3.3 PHYSICAL ENVIRONMENT

3.3.1 Data Sources

Data sources used to describe the physical environment of the planning area include:

- Geologic Map of Chico Quadrangle (California Department of Conservation 1992);
- Geology Map of California (2000);
- Soil Survey of Butte Area, California, Parts of Butte and Plumas Counties (Natural Resources Conservation Service 2005);
- Big Chico Creek Existing Conditions Report (Big Chico Creek Watershed Alliance 1999);
- Butte Creek Existing Conditions Report (CSU Chico 1998);
- Department of Water Resources Lake Oroville web site; and
- Various other technical reports and documents.

3.3.2 Topography

Elevation within the planning area generally ranges from about 100 feet above mean sea level along the west boundary of the planning area to approximately 1,500 feet associated with the foothills of the Sierra Nevada and Cascade Mountains to the east (see Figure 3-2). The lowest elevation in the planning area is 46 feet and the highest elevation is 2,073 feet. Topography of the planning area is generally defined by discrete geological features: Central Valley, alluvial fans and terraces, and foothills of the northern Sierra Nevada and southern Cascade Mountains. The western part of the planning area is naturally flat valley bottom topography with the Sacramento and Feather Rivers (and their tributaries) cutting channels across the planning area. Most of the valley bottom that occurs within the planning area has been artificially leveled to accommodate agricultural production. Agricultural-related infrastructure maintains irrigation and natural drainage flowing across the valley for agricultural use. Most of the valley in this area gently slopes southwest.

The elevation within the planning area increases to the east, and the slope of the landscape more noticeably increases with a western facing aspect. The foothills of both the southern Cascade Mountains and the Sierra Nevada are gradually undulating features ranging in elevation from the valley floor at approximately 100 feet to 1,500 feet above mean sea level within the planning area. The "belt" of foothills run north-south and can be most easily discerned from northeast of the City of Chico to south of Lake Oroville. Major streams have cut valleys through the foothill terrain.

A description of landforms and geology within the planning area is included as Section 3.3.5.

3.3.3 Climate

Climate within the planning area is temperate, annually averaging about 46.5°F during winter and 75.4°F during summer at elevations below 1,500 feet in Butte County. Mean annual air

Figure

3.2 BIO_Topography

temperatures range from about 60 °F to 62 °F (see Figure 3-3). The coolest months of the year are January and December, with minimum low temperatures of about 35°F at Chico and 37°F at Oroville. The warmest months of the year are July and August, with average high temperatures ranging from about 93°F at Chico and to 95°F at Oroville. The average annual number of frost free days in the planning area ranges from about 240 to 260 days (see Figure 3-4) (NRCS 2006).

Precipitation is almost exclusively from rainfall and annually averages about 26 inches at Chico and 30 inches at Oroville. Figure 3-5 shows average annual distribution of precipitation for the planning area and Butte County. About 90 percent of the annual precipitation is received from October through April, with January receiving the greatest average amount of monthly precipitation (NRCS 2005).

3.3.4 Watersheds

The planning area lies within the Sacramento River Basin. Planning area watersheds that are tributary to the Sacramento River include those of Big Chico Creek, Butte Creek, Dry Creek, Honcutt Creek, the Feather River, and the Sutter Bypass. Watersheds of the planning area are defined by the California Interagency Watershed Mapping Committee of CalWater, which is comprised of nine state and federal agencies charged with mapping watersheds in California (NRCS N.D.). The classifications of watersheds are hierarchical and are shown at the hydrologic area level for the planning area in Figure 3-6. The planning area includes portions of 11 watersheds, the largest of which is the Butte Basin watershed that drains 258,113 acres of the planning area. Table 3-1 summarizes the drainage area of each watershed within the planning area. Among the watersheds, the headwaters of the Lower Feather River watershed are wholly located within the planning area and the Below Oroville Reservoir watershed is entirely within the planning area. The upper basins of the remaining watersheds include higher elevation areas east of the eastern boundary of the planning area.

Table 3-1. Watersheds Present in the Planning Area

Watershed	*Acres*
Red Bluff	89,159
Butte Basin	258,113
Upper Dry Creek	31,444
Below Oroville Reservoir	13,486
Sutter Bypass	20,229
Lower Feather River	74,209
South Honcutt Creek	54,357
Upper Big Chico Creek	12,550
Upper Little Chico Creek	2,266
Upper Butte Creek	3,423
Bloomer Hill	5,318
Total	564,554[1]

Source: Calwater 2.2 with modifications to some watershed names

[1] Note that this number is 284 acres more than the total planning area acreage shown in Section 3.2. This 0.05% difference is attributed to the difference between calculating the sum acreage of multiple polygons with the total acreage of one polygon.

Figure

3-3 Mean Annual Air Temperature

Figure

3-4 Frost Free Days

Figure

3-5 Average Precipitation

Figure

3.6 BIO_Butte-Watershed

3.3.5 Geology and Soils

Geology and Landforms of the Planning Area

The planning area occurs at the junction of several distinct landforms and geological features, including a large section of wide and flat valley alluvium, linked to the eastern Cascade and Sierra Nevada mountains by foothills of volcanic rock and mudflows. The planning area includes portions of the Great Valley, Cascade Range, and the Sierra Nevada geomorphic provinces. The western half of the planning area, dominated by the flood plains, basins, and fans of the Sacramento Valley, is characterized by Holocene and Quaternary sedimentary rocks and alluvium (CDMG 2000). The generally flat sections encompassing the Valley extend east-west approximately 10 miles and north-south approximately 50 miles within the planning area. Floodplains naturally have bar-and-channel topography because of alternating periods of sediment deposition and removal by floodwater; however, most areas within the Valley (outside of the active or recently active river channels) have been leveled for agricultural production because of the excellent soil properties on the floodplains (NRCS 2005).

East of the Valley, the northeastern section of the planning area is dominated by foothills associated with the southern Cascade Mountain Range (north and east of Chico). The foothills are characterized by Tertiary volcanic mudflows with small inclusions of Cretaceous marine sedimentary rocks near the eastern boundary. The foothills are marked by a series of dissected ridges of breccias, sandstones, and conglomerates cut by numerous creeks, including Pine, Rock, Mud, Sycamore, Big Chico, Little Chico, Butte, Little Butte, Little Dry, Clear, and Dry Creeks (NRCS 2005). The northern foothills are geologically unique from the southern foothills in that they originated from volcanic and pyroclastic derived mudflows associated with the Cascade Range.

The southeastern part of the planning area is associated with the Sierra Nevada foothills. The Sierra Nevada foothills are also dominated by large sections of igneous and metamorphic rocks, volcanic mud flow features, and are generally older in origin (Paleozoic–Mesozoic) than the Cascade foothills to the north. Continuing east, the foothills are present as large complexes of Mesozoic granitic basement rock.

The distinctive geology of this area has produced a series of physiographic features including most notably foothills covered with large stands of mature oak woodland, slowly eroding and draining west into expanses of low relief; slow-draining grasslands at the base of the eastern foothills; and wide, flat valley floor lands being fed by high precipitation rates in the Cascade and Sierra Nevada Mountain Ranges. The Sacramento and Feather River systems also define the lowland formation with wide areas of riparian forest, river bar, and open water features meandering north to south.

Geologic Formations and Natural Community Relationships

Major geologic formations and features in the planning area include landforms of alluvial, volcanic, plutonic origin (Figure 3-7). This section provides summary descriptions of the major geologic landforms in the planning area and the present and historical dominant vegetation associated with each landform.

Figure

3-7 Geology Map of Chico Quad

Modesto Formation. The Modesto Formation is a late Pleistocene alluvial terrace generally bordering and probably deposited by streams still running today (Blake et al. 1999). This youngest alluvial terrace is derived from a heterogeneous mix of alluvium derived from metamorphic, sedimentary, and volcanic rock 10-16 feet thick (Blake et al. 1999). Modesto Formation is estimated to have formed 10–40 thousand years ago (kya) (California Department of Conservation 1992). Modesto Formation historically supported grasslands, grasslands with vernal pools, and valley oak savanna. Vernal pools are classified as Northern Hardpan Vernal Pools. Vernal pools on Modesto Formation are typically at lower density but are, on average, larger than vernal pools on other alluvial terraces (Platenkamp 1998). Present vegetation is dominated by orchards, mostly of almond and prune trees.

Riverbank Formation. The Riverbank Formation is a mid-Pleistocene alluvial terrace. It is similar to Modesto Formation, but is older and at a higher geomorphic position (Blake et al. 1999). This young terrace is estimated to have formed between 100 and 300 kya. Riverbank Formation supports grasslands with vernal pool and swale terrain (Smith and Verrill). Vernal pool densities on Riverbank Formation tend to be higher and pool sizes larger than on other geologic formations with vernal pools (Platenkamp 1998). Vernal pools on Riverbank Formation are classified as Northern Hardpan Vernal Pools and are often associated with Eastbiggs and Kimball soil series (NRCS 2005).

Red Bluff. Red Bluff Formation is an early Pleistocene alluvial terrace of coarse red gravel derived from Tuscan Formation volcanic material of the Cascades (California Department of Conservation 1992; Blake et al. 1999). Red Bluff is older and at a higher geomorphic position than Riverbank Formation. This high terrace supports mound-swale relief with a cemented duripan (NRCS 2005). Red Bluff Formation supports grassland with vernal pools classified as Northern Hardpan Vernal Pools (Smith and Verrill 1998). Typical soils include Redsluff, Redtough (mounds), and Redswale (swales) series (NRCS 2005).

Laguna Formation. The Laguna Formation is a mid-Pliocene alluvial terrace of interbedded gravel, sand, and silt derived from the Sierran metamorphic rocks (California Department of Conservation 1992). This formation is estimated to have formed between 1.6 and 2.0 million years ago (mya). This terrace supports grassland with vernal pools classified as Northern Hardpan Vernal Pools typically on Oroville and Vistarobles soil series (Smith and Verrill 1998, NRCS 2005). Vernal pools on Laguna Formation typically are smaller and occur at moderate densities relative to vernal pools on other formations (Platenkamp 1998).

Tuscan Formation. The Tuscan Formation is a mid-Pliocene geologic formation composed of lahars (volcanic mudflows), volcanic conglomerate, volcanic sandstone and siltstone, and pumiceous tuffs resulting from volcanic activity in the Cascade Mountains (California Department of Conservation 1992). The Tuscan formation supports grassland with vernal pools classified as Northern Hardpan Vernal Pools often on Doemill and Jokerst soil series (NRCS 2005). Vernal pools on Tuscan Formation are typically small, rocky, and shallow (Jokerst 1990). Upper portions of the Tuscan Formation support Blue Oak Woodland and Savanna and Grassland without vernal pools.

Tuffs of Oroville. The Tuffs of Oroville is a geologic feature found on either side of the Feather River on the west side of Oroville and is composed of interbedded volcaniclastic deposits of

gravel, sand, and tuff (California Department of Conservation 1992). This feature formed between the mid-Pliocene and early Pleistocene (California Department of Conservation 1992). The Tuffs of Orville supports grasslands, with and without vernal pools, blue oak woodland, and interior live oak woodland. Vernal pools are classified as Volcanic Mudflow Vernal Pools.

Lovejoy Basalt. The Lovejoy Basalt is an early Miocene feature created by lava flows. The Lovejoy Balsalt forms Table Mountain in the central eastside of the planning area. Lovejoy Basalt is mostly grassland with vernal pools and swales, classified as Northern Basalt Flow Vernal Pools, with some oak woodland.

Basin. The Basin feature dominates the southwestern portion of the planning area. The Basin is composed of recent (Holocene) alluvium of fine-grained deposits of silt and clay and organic marsh deposits on broad flats between modern water courses (California Department of Conservation 1992, Smith and Verrill 1998). The Basin is associated with overflow areas of the Sacramento and Feather Rivers and distributaries of smaller streams. Historically, prior to construction of levees and dams, the basin would flood annually and supported tule and cattail marshes. Today, rice farming dominates the basin. Managed wetlands, including federal and state wildlife refuges and private duck clubs, have been created in the basin and support biological communities similar to the historical marshes with controlled hydrology.

Sierran Foothill Metamorphics and Volcanics. Sierran Foothill Metamorphics and Volcanics is a group of geologic features originating in the Jurassic, Miocene, and Eocene in the southeast portion of the planning area. These geologic formations support oak woodland, grassland, and chaparral.

Cascade Foothill Volcanics. Cascade Foothill Volcanics is a group of geologic features originating in the mid-Pliocene in the northeast portion of the planning area. These geologic formations support oak woodland and savanna.

Natural Levees and Channel Deposits. Natural Levees and Channel Deposits are associated with Sacramento and Feather Rivers. These recent (Holocene) alluvial deposits formed within the past 10,000 years in the active stream channels, floodplains, and natural levees of these major rivers. Historically, the natural vegetation on these deposits was a broad band of riparian forests (cottonwood-willow and valley oak riparian forests). Today, most of this landform is cultivated as orchards (almond and prune trees) along the Sacramento and lower Feather Rivers. This landform has been heavily disturbed by dredger mining along the Feather River west of Oroville where the landscape is now dominated by mine tailings. Remnants of riparian forest and scrub remain along the Sacramento and Feather Rivers.

Soils of the Planning Area

Table 3-2 and Figure 3-8 identify soils present in the planning area (NRCS 2005). To simplify the presentation, soils have been broken down into General Soil Units within the planning area, as influenced by the physical and biological environment in which they were formed. Local geology, source material, topography, aspect, climate, and time have the greatest influence on soil formation.

Table 3-2. General Soil Units[1]

General Soil Type (Soil Complexes)	*Planning Area Setting*	*Soil Properties*	*Area (acres)*
Sacramento Valley Flood Plain Thermic 1. Parrott-Gianella-Farwell 2. Xerothents, Tailings-Gianella	Landscape: Sacramento Valley Slope range: 0 to 50% Typical vegetation: Walnut and almond orchards, valley oak, Fremont cottonwood, coyotebrush, sycamore, and willow	Very deep, nearly level to steep, moderately well drained to that formed in Sacramento River alluvium to somewhat excessively drained soils that formed in Feather River and Butte Creek alluvium derived from mixed rock sources; on flood plains and stream terraces; fine to coarse loamy and sandy.	53,351
Sacramento Valley Flood Basins Thermic 3. Lofgren-Blavo 4. Esquon-Neerdobe 5. Bosquejo-Galt 6. Gridley Taxadjunct-Subaco Taxadjunct	Landscape: Sacramento Valley Slope range: 0 to 2% Typical vegetation: Rice, carex, spikerush, swampgrass, willow, and cottonwood; Italian ryegrass, curly dock, valley oak in areas adjacent to Butte Creek, safflower; wheat; alfalfa; sugar beet, prune, and almond orchards; and annual grasses and forbs	Moderately deep and deep, nearly level, somewhat poorly drained soils that formed in alluvium derived from mixed rock; on low terraces and in flood basins; very-fine to fine.	162,692
Sacramento Valley Alluvium Fan Thermic 7. Olashes 8. Conejo-Almendra-Vina 9. Haploxerolls-Durixerolls	Landscape: Sacramento Valley Slope range: 0 to 2% Typical vegetation: Almond, walnut, and prune orchards, rice, and beans, valley oak, and annual grasses and forbs, wheat, alfalfa, and safflower	Deep, moderately deep, and very deep; nearly level; somewhat poorly drained, moderately well drained and well drained soils that formed in alluvium derived from volcanic and mixed rock sources; on alluvial fans; fine-loamy and course-loamy particle size.	62,478
Thermic Soils That Formed in Cascade Alluvium; on Fan Terraces in the Sacramento Valley 10. Redsluff-Redtough-Redswale	Landscape: Sacramento Valley Slope range: 0 to 35% Typical vegetation: Annual grasses and forbs	Very deep, shallow, and very shallow; nearly level to steep; moderately well drained, somewhat poorly drained, and poorly drained soils that formed in alluvium; on fan terraces; Loamy alluvium over cemented, gravelly alluvium derived from volcanic and mixed rock sources; Fine-loamy and Loamy.	28,995

1 **Table 3-2. General Soil Units[1]**

General Soil Type (Soil Complexes)	*Planning Area Setting*	*Soil Properties*	*Area (Acres; % Planning Area)*
Thermic Soils on Feather River Terraces in the Sacramento Valley 11. Liveoak-Boga-Loemstone	Landscape: Sacramento Valley Slope range: 0 to 2% Typical vegetation: Walnut, prune, kiwi, peach, and nectarine orchards; valley oak; and annual grasses and forbs	Very deep and deep, nearly level, moderately well drained soils that formed in Feather River alluvium; on terraces; Loamy alluvium over dense, silty alluvium derived from mixed rock sources; Fine-loamy	16,602
Thermic Soils That Formed in Sierra Nevada Alluvium; on Low Fan Terraces in the Sacramento Valley 12. Eastbiggs-Duric Xerarents-Kimball	Landscape: Sacramento Valley Slope range: 0 to 3% Typical vegetation: Annual grasses and forbs, rice, prune orchards, and valley oak	Moderately deep, shallow, and very deep, nearly level, somewhat poorly drained and well drained soils that formed in alluvium; on low terraces; Clayey and loamy alluvium over cemented and loamy alluvium derived from mixed rock sources; Fine	30,649
Thermic Soils That Formed in Sierra Nevada Alluvium; on Intermediate and High Fan Terraces in the Sacramento Valley 13. Thompsonflat-Oroville-Vistarobles	Landscape: Sacramento Valley Slope range: 0 to 30% Typical vegetation: Annual grasses and forbs, blue oak, interior live oak, buckbrush, toyon, and whiteleaf manzanita	Very deep, moderately deep, and shallow, nearly level to moderately steep, moderately well drained and poorly drained soils that formed in alluvium; on intermediate and high fan terraces; Loamy alluvium over clayey alluvium over gravelly and cemented alluvium derived from mixed rock sources; Clayey, Fine and Fine-loamy.	37,826
Thermic Soils on Lovejoy Basalt and Ione Sediments on Sierra Nevada Foothills 14. Palexerults-Rock Outcrop, Basalt-Coalcanyon	Landscape: Sierra Nevada foothills Slope range: 2 to 50% Typical vegetation: Annual grasses and forbs, lichens, interior live oak, blue oak, and valley oak	Exposed bedrock and very deep, nearly level to very steep, well drained soils that formed in colluvium and residuum; on foothills and basalt plateaus; rock outcrops of Lovejoy basalt; Loamy colluvium derived from volcanic rocks over clayey residuum derived from Ione Formation claystone, Gravelly colluvium derived from Lovejoy basalt; Loamy-skeletal, Fine-loamy and fine	18,384

Table 3-2. General Soil Units[1]

General Soil Type (Soil Complexes)	*Planning Area Setting*	*Soil Properties*	*Area (Acres; % Planning Area)*
Thermic Soils on Strath Terraces on Volcanic Cascade Foothills 15. Tuscan-Clearhayes-Typic Xerofluvents	Landscape: Cascade foothills Slope range: 0 to 2% Typical vegetation: Annual grasses and forbs, cottonwood, sycamore, black walnut, and valley oak	Shallow, deep, and very deep, nearly level, somewhat poorly drained and well drained soils that formed in alluvium; on strath terraces on volcanic foothills; Loamy alluvium over clayey alluvium over cemented, gravelly alluvium derived from volcanic rocks, Loamy overbank deposits over gravelly channel deposits derived from volcanic rocks, Sandy alluvium derived from hydraulic mine deposition; Clayey, Coarse-loamy, Fine-loamy and sandy-skeletal.	18,868
Thermic Soils on Volcanic Cascade Foothills 16. Lucksev-Butteside-Carhart 17. Doemill-Jokerst 18. Xerorthents, Shallow-Typic Haploxeralfs-Doemill	Landscape: Cascade foothills Slope range: 2 to 100% Typical vegetation: Annual grasses and forbs, blue oak, interior live oak, canyon live oak, foothill pine, buckbrush, and manzanita	Very shallow, shallow, moderately deep and deep, nearly level to very steep, moderately well drained, well drained, somewhat poorly and poorly drained soils that formed in alluvium, residuum, and colluvium; on foothills; Ridgetops, side slopes, and strath terraces, basins and footslopes on volcanic foothills; fine, clayey and loamy.	62,385
Thermic Soils on Metamorphic Sierra Nevada Foothills 19. Dunstone-Loafercreek-Argonaut Taxadjunct 20. Dunstone-Loafercreek-Oroshore 21. Mounthope-Hartsmill 22. Ultic Haploxeralfs, Thermic, High Terrace	Landscape: Sierra Nevada foothills Slope range: 1 to 90% Typical vegetation: Annual grasses and forbs, interior live oak, blue oak, foothill pine, whiteleaf manzanita, buckbrush, toyon, Pacific madrone, and scattered ponderosa pine	Shallow and moderately deep, very deep and deep, nearly level to very steep, well drained and moderately well drained soils that formed in alluvium, residuum and colluvium derived from metasedimentary metavolcanic and mixed rocks; on foothills and high terraces; Fine, Fine-loamy, Loamy and Loamy-skeletal	48,925

Table 3-2. General Soil Units[1]

General Soil Type (Soil Complexes)	*Planning Area Setting*	*Soil Properties*	*Area (Acres; % Planning Area)*
Thermic Soils on Plutons on Sierra Nevada Foothills 23. Flanly-Swedesflat-Parkshill 24. Crystalhill-Oregongulch-Craigsaddle	Landscape: Sierra Nevada foothills Slope range: 2 to 70% Typical vegetation: Annual grasses and forbs, interior live oak, blue oak, canyon live oak, foothill pine, and buckbrush, Whiteleaf manzanita, toyon, Pacific madrone, and scattered ponderosa pine	Moderately deep, shallow, and very deep, nearly level to very steep, somewhat excessively drained and well drained soils that formed in residuum and colluvium from quartz diorite or gabbro and intrusive igneous rocks; Ridgetops and side slopes on plutons in foothills; Fine-loamy, Loamy, Coarse-loamy	10,407
Mesic Soils on Volcanic Cascade Foothills 25. Rockstripe-Ultic Haploxeralfs, Mesic-Ultic Haploxeralfs	Landscape: Cascade foothills Slope range: 2 to 100% Typical vegetation: Buckbrush, scrub oak, manzanita, annual grasses and forbs, interior live oak, canyon live oak, California black oak, and foothill pine	Very shallow, moderately deep, and deep, nearly level to very steep, somewhat poorly drained and well drained soils that formed in residuum and colluvium; on volcanic foothills; Fine-loamy, fine, loamy-skeletal, clayey-skeletal	2,003
Mesic Soils on Metamorphic Sierra Nevada Foothills 26. Bigridge-Minniecreek	Landscape: Sierra Nevada foothills Slope range: 2 to 70% Typical vegetation: Whiteleaf manzanita, toyon, interior live oak, Pacific madrone, canyon live oak, foothill pine, ponderosa pine, and poison oak	Deep and moderately deep, nearly level to very steep, well drained soils that formed in residuum and colluvium; Ridgetops and side slopes on metamorphic foothills, Fine-loamy	12
39.	Sierra Nevada and Cascade foothills	Frigid soils on moraines	207
99.	Throughout planning area	Water	7,651

1. Modified from NRCS 2005.

Figure

3.8 BIO soils

Hundreds of soil series occur within the planning area. As a result, soils are categorized below by soil complex (grouping of series that have common characteristics) and general soil units (general grouping of soils that have similar characteristics in source material, region, and climate during formation). Soils in the western part of the planning area are all representative of low energy floodplain, flood basin, and lower relief alluvial fan terrace development in geologically young alluvium; however, soils associated with the Sacramento and Feather Rivers have developed on plain features and are generally moderate to well-drained and indicative of a historically higher energy environment (active river system) than neighboring basin soils. These soil units are limited to within and immediately adjacent to the river system.

Soils in the southwestern section of the planning area are generally flood basin-developed, deep and poorly drained, and representative of low energy formation. These areas occur within the planning area between the Sacramento and Feather River systems where the alluvial basins are internally draining (or would be in the absence of modifications to surface flow patterns associated with agriculture production).

Soils in the foothills of the planning area have developed at the base of the Cascade and Sierra Nevada Mountains. Geologically the foothills are alluvial terraces derived from upslope volcanic rock and mudflow associated with the ranges. Soils are diagnostic of their material of origin and, as a result, soils associated with the Cascade foothills are different than soils associated with Sierra Nevada foothills; however, soils associated with both ranges are generally poorly to moderately drained alluvium over clay or cemented gravelly alluvium. They range from red soils associated with the Tuscan series of the northeast planning area to dark volcanic rocky soils in the southeast.

3.3.6 Hydrology

Butte County has numerous surface water bodies, and drainage is primarily to the southwest (see Figure 3-9). These water bodies include rivers and streams, impoundments, vernal pools, irrigation canals, managed wetlands (for waterfowl), stock ponds, and rice fields (when flooded). The planning area is within the drainage basin of the Feather River and the Sacramento River. The Sacramento River flows along the western edge of Butte County. Big Chico Creek and Butte Creek are the primary tributaries to the Sacramento River, and they drain much of the planning area. The streams generally have a high gradient in the steep terrain of the mountains and foothills and then flow slowly across the nearly flat valley floor. In some areas, the streams infiltrate into the valley floor before reaching the Sacramento River. Most streams on the valley floor have been altered for flood control and water diversions.

Big Chico Creek. Big Chico Creek drains most of the northwestern portion of the planning area and flows into the Sacramento River at the western edge of the county just southwest of Chico. Its main tributary is Mud Creek, which includes Rock Creek. Big Chico Creek channel on the valley floor is dry in dry years (Big Chico Creek Watershed Alliance 1999). Mud Creek, a tributary to Big Chico Creek, has a 69-foot waterfall at Richardson Springs that is a barrier to fish. Rock Creek originally flowed into a large marsh near Nord, but it is now a tributary to Mud Creek.

Figure

3.9 Hydrology

Butte Creek. Butte Creek drains the central to southwestern portion of the planning area. South of Chico, it flows along the western boundary of the county with Glenn and Colusa counties. It enters Butte Slough south of Butte County (CSU Chico 1998), then flows into the Sutter Bypass and then into the Sacramento River. A portion of Butte Sink is located in the southwestern corner of the county. Levees are present along one or both sides of the creek from Chico to just downstream of the Glenn-Butte County boundary. The annual mean flow above Parrott-Phelan Dam (southeast of Chico) is 409 cubic feet per second (cfs) (1931 to 1997 data) with a lowest daily mean flow of 44 cfs and a highest daily mean flow of 26,600 cfs. On a monthly basis, the mean flows were highest in January through April and lowest in September (CSU Chico 1998). Within the Butte Creek watershed are a number of natural streams that were never connected to Butte Creek or that have been modified so that they no longer connect. These are now used for water conveyance and storage.

Feather River. The Feather River originates in the Sierra Nevada east of the planning area. The river and its tributaries downstream of Oroville Dam drain the southeastern part of the planning area. Flows below Oroville Dam are highly regulated for fish and wildlife, hydroelectric power production, flood control, and water supply. Flows in the river vary seasonally with peaks in the winter to spring and lows in November to December. Measurements at Gridley from 1995 through 1998 recorded a peak of just over 40,000 cfs and a low of 1,000 cfs (Bratovich et al. 2004). Flow in the Low Flow Channel, from the Fish Barrier Dam to the Thermalito Afterbay Outlet, is relatively constant with low water temperatures all year. Flows at the other facilities are discussed below under Dams and Diversions.

Other Waters. In addition to the rivers and their tributaries, other natural water bodies in the county include thousands of vernal pools, seeps, and marshes. The vernal pools occur in grasslands; some vernal pools are connected through swales and ephemeral drainages to surface tributary systems, which connect to major creeks and rivers, and other vernal pools are isolated from stream drainages. Their water source is direct precipitation and runoff from the surrounding uplands. Vernal pools generally contain water during the rainy season and into spring or summer when they dry out until the following wet season. Marshes can be isolated or connected to streams, and their water sources include runoff from precipitation, overbank flooding, backwater flooding, and shallow groundwater. Seeps are typically isolated and their water source is typically groundwater discharge. Marshes and seeps can have water seasonally or all year, depending on location and water source.

Man-made water bodies include impoundments, irrigation canals, agricultural drains, waterfowl ponds (managed wetlands), and rice fields (when flooded). The largest impoundments in the planning area are the Thermalito Afterbay and Thermalito Forebay, both associated with Lake Oroville (see Figure 3-10). These are discussed below under Dams and Diversions. Smaller impoundments for water storage and livestock are also present. Large areas of managed wetlands are present in the southwestern and western portions of the county. These are relatively flat areas that are flooded, particularly during the winter, to provide habitat for wintering or migrating waterfowl and for hunting opportunities. Water depths are shallow and support emergent aquatic vegetation if soils are moist much to all of the year. More information on managed wetlands is in section 3.5.4.

Figure

3.10 Lake Oroville Facilities

Dams and Diversions

Feather River. Oroville Dam is located at the eastern edge of the planning area. This dam provides flood control, water storage, and power production as well as recreational opportunities. The Oroville-Thermalito Pumped Storage Power Complex (DWR N.D. - a) is located at and below Oroville Dam (see Figure 3-10). This complex includes:

- Hyatt Power Plant at the dam (645 megawatts);
- Thermalito Pumping-Generating Plant (114 megawatts);
- Thermalito Dam Power Plant (3 megawatts) that generates electricity from water released from Oroville Dam for fish habitat between the diversion dam and the Thermolito Afterbay river outlet;
- Thermalito Power Canal that carries water in either direction for pumping back into Lake Oroville;
- Thermalito Diversion Dam that diverts water in the Thermalito Power Canal to the Thermalito Pumping-Generating Plant and provides a tailwater pool for the Hyatt Power Plant; it also acts as a forebay when water is pumped back into Lake Oroville;
- Thermalito Forebay, an offstream reservoir to convey generating and pumping water between the Thermalito Power Canal and the Thermalito Power Plant; it also provides regulatory storage and surge damping for the Oroville-Thermalito Power Complex; and
- Thermalito Afterbay, an offstream reservoir for pumpback water storage, is a major agricultural water supply diversion; it also helps regulate the power system, helps control flows in the river, and provides recreational opportunities.

The maximum controlled release from Oroville Dam is 150,000 cfs (Bratovich et al. 2004). Flows at the facilities are (Bratovich et al. 2004, Bogener 2004):

- Hyatt Power Plant – maximum of 17,400 cfs
- Diversion Dam – minimum of 600 cfs
- Diversion Dam Power Plant – maximum of 615 cfs
- Thermalito Power Canal – maximum capacity of 16,900 cfs
- Pump-back facilities – 9,120 cfs
- Below Thermalito Afterbay – minimum 1,700 cfs October through March and 1,000 cfs April through September, with maximum of 2,500 cfs October 15 to November 30. In dry years with less than 1,942,000 acre-feet of runoff in April through July, the minimum can be reduced to 1,200 cfs October through February and 1,000 cfs in March.

When flows are less than 2,500 cfs, reductions must be less than 200 cfs per 24 hours, except for flood management. Agricultural irrigation diversions of up to 800,000 acre-feet occur from the Thermalito Complex from May through August (Bogener 2004). The Thermalito Afterbay water surface elevation can vary by up to 12 feet.

Butte Creek. A number of dams and diversions are present on Butte Creek and its tributaries. Eight agricultural/wildlife enhancement water diversion dams are present from the southern county boundary to southeast of Chico, and three power generation diversions are present upstream of the planning area (CSU Chico 1998). The Centerville Powerhouse is within the planning area. The Centerville Head Dam, located upstream of the planning area, is a barrier to fish migration. Water is diverted from that dam into the Lower Centerville Canal to the Centerville Powerhouse at up to 180 cfs. Water diverted from the West Fork of the Feather River is released into Butte Creek at the DeSabla Powerhouse above the Centerville Head Dam at an average rate of 65.8 cfs. These diversions are non-consumptive. Two dams on Little Butte Creek provide water for the town of Paradise (CSU Chico 1998).

The Parrott-Phelan Dam near Chico is the first consumptive use diversion of water from Butte Creek and takes 25.4 percent of the flow from April through September. This dam has a fish ladder and the diversion is screened. The Durham Mutual, Adams, and Gorrill Dams are south of Chico. These dams were retrofitted with fish ladders and screens in the late 1990s as part of the CALFED Bay-Delta Program's (CALFED) Ecosystem Restoration Program Fish Passage Improvement element (Department of Water Resources 2005). In 1998, Western Canal, in conjunction with CALFED and the Department of the Interior, also removed Point Four, McGowan, McPherrin, Western Canal East Channel, and Western Canal Main Dams to improve anadromous fish passage on Butte Creek (Department of Water Resources 2005).

The Sanborn Slough Bifurcation takes much of the Butte Creek flow into waterfowl clubs in Butte Sink. In 1998 CALFED completed initial improvements of the structure to enhance fish passage and water control (Department of Water Resources 2005). White Mallard Dam diverts water into White Mallard Canal.

Big Chico Creek. Flood flows in Big Chico Creek are diverted into Lindo Channel, which has a capacity of 14,500 cfs. These flows are further diverted into Sycamore Creek (up to 8,500 cfs). Lindo Channel is 8 miles long and returns to Big Chico Creek about 2.5 miles from its confluence with the Sacramento River (Big Chico Creek Watershed Alliance 1999). A fish ladder located on Big Chico Creek in Upper Bidwell Park that was constructed in the 1950s is in disrepair and impeding passage of anadromous fish upstream of the ladder. DWR has completed designs to improve passage at the site (DWR N.D.b).

Agriculture

Rice fields are the dominant form of agriculture in the southwestern portion of the planning area with orchards and vineyards to the north and southeast, primarily west of Highway 99. Rice fields are flooded from April to September for the rice growing season and are flooded again from October to January for rice decomposition, disease control, and water fowl needs. Orchards and vineyards are also irrigated during the growing season.