Botanical Survey Report for the Casa Diablo 4 Power Plant Site

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Introduction

This report communicates the results of botanical survey work that was performed at the site of the proposed Casa Diablo 4 geothermal power generation facility near Mammoth Lakes, in Mono County, California. The Casa Diablo 4 geothermal power plant and its 1150 ft production tie-in pipeline would be sited adjacent to existing power plants and production wells (Figure 1). The purpose of the botanical survey was to describe the vegetation and to determine whether rare plant species are present.

Construction of the Casa Diablo 4 power plant would impact mostly undeveloped but highly disturbed lands on privately owned property. Botanical survey work in 2001 included 23.2 acres of private property. In addition, survey transects were extended to the north of the power plant site beyond private property boundaries, onto an adjacent 6.8 acres of land administered by the Inyo National Forest land (Figure 2). This created a 300 ft search buffer around the proposed footprint of all project infrastructure (totaling 30.0 acres of studied area). Vegetation within the study area covers low, rolling hills and flats below steep slopes that rise to the north and east, at an average elevation of 7300 ft (2230 m). The study area lies amid an extensive field of fumaroles and hot springs.

The climate at this elevation on the eastern side of the central Sierra Nevada Range is montane, with more than 50% of annual precipitation falling as snow (Mono County Planning Department, 1988). The average winter temperature is 30° F. Constant heat is radiated in the area of fumaroles, which provides a warmer microclimate in some areas during winter months. Hot soils also limit the distribution of plants in the areas nearest active fumaroles. The frost-free growing season for areas that are not influenced by fumaroles is about 120 days. Summer months are characterized by low humidity and moderate daytime temperatures. However, the xeric summer is irregularly interrupted by heavy rains from thunderstorms. The average summer temperature is 70° F (NRCS, 1996).

Literature Search

A list of six rare plant species that could have some potential to occur within the study area was compiled, and subsequently reviewed by personnel from the Inyo National Forest, Bishop Office (Table 1). These species are *Astragalus monoensis* var. *monoensis* (Mono milkvetch), *Botrichium crenulatum* (scalloped moonwort), *Epilobium howellii* (subalpine fireweed), *Lupinus duranii* (Mono Lake lupine), *Plagiobothrys glomeratus* (Mammoth popcorn flower), and *Sedum pinetorum* (Pine City sedum). Potentially occurring rare species were

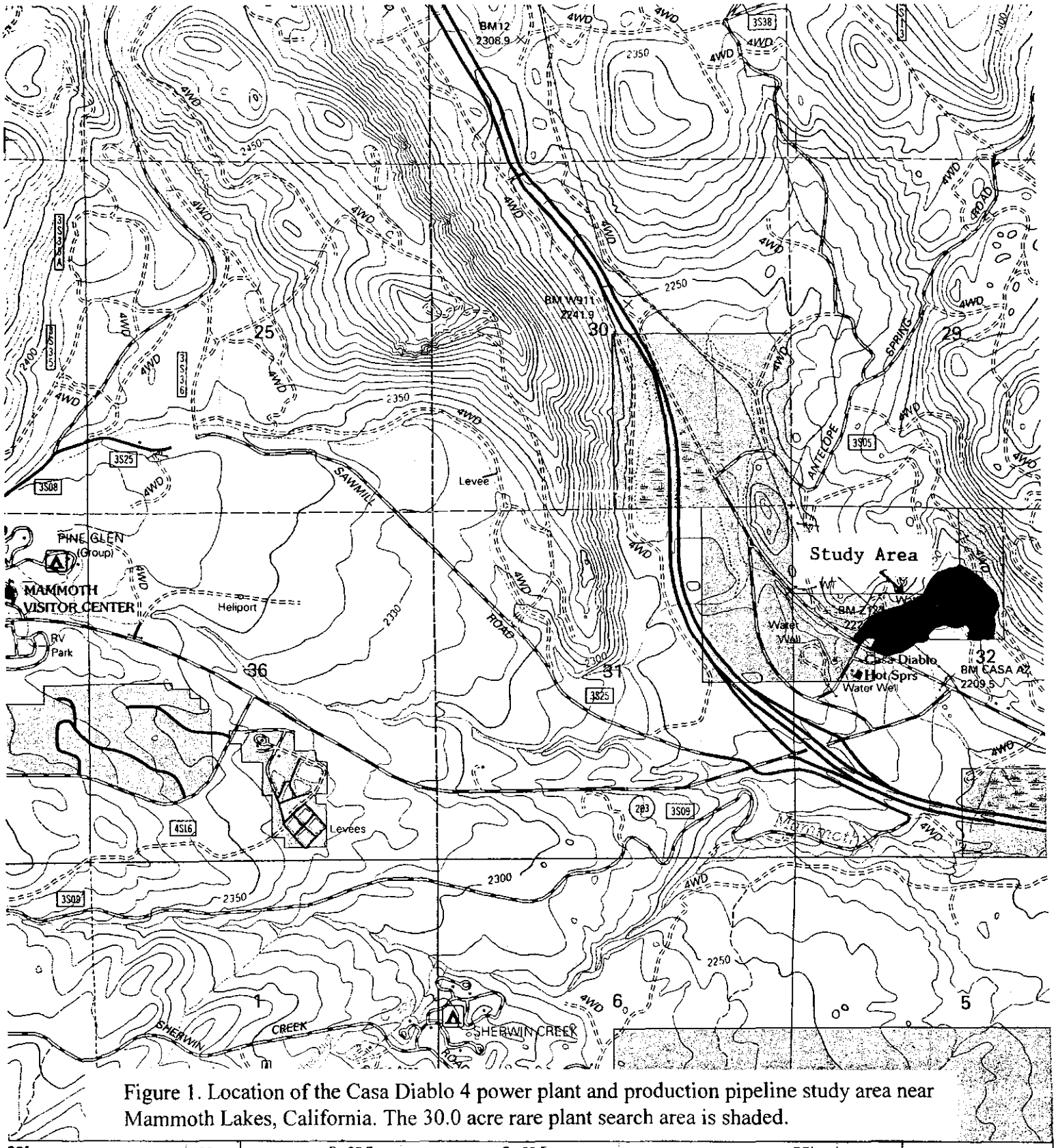

Figure 1. Location of the Casa Diablo 4 power plant and production pipeline study area near Mammoth Lakes, California. The 30.0 acre rare plant search area is shaded.

30' 328 R. 27 E. 329 R. 28 E. 330 55' 331

SCALE 1:24 000

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1000 0 1000 2000 3000 4000 5000 6000 7000 8000 9000 10 000
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CONTOUR INTERVAL 10 METERS

QUADRANGLE LOCATION

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identified during a review of regional data (Mono County Planning Department, 1993, California State Water Resources Control Board, 1993, Halford and Fatooh, 1994, California Department of Fish and Game 2001a, Paulus 2001a, 2001b, U.S. Forest Service, 2001), and a May 2001 search of all California Natural Diversity Database records for the Old Mammoth USGS Quadrangle. Potentially occurring species were also drawn from the current sensitive and watch lists prepared by Inyo National Forest staff (U.S. Forest Service, 1998a, 1998b).

Field Surveys

A site drawing showing the limits of the proposed area that would be converted from vegetation to power plant facilities or disturbed by new pipeline installation was provided by Mr. Bob Sullivan of Mammoth Pacific, L.P. The limits for plant inventory and rare plant search transects ("study area") were then determined by adding a 300 ft buffer around all sides of the construction footprint as shown on the site drawing. The total area of proposed construction and buffer is 30.0 acres (Figure 2).

Field surveys were performed during the month of July 2001. July is within the normal anthesis periods for potentially occurring rare plants (Table 1). Nearby known populations of Mono milkvetch and Mono Lake lupine at Smokey Bear Flat were visited on July 10 in order to form a clear search pattern for recognizing these species if they should occur in the study area, and to verify that important flower and fruit characters would be available at the time of survey work. Mono milkvetch and Mono Lake lupine are often associated with the distinctive Mono Pumice Flats community in Mono County (CNDDB, 2001). This is the habitat observed at Smokey Bear Flat. However, other populations previously documented within a few miles to the north of the study area were found to occur between shrub canopies in an open scrub habitat, or in open forest habitat (Bagley, 1995, CNDDB, 2001). The June Lake populations, which were observed for this study on July 22, 2001, occur in open scrub with general structural similarity and deep pumice soil as found in small fragments of the study area. Populations of Mono milkvetch and Mono Lake lupine at Smokey Bear Flat were flowering but had passed the point of maximum anthesis when they were visited on July 10. Both species exhibited leaves, some flowers, and many mature fruit.

Community descriptions were developed during a site visit on July 9. The site's plant communities were classified using the Holland (1986) system. At this time, relative frequencies and height of dominants were recorded. Thorough searches for rare plants were conducted on July 10-13, 2001. Parallel transects across the study area were searched by walking slowly and wandering side-to-side to view areas around and under shrub canopies. Transects were centered every 50 feet. All plant species encountered were identified. Any species that were not at once recognized were keyed by the consulting botanist using The Jepson Manual (Hickman, 1993) or the Intermountain Flora (Cronquest, et al., 1984). Plants were identified to the level of taxa sufficient to determine rare and sensitive species presence or absence. James Paulus of Bishop, California, performed survey work totaling 25 person hours.

Table 1. Sensitive plant species potentially occurring in the Casa Diablo 4 geothermal power plant study area. Flowering period data is from Skinner and Pavlik (1994). A key to the rank or status symbols follows the table.

Scientific/Common Name Life Form	Rank or Status[1]				Habitat	Flowering Period
	USFWS	DFG	USFS	CNPS		
Astragalus monoensis var. *monoensis* Mono milkvetch herbaceous perennial	SC	R	S	1B	Open scrub, sand or pumice	June-August
Botrychium crenulatum Scalloped moonwort herbaceous perennial	SC	SC	S	1B	Open forest, meadows, marshy	fertile June-July
Epilobium howellii Subalpine fireweed herbaceous perennial			S	1B	Meadows, wet margins	July-August
Lupinus duranii Mono Lake lupine herbaceous perennial	SC	-	W	1B	Open scrub, pumice	May-July
Plagiobothrys glomeratus Mammoth popcorn flower herbaceous annual				2	Sagebrush scrub	June-July
Sedum pinetorum Pine City sedum herbaceous perennial			W		Rocky, open forest?	May-August

1. rank or status, by agency:

USFWS = US Fish and Wildlife Service status under the Endangered Species Act.
SC = Species of Concern (CDFG, 2001a)

DFG = California Department of Fish and Game listings under the Native Plant Protection Act and the California Endangered Species Act (CDFG, 2001a).
R = Rare
SC = Species of Concern

USFS = US Forest Service, Inyo National Forest, Bishop Office.
S = Sensitive List, June 1998 (USFS, 1998a)
W = Watch List, December 1998 (USFS, 1998b)

CNPS = California Native Plant Society listings (Skinner and Pavlik, 1994).
1B = rare and endangered in Calif. and elsewhere
2 = rare, threatened or endangered in California, but more common elsewhere

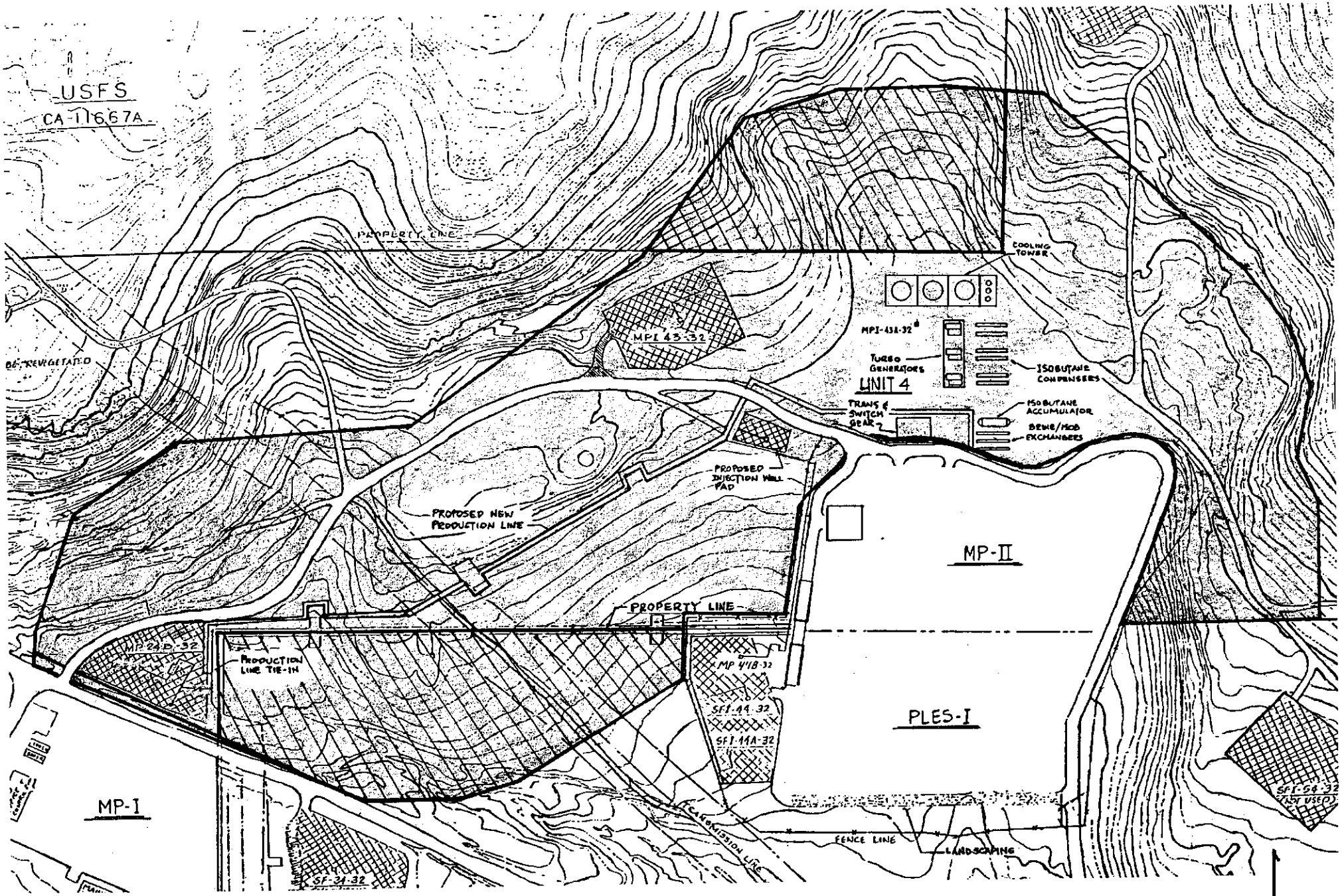

Figure 2. Study area (shaded) is shown for the Casa Diablo 4 Power Plant and Production Pipeline botanical survey performed in July 2001. Forest Service lands are cross-hatched, and the remainder is privately owned. Proposed project elements are also shown.

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Plant communities and species

The majority of the area surveyed is disturbed upland forest and scrub. Devegetation of large areas due to human activities or geothermal venting has fragmented plant communities in the study area (Figure 3). Disturbed areas currently exhibit various stages of seral recovery, the stages including total devegetation, early colonization with pioneer or planted/seeded herbs, and shrub canopy development approximating the species composition and abundances of surrounding relatively undisturbed scrub. About 60% of disturbed habitat areas were likely devegetated by historical uses such as camping and mining of geothermal resources. Vegetation removed by such mechanical disturbances has been replaced mainly by introduced groundcover grasses and herbs. Rarely, these same species are growing among scattered native shrubs that have returned to disturbed areas. Another 40% of the areas controlled by disturbance have only recently become unsuitable for scrub or forest species due to naturally occurring changes in fumarole activity. Dead trees (or stumps) and dead shrub crowns remain where elevated soil temperatures have caused dieback, and cover in these areas now mainly consists of shallow-rooted, native and introduced annual species. Less disturbed plant assemblages that are typical of local Big Sagebrush Scrub and Jeffrey Pine Forest plant communities dominate on gentle slopes across the remainder (53%) of the study area (Table 2).

A total of 78 species belonging to 19 plant families were identified within the study area (Appendix A). The diversity of herbs is higher and herbaceous species are more important where the vegetation is recovering from recent mechanical disturbance. The total number of herb species found (S) was 37 in mechanically disturbed soils. Herb diversity is lower in the relatively less disturbed areas dominated by the Big Sagebrush Scrub community (S = 25) and under Jeffrey Pine Forest canopies (S = 20), where the herbaceous stratum composition differs considerably from adjacent disturbed areas. The proportion of introduced (non-native) herb species was higher (45%) in mechanically disturbed areas and in thermally disturbed areas (41%), in comparison to Big Sagebrush Scrub (8%) and Jeffrey Pine Forest (14%). The number of native shrubs found in the Big Sagebrush Scrub community (S = 11) was observed to be higher than found on disturbed areas (S = 7), in Jeffrey Pine Forest (S = 4), or in the low, open patches of Wright Buckwheat Scrub (S = 3). The shrub species found under pines and in canopy gaps within Jeffrey Pine Forest are all typical of Big Sagebrush Scrub. Trees occur as dominants and have developed 10-40% canopy closure in Jeffrey Pine Forest (S = 3), and as a minor component in Big Sagebrush Scrub (S = 1).

Community transitions (Figure 3) were stark, and community boundaries were readily apparent at most places. The exception was where Big Sagebrush Scrub grades into Jeffrey Pine Forest. The ecotone here is often broad. Some shrub species that predominate in Scrub also occur as an understory stratum with up to 30% cover in the Forest community. In general, the amount of cover that is contributed by the shrub layer is 30-50% in Big Sagebrush Scrub, while it averages less than 20% in Jeffrey Pine Forest with 10-40% tree canopy closure.

Non-native species were found throughout the study area in the herb stratum only (S = 18). While the occurrence of most non-native species is restricted to disturbed habitats along roadways and around fumaroles, one annual grass (*Bromus tectorum*) was also found to be common and abundant throughout the study area, including relatively undisturbed portions of the Big Sagebrush Scrub, Jeffrey Pine Forest, and Wright Buckwheat Scrub communities.

Table 2. Plant communities found within the Casa Diablo 4 study area.

Plant Community Name	Holland Number	Sawyer/Keeler-Wolf Series[2]	Acreage in Study Area[3]
Disturbed (mechanical)	-	Introduced Perennial Grassland	8.4
Disturbed (thermal)	-	-	5.7
Jeffrey Pine Forest[1]	85100	Jeffrey Pine	8.0
Big Sagebrush Scrub[1]	35100	Big Sagebrush	7.3
Wright Buckwheat Scrub	-	-	0.6

1. Taken from Holland (1986)
2. Taken from classification proposed by Sawyer and Keeler-Wolf (1995)
3. 16% of thermal Dist. (.9 ac), 15% of Forest (1.2 ac), and 15% of Scrub (1.1 ac) within Inyo Nat. Forest

Disturbed and Revegetated Soil

The highly variable disturbed-soil assemblages were grouped for the purpose of plant community mapping by whether the primary type of disturbance regime was mechanical (scrapes, road building, or production well pad leveling) or thermal (naturally occurring fumarole activity). The assemblage of species in mechanically disturbed areas is highly diverse and is usually composed of perennial species. Thermally disturbed areas, however, are relatively species depauperate and are dominated by annuals (Appendix A). A large portion of the study area (28%, all on private property) shows evidence of recent or ongoing devegetation due to land use. The Casa Diablo hot springs area has a long history of human use. Uses such as camping have been replaced by activities related to the development of geothermal energy, which has accelerated the fragmentation of more stable plant communities and provided ecological niche opportunities for invasion and dominance by non-native plants. Natural species recolonizations, in combination with recent restoration efforts, have provided sparse to dense cover by herbs and grasses. Only occasionally have patches of shrubs developed in these disturbed areas.

Mechanically disturbed areas are dominated by introduced, often non-native perennial grasses. Some of the common, widespread species such as crested wheatgrass (*Agropyron cristatum*, syn. *A. desertorum*) and intermediate wheatgrass (*Elytrigia intermedia*) were probably included in revegetation seed mixes introduced to the study area. Native shrubs are recovering in patches to levels of cover that are comparable to surrounding Big Sagebrush Scrub, but these patches also include shrub species such as rabbitbrush (*Chrysothamnus* spp.), rabbit goldenbush (*Ericameria bloomeri*), and black sagebrush (*Artemisia nova*) that are not found in less disturbed Scrub assemblages within the study area. Non-native assemblages are more important where topsoil has been scraped away for well pad or road construction. Species restricted to the areas of greatest ongoing disturbance included California willowherb (*Epilobium foliosum*), abundant Russian thistle (*Salsola tragus*) and knotweed (*Polygonum arenastrum*), and scratchgrass (*Muhlenbergia asperifolia*). Existing gravel-capped pads are nearly barren. Existing pipelines,

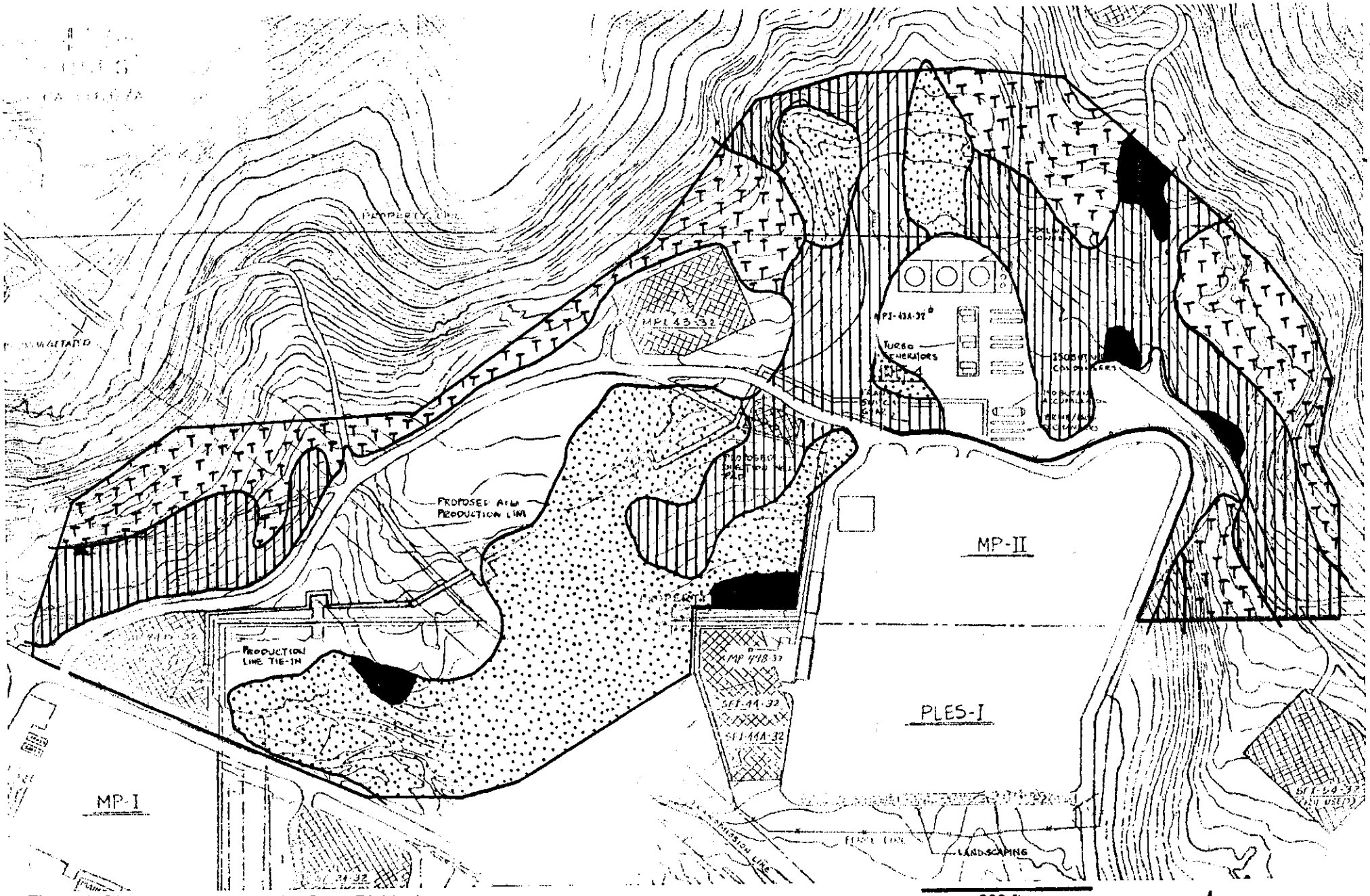

Figure 3. Plant communities at the Casa Diablo 4 power plant study area.

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which cross through the study area elevated on 1-2 ft stilts, are associated with a high degree of vegetative recovery. Pipeline areas exhibit proportionally higher frequencies of Big Sagebrush Scrub dominants (see below) and lower frequencies of non-native grasses.

Non-native annuals such as cheat grass and redstem filaree (*Erodium cicutarium*) attain dominance and up to 90% cover where recent thermal activity has killed native shrubs and trees. Other species that formed dense stands in 2001 are cruciferous, typically winter or early spring annuals such as tumble mustard (*Sisymbrium altissimum*), tansy mustard (*Descurainia sophia*), and pepperweed (*Lepidium* spp.). Perennials are relatively rare in thermally disturbed areas. Low, scattered clumps of woollypod milkvetch (*Astragalus purshii*) and pussypaws (*Calyptridium monospermum*) were found at subdominant frequencies among the non-natives annuals, but no shrub or tree species appear to be adapted to the soil temperatures near the upslope (northern) edge of the study area. All surfaces within about 20 ft of active fumaroles within the study area are barren, but two native annual herbs (*Erigeron divergens* and *Mimulus torreyi*) are found only in the narrow band just outside fumarole barrens. A few small conifers have survived amid the dead and fallen (or logged) trees that once dominated much of the thermally disturbed area. Nearly all of the surviving trees are stunted or appear to be in poor health.

Jeffrey Pine Forest

Jeffrey pine (*Pinus jeffreyi*) accounts for about 90% of the tree canopy cover within the study area. Minor components of mountain juniper (*Juniperus occidentalis* var. *australis*) and single-leaf pinyon (*Pinus monophylla*) are also present in Jeffrey Pine Forest. The average canopy closure is 20% across the study area. The shrubby understory is composed mainly of big sagebrush (*Artemisia tridentata*) and antelope bush (*Purshia tridentata*). These shrubs develop increasing cover with decreasing tree cover.

Generally, forest vegetation on the mountainous slopes within and around the study area transitions into Great Basin Scrub assemblages covering flatter areas to the south, and this occurs at about the latitudinal midline of the study area. The boundary between Jeffrey Pine Forest and Big Sagebrush Scrub within the study area (Figure 3) was somewhat subjectively drawn, based on a perceived continuity of tree dominance and shading, and a related shift in understory percent cover in the Forest community. While the understory assemblage is similar, shrubs have established at least 30% cover in Big Sagebrush Scrub, and on average 20% cover in Jeffrey Pine Forest (Table 3). Perhaps the most definitive way to contrast the two communities is found in the forest floor. The soil profile in Jeffrey Pine Forest includes a continuous, 1-3 inch organic horizon, which is absent from Big Sagebrush Scrub within the study area. The accumulated duff is composed mainly of pine needles and cones.

The understory is sparsely grassy, attaining greatest prominence in nearly pure carpets of cheat grass along the northern edge of the study area. Areas farther from thermal disturbance hold less weedy stands of native perennial herbs including foxtail barley (*Hordeum jubatum*) and needlegrasses (*Acthnatherum* spp.), with an average 10% living cover. Non-native presence in less disturbed areas is confined to perennial grasses such as smooth brome (*Bromus inermis*) that have become established at open Forest edges. Absence of understory vegetation was found only where Jeffrey Pine Forest canopy cover exceeds 40%, and on disturbed roadways.

The average height of dominant Jeffrey pine is about 40 ft. Maximum height was found to vary, with taller trees occurring near the proposed power plant site. One recently fallen tree on surveyed Inyo National Forest land just outside the power plant site was measured at 82 ft. Forest trees are currently in good health, except for where Jeffrey Pine Forest is interrupted by thermal disturbance.

Table 3. Average plant cover and height at the Casa Diablo 4 study area, from observations taken along representative transects in each community present. Diversity of native and non-native species present in July 2001 is also summarized.

Community type	Transect type	Canopy or cover (%)	Average height (ft.)	Diversity	
				native	non-native
Disturbed (mechanical)	trees	0	-	-	-
	shrubs	10	3	7	0
	herbs	50	2	21	16
Disturbed (thermal)	trees	1	10	2	0
	shrubs	0	-	-	-
	herbs	50	1	11	5
Jeffrey Pine Forest	trees	20-30	40	3	0
	shrubs	20	2	4	0
	herbs	10	1	17	3
Big Sagebrush Scrub	trees	1	10	2	0
	shrubs	30-50	1-2	11	0
	herbs	10	1	23	2
Wright Buckwheat Scrub	trees	0	-	-	-
	shrubs	20	1	3	0
	herbs	95	1	9	3

Big Sagebrush Scrub

Big sagebrush and antelope bush are typical dominants of Big Sagebrush Scrub. These native shrubs form 1-2 ft tall stands with 30-50% living cover in relatively undisturbed, open areas between and around Jeffrey Pine Forest canopies. Big sagebrush usually outnumber antelope bush. The Big Sagebrush Scrub community is widespread throughout the Great Basin Floristic Province on the eastern slopes of the Sierra Nevada. It is classified as Basin Sagebrush in the Mono County Master Environmental Assessment (Mono County Planning Dept., 1993).

The amount of existing perennial shrub cover varies across the area of proposed development. Average cover is 30% by native shrubs and less than 10% by perennial grasses (mainly *Elymus elymoides*, and introduced *Elytrigia intermedia*) along the proposed production tie-in pipeline corridor (Figure 2). Average height is 1 ft. About 20% of the shrub cover in all areas of the pipeline corridor is antelope bush, and Wright buckwheat (*Eriogonum wrightii* var. *subscaposum*) is also common at low frequency. There are a few pines and junipers within Big Sagebrush Scrub near the pipeline corridor, sometimes occurring in small clumps.

Several runoff channels from upslope impervious surfaces drain through recently excised, small gullies that cross through the western portion of the Big Sagebrush Scrub community. Rubber rabbitbrush becomes an important dominant along channel edges, increasing the average community height to 2 ft. The stand also becomes grassier. The rhizomatous, native grasses mat muhly (*Muhlenbergia richardsonis*) and saltgrass (*Distichlis spicata*) have stabilized portions of these gullies.

Overall cover in three smaller Big Sagebrush Scrub patches located near the proposed power plant site averages 50%. Average height is 2 ft. Antelope bush contributes 50-80% of the shrub layer where trees from the surrounding Jeffrey Pine Forest provide shade. These patches harbor fewer invasive annuals, in comparison to the more open Scrub along the pipeline corridor. Native perennial grasses, especially needle-and-thread grass (*Hesperostipa comata*), and sometimes densely clumped needlegrasses (*Achnatherum nevadensis* and *A. occidentalis* ssp. *pubescens*), are the most common species in the open areas between shrub canopies. Annual dusty maidens (*Chaenactis stevioides*) and hoary aster (*Machaeranthera canescens*) are common herbs in Big Sagebrush Scrub and in the somewhat similar Wright Buckwheat Scrub.

Wright Buckwheat Scrub

The Wright Buckwheat Scrub community is restricted to several very small community fragments within the study area. Plant cover adjacent to existing patches has been mechanically disturbed, except for the northernmost patch that is adjacent to a large thermally disturbed area (Figure 3). This community's ecotones are characteristically sharp, with the small, open patches of Wright buckwheat grading abruptly into surrounding, more densely vegetated forest or scrub habitats. The average height of vegetation is less than 1 ft. Wright buckwheat is not the only shrub present, but it is overall the most conspicuous because its large mats make up more than 50% of the total cover, and the co-occurring big sagebrush and antelope bush are stunted. The most common herb in the pumice soil between shrubs is hoary aster, which contributes as much as 5% of the total cover. Herbaceous diversity is low (Table 3), but the herbaceous stratum does not otherwise resemble thermally disturbed assemblages. It includes a few scattered non-native grasses such as cheat grass, intermediate wheatgrass, and Canada bluegrass (*Poa compressa*).

Sensitive plant species

No known rare plant communities or populations of rare plant species that occur within the study area were uncovered during the literature search. Search results do indicate that two

plant species (*Lupinus duranii* and *Astragalus monoensis* var. *monoensis*) are known to occur in open pumice flat, open Big Sagebrush Scrub, and in an open Jeffrey Pine Forest (17 occurrences) within five miles of the Project Area (CNDDB, 2001). The Mono Pumice Flats sensitive plant community occurs 2.5 miles to the north at Smokey Bear Flat. The milkvetch *A. monoensis* is a federal Species of Concern and has been state listed as "Rare" since July 1982. The small perennial *L. duranii* is a federal Species of Concern. The latest Inyo National Forest lists include *A. monoensis* as "sensitive", and *L. duranii* as "watchlist". The CDFG considers Mono Pumice Flats to be a sensitive habitat. The Mono Pumice Flats community, which has been described as a *Chrysothamnus parryi - Achnatherum occidentalis* ssp. *pubescens* (syn. *Stipa elmeri*) association (CNDDB, 2001), is distinctive in composition and height from Great Basin scrub communities. No occurrences of these (or any other) rare species, and no occurrences of the Mono Pumice Flat community or pumice flat habitat were documented in a previous assessment of the study area flora (Taylor, 1987).

No occurrences of rare plants or the Mono Pumice Flats community were found within the study area during field surveys conducted in 2001. Well-developed fruits, leaves, and lower plant internodes were available for common *Astragalus* plants encountered during the surveys. Woollypod milkvetch (*Astragalus purshii* var. *tinctus*), a common species found within the study area, has distinctively long-hairy fruit that resemble a ball of cotton. Fruits were available to clearly distinguish woollypod milkvetch from Mono milkvetch, which would have glabrous to sparsely short-hairy fruit during the time that surveys were conducted. No plants were observed having the palmate leaf structure that is typical of *Lupinus* species, including *L. duranii*.

The occurrence of nearly pure stands of Wright buckwheat, classified here as a separate (but fragmented) plant community, may represent a rare combination of native plants because it is confined to fumarole field margins. At least one author (Taylor, 1987) has classified the original, much larger stand that pre-dated construction of the existing power generating facilities as "botanically sensitive habitat" which is not found elsewhere. The small shrub *Eriogonum wrightii*, which can also be found at lower frequencies in Big Sagebrush Scrub throughout the study area, is not itself a rare plant in California.

The perennial herb *Epilobium howellii* has been found near lakes in the Mammoth Basin, but little else is known about its distribution. Generally, it would occur in moist habitats such as Wet Montane Meadow, which were not found within the study area. In May 2001, one specimen was provided by the Inyo National Forest for viewing under a microscope at their Bishop office. Subalpine fireweed would occur as a prostrate and fragile herb of less than 20 cm in height, with sessile leaves. A relatively greater, upright stature, in combination with petioled leaves, readily distinguishes the common native annual *E. foliosum* that was widespread in dry, very disturbed habitats at the study area.

No members of the popcorn flower genus *Plagiobothrys* were found during the rare plant surveys. *Plagiobothrys glomerata*, the only annual species on this list, has not been recorded in the Mammoth area by CNDDB, but potential past occurrences "in the Mammoth area" are noted by Bagley (1997). This species occurs in similar dry habitat in Nevada. Similarly, no subshrubs were found with the unique leaf arrangement expected of *Sedum pinetorum*, and it is concluded that no member of the genus *Sedum* occurs within the study area. Little is known about the current range of this species in California, but historical and possibly questionable references for a Mammoth Basin population cite a montane habitat that is at an elevation at least 1000 ft higher

than Casa Diablo Hot Springs.

No members of the distinctive *Botrychium* genus were found during rare plant surveys. Although this plant is small (typically, having one leaf of less than 10 cm height), individuals growing among forest plants would have been detected using the search methods that were employed. Plant with unusual overall appearance such as *B. crenulatum* would have stood out amid the sparse understory of the Jeffrey Pine Forest community in the study area. No plants with frond-like leaves and sporangia were found.

During the transect surveys, sign of widespread use by deer was observed. Grazing on perennial shrubs was evident, but overall light. There was no evidence that this area had been used for livestock grazing during recent growing seasons. It is concluded that grazing activity did not influence the ability to detect sensitive plants during this survey.

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Appendix A. List of plant species occurring in the Casa Diablo 4 Power Plant study area. Habit summarizes the growth form of each species. Plants occurred in one of five habitats. Habit codes are defined below.

Plant Families and Species		Habit	Occurrence in Study Area: Jeffrey Pine Forest	Big Sagebrush Scrub	Wright Buckwheat Scrub	Mechanically Disturbed Soils	Thermally Disturbed Soils
Gymnosperms							
Cupressaceae							
Juniperus occidentalis var. *australis*	mountain juniper	NT	x	x			
Pinaceae							
Pinus jeffreyi	Jeffrey pine	NT	x	x			x
Pinus monophylla	single leaf pinyon	NT	x				x
Angiosperms							
Dicots							
Asteraceae							
Antennaria rosea	rosy pussytoes	NPH	x				
Artemisia cana ssp. *bolanderi*	silver sagebrush	NS		x			
Artemisia nova	black sagebrush	NS				x	
Artemisia tridentata ssp. *vaseyana*	mountain big sagebrush	NS	x	x	x	x	
Artemisia tridentata ssp. *wyomingensis*	Wyoming big sagebrush	NS	x				
Chaenactis stevioides	dusty maiden	NAH		x	x	x	
Chrysothamnus nauseosus ssp. *albicaulis*	rubber rabbitbrush	NS		x		x	
Chrysothamnus parryi	Parry rabbitbrush	NS		x		x	
Chrysothamnus viscidiflorus ssp. *viscidiflorus*	curl leaf rabbitbrush	NS		x		x	
Ericameria bloomeri	rabbit goldenbush	NS		x		x	
Erigeron divergens	spreading fleabane	NAH					x
Machaeranthera canescens var. *canescens*	hoary aster	NPH		x	x	x	x
Tetradymia canescens	cotton thorn	NS		x			
Tragopogon sp.	salsify	IBH				x	
Wyethia mollis	mules ears	NPH	x	x			

Plant Families and Species		Habit	Occurrence in Study Area: Jeffrey Pine Forest	Big Sagebrush Scrub	Wright Buckwheat Scrub	Mechanically Disturbed Soils	Thermally Disturbed Soils
Boraginaceae							
Cryptantha echinella	prickly cryptantha	NAH					x
Brassicaceae							
Arabis inyoensis	Inyo rock cress	NPH	x	x			x
Brassica nigra	black mustard	IAH				x	
Descurainia sophia	tansy mustard	IAH				x	
Lepidium densiflorum var. *ramosum*	miner's pepperweed	NAH				x	
Lepidium perfoliatum	clasping pepperweed	IAH				x	x
Sisymbrium altissimum	tumble mustard	IAH				x	x
Chenopodiaceae							
Chenopodium atrovirens	pinyon goosefoot	NAH	x				
Chenopodium desiccatum	aridland goosefoot	NAH				x	
Salsola tragus	Russian thistle	IAH				x	x
Fabaceae							
Astragalus purshii	woollypod milkvetch	NPH			x	x	x
Medicago sativa	alfalfa	IPH				x	
Geraniaceae							
Erodium cicutarium	redstem filaree	IAH				x	x
Grossulariaceae							
Ribes cereum var. *cereum*	wax currant	NS	x				
Onagraceae							
Epilobium foliosum	California willowherb	NAH				x	
Gayophytum diffusum ssp. *parviflorum*	summer snowflakes	NAH	x	x	x	x	x

Plant Families and Species		Habit	Occurrence in Study Area: Jeffrey Pine Forest	Big Sagebrush Scrub	Wright Buckwheat Scrub	Mechanically Disturbed Soils	Thermally Disturbed Soils
Papaveraceae							
Argemone munita	prickly poppy	NPH				x	
Polemoniaceae							
Eriastrum sparsiflorum	Great Basin woollystar	NAH		x		x	
Eriastrum wilcoxii	Wilcox woollystar	NAH				x	
Leptodactylon pungens	granite prickly phlox	NPH	x	x			
Linanthus nuttallii ssp. *pubescens*	Nuttall linanthus	NPH	x	x			
Phlox stansburyi	Stansbury phlox	NPH			x		
Polygonaceae							
Eriogonum palmerianum	Palmer buckwheat	NAH				x	x
Eriogonum spergulinum	spurry buckwheat	NAH		x			
Eriogonum umbellatum var. *nevadense*	sulphur flower	NS		x			
Eriogonum wrightii var. *subscaposum*	Wright buckwheat	NS		x	x		
Polygonum arenastrum	knotweed	IAH				x	x
Portulacaceae							
Calyptridium monospermum	oneseeded pussypaws	NPH		x		x	x
Rosaceae							
Prunus andersonii	desert peach	NS		x			
Purshia tridentata var. *tridentata*	antelope bush	NS	x	x		x	
Scrophulariaceae							
Mimulus torreyi	Torrey monkeyflower	NAH		x			
Verbascum thapsus	woolly mullein	IBH				x	

Plant Families and Species		Habit	Occurrence in Study Area: Jeffrey Pine Forest	Big Sagebrush Scrub	Wright Buckwheat Scrub	Mechanically Disturbed Soils	Thermally Disturbed Soils
Monocots							
Cyperaceae							
Carex douglasii	Douglas sedge	NPGL	x			x	x
Carex rossii	Ross sedge	NPGL	x				
Juncaceae							
Juncus mexicanus	Mexican rush	NPGL				xch	x
Liliaceae							
Calochortus sp.	mariposa lily	NPGL	x	x			x
Poaceae							
Achnatherum hymenoides	indian ricegrass	NPG	x	x			
Achnatherum nevadense	Nevada needlegrass	NPG	x	x	x		
Achnatherum occidentalis ssp. *pubescens*	western needlegrass	NPG	x	x	x	x	
Achnatherum pinetorum	pine needlegrass	NPG	x			x	
Agropyron cristatum	crested wheatgrass	IPG				x	
Bromus inermis ssp. *inermis*	smooth brome	IPG	x			x	
Bromus tectorum	cheat grass	IAG	x	x	x	x	x
Dactylis glomerata	orchard grass	IPG				x	
Distichlis spicata	saltgrass	NPG		xch		x	
Elymus elymoides ssp. *elymoides*	squirreltail grass	NPG	x	x	x	x	
Elymus multisetus	big squirreltail grass	NPG		xch			
Elymus trachycaulus ssp. *trachycaulus*	slender wheatgrass	NPG				x	
Elytrigia intermedia ssp. intermedia	intermediate wheatgrass	IPG	x	x		x	
Festuca idahoensis	Idaho fescue	NPG	x	x	x		
Festuca trachyphylla	hard fescue	IPG				x	
Festuca sp.	fescue	NPG				x	
Hesperostipa comata ssp. *comata*	needle and thread grass	NPG	x	x			
Hordeum brachyantherum ssp. *brachyantherum*	meadow barley	NPG		x		x	

Plant Families and Species		Habit	Occurrence in Study Area: Jeffrey Pine Forest	Big Sagebrush Scrub	Wright Buckwheat Scrub	Mechanically Disturbed Soils	Thermally Disturbed Soils
Poaceae (cont.)							
Hordeum jubatum	foxtail barley	NPG	x				
Leymus cinereus	ashy wildrye	NPG		x			
Melica stricta	rock melic	NPG		x			
Muhlenbergia asperifolia	scratchgrass	NPG				x	
Muhlenbergia richardsonis	mat muhly	NPG		xch			
Poa compressa	Canada bluegrass	IPG			x	x	

key to growth habit codes:

A	annual
B	biennial
G	grass
GL	grass-like
H	herb
I	introduced
N	native
P	perennial
S	shrub
T	tree

xch = confined to channels that carry ephemeral flows within the habitat.