CALPINE

FOURMILE HILL GEOTHERMAL DEVELOPMENT PROJECT

Environmental Impact Statement
Environmental Impact Report

Volume II: Final EIS/EIR Appendices

State Clearinghouse No. 96062042

U.S. DEPARTMENT OF THE INTERIOR
BUREAU OF LAND MANAGEMENT

FOREST SERVICE
US
DEPARTMENT OF AGRICULTURE

County of Siskiyou
AIR POLLUTION CONTROL DISTRICT

BONNEVILLE
POWER ADMINISTRATION

FOURMILE HILL GEOTHERMAL DEVELOPMENT PROJECT

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7	Sanyal	Subir K.	President	GeothermEx, Inc.	Suite 201	5221 Central Avenue	Richmond	CA	94804-5829
8	Lovekin	Jim			2100 Jefferson Avenue		Berkeley	CA	94307-1415
9	Dechter	Nancy			705 Kenneth Way		Mt. Shasta	CA	96067
10	Ponder	Steve	Director of Regulatory Affairs	FPL Energy, Inc.	404 Mendocino Avenue, Suite 200		Santa Rosa	CA	95401
11	Colwell	Teri			P.O. Box 712		Seiad Valley	CA	96086
12	Cooley	Dean	Senior Engineer	Pacific Gas & Electric Company	Geysers Power Plant	P.O. Box 456	Healdsburg	CA	95448
13	Huttrer	G.W.	President	Geothermal Management Company, Inc.	720 Granite Street, #202		Frisco	CO	80443-2425
14	Wardlow	Charlene L.			2416 College Park Circle		Santa Rosa	CA	95401
15	Peterson	Russell & Theresa			Route 1, Box 299		TuleLake	CA	96134
16	Johnson	Stuart D.	Staff Geologist	Oxbow Power Services, Inc.	9790 Gateway Drive, Suite 220		Reno	NV	89511
17	Cozzalio	Rex			4041 Capco Road		Hornbrook	CA	96044
18	Cozzalio	Jan			4041 Capco Road		Hornbrook	CA	96044
19	Parker, Jr.	Bertrand A.			6435 Ager Road		Montague	CA	96064
20	Cowardin	R.M.			P.O. Box 231		Yreka	CA	96097
21	McInnis	R. Scott	Head of Project Finance Asia and Australia	ANZ Investment Bank	Global Structured Finance	10 Collyer Quay #17-01/07 Ocean Bldg.	Singapore		049315
22	Freeman	Gary G.			400 Holcomb Road		Montague	CA	96064
23	Robertson-Tait	Ann			50 Highland Boulevard		Kensington	CA	94707
24	Neibling	Harold E.			350 Empire Landing		Long Beach	CA	90803
25	Neibling	Harold E.			350 Empire Landing		Long Beach	CA	90803
26	Kelly	Lawrence	Attorney at Law		311 Collier Way		Etna	CA	96027-0816
27	Eberlein	Neal		Western Distribution Center	2795 Anderson Avenue		Klamath Falls	OR	97603
28	Fiock	Shari			P.O. Box 1854		Yreka	CA	96097
29	Krausse	Robert & Ethel			1509 Seacrest Lane		Brookings	OR	97415
30	Falcone	Don		PG&E Energy Services	345 California Street, 32nd Floor		San Francisco	CA	94104
31	Atcherson-Allen	Anne			3432 Peck Ave. #302		San Pedro	CA	90731
32	Schreiner, Jr.	Alex			235 Yellowstone Pl		Ridgecrest	CA	93555-5505
33	Pieruccini	Olivia			1020 Kingston Dr. #4D		Mt. Shasta	CA	96067
34	Dillman	Vaune V.			9809 North Old Stage Road		Weed	CA	96094
35	Gustafson	Gilda			16943 Antler Way		Weed	CA	96094
36	Janota	Raven			P.O. Box 2293		Redway	CA	95560
37	McAndrew	Abbey			P.O. Box 1413		Mt. Shasta	CA	96067
38	Zukav	Gary			200 N. Washington Dr.		Mt. Shasta	CA	96067
39	Cleaver	Ellen			1208 B N. Old Stage Road		Mt. Shasta	CA	96067
40	Liles	Christopher	President	Scott Valley Systems	P.O. Box 740		Etna	CA	96027
41	Morris	Anna C.			380 Siskiyou Way, Apt. 2		Weed	CA	96094
42	Risch	Peggy			709 Ski Bowl Dr.		Mt. Shasta	CA	96067
43	Grainger	Martha			135 Ski Village Dr.		Mt. Shasta	CA	96067
44	Faggella	George			1025 Deodar Way		Redding	CA	96003
45	West	Susan Doelger			P.O. Box 215		Mt. Shasta	CA	96067
46	Miller	Ray			P.O. Box 475		Mt. Shasta	CA	96067

COMMENTORS ON THE DRAFT EIS/EIR PREPARED FOR THE TELEPHONE FLAT GEOTHERMAL DEVELOPMENT PROJECT — THROUGH 9/14/98

#	Last Name	First Name	Title/Petition	Company	Street Address 1	Street Address 2	City	ST	ZIP
47	Parker	Jacqueline	Certified Physician Assistant		822 Pine Street		Mt. Shasta	CA	96067
48	Kraft	Harry			P.O. Box 123		Danville	CA	94526-0123
49	Miller	Christine			1800 N. Ladera Vista Dr.		Fullerton	CA	92831
50	Loijos	Sandra S.			4001 Eastside Calpella Rd.		Ukiah	CA	95482-9555
51	Wells	Vivian			6324 Shasta Way		Klamath Falls	OR	97603
52	Bowman	Gladys & Ralph			P.O. Box 1556		Alturas	CA	96101
53	Alford	Roberta J.			1517 W. A. Barr Road		Mt. Shasta	CA	96067
54	Yousie	Grant			9112 Rocky Road		Weed	CA	96094
55	Lewis	Laraine			1145 Neptune Way		Mt. Shasta	CA	96067
56	Rehberg	Christine A.			117 W. Lake St.		Mt. Shasta	CA	96067
57	Clutter	Ted J.	Executive Director	Geothermal Resource Council	P.O. Box 1350	2001 Second Street, Suite 5	Davis	CA	95617-1350
58	Fiock	W.B.			404 Walter's Lane		Yreka	CA	96097
59	Geoffian	Marc			3001 Fairlane Road		Yreka	CA	96097
60	Solo	Jacquelyn			P.O. Box 1713		Mt. Shasta	CA	96067-1713
61	Swanson	John A.			625 Marjorie St., Apt. 103		Mt. Shasta	CA	96067-2809
62	Treber	Ralph			1231 Audubon Road		Mt. Shasta	CA	96067
63	Searle	Colleen D.			200 Birch Street		Mt. Shasta	CA	96067
~~64~~	~~Macy~~	~~Natalie~~			~~Rural Route 2~~	~~P.O. Box 184~~	~~Tulelake~~	~~CA~~	~~96134~~
65	Sphan	Sandy			104 West A		Alturas	CA	96101
66	Tiff	Scott R.			205 Shasta Ct.		Mt. Shasta	CA	96067
67	Clark	Kimbal R.			P.O. Box 970		Mt. Shasta	CA	96067
68	Mulvaney	Julie			1933 Stewart St.		Oceanside	CA	92054
69	Taylor	Clarence			21 Brophy Way		Shady Cove	OR	97539
70	Carlin	David E.			1405 Bellevue Ave. #4		Burlingame	CA	94010
71	Mueller	Beulah			10516 Grovedale Dr.		Whittier	CA	90603
72	Henson	Ryan	Conservation Asscoiate	California Wilderness Coalition	P.O. Box 2346		Burney	CA	96013
73	Parsons, Alfred C.	and Folkerts, Lura			130 Villa Road		Mt. Shasta	CA	96067
74	Cowardin	R.M. (Dick)			P.O. Box 231		Yreka	CA	96097
75	Garg	Sabodh	Manager	Maxwell Technologies Inc.	8888 Balboa Avenue		San Diego	CA	92123
76	Reis	Patricia			P.O. Box 627		Mt. Shasta	CA	96067
77	Chitwood	Herbert R.			405 Jefferson Drive		Mt. Shasta	CA	96067
78	Meredeth	Susan Hays			1634 N. Old Stage		Mt. Shasta	CA	96067
79	Light	Bruce			211 Ackley Ave.		Mt. Shasta	CA	96067
80	Butler	Eruber			211 Ackley Avenue		Mt. Shasta	CA	96067
81	Righter	Patricia			P.O. Box 5		Ashland	OR	97520
82	Bennion	Frances L.			1310 Bay Laurel Drive		Menlo Park	CA	94025-5805
83	Wilt	Michael John			3255 Juniper		Santa Rosa	CA	95407
84	Janzen	Marvin L.			6098 AVE 422		Reedley	CA	93654
85	Thackeray	George R.	President	KARE	216 Lane St.	P.O. Box 1234	Yreka	CA	96097
86	Moss	Charles F.			2204 Pine Grove Drive		Mt. Shasta	CA	96067
87	Waring	Alysa			193 E. Division St.		Weed	CA	96094-2316
88	Rivers	Walter			227 Monte Vista		Larkspur	CA	94939
89	Hoffman	Jack and Jane			700 Oakway Rd.		Mt. Shasta	CA	96067
90	Thompson	Larry H.			1601 Felicia Court		Livermore	CA	94550
91	Treadway	Frank O.			1729 Chestnut St.		Redding	CA	96001
92	Gress, Barbara J.	and Semple, Tom			P. O. Box 480		Mt. Shasta	CA	96067
93	Sederholm, Eugene	and Ginter, Susan			P.O. Box 274		Dunsmuir	CA	96025
94	Grady	Kathi Mary			701 Metro Way		Redding	CA	96003

COMMENTORS ON THE DRAFT EIS/EIR PREPARED FOR THE TELEPHONE FLAT GEOTHERMAL DEVELOPMENT PROJECT — THROUGH 9/14/98

#	Last Name	First Name	Title/Petition	Company	Street Address 1	Street Address 2	City	ST	ZIP
95	du Vernet	Dean H.			1448 Fourth Street		Baywood Park	CA	93402-1606
96	Whipple	Ron			P.O. Box 279		Greenview	CA	96037
97	L'Carttier	Avona	General Manager	Arise & Shine Herbal Products	P.O. Box 901		Mt. Shasta	CA	96067
98	Miller	Victoria K. and Henry Shane			P.O. Box 37		Fall River Mills	CA	96028
99	Lewis	Laraine			1145 Neptune Way		Mt. Shasta	CA	96067
100	Sederholm, Eugene	and Ginter, Susan			P.O. Box 274		Dunsmuir	CA	96025
101	Berg	Robert W.			1707 Loafer Hill Rd.		Yreka	CA	96097-9429
102	Wolfe	Leon A.			P.O. Box 23		Mt. Shasta	CA	96067
103	Theil	Sheila			1707 Loafer Hill Road		Yreka	CA	96097
104	Ruelas	Norma			P.O. Box 691		Woodacre	CA	94973
105	Janson	William R.			910 Juniper Drive		Yreka	CA	96097
106	Maier.	Eileen K			730 Greenhorn Road		Yreka	CA	96097
107	Anderson	Ken			730 Green horn Road		Yreka	CA	96097
108	Gould	Catherine			418 Chestnut St. #A		Mt. Shasta	CA	96067-2215
109	Brees	Robert E.			801 Sierra Vista #38		Yreka	CA	96097
110	Hewes	Hal			P.O. Box 271		Etna	CA	96027
111	Schulman	Gail B.			801 Sierra Vista Way #36		Yreka	CA	96097
112	Woodward	Doris			801 Sierra Vista #39		Yreka	CA	96097
113	Cousins	Charlene			2230 Davis Place Rd.		Mt. Shasta	CA	96067
114	Garnette	Andrea			5630 San Diego #3		El Cerrito	CA	94530-3853
115	Jasmer	Lynnette & Bill			30622 Crag View Dr.		Dunsmuir	CA	96025
116	Swanson	John R.			3400 Edmund Blvd.		Minneapolis	MN	55406
117	Teague	Donald S.			11106 Apache Road		Montague	CA	96064-9783
118	Pappe	Don & Judy		Medicine Lake Homeowners Association	12513 Carinthia Dr.		Whittier	CA	90601
119	Stewart	Eloise			11106 Apache Road		Montague	CA	96064
120	Teague	Phyllis			11106 Apache Road		Montague	CA	96064
121	Cox	Susan E.			P.O. Box 1046		Welches	OR	97067
122	Anderson	Clifford E.			2514 N. St.		Sacramento	CA	95816
123	Hesseltine	Glenda			1142 Rivergate Dr. #6		Lodi	CA	95240
124	Gould	C.			418 Chestnut #4		Mt. Shasta	CA	96067
125	Singh	Sulakshna			2689 Sycamore Lane, Apt. D5		Davis	CA	95616
126	Bhakti, Ph.D.	Sara			P.O. Box 652		Santa Cruz	CA	95061
127	Levin	Joan B.			1120 Nye St., #300		San Rafael	CA	94901
128	Lynn	Karen E.			98 Porteous Avenue		Fairfax	CA	94930
129	De Wang	J.L.			P.O. Box 177		Happy Camp	CA	96039
130	Lawson	Monica			6652 Wynne Avenue		Reseda	CA	91335
131	Lyons	Kathy			P.O. Box 127		Weed	CA	96094
132	Liles	Christopher		City of Etna	P.O. Box 460		Etna	CA	96027
133	Silva	Ronald & Jackie			2260 South State Street		Ukiah	CA	95482
134	Cogar	Lisa			4432 Pampas Avenue		Oakland	CA	94619
135	Teague	Don			11106 Apache Road		Montague	CA	96064
136	Yostovriamal	Ed			P.O. Box 1402		Mt. Shasta	CA	96067
137	Morrison	Jim			808 Northridge Court		Yreka	CA	96097
138	Cruz	Del			4150 San Pablo Dam Road #7		El Sobrante	CA	98403
139	Arndt	Marion			6048 Little Neck Pkwy.		Little Neck	NY	11362-2534
140	Thompson	Eve and Jay			723 Pine Ridge Avenue		Mt. Shasta	CA	96067
141	Goldsmith	Warren H.			11138 Apache Road		Montague	CA	96064
142	Gutierrez, Mona	and Marrone, Chris			1037 Lassen Lane		Mt. Shasta	CA	96067

COMMENTORS ON THE DRAFT EIS/EIR PREPARED FOR THE TELEPHONE FLAT GEOTHERMAL DEVELOPMENT PROJECT — THROUGH 9/14/98

#	Last Name	First Name	Title/Petition	Company	Street Address 1	Street Address 2	City	ST	ZIP
143	Phillips	Antoinette C.			2230 Davis Place Road		Mt. Shasta	CA	96067
144	Seeley	Jane			P.O. Box 1472		Mt. Shasta	CA	96067
145	Rehberg	Christine A.			1004 Rockfellow Drive		Mt. Shasta	CA	96067
146	Keno	Linda & Jim			805 W. Miner St.		Yreka	CA	96097
147	Wideman	Rick L.			P.O. Box 713		McCloud	CA	96057
148	Collins	Creta			1020 Kingston #4E		?	?	?
149	Ryan	Shannon			1736 Hutchinson Lane		Silver Springs	MD	20906
150	Perlman	Melinda			P.O. Box 117		Greenview	CA	96037
151	Stanewick	Richard J.			94 Beverly Dr.		Arcata	CA	95521
152	Van Keuren	Felix and Julie			P.O. Box 1304		Mt. Shasta	CA	96067
153	Stevenson	Stacy K. & Anita			P.O. Box 555		Dorris	CA	96023
154	Bradfield	Susan			8828 Sun Valley Dr.		Palo Cedro	CA	96073
155	Mulvaney	Ana K.			4413 Holly Avenue		Dunsmuir	CA	96025
156	Miller	Meredith A.			P.O. Box 567		Mt. Shasta	CA	96067
157	Maier-Anderson	Eileen K.	President	Mt. Shasta Sno-Mobilers, Inc.	P.O. Box 341		Mt. Shasta	CA	96067
158	Maier-Anderson	Eileen K.	President	Mt. Shasta Sno-Mobilers, Inc.	P.O. Box 341		Mt. Shasta	CA	96067
159	Mazzini	Shari			21862 Second St.		Burney	CA	96013
160	Maier	Eileen K.		Graphics by Ei'	730 Greenhorn Road		Yreka	CA	96097
161	Johnson	Kristy			P.O. Box 1278		Mt. Shasta	CA	96067
162	Maier	Eileen K.			730 Greenhorn Road		Yreka	CA	96097
163	Dillon	John			P.O. Box 1644		Mt. Shasta	CA	96097
164	Maier-Anderson	Eileen K.	President	Mt. Shasta Sno-Mobilers, Inc.	P.O. Box 341		Mt. Shasta	CA	96067
165	Foulk.	Dorinda			P.O. Box 1644		Mt. Shasta	CA	96067
166	Spencer	Lorin C. and Annabel T.			1894 North Euclid Avenue		Upland	CA	91784
167	Anderson	Ken		Mt. Shasta Snowmobile Club	730 Greenhorn Road		Yreka	CA	96097
168	Shipman	Wendy & Greg		Mt. Shasta Snowmobile Club	1305 Terrace Dr.		Yreka	CA	96097
169	Parker	Robert D.			1955 Meadow Road		Chico	CA	95926
170	Cockburn	Judith L.			725 Pine St.		Mt. Shasta	CA	96067
171	Skeahan	Greg			611 Annie St.		Yreka	CA	96097
172	Maier	Eileen		Mt. Shasta Snowmobile Club	730 Greenhorn Road		Yreka	CA	96097
173	Rhoades	Rich			1634 N. Old Stage Rd.		Mt. Shasta	CA	96067
174	Langner	Mark			P.O. Box 581		Bridgeport	CA	93517
175	Friden	Stanley M.		Cloud Rim Ranch	8909 Oro Fino Road		Fort Jones	CA	96032
176	Morgan	Dianna			P.O. Box 1771		Mendocino	CA	95460
177	Da	Vid			20 Sunnyside A-156		Mill Valley	CA	94941
178	Jameson	Linda			P.O. Box 855		Mt. Shasta	CA	96067
179	Eastman	Walter Robert			5728 Porcupine Ct.		Lake Shastina/Weed	CA	96094-9326
180	Souza	Robert N.			P.O. Box 587		Seiad Valley	CA	96086
181	Savage	Jennifer			1641 N. Shasta Ranch Rd.		Mt. Shasta	CA	96067
182	Smith	Ann			141 San Francisco Ave. #2		Brisbane	CA	94005
183	Tozier	Elizabeth R.			P.O. Box 815		Aromas	CA	95004
184	Walker	Agnes			17895 Silver Pine Dr.		Penn Valley	CA	95946
185	Risch	Peggy			709 Ski Bowl Dr.		Mt. Shasta	CA	96067
186	Martin	Frances			5711 Denny Avenue		North Hollywood	CA	91601
187	Shockley	Megan			P.O. Box 185		Montague	CA	96064
188	Capovilla	Louie J.			4305 Gray Street		Dunsmuir	CA	96025
189	Salin	Sierra			P.O. Box 758		Fairfax	CA	94930
190	Mays-Salin	Sarah			P.O. Box 758		Fairfax	CA	94930

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#	Last Name	First Name	Title/Petition	Company	Street Address 1	Street Address 2	City	ST	ZIP
191	Miller	Gerry			855 6th St. Apt#12		Santa Monica	CA	90403
192	Makabe	E.			P.O. Box 5766		Hilo	HI	96720
193	Jones	Frances W.			1655 Manitoba Dr.		Sunnyvale	CA	94087
194	Etgen	Benjamin			3600 Whitney Avenue		Sacramento	CA	95821-3128
195	Goodman	Lion			322 Upper Rd.		San Rafael	CA	94903-3041
196	Weinberger	Carolyn D. Jones	Attorney at Law		2844 Garber St.		Berkeley	CA	94705-1315
197	Lightwater	Duane	Attorney and Counselor at Law		512-B Spruce Street		Mt. Shasta	CA	96067
198	Malikowski	Alex			39554 162nd Street, East		Palmdale	CA	93550
199	Stauss	Barbara			363 W. Bissell Ave.		Richmond	CA	94801
200	Woltz	Russell D.			942 Brookwood Avenue		Vallejo	CA	94591
201	Spencer	Amanda	Hyrdogeologist		121 Lincoln Dr.		Sausalito	CA	94965
202	Abitz	James			121 Lincoln Dr.		Sausalito	CA	94965
203	Buchter	Catherine A.			2406 Overlook Drive		Walnut Creek	CA	94596
204	Lusk	Mike			P.O. Box 354		Shasta	CA	96087
205	Moran	Florence	(Petition - 2 names)	Pit River, Ajumai Band	P.O. Box 85		Nubieber	CA	96068
206	Moran	Florence		Pit River Tribe, ICW, Ajumai Band	P.O. Box 85		Nubieber	CA	96068
207	Hill	Bryan K.	Shasta Group Chair	Mother Lode Chapter, Sierra Club	7294 Churn Creek Road		Redding	CA	96002
208	Verrill	Wayne			1621 Eligio Lane		Davis	CA	95616
209	Sedler	Moses			P.O. Box 1124		Fairfax	CA	94978
210	Shaw	John			NO ADDRESS PROVIDED		?	?	
211	Lawton	Corby E.			237 Picnic Ave. #6		San Rafael	CA	94901
212	Bowman	Richard			2319 5th Avenue		San Rafael	CA	94901
213	Griffith	Dean			2319 5th Avenue		San Rafael	CA	94901
214	Griffith	Tami			2319 5th Avenue		San Rafael	CA	94901
215	Paige	Patricia			712 Tamarck Dr.		San Rafael	CA	94903
216	St James	Joelle			16 Stadium Way		Kentfield	CA	94904
217	Jooz	Martha			426 Woodland Avenue		San Rafael	CA	94901
218	Odom	Joseph			98 Porteous Avenue		Fairfax	CA	94930
219	Zilber	Stephen			185 North Redwood Dr., Suite 220		San Rafael	CA	94903
220	Harris	Linda		c/o Bennatte House	NO ADDRESS PROVIDED		Fairfax	CA	94930
221	Daniels III	William R.			34 Forest St.		Mill Valley	CA	94941
222	Farrow	Laura			34 Forest ST.		Mill Valley	CA	94941
223	Finkbine	Steven			22 Belle Ave.		San Anselmo	CA	94560
224	Ginsberg	Jeffery			27 Vista Way		Fairfax	CA	94930
225	MacRauiri	Paadraig			310 Norton Avenue		Blackpoint	CA	94949
226	Dale	Donald			439 D St.		Colma	CA	94014
227	Dale	Toni Ann			439 D. St.		Colma	CA	94014
228	Fox	Tom			92 Meerwaa Ave		Fairfax	CA	94930
229	Spencer, Ph.D.	Daniel T.	Asst. Professor of Religion & Ethics	Department of Philosophy and Religion	Drake University		Des Moines	IA	50311
230	Server	Michael,Janet,Collyn, & Matthew			400 East C Street		Alturas	CA	96101
231	Taylor	Steve			1178 Weatherby Ct "A"		Redding	CA	96003
232	Feeney	Krista			71 Ridge Road		Highland Mills	NY	10930
233	Mitchell	Jeff C.	Chairman	Klamath Tribes Executive Committee	P.O. Box 436		Chiloquin	OR	97624
234	Thompson	Louise			1235 W. Scenic Dr.		Mt. Shasta	CA	96067
235	Austin	Roy			380 Mulberry Avenue, Apt. 1		Red Bluff	CA	96080
236	Russell	Lawrence A.			16010 Cloverdale Road		Anderson	CA	96007
237	Kenyon	Eddie			2721 Viking Way		Redding	CA	96003

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#	Last Name	First Name	Title/Petition	Company	Street Address 1	Street Address 2	City	ST	ZIP
238	Lain	Edward C.			915 W. Miner St., Apt. 48		Yreka	CA	96097
239	Kustal	J.L.		Lamplighters	Heather St., Botley		Hands	U.K.	S0322BT
240	Willcox	Faith M.			414 Steinman Dr.		Ashland	OR	97820
241	Stanley	Melvin D.			1607 Holiday Ln.		Mt. Shasta	CA	96067
242	Cozzalio	Glen			4041 Copco Road		Hornbrook	CA	96044
243	Robinson	Anne			P.O. Box 62		Orleans	CA	95556
244	Denton	John		Great Basin Tree Foundation	1720 Johnson Avenue		Klamath Falls	OR	97601
245	Cardinal	Claudia			754 Timber Way		Weaver	AL	36277
246	Taggart & Family	Greg M.			7568 Sycamore Dr.		Citrus Heights	CA	95610
247	Basker	Paul		Rose Construction	39 Belmont Avenue		Fairfax	CA	94930
248	Kusin	Phyllis			39 Belmont		Fairfax	CA	94930
249	Cameron	William R.			14 Goldfinch Court		Novato	CA	94947
250	Smith	Ronald E.			105 Quail Lane		Bishop	CA	93514
251	Leonard	LeLand			9837 Mathew Ct.		Mt. Shasta	CA	96067
252	Rongen	Anna			1448 Fourth Street		Los Osos	CA	93402
253	Kenyon	Russelle			2721 Viking Way		Redding	CA	96003
254	Scott	Sabira			NO ADDRESS PROVIDED		Mt. Shasta	CA	96067
255	Crespo	Maria-Laura			1111 Butterfield Road		Sajn Anselmo	CA	94960
256	McNames	James			?		?	?	?
257	Hensley	Jack D.			13824 Quartz Valley Road		Fort Jones	CA	96032
258	Epperson	Roy L. & Dorothy D.			605 W. A. Barr Road		Mt. Shasta	CA	96067
259	Borg	Ed			P.O. Box 47		Gazelle	CA	96034
260	Copeland	Railien			P.O. Box 362		Grenada	CA	96038
261	Haining	Jim			801 S. Vista #7		Yreka	CA	96097
262	Heller	Joseph			406 Berry Street		Mt. Shasta	CA	96067
263	Finan	Karen			P.O. Box 827	2139 Eddys Circle	Mt. Shasta	CA	96067
264	Downes	Kathleen			302 E. Jessie Street		Mt. Shasta	CA	96067
265	Gonzalez	Carrie			4041 Copco Road		Hornbrook	CA	96044
266	Truttman	Gary E.			P.O. Box 875		Montague	CA	96064
267	Simpson	Ruth			P.O. Box 1513		Yreka	CA	96097
268	Yount	Jeanne			45115 Pine Shadows Road		McArthur	CA	96056
269	Kingland	Autumn			P.O. Box 173		Montague	CA	96064
270	Cottini	Shawn			4042 Copco Road		Hornbrook	CA	96044
271	Cottini	Dawna			4041 Copco Road		Hornbrook	CA	96044
272	Brown	John E. Jr. & Lilia L.			P.O. Box 931		Mt. Shasta	CA	96067
273	Glover	Shelly			1525 Fresia Way		Redding	CA	96003
274	Mulvaney	Ana K.			4413 Holly Avenue		Dunsmuir	CA	96025
275	Mulvaney	Ana K.			4413 Holly Avenue		Dunsmuir	CA	96025
276	Hagge	Sharron			4427 N. Dunsmuir Avenue		Dunsmuir	CA	96025
277	Hagge	Danny			4427 N. Dunsmuir Avenue		Dunsmuir	CA	96025
278	Hagge	Jacquacy			4427 N. Dunsmuir Avenue		Dunsmuir	CA	96025
279	Bish	David A.			1637 Cessna Court		Redding	CA	96001
280	Kingston	Mindy			P.O. Box 1397		Mt. Shasta	CA	96067
281	Bowen	Bruce			16326 Acero Dr.		Anderson	CA	96007
282	Renner	Joel L.			334 Springwood Lane		Idaho Falls	ID	83404
283	Smith	Joan T.	Chairperson	Ore-Cal RC&D Council	308 Main Street	P.O. Box 785	Dorris	CA	96023
284	Griffith	Ron			30805 Cragview Dr.		Dunsmuir	CA	96025
285	Morgan	Clarence			715 ButteSt.		Yreka	CA	96097

COMMENTORS ON THE DRAFT EIS/EIR PREPARED FOR THE TELEPHONE FLAT GEOTHERMAL DEVELOPMENT PROJECT — THROUGH 9/14/98									
#	Last Name	First Name	Title/Petition	Company	Street Address 1	Street Address 2	City	ST	ZIP
286	Malby	Glenn		Echo Mountain Stone	Tionesta Road, Box 6		Tulelake	CA	96134
287	Gardner	Catherine			515 Redwood Road		Mt. Shasta	CA	96067
288	Williams	Wilhelmina V.			801 Sierra Vista #35		Yreka	CA	96097
289	Feeney	John			42 Ridge Road		Highland Mills	N.Y.	10930
290	Morris	Angela			P.O. Box 208		Pt. Reyes	CA	94956
291	Lee	Mike & Dona			30534 Pudding Creek Road		Fort Bragg	CA	95437
292	Kingston	Mindy			P.O. Box 1397		Mt. Shasta	CA	96067
293	Farioletti	Elizabeth V.			6434 N. Old Stage Road		Weed	CA	96094
294	Losekoot	W.T.			50 Eureka Avenue		Kensington	CA	94707
295	Moore	Michael			2301 Alva Avenue		El Cerrito	CA	94530
296	White	Jack			801 Seirra Vista #34		Yreka	CA	96097
297	Johnson	Mitchell			1528 Lassen Ct.		Vallejo	CA	94591
298	Glaick	Heather			1061 Felicia Court		Li vermore	CA	94550
299	Farrel	David	Chief Federal Activities Officer	U.S. Environmental Protection Agency, Region IX	75 Hawthorne Street		San Francisco	CA	94105
300	Krout	Patricia			2638 N. Harbor Blvd.		Fullerton	CA	92835
301	Samson	Wil			19196 Farwell Avenue		Saratoga	CA	95070
302	Economou	Constantina			10 Panoramic Way		Berkeley	CA	94704
303	Fontenot	Patrick			P.O. Box 884	2 Elm Avenue	Woodacre	CA	94973
304	Capovilla	Louie J.			4305 Gray Street		Dunsmuir	CA	96025
305	Metcalf	Barbara R.			HC04 Box 42501		Alturas	CA	96101
306	Goulden	Tami Lynn			1704 N. Court St.		Alturas	CA	96101
307	Goulden	Yvonne			1704 N. Court St.		Alturas	CA	96101
308	Faist	Betty			1216 Cedarbrook Way		Sacramento	CA	95831
309	Myers	Pamela			P.O. Box 700		Mt. Shasta	CA	96067
310	Claycomb	Christine			828 Douglas Lane		Mt. Shasta	CA	96067
311	Wilson	John			6281 Center Dr.		Redding	CA	96001
312	Wiz	Marty			2102 Tanager Lane		Mt. Shasta	CA	96067
313	Wolfe	Iris			1217 Wertz Road		Mt. Shasta	CA	96067
314	Gengel	Roy W.			1217 Wertz Road		Mt. Shasta	CA	96067
315	Hall	Susan Faist			7648 Roman Oaks Way		Sacramento	CA	95831
316	Hall	Mike			7648 Roman Oaks Way		Sacramento	CA	95831
317	Samson	Marianna			19196 Farwell Avenue		Saratoga	CA	95070
318	Paine	Pan Brian			2530 Dale Creek Road		Weed	CA	96094
319	Baird	Bill			2234 Avalon Drive		Sacramento	CA	95864
320	Baird	Karen			2234 Avalon Drive		Sacramento	CA	95864
321	Ruelas	Norma			P.O. Box 691		Woodacre	CA	94973
322	Lusk	Mike			P.O. Box 354		Shasta	CA	96087
323	Green	G.S.			4429 Las Encinitas Dr.		Fair Oaks	CA	95628
324	Ruelas	Santiago			P.O. Box 691		Woodacre	CA	94973
325	Petterson	Katherine			P.O. Box 543		Kelseyville	CA	95451
326	Fontenot	Valerie B.			P.O. Box 884		Woodacre	CA	94973
327	Malikowski	Marie			39554 162nd Street, East		Palmdale	CA	93550
328	Holub, Ana	and Lucas, Richard			510 Sarah Bell		Mt. Shasta	CA	96067
329	Harman	Bruce			P.O. Box 770		Mt. Shasta	CA	96067
330	Sturgis	Victoria			7470 Seneca Place		La Mesa	CA	91941
331	Glover	Shelley	(Petition - 3 Names)		1525 Fresia Wayh		Redding	CA	96003
332	Painter	Janie	(Petition 787 Names and 105 Form Letters)		1307 Audubon Road		Mt. Shasta	CA	96067

COMMENTORS ON THE DRAFT EIS/EIR PREPARED FOR THE TELEPHONE FLAT GEOTHERMAL DEVELOPMENT PROJECT — THROUGH 9/14/98

#	Last Name	First Name	Title/Petition	Company	Street Address 1	Street Address 2	City	ST	ZIP
333	Painter	Janie			1307 Audubon Road		Mt. Shasta	CA	96067
334	Painter	Rob			1307 Audubon Road		Mt. Shasta	CA	96067
335	Painter	Alison			1307 Audubon Road		Mt. Shasta	CA	96067
336	Plank	Carole			605 GlenMar Dr.		Mt. Shasta	CA	96067
337	Tift	Leslie			205 Shasta Ct.		Mt. Shasta	CA	96067
338	Small	Jean			3845A Vineyard Ave		Pleasanton	CA	94566
339	Small	R. Evans Jr.			3845A Vineyard Avenue		Pleasanton	CA	94566
340	Thomas	Don			5325 Marconi Ave., #59		Sacramento	CA	95608
341	Davis	Suzanne			3940 Oak Villa Circle		Carmichael	CA	95608
342	Brewer	Richard			9319 Vandevire Dr.		Navarre	FL	32566
343	McDonald	Randy			305 Perry Avenue		Mt. Shasta	CA	96067
344	Brewer	Kelly			9319 Vandivere Dr.		Navaree	FL	32566
345	Harris	Dave			16 Winchester Circle		Lebanon	PA	17046
346	Harris	Noell			16 Winchester Circle		Lebanon	PA	17046
347	Turk	David			201 W. Lake		Mt. Shasta	CA	96067
348	Smith	Constana M.			705 Valley Quail Dr.		Mt. Shasta	CA	96067
349	Robertson	Daniel W.			503 Mountain View Dr.		Mt. Shasta	CA	96067
350	Robertson	Sandra M.			503 Mountain View Dr.		Mt. Shasta	CA	96067
351	Meltor	Jacqueline			37500 S. River Road		Clarksburg	CA	95612
352	Paussa	Dixie A.			395 Foothill Blvd.		Napa	CA	94558
353	Paussa	Val			395 Foothill Blvd.		Napa	CA	94558
354	Johnson	Robin			712 Ski Villagw		Mt. Shasta	CA	96067
355	Turlington	Rick			4001 Pomona Pl.		Pittsburg	CA	94565
356	Weaver	James			Terrace Road		Medicine Lake	CA	96134
357	Alverson	Robert M.			7424 W. 89th St.		Los Angeles	CA	90045
358	Cyr	Rye Y.			7818 Ranch River Dr.		Elverta	CA	95626
359	Alverson	Carole L.			7424 W. 89th Street		Los Angeles	CA	90045
360	Wopar?	Eric			1372 Los Alamos Road		?	?	?
361	Hansen	Alice			707 Berry St.		Mt. Shasta	CA	96067
362	Houdoshet	Cindy			5341 Dunsmuir Avenue		Dunsmuir	CA	96025
363	Rainshaw	Loraine			108 South Ash		Mt. Shasta	CA	96067
364	Kramer	Lynn			1469 Sacramento St.		?	?	?
365	Shannon	Tory			342 Pony Trail Dr.		?	?	?
366	Hughes	Jamie Lynn			2708 Grayfox Dr.		Weed	CA	96094
367	Mead	Don			801 South 13 St.		?	?	?
368	Wimmer	Phil			1828 Maple Avenue		?	?	?
369	Barratta	Silvia			522 Hichborn St.		Vallejo	CA	94590
370	Crawford	Judy			404 Ackley		Mt. Shasta	CA	96067
371	Louis	Arnold			P.O. Box 65		Dunsmuir	CA	96023
372	Treea	Jeffery			551 Adams Dr.		Mt. Shasta	CA	96067
373	Burrell	Cheryl			P.O. Box 667		Mt. Shasta	CA	96067
374	George	Jennie L.			836 Moutain View Ln.		Mt. Shasta	CA	96067
375	Zuiderweg	Gretchyn			47 Lakeshore Ct.		Richmond	CA	94804
376	Mark	Robert			29029 So. Cow Cr. Rd.		Whitmore	CA	96096
377	Burrell	Tony			P.O. Box 677		Mt. Shasta	CA	96067
378	Berry	Donna			765 Como St.		Weed	CA	96094
379	Berry	Jennifer			76800 Usal Rd.		Whitethorn	CA	95589
380	Cahill	Dennis			2723 Graham Rd.		Bayside	CA	95524

COMMENTORS ON THE DRAFT EIS/EIR PREPARED FOR THE TELEPHONE FLAT GEOTHERMAL DEVELOPMENT PROJECT — THROUGH 9/14/98

#	Last Name	First Name	Title/Petition	Company	Street Address 1	Street Address 2	City	ST	ZIP
381	Berry	Joe K.			765 Como St.		Weed	CA	96094
382	Peebles	Clifford			710 Pine St. #26		Mt. Shasta	CA	96067
383	Smith	Tom			P.O. Box 603		Mt. Shasta	CA	96067
384	Hiple	Deborah K.			P.O. Box 603		Mt. Shasta	CA	96067
385	Diltz	Muria			631 1/2 E. 14th Ave.		?	?	?
386	Metz	David			631 1/2 E. 14th Ave.		?	?	?
387	Brindley	Peter			65 Elm Ave.		Mill Valley	CA	94941
388	Brindley	Jeanne			65 Elm Ave.		Mill Valley	CA	94941
389	Chavez	Roxanane M.			P.O. Box 463		Gerber	CA	96035
390	Zover	Randy J.			633 Alpine Rd.		Mt. Shasta	CA	96067
391	Acord	Susan			633 Apline Road		Mt. Shasta	CA	96067
392	Johnson	Anne			6905 Linville Dr.		Weed	CA	96094
393	Wells	Frieda			209 Terry Lynn		Mt. Shasta	CA	96067
394	Wharton	Dolores			1020 Kingston Dr. 113		Mt. Shasta	CA	96067
395	Hamilton	Brian			P.O. Box 363		Mc Cloud	CA	96057
396	Johnston	Rob			4105 Oak St.		Dunsmuir	CA	96025
397	Sham	Van			4105 Oak St.		Dunsmuir	CA	96025
398	Beck	Teresa			813C Caroline		Mt. Shasta	CA	96067
399	Evans	Elizabeth A.			P.O. Box 648		Mt. Shasta	CA	96067
400	Worden	Vickie			1372 Los Alamos Road		Santa Rosa	CA	95409
401	Bloomen	Monte L.			6905 Linville Dr.		Weed	CA	96094
402	Janis	William			5404 River Avenue		Dunsmuir	CA	96025
403	Johnson	Kira			6905 Linville Dr.		Weed	CA	96094
404	Nordhues	Randy			225 Wildflower Drive		Martinez	CA	94553
405	Foster	Lynn			616 Spring St.		Mt. Shasta	CA	96067
406	Creston	Lee Ann			225 Wildflower Drive		Martinez	CA	94553
407	Williams	Vernon D.			9816 Cedar Ave.		Bloomington	CA	92316
408	Pollard	Lynda			P.Ol Box 209		Greenview	CA	96037
409	Harbour	Ted			P.O. Box 742		?	?	?
410	Webb	Debbie			P.O. Box 706		?	?	?
411	Weiborn	Coy			500 Dogwood Dr.		Mt. Shasta	CA	96067
412	Welborn	Marijo			P.O. Box 1603		Mt. Shasta	CA	96067
413	Strader	Jan			148 Newton		Fort Jones	CA	96032
414	Solo	Jacquelyn			P.O. Box 1713		Mt. Shasta	CA	96067
415	Strader	Barbara A.			4217 Stewart Springs Road		Weed	CA	96096
416	Tedsen	Karen			514 Lennon St.		Mt. Shasta	CA	96067
417	Turley	Teresa			5076 Baron Dr.		Mt. Shasta	CA	96067
418	Bogardus	Jessica A.			511 Chestnut St.		Mt. Shasta	CA	96067
419	Nash	Roger L.			P.O. Box 418		McCloud	CA	96057
420	Nash	Bonnie M.			P.O. Box 418		McCloud	CA	96057-0418
421	Sadler	Mark & Lisa			300 Grove St.		McCloud	CA	96057
422	Merrithew	Meeka			703 East Hinkley #B		Mt. Shasta	CA	96067
423	Merrithew	Janett			719 Pine Ridge Avenue		Mt. Shasta	CA	96067
424	Haun	Terry			600 Center #213		Mt. Shasta	CA	94553
425	Ballening	Elizabeth			716 SE 55th Ave.		Portland	OR	97215
426	Anderson	Eric			1931 S. Old Stage		Mt. Shasta	CA	96067
427	Farmer	Sayne			6100 Brostermous 344D		Bend	OR	97702
428	Smith	Madeline			2400 Pine Grove Ln		?	?	?

COMMENTORS ON THE DRAFT EIS/EIR PREPARED FOR THE TELEPHONE FLAT GEOTHERMAL DEVELOPMENT PROJECT — THROUGH 9/14/98

#	Last Name	First Name	Title/Petition	Company	Street Address 1	Street Address 2	City	ST	ZIP
429	Palfini	Ed			621 Caroline Avenue		Mt. Shasta	CA	96067
430	Palfini	Kim			621 Caroline Avenue		Mt. Shasta	CA	96067
431	Beck	Jere R.			39573 Little Fall Creek Road		Fall Creek	OR	97438
432	Beck	Melinda			39573 Little Fall Creek Road		Fall Creek	OR	97438
433	Farmer II	Ken			6100 Brosterhous Rd. #3440		Bend	OR	97702
434	Eames	Jason W.			511 Shasta Avenue		Weed	CA	96094
435	Jones	Debbie			2224 Davis Place Road		Mt. Shasta	CA	96067
436	Jones	Matthew			2224 Davis Place Road		Mt. Shasta	CA	96067
437	Davis	Deborah Jean			407 Berry		Mt. Shasta	CA	96067
438	Painter	Janie	(Petition - 787 Names)						
439	{No Name}		(Petition - 66 Names)						
440	Quinn	Bill			725-1st St.	P.O. Box 6	Tulelake	CA	96134
441	Blakeney	Jack and M.			2303 Town Center Dr.		Klamath Falls	OR	97601
442	Hiley	Rudy			P.O. box 340		Tulelake	CA	96134
443	Blakeney	Jack B.			P.O. Box 7321		Klamath Falls	OR	97602
444	Risch	Peggy			709 Ski Bowl Dr.		Mt. Shasta	CA	96067
445	English	Jane			P.O. Box 7		Mt. Shasta	CA	96067
446	Bhakti, Ph.D.	Sara		Gaea Center	P.O. Box 652		Santa Cruz	CA	95061
447	Bhakti, Ph.D.	Sara		Gaea Center	P.O. Box 652		Santa Cruz	CA	95061
448	Thompson	Louise			1235 W. Scenic Dr.		Mt. Shasta	CA	96067
449	Moss	Dori H.		Medicine Lake for Quality	2204 Pine Grove Dr.		Mt. Shasta	CA	96067
450	Painter	Alison		Medicine Lake for Quality	1541 E. Fairmont		Fresno	CA	93704
451	Plank	Carole			605 Glen Mar Dr.		Mt. Shasta	CA	96067
452	Painter	Janie		Medicine Lake Citizens for Quality Env.	P.O. Box 34		Mt. Shasta	CA	96067
453	Phillips	Rick			P.O. Box 309		Weed	CA	96094
454	Aquila	Hodie			214 Shasta Ave.		Mt. Shasta	CA	96067
455	Shott	Bettie			300 Sheldon Ave.		Mt. Shasta	CA	96067
456	Meyer, D.D.S.	Larry J.			518 N. Main St.		Yreka	CA	96097
457	Richtin	Julie			P.O. Box 73		Adin	CA	96006
458	Shuler	Kelly		Fall River RCD	P.O. Box 83		McArthur	CA	96056
459	Grose	Thomas L.T.	Geologist	Colorado Sch. Mines	2001 Wash Cn.		Golden	CO	80401
460	Hill	Bryan K.		Sierra Club	7294 Churn Creek Rd.		Redding	CA	96002
461	Poore	Rick	Director	Fall River Res. Conservation District	1000 Springs Road		Fall River Mills	CA	96028
462	Cook	Steven L.			234 Pony Trail Dr.		Mt. Shasta	CA	96067
463	Jackson	Damon			1496 Railroad Dr.		McKinleyville	CA	95519
464	Douglas	James			6104 Palmer Dr.		Weed	CA	96094
465	Shott	Bettie J.			300 Sheldon Ave.		Mt. Shasta	CA	96067
466	Lorenzen	Laurel			1108 Day Road		McArthur	CA	96056
467	Bruce	Janet			2517 College Avenue		Weed	CA	96094
468	LaPena	Frank R.			1531 42nd St.		Sacramento	CA	95819
469	Gerber	Laurie			251 Hilltop Dr. #29		Redding	CA	96003
470	Ghose	Gail			P.O. Box 1266		Mt. Shasta	CA	96067
471	Wissner	Jay			107 E. Lake St.		Mt. Shasta	CA	96067
472	Stanfield	Sherry			4020 Stewart Springs Road		Weed	CA	96094
473	Ogle	Marguerite			P.O. Box 1022		Mt. Shasta	CA	96067
474	Wideham	Anna			19348 2nd Avenue		Weed	CA	96094
475	Thiessen	Patrice			212 E. Lake		Mt. Shasta	CA	96067
476	Moen	Stephen A.			621 S.W. Morrison #1450		Portland	OR	97205

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#	Last Name	First Name	Title/Petition	Company	Street Address 1	Street Address 2	City	ST	ZIP
477	Popplewell	Deirdre R.			2211 Woolsey Street		Berkeley	CA	94705
478	Dittes	John			467 E. 9th St.		Chico	CA	95926
479	McCoy	Justin			412 Cedar Street		Mt. Shasta	CA	96067-2104
480	Preus	Catherine			610 Hercule Dr.		Mt. Shasta	CA	96067
481	Falls	Rita			4101 Hummingbird Way		Mt. Shasta	CA	96067
482	Tuttle	Will			638 Healdsburg Avenue		Healdsburg	CA	95448
483	Jensen	Peggy			1710 Beach St.		Muskegon	MI	49441
484	Marie	Lea			506 LeBaron Dr.		Mt. Shasta	CA	96067
485	Crook	Wendy			1302 West Scenic		Mt. Shasta	CA	96067
486	Sullivan	Karen			412 Cedar St.		Mt. Shasta	CA	96067
487	Nikolas	Letunic			1325 Heater Ct.	West Linn Dr.	?	CA	?
488	Leavitt	David			1031 1/2 E. Waverly St.		Tucson	AZ	85719
489	Emerson	Doug			19579 Apache Road		Bend	OR	97702
490	Paxton	Dia			162 Fifth Street		Ashland	OR	97520
491	Dobbs	Donna			610 Park Street		Alturas	CA	96101
492	Turner	Richard W. & Roberta M.		Zufall's Mobile Park	7252 White House Drive		Anderson	CA	96007
493	Banhart	Audrey Welch			P.O. Box 554		Montague	CA	96064
494	Woodson	Charles		Hadan Livestock Company	P.O. Drawer 867		Dorris	CA	96023
495	Lakey	Bill and Linda			3938 Roesner Avenue		Redding	CA	96002
496	Gary	Larry J.		Sheet Metal Workers International Association	2840 El Centro Road, Suite 110		Sacramento	CA	95833
497	Thomas	Roger			92520 Highway 96		Somes Bar	CA	95568
498	Throgmorton	Crystal			711 Pine Street		Mt. Shasta	CA	96067
499	Baxter	Bay			93105 Highway 96		Somes Bar	CA	95568
500	Livingston	John			2378 Waldon Street		Redding	CA	96001
501	Swanson	John R.			3400 Edmund Blvd.		Minneapolis	MN	55406
502	Hensley	Jack D.			13824 Quartz Valley Road		Fort Jones	CA	96032
503	Timpe	Jeffrey			20990 Trefoil Lane		Cottonwood	CA	96022
504	Neinman	Susan Salomon			1948 North Mt. Shasta Ranch Road		Mt. Shasta	CA	96067
505	McKay	Carol			P.O. Box 544		Dorris	CA	96023
506	Mariner	Robert H.		U.S. Geological Survey	Mail Stop 434	345 Middlefield Road	Menlo Park	CA	94025
507	Lettunich	Mateo			8545 Carmel Valley Road		Carmel	CA	93923
508	Lettunich	Mateo			8545 Carmel Valley Road		Carmel	CA	93923
509	Victorine	Joe & Mary		Tulelake Grange No. 468	Rt. 1 Box 221		Tulelake	CA	96134
510	Gardner	Catherine			515 Redwood Road		Mt. Shasta	CA	96067
511	Spencer	Lucinda			3502 Nyland Way		Lafayette	CO	80026
512	Sifford	Alex		Sifford Energy Services	P.O. Box 760		Newkowin	OR	97149-0760
513	Capuano, Jr.	Louis E.	President	ThermaSource, Inc.	725 Farmers Lane	P.O. Box 1236	Santa Rosa	CA	95402
514	Logan	Carol		Kalapooya Sacred Circle Alliance	2585 "E" Street		Springfield	OR	97477
515	Osborn	Jan			1027 North Street		Yreka	CA	96097
516	Rowley	John C. and Mary L.		Pajarito Enterprises	3 Jemez Lane		Los Alamos	NM	87544
517	Morrello	Frank		ASTA Construction Co., Inc.	39 N. Front Street	P.O. Box 758	Rio Vista	CA	94571
518	Claypole	Lela L.			514 Sunrise Ct.		Yreka	CA	96097
519	Larsen	Bill	Broker/Owner	Alpine Realty	1008 W.A. Barr Road		Mt. Shasta	CA	96097
520	Barr	Meadow			1409 Highland Dr.		Mt. Shasta	CA	96067
521	Anis	Phil					Oakland	CA	94619
522	Brightwell	Anne L.			7252 White House Dr. Ofc.		Anderson	CA	96007
523	Bell	Randall C.	Shasta Indian		P.O. Box 194		McArthur	CA	96056
524	Campbell	Richard G.	President	Ben Holt Company	201 South Lake Avenue, Suite 300		Pasadena	CA	91101-3094

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#	Last Name	First Name	Title/Petition	Company	Street Address 1	Street Address 2	City	ST	ZIP
525	Nelson	Dave	Sector Superintendent	State of California	Dept. of Parks & Recreation-Cascade Sector	Northern Butess District - P.O. box 2430	Shasta	CA	96087-2430
526	Lorenzen	Laurel & Pete			1108 Day Road		McArthur	CA	96056
527	Lorenzen	Laurel & Pete			1108 Day Road		McArthur	CA	96056
528	Meisner	Brent			Route 2, Box 144		Tulelake	CA	96134
529	Short	Dick			P.O. Box 323		Etna	CA	96027
530	Diel	Christie			17438 Jackrabbit Road		Weed	CA	96094
531	Gust	Robert			205 Oakview Ct.		Yreka	CA	96097
532	Manners	Ruth			3995 McArthur Rd.		Fall River Mills	CA	96028
533	Bloomquist, Ph.D.	R. Gordon	Senior Scientist	Washington State University	925 Plum Street S.E., Bldg. 4	P.O. Box 43165	Olympia	WA	98504-3165
534	Cimino	Richard S.			1281 Ridgewood Rd.		Pleasanton	CA	94566
535	Pedri, P.E.	James C.	Asst. Exe. Officer	California Regional Water Quality Control Board, CVR	415 Knollcrest Drive, Suite 100		Redding	CA	96002
536	Vendiola	Michele			252 E. Bakerview Rd. #122		Bellingham	WA	98226
537	Kovatch	Timothy J.			39955 McArthur Rd.		Fall River Mills	CA	96028
538	McIntosh	Charles			P.O. Box 175		Fall River Mills	CA	96028
539	Krolik	Steven R.	Photographer		400 LOCUST St., Suite 1		San Francisco	CA	94118
540	Stanton	Ken			395 Clark Way		Angwin	CA	94508
541	[No Name]		Petition (276 names)						
542	[No Name]		Petition (1 name)						
543	Mueller, Ph.D.	Robert F.			Route 1, Box 250		Stanton	VA	24401
544	Fong	Calvin C.	Chief, Regulatory Branch	Department of the Army	San Francisco District, Corps of Engineers	333 Market Street	San Francisco	CA	94105-2197
545	Shadley	Link		Madesi Band, Pit River		P.O. Box 976	Astoria	OR	97103
546	Merrill	Mary J.			P.O. Box 976		Astoria	OR	97103
547	Comiskey	Kevin		Comiskey Construction Incorporaed	14420 Garden Valley		Umpqua	OR	97486
548	Cusick	Larry A.			38135 Robin Way		Burney	CA	96013
549	Rinne	Fred			1029 Carolina St.		San Francisco	CA	94107
550	Bedel	Lynn Rae			P.O. Box 114		Fall River Mills	CA	96028
551	Parker	Doug & Phyllis			81 N. Court Road		Ukiah	CA	95482
552	Whelan	Catherine			133 Hillside Drive		Fairfax	CA	94930
553	Whelan	Robert			133 Hillside Drive		Fairfax	CA	94930
554	Coots	John D.	Representative/Organizer		1246 Putman Avenue		Yuba City	CA	95991
555	Schmidt	Kurt			P.O. Box 5190		Klamath Falls	OR	97404
556	Wilson	Scott			P.O. Box 969		McCloud	CA	96057
557	Zanella	Shirley			6504 Bigfoot Lane		Montague	CA	96064
558	Cunnington	Keith			?		?	?	?
559	Robertson	Robert			?		?	?	?
560	Cantwell	Dave			?		?	?	?
561	Wien	Bob			?		?	?	?
562	Erickson	Dave			?		?	?	?
563	Sudol	Pete			?		?	?	?
564	Kenyon	Ed			?		?	?	?
565	Schumacher	Clarence			?		?	?	?
566	Kenyon	Bryan			?		?	?	?
567	Van Dyke	Danny			?		?	?	?
568	Carr	Robert L.			?		?	?	?
569	White	Stephen W.			P.O. Box 637		White Salmon	WA	98672
570	Lawrence	Soliman			9601 Miccosakee Rd #58		Tallahassee	FL	32308

COMMENTORS ON THE DRAFT EIS/EIR PREPARED FOR THE TELEPHONE FLAT GEOTHERMAL DEVELOPMENT PROJECT — THROUGH 9/14/98									
#	Last Name	First Name	Title/Petition	Company	Street Address 1	Street Address 2	City	ST	ZIP
571	Aguilera	Andrew			4237 Patricia Way		Dunsmuir	CA	96027
572	Ward	Stuart			13715 Thrush Rd.		Montague	CA	96064
573	Griffin	C.			P.O. Box 374		Rimrock	AZ	86335
574	Foster	Lynn			616 Spring St.		Mt. Shasta	CA	96067
575	Davenport	Clete & Sue			P.O. Box 517		Fort Jones	CA	96032
576	Crayne	Sara			214 Merritt		Mt. Shasta	CA	96067
577	Nelson Eric T.	and Spencer Martha			7020 SE Hwy. 101		Lincoln City	OR	97367
578	Black, Sr.	Michael J.			925 North St.	P.O. Box 211	McCloud	CA	96057
579	Fiock	Shari	Petition (13 names)		P.O. Box 1854		Yreka	CA	96097
580	[No Name]		Petition (17 names)						
581	Gathering Tribes		Petition (15 names)		1573 Solano Avenue		Berkeley	CA	94707
582	[No Name]		Petition (84 names)						
583	{---}		Petition (226 names)	Medicine Lake Citizens for Quality Environment	P.O. Box 34		Mount Shasta	CA	96067
584	Jackson	John S.			1909 Ager Road		Montague	CA	96064
585	Jackson	Patricia			1909 Ager Road		Montague	CA	96064
586	Zanella	Shirley			6504 Bigfoot Lane		Montague	CA	96064
587	Cunningham	Frances J.			P.O. Box 277		Montague	CA	96064
588	Cunningham	Gene M.			5525 Adobe Lane		Montague	CA	96064
589	Robbins	James			2675 N.E. Lancaster #29		Corvallis	OR	97330
590	Todd	Maureen			P.O. Box 194		Tulelake	CA	96134
591	Hart	Megan			P.O. Box 925		Tulelake	CA	96134
592	Schurwanz	Amber			P.O. Box 1007		Tulelake	CA	96134
593	Takikawa	Jaime J.			362 11th St.		Arcata	CA	95521
594	Girard	Greg			362 11th St.		Arcata	CA	95521
595	Gautreaux	Don			201 Trinity Lane		Mt. Shasta	CA	96067
596	Mitchell	Shirley			1301 Ramona		Mt. Shasta	CA	96067
597	Stafford	Dayna			306 Ida Street		Mt. Shasta	CA	96067
598	Lyman	Laura			815 Caroline Avenue		Mt. Shasta	CA	96067
599	Horner	Evelyn			7944 Ponderosa Dr.		Weed	CA	96094
600	Mathwig	James			503 Walnut Street		Weed	CA	96094
601	Harris	David			1516 Fredrick St.		Mt. Shasta	CA	96067
602	Wagner	Pete			29330 Edgewood Rd.		Weed	CA	96094
603	Mathwig	Donna			503 Walnut St.		Weed	CA	96094
604	Dunlop	Curtis			21019 Dodson Lane		Anderson	CA	96007
605	Meyers	Harry W.			P.O. Box 116		Anderson	CA	96007
606	McKee-Robbins	A.			2675 N.E. Lancaster #29		Corvallis	OR	97330
607	Sardina	Mike			43 Castro Road		?	?	?
608	Bennett	Walter			4275 Compton Road		Eureka	CA	95503
609	Catlett	Robert D.			P.O. Box 1105		Cambria	CA	93428
610	Pye	Carolyn P.			P.O. Box 489		Cambria	CA	93428
611	Buell	Reid			401 Coloma Way		Sacramento	CA	95608
612	Schneider	Greg			816 Kern St.		Chico	CA	95928
613	Meier	Dennise			15495 One Oak Lane		Monte Sereno	CA	95030
614	Fay	Don			1950 Aspen St.		Los Osos	CA	93402
615	Whitney	Lois E.			1728 Redwood St.		Elko	NV	89801
616	McClanahan	Barbara			23 Rd. 3143		Artec	NM	87410
617	Sturges	Diana			1509 Lee		McKinney	TX	75069
618	Hamilton	RoseAnne			39440 Cary Rd.		Anza	CA	92539

COMMENTORS ON THE DRAFT EIS/EIR PREPARED FOR THE TELEPHONE FLAT GEOTHERMAL DEVELOPMENT PROJECT — THROUGH 9/14/98									
#	Last Name	First Name	Title/Petition	Company	Street Address 1	Street Address 2	City	ST	ZIP
619	Pena	Jocelyn			P.O. Box 425		Cotati	CA	94931
620	Bale	Frances N.			P.O. Box 726		Winslow	AZ	86047
621	Mitchell	Ilene			HCR61, Box 263		Winslow	AZ	86047
622	Taluc	Sherry L.			10651 Ridge Avenue		St. Louis	MO	63114
623	Quigley	Joe			20 Sunnyside, #A350		Mill Valley	CA	94941
624	Patak	Agnes			P.O. Box 1307		Redway	CA	95560
625	Stevens	Carol			601 4th Avenue E		Superior	WI	54880
626	McCovey	Jene			1091-A Hallen Dr.		Arcata	CA	95521
627	Frank	April L.			13618 Hill Blvd.		Shasta Lake	CA	96019
628	Oros	Tia			P.O. Box 4569		Arcata	CA	95518
629	Peters	Christopher H.			1966 Edrin Drive		Arcata	CA	95521
630	Waters	Storm			P.O. Box 7941		Missoula	MT	59807
631	Ross	Houston			Rt. 1, Box 148		Earlsboro	OR	74840
632	Teseny	Shannon			23 Cord 3143		Aztec	NM	87410
633	Main	Rose			P.O. Box 41		Harlem	MT	59526
634	Main, Sr.	James			P.O. Box 43		Hays	MT	59527
635	Berger	Rosalind			847 Peralta Avenue		Berkeley	CA	94707
636	Whitewater	Susan			P.O. Box 826		Meeker	OK	74855
637	Thomas	Robin			P.O. Box 695		Boonville	CA	95415
638	Blake	Eva L.			29 Lakeside Avenue		Lakeville	MA	02347
639	Jackson	Johnny			P.O. Box 190		Underwood	WA	98651
640	Echo	June			Rt. 3, P.O. Box 155		Pawnee	OK	74058
641	Harris	Murray A.			2585 "E" St.		Springfield	OR	97477
642	Johnson	Robert O.			3151 Soc. Science Plaza		Irvine	CA	92697
643	Escamea	Nadine			W1428 Ray Road		DePere	WI	54115
644	Cattran	Lillian			1024 Broadway		Eugene	OR	97403
645	Raymond	David			309 Cedar Street #13-B		Santa Cruz	CA	95060
646	Gaudin	Kelly			3527 Greenwood Hts. Dr.		Kneeland	CA	95549
647	Fogel	Cathleen			309 Alta Ave.		Santa Cruz	CA	95060
648	Selverston	Mark			12340 Kelly Avenue		Sebastopol	CA	95472
649	Rosenquist	Martha			201 Los Pines Road		?	?	?
650	Help-Tulley	Leila			P.O. Box 1508		Window Rock	AZ	86515
651	Tejada	Percy			1615 Walnut Avenue		Redding	CA	96001
652	Gemmill	Faith			122 1st Avenue, Box #2		Fairbanks	AK	99701
653	James	Tony			Aishalton, Sout Rupununi		Guyana	South America	
654	Littlefield	Quail			907 N.E. Winchester		Roseburg	OR	97470
655	Littlefield	Quail			907 N.E. Winchester St.		Roseburg	OR	97470
656	Sturnes	Bonnie			3020Bridgeway #332		Sausalito	CA	94965
657	Detweiler	Dustin			Rt. 4, Box 255B		Murphy	NC	28906
658	Costner	Pat			P.O. Box 548		Eureka Springs	AR	72632
659	Poncho	Redhouse			6500 Whitney		Oak	CA	94609
660	Garrett	Elisabeth E.			2428 Bancroft #5		Berkeley	CA	94704
661	Chatterjee	Pratar			1916 Milk Jr. Way		Berkeley	CA	94704
662	Silver Star Reed	Eva			P.O. Box 512		Fall River Mills	CA	96028
663	Rhodes	Mildred			P.O. Box 1668		Cottonwood	CA	96022
664	Tejada	Tami L.			1615 Walnut Avenue		Redding	CA	96001
665	White	Travis			P.O. Box 544		Hoopa	CA	95546

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#	Last Name	First Name	Title/Petition	Company	Street Address 1	Street Address 2	City	ST	ZIP
666	Feliz	Vincent			538 1/2 G. St.		Arcata	CA	95521
667	Garcia	Eddie			1410 Girard N.E. #11		Albuquerque	NM	87106
668	Fred	Ernest			23 Rd 3143		Aztec	NM	87410
669	Crowe	Chuck			507 Center St.		Berea	KY	40403
670	Law	Martha			3420 Clandara Avenue		Las Vegas	NV	89121
671	Xenos	Michelle			5007 Elmhurst Lane		Las Vegas	NV	89108
672	Knutsen	Reinard			5007 Elmhurst Lane		Las Vegas	NV	89108
673	Chen	Hu Yu			#9 Lane 199, Chang An Street		Taintung	Taiwan	950
674	Harvey	Corbin			5007 Elmhurst		Las Vegas	NV	89108
675	Flores, Sr.	Ray			592 Crestmont Dr.		Oakland	CA	94619
676	Chouinard	Michele			P.O. Box 1543		San Anselimo	CA	94960
677	Galii	Ronald D.			P.O. Box 6643		Folsom	CA	95763
678	Thorne	Marion			P.O. Box 7102		Winslow	AZ	86047
679	Bale	Frances N.			P.O. Box 726		Winslow	AZ	86047
680	Poe	Jerome			3142 Lawrence Rd #20		Redding	CA	96002
681	Thing	Johnny			P.O. Box 327		Jacumba	CA	91934
682	Meza	Josefine Lopez			Lista Correo		Volle Palams Tecate	B.C.	21500
683	Anayu	Almo Judit Reyes			Rendon 526, oto Los Mochis		Sinaloa	Mexico	?
684	Quintero	Alfredo			S. Rendon 526 Ote Los Mochis		Sinaloa	Mexico	?
685	Lopez	Maxia Elena Diaz			Rodrigo Valle #7542 Jardines Rubi		Tijuana Baja California	Mexico	22190
686	Rodriguez	Jeso Mario			Rodrigo Valle #7542 Jardines Rubi		Tijuana Baja California.	Mexico	22190
687	Adams	Mary			P.O. Box 262		Oneida	WI	54155
688	Bird	Pamela Blue			P.O. Box 229		Oneida	WI	54155
689	Vielmann	Diana H.			8 Fuente Avenue		San Francisco	CA	94132
690	Matilton	Ray L.			P.O. Box 927		Hoopa	CA	95546
691	Matilton	Donna			P.O. Box 927		Hoopa	CA	95546
692	Thein	Andrea			P.O. Box 487		Ashland	OR	97520
693	Schmidt	Rion M.			P.O. Box 421 Townhouse #15		Cordova	AK	99574
694	McKenney	Shayela			1401 Lerayst		Berkeley	CA	94708
695	Pope	Sky			P.O. box 177		Mammoth	OR	97361
696	Kalafatic	Carol			P.O. Box 3727		New York	NY	10163
697	Coats	Kendal H.			2805 W. Houston Pl		Broken Arrow	OK	74012
698	Solhappy	Sam			P.O. Box 251		Hood River	OR	97031
699	Sprague	Lee			731 Ellsworth St.		San Francisco	CA	94110
700	Weahkee	Sonny			620 Pontiac Dr.		Rio Rancho	NM	87124
701	Tewa	Lucy			P.O. Box 2587		Tuba City	AZ	86045
702	Hutchason	Theresa			3945 Wyoming		St. Louis	MO	63116
703	Cantrell	Lawrence			20211 Burney		Burney	CA	96013
704	Hursey	Roberto			P.O. Box 332		Fall River Mills	CA	96028
705	Waetermans	Hygii F.			150 Oak Manor Ct. #C		Ukiah	CA	95482
706	Woods	Sky			P.O. Box 83		Happy Camp	CA	96039
707	Fragosa	William			5007 Elmhurst Lane		Las Vegas	NV	89108
708	Charles	Faye W.			Rt. 1, Box 23Q		Parker	AZ	85344
709	Thorne	Tara			5120 Trans Canada Hwy.		Duncan	B.C.	VOR-Weo
710	Wilson Gemmill	Valerie			3616 Couns Alene		Shasta Lake	CA	96019
711	Moran	Florence			P.O. Box 85		Nubieber	CA	96068

COMMENTORS ON THE DRAFT EIS/EIR PREPARED FOR THE TELEPHONE FLAT GEOTHERMAL DEVELOPMENT PROJECT — THROUGH 9/14/98

#	Last Name	First Name	Title/Petition	Company	Street Address 1	Street Address 2	City	ST	ZIP
712	Francis	Rose			603-C Broadway		Santa Cruz	CA	95060
713	Carter	Delphina			P.O. Box 553		Parker	AZ	85344
714	Harper	Mamie			P.O. Box 18		Parker	AZ	85344
715	Black	Lorena			Rt. 1, Box 23		Parker	AZ	85344
716	Chacon	Uriel			P.O. Box 1253		Burney	CA	96013
717	Smith	Sofyah			519 A. Chestnut St.		Mt. Shasta	CA	96067
718	Main, Sr.	James			P.O. Box 43		Hays	MT	59527
719	Thunder	Guy H. White			P.O. Box 657		Kyle	SD	57752
720	Evans	Cy			2125 Ferro Rd. S.W.		Albuquerque	NM	87105
721	Plummer	Abe			P.O. Box 3598		Indian Wells	AZ	86031
722	Paddock	Olson A.			P.O. Box 682		Holbrook	AZ	86025
723	Tulley	Earl			P.O. Box 1508		Window Rock	AZ	86515
724	Villarruel	Sharon			P.O. Box 261		Burney	CA	96013
725	Banuelos	Jose			P.O. Box 1253		Burney	CA	96013
726	Cienfugos	Paul			P.O. Box 27		Arcata	CA	95518
727	Chiang	Pamela			310 8th St. #309		Oakland	CA	94607
728	Ouyang	Yung			1811-A 11th Avenue		Oakland	CA	94606
729	Potter	Myrna			Oak 36924		Burney	CA	96013
730	Elliot	Troy			2484 Tzouhalem Road		Duncan	B.C.	V9L5C7
731	Pease	George			P.O. Box 5162		Arcata	CA	95518
732	Francis	Aaron			603C Broadway		Santa Cruz	CA	95060
733	Herrera	Maria-Marta			39 Linda Street		San Francisco	CA	94110-1615
734	Vigolo	Donna L.			P.O. Box 550		Fall River Mills	CA	96028
735	Klasky	Philip M.			2760 Golden Gate		San Francisco	CA	94118
736	Freeman	Jonathon			P.O. Box 828		Bella Vista	CA	96008
737	Bower	Susan			P.O. Box 1510		Hayfork	CA	96041
738	Leon	Joseph			6621 Aruo N.E.		Albuquerque	NM	87105
739	Harris	Willie			484 Shady Dr.		Oneida	WI	54155
740	Noonan	Michelle			19603 Wallers Wy.		Redding	CA	96003
741	Colt	Joseph	Chairman of the Board	Modoc County Board of Supervisors	114 East North Street	P.O. Box 1728	Alturas	CA	96101
742	Shott	James A.			605 Glen Mar		Mt. Shasta	CA	96067
743	Lewis	Steven Alan	Project Leader	Fish and Wildlife Service	6610 Washburn Way		Klamath Falls	OR	97603
744	Farrel	David J.	Federal Activities Office	U.S. Environmental Protection Agency	Region IX	75 Hawthorne Street	San Francisco	CA	94105-3901
745	Haines	Kyle	Forest Protect Coordinator	Klamath Forest Alliance	P.O. Box 820		Etna	CA	96027
746	Sivas	Deborah A.		Stanford Environmental Clinic	Stanford Law School	559 Nathan Abbott Way	Stanford	CA	94305-8610
747	Koch	Donald B.	Acting Regional Manager	Department of Fish and Game	601 Locust Street		Redding	CA	96001
748	West	Peter	Senior Policy Analyst	Renewable Northwest Project	1130 SW Morrison, Suite 330		Portland	OR	97205
749	McArthur	Christine	President	Shasta County Farm Bureau	3605 Bechelli Lane		Redding	CA	96002
750	Baiocchi	Robert J.	Consultant	Fall River Wild Trout Foundation	P.O. Box 357		Quincy	CA	95971
751	Bollinger	Georgia J.			9542 Hill Road		Klamath Falls	OR	97603
752	Jakubowski	Michael			5503 Brentwood Dr.		Klamath Falls	OR	97603
753	Arthur	Josephine Lucille			2564 Lake Shore Drive		Klamath Falls	OR	97601
754	Arthur	Glen			2564 Lakeshore Dr.		Klamath Falls	OR	97601
755	Chamberlin	Carol A.			1145 Tamera Dr.		Klamath Falls	OR	97603
756	Chamberlin	Douglas W.			1145 Tamera Dr.		Klamath Falls	OR	97603
757	Pangelinan	Derek R.			1622 Brittany Dr.		Eugene	OR	97402
758	Fuller	Michelle			1622 Brittany Dr.		Eugene	OR	97402
759	Arthur	David			18789 Sydney Circle		Castro Valley	CA	94546

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#	Last Name	First Name	Title/Petition	Company	Street Address 1	Street Address 2	City	ST	ZIP
760	Arthur	Ellie			18789 Sydney Circle		Castro Valley	CA	94546
761	Hapner	Nina	Research Asscoiate	CATs Californians For Alternatives to Toxics	P.O. box 1195		Arcata	CA	95518
762	Carter, Jr.	Paul			1588 Center Street		Weed	CA	96094
763	McPherson	J. Robert	Attorney at Law		2100 Garden Road, Suite A-208		Monterey	CA	93940
764	Mires	John			5231 Klamath River Road		Yreka	CA	96097
765	Facchin	Phillip and Marina			1321 Mott Airport Rd.		Mt. Shasta	CA	96067
766	Jackson	Jerald and Charlene	Elder of the Modoc Tribe		1026 Homedale		Klamath Falls	OR	97603
767	Gierak	Richard and Cherie	Director of Interactive Citizens United	Ineractive Citizens United	Private Property Activist Group	5814 Highway 96	Yreka	CA	96097
768	Mikec	Jack			610 Meadow Valley		Mt. Shasta	CA	96067
769	Mires	Marie			5231 Klamath River Road		Yreka	CA	96097
770	Hyytinen	Niiolo and Elene			13290 Hodge Drive		Reno	NV	90511
771	Dansie	Roberto	Executive Director	Pit River Health Service, Inc.	36977 Park Avenue		Burney	CA	96013
772	Peery	Harold			815 North St.		Yreka	CA	96097
773	Balma	Wende K.			604 Glen Mar Dr.		Mt. Shasta	CA	96067
774	Johnson	Robin			712 Ski Village		Mt. Shasta	CA	96067
775	Vickery	Jean			51620 Hwy 96		Seiad Valley	CA	96086
776	Miller	H.K. "Bud"			P.O. Box 460	3510 Eddy Creek Road	Weed	CA	96094
777	Risch	Peggy R.			709 Ski Bowl Dr.		Mount Shasta	CA	96067
778	Olson	Audrey			1536 Eldorado		Klamath Falls	OR	97601
779	Foster	Joe and Kim			P.O. Box 700		Happy Camp	CA	96039
780	Crow	Joe			P.O. Box 1421		Mt. Shasta	CA	96067
781	Ellis, Maria J.	and Cook, Jeffrey D.			P.O. Box 153	40205 Baum Lake Road	Cassel	CA	96016-0153
782	Dean	Mark	Executive Director	Yreka Chamber of Commerce	Tourist Information Center	117 W. Miner St.	Yreka	CA	96097
783	Smith	Ann			1536 Eldorado Blvd.		Klamath Falls	OR	97601
784	Jones	Lilias C.			P.O. Box 901		Brookings	SD	57006
785	McFadden	Patrick			1751 Market St. #47		San Francisco	CA	94103
786	Hannelore	Barbara			47 Amador		Goleta	CA	93117
787	du Vernet	Dean H.			1448 Fourth Street		Baywood Park	CA	93402-1606
788	Henson	Pam			47 Amador		Goleta	CA	93117
789	Welch	Lisa			38915 Hwy 101-So.		Soledad	CA	93960
790	Bedard	Matthew			342 5th Street		Greenfield	CA	93927
791	Handley	Julie			38915 Hwy 101-So.		Soledad	CA	93960
792	Handley	Garon			38915 Hwy 101-So.		Soledad	CA	93960
793	Fletcher	Margaret C.			23050 County Rd. 94		Woodland	CA	95695
794	Markin	Martha L.			P.O. Box 462		McCloud	CA	96057-0462
795	Tikkanen	David and Dinah			P.O. Box 962		McCloud	CA	96057
796	Cherney	David			P.O. Box 34		Garberville	CA	95542
797	Wirth	Kay			P.O. Box 987		McCloud	CA	96057
798	Gomes	Gloria		Wintu Tribe of Shasta	3066 School Street		Redding	CA	96002
799	Smutz	Ralph and Helen Noreen			1217 Scenic Dr.		Mt. Shasta	CA	96067
800	Niblack	M. Clayton			1309 Audubon Road		Mt. Shasta	CA	96067
801	Santos	Vernon			708 Butte Avenue		Mt. Shasta	CA	96067
802	Solus	Claris			659 Sunset Dr.		Mt. Shasta	CA	96067
803	Thomas	Bonnie			1310 Dale Creek Rd.		Weed	CA	96094
804	Koller	Keith			213 Hinckley St.		Mt. Shasta	CA	96067
805	Koller	Karen			213 Hinckley St.		Mt. Shasta	CA	96067
806	Bollinger	Wayne		4 Runners 4 Wheel Drive Club	P.O. Box 471		Klamath Falls	OR	97601

COMMENTORS ON THE DRAFT EIS/EIR PREPARED FOR THE TELEPHONE FLAT GEOTHERMAL DEVELOPMENT PROJECT — THROUGH 9/14/98

#	Last Name	First Name	Title/Petition	Company	Street Address 1	Street Address 2	City	ST	ZIP
807	Chavez	Cory			420 Adams		Klamath Falls	OR	97601
808	Bollinger	David E.			9542 Hill Road		Klamath Falls	OR	97603
809	Bollinger	Wayne			1810 Fargo St.		Klamath Falls	OR	97603
810	Balma	Wende K.			604 Glen Mar Dr.		Mt. Shasta	CA	96067
811	Atlas	Debra		DLA Market Development	P.O. Box 536		McCloud	CA	96057
812	Willaims	Michael			505 Berry St.	P.O. Box 1085	Mt. Shasta	CA	96067
813	Lewis	Lynn			5601 Fuller Dr.		Weed	CA	96094
814	Rice	Mike			P.O. Box 638		Weed	CA	96094
815	Backes	Michael			104 Lone Pine Dr.		Mt. Shasta	CA	96067
816	Terry	Kristen			18220 NW Heritage Pkwy. *84		Beaverton	OR	97006
817	Zanni	Barbara J.			407 E. Ivy		Mt. Shasta	CA	96067
818	George	Harold E.			P.O. Box 259		McCloud	CA	96057
819	Bradford	Sheila			500 McCloud Avenue		Mt. Shasta	CA	96067
820	Ferris	Nelia			P.O. Box 2783		Delmar	CA	92014
821	[---]		Petition (34 names)	Plumbers and Steamfitters U.A. Local Union #228					
822	Stevenson	Stacy K. & Anita R.			P.O. Box 555		Dorris	CA	96023
823	Hall	Betty L.			10736 Quartz Valley Road		Fort Jones	CA	96032
824	McGinn	Charlotte			13229 Lakeview Dr.		Ste. Genevieve	MO	63670
825	Henson	Ryan		California Wilderness Coalition	2655 Portage Bay East, Ste. 5		Davis	CA	95616
826	Bucksin, Floyd J.	and Berditschevsky Michelle		Pit River Tribe	P.O. Box 617		Fall River Mills	CA	96028
827	Bucksin, Floyd J.	and Berditschevsky, Michelle		Native Coalition	P.O. Box 1143		Mount Shasta	CA	96067
828	Jones	Deborah			5633 Scripps Street		San Diego	CA	92122-3207
829	Painter	Janie		Medicine Lake Citizens for Quality Environment	P.O. Box 34		Mt. Shasta	CA	96067
830	LaForest	Dale	Director	Mt. Shasta Tomorrow	101 E. Alma Street, 100-A		Mt. Shasta	CA	96067
831	Pierce	James L.			101 E. Alma , suite 100B		Mt. Shasta	CA	96067
832	Parker	Vivian	Conversation Chairperson	California Native Plant Society	Shasta Chapter	P.O. Box 451	Manton	CA	96059
833	Jordan	Mairen			P.O. Box 1824		Yreka	CA	96097
834	Vasquez	Guillermo			Calle Obispo Marroquim Oficima Antiqua Advanci	Ferreo 501 Son Sonata	El Salvator	CA	?
835	Canavan	Kristin			1453 10th Avenue		San Francisco	CA	94122
836	Canavan	Sue			4714 Woodview Dr.		Santa Rosa	CA	95405
837	Tarbet	Priva			11880 Gladys Avenue		Felton	CA	95018
838	Ward	Johann E.			175 Paradise Park		Santa Cruz	CA	95060
839	Marcus	Paula			2975 Valencia Road		Aptos	CA	95003
840	Fisher	Alyne B.			100 west Avenue E		Santa Cruz	CA	95060
841	Viereek	Jennifer			P.O. Box 3518		Freedom	CA	95019
842	Mackles	Craig			110 Meagan Place #6		Thousand Oaks	CA	91362
843	Morill	Don			1308 Beech Lane		Davis	CA	95616
844	Cuneo	Suzanne S & S. Peder			7040 N. Harold Dr.		Tucson	AZ	85743-9343
845	Painter	Alison			1541 E. Fairmont #101		Fresno	CA	93704
846	Niemotka	Anthony			1541 E. Fairmont #101		Fresno	CA	93704
847	Byrne	Michael			Rt. 2, Box 54E		Tulelake	CA	96134
848	Davis	Linda			13413 Lakeview Drive		Ste. Genevieve	MO	63670
849	Parker, M.D.	Jim		Siskiyou Medical Group	P.O. Box 339		Mt. Shasta	CA	96067
850	Phillips	Antoinette C.			2230 Davis Place Rd.		Mt. Shasta	CA	96067
851	Plank	Carole			605 Glen Mar Drive		Mt. Shasta	CA	96067
852	Barrow	Marcia			7411 Sugar Pine Road		Weed	CA	96094
853	Cugier, Jon	and Bradford, Louise K.			4191 Isgrigg Avenue		Dunsmuir	CA	96025

COMMENTORS ON THE DRAFT EIS/EIR PREPARED FOR THE TELEPHONE FLAT GEOTHERMAL DEVELOPMENT PROJECT — THROUGH 9/14/98

#	Last Name	First Name	Title/Petition	Company	Street Address 1	Street Address 2	City	ST	ZIP
854	Newman	Robert E.			2146 Garden Avenue		Redding	CA	96001
855	Marchi	Robert			4747 Humboldt St.		Shasta Lake City	CA	96003
856	Vaughan	Sandra			4105 Oak St.		Dunsmuir	CA	96025
857	Newman	Pamela			2146 Garden Avenue		Redding	CA	96001
858	Linn	Norman K.			P.O. Box 434	560 California St.	McCloud	CA	96057-0434
859	Marchi	Sylvia			4747 Humboldt St.		Redding	CA	96003
860	Cole	Brenda	Petition (48 names)						
861	[No Name]		Petition (6 names)		915 W. Main #13		Yreka	CA	96097
862	Hembling	Brian	Petition (19 names)	Dunsmuir Rotary Club	P.O. Box 263		Dunsmuir	CA	96025
863	[No Name]		Petition (18 names)		2708, 23rd St.		San Francisco	CA	94110
864	Berger		Petition (20 names)		847 Peraltu Avenue		Berkeley	CA	94707
865	[No Name]		Petition (15 names)						
866	Lofton	Erin			484 S. Seawyrds Blvd.		Gilbert	AZ	85233
867	Willey	Brenda			1600 Hill Road		Mt. Shasta	CA	96067
868	Risch	Peggy			709 Ski Bowl Dr.		Mt. Shasta	CA	96067
869	Verster	Janneke			6017 Macks Gulch Rd.		Gazelle	CA	96034
870	Phillips	James J.			1130 Tolman Creek Road		Ashland	OR	97520
871	Xavier	Marjorie			26937 Hayward Blvd.		Hayward	CA	94542
872	DeRose	Janine			P.O. Box 710		Montague	CA	96064
873	Coffin	Philip			679 Colusa Avenue		Berkeley	CA	94707
874	Dole	Malcolm			P.O. Box 85442		Seattle	WA	98145
875	Journey-Lynn	Madeline			1054 54th Street		Sacramento	CA	95819-3904
876	Lewis	Steven Alan	Project Leader	U.S. Department of the Interior	Fish and Wildlife Service	6610 Washburn Way	Klamath Falls	OR	97603
877	Fontenot	Donald			2230 S.E. Oak St.		Portland	OR	97214
878	Hapner	Nina	Research Associate	CATs Californians for Alternatives to Toxics	P.O. Box 1195		Arcata	CA	95518
879	Knichel	Shelly			741 Bismark Ave.		St. Louis	MO	63122
880	Sharon	Edwinna L.			915 W. Miner #13		Yreka	CA	96097
881	Burrell	Tony & Cheryl			P.O. Box 677		Mt. Shasta	CA	96067
882	Jameson	Linda			P.O. Box 855		Mt. Shasta	CA	96067
883	Farrel	David J.	Chief Federal Activities Office	U.S. States Environemtnal Protection Agency	Region IX	75 Hawthorne Street	San Francisco	CA	94105-3901
884	Roehrich	Mary			2700 McConaughy		Etna	CA	96027
885	Hattar	Mai			1018 Oakdale St.		West Covine	CA	91790
886	Hildreth	Gershom			1439 -21st Ave.		San Francisco	CA	94122
887	Macauley	Ed			Hc-6, Box #131-13		Etlan	VA	22719
888	Berditschevsky	Michelle	Project Coordinator	Mount Shasta Bioregional Ecology Center	P.O. Box 1143		Mt. Shasta	CA	96067
889	Yarbrough	Jim			10829 Cozycroft Avenue		Chatsworth	CA	91311
890	Burnim	Joshua			1210 W. Hays St.		Boise	ID	83702

APPENDIX B:

Scoping Materials

United States Department of Interior

BUREAU OF LAND MANAGEMENT
Alturas Resource Area
708 W. 12th Street
Alturas, California 96101-3102

Reply To: 3220 (BLM)
2820 (FS)

Date: June 7, 1996

Dear Interested Party:

The U.S. Department of Interior, Bureau of Land Management (BLM), Alturas Resource Area Office received a Plan of Utilization (POU) from Calpine Corporation for geothermal development activities on Federal Geothermal Leases CA-21924, CA-21925, and CA-21926. The leases are located on the Klamath and Modoc National Forests in Siskiyou and Modoc Counties, California. Since the proposed geothermal development would occur on National Forest lands, the POU was also submitted to the U.S. Department of Agriculture, Forest Service (USFS).

Proposed Action

In the POU, Calpine proposes to develop a 49.9 megawatt (MW) (gross) geothermal power plant, with associated geothermal production and injection wells, well pads, roads, and interconnected geothermal fluid pipelines in the Fourmile Hill project area, which is located approximately three miles northwest of Medicine Lake. The proposed action also includes construction and operation of a 230-kilovolt (kV) transmission line that would extend from the proposed power plant site approximately 24 miles to the east to a connection with the existing Bonneville Power Administration (BPA) Malin-Warner 230-kV transmission line. Additional project information and maps are attached.

Lead Agencies and Environmental Document

The BLM has decision-making authority on all geothermal activities proposed to be conducted on Federal lands, and will therefore serve as a lead Federal agency for the proposed action. Because the proposed action includes a proposed transmission line corridor that crosses National Forest lands, the USFS will also serve as a lead Federal agency for the proposed action. Since a power sales agreement is included in the proposed action, the BPA will participate as a cooperating agency. Pursuant to Section 102(2)(c) of the National Environmental Policy Act

(NEPA), and 42 U.S.C. 4321 et seq., the BLM, USFS, and BPA will be directing a third-party contractor in the preparation of an Environmental Impact Statement (EIS) to address the environmental effects of the proposed action.

The proposed action would require permits from the Siskiyou County Air Pollution Control District (APCD), and is also subject to environmental review under the California Environmental Quality Act (CEQA). The Siskiyou APCD will serve as the lead agency under CEQA, and will direct the preparation of an Environmental Impact Report (EIR) under CEQA. In order to streamline the Federal and state environmental review processes, the environmental document for the proposed action will be prepared as a joint EIS/EIR. A separate Notice of Preparation (NOP) has been prepared to comply with CEQA.

Public Comment and Scoping Meetings

Federal, state, and local agencies and the public are invited to participate in the scoping process for the EIS/EIR. Comments on the proposed project are being requested to assist the lead agencies in preparation of the EIS/EIR. Comments are requested to:

- Determine the scope of issues and analysis;
- Ensure that the environmental analysis and subsequent documentation identifies and addresses all relevant issues and concerns related to the proposed action; and
- Develop and refine feasible alternatives to the proposed action.

To encourage public participation, scoping meetings will be held June 25 to June 27 at the following locations:

Yreka	June 25	6:30 pm	Miners Inn Convention Center 122 E. Miner Street
Klamath Falls	June 26	6:30 pm	Shilo Inn 2500 Almond Street
Alturas	June 27	6:30 pm	Alturas Middle School Gym 906 West 4th Street

Dates, times, and locations of the scoping meetings will also be announced in the local news media.

In addition to the public scoping meetings, the Federal and State Agencies are inviting written comments and suggestions on the proposed action and the scope of the analysis. Written comments should be submitted by July 12, 1996, and should be addressed to:

Mr. Randall Sharp
USFS/BLM
Fourmile Hill Geothermal Development Project EIS/EIR Coordinator
800 W. 12th Street
Alturas, CA 96101

Thank you for taking the time to consider this request. Your participation is important. If you have any questions, please contact Mr. Randall Sharp at (916) 233-5811.

Sincerely,

RICH BURNS
Alturas Resource Area Manager
Bureau of Land Management

THOMAS FARMER
District Ranger, Goosenest Ranger District
Klamath National Forest

BERNIE WEISGERBER
District Ranger, Doublehead Ranger District
Modoc National Forest

Background Information on Proposed and Past Geothermal Activities within the Glass Mountain KGRA

PROPOSED ACTION

Calpine Corporation submitted a Plan of Utilization (POU) to the BLM for constructing, operating, and maintaining a 49.9 MW (gross) dual flash geothermal power plant, with associated geothermal production and injection wells, well pads, roads, interconnected geothermal fluid pipelines, and an accompanying 24-mile 230 kV transmission line. This project, known as the Fourmile Hill Geothermal Development Project, would be located at the Glass Mountain Known Geothermal Resource Area (KGRA) on the Klamath and Modoc National Forests.

Location

The proposed geothermal power plant, well pads, and fluid pipelines would be located within Federal geothermal leases CA21924, CA21925, and CA21926, all within the Glass Mountain KGRA. Leases CA21924 and CA21926 are located on the Klamath National Forest, while lease CA21925 is located on the Modoc National Forest. The proposed power plant site would be located in Section 28 within a six-section area known as the Fourmile Hill project area, located in Section 21, 22, 23, 28, 29, and 30, Township 44 North, Range 3 East, MDB&M, Siskiyou County, California. The planned period of commercial operation for the proposed action is 45 years.

Power Plant and Associated Facilities

The proposed action would involve production of geothermal fluids (hot water and steam) from an underground reservoir. These fluids would be produced from 9 to 11 two-phase production wells located at five proposed production well pad sites (well pads 88-28, 84-28, 56-28, 26-28, and 18-28). The fluids would be transported via surface pipelines to the proposed dual flash geothermal power plant, where the steam would be directed to two steam turbine-driven generators. Spent brine and condensate would be pumped through surface pipelines to the three proposed injection well pads (well pads 87-29, 13-28, and 67-21) for injection to the subsurface geothermal reservoir. There would be one injection well located at each injection well pad.

Each of the production and injection well pads would occupy approximately 2.5 acres, for a total well pad area of about 20 acres. The power plant site would occupy approximately 3.0 acres. There would be a total of 4.25 miles of surface pipelines (1.5 miles of production lines, and 2.75 miles of injection lines), and about 2.5 miles of new roads associated with the power plant and well pads.

The proposed action would also include development of a transmission line that would extend from the proposed geothermal power plant in an easterly direction for approximately 24 miles to a proposed intertie station along the BPA Malin-Warner transmission line. The Malin-Warner line is a 230-kV system that parallels Highway 139. The proposed transmission line would be constructed using H-frame wood poles with steel structures used at certain locations. The transmission line would be located primarily on the Modoc National Forest, with only a small portion of the line near the

power plant site being located on the Klamath National Forest. Right-of-way width would be approximately 125 feet along the constructed length of the transmission line. Construction of access roads for installation of structures and maintenance would be required along portions of the right-of-way.

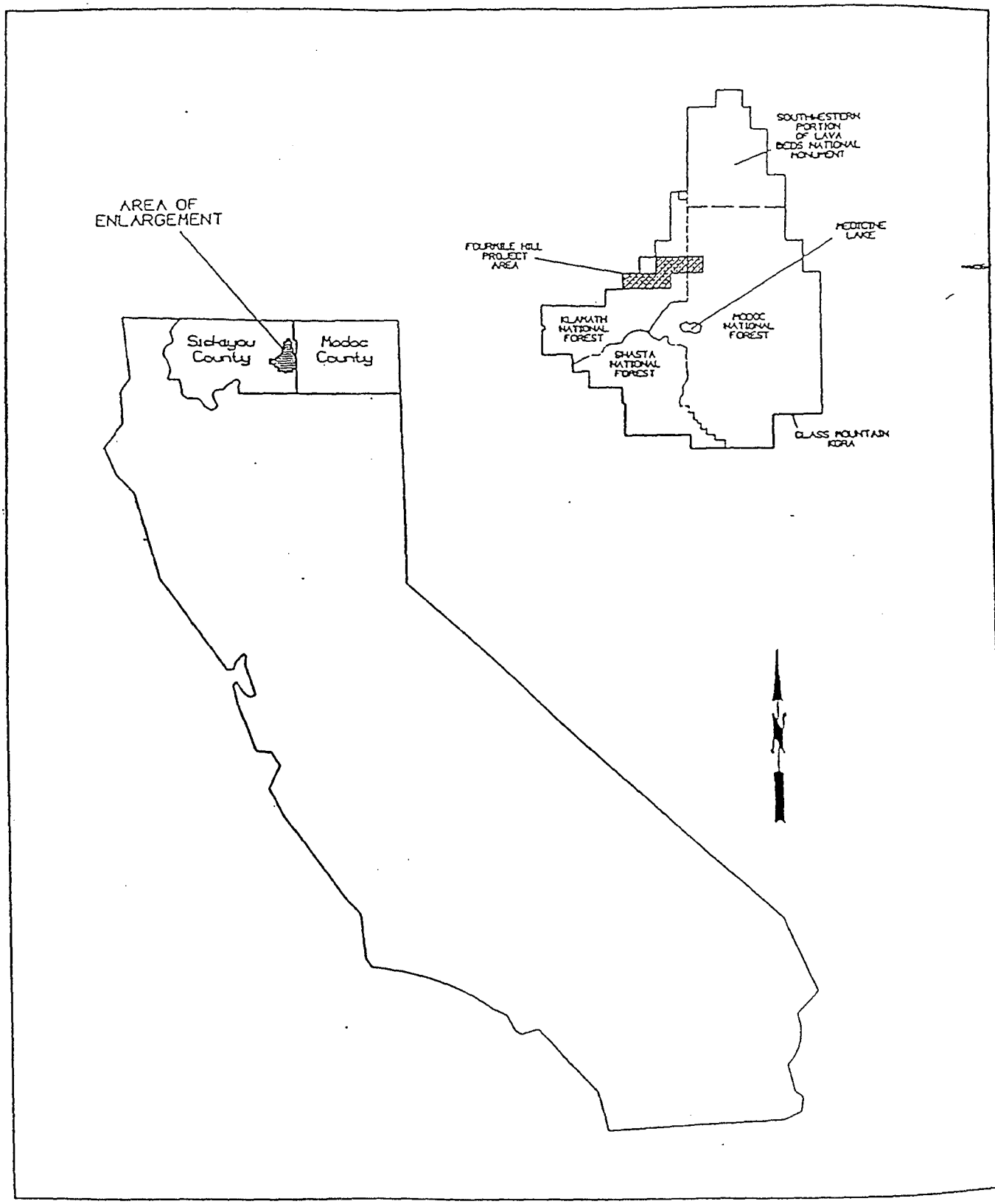
PAST ACTIVITIES

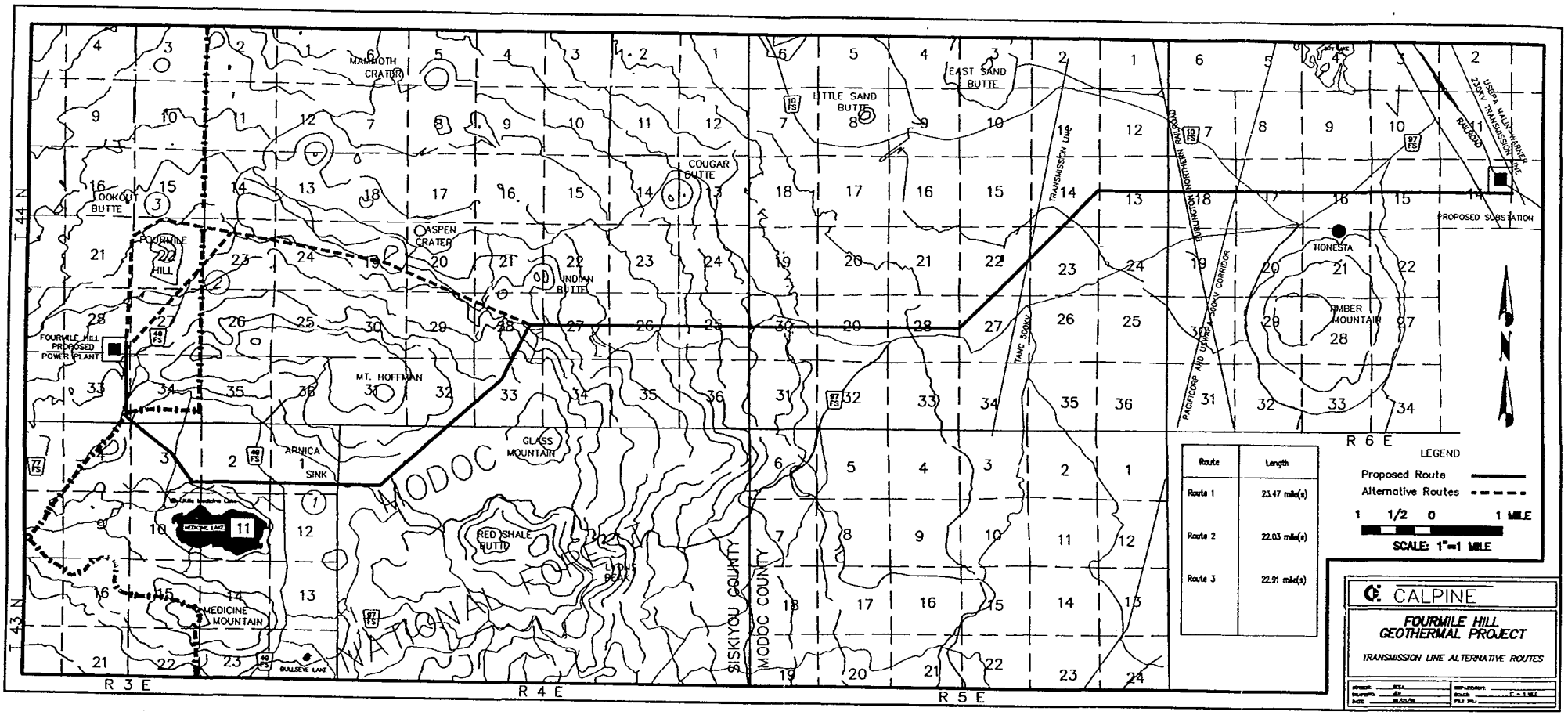
In 1981, the BLM, as lead Federal agency for geothermal leasing, issued numerous leases within the Medicine Lake area for the purpose of exploring and developing a geothermal resource within the project area (i.e., the Glass Mountain KGRA). As part of the authorization for leasing, the BLM and USFS jointly prepared and issued an environmental assessment (EA) for the "casual use and exploration" of the geothermal resource. In 1984, the EA was supplemented to analyze additional potential leases and to address the impacts associated with geothermal development within the KGRA. The supplemental EA identified lease stipulations which provide for surface resource protection measures. These mitigations were and are incorporated as terms and conditions of use and development of the geothermal resource.

As of this date, there has been limited geothermal exploration within the Glass Mountain KGRA; however, within the past two years, there have been two exploration projects proposed in the project vicinity. The first was a proposed exploratory geothermal drilling project within the Glass Mountain KGRA, which was sponsored by the California Energy General Corporation (CEGC). The second project was Calpine's Fourmile Hill Geothermal Exploration Project, which examined the potential environmental effects that would result from an exploratory geothermal drilling program. Environmental assessments and Findings of No Significant Impact (FONSI) were prepared for both of these projects, and were distributed for public review. Records of Decisions (RODs) have been filed for each of these projects as well.

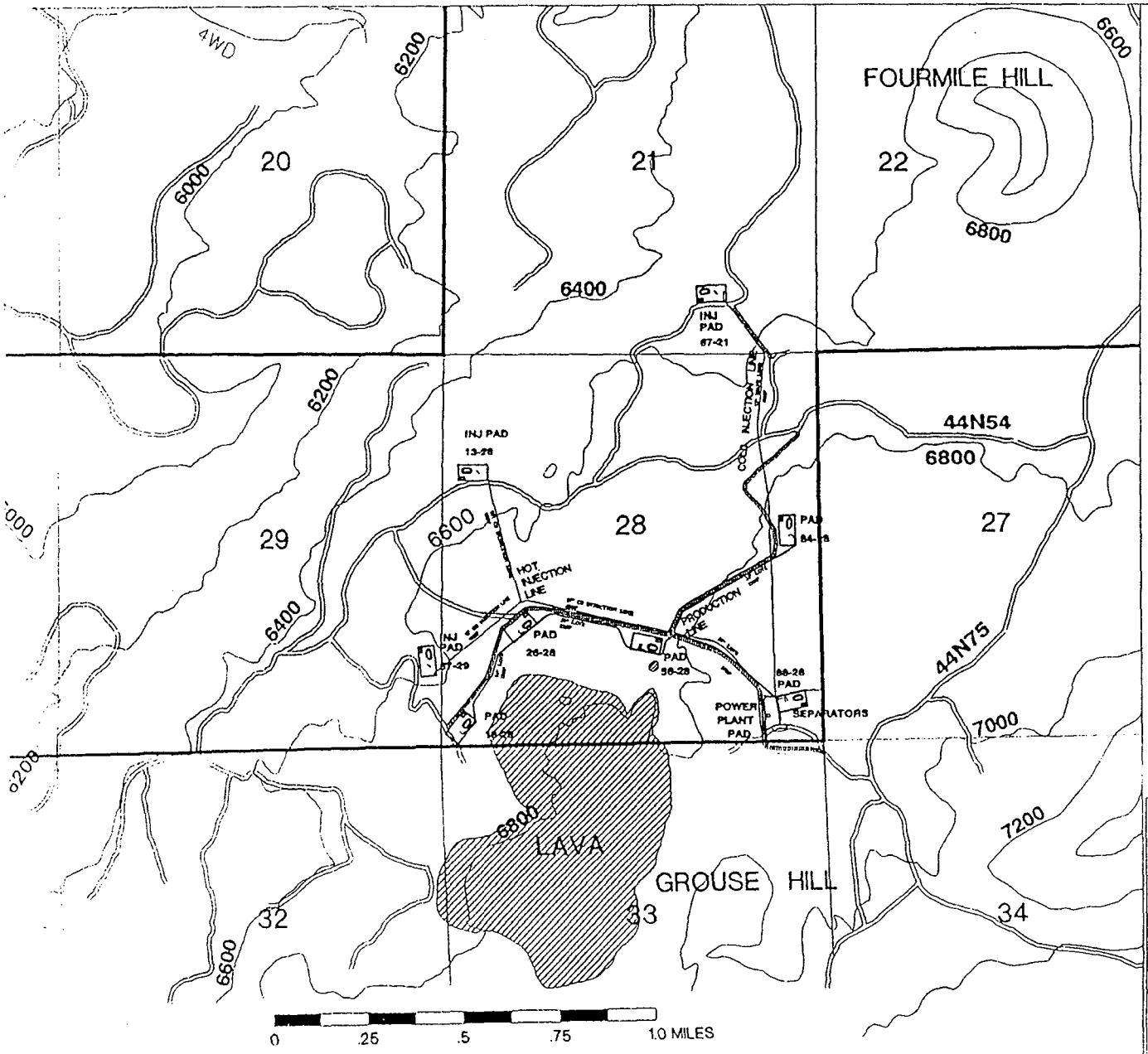
SCOPE OF ANALYSIS

This EIS/EIR for the proposed action will identify a reasonable range of alternative actions, analyze the proposed action and alternatives in terms of direct, indirect and cumulative effects, and identify appropriate mitigation measures for each type of significant effect. The analyses in the EIS/EIR will address potential impacts to geology, minerals, soils, geothermal resources, groundwater, surface water, cultural and paleontological resources, Native American resources, vegetation, wildlife, air quality, visual resources, noise levels, land use, recreation, traffic and access, human health and safety, and social and economic values related to development of the project. Cumulative effects will also be addressed; the EIS/EIR will document the effects on the resources as the result of not only the proposed action but also of previous actions, and any reasonably foreseeable activities in the vicinity of the proposed action.


AREA OF ENLARGEMENT
Siskiyou County
Modoc County
SOUTHWESTERN PORTION OF LAVA BEDS NATIONAL MONUMENT
MEDICINE LAKE
FOURMILE HILL PROJECT AREA
KLAMATH NATIONAL FOREST
MODOC NATIONAL FOREST
SHASTA NATIONAL FOREST
GLASS MOUNTAIN AREA



Route	Length
Route 1	23.47 mile(s)
Route 2	22.03 mile(s)
Route 3	22.91 mile(s)



NOTES:

- 5 PRODUCTION PADS 2.5 ACRES EACH
- APPROXIMATELY 2 1/2 MILES OF NEW ROADS
- 1 POWER PLANT SITE 3 ACRES
- 3 INJECTION PADS 2 1/2 ACRES EACH
- APPROXIMATELY 1 1/2 MILES OF PRODUCTION LINES ABOVE GRADE ON SUPPORTS
- APPROXIMATELY 1 1/2 MILES OF HOT INJECTION LINES ON GRADE
- APPROXIMATELY 1 1/4 MILES OF COLD INJECTION LINES ON GRADE

LEGEND

NEW ROAD

EXISTING ROADS

CALPINE

FOURMILE HILL GEOTHERMAL POWER PLANT 49.9 GMW SEC 21, 28, & 29 T44N R3E SISKIYOU CO. CALIF.

AUTHOR	TTC	DEPARTMENT	ENGINEERING
DRAFTING	CMO	SCALE	REV 2
DATE	MAY 28, 1996	FILE NO	C:\WORK\TIM\4MILEHIL.DGN

Fourmile Hill Geothermal Development Project
Modoc and Klamath National Forests
Glass Mountain KGRA

To ensure that the federal agencies provide the appropriate distribution of future information regarding the proposed geothermal development activities at the Fourmile Hill project area on the Modoc and Klamath National Forests, please:

- Verify your name and address information
- Complete the brief questionnaire
- Return this form to the address printed on the other side of this form (please be sure to affix appropriate first-class postage to ensure delivery)

Name and Address:

Questionnaire:

___ Please include my name on all future mailing lists for this proposed geothermal project.

___ I am not interested in receiving further information regarding the proposed geothermal project; please remove my name from future mailing lists.

___ I will be forwarding my comments to you regarding the proposed geothermal project.

___ I have the following specific comments regarding the proposed geothermal project:

Signed: _____

4310-40
~~1330-40~~

DEPARTMENT OF THE INTERIOR

Bureau of Land Management

[CA-920-06-1330-00]

AGENCY: U.S. Department of Interior, Bureau of Land Management, Alturas Resource Area

ACTION: Notice of Intent to prepare an Environmental Impact Statement for a Plan of Utilization for a proposed geothermal power plant, ancillary facilities, and transmission line on the Klamath and Modoc National Forests in Siskiyou and Modoc Counties, California.

SUMMARY: Notice is given that the Bureau of Land Management (BLM), U.S. Department of Agriculture, Forest Service (USFS), U.S. Department of Energy, Bonneville Power Administration (BPA), and Siskiyou County Air Pollution Control District (APCD) will jointly prepare an Environmental Impact Statement/Environmental Impact Report (EIS/EIR) for a proposed a 49.9 megawatt (MW) (gross) geothermal electric power plant with associated facilities and operations, and a 24-mile 230-kilovolt (kV) transmission line. This proposed action (known as the Fourmile Hill Geothermal Development Project) would be located on the Klamath and Modoc National Forests in northeastern California. BPA will participate in the EIS/EIR process as a cooperating agency to analyze potential effects.

Pursuant to Section 102(2)(c) of the National Environmental Policy Act (NEPA), and 42 U.S.C. 4321 et seq., the BLM, USFS, BPA, and Siskiyou County APCD will be directing a third-party contractor in the preparation of the EIS/EIR on the impacts of the proposed action. Comments are being requested to help identify significant issues or concerns related to the proposed action, determine the scope of issues, identify and refine alternatives to the proposed action.

DATES: Federal, state, and local agencies and the public are invited to participate in the scoping process for the EIS/EIR. Scoping meetings to encourage and facilitate public participation will be held in Yreka (June 25, 1996), Klamath Falls (June 26), and Alturas (June 27). Times and locations of the scoping meetings will be announced in the local news media.

ADDRESS FOR COMMENTS: In addition to the public scoping meetings, the BLM is inviting written comments and suggestions on the proposed action and the scope of the analysis. Written comments or requests to be added to the project mailing list should be submitted by [30 days after date of publication]. Written comments should be addressed to Mr. Randall Sharp, USFS/BLM, Fourmile Hill Geothermal Development Project EIS/EIR Coordinator, 800 W. 12th Street, Alturas, CA 96101.

FOR FURTHER INFORMATION CONTACT:

Mr. Randy Sharp (916) 233-5811.

SUPPLEMENTARY INFORMATION: Calpine Corporation submitted a Plan of Utilization (POU) to the BLM for constructing, operating, and maintaining a 49.9 MW (gross), dual flash geothermal power plant, with associated geothermal production and injection wells, well pads, roads, interconnected geothermal fluid pipelines, and an accompanying 24-mile 230 kV transmission line. This project, known as the Fourmile Hill Geothermal Development Project, would be located at the Glass Mountain Known Geothermal Resource Area (KGRA) on the Klamath and Modoc National Forests.

The proposed geothermal power plant, well pads, and fluid pipelines would be located within Federal geothermal leases CA21924, CA21925, and CA21926, all within the Glass Mountain KGRA. Leases CA21924 and CA21926 are located on the Klamath National Forest, while lease CA21925 is located on the Modoc National Forest. The proposed power plant site would be located in Section 28 within a six-section area known as the Fourmile Hill project area, located in Section 21, 22, 23, 28, 29, and 30, Township 44 North, Range 3 East, MDB&M, Siskiyou County, California. The planned period of commercial operation for the proposed action is 45 years.

The proposed action would involve production of geothermal fluids (hot water and steam) from an underground reservoir. These fluids would be produced from 9 to 11 two-phase production wells located at five proposed production well pad sites (well pads 88-28, 84-28, 56-28, 26-28, and 18-28). The fluids would be transported via surface pipelines to the proposed dual flash geothermal power plant, where the steam would

be directed to two steam turbine-driven generators. Spent brine and condensate would be pumped through surface pipelines to the three proposed injection well pads (well pads 87-29, 13-28, and 67-21) for injection to the subsurface geothermal reservoir. There would be one injection well located at each injection well pad.

Each of the production and injection well pads would occupy approximately 2.5 acres, for a total well pad area of about 20 acres. The power plant site would occupy approximately 3.0 acres. There would be a total of 4.25 miles of surface pipelines (1.5 miles of production lines, and 2.75 miles of injection lines), and about 2.5 miles of new roads associated with the power plant and well pads.

The proposed action would also include development of a transmission line that would extend from the proposed geothermal power plant in an easterly direction for approximately 24 miles to a proposed intertie station along the BPA Malin-Warner transmission line. The Malin-Warner line is a 230-kV system that parallels Highway 139. The proposed transmission line would be constructed using H-frame wood poles with steel structures used at certain locations. The transmission line would be located primarily on the Modoc National Forest, with only a small portion of the line near the power plant site being located on the Klamath National Forest. Right-of-way width would be approximately 125 feet along the constructed length of the transmission line. Construction of access roads for installation of structures and maintenance would be required along portions of the right-of-way.

Alternatives thus far identified for evaluation in the EIS/EIR are: (1) the proposed action, (2) the no action (the consequences of not developing the project), and (3) alternate transmission line route alternatives. The principal issues identified thus far for consideration in the EIS/EIR include potential effects to listed wildlife species, Tribal concerns, potential recreation conflicts, and potential visual impacts. The EIS/EIR will also address other issues such as geology, geothermal resources, hydrology, cultural resources, vegetation, air quality, noise, land use, plans and policies, transportation, human health and safety, socioeconomics, cumulative impacts, as well as any issues raised during the scoping process.

Federal, state, and local agencies and other individuals or organizations who may be interested in or affected by the BLM's decision for the proposed action are invited to participate in the scoping process. Input and comments received during this process will be considered during preparation of the EIS/EIR.

Rich Burns

Rich Burns 4310-40

Alturas Resource Area Manager

May 29, 1996

Date

Notice of Preparation

Notice sent to attached list

To: USFS /BLM
(Agency)
800 W. 12th Street
(Address)
Alturas, CA 96101

Subject: **Notice of Preparation of a Draft Environmental Impact Report**

Lead Agency:

Agency Name Siskiyou County APCD

Street Address 525 South Foothill Drive

City/State/Zip Yreka, California 96097-3090

Contact Patrick Griffin

Consulting Firm:

Firm Name MHA Environmental Consulting, Inc.

Street Address 520 S. El Camino Real, Suite 800

City/State/Zip San Mateo, California 94402

Contact Hub Adams

Siskiyou County Air Pollution Control District will be the Lead Agency and will prepare an environmental impact report for the project identified below. We need to know the views of your agency as to the scope and content of the environmental information which is germane to your agency's statutory responsibilities in connection with the proposed project. Your agency will need to use the EIR prepared by our agency when considering your permit or other approval for the project.

The project description, location, and the potential environmental effects are contained in the attached materials. A copy of the Initial Study (is is not) attached.

Due to the time limits mandated by State law, your response must be sent at the earliest possible date but ***not later than 30 days*** after receipt of this notice.

Please send your response to Patrick Griffin at the address shown above. We will need the name for a contact person in your agency.

Project Title: Fourmile Hill Geothermal Development Project

Project Location: In Siskiyou and Modoc Counties, California, on the Klamath and Modoc National Forests, at the Glass Mountain Known Geothermal Resource Area (see enclosed map)

Project Description: See attached

Date _____

Signature _____

Title Air Pollution Control Specialist

Telephone (916) 841-4029

BLM, Alturas RA
708 West 12th Street
Alturas, CA 96101

BLM, State Director
2800 Cottage Way
Sacramento, CA 95825

California Dept. of Boating and Waterways
1629 "S' Street
Sacramento, CA 95814

California Dept. of Conservation
Division of Oil and Gas
801 K Street, Floor 20
Sacramento, CA 95814

California Dept. of Fish and Game
601 Locust Street
Redding, CA 96001

California Dept. of Fish and Game
1416 9th Street, Room 1270
Sacramento, CA 95814

California Dept. of Forestry
1416 9th Street, Room 1516-2
Sacramento, CA 95814

California Dept. of Forestry and Fire Protection
1809 Fairlane Road
Yreka, CA 96097

California Dept. of Parks and Recreation
1416 9th Street, Room 1431
Sacramento, CA 94296

California Dept. of Transportation,
District 2`
1657 Riverside Drive
Redding, CA 96001

California Public Utilities Commission
505 Van Ness Avenue
San Francisco, CA 94102-3214

California State Lands Commission
200 Oceangate, 12th Floor
Long Beach, CA 90802-4333

Modoc County Planning Department
202 West Fourth Street
Alturas, CA 96101

Native American Heritage Commission
915 Capitol Mall, Rm. 288
Sacramento, CA 95814

RWQCB, Central Valley, Redding Branch Office
415 Knollcrest Drive
Redding, CA 96002

RWQCB, North Coast
5550 Skylane Blvd., Suite A
Santa Rosa, CA 95403

Siskiyou County Planning
P.O. Box 1085
Yreka, CA 96097

State Clearinghouse, Office of Planning and
Research
1400 Tenth Street #121
Sacramento, CA 95814

U.S. Fish and Wildlife Service
2800 Cottage Way - Room E
Sacramento, CA 95825

USFS/BLM
800 W. 12th Street
Alturas, CA 96101

Notice of Preparation
Description of the Fourmile Hill Geothermal Development Project
Siskiyou and Modoc Counties, California

Calpine Corporation submitted a Plan of Utilization (POU) to the Bureau of Land Management (BLM), U.S. Department of Agriculture, Forest Service (USFS), and Siskiyou County Air Pollution Control District (APCD) for constructing, operating, and maintaining a 49.9 megawatt (MW) (gross) dual flash geothermal power plant, with associated geothermal production and injection wells, well pads, roads, interconnected geothermal fluid pipelines, and an accompanying 24-mile 230-kilovolt (kV) transmission line. This project, known as the Fourmile Hill Geothermal Development Project, would be located at the Glass Mountain Known Geothermal Resource Area (KGRA) on the Klamath and Modoc National Forests in Siskiyou and Modoc Counties in northeastern California.

Project Location

The proposed geothermal power plant, well pads, and fluid pipelines would be located within Federal geothermal leases CA21924, CA21925, and CA21926, all within the Glass Mountain KGRA. Leases CA21924 and CA21926 are located on the Klamath National Forest, while lease CA21925 is located on the Modoc National Forest. The proposed power plant site would be located in Section 28 within a six-section area known as the Fourmile Hill project area, located in Section 21, 22, 23, 28, 29, and 30, Township 44 North, Range 3 East, MDB&M, Siskiyou County, California. The planned period of commercial operation for the proposed project is 45 years.

Power Plant and Associated Facilities

The proposed project would involve production of geothermal fluids (hot water and steam) from an underground reservoir. These fluids would be produced from 9 to 11 two-phase production wells located at five proposed production well pad sites (well pads 88-28, 84-28, 56-28, 26-28, and 18-28). The fluids would be transported via surface pipelines to the proposed dual flash geothermal power plant, where the steam would be directed to two steam turbine-driven generators. Spent brine and condensate would be pumped through surface pipelines to the three proposed injection well pads (well pads 87-29, 13-28, and 67-21) for injection to the subsurface geothermal reservoir. There would be one injection well located at each injection well pad.

Each of the production and injection well pads would occupy approximately 2.5 acres, for a total well pad area of about 20 acres. The power plant site would occupy approximately 3.0 acres. There would be a total of 4.25 miles of surface pipelines (1.5 miles of production lines, and 2.75 miles of injection lines), and about 2.5 miles of new roads associated with the power plant and well pads.

The proposed project would also include development of a transmission line that would extend from the proposed geothermal power plant in an easterly direction for approximately 24 miles to a proposed intertie station along the Bonneville Power

Authority's (BPA) Malin-Warner transmission line. The Malin-Warner line is a 230-kV system that parallels Highway 139. The proposed transmission line would be constructed using H-frame wood poles with steel structures used at certain locations. The transmission line would be located primarily on the Modoc National Forest, with only a small portion of the line near the power plant site being located on the Klamath National Forest. Right-of-way width would be approximately 125 feet along the constructed length of the transmission line. Construction of access roads for installation of structures and maintenance would be required along portions of the right-of-way.

Scope of Analysis and Potential Environmental Effects

The EIS/EIR for the proposed project will identify a reasonable range of alternative actions, analyze the proposed project and alternatives in terms of direct, indirect and cumulative effects, and identify appropriate mitigation measures for each type of significant effect. The analyses in the EIS/EIR will address potential impacts to geology, minerals, soils, geothermal resources, groundwater, surface water, cultural and paleontological resources, Native American resources, vegetation, wildlife, air quality, visual resources, noise levels, land use, recreation, traffic and access, human health and safety, and social and economic values related to development of the project. Cumulative effects will also be addressed; the EIS/EIR will document the effects on the resources as the result of not only the proposed project but also of previous projects, and any reasonably foreseeable activities in the vicinity of the proposed project.

PUBLIC MEETING NOTICE

Three public meetings are scheduled for the federal government to gather comments concerning a proposal to construct a geothermal plant on Forest Service land near Medicine Lake. The meetings are part of the scoping process for the Forest Service and Bureau of Land Management to identify issues that should be addressed in the Environmental Impact Statement/Environmental Impact Report.

The project, known as the Fourmile Hill Geothermal Development Project, is located approximately three miles northwest of Medicine Lake and straddles the border of the Modoc and Klamath National Forests. It will encompass about ten acres of land.

The proposal also calls for construction of a 24 mile long 230 kilovolt transmission line that will cross Modoc National Forest land to connect with the existing Bonneville Power Administration system near California State Highway 139.

The public meetings will be held:

Tuesday	June 25	Miners Inn Convention Center	Yreka	6:30 pm
Wednesday	June 26	Shilo Inn	Klamath Falls	6:30 pm
Thursday	June 27	Alturas Middle School gymnasium	Alturas	6:30 pm

For more information, contact Project Coordinator Randall Sharp at 916 233-5811.

****

NEWS RELEASE FAX

USDA Forest Service
USDI Bureau of Land Management
Fourmile Hill Geothermal Development Project
800 West 12th Street
Alturas, California 96101

NEWS RELEASE FAX

****

Public Affairs Offices

Nancy Gardner
Telephone 916 233-5811
Jeff Fontana
Telephone 916 257-5381

FOR IMMEDIATE RELEASE

June 17, 1996

Alturas -- Alturas Resource Area Office, BLM, has received a proposal from Calpine Corporation of Santa Rosa, to develop a 49.9 megawatt geothermal power plant located 3 miles northwest of Medicine Lake on the Klamath and Modoc National Forests in Siskiyou County. The proposal also includes construction of a 230-kilovolt transmission line that would extend from the proposed power plant site east to a connection with existing BPA transmission line in Modoc County. An environmental document for the proposal will be prepared as a joint environmental impact statement/environmental impact report (EIS/EIR).

The public is invited to participate in the scoping process for the EIS/EIR. To encourage public participation, scoping meetings will be held June 25 to June 27 at the following locations: Yreka, June 25, 6:30 pm, Miners Inn Convention Center, 122 E. Miner Street; Klamath Falls, June 26, 6:30 pm, Shilo Inn, 2500 Almond Street; Alturas, June 27, 6:30 pm, Alturas Middle School Gym, 906 West 4th Street.

In addition to public scoping meetings, written comments and suggestions on the proposed action and scope of the analysis are invited. Written comments should be submitted by July 12 and addressed to project coordinator Randall Sharp, USFS/BLM, Fourmile Hill Geothermal Development Project, 800 W. 12th Street, Alturas, CA 96101. For more information contact Randall Sharp at 916-233-5811.

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Editor's note: Background Information on Proposed and Past Geothermal Activities within the Glass Mountain KGRA follows for your use. A location map can be mailed or FAXed to you at your request.

Background Information on Proposed and Past Geothermal Activities within the Glass Mountain KGRA

PROPOSED ACTION

Calpine Corporation submitted a Plan of Utilization (POU) to the BLM for constructing, operating, and maintaining a 49.9 MW (gross) dual flash geothermal power plant, with associated geothermal production and injection wells, well pads, roads, interconnected geothermal fluid pipelines, and an accompanying 24-mile 230 kV transmission line. This project, known as the Fourmile Hill Geothermal Development Project, would be located at the Glass Mountain Known Geothermal Resource Area (KGRA) on the Klamath and Modoc National Forests.

Location

The proposed geothermal power plant, well pads, and fluid pipelines would be located within Federal geothermal leases CA21924, CA21925, and CA21926, all within the Glass Mountain KGRA. Leases CA21924 and CA21926 are located on the Klamath National Forest, while lease CA21925 is located on the Modoc National Forest. The planned period of commercial operation for the proposed action is 45 years.

Power Plant and Associated Facilities

The proposed action would involve production of geothermal fluids (hot water and steam) from an underground reservoir. These fluids would be produced from 9 to 11 two-phase production wells located at five proposed production well pad sites. The fluids would be transported via surface pipelines to the proposed dual flash geothermal power plant, where the steam would be directed to two steam turbine-driven generators. Spent brine and condensate would be pumped through surface pipelines to the three proposed injection well pads for injection to the subsurface geothermal reservoir. There would be one injection well located at each injection well pad.

The proposed action would also include development of a transmission line that would extend from the proposed geothermal power plant in an easterly direction for approximately 24 miles to a proposed intertie station along the BPA Malin-Warner transmission line. The Malin-Warner line is a 230-kV system that parallels Highway 139. The proposed transmission line would be constructed using H-frame wood poles with steel structures used at certain locations. The transmission line would be located primarily on the Modoc National Forest, with only a small portion of the line near the power plant site being located on the Klamath National Forest. Right-of-way width would be approximately 125 feet along the constructed length of the transmission line. Construction of access roads for installation of structures and maintenance would be required along portions of the right-of-way.

Lead Agencies and Environmental Document

The BLM has decision-making authority on all geothermal activities proposed to be conducted on Federal lands, and will therefore serve as a lead Federal agency for the proposed action. Because the proposed action includes a proposed transmission line corridor that crosses National Forest lands, the Forest will also serve as a lead Federal agency for the proposed action. Since a power sales agreement is included in the proposed action, the BPA will participate as a cooperating agency. The BLM, Forest Service, and BPA will be directing a third-party contractor in preparation of an EIS to address the environmental effects of the proposed action.

The proposed action would require permits from the Siskiyou County Air Pollution Control District (APCD) and is also subject to environmental review under the California Environmental Quality Act (CEQA). Siskiyou APCD will serve as the lead agency under CEQA and will direct the preparation of an Environmental Impact Report under CEQA.

PAST ACTIVITIES

In 1981, the BLM, as lead Federal agency for geothermal leasing, issued numerous leases within the Medicine Lake area for the purpose of exploring and developing a geothermal resource within the project area. As part of the authorization for leasing, the BLM and Forest Service jointly prepared and issued an environmental assessment (EA) for the casual use and exploration of geothermal resource. In 1984 the EA was supplemented to analyze additional potential leases and to address the impacts associated with geothermal development within the KGRA (Known Geothermal Resource Area).

To date there has been limited geothermal exploration within the Glass Mountain KGRA; however, within the past two years, there have been two exploration projects proposed in the project vicinity. The first was a proposed exploratory geothermal drilling project within the Glass Mountain KGRA which was sponsored by the California Energy General Corporation. The second project was Calpine's Fourmile Hill Geothermal Exploration Project, which examined the potential environmental effects that would result from an exploratory geothermal drilling program. Envirnonmental assessments and Findings of No Significant Impact were prepared for both of these projects, and were distributed for public review. Records of Decisions have been filed for each of these projects as well.

--END--

United States Department of Agriculture
Forest Service
Klamath National Forest
1312 Fairlane Road
Yreka, CA 96097-9549
(916) 842-6131
TTY (916) 842-5725

DATE: August 7, 1996

Jon Silvius
(916) 842-6131 (w)
(916) 459-3432 (h)

FOR RELEASE: Immediately

GEOTHERMAL MEETING SCHEDULED

DORRIS - Representatives from the federal and state governments, along with members of the Calpine Corporation and MHA Enviornmental Consulting, will provide a briefing at a public meeting scheduled for 6:30 p.m., August 22, 1996 at the Dorris City Hall in Dorris, California.

The briefing is intended to provide the latest information regarding the Calpine Geothermal Project located near Glass Mountain in the Medicine Lake Highlands. The public will be asked to submit comments regarding the scope and content of the project. Public input will be used to determine issues.

This is the fourth public meeting regarding the geothermal project. Other meetings have been held in Yreka, Alturas and Klamath Falls.

For more information, contact Randall Sharp at (916) 233-5811.

* * *

Area geo project is moving forward

HERALD AND NEWS, Klamath Falls, Oregon Friday, April 19, 1996

By TODD KEPPLE
H&N Staff Writer

The Bonneville Power Administration has reached an agreement with two power companies to proceed with an environmental analysis of the Glass Mountain geothermal power project on the Klamath National Forest.

The Bureau of Land Management will take the lead in drafting an environmental impact statement (EIS), working in cooperation with BPA, the Forest Service and Siskiyou County. Agencies involved in the process will meet next week to begin the process.

The 49-megawatt project, expected to be completed in three years, is proposed by Calpine Corp., based in San Jose, Calif., and Trans-Pacific Geothermal Corp., based in Oakland.

The project is proposed for construction along the border of the Klamath and Modoc national forests, near Medicine Lake about 50 miles south of Klamath Falls.

A test well drilled last year to a depth of about 500 feet revealed the geothermal aquifer is capable of power production, said Maurice Richard, program manager for Calpine.

"We're satisfied with the results that we have, and therefore we have confidence to proceed with the expenditure required to proceed with an EIS," Richard said.

Water temperatures of at least 450 Fahrenheit degrees are required to generate power, Richard said. Additional holes are expected to be drilled over the next two years, he added.

The environmental impact statement will cover construction and operation of the plant, a 24-mile transmission line and power purchase agreements. The EIS is expected to be completed by the fall of 1997.

BPA said it is pursuing new sources of "renewable" power despite their relatively high cost, and even though there is currently a surplus of electricity in the Northwest.

"BPA's approach to developing and marketing green power products reflects the (U.S. Energy) department's desire to encourage long-term investments that will benefit future generations in the region," said Charles Curtis, deputy secretary of Energy Department.

BPA officials said the Glass Mountain project is located in an area capable of producing 500 megawatts of power, and is one of the world's largest untapped geothermal resources.

Katherine Potter, spokeswoman for Calpine, said construction would create about 200 temporary jobs, and 15-20 permanent jobs. There is no firm estimate of construction costs, she said.

Glass Mountain is one of several renewable energy projects proposed in the Northwest. The Newberry Geothermal Project has been issued a permit for construction on the Bend-based Deschutes National Forest.

Others projects include wind power facilities in Wyoming and Washington.

GEO From page 1

Mountain Echo
Tuesday, June 18, 1996

Powerplant in the works

ALTURAS -- Alturas Resource Area Office, BLM, has received a proposal from Calpine Corporation of Santa Rosa, to develop a 49.9 megawatt geothermdl power plant located 3 miles northwest of Medicine Lake on the Klamath and Modoc National Forests in Siskiyou County. The proposal also includes construction of a 230-kilovolt transmission line that would extend from the proposed power plant site east to a connection with existing BPA transmission line in Modoc County. An environmental document for the proposal will be prepared as a joint environmentdl impact statement/environmental impact report (EIS/EIR).

The public is invited to participate in the scoping process for the EIS/EIR. To encourage public participation, scoping meetings will be held June 25 to June 27 at the following locations: Yreka, June 25, 6:30 p.m., Miners Inn Convention Center, 122 E. Miner Street; Klamath Falls, June 26, 6:30 p.m., Shilo Inn, 2500 Almond Street; Alturas, June 27, 6:30 p.m., Alturas Middle School Gym, 906 West 4th Street.

In addition to public scoping meetings, written comments and suggestions on the proposed action and scope of the analysis are invited. Written comments should be submitted by July 12 and addressed to project coordinator Randall Sharp, USFS/BLM, Fourmile Hill Geothermal Development Project. 800 W. 12th Street, Alturas. CA 96101.

For more information, contact Randdll Sharp at 916-233-5811

Trio of public meetings set on geo power plant

Three public meetings have been scheduled for the federal government to gather comments as it begins analyzing a proposal for construction of a geothermal power plant on Forest Service land near Medicine Lake.

The meetings in Yreka, Klamath Falls and Alturas next week are part of the "scoping" process in which the Forest Service and the Bureau of Land Management will identify issues that should be addressed in an environmental impact statement.

The 50-megawatt project is proposed by Calpine Corp. of Santa Rosa, Calif., and has been named the Fourmile Hill Geothermal Development Project.

The project would be located about three miles northwest of Medicine Lake, and would straddle the border of the Modoc and Klamath national forests. Medicine Lake is a popular recreation site about 50 miles south of Klamath Falls.

About 10 acres of land would be required for project.

The proposal also calls for construction of a 24-mile-long, 230-kilovolt transmission line that would cross mostly Modoc National Forest land to connect with the Bonneville Power Administration system near Highway 139.

It has not been determined whether any part of the project or transmission line would be visible from recreation facilities at Medicine Lake, according to Randall Sharp, project coordinator for the Bureau of Land Management.

The environmental impact statement, which will identify alternatives for action, including no action, is expected to take more than a year to complete.

To produce power, the project would pump geothermal water with a temperature of at least 450 degrees Fahrenheit from about 10 wells located at five well pads.

The geothermal water would be used to create steam that would drive a pair of generators returned to the aquifer through three injection wells.

If approved, the power plant could begin operation within three years.

The public meetings will be held Tuesday, June 25, at the Miners Inn Convention Center in Yreka, Wednesday, June 26, at Shilo Inn in Klamath Falls, and Thursday, June 27, at the Alturas Middle School gymnasium. All meetings begin at 6:30 p.m.

Written comments and suggestions for the analysis process can be submitted until July 12. Comments should be directed to: Randall Sharp, USFS/BLM, Fourmile Hill Geothermal Development Project, 800 W. 12th St., Alturas, Calif. 96101.

For more information, call Sharp at (916) 233-5811.

Besides a permit from the federal government, the project requires permits from the Siskiyou County Air Pollution Control District, and is subject to review by the California Environmental Quality Act.

An environmental impact report will be prepared by the Siskiyou County Air Pollution Control District.

At a glance

Written comments and suggestions for the analysis process can be submitted until July 12.

Comments should be directed to: Randall Sharp, USFS/BLM, Fourmile Hill Geothermal Development Project, 800 W. 12th St., Alturas, Calif. 96101.

For more information, call Sharp at (916) 233-5811.

Public meetings will be held Tuesday in Yreka, Wednesday in Klamath Falls, and Thursday in Alturas. All meetings begin at 6:30 p.m.

Proposal for power plant gets yeas, nays

Proposed construction of a geothermal power plant near Medicine Lake drew both mild objections and timid support during a scoping meeting Wednesday evening at the Klamath Falls Shilo Inn.

Local residents said a proposed 24-mile power line that would link the plant with the Bonneville Power Administration grid would disrupt the view from their property in the area.

The 49.9-megawatt Fourmile Hill project would be located about three miles north of Medicine Lake, a popular camping spot on the Modoc National Forest.

Calpine Corp. of Santa Rosa, Calif., proposes to lease about 25 acres of forest land for operation of the power plant and geothermal wells. Construction could begin in 1998, with the plant going on line in late 1999.

"I support geothermal development on Glass Mountain," said Larry Hearne, a resident in the Tionesta community south of Tulelake. "But I have a concern about the routing of the power line. There's definitely an adverse visual impact in my neighborhood."

Hearne was one of about a dozen people who attended the meeting to hear about the project proposal, and register comments as the federal government begins analysis of how the power plant would affect the environment.

Hearne urged Calpine to consider an alternate route that would bypass Tionesta.

The Forest Service, the Bureau of Land Management and the Bonneville Power Administration will cooperate in evaluating the project's benefits and impacts.

A draft environmental impact statement is expected to be released in February 1997. There will be a 60-day public comment period following release of the draft environmental impact statement.

A scoping meeting was held Tuesday evening in Yreka, and a third meeting was conducted Thursday evening in Alturas.

– HERALD AND NEWS, Klamath Falls, Oregon Friday, June 28, 1996

HERALD AND NEWS, Klamath Falls, Oregon Sunday, Aug. 11, 1996

Meeting slated for geothermal plans

DORRIS — A public meeting on the Calpine Geothermal Project near Glass Mountain will begin at 6:30 p.m. Aug. 22 at the Dorris City Hall.

Representatives from federal and state government agencies, along with representatives from Calpine Corp. and MHA Environmental Consulting, will provide a briefing.

The briefing is intended to provide the latest information on the project. Glass Mountain is located near Medicine Lake and Tionesta in northern Modoc County. Public comments are wanted regarding the scope and content of the project.

The Dorris session will be the fourth public meeting on the geothermal project. Previous meetings have been held in Yreka, Alturas and Klamath Falls. For more information contact Randall Sharp at (916) 233-5811.

30c per copy - $13.50 per year subscription

Butte Valley Star

Aug 14-20, 1996 | A weekly newspaper serving the Butte Valley area for 68 years | Vol. 69, No. 37

Geothermal meeting scheduled in Dorris

After three public meetings — in Yreka, Alturas and Klamath Falls — that appeared to be inconvenient to most local residents, a fourth public meeting regarding the latest information on the Calpine Geothermal Project located near Glass Mountain in the Medicine Lake Highlands is scheduled in Dorris. Representatives from federal and state governments, along with members of the Calpine Corporation and MHA Environmental Consulting will present the information on August 22 at the Dorris City Hall starting at 6:30 p.m.

Some concern has already been raised at prior meetings and in written comments when it was proposed for exploration wells to be drilled. Several of the comments were concern over Medicine Lake being effected and underground water quality and quantity and whether hot springs located in the area would be effected.

On page 2, an article contains more information on the project along with a map of the area.

30¢ per copy - $13.50 per year subscription

Butte Valley Star

Aug. 14-20, 1996 | A weekly newspaper serving the Butte Valley area for 68 years | Vol. 69, No. 37

At A Glance

Meetings

Booster Club

The Butte Valley Boosters will meet tomorrow evening, August 15, at 7 p.m. to discuss the upcoming fundraiser sock hop during the annual Car Cruise on September 14.

Anyone who would be interested in helping or joining the club is invited to attend.

School Board

The Butte Valley Unified School Board will hold their regular meeting tomorrow, Thursday, August 15, 7 p.m. at Macdoel Elementary.

School is scheduled to start on Monday, August 26. Inservice for teachers will start on August 21.

Neighborhood Watch

Macdoel Neighborhood Watch will hold their next meeting on August 19 at the Macdoel Firehall, at 7 p.m.

Council reviews county curfew ordinance

Siskiyou County Sheriff's Captain Michael Murphy presented the county's curfew ordinance to the council at their regular meeting with the advice that the city adopt this curfew over the city's current ordinance.

According to Murphy, County Counsel prefers that the city adopt the county curfew ordinance and that county probation would also work with the sheriff's department on curfew violations.

Council instructed the clerk to give the city's attorney the ordinance for review.

Murphy also reported on the COPS grant, saying it could not be used to fund the sheriff's contract with the city to provide law enforcement but is still available for two-and half years for the city's use if they employ their own department. Murphy stated that the city would not have to pay back the approximately $7,000 that was used to employ third officer, Roger Erwin.

The council discussed consolidating the volunteer Health and Safety position with the Building Inspector job. Currently the city pays approximately $4,000 a year for the safety officer health insurance and supplies which leaves a gray area as to whether they are an employee of the city or a volunteer position.

At this time the council tabled the matter as the building inspector contract is still under review by the city council, which has recently received a tentative contract from the city attorney. The building inspector has asked for $30 an hour for inspecting plus $30 for one-way trips from Yreka.

Council endorsed the Butte Valley Recreational District and their request for sponsorship through Orc-Cal RC&D to perform grant searches. Council also passed a motion to seek grant funds for the City of Dorris including the Senior Community Center/Economic Development and other projects in the city.

Geothermal meeting scheduled in Dorris

After three public meetings — in Yreka, Alturas and Klamath Falls — that appeared to be inconvenient to most local residents, a fourth public meeting regarding the latest information on the Calpine Geothermal Project located near Glass Mountain in the Medicine Lake Highlands is scheduled in Dorris. Representatives from federal and state governments, along with members of the Calpine Corporation and MHA Environmental Consulting will present the information on August 22 at the Dorris City Hall starting at 6:30 p.m.

Some concern has already been raised at prior meetings and in written comments when it was proposed for exploration wells to be drilled. Several of the comments were concern over Medicine Lake being effected and underground water quality and quantity and whether hot springs located in the area would be effected.

On page 2, an article contains more information on the project along with a map of the area.

Letters to the Editor

Go Rangers!

Dear Editor,

Congratulations to Merrill Police Chief Lee Whalon and Officers Tom Pittman and Joe Hinton on the fine job they are doing in Merrill.

Not only on crime but specifically the ingenuity and organization of the Merrill Rangers This shows real leadership and interest in the youth of our community.

Go Rangers!

Jim Harvie
Candidate for Sheriff
Klamath County
Klamath Falls, Ore.

LETTERS TO THE EDITOR ARE WELCOME

Send your letter (INCLUDE YOUR SIGNATURE AND NAME, FULL ADDRESS, & TELEPHONE NUMBERInclude) to Butte Valley Star, P.O. Box 708, Dorris, CA 96023; or Lost River Star, P.O. Box 768, Merrill, OR 97633.

The Star will not print letters that are *unsigned or have a full address* and reserves the right to print letters according to our discretion.

Sawdust resulting from wood projects accomplished in a home workshop should be saved. It makes a wonderful mulch for your plants and garden.

Medicine Lake geothermal project meeting in Dorris set for August 22

Representatives from the federal and state governments, along with members of the Calpine Corporation and MHA Environmental Consulting, will provide a briefing at a public meeting scheduled for 6:30 p.m. August 22 at the Dorris City Hall.

The briefing is intended to provide the latest information regarding the Calpine Geothermal Project located near Glass Mountain in the Medicine Lake Highlands (see map below). The public will be asked to submit comments regarding the scope and content of the project. Public input will be used to determine issues.

Some concern has already been raised at prior meetings and in written comments when it was proposed for exploration wells to be drilled. Several of the comments were concern over Medicine Lake being effected and underground water quality and quantity and whether hot springs located in the area would be effected.

Another concern was that this project might have a detrimental effect on recreation and private land ownership in the Medicine Lake area. The noise level of construction and maintenance was also listed as a concern along with road conditions from heavy traffic and equipment.

Calpine proposes to develop a 49.9 megawatt (MW) geothermal power plant with associated geothermal production and injection wells, well pads, roads, and interconnected geothermal fluid pipelines in the Fourmile Hill project area, which is located approximately three miles northwest of Medicine Lake.

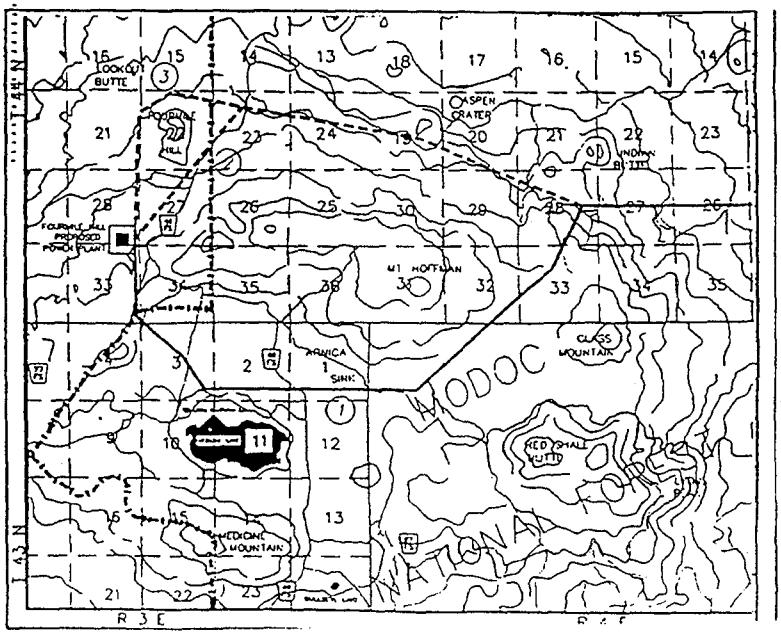
The proposed action includes construction and operation of a 230-kilovolt transmission line that would extend from the proposed power plant site approximately 24 miles to the east to a connection with the existing Bonneville Power Administration Malin-Warner 230-kV transmission line.

The proposed action would involve production of geothermal fluids (hot water and steam) from an underground reservoir produced from 9 to 11 two-phase production wells located at five proposed production well pad sites. The fluids would be transported via surface pipeline to the power plant where the steam would be directed to two steam turbine-driven generators.

Spent brine and condensate would be pumped through surface pipelines to the three proposed injection well pads back into the ground to subsurface geothermal reservoir.

A total of 4.25 miles of surface pipeline and 2.75 miles of injection line is estimated along with approximately 20 acres (2.5 acres per well pad) for the production and injection well pads for the Calpine project. The plan would coopy about 3 acres. The planned period of commercial operation for the proposed action is 45 years.

This is the fourth public meeting regarding the geothermal project. Other meetings have been held in Yreka, Alturas and Klamath Falls. Although the public's written comment period was due July 12, Randy Sharp, USFS/BLM Geothermal Development Project Coordinator, stated that comments would still be taken into consideration throughout the Environmental Impact Statement and Environmental Impact Report analysis.



Aug. 21, 1996, Star

Thursday meeting gives information on geothermal power plant project

Representatives from the federal and state governments, along with members of the Calpine Corporation and MHA Environmental Consulting, will provide a briefing at a public meeting scheduled for 6:30 p.m., August 22 at the Dorris City Hall.

The briefing is to provide the latest information regarding the Calpine Geothermal Project located near Glass Mountain in the Medicine Lake Highlands. The public will be asked to submit comments regarding the scope and content of the project. Public input will be used to determine issues.

Some concern has already been raised at prior meetings and in written comments when it was proposed for exploration wells to be drilled. Several of the comments were concern over Medicine Lake being effected and underground water quality and quantity and whether hot springs located in the area would be effected.

Another concern was that this project might have a detrimental effect on recreation and private land ownership in the Medicine Lake area. The noise level of construction and maintenance was also listed as a concern along with road conditions from heavy traffic and equipment.

Calpine proposes to develop a 49.9 megawatt (MW) geothermal power plant with associated geothermal production and injection wells, well pads, roads, and interconnected geothermal fluid pipelines in the Fourmile Hill project area, which is located approximately three miles northwest of Medicine Lake.

The proposed action includes construction and operation of a 230-kilovolt transmission line that would extend from the proposed power plant site approximately 24 miles to the east to a connection with the existing Bonneville Power Administration Malin-Warner 230-KV transmission line.

A total of 4.25 miles of surface pipeline and 2.75 miles of injection line is estimated along with approximately 20 acres (2.5 acres per well pad) for the production and injection well pads for the Calpine project. The plan would occupy about 3 acres. The planned period of commercial operation for the proposed action is 45 years.

This is the fourth public meeting regarding the geothermal project. Other meetings have been held in Yreka, Alturas and Klamath Falls. Although the public's written comment period was due July 12, Randy Sharp, USFS/BLM Geothermal Development Project Coordinator, stated that comments would still be taken into consideration throughout the Environmental Impact Statement and Environmental Impact Report analysis.

Not represented at meetings

Dear Editor:

As a concerned citizen and Tulelake city council candidate, I recently attended the public meetings held at the Tulelake-Butte Valley Fairgrounds on Aug. 2 and 15. These meetings were pertaining to the overall 15-year Lava Beds National Monument.

I also attended the public meeting on Aug. 22 in Dorris. This meeting was to receive input on the Four-mile Hill Geothermal Development Project environmental impact statements. The project is our beautiful Medicine Lake.

I was really disappointed that not one person from the Tulelake city council was there to represent our city. I'm sure these projects will have some effect on community!

One thing that bothers me, as well others, about the Fore-mile Hill Geothermal Project is the fact that its primary stockholders (48 percent) isn't from within Siskiyou County or even the state of California. They aren't even from the United States! (Sweden, I believe!)

Here's another note: Nov. 5 is your chance to vote! So if you're not registered, go to the local postal service or department of motor vehicles and ask for a voter's registrations card. Fill it out and mail it in today!

Leonard Dowty, Jr.
Tulelake, Calif.

APPENDIX C:

Biological Resources

Appendix C: Biological Resources

This appendix provides background information for the analysis of biological resources for the proposed Fourmile Hill Geothermal Development Project. A summary of the key documents addressing biological resources in the project vicinity that have been reviewed for the analysis is first described. A summary of the special-status plants known to occur in the project region is then presented in Table C-1. Table C-1 is followed by a description of vegetation communities types, and the plants that are commonly associated with each vegetation type. Table C-2 summarizes the methodology used in the biological studies that are referenced in the EIS/EIR. Table C-3 presents the scientific and common name of plant species observed in the project area, and the vegetation communities in which each is typically found.

KEY BIOLOGICAL RESOURCE REFERENCES

Several surveys for vegetation and wildlife species have been conducted in the vicinity of the Fourmile Hill project area. The wellfield and power plant area has been surveyed for general vegetation and wildlife resources and for special-status species as well. All proposed transmission line segments have been covered by botanical surveys that have been conducted for the proposed project, as well as for other projects in the vicinity. All of the transmission line segments within the conifer forest habitats of the Medicine Lake Highlands have also been surveyed for special-status wildlife species, including northern goshawk and northern spotted owl. Habitat suitability surveys that were focused on special-status wildlife have been carried out on the Modoc Plateau portion of the study area, as well.

The following reports that summarize biological survey work for both vegetation and wildlife have been reviewed for the biological analysis of the Fourmile Hill project:

- California-Oregon Transmission Project Draft EIS/EIR. Prepared by Envirosphere Company. November 1986.
- Biological Survey Report, Fourmile Hill Assessment Area. Prepared by Galea Wildlife Consulting. October 1995.
- Biological and Cultural Resource Assessments for the CalpineTransmission Line Project, Volume 1—Report. Prepared by BioSystems Analysis, Inc. and JRP Historical Consulting Services. February 1996.
- Biological and Cultural Resource Assessments for the Calpine Transmission Line Project, Volume 2—Appendices. Prepared by BioSystems Analysis, Inc. and JRP Historical Consulting Services. January 1996.
- Biological Survey Report, Mount Hoffman Assessment Area. Prepared by Galea Wildlife Consulting. June 1996.

The following reports that focus on botanical resources have been reviewed for the biological analysis of the Fourmile Hill project:

- Rare Plant Survey Report for the Calpine Geothermal Project, Medicine Lake, California. Prepared by Peter Figura for Galea Wildlife Consulting. 1995.

- Report on a Rare Plant Survey Conducted in Eastern Siskiyou County, California. Prepared by Maralyn Renner for Galea Wildlife Consulting. 1995.
- Botanical Resources Report for the Fourmile Hill Geothermal Project, Modoc and Klamath National Forests. Prepared by Barbara Leitner for Calpine Corporation. October 1996.

The following reports and resource materials that focus on wildlife resources have been reviewed for the biological analysis of the Fourmile Hill project:

- Northern Spotted Owl Survey Information. Memo to Tom Ratcliff, Forest Biologist, Modoc National Forest from James Villegas, Wildlife Biologist, Doublehead Ranger District. January 30, 1991.
- Biological Assessment, Northern Spotted Owl, Unocal Glass Mountain Geothermal Project. Prepared by R.J. Gutierrez, Ph.D. and Dames & Moore. January 1993.
- Wildlife Habitat Assessment Report of 5 Proposed Drill Pads and 5 Temperature Core Holes for California Exploration Company, Modoc National Forest, California. Prepared by Wildlife Dynamics, Inc. November 1994.
- Fourmile Hill Project Area, Results of 1995 American Marten Surveys. Prepared by Galea Wildlife Consulting. 1996.
- Fourmile Hill Geothermal Exploration Project, Biological Evaluation/Assessment: Threatened, Endangered, Proposed, and Forest Service Sensitive Species. Prepared by Frank Galea, Galea Wildlife Consulting and Dale Oberlag, District Wildlife Biologist, Goosenest Ranger District. March 1996.
- Report on Element Occurrences in the Bonita Butte, Caldwell Butte, Little Glass Mtn., Medicine Lake, Perez, Schonchin Butte, and Spaulding Butte 7.5 minute quadrangles. Prepared by Natural Diversity Data Base, Natural Heritage Division, California Department of Fish and Game. September 20, 1996.
- Fourmile Hill Geothermal Plant Development: Suitability of Grouse Hill Goshawk Stand for Northern Spotted Owl and Limited Operating Period for Northern Goshawk. Memo by Dale Oberlag, District Wildlife Biologist, Goosenest Ranger District. September 9, 1996.
- File Notes on Special-Status Wildlife Species of the Medicine Lake Highlands, Doublehead Ranger District, Modoc National Forest. Prepared by Julie Rechtin, Biological Technician, Big Valley Ranger District. October 1996.
- Habitat Suitability Assessment for Special-Status Bat Species on the Proposed Transmission Routes for the Fourmile Hill Geothermal Project. Prepared by Philip Leitner. April 1997.

Table C-1: Special-Status Plants Known to Occur in the Project Region

Scientific Name Common Name	Listing Status * FWS/CA/CNPS/FS R-E-D Code	Habitat	Flowering Period
Ferns and Fern Allies			
AZOLLACEAE			
Azolla mexicana Mexican mosquito fern	-/-/4/SI	Freshwater marsh, ponds, slow water, exposed mud	August (fertile)
MARSILIACEAE			
Marsilea oligospora Nelson's pepperwort	-/-/3/SI ?-?-1	Freshwater marsh, drying creek beds, vernal ponds	Jul-Aug (fertile)
OPHIOGLOSSACEAE			
Botrychium crenulatum Scalloped moonwort	SC/-/1B/SI 2-1-2	Bogs and fens, meadows in lower montane coniferous forest, freshwater marsh; very localized	Jun-July (fertile)
Gymnosperms			
CUPRESSACEAE			
Cupressus bakeri Baker's cypress	-/-/4/SI 1-2-2	Open slopes and flats, chaparral and lower montane coniferous forest, serpentinite or volcanic	N/A
Dicots			
APIACEAE			
Lomatium peckianum Peck's lomatium	C3/-/2/-	Pine-oak and juniper woodland, on volcanic soils, 2600-5900 ft	Apr-Jun
Tauschia howellii Howell's tauschia	SC/-/1B/-	Dry gravelly open granitic ridges in red fir forest, 6500-7500 ft	Jun-Aug
ASTERACEAE			
Antennaria flagellaris Stoloniferous pussytoes	-/-/4/S 1-2-1	Seasonally moist places in Great Basin scrub	Apr-June
Arnica fulgens Hillside arnica	-/-/2/SI 3-1-1	Open, damp depressions or meadows in sagebrush scrub or montane coniferous forest	May-Aug
Arnica sororia Twin arnica	-/-/2/SI 2-1-1	Loose volcanic soil, openings in Great Basin scrub, pinyon-juniper woodland	May-Jul
Dimeresia howellii Doublet	-/-/4/SI 1-1-1	Dry volcanic soils, pinyon-juniper woodland	May-July
Erigeron elegantulus Volcanic daisy	-/-/4/SI 1-1-1	Volcanic soils in sagebrush scrub and juniper woodland, subalpine coniferous forest	Mar-Aug
Erigeron inornatus var. calidipetris Hot rock daisy	-/-/4/SI 1-1-3	Sandy volcanic soils at edges of depressions, pine and fir woodlands	Jun-Sep
Psilocarphus elatior Tall woolly marbles	-/-/4/SI 1-1-1	Meadows, vernally mesic areas, stock ponds	May-Aug
Trimorpha acris var. debilis Northern daisy	-/-/2/- 2-1-1	Openings, high elevation forest; meadows, among rocks	Jul-Aug
BRASSICACEAE			
Arabis microphylla var. microphylla Small-leaved rock cress	-/-/4/SI 1-1-1	Rock crevices in basalt or granite, pinyon-juniper woodland	July
Arabis oregana Oregon rock cress	C3/-/4/SI	Rocky, north-facing hillsides, chaparral and lower montane coniferous forest, in serpentine	May

Table C-1: Special-Status Plants Known to Occur in the Project Region (continued)

Scientific Name Common Name	Listing Status * FWS/CA/CNPS/FS R-E-D Code	Habitat	Flowering Period
Rorippa columbiae Columbia yellow cress	SC/-/1B/S 3-2-2	Meadows, playas surrounded by pinyon-juniper woodland	May-Sept
BORAGINACEAE			
Hackelia cusickii Cusick's stickseed	-/-/4/SI 1-1-1	Under shelter of low junipers, sometimes in old disturbances, rocky loam soils	Apr-Jul
CAMPANULACEAE			
Campanula scabrella Rough harebell	-/-/4/SI 1-1-2	Alpine boulder and rock field (serpentine or volcanic)	Aug-Sept
CHENOPODIACEAE			
Chenopodium simplex Large-seeded goosefoot	-/-/4/SI 1-1-1	Lower montane coniferous forest (openings, disturbed areas), pinyon-juniper wdld. (carbonate)	June-Oct
ERICACEAE			
Allotropa virgata Sugar stick	-/-/-/PB n/a	Oak, mixed or conifer forests with thick humus; saprophytic	Jun-Aug
Pityopus californicus California pinefoot	C3/-/4/SI	Mixed or coniferous forests in deep shade; saprophytic	May-Jul
FABACEAE			
Astragalus inversus Susanville milk-vetch	-/-/4/SI 1-1-3	Great Basin scrub, lower montane coniferous forest	May-Sept
Lupinus aridus ssp. ashlandensis Mt. Ashland lupine	-/CO/-/-	Dry, coarse granitic soil, open sunny alpine slopes, Mt. Ashland	Jul-Aug
Thermopsis californica var. argentata Silvery false-lupine	-/-/4/SI 1-1-3	Open forests and ridges, pine woodland, pinyon-juniper woodland	Apr-Jul
GENTIANACEAE			
Gentiana affinis var. parvidentata Small-toothed prairie gentian	-/-/3/SI ?-?-1	Low places, big sagebrush scrub, lower montane coniferous forest	Jul-Sept
HYDROPHYLLACEAE			
Phacelia cookei Cooke's phacelia	SC/-/1B/- 3-3-3	Sandy volcanic soils, shrublands and lower montane coniferous forest	Jun-Jul
Phacelia inundata Playa phacelia	-/-/2/SI 2-1-1	Alkaline playas and drying lake margins, big sagebrush scrub, ponderosa pine forest	May-Jul
LAMIACEAE			
Pogogyne floribunda Profuse-flowered pogogyne	-/-/1B/SI 2-2-3	Vernal pools	Jun-Aug
Salvia dorrii var. incana Fleshy sage	-/-/3/SI ?-?-1	Silty and rocky soils in sagebrush scrub, juniper woodland	May-July
MALVACEAE			
Iliamna bakeri Baker's globe mallow	-/-/4/SI 1-1-1	Juniper woodland, sagebrush scrub, volcanic soils	Jul-Aug
ONAGRACEAE			
Camissonia minor Nelson's evening-primrose	-/-/4/SI 1-1-1	Sandy slopes and flats, sagebrush scrub	May-June
POLYGONACEAE			
Eriogonum prociduum Prostrate buckwheat	SC/-/1B/S 2-2-2	Barren volcanic slopes, Great Basin scrub, pinyon-juniper woodland, upper montane coniferous forest	May-Jul

Table C-1: Special-Status Plants Known to Occur in the Project Region (continued)

Scientific Name Common Name	Listing Status * FWS/CA/CNPS/FS R-E-D Code	Habitat	Flowering Period
Polygonum polygaloides ssp. esotericum Modoc County knotweed	-/-/1B/S 3-3-3	Moist areas, vernal pools, swales in big sagebrush scrub	Jun-Aug
PORTULACACEAE			
Claytonia umbellata Great Basin claytonia	-/-/1B/SI 3-1-2	Talus slopes in red fir and lodgepole pine forest	June-Aug (talus)
POLEMONIACEAE			
Collomia larsenii Talus collomia	C3/-/2/S 3-1-2	Volcanic talus, rock field, closed-cone and upper montane coniferous forest	July-Oct
Navarretia subuligera Awl-leaved navarretia	-/-/4/SI 1-1-2	Open, rocky moist places, mixed hardwood, lower coniferous forest	May-Aug
RANUNCULACEAE			
Delphinium stachydeum Spiked larkspur	-/-/4/SI 1-1-2	Great Basin scrub, edges of upper montane coniferous forest	Jul-Aug
ROSACEAE			
Ivesia paniculata Ash Creek ivesia	SC/-/1B/S 2-1-3	Shallow rocky volcanic soils, open sagebrush scrub, juniper woodland	Jun-Jul
Potentilla newberryi Newberry's cinquefoil	-/-/2/SI 2-1-1	Receding shorelines of freshwater marshes	May-Aug
SALICACEAE			
Salix bebbiana Gray willow	-/-/2/SI 2-1-1	Riparian scrub and freshwater marsh	March
SCROPHULARIACEAE			
Gratiola heterosepala Boggs Lake hedge-hyssop	C3/CE/1B/S 1-2-2	Receding water of freshwater marsh, vernal pools	Apr-Jun
Mimulus pygmaeus Egg Lake monkeyflower	SC/-/1B/S 2-1-2	Volcanic clay soils, vernally moist meadows, mud flats, streams	May-Jun
Pedicularis howellii Howell's lousewort	C3/-/4/- 1-1-2	Dry ridges, often on serpentine, in red fir forest	Jun-Aug
Penstemon cinereus Gray beardtongue	-/-/4/SI 1-1-1	Gravelly volcanic soils, rock outcrops, sagebrush scrub, juniper woodland	May-Aug
Penstemon cinicola Ash beardtongue	C3/-/4/SI 1-2-1	Meadows in volcanic, sandy soils, lower montane coniferous forest	Jun-Aug
Penstemon heterdoxus var. shastensis Shasta beardtongue	-/-/4/SI 1-1-3	Dry to moist meadows, openings in conifer forest, volcanic soils	Jun-Aug
Monocots			
CYPERACEAE			
Carex geyeri Geyer's sedge	-/-/4/SI 1-2-1	Dry volcanic slopes, sagebrush, open ponderosa pine woods	May-June
Carex halliana Hall's sedge	-/-/2/SI 3-1-1	Dry, open slopes of meadows, in pumice, juniper woodland, lodgepole pine forest	July-Aug
Carex petaseta Liddon's sedge	-/-/2/SI 2-1-1	Dry to wet meadows, open woods, lower montane coniferous forest	June-July
LILIACEAE			
Calochortus greenei Greene's mariposa lily	SC/-/1B/SI 3-2-2	Volcanic soils, shrubby hillsides and open woodlands	Jun-Aug
Calochortus longebarbatus var. longebarbatus Long-haired star tulip	SC/-/1B/S	Open meadows and drainages, clay soils, lower montane coniferous forests	Jun-July

Table C-1: Special-Status Plants Known to Occur in the Project Region (continued)

Scientific Name Common Name	Listing Status * FWS/CA/CNPS/FS R-E-D Code	Habitat	Flowering Period
Trillium ovatum ssp. oettingeri Salmon Mts. wakerobin	C3/-/4/- 1-2-3	Streamside and lake perimeters, moist wooded slopes, mixed evergreen forest	Feb-May
ORCHIDACEAE			
Cypripedium montanum Mountain lady's slipper	C3/-/4/SI 1-1-2	Moist sites, broadleaf upland and lower montane conif. forest	Mar-July

Notes:

*Status abbreviations are as follows:

FWS--U.S. Fish and Wildlife Service; SC-Species of Concern (formerly Candidate Lists 1 and 2): C3-Candidate List 3, all cases on this list too widespread and/or not threatened;

CA--California Department of Fish and Game; CE-Endangered; CO-Candidate for listing, Oregon;

CNPS--California Native Plant Society; 1B-plants rare, threatened or endangered in California and elsewhere; 2-rare, threatenedo or endangered in California but not elsewhere; 3-plants about which more information is needed, a review list; 4-plants of limited distribution (a watch list);

FS--U.S. Forest Service; S-sensitive (on either the Modoc or Klamath National Forest; SI-Modoc National Forest special interest plants; PB-protection buffer, Northwest Forest Plan.

SOURCE: Leitner 1996

DESCRIPTION OF VEGETATION COMMUNITIES AND ASSOCIATED PLANTS

The follow discussion describes the vegetation communities that have been identified in the project area. For each community, typical vegetation usually found within the community is identified; for the actual vegetation that exists within these communities in the project area, see Section 3.7- Vegetation. Equivalent Wildlife Habitat Relationship (WHR) Unit terms are presented as a cross-reference. Table C-2 (which follows the habitat descriptions) presents the scientific and common name of plant species observed in the project area, and the vegetation communities in which each is typically found.

Lodgepole Pine Forest (WHR Unit: Lodgepole Pine)

This vegetation community is strongly dominated by a single species, lodgepole pine (*Pinus contorta* ssp. *murrayana*). Compared with other conifers, lodgepole pine is tolerant of nutrient-poor soils, disturbance, high light levels, and high soil moisture; it "pioneers" in open or disturbed habitats. Lodgepole pine is often the first conifer to become established following logging and fire, it invades meadows in the absence of fire, and it forms a self-sustaining forest on thin or nutrient-poor soils, often in basins where cold air drainage may also be a factor. In moist sites, lodgepole pine has an understory of many meadow-associated herbs, grasses and sedges (*Carex* spp.). In dry sites, the understory is a very sparse cover of herbs, including Ross' sedge (*Carex rossii*) dwarf lupine (*Lupinus lepidus* var. *sellulus*) and white lupine (*L. albicaulis*). Lodgepole pine forest is widespread in the Medicine Lake Highlands.

Red Fir Forest (WHR Unit: Red Fir)

This vegetation community is dominated by red fir (*Abies magnifica*). In its late seral stage form, red fir forest is a tall, dense forest through which little light penetrates. The overstory is strongly dominated by red fir, although in more sparse or disturbed sites it is joined by lodgepole pine, Jeffrey pine (*Pinus jeffreyi*) and western white pine (*Pinus monticola*) (BioSystems 1996). The understory is usually sparse, consisting of smaller trees of all these species, as well as mountain chinquapin (*Chrysolepis sempervirens*), pinemat manzanita (*Arctostaphylos nevadensis*), greenleaf manzanita (*A. patula*) and wax currant (*Ribes cereum* var. *cereum*), these shrubs typically occurring in openings and rocky outcrops. Accumulations of downed woody debris may be substantial in sheltered sites. Areas mapped as red fir were generally late seral stage stands where this species was clearly dominant, usually with minimal logging. Slopes in the Medicine Lake Highlands with adequate soil development supported extensive stands of red fir forest, although the remaining stands are generally restricted to steep slopes where harvest is difficult.

Upper Montane Mixed Conifer Forest (WHR Units: Subalpine conifer; Lodgepole Pine (in part), Red Fir (in part)

This vegetation community represents a transition between red fir forest, lodgepole pine forest, and lower montane mixed conifer forest. In its natural state, upper montane mixed conifer forest is a dense forest of tall conifers, with a mixture of species co-dominating. In the Medicine Lake Highlands, the principal tree species are red fir, lodgepole pine, western white pine and Jeffrey pine, but at lower elevations red fir disappears and the mixture contains more ponderosa pine (*Pinus ponderosa*), sugar pine

(*Pinus lambertiana*), white fir and incense-cedar (*Calocedrus decurrens*) (BioSystems 1996). The understory varies, depending on elevation and canopy closure. Shrubs such as pinemat and greenleaf manzanita and wax currant are frequent in openings. Western needlegrass (*Achnatherum occidentalis* ssp. *occidentalis*) and squirreltail (*Elymus elymoides*) are common in openings and disturbed sites, and a number of sedges are frequent in the understory. Previous and ongoing human disturbances in the study area have influenced the distribution and dominance of forest trees, as well as the composition and structure of the forest. Logging removes most of the larger red fir and Jeffrey pine, and the resulting forest contains a higher proportion of lodgepole pine and small amounts of other conifers. As a result, some areas mapped on WHR maps as red fir forest were mapped as upper montane mixed conifer forest here.

Meadow (WHR Unit: Wet Meadow; Lodgepole Pine (in part)

Meadows are dense growths of grasses, sedges and other perennial herbs that grow in areas of persistent soil moisture. They occur in topographic lows, surrounded by better-drained, coarser soils on the uplands. Typical species in the meadows include sedges, monkeyflower (*Mimulus* spp.), meadow barley (*Hordeum brachyanthum*), yarrow (*Achillea millefolia*), checkerbloom (*Sidalcea oregana* ssp. *oregana*) and hairgrass (*Deschampsia* sp.). Meadows were mapped only in the immediate vicinity of Medicine Lake.

Montane Chaparral (WHR Unit: Montane Chaparral)

Montane chaparral is a shrub-dominated type that occurs in a mosaic with forested types. It may occur as a seral stage, following fire or logging, and also may occupy rocky areas with limited soil development. In the Medicine Lake Highlands, montane chaparral is usually dominated by greenleaf manzanita, tobacco brush (*Ceanothus velutinus*), mahala mat (*Ceanothus prostratus*), chinquapin, wax currant, and an assortment of herbs and grasses. Most occurrences were to small to map, but an extensive area of montane chaparral occurs on the freshwater pipeline route northeast of the Medicine Lake Glass Flow.

Rock Outcrops (WHR Unit: Barren)

The plant species found in rock outcrops depends upon the type of rock, the size of the outcrop, degree of weathering, elevation and exposure. The recent lava flows of the Medicine Lake Highlands have little soil development, and as a result are very sparsely vegetated. A few Jeffrey pine and lodgepole pine grow in sheltered sites. Shrubs include Davidson's penstemon (*Penstemon davidsonii*), desert ocean spray (*Holodiscus microphyllus* var. *glabrescens*), fern bush (*Chamaebatiaria millefolum*), chinquapin, mahala mat, and manzanita. Rock outcrops in the lower-elevation Modoc Plateau tend to have more soil accumulation due to the greater age of the rocks, and they also tend to support a higher abundance of plant life. Typical of these rock outcrops are Utah serviceberry (*Amelanchier utahensis*), gray horsebrush (*Tetradymia canescens*), and paintbrush (*Castilleja linearifolia*). Rock outcrops are frequent in the study area, but most are too small to map.

Herbaceous (WHR Unit: Barren)

This vegetation community consists of naturally barren areas that support sparse, mostly non-woody vegetation. They may consist of topographic lows, such as Arnica Sink, or outcroppings of pumice or ash deposits. Such areas support small herbaceous perennials such as dwarf lupine, dwarf hulsea (*Hulsea nana*), and buckwheat (*Eriogonum* spp.).

Lower Montane Mixed Conifer Forest (WHR Unit: Ponderosa Pine)

This vegetation community is found between the lower limit of upper montane mixed conifer forest and the upper elevational limit of ponderosa pine forest. It consists of a mixture of lodgepole pine, ponderosa pine, sugar pine, white fir and small amounts of other species. Tree cover is moderate to dense, and the understory is variable depending on tree canopy closure, soil development, and precipitation. Chinquapin and manzanita are more common at the upper elevations, while bitterbrush (*Purshia tridentata*) and Utah serviceberry are more common at the lower elevations.

Ponderosa Pine Forest (WHR Unit: Eastside Pine)

Within the project area, ponderosa pine forest is transitional from the lower montane conifer forest at its higher elevational range to the shrublands and juniper woodlands of the Modoc Plateau at its lower elevational limit. At its upper elevational limit, ponderosa pine somewhat resembles lower montane conifer forest in that small amounts of white fir and incense-cedar are present, and the largely shrub-dominated understory consists mainly of greenleaf manzanita and bitterbrush. At lower elevations, ponderosa pine becomes the sole dominant tree species. Both ponderosa pine and the shrub understory becomes more sparse, and the understory more dominated by herbs such as western needlegrass, squirreltail, wicker buckwheat (*Eriogonum vimineum*), and cheatgrass (*Bromus tectorum*).

Ponderosa Pine Plantation (WHR Unit: Eastside Pine)

This artificial habitat consists of even-age stands of planted ponderosa pines. Since the soil is considerably disturbed in preparation of a tree plantation, the understory shrubs and herbs are those found in disturbed habitats (see below). Ponderosa pine plantation is found on the west side of the Modoc Plateau.

Northern Juniper Woodland (WHR Unit: Juniper Shrub)

Northern juniper woodland is dominated by a single tree species, northern (or western) juniper (*Juniperus occidentalis*). It varies from nearly closed-canopy forest to open savanna, grading into the scrub types found on the Modoc Plateau. Typical understory species in northern juniper woodland include big sagebrush (*Artemisia tridentata*), sticky-leaved rabbitbrush (*Chrysothamnus viscidiflorus*), common rabbitbrush (*C. nauseosus*), and bitterbrush. This habitat type is widespread on the Modoc Plateau.

Sagebrush Scrub (WHR Unit: Shrub)

Sagebrush scrub is a shrubby vegetation community, dominated or co-dominated by big sagebrush, low sagebrush (*Artemisia arbuscula*), common rabbitbrush, sticky

rabbitbrush and bitterbrush, the composition depending on site conditions and management practices. Canopy cover by shrubs is usually high. Sagebrush scrub occupies well-drained soils of moderate depth, grading into northern juniper woodland on more rocky sites, meadows on heavier and less well-drained soils, ponderosa pine forest or bitterbrush scrub in areas of higher rainfall, and rabbitbrush scrub on disturbed sites. Sagebrush scrub is well-represented on the Modoc Plateau.

Rabbitbrush Scrub (WHR Unit: Shrub)

Dominated by sticky-leaved rabbitbrush, this community may be considered successional, resulting from clearing, fire, or other disturbance. Other common species include rubber rabbitbrush, cheatgrass, wicker buckwheat, hareleaf (*Lagophylla ramosissima*), tall annual willowherb (*Epilobium brachycarpum*), and pincushions (*Chaenactis douglasii*). It occurs naturally on old lava flows with a small amount of soil development, and also occurs on deeper soils where human disturbance has taken place. It grades, sometimes abruptly, into sagebrush scrub and northern juniper scrub, or into barren areas where there is ongoing disturbance.

Vernal Marsh/Stockpond (WHR Unit: Water)

Vernal marsh habitats are uncommon in the study area, due to the porosity of the volcanic substrates. Vernal marsh has low, annual herbaceous vegetation, similar to that found in vernal pools: downingia (*Downingia bicornuta*), button-celery (*Eryngium alismaefolium*), rush (*Juncus* spp.), buttercup (*Ranunculus aquatilis*) and sedge. Stockponds are human-made, often highly disturbed examples of seasonal wetlands, and so are included in this habitat type. One large vernal marsh, Dry Lake, is located on the C2 transmission line corridor. Stockponds are scattered throughout the eastern transmission line corridors on the Modoc Plateau.

Disturbed (WHR Unit: no equivalent)

This classification was used where recent, generally human-caused disturbance or fire has resulted in a bare, unvegetated area or sparse vegetation consisting of weedy, pioneering species. The shrub cover is generally low, consisting of sticky-leaved rabbitbrush, rubber rabbitbrush, and Bloomer's goldenbush. Herbaceous cover is low to moderate, consisting mainly of annuals such as wicker buckwheat, cheatgrass, tall annual willowherb, and pincushions.

Agriculture/Planted (WHR Unit: no equivalent)

This habitat type includes actively cultivated areas, and those that have been seeded with non-native perennial bunchgrasses such as crested wheatgrass (*Agropyron cristatum*) for range improvement.

Table C-2: Summary of Methodology of Botanical and Wildlife Studies Referenced in EIS/EIR

Surveyor(s)	Area Surveyed	Date(s) Surveyed	Target Species	Survey Technique(s)	Reference
Dr. R. Gutierrez and Dames & Moore	8,700 acres within Glass Mountain Federal Unit	1992: 18 days btwn May 30 and July 19	Northern spotted owl	stationary call points and repeat visits	Gutierrez and Dames & Moore 1993
BioSystems Analysis, Santa Cruz, CA	Transmission line segments A3, B1, C1 (21,760 acres)	1995: July 1-4, Aug. 25-24, Sept. 8-17,	all potential special status plants	literature search; visual assessment	BioSystems Analysis 1996a
BioSystems Analysis, Santa Cruz, CA	13, 440 acres within previous study site	1995: Oct. 9-12	all potential special status animals	literature search; habitat assessment	BioSystems Analysis 1996a
Galea Wildlife Consulting, Crescent City, CA	Calpine geothermal exploration site: approx. 8,000 acres centered on proposed power plant and wellfield	1994, 1995: spring and summer (number of days unknown)	N. spotted owl, N. goshawk, osprey, bald eagle, Amer. marten, Sierra Nev. red fox, Townsend's big-eared bat, 5 other bat species of special concern	Literature search, habitat suitability assessment, snow tracking	Galea Wildlife Consulting 1995
Peter Figura and Marilyn Renner for Galea Wildlife Consulting	Pipeline corridors and drilling pad sites near Fourmile Hill	1995: July 28-29, Sept. 2-5	all potential special status plants	visual survey	Galea Wildlife Consulting 1995
Galea Wildlife Consulting, Crescent City, CA	Calpine's Mt. Hoffman Assessment Area (approx. 20,500 acres)	1994: June 12-15, 24-26, Aug. 15-17 1995: June 13-15, 25-26, July 19-21, Aug. 16-17, 21-23	Peregrine falcon, N. spotted owl, bald eagle, Amer. marten, Pacific fisher, N. goshawk, great gray owl, Townsend's big-eared bat, Sierra Nev. red fox	stationary call points, call playback, snow tracking, habitat suitability assessment, visual surveys	Galea Wildlife Consulting 1996a

Table C-2: Methodology of Wildlife Studies Within or Near Project Area (continued)

Surveyor(s)	Area Surveyed	Date(s) Surveyed	Target Species	Survey Technique(s)	Reference
Galea Wildlife Consulting, Crescent City, CA	Fourmile Hill Geothermal Project Pad #88-28 and vicinity	1995: April 22, May 3, July 18, 29	American marten	snow tracking, visual surveys for den sites	Galea Wildlife Consulting 1996b
Dr. Phillip Leitner, Orinda, CA	29 12-acre sampling units along all Fourmile Hill Geothermal Development Project transmission line alternatives (= 348 acres)	dates unknown	nine special status bat species	Developed habitat suitability model for diurnal roosts; verified model with field sampling	P. Leitner 1997
Barbara Leitner, Orinda, CA	Entire Fourmile Hill Geothermal Development Project area	1996: July 14-18, Aug. 12-16; 1997: June 2-6, August 15	all potentially occurring species status plants	literature search, visual survey, habitat assessment	B. Leitner 1996, 1997

Table C-3: Plants Observed, by Habitat, in the Study Area

Habitats:

D = Disturbed Areas
H = Herbaceous, Barren
J = Northern Juniper Woodland
L = Lodgepole Pine Forest
M = Meadow
O = Outcroppings, Montane Chaparral
PP = Ponderosa Pine Forest
R = Red Fir Forest
SL = Shrublands, Modoc Plateau
U = Upper Montane Mixed Conifer Forest
V = Vernal Pools, Intermittent Lakes
W = White Fir Forest (Lower Montane Conifer Forest)

Scientific Name **Common Name**	D	H	J	L	M	O	PP	R	SL	U	V	W
ALISMATACEAE												
Damasonium californicum											V	
AMARANTHACEAE												
Amaranthus sp. Pigweed	D											
APIACEAE												
Eryngium alismaefolium Coyote thistle											V	
Eryngium mathiasiae Mathias' button celery											V	
APOCYNACEAE												
Apocynum cf. androsaemifolium Bitter dogbane	D		J			O						
ASCLEPIADACEAE												
Asclepias fasicularis Narrow-leaved knotweed	D								SL			
ASTERACEAE												
Achillea millefolia Common yarrow			J		M							
Ageratina occidentalis Western snakeroot						O						
Agoseris aurantiaca Orange agoseris			J			O						
Antennaria geyerii Pinewoods pussytoes	D											
Antennaria rosea ssp.rosea Rosy pussytoes	D								SL			
Aster foliaceus Alpine leafy-bract aster												
Arnica chamissonis ssp. foliosa Meadow arnica											V	
Artemisia tridentata Big basin sagebrush			J				PP		SL			
Chaenactis douglasii var. douglasii Dusty maidens	D	H	J				PP		SL			
Chrysothamnus nauseosus Rubber rabbitbrush	D		J						SL			
Chrysothamnus viscidiflorus Yellow rabbitbrush	D		J						SL			
Cirsium californicum California thistle	D											
Conyza canadensis Horseweed	D								SL			
Ericameria bloomeri var. bloomeri Rabbitbrush goldenweed	D			L		O	PP		SL	U		W
Erigeron pumilus var. intermedius Hairy daisy					M							
Eriophyllum sp. Woolly sunflower			J							U		
Gnaphalium luteo-album Cudweed	D											

Table C-3: Plants Observed, by Habitat, in the Study Area (continued)

Habitats:

D = Disturbed Areas
H = Herbaceous, Barren
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O = Outcroppings, Montane Chaparral
PP = Ponderosa Pine Forest
R = Red Fir Forest
SL = Shrublands, Modoc Plateau
U = Upper Montane Mixed Conifer Forest
V = Vernal Pools, Intermittent Lakes
W = White Fir Forest (Lower Montane Conifer Forest)

Scientific Name **Common Name**	D	H	J	L	M	O	PP	R	SL	U	V	W
Grindelia camporum var.bracteosum Gumplant									SL			
Helianthus annuus Common sunflower	D											
Hieracium albiflorum White hawkweed						O		R				
Hieracium horridum Prickly hawkweed						O						
Hulsea nana Dwarf hulsea						O						
Iva axillaris Poverty weed	D								SL			
Lactuca serriola Prickly lettuce	D											
Lagophylla ramosissima Hareleaf	D					O			SL			
Lessingia cf. filaginifolia California aster	D								SL	U		
Psilocarpus brevissimus var. brevissimus Dwarf woolly-marbles											V	
Sonchus oleraceus Common sow thistle	D								SL			
Stephanomeria lactucina Lettuce-like stephanomeria	D	H										
Taraxacum officinale Common dandelion	D											
Tetradymia canescens Horsebrush						O						
Tragopogon dubius Goat's beard	D											
BERBERIDACEAE												
Berberis nervosa Oregon grape										U		
BORAGINACEAE												
Cryptantha sp. *Cryptantha*						O						
Hackelia cf. velutina Velvet stickseed								R				
Plagiobothrys cognatus Popcorn flower					M						V	
BRASSICACEAE												
Arabis platysperma var. platysperma Rock cress	D			L		O				U		
Arabis rectissima var. rectissima Rector's rock cress	D			L		O				U		
Arabis sp. Rock cress						O		R		U		
Descurainia sophia Tansy mustard	D		J									
Lepidium sp. Peppergrass	D								SL			
Polyctenium fremontii var.fremontii Polyctenium											V	

Table C-3: Plants Observed, by Habitat, in the Study Area (continued)

Habitats:

D = Disturbed Areas
H = Herbaceous, Barren
J = Northern Juniper Woodland
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SL = Shrublands, Modoc Plateau
U = Upper Montane Mixed Conifer Forest
V = Vernal Pools, Intermittent Lakes
W = White Fir Forest (Lower Montane Conifer Forest)

Scientific Name **Common Name**	D	H	J	L	M	O	PP	R	SL	U	V	W
Sisymbrium sp. Tumble mustard	D											
CAMPANULACEAE												
Downingia bicornuta											V	
Downingia												
Downingia cf. laeta												
Bach's downingia												
CAPRIFOLIACEAE												
Sambucus sp.							PP			U		
Elderberry												
Symphoricarpos mollis								R		U		
Creeping snowberry												
CARYOPHYLLACEAE												
Silene douglasii						O						
Douglas' campion												
CHENOPODIACEAE												
Chenopodium sp.	D								SL			
Goosefoot												
Salsola tragus	D											
Russian thistle												
CUPRESSACEAE												
Calocedrus decurrens							PP					W
Incense cedar												
Juniperus occidentalis var. occidentalis			J				PP					
Western juniper												
CYPERACEAE												
Carex brainerdi				L						U		
Brainerd's sedge												
Carex halliana				L								
Hall's sedge												
Carex raynoldii	D			L				R		U		
Raynold's sedge												
Carex rossii	D			L				R		U		
Ross' sedge												
Carex sparsiflora												
Sparse-flowered sedge												
Cyperus squarrosus											V	
Sedge												
Eleocharis acicularis var. bella											V	
Spike-rush												
Scirpus sp.												
Bulrush												
DRYOPTERIDACEAE												
Woodsia oregana						O						
Cliff fern												

Table C-3: Plants Observed, by Habitat, in the Study Area (continued)

Habitats:

D = Disturbed Areas
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U = Upper Montane Mixed Conifer Forest
V = Vernal Pools, Intermittent Lakes
W = White Fir Forest (Lower Montane Conifer Forest)

Scientific Name **Common Name**	D	H	J	L	M	O	PP	R	SL	U	V	W
Cystopteris fragilis Fragile fern						O						
ERICACEAE												
Allotropa virgata Sugar stick								R				
Arctostaphylos nevadensis Pinemat manzanita				L		O				U		
Arctostaphylos patula Greenleaf manzanita				L		O				U		
Chimaphila umbellata Prince's pine								R				
Pityopus californicus California pinedrops										U		
Pterospora andromedea Pinedrops								R		U		
Pyrola picta White-veined wintergreen								R		U		
EUPHORBIACEAE												
Chamaesyce ocellata ssp. ocellata Spotted spurge	D								SL			
Chamaesyce serpyllifolia ssp. serpyllif. Thyme-leafed spurge	D								SL			
FABACEAE												
Astragalus purshii Milkvetch									SL			
Lupinus albicaulis White lupine				L						U		
Lupinus lepidus var. sellulus Dwarf lupine		H		L						U		
Lupinus argenteus Silver lupine	D								SL			
Lotus purshianus var. purshianus Spanish clover	D											
Trifolium sp. Clover					M							
FAGACEAE												
Chrysolepis sempervirens Mountain chinquapin						O				U		
GENTIANACEAE												
Swertia albicaulis var. albicaulis Swertia			J						SL			
GERANIACEAE												
Erodium cicutarium Redstem filaree	D											

Table C-3: Plants Observed, by Habitat, in the Study Area (continued)

Habitats:

D = Disturbed Areas
H = Herbaceous, Barren
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L = Lodgepole Pine Forest
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PP = Ponderosa Pine Forest
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U = Upper Montane Mixed Conifer Forest
V = Vernal Pools, Intermittent Lakes
W = White Fir Forest (Lower Montane Conifer Forest)

Scientific Name **Common Name**	**D**	**H**	**J**	**L**	**M**	**O**	**PP**	**R**	**SL**	**U**	**V**	**W**
GROSSULARIACEAE												
Ribes cereum var. cereum Wax currant				L		O				U		
Ribes roezlii Sierra gooseberry								R		U		
HYDROPHYLLACEAE												
Phacelia hastata var. compacta Compact phacelia										U		
Phacelia hastata var. hastata Phacelia										U		
JUNCACEAE												
Juncus capitatus Capitate rush												
Juncus parryi Parry's rush		H		L	M	O			SL			
Juncus mexicanus Mexican rush					M				SL			
JUNCAGINACEAE												
Lilaea scilloides Flowering-quillwort											V	
LAMIACEAE												
Agastache parviflora Small leaf giant hyssop						O						
Monardella odoratissima Pacific monardella				L		O				U		
Marrubium vulgare Horehound	D		J			O						
Trichostema oblongum Bluecurls									SL			
LILIACEAE												
Dichelostemma sp. Blue dicks												
Zigadenus venenosus var.venenosus Meadow death camas									SL			
LINACEAE												
Linum sp. Flax			J									
Hesperolinon micranthum Dwarf flax												
LYTHRACEAE												
Lythrum tribracteatum Loosestrife											V	

Table C-3: Plants Observed, by Habitat, in the Study Area (continued)

Habitats:

D = Disturbed Areas
H = Herbaceous, Barren
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PP = Ponderosa Pine Forest
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U = Upper Montane Mixed Conifer Forest
V = Vernal Pools, Intermittent Lakes
W = White Fir Forest (Lower Montane Conifer Forest)

Scientific Name **Common Name**	D	H	J	L	M	O	PP	R	SL	U	V	W
MALVACEAE												
Sidalcea oregana ssp.oregana Oregon checkerbloom					M							
Sidalcea sp. Checkerbloom												
ONAGRACEAE												
Camissonia tanacetifolia ssp. tanacetif. Tansy-leaf suncup									SL		V	
Epilobium augustifolium ssp. circumvag. Fireweed						O				U		
Epilobium foliosum Willowherb	D											
Epilobium brachycarpum Willowherb	D								SL			
Epilobium pygmaeum Smooth spike-primrose											V	
Gayophytum diffusum var. parviflorum Gayophytum				L		O		R		U		
Gayophytum humile Small gayophytum				L		O		R		U		
PAEONIACEAE												
Paeonia brownii Western paeony						O						
PINACEAE												
Abies concolor White fir							PP					W
Abies magnifica Red fir								R		U		
Pinus contorta ssp. murrayana Lodgepole pine				L		O		R		U		
Pinus jeffreyi Jeffrey pine								R		U		
Pinus lambertiana Sugar pine							PP	R		U		W
Pinus monticola Western white pine				L				R		U		
Pinus ponderosa Ponderosa pine			J				PP					W
Tsuga mertensiana Mountain hemlock								R				
POACEAE												
Achnatherum occidentalis ssp. occidentalis Western needlegrass	D		J	L		O	PP		SL	U		W
Agropyron spicatum Crested wheatgrass			J						SL			
Alopecurus geniculatus Water foxtail											V	

Table C-3: Plants Observed, by Habitat, in the Study Area (continued)

Habitats:

D = Disturbed Areas
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SL = Shrublands, Modoc Plateau
U = Upper Montane Mixed Conifer Forest
V = Vernal Pools, Intermittent Lakes
W = White Fir Forest (Lower Montane Conifer Forest)

Scientific Name **Common Name**	**D**	**H**	**J**	**L**	**M**	**O**	**PP**	**R**	**SL**	**U**	**V**	**W**
Bromus carinatus var. carinatus California brome	D									U		
Bromus tectorum Cheatgrass	D		J						SL			
Deschampsia sp. Hairgrass					M						V	
Distichlis spicata Saltgrass	D								SL		V	
Elymus elymoides Squirreltail	D		J	L		O	PP	R	SL	U		W
Elymus triticoides Great Basin wild rye			J						SL			
Hordeum jubatum Foxtail barley					M							
Panicum acuminatum var. acuminatum Panicgrass											V	
Poa sp. Bluegrass						O						
Trisetum spicatum Spike trisetum					M							
POLEMONIACEAE												
Eriastrum sparsiflorum Woolly star									SL			
Leptodactylon pungens Prickly phlox						O						
Linanthus sp. Mustang clover	D											
Navarretia intertexta var. propinqua Navarretia	D?									U		
Navarretia leucocephala White-headed navarretia											V	
Phlox gracilis Annual phlox												
POLYGONACEAE												
Eriogonum nudum var. nudum Naked buckwheat	D			L						U		
Eriogonum nudum var.oblongifolium Oblong-leaf buckwheat										U		
Eriogonum ovalifolium var.purpureum Oval buckwheat			J									
Eriogonum umbellatum var.polyanthum Sulfur buckwheat	D			L		O	PP	R	SL	U		
Eriogonum ursinium Bear buckwheat		H		L						U		
Eriogonum vimineum Wicker buckwheat	D		J						SL			
Polygonum arenastrum Common knotweed	D								SL			
Rumex sp. Curly dock												

Table C-3: Plants Observed, by Habitat, in the Study Area (continued)

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D = Disturbed Areas
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W = White Fir Forest (Lower Montane Conifer Forest)

Scientific Name **Common Name**	D	H	J	L	M	O	PP	R	SL	U	V	W
PORTULACAEAE												
Calyptridium umbellatum Pussy paws	D			L						U		
PTERIDACEAE												
Cryptogramma acrostichoides Parsley fern						O						
RANANCULACEAE												
Ranunculus aquatilus Buttercup											V	
Thalictrum occidentale Western meadow-rue												
RHAMNACEAE												
Ceanothus cf. integerrimus Deer brush										U		
Ceanothus prostratus Mahala mat						O						
Ceanothus velutinus var. velutinus Buckbrush						O				U		
ROSACEAE												
Amelanchier utahensis Utah serviceberry												
Cercocarpus ledifolius Curl-leaf mtn. mahogany	D		J									
Chamaebatiaria millefolium Fern bush						O						
Fragaria virginiana Mountain strawberry								R				
Holodiscus microphyllus var. glabrescens Oceanspray						O						
Potentilla newberryi Newberry cinquefoil											V	
Potentilla glandulosa Potentilla						O						
Prunus emarginata Bitter cherry						O						
Prunus virginiana var. demissa Western choke-cherry						O						
Purshia tridentata var. tridentata Bitterbrush			J				PP		SL			
RUBIACEAE												
Kelloggia galioides Kelloggia						O						
SALIACEAE												
Populus tremuloides Quaking aspen						O						

Table C-3: Plants Observed, by Habitat, in the Study Area (continued)

Habitats:

D = Disturbed Areas
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Scientific Name **Common Name**	D	H	J	L	M	O	PP	R	SL	U	V	W
Salix lasiolepis Arroyo willow												
SCROPHULARIACEAE												
Castilleja linearifolia Narrow-leaf paintbrush			J			O			SL	U		
Castilleja arachnoidea Woolly paintbrush				L						U		
Gratiola ebracteata Bractless hedge hyssop											V	
Limosella sp. Mudwort											V	
Mimulus breweri Brewer's monkeyflower					M							
Mimulus jepsonii Jepson's monkeyflower					M							
Pedicularis semibarbata Bearded lousewort				L				R		U		
Penstemon deustus var. pedicellatus Hot rock penstemon						O			SL			
Penstemon davidsonii var. davidsonii Davidson's penstemon						O						
Penstemon gracilentus Graceful penstemon				L			PP	R		U		
Penstemon laetus var.sagittatus Penstemon					M							
Penstemon procerus var. formosus Penstemon						O						
Penstemon procerus var. procerus Penstemon						O						
Penstemon speciosus Royal penstemon												
Verbascum thapsus Woolly mullein	D								SL			
Veronica sp. Speedwell.					M							
VIOLACEAE												
Viola sp. Violet				L				R		U		
VISCACEAE												
Arceuthobium americanum Lodgep. pn.dwf. mistletoe				L						U		

APPENDIX D:

Visual Resources

Appendix D: Visual Resources

INTRODUCTION

This appendix provides background information for the analysis of visual resources for the proposed Fourmile Hill Geothermal Development Project. A glossary of terms which are typically used in the Visual Resources Management (VRM) system and the Scenery Management System (SMS) is provided. A detailed listing of VQO designation for both the proposed wellfield and power plant and the proposed and alternative transmission line routes, are provided in Tables D-1 and D-2. Table D-3 provides a description of the visible elements of the proposed transmission line from KOPs. This table should be used in conjunction with Table 4.9-1 (Section 4.9), which specifies the visibility of all project features, including the transmission line, from KOPs. The consistency of proposed and alternative transmission line segments with VQO designations, after mitigation, is identified in Table D-4. Consistency determinations in this table are based on a on-the-ground VQO consistency analysis. The agencies and individuals contacted and interviewed during the preparation of the visual analysis are identified in Table D-5.

GLOSSARY OF TERMS

Cultural Modification

Any modification in land, water form, or vegetation; the addition of a structure which creates a visual contrast to the natural character of a landscape. A negative cultural modification is disharmonious with the existing scenery. A positive cultural modification can actually complement and improve a particular scene by adding variety and harmony.

Distance Zones

Areas of landscapes denoted by specified distances from the observer and used as a frame of reference to discuss landscape characteristics or management activities. These include:

Foreground: The limit of this zone is based on the distances at which details can be perceived. Normally in foreground views, the individual boughs of trees form texture. It will usually be limited to areas within 1/4 to 1/2 mile of the observer.

Middleground: This distance extends from the foreground zone to 3 to 5 miles from the observer. Texture normally is characterized by the masses of trees in stands of uniform tree cover. Individual tree forms are usually only discernible in very open or sparse stands.

Background: This zone extends from middleground to infinity. Texture in stands of uniform tree cover is generally very weak or non-existent. In very open or sparse timber stands, texture is seen as groups or patterns of trees.

Feathering

Leaving smaller trees and other vegetation within a transmission line right-of-way under conductors and gradually increasing in height of retained vegetation nearer the edge of the right-of-way.

Intactness

See "Scenic Integrity" below.

Landscape Character

Describes a particular landscape in terms of landform patterns, water characteristics, vegetation patterns, and cultural elements to create an image or picture for the reader. Landscape character is an overall visual and cultural impression of landscape attributes, the physical appearance and cultural context of a landscape that gives it an identity and "sense of place." Often, a landscape character description also will include existing landscape attributes which will affect senses other than sight, such as sound, smell, taste, and touch.

Scalloping

Clearing a transmission line right-of-way to give a curved, undulating appearance (rather than a straight line edge condition). Scalloping is typically achieved through marking the backline based on the tree heights in relation to the conductors' position at maximum sag and at maximum swing.

Scenic Attractiveness

Scenic Attractiveness classes determine the relative scenic value of lands within a particular Landscape Character. The landscape elements of landform, vegetation, rocks, cultural features, and water features are described in terms of their line, form, color, texture, and composition.

Scenic Integrity

Scenic Integrity indicates the degree of intactness and wholeness of the Landscape Character or a measure of the degree of visible disruption of the Landscape Character. A landscape with very minimal visual disruption is considered to have high Scenic Integrity. Those landscapes having increasingly discordant relationships among scenic attributes are viewed as having diminished Scenic Integrity.

Sensitivity Level

A particular degree or measure of viewer interest in the scenic qualities of the landscape. Three sensitivity levels are employed, each identifying a different level of user concern for the visual environment, as identified below.

- Level 1–Highest Sensitivity (includes all seen areas from primary travel routes where at least one-fourth of the visitors have a major concern for the scenic qualities)

- Level 2–Average Sensitivity ((includes all seen areas from primary travel routes where fewer than one-fourth of the visitors have a major concern for the scenic qualities)
- Level 3–Lowest Sensitivity

VQO Designations

Preservation: This visual quality objective allows for ecological changes only. Management activities except for very low visual impact recreation facilities are prohibited.

Retention: This visual quality objective provides for management activities which are not visually evident. Under retention, activities may only repeat the form, line, color, and texture which are frequently found in the characteristic landscape. Changes in their qualities of size, amount, intensity, direction, pattern, etc., should not be evident.

Partial Retention: This visual quality objective provides for management activities which remain visually subordinate to the characteristic landscape. Activities may repeat form, line, color, or texture common to the characteristic landscape, but changes in their qualities of size, amount, intensity, direction, pattern, etc., remain visually subordinate to the characteristic landscape. Activities may also introduce form, line, color, or texture which are found infrequently or not at all in the characteristic landscape, but they should remain visually subordinate to the visual strength of the characteristic landscape.

Modification: Under this visual quality objective management activities may visually dominate the original characteristic landscape. However, activities of vegetative and landform modification must borrow from the naturally established form, line, color and texture so complete and at such a scale that its visual characteristics are those of natural occurrences within the surrounding area or character type. Additional parts of these activities such as structures, roads, slash, root wads, etc., must remain visually subordinate to the proposed composition. Activities which are included are predominantly the introduction of facilities such as buildings, roads, signs, should borrow naturally form, line, color, and texture so completely and at such a scale that its visual characteristics are compatible with the natural surroundings.

Table D-1 : Visual Quality Objectives for Wellfield and Power Plant Area

Proposed Facility	VQO Designation	Comments
Power Plant & Well Pad P-1	Retention	
Well Pad P-2	Retention Modification	Well pad appears to be on the border of two VQO designations
Injection Well Pad I-1 Well Pad P-5 Well Pad P-4 Well Pad P-3 Injection Well Pad I-3	Modification	
Access Road: FR 49 to Power Plant	Retention	
Access Road: Power Plant to Well P-5	Retention Modification	Appx. 1,250 feet in Retention
All other Access Roads	Modification	
Pipeline: Power Plant to Well Pad P-2	Retention	
Pipeline: Power Plant to Well Pad P-5	Retention Modification	Appx. 1,250 feet in Retention
All other Pipelines	Modification	

SOURCES: Klamath National Forest Land and Resource Management Plan, Final Environmental Impact Statement, Forest Visual Quality Objectives Map (1994b); Modoc National Forest Land and Resource Management Plan, Visual Quality Objectives Map (1991a); 2M Associates 1996.

Table D-2: Visual Quality Objectives for Transmission Line Segments

Route Segment	Station Point From	Station Point To	VQO Designation
A1	0.0	1.2	Retention
	1.2	3.8	Partial Retention
	3.8	4.0	Modification
	4.0	4.2	Partial Retention
	4.2	4.8	Modification
A1 / A2	4.8	5.1	Partial Retention
A2	5.1	5.4	Modification
	5.4	5.5	Partial Retention
	5.5	5.9	Modification
	5.9	6.8	Partial Retention
	6.8	7.9	Modification
A2 /B1	7.9	9.0	Partial Retention
B1	9.0	10.0	Modification
	10.0	12.3	Partial Retention
	12.3	13.8	Modification
	13.8	14.5	Partial Retention
	14.5	15.3	Modification
C1	15.3	15.4	Partial Retention
	15.4	16.9	Modification
	16.9	17.2	Partial Retention
	17.2	18.6	Modification
	18.6	23.4	Partial Retention
		end of segment	
A3	0.0	0.5	Retention
	1.5	2.3	Modification
	2.3	2.7	Retention
	2.7	3.7	Partial Retention
	3.7	4.8	Modification
	4.8	5.2	Partial Retention
	5.2	6.0	Modification
	6.0	6.9	Partial Retention
		end of segment	

Table D-2: Visual Quality Objectives for Transmission Line Segments (Continued)

Route Segment	Station Point From	To	VQO Designation
B2	0.0	0.2	Modification
	0.2	0.9	Partial Retention
	0.9	2.7	Modification
	2.7	4.4	Partial Retention
	4.4	5.1	Modification
	5.1	5.5	Partial Retention
	5.5	7.0	Modification
	7.0	7.8	Note: Private Property
	7.8	8.2	Retention
	8.2	11.0	Partial Retention
	11.0	11.6	Modification
	11.6	12.3	Partial Retention
	12.3	12.7	Modification
		end of segment	
C2	0.0	1.4	Partial Retention
	1.4	2.2	Modification
	2.2	3.3	Partial Retention
	3.3	4.2	Modification
	4.2	4.8	Partial Retention
	4.8	4.9	Partial Retention
	4.9	6.9	Partial Retention
	6.9	8.9	Partial Retention
		end of segment	

SOURCES: Klamath National Forest Land and Resource Management Plan, Final Environmental Impact Statement, Forest Visual Quality Objectives Map (1994b); Modoc National Forest Land and Resource Management Plan, Visual Quality Objectives Map (1991a); 2M Associates 1996.

Table D-3: Visibility of Transmission Line Segments From KOPs

KOP	Location	Visibility
1	Medicine Lake Recreation Area: Hogue Campground Shoreline	Not visible; campground views oriented to south
2	Medicine Lake Recreation Area: Boat Launch	Transmission line clearing from milepost 0.8 to 2.2 parallel with view; would likely remain evident Upper portions of towers and conductors seen in middleground above tree line from approximately mileposts 0.6 to 3.1; viewed from a lower elevation against forest and lava flow backdrop Skyline effect of line/towers at crossing of caldera rim near Grouse Hill evident Contrast of towers and conductors would compete with natural contrast qualities presented by lava flow seen above homogenous forest canopy VQO objective in seen route area: Retention from mileposts 0.6 to 1.2; Partial Retention from mileposts 1.2 to 3.1
3	Medicine Lake Recreation Area: Medicine Lake	Transmission line clearing from milepost 0.8 to 2.2 parallel with view; would likely remain evident Upper portions of towers and conductors seen in middleground above treeline from approximately mileposts 0.6 to 3.3; viewed from inferior position against forest and lava flow backdrop Skyline effect of line/towers at crossing of caldera rim near Grouse Hill evident Contrast of towers and conductors would compete with natural contrast qualities presented by lava flow seen above homogenous forest canopy VQO objective in seen route area: Retention from mileposts 0.6 to 1.2; Partial Retention from milepost 1.2 to 3.3
4	Medicine Lake Recreation Area: Medicine Lake Lava Flow Trail	Within defined Medicine Lake Recreation Area Towers, conductors, forest clearing of right-of-way, and access road seen in foreground at crossing with trail with changes evident in qualities of size, amount, intensity, direction, pattern, etc. Affects approximately 25% of trail length between Medicine Lake Road and the Medicine Lake Lava Flow VQO objective in seen route area: Partial Retention
5	Medicine Lake Recreation Area: Private recreation residence	Upper portions of towers and conductors seen in middleground above treeline from approximately mileposts 0.6 to 3.3; viewed from inferior position against forest backdrop Skyline effect of line/towers at crossing of caldera rim near Grouse Hill evident Contrast of towers and conductors would compete with natural contrast qualities presented by lava flow seen above homogenous forest canopy VQO objective in seen route area: Retention from mileposts 0.6 to 1.2; Partial Retention from milepost 1.2 to 3.3

Table D-3: Visibility of Transmission Line Segments From KOPs (continued)

KOP	Location	Visibility
6	Little Mount Hoffman Lookout	Upper portions of towers and conductors seen in middleground intermittently from approximately mileposts 0.3 to 0.8 and mileposts 4.5 to 5.6; viewed from higher elevation against forest backdrop VQO objective in seen route area: Retention and Partial Retention
7	Primary Forest Route 49: east of proposed power plant site	Not visible
8	Primary Forest Route 49: Medicine Lake vista point	Upper portions of towers and conductors seen in middleground from approximately mileposts 1.0 to 2.2; viewed from superior position with forest and lake backdrop Contrast would be only management activity evident and would compete with natural contrast qualities presented by lava flow, lake waters, and homogenous forest canopy. VQO objective in seen route area: Partial Retention
9	Primary Forest Route 49: crossing point east of Medicine Lake	Towers, conductors, forest clearing, and access road seen in foreground at crossing with road Affects views from approximately 1/4 mile in either direction VQO objective in seen route area: Partial Retention
10	Primary Forest Route 77 (44N50)	Towers, conductors, forest clearing, and access road seen in foreground at crossing with road Affects views from approximately 1/8 to 1/4 mile in either direction VQO objective in seen route area: Retention
11	Arnica Sink	Upper portions of towers and conductors seen in middleground from approximately mileposts 3.5 to 4.1; viewed against forest backdrop VQO objective in seen route area: Partial Retention/Modification
12	Forest Road 43N99 / Lyons Peak Loop Road	Upper portions of towers and conductors seen in middleground from approximately mileposts 5.0 to 6.2; viewed from superior position against forest backdrop VQO objective in seen route area: Partial Retention /Modification
13	Primary Forest Route 97	Transmission line right-of-way seen in middleground and background coming down from Highlands area from approximately mileposts 9.5 to 14.5.
14	Tionesta	Towers and conductors intermittently seen in foreground/middleground from approximately mileposts 19.7 to 20.7; viewed through sparse pines against land and sky backdrop VQO objective in seen route area: Partial Retention
15	Timber Mountain Fire Lookout	Transmission line right-of-way seen in middleground and background coming down from Highlands area from approximately mileposts 9.5 to 14.5. VQO objective in seen route area: Partial Retention/ Modification

Table D-3: Visibility of Transmission Line Segments From KOPs (continued)

KOP	Location	Visibility
16	State Highway 139: proposed transmission line route crossing (Segment C1)	Towers, conductors, forest clearing, and access road seen in foreground at crossing with road VQO objective in seen route area: Partial Retention
17	State Highway 139: alternative transmission line route crossing (Segment C2)	Not evident
18	Lava Beds National Monument: Gillem Camp	Not readily evident
19	Lava Beds National Monument Road Vista Point	Not readily evident
20	Lava Beds National Monument: Schonchin Butte Lookout	Not readily evident
21	Lava Beds National Monument: Cave Loop Road	Not readily evident

SOURCE: 2M Associates 1996

Table D-4: Consistency of Transmission Line Segments with VQO designations, After Mitigation

Station Point				
Route Segment	**From**	**To**	**VQO Designation**	**VQO Consistency After Mitigation**
A1	0.0	1.2	Retention	Consistent
	1.2	3.8	Partial Retention	Consistent
	3.8	4.0	Modification	Consistent
	4.0	4.2	Partial Retention	Consistent
	4.2	4.8	Modification	Consistent
A1 / A2	4.8	5.1	Partial Retention	Consistent
A2	5.1	5.4	Modification	Consistent
	5.4	5.5	Partial Retention	Consistent
	5.5	5.9	Modification	Consistent
	5.9	6.8	Partial Retention	Consistent
	6.8	7.9	Modification	Consistent
A2 /B1	7.9	9.0	Partial Retention	Consistent
B1	9.0	10.0	Modification	Consistent
	10.0	12.3	Partial Retention	Consistent
	12.3	13.8	Modification	Consistent
	13.8	14.5	Partial Retention	Consistent
	14.5	15.3	Modification	Consistent
C1	15.3	15.4	Partial Retention	Consistent
	15.4	16.9	Modification	Consistent
	16.9	17.2	Partial Retention	Consistent
	17.2	18.6	Modification	Consistent
	18.6	23.4	Partial Retention	Consistent

Table D-4: Consistency of Transmission Line Segments with VQO designations, After Mitigation (Continued)

	Station Point			
Route Segment	**From**	**To**	**VQO Designation**	**VQO Consistency After Mitigation**
A3	0.0	0.5	Retention	Consistent
	1.5	2.3	Modification	Consistent
	2.3	2.7	Retention	Consistent
	2.7	3.7	Partial Retention	Consistent
	3.7	4.8	Modification	Consistent
	4.8	5.2	Partial Retention	Consistent
	5.2	6.0	Modification	Consistent
	6.0	6.9	Partial Retention	Consistent
B2	0.0	0.2	Modification	Consistent
	0.2	0.9	Partial Retention	Consistent
	0.9	2.7	Modification	Consistent
	2.7	4.4	Partial Retention	Consistent
	4.4	5.1	Modification	Consistent
	5.1	5.5	Partial Retention	Consistent
	5.5	7.0	Modification	Consistent
	7.0	7.8	Note: Private Property	Consistent
	7.8	8.2	Retention	Consistent
	8.2	11.0	Partial Retention	Consistent
	11.0	11.6	Modification	Consistent
	11.6	12.3	Partial Retention	Consistent
	12.3	12.7	Modification	Consistent
C2	0.0	1.4	Partial Retention	Consistent
	1.4	2.2	Modification	Consistent
	2.2	3.3	Partial Retention	Consistent
	3.3	4.2	Modification	Consistent
	4.2	4.8	Partial Retention	Consistent
	4.8	4.9	Partial Retention	Consistent
	4.9	6.9	Partial Retention	Consistent
	6.9	8.9	Partial Retention	Consistent

SOURCE: 2M Associates 1996

Table D-5: Agencies and Individuals Consulted

Date	Agency / Interest	Individual
June 27, 1996	National Park Service, Lava Beds National Monument	Craig Dorman
June 27, 1996	Modoc National Forest	Jenny Bradley
July 1, 1996	Klamath National Forest	Jerry Mosier
July 3, 1996	Modoc National Forest, Doublehead Ranger District	Bernard Weisgerber Mike Kegg
July 3, 1996	Klamath National Forest, Goosenest Ranger District	Jim Stout
July 3, 1996	National Park Service, Lava Beds National Monument	Craig Dorman Chuck Barat Chris Roundtree
July 4, 1996	Modoc National Forest, Doublehead Ranger District	Dave Sinclear Mike Kegg
July 4, 1996	Medicine Lake property owner	Nick Lettunich
August 2, 1996	State of California, Department of Parks and Recreation, Division of Off-Highway Motor Vehicle Recreation	Grant Jensen
August 21, 1996	State of California, Department of Parks and Recreation, Division of Off-Highway Motor Vehicle Recreation	Barry Jones
September 20, 1996	Calpine Corporation	Ed Merrihew
October 10, 1996	Modoc National Forest, Doublehead Ranger District	Mike Kegg
October 14, 1996	Calpine Corporation	Bob Orloff
October 15, 1996	Siskiyou County Planning Department	Rick Barnham
October 18, 1996	National Park Service, Lava Beds National Monument	Gary Hathaway
November 15, 1996	Klamath National Forest, Goosenest Ranger District	Jim Stout
November 15, 1996	Klamath National Forest	Jerry Mosier
November 19, 1996	Klamath National Forest	Jerry Mosier

APPENDIX E:

Meteorological Data

Appendix E

This appendix contains additional background and technical meteorological data that support the analyses contained in section 3.13. Seasonal windroses for the power plant site are provided in Figures E-1 through E-4. Windroses for six-hour periods at the power plant site are provided in Figures E-5 through E-8.

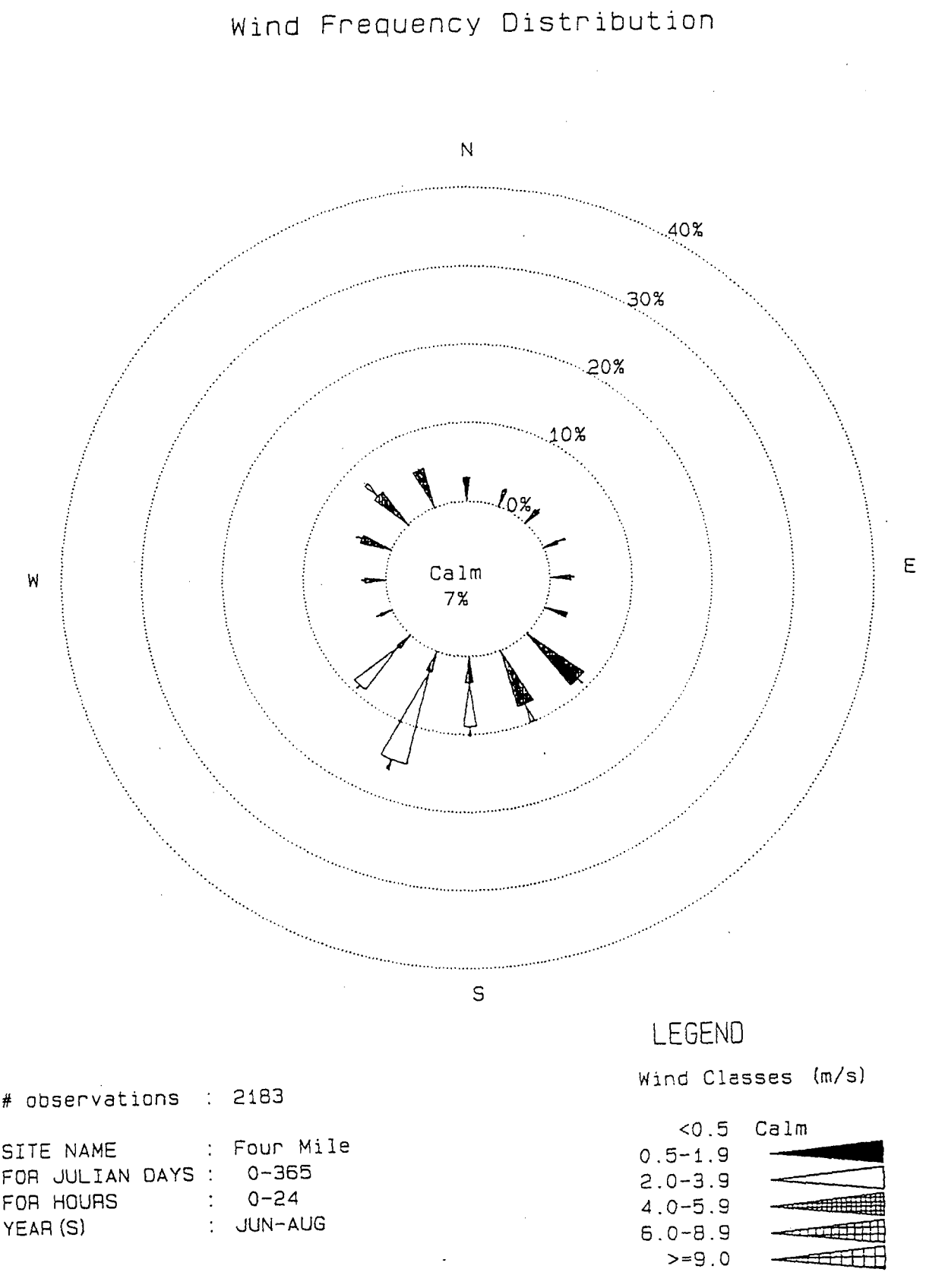

Figure E-1 Wind Frequency Distribution for Fourmile Hill from June 1995 through August 1995 - All Hours

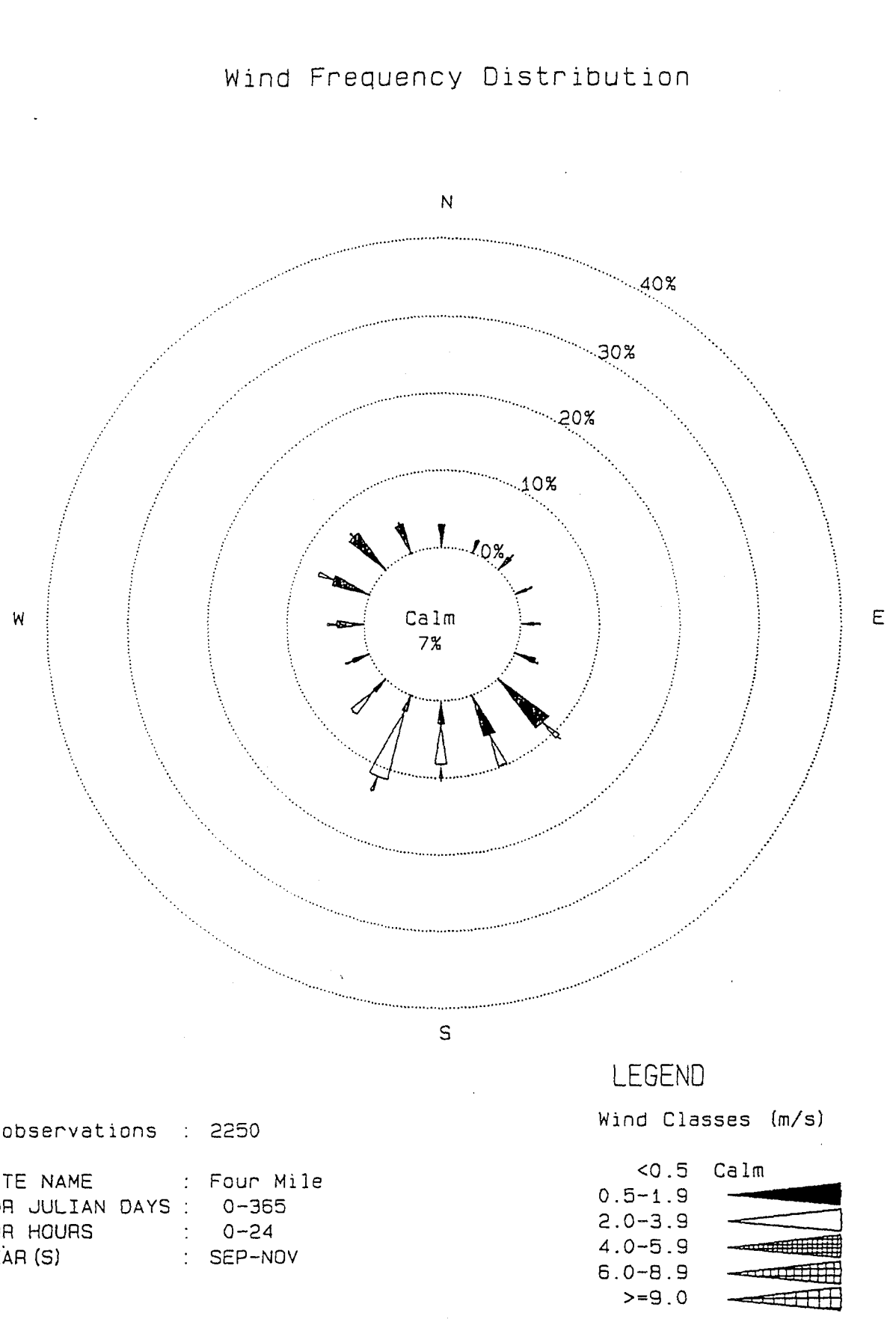

Figure E-2 Wind Frequency Distribution for Fourmile Hill - November 1994, September 1995 through November 1995 - All Hours

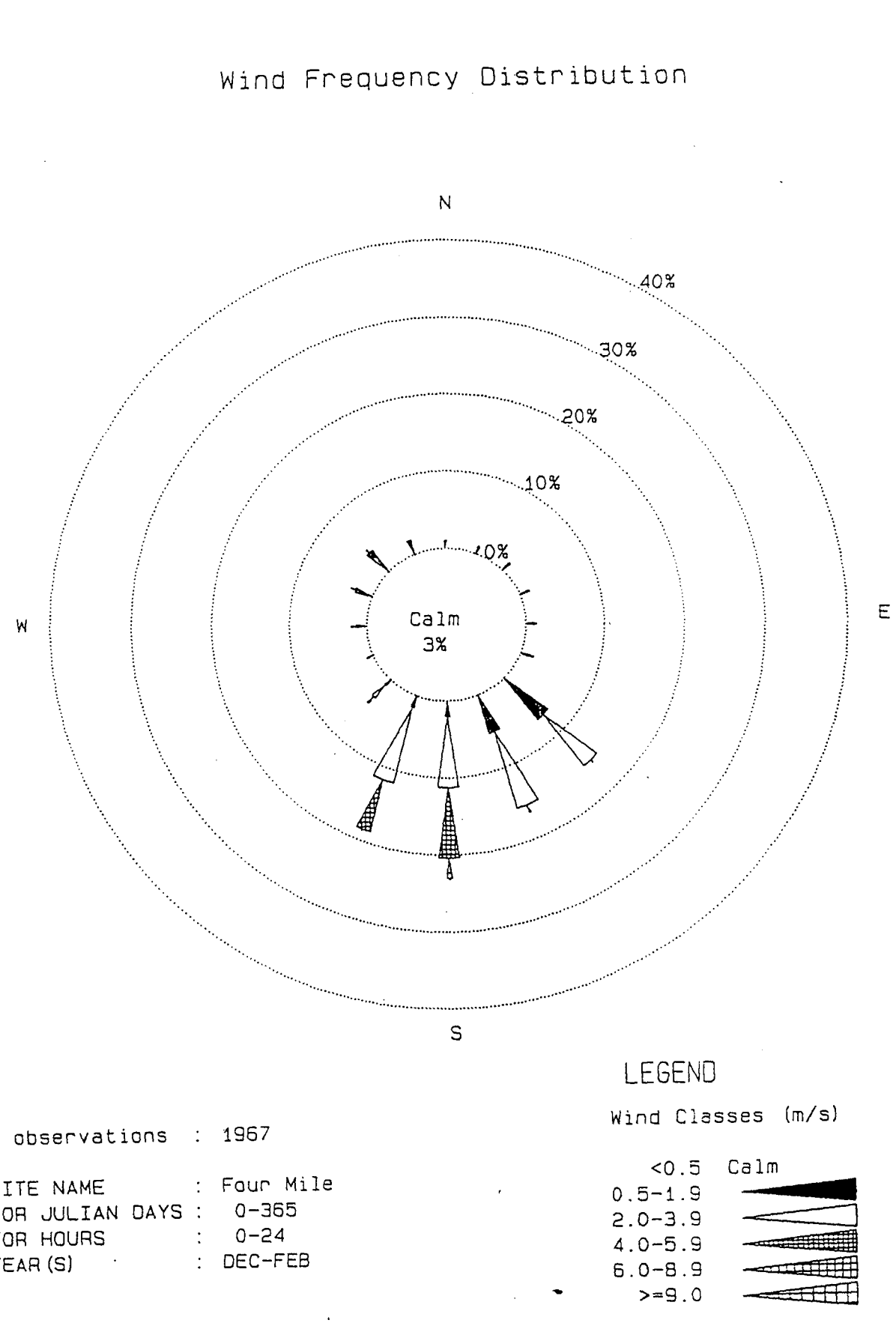

Figure E-3 Wind Frequency Distribution for Fourmile Hill from December 1994 through February 1995 - All Hours

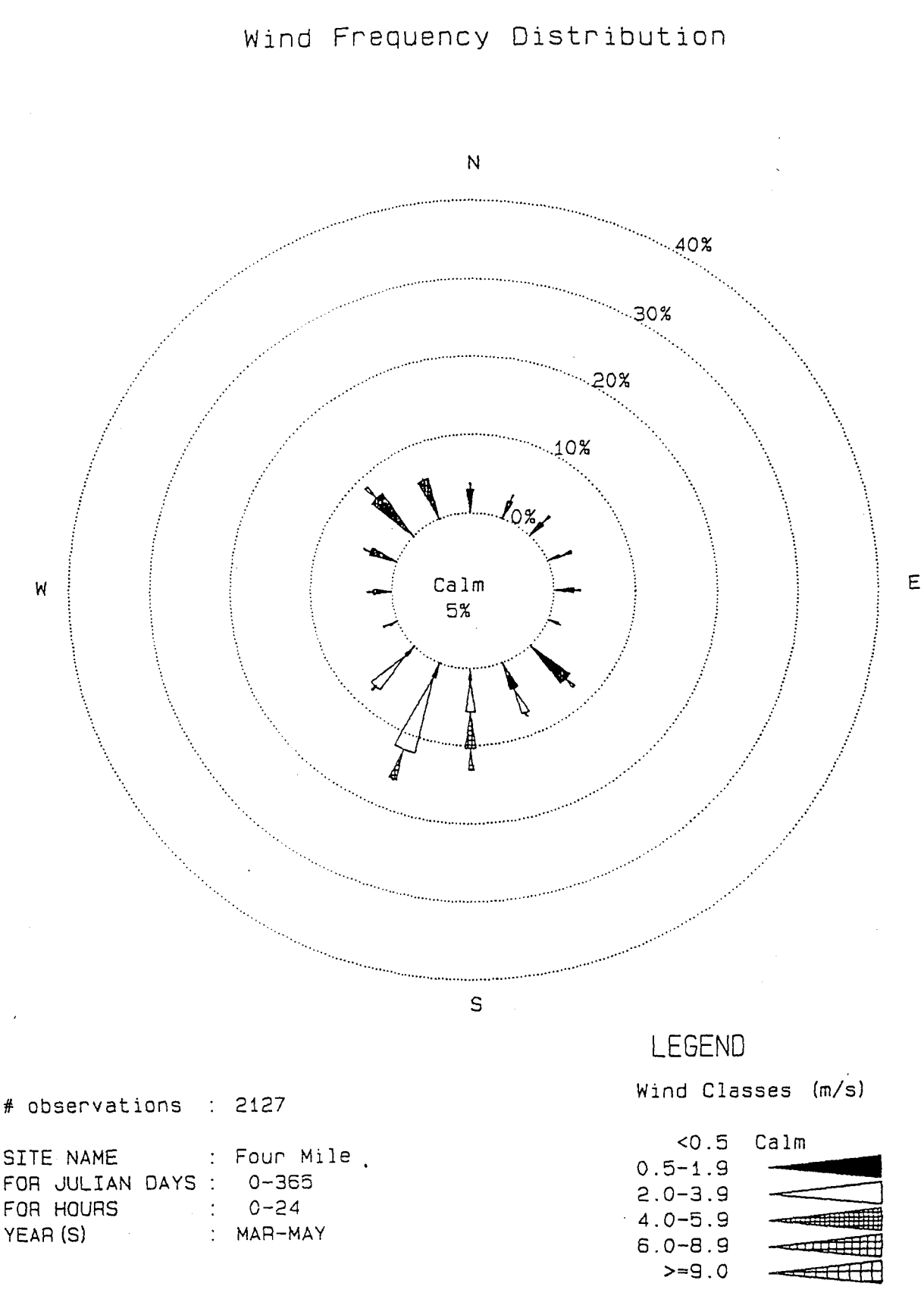

Figure E-4 Wind Frequency Distribution for Fourmile Hill from March 1995 through May 1995 - All Hours

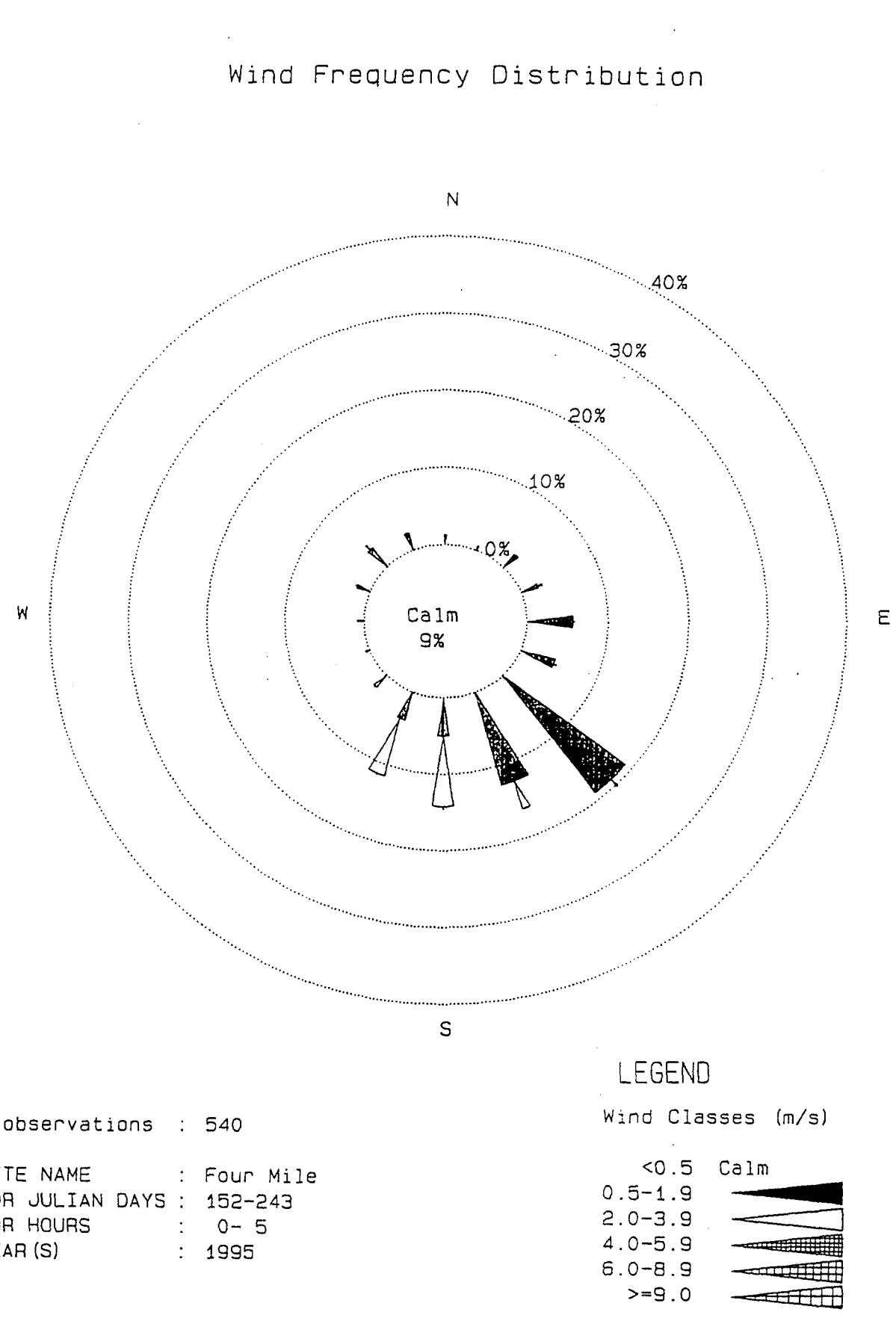

Figure E-5 Wind Frequency Distribution for Fourmile Hill from June 1995 through August 1995 - Hours 00 - 05 PST

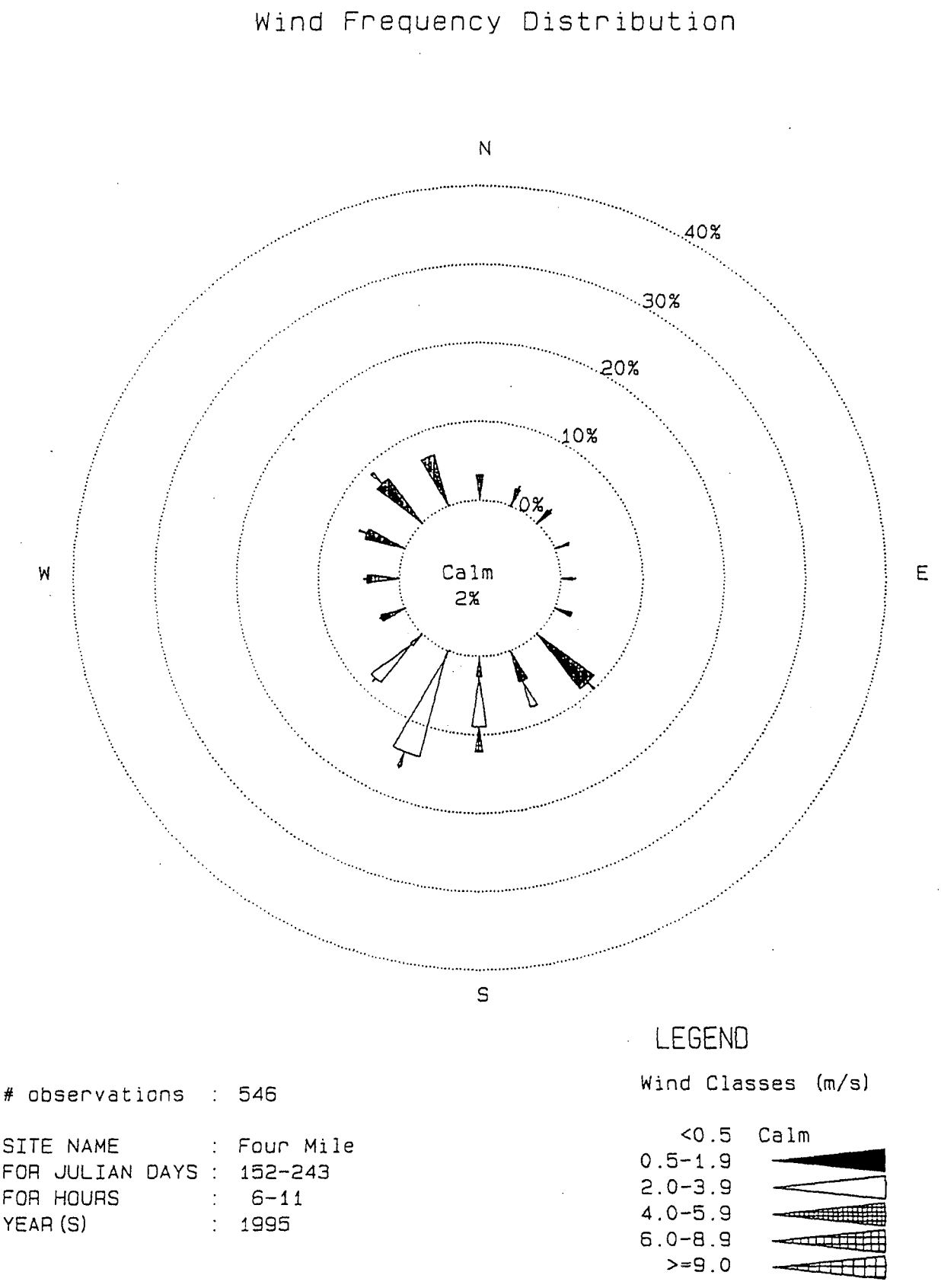

Figure E-6 Wind Frequency Distribution for Fourmile Hill from June 1995 through August 1995 - Hours 06 - 11 PST

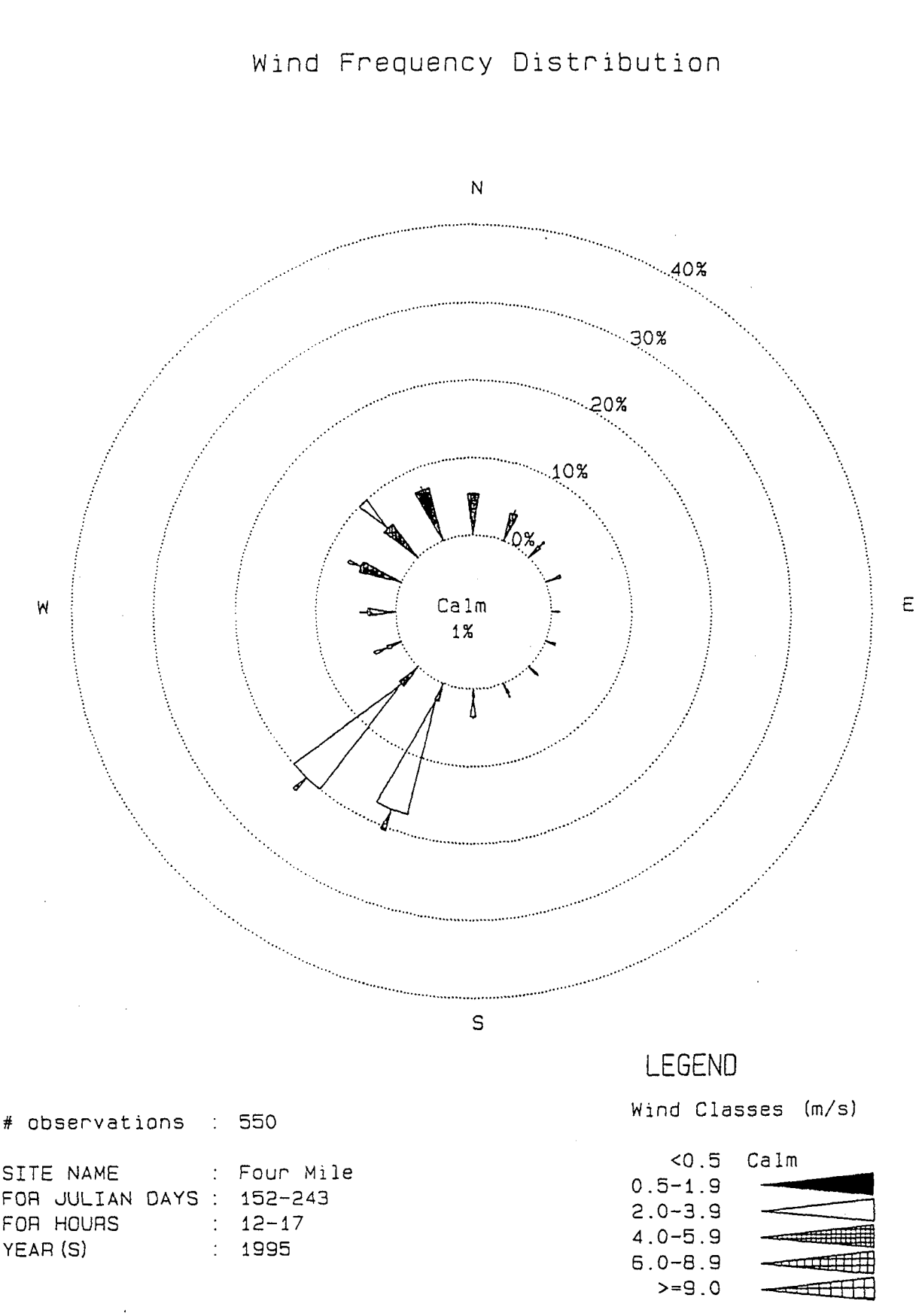

Figure E-7 Wind Frequency Distribution for Fourmile Hill from June 1995 through August 1995 - Hours 12 - 17 PST

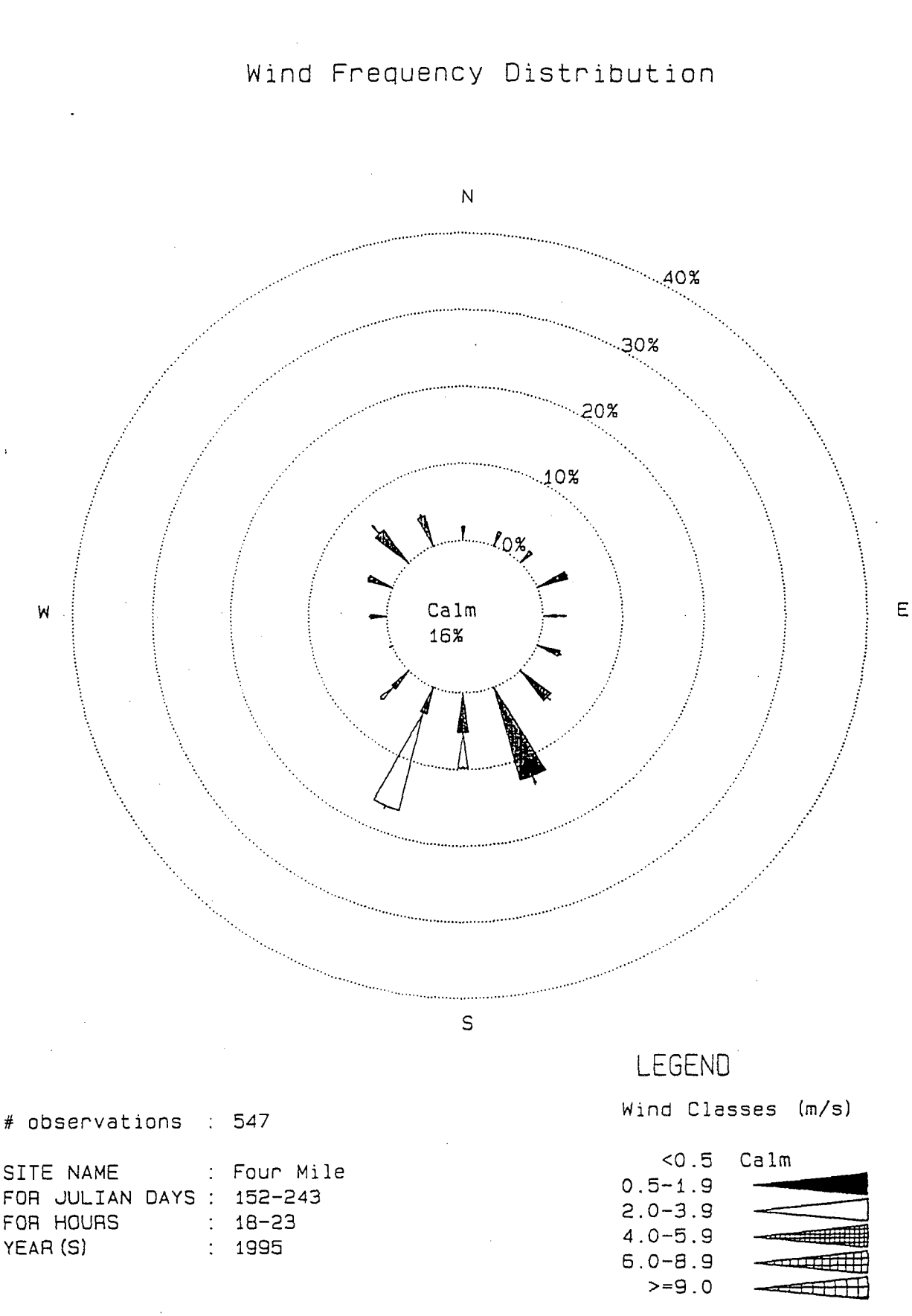

Figure E-8 Wind Frequency Distribution for Fourmile Hill from June 1995 through August 1995 - Hours 18 - 23 PST

APPENDIX F:

Air Quality Impact Assessment

Appendix F

Fourmile Hill Geothermal Development Project

Air Quality Impact Assessment

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Contents

Calpine plans to develop the well field and construct the power plant over a three-year period. The development and construction schedule has been designed to accommodate several constraints, as well as to provide strategic additional data about the geothermal resource as early in the schedule as possible.

Although roadways sufficient for Calpine's needs exist that would allow access to the project area from other directions, the U.S. Forest Service will require that Calpine access the project area from the north. Calpine will need to construct several portions of onsite roadway and improve several sections of existing onsite roads during the first year of well field development in order to approach the power plant site and most of the well pad sites. Figure 1 illustrates the proposed new and improved roadway sections on site. The segments have been assigned identifiers for the purpose of the air quality impact analysis; these are indicated in Figure 1, as well.

In order to protect the identified Goshawk habitat in the project area, the U.S. Forest Service will also require that Calpine cannot perform any construction activities at any time within ¼ mile of the Goshawk nest found in the northwest quarter of Section 28, and cannot perform construction activities within ½ mile of the nest during the months of January through August. Calpine has planned the construction activities for each year around these requirements.

The climate of the project area places additional constraints on the construction schedule. The project area often has snow on the ground as late in the year as June. For this reason, Calpine has planned outdoor construction activities to begin in May of each year, realizing that it may be necessary to move some snow away from the work areas when construction begins each year. Outdoor construction activities will end by October 15 of each year. Indoor construction activities (*e.g.*, at the power plant after the building structures have been erected) may continue year-round, and drilling activities may continue as late as the end of each calendar year.

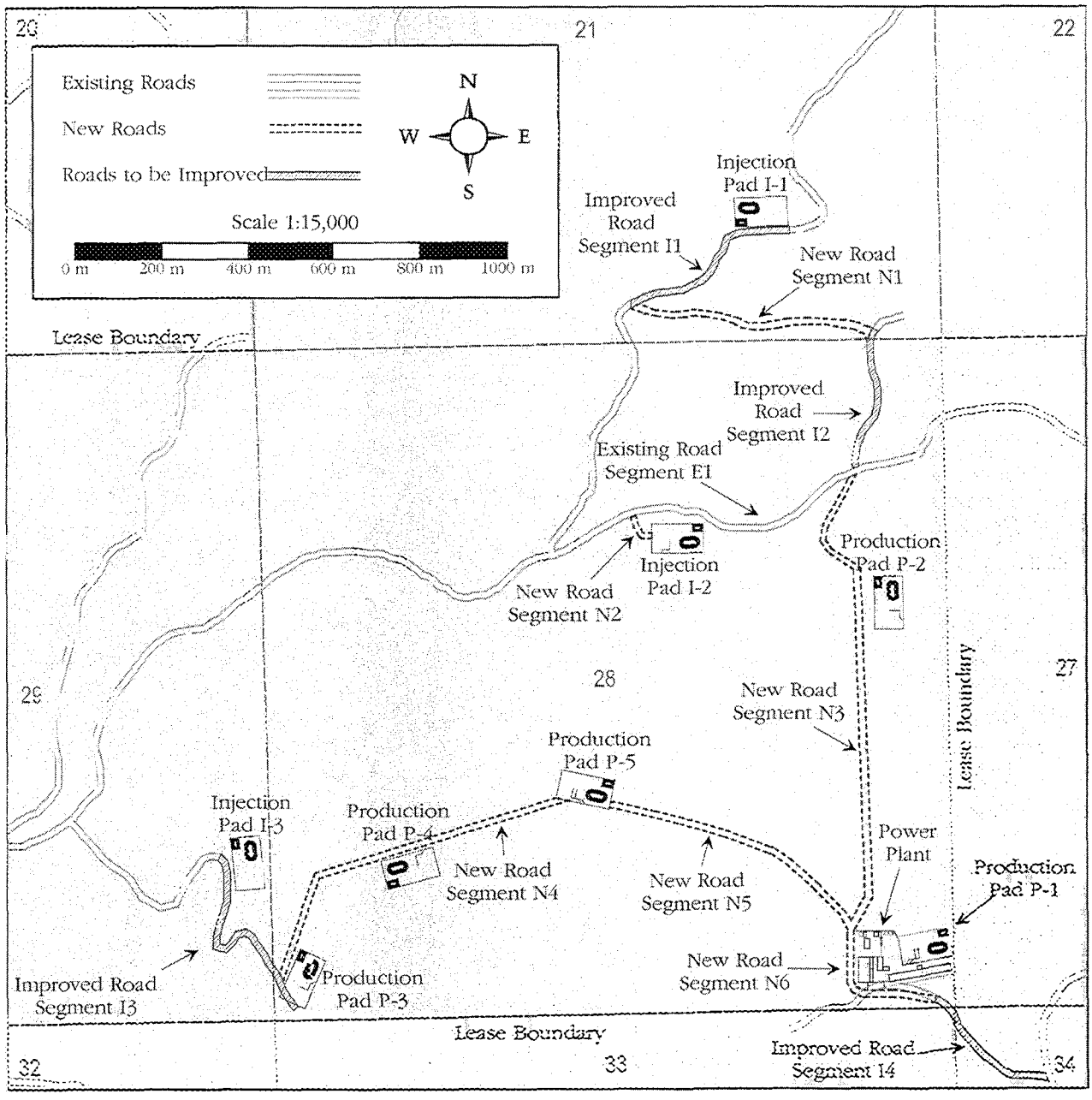
Following is a description of the activities as currently planned by Calpine for each year of well field development and power plant construction. The scheduling of these activities may change as the design of the facility is finalized and additional constraints come to light.

1.1 Construction Activities

First Year of Development and Construction

Calpine plans to construct all of the onsite roadways and well pads in the first year. Work would begin in May, with snow removal (if necessary) and access road construction. As soon as possible, Pad P-1 would be constructed. Following construction of Pad P-1, drilling of the first on that pad would commence. Calpine would use just one drill rig during the first year.

Figure 1. Fourmile Hill Geothermal Project



During the months of June, July and August, Calpine would construct new roadway segments N1, N3, and N6 (as indicated in Figure 1), and would improve segments I1 and I2. The total construction width would be about 40 feet along roadway segments that would eventually be paralleled by pipeline(s). Segments without pipelines alongside would average about 30 feet construction width. The traveled portion of the completed roadways would be about 20 feet. Calpine plans to surface the roads with macadam pavement.[1]

Also during the months of June, July and August, Calpine would drill and complete the first on Pad P-1. The first well would not be flow tested until a second well was completed, because the second well will be needed for reinjection of the produced brine. The locations of well pads P-2, I-1 and P-3 are all more than ½ mile from the Goshawk nest, and these pads (as well as Pad P-1) would be constructed prior to August 31 of the first year. If all goes well, Calpine would begin drilling a second well on Pad P-2 or Pad P-3 in July or August of the first year.

During the period September 1 through October 15, Calpine would construct new roadway segments N2, N4 and N5, and improve segments I3 and I4. Well pads P-5, P-4, I-3 and I-2 would be completed during this period. Drilling of the second well (at Pad P-2 or Pad P-3) would continue and may be completed.

After the second well is completed, perhaps as early as October 1, flow testing of one of the two wells would begin. The produced steam would be vented through a portable silencer, and the produced brine would be drained to the sump and then injected into the other well. After flow testing the first well, the silencer would be moved to the other well, and it would be flow tested. Each well may be flow-tested for as long as six weeks, although the actual period will probably be shorter. (Calpine expects that the average flow test duration would be about two weeks.) Work at the project site would end for the first year after the second well is flow-tested.

Second Year of Development and Construction

During the second year, Calpine plans to begin construction of the power plant, and to construct as many as four wells. As in the first year, only one drill rig would be used. During the period May to August, the power plant site would be constructed, two wells would be drilled, and a third well may be started. The first well would be drilled on the same pad as the second well of the year before. The second well would be drilled on Pad P-2 or Pad P-3 (whichever wasn't drilled the prior year). If a third well was started before August 31, it would be on the same pad as the second well. The new wells would be flow tested after each was completed. Combinations of two wells may be tested together to assess the response of the geothermal resource.

After September 1, the third and fourth wells would be completed. If the third well was started prior to August 31, it would be on Pad P-2 or Pad P-3. If it was started on September 1 or later, it would be most likely on Pad P-5. The fourth well would also be on pad P-5. The new wells would be completed and flow-tested by the year-end. By October 15, the earth work for the power plant site would be completed. Some of the buildings would be completed before year-end, and construction work inside the building may continue through the winter. The diesel generator that

[1]Macadam pavement refers to an asphalt-like surface that is created by the application of thick oil to a dirt surface, sometimes with gravel, and subsequent compaction by vehicles traveling over it. The resulting surface is more durable than a dirt or gravel surface alone.

would later serve as the plant's backup generator may be installed at the plant site by the end of the year and used to produce power for use during the remainder of the plant construction.

Third Year of Development and Construction

Construction of the well field equipment (wells and pipelines) and the power plant would be completed during the third year. Indoor work at the power plant may continue through the winter from the prior year. Well drilling would begin in May (or as soon thereafter as possible), using two or three drill rigs. As many as 6 new wells would be drilled at Pads P-1, P-2, I-3 and P-3 prior to September 1. Each new well would be flow tested after it was completed. Outside work at the power plant would begin in May, and continue until the plant is completed.

After September 1, drill rigs would be moved to three of Pads P-5, P-4, I-3 and I-2. Well drilling, construction and flow-testing would continue until year-end.

Pipelines would be constructed between May and mid-October, beginning with work outside of the ½ mile radius of the Goshawk nest. After September 1, work within the ½ mile radius will be completed.

Fourth Year (Plant Startup and Operation)

The power plant would begin operation as soon as possible. Although it is anticipated that enough production wells would be on line to operate the plant at capacity at the time of startup, the production rate of geothermal well fields often declines rapidly at first. Therefore, a new (infill) well may be drilled during the first year as the plant is operating, and others may be drilled in subsequent years.

1.2 Sources of Emissions During Development and Construction

There will be a number of sources of emissions to the atmosphere during the construction of the power plant and development of the well field. This section describes these sources.

Fugitive Dust

Fugitive dust emissions will be created by the following activities:

- road construction
- the earth work required for well pad and power plant site construction
- worker vehicle, haul vehicle, and equipment travel

These activities release fugitive dust emissions due to the mechanical disturbance of soil (scraping, loading, dumping, grading, *etc.*), and by entraining loose surface dust into the atmosphere by the turbulence associated with the movement of equipment and vehicles.

Although wind erosion of bare soil can result in significant fugitive dust emissions in some circumstances, this is not expected to be the case at the proposed project, for several reasons. The wind speeds are generally quite low at the project site. The forest canopy is high, providing a very

effective wind screen. Also, the ground surface is wet or covered with snow for as long as seven months of the year, effectively eliminating any potential wind erosion during those periods.

Fugitive dust emissions would be controlled by application of water during construction activities. A well-managed watering program can reduce fugitive dust emissions by more than 50%.

Drill Rig Emissions

Well drilling activities can produce emissions in several ways, not all of which are expected to occur at the Fourmile Hill project site. First, drill rigs are powered by large stationary diesel generators. The generators exhaust contains particulate matter in the form of soot, as well as oxides of nitrogen, oxides of sulfur, carbon monoxide, and various organic gases. In the case of air drilling, additional diesel engines are used to power the air compressors. Also in the case of air drilling, the return air from the drill hole (exiting the blooie line) may contain significant quantities of particulate matter (from the cuttings), as well as gases and particulate matter from the resource itself (once the hole has advanced to the depth of the resource).

Calpine intends to use mud drilling exclusively at the Fourmile Hill project. This would eliminate the potential emissions discussed above from the air compressor engines and contaminants in the return air from the drill hole. Thus, only the diesel generator engines are expected to produce significant emissions during drilling.

Flow Testing Wells

Wells would be flow tested by allowing them to vent while monitoring the steam flow. Prior to plant startup, Calpine would perform each flow test by attaching the well to a flash tank followed by a portable silencer. The liquid phase (brine) collected from the flash tank and silencer would be directed to a sump. The gas phase from the flash tank would be directed to the portable silencer. Water would be injected into the line between the flash tank and silencer, in order to scrub out particulate matter. In the portable silencer, the injected liquid and some condensed steam would be once again separated from the gas phase. The gas phase (steam and noncondensible gases) would exit out the top, while the hot brine (containing dissolved and suspended solids present in the resource) would be directed to a sump. Brine collected in the sump would be pumped to another well for reinjection. Because silencers are not 100% efficient in separating the gas and liquid phases, some of the liquids (and attendant aqueous and solid phase substances) would exit from the top of the silencer as droplets, along with the vapor phase exhaust.[2] Thus, flow testing would be a source of organic and inorganic noncondensible gases (*e.g.*, hydrogen sulfide and ammonia), as well aqueous and solid phase substances contained in carryover droplets.

Because the concentrations of hydrogen sulfide in the geothermal fluids are expected to be quite low, it is expected that abatement of hydrogen sulfide emissions from the wellhead during flow testing will not be necessary. If higher-than-expected hydrogen sulfide concentrations are encountered, wellhead abatement may be needed, which could be accomplished by caustic injection between the flash tank and the portable silencer.

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[2]These droplets should not be confused with the recondensate droplets that form in the steam plume. Recondensate is essentially pure water, and contains none of the contaminants found in the carryover droplets. The vast majority of the droplets seen in a steam plume are recondensate droplets.

1.3 Sources of Emissions During Normal Plant Operation

A simplified flow diagram for the proposed project is presented in Section 2 of the DEIS/DEIR. As described in Section 2, the project would include a well field ultimately comprising approximately nine to eleven production wells, approximately production wells, three or more injection wells, and a dual-flash power plant with two dual-pressure steam turbines, a direct-contact condenser, a large counterflow, mechanically-induced draft cooling tower, and hydrogen sulfide abatement equipment. There would be a standby diesel generator of about 0.5 MW capacity, which would be used to provide power for safe shutdown and standby of the plant and well field in the case of dual turbine outage, but would not be used (except for testing) under normal circumstances.

There would be several sources of emissions to the atmosphere during normal operations.

Plant Vent Silencer

The plant would be equipped with several (probably three or four) vent silencers. Silencers are large cylindrical vessels that allow steam to expand and decelerate before being released to the atmosphere. Noise is reduced by decelerating the flow, and is directed upward by the shape of the silencers. Under normal operations, the silencers would receive the low pressure liquids from the second flash, where they would flash once again. As described above for the portable silencers, the plant silencers would remove most of the remaining liquids from the flow, but would allow a small fraction of them (one percent or less) to be carried over as droplets in the exhaust stream.

Cooling Tower

The cooling tower would receive condensed steam and cooling water from the direct-contact condenser. Within the cooling tower, the warm water from the condenser would be sprayed over the tower *fill*. The fill of a cooling tower is a collection of baffle devices that are intended to break up the spray and increase the air/water contact area. Within a cooling tower, water falls through and over the fill, eventually ending up in the cold water basin at the bottom of the tower. Water would be pumped from the cold water basin back to the condenser, where it would cool the steam coming from the turbine. The process of spraying water in a cooling tower and the splashing and splattering that goes on in the fill creates droplets. Some of these droplets would be carried up through the tower by the draft created by the fans. At the top all modern cooling towers, just below the fans, are *drift eliminators*, devices that serve to remove most of these droplets from the exhaust stream and return them to the circulating water in the tower. High-efficiency drift eliminators can typically reduce drift exiting from a cooling tower to less than 0.008% of the water circulation rate.[3] The remaining drift which escapes the drift eliminators would contain some of the dissolved and suspended solids carried over from the primary and secondary flash tanks, through the turbines, and into the water of the condenser.

[3]California Air Resources Board, 1989. *Technical Support Document to the Proposed Hexavalent Control Measure for Cooling Towers.* Stationary Source Division.

Hydrogen Sulfide Abatement

Noncondensible gases present in the turbine exhaust would be directed to a hydrogen sulfide abatement system and then to the cooling tower, so that they would exit along with the cooling tower exhaust. This is referred to as a *primary* abatement system. The primary hydrogen sulfide abatement system would remove 95% or more of the hydrogen sulfide present in the noncondensible gas stream. Most likely, the hydrogen sulfide abatement system would employ the Stretford process or the LoCat process. Both of these are systems chemically remove hydrogen sulfide gas by converting sulfide to elemental sulfur.

Hydrogen sulfide present in the cooling water would be removed by a 6water treatment system (most likely an iron chelate system). The system would remove 75% or more of the hydrogen sulfide in the cooling water. This system would be what is known as a *secondary* abatement system

Mercury Abatement

If necessary, a mercury removal system would be installed upstream of the primary hydrogen sulfide abatement system. This system would remove mercury present in the noncondensible gas stream. Such a system would be installed if needed to prevent the sulfur cake produced by the primary hydrogen sulfide abatement system from being classified as a hazardous waste due to mercury content, or if needed to ensure that mercury emissions do not exceed the levels presented in Tables 1 and 3 of this appendix.

Fugitive Emissions from Pipe Connectors and Valves

Calpine intends to minimize the number of connectors used in the pipelines carrying the produced geothermal fluids by welding pipe sections wherever possible. Although all pipe fittings and valves would be designed and maintained to minimize leakage, trace amounts of noncondensible gases and steam could escape from pipe fittings and valves. Due to the expected very low concentrations of these gases in the fluids and small number of fittings, it is expected that fugitive emissions from these sources would be negligible.

Drilling of Infill Wells

As discussed above, it would be necessary to drill infill wells in order to maintain the steam flow to the power plant. The emissions sources associated with drilling these wells would be the same as those discussed above for drilling during the initial development of the wellfield.

Venting Wells through Portable Silencers

Occasionally, during normal operations, it would be necessary to vent wells through portable silencers. This normally would occur only when some portion of the pipeline to the power plant is unavailable for some reason (*e.g.*, repair or maintenance). In such cases, the geothermal fluids would be directed to a flash tank and portable silencer combination, with water injection for particulate matter control (as would occur during flow testing of wells). Emissions during these situations would be the same as during flow testing of production wells prior to power plant startup.

1.4 Emissions During Plant Upsets

If the electrical transmission line became unavailable, Calpine would have to immediately reduce the output from the turbines. If possible, one or both of the turbines would be kept in operation, generating plant power. If this is possible, the plant would have enough power available to restart itself when the transmission line again became available. However, if the turbines can't be kept in operation, the backup generator would be used to produce plant power sufficient to safely maintain the plant in a standby mode. Once the transmission line is back in service, power sufficient to restart the plant would be backfed into the plant from the transmission line.

If there is a unit load reduction a unit trip for a plant process cause (as opposed to a transmission cause), there are several possible scenarios. Each unit would have a 100% capacity turbine bypass system, comprising a pressure-controlled valve and piping that runs from a point upstream of the turbine stop valve to the condenser. If a unit trips (turbine stop valve closes) or experiences a load run back (turbine control valve throttles), the pressure in the steam line would increase. If circulatory water flow to, and gas removal from, the condenser are maintained (as they may be during a trip and would be during a run-back), the turbine bypass(es) would be available to relieve all (in the case of a trip) or some (in the case of a run-back) of the steam flow directly into the condenser. If this is the case, non-condensible gas treatment could be maintained. During the transition to turbine bypass mode, pressure relief valves at the vent silencers may relieve some steam flow to the silencers, then they will close.

If the condenser and turbine bypass are unavailable after a turbine trip, all of the steam flow to the affected unit will have to be relieved through the plant silencer. Depending on the length of the outage, the flow from the wells may be fully vented or it may be gradually reduced using the well flow control valves. In this situation, hydrogen sulfide emissions would be abated by a secondary abatement system that would inject hydrogen peroxide or a caustic solution into the produced steam upstream of the plant silencer, where the steam would be released. The backup abatement system would provide about 80% hydrogen sulfide control efficiency. The total hydrogen sulfide emission rate during plant upsets would be comparable to emissions during normal operations.

In most cases, the turbine bypass system would be operational and would direct steam flow to the condenser when a turbine is down, which would provide for non-condensible gas treatment. Additionally, depending on the length of the outage, the flow from the wells may be fully ventetd or it may be gradually reduced using the well flow control valves. Calpine has indicated that they would reduce flow to about two-thirds by throttling back the wells for upsets lasting longer than 24 hours. However, only upset scenarios including venting of the full steam flow through the plant silencers were used in the analyses of maximum potential air quality impacts. Upsets that resulted in shutdown of only one turbine, or in which Calpine reduced flow from the wellfield, would have lesser emissions than the full-flow case described above.

Based on operating experience at similar facilities, Calpine estimates that an average of three or four short-duration plant upsets, averaging about six hours duration, will occur in a typical year. Approximately once every two years, Calpine expects that a planned plant shutdown (or outage) will occur, typically lasting two or three days. Calpine anticipates that an unplanned, long-term upset (lasting 10 to 15 days) may occur every three to ten years. The expected average number of hours per year for each of these upset conditions were used to estimate the contribution of upset emissions to annual average emissions.

2.0
Analysis of Impacts

The potential impacts of the proposed project, including the development of the well field and construction of the power plant, the construction of the transmission line, and operation of the proposed facility were quantitatively assessed. This section presents the methods used to evaluate the impacts of the proposed project on ambient air quality and visibility, and the criteria that were used to assess the significance of those impacts. It also presents the results of those analyses, and identifies the potentially significant impacts.

Air quality impacts were quantitatively analyzed by a four-step process. First, the proposed project was reviewed in order to identify activities and equipment that may be sources of emissions to the atmosphere. This included review of the development and construction phases of the power plant and well field, construction of the transmission line, normal operation of the power plant, plant upsets, and operational activities that may occur infrequently. Section 1 of this appendix discusses the potential sources of emissions. Second, emissions were estimated for each of the potential sources. Third, the emissions were used, along with appropriate meteorological, geographical and engineering data in dispersion and visibility models in order to prepare estimated concentrations of emitted substances in the ambient air and the potential for plume visibility. Finally, the estimated impacts were compared to appropriate criteria of significance in order to identify those estimated impacts that are considered significant.

In order to complete this process for each substance that may be emitted from or at the proposed project, there must exist the data necessary to estimate emissions of the substance and an appropriate method for preparing those estimates. Also, there must exist either a standard to which estimated concentrations may be compared, or toxicity data appropriate for assessing the contribution of the substance to the potential for adverse health effects. Substances expected to be emitted from the proposed project were included in this quantitative assessment if:

- A National Ambient Air Quality Standard or California Ambient Air Quality Standards exists for the pollutant. (These are referred to as "criteria pollutants.")

- The California Environmental Protection Agency's Office of Environmental Health Hazard Assessment (OEHHA) has published a cancer potency factor, unit risk factor, chronic reference exposure level or acute reference exposure level.

A number of the substances fitting these criteria are also listed pursuant to California's Proposition 65 as Chemicals Known to the State of California to Cause Cancer or Reproductive Toxicity. However, for two substances that are included in these lists (cobalt and antimony), there are no ambient air quality standards, and OEHHA has not published a cancer potency factor, unit risk factor, chronic reference exposure level, or an acute reference exposure level. Estimated emissions and concentrations in ambient air are presented in this section for these substances, but they could not be included in the assessment of potential health risk.

In all tables of this appendix, values are presented in italics for substances for which the geothermal fluids have been analyzed, but were not detected in the fluids. These substances include beryllium, cadmium, cobalt, manganese, nickel, selenium, copper, asbestos and hydrochloric acid. The estimated emission rates, ambient concentrations and potential health effects presented for those substances have been estimated by assuming that they are present in the geothermal fluids at concentrations equal to one-half of the analytical reporting limits. This is a common procedure for accounting for "non-detects."

In response to comments submitted on the Draft EIS/EIR, an additional substance, radon, was included in these analyses. There is no ambient air quality standard for radon, and OEHHA has not published any of the toxicity data needed for quantitative assessment of the potential contribution of radon to potential adverse health effects. However, radon is a recognized constituent of the fluids produced from geothermal resources worldwide, and the U.S. Environmental Protection Agency has recommended that measures be taken to reduce radon concentrations inside residences if the concentration exceeds four picoCuries per liter of air (pCi/l). Emission estimates and estimated concentrations of radon in ambient air have been calculated in the same manner as for other gaseous constituents of the geothermal fluids, and the estimated concentrations were compared to the EPA's 4 pCi/l level. For consistency, estimated emissions and ambient air concentrations of radon are presented in the same units as all other substances (pounds per day, pounds per year, and micrograms per cubic meter). The highest estimated concentrations were then converted to picoCuries per liter.

2.1 Estimation of Emissions

Short-term maximum and long-term average emission rates were estimated for substances potentially emitted to the atmosphere during the development of the well field, and construction of the facilities and roadways at the project site, as discussed in Section 1 of this appendix.

Calpine staff prepared estimates of the emissions of substances expected to be present in the geothermal fluids during normal plant operations, during well venting, and under plant upset conditions. These estimates were based on the known or guaranteed performance of equipment (*e.g.*, vent silencers and cooling towers), the expected composition of the geothermal resource, and engineering calculations.

Fugitive Dust

Fugitive dust emissions associated with general earthwork (*e.g.*, well pad construction) were estimated using a factor recommended by the U.S. Environmental Protection Agency for total dust emissions for such activities.[4] Based on data for individual dust-generating activities for which particle size distribution data are available, it was assumed that 50% of the dust emitted from general earthwork activities is 10 micrometers (μm) or less in diameter. This emission factor was reduced by 50% for earthwork at the power plant, well field and along the transmission line right-of-way to account for the control effectiveness of the dust control program that will be used.

The roadways on site will be surfaced with macadam pavement. Emissions associated with vehicle travel over these roads were estimated using an U.S. Environmental Protection Agency (USEPA)

[4]U.S. Environmental Protection Agency, 1995. *Compilation of Air Pollutant Emission Factors. Volume I. Stationary Point and the Area Sources.* p. 13.2.3-1. Section revised 10/96.

PM_{10} emission factor equation recommended for paved roads.[5] Calculation of the factor required information regarding the silt loading of the roadway surface and the average weight of vehicles traveling over the road. Because the actual silt loading of the roadways at the project site can not be predicted in advance, an average value for silt loading on haul roads at surface coal mines was used.[6] The nature of activities at surface coal mines and at the proposed project suggest that roadways at mines are considerably dustier than the roads at the proposed project will be, thus the use of these data has produced some overestimation of fugitive dust emissions from roadways on site.

The average vehicle weights were calculated on a year-by-year basis. This was done because the vehicle fleet during construction is expected to be quite different than after plant operation begins. Heavy trucks will contribute a much smaller fraction of the total vehicle-miles traveled after construction is complete. For instance, in the third year of construction, it was estimated that pickup trucks will travel over 120,000 vehicle-miles, while big-rig trucks will travel less than 4,000 vehicle-miles. After startup, pickup trucks are expected to travel about 41,000 vehicle-miles annually, while big-rigs will travel about 200 vehicle-miles during years in which infill wells are drilled, and less in other years.

Transmission Line Construction

G.E. Raleigh & Associates provided detailed equipment and activity information for the construction of the transmission line. The construction will take place during the summer months of two consecutive years. Fugitive dust emissions from equipment activities were estimated using available USEPA emission factors for similar equipment and activities.[7] The access roads used for the transmission line will not be paved. Accordingly, an emission factor equation recommended by the USEPA for unpaved roadways was used to estimate emissions from vehicle travel over unpaved transmission line access roads. Calpine will implement a dust control program, as required by the U.S.Forest Service, for these roads. The program may include watering, use of dust palliatives and/or other measures, as necessary. It is expected that this program will reduce emissions by at least 50%, so a 50% control factor was used in the estimation of fugitive dust emissions.

It was estimated that maximum daily PM_{10} emissions associated with transmission line construction for the first and second year of construction would be about 145 and 73 lbs/day, respectively. These values include the construction activities and vehicle travel over the 5,000 meters of access road closest to the work area on any day. (The actual off-road distance traveled by worker vehicles, equipment trucks and logging trucks would vary from location to location, depending on the proximity of existing roads, topography, *etc.*)

Drill Rigs and Power Plant Backup Generator

Emissions from drill rigs were estimated using USEPA emission factors for heavy-duty stationary diesel engines, and the total horsepower of the engines used in the generators of a typical drill rig (approximately 2,550 bhp) and average loading factors of 67% for the maximum hourly and daily

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[5] *ibid.*, p. 13.2.1-1.

[6] *ibid.*, p. 11.9-8.

[7] *ibid.*

emissions and 33% for the average daily emissions.[8] The emission factors used reflect control of NO_x emissions by ignition timing retard. (See Section 6 of this appendix.) These factors were also used to estimate the emissions of the power plant backup generator.

Emissions from the Power Plant

Emissions from the power plant during normal operations and during two types of upset conditions were estimated by Calpine staff based on the expected makeup of the geothermal fluids using engineering and material balance calculations. Calpine staff provided emissions estimates for the cooling tower and for the plant vent silencer under normal operating and upset conditions. For upset scenarios in which the turbine bypass(es) are available, the expected control efficiency of the hydrogen sulfide abatement system was used in the calculations. For bypass-unavailable upset scenarios, the expected control efficiency of the caustic injection system was used. Table 1 presents the estimated emissions from the cooling tower and vent silencer under normal operating conditions. Table 2 presents the estimated emissions from the vent silencer during a bypass-unavailable outage of both turbines. Table 3 presents the estimated annual average emissions from the plant silencers and cooling tower. These estimates were derived from the estimated emission rates during normal plant operation and during upsets, and the expected frequency of upsets.

Emissions from the Well Field

Under normal operating conditions, there are expected to be no significant emissions from the well field except fugitive dust from the on-site vehicles traveling over site roads. However, emissions may occur from several non-routine events.

As discussed in Section 1.1 of this appendix, production wells drilled prior to plant startup would be flow tested in order to assess their production capacity. When this occurs, the well would be vented to the atmosphere through a flash tank and portable silencer. Essentially all of the other noncondensible gases would be released to the atmosphere, as well as the dissolved and suspended solids present in the liquid phase droplets that escape the silencer. During operation of the plant, there may be other circumstances that require well venting through a portable silencer. This would be done in the same fashion as flow testing, and emissions are expected to be the same.

Calpine staff estimated emissions of substances present in the geothermal fluids during well venting based on expected well production rates, the expected makeup of the resource, and engineering calculations. Table 4 presents these estimated maximum emission rates for well venting through a portable silencer.

Annual emissions due to venting wells were estimated from Calpine's estimated emission rates during venting or flow testing and the expected number of well-hours per year that wellhead venting will occur. This was done on a year-by-year basis, because the number of wells flow tested will vary considerably during the three years of well field development. The results are presented in Table 5.

[8] *ibid.*, p.3.4-4. Revised 10/96.

Table 1. Estimated Emissions During Normal Operation

Substance	Cooling Tower lbs/day	Vent Silencer lbs/day	Total lbs/day
Hydrogen Sulfide	2.0E+01	1.9E+01	3.9E+01
Lead	*2.3E-06*	*2.3E-05*	*2.5E-05*
Antimony	2.1E-05	2.1E-04	2.3E-04
Arsenic	1.8E-05	6.8E-03	6.9E-03
Beryllium	*2.3E-07*	*2.3E-06*	*2.5E-06*
Cadmium	*2.3E-07*	*2.3E-06*	*2.5E-06*
Chromium	*2.3E-07*	*2.3E-06*	*2.5E-06*
Cobalt	*2.3E-07*	*2.3E-06*	*2.5E-06*
Manganese	*9.3E-07*	*9.1E-06*	*1.0E-05*
Mercury	6.6E-04	0.0E+00	6.6E-04
Nickel	*9.3E-07*	*9.1E-06*	*1.0E-05*
Selenium	*2.3E-07*	*2.3E-06*	*2.5E-06*
Boron	2.1E-03	2.1E-02	2.3E-02
Ammonia	9.5E+01	0.0E+00	9.5E+01
Volatile Organic Compounds	3.6E+01	0.0E+00	3.6E+01
Particulate Matter	1.2E+00	7.9E+00	9.1E+00
Radon	1.5E-09	0.0E+00	1.5E-09
Copper	*3.0E-07*	*3.0E-06*	*3.3E-06*
Zinc	1.1E-05	1.1E-04	1.2E-04
Asbestos	*4.6E-06*	*4.6E-05*	*5.0E-05*
Benzene	4.7E-01	0.0E+00	4.7E-01
Toluene	8.2E-01	0.0E+00	8.2E-01
1,3 & 1,4 - Xylene	1.3E-01	0.0E+00	1.3E-01
1,2 - Xylene	4.7E-02	0.0E+00	4.7E-02
Hydrochloric acid	*4.6E-08*	*4.6E-07*	*5.0E-07*
Sulfate	4.1E+00	5.0E-02	4.1E+00

Table 2. Estimated Emissions During Dual-Turbine Upset, Turbine Bypass Unavailable

Substance	Vent Silencer	
	lbs/day	lbs/hr
Hydrogen Sulfide	3.7E+01	1.6E+00
Lead	*9.3E-05*	*3.9E-06*
Antimony	8.6E-04	3.6E-05
Arsenic	2.8E-02	1.2E-03
Beryllium	*9.3E-06*	*3.9E-07*
Cadmium	*9.3E-06*	*3.9E-07*
Chromium	*9.3E-06*	*3.9E-07*
Cobalt	*9.3E-06*	*3.9E-07*
Manganese	*3.7E-05*	*1.6E-06*
Mercury	2.1E-01	8.7E-03
Nickel	*3.7E-05*	*1.6E-06*
Selenium	*9.3E-06*	*3.9E-07*
Boron	8.6E-02	3.6E-03
Ammonia	1.2E+02	5.0E+00
Volatile Organic Compounds	4.4E+01	1.9E+00
Particulate Matter	4.4E+01	1.8E+00
Radon	1.5E-09	6.1E-11
Copper	*1.2E-05*	*5.1E-07*
Zinc	4.5E-04	1.9E-05
Asbestos	*1.9E-04*	*7.8E-06*
Benzene	4.7E-01	1.9E-02
Toluene	8.2E-01	3.4E-02
1,3 & 1,4 - Xylene	1.3E-01	5.3E-03
1,2 - Xylene	4.7E-02	2.0E-03
Hydrochloric acid	*1.9E-06*	*7.8E-08*
Sulfate	2.0E-01	8.5E-03

Table 3. Estimated Annual Average Emissions from Power Plant Cooling Tower and Vent Silencer

Substance	Cooling Tower lbs/yr	Vent Silencer lbs/yr
Hydrogen Sulfide	7.2E+03	7.0E+03
Lead	*8.4E-04*	*8.5E-03*
Antimony	7.7E-03	7.8E-02
Arsenic	6.6E-03	2.5E+00
Beryllium	*8.4E-05*	*8.5E-04*
Cadmium	*8.4E-05*	*8.5E-04*
Chromium	*8.4E-05*	*8.5E-04*
Cobalt	*8.4E-05*	*8.5E-04*
Manganese	*3.3E-04*	*3.4E-03*
Mercury	2.4E-01	6.0E-01
Nickel	*3.3E-04*	*3.4E-03*
Selenium	*8.4E-05*	*8.5E-04*
Boron	7.7E-01	7.8E+00
Ammonia	3.4E+04	3.4E+02
Volatile Organic Compounds	1.3E+04	1.3E+02
Particulate Matter	4.3E+02	3.0E+03
Radon	5.3E-07	4.2E-09
Copper	*1.1E-04*	*1.1E-03*
Zinc	4.0E-03	4.1E-02
Asbestos	*1.7E-03*	*1.7E-02*
Benzene	1.7E+02	1.3E+00
Toluene	3.0E+02	2.3E+00
1,3 & 1,4 - Xylene	4.6E+01	3.7E-01
1,2 - Xylene	1.7E+01	1.4E-01
Hydrochloric acid	*1.7E-05*	*1.7E-04*
Sulfate	1.5E+03	1.8E+01

Table 4. Estimated Emissions for Venting Well w/Portable Silencer

Substance	Portable Silencer (ea)	
	lbs/day	lbs/hr
Hydrogen Sulfide	1.9E+01	8.0E-01
Lead	*5.2E-05*	*2.2E-06*
Antimony	4.8E-04	2.0E-05
Arsenic	1.6E-02	6.5E-04
Beryllium	*5.2E-06*	*2.2E-07*
Cadmium	*5.2E-06*	*2.2E-07*
Chromium	*5.2E-06*	*2.2E-07*
Cobalt	*5.2E-06*	*2.2E-07*
Manganese	*2.1E-05*	*8.7E-07*
Mercury	2.0E-02	8.5E-04
Nickel	*2.1E-05*	*8.7E-07*
Selenium	*5.2E-06*	*2.2E-07*
Boron	4.8E-02	2.0E-03
Ammonia	2.9E+00	1.2E-01
Volatile Organic Compounds	2.1E+00	8.8E-02
Particulate Matter	8.1E+00	3.4E-01
Radon	1.5E-10	6.3E-12
Copper	*6.7E-06*	*2.8E-07*
Zinc	2.5E-04	1.0E-05
Asbestos	*1.0E-04*	*4.3E-06*
Benzene	1.1E-02	4.5E-04
Toluene	8.1E-02	3.4E-03
1,3 & 1,4 - Xylene	6.5E-03	2.7E-04
1,2 - Xylene	2.4E-03	9.9E-05
Hydrochloric acid	*1.0E-06*	*4.3E-08*
Sulfate	1.1E-01	4.7E-03

Table 5. Estimated Annual Emissions from Well Venting and Flow Testing

Substance	First Year (lbs/yr)	Second Year (lbs/yr)	Third Year (lbs/yr)	After Plant Startup (lbs/yr)
Hydrogen Sulfide	5.4E+02	1.1E+03	2.4E+03	1.2E+02
Lead	*1.5E-03*	*2.9E-03*	*6.5E-03*	*3.1E-04*
Antimony	1.3E-02	2.7E-02	6.0E-02	2.9E-03
Arsenic	4.4E-01	8.7E-01	2.0E+00	9.3E-02
Beryllium	*1.5E-04*	*2.9E-04*	*6.5E-04*	*3.1E-05*
Cadmium	*1.5E-04*	*2.9E-04*	*6.5E-04*	*3.1E-05*
Chromium	*1.5E-04*	*2.9E-04*	*6.5E-04*	*3.1E-05*
Cobalt	*1.5E-04*	*2.9E-04*	*6.5E-04*	*3.1E-05*
Manganese	*5.8E-04*	*1.2E-03*	*2.6E-03*	*1.2E-04*
Mercury	5.7E-01	1.1E+00	2.6E+00	1.2E-01
Nickel	*5.8E-04*	*1.2E-03*	*2.6E-03*	*1.2E-04*
Selenium	*1.5E-04*	*2.9E-04*	*6.5E-04*	*3.1E-05*
Boron	1.3E+00	2.7E+00	6.0E+00	2.9E-01
Ammonia	8.0E+01	1.6E+02	3.6E+02	1.7E+01
Volatile Organic Compounds	5.9E+01	1.2E+02	2.7E+02	1.3E+01
Particulate Matter	2.3E+02	4.5E+02	1.0E+03	4.9E+01
Radon	4.3E-09	8.5E-09	1.9E-08	9.1E-10
Copper	*1.9E-04*	*3.8E-04*	*8.5E-04*	*4.0E-05*
Zinc	7.0E-03	1.4E-02	3.1E-02	1.5E-03
Asbestos	*2.9E-03*	*5.8E-03*	*1.3E-02*	*6.2E-04*
Benzene	3.0E-01	6.1E-01	1.4E+00	6.5E-02
Toluene	2.3E+00	4.5E+00	1.0E+01	4.8E-01
1,3 & 1,4 - Xylene	1.8E-01	3.6E-01	8.1E-01	3.9E-02
1,2 - Xylene	6.7E-02	1.3E-01	3.0E-01	1.4E-02
Hydrochloric acid	*2.9E-05*	*5.8E-05*	*1.3E-04*	*6.2E-06*
Sulfate	3.1E+00	6.3E+00	1.4E+01	6.7E-01

Power Plant Operation

Calpine staff estimated emissions from the power plant of substances present in the geothermal fluids during normal plant operations and during upset conditions. These estimates were based on the expected composition of the geothermal fluids, the physics of the fluid separation in the flash tanks, the performance of the proposed plant silencers, condenser, cooling tower, and hydrogen sulfide abatement system. Emission rates were estimated for the identified emission points (the plant vent silencer and the cooling tower) for normal operating conditions, and under a dual-turbine outage upset condition that would result in 100% of the produced steam flow being directed to the plant vent silencer. Only upset scenarios including venting of the full steam flow through the plant silencers were used in the analyses of maximum potential air quality impacts. Upsets that resulted in shutdown of only one turbine, or in which Calpine reduced flow from the well field, would have lesser emissions than the full-flow case.

Summary of Estimated Emissions

Tables 6 through 11 present the estimated maximum daily emissions of criteria pollutants (those for which a California or federal ambient air quality standard exists) for each year of construction and development of the well field and power plant, and for plant operation after startup under various scenarios. (Different scenarios are used for the various pollutants, because different situations would lead to maximum emissions for different pollutants. For instance, emissions of combustion products after plant startup would be maximized when the plant backup diesel generator is in operation during a plant upset and a drill rig is drilling an infill well. Hydrogen sulfide emissions would be maximized in the unlikely event that a plant upset coincided with venting two wells.) Note that the normal operation scenario is not listed in Tables 6, 7, and 8 because no combustion products (other than minor emissions from worker vehicles) would be emitted from the normally operating facility.

Tables 12 through 17 present the estimated annual emissions of criteria pollutants for each year of development and construction, as well as after plant startup.

Table 6. Estimated Maximum Daily Nitrogen Oxides Emissions

Source	Maximum Daily NO_x Emissions (lb/day)					
	Development and Construction			After Plant Startup		
	Year 1	Year 2	Year 3	Dual Turbine Outage Upset	Drilling Infill Well	Upset + Drilling Well
Rig Engines	530	530	1,591	0	530	530
Plant Backup Generator	0	234	234	234	0	234
	530	**764**	**1,825**	**234**	**530**	**764**

Table 7. Estimated Maximum Daily Sulfur Oxides Emissions

Source	Maximum Daily Sulfur Oxides Emissions (lb/day)					
	Development and Construction			After Plant Startup		
	Year 1	Year 2	Year 3	Dual Turbine Outage Upset	Drilling Infill Well	Upset + Drilling Well
Rig Engines	17	17	50	0	17	17
Plant Backup Generator	0	7	7	7	0	7
	17	**24**	**57**	**7**	**17**	**24**

Table 8. Estimated Maximum Daily Carbon Monoxide Emissions

Source	Maximum Daily Carbon Monoxide Emissions (lb/day)					
	Development and Construction			After Plant Startup		
	Year 1	Year 2	Year 3	Dual Turbine Outage Upset	Drilling Infill Well	Upset + Drilling Well
Rig Engines	224	224	673	0	224	224
Plant Backup Generator	0	99	99	99	0	99
	224	**323**	**772**	**99**	**224**	**323**

Table 9. Estimated Maximum Daily PM_{10} Emissions

Source	Maximum Daily PM_{10} Emissions (lb/day)							
	Development and Construction			After Plant Startup				
	Year 1	Year 2	Year 3	Normal Operation	Normal Operation + Drill Rig	Normal Operation + 2 Wells Venting	Dual Turbine Outage Upset	Upset + 2 Wells Venting
Fugitive Dust								
Traffic	26	35	107	18	18	18	18	18
Earthwork	51	41	0	0	0	0	0	0
Rig Engines	29	29	86	0	29	0	0	0
Plant Backup Generator	0	13	13	0	0	0	13	13
Cooling Tower	0	0	0	1	1	1	0	0
Plant Vent Site	0	0	0	8	8	8	44	44
Wellhead Venting and Flow Testing	8	16	16	0	0	16	0	16
	114	**133**	**222**	**27**	**56**	**43**	**75**	**91**

Table 10. Estimated Maximum Daily Hydrogen Sulfide Emissions

Source	Maximum Daily Hydrogen Sulfide Emissions (lb/day)						
	Development and Construction			After Plant Startup			
	Year 1	Year 2	Year 3	Normal Operation	Dual Turbine Outage Upset	Upset + Venting One Well	Upset + Venting Two Wells
Plant Silencer	0	0	0	19	37	37	37
Cooling Tower	0	0	0	20	0	0	0
Venting Wells	19	38	38	0	0	19	38
	19	**38**	**38**	**39**	**37**	**56**	**76**

Table 11. Estimated Maximum Daily Lead Emissions

Source	Maximum Daily Lead Emissions (lb/day)						
	Development and Construction			After Plant Startup			
	Year 1	Year 2	Year 3	Normal Operation	Dual Turbine Outage Upset	Upset + Venting One Well	Upset + Venting Two Wells
Plant Silencer	*0*	*0*	*0*	*0.000023*	*0.000093*	*0.000093*	*0.000093*
Cooling Tower	*0*	*0*	*0*	*0.000002*	*0*	*0*	*0*
Venting Wells	*0.000052*	*0.000104*	*0.000104*	*0.000000*	*0.000000*	*0.000052*	*0.000104*
	0.000052	***0.000104***	***0.000104***	***0.000025***	***0.000093***	***0.000145***	***0.000197***

Table 12. Estimated Annual Nitrogen Oxides Emissions

Source	Annual Nitrogen Oxides Emissions (lb/yr)			
	Year 1	Year 2	Year 3	After Plant Startup
Rig Engines	25,990	51,979	155,938	12,995
Plant Backup Generator	0	5,265	42,705	947
	25,990	**57,244**	**198,643**	**13,942**

Table 13. Estimated Annual Sulfur Oxides Emissions

Source	Annual Sulfur Oxides Emissions (lb/yr)			
	Year 1	Year 2	Year 3	After Plant Startup
Rig Engines	809	1,617	4,852	404
Plant Backup Generator	0	164	1,329	29
	809	**1,781**	**6,181**	**434**

Table 14. Estimated Annual Carbon Monoxide Emissions

Source	Annual Carbon Monoxide Emissions (lb/yr)			
	Year 1	Year 2	Year 3	After Plant Startup
Rig Engines	10,996	21,991	65,974	5,498
Plant Backup Generator	0	2,228	18,068	401
	10,996	**24,219**	**84,041**	**5,899**

Table 15. Estimated Total Annual PM_{10} Emissions

Source	Annual PM_{10} Emissions (lb/yr)			
	Year 1	Year 2	Year 3	After Plant Startup
Fugitive Dust				
Traffic	5,632	6,101	19,032	4,876
Earthwork	5,080	1,741	0	0
Rig Engines	1,399	2,799	8,397	700
Plant Backup Generator	0	284	2,300	51
Cooling Tower	0	0	0	426
Plant Vent Site	0	0	0	2,984
Wellhead Venting & Flow Testing	227	454	1,021	49
	12,338	**11,378**	**30,749**	**9,086**

Table 16. Estimated Annual Hydrogen Sulfide Emissions

Source	Annual Hydrogen Sulfide Emissions (lb/yr)			
	Year 1	Year 2	Year 3	After Plant Startup
Plant Silencer	0	0	0	7,037
Cooling Tower	0	0	0	7,235
Venting Wells	538	1,075	2,419	115
	538	**1,075**	**2,419**	**14,388**

Table 17. Estimated Annual Lead Emissions

Source	Annual Lead Emissions (lb/yr)			
	Year 1	Year 2	Year 3	After Plant Startup
Plant Silencer	*0*	*0*	*0*	*0.008*
Cooling Tower	*0*	*0*	*0*	*0.001*
Venting Wells	*0.001*	*0.003*	*0.007*	*0.000*
	0.001	***0.003***	***0.007***	***0.010***

2.2 Dispersion Modeling

Dispersion models are objective computational tools for estimating ambient airborne concentrations of substances emitted into the atmosphere. Many dispersion models are available for various applications. The dispersion analyses presented here were completed using a model recommended by the USEPA for this type of application: USEPA's Industrial Source Complex - Short Term (ISCST3) model.[9,10,11]

ISCST3 is considered a refined dispersion model for receptors in simple terrain (elevations at or below the source elevation), which means it considers the actual configuration of the sources, receptors and site-specific meteorology in preparing concentration estimates.

The proposed project is located in a region of terrain that is considered "complex" for the purpose of dispersion modeling. (This means that some areas are above the expected level of the pollutant plumes under some conditions.) Prior to the development of ISCST3, it was necessary to use both simple terrain and complex terrain models to estimate ambient concentrations in regions of complex terrain. The current version of the model incorporates the COMPLEX I complex terrain algorithms so that it may be used to estimate concentrations for all receptors. The COMPLEX I algorithm is considered a screening method for assessing the impacts of a source on receptor locations that are above the source elevation. It uses conservative, simplifying assumptions regarding plume behavior and interaction with terrain. The use of these simplifying assumptions reduces input data requirements and thus makes the screening algorithm much simpler to use than refined complex terrain models. Screening models are often used for sources that have very low emissions of the substance in question. If the concentrations estimated by a screening model indicate that they will have no significant impacts, there is no need to go to the additional effort and expense of a refined dispersion model.

ISCST3 was used to estimate the annual average and short-term maximum concentrations of criteria pollutants emitted from the facility so that they could be compared to the appropriate California and federal air quality standards and to assess their potential to produce adverse health effects.

The following types of data were needed for input to ISCST3:

- the location, ground surface elevation, and height above grade of each emission point;
- the type of source (point source, area source, or volume source);
- the physical characteristics of the release (dimensions of the source, flow rate, temperature, *etc.*);

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[9]U.S. Environmental Protection Agency, 1986. *Guideline on Air Quality Models (Revised).* with Supplements A (1987) and B (1993). EPA-450/2-78-027R. pp. 4-9 - 5-5.

[10]U.S. Environmental Protection Agency, 1995. *User's Guide for the Industrial Source Complex (ISC3) Dispersion Models. Volume I - User Instructions.* Office of Air Quality Planning and Standards. EPA-454/B-95-003a.

[11]U.S. Environmental Protection Agency, 1995 and 1996. *Model Change Bulletin #1* and *Model Change Bulletin #2 for the Industrial Source Complex Dispersion Model (ISC3).* Office of Air Quality Planning and Standards, Support Center for Regulatory Air Models.

- the projected height and crosswind width (for each of 36 wind directions) of any structures or buildings (or combinations thereof) in the vicinity of each point source that may affect dispersion from that source;
- the emission rate from each source of the substance for which estimated concentrations are sought;
- locations, ground surface elevations, and height above grade of each model receptor (point at which airborne concentrations are to be estimated);
- meteorological data for each meteorological condition of interest that may result in different concentrations at each receptor; and
- the averaging period over which concentrations are to be calculated.

Locations of emissions sources were obtained from hard copy and AutoCad maps of the proposed facility prepared by Calpine. Also used were U.S. Geologic Survey (USGS) 7½-minute series topographic maps, 1:100,000 scale topographic maps, and USGS Digital Line Graph (DLG) 1:100,000-scale files. Surface elevations for source and receptor locations were obtained from USGS three-arcsecond Digital Elevation Model files of the project area. Heights above grade of elevated emission sources were obtained from data supplied by Calpine. Fugitive dust sources (roadways, well pads, and the power plant site) were represented by one or more rectangular area sources. Point sources (portable well silencers, the plant vent silencer, and each cell of the cooling tower) were represented in the model as individual point sources, and the appropriate release characteristics (temperature, flow rate, height and diameter) were provided by Calpine. The location of each source was input to the model in Universal Transverse Mercator (UTM) coordinates.

Emission rates used in the models were those estimated as described in the preceding subsection. Annual average emission rates were used in model runs to estimate annual average concentrations, while hourly emission rates were used to estimate the maximum short-term concentrations. Fugitive dust emissions were specified to occur during the work hours of 7:00 AM to 12:00 noon and 1:00 PM to 6:00 PM. Emissions from all other sources were specified to occur at all hours of the day.

The wind direction-dependent building heights and widths for each point source that could be affected by nearby structures were calculated using the USEPA's Building Profile Input Program (BPIP), used as directed in the User's Guide.[12,13] For the drill rigs, the typical height and width of the solid structures at the drill site (generator and pump enclosures, and storage tanks) were used to create the building height/width data for the rig generator exhaust sources.

As described in Section 3.13 of the DEIS/DEIR, meteorological data were collected by T&B Systems at the power plant site during the period November 1994 through November 1995. These data included hourly average wind speed, wind direction, temperature and standard deviation of wind direction (a measure of atmospheric stability). The hourly data, along with monthly average

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[12]U.S. Environmental Protection Agency, 1995. *User's Guide to the Building Profile Input Program.* Office of Air Quality Planning and Standards.

[13]U.S. Environmental Protection Agency, 1985. *Guideline for the Determination of Good Engineering Practice Stack Height (Technical Support Document for the Stack Height Regulations.* EPA-450/4-80-023R

mixing height data from Holzworth[14] were processed using the USEPA's Meteorological Preprocessor for Regulatory Models (MPRM). MPRM converted the data into the format required by ISCST3, and calculated hourly values of the needed data from the raw values recorded at the proposed plant site and the monthly mixing height data.

Receptor locations were selected by MHA staff, based on review of activity patterns in the project area and the population distribution in the surrounding areas. Twenty-two receptor locations were input to the dispersion model. These locations are presented in Figure 2 and 3. Table 18 describes the receptor locations, and presents the elevation of each.

Numerous model runs were required for each criteria pollutant, because maximum hourly and annual average emission rates varied between years of construction and after plant startup. Also, in the case of emissions associated with drilling and venting wells, there were a large number of potential combinations of concurrent activities that could combine to create maximum ambient concentrations. For instance, during the third year of construction when Calpine may use as many as three drill rigs, rigs could be operating on any three of the eight well pads at any given time, while flow testing is performed at any two of the five production well pads. No attempt was made to model each and every possible scenario; rather, situations likely to produce maximum impacts at any receptor were identified and included in the modeled scenarios.

For the purpose of estimating maximum and annual sulfur dioxide (SO_2) concentrations, it was assumed that all sulfur oxides (SO_x) emissions would be in the form of, or instantaneously converted to, SO_2.

Most combustion sources emit NO_x primarily or exclusively in the form of nitric oxide (NO). However, nitrogen dioxide (NO_2) is the nitrogen oxide for which California and federal ambient air quality standards have been set. Oxidation of NO to NO_2 in the atmosphere is controlled primarily by the presence of oxidants (most notably ozone, O_3). The USEPA recommends the method of Cole and Summerhays (the ozone-limiting method) for estimating ambient NO_2 concentrations based on modeled NO_x concentrations.[15,16] This method was used to estimate the maximum one-hour average NO_2 concentrations presented here. The maximum one-hour average O_3 concentration measured during a five-year period at Mt. Lassen (92 parts per billion) was used in these calculations, although it is unlikely that maximum NO_x and O_3 concentrations would occur concurrently. To the extent that actual ozone concentrations at the time of maximum NO_x concentrations would be less than the maximum concentration used in these calculations, the estimated maximum NO_2 concentrations have been overstated.

For the analysis of fugitive dust impacts associated with construction of the transmission line, a worst-case scenario of work area and access roadway positioning along the right of way was

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[14]Holzworth, George C., 1964. "Estimates of mean maximum mixing depths in the contiguous United States." *Monthly Weather Review* 92:5, pp. 235-242.

[15]U.S. Environmental Protection Agency, 1986. *Guideline on Air Quality Models (Revised).* with Supplements A (1987) and B (1993). EPA-450/2-78-027R. pp. 6-5.

[16]Cole, H.S., and J.E. Summerhays. "A review of techniques available for estimating short-term NO_2 concentrations." *J. Air Pollution Control Assoc.* 29:8, pp. 812-817.

Figure 2. Receptor Locations Used in Dispersion Modeling

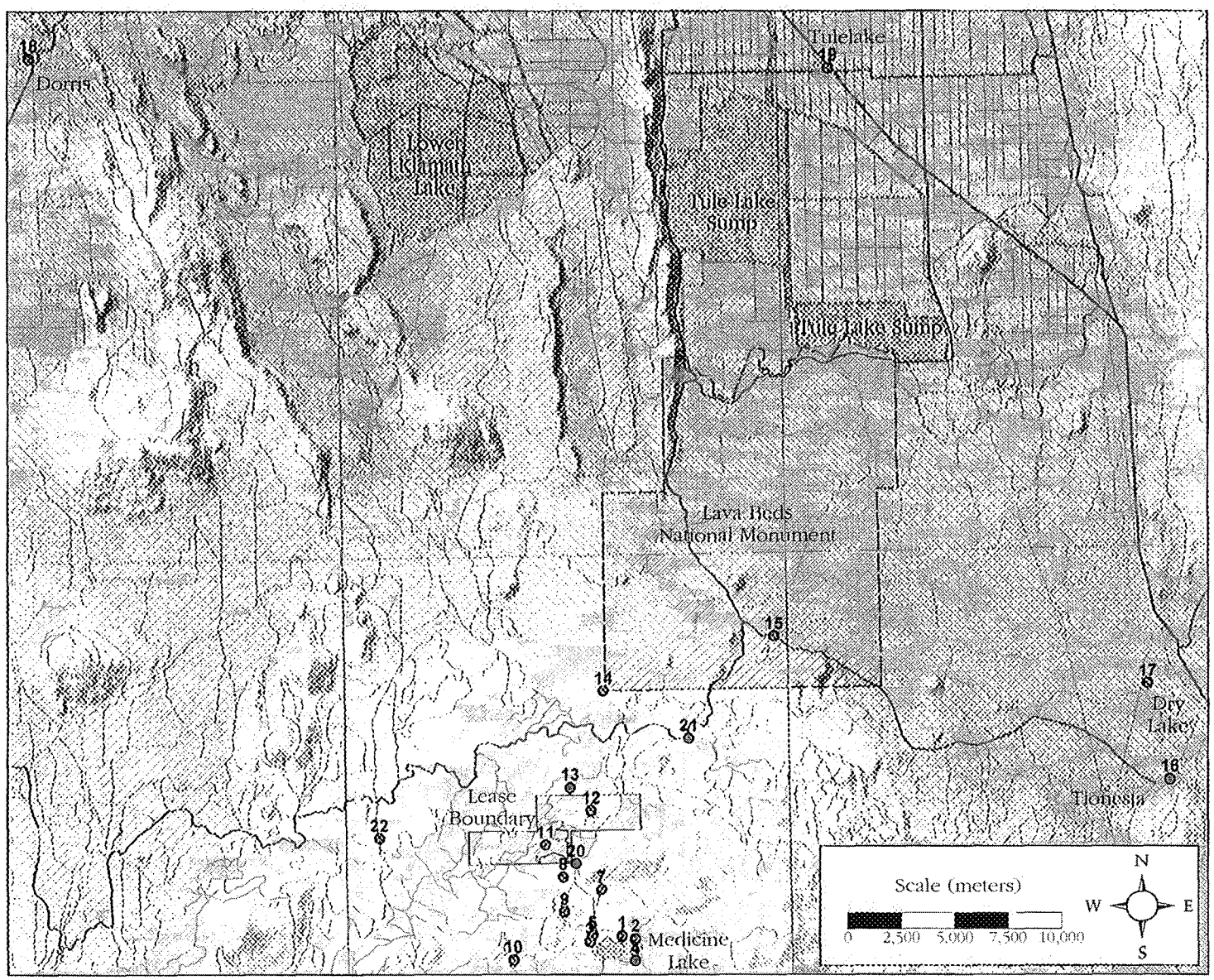

Figure 3. Locations of Model Receptors Near the Project Site

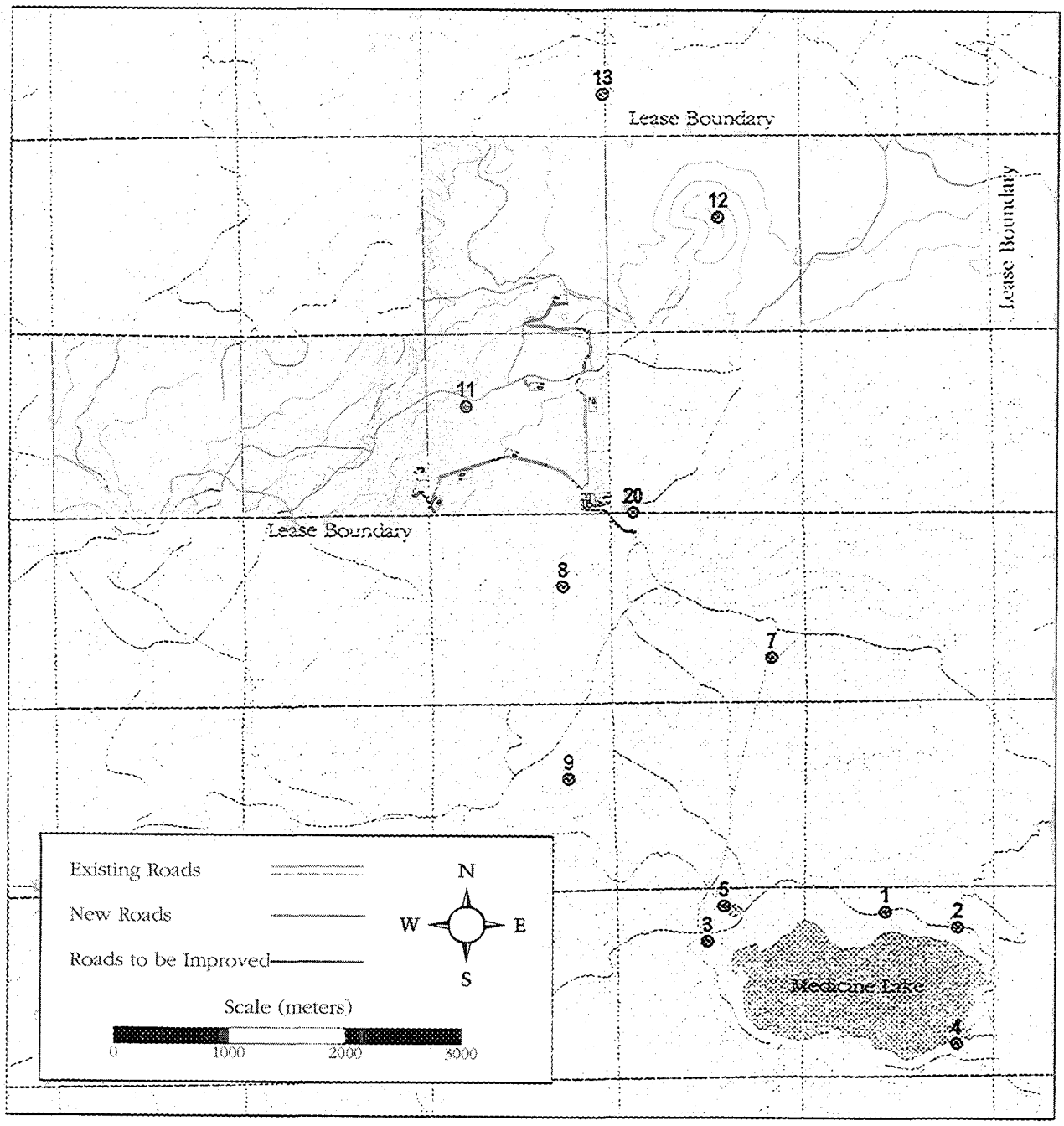

Table 18. Receptor Locations and Elevations Used in Dispersion Modeling

Receptor Number and Location	UTM Coordinates		Elevation	
	Easting (meters)	Northing (meters)	(feet)	(meters)
1 Medicine Lake Campground	617,048	4,604,775	6,685	2,038
2 Medicine Lake Campground	617,672	4,604,643	6,726	2,050
3 Medicine Lake Cmpgnd HQ	615,540	4,604,516	6,716	2,047
4 Medicine Lake Cabins	617,667	4,603,645	6,700	2,042
5 Little Medicine Lake	615,679	4,604,817	6,720	2,049
6 Medicine Mountain	616,806	4,602,207	7,480	2,280
7 Medicine Lake Glass Flow	616,085	4,606,954	6,860	2,091
8 Grouse Hill	614,284	4,607,556	7,150	2,180
9 Badger Peak	614,346	4,605,903	7,354	2,242
10 Little Mt. Hoffman	611,946	4,603,677	7,310	2,228
11 Goshawk Nest	613,439	4,609,098	6,600	2,012
12 Fourmile Hill	615,601	4,610,729	7,076	2,157
13 Lookout Butte	614,608	4,611,779	7,310	2,228
14 SW Crnr Lava Beds NM	616,155	4,616,281	5,660	1,725
15 Lava Beds Vis Ctr	624,155	4,618,946	4,766	1,453
16 Tionesta	642,693	4,612,175	4,195	1,279
17 Dry Lake	641,648	4,616,661	4,150	1,265
18 Dorris	589,234	4,646,114	4,240	1,293
19 Tulelake	626,707	4,645,705	4,033	1,229
20 FS 49 near plant site	614,890	4,608,195	6,940	2,116
21 Door Knob Snowmobile Park	620,171	4,614,073	5,600	1,717
22 Fourcorners-Medicine Lake Snowmobile Park	605,658	4,609,390	5,300	1,616

developed for the first and second year of construction. Then, the maximum 24-hour average PM_{10} was estimated using the ISCST3 model and with the transmission line right of way at all possible directional orientations. Model receptors were placed along the right of way at distances of 20, 50, 100, 200, 500, 1,000, 5,000 and 10,000 meters from the centerline, on both sides. For each receptor, the maximum estimated 24-hour average concentration for *any* right of way orientation was selected.

This section presents the results of the dispersion modeling discussed in Section 2, and compares the results of appropriate criteria of significance in order to assess the significance of the estimated impacts.

3.1 Significance Criteria

The CEQA Guidelines[17] provide criteria for determination of impacts that are to be considered significant. Of relevance to air quality impacts, Appendix G of that document states that "a project will normally have a significant effect on the environment if it will:...(b) Have a substantial, demonstrable negative aesthetic effect;...(v) Create a potential public health hazard or...(x) Violate any ambient air quality standard, contribute substantially to an existing or projected air quality violation, or expose sensitive receptors to substantial pollutant concentrations." CEQA and the *Guidelines* do not define the terms "sensitive receptors" and "substantial pollutant concentrations." Current health risk assessment guidance used widely in California (the *CAPCOA Risk Assessment Guidelines*[18]) defines sensitive receptors as "individuals who may be more sensitive to toxic exposures than the general population." For risk assessment purposes, locations such as hospitals, day care centers and schools are often identified as sensitive receptors locations.

In compliance with this guidance, air quality impacts are identified as significant in this section if : 1) the estimated concentration of a criteria pollutant at any receptor exceeds its California or federal ambient air quality standard for the appropriate averaging time (*i.e.*, estimated maximum 24-hour average concentrations were compared to 24-hour average standards for that pollutant), 2) the estimated concentration, added to measured or reasonably expected background concentrations in the area, exceeds a relevant California or federal ambient air quality standard, 3) the maximum one-hour average concentration of a non-criteria pollutant exceeds an acute Reference Exposure Level (REL) published for it in the *CAPCOA Risk Assessment Guidelines*, 4) the estimated annual average concentration of a non-criteria pollutant exceeds a chronic Reference Exposure Level published for it in the *CAPCOA* guidelines, 5) the estimated maximum one-hour average or annual average concentration of a non-criteria pollutant approaches the corresponding Reference Exposure Level at a receptor location at which sensitive receptors are likely to be located.

Fugitive dust generation is a consequence of nearly every construction project involving earthwork of any kind. It is also a consequence of vehicle travel on paved and unpaved roadways, and of wind erosion of bare soil in many parts of the state and country. Some portion of fugitive dust comprises particles smaller than 10 micrometers (μm) and therefore adds to atmospheric PM_{10}

[17]State of California, 1995. *CEQA: The Environmental Quality Act, Law and Guidelines.* Office of Planning and Research.

[18]California Air Pollution Control Officers Association (CAPCOA), 1993. *Air Toxics "Hot Spots" Program Revised 1992 Risk Assessment Guidelines.* p. III-18.

levels. In most air pollution control districts (particularly in non-urban areas), fugitive dust created during construction is not considered in the air quality permitting process, and is treated as a temporary nuisance. However, the California and federal ambient PM_{10} standards do not draw any formal distinctions regarding the source(s) of PM_{10}, nor does CEQA. An exceedance caused by fugitive dust from a nearby source is still considered an exceedance, and projected exceedance of the California or federal PM_{10} standard by a proposed project is considered a significant impact.

The California and federal ambient air quality standards apply in "ambient airspace", which is generally taken to mean any place to which the public has access, regardless of ownership, or the likely duration of stay. Thus, a projected exceedance of any relevant standard at any location (even a remote area) is considered a significant environmental effect under CEQA.

This section presents the results of the air quality impact analysis - the estimated ambient pollutant concentrations. These concentrations are expressed in micrograms per cubic meter ($\mu g/m^3$) *at* the receptor elevations (about 1,200 to 2,100 meters, or about 4,000 to 7,500 feet, above sea level). At these elevations, the atmosphere is about 10% to 25% less dense than at sea level. Thus, if these concentrations were converted to micrograms per *standard* cubic meter, they would be about 12% to 30% higher, depending on the temperature and elevation of the receptor. Such conversions are generally not made for the purpose of comparison to federal ambient air quality standards[19], but should be made for the comparison to California standards for gaseous pollutants (although this is rarely done). The estimated concentrations presented in this section are not converted to standard concentrations (equivalent concentrations at sea level pressure and 25°C). However, where this conversion would cause a reported value to exceed a California standard, it is noted in the text.

3.2 Estimated Impacts

Particulate Matter (PM_{10})

Table 19 presents the results of the analysis of potential impacts of development, construction and operation of the power plant and well field on 24-hour average ambient PM_{10} concentrations. The estimated maximum impact of the project on these short-term average concentrations is about 21 $\mu g/m^3$ during plant construction, and 17 $\mu g/m^3$ during a worst-case scenario after plant startup. Under all scenarios, the highest concentrations are estimated for receptor 20, located on Forest Service Road 49 near the plant site. Under normal plant operating conditions, the maximum estimated 24-hour average PM_{10} concentration is just over 1 $\mu g/m^3$. These maximum estimated impacts, when added to typical background PM_{10} concentrations in the project area, are below the federal and California 24-hour average ambient PM_{10} standards. Thus, none of the modeled impacts of the project are sufficient to cause or contribute to an exceedance of the California or federal 24-hour PM_{10} standards.

[19]Rhoads, R.G. (Director, U.S. Environmental Protection Agency Office of Air Quality Planning and Standards Monitoring and Analysis Division), 1984. "Correcting atmospheric dispersion models to standard temperature and pressure." memorandum to R.L. Duprey, Director, U.S. Environmental Protection Agency, Region VIII Air and Waste Management Division.

Table 19. Estimated Maximum 24-Hour Average PM_{10} Impacts, $\mu g/m^3$

Receptor Number and Location	Construction and Development			After Plant Startup			
	Year 1	Year 2	Year 3	Normal Operation	Dual Turbine Outage Upset	Normal Operation While Drilling One Well	Worst Case Impact After Plant Startup*
1 Medicine Lake Campground	0.8	0.3	1.3	0.1	0.2	1.0	1.1
2 Medicine Lake Campground	0.9	0.4	1.1	0.1	0.2	0.6	0.7
3 Medicine Lake Cmpgnd HQ	0.5	0.5	1.7	0.04	0.1	0.8	0.9
4 Medicine Lake Cabins	0.6	0.2	1.1	0.1	0.1	0.6	0.6
5 Little Medicine Lake	0.6	0.7	1.7	0.1	0.2	0.8	1.1
6 Medicine Mountain	0.3	0.1	0.8	0.1	0.3	0.6	0.7
7 Medicine Lake Glass Flow	3.1	1.2	2.9	0.2	0.5	1.9	2.1
8 Grouse Hill	5.1	2.1	8.7	1.2	4.2	6.5	7.6
9 Badger Peak	1.0	0.6	2.7	0.3	1.4	2.2	2.6
10 Little Mt. Hoffman	0.4	0.2	0.6	0.1	0.4	0.6	0.6
11 Goshawk Nest	9.9	2.6	6.2	0.5	0.6	5.7	5.9
12 Fourmile Hill	1.7	0.5	2.2	0.4	1.4	2.2	2.5
13 Lookout Butte	1.6	0.5	1.8	0.2	0.8	1.4	1.6
14 SW Crnr Lava Beds NM	0.4	0.02	0.3	0.1	0.1	0.2	0.2
15 Lava Beds Vis Ctr	0.2	0.02	0.2	0.01	0.04	0.09	0.1
16 Tionesta	0.03	0.0001	0.04	0.01	0.02	0.03	0.04
17 Dry Lake	0.05	0.0004	0.07	0.01	0.02	0.04	0.04
18 Dorris	0.04	0.01	0.07	0.01	0.03	0.05	0.06
19 Tulelake	0.02	0.002	0.08	0.01	0.02	0.03	0.03
20 FS Road 49 near plant site	20.5	11.4	18.0	1.2	3.7	16.4	16.9
21 Door Knob Snowmobile Park	0.4	0.0	0.4	0.0	0.1	0.2	0.2
22 Fourcorners-Medicine Lake Snowmobile Park	0.6	0.1	0.4	0.02	0.05	0.2	0.2

* For all receptors, estimated worst-case impact after plant startup is during a dual-turbine upset while drilling an infill well and venting two wells.

The results of the annual average PM_{10} impact analysis for the development, construction and operation of the well field and power plant are presented in Table 20. None of the modeled impacts of the project are sufficient to cause or contribute to the exceedance of the California or federal annual PM_{10} standards.[20]

Because the maximum short-term and annual average PM_{10} emissions associated with development, construction and operation of the well field and power plant are not expected to cause or contribute to an exceedance of the California or federal PM_{10} standards, the impact of these emissions is not considered to be significant.

The results of the analysis of potential impacts of transmission line construction on ambient PM_{10} concentrations are presented in Table 21. As discussed in Section 2.2 of this appendix, these impacts were analyzed for a worst-case construction scenario on a segment of the transmission line corridor in any orientation. The results are presented as maximum 24-hour concentrations associated with the transmission lines construction during the first year (right-of-way clearing) and the second year (construction) for various distances from the right-of-way centerline. These estimated concentrations represent the maximum impact of these activities on 24-hour average PM_{10} concentrations at these distances under the combination of the worst-case scenario of activities and the meteorological scenario producing the highest estimated concentration for any receptor at the stated distance from the right-of-way. Under more favorable meteorological conditions, and to the extent that construction activities are not carried out in close proximity to one another, the actual impacts would be expected to be lower.

The analysis indicates that, like most construction projects involving land clearing and travel over unpaved surfaces, fugitive dust emissions associated with the construction of the transmission line could cause exceedances of the California and federal 24-hour PM_{10} standards at locations close to the construction activities on some days. Exceedances of this standard could occur within approximately 300 feet of the right-or-way center line. The modeling of worst-case conditions predicts that the Medicine Lake campgrounds would not be expected to experience short-term exceedances of the PM_{10} standard as a result of transmission line construction activities, as the closest campsites would be at least 400 feet away from the edge of the transmission line right-of-way. The closest residences in the Tionesta area are approximately 1,500 feet from the transmission line right-of-way, thus transmission line construction activities are not expected to produce exceedances of the state 24-hour PM_{10} standard there, either. Because the construction activities will advance down the right-of-way at an average rate of about 2/10ths mile per day, the impacts of the construction activities on any given location will most likely be limited to one or several days, distributed over the two summers of construction activity. Regardless of the transmission line route selected, the areas potentially affected by the fugitive dust emissions would run parallel to the right-of-way.

[20]The California annual PM_{10} standard is for the annual *geometric* mean. Although the ISCST3 dispersion model used for this analysis cannot calculate geometric mean concentrations, a geometric mean is always lower than the arithmetic mean calculated from the same observations. Therefore, the annual geometric mean PM_{10} concentrations are expected to be lower than those presented here.

Table 20. Estimated Annual Average PM_{10} Impacts, $\mu g/m^3$

Receptor Number and Location	Development and Construction			After Plant Startup
	Year 1	Year 2	Year 3	
1 Medicine Lake Campground	0.010	0.019	0.044	0.008
2 Medicine Lake Campground	0.010	0.020	0.040	0.008
3 Medicine Lake Cmpgnd HQ	0.008	0.021	0.037	0.006
4 Medicine Lake Cabins	0.007	0.016	0.032	0.006
5 Little Medicine Lake	0.009	0.025	0.043	0.008
6 Medicine Mountain	0.005	0.011	0.018	0.006
7 Medicine Lake Glass Flow	0.038	0.062	0.120	0.025
8 Grouse Hill	0.087	0.135	0.301	0.074
9 Badger Peak	0.016	0.035	0.058	0.016
10 Little Mt. Hoffman	0.005	0.010	0.016	0.005
11 Goshawk Nest	0.145	0.160	0.441	0.090
12 Fourmile Hill	0.040	0.063	0.115	0.052
13 Lookout Butte	0.033	0.069	0.108	0.035
14 SW Crnr Lava Beds NM	0.006	0.009	0.016	0.005
15 Lava Beds Vis Ctr	0.002	0.003	0.005	0.001
16 Tionesta	0.000	0.001	0.001	0.000
17 Dry Lake	0.001	0.001	0.002	0.000
18 Dorris	0.001	0.001	0.002	0.001
19 Tulelake	0.001	0.002	0.003	0.001
20 FS Road 49 near plant site	0.572	0.634	1.647	0.350
21 Door Knob Snowmobile Park	0.003	0.004	0.008	0.002
22 Fourcorners-Medicine Lake Snowmobile Park	0.002	0.003	0.005	0.001

Table 21. Estimated Maximum 24-Hour Average PM_{10} Concentration During Transmission Line Construction

Distance from ROW Centerline (meters)	Estimated Maximum 24-Hour PM_{10} Concentration ($\mu g/m^3$)	
	Year 1	Year 2
50	63.3	68.5
100	33.5	25.4
200	17.2	8.2
500	6.5	2.1
1,000	2.8	0.8
2,000	1.1	0.4
5,000	0.4	0.2
10,000	0.2	0.1

Fugitive dust impacts associated with construction activities are generally not treated as significant impacts by local air pollution regulatory agencies. However, the CEQA guidelines do not discern between air quality impacts related to construction dust and those due to other sources. Therefore, the potential impact of transmission line construction dust on short-term ambient PM_{10} concentrations within the nearest 300 feet is considered a potentially significant impact.

Sulfur Oxides

Tables 22, 23, and 24 present the estimated maximum one-, three-, and 24-hour average sulfur dioxide concentrations associated with the project. Table 25 presents the estimated annual average sulfur dioxide impacts. These tables present no estimated SO_2 impacts for normal operations after plant startup because there will be no significant sources of SO_x emissions under normal operating conditions. Except for minor emissions from vehicles, SO_x will be emitted only during the drilling of infill wells (from the rig engines) and from the plant's diesel backup generator when it is tested or during an upset. The estimated SO_2 impacts for all phases of the project and under all operating scenarios are well below their respective California and federal standards. The project is not expected to cause or contribute to an exceedance of any SO_2 standard or REL, therefore the impact of project SO_x emissions on ambient air quality is not considered significant.

Nitrogen Oxides

Table 26 presents the estimated maximum one-hour average ambient NO_2 concentrations associated with project emissions. These tables present no estimated NO_2 impacts for normal operations after plant startup because there will be no significant sources of NO_x emissions under normal operating conditions. Except for minor emissions from vehicles, NO_x will be emitted only during the drilling of infill wells (from the rig engines) and from the plant's diesel backup generator when it is tested or during an upset. Table 27 presents the estimated annual average ambient NO_2 concentrations associated with the project. The estimated NO_2 impacts for all phases of the

Table 22. Estimated Maximum 1-Hour Average Sulfur Dioxide Impacts ($\mu g/m^3$)

Receptor Number and Location	Development and Construction			After Startup	
	Year 1	Year 2	Year 3	Dual Turbine Upset	Dual-Turbine Upset While Drilling Infill Well
1 Medicine Lake Campground	3.1	3.1	7.2	0.8	3.4
2 Medicine Lake Campground	3.6	3.1	7.1	1.3	4.9
3 Medicine Lake Cmpgnd HQ	4.8	4.8	6.9	0.3	4.8
4 Medicine Lake Cabins	2.3	2.3	6.0	0.3	3.2
5 Little Medicine Lake	4.1	4.1	5.7	0.4	4.6
6 Medicine Mountain	0.9	0.9	1.4	0.2	0.9
7 Medicine Lake Glass Flow	7.1	7.1	8.0	1.3	7.1
8 Grouse Hill	9.8	7.0	16.6	3.1	13.0
9 Badger Peak	1.9	1.9	4.6	0.7	2.4
10 Little Mt. Hoffman	0.7	0.8	2.0	0.2	0.8
11 Goshawk Nest	10.8	18.4	18.4	3.7	18.4
12 Fourmile Hill	3.2	3.8	6.0	0.6	3.8
13 Lookout Butte	1.8	1.9	4.4	0.4	2.9
14 SW Crnr Lava Beds NM	1.7	1.7	2.7	0.2	1.7
15 Lava Beds Vis Ctr	0.7	0.7	2.5	0.1	1.1
16 Tionesta	0.1	0.1	0.2	0.0	0.1
17 Dry Lake	0.2	0.2	0.5	0.1	0.2
18 Dorris	0.2	0.3	0.7	0.1	0.3
19 Tulelake	0.4	0.4	0.9	0.0	0.4
20 FS Road 49 Near Plant Site	28.7	15.3	31.5	12.1	28.7
21 Door Knob Snowmobile Park	1.7	2.0	4.3	0.3	2.0
22 Fourcorners-Medicine Lake Snowmobile Park	1.3	1.8	4.6	0.5	1.9

Table 23. Estimated Maximum 3-Hour Average Sulfur Dioxide Impacts ($\mu g/m^3$)

Receptor Number and Location	Development and Construction			After Startup	
	Year 1	Year 2	Year 3	Dual Turbine Upset	Dual-Turbine Upset While Drilling Infill Well
1 Medicine Lake Campground	1.6	1.6	5.1	0.3	2.4
2 Medicine Lake Campground	1.5	2.0	3.2	0.5	2.0
3 Medicine Lake Cmpgnd HQ	1.8	1.8	3.2	0.1	1.8
4 Medicine Lake Cabins	1.8	1.8	4.4	0.1	1.8
5 Little Medicine Lake	1.8	1.8	3.0	0.2	2.3
6 Medicine Mountain	0.4	0.4	0.9	0.1	0.4
7 Medicine Lake Glass Flow	3.6	3.6	5.0	0.9	3.6
8 Grouse Hill	7.7	5.8	12.0	3.0	9.5
9 Badger Peak	1.3	1.3	2.9	0.5	1.8
10 Little Mt. Hoffman	0.5	0.6	1.4	0.1	0.6
11 Goshawk Nest	3.7	6.1	8.5	1.2	8.5
12 Fourmile Hill	1.9	2.2	3.8	0.4	2.2
13 Lookout Butte	1.1	1.4	3.3	0.3	1.7
14 SW Crnr Lava Beds NM	0.6	0.6	1.1	0.1	0.6
15 Lava Beds Vis Ctr	0.3	0.3	1.0	0.0	0.4
16 Tionesta	0.0	0.0	0.1	0.0	0.0
17 Dry Lake	0.1	0.1	0.2	0.0	0.1
18 Dorris	0.1	0.1	0.3	0.0	0.1
19 Tulelake	0.1	0.1	0.3	0.0	0.1
20 FS Road 49 Near Plant Site	20.6	8.3	25.4	7.4	21.1
21 Door Knob Snowmobile Park	0.6	0.8	1.5	0.2	0.8
22 Fourcorners-Medicine Lake Snowmobile Park	0.4	0.6	1.5	0.2	0.6

Table 24. Estimated Maximum 24-Hour Average Sulfur Dioxide Impacts ($\mu g/m^3$)

Receptor Number and Location	Development and Construction			After Startup	
	Year 1	Year 2	Year 3	Dual Turbine Upset	Dual-Turbine Upset While Drilling Infill Well
1 Medicine Lake Campground	0.3	0.3	0.9	0.1	0.4
2 Medicine Lake Campground	0.2	0.3	0.6	0.1	0.4
3 Medicine Lake Cmpgnd HQ	0.4	0.5	1.1	0.0	0.5
4 Medicine Lake Cabins	0.3	0.3	0.7	0.0	0.3
5 Little Medicine Lake	0.6	0.6	1.0	0.1	0.6
6 Medicine Mountain	0.1	0.2	0.4	0.0	0.2
7 Medicine Lake Glass Flow	1.0	1.0	1.6	0.2	1.0
8 Grouse Hill	1.6	1.8	3.7	0.8	2.3
9 Badger Peak	0.5	0.5	1.2	0.2	0.7
10 Little Mt. Hoffman	0.1	0.1	0.3	0.0	0.1
11 Goshawk Nest	0.7	0.8	3.4	0.2	3.3
12 Fourmile Hill	0.5	0.6	1.1	0.1	0.6
13 Lookout Butte	0.3	0.4	0.8	0.1	0.5
14 SW Crnr Lava Beds NM	0.1	0.1	0.2	0.0	0.1
15 Lava Beds Vis Ctr	0.0	0.0	0.1	0.0	0.1
16 Tionesta	0.0	0.0	0.0	0.0	0.0
17 Dry Lake	0.0	0.0	0.0	0.0	0.0
18 Dorris	0.0	0.0	0.0	0.0	0.0
19 Tulelake	0.0	0.0	0.0	0.0	0.0
20 FS Road 49 Near Plant Site	8.1	2.4	10.1	1.7	9.2
21 Door Knob Snowmobile Park	0.1	0.1	0.2	0.0	0.1
22 Fourcorners-Medicine Lake Snowmobile Park	0.1	0.1	0.2	0.0	0.1

Table 25. Estimated Annual Average Sulfur Dioxide Impacts ($\mu g/m^3$)

Receptor Number and Location	Development and Construction			After Plant Startup
	Year 1	Year 2	Year 3	
1 Medicine Lake Campground	0.00003	0.00028	0.00169	0.00006
2 Medicine Lake Campground	0.00005	0.00030	0.00153	0.00006
3 Medicine Lake Cmpgnd HQ	0.00003	0.00028	0.00135	0.00006
4 Medicine Lake Cabins	0.00003	0.00021	0.00115	0.00005
5 Little Medicine Lake	0.00003	0.00034	0.00165	0.00006
6 Medicine Mountain	0.00003	0.00013	0.00072	0.00003
7 Medicine Lake Glass Flow	0.00022	0.00091	0.00491	0.00019
8 Grouse Hill	0.00033	0.00211	0.01290	0.00056
9 Badger Peak	0.00007	0.00043	0.00236	0.00011
10 Little Mt. Hoffman	0.00002	0.00011	0.00057	0.00003
11 Goshawk Nest	0.00005	0.00094	0.00600	0.00029
12 Fourmile Hill	0.00026	0.00073	0.00484	0.00026
13 Lookout Butte	0.00017	0.00057	0.00356	0.00021
14 SW Crnr Lava Beds NM	0.00001	0.00008	0.00053	0.00001
15 Lava Beds Vis Ctr	0.00000	0.00003	0.00019	0.00000
16 Tionesta	0.00000	0.00001	0.00007	0.00000
17 Dry Lake	0.00000	0.00001	0.00006	0.00000
18 Dorris	0.00000	0.00001	0.00010	0.00000
19 Tulelake	0.00000	0.00002	0.00011	0.00000
20 FS Road 49 Near Plant Site	0.00219	0.01132	0.08736	0.00185
21 Door Knob Snowmobile Park	0.00001	0.00005	0.00031	0.00001
22 Fourcorners-Medicine Lake Snowmobile Park	0.00001	0.00002	0.00011	0.00001

Table 26. Estimated Maximum 1-Hour Average Nitrogen Dioxide Impacts ($\mu g/m^3$)

Receptor Number and Location	Development and Construction			After Startup	
	Year 1	Year 2	Year 3	Dual Turbine Upset	Dual-Turbine Upset While Drilling Infill Well
1 Medicine Lake Campground	98.2	98.2	166.2	24.9	108.6
2 Medicine Lake Campground	116.6	101.0	165.8	42.1	158.6
3 Medicine Lake Cmpgnd HQ	154.1	154.1	165.3	10.2	154.1
4 Medicine Lake Cabins	73.7	73.7	162.5	9.1	101.3
5 Little Medicine Lake	130.2	130.2	161.4	12.1	148.0
6 Medicine Mountain	29.9	29.9	44.7	5.2	29.9
7 Medicine Lake Glass Flow	165.0	165.0	167.7	41.5	165.0
8 Grouse Hill	172.0	163.0	193.6	101.1	182.1
9 Badger Peak	60.6	62.3	148.9	21.1	78.2
10 Little Mt. Hoffman	21.0	26.0	63.2	6.1	27.1
11 Goshawk Nest	178.3	202.7	202.8	119.1	202.7
12 Fourmile Hill	101.2	120.6	160.2	19.4	120.6
13 Lookout Butte	56.6	61.8	141.1	13.9	92.2
14 SW Crnr Lava Beds NM	53.4	53.4	85.6	5.7	53.4
15 Lava Beds Vis Ctr	22.0	23.9	79.7	2.5	35.1
16 Tionesta	2.3	3.1	7.5	1.2	3.2
17 Dry Lake	5.5	7.0	17.2	1.8	7.0
18 Dorris	7.6	9.5	24.0	2.2	9.5
19 Tulelake	12.8	12.8	29.0	0.9	12.8
20 FS Road 49 Near Plant Site	233.7	190.8	242.8	180.7	233.8
21 Door Knob Snowmobile Park	54.2	65.4	137.7	11.2	65.4
22 Fourcorners-Medicine Lake Snowmobile Park	41.3	56.3	148.1	15.0	62.2

Table 27. Estimated Annual Average Nitrogen Dioxide Impacts ($\mu g/m^3$)

Receptor Number and Location	Development and Construction			After Plant Startup
	Year 1	Year 2	Year 3	
1 Medicine Lake Campground	0.0011	0.0090	0.0542	0.0022
2 Medicine Lake Campground	0.0015	0.0096	0.0491	0.0023
3 Medicine Lake Cmpgnd HQ	0.0009	0.0090	0.0433	0.0019
4 Medicine Lake Cabins	0.0009	0.0068	0.0369	0.0017
5 Little Medicine Lake	0.0010	0.0110	0.0529	0.0023
6 Medicine Mountain	0.0008	0.0042	0.0232	0.0012
7 Medicine Lake Glass Flow	0.0071	0.0291	0.1578	0.0075
8 Grouse Hill	0.0106	0.0676	0.4145	0.0189
9 Badger Peak	0.0024	0.0139	0.0757	0.0039
10 Little Mt. Hoffman	0.0007	0.0037	0.0184	0.0011
11 Goshawk Nest	0.0016	0.0303	0.1927	0.0096
12 Fourmile Hill	0.0084	0.0236	0.1555	0.0096
13 Lookout Butte	0.0056	0.0183	0.1143	0.0078
14 SW Crnr Lava Beds NM	0.0003	0.0025	0.0170	0.0004
15 Lava Beds Vis Ctr	0.0001	0.0010	0.0061	0.0001
16 Tionesta	0.0000	0.0003	0.0021	0.0000
17 Dry Lake	0.0000	0.0003	0.0018	0.0000
18 Dorris	0.0001	0.0004	0.0033	0.0001
19 Tulelake	0.0001	0.0006	0.0037	0.0001
20 FS Road 49 Near Plant Site	0.0703	0.3640	2.8069	0.0628
21 Door Knob Snowmobile Park	0.0002	0.0016	0.0101	0.0002
22 Fourcorners-Medicine Lake Snowmobile Park	0.0002	0.0007	0.0034	0.0002

project and under all operating scenarios are well below their respective California (one-hour average) and federal (annual average) standards, as well as the acute REL. The project is not expected to cause or contribute to an exceedance of any NO_2 standard or REL, therefore the impact of project NO_x emissions on ambient air quality is not considered significant.

Carbon Monoxide

Tables 28 and 29 present the estimated maximum one- and eight-hour average ambient carbon monoxide concentrations associated with project emissions. As in the case of NO_2 and SO_2, these tables present no estimated CO impacts for normal operations after plant startup because there will be no significant sources of CO emissions under normal operating conditions. The estimated CO impacts for all phases of the project and under all operating scenarios are well below their respective California (one- and eight-hour average) and federal (one- and eight-hour average) standards. The project is not expected to cause or contribute to an exceedance of any CO standard, therefore the impact of project CO emissions on ambient air quality is not considered significant. There are no RELs for CO.

Hydrogen Sulfide

Table 30 presents the estimated maximum one-hour average hydrogen sulfide concentrations associated with the project. The estimated H_2S impacts for all phases of the project and under all operating scenarios are below the California one-hour average standard and the chronic and acute RELs. (The standard and the RELs are 42 $\mu g/m^3$.) Background H_2S concentrations in the area are believed to be negligible, so the project is not expected to cause or contribute to an exceedance of the California standard. Therefore, the impact of project H_2S emissions on ambient air quality is not considered significant.

Lead

Table 31 presents the estimated maximum monthly-average ambient airborne lead concentrations associated with project emissions. Because average concentrations calculated over longer averaging times are always lower than shorter-term maximum calculated from the same data, calendar quarter average and annual average lead concentrations would be lower than the monthly values presented here. The estimated concentrations are far below the California (monthly-average) and federal (calendar quarter average) ambient lead standards. Since project lead emissions are not expected to cause or contribute significantly to an exceedance of the California lead standard, the federal lead standard, or the REL, these impacts are not considered significant.

Other Pollutants

Table 32 presents the estimated annual average concentrations of non-criteria pollutants emitted from the operating facility. All of the estimated annual average concentrations are well below their RELs, thus these impacts are not considered significant.

Table 33 presents the estimated maximum one-hour average concentrations of non-criteria and criteria pollutants emitted from the operating facility for which RELs are listed in the *CAPCOA Risk Assessment Guidelines*, under the worst-case emissions scenarios (a dual-turbine upset while wells are being vented with portable silencers) and worst-case meteorological scenario. All of the

Table 28. Maximum 1-Hour Average Carbon Monoxide Impacts ($\mu g/m^3$)

Receptor Number and Location	Development and Construction			After Startup	
	Year 1	Year 2	Year 3	Dual Turbine Upset	Dual-Turbine Upset While Drilling Infill Well
1 Medicine Lake Campground	41.7	41.7	97.8	10.5	46.1
2 Medicine Lake Campground	49.5	42.9	96.8	17.8	67.3
3 Medicine Lake Cmpgnd HQ	65.4	65.4	94.5	4.3	65.4
4 Medicine Lake Cabins	31.3	31.3	82.1	3.9	43.0
5 Little Medicine Lake	55.3	55.3	78.0	5.1	62.8
6 Medicine Mountain	12.7	12.7	19.0	2.2	12.7
7 Medicine Lake Glass Flow	96.8	96.8	108.5	17.6	96.8
8 Grouse Hill	133.9	95.6	225.6	42.8	176.7
9 Badger Peak	25.7	26.4	63.2	9.0	33.2
10 Little Mt. Hoffman	8.9	11.0	26.8	2.6	11.5
11 Goshawk Nest	146.7	250.6	250.8	50.4	250.6
12 Fourmile Hill	43.0	51.2	81.8	8.2	51.2
13 Lookout Butte	24.0	26.2	59.9	5.9	39.1
14 SW Crnr Lava Beds NM	22.7	22.7	36.4	2.4	22.7
15 Lava Beds Vis Ctr	9.3	10.1	33.8	1.1	14.9
16 Tionesta	1.0	1.3	3.2	0.5	1.4
17 Dry Lake	2.3	3.0	7.3	0.8	3.0
18 Dorris	3.2	4.0	10.2	0.9	4.0
19 Tulelake	5.4	5.4	12.3	0.4	5.4
20 FS Road 49 Near Plant Site	390.6	208.1	429.3	165.2	390.8
21 Door Knob Snowmobile Park	23.0	27.7	58.4	4.8	27.7
22 Fourcorners-Medicine Lake Snowmobile Park	17.5	23.9	62.9	6.4	26.4

Table 29. Maximum 8-Hour Average Carbon Monoxide Impacts ($\mu g/m^3$)

Receptor Number and Location	Development and Construction			After Startup	
	Year 1	Year 2	Year 3	Dual Turbine Upset	Dual-Turbine Upset While Drilling Infill Well
1 Medicine Lake Campground	10.6	11.2	36.0	2.1	15.6
2 Medicine Lake Campground	8.9	13.0	22.7	3.1	14.0
3 Medicine Lake Cmpgnd HQ	12.9	13.3	34.5	1.0	13.4
4 Medicine Lake Cabins	10.2	10.7	29.4	1.0	10.7
5 Little Medicine Lake	13.4	13.6	30.1	1.6	13.6
6 Medicine Mountain	2.9	3.4	8.2	0.9	3.8
7 Medicine Lake Glass Flow	26.4	26.4	43.5	6.6	26.4
8 Grouse Hill	65.7	42.5	95.8	17.2	80.5
9 Badger Peak	11.9	14.6	31.8	5.4	17.3
10 Little Mt. Hoffman	4.7	4.3	10.5	1.2	5.9
11 Goshawk Nest	22.5	31.5	63.8	6.9	63.1
12 Fourmile Hill	13.1	14.9	29.9	3.3	15.8
13 Lookout Butte	9.5	11.3	26.1	2.2	11.4
14 SW Crnr Lava Beds NM	3.0	2.9	5.3	0.3	3.1
15 Lava Beds Vis Ctr	1.3	1.5	4.8	0.2	2.1
16 Tionesta	0.2	0.2	0.5	0.1	0.2
17 Dry Lake	0.5	0.6	1.4	0.1	0.6
18 Dorris	0.4	0.5	1.3	0.1	0.5
19 Tulelake	0.7	0.7	1.5	0.1	0.7
20 FS Road 49 Near Plant Site	220.5	69.8	246.5	55.0	237.1
21 Door Knob Snowmobile Park	3.0	3.8	7.8	0.7	3.8
22 Fourcorners-Medicine Lake Snowmobile Park	2.4	3.3	8.5	0.9	3.6

Table 30. Estimated Maximum 1-Hour Average Hydrogen Sulfide Impacts ($\mu g/m^3$)

Receptor Number and Location	Development and Construction			After Startup				
	Year 1	Year 2	Year 3	Normal Operation	Normal Operation w/1 Well Venting	Normal Operation w/2 Wells Venting	Dual-Turbine Plant Upset	Dual-Turbine Upset w/2wells Venting
1 Medicine Lake Campground	1.0	1.0	1.5	0.4	1.2	1.5	0.4	1.5
2 Medicine Lake Campground	1.3	1.3	1.7	0.4	1.4	1.9	0.4	1.9
3 Medicine Lake Cmpgnd HQ	1.5	1.5	2.2	0.3	1.6	2.3	0.3	2.3
4 Medicine Lake Cabins	1.0	1.0	1.6	0.4	1.4	1.6	0.4	1.6
5 Little Medicine Lake	1.5	1.5	2.2	0.3	1.6	2.4	0.3	2.4
6 Medicine Mountain	0.5	0.9	0.9	1.0	1.5	1.9	1.0	1.9
7 Medicine Lake Glass Flow	1.8	2.0	3.2	0.7	2.3	3.7	0.5	3.7
8 Grouse Hill	9.8	13.9	13.9	15.7	25.5	29.5	16.6	30.3
9 Badger Peak	2.2	3.7	3.7	3.9	6.1	7.6	3.9	7.6
10 Little Mt. Hoffman	0.8	1.5	1.5	1.5	2.3	3.0	1.5	3.0
11 Goshawk Nest	2.1	2.1	2.1	1.8	2.1	2.1	0.5	2.1
12 Fourmile Hill	3.5	5.9	5.9	6.3	9.1	11.1	8.5	13.3
13 Lookout Butte	1.8	3.3	3.3	2.6	4.4	5.9	2.7	6.0
14 SW Crnr Lava Beds NM	0.5	0.9	0.9	0.5	1.0	1.5	0.7	0.9
15 Lava Beds Vis Ctr	0.2	0.3	0.3	0.2	0.3	0.5	0.2	0.4
16 Tionesta	0.0	0.1	0.1	0.1	0.1	0.2	0.1	0.2
17 Dry Lake	0.1	0.2	0.2	0.1	0.2	0.3	0.1	0.2
18 Dorris	0.1	0.1	0.2	0.1	0.1	0.2	0.1	0.3
19 Tulelake	0.1	0.1	0.1	0.1	0.1	0.2	0.1	0.2
20 FS Road 49 Near Plant Site	5.3	6.5	8.8	14.7	21.2	21.8	5.2	10.1
21 Door Knob Snowmobile Park	0.5	1.0	1.0	0.4	0.8	1.3	0.4	1.0
22 Fourcorners-Medicine Lake Snowmobile Park	0.4	0.7	0.8	0.3	0.8	1.2	0.4	1.2

Table 31. Estimated Maximum Monthly-Average Lead Impacts ($\mu g/m^3$)

Receptor Number and Location	Development and Construction			After Startup		
	Year 1	Year 2	Year 3	Normal Operations	Normal Operations w/1 Well Venting	Normal Operations w/2 Wells Venting
1 Medicine Lake Campground	*0.00000004*	*0.00000004*	*0.00000013*	*0.00000001*	*0.00000010*	*0.00000014*
2 Medicine Lake Campground	*0.00000007*	*0.00000007*	*0.00000014*	*0.00000001*	*0.00000009*	*0.00000015*
3 Medicine Lake Cmpgnd HQ	*0.00000005*	*0.00000005*	*0.00000009*	*0.00000001*	*0.00000009*	*0.00000016*
4 Medicine Lake Cabins	*0.00000005*	*0.00000005*	*0.00000011*	*0.00000001*	*0.00000008*	*0.00000012*
5 Little Medicine Lake	*0.00000007*	*0.00000007*	*0.00000011*	*0.00000001*	*0.00000010*	*0.00000020*
6 Medicine Mountain	*0.00000003*	*0.00000004*	*0.00000005*	*0.00000001*	*0.00000005*	*0.00000009*
7 Medicine Lake Glass Flow	*0.00000011*	*0.00000024*	*0.00000024*	*0.00000002*	*0.00000017*	*0.00000026*
8 Grouse Hill	*0.00000037*	*0.00000055*	*0.00000080*	*0.00000019*	*0.00000061*	*0.00000093*
9 Badger Peak	*0.00000014*	*0.00000024*	*0.00000025*	*0.00000007*	*0.00000021*	*0.00000032*
10 Little Mt. Hoffman	*0.00000004*	*0.00000005*	*0.00000005*	*0.00000001*	*0.00000005*	*0.00000008*
11 Goshawk Nest	*0.00000017*	*0.00000017*	*0.00000048*	*0.00000001*	*0.00000044*	*0.00000059*
12 Fourmile Hill	*0.00000029*	*0.00000034*	*0.00000047*	*0.00000014*	*0.00000043*	*0.00000060*
13 Lookout Butte	*0.00000025*	*0.00000048*	*0.00000048*	*0.00000008*	*0.00000033*	*0.00000056*
14 SW Crnr Lava Beds NM	*0.00000002*	*0.00000004*	*0.00000005*	*0.00000001*	*0.00000004*	*0.00000006*
15 Lava Beds Vis Ctr	*0.00000000*	*0.00000001*	*0.00000001*	*0.00000000*	*0.00000001*	*0.00000001*
16 Tionesta	*0.00000000*	*0.00000000*	*0.00000000*	*0.00000000*	*0.00000000*	*0.00000000*
17 Dry Lake	*0.00000000*	*0.00000000*	*0.00000000*	*0.00000000*	*0.00000000*	*0.00000000*
18 Dorris	*0.00000000*	*0.00000001*	*0.00000001*	*0.00000000*	*0.00000001*	*0.00000001*
19 Tulelake	*0.00000001*	*0.00000001*	*0.00000001*	*0.00000000*	*0.00000001*	*0.00000001*
20 FS Road 49 Near Plant Site	*0.00000040*	*0.00000060*	*0.00000077*	*0.00000014*	*0.00000044*	*0.00000081*
21 Door Knob Snowmobile Park	*0.00000001*	*0.00000001*	*0.00000001*	*0.00000000*	*0.00000001*	*0.00000001*
22 Fourcorners-Medicine Lake Snowmobile Park	*0.00000000*	*0.00000001*	*0.00000001*	*0.00000000*	*0.00000001*	*0.00000001*

Table 32. Estimated Annual Average Airborne Concentrations of Substances Present in the Geothermal Fluids Emitted from the Operating Power Plant ($\mu g/m^3$)

Receptor Number and Location	Ammonia	Arsenic	*Asbestos*	Benzene	*Beryllium*	*Cadmium*	*Copper*	*Hydro-chloric Acid*	Hydrogen Sulfide	*Lead*
1 Medicine Lake Campground	1.6E-02	7.4E-07	5.7E-09	7.6E-05	2.8E-10	2.8E-10	3.7E-10	5.7E-11	5.2E-03	2.8E-09
2 Medicine Lake Campground	1.8E-02	8.2E-07	6.3E-09	8.8E-05	3.2E-10	3.2E-10	4.1E-10	6.3E-11	5.9E-03	3.2E-09
3 Medicine Lake Cmpgnd HQ	1.2E-02	6.3E-07	4.8E-09	5.8E-05	2.4E-10	2.4E-10	3.1E-10	4.8E-11	4.1E-03	2.4E-09
4 Medicine Lake Cabins	1.3E-02	5.9E-07	4.5E-09	6.1E-05	2.3E-10	2.3E-10	2.9E-10	4.5E-11	4.1E-03	2.3E-09
5 Little Medicine Lake	1.4E-02	7.2E-07	5.4E-09	6.8E-05	2.7E-10	2.7E-10	3.5E-10	5.4E-11	4.7E-03	2.7E-09
6 Medicine Mountain	2.9E-02	1.8E-06	1.3E-08	1.4E-04	6.5E-10	6.5E-10	8.5E-10	1.3E-10	1.1E-02	6.5E-09
7 Medicine Lake Glass Flow	4.7E-02	1.8E-06	1.4E-08	2.3E-04	7.0E-10	7.0E-10	9.2E-10	1.4E-10	1.4E-02	7.0E-09
8 Grouse Hill	2.9E-01	1.2E-05	9.5E-08	1.4E-03	4.8E-09	4.8E-09	6.2E-09	9.5E-10	9.3E-02	4.8E-08
9 Badger Peak	7.3E-02	4.2E-06	3.2E-08	3.6E-04	1.6E-09	1.6E-09	2.1E-09	3.2E-10	2.7E-02	1.6E-08
10 Little Mt. Hoffman	2.6E-02	1.5E-06	1.1E-08	1.3E-04	5.5E-10	5.5E-10	7.1E-10	1.1E-10	9.3E-03	5.5E-09
11 Goshawk Nest	1.2E-02	6.2E-07	4.7E-09	5.7E-05	2.3E-10	2.3E-10	3.0E-10	4.7E-11	3.7E-03	2.3E-09
12 Fourmile Hill	3.3E-01	1.2E-05	9.2E-08	1.6E-03	4.6E-09	4.6E-09	6.0E-09	9.2E-10	9.9E-02	4.6E-08
13 Lookout Butte	1.6E-01	8.1E-06	6.2E-08	7.6E-04	3.1E-09	3.1E-09	4.0E-09	6.2E-10	5.4E-02	3.1E-08
14 SW Crnr Lava Beds NM	9.2E-03	6.3E-07	4.6E-09	4.5E-05	2.3E-10	2.3E-10	3.0E-10	4.6E-11	3.6E-03	2.3E-09
15 Lava Beds Vis Ctr	2.7E-03	1.6E-07	1.2E-09	1.3E-05	6.0E-11	6.0E-11	7.8E-11	1.2E-11	1.0E-03	6.0E-10
16 Tionesta	7.4E-04	4.8E-08	3.5E-10	3.6E-06	1.8E-11	1.8E-11	2.3E-11	3.5E-12	2.8E-04	1.8E-10
17 Dry Lake	5.9E-04	2.9E-08	2.2E-10	2.9E-06	1.1E-11	1.1E-11	1.4E-11	2.2E-12	2.0E-04	1.1E-10
18 Dorris	2.1E-03	9.2E-08	7.2E-10	1.0E-05	3.6E-11	3.6E-11	4.7E-11	7.2E-12	6.9E-04	3.6E-10
19 Tulelake	2.2E-03	1.4E-07	1.0E-09	1.1E-05	5.1E-11	5.1E-11	6.6E-11	1.0E-11	8.3E-04	5.1E-10
20 FS Road 49 Near Plant Site	2.8E-01	1.9E-06	2.6E-08	1.4E-03	1.3E-09	1.3E-09	1.7E-09	2.6E-10	6.4E-02	1.3E-08
21 Door Knob Snowmobile Park	4.7E-03	2.6E-07	2.0E-09	2.3E-05	9.9E-11	9.9E-11	1.3E-10	2.0E-11	1.7E-03	9.9E-10
22 Fourcorners-Medicine Lake Snowmobile Park	1.5E-03	6.2E-08	4.9E-10	7.5E-06	2.4E-11	2.4E-11	3.2E-11	4.9E-12	4.8E-04	2.4E-10

Table 32. Estimated Annual Average Airborne Concentrations of Substances Present in the Geothermal Fluids Emitted from the Operating Power Plant ($\mu g/m^3$), Concluded

Receptor Number and Location	*Manganese*	Mercury	*Nickel*	*Selenium*	Toluene	Zinc	Xylene	Sulfate	Radon
1 Medicine Lake Campground	1.1E-09	3.7E-07	1.1E-09	2.8E-10	1.3E-04	1.4E-08	2.9E-05	6.7E-04	2.4E-13
2 Medicine Lake Campground	1.3E-09	4.2E-07	1.3E-09	3.2E-10	1.5E-04	1.5E-08	3.3E-05	7.7E-04	2.8E-13
3 Medicine Lake Cmpgnd HQ	9.5E-10	3.3E-07	9.5E-10	2.4E-10	1.0E-04	1.1E-08	2.2E-05	5.1E-04	1.8E-13
4 Medicine Lake Cabins	9.0E-10	3.1E-07	9.0E-10	2.3E-10	1.1E-04	1.1E-08	2.3E-05	5.3E-04	1.9E-13
5 Little Medicine Lake	1.1E-09	3.8E-07	1.1E-09	2.7E-10	1.2E-04	1.3E-08	2.6E-05	6.0E-04	2.1E-13
6 Medicine Mountain	2.6E-09	6.9E-07	2.6E-09	6.5E-10	2.5E-04	3.1E-08	5.3E-05	1.2E-03	4.5E-13
7 Medicine Lake Glass Flow	2.8E-09	1.0E-06	2.8E-09	7.0E-10	4.1E-04	3.4E-08	8.6E-05	2.0E-03	7.3E-13
8 Grouse Hill	1.9E-08	5.7E-06	1.9E-08	4.8E-09	2.5E-03	2.3E-07	5.3E-04	1.2E-02	4.4E-12
9 Badger Peak	6.3E-09	1.7E-06	6.3E-09	1.6E-09	6.3E-04	7.6E-08	1.3E-04	3.1E-03	1.1E-12
10 Little Mt. Hoffman	2.2E-09	5.9E-07	2.2E-09	5.5E-10	2.2E-04	2.6E-08	4.7E-05	1.1E-03	3.9E-13
11 Goshawk Nest	9.4E-10	5.6E-07	9.4E-10	2.3E-10	1.0E-04	1.1E-08	2.2E-05	5.0E-04	1.8E-13
12 Fourmile Hill	1.8E-08	5.4E-06	1.8E-08	4.6E-09	2.8E-03	2.2E-07	5.9E-04	1.4E-02	5.0E-12
13 Lookout Butte	1.2E-08	3.5E-06	1.2E-08	3.1E-09	1.3E-03	1.5E-07	2.8E-04	6.6E-03	2.4E-12
14 SW Crnr Lava Beds NM	9.2E-10	2.4E-07	9.2E-10	2.3E-10	7.9E-05	1.1E-08	1.7E-05	3.9E-04	1.4E-13
15 Lava Beds Vis Ctr	2.4E-10	6.3E-08	2.4E-10	6.0E-11	2.3E-05	2.9E-09	4.9E-06	1.2E-04	4.1E-14
16 Tionesta	7.0E-11	1.8E-08	7.0E-11	1.8E-11	6.3E-06	8.4E-10	1.3E-06	3.2E-05	1.1E-14
17 Dry Lake	4.4E-11	1.3E-08	4.4E-11	1.1E-11	5.0E-06	5.3E-10	1.1E-06	2.5E-05	9.0E-15
18 Dorris	1.4E-10	4.2E-08	1.4E-10	3.6E-11	1.8E-05	1.7E-09	3.9E-06	9.1E-05	3.3E-14
19 Tulelake	2.0E-10	5.3E-08	2.0E-10	5.1E-11	1.9E-05	2.4E-09	4.0E-06	9.4E-05	3.4E-14
20 FS Road 49 Near Plant Site	5.2E-09	3.1E-06	5.2E-09	1.3E-09	2.4E-03	6.2E-08	5.2E-04	1.2E-02	4.4E-12
21 Door Knob Snowmobile Park	4.0E-10	1.0E-07	4.0E-10	9.9E-11	4.0E-05	4.8E-09	8.6E-06	2.0E-04	7.2E-14
22 Fourcorners-Medicine Lake Snowmobile Park	9.7E-11	3.1E-08	9.7E-11	2.4E-11	1.3E-05	1.2E-09	2.8E-06	6.6E-05	2.4E-14

Table 33. Estimated Maximum One-Hour Average Concentrations of Substances Emitted from the Proposed Project After Plant Startup (Worst-Case Scenario)

Substance	Maximum One-Hour Average Concentration ($\mu g/m^3$)					
	Receptor 4 (Medicine Lake Cabins)	Receptor 5 (Little Medicine Lake)	Receptor 8 (Grouse Hill)	Receptor 11 (Goshawk Nest)	Receptor 12 (Fourmile Hill)	Receptor 20 (FS Rd 49)
Sulfur dioxide	3.2	4.6	13.0	18.4	3.8	28.7
Nitrogen dioxide	101.3	148.0	182.1	202.7	120.6	233.8
Hydrogen sulfide	1.6	2.4	30.3	2.1	13.3	21.8
Mercury	2.4E-03	2.2E-03	1.1E-01	3.1E-03	5.7E-02	3.5E-02
Nickel	*7.6E-07*	*6.8E-07*	*3.5E-05*	*9.7E-07*	*1.8E-05*	*1.1E-05*
Selenium	*1.9E-07*	*1.7E-07*	*8.8E-06*	*2.4E-07*	*4.5E-06*	*2.7E-06*
Ammonia	1.2E+00	1.1E+00	5.6E+01	1.5E+00	2.9E+01	1.7E+01
Copper	*2.5E-07*	*2.2E-07*	*1.1E-05*	*3.1E-07*	*5.8E-06*	*3.6E-06*
Xylene	1.8E-03	1.7E-03	8.5E-02	2.4E-03	4.4E-02	2.7E-02
Hydrochloric Acid	*3.8E-08*	*3.4E-08*	*1.8E-06*	*4.8E-08*	*9.0E-07*	*5.5E-07*
Sulfate	4.1E-03	3.7E-03	1.9E-01	5.2E-03	9.8E-02	5.9E-02
Total Acute Hazard Indices for Facility-Emitted Pollutants						
Respiratory Irritation	2.6E-01	3.8E-01	1.2E+00	5.1E-01	6.0E-01	1.1E+00
Central Nervous System	8.0E-05	7.2E-05	3.7E-03	1.0E-04	1.9E-03	1.2E-03
Immune System	7.6E-07	6.8E-07	3.5E-05	9.7E-07	1.8E-05	1.1E-05
Kidney	8.0E-05	7.2E-05	3.7E-03	1.0E-04	1.9E-03	1.2E-03
Liver	8.0E-05	7.2E-05	3.7E-03	1.0E-04	1.9E-03	1.2E-03

concentrations of these pollutants are below their respective RELs, thus these impacts are not considered significant.

Potential Health Effects

At the request of the Siskiyou County Air Pollution Control District, estimated excess lifetime cancer risk, chronic total hazard index and acute total hazard index were calculated using the procedures outlined in the *CAPCOA Risk Assessment Guidelines*. The excess lifetime cancer risk for each receptor was calculated by multiplying the estimated concentration of each substance presented in Table 32 by the corresponding unit risk factor (if applicable), and then summing the risks for all substances. The chronic total hazard index was calculated by dividing the concentration of each substance presented in Table 32 by the corresponding chronic REL (if applicable), and then summing the results for each affected organ or system. The acute total hazard index was calculated the same fashion as the chronic hazard index, using the estimated maximum one-hour average concentrations presented in Table 33 and the acute applicable acute RELs. URFs exist only for substances that are known or suspected carcinogens. Chronic RELs exist for substances that may produce adverse health effects due to sufficiently high long-term exposures, and acute RELs exist only for substances that may produce adverse health effects due to sufficiently high short-term exposures. Not all three values exist for each substance, because the potential health effects are different for each pollutant. Table 34 presents the URFs and RELs for the substances expected to be emitted from the operating facility.

Table 35 presents the estimated excess lifetime cancer risk for each receptor location. Implicit in the risk calculation method recommended in the *CAPCOA Guidelines* is the assumption of a 70-year exposure period. Therefore, the risk estimates presented in Table 35 can be interpreted as the estimated increase in risk of getting any type of cancer during one's lifetime associated with exposure to emissions at the concentrations presented in Table 33 *for 70 years*. Air pollution control districts generally consider estimated excess lifetime cancer risks of less than 10^{-6} (one cancer case per million persons exposed) to 10^{-5} (one cancer case per 100,000 persons exposed) to be not significant. For each receptor location, the estimated excess lifetime cancer risk is less than 10^{-6}.

Table 36 presents the estimated total chronic hazard index associated with the estimated long-term average concentrations presented in Table 32 for each receptor location and target organ system. All of the estimated total chronic hazard indices are much less than one. This indicates that no adverse health effects are expected as a consequence of long-term exposures to emissions from the proposed project at any of the receptor locations.

Table 37 presents the estimated total acute hazard index for each affected organ or system associated with the estimated maximum one-hour average concentrations estimated for receptor 8 (Grouse Hill). This receptor had the highest estimated total acute hazard index. The maximum total hazard index for the non-criteria pollutants and hydrogen sulfide for any affected organ or system is 0.75 (for respiratory irritation). The *CAPCOA Guidelines* indicate that, if the total acute hazard index exceeds 0.5, then the background concentrations of criteria pollutants should be considered in the calculation, as well.

As discussed in Section 3.13 of the DEIS/DEIR, the background concentrations of all criteria pollutants except ozone and PM_{10} are believed to be negligible. The average background concentration of ozone in the project area is about 50 parts per billion, or about 100 $\mu g/m^3$. The acute REL for ozone is 180 $\mu g/m^3$. Adding the hazard index for ozone (100 $\mu g/m^3$/180 $\mu g/m^3$ =

Table 34. Unit Risk Factors and Reference Exposure Levels for Substances Emitted from the Proposed Facility

Substance	Unit Risk Factor ($m^3/\mu g$)	Reference Exposure Level ($m^3/\mu g$)	
		Chronic	Acute
Ammonia	–	100	2,100
Arsenic	3.3E-03	0.5	–
Asbestos	6.3E-02	–	–
Benzene	2.9E-05	71	–
Beryllium	2.4E-03	0.0048	–
Cadmium	4.2E-03	3.5	–
Copper	–	2.4	10
Hydrochloric Acid	–	7	3,000
Hydrogen Sulfide	–	42	42
Lead	8.0E-05	1.5	–
Manganese	–	0.4	–
Mercury	–	0.3	30
Nickel	2.6E-04	0.24	1
Selenium	1.4E-04	0.5	2
Toluene	–	200	–
Xylene	–	300	4,400
Zinc	–	35	–
Sulfate	–	25	25

Source:
CAPCOA Air Toxics "Hot Spots" Program Risk Assessment Guidelines
Tables III-6, III-7, III-8 & III-10

Notes:
Asbestos unit risk factor was converted to mass units.
Unit risk factos for lead and selenium are "screening" risk factors.

Table 35. Estimated Excess Lifetime Cancer Risk for Each Receptor (for 70-year exposure)

Receptor Number and Location	Estimated Excess Lifetime Cancer Risk
1 Medicine Lake Campground	5.0E-09
2 Medicine Lake Campground	5.7E-09
3 Medicine Lake Cmpgnd HQ	4.1E-09
4 Medicine Lake Cabins	4.0E-09
5 Little Medicine Lake	4.7E-09
6 Medicine Mountain	1.1E-08
7 Medicine Lake Glass Flow	1.3E-08
8 Grouse Hill	8.7E-08
9 Badger Peak	2.6E-08
10 Little Mt. Hoffman	9.2E-09
11 Goshawk Nest	4.0E-09
12 Fourmile Hill	9.0E-08
13 Lookout Butte	5.3E-08
14 SW Crnr Lava Beds NM	3.7E-09
15 Lava Beds Vis Ctr	9.9E-10
16 Tionesta	2.8E-10
17 Dry Lake	1.9E-10
18 Dorris	6.5E-10
19 Tulelake	8.3E-10
20 FS Road 49 Near Plant Site	4.8E-08
21 Door Knob Snowmobile Park	1.7E-09
22 Fourcorners-Medicine Lake Snowmobile Park	4.5E-10

Table 36. Estimated Chronic Total Hazard Indices for Each Receptor and Affected Organ or System

Receptor Number and Location	Cardio-vascular System	Nervous System	Immune System	Kidney	Gastro-intestinal System and Liver	Repro-ductive System	Respira-tory System	Skin
1 Medicine Lake Campground	5.1E-06	1.3E-04	6.6E-09	1.2E-06	1.2E-06	1.9E-09	1.6E-04	1.6E-04
2 Medicine Lake Campground	5.8E-06	1.4E-04	7.4E-09	1.4E-06	1.4E-06	2.2E-09	1.9E-04	1.8E-04
3 Medicine Lake Cmpgnd HQ	4.0E-06	9.9E-05	5.6E-09	1.1E-06	1.1E-06	1.6E-09	1.2E-04	1.2E-04
4 Medicine Lake Cabins	4.1E-06	1.0E-04	5.3E-09	1.0E-06	1.0E-06	1.5E-09	1.3E-04	1.3E-04
5 Little Medicine Lake	4.7E-06	1.1E-04	6.3E-09	1.3E-06	1.3E-06	1.9E-09	1.5E-04	1.4E-04
6 Medicine Mountain	9.4E-06	2.6E-04	1.5E-08	2.3E-06	2.3E-06	4.5E-09	3.1E-04	2.9E-04
7 Medicine Lake Glass Flow	1.5E-05	3.5E-04	1.6E-08	3.4E-06	3.4E-06	4.8E-09	5.0E-04	4.8E-04
8 Grouse Hill	9.0E-05	2.2E-03	1.1E-07	1.9E-05	1.9E-05	3.3E-08	3.0E-03	2.9E-03
9 Badger Peak	2.4E-05	6.4E-04	3.7E-08	5.8E-06	5.8E-06	1.1E-08	7.7E-04	7.4E-04
10 Little Mt. Hoffman	8.2E-06	2.3E-04	1.3E-08	2.0E-06	2.0E-06	3.8E-09	2.7E-04	2.6E-04
11 Goshawk Nest	4.8E-06	9.0E-05	5.5E-09	1.9E-06	1.9E-06	1.6E-09	1.2E-04	1.2E-04
12 Fourmile Hill	9.8E-05	2.4E-03	1.1E-07	1.8E-05	1.8E-05	3.1E-08	3.4E-03	3.3E-03
13 Lookout Butte	5.0E-05	1.3E-03	7.2E-08	1.2E-05	1.2E-05	2.1E-08	1.6E-03	1.6E-03
14 SW Crnr Lava Beds NM	3.0E-06	8.7E-05	5.4E-09	7.9E-07	7.9E-07	1.6E-09	9.7E-05	9.3E-05
15 Lava Beds Vis Ctr	8.7E-07	2.4E-05	1.4E-09	2.1E-07	2.1E-07	4.1E-10	2.8E-05	2.7E-05
16 Tionesta	2.4E-07	6.8E-06	4.1E-10	6.1E-08	6.1E-08	1.2E-10	7.8E-06	7.5E-06
17 Dry Lake	1.9E-07	4.9E-06	2.6E-10	4.2E-08	4.2E-08	7.6E-11	6.2E-06	5.9E-06
18 Dorris	6.6E-07	1.7E-05	8.4E-10	1.4E-07	1.4E-07	2.4E-10	2.2E-05	2.1E-05
19 Tulelake	7.2E-07	2.0E-05	1.2E-09	1.8E-07	1.8E-07	3.4E-10	2.3E-05	2.2E-05
20 FS Road 49 Near Plant Site	8.0E-05	1.5E-03	3.0E-08	1.0E-05	1.0E-05	8.8E-09	3.0E-03	2.9E-03
21 Door Knob Snowmobile Park	1.5E-06	4.1E-05	2.3E-09	3.5E-07	3.5E-07	6.8E-10	5.0E-05	4.8E-05
22 Fourcorners-Medicine Lake Snowmobile Park	4.8E-07	1.2E-05	5.7E-10	1.0E-07	1.0E-07	1.7E-10	1.6E-05	1.6E-05

Table 37. Estimated Maximum Acute Hazard Index at Point of Maximum Impact for Each Substance and Affected Organ or System at Receptor 8 (Grouse Hill)

Substance	Central Nervous System	Immune System	Kidney	Liver	Respiratory Irritation
Hydrogen sulfide					7.2E-01
Mercury	3.7E-03		3.7E-03	3.7E-03	3.7E-03
Nickel		*3.5E-05*			
Selenium					*4.4E-06*
Ammonia					2.6E-02
Copper					*1.1E-06*
Xylene					1.9E-05
Hydrochloric Acid					*5.8E-10*
Sulfate					7.6E-03
Total Hazard Index for Non-Criteria Pollutants	**3.7E-03**	**3.5E-05**	**3.7E-03**	**3.7E-03**	**7.6E-01**
Ozone					5.6E-01
Total Hazard Index for Non-Criteria Pollutants plus Background Ozone	**3.7E-03**	**3.5E-05**	**3.7E-03**	**3.7E-03**	**1.3E+00**
Sulfur dioxide					2.0E-02
Nitrogen dioxide					3.9E-01
Total Hazard Index for Non-Criteria Pollutants plus Facility Emitted Criteria Pollutants	**3.7E-03**	**3.5E-05**	**3.7E-03**	**3.7E-03**	**1.2E+00**

0.56) to the total acute hazard index presented in Table 37 yields a higher total hazard index of 1.3. Although the *CAPCOA Guidelines* do not require it, logic suggests that criteria pollutants emitted by the facility should also be considered. However, the nitric oxide (NO) emissions from the drill rig in the worst case scenario would immediately react with any ozone present at the point of maximum impact (and at farther distances downwind), reducing it to molecular oxygen (O_2). (This is referred to as "ozone scavenging.") Including the estimated maximum one-hour average concentration of sulfur dioxide and nitrogen dioxide in the calculation of the total acute hazard index results in a value of 1.3 for the toxicological endpoint of respiratory irritation. Table 37 presents the total acute hazard indices calculated by each of these methods.[21]

These results suggest the possibility of respiratory irritation if a person where located at this receptor when normal or upset plant operations occurred concurrently with the drilling of an infill well and two wells venting, worst-case meteorological conditions, and the annual average ozone concentrations. However, this effect is not expected to occur, because it is very unlikely that all of the conditions necessary to produce this effect would occur concurrently, and because adverse health effects have not been observed at concentrations near the acute REL.

Drilling of infill wells is expected to occur, on the average, once every several years and last about six weeks (this represents about five percent of the time). Venting of wells is also expected to occur infrequently. (Flow testing of infill wells would not occur concurrently with drilling, because no more than one infill well would be drilled at a time and a well could not be flow tested until the drilling was completed.) In most cases, venting of a production well would *decrease* the emission rates from the power plant because that well would be off-line, reducing the steam flow to the plant.

Worst-case meteorological conditions generally occur at night and are more frequent during the winter months, when ambient ozone concentrations are usually quite low. This would limit the formation of NO_2 to concentrations much lower than the maximum concentrations estimated. Grouse Hill is not a heavily used recreation area, and is probably only rarely used (if at all) during the winter or at night. Thus, the likelihood of a human receptor being present at the point of maximum impact when the worst-case scenario occurs (if ever), is very low, and the actual impacts would likely be much less than estimated.

The hydrogen sulfide ambient air quality standard is based on odor, not on respiratory irritation. The acute Reference Exposure Level (REL) for hydrogen sulfide has been set equal to the California ambient air quality standard. The lowest hydrogen sulfide concentration for which respiratory irritation associated with short-term exposure has been reported in a scientific study is about 2.5 parts per million (83 times higher than the ambient air quality standard and the acute REL).[22]

Total hazard indices for all other toxicological endpoints are much lower, indicating that no other adverse health effects are expected, even under the unlikely worst-case scenario.

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[21]In the table, "noncriteria pollutants" refers to the substances present in the geothermal resource that are expected to be emitted from the proposed facility, including hydrogen sulfide. Strictly speaking, however, hydrogen sulfide and sulfates are *criteria* pollutants, because there are California ambient air quality standards for hydrogen sulfide and sulfates.

[22]Bhambhani Y, and Singh M. 1985. Effects of hydrogen sulphide on selected metabolic and cardio-respiratory variables during rest and exercise. Report submitted to Alberta Worker's Health and Safety and Compensation. June, 1985. Cited by Alberta Health (1990).

The same calculations for the other five nearby receptor locations presented in Table 32 were completed and are presented in Table 38. All results were less than one (indicating that adverse health effects are not expected under any circumstances), except for the receptor 20 (Forest Service Road 49 near the power plant) when the effects of all project-emitted criteria pollutants were considered. For the reasons stated above for receptor 8, the actual maximum concurrent ambient pollutant concentrations would likely be much lower than estimated, and thus acute hazard index would be much lower.

The CEQA guidelines provide no guidance on the assessment of the significance of estimated acute hazard indices.

Radon

As discussed in Section 2.0 of this appendix, the Cal-EPA has not published the toxicity data for radon that would be necessary for it to be included in the quantitative risk assessment calculations.

The. highest estimated contribution to annual average radon concentration in ambient air associated with emissions from the proposed project is about $5x10^{-12}$ $\mu g/m^3$ or 0.0008 pCi/l (at the top of Fourmile Hill). The highest estimated contribution at any location where continuous or near-continuous occupation is expected is $1.9x10^{-13}$ $\mu g/m^3$ (0.00003 pCi/l) at the Medicine Lake Cabins. These concentrations are more than three orders of magnitude below the level at which the U.S. Environmental Protection Agency recommends corrective measures. Therefore, radon emissions from the proposed project are not expected to have a significant impact on radon concentrations in ambient air.

Table 38. Estimated Maximum Acute Hazard Index for Each Affected Organ or System at Six Receptor Locations Close to the Proposed Project

Substance	Estimated Maximum Total Acute Hazard Indices					
	Receptor 4 (Medicine Lake Cabins)	Receptor 5 (Little Medicine Lake)	Receptor 8 (Grouse Hill)	Receptor 11 (Goshawk Nest)	Receptor 12 (Fourmile Hill)	Receptor 20 (FS Rd 49)
Respiratory Irritation	5.9E-01	6.1E-01	1.3E+00	6.1E-01	8.9E-01	1.1E+00
Central Nervous System	8.0E-05	7.2E-05	3.7E-03	1.0E-04	1.9E-03	1.2E-03
Immune System	7.6E-07	6.8E-07	3.5E-05	9.7E-07	1.8E-05	1.1E-05
Kidney	8.0E-05	7.2E-05	3.7E-03	1.0E-04	1.9E-03	1.2E-03
Liver	8.0E-05	7.2E-05	3.7E-03	1.0E-04	1.9E-03	1.2E-03

4.0
Estimated Impacts on Visibility

Potential effects of project emissions on visibility were assessed using the Level 2 analysis procedure recommended by the U.S. Environmental Protection Agency.[23] For single sources, impacts on visibility are assessed by evaluating the perceptibility of the plume against a bright sky background and a dark terrain background. The EPA's VISCREEN model was used to perform this evaluation. VISCREEN evaluates plume perceptibility by estimating plume/background contrast at three light wavelengths, and then compares the overall brightness contrast and color difference (ΔE) to empirically-derived human perception thresholds. The thresholds used in the model as screening criteria have been developed with recognition of, and adjustment for, the fact that casual observers are less likely to notice a plume that they are not looking for than are trained observers.

VISCREEN requires input of the total emissions of primary particulate matter, nitrogen oxides, primary nitrogen dioxide, soot, and primary sulfate.[24] Soot (elemental carbon particles) strongly affects plume visibility, and diesel smoke is primarily soot. Therefore, the PM_{10} emission rates estimated for the diesel generators were input as soot. Diesel exhaust contains little or no primary NO_2; the NO_x present in the exhaust is nearly all in the form of nitric oxide (NO). The NO_x emissions were all input as NO, as recommended in the EPA guidance cited above. Internally, the VISCREEN model assumes that 10% of the NO_x emissions are emitted as primary NO_2 or are converted to NO_2 in-plume. The project is not expected to emit primary sulfate compounds.

Worst-case emission scenarios for each of the three years of construction were input to the model, as well as four scenarios for the plant after startup: normal operation, a dual-turbine outage upset, normal operation while drilling an infill well, and a dual-turbine outage upset while venting two wells. The distance to the observation point was input as 8.1 kilometers, corresponding to the distance from the proposed power plant to the southwest corner of the Lava Beds National Monument and Wilderness Areas ("Lava Beds").

In a Level 1 analysis, a default worst-case meteorological scenario is used in VISCREEN. In the Level 2 analysis performed for the proposed project, hourly meteorological scenarios (measured by the on-site meteorological monitoring program conducted for this project) that include wind directions which could not transport project emissions towards Lava Beds were eliminated. (Wind directions blowing in the general direction of Lava Beds prevail about one third of the time in the area of the proposed project.) The remaining meteorological data were sorted from least favorable to most favorable dispersion conditions for the time periods midnight to 6:00 AM, 6:00 AM to noon, noon to 6:00 PM, and 6:00 PM to midnight (local standard time). Then, for each of the four

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[23]U.S. Environmental Protection Agency, 1992. *Workbook for Plume Visual Impact Screening and Analysis (Revised).* EPA-454/R-92-023.

[24]*Primary* pollutants refer to those emitted directly from a source. *Secondary* pollutants are those that are formed from primary pollutants after some residence time in the atmosphere (and frequently after reaction with other pollutants or atmospheric constituents).

time periods, the meteorological scenarios that make up the least favorable 1% of the scenarios were eliminated. The least favorable scenarios remaining for each of the four time periods were F stability and 2 meters per second (m/s) wind speed for the midnight to 6:00 AM and 6:00 PM to midnight time periods, and D stability at 1 m/s and 3 m/s, respectively for the 6:00 AM to noon and noon to 6:00 PM time periods. The least favorable of these scenarios (F stability and 2 m/s) was used as input to VISCREEN.

The results of this analysis indicate that a plume from the project area may be visible from the southwest corner of Lava Beds under some meteorological conditions during each year of development and construction, as well as under each of the scenarios after plant startup. During development and construction, the model results indicate that the plume may be visible both outside Lava Beds, and within its boundaries. For each of the post-startup scenarios described above, the VISCREEN results indicated that the plume would only be visible close to the source, and not within Lava Beds. In a Level 2 visibility analysis, no attempt is made to assess the frequency of occurrence of a visible plume. The output of the VISCREEN model is presented as Attachment 1 to this appendix.

Experience with drill rig operations in applications similar to the proposed project is not consistent with these results. Although diesel engines are can produce visible smoke near the source when under heavy load or when operated improperly, plumes visible at considerable distances from the rigs have not been observed at similar projects in the Geysers KGRA, where geothermal operations have been ongoing for many years.[25]

VISCREEN, as its name implies, is a screening model. This means that it is intended to be relatively simple to use and require relatively simple input data, while quickly identifying those projects that will *not* cause visible plume impacts. More sophisticated models (such as EPA's PLUVUE II) eliminate many of these assumptions, but require much more extensive input data. The following (quoted from EPA's *Workbook for Plume Visual Impact Screening and Analysis*) describes the conservatism of the VISCREEN model.

"VISCREEN was designed to be conservative by making the following model assumptions:

1. It is assumed that the line of sight is horizontal so that it intersects the most plume material. Nonhorizontal lines of sight intersect less plume material because horizontal dispersion of plumes exceeds vertical dispersion, especially under stable conditions.

2. NO_2 conversion is conservatively treated by assuming the plume is uniformly mixed in the 22.5° sector. This enhanced dispersion mixes the plume with more ambient O_3, resulting in greater conversion. However, the assumed enhanced dispersion does not decrease the line-of-sight integral of plume material for the assumed horizontal viewing directions. Only the vertical dimensions of the plume determine the magnitude of the plume material that intersects the horizontal line of sight.

3. Worst-case sun (scattering) angles are assumed. The forward scatter case (θ=10°) yields very bright plumes because the plume is placed nearly directly in front of the observer. This geometry would rarely occur in reality. The backward scatter case (θ=140°) yields the darkest possible plumes. Thus, the screening calculations are likely to yield the brightest and

[25]Reynolds, Robert (Lake County Air Pollution Control Officer), 1997. Personal communication. March 26.

darkest possible plumes. It is left to more detailed PLUVUE modeling to identify realistic worst-case sun angles that would occur at specific times of interest.

4. Multiple scattering is ignored in VISCREEN. Light scattered into the line of sight from directions other than directly from the sun tend to slightly decrease the plume contrast for the worst-case sun angles assumed.

5. For terrain viewing backgrounds, the terrain is assumed to be black (the darkest possible) and located as close to the observer and plume as possible . This assumption yields the darkest possible background against which particulate plumes are likely to be most visible. In reality, terrain viewing backgrounds (if indeed terrain is behind the plume) would be less dark and would be located farther from the observer.

6. Meteorological conditions are assumed to persist for at least 12 hours. After 12 hours, some additional dispersion is assumed in VISCREEN (by increased wind speeds), but the plume is still considered to remain intact. More realistic treatment of the persistence of worst-case conditions would most likely yield lower plume visual impacts.

7. Default meteorological conditions assumed for the most conservative Level-1 screening (F, 1 m/s, γ=11.25°) are extreme and are expected to be more conservative than worst-case conditions identified in the more realistic Level-2 and Level-3 analyses.

8. The screening threshold (ΔE=2; contrast of 0.05) was selected at the upper bound of perceptibility threshold, representing a reasonable estimate for casual observers in the field."

In the quoted text, θ is the angle between the plume centerline and the sun. Thus, θ=10° means that the sun is assumed to be shining almost directly along the axis of the plume. This can only occur when the sun is very low in the sky (*i.e.*, at dawn or dusk, or at very high latitudes). In the area of the proposed project, θ=10° could only occur at dawn or dusk, under conditions of east or west winds, respectively. Neither of these wind directions would transport the plume towards Lava Beds National Monument.

The notation (F, 1 m/s, γ=11.25°) in number 7 refers to "F" atmospheric stability category and a wind speed of 1 m/s (about 2 mph). γ is the angle formed by the observer, the source and the plume axis. γ=11.25° indicates that the plume is headed very close to, but not directly at, the observer. F stability category can occur only during nighttime hours (including up to an hour before sunset and an hour after sunrise). Meteorological monitoring data collected at the proposed project site indicates that for an observer located anywhere within Lava Beds National Monument, the scenario (F, 1 m/s, γ=11.25°) could occur about 0.9% of the time during the hours of midnight and 6:00 AM, about 0.4% of the time between 6:00 PM and midnight. This scenario did not occur at all during the hours of 6:00 AM and 6:00 PM during the year of monitoring at the proposed project site.[26]

Based on the Level 2 VISCREEN analysis, the impact of the emissions from the proposed project on visibility in the Lava Beds National Monument and Wilderness Areas is considered a potentially significant impact.

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[26]As described above, the VISCREEN default worst-case meteorological scenarios are not used in a Level 2 analysis; rather, a worst-case scenario is selected from site-specific meteorological data. For this analysis, the scenario was (F, 2 m/s, γ=11.25°).

From an air quality perspective, the alternatives to the proposed action would not change the frequency, magnitude or nature of most impacts. Emissions from the power plant and steam field, during construction and after plant startup, would be same for each alternative.

As discussed in Section 3.2 of this appendix, construction of the transmission lines could cause exceedances of the California 24-hour PM_{10} standard close to the right-of-way (within about 100 meters) for one or several days during the two summers of construction. The locations of these impacts would be determined by the transmission line route. Thus, the potentially impacted areas could include some areas of the Medicine Lake campground under Alternatives 1, 2, 3, and 4. In Alternatives 5 and 6, the transmission line corridor would pass north of Mt. Hoffman, and therefore eliminate potential impacts to the Medicine Lake campground area. Alternatives 1, 3, and 5 include transmission line corridor alignments passing near Tionesta, while Alternatives 2, 4, and 6 include alignments near Dry Lake. In any event, the fugitive dust impacts associated with transmission line construction would be mitigated by a dust control program which is expected to reduce this impact to less than significant at any receptor point (as discussed in the following section.)

As discussed in Section 4 of this appendix, the visibility analysis performed for the proposed project indicates a potentially significant impact associated with NO_x and particulate matter emissions from onsite sources (primarily drilling rigs) during construction, well drilling and worst-case plant upset conditions. This impact would be the same under each of the alternatives (except the no-action alternative).

The estimated impacts of emissions of all pollutants from the onsite sources associated with plant and well field construction, and plant operation, would be the same under each of the alternatives (except the no-action alternative).

The no-action alternative would avoid the air quality impacts discussed in this section.

Section 4 of this appendix presents the estimated impacts of the proposed project on ambient air quality. The only potentially significant impact identified was the impact of fugitive dust emissions associated with transmission line construction on short-term (24-hour average) ambient PM_{10} concentrations. Section 5 presents the assessment of potential impacts of the proposed project on visibility within Lava Beds National Monument. The impacts of project construction were found to be potentially significant, as was the impact of plant operation during upset conditions and during the drilling of infill wells.

6.1 Mitigation of Fugitive Dust Impacts Associated with Transmission Line Construction

The primary activities contributing to fugitive dust impacts during transmission line construction are expected to be access road construction, tower pad preparation, tower erection, and vehicle traffic (worker vehicles and logging trucks). Section 2 of the DEIS/DEIR discusses these activities. The estimated PM_{10} impacts presented in Table 21 are the maximum potential incremental 24-hour average PM_{10} impacts at various distances from the right-of-way centerline with *no* fugitive dust controls.

The U.S. Forest Service has indicated that they will require that a fugitive dust control program be implemented during transmission line construction, similar to those required during logging operations.[27] The program will require control measures such as watering roadways or application of dust palliatives, as necessary to eliminate significant fugitive dust emissions. It is expected that with this mitigation, transmission line construction impacts on ambient PM_{10} concentrations will not be significant.

6.2 Mitigation of Visibility Impacts

The primary sources of emissions associated with the potentially-visible plumes identified by the VISCREEN model are the drill rigs and the plant backup diesel generator. The NO_x and PM_{10} emission rates used in the analyses presented in this appendix are most likely overestimated, due to the conservative assumptions used to estimate them.

For reasons that are discussed in Section 5 of this appendix, the visibility impacts are believed to be overestimated by the VISCREEN model. Significant visibility impacts have not been observed at similar projects in the Geysers KGRA.[28] If, as expected, the proposed project did not produce significant visibility impacts, mitigation would not be necessary.

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[27]Sharp, Randall., 1997. Comments at meeting held March 20, Redding, CA. U.S. Forest Service.

[28]Reynolds, Robert, 1997. Personal communication. March 28. Lake County Air Pollution Control District.

The potentially significant visibility impact identified by the VISCREEN analysis is due to NO_x and PM_{10} emissions. NO_x would be emitted from drill rigs (during well field development and when drilling infill wells after plant startup) and from the plant backup generator during plant construction (when it may be used to produce electrical power for construction equipment), periodic testing, and during dual-turbine plant upsets.

Prior to plant startup, the dominant sources of PM_{10} would be fugitive dust from construction activities and onsite vehicle travel, and drill rig engines. Well flow testing and the diesel generator would be minor sources of PM_{10}. After plant startup, PM_{10} emissions would be much lower. About half of the total PM_{10} emissions during normal operation would be from fugitive dust emissions from vehicle traffic onsite, with the emissions from the cooling tower and plant vent silencer making up the other half. Under upset conditions, emissions from the plant vent silencer would be the dominant source.

In general, there are two ways emissions of a pollutant can be reduced: reduction of the source extent, or increased control of emissions. Reduction of source extent refers to minimizing the pollution-causing activity or process (*e.g.*, minimizing the number of hours of operation of an industrial boiler). Emissions control can be accomplished, in some cases, by the design or manner of operation of a process or device so that it produces less of a pollutant per unit of production. In some cases, emissions control can be accomplished by abatement systems that remove a pollutant from an exhaust stream.

Reduction of Source Extent

In the case of the drill rigs, the maximum hourly and daily emissions could be mitigated in the third year of well field development by using two rigs instead of three. If this were necessary, Calpine would then have to drill throughout the winter in order to complete enough wells to begin plant operation the following spring. Due to the severity of the winter in the proposed project area, this strategy is undesirable due to issues of worker safety, and equipment and employee access requirements, and is considered a last resort. The use of only two drill rigs in the third year would not reduce the total project PM_{10} and NO_x emissions; rather, it would "spread out" the emissions associated with the most active phase of drilling over a longer time period.

In the case of the plant backup generator, there would be no practical way to reduce the hours of operation. During plant construction, the generator would supply power for tools and equipment until the transmission line was completed and would therefore be essential. After plant startup, the generator would only be operated in the case of transmission line failure (and during periodic testing and maintenance of the generator).

In the case of fugitive dust emissions associated with vehicle travel on site, reduction of source extent would mean reducing the vehicle-miles traveled. It is unlikely that reductions below the levels presently planned could be practically achieved, because Calpine has already planned to use crew buses to transport workers to and from the site (to the extent possible), and the worker vehicle travel on site that is currently planned will be necessary to successfully and safely construct and operate the well field and power plant.

Reduction of the source extent for the cooling tower and plant vent silencer would mean reducing the operation of the power plant. This would not be feasible, for obvious reasons. Plant upsets

(the scenarios producing the highest short-term emission rates) are undesirable events that would be avoided as much as possible for many reasons, including air quality impacts.

Emissions Control Technology

Reduction of NO_x emissions from the drill rig engines and plant backup generator may be mitigated by emission controls.

Pursuant to Section 107 of the 1990 Clean Air Act, the U.S. Environmental Protection Agency has published a study of alternative control techniques (ACT) for stationary reciprocating engines.[29] The study identifies two control technologies for NO_x emissions from diesel engines: injection timing retard and selective catalytic reduction.

Injection timing retard refers to adjusting an engine's timing such that the fuel is injected into the cylinder later in the cycle, while the piston is traveling downward. Generally, the amount of retardation (relative to standard timing) is 3° to 6°. This reduces NO_x emissions because the combustion takes place at a lower temperature, resulting in less conversion of nitrogen and oxygen present in the intake air to react to form nitric oxide (NO).[30] In some cases, an engine can be adjusted to run satisfactorily by simply retarding the timing by a set amount, but some engines must be retrofitted with a sophisticated engine timing controller in order to avoid smoking and/or difficult starting. Injection timing retardation may result in a decrease in engine power output and a commensurate increase in brake-specific fuel consumption (fuel use rate per horsepower produced). Injection timing retard reduces NO_x emissions by 20 to 30%. Using EPA figures, the cost of fitting injection timing retard to a typical drill (with three 850-horsepower engines), would be about $36,000 per rig. The total annual operating cost would be about $30,000 per rig. The total cost of NO_x control would be about $1,000 per ton of NO_x controlled.

The U.S. Environmental Protection Agency emission factors used to estimate diesel engine NO_x emissions for the proposed project (as described in Section 2.1 and presented in Tables 6 and 12), are for engines with NO_x control by injection timing retard. Thus, this control technology has been included in the emissions estimates presented here and used as input to the visibility and dispersion models.

Selective catalytic reduction is a system in which ammonia is injected into the engine exhaust. In the presence of a base metal or zeolite catalyst, the NO_x in the exhaust reacts with the ammonia to form molecular nitrogen (N_2) and water. SCR systems can reduce NO_x emissions by about 80 to 90%. SCR causes a decrease of power output and an increase of brake-specific fuel consumption, due to the increase exhaust system back pressure caused by the catalyst bed. The system requires power to run the pumping equipment used to feed and vaporize the ammonia.

At the time of publication of EPA's Alternative Control Technique document (1993), only nine applications of SCR on diesel engines were identified in the United States, and another 10 in foreign countries.

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[29]U.S. Environmental Protection Agency, 1993. *Internal Combustion Engines Alternative Control Techniques* Office of Air Quality Planning and Standards, Control Technology Center. EPA-453/R-93-032.

[30]In a diesel engine, injection timing retardation delays ignition of the fuel-air charge, thus it is sometimes referred to as "ignition timing retard."

Based on data presented by EPA and the size and expected hours of operation for the proposed project, data presented in the EPA ACT document indicate that SCR would cost roughly $250,000 per rig to install and $300,000 per rig annually to operate. (An equipment vendor in California estimated the installed equipment price to be about $200,000 per engine, or more than twice the EPA figure.[31]) Using EPA data, the total cost of NO_x control would be on the order of about $4,000 per ton of NO_x controlled.[32] Most likely, the cost of installation and operation for a transportable source such as a drill rig would be higher than the estimated costs cited here.

The use of SCR would have adverse logistical and environmental consequences. Operation of a SCR system would require ammonia, a hazardous material which would have to be transported to, and stored at, the project site. Operation of a single drill rig would require several hundred pounds of ammonia per day. Use of two or three rigs during the third year of construction would require proportionately more ammonia.

SCR systems require careful control of NO_x/NH_3 ratio. If too little ammonia is injected, the control efficiency decreases. If too much is injected, the excess ammonia is emitted to the atmosphere. This is referred to as "ammonia slip." The excess ammonia may react with sulfur or other compounds in the exhaust or atmosphere to form ammonium compounds, creating PM_{10}. For this reason, SCR is most successfully used in applications with relatively constant NO_x emissions and exhaust conditions. Control of the appropriate NO_x/NH_3 ratio would probably be difficult on a drill rig, where the load on the engines varies considerably over short periods of time.

Catalysts used in SCR systems have a finite lifetime. With time, the catalyst bed becomes less effective until it eventually must be replaced. Depending on the catalyst, disposal as a hazardous waste may be required. According to EPA,

> "While spent precious metal and zeolite catalysts are not considered hazardous waste, it has been argued that vanadium- and titanium-based catalysts are classified as hazardous waste and therefore must be handled and disposed of in accordance with hazardous waste regulations. According to the Best Demonstrated Available Technology (BDAT) Treatment Standards for Vanadium P119 and P120, spent catalysts containing vanadium pentoxide are not classified as hazardous waste.
>
> State and local agencies are authorized to establish their own hazardous waste classification criteria, however, and spent catalyst material may be classified as a hazardous material in some areas. For example, the State of California has reportedly classified spent catalyst material containing vanadium pentoxide as a hazardous waste."[33]

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[31]Rayford, Robert, 1997. Personal Communication. March 31. Quinn Power Systems, Fresno, CA.

[32]These figures are based on the assumption that the engines would have to be individually fitted with SCR systems. The cost data provided by EPA are for stationary installations. Designed transportable systems for a drill rig would probably tend to increase the cost, while sharing some of the abatement system components (if possible) would probably tend to lower the costs.

[33]U.S. Environmental Protection Agency, 1993. *Internal Combustion Engines Alternative Control Techniques* Office of Air Quality Planning and Standards, Control Technology Center. EPA-453/R-93-032.

SCR systems can cause a variety of operational problems when used with diesel engines, particularly in load-varying applications. The problems include plugging of the catalyst bed, poisoning of the catalyst, and engine overheating.[34]

The EPA's alternative control technique study identified no control technologies for PM_{10} from stationary diesel engines.

In order to assess where and in what situations these control technologies have been required elsewhere in the country, the author reviewed all entries in the U.S. Environmental Protection Agency's RACT, BACT and LAER Clearinghouse (RBLC) data base and the California Air Resources Board's BACT data base for diesel engines.[35] There were about 50 control technology determinations for large, stationary diesel engines in these two data bases. (Determinations made in California appeared in both data bases.)

The most common types of stationary diesel engine listed in the RBLC data base were emergency or backup generator engines. In each case, the BACT determination was "no feasible controls" for NO_x and PM_{10} In some cases, limitation of emissions was achieved by limiting the total number of operations or fuel burned. Examples of BACT determinations for this type of engine are:

- In 1987, the Alaska Department of Environmental Quality determined that no controls were feasible for three 2,300 kW diesel generators permitted for a mining operation on Admiralty Island, and for a 1,000-kW generator at a petroleum refinery at North Pole, Alaska.
- In 1990, the Connecticut Bureau of Air Management determined that no controls were feasible for a 1,600 MMBtu/hr diesel generator installed by the U.S. Department of Energy in Windsor, CT.

For large diesel engines that are temporary or intermittent sources, injection timing retardation has sometimes been required. For instance:

- In 1989, the Florida Department of Environmental Regulation required timing retardation for two 13,266-horsepower generators installed by the Key West Electric System. (The generators most likely were peaking units used to provide additional capacity only at times of peak electrical demand.)
- In 1994, the Feather River Air Quality Management District required 4 degrees of injection timing retard for a 600-kW Caterpillar generator at an aggregate processing facility.
- In 1990, the Monterey Bay Unified Air Pollution Control District required 6 degrees of injection timing retard for a 480-horsepower and a 400-horsepower diesel engine on an exploration oil drilling rig.

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[34]Steele, Jerry, 1997. Personal communication. Monterey Bay Unified Air Pollution Control District.

[35]RACT, BACT and LAER are acronyms for Reasonably Available Control Technology, Best Available Control Technology, and Lowest Achievable Emission Rate, respectively. RACT, BACT and LAER are emission levels and/or control technologies that have been formally identified by a permitting agency as being feasible for controlling emissions and required for a permitted source. LAER represents a much more stringent level of control that RACT or BACT. Only BACT determinations were included in the RBLC data base for internal combustion sources burning diesel fuel (probably because no RACT or LAER determinations have been made to date for this source type).

- In 1989, the Monterey Bay Unified Air Pollution Control District (MBUAPCD) required 5 degrees of individual ignition timing retard for three 850-horsepower diesel engines on a drill rig. (The three Caterpillar D398TA engines used for this source are the same as the engines that would most likely be used on drill rigs at the Fourmile Hill project.)
- In 1991, the San Joaquin Valley Unified Air Pollution Control District required fuel injection timing retard of 4° or more, turbocharging, intercooling and aftercooling for a 950-horsepower diesel generator being used at an asphalt batch plant to produce electrical power until a the local utility could provide service to the site. The plant was being moved to a new location, and the engine was part of the equipment that was moved. The BACT determination found that selective catalytic reduction was not economically feasible.
- In 1989, the Hawaii Clean Air Branch required "variable FITR" (variable fuel injection timing retard), for four 7.86-MW diesel generators installed by Citizens Utilities Company on the island of Kauai. In 1991, variable FITR, turbocharging and intercooling were required for four more 7.86-MW generators installed at the same station. In 1995, variable FITR and "intake air cooling" was required for three 2.26-MW generators installed on Molokai.

For very large engines that are expected to be in frequent or long-term, continuous use, or in areas that have serious ozone problems, more stringent controls have been required in some instances. Examples include:

- In 1989, California's South Coast Air Quality Management District (SCAQMD) required a selective catalytic reduction system (SCR) for a 2,100-horsepower Caterpillar diesel engine. The system was expected to reduce NO_x emissions by 80%. No PM_{10} reductions were estimated.
- In 1990, the SCAQMD required SCR for three diesel engines totaling 7,040 horsepower. The engines were manifolded together so that they shared a common emission control system. This system was expected to reduce NO_x emissions by 94% and PM_{10} emissions by 80%.[36]
- In 1992, the Philadelphia Department of Public Health required SCR for seven 1,635 kW (each) diesel generators installed at a water treatment plant, and for eleven 1,165-kW engines installed at another plant. The SCR system was expected to reduce NO_x emissions by 80%. No reductions of PM_{10} emissions were estimated.

It is clear, from the foregoing examples and a more thorough review of the data base, that Best Available Control Technology for NO_x emissions from diesel engines has varied from no controls to very stringent controls. In general, no controls have been required for emergency generators. Some temporary and intermittent sources have been required to use retarded injection timing, and in some cases, intercoolers and/or aftercoolers. Only large sources or sources in areas with serious ozone pollution problems have been required to use the much more expensive selective catalytic reduction technology.

Interestingly, the requirements for turbochargers, intercoolers, intake air coolers, and aftercoolers that appear in some of the BACT determinations are not mentioned at all in EPA's Alternative Control Technology document, even though several of the determinations predate the EPA document. This may be because EPA considers these devices to be part of the intrinsic design of the engines, and not control emissions control technology. At any rate, the diesel engines used on drill rigs typically are turbocharged and aftercooled.

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[36]The permittee and the District apparently expected that the catalyst bed would remove particulate matter from the exhaust stream.

The two BACT determinations for drill rigs in the Monterey Bay Unified Air Pollution Control District are the most similar and relevant to the drill rigs at the proposed facility. Both require injection timing retard. MBUAPCD required injection timing retard in both instances.

One other potential method for greatly reducing NO_x emissions from drill rigs would be to use lean-burn, spark-ignited engines burning natural gas fuel. Lean-burn gas engines reportedly can produce NO_x emissions as low as 1 to 2 grams per brake horsepower-hour (g/bhp-hr).[37] This is about 17 to 34% of the expected emission rate achievable with a diesel engine using injection timing retard. No drilling contractors have been identified to date that can provide gas-powered drill rigs, and it is unknown how such engines would perform in this application.

Based on review of the economic, logistical, and environmental consequences of the control technologies available for diesel engines, as well as historical requirements for their use, it appears that injection timing retard is the only proven and feasible NO_x emission control technique for diesel engines in this application. SCR does not appear to be feasible because 1) it is very expensive, 2) it is not proven for load-varying applications such as drill rigs, 3) it would require the transport and handling of an additional hazardous material to and at the project site, 4) it may produce a hazardous waste, and 5) PM_{10} emissions may be increased, due to ammonia slip. As noted above, the emissions estimates presented in this document were prepared with the assumption that diesel engines with ignition timing retard will be used.

If the potential visible plume impact identified by the VISCREEN model actually occurred in the Fourmile Hill project area, Calpine would attempt to change over to gas-fired drill rigs. There is no guarantee that a gas-fired rig appropriate for the project would be available. All other feasible NO_x and PM_{10} mitigation measures have already been incorporated into the project design. Thus, the visibility impact, if it occurs, might be an unavoidable impact.

[37]Rayford, Robert, 1997. Personal Communication. March 31. Quinn Power Systems, Fresno, CA.

Attachment A

VISCREEN Model Output

Visual Effects Screening Analysis for
Source: Construction, Year 1
Class I Area: SW Corner Lava Beds

*** User-selected Screening Scenario Results ***

Input Emissions for

Particulates	85.20	LB /DAY
NOx (as NO2)	530.40	LB /DAY
Primary NO2	.00	LB /DAY
Soot	28.60	LB /DAY
Primary SO4	.10	LB /DAY

PARTICLE CHARACTERISTICS

	Density	Diameter
Primary Part.	2.5	6
Soot	2.0	1
Sulfate	1.5	4

Transport Scenario Specifications:

Background Ozone:	.05 ppm
Background Visual Range:	200.00 km
Source-Observer Distance:	8.10 km
Min. Source-Class I Distance:	8.10 km
Max. Source-Class I Distance:	28.40 km
Plume-Source-Observer Angle:	11.25 degrees
Stability:	6
Wind Speed:	2.00 m/s

R E S U L T S

Asterisks (*) indicate plume impacts that exceed screening criteria

Maximum Visual Impacts INSIDE Class I Area
Screening Criteria ARE Exceeded

					Delta E		Contrast	
Backgrnd	Theta	Azi	Distance	Alpha	Crit	Plume	Crit	Plume
SKY	10.	164.	28.4	4.	2.00	1.073	.05	-.017
SKY	140.	164.	28.4	4.	2.00	1.565	.05	-.050*
TERRAIN	10.	164.	28.4	4.	2.00	4.682*	.05	.044
TERRAIN	140.	164.	28.4	4.	2.00	1.374	.05	.021

Maximum Visual Impacts OUTSIDE Class I Area
Screening Criteria ARE Exceeded

					Delta E		Contrast	
Backgrnd	Theta	Azi	Distance	Alpha	Crit	Plume	Crit	Plume
SKY	10.	2.	1.0	167.	2.00	3.372*	.05	-.040
SKY	140.	2.	1.0	167.	2.00	4.796*	.05	-.122*
TERRAIN	10.	2.	1.0	167.	2.00	15.850*	.05	.099*
TERRAIN	140.	2.	1.0	167.	2.00	3.428*	.05	.028

Visual Effects Screening Analysis for
Source: Construction, Year 2
Class I Area: SW Corner Lava Beds

*** User-selected Screening Scenario Results ***

Input Emissions for

Particulates	92.20	LB /DAY
NOx (as NO2)	764.40	LB /DAY
Primary NO2	.00	LB /DAY
Soot	41.20	LB /DAY
Primary SO4	.20	LB /DAY

PARTICLE CHARACTERISTICS

	Density	Diameter
Primary Part.	2.5	6
Soot	2.0	1
Sulfate	1.5	4

Transport Scenario Specifications:

Background Ozone:	.05 ppm
Background Visual Range:	200.00 km
Source-Observer Distance:	8.10 km
Min. Source-Class I Distance:	8.10 km
Max. Source-Class I Distance:	28.40 km
Plume-Source-Observer Angle:	11.25 degrees
Stability:	6
Wind Speed:	2.00 m/s

R E S U L T S

Asterisks (*) indicate plume impacts that exceed screening criteria

Maximum Visual Impacts INSIDE Class I Area
Screening Criteria ARE Exceeded

					Delta E		Contrast	
Backgrnd	Theta	Azi	Distance	Alpha	Crit	Plume	Crit	Plume
SKY	10.	164.	28.4	4.	2.00	1.864	.05	-.032
SKY	140.	164.	28.4	4.	2.00	2.154*	.05	-.069*
TERRAIN	10.	164.	28.4	4.	2.00	5.555*	.05	.053*
TERRAIN	140.	164.	28.4	4.	2.00	1.889	.05	.029

Maximum Visual Impacts OUTSIDE Class I Area
Screening Criteria ARE Exceeded

					Delta E		Contrast	
Backgrnd	Theta	Azi	Distance	Alpha	Crit	Plume	Crit	Plume
SKY	10.	2.	1.0	167.	2.00	4.283*	.05	-.070*
SKY	140.	2.	1.0	167.	2.00	5.737*	.05	-.157*
TERRAIN	10.	2.	1.0	167.	2.00	17.808*	.05	.114*
TERRAIN	140.	2.	1.0	167.	2.00	4.210*	.05	.036

Visual Effects Screening Analysis for
Source: Construction, Year 3
Class I Area: SW Corner Lava Beds

*** User-selected Screening Scenario Results ***

Input Emissions for

Particulates	123.30	LB /DAY
NOx (as NO2)	1825.20	LB /DAY
Primary NO2	.00	LB /DAY
Soot	98.30	LB /DAY
Primary SO4	.20	LB /DAY

PARTICLE CHARACTERISTICS

	Density	Diameter
Primary Part.	2.5	6
Soot	2.0	1
Sulfate	1.5	4

Transport Scenario Specifications:

Background Ozone:	.05 ppm
Background Visual Range:	200.00 km
Source-Observer Distance:	8.10 km
Min. Source-Class I Distance:	8.10 km
Max. Source-Class I Distance:	28.40 km
Plume-Source-Observer Angle:	11.25 degrees
Stability:	6
Wind Speed:	2.00 m/s

R E S U L T S

Asterisks (*) indicate plume impacts that exceed screening criteria

Maximum Visual Impacts INSIDE Class I Area
Screening Criteria ARE Exceeded

					Delta E		Contrast	
Backgrnd	Theta	Azi	Distance	Alpha	Crit	Plume	Crit	Plume
SKY	10.	164.	28.4	4.	2.00	5.336*	.05	-.098*
SKY	140.	164.	28.4	4.	2.00	4.584*	.05	-.145*
TERRAIN	10.	164.	28.4	4.	2.00	9.478*	.05	.096*
TERRAIN	140.	164.	28.4	4.	2.00	4.072*	.05	.065*

Maximum Visual Impacts OUTSIDE Class I Area
Screening Criteria ARE Exceeded

					Delta E		Contrast	
Backgrnd	Theta	Azi	Distance	Alpha	Crit	Plume	Crit	Plume
SKY	10.	2.	1.0	167.	2.00	10.330*	.05	-.186*
SKY	140.	2.	1.0	167.	2.00	9.817*	.05	-.294*
TERRAIN	10.	2.	1.0	167.	2.00	25.868*	.05	.182*
TERRAIN	140.	2.	1.0	167.	2.00	7.612*	.05	.078*

Visual Effects Screening Analysis for
Source: Normal Operations
Class I Area: SW Corner Lava Beds

*** User-selected Screening Scenario Results ***

Input Emissions for

Particulates	27.10	LB /DAY
NOx (as NO2)	.00	LB /DAY
Primary NO2	.00	LB /DAY
Soot	.00	LB /DAY
Primary SO4	4.11	LB /DAY

PARTICLE CHARACTERISTICS

	Density	Diameter
Primary Part.	2.5	6
Soot	2.0	1
Sulfate	1.5	4

Transport Scenario Specifications:

Background Ozone:	.05 ppm
Background Visual Range:	200.00 km
Source-Observer Distance:	8.10 km
Min. Source-Class I Distance:	8.10 km
Max. Source-Class I Distance:	28.40 km
Plume-Source-Observer Angle:	11.25 degrees
Stability:	6
Wind Speed:	2.00 m/s

R E S U L T S

Asterisks (*) indicate plume impacts that exceed screening criteria

Maximum Visual Impacts INSIDE Class I Area
Screening Criteria ARE NOT Exceeded

					Delta E		Contrast	
Backgrnd	Theta	Azi	Distance	Alpha	Crit	Plume	Crit	Plume
SKY	10.	164.	28.4	4.	2.00	.550	.05	.011
SKY	140.	164.	28.4	4.	2.00	.124	.05	-.004
TERRAIN	10.	164.	28.4	4.	2.00	1.613	.05	.013
TERRAIN	140.	164.	28.4	4.	2.00	.156	.05	.003

Maximum Visual Impacts OUTSIDE Class I Area
Screening Criteria ARE Exceeded

					Delta E		Contrast	
Backgrnd	Theta	Azi	Distance	Alpha	Crit	Plume	Crit	Plume
SKY	10.	2.	1.0	167.	2.00	1.549	.05	.027
SKY	140.	2.	1.0	167.	2.00	.310	.05	-.011
TERRAIN	10.	2.	1.0	167.	2.00	6.752*	.05	.036
TERRAIN	140.	2.	1.0	167.	2.00	.453	.05	.004

Visual Effects Screening Analysis for
Source: Plant Upset
Class I Area: SW Corner Lava Beds

*** User-selected Screening Scenario Results ***

Input Emissions for

Particulates	61.90	LB /DAY
NOx (as NO2)	234.00	LB /DAY
Primary NO2	.00	LB /DAY
Soot	12.60	LB /DAY
Primary SO4	.20	LB /DAY

PARTICLE CHARACTERISTICS

	Density	Diameter
Primary Part.	2.5	6
Soot	2.0	1
Sulfate	1.5	4

Transport Scenario Specifications:

Background Ozone:	.05 ppm
Background Visual Range:	200.00 km
Source-Observer Distance:	8.10 km
Min. Source-Class I Distance:	8.10 km
Max. Source-Class I Distance:	28.40 km
Plume-Source-Observer Angle:	11.25 degrees
Stability:	6
Wind Speed:	2.00 m/s

R E S U L T S

Asterisks (*) indicate plume impacts that exceed screening criteria

Maximum Visual Impacts INSIDE Class I Area
Screening Criteria ARE Exceeded

					Delta E		Contrast	
Backgrnd	Theta	Azi	Distance	Alpha	Crit	Plume	Crit	Plume
SKY	10.	164.	28.4	4.	2.00	.337	.05	-.000
SKY	140.	164.	28.4	4.	2.00	.760	.05	-.025
TERRAIN	10.	164.	28.4	4.	2.00	3.097*	.05	.027
TERRAIN	140.	164.	28.4	4.	2.00	.676	.05	.011

Maximum Visual Impacts OUTSIDE Class I Area
Screening Criteria ARE Exceeded

					Delta E		Contrast	
Backgrnd	Theta	Azi	Distance	Alpha	Crit	Plume	Crit	Plume
SKY	10.	2.	1.0	167.	2.00	1.036	.05	-.000
SKY	140.	2.	1.0	167.	2.00	2.330*	.05	-.062*
TERRAIN	10.	2.	1.0	167.	2.00	11.492*	.05	.067*
TERRAIN	140.	2.	1.0	167.	2.00	1.680	.05	.014

Visual Effects Screening Analysis for
Source: Norm Ops + Drilling Well
Class I Area: SW Corner Lava Beds

*** User-selected Screening Scenario Results ***

Input Emissions for

Particulates	27.10	LB /DAY
NOx (as NO2)	530.40	LB /DAY
Primary NO2	.00	LB /DAY
Soot	28.60	LB /DAY
Primary SO4	4.11	LB /DAY

PARTICLE CHARACTERISTICS

	Density	Diameter
Primary Part.	2.5	6
Soot	2.0	1
Sulfate	1.5	4

Transport Scenario Specifications:

Background Ozone:	.05 ppm
Background Visual Range:	200.00 km
Source-Observer Distance:	8.10 km
Min. Source-Class I Distance:	8.10 km
Max. Source-Class I Distance:	28.40 km
Plume-Source-Observer Angle:	11.25 degrees
Stability:	6
Wind Speed:	2.00 m/s

R E S U L T S

Asterisks (*) indicate plume impacts that exceed screening criteria

Maximum Visual Impacts INSIDE Class I Area
Screening Criteria ARE Exceeded

						Delta E		Contrast	
Backgrnd	Theta	Azi	Distance	Alpha	Crit	Plume	Crit	Plume
SKY	10.	164.	28.4	4.	2.00	1.668	.05	-.031
SKY	140.	164.	28.4	4.	2.00	1.486	.05	-.047
TERRAIN	10.	164.	28.4	4.	2.00	3.070*	.05	.030
TERRAIN	140.	164.	28.4	4.	2.00	1.292	.05	.019

Maximum Visual Impacts OUTSIDE Class I Area
Screening Criteria ARE Exceeded

						Delta E		Contrast	
Backgrnd	Theta	Azi	Distance	Alpha	Crit	Plume	Crit	Plume
SKY	10.	2.	1.0	167.	2.00	4.777*	.05	-.076*
SKY	140.	2.	1.0	167.	2.00	4.637*	.05	-.114*
TERRAIN	10.	2.	1.0	167.	2.00	9.935*	.05	.058*
TERRAIN	140.	2.	1.0	167.	2.00	3.247*	.05	.024