Chapter 12
Botanical Resources and Wetlands

12.1 Affected Environment

This section describes the affected environment related to botanical resources and wetlands for the dam and reservoir modifications that are proposed under SLWRI action alternatives. For a more in-depth description, see the *Botanical Resources and Wetlands Technical Report.*

The botanical resources and wetlands setting for the Shasta Lake and vicinity portion of the primary study area consists of the impoundment area (five arms and the Main Body of Shasta Lake, as described below) and the relocation areas (Figure 12-1).

Reclamation established project boundaries for focused surveys in the areas that would be subject to inundation under the various enlargement scenarios. The lower boundary corresponds to the current full pool elevation defined by Reclamation (1,070-foot mean sea level contour line). The upper boundary was established using the 1,090-foot mean sea level contour line around the entire lake. This area is referred to as the "impoundment area" (Figure 12-1).

Areas subject to physical disturbance as an indirect result of the proposed project (i.e., areas proposed as relocation sites for roadways, bridges, utilities, and campgrounds that would be inundated after the enlargement of Shasta Dam as well as proposed dike locations) were incorporated into the Shasta Lake and vicinity portion of the primary study area. These locations are hereafter referred to as "relocation areas" (Figure 12-1).

To examine the biological resources along riverine reaches that would be subject to inundation if Shasta Dam were enlarged, reaches of 11 streams and rivers that are tributary to Shasta Lake were also incorporated into the Shasta Lake and vicinity portion of the primary study area. These streams were selected by Reclamation in conjunction with USFS as an initial sampling of streams representative of riverine and riparian habitats. Subsequently, botany studies have been expanded into select areas of the impoundment area and within all of the relocation areas.

For the purposes of this investigation, approximate acreages for vegetation types and waters of the United States are reported by arm of the lake. For a relocation area that falls between two arms, the area is included with the arm that has the most acreage of the vegetation type or water of the United States.

Vegetation communities and special-status plant species in the extended study area are discussed in less detail. The extended study area includes the Sacramento River basin from Red Bluff Pumping Plant (RBPP) south to the Delta. It also includes the San Francisco Bay/Sacramento–San Joaquin River Delta (Bay-Delta) area and portions of the American River basin, San Joaquin River basin, and the water service areas of the CVP and the SWP.

Descriptions of biological resources were derived primarily from the following sources:

- Shasta Lake Water Resources Investigation Mission Statement Milestone Report (Reclamation 2003)
- Shasta Lake Water Resources Investigation Initial Alternatives Information Report (Reclamation 2004)
- Chapter 3, "Biological Environment," in the Draft Shasta Lake Water Resources Investigation Plan Formulation Report (Reclamation 2007)
- USFWS Endangered Species Lists
- The California Natural Diversity Database (CNDDB)
- The California Native Plant Society (CNPS) online inventory
- Numerous technical studies of botanical and wetland resources conducted in the Shasta Lake and vicinity portion of the primary study area since 2002.

Several attachments to the *Botanical Resources and Wetlands Technical Report* provide detailed lists and descriptions of special-status species present in the primary and extended study areas:

- Attachment 1, "Lists of All Special-Status Plant Species Known from or Potentially Present in the Primary and Extended Study Areas"
- Attachment 2, "List of Plant Species Observed in the Shasta Lake and Vicinity Portion of the Primary Study Area"
- Attachment 3, "Special-Status Plant Species Known to Occur in the Shasta Lake and Vicinity Portion of the Primary Study Area"
- Attachment 4, "List of All Sensitive Plant Species in the Extended Study Area Reported to the CNDDB"
- Attachment 5, "Known Weed Source Locations, Potential Mode of Spread, and Risk of Spread"

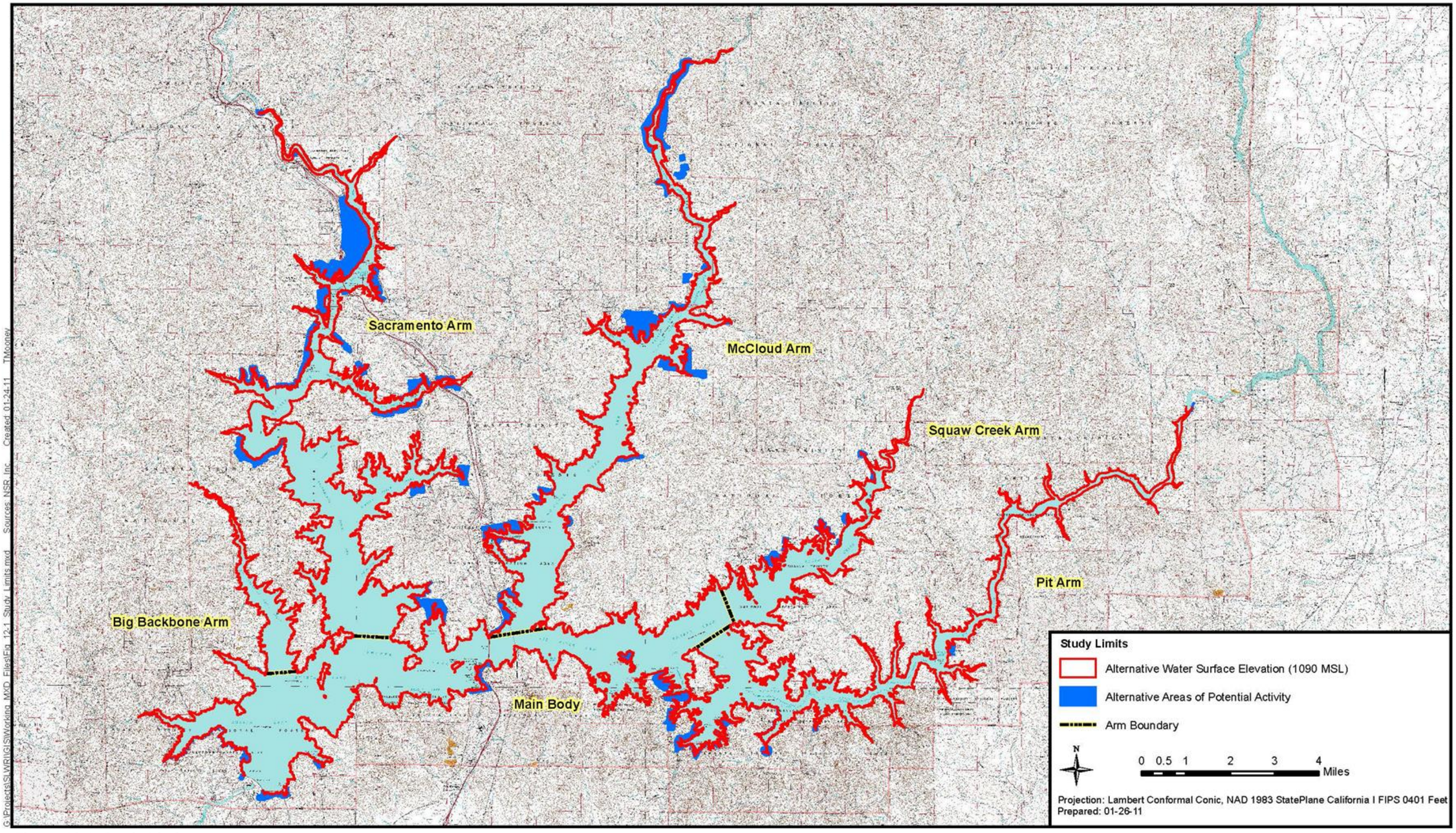

Figure 12-1. Study Limits

This page left blank intentionally.

12.1.1 Vegetation Communities

Shasta Lake and Vicinity

Reclamation conducted extensive mapping to characterize the plant communities in the Shasta Lake and vicinity portion of the primary study area. The study area for botanical resources and wetlands in the Shasta Lake and vicinity portion of the primary study area corresponds to the area that would be subject to inundation under the five action alternatives and areas where infrastructure would be removed, modified, or relocated (Figure 12-1). The vegetation mapping followed the technical approach described in *A Manual of California Vegetation* (MCV) (Sawyer and Keeler-Wolf 1995), using the vegetation alliance classification system described in *A Manual of California Vegetation, Second Edition* (Sawyer, Keeler-Wolf, and Evens 2009).

MCV represents the most recent effort to provide a common and accepted vegetation classification system for use throughout California. It classifies vegetation into a set of plant alliances, provisional alliances, special stands, or semi-natural stands. In this system, the plant species dominance or importance in the layer (i.e., tree, shrub, and ground) with the greatest amount of cover determines the vegetation alliance classification. The same approach used to describe and classify MCV types was applied when other vegetation types not described in the current MCV were encountered and determined to be significant vegetative components.

Vegetation mapping was conducted using recent 1:2,400-scale rectified color aerial photography. All vegetation mapping was performed in the field by ground truthing the primary study area from boat, vehicle, and/or on foot. MCV plant alliances were identified and delineated onto the aerial photographs. The delineated boundaries were digitized and generated in ArcGIS/ArcInfo software for display and data query purposes.

The Shasta Lake and vicinity area is characterized by a variety of vegetation types typical of transitional mixed woodland and low-elevation forest habitats. MCV plant series types in this portion of the primary study area are birch-leaf mountain mahogany chaparral, black willow thicket, blue oak woodland, Brewer's oak scrub, buck brush chaparral, California annual grassland, California black oak forest, California ash chaparral, California buckeye groves, California yerba santa scrub, canyon live oak forest, deer brush chaparral, Fremont cottonwood forest, ghost pine woodland, Himalayan blackberry brambles, interior live oak chaparral, interior live oak woodland, knobcone pine forest, mixed willow, Oregon ash groves, Oregon white oak woodland, pale spike rush marshes, ponderosa pine–Douglas fir forest, ponderosa pine forest, red osier thickets, sandbar willow thickets, spicebush thickets, valley oak woodland, white alder groves, and white leaf manzanita chaparral. Vegetation in each of these series varies, with dramatic changes often occurring in relation to aspect, slope, geologic substrate, or juxtaposition with other habitats.

The acreage of MCV types found in the impoundment area along the Main Body and the five arms of Shasta Lake is shown in Table 12-1, and the acreage of MCV types found in the relocation areas along the Main Body and the five arms of Shasta Lake is shown in Table 12-2. The locations of each type are depicted on Figures 12-2a through 12-2f. General descriptions of each type are provided below. Plant taxonomy follows Baldwin et al. (2012).

Table 12-1. Summary of Plant Communities in the Impoundment Area

Plant Series	Area (Acres)					
	Main Body	Big Backbone Arm	Sacramento Arm	McCloud Arm	Squaw Creek Arm	Pit Arm
Arroyo willow thickets	0.15	0.00	13.16	11.18	0.00	2.84
Barren[1]	2.30	0.00	0.55	0.00	0.00	0.00
Birch-leaf mountain-mahogany chaparral	0.00	0.00	0.00	2.23	0.00	0.00
Black willow thicket	0.00	0.00	0.02	0.00	0.00	0.02
Blue oak woodland	1.27	0.00	0.00	0.70	0.00	4.08
Brewer oak scrub	9.78	0.17	51.62	4.99	4.51	7.78
Buck brush chaparral	0.90	2.42	2.11	1.59	0.67	0.19
California annual grassland	0.58	0.34	4.17	0.94	0.00	0.33
California black oak forest	71.45	14.14	160.32	47.44	1.72	5.06
California buckeye groves	0.00	0.00	0.20	0.01	0.00	0.00
California yerba santa scrub	0.75	0.00	0.00	0.00	0.00	11.58
Canyon live oak forest	9.80	18.41	53.80	48.31	26.78	110.51
Deer brush chaparral	0.18	0.00	0.00	0.08	0.00	2.34
Fremont cottonwood forest	0.00	0.00	0.07	0.00	0.00	0.05
Ghost pine woodland	54.05	0.00	51.29	13.50	22.03	30.54
Himalayan blackberry brambles	0.00	0.00	0.00	0.00	0.00	0.44
Interior live oak chaparral	1.24	0.00	10.05	0.01	0.00	24.22
Interior live oak woodland	2.00	0.00	0.14	0.09	0.00	2.28
Knobcone pine forest	32.96	0.40	16.38	20.72	47.87	79.83
Mixed willow	1.39	1.46	14.56	0.16	0.19	0.83
Oregon ash groves	0.00	0.00	0.00	0.17	0.00	0.00
Oregon white oak woodland	0.00	0.00	0.00	1.09	0.00	0.66

Table 12-1. Summary of Plant Communities in the Impoundment Area (contd.)

Plant Series	Area (Acres)					
	Main Body	Big Backbone Arm	Sacramento Arm	McCloud Arm	Squaw Creek Arm	Pit Arm
Ponderosa pine–Douglas fir forest	5.02	0.00	28.37	50.04	69.02	127.51
Ponderosa pine forest	225.95	36.67	212.79	208.77	59.33	101.18
Red osier thickets	0.00	0.00	0.00	0.12	0.00	0.00
Riverine[1]	0.00	0.88	5.24	15.43	1.41	0.00
Sandbar willow thickets	0.00	0.00	0.00	0.28	0.07	0.00
Spicebush thickets	0.00	0.00	0.00	0.06	0.00	0.00
Urban[1]	22.04	0.00	0.00	0.00	0.00	1.92
White alder groves	1.34	4.47	9.70	12.40	1.18	2.85
White leaf manzanita chaparral	16.60	12.30	98.22	6.21	7.49	2.86
Total	459.76	91.67	732.20	446.49	242.28	519.90

Notes
[1] CWHR Wildlife Habitat Type; no corresponding plant series type.

Table 12-2. Summary of Plant Communities in the Relocation Areas

Plant Series	Area (Acres)					
	Main Body	Big Backbone Arm	Sacramento Arm	McCloud Arm	Squaw Creek Arm	Pit Arm
Barren[1]	23.75	0.00	87.90	36.33	11.53	18.87
Birch-leaf mountain-mahogany chaparral	0.00	0.00	0.07	0.41	0.00	0.00
Black willow thicket	0.00	0.00	0.03	0.00	0.00	0.00
Blue oak woodland	0.00	0.00	0.00	3.68	0.00	1.09
Brewer oak scrub	9.24	0.00	39.30	23.83	0.00	0.27
Buck brush chaparral	0.00	0.00	1.30	2.11	0.00	0.08
California annual grassland	5.02	0.00	23.06	10.40	0.84	0.88
California ash chaparral	0.00	0.00	0.00	0.68	0.00	0.00
California black oak forest	45.03	0.00	190.50	125.40	1.29	0.23
California buckeye groves	0.30	0.00	0.00	1.58	0.00	0.00
California yerba santa scrub	0.33	0.00	0.00	0.00	0.00	14.30

Table 12-2. Summary of Plant Communities in the Relocation Areas (contd.)

Plant Series	Area (Acres)					
	Main Body	Big Backbone Arm	Sacramento Arm	McCloud Arm	Squaw Creek Arm	Pit Arm
Canyon live oak forest	1.18	0.00	13.92	96.62	4.98	23.85
Deer brush chaparral	0.18	0.00	0.00	0.57	0.00	5.64
Fremont cottonwood forest	0.00	0.00	0.56	0.00	0.00	0.05
Ghost pine woodland	124.50	0.00	84.08	48.74	13.48	13.68
Himalayan blackberry brambles	0.18	0.00	0.00	0.06	0.00	0.16
Interior live oak chaparral	0.00	0.00	2.42	0.00	0.00	45.35
Interior live oak woodland	0.72	0.00	0.00	0.00	0.00	1.12
Knobcone pine forest	0.11	0.00	55.68	13.61	1.94	23.21
Lacustrine[1]	0.00	0.00	0.00	0.16	0.00	0.00
Mixed willow	0.079	0.00	1.26		0.06	0.35
Oregon ash groves	0.00	0.00	0.00	0.50	0.00	0.00
Oregon white oak woodland	0.00	0.00	0.00	5.72	0.07	0.00
Pale spike rush marshes	0.00	0.00	6.51	0.00	0.00	0.00
Ponderosa pine–Douglas fir forest	0.00	0.00	23.78	149.91	28.80	19.27
Ponderosa pine forest	185.34	0.00	555.71	497.08	43.08	50.13
Riverine[1]	0.00	0.00	0.39	0.00	0.00	0.00
Sandbar willow thickets	0.00	0.00	0.00	0.09	0.00	0.00
Spicebush thickets	0.00	0.00	0.00	0.64	0.00	0.00
Urban[1]	20.71	0.00	229.37	0.48	0.00	0.57
Valley oak woodland	0.00	0.00	1.05	0.00	0.00	0.00
White alder groves	0.00	0.00	2.51	2.75	0.17	0.00
White leaf manzanita chaparral	15.93	0.00	77.38	15.51	4.38	0.17
Total	432.60	0.00	1,396.35	1,036.70	110.61	219.04

Note:
[1] CWHR Wildlife Habitat Type; no corresponding plant series type included in *A Manual of California Vegetation* (Sawyer and Keeler-Wolf 1995).

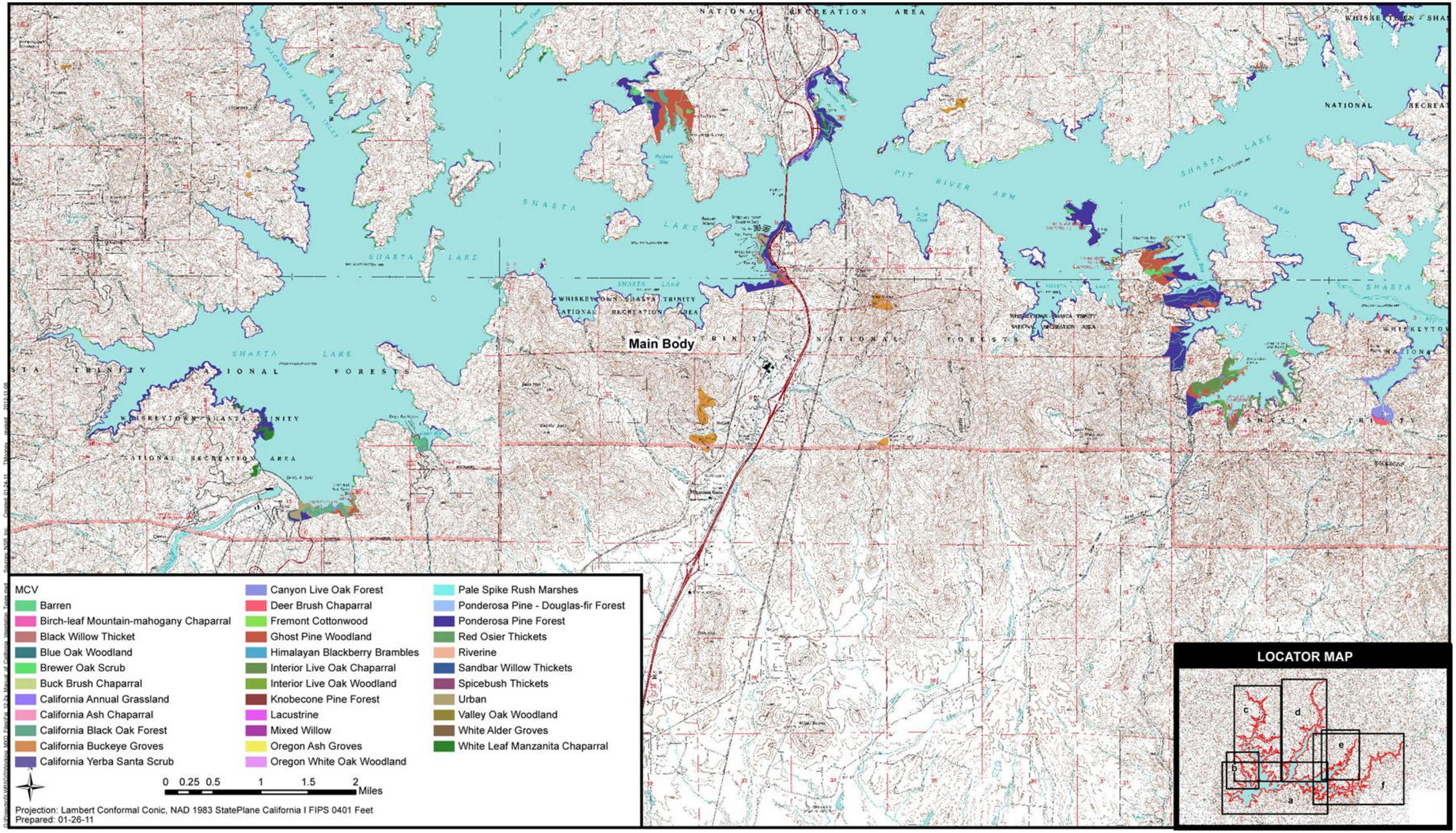

Figure 12-2a. Manual of California Vegetation Types

This page left blank intentionally.

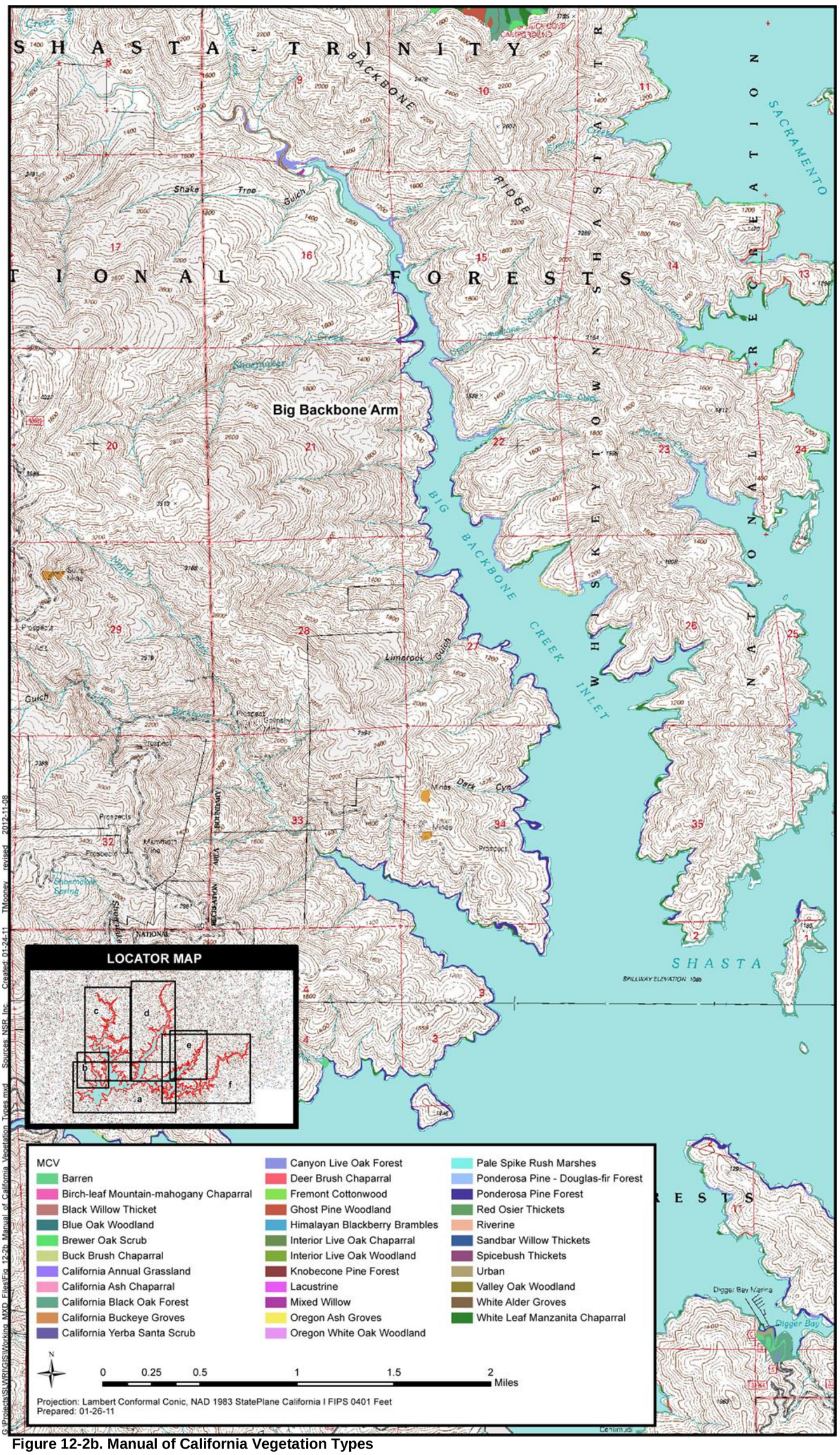

Figure 12-2b. Manual of California Vegetation Types

This page left blank intentionally.

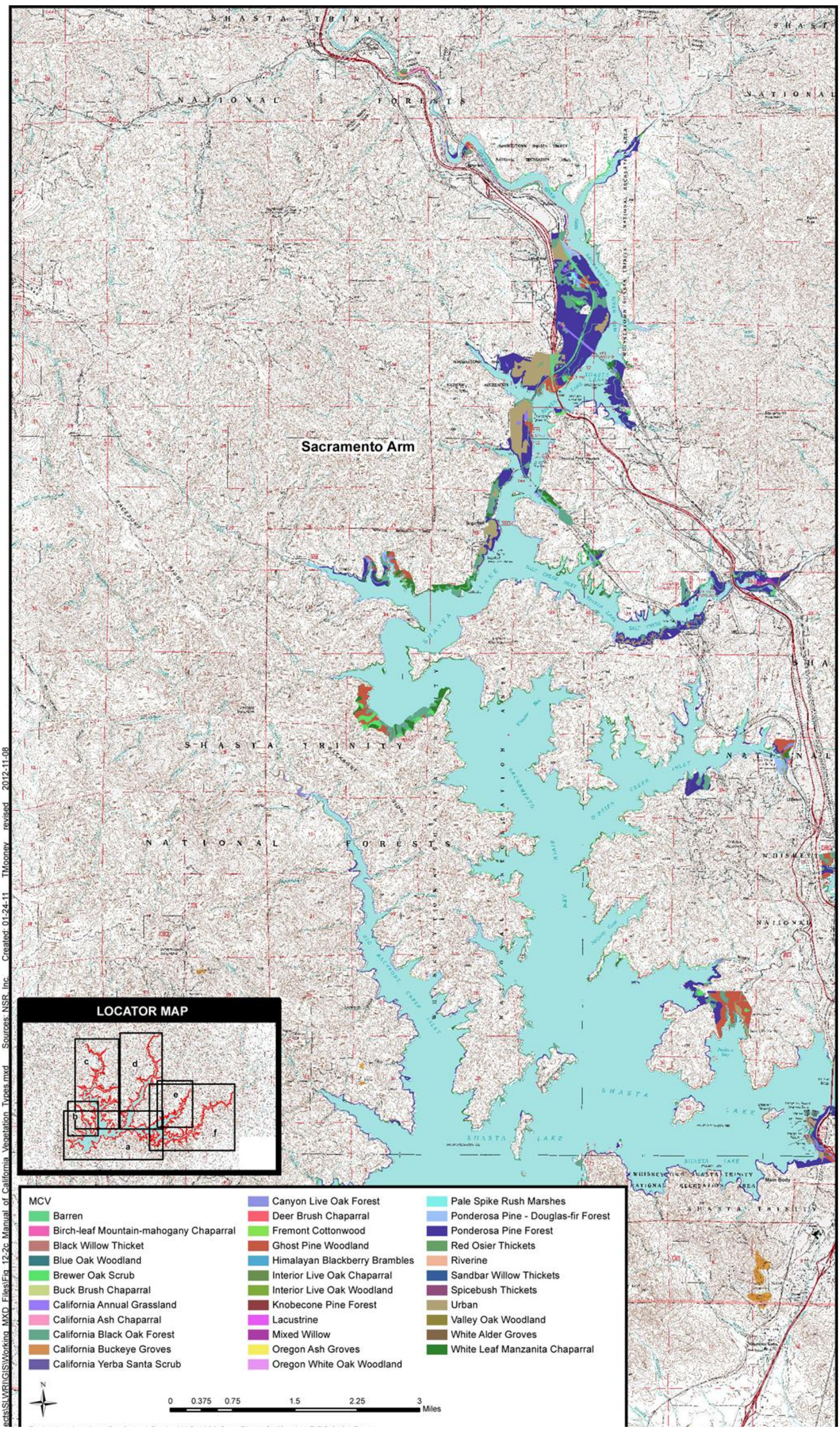

Figure 12-2c. Manual of California Vegetation Types

This page left blank intentionally.

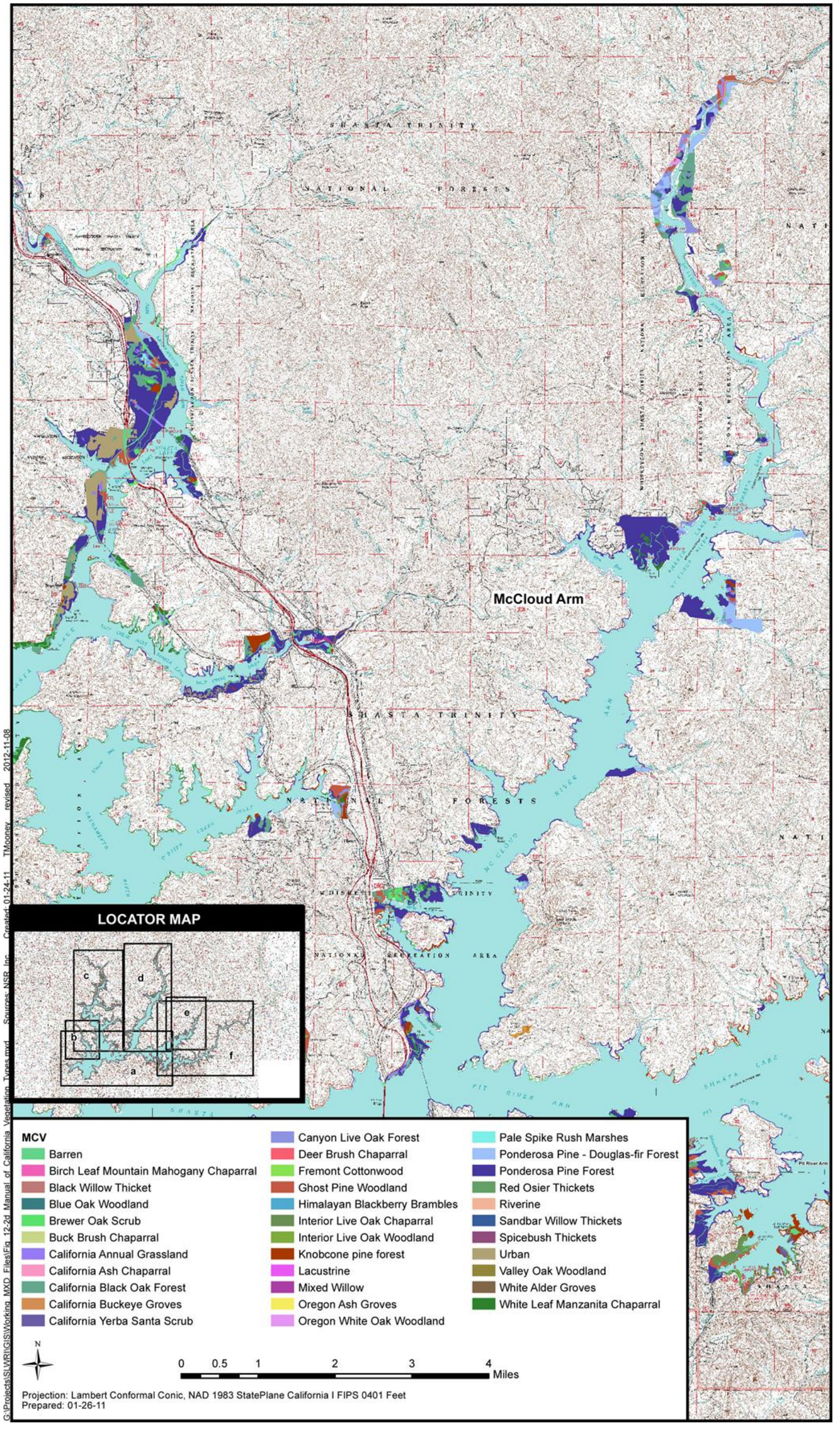

Figure 12-2d. Manual of California Vegetation Types

This page left blank intentionally.

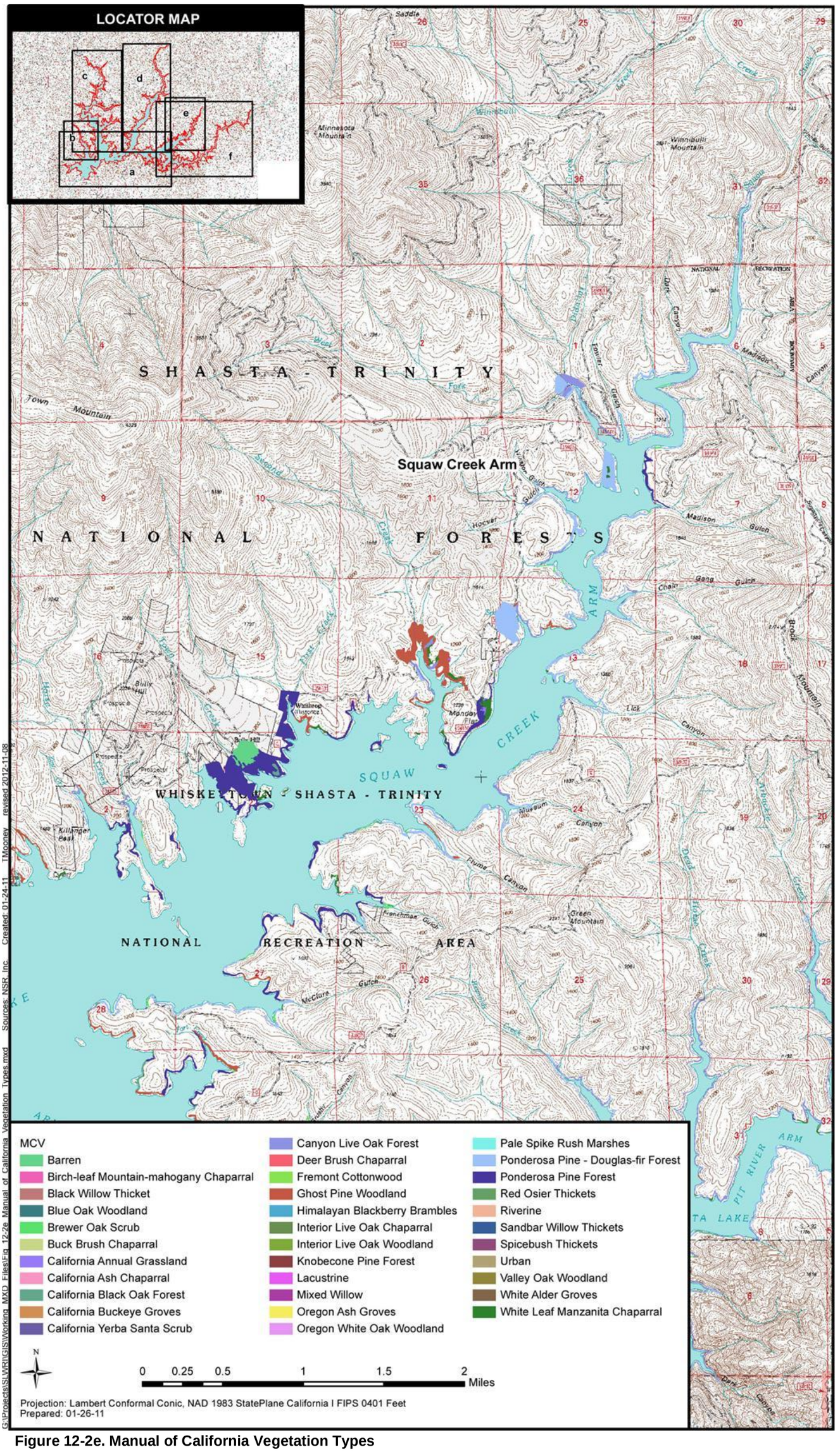

Figure 12-2e. Manual of California Vegetation Types

This page left blank intentionally.

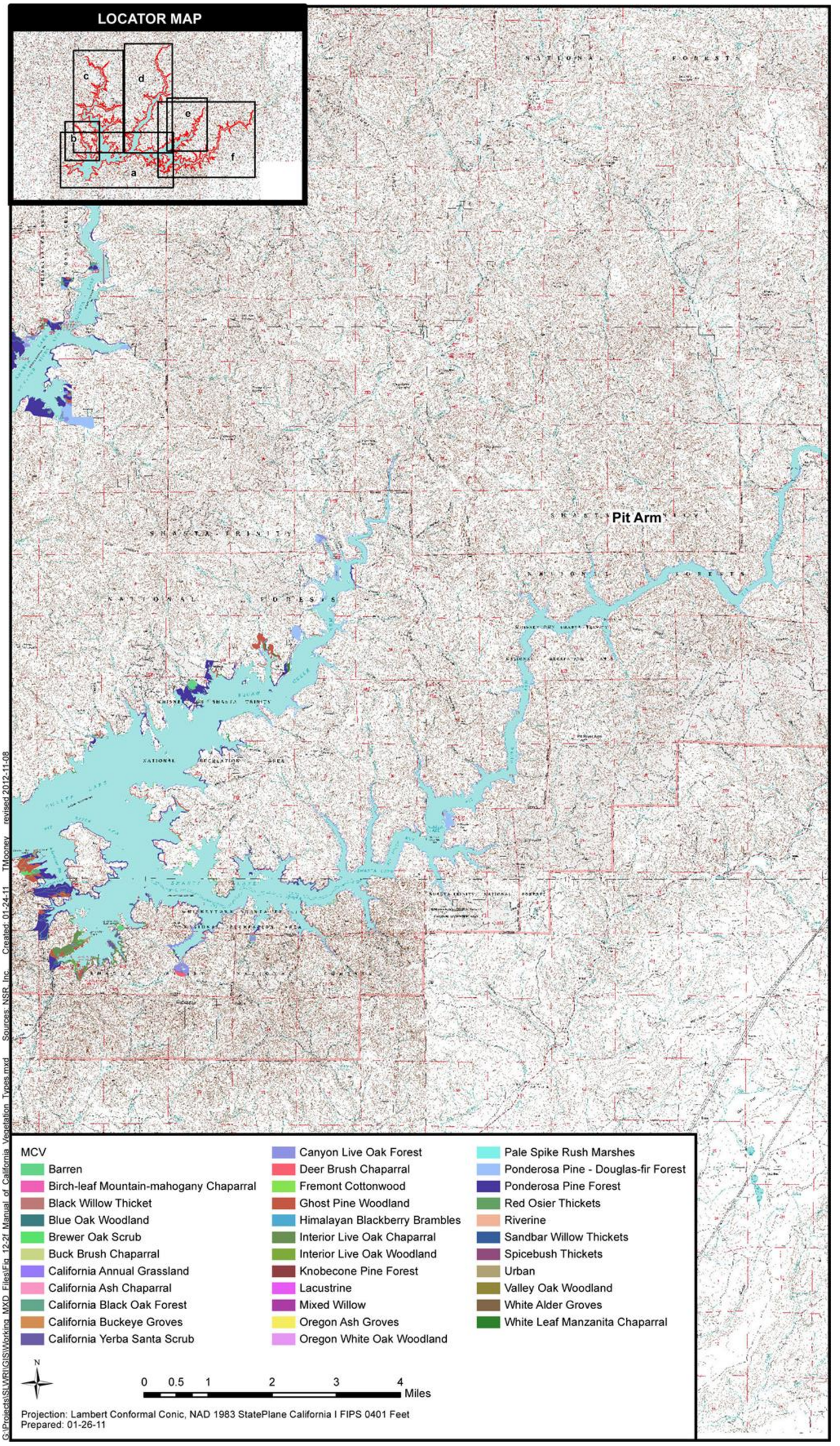

Figure 12-2f. Manual of California Vegetation Types

This page left blank intentionally.

Barren Barren habitat consists mainly of nonvegetated human-made features. Barren habitat is scattered throughout the Shasta Lake and vicinity portion of the primary study area, including boat ramps, parking lots, and roads. Other barren habitats are a large gravel plain feature at the confluence of Butcher Creek and Shasta Lake (Main Body) and a sealed riprap feature adjacent to Interstate 5 near the upper Sacramento Arm and Shasta Lake confluence. Vegetation is usually not present, although sparse opportunistic grasses/forbs or weedy species may occur.

Birch-Leaf Mountain-Mahogany Chaparral Birch-leaf mountain-mahogany chaparral is a relatively common associate species in many chaparral and woodland plant series types. As a plant series, birch-leaf mountain-mahogany occurs in the Shasta Lake and vicinity portion of the primary study area along the upper McCloud and Sacramento arms. These sites are located on floodplain terraces and are characterized as moderate to dense chaparral stands dominated by birch-leaf mountain-mahogany (*Cercocarpus betuloides*), with occasional buck brush (*Ceanothus cuneatus*), poison oak (*Toxicodendron diversilobum*), western redbud (*Cercis occidentalis*), yerba santa (*Eriodictyon californicum*), and Brewer oak (*Q. garryana* var. b*reweri*).

Black Willow Thicket Although commonly associated with willow and other riparian plant series types, black willow thicket is uncommon in the Shasta Lake and vicinity portion of the primary study area. This plant series is dominated by black willow (*Salix gooddingii*), with spicebush (*Calycanthus occidentalis*), rushes (*Juncus* spp.), and California grape (*Vitis californica*). It occurs at only two locations in the Shasta Lake and vicinity portion of the primary study area, one along the Sacramento Arm and the other in the Jones Valley area (Pit Arm).

Blue Oak Woodland The blue oak plant series occurs mainly as small inclusions within other more prevalent plant series types; however, moderate-sized stands also occur. This plant series occurs at scattered locations along the Main Body, McCloud Arm, and Pit Arm and is characterized by open to moderate woodlands dominated by blue oak (*Quercus douglasii*). Associated tree species include occasional interior live oak (*Q. wislizenii* var. *wislizenii*) and gray pine (*Pinus sabiniana*). The shrub layer is open or absent, and a moderate to dense forb layer dominates the understory.

Brewer Oak Scrub The Brewer oak plant series consists of moderate to very dense stands of Brewer oak, the shrub form of Oregon white oak (*Q. garryana* var. *garryana*). This plant series type is widespread throughout the Shasta Lake and vicinity portion of the primary study area. Brewer oak stands are often nearly pure; occasionally, however, shrub species such as poison oak, white leaf manzanita, yerba santa, buck brush, bush poppy (*Dendromecon rigida*), Fremont's silktassel (*Garrya fremontii*), deer brush (*Ceanothus integerrimus*), skunkbrush (*Rhus trilobata*), and snowdrop bush (*Styrax officinalis*) occur in association with Brewer oak.

Buck Brush Chaparral Buck brush chaparral occurs at scattered locations throughout the Shasta Lake and vicinity portion of the primary study area. This plant series is dominated by moderate to dense stands of buck brush. Associated species include white leaf manzanita, poison oak, western redbud, yerba santa, Brewer oak, birch-leaf mountain-mahogany, and coffeeberry (*Frangula* sp.).

California Annual Grassland California annual grassland is uncommon in the Shasta Lake and vicinity portion of the primary study area, occurring only as small inclusions in other more prevalent plant series types or in areas subjected to previous disturbance. Dominant species include wild oat (*Avena fatua*), downy brome (*Bromus tectorum*), ripgut (*B. diandrus*), yellow star-thistle (*Centaurea solstitialis*), squirreltail (*Elymus elymoides*), and European hairgrass (*Aira caryophyllea*).

California Ash Chaparral California ash (*Fraxinus dipetala*) is a relatively common associate species in many chaparral and woodland plant series types. As a plant series, California ash chaparral occurs in the Shasta Lake and vicinity portion of the primary study area at several locations along the McCloud Arm. This plant series is characterized as a moderate to dense chaparral stand dominated by California ash, with occasional birch-leaf mountain-mahogany, buck brush, poison oak, western redbud, yerba santa, and Brewer oak.

California Black Oak The black oak series is characterized by moderate to dense stands of California black oak (*Quercus kelloggii*). This plant series is relatively common throughout the Shasta Lake and vicinity portion of the primary study area. Understory associates include white leaf manzanita (*Arctostaphylos viscida*), poison oak, snowdrop bush (*Styrax officinalis*), and buck brush. The ground layer is open to dense and is dominated by various grasses and forbs.

California Buckeye Groves Although a common associate in many plant series types in the Shasta Lake and vicinity portion of the primary study area, California buckeye groves are uncommon as a plant series type. This plant series is dominated by California buckeye (*Aesculus californica*). Associated species include poison oak, Brewer oak, buck brush, and various grasses and forbs. It occurs at only several scattered locations in the Sacramento Arm, McCloud Arm, and Pit Arm.

California Yerba Santa Scrub California yerba santa scrub is a relatively common associate species in many chaparral and woodland plant series types. California yerba santa is a pioneer species that readily responds to various disturbances and wildfire. As a plant series, California yerba santa scrub occurs in the Shasta Lake and vicinity portion of the primary study area at two general locations subject to recent wildfire: the Dry Creek area (Main Body) and the Jones Valley area (Pit Arm). This plant series is characterized as moderate to dense chaparral stands dominated by California yerba santa, with occasional

shrub interior live oak, shrub canyon live oak, buck brush, poison oak, western redbud, and Brewer oak.

Canyon Live Oak Forest The canyon live oak plant series is characterized by moderate to dense stands of canyon live oak (*Quercus chrysolepis*). This plant series is relatively common throughout the Shasta Lake and vicinity portion of the primary study area. Associated tree species include occasional California black oak. Understory associates include white leaf manzanita and poison oak. The ground layer is open to moderate and is dominated by various grasses and forbs.

Deer Brush Chaparral Deer brush chaparral is a relatively common associate in chaparral and forest plant series types in the Shasta Lake and vicinity portion of the primary study area; however, deer brush is uncommon in the study area as a plant series type. This plant series is dominated by deer brush. It occurs at several scattered locations along the Main Body, McCloud Arm, and Pit Arm.

Fremont Cottonwood Forest In the Shasta Lake and vicinity portion of the primary study area, Fremont cottonwood forest is an uncommon plant series type that occurs as single stands of trees along small portions of the upper Sacramento Arm and the Pit Arm. The dominant species is Fremont cottonwood (*Populus fremontii*).

Ghost (Gray) Pine The ghost pine plant series occurs in all parts of the Shasta Lake and vicinity portion of the primary study area except along the Big Backbone Arm. This plant series type is characterized by open to moderate stands of gray pine. Associated species include blue oak, canyon live oak, interior live oak, and California black oak. Shrub species are moderate to dense and include white leaf manzanita, western redbud, buck brush, Brewer oak, poison oak, and yerba santa.

Himalayan Blackberry Brambles Himalayan blackberry (*Rubus armeniacus*) is a common associate in many riparian plant series and in various other plant series with mesic microhabitats and/or previous disturbance. As a plant series, Himalayan blackberry brambles occur in portions of the Dry Creek (Main Body) and Jones Valley (Pit Arm) areas recently disturbed by wildfire. This plant series occurs in and along drainage and stream features and is characterized as dense thickets of Himalayan blackberry. Associated species include spicebush, willow, and rushes.

Interior Live Oak Chaparral In the Shasta Lake and vicinity portion of the primary study area, the interior live oak chaparral plant series is relatively uncommon, occurring mainly along the Sacramento Arm. However, this plant series also occurs at scattered locations along the Main Body, the McCloud Arm, and the Pit Arm. This plant series is dominated by moderate to dense stands of the shrub form of interior live oak. Associated species include Brewer oak, white leaf manzanita, poison oak, and buck brush.

Interior Live Oak Woodland The interior live oak woodland plant series is uncommon in the Shasta Lake and vicinity portion of the primary study area. It occurs in several small areas along the Sacramento Arm, the Pit Arm, the McCloud Arm, and the Main Body.

Knobcone Pine Forest The knobcone pine forest plant series consists of open to dense knobcone pine (*Pinus contorta*) stands. This plant series is scattered throughout all portions of the Shasta Lake and vicinity portion of the primary study area. Knobcone pine forest often occurs at locations characterized by disturbances, including historic mining activities and past or recent wildfires. Dominant species include knobcone pine, with occasional canyon live oak, California black oak, ponderosa pine (*Pinus ponderosa*), and gray pine. The shrub layer is moderate to dense and is dominated by white leaf manzanita and poison oak. The ground layer varies and is dominated by various grasses and forbs.

Lacustrine Lacustrine habitat consists of the area regularly inundated by Shasta Lake (i.e., areas at and below the 1,070-foot elevation). Most of this area is barren of vegetation and is characterized as exposed soil and/or rock. Portions of the lacustrine habitat do support vegetation, including woody riparian species such as black willow, button willow (*Cephalanthus occidentalis*), Fremont cottonwood, and various grasses and forbs, during draw-down periods.

Mixed Willow Mixed willow is the most common willow plant series type in the Shasta Lake and vicinity portion of the primary study area and occurs throughout the entire area. Dominant species include red willow (*Salix laevigata*), black willow, shining willow (*S. lasiandra*), arroyo willow (*S. lasiolepis*), and narrowleaf willow (*S. exigua*).

Oregon Ash Groves Oregon ash groves are an uncommon plant series type in the Shasta Lake and vicinity portion of the primary study area. This type occurs along the upper McCloud Arm and is dominated by open to moderate stands of Oregon ash (*Fraxinus latifolia*) with willow, California grape, mock orange, brickellbush (*Brickellia* sp.), and poison oak.

Oregon White Oak Woodland The Oregon white oak woodland plant series is uncommon in the Shasta Lake and vicinity portion of the primary study area and occurs as small inclusions in other more prevalent plant series types. This plant series is characterized by open to moderate woodlands dominated by Oregon white oak. Associated tree species include occasional canyon live oak, blue oak, and California black oak. The shrub layer is open or absent, and a moderate to dense forb layer dominates the understory.

Pale Spike Rush Marshes Pale spike rush is an uncommon plant series in the Shasta Lake and vicinity portion of the primary study area; it is known to occur only in a portion of one relocation area near Lakehead (Sacramento Arm). This plant series is characterized as a seasonal wetland dominated by a complex of

annual and perennial upland and wetland plant species. Dominant species include pale spike rush (*Eleocharis macrostachya*), jointed coyote-thistle (*Eryngium articulatum*), pennyroyal (*Mentha pulegium*), panic grass (*Panicum acuminatum*), iris-leaf rush (*Juncus xiphioides*), sedges (*Carex* spp.), rushes, poison oak, white leaf manzanita, western choke-cherry (*Prunus virginiana*), interior rose (*Rosa woodsii*), and Himalayan blackberry.

Ponderosa Pine–Douglas-Fir Ponderosa pine-Douglas-fir is the second-most-common conifer plant series type in the Shasta Lake and vicinity portion of the primary study area, occurring everywhere except along the Big Backbone Arm. This plant series is characterized by open to dense conifer stands dominated by Douglas-fir (*Pseudotsuga menziesii*) and ponderosa pine. Associated species include occasional sugar pine (*P. lambertiana*), incense cedar (*Calocedrus decurrens*), canyon live oak, and California black oak. Associated understory species vary and include Pacific dogwood (*Cornus nuttallii*), mock orange (*Philadelphus lewisii*), poison oak, snowdrop bush, and white leaf manzanita. The ground layer is open to moderate and is dominated by various grasses and forbs.

Ponderosa Pine Ponderosa pine is the most common conifer plant series type in the Shasta Lake and vicinity portion of the primary study area and is scattered throughout all portions of the area. This plant series is characterized by open to dense conifer stands dominated by ponderosa pine. Associated species include occasional Douglas-fir, sugar pine, incense cedar, canyon live oak, and California black oak. Associated understory species vary and include redbud, buck brush, mock orange, poison oak, snowdrop bush, and white leaf manzanita. The ground layer is open to moderate and is dominated by various grasses and forbs.

Red Osier Thickets Red osier is a common associate in many riparian plant series types in the Shasta Lake and vicinity portion of the primary study area. As a plant series, red osier thickets are an uncommon plant series type. In the vicinity of Shasta Lake, red osier thickets are found along the upper McCloud Arm. Dominant species include red osier (*Cornus stolonifera*), brown dogwood (*C. glabrata*), mock orange, spicebush, and California grape.

Riverine Riverine habitat includes the free-flowing portions of the larger Shasta Lake tributaries occurring in the Shasta Lake and vicinity portion of the primary study area. The riverine habitat is highly variable and ranges from moderate, low-gradient to steep, well-confined stream reaches.

Sandbar Willow Thickets Sandbar willow thicket is an uncommon plant series that occurs at one location each along the McCloud Arm and the Squaw Creek Arm. Dominant species include narrowleaf willow, with occasional red willow, black willow, shining willow, and arroyo willow.

Spicebush Thickets Spicebush is a common associate in many riparian plant series types in the Shasta Lake and vicinity portion of the primary study area. As a plant series, spicebush thickets are an uncommon plant series type. This plant series occurs at several locations along the McCloud Arm. Dominant species include spicebush, red osier, mock orange, and California grape.

Urban Urban habitat consists of various man-made features scattered throughout the Shasta Lake and vicinity portion of the primary study area, including resorts and a portion of the visitor center complex at Shasta Dam. These features are typically a combination of various buildings, pavement areas with manicured landscaping, and lawns.

Valley Oak Woodland Valley oak woodland is an uncommon plant series and occurs at two small locations in the Lakehead area (Sacramento Arm). Dominant species include valley oak (*Quercus lobata*) with white leaf manzanita, redbud, poison oak, and various grasses and forbs.

White Alder Groves The white alder plant series occurs in the riparian vegetation found in drainages throughout the Shasta Lake and vicinity portion of the primary study area. This plant series is characterized as narrow bands of vegetation occurring in and along the margins of rivers, streams, or other drainages. Dominant species include white alder (*Alnus rhombifolia*) with occasional Oregon ash, red osier, big-leaf maple (*Acer macrophyllum*), narrowleaf willow, red willow, shining willow, and arroyo willow. Associated shrubs include spicebush, mock orange, California blackberry (*Rubus ursinus*), mugwort (*Artemisia douglasiana*), ninebark (*Physocarpus capitatus*), and western azalea (*Rhododendron occidentale*). Common lianas include California grape, pipevine (*Aristolochia californica*), greenbriar (*Smilax californica*), and virgin's bower (*Clematis ligusticifolia*). The ground layer is open to dense and is dominated by sedges with various grasses and forbs.

White Leaf Manzanita Chaparral White leaf manzanita is the most common chaparral plant series type in the Shasta Lake and vicinity portion of the primary study area and is scattered throughout all portions of the area. The dominant species is white leaf manzanita. Associated species include occasional common manzanita (*A. manzanita*), western redbud, buck brush, deer brush, poison oak, birch-leaf mountain-mahogany, interior live oak (shrub form), Fremont's silktassel, bush poppy, yerba santa, and Brewer's oak.

Upper Sacramento River (Shasta Dam to Red Bluff)

The plant communities present in the primary study area between Shasta Dam and RBPP are grouped into common and sensitive communities as described below, and the relevant aspects of their ecology are discussed in detail in the *Botanical Resources and Wetlands Technical Report*, and summarized below for sensitive communities. These descriptions are generally applicable to the extended study area as well. (Plant community names and descriptions used in

this section are based primarily on the Preliminary Descriptions of the Terrestrial Natural Communities of California (Holland 1986).)

Common plant communities present within the primary study area include annual grassland, chaparral, and agricultural lands. The upper banks along steep-sided, bedrock constrained segments of the Sacramento River and its tributaries are characterized primarily by upland communities, including blue oak woodland, foothill pine-oak woodland, and chaparral. These segments occur primarily between Shasta Dam and Redding.

Sensitive plant communities include those that are of special concern to resource agencies or are afforded specific consideration through CEQA, Section 1602 of the California Fish and Game Code, Section 404 of the Federal Clean Water Act (CWA), and the State's Porter-Cologne Water Quality Control Act, as discussed under "Regulatory Framework."

Oak Woodlands Oak woodlands present in the primary study area include blue oak woodland, blue oak savanna, foothill pine-oak woodland, and valley oak woodland. The oaks that dominate the tree layer of oak savannas and woodlands are long-lived trees that are resilient to damage; their stems often survive fire, and when their stems are killed by fire or are cut down, basal sprouts often grow into new stems. (Valley oak also tolerates inundation during winter before it has leafed out.) Nonetheless, there are concerns regarding the status and ongoing trends of tree mortality and recruitment in tree canopies of blue oak- and valley oak-dominated savannas and woodlands (Tyler, Kuhn, and Davis 2006).

Riparian Communities California's riparian communities have experienced the most extensive reductions in their acreage, and in the Sacramento Valley more than 90 percent of riparian vegetation has been converted to agriculture or development, and the remainder substantially altered by dams, diversions, gravel mining, grazing practices, and invasive species (Hunter et al. 1999).

In the primary study area, much of the Sacramento River from Shasta Dam to Redding is deeply entrenched in bedrock, which precludes development of extensive areas of riparian vegetation. The river corridor between Redding and Red Bluff, however, still maintains extensive areas of riparian vegetation.

Riparian communities present within the floodplain of the Sacramento River, within the primary study area, include blackberry scrub, Great Valley willow scrub, Great Valley cottonwood riparian forest, Great Valley mixed riparian forest, and Great Valley valley oak riparian forest. Willow and blackberry scrub and cottonwood- and willow-dominated riparian communities are present along active channels and on the lower flood terraces whereas valley oak–dominated communities occur on higher flood terraces.

More than 15 native species of deciduous trees and shrubs occur in the riparian forests, woodlands, and scrubs of the Central Valley and the Delta (Conard, MacDonald, and Holland 1977;, Vaghti and Greco 2007). Flow regime, disturbance, and species attributes determine the species composition and physical structure of this woody vegetation. Although flow regime influences the dispersal, establishment, growth, and survival of all the woody riparian species, Fremont's cottonwood (*Populus fremontii*) and the willow species (*Salix* sp.) particularly depend on specific hydrologic events for their recruitment. During seed release, flows must be high enough to disperse seed to surfaces where scouring by subsequent flows does not occur, yet not so high that seedlings desiccate after flows recede, and flows must recede gradually to enable germination and seedling establishment while the substrate is still moist (Mahoney and Rood 1998).

Fremont's cottonwood and willow species are rapidly growing, shade intolerant and relatively short-lived (Burns and Honkala 1990, Vaghti and Greco 2007). Within 10 to 20 years, initially shrubby thickets have reached 10–40 feet in height. Other species, such as Oregon ash (*Fraxinus latifolia*) and valley oak (*Quercus lobata*), establish concurrently or subsequent to the willows and cottonwood, grow more slowly but are more tolerant of shade, and are longer-lived (Burns and Honkala 1990, Tu 2000). In the absence of frequent disturbance, these species enter the canopy, particularly after 50 years, as mortality of willows and cottonwood frees space. Conversely, frequent disturbance prevents the transition to mature mixed riparian or valley oak forests.

The operation of Shasta Dam has limited the frequency, magnitude, and duration of intermediate and larger flows during fall and winter, since the dam's construction, and flow volumes have been greater during the growing season. The operation of Shasta Dam also produces increasing flow volumes during the period of cottonwood seed dispersal (rather than flow volume decreasing during this period), largely precluding establishment of cottonwoods (and to a lesser extent willows) throughout much of the riparian zone (Roberts et al. 2002). The combined effect of these changes in flow regime has been a decrease in early- and mid-successional communities along the Sacramento River that is still ongoing (Fremier 2003).

Wetland Communities Similar to riparian communities, much of the wetland habitat that once occurred in the Sacramento River Valley has been eliminated as a consequence of land use conversion to agriculture and urbanization. It is estimated that nearly 1.5 million acres of wetlands once occurred in the Central Valley. Today, approximately 123,000 acres remain. Wetland communities that are likely to occur in the primary study area between Shasta Dam and RBPP include freshwater marsh, freshwater seep, northern hardpan vernal pools, northern volcanic mudflow vernal pools, and other seasonal wetlands.

Freshwater marshes are herbaceous wetland plant communities that occur along rivers and lakes and are characterized by dense cover of perennial, emergent plant species. Marshes are typically perennial wetlands, but may dry out for short periods of time. In marsh vegetation, vegetation structure and species richness are strongly influenced by disturbance, changes in water levels, and the range of elevations present at a site (Keddy 2000). Disturbances, and water level drawdowns that expose previously submerged surfaces, provide opportunities for species to establish, which creates diversity in species composition and vegetation structure. With increasing depth of water, the growth of marsh plants is reduced, and thus this vegetation type is typically restricted to shallow water.

Freshwater seep is a wetland plant community characterized by dense cover of perennial herb species usually dominated by rushes, sedges, and grasses. Freshwater seep communities occur on sites with permanently moist or wet soils resulting from daylighting groundwater.

Vernal pools are seasonal wetlands that fill during winter rains and dry up in spring. They occur in undulating or mima mound (i.e., mound-intermound) topography where the soil or underlying rock has layers that are relatively impermeable to water. Vernal pools may be isolated from one another, but more often they are interconnected by swales or ephemeral drainages in vernal pool complexes that may extend for hundreds of acres. Vernal pool complexes generally include water features. The two predominant types of vernal pool communities in the primary study area are northern hardpan vernal pools and northern volcanic mudflow vernal pools.

Pool size and the depth, duration, and seasonal timing of ponding are important factors that influence the composition and diversity of plant and animal species in vernal pools (Solomeshch, Barbour, and Holland 2007). Consequently, the vegetation of vernal pools can vary substantially from year to year in response to interannual fluctuations in climate.

Management activities such as grazing and burning also influence species composition and diversity. In fact, recent research indicates that the abundance of nonnative grasses, grazing practices, and hydrology are strongly interrelated and can substantially affect the plant communities of vernal pools (Robins and Vollmar 2002, Pyke 2004, Marty 2005).

Seasonal wetlands are ephemeral wetlands that pond or remain flooded for long periods during a portion of the year, generally the rainy winter season, then dry up, typically in spring. They often occur in shallow depressions on flood terraces that are occasionally to infrequently flooded. Seasonal wetlands are herbaceous communities typically characterized by species adapted for growth in both wet and dry conditions, and may contain considerable cover of upland species as well. Seasonal wetlands differ from vernal pools in that they do not have a restrictive hardpan layer and are usually dominated by nonnative plant species, especially nonnative grasses.

Lower Sacramento River and Delta A large number of natural plant communities occur in the extended study area, and some are described in this section and the "CVP/SWP Service Areas" section, or in the *Botanical Resources and Wetlands Technical Report*. The other natural plant communities are described in the following sections, and in Mayer and Laudenslayer (1988), Sawyer and Keeler-Wolf (1995), and CALFED (2000a). In addition to natural plant communities, plant communities of agricultural and urban areas occupy extensive portions of the extended study area.

The lower Sacramento River can be subdivided into distinct reaches that differ in topography, hydrology, and geomorphology; and thus, in vegetation and associated habitat functions.

Red Bluff Pumping Plant to Colusa In this reach, the Sacramento River is classified as a meandering river, where relatively stable, straight sections alternate with more sinuous, dynamic sections (Resources Agency 2003). The channel remains active and has the potential to migrate in times of high water. Point bars, islands, high and low terraces, instream woody cover, early-successional riparian plant growth, and other evidence of river meander and erosion are common in this reach. Major physiographic features include floodplains, basins, terraces, active and remnant channels, and oxbow sloughs. These features sustain a diverse array of riparian plant communities.

Colusa to the Delta The general character of the Sacramento River changes quite drastically downstream from Colusa from a dynamic and active meandering channel to a confined, narrow channel restricted from migration. Surrounding agricultural lands encroach directly adjacent to the levees, which have cut the river off from most of its riparian corridor, especially on the eastern side of the river. Most of the levees in this reach are lined with riprap, allowing the river no erodible substrate and limiting the extent of riparian vegetation.

Primary Tributaries to the Lower Sacramento River The primary tributaries of the lower Sacramento River are the Feather River, American River, and the Sacramento River floodplain bypasses. The aquatic ecosystem in the lower Feather River, down to the confluence with the Sacramento River at Verona, is influenced by DWR's Oroville Facilities. The upper extent is fairly confined by levees as the river flows through the city of Oroville. Downstream from Oroville, the Feather River is fairly active and meanders its way south to Marysville. However, this stretch is bordered by active farmland, which confines the river into an incised channel in certain stretches and limits the width of riparian woodland. Some of this adjacent farmland is in the process of being restored to floodplain habitat with the relocation of levees to become setback levees.

The lower American River (below Folsom and Nimbus Dams) is fairly low gradient. Most of the lower American River is surrounded by the American River Parkway, which preserves the surrounding riparian zone. The river

channel does not migrate to a large degree because it has become deeply incised, leaving tall cliffs and bluffs adjacent to the river.

Multiple water diversion structures in the lower Sacramento River move floodwaters into floodplain bypass areas during high-flow events. These floodplain bypass areas – the Butte basin, Sutter Bypass, and Yolo Bypass – provide broad, inundated floodplain habitat during wet years. Unlike other Sacramento River and Delta habitats, floodplains and floodplain bypasses are seasonally dewatered (as high flows recede). Their predominant communities include grassland, seasonal wetlands, and agricultural vegetation.

Sacramento–San Joaquin River Delta The Delta comprises an area of approximately 750,000 acres divided into a number of islands by hundreds of miles of waterways. Before reclamation, the Delta was inundated each year by winter and spring runoff, which changed channel geometry in response to flood conditions and tidal influence. Consequently, there were extensive areas of marsh in the Delta.

Nearly all of the Delta's marshland has since been reclaimed by agriculture, peat production, and urban and industrial uses. More than 1,000 miles of levees protect this reclaimed land (CALFED 2000b). However, some small islands remain in a quasinatural state, as do some other areas with aquatic and wetland communities (e.g., "flooded islands" that were once reclaimed land, but have been abandoned after levee failures). The species composition and ecology of these riparian, marsh, and aquatic plant communities differ from the composition and ecology of communities in the upper and lower Sacramento River portions of the combined primary and extended study areas and are described below.

Along the lower Sacramento River and in the Delta, riparian vegetation is characterized by narrow linear strips of trees and shrubs, in single- to multiple-story canopies. Tree canopies may be continuous or discontinuous, or absent altogether (as in riparian scrubs). These patches of riparian vegetation may be on or at the toe of levees (particularly in the Delta). Riparian communities in this region include cottonwood-willow woodland, Valley oak riparian woodland, riparian scrub, and willow scrub. These communities are described below.

The dynamics of riparian communities along the lower Sacramento River and in the Delta are similar to those described for riparian communities along the upper Sacramento River. However, along the Sacramento River south of Colusa, in the flood bypasses, and in the Delta, the disturbances that remove riparian vegetation, or create newly exposed surfaces where riparian vegetation can establish, differ somewhat from those along the upper Sacramento River. In these downstream areas, disturbances related to meander migration are more limited, and anthropogenic (human-caused) disturbances, such as levee maintenance and trampling, are greater than those upstream. This is because of

the close proximity to levees, extensive placement of bank protection, and greater human population.

In addition to the wetland communities described for the upper Sacramento River, the Delta has tidal freshwater and brackish-water emergent marshes that like nontidal marshes are dominated by clonal perennial plants. This community occurs on instream islands and along tidally influenced waterways. In addition to the environmental factors affecting nontidal marshes, the species composition of tidal marshes in the Delta is also affected by regional salinity gradients.

The Delta also supports extensive areas of aquatic vegetation. These communities consists of submerged plants generally rooted in the substrate, whose stems may partially extend above the water surface (e.g., during flowering) and floating plants that are generally not rooted in the substrate. The availability of light (which decreases with depth), turbidity, and shade cast by overtopping vegetation can restrict submerged plants to relatively shallow areas. In the Delta (which has turbid waters), most submerged vegetation appears to be restricted to areas less than 5–10 feet deep. The velocity of flows may contribute to this depth restriction.

CVP/SWP Service Areas Although agricultural and urban land uses have substantially reduced the area and connectivity of natural vegetation, the service areas still contain a large diversity of both lowland and upland plant communities, including many sensitive plant communities (see the *Botanical Resources and Wetlands Technical Report*). The most dramatic difference between historical and existing conditions is the fragmentation of what were once large contiguous blocks of habitat. Significant changes to the natural landscape in the region occurred in the late 1800s and early 1900s with land conversions to agriculture. However, in Southern California, that pattern shifted dramatically compared to the pattern in the Central Valley, as urban growth in the region that started in the 1900s began to convert large areas of agricultural lands and of remaining natural vegetation to developed land uses.

12.1.2 Special-Status Species

Special-status species addressed in this section include plants that are legally protected or are otherwise considered sensitive by Federal, State, or local resource conservation agencies and organizations. These include species that are State listed and/or Federally listed as rare, threatened, or endangered; those considered as candidates or proposed for listing as threatened or endangered; species identified by CDFW as Species of Special Concern or USFS as sensitive, endemic, or needing additional survey or management actions; and plants considered jointly by CDFW and CNPS to be rare, threatened, or endangered; and species afforded protection under local planning documents, including the CALFED Bay-Delta Program's (CALFED) Multi-Species Conservation Strategy (MSCS).

Shasta Lake and Vicinity

Within the Shasta Lake and vicinity portion of the primary study area are a wide variety of vegetative communities and habitat components that support a large diversity of plant species. To aid in determining the potential impacts of the project, a list of potential plant species of concern was developed.

For the purposes of this evaluation, botanical species of concern are plants, lichen, and fungi that fall into any of the following categories:

- Designated as rare or listed as threatened or endangered by the State or Federal government
- Proposed for designation as rare or listing as threatened or endangered by the State or Federal government
- Candidate species for State or Federal listing as threatened or endangered
- Ranked as California Rare Plant Rank (CRPR) 1A, 1B, 2, 3, or 4 (formerly CNPS List 1A, 1B, 2, 3, or 4)
- Considered sensitive or endemic by USFS
- Considered a survey and manage species by USFS or U.S. Department of the Interior, Bureau of Land Management (BLM)
- Designated as an MSCS covered species by CALFED

Potentially occurring plant species of concern were determined by performing several database searches, reviewing USFWS and CDFW special-status species lists for Shasta County, reviewing other appropriate literature, discussions with resource agency personnel, and professional experience in the region. Additionally, results from the various vegetation habitat mapping efforts, botanical surveys, and wildlife surveys conducted in the area by Reclamation since 2002 were used in developing the list of species of concern.

Table 12-3 summarizes special-status plant species identified as having a potential to occur in the Shasta Lake and vicinity portion of the primary study area.

The CNDDB was reviewed for records of special-status plant species in or near the Shasta Lake and vicinity portion of the primary study area. The CNDDB is a database consisting of historical observations of special-status plant species, wildlife species, and natural communities. The CNDDB is limited to reported sightings and is not a comprehensive list of special-status species that may occur in a particular area.

Table 12-3. Plant Species of Concern with Potential to Occur in the Shasta Lake and Vicinity Portion of the Primary Study Area

Common Name	Scientific Name	Status[1]
Shasta ageratina	*Ageratina shastensis*	CRPR 1B.2, USFS E
Bent-flowered fiddleneck	*Amsinckia lunaris*	CRPR 1B.2, BLMS
Mallory's manzanita	*Arctostaphylos malloryi*	CRPR 4.3
Shasta County arnica	*Arnica venosa*	CRPR 4.2, USFS E
Depauperate milk-vetch	*Astragalus pauperculus*	CRPR 4.3
Moonwort, grape-fern	Botrychium subgenus Botrychium	USFS S, S&M
Yellow-twist horsehair	*Bryoria tortuosa*	BLMS
Green bug moss	*Buxbaumia viridis*	USFS S, BLMS, S&M
Callahan's mariposa lily	*Calochortus syntrophus*	CRPR 1B.1
Butte County morning-glory	Calystegia atriplicifolia ssp. buttensis	CRPR 4.2
Castle Crags harebell	*Campanula shetleri*	CRPR 1B.3, USFS S, BLMS
Buxbaum's sedge	*Carex buxbaumii*	CRPR 4.2
Bristly sedge	*Carex comosa*	CRPR 2.1, MSCS r
Shasta clarkia	Clarkia borealis ssp. arida	CRPR 1B.1, MSCS m, BLMS
Northern clarkia	Clarkia borealis ssp. borealis	CRPR 1B.3, BLMS
Silky cryptantha	*Cryptantha crinita*	CRPR 1B.2, MSCS m, BLMS
California lady's-slipper	*Cypripedium californicum*	CRPR 4.2
Clustered lady's-slipper	*Cypripedium fasciculatum*	CRPR 4.2, USFS S, BLMS, S&M
Mountain lady's-slipper	*Cypripedium montanum*	CRPR 4.2, USFS S, BLMS, S&M
Butte County fritillary	*Fritillaria eastwoodiae*	CRPR 3.2, USFS S
Dubious pea	Lathyrus sulphureus var. argillaceus	CRPR 3
Broad-lobed linanthus	*Leptosiphon latisectus*	CRPR 4.3
Cantelow's lewisia	*Lewisia cantelovii*	CRPR 1B.2, USFS S, BLMS
Howell's lewisia	Lewisia cotyledon var. howellii	CRPR 3.2
Bellinger's meadowfoam	Limnanthes floccosa ssp. bellingeriana	CRPR 1B.2, MSCS m, BLMS
Awl-leaved navarretia	*Navarretia subuligera*	CRPR 4.3
Shasta snow-wreath	*Neviusia cliftonii*	CRPR 1B.2, USFS S, MSCS m, BLMS
Thread-leaved beardtongue	*Penstemon filiformis*	CRPR 1B.3, MSCS m, USFS S, BLMS
Narrow-petaled rein orchid	*Piperia leptopetala*	CRPR 4.3
Bidwell's knotweed	*Polygonum bidwelliae*	CRPR 4.3
Eel-grass pondweed	*Potamogeton zosteriformis*	CRPR 2.2, MSCS m
Pacific fuzzwort	*Ptilidium californicum*	USFS S, BLMS, S&M
Brownish beaked-rush	*Rhynchospora capitellata*	CRPR 2.2
Sanford's arrowhead	*Sagittaria sanfordii*	CRPR 1B.2, MSCS m, BLMS
Marsh skullcap	*Scutellaria galericulata*	CRPR 2.2, MSCS m
Canyon Creek stonecrop	Sedum obtusatum ssp. paradisum	CRPR 1B.3, USFS S, BLMS
English Peak greenbriar	*Smilax jamesii*	CRPR 1B.3, USFS S, MSCS m, BLMS

Table 12-3. Plant Species of Concern with Potential to Occur in the Shasta Lake and Vicinity Portion of the Primary Study Area (contd.)

Common Name	Scientific Name	Status[1]
Obtuse starwort	*Stellaria obtusa*	CRPR 4.3
Slender false lupine	Thermopsis gracilis var. gracilis	CRPR 4.3
Shasta huckleberry	Vaccinium sp. nov.	Genetically and morphologically distinct from coastal and Sierra Nevada populations; taxonomic treatment in preparation. Considered a special-status species for the purposes of this evaluation.
Oval-leaved viburnum	*Viburnum ellipticum*	CRPR 2.3

Notes:
1 Status Codes
CRPR 1B = Plants rare, threatened, or endangered in California and elsewhere
CRPR 2 = Plants rare, threatened, or endangered in California but more common elsewhere
CRPR 3 = Plants for which more information is need—a review list
CRPR 4 = Plants of limited distribution—a watch list

CRPR Threat Ranks
0.1 = Seriously threatened in California
0.2 = Fairly threatened in California
0.3 = Not very threatened in California

Multi Species Conservation Strategy (MSCS) covered species
R = Recovery. Recover species' populations within the MSCS focus area to levels that ensure the species' long-term survival in nature.
r = Contribute to recovery. Implement some of the actions deemed necessary to recover species' populations within the MSCS focus area.
m = Maintain. Ensure that any adverse effects on the species that could be associated with implementation of CALFED actions will be fully offset through implementation of actions beneficial to the species (CALFED 2000c).

Key:
BLMS = BLM sensitive
CRPR = California Rare Plant Rank
USFS = U.S. Forest Service
USFS E = USFS Endemic Species
USFS S = USFS Sensitive Species
S&M = Survey and Manage Species
MSCS = Multi Species Conservation Strategy

A search of the CNPS Electronic Inventory was also conducted. The Electronic Inventory allows users to query the database using a set of variable search criteria. The result of the search is a list of potentially occurring special-status plant species. The criteria used for the query included all CRPR 1A, 1B, 2, 3, and 4 plants occurring in Shasta County in closed-cone coniferous forest, chaparral, cismontane woodland, lower montane coniferous forest, marshes and swamps, pebble plain, valley and foothill grasslands, riparian forest, riparian woodland, and riparian scrub habitats between the elevations of approximately 900 feet and 2,500 feet.

Botanical Surveys Because botanical studies are ongoing, detailed technical memoranda describing methods, results, and conclusions will be provided in the Final EIS.

Reclamation conducted several botanical surveys for special-status plant species in the Shasta Lake and vicinity portion of the primary study area. Botanical surveys were conducted in 2002, 2003, 2004, 2009, and 2010. A list of species

observed during the surveys is provided as Attachment 2 to the Botanical Resources Technical Report in the Biological Resource Appendix. Baldwin et al. (2012) is used as the standard reference for taxonomic nomenclature and identification.

Botanical surveys were performed during 2002 along the Big Backbone and Squaw Creek arms. In 2003, botanical surveys were conducted along 11 selected riverine reaches: Little Backbone Creek, Sugarloaf Creek, upper Sacramento River, middle Salt Creek, Salt Creek, Nosoni Creek, Dekkas Creek, Campbell Creek, Flat Creek, Ripgut Creek, and Potem Creek. The surveys were conducted in general accordance with the technical methods prescribed by Nelson (1994). In 2004, botanical surveys were conducted at a series of randomly and nonrandomly selected locations. Nonrandomly selected sites were located throughout the Shasta Lake and vicinity portion of the primary study area (not including relocation areas) based on 2002 and 2003 survey results. Sites were selected based on the presence of unique habitat and ecological attributes, such as recently burned areas, unique geologic substrates, late-seral forests, and uncommon plant series. Nonrandomly selected sites varied in size and often included several plant series types. Randomly selected sites were selected throughout the area using plant series polygons developed from previously completed vegetation mapping. Using geographic information systems (GIS), individual vegetation polygons were assigned a unique number, and 100 numbers (i.e., vegetation polygons) were then randomly selected.

Based on previous surveys resulting in discoveries of Shasta snow-wreath (*Neviusia cliftonii*) and Shasta huckleberry (*Vaccinium* sp. nov), specific surveys for these species have been conducted since 2009. These surveys were designed to identify potential habitat for and locate populations of these species outside of the proposed project area. Pedestrian surveys were conducted to search the focus areas identified. Using methods described in Lindstrand and Nelson (2006), potential survey areas were identified using soil and geologic information at known sites and choosing areas with those same characteristics. In addition, survey sites were identified using intuitive techniques, such as selecting areas with vegetative cover types similar to those of known populations and areas near known populations (regardless of vegetative cover).

A genetic study of the Shasta snow-wreath was conducted in 2009 and 2010 to help determine potential project impacts and evaluate potential mitigation measures. The goal of the genetic study was to (1) determine whether all Shasta snow-wreath populations are genetically identical, (2) determine whether there are several homogeneous population clusters, or (3) whether some other pattern is present. Twenty-one of the 23 known Shasta snow-wreath sites were included in the study. The genetic study determined that the species is characterized by low genetic diversity and high levels of genetic differentiation (National Forest Genetics Laboratory 2010, DeWoody et al. 2012). No strong patterns were found between the Shasta snow-wreath populations and several physical and geographic variables, including soil, geology, population size, and geographic

location. Although high levels of genetic differentiation and no strong population patterns are present, the genetic study found three general population clusters, providing insight and basic species information for potential mitigation planning.

A separate genetic study was conducted in 2009 and 2010 to describe the genetics of Shasta *Vaccinium* (huckleberry). The goal of the study was to determine if the Shasta *Vaccinium* was different genetically from coastal and Sierra Nevada *Vaccinium* populations and, if so, to determine if it warrants recognition as a new taxon. The genetic study determined that the species is genetically distinct from the other *Vaccinium* populations (National Forest Genetics Laboratory 2010, DeWoody et al. 2012). Based on the results of the genetic study combined with distinct morphologic and ecologic characteristics, the Shasta huckleberry appears to be an uncommon and geographically restricted species and warrants recognition as a new taxon. The taxonomic treatment is in preparation.

In 2010, botanical surveys were conducted in all relocation areas, including the dam footprint. The surveys were conducted in general accordance with the technical methods prescribed by Nelson (1994).

Seven special-status plant species were found during the survey efforts and/or incidentally during other technical studies: Shasta County arnica (*Arnica venosa*), Northern clarkia (*Clarkia borealis* ssp. *borealis*), Cantelow's lewisia (*Lewisia cantelovii*), Shasta snow-wreath, slender false lupine (*Thermopsis gracilis* var. *gracilis*), Shasta huckleberry, and oval-leaved viburnum (*Viburnum ellipticum*).

One population of Shasta County arnica was found in ponderosa pine habitat south of Bridge Bay Resort along the Main Body and another near the privately owned cabins on USFS lands in the Salt Creek inlet on the Sacramento Arm. Additionally, USFS has located a population along the Sacramento Arm north of Slaughterhouse Island during surveys conducted in 2010 (Figure 12-3a and 12-3c).

One population of northern clarkia was found in hardwood-conifer/chaparral habitat near Bailey Cove on the McCloud Arm, and another population was found in hardwood-conifer/chaparral habitat in Sugarloaf Cove west of Beehive Point on the Sacramento Arm. The northern clarkia locations are shown in Figures 12-3c through 12-3d.

One population of Cantelow's lewisia was discovered on a rock outcrop on the right bank of the upper Sacramento River near the Shasta Lake/upper Sacramento River transition zone. Additionally, three populations were found along the Sacramento Arm near Elmore Mountain during surveys conducted in 2010 (Figure 12-3c).

Shasta snow-wreath is currently known from 23 locations, most of which occur at or near the periphery of Shasta Lake. Ten Shasta snow-wreath populations occur in habitats associated with limestone formations, and 13 occur in other habitat types. Most populations are associated with stream drainages or the lower portions of upland slopes. Of these, 13 Shasta snow-wreath populations were discovered during the botanical surveys along the McCloud Arm (south of Shasta Caverns and Keluche Creek), Pit Arm (Brock Creek, Ripgut Creek, Flat Creek, Stein Creek, and west of Stein Creek), and the Main Body (Blue Ridge east, Blue Ridge west, Blue Ridge middle, Cove Creek, south of Cove Creek, and Jones Valley). Locations of Shasta snow-wreath found incidentally and during the surveys are shown in Figures 12-3a through 12-3f.

Slender false lupine populations were discovered in all portions of the primary study area, generally on low-gradient slopes. Locations of slender false lupine found during the surveys and incidentally are shown in Figures 12-3a through 12-3f.

Shasta huckleberry is currently known from 21 general locations in the upper Spring Creek, Dry Fork, (little) Squaw Creek, Shoemaker Gulch, and Little Backbone Creek drainages. Other general locations include South Fork Mountain, Bohemotash Mountain, and the vicinity of Bully Hill. All locations occur in an area historically known as the Copper Belt of Shasta County and many in the immediate vicinity of historic copper mining activities. Shasta huckleberry occurs at four locations in the SLWRI project area: (little) Squaw Creek, Shoemaker Gulch, Little Backbone Creek, and Horse Creek near Bully Hill. Locations of Shasta huckleberry found during the surveys are shown in Figures 12-3a through 12-3f.

Two oval-leaved viburnum populations were found during the surveys. One population was found in a forested upland slope west of Pine Point Campground along the McCloud Arm and a second in chaparral habitat at Jones Valley along the Pit Arm near the Clikapudi Trail. Locations of oval-leaved viburnum found during the surveys are shown in Figures 12-3d and 12-3f.