedges. The Deven soils are rangeland soils, and support vegetation and available forage amounts consistent with Range Sites 23 and 8.

This unit makes up approximately 2.0 percent of the survey area. It consists of approximately 35 percent Jacket soils, 25 percent Deven soils and 20 percent Hiibner soils. The remaining 20 percent of this unit is primarily made up of Ruckles, Pass Canyon, Keating, Fordice, Elmore, and Lawyer families.

The Jacket soils are moderately deep in this unit. They are well drained, have slow permeability, and are over volcanic tuff. They have a dark brown and reddish brown loam surface over a clay loam to clay subsoil.

The Deven soils are 10 to 20 inches deep and are well drained. Permeability is slow, and the Deven soils here are over soft to hard volcanic tuff. They have a thin, brown, cobbly loam or clay loam surface over a clay or clay loam subsoil.

The Hiibner soils are moderately deep and are well drained. Permeability is slow, and these soils are over volcanic tuff or basalt. They have a brown, stony loam to very cobbly loam surface over a very cobbly clay subsoil.

Lower Elevation Rangeland Soils Mainly on 0 to 40 Percent Slopes.

The six map units in this group make up about 45 percent of the survey area. The soils are on basalt or volcanic plateaus and mountain uplands of volcanic origin. About 85 percent of the total acreage in this group is composed of shallow soils over a silica duripan, or over basalt or tuff bedrock. The Searles, Simpson, Supan, Los Gatos and Keating family soils are moderately deep to deep over basalt or tuff bedrock and make up about 15 percent of the total acreage in this group. The soils in this group are all well drained. The shallow soils have loam or clay loam surface textures with surface gravel, cobble and stone size rock fragments. The deeper soils have a loam or clay loam surface texture and are mostly free of surface rock fragments.

The elevation ranges from 4,200 to 6,400 feet. The average annual precipitation is 10 to 20 inches and the

average annual air temperature is 44 to 50°F. The frost-free period ranges from 80 to 110 days.

The soils are used mostly for range.

3. Bakeoven family-lava flow-Searles family

This unit occurs primarily in the northwest quarter of the survey area. This unit is mainly on basalt plateaus with relatively recent basalt lava flows. Much of this unit has a recent thin (1 to 12 inch) deposit of pumice on the surface. Scattered volcanic cinder cones with steep sideslopes are found here also. Slopes are mainly 1 to 20 percent in this unit, and annual precipitation ranges from 10 to 16 inches. Elevation ranges from 4,200 to 5,000 feet. The frost-free season is 90 to 110 days.

The Bakeoven and Searles soils are rangeland soils and support vegetation and available forage amounts consistent with Range Sites 4, 7, 16, and 17. Other uses are for wildlife, aesthetic values, and watershed.

This unit makes up approximately 3.9 percent of the survey area. It is about 30 percent Bakeoven soils, 20 percent lava flow rock, and 20 percent Searles soils. The remaining 30 percent of this unit is made up primarily of the Wenatchee, Castlevale, Gwin, and Stukel families and mesic, Lithic Xerorthents.

The Bakeoven soils are 7 to 20 inches deep over basalt bedrock and are well drained. Permeability is moderately rapid. They normally have a dark grayish brown and grayish brown, very cobbly fine sandy loam surface and subsurface. If a pumice overburden is present, it will have a very gravelly coarse sandy loam or very gravelly loamy coarse sand surface texture.

Lava flow consists of hard fractured vesicular basalt flow rock and collapsed, exposed lava tubes.

The Searles soils are moderately deep over basalt bedrock and are well drained. Permeability is moderately slow. They have a brown, gravelly sandy loam surface over a cobbly loam to extremely cobbly clay loam subsoil. If a pumice overburden is present, it will have a very gravelly coarse sandy loam or very gravelly loamy coarse sand surface texture.

4. Puls-Indian Creek-Simpson families

This unit occurs primarily on the Modoc Plateau geomorphic province, in the central and northwest portions of the survey area on nearly level to undulating basalt plateaus. A strongly cemented to indurated silica duripan, which ranges in thickness of only a few millimeters up to about two feet, overrides the basalt bedrock in

most of this unit. Slopes range from 0 to 10 percent, and elevation ranges from 4,200 to 5,200 feet. Annual precipitation ranges from 10 to 14 inches, and the frost-free season ranges from 80 to 110 days.

The Puls, Indian Creek and Simpson family soils are rangeland soils and support vegetation and available forage amounts consistent with Range Sites 1, 7, and 12, respectively.

This unit makes up approximately 8.8 percent of the survey area. It is about 30 percent Puls, 20 percent Indian Creek, and 15 percent Simpson soils. The remaining 35 percent of the unit is made up primarily of the Packwood, Ditchcamp, Barnard, Cowiche, Wrentham, Bakeoven, Deven, Alicel, and Dishner families and rock outcrop.

The Puls soils are 10 to 20 inches deep to a silica duripan. They are well drained, and have very slow permeability. They have a pinkish gray, very stony clay loam surface soil over a clay subsoil. The effective rooting depth is normally less than 10 inches in this soil due to a very hard or extremely hard, very dense clay layer overriding the silica duripan. Roots cannot effectively penetrate this dense clay layer.

The Indian Creek soils are 10 to 20 inches deep to a silica duripan. They are well drained and have very slow permeability. They normally have a brown to light brown, cobbly clay loam surface over a clay subsoil.

The Simpson soils are moderately deep and are well drained. Permeability is slow. These soils are over basalt bedrock. They normally have a brown loam or clay loam surface over a silty clay loam, silty clay, or clay subsoil.

5. Deven-Bieber-Pass Canyon families

This unit occurs on basalt plateaus throughout the survey area but is most prominent in the north central portion. About half of this unit is directly over basalt bedrock, and the other half has a strongly cemented to indurated thin silica duripan, which normally overrides basalt bedrock. Slopes range from 0 to 20 percent, and elevation ranges from 4,300 to 6,000 feet. Annual precipitation ranges from 14 to 20 inches, and the frost-free season ranges from 80 to 110 days.

These soils are rangeland soils and support vegetation and available forage amounts consistent with Range Site 8, and with less amounts of Range Sites 1, 4, and 23.

This unit makes up approximately 20.5 percent of the survey area. It is about 30 percent Deven, 20 percent

Bieber, and 20 percent Pass Canyon soils. The remaining 30 percent of this unit is made up primarily of the Barnard, Packwood, Roval, and Puls families and mesic, Lithic Xerorthents and rock outcrop.

The Deven soils are 10 to 20 inches deep, well drained, and over hard basalt bedrock. Permeability is slow. They normally have a thin brown cobbly loam or clay loam surface over a clay or clay loam subsoil.

The Bieber soils are 7 to 20 inches deep to a relatively thin silica duripan which normally overlies basalt bedrock. These soils are well drained, and permeability is very slow. They normally have a thin brown very cobbly loam surface over a clay subsoil.

The Pass Canyon soils are 8 to 20 inches deep over basalt bedrock. They are well-drained, and permeability is moderately slow. They normally have a dark grayish brown, very cobbly loam surface over a clay loam or cobbly clay loam subsoil.

6. Gwin-Ruckles-Pass Canyon families

This unit occurs primarily on sideslopes and toeslopes of mountain uplands in the southern and eastern portions of the survey area. Slopes range from 2 to 70 percent, and elevation ranges from 4,400 to 6,400 feet. Annual precipitation ranges from 14 to 20 inches, and the frost-free season is 80 to 110 days.

These soils are rangeland soils and support vegetation and available forage amounts consistent with Range Site 8, with lesser amounts of Range Site 1 and 23. Other uses are for wildlife and watershed.

This unit makes up approximately 1.4 percent of the survey area. It is about 30 percent Gwin, 25 percent Ruckles, and about 20 percent Pass Canyon soils. The remaining 25 percent of this unit is made up primarily of the Bieber and Fordice families, mesic, Lithic Xerorthents, and rock outcrop.

The Gwin soils are 8 to 20 inches deep over basalt, andesite, or tuff. They are well drained, and permeability is moderately slow. They normally have a dark grayish brown, very cobbly loam surface over an extremely cobbly clay loam subsoil.

The Ruckles soils are 10 to 20 inches deep over basalt or tuff. They are well drained, and permeability is slow. They normally have a brown, very cobbly loam surface over a very gravelly clay or very cobbly clay subsoil.

The Pass Canyon soils are 8 to 20 inches deep over basalt bedrock. They are well drained, and permeability is

moderately slow. They normally have a dark grayish brown, very cobbly loam surface over a clay loam or cobbly clay loam subsoil.

7. Supan-Los Gatos-Pass Canyon families

This unit occurs primarily on basalt plateaus in the north central portion of the survey area. Slopes range from 1 to 35 percent but are mainly less than 20 percent. Elevation ranges from 4,300 to 6,000 feet, and annual precipitation ranges from 14 to 18 inches. The frost-free growing season is 80 to 110 days.

These soils are rangeland soils and support vegetation and available forage amounts consistent with Range Sites 13 and 8 with lesser amounts of range sites 4 and 1. The Supan and Los Gatos soils provide very favorable conditions for increaser species such as western juniper, and some areas of this unit have become quite dense with a western juniper overstory.

This unit makes up about 5.8 percent of the survey area. It is about 30 percent Supan, 20 percent Los Gatos, and 20 percent Pass Canyon soils. The remaining 30 percent of this unit is made up primarily of the Ridd, Stuke, Gwin, and Casuse families and rock outcrop.

The Supan soils are moderately deep and deep over basalt bedrock. They are well drained, and permeability is moderately slow. They normally have a thick brown loam surface over a gravelly clay loam, clay loam, or very gravelly clay loam subsoil.

The Los Gatos soils are moderately deep over basalt or tuff. They are well drained, and permeability is moderate. They normally have a brown gravelly loam surface over a clay loam or gravelly clay loam subsoil.

The Pass Canyon soils are 8 to 20 inches deep over basalt bedrock. They are well drained, and permeability is moderately slow. They normally have a dark grayish brown, very cobbly loam surface over a clay loam or cobbly clay loam subsoil.

8. Deven-Keating-Pass Canyon families

This unit occurs on basalt plateaus and on mountain uplands throughout the survey area. Slopes range from 1 to 60 percent, and elevation ranges from 4,300 to 6,000 feet. Annual precipitation ranges from 14 to 20 inches, and the frost-free season is 80 to 110 days.

These soils are rangeland soils and support vegetation and available forage amounts consistent with Range Sites 8 to 18, with lesser amounts of Range Sites 23,

13 and 1. Other uses of this unit are for wildlife and for watershed.

This unit makes up about 5.2 percent of the survey area. It is about 35 percent Deven, 30 percent Keating, and 15 percent Pass canyon soils. The remaining 20 percent of this map unit is made up primarily of the Hiibner, Bieber, Barnard, Ridd, and Ruckles families.

The Deven soils are 10 to 20 inches deep and are either over soft to hard volcanic tuff or basalt bedrock in this unit. They are well drained, and permeability is slow. They normally have a thin brown cobbly loam or clay loam surface over a clay or clay loam subsoil.

The Keating soils are moderately deep over volcanic tuff or basalt bedrock. They are well drained, and permeability is slow. They normally have a thin dark grayish brown, cobbly clay loam surface over a clay loam to clay subsoil.

The Pass Canyon soils are 8 to 20 inches deep over hard to soft volcanic tuff or basalt bedrock in this unit. They are well drained, and permeability is moderately slow. They normally have a dark grayish brown very cobbly loam surface over a clay loam or cobbly clay loam subsoil.

Predominantly Nearly Level Alluvial Soils That Are Subject to Flooding.

The one map unit making up this group represents about 4 percent of the survey area. It is dominated by deep or very deep (greater than 60 inches) clayey soils primarily on clay basins and drainages of basalt plateaus. The soils are moderately well drained to somewhat poorly drained. The average annual temperature is 44 to 49°F.

9. Aikman-Cardon families

This unit occurs on nearly level basalt plateaus in alluvial clay basins and drainages. The majority of this unit is in the central part of the survey area. Slopes are 0 to 2 percent, and elevation ranges from 4,300 to 6,000 feet. Annual precipitation ranges from 12 to 20 inches, and the frost-free season is 80 to 110 days. These soils are subject to spring flooding.

These soils are rangeland soils and support vegetation and available forage amounts consistent with Range Sites 24, 25, and 26. Other uses are for wildlife wetland developments and farming.

This unit consists of about 55 percent Aikman and 15 percent Cardon soils. The remaining 30 percent of this

unit is made up primarily of the Carlisle, Jacknife, and Barnard families, Aquolls, and Xerofluvents.

The Aikman soils are mainly greater than 40 inches with some pedons 20 to 40 inches deep and are normally over basalt or clayey alluvium. They are moderately well drained, and permeability is very slow. They normally have a dark gray silty clay surface over a silty clay or clay substratum.

The Cardon soils are greater than 40 inches deep and are formed from clayey alluvium derived mainly from basalt or andesite. They are somewhat poorly drained, and permeability is very slow. They normally have a very dark gray clay surface over a clay substratum or stratified clay to clay loam substratum.

Lower to Mid Elevation Dominately Woodland Soils Which Have formed in Relatively Recent Volcanic Parent Materials.

The five map units in this group make up about 10 percent of the survey area. The soils are on basalt plateaus and sideslopes of volcanic mountain uplands. They are well drained to somewhat excessively drained. They have surface textures which range from sandy loams to loamy sands and contain from 10 to 50 percent cinder and/or pumice gravels. The soils are normally moderately deep to deep over cinders, pumice, basalt or andesite, except for the Lithic Xerumbrepts which are shallow over basalt bedrock. The parent material is derived from pyroclastic volcanic ejecta and from basic igneous rocks.

The elevation ranges from 4,200 to 7,000 feet. The average annual precipitation is 16 to 45 inches, and the average annual temperature is 44 to 49°F. The frost free period ranges from 60 to 110 days.

The soils are used mainly for timber and wildlife with less emphasis on range.

10. Alcot-Sadie-Germany deep families

This unit consists of deep soils located essentially east and south of the Burnt Lava Flow Virgin Area on the western edge of the survey area. It is on basalt plateaus and lower sideslopes of cinder cones at elevations of 4,350 to 5,500 feet. Slopes range from 1 to 20 percent. Annual precipitation ranges from 20 to 30 inches, and the frost-free growing season is 80 to 110 days.

These soils support a mixed conifer forest which consists of ponderosa pine, white fir, incense cedar, and sugar pine, with a forest survey site index of 3 to 4.

Understory vegetation may consist of greenleaf manzanita, ceanothus, rabbitbrush, snowberry, bitterbrush, big sagebrush, arrowleaf balsamroot, and some perennial grasses and sedges.

This unit makes up about 0.7 percent of the survey area. It is about 30 percent Alcot, 30 percent Sadie, and 25 percent Germany soils. The remaining 15 percent of this unit is made up primarily of the Elmore and Lawyer families, Lithic Xerumbrepts and lava flow rock.

The Alcot soils are greater than 40 inches deep. They are somewhat excessively drained, and permeability is moderately rapid. They normally have a yellowish brown, gravelly sandy loam surface over a very gravelly sandy loam substratum which normally grades to extremely gravelly loamy coarse sand with depth.

The Sadie soils are greater than 40 inches deep. They are well drained, and permeability is moderately rapid. They normally have a yellowish brown, gravelly sandy loam surface over a gravelly coarse sandy loam subsoil and substratum.

The Germany soils in this unit are greater than 40 inches deep. They are well drained, and permeability is moderately rapid. They normally have a dark yellowish brown, fine sandy loam surface soil over a cobbly fine sandy loam to very cobbly fine sandy loam subsoil and substratum.

11. Alcot-Holland families, pumice overburden

This unit is composed of moderately deep and deep soils with a recent pumice deposition of 4 inches to greater than 40 inches thick. It is on basalt plateaus and lower sideslopes of volcanic mountain uplands in the west central portion of the survey area. Slopes range from 1 to 40 percent, and elevation ranges from 4,200 to 5,500 feet. Annual precipitation ranges from 16 to 25 inches, and the frost-free growing season is 80 to 110 days.

These soils support an open forest canopy of ponderosa pine and Jeffrey pine, with some incense cedar and white fir. Forest survey site class is normally 5 to 6. Understory vegetation may consist of bitterbrush, big sagebrush, rabbitbrush, greenleaf manzanita, squawcarpet, and various perennial grasses and sedges.

This unit makes up about 1.7 percent of the survey area. It is about 45 percent Alcot and 25 percent Holland soils. The remaining 30 percent of this unit is made up primarily of the Neer, Skalan, and Menzel families and rock outcrop.

The Alcot soils in this unit are greater than 40 inches deep and contain a relatively recent pumice deposition of 10 inches to greater than 40 inches thick. The pumice normally consists of a grayish brown, gravelly coarse loamy sand over a very pale brown, extremely gravelly coarse sand. The underlying soil, if present, is a very gravelly sandy loam to a very gravelly loamy sand. The Alcot soils are somewhat excessively drained, and permeability is rapid in the pumice deposit and moderately rapid below.

The Holland soils are moderately deep and deep contain a relatively recent pumice deposition of 4 to 20 inches thick. The pumice normally consists of a grayish brown, gravelly coarse loamy sand over a very pale brown, extremely gravelly coarse sand. The underlying soil normally consists of a loam, clay loam, or gravelly clay loam. The Holland soils are well drained, and permeability is rapid in the pumice deposit and moderately slow below.

12. Lava flow - Germany family - Lithic Xerumbrepts

This unit is composed of shallow and moderately deep soils and lava flow rock on relatively recent hummocky basalt lava flow plateaus south and east of the Medicine Lake Highlands. Slopes are mainly 1 to 10 percent, and elevation ranges from 4,300 to 5,000 feet. Annual precipitation ranges from 16 to 25 inches, and the frost-free growing season is 80 to 110 days.

This unit consists of exposed basalt lava flow rock, heavily scattered throughout the unit in reef-like formations. The Germany soil is normally found in small 0.1 to 2.0 acre isolated depressions among the lava flow rock, while the Lithic Xerumbrepts soils are normally found on the upper areas of this unit and immediately adjacent to or on the flow

rock. The Germany soils support open forest canopy stands of ponderosa pine and Jeffrey pine, with a forest survey site class of 5 to 6. The Lithic Xerumbrepts soils can support very open stands of ponderosa pine with a Forest survey site class of 6 where this soil is about 14 to 20 inches in depth. Where this soil is shallower than about 14 inches in depth it supports range type vegetation with vegetation and available forage amounts generally consistent with Range Site 8, with less amounts of range Site 1.

This unit makes up about 4.9 percent of the survey area. It is about 25 percent lava flow rock, 20 percent Germany, and 20 percent Lithic Xerumbrepts soils. The remaining 35 percent of this unit is composed primarily of the Pass Canyon, Elmore, Gwin, Lawyer, and Sadie families and mesic, Lithic Xerorthents.

Lava flow rock consists of relatively recent, hard fractured vesicular basalt flow rock and collapsed lava tubes in broken reef-like formations. An amazing amount of ponderosa pine and various shrubs are growing out of these fractured lava flow rock formations in many areas.

The Germany soils are moderately deep in this unit. They are well drained, and permeability is moderately rapid. They normally have a dark yellowish brown, fine sandy loam surface soil over a cobbly fine sandy loam to very cobbly fine sandy loam subsoil and substratum.

The Lithic Xerumbrepts soils are 10 to 20 inches deep over basalt bedrock. They are well drained, and permeability is moderately rapid. They normally have a brown, very cobbly sandy loam surface over extremely cobbly sandy loam subsurface.

13. Stonewell-Yallani families

This unit is composed of moderately deep and deep soils on volcanic mountain uplands on the south side of the Medicine Lake Highlands. Slopes range from 2 to 70 percent, and elevation ranges from 4,600 to 7,000 feet. Annual precipitation ranges from 25 to 45 inches, and the frost-free growing season is 60 to 90 days.

These soils support dense stands of white fir forest or mixed conifer forest of white fir, red fir, incense cedar, sugar pine, and ponderosa pine. Forest survey site class is 4 to 5. Understory vegetation is normally very sparse and may consist of greenleaf manzanita, snowbrush, squawcarpet, mint, currant, ceanothus, chinquapin, and few perennial grasses and sedges.

This unit makes up about 1.3 percent of the survey area. It is about 40 percent Stonewell and 35 percent Yallani soils. The remaining 25 percent of this unit is composed primarily of the Sheld, Ahart, and Xynbar families and frigid, Lithic Xerorthents and rock outcrop.

The Stonewell soils are greater than 30 inches deep. They are well drained, and permeability is moderately rapid. They normally have a dark grayish brown, gravelly sandy loam surface over a very gravelly sandy loam, extremely gravelly loamy sand, or extremely gravelly sand substratum.

The Yallani soils are greater than 30 inches deep. They are well drained, and permeability is moderately rapid. They normally have a brown gravelly sandy loam surface over an extremely cobbly fine sandy loam or extremely cobbly loam subsoil.

14. Stonewell-Yallani-Inville families, pumice overburden

This unit is composed of deep soils with a recent pumice deposition of 6 inches to greater than 40 inches thick. It is on volcanic mountain uplands on the north and east sides of the Medicine Lake Highlands. Slopes range from 2 to 40 percent, and elevation ranges from 5,300 to 6,500 feet. Annual precipitation ranges from 20 to 40 inches, and the frost-free growing season is 60 to 90 days.

These soils support open to semi-dense stands of white fir, or mixed conifer forests of white fir, ponderosa pine, incense cedar, and sugar pine or lodgepole pine forests. Forest survey site class fluctuates from 4, where the pumice deposit is thin, to 6 or 7, where the pumice deposit is deep. Understory vegetation may consist of greenleaf manzanita, rabbitbrush, ceanothus, bitterbrush, squawcarpet, and few perennial grasses and sedges.

This unit makes up about 1.2 percent of the survey area. It is about 40 percent Stonewell, 25 percent Yallani, and 15 percent Inville soils. The remaining 20 percent is made up mainly of frigid, Lighic Xerorthents and rock outcrop.

The Stonewell soils are deep and contain a relatively recent pumice deposition of 6 inches to greater than 40 inches thick. The pumice deposit normally consists of a grayish brown, gravelly coarse loamy sand over a very pale brown, extremely gravelly coarse sand. The underlying soil, if present, is normally a very gravelly sandy loam, extremely gravelly loamy sand, or extremely gravelly coarse sand. They are somewhat excessively drained, and permeability is rapid in the pumice deposit and moderately rapid below.

The Yallani soils are deep and contain a relatively recent pumice deposition of 6 to 20 inches thick. The pumice deposit normally consists of a grayish brown, gravelly coarse loamy sand over a very pale brown, extremely gravelly coarse sand. The underlying soil normally consists of an extremely cobbly fine sandy loam or extremely cobbly loam. It is well drained, and permeability is rapid in the pumice deposit and moderately rapid below.

The Inville soils are deep and contain a relatively recent pumice deposition 8 to 20 inches thick. The pumice deposit normally consists of a grayish brown, gravelly loamy sand or very gravelly loamy coarse sand over extremely gravelly coarse sand or gravelly loamy sand. The underlying soil normally consists of a very gravelly

sandy loam to very gravelly loam. It is well drained, and permeability is rapid in the pumice deposit and moderate below.

Mid Elevation Soils on Gently Sloping to Extremely Steep Mountains in the Eastern Half of the Survey Area.

The three map units in this group make up about 14 percent of the survey area and are located primarily in the eastern and southern areas of the survey. The soils are on mountain uplands and are well drained. They have surface textures of loam or clay loam that are normally gravelly, cobbly or stony. The soils are shallow, moderately deep or deep over basic igneous rocks composed of basalt, andesite or tuff.

The elevation ranges from 5,400 to 7,500 feet. The average annual precipitation is 20 to 30 inches, and the average annual air temperature is 40 to 46°F. The frost free period ranges from 60 to 90 days.

The moderately deep and deep soils are used for timber, wildlife and transitory range, and the shallow soils are used mainly for range and wildlife.

15. Smarts-DeMasters-Patio families

This unit is composed of moderately deep and deep soils on mountain uplands. Slopes range from 1 to 90 percent, but are predominately less than 40 percent. Elevation ranges from 5,400 to 7,500 feet, and annual precipitation is mainly 20 to 30 inches. The frost-free growing season is 60 to 90 days.

These soils normally support dense stands of white fir, or mixed conifer forests of white fir, ponderosa pine, and incense cedar. Forest survey site class is 4 to 5. Understory vegetation is normally very sparse and may consist of greenleaf manzanita, snowberry, serviceberry, Ribes spp., currant spp., squawcarpet, and a few perennial grasses and sedges.

This unit makes up about 8.3 percent of the survey area. It is about 35 percent Smarts, 20 percent DeMasters, and 15 percent Patio soils. The remaining 30 percent of this unit is composed primarily of the Lamondi, Mascamp, Anatone, Cavanaugh, Merlin, Merkel, Gleason, and Wapal families and rock outcrop.

The Smarts soils are moderately deep and deep and are mainly over basalt. They are well drained, and permeability is moderately slow. They normally have a reddish brown, stony loam surface over a very cobbly

loam, very gravelly loam, and extremely gravelly clay loam subsoil.

The DeMasters soils are mainly deep over basalt. They are well drained, and permeability is moderately slow. They normally have a thick brown or reddish brown loam or gravelly loam surface over a gravelly clay loam to extremely cobbly clay loam subsoil.

The Patio soils are moderately deep and deep and are mainly over basalt, andesite, or obsidian. They are well drained, and permeability is moderate. They normally have a yellowish brown, very gravelly loam surface over an extremely gravelly loam or extremely cobbly loam subsoil.

16. Bertag-Smarts-Cavanaugh families

This unit is composed of moderately deep and deep soils on mountain uplands. Slopes range from 10 to 65 percent, and elevation ranges from 5,500 to 7,500 feet. Annual precipitation ranges from 20 to 30 inches, and the frost-free growing season is 60 to 90 days.

These soils support dense stands of white fir, or mixed conifer forests of white fir, ponderosa pine, and incense cedar. Forest survey site class is 4 to 5. Understory vegetation is normally very sparse and may consist of snowberry, seviceberry, ceanothus, mulesears, currant spp., Ribes spp., squawcarpet, lupine, and few perennial grasses and sedges.

This unit makes up about 0.9 percent of the survey area. It is about 35 percent Bertag, 20 percent Smarts, and 15 percent Cavanaugh soils. The remaining 30 percent of this unit is composed primarily of the Patio, DeMasters, Mascamp, Manilla, and Merlin families.

The Bertag soils are moderately deep and deep and are mainly over tuff. They are well drained, and permeability is slow. They normally have a dark brown loam surface over a cobbly clay loam and gravelly clay subsoil.

The Smarts soils are moderately deep and deep and are over basalt or tuff. They are well drained, and permeability is moderately slow. They normally have a reddish brown, stony loam surface over a very cobbly loam, very gravelly loam, and extremely gravelly clay loam subsoil.

The Cavanaugh soils are greater than 30 inches deep over tuff or basalt bedrock. They are well drained, and

permeability is slow. They normally have a dark brown cobbly loam and very cobbly loam surface over very cobbly clay loam to extremely gravelly clay subsoil.

17. Anatone-Bearskin-Merlin families

This unit is composed of shallow soils on mountain uplands and remnants of basalt plateaus. Slopes range from 1 to 90 percent, and elevation ranges from 5,500 to 7,500 feet. Annual precipitation ranges from 20 to 30 inches, and the frost-free growing season is 60 to 90 days.

These soils are rangeland soils and support vegetation and available forage amounts consistent with Range Site 9. Other uses are for wildlife, recreation, and watershed.

This unit makes up about 4.6 percent of the survey area. It is about 35 percent Anatone, 15 percent Bearskin, and 15 percent Merlin soils. The remaining 35 percent of this unit is made up primarily of the Smarts, Manila, Mascamp, Bertag, Patio, Ginser, Hades, and Vipont families, Rubble land, and Rock outcrop.

The Anatone soils are 8 to 20 inches deep over basalt, andesite, obsidian, or tuff. They are well drained, and permeability is moderate. They normally have a brown cobbly loam surface over a very cobbly loam subsurface.

The Bearskin soils are 10 to 20 inches deep over tuff or basalt. They are well drained, and permeability is moderately slow. They normally have a brown cobbly loam surface over a cobbly silty clay loam subsoil.

The Merlin soils are 8 to 20 inches deep over tuff or basalt. They are well drained, and permeability is slow. They normally have a grayish brown, very cobbly clay loam surface over a gravelly clay subsoil.

High Elevation Nearly Level to Extremely Steep Soils on the Medicine Lake Highlands and on the Warner Mountains.

The three map units in this group make up about 4 percent of the survey area. The soils are on the higher elevations of both the Medicine Lake shield volcano and the older Warner Mountain range. The soils are well drained to somewhat excessively drained. They have surface textures of sand, loamy sands, sandy loam and loam and are gravelly or cobbly. The soils are mainly moderately deep to deep, except for the Cheadle soil which is shallow. They formed from basic igneous rocks made up of andesite, basalt, tuff, cinders or obsidian.

The elevation ranges from 6,500 to 9,900 feet. The average annual precipitation is 25 to 45 inches, and the average annual air temperature is 34 to 40°F. The frost free period ranges from less than 30 days to about 70 days.

These soils are used for timber production and range. Other uses are for wildlife, aesthetic values, recreation and watershed.

18. Divers-Lapine-Kinzel families

This unit is composed of moderately deep and deep soils which may have a recent pumice deposition of up to 24 inches thick. It is in the Medicine Lake Caldera and volcanic mountain sideslopes of the Medicine Lake Highlands. Slopes range from 1 to 60 percent, and elevation ranges from 6,500 to 7,900 feet. Annual precipitation is 35 to 45 inches, and the frost-free season is 40 to 70 days.

These soils support red fir forest or mixed conifer forest of lodgepole pine, western white pine, red fir, and mountain hemlock. Forest survey site class is 5 to 6. Understory vegetation may include pentstemon, prostrate manzanita, mint, snowberry, and chinquapin, and is normally very sparse.

This unit makes up about 1.3 percent of the survey area. It is about 35 percent Divers, 30 percent Lapine, and 15 percent Kinzel soils. The remaining 20 percent of this unit is made up primarily of the Wuksi family and rock outcrop.

The Divers soils are greater than 30 inches deep over basalt or cinders. They are somewhat excessively drained, and permeability is rapid in the pumice overburden, if present, and moderately rapid below. They normally have a brown, very gravelly loamy coarse sand surface over an extremely cobbly sandy loam subsoil.

The Lapine soils are greater than 30 inches deep and are mainly over cinders. They are somewhat excessively drained, and permeability is rapid. They normally have a grayish brown, very gravelly coarse sand surface over extremely gravelly coarse sand, Extremely gravelly sandy loam, or extremely gravelly loamy coarse sand substratum.

The Kinzel soils are moderately deep over weakly cemented or compacted volcanic ash and cinders. They are well drained, and permeability is moderately rapid. They normally have a dark grayish brown, gravelly loamy sand surface over very cobbly sandy loam to extremely stony sandy loam subsoil.

19. Behanin deep-Gralic-Loberg families

This unit consists of moderately deep and deep soils on mid to upper sideslopes, ridges, and crests of mountains in the Warner Mountain range. Slopes range from 10 to 65 percent, and elevation ranges from 7,000 to 8,000 feet. Annual precipitation is 25 to 35 inches, and the frost-free season is 40 to 70 days.

These soils support open to dense stands of white fir and lodgepole pine forest or lodgepole pine and western white pine forest. Other trees may include Washoe pine, quaking aspen, and ponderosa pine. Forest survey site class is 5 to 6. Understory vegetation is very sparse and may include prostrate manzanita, snowberry, forbs, currant spp., and few perennial grasses.

This unit makes up about 0.7 percent of the survey area. It is about 25 percent Behanin, 20 percent Gralic, and 20 percent Loberg soils. The remaining 35 percent of this unit is made up primarily of Woodhurst, Gallatin, Supervisor, Friana, and Cheadle families and Rubble land.

The Behanin deep soils are over andesite, basalt, or tuff. They are well drained, and permeability is moderate. They normally have a very dark grayish brown, very gravelly loam surface over very stony loam and extremely gravelly loam subsurface.

The Gralic soils are greater than 30 inches deep over andesite or obsidian. They are well drained, and permeability is moderately rapid. They normally have a grayish brown, very gravelly fine sandy loam surface over very gravelly sandy loam and very gravelly loamy sand substratum.

The Loberg soils are moderately deep over tuff. They are well drained, and permeability is slow. They normally have a brown gravelly loam surface over a very gravelly clay loam subsoil.

20. Cheadle-Supervisor-Behanin Families

This unit consists of shallow and moderately deep soils on mid to upper sideslopes, ridges, and crests of mountain uplands on the Warner Mountain range. Slopes range from 5 to 100 percent. Elevation ranges from 7,000 to 9,900 feet. Annual precipitation is 25 to 35 inches, and the frost-free season is less than 30 days to 70 days.

These soils are either rangeland soils, or support semi-dense stands of white bark pine with some lodgepole pine, western white pine, and quaking aspen. The forest survey site class on the forested areas is 7 due to the very

short growing season and severe windswept exposures. The rangeland areas support vegetation and available forage amounts consistent with Range Sites 9 and 14. Other uses are for wildlife, aesthetic values, recreation, and watershed.

This unit makes up about 1.7 percent of the survey area. It is about 30 percent Cheadle, 20 percent Supervisor, and 15 percent Behanin soils. The remaining 35 percent of this unit is made up primarily of the Gallatin and Duncom families, Cryoborolls, wet, Lithic Cryochrepts, Rock outcrop, and Rubble land.

The Cheadle soils are 8 to 20 inches deep over andesite, obsidian, or tuff. They are well drained, and permeability is moderate. They normally have a dark grayish brown, very cobbly loam surface over a very cobbly loam or very cobbly clay loam subsurface.

The Supervisor soils are moderately deep over andesite, obsidian, or tuff. They are well drained, and permeability is moderate. They normally have a dark grayish brown, gravelly fine sandy loam surface over a very gravelly sandy loam subsoil.

The Behanin soils are moderately deep over andesite or tuff. They are well drained, and permeability is moderate. They normally have a very dark grayish brown, very gravelly loam surface over very stony loam and extremely gravelly loam subsurface.

Miscellaneous Areas With Little or No Soil Present.

The two miscellaneous units which make up this group are the Lava flow rock-Rock outcrop unit, and water. Together they make up over 5 percent of the survey area. The Lava flow rock and Rock outcrop is of basic igneous rock.

The miscellaneous units which make up this group are used mainly for aesthetic values, recreation, wildlife and watershed.

21. Lava flow rock-Rock outcrop

This miscellaneous land type occurs throughout the survey area, with the main areas of concentration being in and around the Medicine Lake Highlands and on the east side of the Warner Mountain range. It can be found on nearly level basalt plateaus to extremely steep mountain sideslopes.

This land type is used mainly for aesthetic values, recreation, some wildlife, and for watershed.

This unit makes up about 3.2 percent of the survey area. It is about 60 percent Lava flow rock and 15 percent Rock outcrop. The remaining 25 percent of this unit is composed primarily of the Bakeoven and Cheadle families, frigid, Lithic Xerorthents, Lithic Cryochrepts, and Rubble land.

Lava flow rock consists of relatively recent, hard vesicular basalt flow rock or obsidian flow rock.

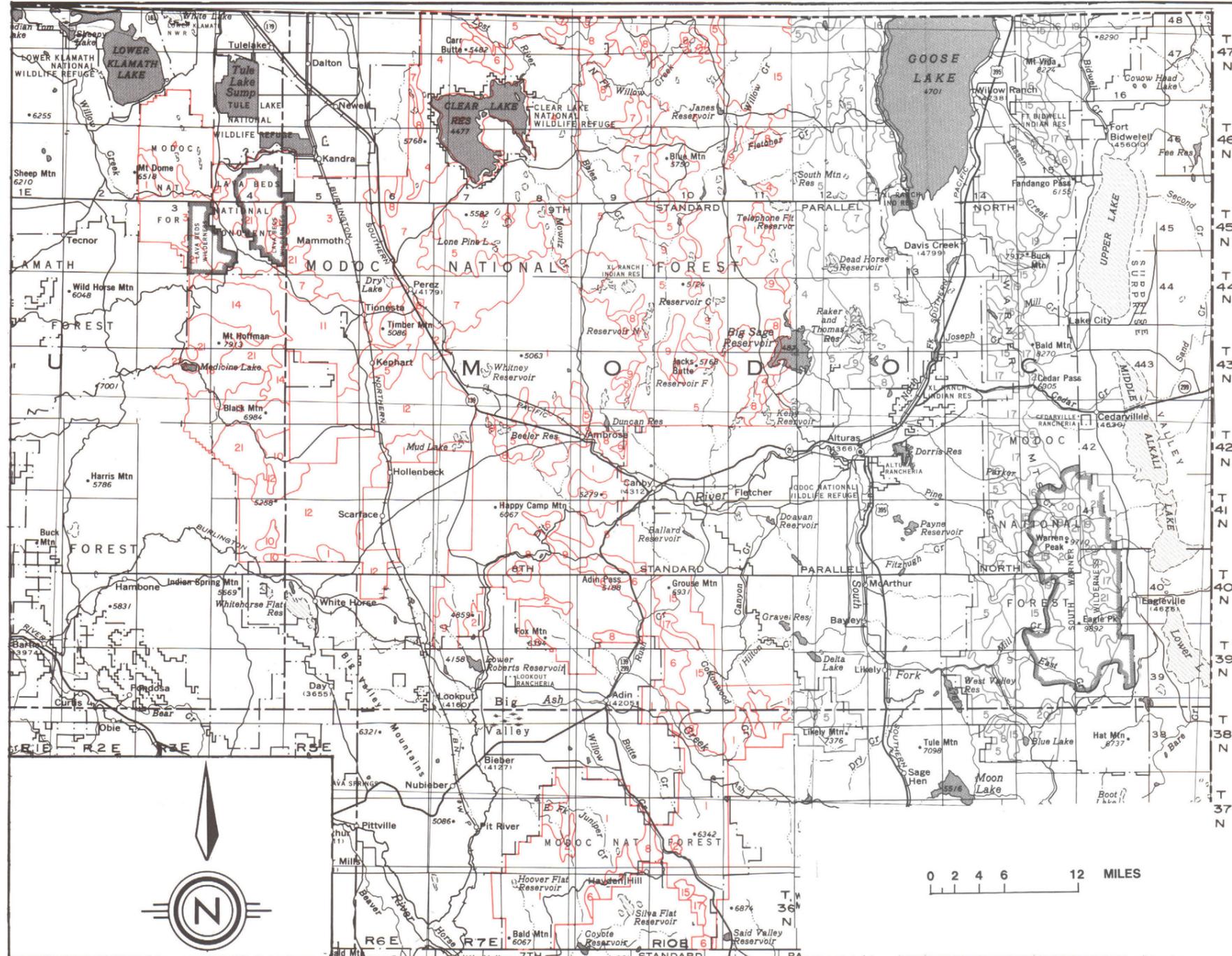
Rock outcrop consists of basalt, andesite, or conglomerate tuff bedrock and may have minor accumulations of aeolian soil deposition in some fractures.

22. Water

This unit consists of large bodies of water which make up about 2.2 percent of the survey area. These areas are Medicine Lake, Clear Lake Reservoir, and Big Sage Reservoir.

**MODOC NATIONAL FOREST, CALIF.
GENERAL SOIL MAP
(703 SOIL SURVEY AREA)**

MAP UNIT LEGEND



LOWER ELEVATION DOMINATELY WOODLAND SOILS MAINLY ON 0 TO 40 PERCENT SLOPES

1. Lawyer - Elmore families: Moderately deep and deep, well-drained soils on basalt plateaus and mountain sideslopes.
2. Jacket - Deven - Hibner families: Moderately deep and shallow, well-drained soils on mountain sideslopes.

LOWER ELEVATION RANGELAND SOILS MAINLY ON 0 TO 40 PERCENT SLOPES

3. Bakeoven family - Lava flow - Searles family: Shallow and moderately deep, well-drained soils and lava flow rock on basalt plateaus.
4. Puls - Indian Creek - Simpson families: Shallow soils over a silica durapan and moderately deep, well-drained soils on basalt plateaus.
5. Deven - Bieber - Pass Canyon families: Shallow, well-drained soils over basalt bedrock, or, over a silica durapan on basalt plateaus.
6. Gwin - Ruckles - Pass Canyon families: Shallow, well-drained soils primarily on mountain sideslopes.
7. Supan - Los Gatos - Pass Canyon families: Deep, moderately deep and shallow, well-drained soils primarily on basalt plateaus.
8. Deven - Keating - Pass Canyon families: Shallow and moderately deep, well-drained soils on mountain sideslopes and basalt plateaus.

DOMINATELY NEARLY LEVEL ALLUVIAL SOILS THAT ARE SUBJECT TO FLOODING

9. Aikman - Cardon families: Deep and moderately deep, moderately well-drained to somewhat poorly drained soils found primarily on alluvial depressions and drainages.

LOWER TO MID ELEVATION DOMINATELY WOODLAND SOILS WHICH HAVE FORMED IN RELATIVELY RECENT VOLCANIC PARENT MATERIALS

10. Alcot - Sadie - Germany deep families: Deep, well-drained to somewhat excessively drained soils on basalt plateaus and sideslopes of cinder cones.
11. Alcot - Holland families, pumice overburden: Moderately deep, well-drained to somewhat excessively drained soils on basalt plateaus and lower volcanic mountain sideslopes.
12. Lava flow - Germany family - Lithic Xerumbrepts: Lava flow rock, moderately deep and shallow, well-drained soils on geologically recent basalt plateaus.
13. Stonewell - Yallani families: Moderately deep and deep, well-drained soils on volcanic mountain sideslopes and ridges.
14. Stonewell - Yallani - Inville families, pumice overburden: Deep, well-drained soils on volcanic mountain sideslopes and ridges.

MID ELEVATION SOILS ON GENTLY SLOPING TO EXTREMELY STEEP MOUNTAINS IN THE EASTERN HALF OF THE SURVEY AREA

15. Smarts - DeMasters - Patio families: Moderately deep and deep, well-drained soils on mountain sideslopes and ridges.
 16. Bertag - Smarts - Cavanaugh families: Moderately deep and deep, well-drained soils on mountain sideslopes.
 17. Anatore - Bearskin - Merlin families: Shallow, well-drained soils on mountain sideslopes, ridges and crests.
- HIGH ELEVATION NEARLY LEVEL TO EXTREMELY STEEP SOILS ON THE MEDICINE LAKE HIGHLANDS AND ON THE WARNER MOUNTAINS.
18. Divers - Lapine - Kinzel families: Moderately deep and deep, somewhat excessively drained and well-drained soils on volcanic mountain sideslopes and on the Medicine Lake Caldera.
 19. Behanin deep - Gralic - Loberg families: Moderately deep and deep, well-drained soils on mid to upper mountain sideslopes, ridges and crests.
 20. Cheadle - Supervisor - Behanin families: Shallow and moderately deep, well-drained soils on mid to upper mountain sideslopes, ridges and crests.

MISCELLANEOUS AREAS WITH LITTLE OR NO SOIL PRESENT

21. Lava flow rock - Rock outcrop: Lava flow rock and rock outcrop which occurs on low elevation Basalt plateaus to the highest elevation mountain sideslopes and ridges.
22. Water: Large open bodies of water.

Introduction to Map Unit Descriptions, Characteristics and Interpretations for Management

The map units on the soil maps attached to the back of this survey report represent the soils in the survey area. The map unit descriptions in this section, along with the soil maps, can be used to determine the suitability and potential of a soil for specific uses. They also can be used to plan the management needed for those uses. The map unit description contains additional information on the soil characteristics and interpretations for use and management.

A map unit delineation on a map represents an area dominated by one or more major kinds of soil or miscellaneous areas. A map unit is identified and named according to the taxonomic classification of the dominant soils or miscellaneous areas. Within a taxonomic class there are precisely defined limits for the properties of the soils. On the landscape, however, the soils and miscellaneous areas are natural phenomena, and they have the characteristic variability of all natural phenomena. Thus, the range of some observed properties may extend beyond the limits defined for a taxonomic class. Areas of soils of a single taxonomic class rarely, if ever, can be mapped without including areas of other taxonomic classes. Consequently, every map is made up of the soils or miscellaneous areas for which it is named and some "included" areas that belong to other taxonomic classes.

All map units include small scattered areas of soils other than those for which the map unit is named. Some of these included soils have properties that differ substantially from those of the major soil or soils. Such differences could significantly affect use and management of the soils in the map unit. The included soils and their normal percentage of inclusion in total are identified in each map unit description.

The presence of included areas in a map unit in no way diminishes the usefulness or accuracy of the data. The objective of mapping is not to delineate pure taxonomic classes but rather to separate the landscape into segments that have similar use and management requirements. The delineation of such landscape segments on the map provides sufficient information for the development of resource plans, but if intensive use of small areas is planned, onsite investigation to precisely define and locate the soils and miscellaneous areas is needed.

A symbol identifying the soil precedes the map unit name in the soil descriptions. Each description includes general facts about the soil and gives the principal

hazards and limitations to be considered in planning for specific uses.

Soils that have profiles that are almost alike make up a soil family. Except for differences in texture of the surface layer or of the underlying material, all soils of a family have major horizons that are similar in composition, thickness, and arrangement.

Soils of one family can differ in texture of the surface layer or of the underlying material. They also can differ in slope, total depth, amount of surface rock fragments, and other characteristics that affect their use. On the basis of such differences, a soil family is divided into soil phases. Most of the areas shown on the soil maps are phases of soil families. The name of a soil phase commonly indicates a feature that affects use or management. For example, Alcot family, 20 to 40 inch pumice overburden, 1 to 10 percent slopes, is one of several phases in the Alcot family.

Most map units are made up of two or more major soils or miscellaneous areas. These map units are called soil complexes or soil associations.

A soil complex consists of two or more soils or miscellaneous areas in such an intricate pattern or in such small areas that they cannot be shown separately on the soil maps. The pattern and proportion of the soils or miscellaneous areas are somewhat similar in all areas. Behanin deep-Gallatin families complex, 10 to 35 percent slopes, is an example.

A soil association is made up of two or more geographically associated soils or miscellaneous areas that are shown as one unit on the maps. Because of present or anticipated soil uses in the survey area, it was not considered practical or necessary to map the soil or miscellaneous areas separately. The pattern and relative proportion of the soils or miscellaneous areas are somewhat similar. Anatone-Smarts families association, 5 to 20 percent slopes, is an example.

This survey also includes two miscellaneous areas which show on the soil maps. These areas have little or no soil material and support little or no vegetation. These areas are: Lava flow rock symbolized by "V" on the soil maps, and open areas of water symbolized by "W" on the soil maps. In addition, three other miscellaneous areas were mapped in complex or association with one or two soil types on many soil map units. These include Rock outcrop, Rubble land and Lava flow. Anatone-Bearskin families-Rock outcrop association, 40 to 70 percent slopes is an example.

Table 4 gives the acreage and proportionate extent of each map unit. The Glossary defines many of the terms used in describing the soils.

In the following pages is a brief explanation of the detailed soil map unit descriptions, characteristics and their interpretations for management.

Mapping Unit Symbol and Name. This is a three digit numerical symbol of the mapping unit (which is also shown on the soil maps) followed by the name of the mapping unit. These mapping units are in numerical sequence beginning with number 101 and going thru 282. Six previously numbered map units no longer exist (i.e., 119, 143, 160, 172, 234, and 248) due to their close correlation and subsequent joining with other mapping units. Below the mapping unit name is given the included soils and miscellaneous land types and their overall percentage of the mapping unit.

Mapping Unit Components and Approximate Proportions. Components are listed and the approximate percentage of the mapping unit is given in parentheses. The percentage of the main components together with the percentage of inclusions listed above equal 100.

Physiographic Position, Slope, Elevation. This is a description of the landform and relative position of the soils and/or miscellaneous areas of the mapping unit plus the slope range and elevation range of the mapping unit. In those units, or a particular soil within a unit where spring flooding is common, it will state "subject to spring flooding".

Typical Vegetation, Precipitation (PPT). This shows the dominant climax vegetation types by common name that were observed and identified in the field when mapping these units. In some areas where wildfires or man's activities have resulted in some other vegetative successional stage, that vegetation may not be named. Precipitation in inches shown at the end of the typical vegetation description shows the annual precipitation zone this map unit has been mapped in based on isohyets developed by the California Department of Natural Resources - Hydrology Section and later modified to a minor extent by Mark Cleveland past Modoc National Forest Hydrologist.

Brief Soil Profile Description. The Brief Soil Profile Description is an abridged version of the typical pedon description given for each taxonomic unit. Listed are thickness in inches, dry color, texture, structure, dry consistence, and pH for three layers: Surface Layer (A horizons), Subsoil (B horizons), and Substratum (C Horizons). If an O horizon was described for the typical pedon, it is also included with the Surface Layer.

Effective Rooting Depth in Inches and Type of Underlying Material. The effective rooting depth in inches reflects the soil depth to a root limiting contact whether it be hard or soft bedrock, a duripan, or over a dense very hard to extremely hard clay layer as is the case with the Puls family. The type of underlying material identifies the type of bedrock or parent material normally found with that soil type in that mapping unit.

Soil Erodibility (K-factor). Indicates the susceptibility of a soil to sheet and rill erosion by water. Factor K is one of six factors used in the Universal Soil Loss Equation (USLE) to predict the average annual rate of soil loss by sheet and rill erosion in tons per acre per year. The estimates are based primarily on the soils surface texture and organic matter (up to 4 percent) and on soil permeability. The estimates are modified by the presence of rock fragments. Values of K in this survey range from 0.15 to 0.49. The higher the value the more susceptible the soil is to sheet and rill erosion by water.

Erosion Hazard Maximum. This rating indicates the level of risk of soil loss by erosion and is based on the assumption that most or all of the vegetative surface cover has been removed due to management practices or to wildfire. The risk is low if the expected soil loss is small, moderate if standard and non-intensive measures are needed to control erosion, and high or very high if excessive soil loss is expected without intensive and/or expensive measures to control erosion. The process used for evaluating the potential of a soil within a mapping unit for erosion includes such soil characteristics as texture, structure, permeability, and depth at which permeability begins. The process also considers such other factors as slope and length of slope, distribution and form of precipitation, aspect and any remaining vegetative cover.

Soil profile permeability refers to the ability of a soil to transmit water or air. The estimates indicate the rate of downward movement of water when the soil is saturated. They are based on soil characteristics observed in the field, particularly structure, porosity, and texture. Permeability is measured as the number of inches per hour that water moves downward through the saturated soil. Terms describing permeability include: Very Slow, less than 0.06 inches; Slow, 0.06 to 0.2 inches; Moderately Slow, 0.2 to 0.6 inches; Moderate, 0.6 to 2.0 inches; Moderately Rapid, 2.0 to 6.0 inches; Rapid, 6.0 to 20 inches; and Very Rapid, greater than 20 inches.

Soil Drainage Class. This interpretation is the natural drainage class assigned to that soil type. It 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, 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, 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.

Soil Manageability Class. The ease of managing land depends on the kinds and intensities of cultivation and harvest techniques. It is also dependent on soil and topographic features, although the importance of these features is related to the type of management system. Nevertheless, there are certain features that affect the ease of management with mechanized equipment, regardless of the kind of management, even though some management systems may be affected more than others. The soil manageability classification rates soils and their topography on the basis of features which reduce the ease of equipment operation and increased required soil protection measures for most systems, particularly those commonly practiced in forestry and intensive range management.

There are four soil manageability classes. Classes 2, 3, and 4 are qualified by one or more management option modifiers. Soil manageability classes and their definitions are: Class 1 - Easy to manage. Soils in this class are on stable slopes of less than 30 percent. They are moderately deep or deep and do not have any more than slight management problems. No management option modifiers apply to this class. Class 2 - Readily manageable. Soils in this class are on slopes of 30 to 40 percent (depending on soil type) but have a moderate management option modification, such as moderate erosion potential. Possible symbols are 2s, 2ed, 2w, etc., but not 2g. Class 3 - Moderately difficult to manage. Soils in this class are on steep slopes (35 to 60 percent or 40 to 60 percent on some units) or have a substantial management option modification, or both. Possible symbols are 3g, 3D, 3Pg, etc. Class 4 - Very difficult to manage. Soils in this class are on very steep slopes (greater than 60 percent). They may or may not have other management option modifiers. Possible symbols are 4G, 4Gpx, 4GD, etc.

Management option modifiers were chosen in the order in which they are listed below. Only one symbol could be chosen from each of the three following sets:

Set 1 modifier symbols include (G) slopes greater than 60 percent; (g) slopes 35 or 40 to 60 percent; (S) high potential for slope failure; (s) moderate potential for slope failure; (E) high or very high erosion hazard; (e) moderate erosion hazard.

Set 2 modifier symbols include: (D) total soil depth less than 10 inches; (d) soil depth 10 to 20 inches; (P) available water holding capacity less than 1.2 inches in the top 20 inches of soil; (p) available water holding

capacity between 1.2 and 2.4 inches in the top 20 inches of soil.

Set 3 modifier symbols include: (W) poorly drained soils; (w) somewhat poorly drained soils; (X) rock outcrop or surface boulders representing more than 15 percent of the area; (x) rock outcrop or surface boulders representing between 3 and 15 percent of the area.

Within each set uppercase modifier symbols were chosen before any lower case symbols could be selected.

Soil Manageability Group. Five soil manageability groups have been developed for utilization in broad planning. The groups rate soil map units. Only one group applies to a map unit. Soil manageability classes rate soil map unit components, and as many classes may apply to a map unit as there are major components in the soil map unit.

The soil manageability groups are defined by the soil manageability classes which apply to the components in a soil map unit. They are designated by Roman numerals in order to distinguish them from soil manageability class symbols, which are designated by Arabic numerals. The soil manageability group rating for each map unit is found directly below the soil manageability class rating of the first named soil type or miscellaneous land form of each map unit description.

The five soil manageability groups and their definitions are: Group 1A - Class 1 components predominate, with less than 30 percent Class 2 components and less than 10 percent Classes 3 and 4 components. Group I - Class 1 components predominate, with less than 50 percent Class 2 components, less than 20 percent Class 3 components, and less than 10 percent Class 4 components by area. Group II - Class 2 components predominate, with less than 50 percent Class 3 components by area.

Group IV - Class 4 components predominate, or occupy at least 40 percent of the map unit area.

A soil map unit was always placed in the group with the lowest numeral in cases where the group definitions would allow it to be in more than one soil manageability group.

Forest Survey Site Class (Dunnings Site Class). Potential timber site productivity ratings for these timber site class determinations were made using age/height relationships of some representative trees and tree species from each soil map unit and soil type. This data was then compared with the potential density of stocking, or potential crown canopy closure. Various tree species productivity site curves were used, depending on the representative species being sampled, to arrive at the corresponding Dunnings site or Forest survey site ratings. Potential stocking densities were then determined, using ocular estimates of density and such soil and climatic factors as soil depth, available water-holding capacity, annual precipitation, and relative estimates of annual evapo-transpiration needs in each soil map unit. These two determinations were then correlated, to arrive at the potential timber site productivity of a given soil map unit and soil type within the map unit. Table 1 shows the relationship between yield in cubic feet per acre per year at culmination of mean annual increment (CMAI), forest survey site class (FSSC) symbol and Dunnings site class (DSC) measurements and potential crown closure (PCC) for Ponderosa pine (PP) and white fir (WF).

In areas where timber was absent due to wildfire or clearcutting, the soil type, depth and climatic conditions became the overriding influence in determining productivity. In most of these cases, however, there was still some evidence of measurable site productivity in the form of a few standing snags, decomposing stumps and logs, or sparsely populated encroaching timber.

Table 1. - Relationship Between Forest Survey and Dunning Site Classes at Various Potential Crown Covers.

Forest Survey Site Class Symbol	Yields in Cubic feet per acre per year	70 to 100% Potential Crown Closure	40 to 70% Potential Crown Closure	10 to 40% Potential Crown Closure
3	120-165	1 (PP), 2 (WF)		
4	85-120	2 (PP), 3 (WF)		
5	50-85	4, 5 (WF); 3, 4 (PP)	3 (WF)	
6	20-50	5 (PP)	4 (PP)	3 (PP)
7	<20			

Range site. Soils that have the capacity to produce the same kinds, amounts, and approximate proportions of range plants are grouped into range sites (11, 12, 13). A range site is the product of all environmental factors responsible for its development. These environmental factors include such things as soil type and depth, surface rock fragments, drainage, annual precipitation, elevation, slope, aspect, and growing season.

Soils that are capable of at least Dunnings site class 5 or forest survey site class 6 commercial timber production were not placed in a range site. Many of these soils that are capable for commercial timber production also produce range forage and are suitable for grazing. These timber soils are normally used only as transitory range for domestic livestock due to their more intensive timber and wildlife management.

A plant community existing within a range site that has not undergone abnormal disturbance is the potential, or climax, plant community for that site. Climax plant communities are not precise or fixed in their composition but vary, within reasonable limits, from year to year and from place to place.

Abnormal disturbance such as overuse by livestock, excessive burning, erosion, or plowing results in changes in the climax plant community or even complete destruction if disturbance is drastic enough. When the range site has not deteriorated significantly under such disturbance, secondary plant succession progresses in the direction of the natural potential or climax plant community for the site.

Range management requires a knowledge of the kinds of soil and of the potential natural plant community. It also requires an evaluation of the present range condition. 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. Range condition is an ecological rating only. It does not have a specific meaning that pertains to the present plant community in a given use.

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 optimum production of vegetation, reduction of undesirable brush species, 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.

In the following pages, the sixteen range sites that occur in this survey area are briefly described and the potential plant communities on these sites are named. Because of the broad range of environmental factors in this survey area and the reconnaissance level of survey intensity, the potential plant community can be quite broad in terms of species composition and percent.

An estimate is also given of the total production which is the amount of vegetation that can be expected to grow annually on well managed rangeland that is supporting

the potential natural plant community. It includes all vegetation, whether or not it is palatable to grazing animals. It includes the current year's growth of leaves, twigs, and fruits of woody plants. It does not include the increase in stem diameter of trees and shrubs. 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 precipitation and the temperatures make growing conditions substantially better than average. In a normal year, growing conditions are about average. In an unfavorable year, growing conditions are well below average, generally because of low available soil moisture.

Dry weight is the total annual yield per acre of air-dry vegetation. Yields are adjusted to a common percent of air-dry moisture content. The relationship of green weight to air-dry weight varies according to such factors as exposure, amount of shade, recent rains, and unseasonable dry periods.

The potential plant community including grasses and grasslikes, forbs, shrubs and trees that make up most of the potential natural plant community on each rangesite are listed by common name. The expected percentage of each species or group of species making up the characteristic vegetation is also given. The amount that can be used as forage depends on the kinds of grazing animals and on the grazing season.

Range Site 1. Very Shallow Stony Loam

This range site occurs in scattered localized areas throughout the survey area at elevations of 4,200 - 8,000 feet. Slopes normally range from 0-10 percent with a minor percentage of this range site on steeper slopes of up to 100 percent. On the majority of this range site the climate is cool and normally averages 10 to 18 inches of precipitation, most of which falls during the winter as snow. Annual precipitation can range up to 30 inches at the highest elevations where this range site occurs in the Warner Mountain Wilderness area. The frost free growing season ranges from about 40 to 110 days in most years.

The soils are very shallow, averaging 4 to 10 inches in depth to a root limiting contact and are normally characterized by a loamy surface with 30 to 80 percent (40 percent average) surface coarse fragments mostly of the 3/4" to 24" size. These soils are characterized by either very little development (Entisols), or, they are highly developed with a very strong (Abruptic) clay texture in the subsoil. These soils can be over hard bedrock, volcanic tuff or a duripan. The potential erosion hazard ranges from moderate to very high due mainly to the relatively high water runoff rates associated with this

range site. The available water holding capacity is very low. These soils are very droughty and herbaceous plant growth normally ceases by mid June in most years.

The potential plant community on this site consists of about 45 to 70 percent grasses and grasslike plants, 5 to 15 percent forbes, and 15 to 35 percent shrubs and trees. Of the grasses and grasslike plants, bluegrasses make up about 35 to 55 percent of the plant community; and bluebunch wheatgrass, Thurbers needlegrass, bottlebrush squirreltail and onspike oatgrass which each make up 5 percent or less. Forbes include phlox species, western yarrow, buckwheat, hawksbeard and a few other species which together represent 5 to 15 percent of the total community. Shrubs and trees include low sagebrush, 10 to 20 percent; rabbitbrush, 3 to 5 percent; mountain mahogany, less than 2 percent; and western juniper, less than 5 percent.

The estimated total production per acre of air dry vegetation is 300 pounds in favorable years, 200 pounds in normal years and 100 pounds in unfavorable years.

Range Site 4. Shallow Loam

This range site occurs in scattered areas throughout the survey area at elevations of 4,300 to 5,500 feet. Slopes normally range from 0 to 15 percent but can go as high as 35 percent. The climate is cool and rainfall averages 10 to 16 inches, most of which falls during the winter as snow. The frost free growing season is 80 to 110 days in most years.

The soils are shallow and normally average 14 to 20 inches in depth to a root limiting contact. The surface is normally a loam and normally has few or no surface coarse fragments. The subsurface soil (below about 4 inches) ranges from clay loam to clay in texture and normally contains less than 35 percent by volume coarse fragments. These soils can be over hard bedrock, volcanic tuff, or a duripan. The erosion hazard potential is normally moderate. The available water holding capacity is low. These soils normally become dry and herbaceous plant growth ceases by the end of June in most years.

The potential plant community on this site consists of about 50 to 65 percent grasses and grasslike plants, 10 to 15 percent forbes, and 20 to 35 percent shrubs and trees. Of the grasses and grasslike plants, Idaho fescue makes up about 25 to 50 percent and bluebunch wheatgrass makes up about 10 to 35 percent of the plant community; bluegrasses, 2 to 10 percent; Thurbers needlegrass, 5 to 10 percent; bottlebrush squirreltail, 3 to 8 percent and prairie junegrass less than 3 percent. Forbes include arrowleaf balsam-root, 3 to 10 percent;

cutleaf balsamroot, 1 to 7 percent; and mule ears, hawksbeard, phlox species, buckwheat, lupine and other species which together make up about 6 to 10 percent. Shrubs and trees include big sagebrush, 5 to 25 percent; low sagebrush and western juniper, up to 20 percent each; bitterbrush, 2 to 10 percent; rabbitbrush, 1 to 5 percent; and up to 12 percent of other shrubs. Other trees and shrubs including ponderosa pine, up to 2 percent; and mountain mahogany, up to 5 percent may occasionally occur as a topoedaphic climax.

The estimated total production per acre of air dry vegetation is 1,100 pounds in favorable years, 800 pounds in normal years and 600 pounds in unfavorable years.

Range Site 7. Shallow Stony Loam, 10 to 14 inch precipitation zone

This range site occurs on the Modoc Plateau Geomorphic Province at elevations of 4,200 to 5,200 feet. Slopes are normally 0 to 15 percent. The climate is cool and arid averaging 10 to 14 inches of precipitation, most of which falls during the winter as snow. The frost free growing season is 80 to 110 days in most years.

The soils are shallow (10 to 20 inches deep) but generally average 10 to 15 inches in depth to a root limiting contact and are characterized by a loamy surface with 15 to 80 percent (average 35 percent) surface coarse fragments mostly of the 3" to 24" size. The subsurface soil (below about 2 to 4 inches) has a textural range from loam to clay and normally contains less than 35 percent by volume coarse fragments. These soils are over hard andesite or basalt bedrock, or silica duripan. The potential erosion hazard is normally moderate. The available water holding capacity is low to very low. These soils are very droughty and herbaceous plant growth normally ceases by mid June in most years.

The potential plant community on this site consists of about 50 to 60 percent grasses and grasslike plants, 10 to 20 percent forbes, and 20 to 30 percent shrubs and trees. Of the grasses and grasslike plants, bluebunch wheatgrass makes up about 25 to 35 percent and Idaho fescue makes up about 5 to 15 percent of the plant community; bluegrasses, 2 to 10 percent; and prairie junegrass, bottlebrush squirreltail and Thurbers needlegrass each making up less than 5 percent. Forbes include arrowleaf balsam-root, 1 to 5 percent; and lupine, hawksbeard, phlox species, buckwheat, western yarrow and other species together making up less than 20 percent. Shrubs and trees include low sagebrush, 15 to 25 percent; western juniper, up to 10 percent, and rabbitbrush, bitterbrush and shrubby buckwheat which make up less than 5 percent each. Other shrubs include big sagebrush and mountain mahogany which together can make

up to 15 percent of the community and occur mostly around the Lava Beds National Monument area and further west.

The estimated total production per acre of air dry vegetation is 750 pounds in favorable years, 550 pounds in normal years and 350 pounds in unfavorable years.

Range Site 8. Shallow Stony Loam, 14 to 20 inch precipitation zone

About 80 percent of this range site occurs on the Modoc Plateau geomorphic province. Slopes normally range from 0 to 10 percent. Elevations are normally 4200-5500 feet. The other 20 percent of this range site occurs in mountain uplands with slopes ranging to 70 percent, and elevations up to 6000 feet and mainly on southerly or westerly aspects. The climate is cool and averages 14 to 20 inches of precipitation. Most of the precipitation falls during the winter as snow. The frost free growing season normally averages about 80 to 110 days in most years. It can drop to 60 days at the higher elevations.

The soils are shallow, averaging 10 to 20 inches in depth to a root limiting contact and are characterized by a loamy surface with 15 to 80 percent (35 percent average) surface coarse fragments of the 3/4" to 24" size. The subsurface soil (below about 2 to 4 inches) has a textural range from loam to clay and normally contains less than 35 percent by volume coarse fragments. These soils can be over hard bedrock, volcanic tuff, or a duripan. The water holding capacity is low to very low. The potential erosion hazard ranges from moderate to very high. The soils normally become dry, and herbaceous plant growth ceases by the end of June in most years.

The potential plant community on this site consists of about 50 to 60 percent grasses and grasslike plants, 10 to 20 percent forbes, and 20 to 30 percent shrubs and trees. Of the grasses and grasslike plants, Idaho fescue makes up about 35 to 45 percent and bluebunch wheatgrass makes up about 5 to 10 percent of the plant community; bluegrasses, 2 to 5 percent; bottlebrush squirreltail, 1 to 3 percent; and Thurbers needlegrass, 2 to 4 percent. Forbes include arrowleaf balsam-root, 3 to 5 percent; and lupine, hawksbeard, buckwheat, phlox species, western yarrow and other species together making up 15 percent or less. Shrubs and trees include low sagebrush and western juniper, up to 20 percent each, big sagebrush and bitterbrush, up to 10 percent each; ceanothus species, up to 5 percent; and shrubby buckwheat, rabbitbrush and mountain mahogany, each making up less than 3 percent. Other trees include ponderosa pine which occasionally occur in very sparse stands making up to 5 percent of the community as a topoedaphic climax.

The estimated total production per acre of air dry vegetation is 1,000 pounds in favorable years, 750 pounds in normal years and 500 pounds in unfavorable years.

Range Site 9. Shallow Stony Loam, 20 to 35 inch precipitation zone

This range site occurs on higher elevations (above 5,500 feet) in mountain uplands. Slopes vary from about 5 to 80 percent but are predominately between 15 and 50 percent and on southerly to westerly aspects. The climate is normally cool and relatively moist receiving 20 to 35 inches of annual precipitation, most of which falls during the winter as snow. A small but significant amount of precipitation falls during the summer growing season from thunder showers, especially in the higher elevations (above 7,000 feet) near the eastern edge of the survey area. The frost free growing season ranges from less than 30 days at the highest elevations to about 90 days at the lower elevations in most years.

The soils are shallow, averaging 10 to 20 inches in depth to a root limiting contact and are characterized by a loamy surface with 15 to 70 percent (average 35 percent) surface coarse fragments of the 3/4" to 24" size. These soils are generally weakly developed and normally contain greater than 35 percent by volume coarse fragments in the sub-soil on the steeper sideslopes. The subsurface soil (below about 4-8 inches) ranges from loam to clay. These soils are mainly over basalt and andesite bedrock or conglomerated volcanic tuff. The potential erosion hazard ranges from moderate to very high due mainly to the relatively steep slopes and high water runoff rates associated with this range site. The available water holding capacity is very low or low.

The potential plant community on this site consists of about 50 to 60 percent grasses and grasslike plants, 10 to 20 percent forbes, and 20 to 30 percent shrubs and trees. Of the grasses and grasslike plants, Idaho fescue makes up about 20 to 35 percent of the plant community; California oatgrass up to 15 percent; sedges, 2 to 10 percent; and bottlebrush squirreltail, bluegrasses and needlegrass make up to 5 percent each. Forbes include mule ears, 5 to 20 percent; and arrowleaf balsam-root and other species together making up to 15 percent. Shrubs and trees include big sagebrush, 2 to 20 percent; low sagebrush, up to 15 percent; western juniper, up to 5 percent; and shrubby buckwheat, squawcarpet, snowberry, bitterbrush and mountain mahogany which make up to 5 percent or less each. Other trees include ponderosa pine and white fir which may occur in very

sparse stands each making up less than 5 percent of the community as a topoedaphic climax.

The estimated total production per acre of air dry vegetation is 1,400 pounds in favorable years, 1,000 pounds in normal years and 700 pounds in unfavorable years.

Range Site 12. Loamy, 10 to 14 inch precipitation zone

This range site occurs mainly in the northwest part of the survey area on the Modoc Plateau Geomorphic Province at elevations of 4,200 to 5,400 feet. Slopes range from 0 to 35 percent but are predominately 0 to 15 percent. The climate is cool and arid averaging 10 to 14 inches of precipitation, most of which falls during the winter as snow. The frost free growing season is 80 to 110 days in most years.

The soils are generally moderately deep, averaging 20 to 40 inches in depth to a root limiting contact and are characterized by a loamy surface essentially free of coarse fragments greater than 3" in diameter. The subsurface soil (below about 6-10 inches) is loam, clay loam, or clay and is relatively free of coarse fragments except on the Clear Lake hills on the western edge of Clear Lake reservoir. The soils in this range site are normally over basalt or andesite bedrock. Water runoff is low to moderate and the plant available water holding capacity is moderate. These soils normally become dry, and herbeceous plant growth ceases by mid July in most years.

The potential plant community on this site consists of about 50 to 60 percent grasses and grasslike plants, 10 to 20 percent forbes, and 30 to 40 percent shrubs and trees. Of the grasses and grasslike plants, bluebunch wheatgrass makes up about 35 to 45 percent and Idaho fescue makes up about 10 to 15 percent of the plant community; bluegrasses and Thurbers needlegrass each make up 5 to 10 percent; and bottlebrush squirreltail and prairie junegrass each make up 2 to 5 percent. Forbes include arrowleaf balsam-root, 4 to 10 percent; and buckwheat, phlox species, lupine, western yarrow, vetch, hawksbeard and other species which together make up to 16 percent. Shrubs and trees include big sagebrush, 15 to 20 percent; western juniper, 5 to 15 percent; and bitterbrush and rabbitbrush, 2 to 5 percent each.

The estimated total production per acre of air dry vegetation is 1,300 pounds in favorable years, 900 pounds in normal years and 450 pounds in unfavorable years.

Range Site 13. Loamy, 14 to 20 inch precipitation zone

The majority of this range site occurs on the Modoc Plateau Geomorphic Province. Small isolated areas, however, occur throughout the survey area. Elevations range from 4,400 to 5,800 feet and slopes are normally 0 to 15 percent, but range to 35 percent. The climate is cool and annual precipitation averages 14 to 20 inches, most of which falls during the winter as snow. The frost free growing season is 80 to 110 days in most years.

The soils are generally moderately deep (20 to 40 inches) with minor amounts deeper than 40 inches to a root limiting contact. The surface soil is a loam and is relatively free of surface coarse fragments greater than 3" in diameter. The subsurface soil (below about 6-15 inches) is normally a clay loam or clay and normally contains less than 35 percent by volume coarse fragments. The soils can be over basalt or andesite bedrock, volcanic tuff, or a silica duripan. Water runoff is normally low and the potential erosion hazard is low to moderate. The plant available water holding capacity is moderate to high. These soils normally become dry, and herbaceous plant growth ceases by mid July in most years.

The potential plant community on this site consists of about 55 to 70 percent grasses and grasslike plants, 10 to 15 percent forbes, and 20 to 30 percent shrubs and trees. Of the grasses and grasslike plants, Idaho fescue makes up about 40 to 55 percent and bluebunch wheatgrass makes up about 5 to 15 percent of the plant community; prairie junegrass, 3 to 8 percent; bluegrasses, 2 to 6 percent; Thurbers needlegrass, 1 to 5 percent; and bottlebrush squirreltail, 1 to 2 percent. Forbes include mule ears, 1 to 5 percent; arrowleaf balsam-root, up to 5 percent; and cutleaf balsam-root, hawksbeard, lupine, phlox species and other species each of which makes up less than 4 percent. Shrubs and trees include big sagebrush, 15 to 25 percent; bitterbrush, 2 to 10 percent; and rabbitbrush, 1 to 2 percent; western juniper, up to 10 percent; mountain mahogany and bitter cherry, up to 2 percent each. Other trees include ponderosa pine, which may occur in very sparse stands making up to 5 percent of the community as a topoedaphic climax.

Some large areas of this range site have nearly solid stands of western juniper, plus mountain mahogany and big sagebrush which is mainly the result of increased wildfire suppression efforts over the past 60 years or so.

The estimated total production per acre of air dry vegetation is 1,600 pounds in favorable years, 1,150 pounds in normal years and 700 pounds in unfavorable years.

Range Site 14. Loamy, 20 to 35 inch precipitation zone

This range site occurs above 5,500 feet elevation in mountain uplands in the south and eastern areas of the survey. Slopes range from 0 to 60 percent, but are predominately 10 to 30 percent. The climate is cold with cold long winters and short summers. Annual precipitation is 20 to 35 inches, most of which falls during the winter as snow. A small but significant amount of the precipitation falls during the summer growing season from thunder showers, especially in the higher elevations (above 7,000 feet) near the eastern edge of the survey area. The frost free growing season ranges from less than 30 days at the highest elevations to about 90 days at the lower elevations in most years.

The soils are mainly moderately deep (20 to 40 inches) with minor amounts deeper than 40 inches to a root limiting contact. The surface soil is a loam, or fine sandy loam, and is relatively free of surface coarse fragments greater than 3" in diameter. Some areas of this range site in the higher elevations have up to 40 percent surface coarse fragments of the 1/4" to 3" size. The subsurface soil (below about 10 to 20 inches) is a loam or clay loam and normally contains between 10 to 50 percent by volume coarse fragments which normally increase in amount as the slope percent increases. These soils are mainly over basalt or andesite bedrock. The plant available water holding capacity is normally moderate. The water runoff rate ranges from low on relatively flat areas to high on steeper areas on southerly aspects subject to more rapid snow melt. The potential erosion hazard is mainly moderate to high.

The potential plant community on this site consists of about 60 to 75 percent grasses and grasslike plants, 10 to 15 percent forbes, and 10 to 25 percent shrubs and trees. Of the grasses and grasslike plants, Idaho fescue makes up about 45 to 65 percent and bluebunch wheatgrass makes up about 2 to 10 percent of the plant community; needlegrass and bluegrass, 1 to 5 percent each; and bottlebrush squirreltail, 1 to 2 percent. Forbes include arrowleaf balsam-root, 2 to 8 percent; lupine, 1 to 4 percent; and other species which make up to 10 percent. Shrubs and trees include big sagebrush, 5 to 15 percent; western juniper, up to 10 percent; ponderosa pine and white fir, up to 5 percent each; and bitterbrush, rabbitbrush, mountain mahogany and bitter cherry, up to 2 percent each.

The estimated total production per acre of air dry vegetation is 1,900 pounds in favorable years, 1,400 pounds in normal years and 900 pounds in unfavorable years.

Range Site 16. Gravelly Coarse Loam, 10 to 16 inch precipitation zone

This range site occurs mainly in the northwest corner of the survey area at elevations of 4,200 to 5,000 feet. A volcanic pumice overburden blankets the area. Slopes are mainly between 0 to 15 percent but range up to 40 percent. The climate is cool and relatively dry with 10 to 16 inches of precipitation, most of which falls during the winter as snow. The frost free growing season is 80 to 110 days in most years.

The soils are mainly moderately deep (20 to 40 inches) to a root limiting contact of basalt bedrock or lava flow rock. This range site is mainly the result of a geologically recent thin pumice deposit over an older loamy soil. Where only 1 to 3 inches of pumice was deposited it has been intermixed with the loam to form a gravelly or very gravelly coarse sandy loam surface. The thicker pumice deposits on this range site remain relatively undisturbed and generally have a texture of gravelly coarse loamy sand or sand consisting totally of pumice. The subsoil, or, buried soil is normally a loam to a heavy clay loam and may contain from 5 to 70 percent by volume coarse fragments consisting mainly of basalt. The plant available water holding capacity is mostly moderate. The water runoff rate is low and the potential erosion hazard is low to moderate. These soils normally become dry and herbaceous plant growth ceases by mid July in most years.

The potential plant community on this site consists of about 45 to 65 percent grasses and grasslike plants, 10 to 20 percent forbes, and 25 to 45 percent shrubs and trees. Of the grasses and grasslike plants, bluebunch wheatgrass makes up about 30 to 45 percent and Idaho fescue makes up about 5 to 20 percent of the plant community; Thurbers needlegrass and bottlebrush squirreltail each make up 3 to 15 percent; bluegrasses, up to 10 percent; and wildrye, up to 6 percent. Forbes include arrowleaf balsam-root, 2 to 8 percent. Shrubs and trees include bitterbrush, 10 to 20 percent; big sagebrush, 5 to 20 percent; rabbitbrush, 5 to 15 percent; western juniper, 3 to 15 percent; mountain mahogany, up to 10 percent, shrubby buckwheat, 1 to 4 percent; and up to 2 percent ponderosa pine. Mountain mahogany may occasionally occur in large nearly solid stands as a topoedaphic climax.

The estimated total production per acre of air dry vegetation is 1,200 pounds in favorable years, 800 pounds in normal years and 500 pounds in unfavorable years.

Range Site 17. Stony Loam, 10 to 14 inch precipitation zone

This range site occurs on the Modoc Plateau Geomorphic Province on the northwest corner of the survey area and to the southeast of Clear Lake reservoir. Elevations range from 4,200 to 4,700 feet. The climate is cool and arid with 10 to 14 inches of precipitation, most of which falls during the winter as snow. Slopes are mainly 0 to 10 percent. The frost free growing season is 80 to 110 days in most years.

The soils are mainly moderately deep (20 to 40 inches) to a root limiting contact of basalt bedrock or silica duripan. The surface soil is a loam or light clay loam and normally contains between 10 to 30 percent surface fragments greater than 3 inches in diameter. The subsurface soil (below about 4-8 inches) is a clay loam to clay and normally contains less than 35 percent by volume coarse fragments. Water runoff is low to moderate and the plant available water holding capacity is moderate. The erosion hazard potential is low to moderate. These soils normally become dry and herbaceous plant growth ceases by mid July in most years.

The potential plant community on this site consists of about 50 to 65 percent grasses and grasslike plants, 10 to 15 percent forbes, and 20 to 30 percent shrubs and trees. Of the grasses and grasslike plants, bluebunch wheatgrass makes up about 35 to 55 percent and Idaho fescue and Thurbers needlegrass can each make up to 10 percent of the plant community; bluegrasses, 3 to 8 percent; and bottlebrush squirreltail, up to 5 percent. Forbes include arrowleaf balsam-root and mule ears, 2 to 5 percent each; and phlox species, buckwheat, lupine, hawksbeard and other species which together make up to 10 percent. Shrubs and trees include big sagebrush; 15 to 20 percent; bitterbrush and western juniper, up to 10 percent each; mountain mahogany, up to 15 percent; ponderosa pine, up to 2 percent; and other shrubs, up to 10 percent.

The estimated total production per acre of air dry vegetation is 1,200 pounds in favorable years, 700 pounds in normal years and 350 pounds in unfavorable years.

Range Site 18. Stony Loam, 14 to 20 inch precipitation zone

This range site occurs on scattered areas throughout the survey area at elevations of 4,300 to 5,800 feet. Slopes range from 0 to 50 percent, but are mostly 5 to 40 percent. The climate is cool with 14 to 20 inches of precipitation, most of which falls during the winter as snow. The frost free growing season is 80 to 110 days in most years.

The soils are mainly moderately deep (20 to 40 inches) to a root limiting contact of basalt bedrock or volcanic tuff. The surface soil is a loam or light clay loam and normally contains between 10 to 30 percent surface coarse fragments greater than 3 inches in diameter. The subsurface soil (below 3-6 inches) is a clay loam to clay and normally contains less than 35 percent by volume coarse fragments. Water runoff is moderate to rapid and the plant available water holding capacity is moderate. The erosion hazard potential is normally moderate to high. These soils normally become dry and herbaceous plant ceases by mid July in most years.

The potential plant community on this site consists of about 55 to 65 percent grasses and grasslike plants, 10 to 15 percent forbes, and 25 to 35 percent shrubs and trees. Of the grasses and grasslike plants, Idaho fescue makes up about 35 to 45 percent and bluebunch wheatgrass makes up about 5 to 10 percent of the plant community; bluegrasses, 2 to 8 percent; Thurbers needlegrass, up to 5 percent; and bottlebrush squirreltail; up to 2 percent. Forbes include mule ears and hawksbeard which each make up 2 to 4 percent; lupine, 1 to 3 percent; aster, 1 to 2 percent; and arrowleaf balsam-root, western yarrow buckwheat, grousel and other species which together make up to 10 percent. Shrubs and trees include big sagebrush, 15 to 20 percent; western juniper, up to 15 percent; mountain mahogany, up to 15 percent; bitterbrush, snowberry and ponderosa pine, up to 5 percent each; rabbitbrush, 1 to 2 percent; and other shrubs, up to 10 percent.

The estimated total production per acre of air dry vegetation is 1,500 pounds in favorable years, 1,000 pounds in normal years and 600 pounds in unfavorable years.

Range Site 19. Stony Loam, 20 to 35 inch precipitation zone

This range site occurs mainly in mountain uplands in the south and eastern areas of the survey area on southerly and westerly aspects above 5,500 feet elevation. Slopes are predominately 10 to 40 percent. The climate is cool with long cold winters and short warm summers. Annual

precipitation averages 20 to 35 inches, most of which falls during the winter as snow. A small but significant amount of the precipitation falls during the summer growing season from thunder showers, especially in the higher elevations (above 7,000 feet) near the eastern edge of the survey area. The frost free growing season is less than 30 days at the highest elevations to about 90 days at the lower elevations in most years.

The soils are mainly moderately deep (20 to 40 inches) to a root limiting contact of basalt or andesite bedrock, or conglomerated tuff. The surface soil is a loam or clay loam and normally contains between 15 to 35 percent surface coarse fragments greater than 3" in diameter. The subsurface soil (below 4 - 10 inches) is a loam, clay loam or clay and may contain between 10 to 80 percent by volume coarse fragments. Water runoff is moderate to rapid and the plant available water holding capacity is low to moderate. The erosion hazard potential is moderate to high.

The potential plant community on this site consists of about 55 to 70 percent grasses and grasslike plants, 10 to 15 percent forbes, and 15 to 30 percent shrubs and trees. Of the grasses and grasslike plants, Idaho fescue makes up about 40 to 50 percent of the plant community; bluebunch wheatgrass, 2 to 8 percent; bluegrasses, 1 to 5 percent, needlegrass and bromes, up to 3 percent each; and bottlebrush squirreltail, up to 2 percent. Forbes include arrowleaf balsam-root, 1 to 5 percent; mule ears, 2 to 4 percent, lupine, up to 2 percent; other species, up to 10 percent. Shrubs and trees include big sagebrush, 10 to 15 percent; western juniper, up to 15 percent; mountain mahogany, up to 10 percent; bitterbrush, white fir and ponderosa pine, up to 3 percent each; and rabbitbrush and snowberry, up to 2 percent each.

The estimated total production per acre of air dry vegetation is 1,700 pounds in favorable years, 1,200 pounds in normal years and 700 pounds in unfavorable years.

Range Site 23. Shallow Stony Clay

The majority of this range site occurs mainly in the south central portion of the survey area in mountain uplands at elevations of 4,400 to 5,800 feet. Slopes range from 0 to 60 percent but are mostly 5 to 40 percent. The climate is cool with 14 to 20 inches of precipitation, most of which falls during the winter as snow. The frost free growing season is 80 to 110 days in most years.

The soils are shallow (10 to 20 inches) in depth to a root limiting contact of soft volcanic tuff which weathers to clay. Some soils are over basalt bedrock. The surface soil is a heavy clay loam or clay and normally contains

between 10 to 35 percent (except in map units 150 and 137 which contains less than 10 percent) surface coarse fragments mostly greater than 3" in diameter. The subsurface soil (below 2-4 inches) is normally a clay and contains less than 35 percent by volume coarse fragments. Water runoff is moderate to very rapid and the plant available water holding capacity is low. The erosion hazard potential is moderate to very high. These soils normally become dry and herbaceous plant growth ceases by late June in most years.

The potential plant community on this site consists of about 55 to 75 percent grasses and grasslike plants, 5 to 20 percent forbes, and 15 to 30 percent shrubs and trees. Of the grasses and grasslike plants, mountain brome makes up about 20 to 40 percent and Idaho fescue makes up about 10 to 25 percent of the plant community; bluegrasses, 3 to 10 percent; wildrye, up to 10 percent; and bottlebrush squirreltail, 2 to 5 percent. Forbes include lomatium, 3 to 5 percent; hawksbeard, 2 to 4 percent; lupine, 1 to 3 percent; and other species, up to 15 percent. Shrubs and trees include low sagebrush, 2 to 15 percent; big sagebrush and western juniper, up to 10 percent each; shrubby buckwheat and bitterbrush, up to 4 percent each; ponderosa pine up to 5 percent; and rabbitbrush and squawapple, up to 3 percent each.

The estimated total production per acre of air dry vegetation is 1,100 pounds in favorable years, 900 pounds in normal years and 600 pounds in unfavorable years.

Range Site 24. Clay Basin

This range site occurs primarily on the Modoc Plateau Geomorphic Province at elevations of 4,400 to 6,000 feet on broad relatively flat concave alluvial depressions. Slopes are 0 to 2 percent. The climate is cool with annual precipitation normally in the 12 to 20 inch range which mostly falls as snow during the winter. The frost free growing season is 80 to 110 days in most years.

The soils range from moderately deep to deep (20 to 40 plus inches) and may be over a silica duripan, basalt bedrock, or deeper alluvium. The surface soil is normally a silty clay or clay and is essentially free of surface coarse fragments (except possibly along the periphery of the units). These soils normally have a high shrink-swell potential and are characterized by surface cracks of 1/2 to 3 inches in width and extending down at least 20 inches after the soils become dry. The subsurface soil (below about 1 to 5 inches) is a clay but commonly grades into a clay loam or gravelly clay loam below about 35 to 40 inches. Spring runoff water tends to pond in these areas. The plant available water holding capacity is usually moderate. Because of the heavy dense clay and its high shrink-swell potential these soils become

very hard and dense as they dry out. Herbaceous plant rooting depth normally does not extend beyond about 15 to 20 inches and plants usually cease growth by late June or early July in most years.

The potential plant community on this site consists of about 35 to 55 percent grasses and grasslike plants, 5 to 15 percent forbes, and 20 to 40 percent shrubs. Of the grasses and grasslike plants, slender wheatgrass makes up about 15 to 35 percent and wildrye and mat muhly each make up about 5 to 10 percent of the plant community; sedges and rushes, up to 4 percent; bluegrasses and meadow barley, up to 2 percent each; and bottlebrush squirreltail up to 5 percent. Forbes include buckwheat and yampah, up to 2 percent each, biscuitroot and other species which together make up to 12 percent. Shrubs include silver sagebrush, 20 to 35 percent; and rabbitbrush and low sagebrush, up to 10 percent each.

The estimated total production per acre of air dry vegetation is 1,200 pounds in favorable years, 700 pounds in normal years and 300 pounds in unfavorable years.

Range Site 25. Semi-Wet Meadow

This range site occurs on small localized alluvial basins and drainages throughout the survey area at elevations of 4,400 to 6,400 feet. Slopes are 0 to 5 percent. The climate is cool and precipitation varies from 12 inches to over 20 inches and mostly falls as snow during the winter. The frost free growing season is 60 to 110 days in most years.

The soils are poorly drained and greater than 40 inches in depth over basalt bedrock or deeper alluvium. The surface soil is normally a silty clay loam or clay loam, dark in color, and relatively free of coarse fragments. The subsurface soil (below about 4-8 inches) is normally a silty clay loam, clay loam, or clay with 0-35 percent by volume coarse fragments. The soils commonly have a perched watertable within about 2 to 3 feet of the surface. Because of the perched water table and the capillary action of the soil water, the soil has a natural sub-irrigation system which greatly affects the plant community and increases production yields. The plants in this range site normally stay green and growing throughout the growing season.

The potential plant community on this site consists of about 60 to 80 percent grasses and grasslike plants, 10 to 20 percent forbes, and 0 to 30 percent, shrubs and woody plants. The grasses and grasslike plants consist of sedges, rushes, wildryes, bluegrasses, wheatgrasses, barleys, timothy, mat muhly and spikerush which together makes up 60 to 80 percent of the total plant commu-

nity. Forbs include clover, western yarrow, iris, cinquefoil and other species which together make up 10 to 20 percent.

Shrubs and trees include willow, silver sagebrush, wil-drose, quaking aspen and others which together can make up to 30 percent.

The estimated total production per acre of air dry vegetation is 5,500 pounds in favorable years, 3,850 pounds in normal years and 2,200 pounds in unfavorable years.

Range Site 26. Wet Clay Basin

This range site occurs primarily on the Modoc Plateau Geomorphic Province at elevations of 4,400 to 6,000 feet on broad nearly level concave alluvial basins. Slopes are 0 to 2 percent. The climate is cool with annual precipitation normally in the 12 to 20 inch range which falls as snow during the winter. The frost free growing season is 80 to 110 days in most years.

The soils are mainly poorly drained, and are greater than 40 inches in depth over basalt bedrock, or deeper alluvium. The surface soil is normally a silty clay or clay texture and black or grayish in color and free of coarse fragments. The subsurface soil (below about 1 to 5 inches) is a clay but commonly grades into a gravelly clay loam or clay loam below about 35 to 40 inches. Spring runoff waters during normal or wet years collect in these clay basins for extended periods of time into the growing season thereby strongly influencing the vegetative composition and production yields. The soils normally remain moist and surface cracking, therefore, is not in evidence until about September or October. In some areas excessive salt concentrations have resulted through capillary action of soil water rising to the surface, then being evaporated leaving the salts behind. These areas can normally be identified by a thin whitish salt crust on the soil surface and/or the growth of salt tolerant plants such as inland saltgrass, kochia, or foxtail barley. Eventually these saline areas may become nonproductive as the salt concentrations continue to increase.

The potential plant community on this site consists of about 85 to 95 percent grasses and grasslike plants, and 5 to 15 percent forbs. The grasses and grasslike plants consist of spikerush, rushes, mat muhly, sedges, Nevada bluegrass and foxtail barley which together makes up 85 to 95 percent of the total plant community. The remainder of this plant community is composed of various forb species and constitute 5 to 15 percent.

The estimated total production per acre of air dry vegetation is 2,000 pounds in favorable years, 1,250 pounds in normal years and 500 pounds in unfavorable years.

Water Runoff Potential. This rating indicates the relative velocity of surface water runoff over a soil type and its associated map unit under natural vegetative conditions. Factors considered in rating runoff were slope, average length of slope and hydrologic soil groups. Velocity of runoff directly affects surface soil erosion by water, and, therefore, becomes an important parameter in predicting surface erosion, gullying, and channel scouring. This also becomes an important parameter for proper design of structures such as culverts, bridges, dams, spillways, and roads. The Water Runoff Potential also gives a good indication of the relative amount of soil water recharge a soil might receive for plant growth and soil development.

The five classes of water runoff and their definitions are:

Very Slow. Free water lies on the surface for long periods or enters immediately into the soil. Velocity is such that erosion by runoff would be minimal.

Slow. Free water covers the soil for significant periods or enters the soil rapidly; a large part of the water passes through the profile or evaporates into the air. The velocity is such that erosion by runoff would normally be only of slight concern.

Moderate. Surface water flows away at such a rate that a moderate proportion of the water enters the soil profile and free water lies on the surface for only short periods. With moderate runoff, the loss of water over the surface does not reduce seriously the supply available for plant growth. The velocity of the runoff is such that erosion by runoff could present a moderate to serious concern.

Rapid. A large proportion of the precipitation moves rapidly over the surface of the soil and a small part moves through the soil profile. Surface water runs off nearly as fast as it is added. The rapid velocity of the runoff would pose a serious concern to soil erosion by runoff.

Very Rapid. Most of the water moves very rapidly over the surface of the soil and only a very small part moves through the soil profile. The very rapid velocity of the runoff could result in very severe erosional problems.

Natural Watershed Sensitivity. This rating was developed as a method to help set watershed threshold levels for cumulative watershed impact analysis. It rates the potential of the map unit to contribute to water runoff and determines how rapidly it will respond with

runoff from a given storm event or spring melt, and its sensitivity to erosion and slope stability. To determine natural watershed sensitivity rating by watershed, a proportionate rating is used based on area percentage of each soil map unit within the watershed. An overall watershed adjective rating of low, moderate, high or very high is only relative to the soils and watersheds in this survey area and is used as an indicator to help set the final cumulative watershed threshold level for a particular watershed.

The four natural watershed sensitivity ratings indicate the level of sensitivity by mapping unit and ultimately by whole watersheds when the above analysis is determined. The sensitivity is low if a large amount of disturbance can be tolerated before off-site degradation occurs, Moderate if a moderate amount of disturbance can be tolerated, and High or Very High if corresponding lower amounts of watershed disturbance can be tolerated before off-site watershed degradation is expected to occur.

Hydrologic Soil Groups. are used to estimate relative amounts of runoff from precipitation. Soils not protected by vegetation are assigned to one of four groups. They are grouped according to the intake of water when the soils are thoroughly wet and receive precipitation from long-duration storms.

The four hydrologic soil groups are:

Group A. Soils have a high infiltration rate (potential for a low volume of runoff) when thoroughly wet. These consist mainly of deep, well drained to excessively drained sands or gravelly sands. 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 having a layer that impedes the downward movement of water or soils of moderately fine texture or fine texture. These soils have a slow rate of water transmission.

Group D. Soils having a very slow infiltration rate (potential for a high volume of runoff) when thoroughly wet. These consist chiefly of clays 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.

Available Water Holding Capacity (AWC) Rating. This available water holding capacity rating refers to the quantity of water that the whole soil is capable of storing for use by plants. The capacity varies, depending on soil properties that affect the retention of water and the depth of the root zone. The most important properties are the content of organic matter, soil texture, soil mineralogy, kind and volume of rock fragments, bulk density, and soil structure. Available water holding capacity is an important factor in determining the chance of conifer seedling survival and in the choice of plants to be seeded in range or wildlife vegetation manipulation projects or watershed stabilization or improvement work. Available water holding capacity is not an estimate of the quantity of water actually available to plants at any given time. The capacity for water storage is given as an adjective rating and includes the whole soil depth to 60 inches or to a root restricting contact if shallower. Total soil depth will always include a range in depth as shown under **effective rooting depth in inches and type of underlying material**. This range in depth will often result in a range in AWC adjective ratings such as very low to low, or low to moderate, and so on. The adjective ratings represent the plant available water in inches of water for the whole soil depth and are as follows: Very Low, 0.6 to 1.5 inches; Low, 1.5 to 3.5 inches; Moderate, 3.5 to 6.5 inches; and High, 6.5 plus inches.

Inches of AWC in Top 20 inches of Soil or to a root limiting depth, if shallower. This available water holding capacity rating shows only the total plant available water in inches in the top 20 inches of soil or to a root limiting depth, if shallower. This represents a major factor in determining the **chance of seedling survival rating** of the map unit descriptions, characteristics and interpretations for management.

Susceptibility to Burning Damage. Soil damage can sometimes occur from burning. The risk of damage increases with the intensity of heat. The damage is mainly related to the loss of organic matter and actual soil loss by erosion. Some soils and soil map units have characteristics which enable them to withstand this loss better than other soils and map units. These characteristics are used to rate the soils for their susceptibility to broadcast-burn damage. The soil factors used were soil erosion hazard maximum, allowable soil loss, organic matter content, nutrient distribution in the soil profile, surface texture and percentage of rock fragments. Topographic features used were slope and aspect.

There are three levels of risk used. The susceptibility to

burning damage is Low if only minimal soil damage is expected through a properly planned and implemented prescribed broadcast burn, Moderate if moderate soil damage is expected to occur unless some intensive measures are planned for and implemented, and High if excessive soil damage is expected unless intensive and more expensive measures are incorporated in a prescribed broadcast burn.

Slope Stability Hazard Rating. Slope stability, as used here, is an estimate of the stability behavior of landscapes. All categories from slow creep to rapid mass movement are included. The ratings of high, moderate and low are used to indicate levels of risk. Soil and map unit factors used in this rating process were steepness of slope, fine-textured subsoils with soil strength (R-value ratings in the 0-30 range), soil underlain by nearly impervious material, and units with evidence of past slope stability failure.

Allowable Soil Loss in Tons/Acre/Year. This is also referred to as the T factor in the Universal Soil Loss Equation (USLE). The T factor is an estimate of the maximum average annual rate of soil erosion by wind or water that can occur without affecting crop productivity over a sustained period. The rate is in tons per acre per year. Values of 1, 2, 3 or 5 are used and are based on total soil depth over renewable or non-renewable substrata material. These numbers represent the permissible tons of soil loss per acre per year where food, feed, and fiber plants are to be grown. Only inconclusive data is available to test the validity of these values for forested soils and their corresponding intensities of management. It is felt at this time, however, that these values should also be representative for forest soils in this survey area.

Chance of Seedling Survival. The chance of Seedling Survival rating is a relative rating of the potential for survival of bare root conifer seedlings in clearcut areas the first season following planting (2). Adequate soil moisture appears to be the most limiting factor effecting the biological health and survival of first year planted conifer seedlings in this survey area. This rating, therefore, confined itself to those factors directly related to conifer seedling moisture supply and demand.

Moisture supply is expressed in terms of AWC in the top 20 inches of the soil which is that portion of the soil profile potentially utilized by the seedling root system during its first growing season. The top 2 inches of the seedling root zone was not included in the moisture supply due to very high solar radiation intensities which result in the rapid drying of the soil.

Moisture demand by the tree is expressed as the seasonal evapo-transpiration use expected under the climatic conditions prevailing on the site. Climatic conditions in turn are influenced by geographic location and topographic features of the site. These variables are considered in the computation of water use in inches.

The difference between moisture supply and moisture demand is the water balance. This water balance is an expression of the relative plant moisture stress experienced by the seedlings assuming there is no vegetative competition. The seedling survival rating is high if the calculated water balance is greater than 1.5 inches, Moderate if the water balance is between 0.8 and 1.5 inches, Low if between 0.3 and 0.8 inches, and Very Low if the calculated water balance is less than 0.3 inches. High is defined as having a good survival potential and will require none to minor mitigating measures. Moderate is defined as having a fair survival potential and may require some mitigating measures on high elevation soils or on sites with high evapotranspiration potentials. Low is defined as having a poor survival potential without mitigating measures. It will require considerable effort to change plant moisture stress and/or edaphic conditions to insure adequate survival. These soils have one or more severely limiting factors: Low AWC, high rock fragment content, limiting soil depth, southeast to west exposures or wind swept high elevation soils. Very Low is defined as having a very poor survival potential without mitigating measures. Numerous planting failures are likely. It will require many and expensive measures to modify the plant stress and edaphic conditions to insure adequate survival. These soils have a number of severely limiting factors which may include: shallow soils, very low AWC, very high rock fragment content, southeast to west exposures, or severe windswept high elevation soils.

Rating for Timber Site Preparation, Plantability, and Climatic Concerns. This rating was developed as a means of alerting foresters to some of the important soil physical factors and climatic considerations as related to soil type and soil map units capable of commercial timber production. Its intent is to help foresters in their decisions concerning types of equipment or methods for site preparation and planting.

There are three ratings: Good - means there are no serious soil or climatic concerns relating to the above decisions. Fair - means there are some serious soils and/or climatic concerns. Poor - means there are some very serious soil and/or climatic concerns related to the above decisions. The fair and poor ratings are qualified by one or more soil or climatic concern numerical modifiers. The good rating may have #11 as a climatic concern numerical modifier.

Following is a brief description of the numerical modifiers that follow the adjective ratings in the mapping unit descriptions:

- [1] Surface stones and boulders (greater than 10" diameter) and rock outcrop 8-15% of area.
- [2] Surface stones and boulders (greater than 10" diameter) and rock outcrop >15% of area.
- [3] 30-60% coarse fragments (greater than 3/4" diameter) in top 20 inches of soil.
- [4] 60+% coarse fragments (greater than 3/4" diameter) in top 20 inches of soil.
- [5] 4-20" pumice overburden (includes pumice sands and gravels, cinders, ash).
- [6] 20+ inches of pumice overburden (includes pumice sands and gravels).
- [7] 20-40" to a root-restricting layer.
- [8] 40-60% slope gradient (35-60% in some map units).
- [9] 60+% slope gradient.
- [10] Hot, dry summers and marginal to moderate precipitation (16-25" precipitation zone).
- [11] Hot, dry summers and marginal precipitation (16-20" precipitation zone) and normally on southeast to west aspects.
- [12] Reduced growing season and generally exposed, windy conditions (normally found at elevations of 7,000-8,000 feet).
- [13] Severely reduced growing season in cold, very windy conditions (normally above 8,000 feet elevation on the eastern edge of the survey area). These conditions normally restrict tree growth to less than 20 cubic feet per acre per year.

Estimated Engineering Properties. The estimated engineering properties rated in this soil survey are R-value and the Unified and AASHTO ratings.

R-Value. The R-value (resistance value) engineering test (5) was designed as a method of evaluating treated and untreated materials for use as base, subbase, and subgrade road material. The higher the R-value, the more structurally sound the material is and the more applications it has for road material. Each soil family

was rated as having either a 0-30, 30-60, or 60+ R-value by its particle size classification.

An R-value rating of 0-30 indicates low soil strength. Probable soil types in the Unified Soil Classification System would include clayey sands, clayey silts, sandy clay, silty clay and heavy clay. Its probable use in structural section would include imported borrow, selected material or basement soil.

An R-value rating of 30-60 indicates soils with moderate soil strength. Probable soil types in the Unified Soil Classification System would include silty sands, clayey sands, sandy silt, silt and clayey silt. Its probable use in structural section would include aggregate base, imported borrow, selected material and basement material.

An R-value rating of 60+ indicates soils with high soil strength. Probable soil types in the Unified Soil Classification System would include sand, clayey gravel, silty gravel, sandy gravel, gravel and crushed rock. Its probable use in structural section would include aggregate base, aggregate subbase and selected material.

Unified and AASHTO classification of the soils is determined according to the system adopted by the American Association of State Highway and Transportation Officials (1) and the Unified Soil Classification System (3).

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 and according to plasticity index, liquid limit, and organic matter content. Sandy and gravelly soils are identified as GW, GP, GM, GC, SW, SP, SM, and SC; silty and clayey soils as ML, CL, OL, MH, CH, and OH; and highly organic soils as PT. Soils exhibiting engineering properties of two groups can have a dual classification, for example, SP-SM.

The AASHTO system classifies soils according to those properties that affect roadway construction and maintenance. In this system, the fraction of a mineral soil that is less than 3 inches in diameter is classified in one of seven groups 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 (silt and clay). At the other extreme, soils in group A-7 are fine grained. Highly organic soils are classified in group A-8 on the basis of visual inspection. The A-1 and A-2 groups are further classified as A-1-a, A-1-b, A-2-4, A-2-5, A-2-6 and A-2-7.

101 AIKMAN FAMILY, 0 to 2 percent slopes

Map Unit Components	Aikman family (75 percent)
Position, Slope, and Elevation	On alluvial basins of basalt plateaus, (subject to spring flooding); 0 to 2 percent slopes; 4300 to 5800 feet.
Typical Vegetation and Precipitation (ppt)	Silver sagebrush, low sagebrush, sedges, forbes, grasses; 14 to 20 inches ppt.
Surface Layer	0 to 4 inches; dark gray and dark grayish brown silty clay, granular and platy structure; very hard, pH 6.6 to 7.0.
Substratum	4 to 60 inches; dark grayish brown and grayish brown silty clay, prismatic and blocky structure to massive, very hard to extremely hard, pH 7.0 to 7.4.
Rooting Depth (in.) to Underlying Material	40 plus; clayey alluvium
Erosion Factor (K)	.37
Max. Erosion Hazard	Moderate
Soil Permeability	Very slow
Drainage Class	Moderately well drained
Soil Manageability Class	2ew
Group	II
Forest Site Class	7 (non-commercial)
Range Site	24, 26
Water Runoff Potential	Very Slow
Watershed Sensitivity	6 (Moderate)
Hydrologic Soil Group	D
Available Water Capacity (AWC)	Moderate to High
Upper 20 inches	2.6 inches
Susceptibility to Burning Damage	Low
Slope Stability Hazard	Low
Allowable Soil Loss	5 tons/acre/year
Chance of Seedling Survival	Not Rated
Rating for Timber Site	Not Rated
R-Value	0-30
Soil horizons in inches, USDA, Unified, AASHTO	0-60; Silty clay Unified: CH AASHTO: A-7
Included Areas:	Included with this soil in mapping and making up about 25 percent of the acreage are the Barnard, Cardon, Packwood, Bieber, Dishner, Keating and Jackknife families.

102 AIKMAN-CARDON FAMILIES COMPLEX, 0 to 2 percent slopes

Map Unit Components	Aikman family (50 percent)	Cardon family (35 percent)
Position, Slope, and Elevation	On alluvial basins and flood plains (subject to spring flooding), 0 to 2 percent slopes; 4600 to 5500 feet.	On alluvial basins and flood plains (subject to spring flooding), 0 to 2 percent slopes; 4600 to 5500 feet.
Typical Vegetation and Precipitation (ppt)	Silver sagebrush, sedges, forbes, grasses; 14 TO 18 inches ppt.	Sedges, forbes, grasses, 14 to 18 inches ppt.
Surface Layer	0 to 4 inches; dark gray and dark grayish brown silty clay, granular and platy structure; very hard, pH 6.6 to 7.0.	0 to 4 inches; very dark gray clay, black, moist, platy and blocky structure, hard, pH 6.8.
Substratum	4 to 60 inches; dark grayish brown and grayish brown silty clay, prismatic and blocky structure to massive, very hard to extremely hard, pH 7.0 to 7.4.	4 to 36 inches; dark gray clay, very dark gray, moist, prismatic and angular blocky structure, extremely hard, ph 6.8: over 36 to 60 inches; mottled grayish brown, light brownish gray to olive yellow clay and clay loam, blocky structure, hard to very hard, pH 7.0 to 7.2.
Rooting Depth (in.) to Underlying Material	40 plus; clayey alluvium	40 plus; clayey alluvium
Erosion Factor (K)	.37	.37
Max. Erosion Hazard	Moderate	Moderate
Soil Permeability	Very slow	Very slow
Drainage Class	Moderately well drained	Somewhat poorly drained
Soil Manageability Class	2ew	3ew
Group	II	
Forest Site Class	7 (non-commercial)	7 (non-commercial)
Range Site	24, 26	26, 25
Water Runoff Potential	Very Slow	Very Slow
Watershed Sensitivity	6 (moderate)	6
Hydrologic Soil Group	D	D
Available Water Capacity (AWC)	Moderate to High	Moderate to High
Upper 20 inches	2.6 inches	2.6 inches
Susceptibility to Burning Damage	Low	Low
Slope Stability Hazard	Low	Low
Allowable Soil Loss	5 tons/acre/year	5 tons/acre/year
Rating for Timber Site	Not Rated	Not Rated
R-Value	0-30	0-30
Soil horizons in inches, USDA, Unified, AASHTO	0-60; Silty clay Unified: CH AASHTO: A-7	0-36; Clay Unified: CH AASHTO: A-7 36-46; Clay and clay loam Unified: CH, CL, MH AASHTO: A-6, A-7 46-60; Clay Unified: CH AASHTO: A-7
Included Areas:	Included with these soils in mapping and making up about 15 percent of the acreage are the Barnard, Bieber, Jackknife, and Deven families and unnamed aquolls and aquents.	

103 AIKMAN-BARNARD FAMILIES ASSOCIATION, 0 to 2 percent slopes

Map Unit Components	Aikman family (50 percent)	Barnard family (30 percent)
Position, Slope, and Elevation	On alluvial basins on basalt plateaus (subject to spring flooding), 0 to 2 percent slopes; 4400 to 6000 feet.	On outer edges of alluvial basins on basalt plateaus; 1 to 2 percent slopes; 4400 to 6000 feet.
Typical Vegetation and Precipitation (ppt)	Silver sagebrush, sedges, forbes, grasses; 12 to 16 inches ppt.	Big sagebrush, low sagebrush, forbes, cheatgrass, other grasses; 12 to 16 inches ppt.
Surface Layer	0 to 4 inches; dark gray and dark grayish brown silty clay, granular and platy structure; very hard, pH 6.6 to 7.0.	0 to 8 inches; grayish brown to dark grayish brown cobbly loam to gravelly clay loam, platy and blocky structure, slightly hard, pH 6.5 to 7.0.
Substratum	4 to 60 inches; dark grayish brown and grayish brown silty clay, prismatic and blocky structure to massive, very hard to extremely hard, pH 7.0 to 7.4.	32 plus inches; weakly to strongly cemented silica duripan.
Rooting Depth (in.) to Underlying Material	20 to 40 plus; clayey alluvium, basalt	20 to 40; silica duripan over basalt
Erosion Factor (K)	.37	.37
Max. Erosion Hazard	Moderate	Low
Soil Permeability	Very slow	Slow
Drainage Class	Moderately well drained	Well drained
Soil Manageability Class	2ew	1
Group	II	
Forest Site Class	7 (non-commercial)	7 (non-commercial)
Range Site	24, 26	18, 17
Water Runoff Potential	Very Slow	Slow
Watershed Sensitivity	6 (Moderate)	6
Hydrologic Soil Group	D	C
Available Water Capacity (AWC)	Low to High	Low to Moderate
Upper 20 inches	2.6 inches	2.6 inches
Susceptibility to Burning Damage	Low	Low
Slope Stability Hazard	Low	Low
Allowable Soil Loss	2-5 tons/acre/year	2 tons/acre/year
Rating for Timber Site	Not Rated	Not Rated
R-Value	0-30	0-30
Soil horizons in inches, USDA, Unified, AASHTO	0-60; Silty clay Unified: CH AASHTO: A-7	0-3; Cobbly loam Unified: ML-CL, CL AASHTO: A-4, A-6 3-8; Gravelly clay loam Unified: CL AASHTO: A-6, A-7 8-32; Gravelly silty clay Unified: CH AASHTO: A-7 32+; Silica duripan
Included Areas:	Included with these soils in mapping and making up about 20 percent of the acreage are the Bieber, Packwood, Puls, Deven and Cardon families, unnamed Xerofluvents and aquents.	

104 ALCOT FAMILY, 20 to 40 inch pumice overburden, 1 to 10 percent slopes

Map Unit Components	Alcot family, pumice overburden phase (65 percent)
Position, Slope, and Elevation	On undulating basalt plateaus covered with a moderately deep deposit of recent pyroclastic pumice; 1 to 10 percent slopes; 4400 to 4800 feet.
Typical Vegetation and Precipitation (ppt)	Ponderosa pine, Jeffrey pine, bitterbrush, rabbitbrush, big sagebrush, Ross's sedge, grasses; 20 to 25 inch ppt.
Surface Layer	1 to 0 inches; ponderosa pine needles and twigs, over 20 inches of pumice overburden consisting of grayish brown gravelly coarse loamy sand grading to a very pale brown extremely gravelly coarse sand. (Pumice thickness ranges from 20 to 40 inches) OVER 20 to 33 inches; light yellowish brown very gravelly sandy loam, subangular blocky structure, soft, pH 6.8.
Substratum	33 to 60 plus inches; brownish yellow and light yellowish brown very gravelly sandy loam and very gravelly loamy sand, massive, soft, pH 6.4.
Rooting Depth (in.) to Underlying Material	40 plus; cinders, basalt
Erosion Factor (K)	.15
Max. Erosion Hazard	Low
Soil Permeability	Rapid in the pumice overburden to moderately rapid below.
Drainage Class	Somewhat excessively drained
Soil Manageability Class	3P
Group	III
Forest Site Class	5 (3-4)
Range Site	Not placed in a range site.
Water Runoff Potential	Very slow
Watershed Sensitivity	9 (Low)
Hydrologic Soil Group	A
Available Water Capacity (AWC)	Moderate to high
Upper 20 inches	2.5 inches
Susceptibility to Burning Damage	High
Slope Stability Hazard	Low
Allowable Soil Loss	3 tons/acre/year
Rating for Timber Site	Fair (6)
R-Value	60+
Soil horizons in inches, USDA, Unified, AASHTO	0-6; Gravelly loamy coarse sand Unified: SW-SM, SM AASHTO: A-1-b 6-20; Extremely gravelly coarse sand Unified: GP, GW-GM AASHTO: A-1-a, A-1-b 20-53; Very gravelly sandy loam Unified: GM-GC AASHTO: A-2-4 53-60; Very gravelly loamy sand Unified: GM AASHTO: A-1-b, A-2-4
Included Areas:	Included with this soil in mapping and making up about 30 percent of the acreage are the Menzel family, unnamed cindery over loamy, mixed, and cindery over medial-skeletal, mesic soils. Alcot soils with deeper and shallower depths of pumice overburden, and rock outcrop.

105 ALCOT FAMILY, 40 to 60 inch pumice, 5 to 35 percent slopes

Map Unit Components	Alcot family, pumice phase (75 percent)
Position, Slope, and Elevation	On volcanic mountain sideslopes and toeslopes which have been covered with a deep deposit of recent pyroclastic pumice; 5 to 35 percent slopes; 4600 to 5500 feet.
Typical Vegetation and Precipitation (ppt)	Sparsely stocked Jeffrey pine, ponderosa pine, white fir, greenleaf manzanita, bitterbrush, rabbitbrush, squaw carpet, Columbia needlegrass, Ross's sedge, other grasses: 16 to 25 inches ppt.
Surface Layer	1 to 0 inches; ponderosa pine needles mixed with pumice gravels, over 0 to 4 inches; dark grayish brown very gravelly loamy sand (pumice), single grained, loose, pH 6.4.
Substratum	4 to 60 inches; light gray to white extremely gravelly coarse sand (pumice), single grained, loose, pH 6.6.
Rooting Depth (in.) to Underlying Material	40 plus; pumice, cinders, basalt
Erosion Factor (K)	.15
Max. Erosion Hazard	Low to moderate
Soil Permeability	Rapid
Drainage Class	Somewhat excessively drained
Soil Manageability Class	3eP
Group	III
Forest Site Class	6-7 (4 to non-commercial)
Range Site	Not placed in a range site.
Water Runoff Potential	Very Slow
Watershed Sensitivity	9 (Low)
Hydrologic Soil Group	A
Available Water Capacity (AWC)	Moderate to High
Upper 20 inches	2.5 inches
Susceptibility to Burning Damage	High
Slope Stability Hazard	Low
Allowable Soil Loss	3 tons/acre/year
Rating for Timber Site	Fair (6, 10)
R-Value	60+
Soil horizons in inches, USDA, Unified, AASHTO	0-4; Very gravelly loamy sand Unified: GM, SM AASHTO: A-1-b, A-2-4 4-60; Extremely gravelly sand Unified: GP, GW-GM AASHTO: A-1-a, A-1-b
Included Areas:	Included with this soil in mapping and making up about 25 percent of the acreage are Neer and Skalan families and unnamed cindery over medial, and cindery over medial-skeletal, mesic soils, Lithic Xerorthents, mesic, and rock outcrop.

106 ALCOT-NEER FAMILIES ASSOCIATION, 10 to 20 inch pumice overburden, 5 to 30 percent slopes

Map Unit Components	Alcot family, pumice overburden phase (50 percent)	Neer family (25 percent)
Position, Slope, and Elevation	On smooth sideslopes and concave areas of undulating volcanic mountain uplands; 5 to 20 percent slopes; 4400 to 5300 feet.	On upper sideslopes, ridges and knolls of volcanic mountain uplands; 10 to 30 percent slopes; 4400 to 5300 feet.
Typical Vegetation and Precipitation (ppt)	Ponderosa pine, Jeffrey pine, bitterbrush, big sagebrush, greenleaf manzanita, rabbitbrush, Ross's sedge, grasses; 16 to 25 inches ppt.	Ponderosa pine, Jeffrey pine, bitterbrush, big sagebrush, greenleaf manzanita, rabbitbrush, Ross's sedge, grasses; 16 to 25 inches ppt.
Surface Layer	1 to 0 inches; ponderosa pine needles and twigs, over 20 inches of pumice overburden consisting of grayish brown gravelly coarse loamy sand grading to very pale brown extremely gravelly coarse sand. (Pumice thickness ranges from 10 to 20 inches.) OVER 20 to 33 inches; light yellowish brown very gravelly sandy loam, subangular blocky structure, soft, pH 6.8.	1 to 0 inches of ponderosa pine needles and twigs, over 18 inches of pumice overburden consisting of 5 inches of grayish brown gravelly coarse loamy sand over 13 inches of very pale brown extremely gravelly coarse sand. (Pumice thickness ranges from 10 to 20 inches.) OVER 18 to 22 inches; yellowish brown very gravelly sandy loam, granular structure, slightly hard, pH 6.8.
Rooting Depth (in.) to Underlying Material	40 plus; cinders, basalt	40 plus; basalt, andesite
Erosion Factor (K)	.15	.15
Max. Erosion Hazard	Low to moderate	Low to moderate
Soil Permeability	Rapid in the pumice overburden to moderately rapid below.	Rapid in the pumice overburden to moderately rapid below.
Drainage Class	Somewhat excessively drained	Well Drained
Soil Manageability Class Group	2ep II	2ep
Forest Site Class	6 (4-5)	5 (3-4)
Range Site	Not placed in a range site.	Not placed in a range site.
Water Runoff Potential	Very slow	Very Slow
Watershed Sensitivity	9 (Low)	9
Hydrologic Soil Group	A	A
Available Water Capacity (AWC) Upper 20 inches	Moderate to high 2.5 inches	Moderate to High 2.5 inches
Susceptibility to Burning Damage	High	High
Slope Stability Hazard	Low	Low
Allowable Soil Loss	3 tons/acre/year	3 tons/acre/year
Rating for Timber Site	Fair (5,10)	Fair (5,10)
R-Value	60+	60+
Soil horizons in inches, USDA, Unified, AASHTO	0-6; Gravelly loamy coarse sand Unified: SW-SM, SM AASHTO: A-1-b 6-20; Extremely gravelly coarse sand Unified: GP, GW-GM AASHTO: A-1-a, A-1-b 20-53; Very gravelly sandy loam Unified: GM-GC AASHTO: A-2-4 53-60; Very gravelly loamy sand Unified: GM AASHTO: A-1-b, A-2-4	0-5; Gravelly loamy coarse sand Unified: SW-SM, SM AASHTO: A-1-b 5-18; Extremely gravelly coarse sand Unified: GP, GW-GM AASHTO: A-1-a, A-1-b 18-28; Very gravelly coarse sand and very cobbly sandy loam Unified: GM-GC AASHTO: A-2-4 28-60; Extremely cobbly coarse sandy loam Unified: GM, GW-GM AASHTO: A-1-b
Included Areas:	Included with these soils in mapping and making up about 25 percent of the acreage is the Menzel family, Lithic Xerorthents, mesic, rock outcrop, and Alcot soils with a deeper pumice overburden.	

107 ALCOT-SADIE FAMILIES COMPLEX, 1 to 20 percent slopes

Map Unit Components	Alcot family (45 percent)	Sadie family (35 percent)
Position, Slope, and Elevation	On undulating basalt plateaus and sideslopes of volcanic cinder cones; 1 to 20 percent slopes; 4400 to 5500 feet.	On undulating basalt plateaus and sideslopes of volcanic cinder cones; 1 to 20 percent slopes; 4400 to 5500 feet.
Typical Vegetation and Precipitation (ppt)	Mixed conifer forest of ponderosa pine, white fir, sugar pine, incense-cedar, plus greenleaf manzanita, snowberry, ceonothus, Ross's sedge, grasses; 20 to 30 inches ppt.	Mixed conifer forest of ponderosa pine, white fir, sugar pine, incense-cedar, plus greenleaf manzanita, snowberry, ceonothus Ross's sedge, grasses; 20 to 30 inches ppt.
Surface Layer	1 to 0 inches of white fir and ponderosa pine needles and twigs, over 0 to 9 inches; brown and yellowish brown gravelly to very gravelly light sandy loam, granular structure, soft, pH 6.6.	2 to 0 inches of ponderosa pine and white fir needles and twigs, over 0 to 5 inches; yellowish brown gravelly sandy loam, granular structure, soft, pH 7.0.
Substratum	9 to 60 inches; light yellowish brown very gravelly light sandy loam, weak subangular blocky and massive structure, soft, pH 6.4.	19 to 50 inches; brownish yellow gravelly coarse sandy loam, massive, pH 6.8.
Rooting Depth (in.) to Underlying Material	40 plus; volcanic ash, cinders, basalt	40 plus; volcanic ash, cinders, basalt
Erosion Factor (K)	.20	.20
Max. Erosion Hazard	Low to Moderate	Low to moderate
Soil Permeability	Moderately rapid	Moderately Rapid
Drainage Class	Somewhat excessively drained.	Well drained.
Soil Manageability Class Group	2e II	2e
Forest Site Class	3 (1-3)	3 (1-3)
Range Site	Not placed in a range site.	Not placed in a range site.
Water Runoff Potential	Very Slow	Very slow
Watershed Sensitivity	9 (Low)	9
Hydrologic Soil Group	A	B
Available Water Capacity (AWC) Upper 20 inches	Moderate to High 2.6 inches	Moderate to High 2.7 inches
Susceptibility to Burning Damage	Moderate	Moderate
Slope Stability Hazard	Low	Low
Allowable Soil Loss	3 tons/acre/year	3 tons/acre/year
Rating for Timber Site	Good	Good
R-Value	60+	60+
Soil horizons in inches, USDA, Unified, AASHTO	0-4; Gravelly sandy loam Unified: SM, SM-SC AASHTO: A-2-4, A-4 4-60; Very gravelly sandy loam Unified: GM, GM-GC AASHTO: A-2-4	0-5; Gravelly sandy loam Unified: SM, SM-SC AASHTO:A-2-4 5-50; Gravelly coarse sandy loam Unified: SM AASHTO: A-1-b 50+; Unweathered bedrock
Included Areas:	Included with these soils in mapping and making up about 20 percent of the acreage are the Zynbar, Germany and Elmore families, Lithic Xerumbrepts, mesic, rock outcrop, lava flow rock and unnamed soils similar to the Germany family but medial-sketetal.	

108 ALCOT-MENZEL FAMILIES COMPLEX, 10 to 20 inch pumice overburden, 1 to 10 percent slopes

Map Unit Components	Alcot family, pumice overburden phase (45 percent)	Menzel family, (40 percent)
Position, Slope, and Elevation	On nearly level to undulating basalt plateaus; 1 to 10 percent slopes; 4200 to 4600 feet.	On nearly level to undulating basalt plateaus; 1 to 10 percent slopes; 4200 to 4600 feet.
Typical Vegetation and Precipitation (ppt)	Ponderosa pine, bitterbrush, big sagebrush, rabbitbrush, Phlox spp., buckwheat, Ross's sedge, bottlebrush, needlegrass, cheatgrass; 16 to 20 inches ppt.	Ponderosa pine, bitterbrush, big sagebrush, rabbitbrush, Phlox spp., buckwheat, Ross's sedge bottlebrush, needlegrass, cheatgrass; 16 to 20 inches ppt.
Surface Layer	1 to 0 inches; ponderosa pine needles and twigs, over 20 inches of pumice overburden consisting of grayish brown gravelly coarse loamy sand grading to very pale brown extremely gravelly coarse sand (pumice thickness ranges from 10 to 20 inches) OVER 20 to 33 inches; light yellowish brown very gravelly sandy loam, subangular blocky structure, soft, pH 6.8	1/2 to 0 inches of ponderosa pine needles and pumice gravel pavement, over 14 inches of pumice overburden consisting of grayish brown gravelly coarse sand grading to very pale brown extremely gravelly coarse sand (pumice thickness ranges from 10 to 20 inches) OVER 14 to 18 inches; yellowish brown gravelly sandy loam, granular and blocky structure, soft, pH 6.8.
Rooting Depth (in.) to Underlying Material	40 plus; volcanic ash, cinders, basalt	40 plus; volcanic ash, cinders, basalt
Erosion Factor (K)	.15	.15
Max. Erosion Hazard	Low	Low
Soil Permeability	Rapid in the pumice overburden over moderately rapid below	Rapid in the pumice overburden over moderately rapid below
Drainage Class	Somewhat excessively drained SOIL MANAGEABILITY: CLASS: 2p GROUP: II	Well drained. SOIL MANAGEABILITY: CLASS: 2p
Forest Site Class	5 (3-4)	5 (3-4)
Range Site	Not placed in a range site.	Not placed in a range site.
Water Runoff Potential	Very Slow	Very Slow
Watershed Sensitivity	9 (Low)	9
Hydrologic Soil Group	A	A
Available Water Capacity (AWC)	Moderate to High	Moderate to High
Upper 20 inches	2.5 inches	2.5 inches
Susceptibility to Burning Damage	Moderate to High	Moderate to High
Slope Stability Hazard	Low	Low
Allowable Soil Loss	3 tons/acre/year	3 tons/acre/year
Rating for Timber Site	Fair (5,10)	Fair (5,10)
R-Value	60+	60+
Soil horizons in inches, USDA, Unified, AASHTO	0-6; Gravelly loamy coarse sand Unified: SW-SM, SM AASHTO: A-1-b 6-20; Extremely gravelly coarse sand Unified: GP, GW-GM AASHTO: A-1-a, A-1-b 20-53; Very gravelly sandy loam Unified: GM-GC AASHTO: A-2-4 53-60; Very gravelly loamy sand Unified: GM AASHTO: A-1-b, A-2-4	0-4; Gravelly coarse sand Unified: SP, SW-SM AASHTO: A-1-b 4-14; Extremely gravelly coarse sand Unified: GP, GW-GM AASHTO: A-1-a, A-1-b 14-44; Gravelly sandy loam Unified: SM, SM-SC AASHTO: A-2-4 44-60; Very gravelly sandy loam Unified: SM, SM-SC, GM-GC AASHTO: A-2-4
Included Areas:	Included with these soils in mapping and making up about 15 percent of the acreage are the Holland and Skalan families and rock outcrop.	

109 ALICEL FAMILY, 5 to 25 percent slopes

Map Unit Components	Alicel family (80 percent)
Position, Slope, and Elevation	On rolling foothills and alluvial fans; 5 to 25 percent slopes; 4200 to 5000 feet.
Typical Vegetation and Precipitation (ppt)	Few western juniper, big sagebrush, rabbitbrush, bitterbrush, Chrycopsis spp., cheatgrass, crested wheatgrass, Idaho fescue, bottlebrush, thurbers needlegrass, sandberg bluegrass; 10 to 14 inches ppt.
Surface Layer	0 to 38 inches; brown gravelly loam and loam, granular to massive structure, slightly hard, pH 6.4 to 7.0.
Substratum	38 to 45 inches; light yellowish brown gravelly fine sandy loam, massive, hard, pH 7.0.
Rooting Depth (in.) to Underlying Material	30 plus; basalt, andesite
Erosion Factor (K)	.32
Max. Erosion Hazard	Low to moderate
Soil Permeability	Moderate
Drainage Class	Well drained
Soil Manageability Class	2e
Group	II
Forest Site Class	7 (non-commercial)
Range Site	12
Water Runoff Potential	Slow
Watershed Sensitivity	8 (Low)
Hydrologic Soil Group	B
Available Water Capacity (AWC)	Moderate to High
Upper 20 inches	3.0 inches
Susceptibility to Burning Damage	Low
Slope Stability Hazard	Low
Allowable Soil Loss	3 tons/acre/year
Rating for Timber Site	No Rated
R-Value	30-60
Soil horizons in inches, USDA, Unified, AASHTO	0-38; Gravelly loam and loam Unified: ML-CL AASHTO: A-4 38-45; Gravelly fine sandy loam Unified: SM-SC, ML-CL AASHTO: A-2-4, A-4 45+; Unweathered bedrock
Included Areas:	Included with this soil in mapping and making up about 20 percent of the acreage are the Cowiche, Wrentham, Supan, Alcot and Stukel families, Lithic Xerorthents, mesic, and Rock outcrop.

110 ANATONE-BEARSKIN FAMILIES-ROCK OUTCROP ASSOCIATION, 40 to 70 percent slopes

Map Unit Components	Anatone family (35 percent)	Bearskin family (30 percent)	Rock outcrop (15 percent)
Position, Slope, and Elevation	Mainly on southerly aspects of upper sideslopes, ridges and knolls of mountain uplands; 40 to 70 percent slopes; 5500 to 7000 feet.	Mainly on southerly aspects of sideslopes of mountain uplands; 40 to 60 percent slopes; 5500 to 7000 feet.	On ridges, knolls and scarp breaks of mountain uplands; 40 to 70 percent slopes; 5500 to 7000 feet.
Typical Vegetation and Precipitation (ppt)	Western juniper, low sagebrush, rabbit- brush, mountain mahogany, Phlox spp., Idaho fescue, cheatgrass; 20 to 25 inches ppt.	Western juniper, few ponderosa pine and white fir, low sagebrush, big sagebrush rabbitbrush, mulesear, paintbrush, Idaho fescue, wheatgrass, cheatgrass; 20 to 25 inches ppt.	Mainly barren with few western juniper, and shrubs in fractures; 20 to 25 inches ppt.
Surface Layer	0 to 17 inches; brown cobbly loam to very cobbly loam, granular and blocky structure, slightly hard, pH 6.8 to 7.0.	0 to 8 inches; brown cobbly loam, platy and granular structure, soft to slightly hard, pH 6.8.	NOT APPLICABLE: Basalt, andesite or conglomerated tuff bedrock with minor accumulations of aeolian soil deposition in some fractures.
Rooting Depth (in.) to Underlying Material	8 to 20; andesite, basalt, tuff	10 to 20; basalt, andesite, tuff	
Erosion Factor (K)	.37	.37	
Max. Erosion Hazard	High to very high	High to very high	
Soil Permeability	Moderate	Moderately slow	
Drainage Class	Well drained	Well drained	
Soil Manageability Class Group	3Ed III	3Ed	
Forest Site Class	7 (non-commercial)	7 (non-commercial)	
Range Site	9, 1	9	
Water Runoff Potential	Very Rapid	Rapid	Very Rapid
Watershed Sensitivity	3 (very high)	3	0
Hydrologic Soil Group	D	D	
Available Water Capacity (AWC) Upper 20 inches	Very low to low 1.0 to 2.5 inches	Low 1.5 to 2.9 inches	
Susceptibility to Burning Damage	Moderate	Moderate	
Slope Stability Hazard	Low	Low	
Allowable Soil Loss	1 tons/acre/year	1 tons/acre/year	
Chance of Seedling Survival	Not Rated	Not Rated	
Rating for Timber Site	Not Rated	Not Rated	
R-Value	30-60	30-60	
Soil horizons in inches, USDA, Unified, AASHTO	0-8; Cobbly loam Unified: ML-CL, CL AASHTO: A-4, A-6 8-17; Very cobbly loam Unified: GM-GC, GC, ML-CL, CL AASHTO: A-2-4, A-2-6, A-4, A-6 17+ Unweathered bedrock	0-8; Cobbly loam Unified: ML-CL, CL AASHTO: A-4, A-6 8-18; Cobbly silty clay loam Unified: CL, MH AASHTO: A-6 18+; Weathered bedrock	
Included Areas:	Included with this unit in mapping and making up about 20 percent of the acreage are Smarts, DeMasters, Ginser, Manila, Merlin, Ruckles, Lamondi, Bertag, Wapal, Mascamp families, Lithic Xerorthents, frigid, and rubbleland.		

111 ANATONE-BEARSKIN-SMARTS FAMILIES ASSOCIATION, 2 to 20 percent slopes

Map Unit Components	Anatone family (35 percent)	Bearskin family (25 percent)	Smarts family (20 percent)
Position, Slope, and Elevation	Mainly on southerly aspects of upper sideslopes, ridges and knolls of mountain uplands; 2 to 20 percent slopes; 5500 to 7000 feet.	Mainly on southerly aspects of sideslopes of Mountain uplands; 2 to 20 percent slopes; 5500 to 7000 feet.	Mainly on southerly aspects and in draws and concave lower sideslopes of mountain uplands; 2 to 20 percent slopes; 5500 to 7000 feet.
Typical Vegetation and Precipitation (ppt)	Western juniper, low sagebrush, rabbitbrush, mountain mahogany, Phlox spp., Idaho fescue, cheatgrass; 20 to 25 inches ppt.	Western juniper, few ponderosa pine and white fir, low sagebrush, big sagebrush, rabbitbrush mulesear, vetch, paintbrush, Idaho fescue, wheatgrass, cheatgrass; 20 to 25 inches ppt.	
Surface Layer	0 to 17 inches; brown cobbly loam to very cobbly loam, granular and blocky structure, slightly hard, pH 6.8 to 7.0.	0 to 8 inches; brown cobbly loam, platy and granular structure, soft to slightly hard, pH 6.8.	1/2 to 0 inches; ponderosa pine and white fir needles and twigs, over 0 to 20 inches; reddish brown stony loam and very cobbly loam, granular and blocky structure, slightly hard to hard, pH 6.6 to 6.8.
Rooting Depth (in.) to Underlying Material	8 to 20; andesite, basalt, tuff	10 to 20; basalt, tuff	20 to 40; basalt, tuff
Erosion Factor (K)	.37	.37	.32
Max. Erosion Hazard	Moderate	Moderate	Low to moderate
Soil Permeability	Moderate	Moderately slow	Moderately slow
Drainage Class	Well drained	Well drained	Well drained
Soil Manageability Class Group	2ed II	2ed	2ep
Forest Site Class	7 (non-commercial)	7 (non-commercial)	5-6 (3-5)
Range Site	9,1	9	Not placed in a range site.
Water Runoff Potential	Moderate	Moderate	Slow
Watershed Sensitivity	5 (Moderate)	6	7
Hydrologic Soil Group	D	D	B
Available Water Capacity (AWC)	Very Low to Low	Low	Low to Moderate
Upper 20 inches	1.0 to 2.5 inches	1.5 to 2.9 inches	2.1 inches
Susceptibility to Burning Damage	Low	Low	Moderate
Slope Stability Hazard	Low	Low	Low
Allowable Soil Loss	1 tons/acre/year	1 tons/acre/year	2 tons/acre/year
Rating for Timber Site	Not Rated	Not Rated	Poor (2,3,7)
R-Value	30-60	30-60	30-60

111 ANATONE-BEARSKIN-SMARTS FAMILIES ASSOCIATION (continued)

Soil horizons in inches, USDA, Unified, AASHTO

0-8; Cobble loam Unified: ML-CL, CL AASHTO: A-4, A-6	0-8; Cobble loam Unified: ML-CL, CL AASHTO: A-4, A-6	0-14; Stony loam Unified: ML-CL, ML AASHTO: A-4, A-6
8-17; Very cobbly loam Unified: GM-GC, GC, ML-CL, CL AASHTO: A-2-4, A-2-6, A-4, A-6	8-18; Cobble silty clay loam Unified: CL, MH AASHTO: A-6	14-28; Very cobbly loam, very gravelly loam Unified: GM-GC, GC, ML-CL, CL AASHTO: A-2-4, A-2-6, A-4, A-6
17+; Unweathered bedrock	18+; Weathered bedrock	28-35; Extremely gravelly clay loam Unified: GC AASHTO: A-2-6
		35+; Weathered bedrock

Included Areas:

Included with these soils in mapping and making up about 20 percent of the acreage are the DeMasters, Lamondi, Manila, Merlin, Bertag, Wapal, Mascamp families and Lithic Xerorthents, frigid, and Smarts family, deep.

112 ANATONE-BEARSKIN-SMARTS FAMILIES ASSOCIATION, 20 to 40 percent slopes

Map Unit Components	Anatone family (35 percent)	Bearskin family (30 percent)	Smarts family (15 percent)
Position, Slope, and Elevation	Mainly on southerly aspects of upper sideslopes, ridges and knolls of mountain uplands 20 to 40 percent slopes; 5500 to 7000 feet.	Mainly on southerly aspects of sideslopes of mountain uplands; 20 to 40 percent slopes; 5500 to 7000 feet.	Mainly on southerly aspects and in draws and concave lower sideslopes of mountain uplands; 20 to 40 percent slopes; 5500 to 7000 feet.
Typical Vegetation and Precipitation (ppt)	Western juniper, low sagebrush, rabbitbrush, mountain mahogany, Phlox spp., Idaho fescue, cheatgrass; 20 to 25 inches ppt.	Western juniper, few ponderosa pine and white fir, low sagebrush, big sagebrush, rabbitbrush, mulesear, vetch, paintbrush, Idaho fescue, wheatgrass, cheatgrass; 20 to 25 inches ppt.	
Surface Layer	0 to 17 inches; brown cobbly loam to very cobbly loam, granular and blocky structure, slightly hard, pH 6.8 to 7.0.	0 to 8 inches; brown cobbly loam, platy and granular structure, soft to slightly hard, pH 6.8.	1/2 to 0 inches; ponderosa pine and white fir needles and twigs, over 0 to 20 inches; reddish brown stony loam and very cobbly loam, granular and blocky structure, slightly hard and hard, pH 6.6 to 6.8.
Rooting Depth (in.) to Underlying Material	8 to 20; andesite, basalt, tuff	10 to 20; basalt, tuff	20 to 40; basalt, tuff
Erosion Factor (K)	.37	.37	.32
Max. Erosion Hazard	Moderate to high	Moderate to high	Moderate
Soil Permeability	Moderate	Moderately slow	Moderately slow
Drainage Class	Well drained	Well drained	Well drained
Soil Manageability Class Group	3Ed III	3Ed	2Ep
Forest Site Class	7 (non-commercial)	7 (non-commercial)	5-6 (3-5)
Range Site	9,1	9	Not placed in a range site.
Water Runoff Potential	Rapid	Rapid	Slow
Watershed Sensitivity	4 (Moderate)	5	7
Hydrologic Soil Group	D	D	B
Available Water Capacity (AWC)	Very Low to Low	Low	Low to Moderate
Upper 20 inches	1.0 to 2.5 inches	1.5 to 2.9 inches	2.1 inches
Susceptibility to Burning Damage	Moderate	Moderate	Moderate
Slope Stability Hazard	Low	Low	Low
Allowable Soil Loss	1 tons/acre/year	1 tons/acre/year	2 tons/acre/year
Chance of Seedling Survival	Not Rated	Not Rated	Low
Rating for Timber Site	Not Rated	Not Rated	Poor (2,3,7)
R-Value	30-60	30-60	30-60

112 ANATONE-BEARSKIN-SMARTS FAMILIES ASSOCIATION (continued)

Soil horizons in
inches, USDA,
Unified, AASHTO

0-8; Cobbly loam Unified: ML-CL, CL AASHTO: A-4, A-6	0-8; Cobbly loam Unified: ML-CL, CL AASHTO: A-4, A-6	0-14; Stony loam Unified: ML-CL, ML AASHTO: A-4, A-6
8-17; Very cobbly loam Unified: GM-GC, GC, ML-CL, CL AASHTO: A-2-4, A-2-6, A-4, A-6	8-18; Cobbly silty clay loam Unified: CL, MH AASHTO: A-6	14-28; Very cobbly loam, very gravelly loam Unified: GM-GC, GC, ML-CL, CL AASHTO: A-2-4, A-2-6, A-4, A-6
17+; Unweathered bedrock	18+; Weathered bedrock	28-35; Extremely gravelly clay loam Unified: GC AASHTO: A-2-6
		35+; Weathered bedrock

Included Areas:

Included with these soils in mapping and making up about 20 percent of the acreage are the DeMasters, Lamondi, Manila, Merlin, Ruckles, Bertag, Wapal, Mascamp families, Lithic Xerorthents, frigid, and Smarts family, deep.

113 ANATONE-MERLIN FAMILIES - ROCK OUTCROP ASSOCIATION, 40 to 90 percent slopes

Map Unit Components	Anatone family (35 percent)	Merlin family (30 percent)	Rock outcrop (20 percent)
Position, Slope, and Elevation	On ridges, knolls and sideslopes of mountain uplands; 40 to 90 percent slopes; 5500 to 7200 feet.	On sideslopes and slight concave areas of mountain uplands; 40 to 70 percent slopes; 5500 to 7200 feet.	On ridges, knolls and deeply incised drainages of mountain uplands; 40 to 90 percent slopes; 5500 to 7200 feet.
Typical Vegetation and Precipitation (ppt)	Few western juniper, few white fir, low sagebrush, mountain mahogany, Phlox spp., Idaho fescue, cheatgrass, other grasses; 20 to 30 inches ppt.	Few western juniper, few white fir and ponderosa pine, low sagebrush, big sagebrush, mountain mahogany, Idaho fescue, Poa spp., other grasses; 20 to 30 inches ppt.	
Surface Layer	0 to 17 inches; brown cobbly loam to very cobbly loam, granular and blocky structure, slightly hard, pH 6.8 to 7.0.	0 to 2 inches; grayish brown very cobbly clay loam, granular structure, slightly hard, pH 6.4.	NOT APPLICABLE: Basalt, andesite or conglomerated tuff bedrock with minor accumulations of aeolian soil deposition in some fractures.
Rooting Depth (in.) to Underlying Material	8 to 20; andesite, tuff	10 to 20; tuff	
Erosion Factor (K)	.37	.32	
Max. Erosion Hazard	High to very high	High to very high	
Soil Permeability	Moderate	Slow	
Drainage Class	Well drained	Well drained	
Soil Manageability Class	4Gd	4Sd	
Group	IV		
Forest Site Class	7 (non-commercial)	7 (non-commercial)	
Range Site	9,1	9	
Water Runoff Potential	Very Rapid	Very Rapid	Very Rapid
Watershed Sensitivity	2 (Very High)	1	0
Hydrologic Soil Group	D	D	
Available Water Capacity (AWC)	Very Low to Low	Very Low to Low	
Upper 20 inches	1.0 to 2.5 inches	1.1 to 2.3 inches	
Susceptibility to Burning Damage	Moderate	Moderate	
Slope Stability Hazard	Low to Moderate	High	
Allowable Soil Loss	1 tons/acre/year	1 tons/acre/year	
Rating for Timber Site	Not Rated	Not Rated	
R-Value	30-60	0-30	
Soil horizons in inches, USDA, Unified, AASHTO	0-8; Cobbly Loam Unified: ML-CL, CL AASHTO: A-4, A-6 8-17; Very cobbly loam Unified: GM-GC, GC, ML-CL, CL AASHTO: A-2-4, A-2-6, A-4, A-6 17+; Unweathered bedrock	0-2; Very cobbly clay loam Unified: GC, CL, CH AASHTO: A-6, A-7 2-12; Gravelly clay Unified: CH AASHTO: A-7 12+; Unweathered bedrock	
Included Areas:	Included with this unit in mapping and making up about 15 percent of the acreage are the Mascamp, Ruckles, Bertag, Cavanaugh and Smarts families, Lithic Xerorthents, frigid, and rubbleland.		

114 ANATONE-PATIO FAMILIES-RUBBLELAND ASSOCIATION, 60 to 90 percent slopes

Map Unit Components	Anatone family (40 percent)	Patio family, (25 percent)	Rubbleland, (20 percent)
Position, Slope, and Elevation	Mainly on southerly aspects of upper sideslopes, ridges, and knolls of mountain uplands; 60 to 90 percent slopes; 5500 to 6600 feet.	Mainly on northerly aspects of mountain uplands; 60 to 80 percent slopes; 5500 to 6600 feet.	On deeply incised drainages and sideslopes of mountain uplands; 70 to 90 percent slopes; 5500 to 6600 feet.
Typical Vegetation and Precipitation (ppt)	Western juniper, low sagebrush, mountain mahogany, big sagebrush, rabbitbrush, western yarrow, Idaho fescue, other grasses; 20 to 25 inches ppt.	White fir forest, or mixed conifer forest of white fir and ponderosa pine, plus squaw carpet, serviceberry, forbes, Ross's sedge, few grasses; 20 to 25 inches ppt.	
Surface Layer	0 to 17 inches; brown cobbly loam to very cobbly loam, granular and blocky structure, slightly hard, pH 6.8 to 7.0.	0 to 19 inches; dark grayish brown to brown very gravelly loam, granular and blocky structure, soft, pH 6.8.	NOT APPLICABLE: Colluvial deposition of angular cobbles, stones and boulders of basalt or andesite rock material.
Rooting Depth (in.) to Underlying Material	8 to 20; andesite	20 to 40; andesite	
Erosion Factor (K)	.37	.28	
Max. Erosion Hazard	Very high	Very high	
Soil Permeability	Moderate	Moderate	
Drainage Class	Well drained	Well drained	
Soil Manageability Class	4Gd	4Gp	
Group	IV		
Forest Site Class	7 (non-commercial)	5-6 (4-5)	
Range Site	9,1	Not placed in a range site.	
Water Runoff Potential	Very Rapid	Rapid	Very Rapid
Watershed Sensitivity	2 (High)	4	2
Hydrologic Soil Group	D	B	
Available Water Capacity (AWC)	Very Low to Low	Low to Moderate	
Upper 20 inches	1.0 to 2.5 inches	2.3 inches	
Susceptibility to Burning Damage	Moderate	High	
Slope Stability Hazard	Moderate	Moderate	
Allowable Soil Loss	1 tons/acre/year	2 tons/acre/year	
Rating for Timber Site	Not Rated	Poor (7,9)	
R-Value	30-60	30-60	
Soil horizons in inches, USDA, Unified, AASHTO	0-8; Cobbly loam Unified: ML-CL, CL AASHTO: A-4, A-6 8-17; Very cobbly loam Unified: GM-GC, GC, ML-CL, CL AASHTO: A-2-4, A-2-6, A-4, A-6 17+; Unweathered bedrock	0-28; Very gravelly loam Unified: GM, GM-GC AASHTO: A-2-4 28+; Unweathered bedrock	
Included Areas:	Included with this unit in mapping and making up about 15 percent of the acreage are the Mascamp, Wapal, Smarts and Cavanaugh families, Lithic Xerorthents, frigid, and Rock outcrop.		

115 ANATONE-SMARTS FAMILIES ASSOCIATION, 5 to 20 percent slopes

Map Unit Components	Anatone family (45 percent)	Smarts family (30 percent)
Position, Slope, and Elevation	On upper sideslopes, ridges and knolls of mountain uplands; 5 to 20 percent slopes; 5500 to 7500 feet.	On sideslopes and toeslopes of mountain uplands; 5 to 20 percent slopes; 5500 to 7500 feet.
Typical Vegetation and Precipitation (ppt)	Western juniper, few scattered ponderosa pine and white fir, mountain mahogany, big sagebrush, low sagebrush, mulesear, Carex spp., grasses; 20 to 30 inches ppt.	White fir forest, or mixed conifer forest of white fir, ponderosa pine, incense-cedar, western juniper, plus mountain mahogany, big sagebrush, snowberry, greenleaf manzanita, Ross's sedge, few grasses; 20 to 30 inches ppt.
Surface Layer	0 to 17 inches; brown cobbly loam to very cobbly loam, granular and subangular blocky structure, slightly hard, pH 7.0 to 6.8.	1/2 to 0 inches of ponderosa pine and white fir needles and twigs, over 0 to 20 inches; reddish brown stony loam and very cobbly loam, granular and blocky structure, slightly hard to hard, pH 6.6 to 6.8.
Rooting Depth (in.) to Underlying Material	10 to 20; basalt, andesite, conglomerated tuff	20 to 40; andesite, soft to hard basalt
Erosion Factor (K)	.37	.32
Max. Erosion Hazard	Moderate	Low to moderate
Soil Permeability	Moderate	Moderately slow
Drainage Class	Well drained	Well drained
Soil Manageability Class Group	2edx II	2epx
Forest Site Class	7 (non-commercial)	5-6 (3-5)
Range Site	9	Not placed in a range site.
Water Runoff Potential	Moderate	Slow
Watershed Sensitivity	5 (Moderate)	7
Hydrologic Soil Group	D	B
Available Water Capacity (AWC) Upper 20 inches	Very Low to Low 1.2 to 2.5 inches	Low to Moderate 2.1 inches
Susceptibility to Burning Damage	Low	Moderate
Slope Stability Hazard	Low	Low
Allowable Soil Loss	1 tons/acre/year	2 tons/acre/year
Rating for Timber Site	Not Rated	Poor (2,3,7)
R-Value	30-60	30-60
Soil horizons in inches, USDA, Unified, AASHTO	0-8; Cobbly loam Unified: ML-CL, CL AASHTO: A-4, A-6 8-17; Very cobbly loam Unified: GM-GC, GC, ML-CL, CL AASHTO: A-2-4, A-2-6, A-4, A-6 17+; Unweathered bedrock	0-14; Stony loam Unified: ML-CL, ML AASHTO: A-4, A-6 14-28; Very cobbly loam, very gravelly loam Unified: GM-GC, GC, ML-CL, CL AASHTO: A-2-4, A-2-6, A-4, A-6 28-35; Extremely gravelly clay loam Unified: GC AASHTO: A-2-6 35+; Weathered bedrock
Included Areas:	Included with these soils in mapping and making up about 25 percent of the acreage are the Bearskin, Mascamp, Lamondi, Smarts, deep, and DeMasters families, rock outcrop, and Lithic Xerorthents, frigid.	

116 ANATONE-SMARTS FAMILIES ASSOCIATION, 20 to 40 percent slopes

Map Unit Components	Anatone family (45 percent)	Smarts family (30 percent)
Position, Slope, and Elevation	On sideslopes, ridges and knolls of mountain uplands; 20 to 40 percent slopes; 5500 to 7500 feet.	Generally on northerly aspects of sideslopes of mountain uplands; 20 to 40 percent slopes; 5500 to 7500 feet.
Typical Vegetation and Precipitation (ppt)	Western juniper, few scattered ponderosa pine and white fir, mountain mahogany, big sagebrush, low sagebrush, mulesear, carex spp., grasses; 20 to 30 inches ppt.	White fir forest or mixed conifer forest of white fir, ponderosa pine, incense-cedar, western juniper, plus mountain mahogany, big sagebrush, snowberry, greenleaf manzanita, Ross's sedge, few grasses; 20 to 30 inches ppt.
Surface Layer	0 to 17 inches; brown cobbly loam to very cobbly loam, granular and subangular blocky structure, slightly hard, pH 7.0 to 6.8.	1/2 to 0 inches of ponderosa pine and white fir needles and twigs, over 0 to 20 inches; reddish brown stony loam and very cobbly loam, granular and blocky structure, slightly hard and hard, pH 6.6 to 6.8.
Rooting Depth (in.) to Underlying Material	10 to 20; basalt, andesite, conglomerated tuff	20 to 40; andesite and soft to hard basalt
Erosion Factor (K)	.37	.32
Max. Erosion Hazard	Moderate to high	Moderate
Soil Permeability	Moderate	Moderately slow
Drainage Class	Well drained	Well drained
Soil Manageability Class Group	3Edx III	2epx
Forest Site Class	7 (non-commercial)	5-6 (3-5)
Range Site	9	Not placed in a range site
Water Runoff Potential	Rapid	Slow
Watershed Sensitivity	4 (Moderate)	7
Hydrologic Soil Group	D	B
Available Water Capacity (AWC) Upper 20 inches	Very Low to Low 1.2 to 2.5 inches	Low to Moderate 2.1 inches
Susceptibility to Burning Damage	Moderate	Moderate
Slope Stability Hazard	Low	Low
Allowable Soil Loss	1 tons/acre/year	2 tons/acre/year
Chance of Seedling Survival	Not Rated	Low
Rating for Timber Site	Not Rated	Poor (2, 3, 7)
R-Value	30-60	30-60
Soil horizons in inches, USDA, Unified, AASHTO	0-8; Cobbly loam Unified: ML-CL, CL AASHTO: A-2-4, A-2-6 8-17; Very cobbly loam Unified: GM-GC, GC, ML-CL, CL AASHTO: A-2-4, A-2-6, A-4, A-6 17+; Unweathered bedrock	0-14; Stony loam Unified: ML-CL, ML AASHTO: A-4, A-6 14-28; Very cobbly loam, very gravelly loam Unified: GM-GC, GC, ML-CL, CL AASHTO: A-2-4, A-2-6, A-4, A-6 28-35; Extremely gravelly clay loam Unified: GC AASHTO: A-2-6 35+; Weathered bedrock
Included Areas:	Included with these soils in mapping and making up about 25 percent of the acreage are the Mascamp, Bearskin, Lamondi, Smarts, deep, and DeMasters families, Lithic Xerorthents, frigid and rock outcrop.	

117 ANATONE-SMARTS FAMILIES-ROCK OUTCROP ASSOCIATION, 40 to 70 percent slopes

Map Unit Components	Anatone family (45 percent)	Smarts family (25 percent)	Rock outcrop (15 percent)
Position, Slope, and Elevation	On upper sideslopes, ridges and knolls of mountain uplands; 40 to 70 percent slopes; 5500 to 7500 feet.	Generally on northerly aspects of sideslopes of mountain uplands; 40 to 60 percent slopes; 5500 to 7500 feet.	Steep scarps and ridge tops of mountain uplands; 50 to 70 percent slopes; 5500 to 7500 feet.
Typical Vegetation and Precipitation (ppt)	Western juniper, few scattered ponderosa pine and white fir, mountain mahogany, low sagebrush, big sagebrush, mulesear, Carex spp., grasses; 20 to 30 inches ppt.	White fir forest, or mixed conifer forest of white fir, ponderosa pine, incense-cedar, western juniper, plus mountain mahogany, snowberry, greenleaf manzanita, Ross's sedge, few grasses; 20 to 30 inches ppt.	
Surface Layer	0 to 17 inches; brown cobbly loam to very cobbly loam, granular and subangular blocky structure, slightly hard, pH 7.0 to 6.8.	1/2 to 0 inches; ponderosa pine and white fir needles and twigs, over 0 to 20 inches; reddish brown stony loam and very cobbly loam, granular and blocky structure, slightly hard and hard, pH 6.6 to 6.8.	NOT APPLICABLE: Basalt, andesite or conglomerated tuff bedrock with minor accumulations of aeolian soil deposition in some fractures.
Rooting Depth (in.) to Underlying Material	10 to 20; basalt, andesite, conglomerated tuff	20 to 40; andesite, soft to hard basalt	
Erosion Factor (K)	.37	.32	
Max. Erosion Hazard	High to very high	High	
Soil Permeability	Moderate	Moderately slow	
Drainage Class	Well drained	Well drained	
Soil Manageability Class Group	3Edx III	3Epx	
Forest Site Class	7 (non-commercial)	5-6 (3-5)	
Range Site	9	Not placed in a range site.	
Water Runoff Potential	Very Rapid	Moderate	Very Rapid
Watershed Sensitivity	3 (High)	6	0
Hydrologic Soil Group	D	B	
Available Water Capacity (AWC) Upper 20 inches	Very Low to Low 1.2 to 2.5 inches	Low to Moderate 2.1 inches	
Susceptibility to Burning Damage	Moderate	Moderate to High	
Slope Stability Hazard	Low	Low	
Allowable Soil Loss	1 tons/acre/year	2 tons/acre/year	
Chance of Seedling Survival	Not Rated	Low	
Rating for Timber Site	Not Rated	Poor (2,3,7,8)	
R-Value	30-60	30-60	

117 ANATONE-SMARTS FAMILIES-ROCK OUTCROP ASSOCIATION (continued)

Soil horizons in
inches, USDA,
Unified, AASHTO

- | | |
|--|--|
| <p>0-8; Cobble loam
Unified: ML-CL, CL
AASHTO: A-4, A-6</p> <p>8-17; Very cobbly loam
Unified: GM-GC,
GC, ML-CL, CL
AASHTO: A-2-4,
A-2-6, A-4, A-6</p> <p>17+; Unweathered bedrock</p> | <p>0-14; Stony loam
Unified: ML-CL, ML
AASHTO: A-4, A-6</p> <p>14-28; Very cobbly loam, very
gravelly loam
Unified: GM-GC, GC,
ML-CL, CL
AASHTO: A-2-4, A-2-6,
A-4, A-6</p> <p>28-35; Extremely gravelly clay
loam
Unified: GC
AASHTO: A-2-6</p> <p>35+; Weathered bedrock</p> |
|--|--|

Included Areas:

Included with this unit in mapping and making up about 15 percent of the acreage are the Bearskin, Mascamp, Lamondi, Smarts, deep, and DeMasters families, Lithic Xerorthents, frigid, and rubbleland.

**118 BAKEOVEN FAMILY-LAVA FLOW-LITHIC XERORTHERTS, MESIC ASSOCIATION,
1 to 15 percent slopes**

Map Unit Components	Bakeoven family (40 percent)	Lava flow (25 percent)	Lithic Xerorthents, mesic (20 percent)
Position, Slope, and Elevation	On nearly level to undulating basalt plateaus; 1 to 10 percent slopes; 4200 to 4800 feet.	Hummocky disaggregated lava flow rock and collapsed lava tubes with slope lengths of 10 to 40 feet; 5 to 15 percent slopes; 4200 to 4800 feet.	On nearly level to undulating basalt plateaus; 1 to 10 percent slopes; 4200 to 4800 feet.
Typical Vegetation and Precipitation (ppt)	Western juniper, big sagebrush, low sagebrush, desert mahogany, rabbitbrush, chrysopsis spp., sandberg bluegrass, bottlebrush, Idaho fescue, cheatgrass; 10 to 14 inches ppt.	Barren; 10 to 14 inches ppt.	
Surface Layer	0 to 11 inches; dark grayish brown and grayish brown very cobbly fine sandy loam, subangular blocky structure; slightly hard, pH 6.6.	NOT APPLICABLE: Fractured vesicular, basalt flow rock with minor accumulations of aeolian soil deposition in some fractures.	0 to 5 inches; brown and yellowish brown very cobbly loam and gravelly loam; platy and granular structure; slightly hard; pH 6.6 to 6.8.
Rooting Depth (in.) to Underlying Material	10 to 20; fractured basalt		4 to 10; fractured basalt
Erosion Factor (K)	.24		Variable
Max. Erosion Hazard	Moderate		Moderate
Soil Permeability	Moderately rapid		Moderate
Drainage Class	Well drained		Somewhat excessively drained
Soil Manageability Class Group	2edx III	3eDx	
Forest Site Class	7 (non-commercial)		7 (non-commercial)
Range Site	7		1
Water Runoff Potential	Slow	Rapid	Moderate
Watershed Sensitivity	7 (Moderate)	4	5
Hydrologic Soil Group	D		D
Available Water Capacity (AWC)	Very Low to Low		Very Low
Upper 20 inches	1.0 to 1.9 inches		0.6 to 1.5 inches
Susceptibility to Burning Damage	Low		Low
Slope Stability Hazard	Low		Low
Allowable Soil Loss	1 tons/acre/year		1 tons/acre/year
Chance of Seedling Survival	Not Rated		Not Rated
Rating for Timber Site	Not Rated		Not Rated
R-Value	30-60		Not Rated
Soil horizons in inches, USDA, Unified, AASHTO	0-11; Very cobbly fine sandy loam Unified: SM, SM-SC AASHTO: A-4 11+; Unweathered bedrock		0-5; Variable Unified: Not Rated AASHTO: Not Rated 5+; Unweathered bedrock
Included Areas:	Included with this unit in mapping and making up about 15 percent of the acreage are the Castlevale, Pass Canyon, Dishner, Searles, Sheld, Wenatchee, Gwin and Stukel families and Lava flow rock with steeper slopes.		

120 BAKEOVEN FAMILY-ROCK OUTCROP ASSOCIATION, 20 to 60 percent slopes

Map Unit Components	Bakeoven family (45 percent)	Rock outcrop (35 percent)
Position, Slope, and Elevation	On sideslopes and toeslopes of mountain uplands and basalt plateau breaks; 20 to 50 percent slopes; 4200 to 5000 feet.	On upper slopes, ridges and knolls of mountain uplands and basalt plateau breaks; 40 to 60 percent slopes; 4200 to 5000 feet.
Typical Vegetation and Precipitation (ppt)	Western juniper, big sagebrush, bitterbrush, low sagebrush, rabbitbrush, Ribes spp., bottlebrush, Idaho fescue, wheatgrass, other grasses; 10 to 14 inches ppt.	Barren; 10 to 14 inches ppt.
Surface Layer	0 to 11 inches; dark grayish brown to grayish brown very cobbly fine sandy loam, subangular blocky structure; slightly hard, pH 6.6.	NOT APPLICABLE: Basalt andesite or conglomerated tuff bedrock with minor accumulations of aeolian soil deposition in some fractures.
Rooting Depth (in.) to Underlying Material	8 to 20; basalt colluvium	
Erosion Factor (K)	.24	
Max. Erosion Hazard	Moderate to high	
Soil Permeability	Moderately rapid	
Drainage Class	Well drained	
Soil Manageability Class	3EPx	
Group	III	
Forest Site Class	7 (non-commercial)	
Range Site	7, 1	
Water Runoff Potential	Moderate	Very Rapid
Watershed Sensitivity	6 (High)	2
Hydrologic Soil Group	D	
Available Water Capacity (AWC)	Very Low to Low	
Upper 20 inches	0.8 to 1.9 inches	
Susceptibility to Burning Damage	Low	
Slope Stability Hazard	Low	
Allowable Soil Loss	1 tons/acre/year	
Chance of Seedling Survival	Not Rated	
Rating for Timber Site	Not Rated	
R-Value	30-60	
Soil horizons in inches, USDA, Unified, AASHTO	0-11; Very cobbly fine sandy loam Unified: SM, SM-SC AASHTO: A-4	
	11+; Unweathered bedrock	
Included Areas:	Included with this unit in mapping and making up about 20 percent of the acreage are the Searles, Wenatchee, Stukel, Ginser and Castlevale families and Lithic Xerorthents, mesic, and rubbleland.	

**121 BAKEOVEN FAMILY-ROCK OUTCROP-WENATCHEE FAMILY ASSOCIATION,
1 to 20 percent slopes**

Map Unit Components	Bakeoven family (40 percent)	Rock outcrop (25 percent)	Wenatchee family (20 percent)
Position, Slope, and Elevation	On sideslopes of basalt plateau breaks 1 to 20 percent slopes; 4200 to 5000 feet.	On ridges and knolls of basalt plateau breaks; 10 to 20 percent slopes; 4200 to 5000 feet.	On lower sideslopes and toeslopes of basalt plateau sideslopes; 1 to 15 percent slopes; 4200 to 5000 feet.
Typical Vegetation and Precipitation (ppt)	Western juniper, low sagebrush, rabbitbrush, wheatgrass, sandberg bluegrass, Idaho fescue cheatgrass; 10 to 16 inches ppt.	Barren; 10 to 16 inches ppt.	
Surface Layer	A thin pumice overburden of up to 5 inches thick may be present, OVER 0 to 11 inches; dark grayish brown and grayish brown very cobbly fine sandy loam, subangular blocky structure; slightly hard, pH 6.6.	NOT APPLICABLE: Basalt bedrock with minor accumulations of aeolian soil deposition in some fractures.	9 inches of pumice overburden consisting of brown gravelly coarse sandy loam over very pale brown extremely gravelly coarse loamy sand (pumice thickness in this map unit ranges from 0 to 5 inches) OVER 9 to 15 inches; pale brown fine sandy loam, subangular blocky structure, soft, pH 6.8.
Rooting Depth (in.) to Underlying Material	8 to 20; basalt		20 to 40; basalt
Erosion Factor (K)	.24		.20
Max. Erosion Hazard	Moderate		Low to Moderate
Soil Permeability	Moderately rapid		Moderate
Drainage Class	Well drained		Well drained
Soil Manageability Class Group	3ePx III	2e	
Forest Site Class	7 (non-commercial)		7 (non-commercial)
Range Site	7, 1		16
Water Runoff Potential	Slow	Rapid	Slow
Watershed Sensitivity	7 (Moderate)	2	8
Hydrologic Soil Group	D		B
Available Water Capacity (AWC) Upper 20 inches	Very Low to Low 0.8 to 1.9 inches		Low to Moderate 2.6 inches
Susceptibility to Burning Damage	Low		Moderate
Slope Stability Hazard	Low		Low
Allowable Soil Loss	1 tons/acre/year		2 tons/acre/year
Chance of Seedling Survival	Not Rated		Not Rated
Rating for Timber Site	Not rated		Not Rated
R-Value	30-60		30-60

121 BAKEOVEN FAMILY-ROCK OUTCROP-WENATCHEE FAMILY ASSOCIATION (continued)

Soil horizons in
inches, USDA,
Unified, AASHTO

0-11; Very cobbly fine sandy loam
Unified: SM, SM-SC
AASHTO: A-4
11+; Unweathered bedrock

0-5; Gravelly coarse sandy loam
Unified: SM
AASHTO: A-1-b
5-9; Extremely gravelly loamy
coarse sand
Unified: SM, GM
AASHTO: A-1-a, A-1-b
9-15; Fine sandy loam
Unified: SM-SC, ML-CL
AASHTO: A-4
15-27; Loam
Unified: CL
AASHTO: A-4, A-6
27+; Unweathered bedrock

Included Areas:

Included with this unit in mapping and making up about 15 percent of the acreage are the Stukel, Lawyer, Searles, Gwin and Elmore families and unnamed soils similar to the Alicel family but not Pachic, and rock outcrop with steeper slopes.

122 BAKEOVEN-STUKEL FAMILIES-LAVA FLOW ASSOCIATION, 1 to 15 percent slopes

Map Unit Components	Bakeoven family (35 percent)	Stukel family (30 percent)	Lava flow (20 percent)
Position, Slope, and Elevation	On undulating upper slopes and knolls of basalt plateaus; 1 to 15 percent slopes; 4300 to 5000 feet.	On isolated small depressions between lava flow rock on basalt plateaus; 1 to 10 percent slopes; 4300 to 5000 feet.	Hummocky disaggregated lava flow rock and collapsed lava tubes on basalt plateaus; 5 to 15 percent slopes; 4300 to 5000 feet.
Typical Vegetation and Precipitation (ppt)	Western juniper, big sagebrush, bitterbrush, desert mahogany, bluebunch wheatgrass, bluegrass, cheatgrass, bottlebrush, 10 to 14 inches ppt.	Western juniper, big sagebrush, bitterbrush, desert mahogany, bluebunch wheatgrass, bluegrass, cheatgrass, bottlebrush, 10 to 14 inches ppt.	
Surface Layer	0 to 11 inches; dark grayish brown and grayish brown very cobbly fine sandy loam, subangular blocky structure; slightly hard, pH 6.6.	0 to 11 inches; grayish brown to brown very cobbly loam to loam granular and blocky structure, soft to slightly hard, pH 6.2 to 7.2.	NOT APPLICABLE: Fractured vesicular basalt flow rock with minor accumulations of aeolian soil deposition in some fractures.
Rooting Depth (in.) to Underlying Material	8 to 15; Basalt	10 to 20; Basalt	
Erosion Factor (K)	.24	.37	
Max. Erosion Hazard	Moderate	Moderate	
Soil Permeability	Moderately rapid	Moderate	
Drainage Class	Well drained	Well drained	
Soil Manageability Class	2ed	2ed	
Group	II		
Forest Site Class	7 (non-commercial)	7 (non-commercial)	
Range Site	7, 1	7, 4	
Water Runoff Potential	Slow	Slow	Rapid
Watershed Sensitivity	7 (Moderate)	6	6
Hydrologic Soil Group	D	D	
Available Water Capacity (AWC)	Very Low	Very Low to Low	
Upper 20 inches	0.8 to 1.5 inches	1.4 to 2.8 inches	
Susceptibility to Burning Damage	Moderate	Moderate	
Slope Stability Hazard	Low	Low	
Allowable Soil Loss	1 tons/acre/year	1 tons/acre/year	
Chance of Seedling Survival	Not Rated	Not Rated	
Rating for Timber Site	Not Rated	Not Rated	
R-Value	30-60	30-60	
Soil horizons in inches, USDA, Unified, AASHTO	0-11; Very cobbly fine sandy loam Unified: SM, SM-SC AASHTO: A-4 11+; Unweathered bedrock	0-3; Very cobbly loam Unified: SM, SM-SC, ML, ML-CL AASHTO: A-2-4, A-4 3-11; Loam Unified: ML, ML-CL AASHTO: A-4 11+; Unweathered bedrock	
Included Areas:	Included with this unit in mapping and making up about 15 percent of the acreage are the Searles, Pass Canyon, Cowiche, and Alicel families, Lithic Xerorthents, mesic and lava flow rock with steeper slopes.		

123 BEHANIN-CHEADLE FAMILIES ASSOCIATION, 10 to 35 percent slopes

Map Unit Components	Behanin family (60 percent)	Cheadle family (25 percent)
Position, Slope, and Elevation	On sideslopes of mountain uplands; 10 to 35 percent slopes; 7600 to 9500 feet.	On upper sideslopes, ridges, and knolls of mountain uplands; 15 to 35 percent slopes; 7600 to 9500 feet.
Typical Vegetation and Precipitation (ppt)	White bark pine, lodgepole pine, western white pine, quaking aspen, big sagebrush, mulesear, lupine, prostrate manzanita, current spp., Idaho fescue, bottlebrush; 25 to 35 inches ppt.	Few white bark pine, big sagebrush, low sagebrush, mulesear, current spp., Idaho fescue, bottlebrush; 25 to 35 inches ppt.
Surface Layer	1 to 0 inches; lodgepole pine and western white pine needles and twigs, over 0 to 32 inches; dark grayish brown to brown very gravelly loam to very cobbly loam, granular to subangular blocky structure, slightly hard, pH 6.0 to 6.4.	0 to 17 inches; dark grayish brown to brown very cobbly loam to very cobbly clay loam; granular and subangular blocky structure, slightly hard to hard, pH 6.6.
Substratum	32 plus inches; weathering in place semi-soft yellowish brown tuff conglomerate which rubs to a sandy loam texture.	
Rooting Depth (in.) to Underlying Material	20 to 40; andesite, tuff	10 to 20; andesite, tuff
Erosion Factor (K)	.28	.37
Max. Erosion Hazard	Moderate	Moderate to high
Soil Permeability	Moderate	Moderate
Drainage Class	Well drained	Well drained
Soil Manageability Class	2e	2ed
Soil Manageability Group	II	
Forest Site Class	6-7 (5 to non-commercial)	7 (non-commercial)
Range Site	Not placed in a range site.	9
Water Runoff Potential	Slow	Rapid
Watershed Sensitivity	6 (Moderate)	4
Hydrologic Soil Group	B	D
Available Water Capacity (AWC)	Low to Moderate	Very Low to Low
Upper 20 inches	2.6 inches	1.2 to 2.4 inches
Susceptibility to Burning Damage	Moderate	Low
Slope Stability Hazard	Low	Low
Allowable Soil Loss	2 tons/acre/year	1 tons/acre/year
Chance of Seedling Survival	Moderate	Not Rated
Rating for Timber Site	(7,12,13)	Not Rated
R-Value	30-60	30-60
Soil horizons in inches, USDA, Unified, AASHTO	0-32; Very gravelly loam, very cobbly loam Unified: SM-SC, SC AASHTO: A-2-4, A-2-6 32+; Weathered bedrock	0-12; Very cobbly loam Unified: SM-SC, SC AASHTO: A-2-4, A-2-6, A-4, A-6 12-17; Very cobbly clay loam Unified: SC AASHTO: A-6, A-2-6 17+; Unweathered bedrock
Included Areas:	Included with these soils in mapping and making up about 15 percent of the acreage are the Duncom, Supervisor and Gallatin families, Lithic Cryochrepts and rock outcrop.	

124 BEHANIN-CHEADLE FAMILIES ASSOCIATION, 35 to 60 percent slopes

Map Unit Components	Behanin family (50 percent)	Cheadle family (30 percent)
Position, Slope, and Elevation	On sideslopes of mountain uplands; 35 to 55 percent slopes; 7600 to 9700 feet.	On upper sideslopes, ridges, and knolls of mountain uplands; 35 to 60 percent slopes; 7600 to 9700 feet.
Typical Vegetation and Precipitation (ppt)	White bark pine, lodgepole pine, western white pine, quaking aspen, big sagebrush, mulesear, lupine, prostrate manzanita, current spp., Idaho fescue, bottlebrush; 25 to 35 inches ppt.	Few white bark pine, big sagebrush, low sagebrush, mulesear, current spp., Idaho fescue, bottlebrush; 25 to 35 inches ppt.
Surface Layer	1 to 0 inches; lodgepole and western white pine needles and twigs, over 0 to 32 inches; dark grayish brown to brown very gravelly loam to very cobbly loam, granular to subangular blocky structure, slightly hard, pH 6.0 to 6.4.	0 to 17 inches; dark grayish brown to brown very cobbly loam to very cobbly clay loam; granular and subangular blocky structure, slightly hard to hard; pH 6.6.
Substratum	32 plus inches; weathering in place semi-soft yellowish brown tuff conglomerate which rubs to a sandy loam texture.	
Rooting Depth (in.) to Underlying Material	20 to 40; andesite, tuff	10 to 20; andesite
Erosion Factor (K)	.28	.37
Max. Erosion Hazard	High	High to very high
Soil Permeability	Moderate	Moderate
Drainage Class	Well drained	Well drained
Soil Manageability Class Group	3E III	3Ed
Forest Site Class	6-7 (5 to non-commercial)	7 (non-commercial)
Range Site	Not placed in a range site.	9
Water Runoff Potential	Moderate	Very Rapid
Watershed Sensitivity	5 (High)	3
Hydrologic Soil Group	B	D
Available Water Capacity (AWC) Upper 20 inches	Low to Moderate 2.6 inches	Very Low to Low 1.2 to 2.4 inches
Susceptibility to Burning Damage	Moderate to High	Moderate
Slope Stability Hazard	Low	Low
Allowable Soil Loss	2 tons/acre/year	1 tons/acre/year
Chance of Seedling Survival	Moderate	Not Rated
Rating for Timber Site	Poor (7,8,12,13)	Not Rated
R-Value	30-60	30-60
Soil horizons in inches, USDA, Unified, AASHTO	0-32; Very gravelly loam, very cobbly loam Unified: SM-SC, SC AASHTO: A-2-4, A-2-6 32+; Weathered bedrock	0-12; Very cobbly loam Unified: SM-SC, SC AASHTO: A-2-4, A-2-6, A-4, A-6 12-17; Very cobbly clay loam Unified: SC AASHTO: A-6, A-2-6 17+; Unweathered bedrock
Included Areas:	Included with these soils in mapping and making up about 20 percent of the acreage are the Duncom, Supervisor and Gallatin families, Lithic Cryochrepts, rock outcrop, and rubbleland.	

125 BEHANIN, deep-GALLATIN FAMILIES COMPLEX, 10 to 35 percent slopes

Map Unit Components	Behanin family, deep (65 percent)	Gallatin family (20 percent)
Position, Slope, and Elevation	On sideslopes of mountain uplands; 10 to 35 percent slopes; 7000 to 7500 feet.	On sideslopes and drainageways of mountain uplands; 10 to 35 percent slopes; 7000 to 7500 feet.
Typical Vegetation and Precipitation (ppt)	White fir; lodgepole pine, western white pine, snowberry, forbes, few grasses; 25 to 30 inches ppt.	Quaking aspen, few white fir, snowberry, lupine, mulesear, bottlebrush, other grasses; 25 to 30 inches ppt.
Surface Layer	1-1/2 to 0 inches of white fir needles and twigs, over 0 to 60 inches; very dark grayish brown to brown very gravelly loam, very stony loam and extremely gravelly loam, granular to subangular blocky structure, slightly hard, pH 6.0 to 6.4.	0 to 29 inches; dark grayish brown loam to very cobbly loam, granular to subangular blocky structure, slightly hard, pH 6.2 to 6.4.
Rooting Depth (in.) to Underlying Material	40 plus; andesite	20 to 40; andesite, tuff
Erosion Factor (K)	.28	.32
Max. Erosion Hazard	Moderate	Moderate
Soil Permeability	Moderate	Moderate
Drainage Class	Well Drained	Well Drained
Soil Manageability Class	2e	2e
Soil Manageability Group	II	
Forest Site Class	5-6 (4-5)	7 (non-commercial)
Range Site	Not placed in a range site.	14, 19
Water Runoff Potential	Slow	Slow
Watershed Sensitivity	7 (Moderate)	6
Hydrologic Soil Group	B	B
Available Water Capacity (AWC)	Moderate	Low to Moderate
Upper 20 inches	2.4 inches	3.2 inches
Susceptibility to Burning Damage	Moderate	Moderate
Slope Stability Hazard	Low	Low
Allowable Soil Loss	3 tons/acre/year	2 tons/acre/year
Chance of Seedling Survival	Moderate	Not Rated
Rating for Timber Site	Fair (12)	Not Rated
R-Value	30-60	30-60
Soil horizons in inches, USDA, Unified, AASHTO	0-34; Very gravelly loam, very stony loam Unified: SM, SM-SC, ML-CL AASHTO: A-2-4, A-2-6, A-4 34-60; Extremely gravelly loam Unified: SM-SC, SC AASHTO: A-2-4, A-2-6, A-4, A-6	0-21; Loam Unified: ML-CL, CL AASHTO: A-4, A-6 21-29; Very cobbly loam Unified: SM-SC, SC, ML-CL, CL AASHTO: A-4, A-6 29+; Unweathered bedrock
Included Areas:	Included with these soils in mapping and making up about 15 percent of the acreage are the Woodhurst, Supervisor, Cheadle and Duncom families.	

126 BEHANIN, deep-SUPERVISOR FAMILIES COMPLEX, 15 to 40 percent slopes

	Behanin family, deep (50 percent)	Supervisor family (35 percent)
Map Unit Components		
Position, Slope, and Elevation	On sideslopes of mountain uplands; 15 to 40 percent slopes; 7000 to 8000 feet.	On sideslopes of mountain uplands; 15 to 40 percent slopes; 7000 to 8000 feet.
Typical Vegetation and Precipitation (ppt)	Lodgepole pine, white fir, few washoe pine, quaking aspen and western white pine, prostrate manzanita, ceonothus, few grasses; 25 to 30 inches ppt.	Lodgepole pine, white fir, few washoe pine, quaking aspen and western white pine, prostrate manzanita, ceonothus, few grasses; 25 to 30 inches ppt.
Surface Layer	1-1/2 to 0 inches of white fir needles and twigs, over 0 to 60 inches; very dark grayish brown to brown very gravelly loam, very stony loam and extremely gravelly loam, granular to subangular blocky structure, slightly hard, pH 6.0 to 6.4.	1 to 0 inches; lodgepole pine needles, over 0 to 12 inches; dark grayish brown to brown gravelly fine sandy loam, granular and blocky structure, slightly hard, pH 5.8 to 6.2.
Rooting Depth (in.) to Underlying Material	40 plus; andesite, basalt	20 to 40; andesite, tuff
Erosion Factor (K)	.28	.20
Max. Erosion Hazard	Moderate	Moderate
Soil Permeability	Moderate	Moderate
Drainage Class	Well drained	Well drained
Soil Manageability Class	2e	2ep
Group	II	
Forest Site Class	5-6 (4-5)	6 (4-5)
Range Site	Not placed in a range site.	Not placed in a range site.
Water Runoff Potential	Slow	Slow
Watershed Sensitivity	7 (Moderate)	7
Hydrologic Soil Group	B	B
Available Water Capacity (AWC)	Moderate	Low to Moderate
Upper 20 inches	2.4 inches	2.2 inches
Susceptibility to Burning Damage	Moderate	Moderate
Slope Stability Hazard	Low	Low
Allowable Soil Loss	3 tons/acre/year	2 tons/acre/year
Chance of Seedling Survival	Moderate	Low to Moderate
Rating for Timber Site	Fair (12)	Fair (7,12)
R-Value	30-60	60+
Soil horizons in inches, USDA, Unified, AASHTO	0-34; Very gravelly loam, very stony loam Unified: SM, SM-SC, ML-CL AASHTO: A-2-4, A-2-6, A-4 34-60; Extremely gravelly loam Unified: SM-SC, SC AASHTO: A-2-4, A-2-6, A-4, A-6	0-12; Gravelly fine sandy loam Unified: SM, SM-SC AASHTO: A-2-4, A-4 12-26; Very gravelly sandy loam Unified: GM, GM-GC, SM, SM-SC AASHTO: A-1-b, A-2-4 26+; Weathered bedrock
Included Areas:	Included with these soils in mapping and making up about 15 percent of the acreage are the Gallatin, Cheadle, Gralic, and Loberg families and rock outcrop.	

127 BERTAG, deep-CAVANAUGH-MASCAMP FAMILIES ASSOCIATION, 35 to 60 percent slopes

Map Unit Components	Bertag family, deep (40 percent)	Cavanaugh family (25 percent)	Mascamp family (20 percent)
Position, Slope, and Elevation	On steep sideslopes of basalt plateau breaks, incised drainages and mountain uplands; 35 to 60 percent slopes; 5500 to 7000 feet.	On steep sideslopes and incised drainages of basalt plateau breaks and mountain uplands; 35 to 60 percent slopes; 5500 to 7000 feet.	On ridges, knolls and upper sideslopes of basalt plateau breaks and mountain uplands; 40 to 60 percent slopes; 5500 to 7000 feet.
Typical Vegetation and Precipitation (ppt)	White fir forest, or mixed conifer forest of ponderosa pine and white fir plus snowberry squaw carpet, Ribes spp., Ross's sedge, few grasses; 20 to 30 inches ppt.	White fir forest, or mixed conifer forest of ponderosa pine, white fir, western juniper plus mountain mahogany, big sagebrush, mulesear, snowberry, Ross's sedge, grasses; 20 to 30 inches ppt.	
Surface Layer	1-1/2 to 0 inches of white fir and ponderosa pine needles and twigs, over 0 to 13 inches; dark brown loam, granular and blocky structure, slightly hard, pH 6.4.	1 to 0 inches of white fir and ponderosa pine needles, over 0 to 13 inches; dark brown and brown cobbly loam to very cobbly loam, granular and blocky structure, slightly hard, pH 6.4.	0 to 6 inches; dark grayish brown very cobbly loam, granular structure, slightly hard, pH 6.8.
Rooting Depth (in.) to Underlying Material	40 plus; tuff	30 plus; tuff, basalt	10 to 20; basalt, andesite, tuff
Erosion Factor (K)	.43	.37	.37
Max. Erosion Hazard	High	High	High to very high
Soil Permeability	Slow	Slow	Moderate
Drainage Class	Well drained	Well drained	Well drained
Soil Manageability Class	3S	3S	3Ed
Group	III		
Forest Site Class	4 (2-3)	4-5 (3-4)	7 (non-commercial)
Range Site	Not placed in a range site.	Not placed in a range site.	9
Water Runoff Potential	Rapid	Rapid	Rapid
Watershed Sensitivity	4 (High)	4	4
Hydrologic Soil Group	C	C	D
Available Water Capacity (AWC)	Moderate to High	Low to Moderate	Very Low to Low
Upper 20 inches	2.9 inches	2.5 inches	1.2 to 2.5 inches
Susceptibility to Burning Damage	Moderate	Moderate	Moderate
Slope Stability Hazard	High	High	Low
Allowable Soil Loss	3 tons/acre/year	3 tons/acre/year	1 tons/acre/year
Chance of Seedling Survival	Moderate	Low to Moderate	Not Rated
Rating for Timber Site	Fair (8)	Fair (3,8)	Not Rated
R-Value	0-30	0-30	30-60

127 BERTAG, deep-CAVANAUGH-MASCAMP FAMILIES ASSOCIATION (continued)

Soil horizons in
inches, USDA,
Unified, AASHTO

0-13; Loam Unified: ML-CL, CL AASHTO: A-4, A-6	0-7; Cobbly loam Unified: ML-CL, CL AASHTO: A-4, A-6	0-12; Very cobbly loam, very gravelly loam Unified: SM-SC, SC AASHTO: A-4
13-20; Cobbly clay Unified: CL, CH AASHTO: A-6, A-7	7-13; Very cobbly loam Unified: SM-SC, SC AASHTO: A-4, A-6	12-19; Very gravelly clay loam Unified: SC AASHTO: A-2-6, A-6
20-60; Gravelly clay Unified: CH AASHTO: A-7	13-18; Very cobbly clay loam Unified: CL AASHTO: A-6	19+; Unweathered bedrock
	18-60; Very gravelly clay, extremely gravelly clay loam. Unified: GC AASHTO: A-2-7, A-7	

Included Areas:

Included with these soils in mapping and making up about 15 percent of the acreage are the DeMasters, Smarts, Anatone, Merlin and Manila families and rock outcrop.

128 BERTAG-SMARTS FAMILIES ASSOCIATION, 10 to 40 percent slopes

Map Unit Components	Bertag family (40 percent)	Smarts family, (35 percent)
Position, Slope, and Elevation	On toeslopes and lower sideslopes of mountain uplands; 10 to 35 percent slopes; 5500 to 6500 feet.	On sideslopes, ridges and knolls of mountain uplands; 10 to 40 percent slopes; 5500 to 6500 feet.
Typical Vegetation and Precipitation (ppt)	White fir forest, or mixed conifer forest of white fir and ponderosa pine, plus snowbrush serviceberry, lupine, Ross's sedge, few grasses; 20 to 30 inches ppt.	White fir forest, or mixed conifer forest of white fir, ponderosa pine, incense-cedar, plus few juniper, serviceberry, snowberry, mountain mahogany, Ross's sedge, few grasses; 20 to 30 inches ppt.
Surface Layer	1 to 0 inches of white fir and ponderosa pine needles, over 0 to 4 inches; dark grayish brown loam, platy and granular structure, slightly hard, pH 6.2.	1/2 to 0 inches; ponderosa pine and white fir needles and twigs, over 0 to 20 inches; reddish brown stony loam and very cobbly loam, granular and blocky structure, slightly hard and hard, pH 6.6 to 6.8.
Substratum	29 plus inches semi-hard tuff and tuff conglomerate.	
Rooting Depth (in.) to Underlying Material	20 to 40; tuff	20 to 40; basalt, tuff
Erosion Factor (K)	.43	.32
Max. Erosion Hazard	Moderate	Low to moderate
Soil Permeability	Slow	Moderately Slow
Drainage Class	Well drained	Well drained
Soil Manageability Class	2e	2ep
Group	II	
Forest Site Class	5 (3-4)	5 (3-4)
Range Site	Not placed in a range site.	Not placed in a range site.
Water Runoff Potential	Moderate	Slow
Watershed Sensitivity	5 (Moderate)	7
Hydrologic Soil Group	C	B
Available Water Capacity (AWC)	Low to Moderate	Low to Moderate
Upper 20 inches	2.9 inches	2.1 inches
Susceptibility to Burning Damage	Moderate	Moderate
Slope Stability Hazard	Low to Moderate	Low
Allowable Soil Loss	2 tons/acre/year	2 tons/acre/year
Chance of Seedling Survival	Moderate to high	Low
Rating for Timber Site	Fair (7)	Fair (1,3,7)
R-Value	0-30	30-60
Soil horizons in inches, USDA, Unified, AASHTO	0-4; Loam Unified: ML-CL, CL AASHTO: A-4, A-6 4-29; Clay loam, clay Unified: CL, CH AASHTO: A-6, A-7 29+; Weathered bedrock	0-14; Stony loam Unified: ML-CL, CL AASHTO: A-4, A-6 14-28; Very cobbly loam, very gravelly loam Unified: GM-GC, GC, ML-CL, CL AASHTO: A-2-4, A-2-6, A-4, A-6 28-35; Extremely gravelly clay loam Unified: GC AASHTO: A-2-6 35+; Weathered bedrock
Included Areas:	Included with these soils in mapping and making up about 25 percent of the acreage are the Merlin, Anatone, DeMasters, Bearskin, Mascamp, and Lamondi families, Bertag, deep, and Smarts, deep, families and unnamed soils similar to the Bertag family but shallower and over soft to hard tuff.	

129 BERTAG-SMARTS, deep-CAVANAUGH FAMILIES COMPLEX, 35 to 60 percent slopes

Map Unit Components	Bertag family, deep (40 percent)	Smarts family, deep (25 percent)	Cavanaugh family (20 percent)
Position, Slope, and Elevation	On steep sideslopes of mountain uplands; 35 to 50 percent slopes; 5500 to 7000 feet.	On steep sideslopes and ridges of mountain uplands; 35 to 60 percent slopes; 5500 to 7000 feet.	On steep sideslopes of mountain uplands; 35 to 60 percent slopes; 5500 to 7000 feet.
Typical Vegetation and Precipitation (ppt)	White fir forest, or mixed conifer forest of white fir, ponderosa pine, plus snowberry, serviceberry, current spp., Ross's sedge, few grasses; 20 to 30 inches ppt.	White fir forest, or mixed conifer forest of white fir, ponderosa pine, plus few western juniper, serviceberry, snowberry, mulesear, lupine, Ross's sedge, few grasses 20 to 30 inches ppt.	
Surface Layer	1-1/2 to 0 inches of white fir and ponderosa pine needles and twigs, over 0 to 13 inches; dark brown loam, granular and blocky structure, slightly hard, pH 6.4.	2 to 0 inches of white fir needles and twigs, over 0 to 18 inches; brown stony loam, granular structure, soft, pH 6.2.	1 to 0 inches of white fir and ponderosa pine needles, over 0 to 13 inches; dark brown and brown cobbly loam to very cobbly loam, granular and blocky structure, slightly hard, pH 6.4.
Substratum		32 to 50 inches; pale brown extremely gravelly loam, massive, soft, pH 6.0.	
Rooting Depth (in.) to Underlying Material	40 plus; tuff	40 plus; basalt, tuff	30 plus; tuff
Erosion Factor (K)	.43	.32	.37
Max. Erosion Hazard	High	High	High
Soil Permeability	Slow	Moderately slow	Slow
Drainage Class	Well drained	Well drained	Well drained
Soil Manageability Class Group	3S III	3EP	3S
Forest Site Class	4 (2-3)	4 (2-3)	4-5 (3-4)
Range Site	Not placed in a range site.	Not placed in a range site.	Not placed in a range site.
Water Runoff Potential	Rapid	Moderate	Rapid
Watershed Sensitivity	4 (High)	6	4
Hydrologic Soil Group	C	B	C
Available Water Capacity (AWC) Upper 20 inches	Moderate to High 2.9 inches	Moderate 2.6 inches	Low to Moderate 2.5 inches
Susceptibility to Burning Damage	Moderate	Moderate	Moderate
Slope Stability Hazard	High	Low	High
Allowable Soil Loss	3 tons/acre/year	3 tons/acre/year	3 tons/acre/year
Chance of Seedling Survival	Moderate to High	Moderate	Low to Moderate
Rating for Timber Site	Fair (8)	Fair (1,8)	Fair (3,8)
R-Value	0-30	30-60	0-30

129 BERTAG-SMARTS, deep-CAVANAUGH FAMILIES COMPLEX (continued)

Soil horizons in
inches, USDA,
Unified, AASHTO

0-13; Loam
Unified: ML-CL, CL
AASHTO: A-4, A-6
13-20; Cobbly clay loam
Unified: CL, CH
AASHTO: A-6, A-7
20-60; Gravelly clay
Unified: CH
AASHTO: A-7

0-18; Stony loam
Unified: ML-CL, CL
AASHTO: A-4
18-50; Extremely gravelly
clay loam, extremely
gravelly loam
Unified: SC
AASHTO: A-2-6, A-6
50+; Weathered bedrock

0-7; Cobbly loam
Unified: ML-CL, CL
AASHTO: A-4, A-6
7-13; Very cobbly loam
Unified: SM-SC, SC
AASHTO: A-4, A-6
13-18; Very cobbly clay loam
Unified: CL
AASHTO: A-6
18-60; Very gravelly clay,
extremely gravelly
clay loam
Unified: GC
AASHTO: A-2-7, A-7

Included Areas:

Included with these soils in mapping and making up about 15 percent of the acreage are the Lamondi, DeMasters, Manila, Bearskin and Merlin families, rock outcrop and rubbleland.

130 BIEBER-BARNARD FAMILIES COMPLEX, 1 to 20 percent slopes

Map Unit Components	Bieber family (45 percent)	Barnard family (35 percent)
Position, Slope, and Elevation	Undulating to nearly level basalt plateaus; 1 to 20 percent slopes; 4300 to 6000 feet.	Undulating to nearly level basalt plateaus; 1 to 20 percent slopes; 4300 to 6000 feet.
Typical Vegetation and Precipitation (ppt)	Low sagebrush, black sagebrush, few western juniper, Phlox spp., cheatgrass, other grasses; 14 to 16 inches ppt.	Big sagebrush, silver sagebrush, mountain mahogany, Carex spp., other grasses; 14 to 16 inches ppt.
Surface Layer	0 to 4 inches; brown very cobbly loam, blocky and granular structure, hard, pH 6.8.	0 to 8 inches; grayish brown to dark grayish brown cobbly loam to gravelly clay loam, platy and blocky structure, slightly hard, pH 6.5 to 7.0.
Substratum	18 plus inches; strongly cemented silical duripan.	32 plus inches; weakly to strongly cemented silica duripan.
Rooting Depth (in.) to Underlying Material	10 to 20; silica duripan, basalt	20 to 40; silica duripan, basalt
Erosion Factor (K)	.37	.37
Max. Erosion Hazard	Moderate	Low to moderate
Soil Permeability	Very slow	Slow
Drainage Class	Well drained	Well drained
Soil Manageability Class	2ed	2e
Soil Manageability Group	II	
Forest Site Class	7 (non-commercial)	7 (non-commercial)
Range Site	8	13, 18
Water Runoff Potential	Moderate	Slow
Watershed Sensitivity	5 (Moderate)	6
Hydrologic Soil Group	D	C
Available Water Capacity (AWC)	Very Low to Low	Low to Moderate
Upper 20 inches	1.2 to 2.5 inches	2.6 inches
Susceptibility to Burning Damage	Low	Low
Slope Stability Hazard	Low	Low
Allowable Soil Loss	1 tons/acre/year	2 tons/acre/year
Chance of Seedling Survival	Not Rated	Not Rated
Rating for Timber Site	Not Rated	Not Rated
R-Value	0-30	0-30
Soil horizons in inches, USDA, Unified, AASHTO	0-4; Very cobbly loam Unified: SC, CL AASHTO: A-6 4-18; Clay Unified: CH AASHTO: A-7 18+; Silica duripan	0-3; Cobbly loam Unified: ML-CL, CL AASHTO: A-4, A-6 3-8; Gravelly clay loam Unified: CL, MH AASHTO: A-6, A-7 8-32; Clay, gravelly silty clay Unified: CH AASHTO: A-7 32+; Silica duripan
Included Areas:	Included with these soils in mapping and making up about 20 percent of the acreage are the Keating, Aikman, Deven, Indian Creek, Packwood and Ditchcamp families, Xerofluvents, rubbleland and areas of greater slopes.	

131 BIEBER-BARNARD-SIMPSON FAMILIES COMPLEX, 1 to 10 percent slopes

Map Unit Components	Bieber family (50 percent)	Barnard family (25 percent)	Simpson family (15 percent)
Position, Slope, and Elevation	On low lying areas of undulating basalt plateaus; 1 to 5 percent slopes; 4500 4800 feet.	On mounds and upper areas of undulating basalt plateaus; 2 to 10 percent slopes; 4500 to 4800 feet.	On ridges and upper areas of undulating basalt plateaus; 2 to 10 percent slopes; 4500 to 4800 feet.
Typical Vegetation and Precipitation (ppt)	Few western juniper, low sagebrush, black sagebrush, Idaho fescue, cheatgrass; 12 to 14 inches ppt.	Few western juniper, big sagebrush, low sagebrush, rabbitbrush, Idaho fescue, Poa spp., wheatgrass; 12 to 14 inches ppt.	
Surface Layer	0 to 4 inches; brown very cobbly loam, blocky and granular structure, hard, pH 6.8.	0 to 8 inches; grayish brown to dark grayish brown cobbly loam to gravelly clay loam, platy and blocky structure, slightly hard, pH 6.5 to 7.0.	0 to 3 inches; brown loam, granular structure, slightly hard, pH 7.2.
Substratum	18 plus inches; strongly cemented silica duripan.	32 plus inches; weakly to strongly cemented silica duripan.	28 to 30 inches; yellowish brown semi-consolidated ashy tuff which rubs to a clay loam, massive, very hard, pH 7.6.
Rooting Depth (in.) to Underlying Material	8 to 20; silica duripan over basalt	20 to 40; silica duripan over basalt	20 to 40; basalt
Erosion Factor (K)	.37	.37	.43
Max. Erosion Hazard	Moderate	Low to moderate	Low to moderate
Soil Permeability	Very slow	Slow	Slow
Drainage Class	Well drained	Well drained	Well drained
Soil Manageability Class Group	2ed II	2e	2e
Forest Site Class	7 (non-commercial)	7 (non-commercial)	7 (non-commercial)
Range Site	7, 1	17	12, 17
Water Runoff Potential	Slow	Slow	Slow
Watershed Sensitivity	5 (Moderate)	6	6
Hydrologic Soil Group	D	C	C
Available Water Capacity (AWC)	Very Low to Low	Low to Moderate	Low to Moderate
Upper 20 inches	1.0 to 2.6 inches	2.6 inches	2.7 inches
Susceptibility to Burning Damage	Low	Low	Low
Slope Stability Hazard	Low	Low	Low
Allowable Soil Loss	1 tons/acre/year	2 tons/acre/year	2 tons/acre/year
Chance of Seedling Survival	Not Rated	Not Rated	Not Rated
Rating for Timber Site	Not Rated	Not Rated	Not Rated
R-Value	0-30	0-30	0-30

131 BIEBER-BARNARD-SIMPSON FAMILIES COMPLEX (continued)

Soil horizons in
inches, USDA,
Unified, AASHTO

0-4; Very cobbly loam Unified: SC, CL AASHTO: A-6	0-3; Cobbly loam Unified: ML-CL, CL AASHTO: A-4, A-6	0-3; Loam Unified: ML-CL, CL AASHTO: A-4, A-6
4-18; Clay Unified: CH AASHTO: A-7	3-8; Gravelly clay loam Unified: CL, MH AASHTO: A-6, A-7	3-8; Silty clay loam Unified: CL, MH, CH AASHTO: A-6, A-7
18+; Silica duripan	8-32; Clay, gravelly silty clay Unified: CH AASHTO: A-7	8-28; Silty clay Unified: CH AASHTO: A-7
	32+; Silica duripan	28-30; Clay loam Unified: CL, MH, CH AASHTO: A-6, A-7
		30+; Unweathered bedrock

Included Areas:

Included with these soils in mapping and making up about 15 percent of the acreage are the Aikman, Puls, Dishner, Deven, and Cowiche families.

132 BIEBER-DEVEN-ROVAL FAMILIES COMPLEX, 1 to 10 percent slopes

Map Unit Components	Bieber family (35 percent)	Deven family (30 percent)	Roval family (20 percent)
Position, Slope, and Elevation	On nearly level to undulating slightly concave areas of basalt plateaus; 1 to 5 percent slopes; 4600 to 5800 feet.	On nearly level to undulating slightly convex areas of basalt plateaus; 1 to 10 percent slopes; 4600 to 5800 feet.	On nearly level to undulating basalt plateaus; 1 to 10 percent slopes; 4600 to 5800 feet.
Typical Vegetation and Precipitation (ppt)	Western juniper, low sagebrush, black sagebrush, Phlox spp., Idaho fescue, Poa spp., cheatgrass, other grasses; 14 to 16 inches ppt.	Western juniper, low sagebrush, Carex spp., Phlox spp., Idaho fescue, Poa spp., cheatgrass, other grasses; 14 to 16 inches ppt.	
Surface Layer	0 to 4 inches; brown very cobbly loam, blocky and granular structure, hard, pH 6.8.	0 to 2 inches; brown cobbly loam, granular structure, soft, pH 6.3.	0 to 2 inches; brown very cobbly loam, platy and granular structure, slightly hard, pH 6.6.
Substratum	18 plus inches; strongly cemented silica duripan.		13 to 14 inches; strongly cemented silica duripan.
Rooting Depth (in.) to Underlying Material	8 to 15; silica duripan over basalt or tuff.	8 to 15 hard fractured basalt, or soft to hard tuff.	10 to 20; silica duripan over basalt or tuff.
Erosion Factor (K)	.37	.37	.37
Max. Erosion Hazard	Moderate	Moderate	Moderate
Soil Permeability	Very slow	Slow	Slow
Drainage Class	Well drained	Well drained	Well drained
Soil Manageability Class Group	2edx II	2edx	2ed
Forest Site Class	7 (non-commercial)	7 (non-commercial)	7 (non-commercial)
Range Site	8, 1	8, 1	8
Water Runoff Potential	Moderate	Moderate	Moderate
Watershed Sensitivity	5 (Moderate)	5	6
Hydrologic Soil Group	D	D	D
Available Water Capacity (AWC) Upper 20 inches	Very Low to Low 1.0 to 1.9 inches	Very Low to Low 1.0 to 2.1 inches	Low 1.5 to 3.0 inches
Susceptibility to Burning Damage	Low	Low	Low
Slope Stability Hazard	Low	Low	Low
Allowable Soil Loss	1 tons/acre/year	1 tons/acre/year	1 tons/acre/year
Chance of Seedling Survival	Not Rated	Not Rated	Not Rated
Rating for Timber Site	Not Rated	Not Rated	Not Rated
R-Value	0-30	0-30	30-60
Soil horizons in inches, USDA, Unified, AASHTO	0-4; Very cobbly loam Unified: SC, CL AASHTO: A-4, A-6 4-18; Clay Unified: CH AASHTO: A-7 18+; Silica duripan	0-2; Cobbly loam Unified: ML-CL, CL AASHTO: A-4, A-6 2-7; Clay loam Unified: CL, MH, CH AASHTO: A-6, A-7 7-16; Clay Unified: CH AASHTO: A-7 16+; Unweatehered bedrock	0-2; Very cobbly loam Unified: SM-SC, SC AASHTO: A-2-4, A-4 2-10; Clay loam Unified: CL, MH AASHTO: A-6 10-13; Clay Unified: CH AASHTO: A-7 13-14; Silica duripan 14+; Unweathered bedrock
Included Areas:	Included with these soils in mapping and making up about 15 percent of the acreage are the Gwin, Pass Canyon, Lawyer, Barnard, Stukel and Keating families, Lithic Xerorthents, mesic, and Rock outcrop.		

133 BIEBER-ROVAL FAMILIES COMPLEX, 1 to 15 percent slopes

Map Unit Components	Bieber family (50 percent)	Roval family (35 percent)
Position, Slope, and Elevation	On gently undulating basalt plateaus and sideslopes of hills; 1 to 15 percent slopes; 4600 to 5500 feet.	On gently undulating basalt plateaus and sideslopes of hills; 1 to 15 percent slopes 4600 to 5500 feet.
Typical Vegetation and Precipitation (ppt)	Western juniper, low sagebrush, big sagebrush, bitterbrush, western yarrow, Phlox spp., Idaho fescue, bluebunch wheatgrass, sandberg bluegrass, other grasses; 14 to 16 inches; ppt.	Western juniper, low sagebrush, big sagebrush, Phlox spp., sandburg bluegrass, cheatgrass, other grasses; 14 to 16 inches ppt.
Surface Layer	0 to 4 inches; brown very cobbly loam, blocky and granular structure, hard, pH 6.8.	0 to 2 inches; brown very cobbly loam, platy and granular structure, slightly hard, pH 6.6.
Substratum	18 plus inches; strongly cemented silica duripan.	13 to 14 inches; strongly cemented silica duripan.
Rooting Depth (in.) to Underlying Material	12 to 20; silica duripan over basalt.	12 to 20; silica duripan over basalt.
Erosion Factor (K)	.37	.37
Max. Erosion Hazard	Moderate	Moderate
Soil Permeability	Very slow	Slow
Drainage Class	Well drained	Well drained
Soil Manageability Class	2ed	2ed
Soil Manageability Group	II	
Forest Site Class	7 (non-commercial)	7 (non-commercial)
Range Site	8	8
Water Runoff Potential	Moderate	Moderate
Watershed Sensitivity	5 (Moderate)	6
Hydrologic Soil Group	D	D
Available Water Capacity (AWC)	Low	Low
Upper 20 inches	1.5 to 2.5 inches	1.8 to 3.0 inches
Susceptibility to Burning Damage	Low	Low
Slope Stability Hazard	Low	Low
Allowable Soil Loss	1 tons/acre/year	1 tons/acre/year
Chance of Seedling Survival	Not Rated	Not Rated
Rating for Timber Site	Not Rated	Not Rated
R-Value	0-30	30-60
Soil horizons in inches, USDA, Unified, AASHTO	0-4; Very cobbly loam Unified: SC, CL AASHTO: A-6 4-18; Clay Unified: CH AASHTO: A-7 18+; Silica duripan	0-2; Very cobbly loam Unified: SM-SC, SC AASHTO: A-2-4, A-4 2-10; Clay loam Unified: CL, MH AASHTO: A-6 10-13; Clay Unified: CH AASHTO: A-7 13-14; Silica duripan 14+; Unweathered bedrock
Included Areas:	Included with these soils in mapping and making up about 15 percent of the acreage are the Packwood, Puls, Keating, Deven, Barnard and Ditchcamp families.	

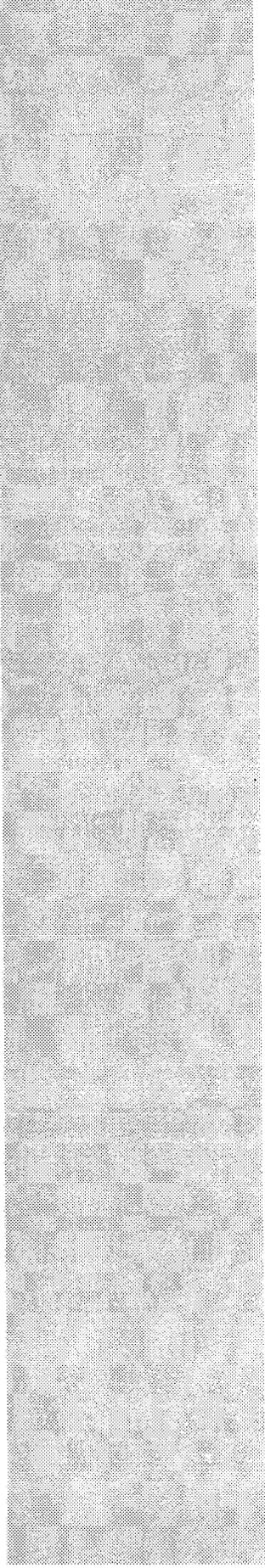
134 BIEBER-ROVAL-BARNARD FAMILIES COMPLEX, 1 to 10 percent slopes

Map Unit Components	Bieber family (45 percent)	Roval family (25 percent)	Barnard family (15 percent)
Position, Slope, and Elevation	On undulating basalt plateaus; 1 to 10 percent slopes; 4500 to 5200 feet.	On slightly convex areas of undulating basalt plateaus; 2 to 10 percent slopes; 4500 to 5200 feet.	On low lying areas of unit on undulating basalt plateaus; 1 to 5 percent slopes; 4500 to 5200 feet.
Typical Vegetation and Precipitation (ppt)	Western juniper, low sagebrush, rabbit- brush, Phlox spp., western yarrow, Idaho fescue, wheatgrass, bottlebrush, cheatgrass; 14 to 16 inches ppt.	Western juniper, low sagebrush, big sagebrush, bitterbrush, wheatgrass, Idaho fescue, bottlebrush, cheatgrass; 14 to 16 inches ppt.	
Surface Layer	0 to 4 inches; brown very cobbly loam, blocky and granular structure, hard, pH 6.8.	0 to 2 inches; brown very cobbly loam, platy and granular structure, slightly hard, pH 6.6.	0 to 8 inches; grayish brown to dark grayish brown cobbly loam to gravelly clay loam, platy and blocky structure, slightly hard, pH 6.5 to 7.0.
Substratum	18 plus inches; strongly cemented silica duripan.	13 plus inches; strongly cemented silica duripan.	32 plus inches; weakly to strongly cemented silica duripan.
Rooting Depth (in.) to Underlying Material	10 to 20; silica duripan over basalt	10 to 20; silica duripan over basalt	20 to 40; silica duripan over basalt
Erosion Factor (K)	.37	.37	.37
Max. Erosion Hazard	Moderate	Moderate	Low to moderate
Soil Permeability	Very slow	Slow	Slow
Drainage Class	Well drained	Well drained	Well drained
Soil Manageability Class Group	2ed II	2ed	2e
Forest Site Class	7 (non-commercial)	7 (non-commercial)	7 (non-commercial)
Range Site	8	8	18, 24
Water Runoff Potential	Moderate	Moderate	Slow
Watershed Sensitivity	5 (Moderate)	6	6
Hydrologic Soil Group	D	D	C
Available Water Capacity (AWC)	Very Low to Low	Low	Low to Moderate
Upper 20 inches	1.3 to 2.6 inches	1.5 to 3.0 inches	2.6 inches
Susceptibility to Burning Damage	Low	Low	Low
Slope Stability Hazard	Low	Low	Low
Allowable Soil Loss	1 tons/acre/year	1 tons/acre/year	2 tons/acre/year
Chance of Seedling Survival	Not Rated	Not Rated	Not Rated
Rating for Timber Site	Not Rated	Not Rated	Not Rated
R-Value	0-30	30-60	0-30
Soil horizons in inches, USDA, Unified, AASHTO	0-4; Very cobbly loam Unified: SC, CL AASHTO: A-6 4-18; Clay Unified: CH AASHTO: A-7 18+; Silica duripan	0-2; Very cobbly loam Unified: SM-SC, SC AASHTO: A-2-4, A-4 2-10; Clay loam Unified: CL, MH AASHTO: A-6 10-13; Clay Unified: CH AASHTO: A-7 13-14; Silica duripan 14+; Unweathered bedrock	0-3; Cobbly loam Unified: ML-CL, CL AASHTO: A-4, A-6 3-8; Gravelly clay loam Unified: CL, MH AASHTO: A-6, A-7 8-32; Clay, gravelly silty clay Unified: CH AASHTO: A-7 32+; Silica duripan

134 BIEBER-ROVAL-BARNARD FAMILIES COMPLEX (continued)

Included Areas:

Included with these soils in mapping and making up about 15 percent of the acreage are the Ditchcamp, Deven, Pass Canyon, Puls, and Aikman families and Lithic Xerorthents, mesic.



135 BIEBER-ROVAL-PULS FAMILIES COMPLEX, 1 to 15 percent slopes

Map Unit Components	Bieber family (35 percent)	Roval family (30 percent)	Puls family (20 percent)
Position, Slope, and Elevation	On undulating basalt plateaus; 1 to 15 percent slopes; 4500 to 5800 feet.	On upper slopes and knolls of undulating basalt plateaus; 2 to 15 percent slopes; 4500 to 5800 feet.	On slight depressions of basalt plateaus; 1 to 10 percent slopes; 4500 to 5800 feet.
Typical Vegetation and Precipitation (ppt)	Low sagebrush, few western juniper, Phlox spp., Idaho fescue, cheatgrass; 14 to 16 inches ppt.	Western juniper, low sagebrush, big sagebrush sandberg bluegrass, Idaho fescue, bottlebrush; 14 to 16 inches ppt.	
Surface Layer	0 to 4 inches; brown very cobbly loam, blocky and granular structure, hard, pH 6.8.	0 to 2 inches; brown very cobbly loam, platy and granular structure, slightly hard, pH 6.6.	0 to 5 inches; pinkish gray very stony clay loam, granular structure, slightly hard, pH 6.3.
Substratum	18 plus inches; strongly cemented silica duripan.	13 plus inches; strongly cemented silica duripan.	19 to 28 inches; indurated silica duripan.
Rooting Depth (in.) to Underlying Material	10 to 20; silica duripan over basalt	10 to 20; silica duripan over basalt	5 to 10; dense very hard clay over silica duripan at 10 to 20 inches
Erosion Factor (K)	.37	.37	.37
Max. Erosion Hazard	Moderate	Moderate	Moderate
Soil Permeability	Very slow	Slow	Very slow
Drainage Class	Well drained	Well drained	Well drained
Soil Manageability Class Group	2ed II	2ed	3eDx
Forest Site Class	7 (non-commercial)	7 (non-commercial)	7 (non-commercial)
Range Site	8	8	1
Water Runoff Potential	Moderate	Moderate	Moderate
Watershed Sensitivity	5 (Moderate)	6	5
Hydrologic Soil Group	D	D	D
Available Water Capacity (AWC) Upper 20 inches	Very Low to Low 1.3 to 2.6 inches	Low 1.5 to 3.0 inches	Very Low to Low 1.1 to 2.7 inches
Susceptibility to Burning Damage	Low	Low	Low
Slope Stability Hazard	Low	Low	Low
Allowable Soil Loss	1 tons/acre/year	1 tons/acre/year	1 tons/acre/year
Chance of Seedling Survival	Not Rated	Not Rated	Not Rated
Rating for Timber Site	Not Rated	Not Rated	Not Rated
R-Value	0-30	30-60	0-30
Soil horizons in inches, USDA, Unified, AASHTO	0-4; Very cobbly loam Unified: SC, CL AASHTO: A-6 4-18; Clay Unified: CH AASHTO: A-7 18+; Silica duripan	0-2; Very cobbly loam Unified: SM-SC, SC AASHTO: A-2-4, A-4 2-10; Clay loam Unified: CL, MH AASHTO: A-6 10-13; Clay Unified: CH AASHTO: A-7 13-14; Silica duripan 14+; Unweathered bedrock	0-5; Very stony clay loam Unified: ML, CL AASHTO: A-6, A-7 5-19; Clay loam, clay Unified: CL, CH AASHTO: A-7 19-28; Silica duripan 28+; Unweathered bedrock
Included Areas:	Included with these soils in mapping and making up about 15 percent of the acreage are the Deven, Pass Canyon, Simpson, Barnard, Aikman and Fordice families and Lithic Xerorthents, mesic.		

136 CARDON FAMILY, 0 to 2 percent slopes

Map Unit Components	Cardon family (75 percent)
Position, Slope, and Elevation	On nearly level slightly concave alluvial basins and drainages, (subject to spring flooding); 0 to 2 percent slopes; 4700 to 5200 feet.
Typical Vegetation and Precipitation (ppt)	Silver sagebrush, sedges, forbes, timothy, Kentucky bluegrass, other grasses; 14 to 18 inches ppt.
Surface Layer	0 to 4 inches; very dark gray clay, black, moist, platy and blocky structure, hard, pH 6.8.
Substratum	4 to 36 inches; dark gray clay very dark gray, moist, prismatic and angular blocky structure, extremely hard, pH 6.8: over 36 to 60 inches; mottled grayish brown, light brownish gray to olive yellow clay and clay loam, blocky structure, hard to very hard, pH 7.0 to 7.2.
Rooting Depth (in.) to Underlying Material	40 plus; clayey alluvium
Erosion Factor (K)	.37
Max. Erosion Hazard	Moderate
Soil Permeability	Very slow
Drainage Class	Somewhat poorly drained
Soil Manageability Class	3eW
Group	III
Forest Site Class	7 (non-commercial)
Range Site	26, 25
Water Runoff Potential	Very Slow
Watershed Sensitivity	6 (Moderate)
Hydrologic Soil Group	D
Available Water Capacity (AWC)	Moderate to High
Upper 20 inches	2.6 inches
Susceptibility to Burning Damage	Low
Slope Stability Hazard	Low
Allowable Soil Loss	5 tons/acre/year
Chance of Seedling Survival	Not Rated
Rating for Timber Site	Not Rated
R-Value	0-30
Soil horizons in inches, USDA, Unified, AASHTO	0-36; Clay Unified: CH AASHTO: A-7 36-46; Clay, Clay loam Unified: CH, CL, MH AASHTO: A-6, A-7 46-60; Clay Unified: CH AASHTO: A-7
Included Areas:	Included with this soil in mapping and making up about 25 percent of the acreage are the Aikman, Barnard and Bieber families and unnamed Xerofluvents and Aquolls.

137 CARDON-JACKET-DEVEN FAMILIES ASSOCIATION, 5 to 25 percent slopes

Map Unit Components	Cardon family (35 percent)	Jacket family (25 percent)	Deven family (25 percent)
Position, Slope, and Elevation	On lower sideslopes and alluvial drainages of mountain uplands; 5 to 15 percent slopes; 5600 to 6200 feet.	On sideslopes and ridges of mountain uplands; 5 to 25 percent slopes; 5600 to 6200 feet.	On sideslopes and knolls and eroded drainages of mountain uplands; 5 to 25 percent slopes; 5600 to 6200 feet.
Typical Vegetation and Precipitation (ppt)	Sedges, forbes, moss, timothy, Poa spp., other grasses; 18 to 20 inches ppt.	Ponderosa pine, few white fir, western juniper, mountain mahogany, big sagebrush, Ross's sedge, few grasses; 18 to 20 inches ppt.	
Surface Layer	0 to 4 inches; very dark gray clay, black, moist, platy and blocky structure, hard, pH 6.8.	1 to 0 inches, ponderosa pine needles and twigs, over 0 to 2 inches; very dark grayish brown cobbly clay loam, granular structure, slightly hard, pH 6.2.	0 to 2 inches; brown cobbly loam, platy and granular structure, slightly hard, pH 7.0.
Substratum	4 to 36 inches; dark gray clay, very dark gray, moist, prismatic and angular blocky structure, extremely hard, pH 6.8; over 36 to 60 inches; mottled grayish brown, light brownish gray to olive yellow clay and clay loam, blocky structure, hard to very hard, pH 7.0 to 7.2.	34 plus inches; weathered in place platy to massive semi-soft volcanic tuff.	13 to 25 plus inches; weathered in place platy to massive soft to hard volcanic tuff.
Rooting Depth (in.) to Underlying Material	40 plus; tuff, clayey alluvium	20 to 40; tuff	10 to 20; tuff
Erosion Factor (K)	.37	.32	.37
Max. Erosion Hazard	Moderate	Moderate	Moderate
Soil Permeability	Very slow	Slow	Slow
Drainage Class	Somewhat poorly drained	Well drained	Well drained
Soil Manageability Class Group	3eW II	2e	2ed
Forest Site Class	7 (non-commercial)	5-6 (3-5)	7 (non-commercial)
Range Site	25	Not placed in a range site.	23, 8
Water Runoff Potential	Moderate	Moderate	Rapid
Watershed Sensitivity	4 (High)	5	4
Hydrologic Soil Group	D	C	D
Available Water Capacity (AWC) Upper 20 inches	Moderate to High 2.6 inches	Low to Moderate 2.6 inches	Very Low to Low 1.4 to 2.9 inches
Susceptibility to Burning Damage	Low	Moderate	Low
Slope Stability Hazard	Low	Low	Low
Allowable Soil Loss	5 tons/acre/year	2 tons/acre/year	1 tons/acre/year
Chance of Seedling Survival	Not Rated	Low	Not Rated
Rating for Timber Site	Not Rated	Fair (7,10)	Not Rated
R-Value	0-30	0-30	0-30

137 CARDON-JACKET-DEVEN FAMILIES ASSOCIATION (continued)

Soil horizons in
inches, USDA,
Unified, AASHTO

0-36; Clay Unified: CH AASHTO: A-7	0-2; Cobbly clay loam Unified: CL, MH AASHTO: A-6	0-2; Cobbly loam Unified: ML-CL, CL AASHTO: A-4, A-6
36-46; Clay, clay loam Unified: CH, CL, MH AASHTO: A-6, A-7	2-34; Clay Unified: CH AASHTO: A-7	2-13; Clay loam, clay Unified: CL, CH AASHTO: A-7
46-60; Clay Unified: CH AASHTO: A-7	34+; Weathered bedrock	13+; Weathered bedrock

Included Areas:

Included with these soils in mapping and making up about 15 percent of the acreage are the Hiibner, Lawyer and Keating families and Lithic Xerorthents, mesic.

138 SAPRISTS, 0 to 2 percent slopes

Map Unit Components	Saprists (70 percent)
Position, Slope, and Elevation	On slightly concave alluvial basins and drainages (subject to spring flooding); 0 to 2 percent slopes; 5000 to 5100 feet.
Typical Vegetation and Precipitation (ppt)	Club moss, milk thistle, foxtail barley, sedges, forbes and other grasses; 14 to 16 inches ppt.
Surface Layer	0 to 24 inches of black to dark reddish brown highly decomposed organic matter; soft platy structure; (pH 6.2-6.6) over 24 to 60 inches of black with 50 to 60 percent mottled colors of very dark gray and light brownish gray highly decomposed organic matter; soft platy structure; (pH 6.4-6.8).
Rooting Depth (in.) to Underlying Material	40 plus; decomposed organic matter
Erosion Factor (K)	Not Rated.
Max. Erosion Hazard	Low
Soil Permeability	Slow
Drainage Class	Very poorly drained
Soil Manageability Class	3W
Group	III
Forest Site Class	7 (non-commercial)
Range Site	25
Water Runoff Potential	Very Slow
Watershed Sensitivity	9 (Low)
Hydrologic Soil Group	D
Available Water Capacity (AWC)	High
Upper 20 inches	4.0 inches
Susceptibility to Burning Damage	High
Slope Stability Hazard	Low
Allowable Soil Loss	Not Rated tons/acre/year
Chance of Seedling Survival	Not Rated
Rating for Timber Site	Not Rated
R-Value	0-30
Soil horizons in inches, USDA, Unified, AASHTO	0-60; Organic material Unified: Pt AASHTO: A-8
Included Areas:	Included with this soil in mapping and making up about 30 percent of the acreage are the Supan and Jacknife families and unnamed fluvaquents and Aquolls.

**139 CASTLEVALE-BAKEOVEN FAMILIES COMPLEX, 2 to 8 inch pumice overburden,
1 to 10 percent slopes**

Map Unit Components	Castlevale family (45 percent)	Bakeoven family (35 percent)
Position, Slope, and Elevation	On undulating basalt plateaus; 1 to 10 percent slopes; 4200 to 4600 feet.	On undulating basalt plateaus; 1 to 10 percent slopes; 4200 to 4600 feet.
Typical Vegetation and Precipitation (ppt)	Western juniper, big sagebrush, low sagebrush, rabbitbrush, mustard, buckwheat, wheatgrass, cheatgrass; 10 to 14 inches ppt.	Western juniper, few ponderosa pine, big sagebrush, bitterbrush, wheatgrass, cheatgrass, other grasses 10 to 14 inches ppt.
Surface Layer	8 inches of pumice overburden consisting of grayish brown very gravelly coarse sandy loam grading to pale brown extremely gravelly coarse sandy loam. (Pumice thickness ranges from 2 to 8 inches.) OVER 8 to 13 inches; yellowish brown gravelly sandy loam, subangular blocky structure, soft, pH 6.8.	A thin pumice overburden up to 8 inches thick may be present, OVER 0 to 11 inches; dark grayish brown and grayish brown very cobbly fine sandy loam, subangular blocky structure; slightly hard, pH 6.6.
Rooting Depth (in.) to Underlying Material	8 to 20; basalt	10 to 20; basalt
Erosion Factor (K)	.24	.24
Max. Erosion Hazard	Low to moderate	Low to moderate
Soil Permeability	Moderate	Moderately rapid
Drainage Class	Well drained	Well drained
Soil Manageability Class Group	2ed II	2ed
Forest Site Class	7 (non-commercial)	7 (non-commercial)
Range Site	4, 1	7
Water Runoff Potential	Slow	Slow
Watershed Sensitivity	7 (Moderate)	7
Hydrologic Soil Group	D	D
Available Water Capacity (AWC) Upper 20 inches	Very Low to Low 1.0 to 2.4 inches	Very Low to Low 1.0 to 1.9 inches
Susceptibility to Burning Damage	Moderate	Moderate
Slope Stability Hazard	Low	Low
Allowable Soil Loss	1 tons/acre/year	1 tons/acre/year
Chance of Seedling Survival	Not Rated	Not Rated
Rating for Timber Site	Not Rated	Not Rated
R-Value	30-60	30-60
Soil horizons in inches, USDA, Unified, AASHTO	0-8; Very gravelly coarse sandy loam extremely gravelly coarse sandy loam. Unified: SW-SM, SM AASHTO: A-1-b, A-1-a 8-13; Gravelly sandy loam Unified: SM-SC, SM AASHTO: A-2-4 13-18; Gravelly loam Unified: SM-SC, SC AASHTO: A-4, A-6 18+; Unweathered bedrock	0-11; Very cobbly fine sandy loam Unified: SM, SM-SC AASHTO: A-4 11+; Unweathered bedrock
Included Areas:	Included with these soils in mapping and making up about 20 percent of the acreage are the Wenatchee and Searles families, Lithic Xerorthents, mesic, and Rock outcrop.	

**140 CASTLEVALE-WENATCHEE-SEARLES FAMILIES COMPLEX, 2 to 12 inch pumice overburden,
1 to 10 percent slopes**

Map Unit Components	Castlevale family (35 percent)	Wenatchee family (30 percent)	Searles family (20 percent)
Position, Slope, and Elevation	On convex areas of undulating basalt plateaus; 1 to 10 percent slopes; 4200 to 4600 feet.	On gentle concave areas on basalt plateaus; 1 to 5 percent slopes; 4200 to 4600 feet.	On gentle concave areas on basalt plateaus; 1 to 10 percent slopes, 4200 to 4600 feet.
Typical Vegetation and Precipitation (ppt)	Western juniper, big sagebrush, low sagebrush, rabbitbrush, mustard, buckwheat, bottlebrush, cheatgrass; 12 to 14 inches ppt.	Western juniper, big sagebrush, rabbitbrush, bitterbrush, Ribes spp., bottlebrush, needlegrass, sandberg bluegrass; 12 to 14 inches ppt.	
Surface Layer	8 inches of pumice overburden consisting of grayish brown very gravelly coarse sandy loam grading to pale brown extremely gravelly coarse sandy loam. (Pumice thickness ranges from 2 to 12 inches.) OVER 8 to 13 inches; yellowish brown gravelly sandy loam, subangular blocky structure, soft, pH 6.8.	9 inches of pumice overburden consisting of brown gravelly coarse sandy loam over very pale brown extremely gravelly coarse loamy sand (pumice thickness ranges from 2 to 12 inches) OVER 9 to 15 inches; pale brown fine sandy loam, subangular blocky structure, soft, pH 6.8.	A thin pumice overburden of up to 12 inches thick may be present, OVER 0 to 7 inches; brown gravelly sandy loam, gravels are pumice, granular structure, soft, pH 7.0.
Rooting Depth (in.) to Underlying Material	8 to 20; basalt	20 to 40; basalt	20 to 40; basalt
Erosion Factor (K)	.24	.20	.24
Max. Erosion Hazard	Low to moderate	Low	Low
Soil Permeability	Moderate	Moderate	Moderately slow
Drainage Class	Well drained	Well drained	Well drained
Soil Manageability Class	2edx	1	1
Soil Manageability Group	II		
Forest Site Class	7 (non-commercial)	7 (non-commercial)	7 (non-commercial)
Range Site	7, 1	16	16
Water Runoff Potential	Slow	Very Slow	Very Slow
Watershed Sensitivity	7 (Low)	8	9
Hydrologic Soil Group	D	B	B
Available Water Capacity (AWC) Upper 20 inches	Very Low to Low 1.0 to 2.4 inches	Low to Moderate 2.6 inches	Low to Moderate 2.3 inches
Susceptibility to Burning Damage	Moderate	Moderate	Moderate
Slope Stability Hazard	Low	Low	Low
Allowable Soil Loss	1 tons/acre/year	2 tons/acre/year	2 tons/acre/year
Chance of Seedling Survival	Not Rated	Not Rated	Not Rated
Rating for Timber Site	Not Rated	Not Rated	Not Rated
R-Value	30-60	30-60	30-60

140 CASTLEVALE-WENATCHEE-SEARLES FAMILIES COMPLEX (continued)

Soil horizons in inches, USDA, Unified, AASHTO

0-8; Very gravelly coarse sandy loam, extremely gravelly coarse sandy loam Unified: SW-SM, SM AASHTO: A-1-b, A-1-a	0-5; Gravelly coarse sandy loam Unified: SM AASHTO: A-1-b	0-7; Gravelly sandy loam Unified: SM, SM-SC AASHTO: A-4
8-13; Gravelly sandy loam Unified: SM-SC, SM AASHTO: A-2-4	5-9; Extremely gravelly loamy coarse sand Unified: SM, GM AASHTO: A-1-a, A-1-b	7-14; Cobbly loam Unified: ML-CL, CL AASHTO: A-4, A-6
13-18; Gravelly loam Unified: SM-SC, SC AASHTO: A-4, A-6	9-15; Fine sandy loam Unified: SM-SC, ML-CL 34+; AASHTO: A-4	14-34; Extremely cobbly loam Unified: SC AASHTO: A-6
18+; Unweathered bedrock	15-27; Loam Unified: CL AASHTO: A-4, A-6	Unweathered bedrock
	27+; Unweathered bedrock	

Included Areas:

Included with these soils in mapping and making up about 15 percent of the acreage are the Skalan, Stukel, Holland, Bakeoven families and Lithic Xerorthents, mesic, and Rock outcrop.

141 CAVANAUGH-PATIO deep FAMILIES ASSOCIATION, 35 to 65 percent slopes

Map Unit Components	Cavanaugh family (50 percent)	Patio family, deep (30 percent)
Position, Slope, and Elevation	On steep hummocky relief sideslopes of mountain uplands; 35 to 65 percent slopes; 5800 to 7200 feet.	On steep smooth sideslopes of mountain uplands; 35 to 65 percent slopes; 5800 to 7200.
Typical Vegetation and Precipitation (ppt)	White fir forest, or mixed conifer forest of white fir, ponderosa pine, incense- cedar, plus snowberry, ceonothus, mulesear, few grasses, Ross's sedge; 20 to 30 inches ppt.	White fir forest, or mixed conifer forest of white fir, ponderosa pine, plus snowberry, forbes, Ross's sedge, few grasses; 20 to 30 inches ppt.
Surface Layer	1 to 0 inches of white fir and ponderosa pine needles, over 0 to 13 inches; dark brown and brown cobbly loam to very cobbly loam, granular and blocky structure, slightly hard, pH 6.4.	1 to 0 inches of white fir needles, over 0 to 18 inches; yellowish brown very gravelly loam, granular structure, slightly hard, pH 6.2 to 6.8.
Rooting Depth (in.) to Underlying Material	30 plus; tuff	40 plus; andesite
Erosion Factor (K)	.37	.28
Max. Erosion Hazard	High	High
Soil Permeability	Slow	Moderate
Drainage Class	Well drained	Well drained
Soil Manageability Class	3S	3Ep
Soil Manageability Group	III	
Forest Site Class	4-5 (3-4)	4 (3)
Range Site	Not placed in a range site.	Not placed in a range site.
Water Runoff Potential	Rapid	Moderate
Watershed Sensitivity	4 (High)	6
Hydrologic Soil Group	C	B
Available Water Capacity (AWC)	Low to Moderate	Moderate
Upper 20 inches	2.5 inches	2.3 inches
Susceptibility to Burning Damage	Moderate	Moderate
Slope Stability Hazard	High	Low
Allowable Soil Loss	3 tons/acre/year	3 tons/acre/year
Chance of Seedling Survival	Low to Moderate	Low to Moderate
Rating for Timber Site	Fair (3,8)	Fair (8)
R-Value	0-30	30-60
Soil horizons in inches, USDA, Unified, AASHTO	0-7; Cobbly loam Unified: ML-CL, CL AASHTO: A-4, A-6 7-13; Very cobbly loam Unified: SM-SC, SC AASHTO: A-4, A-6 13-18; Very cobbly clay loam Unified: CL AASHTO: A-6 18-60; Very gravelly clay, extremely gravelly clay loam Unified: GC AASHTO: A-2-7, A-7	0-60; Very gravelly loam, extremely gravelly loam, extremely cobbly loam Unified: SM, SM-SC AASHTO: A-2-4, A-2-6
Included Areas:	Included with these soils in mapping and making up about 20 percent of the acreage are the Anatone, Wapal, DeMasters, Manila and Bertag families and Rock outcrop.	

142 CHEADLE-GALLATIN FAMILIES-ROCK OUTCROP ASSOCIATION, 10 to 60 percent slopes

Map Unit Components	Cheadle family (40 percent)	Gallatin family (30 percent)	Rock outcrop (15 percent)
Position, Slope, and Elevation	On upper sideslopes and convex areas of mountain uplands; 10 to 60 percent slopes; 7500 to 9000 feet.	On lower sideslopes and toeslopes of mountain uplands; 10 to 50 percent slopes; 7500 to 9000 feet.	On ridges and scarp faces of mountain uplands; 30 to 60 percent slopes; 7500 to 9000 feet.
Typical Vegetation and Precipitation (ppt)	Big sagebrush, low sagebrush, Phlox spp., buckwheat, mulesear, Idaho fescue, other grasses; 25 to 35 inches ppt.	Few white bark pine, few lodgepole pine, quaking aspen, big sagebrush, lupine, mulesear, skunk cabbage, Idaho fescue, other grasses; 25 to 35 inches ppt.	
Surface Layer	0 to 17 inches; dark grayish brown to brown very cobbly loam to very cobbly clay loam, granular and subangular blocky structure, slightly hard to hard, pH 6.6.	0 to 29 inches; dark grayish brown loam to very cobbly loam, granular to subangular blocky structure, slightly hard, pH 6.2 to 6.4.	NOT APPLICABLE: Basalt, andesite or conglomerated tuff bedrock with minor accumulations of aeolian soil deposition in some fractures.
Rooting Depth (in.) to Underlying Material	10 to 20; andesite, tuff	20 to 40; andesite, basalt	
Erosion Factor (K)	.37	.32	
Max. Erosion Hazard	Moderate to high	Moderate to high	
Soil Permeability	Moderate	Moderate	
Drainage Class	Well drained	Well drained	
Soil Manageability Class Group	3Ed III	2e	
Forest Site Class	7 (non-commercial)	7 (non-commercial)	
Range Site	9	14, 19	
Water Runoff Potential	Rapid	Moderate	Very Rapid
Watershed Sensitivity	4 (High)	6	0
Hydrologic Soil Group	D	B	
Available Water Capacity (AWC) Upper 20 inches	Very Low to Low 1.2 to 2.4 inches	Low to Moderate 3.2 inches	
Susceptibility to Burning Damage	Moderate	Moderate	
Slope Stability Hazard	Low	Low	
Allowable Soil Loss	1 tons/acre/year	2 tons/acre/year	
Chance of Seedling Survival	Not Rated	Not Rated	
Rating for Timber Site	Not Rated	Not Rated	
R-Value	30-60	30-60	
Soil horizons in inches, USDA, Unified, AASHTO	0-12; Very cobbly loam Unified; SM-SC, SC AASHTO: A-2-4, A-2-6, A-4, A-6 12-17; Very cobbly clay loam Unified: SC AASHTO: A-6, A-2-6 17+; Unweathered bedrock	0-21; Loam Unified: ML-CL, CL AASHTO: A-4, A-6 21-29; Very cobbly loam Unified: SM-SC, SC, ML-CL, CL AASHTO: A-4, A-6 29+; Unweathered bedrock	
Included Areas:	Included with this unit in mapping and making up about 15 percent of the acreage are the Duncom and Supervisor families, Lithic Cryochrepts, Tuff outcrop, Cryoborolls, wet and Rubble land.		