CHAPTER 3.0 REGION DESCRIPTION

3.1 Introduction

The Upper Feather River watershed encompasses 2.3 million acres in the northern Sierra Nevada, where that range intersects the Cascade Range to the north and the Diamond Mountains of the Great Basin and Range Province to the east. The watershed drains generally southwest to Lake Oroville, the largest reservoir of the California State Water Project (SWP). Water from Lake Oroville enters a comprehensive system of natural and constructed conveyances to provide irrigation and domestic water as well as to supply natural aquatic ecosystems in the Lower Feather River, Sacramento River, and the Sacramento-San Joaquin Delta. Lake Oroville is the principal storage facility of the SWP, which delivers water to over two-thirds of California’s population and provides an average of 34.3 million acre-feet (AF)/year of agricultural water to the Central Valley.

Lands to the east of the Upper Feather River watershed drain to Eagle and Honey Lakes that are closed drainage basins in the Basin and Range Province, while lands to the north, west, and south drain to the Sacramento River via the Pit River, Yuba River, Battle Creek, Thomas Creek, Big Chico Creek, and Butte Creek. Mount Lassen, the southernmost volcano in the Cascade Range, defines the northern boundary of the region. Sierra Valley, the largest valley in the Sierra Nevada, defines the southern boundary. At the intersection of the Great Basin, the Sierra Nevada Mountains, and the Cascade Range, the Region supports a diversity of habitats including an assemblage of meadows and alluvial valleys interconnected by river gorges and rimmed by granite and volcanic mountains. The wild and scenic Middle Fork of the Feather River plunges through granite walls and boulders for nearly 80 miles. The North Fork of the Feather River provides water for some of the most important hydroelectric and water supply developments in California, and during winter storm events is ringed by over 50 waterfalls plunging to the river and roadway from the cliffs and tributary streams within the Feather River canyon.

3.2 Explanation of Regional IRWM Boundary

3.2.1 Jurisdictional Boundaries

Land ownership in the Integrated Regional Water Management (IRWM) Plan Area is approximately 64 percent Federal, 1 percent State, and 35 percent private. Federal lands are managed primarily by the U.S. Forest Service (USFS) except for less than 1 percent of the watershed that is within Lassen Volcanic National Park and some Bureau of Land Management lands in the Sierra Valley watershed. Approximately 50 percent of the National Forest System lands in the watershed are administered by the Plumas National Forest, with the remainder administered by the Tahoe and Lassen National Forests. The private land in the watershed is primarily used for commercial timber and agriculture, and is interspersed with historic community settlements and recreational developments. The Region is also entirely within the boundary of the Central Valley Regional Water Quality Control Board (Central Valley RWQCB).

The entire IRWM Plan Area is within the portion of the Feather River watershed that drains to Lake Oroville. The boundary of the watershed largely corresponds to the boundary of Plumas County, but also includes portions of six neighboring counties (Table 3-1, Figure 3-1).

Figure 3-1 Map of Upper Feather River IRWM Region

Table 3-1. Counties within the Upper Feather River Watershed

County	Total Size (ac.)1	Area in Watershed (ac.)2	Percentage in Watershed	Percent of Watershed
Butte	1,073,340	345,850	32.2	14.9
Lassen	3,021,050	119,394	3.9	5.2
Plumas	1,672,640	1,653,456	98.9	71.7
Shasta	2,462,340	13,574	0.6	0.6
Sierra	615,680	172,367	27.9	7.5
Tehama	1,895,870	136	<0.1	<0.1
Yuba	411,970	1,780	0.4	<0.1
Total	--	2,306,557	--	100

[1]Source: http://www.dof.ca.gov/html/FS_DATA/STAT-ABS/documents/A1.pdf
[2]Source: Plumas County 2009

There are two incorporated cities in the IRWM Plan Area: the City of Portola in Plumas County and the City of Loyalton in Sierra County. There are approximately 37 unincorporated communities, including but not limited to Quincy, East Quincy, Delleker, Chester, Greenville, Taylorsville, Westwood, Sierraville, and Graeagle.

A total of 27 water, wastewater, conservation, irrigation, and flood control districts are located entirely within the IRWM Plan Area (Table 3-2, Figure 3-2, and Figure 3-3). With the possible exception of irrigation districts, these individual district service areas do not significantly affect the land management of the Upper IRWM Planning Area.

Figure 3-2 Map of Counties within the Upper Feather River IRWM Region

Table 3-2. Agency Services within the Upper Feather River IRWM Plan Area

Agency/District	Water	Wastewater	Irrigation	Conservation	Flood Control	Groundwater
Plumas County Flood Control and Water Conservation District	X				X	X
Sierra Valley Groundwater Management District						X
Sierra Valley Mutual Water District[b]			X			
Last Chance Creek Water District			X			
Feather River Resource Conservation District				X		
Sierra Valley Resource Conservation District				X		
City of Loyalton	X	X				
City of Portola	X	X			X	
Chester Public Utility District	X	X				
East Quincy Community Services District	X	X				
Gold Mountain Community Services District	X	X				
Greenhorn Creek Community Services District	X	X				
Grizzly Lake Resort Community Services District	X	X				
Grizzly Ranch Community Services District	X	X				
Indian Valley Community Services District	X	X				
Plumas Eureka Community Service District	X	X				
Quincy Community Services District	X	X				
Walker Ranch Community Services District	X	X				
Westwood Community Services District	X	X				
Beckwourth County Service Area		X				
West Almanor Community Services District		X				
Clio Public Utilities District	X					
Clear Creek Community Services District	X					
Hamilton Branch Community Services District	X					
Johnsville Public Utilities District	X					
Graeagle Community Services District	X					
Feather River Canyon Community Service District	X					
Department of Water Resources: Indian Valley and Sierra Valley Water Master Service Areas			X			

[a] Source: Plumas, Sierra, and Lassen Local Agency Formation Commissions
[b] The Sierra Valley Mutual Water District is not a special district; it is a private irrigation district.

It is important to note that approximately 40 percent[1] of the population in the Upper Feather River Region relies on individual wells and septic systems and, therefore, are not served by municipal water and wastewater districts. Additionally, dependence on groundwater by municipal services providers and domestic households is a significant jurisdictional water management characteristic and a challenge for the Region.

[1] Plumas County. 2009. *Regional Acceptance Process Application.*

3.2.2 Physical Boundaries

The physical boundaries of the IRWM Plan Area are the Feather River watershed's mountain escarpments upstream of Oroville Dam. Lake Oroville, the downstream terminus of the Plan Area, provides a fixed point, where the effects of management actions in the upper watershed drain to infrastructure of statewide water importance. This reflects land and water management on a regional scale as it is monitored and measured as inflows to Lake Oroville, the SWP, and PG&E's "Stairway of Power." The Feather River is unique among Sierra Nevada streams in that it breaches the Sierra Crest of the Diamond Mountains and drains both the west and east slopes of the Sierra Range to the Sacramento River. The Feather River is one of the largest watersheds in the Sierra Nevada.

The northern boundary of the IRWM Plan Area runs southeast from Mount Lassen, through volcanic highlands separating the Feather River and Pit River watersheds, until intersecting the crest of the Diamond Mountains east of Lake Almanor. The boundary follows the Diamond Mountains south, crosses the historic Beckwourth Pass (the lowest pass in the Northern Sierra for the first European settlers to the region), and runs westward along the Sierra Crest which separates the Feather River watershed from the Truckee River watershed. The Sierra Crest also forms the southwest boundary of the IRWM Plan Area, where the Yuba River drains the western slope of the range and the Feather River drains the eastern slope. The Region includes the western slope of the Sierra Nevada where the Middle and North Forks of the Feather River carve through the lava flows of the foothills, and follow the western slopes of the Sierra Nevada and the southern end of the Cascade Range to the base of Mount Lassen.

Because of the small population and limited municipal infrastructure in the IRWM Plan Area, water management issues in the Plan Area are predominantly defined by landscape-scale hydrologic processes and focus on the intersection of water and land management activities, such as watershed management, forest management, agricultural irrigation practices, and integrated surface and groundwater management. Despite the small population of the region, land and water management activities in the Plan area have significant implications for both upstream and downstream beneficiaries of flood control, water supply, and hydroelectric power. The physical boundary of the IRWM Plan Area reflects the watershed- and landscape-scale issues that define the region, and provides a workable geographic scale for addressing those issues in an effective, efficient, and integrative manner for both local, regional, and downstream needs and values.

Figure 3-3 Map of Water and Wastewater Districts in the Upper Feather River IRWM Region

3.2.3 Neighboring/Overlapping IRWM Region Boundaries

The Upper Feather River IRWM Plan Area borders or overlaps with six adjacent IRWM plan areas (Figure 3-4).

3.2.3.1 Upper Pit River Watershed IRWM Region

The Upper Pit River Watershed IRWM Region lies to the north of the Upper Feather River IRWM Plan Area, and there is no overlap in plan area boundaries. The Pit River is the principal drainage of northeastern California and drains large portions of Modoc, Lassen, Shasta, and Siskiyou counties. The two plan areas share a short boundary east of Mount Lassen, mostly within Lassen Volcanic National Park.

3.2.3.2 Lahontan Basins IRWM Region

The Lahontan Basins IRWM Region encompasses portions of the Susan River, Madeline Plains, and Smoke Creek watersheds in California, and lies within Lassen County and the extreme northeast corner of Sierra County, north and east of the Upper Feather River IRWM Plan Area. The divide between these watersheds and the Upper Feather River watershed also marks the boundary between the Central Valley RWQCB and the Lahontan RWQCB, and between IRWM funding areas. The Upper Feather River IRWM Plan Area does not overlap geographically with the Lahontan Basins IRWM Plan Area; however, there are multiple jurisdictional overlapping IRWM areas in Sierra County.

3.2.3.3 Cosumnes, American, Bear, Yuba (CABY) IRWM Region

The CABY IRWM Region encompasses the watersheds on the western slope of the Sierra Nevada between the Feather and Mokelumne Rivers, and borders the Upper Feather River IRWM Plan Area to the southwest along the divide between the Feather River and Yuba River watersheds. There is no overlap between the Upper Feather River and CABY IRWM Plan Areas.

3.2.3.4 Yuba County IRWM Region

Yuba County adopted an IRWM Plan in 2008, to manage the fisheries and riparian habitats on the Yuba River, which enters the Lower Feather River at Marysville. The plan area includes all of Yuba County, 1,780 acres of which is in the Upper Feather River IRWM Plan Area. This area of overlap lies in the extreme northeast of Yuba County, where the Yuba-Butte county line crosses the hydrologic divide between the Upper Yuba River and the Middle Fork Feather River and is characterized by National Forest ownerships.

3.2.3.5 Tahoe-Sierra IRWM Region

The Tahoe-Sierra IRWM Region encompasses portions of the Tahoe Basin and the Truckee and Carson River systems in California, and borders the Upper Feather River IRWM Plan Area on the south. The divide between these watersheds and the Upper Feather River watershed also marks the boundary between the Central Valley RWQCB and the Lahontan RWQCB, and between IRWM funding areas. The Upper Feather River IRWM Plan Area does not overlap geographically with the Tahoe-Sierra IRWM Plan Area; however, there is jurisdictional overlap on the part of Sierra County and Tahoe National Forest. There is a hydrologic connection between the watersheds through a water diversion from the Little Truckee River to Sierra Valley.

Figure 3-4 Map of Neighboring IRWM Regions

3.2.3.6 Northern Sacramento Valley IRWM Region

The Northern Sacramento Valley IRWM Region includes all of Sutter, Colusa, Glenn, Butte, and Tehama counties, and the southwestern half of Shasta County. The North Sacramento Valley IRWM Plan Area overlaps the Upper Feather River IRWM Plan Area in the eastern one-third of Butte County. Both plans consider the overlap area to be an important and appropriate part of their respective plan areas for the following reasons:

1. The Upper Feather River IRWM Plan Area is based on a watershed boundary that encompasses the entire Feather River watershed upstream of Oroville Dam;
2. It is important to include Lake Oroville and the western portion of the Upper Feather River watershed in the IRWM Plan Area because the impoundment at Lake Oroville integrates effects of management activities across the entire upper watershed, and provides a logical physical and institutional point of division between the Upper and Lower Feather River regions;
3. Plumas National Forest, which is a key partner in the Upper Feather River IRWM Plan and manages nearly half of the land in the Upper Feather River watershed, extends into Butte County in the vicinity of Lake Oroville, and;
4. The Northern Sacramento Valley IRWM Plan Area includes all of Butte County for practical administrative reasons, and the Butte-Plumas county line does not follow any natural or hydrologic divide and so represents an arbitrary division of the Feather River watershed upstream of the confluence of the major forks of the Feather River at Oroville Dam.

Primary issues within the Northern Sacramento Valley IRWM Plan Area relate to groundwater management and conjunctive use focused on the Sacramento Valley floor, while primary issues in the Upper Feather River IRWM Plan Area relate to management of watershed values for upstream and downstream recipients, and ecological integrity in headwaters areas. Butte County and the Upper Feather River IRWM Plan have entered into a Memorandum of Understanding regarding divisions of responsibility and coordination of land and water management activities in the overlap area. Butte and Plumas Counties have communicated and coordinated on water management issues of mutual interest for decades such as the FERC hydroelectric licenses in the NFFR, as “Area of Origin” State Water Project Contractors, and over public safety issues in the Feather River Canyon such as railroad and roadway pollution spills and other accidents, floods and wildfires.

3.2.3.7 Opportunities for Integration of Water Management

The RWMG and consultant team members communicate with neighboring IRWMs to share lessons learned, process feedback, and share resources where appropriate. Additionally, members of the UFR IRWM Plan update team regularly attend and are involved in the Sierra Water Workgroup, a group that works to coordinate local and regional water planning efforts in the Sierra. See *Chapter 7 Land Use and Water Planning* for further discussion.

3.3 Social and Cultural Characteristics of the Regional Community

3.3.1 Population and Demographics

The Upper Feather River IRWM Plan Area is predominantly rural and mountainous, with a population density of approximately seven people per square mile not including the more densely populated parts of Butte County such as Oroville East and Concow. Population centers in the Plan Area include the communities of Chester, Westwood, Quincy, East Quincy, Delleker, Graeagle, Sierraville, Greenville, Taylorsville, Loyalton, Beckwourth, Chilcoot-Vinton, and Portola. The population of the Plan Area is approximately 33,200, with approximately 20,000 of those living in Plumas County, less than 2,000 in Lassen County, less than 2,000 in Sierra County, and none in Shasta, Tehama, and Yuba counties. The remainder, approximately 9,200 people, live in eastern Butte County. The Butte County communities are oriented toward Sacramento Valley cities such as Chico, and are economically and culturally distinct from the majority of the Plan Area with some significant exceptions discussed below. The population trend in Plumas and Sierra counties has been negative since 2005 and the California Department of Finance predicts continued population declines in those counties through 2030.

According to U.S. Census Bureau data, the majority of the inhabitants of the Plan Area are White persons not of Hispanic/Latino origin (91.1 percent). The next largest group is Hispanic/Latino (8.3 percent), followed by Native American and Alaska Native (3.2 percent), African American (1 percent), Asian (1 percent), and Native Hawaiian and other Pacific Islanders (0.1 percent). The population of the Plan Area is older than the statewide average; all age groups under 20 years have declined since 2000, while all age groups between 45 and 75 years have increased. The timber industry in the region has been in decline since the late 1980s, which has led to a departure of working-age people with children. At the same time, the number of retirees and part-time residents has increased markedly. This trend is expected to continue for the next several decades. The "capacity" issue that is an IRWM Planning priority in this Plan update is directly related to the changing demographics and the loss of working-age residents and families to economic and employment opportunities in other regions of California.

3.3.2 Disadvantaged Communities

The Department of Water Resources defines a Disadvantaged Community (DAC) as one with an annual median household income (MHI) that is less than 80 percent of the statewide average MHI. Analysis of DACs in the Plan Area is based on data from the U.S. Census American Community Survey 5-Year Data: 2009-2013. U.S. Census geographies used to identify DACs include Census Designated Places, Tracts, and Block Groups. During the 5-year period used for this analysis, the statewide average MHI was $61,094; therefore, the threshold for defining a DAC was $61,094*0.8 = $48,875.


Greenville, California (Plumas County)

Water and/or wastewater services in most of the Plan Area are provided by 22 local districts (Table 3-2), in addition to individual private wells and septic systems. Most of these special districts serve rural communities where the tax base is declining due to population and job loss, and is already limited by a large proportion of the land being in federal ownership. The aging residents of these areas are increasingly challenged to maintain basic services as local and federal budgets shrink and the traditional pool of volunteers to serve on local district boards is lost. Nearly all of the communities in the portion of the Plan Area in Plumas, Lassen, and Sierra counties qualified as DACs for the period 2009-2013 (Table 3-3, Figure 3-5). Plumas and Sierra counties, which represent 79.2 percent of the region's population, have an overall MHI that falls below the threshold for DACs at $45,794 and $39,009, respectively.

Table 3-3 Disadvantaged Communities in the Upper Feather River IRWM Plan Area

Community	Population	Households	Annual MHI[b]	Percent of Statewide MHI[c]	County
Westwood CDP	1,582	748	$28,158	46.1	Lassen
Clear Creek CDP	192	93	$33,542	54.9	Lassen
Warner Valley CDP	5	5	NA	--	Plumas
Chester CDP	1,908	891	$40,331	66.0	Plumas
Lake Almanor Peninsula CDP	482	220	$46,667	76.4	Plumas
Almanor CDP	10	10	NA	--	Plumas
Canyondam CDP	0	0	NA	--	Plumas
Greenville CDP	922	488	$30,129	49.3	Plumas
Crescent Mills CDP	233	70	$31,413	51.4	Plumas
Caribou	0	0	NA	--	Plumas
Indian Falls CDP	35	20	NA	--	Plumas
Twain CDP	21	11	NA	--	Plumas
Belden CDP	52	37	NA	--	Plumas
Tobin	11	11	NA	--	Plumas
Bucks Lake CDP	0	0	NA	--	Plumas
Quincy CDP	1,442	732	$44,417	72.7	Plumas
East Quincy CDP	2,560	1,158	$45,417	74.3	Plumas
Spring Garden CDP	0	0	NA	--	Plumas
Cromberg CDP	135	86	$31,111	50.9	Plumas
La Porte CDP	13	13	NA	--	Plumas
Little Grass Valley	19	9	NA	--	Plumas
Johnsville CDP	8	5	NA	--	Plumas
Graeagle CDP	548	311	$42,688	69.9	Plumas
Blairsden CDP	26	16	NA	--	Plumas
Clio CDP	35	35	$25,250	41.3	Plumas
Whitehawk CDP	31	23	NA	--	Plumas
Gold Mountain CDP	25	14	NA	--	Plumas
Mabie CDP	0	0	NA	--	Plumas
Delleker CDP	824	310	$33,750	55.2	Plumas
Portola City	2,880	1,163	$34,942	57.2	Plumas
Lake Davis	38	25	NA	--	Plumas
Chilcoot-Vinton CDP	233	105	$47,607	77.9	Plumas
Calpine CDP	180	87	$17,472	28.6	Sierra
Sattley CDP	59	35	NA	--	Sierra
Sierraville CDP	105	29	NA	--	Sierra
Loyalton City	840	306	$34,063	55.8	Sierra
Sierra Brooks CDP	312	142	$32,685	53.5	Sierra

[a]CDP=Census Designated Place
[b]NA=no data available
[c]DAC threshold is 80 percent
Source: Data included in the table above was taken from the DWR's DAC mapping tool, which utilizes U.S. Census American Community Survey (ACS) 5-Year Data: 2009 - 2013 (with an MHI of $61,094 and hence a calculated DAC threshold of $48,875). Available at: http://www.water.ca.gov/irwm/grants/resources_dac.cfm

Figure 3-5 Disadvantaged Communities in the UFR Region

The data included in the table above is taken from the DWR DAC mapping tool, which utilizes the U.S. Census American Community Survey (ACS) 5-year data: 2009-2013. The ACS dataset did not include MHI information for the smaller CDPs, which resulted in "NA" for that category. The DWR methodology identifies these CDPs as being DACs.

A Socio-Economic Assessment of the Upper Feather River Watershed was prepared by the Sierra Institute for Environment and Community to further refine the DWR mapping of DACs. The data replied upon by DWR for identifying DACs contains data gaps, particularly for rural regions. The DACs listed in Table 3-3 were identified through a combination of the two methods. The Assessment is included in Appendix 3-1.

3.3.3 Native American Tribes

The Maidu Tribes traditionally inhabited the northern Sierra Nevada and southern Cascades between Lassen Peak and the American River. Three groups of closely related peoples are referred to as the Maidu: the Mountain Maidu of Plumas and Lassen counties, the Konkow of Butte and Yuba counties, and the Nisenan of Yuba, Nevada, Placer, Sacramento, and El Dorado counties. Maidu tribal interactions and cultural connections continue today, and interregional coordination among tribal groups and families is an important aspect of the Plan. The Maidu are a community of people who have lived upon this land for untold generations.[2] The ancestral homeland of the Mountain (Yamani) Maidu extends from Eagle Lake and Honey Lake in Lassen County east to Sierra Valley, south to the Feather River Canyon, and west to Mount Lassen.[3] Contemporary understanding of the traditional boundaries of tribal homelands is based on oral history and an incomplete archaeological record and so is necessarily approximated in published literature.

The Yamani Maidu ancestral homeland includes a wide range of mountain, valley, lake, spring, and stream environments that were used seasonally by the people and by neighboring tribes through extensive trading networks, resource stewardship agreements, and shared cultural values and extended family ties.

Oral histories of Maidu families place the estimated population of Yamani Maidu in the Upper Feather River watershed at around 22,000 people at the time of European contact, compared to an estimated 1,500 Maidu people today The Maidu population was sustained by rigorous stewardship to maintain ecosystem health, species diversity, water resources, and beneficial interactions between people and place that provided for material well-being and spiritual progression. Stewardship of resources was coordinated by family units residing seasonally in various locations throughout the watershed.[4]

Following the arrival of large numbers of Europeans in the Sierra Nevada during the California Gold Rush, local Native Americans were dispossessed of their ancestral lands throughout the region. The Upper Feather River watershed includes areas covered by one of 18 treaties made between California Indians and the United States between 1851 and 1852 that were not ratified by the U.S. Senate. The areas covered by the un-ratified treaty include western Genesee Valley, Mount Hough, and parts of Indian Valley and American Valley.[5] There are currently two federally recognized Tribes (Greenville Indian Rancheria and Susanville Indian Rancheria), three federally unrecognized Tribes--the Tsi-Akim Maidu, the United Maidu Nation and Honey Maidu are petitioning for federal recognition--and there are numerous trust allotment lands in the Upper Feather River watershed. The Greenville Rancheria is a federally recognized Tribe of Maidu Indians of California, located east of Greenville. Susanville Indian Rancheria's (SIR) land base is

[2] Cunningham, F. 2007. *Maidu Summit Consortium Land Management Proposal;* page 28.
[3] Cunningham, Trina. 2015. Email correspondence. 15 August.
[4] Cunningham, Trina. 2015. Email correspondence, 15 August.
[5] Ibid.

1,340.74 acres, including one property in Plumas County located within the Upper Feather River watershed. Tribes and bands associated with the SIR include Mountain Maidu, Northern Paiute, Washoe and Pit River whose ancestors lived in the northeastern California and northwestern Nevada region since time immemorial.

There are thousands of significant Maidu cultural sites in the watershed, including the strong cultural ties by surrounding tribal communities to Homer Lake, which drains into the Mountain Meadows area in the Lake Almanor basin. Survey data are on file at the Plumas National Forest and the Northeast Information Center at California State University, Chico.

3.3.4 Economic Conditions and Trends

Median household income in the rural portion of the Plan Area is lower than the statewide average. Overall, with the exception of a few pockets of development within the region, communities in the UFR Region have a MHI less than 80 percent of the statewide average (Table 3-3). The 2013 median household income of $45,794 in Plumas County is lower than the statewide average of $61,094; MHI is lower for all levels of education, with the largest disparity among holders of graduate or professional degrees.[6] The map of disadvantaged communities within the Upper Feather River Region (Figure 3-5) continued decline in families with children and the increase in retirees living on fixed income is likely to widen the income disparity in the future. In recent history, the traditional economic base in Plumas County was the timber industry, which has been in decline since the late 1980s. Current economic trends are more favorable for agriculture, tourism, seasonal recreational developments, retail, and health services. The departure of families and upward shift in the age structure of the population is reflected in the closing of three elementary schools, one middle school, and two high schools in Plumas County since 2000,[7] and is directly related to the decline of timber harvesting and wood processing jobs in beginning in the late 1990s.

Because most communities in the watershed are very small, large percentage shifts in economic patterns can result from changes of only a few jobs. Unemployment in the Plan Area was 13.1 percent in March of 2015, which was down from a peak of 23.9 percent in 2010. Employment in the region has shifted from predominantly timber and agriculture to education, government agencies, retail, and health services. Employment by sector differs markedly among communities in the Plan Area because of small population sizes. Retail services account for most of the employment in tourism-oriented communities such as Graeagle and Chester, while education is the principal sector in Quincy, which is the location of Feather River Community College.[8]

3.3.5 Social and Cultural Values

The Yamani Maidu traditionally lived in seasonal settlements throughout the Upper Feather River watershed, occupied in harmony with the seasons. Permanent villages in mountain locations during the winter and predominately in lower elevation valleys provided shelter from winter storms and access to water and other natural resources. European settlements were at first highly ephemeral, concentrated at mining sites that were usually abandoned a few years after being established. Later settlements were more permanent, located at the most productive mines and around the timber mills and agricultural operations in the alluvial valleys and along railroad and stagecoach routes serving the mines and connecting agricultural and forest production enterprises to larger markets to the east and west.

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[6] Sierra Institute, 2012. *Upper Feather River Watershed Socioeconomic Assessment.*

[7] Ibid.

[8] Sierra Institute. 2012. *Upper Feather River Watershed Socioeconomic Assessment.*

Beginning in the early Twentieth Century, the potential of the Feather River for hydroelectric power generation was fully developed by Pacific Gas and Electric (PG&E); later the State Water Project began developing surface water storage in the watershed for water and hydroelectric needs statewide. This resulted in a complex and interconnected system of dams, powerhouses, and diversions, especially on the North Fork Feather River. More recent settlement patterns followed the development of tourism around the many lakes, valleys and free-flowing river segments in the region. Some of the largest lakes in the region, including Oroville, Almanor, and Butt Valley reservoir, were created by damming alluvial valleys and large meadows in parts of the North, Middle and South Forks of the Feather River for hydroelectric generation and water storage.

With a few exceptions, the Upper Feather River Region has maintained its rural character in the pre-automobile age through shared and cherished values around resource stewardship and community and individual self-reliance. The small population in the watershed has preserved a town-hall style of governance based on consensus-building, personal relationships, and informal lines of communication, as well as a relatively high level of civic engagement for its sparse population and lower-income status as compared to more urbanized regions in California.[9]

Branding day in Indian Valley, Plumas County (Source: SRWP)

The predominant land use in Plumas County and the portion of Lassen County in the Plan Area is open space, with approximately 94 percent of the private lands managed for timber, agriculture, and other commodity and amenity "open space" uses. The federally managed parts of the Region include the Bucks Wilderness area, the Lakes Basin recreation area and significant meadow, wetland, botanical and wildlife areas, which are conserved and managed for those purposes. State managed lands consist of the Plumas-Eureka State Park, which is managed primarily for passive recreation uses near the community of Blairsden. The Plumas County General Plan calls for land uses that facilitate recreation, community and business development consistent with residents' values in relation to open space, preservation of landscape character, and resource protection and stewardship.

The portion of Sierra County in the Plan Area is mostly in Sierra Valley, a large complex of montane meadows the size of Lake Tahoe, which supports historic and modern agricultural and recreational developments and uses. Much of Sierra Valley is utilized for hay and livestock production.

The portion of Shasta County inside the Plan Area consists of parts of Lassen Volcanic National Park and has no residents. The portions of Tehama and Yuba counties inside the Plan Area are also unpopulated and consist of small pockets of back country where the county lines cross the topographic boundaries of the watershed. The portion of Butte County inside the Plan Area is mostly unpopulated and includes Plumas National Forest Lands, Lake Oroville, and the canyons of the North Fork and Middle Fork Feather River. Communities in Butte County located inside the Upper Feather River Region are focused more toward Sacramento Valley cities such as Chico and Oroville. Cultural affinities for the rural areas of the upper watershed are defined by water-based recreation including snow sports, the importance of seasonal movement of livestock between foothill winter ranges and summer pastures in the upland valleys for maintaining ranching livelihoods and lifestyles, and by the diversity of wildlife species that migrate to and from the foothills to the upland portions of the watershed with the seasons.

[9] Plumas County. 2009. *Regional Acceptance Process Application.*

3.4 Environmental Setting

3.4.1 Climate and Precipitation

The Upper Feather River IRWM Plan Area lies in the northern Sierra Nevada, and generally has a Mediterranean climate characterized by hot dry summers and wet winters. Local climate varies markedly, due to the diversity of elevation, terrain, and aspect in the Plan Area. Because the Upper Feather River watershed has the unique property of lying on both sides of the Sierra Crest, precipitation is much lower in the eastern portion of the watershed than in the western portion. The western slope of the watershed receives up to 90 inches of precipitation per year, while the Sierra Valley floor receives as little as 11 inches. Precipitation also varies across the Region from north to south with the highest precipitation, runoff, and groundwater storage occurring as snow in the Cascade-Sierra zone.

3.4.2 Topography, Geology and Soils

Topography in the Plan Area is generally mountainous, but varied and complex. Elevation ranges from 900 feet at the surface of Lake Oroville, to over 10,400 feet at Lassen Peak. The crests of the Sierra Nevada and Diamond Mountains range from 6,000 to 7,000 feet, and the system of valleys forming the interior of the watershed generally slopes slightly upward to the southeast from 4,500 feet at Lake Almanor to approximately 5,000 feet in Sierra Valley. Peaks and ridges in this interior area are generally between 5,500 to 7,000 feet, but reach over 8,000 feet at Mount Ingalls.

The Upper Feather River watershed occupies the region of intersection between the Sierra Nevada, the Basin and Range, and the Cascades, all of which have very different geologic origins. The Sierra Nevada is characterized by granitic plutons formed by solidification of magma underground during the subduction under the Farallon Plate by the North American Plate, 115 to 87 million years before present, then uplifted by tilting of a block of crust between the Coast Ranges and the Basin and Range Province beginning approximately 10 million years before present.[10] The Sierra Crest runs unbroken for over 400 miles from the northwest portion of the Plan Area to Tehachapi Pass in southern California, with continuous elevations between 8,000 and 14,000 feet for most of its length.

The Cascade Range is a series of active volcanoes formed by ongoing subduction of the Gorda and Juan de Fuca Plates by the North American Plate in the Cascadia Subduction Zone, which lies off the Pacific Northwest Coast between Cape Mendocino and Vancouver Island. Unlike the granitic Sierra Nevada, the volcanic Cascades consist of Andesitic and Basaltic lava that solidifies above-ground, forming high stratovolcanoes such as Mount Shasta, Mount Rainier, and Mount Lassen, or low, broad shield volcanoes such as the Medicine Lake highlands, depending on the chemical makeup of the erupting magma. In contrast to the Sierra Nevada, the Cascade Range is characterized by a generally elevated volcanic highland of 4,000 to 5,000 feet punctuated by isolated, conical peaks rising over 5,000 feet above the surrounding terrain. Most of the peaks in the Cascade Range are less than 2 million years old, and many are less than 100,000 years old.[11]

The Basin and Range Province is characterized by block faulting caused by crustal extension that results in a series of northwest trending, parallel mountain ranges separated by endorheic basins. These ranges contain a mix of granitic and sedimentary rocks, and the Province is associated with extensive volcanism.

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[10] Schoenherr, Allan. 1995. *A Natural History of California*. Oakland: University of California Press. Available: http://www.ucpress.edu/book.php?isbn=9780520069220

[11] Harris, Stephen L. 2005. *Fire Mountains of the West: The Cascade and Mono Lake Volcanoes,* 3rd ed. Missoula: Mountain Press Publishing Company.

The Diamond Mountains are a western range of the Basin and Range, and formed through a process of block faulting along the eastern edge of the Sierra Nevada similar to that which formed the Carson Range and the Lake Tahoe Basin. Sierra Valley, which lies to the west of the Diamond Mountains, is a basin that once held a lake similar to Lake Tahoe, but is now filled with up to 2,000 feet of sediment.

The eastern escarpment of the Sierra Nevada south of the Middle Fork Feather River is formed by the Plumas Trench, which runs northwest from Sierra Valley, through Mohawk Valley, to the American Valley. The Plumas Trench is a graben, formed by faulting that raised the Sierra Nevada to the west and Grizzly Ridge and Beckwourth Peak to the east. East of Grizzly Ridge lie Grizzly Valley and Clover Valley, which are bounded on the east by the Diamond Mountains. Geology in the northern portion of the watershed is more complex, including the southern slopes of Mount Lassen, portions of the volcanic Modoc Plateau around Westwood, Wheeler Peak, Keddie Ridge, and the northern end of the Diamond Mountains.

South of the North Fork Feather River, the Sierra Crest divides the watershed into distinct western and eastern halves. The western half is dominated by the western slope of the Sierra Nevada, with streams flowing west through steep-sided, V-shaped, granitic canyons. The eastern half is dominated by the complex faulting and mix of granitic and volcanic geology described above, with streams flowing mainly northwest or southeast through broad, alluvial valleys formed by ice-age lakes. This part of the watershed contains numerous springs and montane wet meadow complexes that result from the flatter terrain and porous volcanic and alluvial soils.

Due to its complex geology, the watershed has diverse soils. In general, soils are deeper and more productive in the western portion, as a result of warmer temperatures and higher precipitation west of the Sierra Crest. Throughout the watershed, north-facing slopes tend to have deeper, more productive soils.

Many granitic soils are highly erosive. The erosion hazard to exposed soil is "high" on 29 percent of Plumas National Forest System lands; the majority of this high erosion hazard classification occurs in granitic soils. The volcanic rock and soils of the east side are susceptible to landslides; 14 percent of the Plumas National Forest is classified as "high" risk to landslides[12].

The complex intermountain and inter-province geology and soils in the region, in combination with the generally older and more weathered characteristics of mountains and valleys, is highly efficient at collecting and storing water; along with the Gold Rush, water production and conservation has shaped the history of the region and continues to significantly influence current and future land and water planning and management in the region to this day.

3.4.3 Terrestrial Ecosystems

According to the USDA CALVEG project, 52.1 percent of the watershed is covered by vegetation types that are classified by the CDFW California Wildlife Habitat Relationships System as Sierran mixed conifer series, including ponderosa pine (*Pinus ponderosa*), foothill pine (*Pinus sabiniana*), Douglas-fir (*Pseudotsuga menziesii*) and incense cedar (*Calocedrus decurrens*) alliances. In the upper elevations, the Sierran mixed conifer series gives way to the red fir (*Albies magnifica*) alliance, which covers 18.6 percent of the watershed (Table 3-4, Figure 3-6).

[12] Ecosystem Sciences Foundation (ESF). 2005. *Integrated Regional Water Management Plan, Upper Feather River Watershed,* vol. 1, p. 4-10. Available: http://www.feather-river-crm.org/pdf/MOU/IRWMP_063005.pdf

Table 3-4 Vegetation and Land Cover in the Upper Feather River Watershed IRWM Plan Area

Community1	Area (ac.)2	Percent of Plan Area
Sierran Mixed Conifer	1,200,583	52.1
Red Fir	429,118	18.6
Urban – Agriculture	175,664	7.6
Sagebrush	114,575	4.9
Mixed Chaparral	87,827	3.8
Jeffrey Pine	83,815	3.6
Montane Hardwood	73,800	3.2
Montane Chaparral	50,370	2.2
Water	46,612	2.0
Lodgepole Pine	11,534	0.5
Perennial Grass	9,835	0.4
Juniper	9,543	0.4
Barren	8,801	0.4
Blue Oak Woodland	4,156	0.2
Annual Grass	324	<0.1
Total	2,306,557	100.0

1Community names are from the California Wildlife Habitat Relationships System
2Area from CALVEG Project

The Urban-Agriculture cover-type is the third most extensive, covering 7.6 percent of the watershed. The majority of this cover type occurs as agriculture in Sierra Valley, Mohawk Valley, and the American Valley. Sagebrush (*Artemisia tridentata*) communities are found in east-side watersheds such as the Last Chance and Red Clover subwatersheds of the East Branch, and Sierra Valley in the Middle Fork. Sagebrush communities cover 4.9 percent of the watershed and are found on valley floors, where they are encroaching on meadows due to lowered water tables caused by stream incision and loss of riparian vegetation. Mixed chaparral, Jeffrey pine (*Pinus jeffreyi*), montane hardwood, and montane chaparral habitats occur throughout the watershed in small areas, cover between 2 and 4 percent of the watershed individually, and combine for approximately 13 percent cover. Lodgepole pine (*Pinus contorta*), blue oak (*Quercus douglasii*), juniper (*Juniperus* spp.), perennial grassland, annual grassland, and barren land cover less than 1 percent of the watershed each, and combine for approximately 2 percent total cover. The remaining 2 percent of the watershed is covered by open water in reservoirs and natural lakes.

All traditional species are important to Yamani Maidu. This includes direct human management and use, as companion plants for other plant species and pollinators, and as part of an integral ecological system including water health for the benefit of the entire ecosystem. The Yamani Maidu have maintained this landscape for untold generations both pre and post European contact. Restoration of species no longer present or in limited numbers is a desired condition from the tribal perspective of knowledge and place.

Figure 3-6 Map of vegetation communities in the Upper Feather River Region

3.4.4 Aquatic Ecosystems and Fisheries

The Upper Feather River Watershed has a wide variety of aquatic habitats including natural ponds and lakes, reservoirs and canals, springs and meadows, small alpine streams, and large, canyon-bounded rivers. The fisheries of the watershed are also varied with numerous species of native and non-native fish occupying the varied habitats. Fisheries in the watershed can be generalized into two categories: cold water streams and rivers, and cold and warm water lakes and reservoirs.

Historically, the Upper Feather River Watershed provided spawning habitat to anadromous Chinook salmon (*Oncorhynchus tshawytscha*) and steelhead (*Oncorhychus mykiss*), that migrated from the Pacific Ocean to spawn in the headwaters streams of the Feather River. The Oroville Dam now blocks this migration, and ocean-run salmonids are no longer present in the watershed above the dam. The Feather River Fish Barrier Dam, located just downstream of Oroville Dam, now diverts migrating salmon and steelhead to the Feather River Fish Hatchery Ladder, where they are collected for artificial spawning.

One-year-old hatchlings are released into the Feather River or transported downstream to the Delta where they migrate to the Pacific Ocean until returning to the lower Feather River to spawn as adults.[13]

Fisheries in the Upper Feather River Watershed are managed by the California Department of Fish and Wildlife (CDFW) and the DWR. Fisheries management has included stocking and removals at several locations in the watershed, and introduced game species have migrated into most streams and lakes in the watershed.

There have been proposals by the National Marine Fisheries Services (NMFS) to reintroduce steelhead and salmon to the North Fork Feather River watershed through a trap and haul program, but the current Habitat Expansion Agreement between NMFS, DWR, and PG&E has moved away from the North Fork Feather River watershed--at least for the present.[14]

Tribal representatives advocate for restoring salmon and other native fish species in the watershed of the Upper Feather River region. The Maidu people are proponents of working in collaborative stewardship to assist in fish restoration, utilizing cultural knowledge and including historical precedence and traditional practices for fostering fish passage.

There are currently 17 common fish species known to occur in the Upper Feather River Watershed,[15] of which 13 are non-native (Table 3-5). The actual extent and distribution of these species is generally unclear.

Table 3-5 Common fish species in the Upper Feather River Watershed IRWM Plan Area

Common Name	Scientific Name
Rainbow Trout	*Oncorhynchus mykiss*
Eagle Lake Rainbow Trout	*Oncorhynchus mykiss aquilarum*
Eagle Lake Rainbow Trout	*Oncorhynchus mykiss aquilarum*
Eastern Brook Trout	*Salvelinus fontinalis**
Brown Trout	*Salmo trutta**
Lake Trout (Mackinaw)	*Salvelinus namaycush**

[13] ESF, 2005, p. 4-29.

[14] Plumas Co. 2009. p. 20.

[15] ESF, 2005.

Common Name	Scientific Name
Kokanee Salmon	*Oncorhynchus nerka**
Carp	*Cyprinus carpio**
Channel Catfish	*Ictalurus Punctatus**
Hitch	*Lavinia exilicauda*
Speckled Dace	*Rhinichthys osculus*
Brown Bullhead	*Ameiurus nebulosus**
Bluegill	*Lepomis macrochirus**
Redear Sunfish	*Lepomis microlophus**
Green Sunfish	*Lepomis cyanellus**
Black Crappie	*Pomoxis nigromaculatus**
Largemouth Bass	*Micropterus salmoides**
*Non-native	

3.4.5 Endangered and Special-Status Species

The Upper Feather River IRWM Plan Area includes five special-status habitats, 25 special-status animal species, and 66 special-status plant species with reported occurrences in the California Natural Diversity Database (CNDDB; Table 3-6). Special-status animal species in the Plan Area include five invertebrates, four amphibians, one reptile, eight birds, and seven mammals. Special-status species are species that are listed or candidates for listing under the Federal or State Endangered Species Acts, species of special concern to federal or State resource management agencies, and plants that have a California Rare Plant Rank of 1B or 2B, indicating that they are rare, threatened, or endangered in California. Special-status habitats are either rare or contain a high concentration of special-status species.

There are CNDDB-reported occurrences in the Plan Area of three federally-listed animals and two federally listed plants: valley elderberry longhorn beetle (*Desmocerus californicus dimorphus*), California red-legged frog (*Rana aurora draytonii*), Sierra Nevada yellow-legged frog (*Rana sierrae*), Webber's ivesia (*Ivesia webberi*), and slender orcutt grass (*Orcuttia tenuis*). There are CNDDB-reported occurrences for six species that are State-listed only, with no federal listing: willow flycatcher (*Empidonax traillii*; the southwestern subspecies *E. t. extimus* is federally-listed), greater sandhill crane (*Grus canadensis tabida*), and bank swallow (*Riparia riparia*).

Habitat for the valley elderberry longhorn beetle extends to approximately the 3,000 foot elevation contour on the western slope of the Sierra Nevada; therefore, suitable habitat for this species in the Plan Area is restricted to the extreme western portion around Lake Oroville. Additionally, there is currently suitable habitat in T23 NE, R5E, S32, well above Lake Oroville. Webber's ivesia is reported in the Plan Area only in the Sierra Valley area.

Sandhill Crane (Courtesy of Kristi Jamason)

Special-status habitats in the Region are: Darlingtonia seep, montane freshwater marsh, northern interior cypress forest, northern vernal pool, and Sphagnum fen. Darlingtonina seeps support rare insectivorous plants such as California pitcher plant (*Darlingtonia californica*) and sundews (*Drosera* spp.) that obtain Nitrogen by trapping and digesting insects, and occur in the Plan Area in the East Branch of the North Fork and Spanish Creek subwatersheds. Montane freshwater marsh habitats were once extensive in the high-elevation valleys in the Region but have been reduced through draining for agriculture, early sluice mining operations, and from the widespread extirpation of beaver from the UFR during the fur-trading era of the early 1800s. Northern interior cypress forest occurs in the Lights Creek and Upper Indian Creek subwatersheds. Also occurring in the region, serpentine soils containing levels of iron and magnesium are toxic to most plants, are nutrient-poor, and have very low water retention, which has led to the evolution of a unique flora of serpentine endemic plant species able to tolerate the harsh conditions.

Vernal pools are shallow seasonal wetlands that form under special conditions of heavy soils with a restrictive layer that retards drainage, and flat topography that forms micro-basins. Vernal pools form in the spring and retain water far longer than surrounding terrain. The seasonal inundation and gradual drying of vernal pools has resulted in the evolution of a unique endemic flora that is distinct from immediately surrounding areas. Sphagnum fens support thick, spongy layers of living and dead moss (*Sphagnum* spp.) that form highly acidic, nutrient-poor, permanently waterlogged peat soils. A Sphagnum fen occurs in the southwest part of the Yellow Creek subwatershed.

Table 3-6. Special-Status Species and Habitats in the Upper Feather River IRWM Plan Area[1]

Life Form	Scientific Name	Common Name	Status[2]	Number of Occurrences[3]
Habitat	--	Darlingtonia seep	--/--	7
Habitat	--	montane freshwater marsh	--/--	2
Habitat	--	northern interior cypress forest	--/--	2
Habitat	--	northern vernal pool	--/--	4
Habitat	--	Sphagnum fen	--/--	1
Invertebrate	*Desmocerus californicus dimorphus*	valley elderberry longhorn beetle	FT/--	1
Invertebrate	*Ecclysomyia bilera*	Kings Creek ecclysomyian caddisfly	--/--	1
Invertebrate	*Hydroporus leechi*	Leech's skyline diving beetle	--/--	1
Invertebrate	*Neothremma genella*	golden-horned caddisfly	--/--	1
Invertebrate	*Parapsyche extensa*	Kings Creek parapsyche caddisfly	--/--	1
Amphibian	*Rana aurora draytonii*	California red-legged frog	FT/--	2
Amphibian	*Rana boylii*	foothill yellow-legged frog	--/--	5
Amphibian	*Rana cascadae*	cascades frog	--/--	13
Amphibian	*Rana muscosa*	mountain yellow-legged frog	FE/--	16
Reptile	*Actinemys marmorata marmorata*	northwestern pond turtle	--/--	2
Bird	*Accipiter gentilis*	northern goshawk	--/--	46
Bird	*Cypseloides niger*	black swift	--/--	1
Bird	*Empidonax traillii*	willow flycatcher	--/SE	16
Bird	*Grus canadensis tabida*	greater sandhill crane	--/ST	43
Bird	*Haliaeetus leucephalus*	bald eagle	FDL/SE	30
Bird	*Pandion haliaetus*	osprey	--/--	40
Bird	*Riparia riparia*	bank swallow	--/ST	3
Bird	*Strix nebulosa*	great grey owl	--/SE	1
Mammal	*Gulo gulo*	California wolverine	--/ST	3
Mammal	*Lasiurus blossevillii*	western red bat	--/--	1
Mammal	*Lepus americanus tahoensis*	Sierra Nevada snowshoe hare	--/--	1
Mammal	*Martes americana*	pine marten	--/--	10

Life Form	Scientific Name	Common Name	Status[2]	Number of Occurrences[3]
Mammal	*Martes pennanti pacifica*	Pacific fisher	FC/SC	13
Mammal	*Taxidea taxus*	American badger	--/--	9
Mammal	*Vulpes vulpes necator*	Sierra Nevada red fox	--/ST	5
Plant	*Agrostis hendersonii*	Henderson's bent grass	--/--	3
Plant	*Allium jepsonii*	Jepson's onion	--/--	15
Plant	*Astragalus lemmonii*	Lemmon's milk-vetch	--/--	2
Plant	*Astragalus lentiformis*	lens-pod milk-vetch	--/--	55
Plant	*Astragalus pulsiferae var. pulsiferae*	Pulsifer's milk-vetch	--/--	17
Plant	*Astragalus tener ver. ferrisiae*	Ferris's milk-vetch	--/--	1
Plant	*Astragalus webberi*	Webber's milk-vetch	--/--	11
Plant	*Balsamorhiza macrolepis var. macrolepis*	big-scale balsamroot	--/--	1
Plant	*Betula pumila var. glandulifera*	resin birch	--/--	2
Plant	*Boechera constancei*	Constance's rock-cress	--/--	50
Plant	*Bruchia bolanderi*	Bolander's brachia	--/--	2
Plant	*Calystegia atriplicifolia ssp. buttensis*	Butte County morning-glory	--/--	6
Plant	*Carex lasiocarpa*	slender sedge	--/--	6
Plant	*Carex limosa*	shore sedge	--/--	8
Plant	*Carex petasata*	Liddon's sedge	--/--	1
Plant	*Carex sheldonii*	Sheldon's sedge	--/--	14
Plant	*Clarkia biloba ssp. brandegeeae*	Brandegee's clarkia	--/--	2
Plant	*Clarkia gracilis ssp. albicaulis*	white-stemmed clarkia	--/--	6
Plant	*Clarkia mildrediae ssp. mildrediae*	Mildred's clarkia	--/--	39
Plant	*Clarkia mosquinii*	Mosquin's clarkia	--/--	41
Plant	*Corallorhiza trifida*	northern coralroot	--/--	1
Plant	*Drosera anglica*	English sundew	--/--	9
Plant	*Eleocharis torticulmis*	California twisted spike-rush	--/--	2
Plant	*Epilobium howellii*	subalpine fireweed	--/--	1
Plant	*Epilobium luteum*	yellow willowherb	--/--	1
Plant	*Epilobium palustre*	marsh willowherb	--/--	1
Plant	*Erigeron nevadincola*	Nevada daisy	--/--	4
Plant	*Eriogonum spectabile*	Barron's buckwheat	--/--	2
Plant	*Fritillaria eastwoodiae*	Butte County fritillary	--/--	47
Plant	*Hulsea nana*	little hulsea	--/--	2
Plant	*Ivesia aperta var. aperta*	Sierra Valley ivesia	--/--	40
Plant	*Ivesia baileyi var. baileyi*	Bailey's ivesia	--/--	6
Plant	*Ivesia sericoleuca*	Plumas ivesia	--/--	34
Plant	*Ivesia webberi*	Webber's ivesia	FT/--	3

Life Form	Scientific Name	Common Name	Status[2]	Number of Occurrences[3]
Plant	*Juncus leiospermus var. leiospermus*	Red Bluff dwarf rush	--/--	1
Plant	*Lewisia cantelovii*	Cantelow's lewisia	--/--	29
Plant	*Lomatium foeniculaceum var. macdougalii*	MacDougal's lomatium	--/--	2
Plant	*Lomatium hendersonii*	Henderson's lomatium	--/--	3
Plant	*Lupinus dalesiae*	Quincy lupine	--/--	158
Plant	*Mielichhoferia tehamensis*	Lassen Peak copper-moss	--/--	1
Plant	*Monardella douglasii ssp. venosa*	veiny monardella	--/--	1
Plant	*Monardella follettii*	Follett's monardella	--/--	28
Plant	*Monardella stebbinsii*	Stebbins's monardella	--/--	8
Plant	*Orcuttia tenuis*	slender orcutt grass	FT/SE	4
Plant	*Oreostemma elatum*	tall alpine-aster	--/--	10
Plant	*Penstemmon janishiae*	Janish's beardtongue	--/--	3
Plant	*Penstemmon personatus*	closed-throated beardtongue	--/--	22
Plant	*Potamogeton epihydrus ssp. nuttallii*	Nuttall's pondweed	--/--	1
Plant	*Potamogeton praelongus*	white-stemmed pondweed	--/--	1
Plant	*Pyrrocoma lucida*	sticky pyrrocoma	--/--	53
Plant	*Rhynchospora alba*	white beaked-rush	--/--	3
Plant	*Rhynchospora capitellata*	brownish beaked-rush	--/--	4
Plant	*Sagittaria sanfordii*	Sanford's arrowhead	--/--	1
Plant	*Scheuchzeria palustris var. americana*	American scheuchzeria	--/--	4
Plant	*Schoenoplectus subterminalis*	water bulrush	--/--	6
Plant	*Scutellaria galericulata*	marsh skullcap	--/--	3
Plant	*Sedum albomarginatum*	Feather River stonecrop	--/--	16
Plant	*Senecio eurycephalus var. lewisrosei*	cut-leaved ragwort	--/--	30
Plant	*Silene occidentalis ssp. longistipitata*	long-stiped campion	--/--	1
Plant	*Silene suksdorfii*	Cascade alpine campion	--/--	2
Plant	*Solidago gigantea*	smooth goldenrod	--/--	1
Plant	*Stachys palustris ssp. pilosa*	marsh hedge nettle	--/--	1
Plant	*Stanleya viridflora*	green-flowered prince's plume	--/--	1
Plant	*Trimorpha acris var. debilis*	northern daisy	--/--	2
Plant	*Utricularia intermedia*	flat-leaved bladderwort	--/--	9
Plant	*Utricularia ochroleuca*	cream-flowered bladderwort	--/--	2

[1]Source: CNDDB, 2005, as reported in ESF, 2005.
[2]Status: F=Federal Listing; S=State Listing; E=Endangered; T=Threatened; C=Candidate; DL=Delisted
[3]Number of CNDDB reported occurrences as of 2005

3.4.6. Invasive Species

Invasive species and noxious weeds are found throughout the watershed. These species affect native communities and many are agricultural pests. Governing districts and local stakeholders have made control and eradication of non-native and invasive species a top priority. Invasive weeds are considered a major problem in the watershed for their increasing potential to adversely affect the agricultural and recreational economy and natural environment. A number of invasive species have had significant negative impacts in the watershed by outcompeting native plant and animal species, altering the natural fire frequency and severity, lowering crop production, decreasing available water supplies, reducing rangeland productivity, hindering recreational opportunities, and increasing the potential for erosion. Common noxious weeds found throughout the watershed include: yellow star thistle (*Centaurea solstitialis*), medusahead (*Elymus caput-medusae*), musk thistle (*Carduus nutans*), perennial pepperweed (*Lepidium latifolium*), and scotch broom (*Cytisus scoparius*). Table 3-7 lists the managed noxious weeds within the region.

Table 3-7 Noxious Weeds Managed by the Plumas-Sierra County Department of Agriculture

Common Name	Scientific Name
Musk thistle	*Carduus nutans*
Spotted knapweed	*Centaurea stoebe*
Diffuse knapweed	*Centaurea diffusa*
Russian knapweed	*Rhaponticum repens*
Russian thistle	*Salsola targus*
Dalmatian toadflax	*Linaria dalmatica*
Dyer's woad	*Isatis tinctoria*
Tall whitetop (aka perennial pepperweed)	*Lepidium latifolium*
Yellow star thistle	*Centaurea solstitialis*
Hoary cress	*Cardaria sp.*
Rush skeletonweed	*Chondrilla juncea*
Scotch thistle	*Onopordum acanthium*
Scotch broom	*Cytisus scoparius*
French broom	*Genista monspessulana*
Spanish broom	*Spartium junceum*
Stinkwort	*Dittrichia graveolens*
Canada thistle	*Cirsium arvense*
Bull thistle	*Cirsium vulgare*
Tree of heaven	*Ailanthus altissima*
Field bindweed	*Convolvulus arvensis*
Leafy spurge	*Euphorbia virgata* (nearly eradicated)
Salt cedar	*Tamerix sp.* (nearly eradicated)
Mediterranean Sage	*Salvia aethiopis* (nearly eradicated)
Medusahead	*Taeniatherum caput-medusae*
Sulfur cinquefoil	*Potentilla recta*
Klamath weed	*Hypericum perforatum* (mostly under biological control)
Barbed goatgrass	*Aegilops triuncialis*
Jointed goatgrass	*Aegilops cylindrica*
Ovate goat grass	*Aegilops ovata*
Puncture vine	*Tribulus terrestris*

Common Name	Scientific Name
Eurasian watermilfoil	*Myriophyllum spicatum*
Common tansey	*Tanacetum vulgare*
Fennel	*Foeniculum vulgare*
Poison hemlock	*Conium maculatum*
Russian olive	Elaeagnus angustifolia
Italian thistle (found only in Butte County portion of UFR Region)	*Carduus tenuiflorus*
Source: Plumas-Sierra Counties Agricultural Commissioner, November 2015.	

3.4.6 Role of Wildfire

Forest and chaparral ecosystems in the northern Sierra Nevada region have evolved with a natural fire ecology characterized by frequent, localized, low and moderate intensity fires. Water management in the region includes widespread interest in the reintroduction of low and moderate intensity fire. Indigenous peoples deliberately burned at varied fire intensities and at variable "fire return" intervals for optimal species habitats and for landscape-scale ecological enhancement which benefited the People and animals. The use of fire in this way had multiple benefits. It kept the forest open in a park-like setting, protecting the region from catastrophic forest fires, increased understory species, ensured rapid nutrient cycling, decreased diseases, and enhanced benefit for multiple plant and animal species.[16] Many shrub species resprout from below-ground crowns following a fire, and many tree species require low-intensity fire to trigger seed germination. Forest management practices starting with the arrival of Europeans in the mid-1800s focused on fire suppression and resulted in substantial buildup of biomass over historic conditions. Drought, disease, and pests have combined to convert that increased biomass into volatile fuel. In recent decades, with the ecological trends of more widespread and severe fires, there are serious threats to human lives and property from severe wildfires when residential development expands into high fire hazard forested areas.


Chips Fire, 2012 (Source: USFS)

In combination, wind, steep terrain, and water-stressed trees and highly flammable forest fuels all contribute to increasing wildland fire hazard threats to residential homes, recreational developments, and whole communities located within forests. The California Department of Forestry and Fire Protection has designated a majority of the Plan Area as having a very high fire hazard rating.

In a changing climate, the role of Traditional Ecological Knowledge (TEK) becomes even more important, specifically the reintroduction of fire as maintenance of water resources. TEK has sustained the Maidu through prolonged droughts based on traditions of understanding relations between fire, water, and location.

[16] Cunningham, F. 2007. *Maidu Summit Consortium Land Management Plan;* page 29.

3.5 Description of Watersheds and Water Systems

3.5.1 Watersheds and Groundwater Basins

The Upper Feather River Watershed is divided into four main branches (Table 3-8): the West Branch, the North Fork, the Middle Fork, and the South Fork of the Feather River. The West Branch and South Fork are relatively small, comprising 8.1 percent of the watershed. The North Fork of the Feather River is the largest branch, draining 59.8 percent of the watershed. Its upper reaches are divided into two main branches: the Upper North Fork and the East Branch of the North Fork. The Middle Fork drains the remaining 32.1 percent of the watershed.[17] The Upper Feather River watershed discharges approximately 3.8 million AF of water per year into Lake Oroville, based on average daily flows measured at gauging stations on the four main branches of the River over periods ranging as far back as the 1930s. These data are a rough approximation and do not necessarily reflect recent drought conditions. The Middle Fork contributes proportionally less water by area, due to it draining the comparatively dry Sierra Valley and the eastern slope of the Sierra Crest. The West Branch and South Fork contribute proportionally more water by area, because both of those watersheds are entirely on the comparatively wet west side of the Sierra Crest.

Table 3-8 Major Divisions of the Upper Feather River Watershed

Major Division	Area (ac.)	Percent of Watershed Area	Mean Daily Flow (cfs)[a]	Mean Daily Flow (gal. x 1,000)	Mean Annual Inflow to Lake Oroville (AF)	Percent of Annual Total
West Branch	106,102	4.6	350	226,210.9	253,388.8	6.6
North Fork	1,379,321	59.8	3,230	2,087,603.7	2,338,416.5	60.4
Middle Fork	740,405	32.1	1,500	969,475.4	1,085,951.9	28.1
South Fork	80,729	3.5	260	168,042.4	188,231.7	4.9
Total	2,306,557	100.0	5,340	3,451,332.4	3,865,988.9	100.0

[a]Source: California Department of Water Resources. Mean daily flows are calculated for different periods in each division, based on availability of data.

The Upper Feather River watershed comprises 23 subwatersheds, which are described below. The West Branch and South Fork each consists of a single subwatershed, as their watersheds are small and comparatively simple. The Middle Fork is divided into 6 subwatersheds, and the North Fork comprises the remaining 15 subwatersheds. Figure 3-7 depicts the subwatershed locations within the entire watershed.[18]

[17] ESF, 2005, p. 4-12

[18] ESF, 2005, p. 4-12.

Figure 3-7 Subwatersheds within the Upper Feather River watershed.

3.5.1.1 Watershed Descriptions

Each of the 23 subwatersheds of the Upper Feather River watershed, along with its component stream reaches, lakes, dams, diversions, and reservoirs, is discussed below. The descriptions are organized by location within each of the four main forks: the West Branch, the North Fork, the Middle Fork, and the South Fork. The North and Middle Forks are generally described before their subwatersheds are discussed.

North Fork of the Feather River

The North Fork of the Feather River is the largest branch of the Upper Feather River. The large East Branch of the North Fork drains much of the east side of the Sierra Crest. Its headwaters flow from the Diamond Mountains in the north and east. Headwater streams originate in high alluvial valleys, while the lower reaches flow through steep canyons west of the Sierra Crest. There are several major dams along the North Fork that supply power and water for the large urban and agricultural developments to the south and west.

The North Fork of the Feather River is divided into two main branches, the main stem of the North Fork, and the East Branch of the North Fork. The main stem of the North Fork is divided into five subwatersheds above its confluence with the East Branch. The East Branch is divided into eight subwatersheds above the confluence. Two subwatersheds are below the confluence, and these two reaches, Bucks-Grizzly and North Lake Oroville, are the subject of Federal Energy Regulatory Commission (FERC) License Nos. 619, 1962, and 2100.

Middle Fork of the Feather River

The Middle Fork of the Feather River headwaters flows from the Frenchman area of the Diamond Mountains and the mountains surrounding Sierra Valley. The upper reaches lie in the large meadows of Sierra Valley, but after it flows through Mohawk Valley, the Middle Fork enters a wilderness canyon that is designated a Wild and Scenic River. The Middle Fork of the Feather River consists of two subwatersheds that contain broad valleys, Sierra Valley and Lake Davis-Long Valley.

West Branch Feather River Subwatershed

The headwaters of the West Branch of the Feather River are along the western side of the Sierra Crest. The West Branch flows southward through a steep canyon into the west side of Lake Oroville, which floods its bottom reach.

There are no major dams or impoundments on the West Branch; however, there are three small dams. The Round Valley Dam is on the West Branch of the Feather itself, while Philbrook and Concow dams are on tributaries bearing those names. The Philbrook Dam, built in 1877, is the oldest existing dam within the watershed.

Upper North Fork Feather River Subwatershed

The Upper North Fork of the Feather River subwatershed is in the extreme northwest portion of the Plan Area. The headwaters of the North Fork of the Feather River flow off the slopes of Mt. Lassen and Mt. Conrad, southwest of Lake Almanor. This section of the watershed receives high precipitation; over 90 inches per year near Lassen Peak. It has typical eastside stream characteristics, with streams flowing through alluvial valleys. The largest natural lake within the subwatershed is Juniper Lake in the northeast corner of the subwatershed, just north of Mt. Harkness.

The only major diversion within the subwatershed is the Chester Diversion on the North Fork just west of the town of Chester on the northwest shore of Lake Almanor. It diverts water south and west of the town of Chester and into Lake Almanor for emergency flood protection during large storm events and for big snowpack years.

Bailey-Lake Almanor Subwatershed

Located between the Upper North Fork of the Feather River and Hamilton Branch subwatersheds, the Bailey-Lake Almanor subwatershed includes the drainage area of Bailey Creek and the catchment of Lake Almanor itself. Lake Almanor receives water from two major diversions, the Chester Diversion in the Upper North Fork subwatershed and from Hamilton Branch diversion from the Hamilton Branch subwatershed. Lake Almanor was created in 1914 for hydropower production by the Western Power Company is now the largest hydroelectric reservoir and power generating facility for FERC No. 2105. In 1927, Lake Almanor Dam was constructed and increased the lake's capacity to 1.3 million AF. A tunnel connects Lake Almanor with Butt Lake to the southwest. Lake Almanor water levels, water quality, and recreation issues are managed by PG&E, under FERC No. 2105, and are affected by downstream requirements of PG&E's FERC No. 1962 and 2107 licenses.[19]

Hamilton Branch Subwatershed

Bounded by the Diamond Mountains to the north, the Hamilton Branch subwatershed drains into Lake Almanor. In 1927, Indian Ole Dam was built along Hamilton Creek, creating Mountain Meadows Reservoir. The reservoir has a capacity of 24,800 AF, and is connected to Lake Almanor through a diversion canal. Mountain Meadows Reservoir is the only major water body within this subwatershed.

Butt Valley Subwatershed

Located southwest of the Lake Almanor subwatershed, the Butt Valley subwatershed flows southeast into the Seneca reach of the North Fork. The major stream is Butt Creek, which flows east from its headwaters along the eastern Sierra Crest and then south into Butt Valley Reservoir. Just before Butt Creek reaches the reservoir, a tunnel from Lake Almanor connects the two subwatersheds at a powerhouse on the northwest side of Butt Valley Reservoir. The reservoir covers 1,600 acres and has a capacity of 49,800 AF. PG&E manages Butt Valley Reservoir water levels, water quality, and recreation issues under its FERC License No. 2105.

Seneca Subwatershed

The Upper North Fork, Baily-Lake Almanor, Hamilton Branch, and Butt Valley subwatersheds flow into the Seneca subwatershed. The North Fork Feather River flows from the outlet below the Lake Almanor Dam south and west as it approaches the Sierra Crest. Just below the confluence of Butt Creek and North Fork Feather River, a tunnel connects Butt Valley Reservoir with the North Fork at Caribou Powerhouse. As the river flows southwest, the canyon becomes steeper and deeper, reaching over 3,000 feet deep at the bottom of this reach at the confluence with the East Branch North Fork.

PG&E operates a number of dams, diversions, penstocks, and powerhouses in this subwatershed; the operations of the facilities are regulated as part of the FERC No. 2105 license. Recreation management, reservoir operations, streamflow quantity and timing, stream habitat management, water quality in Lower Butt Creek and North Fork Feather River are dictated by FERC No. 2105 operations and include

[19] ESF. 2005. p. 4-21.

obligations for meeting specific downstream water flow and quality requirements and recreational flow conditions mandated in FERC No. 1962 and to a lesser extent for FERC No. 2107.

Yellow Creek Subwatershed

The Yellow Creek subwatershed includes Humbug Valley and consists of approximately 49,000 acres. The USFS, DFW, and CalTrout have collaborated with PG&E on resource management in the subwatershed for decades, particularly in the projection and restoration of Yellow Creek. Yellow Creek is a DFW-designated wild trout fishery that is protected by special fishing regulations.[20]

Bucks-Grizzly Subwatershed

The Bucks-Grizzly subwatershed is part of the North Fork Feather River Watershed, starting at the confluence of the East Branch North Fork Feather River and the North Fork Feather River, and extending downstream to the Poe Hydroelectric Project (FERC No. 2107) diversion dam on the North Fork Feather River. The Bucks-Grizzly subwatershed is bounded on the west by the West Branch Feather River subwatershed, and on the East by Spanish Creek subwatershed, Nelson-Onion Valley subwatershed, and Lower Middle Fork Feather River. State Highway 70 runs alongside the North Fork Feather River throughout this reach.

Bucks-Grizzly subwatershed includes numerous diversions and hydropower projects on the North Fork Feather River. Water is released from the Belden Powerhouse into Rock Creek Reservoir at the top of the reach. Water diverted at Rock Creek Dam enters a penstock and electricity is generated downstream where the water is again diverted at the Cresta Dam to produce electricity even farther downstream near the top of the Poe Hydroelectric Project. The Rock Creek and Cresta projects are collectively licensed by FERC No. 1962 . Water temperature, timing and quantity of flow, sediment management, and recreation management are addressed in the FERC License No. 1962, which includes mandatory conditions by the State Water Resources Control Board and the Plumas National Forest through their statutory authority over these issues.

The Bucks-Grizzly subwatershed also includes numerous dams on tributaries to the North Fork Feather River. Spring Valley Lake, operated by CDFW, is a 75 AF reservoir behind an earthen dam located in the headwaters of Rock Creek at approximately 6,600 feet above sea level. PG&E under FERC license No.619 operates Lower Three Lakes Dam on Milk Ranch Creek. It has a capacity of 606 AF and is adjacent to Bucks Lake Wilderness. Bucks Diversion and Bucks Storage are located on Bucks Creek, the largest tributary to the North Fork Feather River in the Bucks-Grizzly subwatershed. Both are operated by PG&E, and together impound more than 100,000 AF of water. Grizzly Forebay is also operated by PG&E, and is located on Grizzly Creek.

Bucks Lake Wilderness is situated in the Bucks-Grizzly subwatershed and encompasses approximately 21,000 acres. The Pacific Crest National Scenic Trail bisects the subwatershed and the Bucks Lake Wilderness. Elevations within Bucks Lake Wilderness range from 2,000 feet in the North Fork Feather Canyon to more than 6,900 feet at Spanish Peak.

North Lake Oroville Subwatershed

The North Lake Oroville subwatershed includes the most-downstream reach of the North Fork Feather River, starting downstream of the Poe Hydropower Project (FERC No. 2107) diversion dam, and extending

[20] Pacific Forest and Watershed Lands Stewardship Council. 2001. Land Conservation Plan: Volume II; pg FR-31.

downstream to include North Lake Oroville and Oroville Dam (FERC No. 2100). The North Lake Oroville subwatershed is bounded on the west by the West Branch Feather River subwatershed and on the east by the Lower Middle Fork Feather River subwatershed and South Lake Oroville subwatershed. State Highway 70 runs adjacent to the North Fork Feather River from Lake Oroville to the northern extent of the reach. Poe Powerhouse utilizes water from nine miles of the North Fork Feather River to generate electricity during peak demand periods. Lake Madrone Water District operates one small reservoir of 200 AF on Berry Creek in the southern portion of the subwatershed near Lake Oroville.

Wolf Creek Subwatershed

The Wolf Creek subwatershed, located southeast of Lake Almanor, is a tributary to Lower Indian Creek. The subwatershed is separated from the Hamilton Branch subwatershed to the north by Keddie Ridge, which runs northwest to southeast. Wolf Creek, the main stream in the watershed, runs east along Highway 89 through the community of Greenville. The stream has been the focus of restoration efforts in the past. Wolf Creek is somewhat incised for much of the reach along the highway and through Greenville. Past Greenville, it flows out into Indian Valley, where it empties into Indian Creek. Bidwell Lake Dam on North Canyon Creek in the southern end of the watershed. Round Valley Reservoir, the only major impoundment within the subwatershed, is a dedicated water supply for the community of Greenville. There are also several irrigation diversions within the subwatershed. The Lower Wolf Creek watershed (25,748 acres), which begins just upstream of Greenville, has been identified by the Plumas National Forest as a priority watershed for restoration.

Lights Creek Subwatershed

The headwaters of Lights Creek flow south off of Diamond Mountain and make their way into the upper end of North Arm of Indian Valley before entering Indian Creek. There are no major lakes, reservoirs, dams or diversions within this subwatershed. There was mining along Lights Creek, and tailings can be found within the valley bottom sediments. There are also several irrigation diversions within the subwatershed.

Upper Indian Creek Subwatershed

The Upper Indian Creek subwatershed is located east of the Lights Creek subwatershed. The headwaters of Indian Creek flow off the south side of Diamond Mountain. Several small creeks that run off of the southwest side of the Diamond Mountains join the main stream in the Antelope Lake area. Antelope Lake reservoir is created by Antelope Lake Dam, a 22,566 AF capacity dam built in 1964. From the reservoir, Upper Indian Creek flows south into the head of Genesee Valley, just below the confluence of Last Chance Creek and Red Clover Creek. All of these waters come together to form Lower Indian Creek. The Upper Indian Creek subwatershed has been identified as a high priority watershed for restoration, with the main stem identified as a priority stream.

Last Chance Creek Subwatershed

This subwatershed drains the southwest slope of the Diamond Mountains from the Clarks Peak area in the north (adjacent to Upper Indian Creek), south to the Frenchman area. Last Chance Creek flows east to west along the Diamond Mountains. The Creek and its many small tributaries flow through a network of high meadow systems. Clarks Creek drains the north end of the subwatershed and then joins Last Chance Creek as the stream turns south toward Squaw Valley. Squaw Queen Creek flows east to west through the open meadows of Squaw Valley, roughly parallel to Last Chance Creek. Squaw Creek then flows into Last Chance Creek, and the waters flow west toward the confluence with Red Clover Creek and then Indian Creek. There are no major impoundments, lakes, or other large water bodies in this subwatershed. Meadow restoration projects have been implemented in the subwatershed.

Red Clover Creek Subwatershed

The Red Clover Creek subwatershed is a narrow catchment flowing from the Frenchman area at the edge of Sierra Valley. It runs west-northwest between Lake Davis and Squaw Queen Creek. Dixie Creek drains off of Dixie Mountain into a meadow system nearly connected to Squaw Valley; it then flows into Red Clover Creek in the larger Red Clover Valley. Red Clover Valley is a large open valley separated from Lake Davis by Crocker Mountain. Meadow restoration projects have been implemented in the subwatershed.

The waters of Red Clover Creek then flow west to the confluence with Last Chance Creek, and then into Lower Indian Creek. There are no major water bodies or substantial water infrastructure facilities within this subwatershed.

Lower Indian Creek Subwatershed

Lower Indian Creek begins when Last Chance and Red Clover Creeks, after coming together upon entering Genesee Valley, flow into Upper Indian Creek. The Creek flows west through Genesee Valley in a broad incised channel. Ward Creek, a tributary to Indian Creek, has a hydroelectric power plant on it. Two main tributaries enter at the bottom of Genesee Valley: Hosselkus Creek from the Kettle Rock-Eisenhower area to the north, and Little Grizzly Creek from the Lake Davis area to the south. Dolly Creek, a tributary to Little Grizzly Creek, was the site of Walker Mine. The USFS manages a small concrete dam at the Walker Mine tailings site that serves to maintain the historic impoundment of the tailings.

After Hosselkus Creek and Little Grizzly Creek enter Indian Creek, Indian Creek leaves Genesee Valley and passes through a narrower valley between Mt. Jura and Grizzly Peak toward the community of Taylorsville and Indian Valley. Lights Creek enters into Indian Creek out of the North Arm of Indian Valley. At the west side of the valley, Wolf Creek enters just after flowing through Greenville. Indian Creek then flows south to its confluence with Spanish Creek to form the East Branch of the North Fork. There are no major waterbodies or substantial water infrastructure facilities in this subwatershed. There are several irrigation diversions within the subwatershed. Additionally, groundwater is pumped for irrigaton and domestic uses.

Spanish Creek Subwatershed

This subwatershed is centrally located within the Upper Feather River Watershed. Spanish Creek's headwaters are high on the eastern side of the Sierra Crest in the Spanish Peak area above Bucks Lake. There are two impoundments built on Silver Creek and Wapaunsie Creek, which are tributaries of Spanish Creek. Spanish Creek and its tributaries flow east from the Sierra Crest, through Meadow Valley, into the western end of American Valley, and past the town of Quincy. From the eastern part of the subwatershed, Greenhorn and Thompson Creeks flow west down the Plumas Trench into Thompson Valley, and then into Spanish Creek at the eastern end of American Valley. The Tollgate Creek-Spanish Creek watershed (22,850 acres), which begins immediately downstream of the confluence of Spanish and Greenhorn Creeks, has been identified by the Plumas National Forest as a priority watershed for restoration.

Because the headwaters of Spanish Creek flow from high Sierra peaks, the western part of the subwatershed receives uncharacteristically high precipitation for the East Branch of the North Fork. It, therefore, has a large discharge compared to other subwatersheds of the East Branch.

Lower East Branch of the North Fork of the Feather River Subwatershed

The confluence of Spanish Creek and Lower Indian Creek form the East Branch of the North Fork of the Feather River. The river runs roughly east to west through the Feather River canyon. As the river approaches the Sierra Crest to the west, the river enters the approximately 1,000-yard Serpentine Canyon along a railroad grade and Highway 70. The East Branch of the North Fork of the Feather River meets the North Fork at the end of the canyon at French Bar, the western end of the subwatershed.

Frenchman Lake Subwatershed

This small subwatershed is located north of Sierra Valley, from the Diamond Mountains in the east to Dixie Mountain in the west. Little Last Chance Creek flows southeast from the divide with Last Chance Creek into Frenchman Lake, a 1,500-acre reservoir in Little Last Chance Valley. Frenchman Lake, at 55,000 AF, is managed primarily for irrigation and recreation.

Sierra Valley Subwatershed

Sierra Valley is the largest valley in the IRWM Plan Area. The valley is a broad expanse of meadows crossed by a network of stream channels. Although there is only one small dam within the subwatershed (on Antelope Creek), there is a network of irrigation canals throughout the valley. Sierra Valley is an ancient lake basin, and contains several seasonal and perennial standing water bodies. The many stream channels, along with Little Last Chance Creek (from the Frenchman area), come together to form the Middle Fork of the Feather River in the northwest corner of the valley.

Lake Davis-Long Valley Subwatershed

The Middle Fork flows northwest out of Sierra Valley then northeast toward the Sierra Crest and the Nelson-Onion Valley subwatershed. In the northern part of the subwatershed, Big Grizzly Creek flows off of Grizzly Peak through Grizzly Valley and empties into Lake Davis, an 83,000-AF capacity reservoir. Below Lake Davis, there is a small private dam on Big Grizzly Creek before it flows into the Middle Fork. The Big Grizzly Creek watershed (33,438 acres) has been identified by the Plumas National Forest as a priority watershed for restoration.

Downstream of Big Grizzly Creek, the Middle Fork flows through the town of Portola and Humbug Valley. The river enters the Mohawk Valley and the community of Graeagle as it turns northwest to parallel the Sierra Crest. Above the Mohawk Valley to the southwest, four small dams exist up in the high lakes area. Several natural lakes exist in the vicinity, including the largest, Gold Lake. The Frazier Creek watershed (33,772 acres), which includes Gold Lake and the community of Graeagle, has been identified by the Plumas National Forest as a priority watershed for restoration. After following Mohawk valley northwest the river turns west and begins to cut through the high Sierra. This is the beginning of the Middle Fork Canyon, which is the Wild and Scenic portion of the Middle Fork, exceeding 3,000 feet from ridge to river in some places.

Nelson-Onion Valley Subwatershed

The Middle Fork flows west out of the Lake Davis-Long Valley subwatershed to be joined by Nelson Creek at the east end of the Nelson-Onion Valley subwatershed. Nelson Creek drains a basin between the north slope of the Sierra Crest and Eureka Ridge. After gaining the substantial flow of Nelson Creek, the Middle Fork enters the Middle Fork Canyon. There are no major waterbodies or substantial water infrastructure facilities in the subwatershed. Both the Nelson Creek watershed (29,119 acres) and the Washington Creek watershed (12,635 acres), which includes the stretch of Middle Fork immediately downstream of the Nelson Creek confluence, have been identified by the Plumas National Forest as a priority watersheds for restoration.

Lower Middle Fork Subwatershed

The Middle Fork flows from the northeast to southwest through the canyon as west-side tributaries such as the Little North Fork and South Branch of the Middle Fork add to its flow. It then empties into Lake Oroville just below Bald Rock Canyon in Feather Falls National Scenic Area. There are no major waterbodies or substantial water infrastructure facilities in the subwatershed. The Little North Fork of Middle Fork Feather watershed (29,627 acres) includes the streams in the northwest quarter of the subwatershed and has been identified by the Plumas National Forest as a priority watershed for restoration.

South Lake Oroville Subwatershed

This small subwatershed encompasses the uplands surrounding the arm of Lake Oroville that floods the bottoms of the Middle Fork and South Fork canyons. Lake Oroville is the largest water body within the entire watershed, with a 3.5 million AF capacity. Its 15,805-acre surface spans the South Lake Oroville and North Lake Oroville subwatersheds.

South Fork of Feather River Subwatershed

Like the West Branch, the South Fork contains only one subwatershed. The South Fork subwatershed is a roughly linear northeast to southwest drainage off the western slope of the Sierra Nevada.

This small sub-watershed contains seven dams. The largest reservoir is Little Grass Valley Reservoir on the main stem of the South Fork. At 93,010 AF of capacity, Little Grass Valley is the fourth largest water body within the Upper Feather River Watershed. This reservoir is just west of Gibsonville Ridge, the southern edge of the Upper Feather River Watershed. Downstream of the South Fork Diversion (owned by the South Feather Water and Power), the river passes between Lumpkin and Mooreville Ridge. Lost Creek drains the area east of Mooreville Ridge before entering at the deeper, 1,200 foot canyon south of Fields Ridge. Lost Creek passes through several reservoirs before entering the South Fork. The largest, Sly Creek, has over 65,000 AF of capacity. There is another small dam on Grizzly Creek, a small tributary to the south. After passing through Forbstown Diversion (owned by the South Feather Water and Power), the South Fork spills into Ponderosa Reservoir, at the top of the southernmost arm of Lake Oroville.

3.5.1.2 Groundwater Basins

The water resources of the Upper Feather River watershed consist of surface waters (streams, rivers, lakes and reservoirs) as well as subsurface waters. The majority of the subsurface water resources of the Upper Feather River watershed are contained in groundwater basins. A groundwater basin is defined as an area underlain by permeable materials capable of furnishing a significant supply of groundwater to wells or storing a significant amount of water. A groundwater basin is three-dimensional and includes both the surface extent and also all of the subsurface fresh water-yielding materials.

Due to the steep V-shaped canyons of the western slopes of the Sierra Nevada, there are no large groundwater basins west of the Sierra Crest. Near Lake Oroville, the Sacramento Valley Eastside Groundwater Basin marks the edge of the underground storage reservoirs contained under the Sacramento Valley. The alluvial valleys of the eastside subwatersheds allow water to percolate into subsurface reservoirs. The watershed of the North Fork contains most of the groundwater basins in the region; however, the largest groundwater basin in the Plan Area, the Sierra Valley Groundwater Basin, is in the watershed of the Middle Fork.

The DWR identifies 14 groundwater basins in the Plan Area (Figure 3-8):[21]

- 5-7 Lake Almanor Valley
- 5-8 Mountain Meadows Valley
- 5-9 Indian Valley
- 5-10 American Valley
- 5-11 Mohawk Valley
- 5-12 Sierra Valley (2 sub-basins)
- 5-56 Yellow Creek Valley
- 5-57 Last Chance Creek Valley
- 5-58 Clover Valley
- 5-59 Grizzly Valley
- 5-60 Humbug Valley
- 5-87 Middle Fork
- 5-95 Meadow Valley
- Modoc Plateau Pleistocene Volcanic Area (not described)

Lake Almanor Valley Groundwater Basin

The Lake Almanor Valley Groundwater Basin covers 7,150 acres along the northwest shore of Lake Almanor. The basin is bounded by Lake Almanor to the southeast and on all other sides by Pliocene basalt. The basin consists of Quaternary lake deposits and Pleistocene non-marine sediments.

In 1960, the DWR estimated the storage capacity to be 45,000 AF for a saturated depth interval of 10 to 210 feet. There are no known groundwater management plans, groundwater ordinances, or basin adjudications associated with this groundwater basin. In 2014, DWR ranked the basin as an overall basin priority of very low, based on overdraft and water quality impairments.[22] However, the Maidu People would like to revist the management plan and the ranking decision previously made.

Mountain Meadows Valley Groundwater Basin

The 8,145-acre Mountain Meadows Valley Groundwater Basin is located to the northeast of Lake Almanor. The basin consists of Quaternary alluvium which encircles Mountain Meadows reservoir. The basin is bounded to the northeast by Jurassic to Triassic metavolcanic rocks and Tertiary non-marine sediments. The basin is bounded to the southeast by Miocene volcanic rocks and to the northwest by Pleistocene basalt. There are no known groundwater management plans, groundwater ordinances, basin adjudications, or monitoring programs in place. In 2014, DWR ranked the basin as an overall basin priority of very low.[23]

[21] CA Department of Water Resources. 2003. *California's Groundwater*. Bulletin 118. Available at: http://www.water.ca.gov/pubs/groundwater/bulletin_118/california's_groundwater__bulletin_118_-_update_2003_/bulletin118_entire.pdf.

[22] CA Department of Water Resources, May 30, 2014. *CASGEM Basin Summary – Sacramento Hydrologic Region, Lake Almanor Valley*. Available at: http://www.water.ca.gov/groundwater/casgem/pdfs/basin_prioritization/NRO%20101.pdf

[23] ---. *CASGEM Basin Summary – Sacramento Hydrologic Region, Mountain Meadows Valley*. Available at: http://www.water.ca.gov/groundwater/casgem/pdfs/basin_prioritization/NRO%20102.pdf

Figure 3-8 Groundwater basins within the Upper Feather River watershed

Meadow Valley Groundwater Basin

This 5,730-acre groundwater basin lies within the Melones Fault Zone of the Sierra Nevada. The basin is bounded on the west by the Mesozoic ultrabasic rocks, to the north by Pliocene pyroclastic rocks, and to the east by ultrabasic intrusive rocks and Paleozoic marine sediments. There is no information on groundwater storage or quality for this basin. In addition, there are no known groundwater management plans, groundwater ordinances, or basin adjudications. In 2014, DWR ranked the basin as an overall basin priority of very low based on overdraft and water quality impairments.[24] As in Lake Almanor Valley Groundwater Basin above, the Maidu People would like to revist the management plan and the ranking decision previously made for the Meadow Valley Groundwater Basin.

Indian Valley Groundwater Basin

This 29,410-acre groundwater basin is an irregularly shaped basin bounded by Paleozoic to Mesozoic marine, volcanic, and metavolcanic rocks. This basin includes Genesee Valley, Indian Valley, and Bucks Valley. In 1960, the DWR (1960) estimated the storage capacity to be 100,000 AF for a saturated depth interval of 10-210 feet. There is no information about water quality for this basin. In addition, there are no known groundwater management plans, groundwater ordinances, or basin adjudications. In 2014, DWR ranked the basin as an overall basin priority of very low.[25]

Middle Fork of the Feather River Groundwater Basin

The Middle Fork of the Feather River Groundwater basin encompasses 4,340 acres and consists primarily of Quaternary lake and alluvial deposits. This region is dominated by northwest trending faults. One of these faults forms the basin boundary to the east, while the northern and southern boundaries are formed by Pliocene and Miocene volcanic rocks. The eastern boundary is formed by Paleozoic marine deposits. There are no known groundwater management plans, groundwater ordinances, or basin adjudications. In 2014, DWR ranked the basin as an overall basin priority of very low.[26]

Humbug Valley Groundwater Basin

This 9,980-acre basin is situated in the Penman Peak-Beckwourth Peak area northeast of Mohawk Valley. Humbug Valley is approximately six miles long by three miles wide, and is bounded to the north by the volcanic rocks of Penman Peak, to the southeast by Miocene volcanic rocks of Beckwourth Peak, and to the northeast by Mesozoic granitic rocks. The floor of the canyon is composed mainly of level alluvium and gently sloping lake deposits at the western end of the valley. In 1963 the DWR[27] estimated the storage capacity to be 76,000 AF to a depth of 100 feet. There are no known groundwater management

[24] ---. *CASGEM Basin Summary – Sacramento Hydrologic Region, Meadow Valley Groundwater Basin.* Available at: http://www.water.ca.gov/groundwater/casgem/pdfs/basin_prioritization/NRO%20113.pdf

[25] CA Department of Water Resources, May 30, 2014. *CASGEM Basin Summary – Sacramento Hydrologic Region, Indian Valley Groundwater Basin.* Available at: http://www.water.ca.gov/groundwater/casgem/pdfs/basin_prioritization/NRO%20107.pdf

[26] ---. *CASGEM Basin Summary – Sacramento Hydrologic Region, Middle Fork of the Feather River Groundwater Basin.* Available at: http://www.water.ca.gov/groundwater/casgem/pdfs/basin_prioritization/NRO%20104.pdf

[27] CA Department of Water Resources (a). 1963. *Northeastern Counties Groundwater Investigation*, vol. 1, Text. Bulletin 98.

plans, groundwater ordinances, or basin adjudications. In 2014, DWR ranked the basin as an overall basin priority of very low.[28]

Grizzly Valley Groundwater Basin

The Grizzly Valley Groundwater Basin lies within a graben bounded to the northeast by Grizzly Valley Fault and to the southwest by a series of northwest trending faults. The 13,440-acre basin is bounded to the north by Miocene volcanic rocks and to the south by Paleozoic marine sediments, Mesozoic granitic rocks, recent volcanics, and Tertiary intrusive rocks. Grizzly Creek drains the valley and is a tributary to the Middle Fork Feather River. There are no known groundwater management plans, groundwater ordinances, or basin adjudications. In 2014, DWR ranked the basin with an overall basin priority of very low.[29]

Clover Valley Groundwater Basin

The Clover Valley Groundwater Basin is an irregularly shaped basin of 16,780 acres that includes McReynolds Valley, Squaw Valley, Clover Valley, and Wakeynolds Valley. These valleys consist of alluvium deposits and lake sediments. The basin is bounded by Miocene volcanic rocks on the north, east, and south and by recent volcanic and Mesozoic granitic rocks to the west. Dixie Creek and Red Clover Creek drain the southern two thirds of the basin to the west, and Squaw Queen Creek drains the northern third of the basin to the northeast. There are no known groundwater management plans, groundwater ordinances, or basin adjudications. In 2014, DWR ranked the basin with an overall basin priority of very low.[30]

Last Chance Creek Valley Groundwater Basin

The Last Chance Creek Groundwater Basin is a narrow, east/west trending basin located at the southwestern foot of the Diamond Mountains and covers 4,660 acres. The basin is bounded to the south by Tertiary pyroclastic rocks and to the north by Miocene volcanics, Mesozoic granitic rocks, and Tertiary pyroclastic rocks. Eocene basalt borders the basin in the west. There are no known groundwater management plans, groundwater ordinances, or basin adjudications. In 2014, DWR ranked the basin with an overall basin priority of very low.[31]

Yellow Creek Valley Groundwater Basin

The Yellow Creek Groundwater Basin is a 2,310-acre basin located to the southwest of Lake Almanor and consists of Quaternary alluvium. The valley is drained to the south by Yellow Creek. The valley is bounded to the east by Mesozoic and Paleozoic marine sediments, to the north and west by Tertiary volcanic rocks, and to the south by recent volcanic and Paleozoic marine sediments. There are no known groundwater

[28] ---CA Department of Water Resources, May 30, 2014. *CASGEM Basin Summary – Sacramento Hydrologic Region, Humbug Valley Groundwater Basin.* Available at: http://www.water.ca.gov/groundwater/casgem/pdfs/basin_prioritization/NRO%2094.pdf

[29] ---. *CASGEM Basin Summary – Sacramento Hydrologic Region, Grizzly Valley Groundwater Basin.* Available at: http://www.water.ca.gov/groundwater/casgem/pdfs/basin_prioritization/NRO%2087.pdf

[30] CA Department of Water Resources, May 30, 2014. *CASGEM Basin Summary – Sacramento Hydrologic Region, Clover Valley Groundwater Basin.* Available at: http://www.water.ca.gov/groundwater/casgem/pdfs/basin_prioritization/NRO%2086.pdf

[31] ---. *CASGEM Basin Summary – Sacramento Hydrologic Region, Last Chance Creek Valley Groundwater Basin.* Available at: http://www.water.ca.gov/groundwater/casgem/pdfs/basin_prioritization/NRO%2085.pdf

management plans, groundwater ordinances, or basin adjudications. In 2014, DWR ranked the basin with an overall basin priority of very low.[32]

Sierra Valley Sub-Basin

The 117,380 acre Sierra Valley Sub-basin covers the majority of the Sierra Valley Groundwater Basin. Sierra Valley is an irregularly shaped, complexly faulted valley in eastern Plumas and Sierra counties. The basin is bounded to the north by Miocene pyroclastic rocks of Reconnaissance Peak, to the west by Miocene andesite of Beckwourth Peak, to the south and east by Tertiary andesite, and to the east by Mesozoic granitic rocks. The primary water-bearing formations in Sierra Valley are Holocene sedimentary deposits, Pleistocene lake deposits, and Pleistocene lava flows.

The aquifers of the valley are mainly alluvial fan and lake deposits. The alluvial fans grade laterally from the basin boundaries into course lake and stream deposits. The deposits of silt and clay act as aquitards or aquicludes in the formation. Aquiclude materials are predominantly fine-grained lake deposits. In the central part of the basin, alluvial, lake, and basin deposits compose the upper 30 to 200 feet of aquitard material that overlies a thick sequence of interstratified aquifers and aquicludes.

Most of the upland recharge areas are composed of permeable materials occurring along the upper portions of the alluvial fans that border the valley. Recharge to groundwater is primarily by way of infiltration of surface water from the streams that drain the mountains and flow across the fans. Increases in groundwater development in the mid to late 1970s resulted in the cessation of flow in many artesian wells. Large pumping depressions formed over the areas where heavy pumping occurred. Water levels in a flowing artesian well in the northeast portion of the basin declined to more than 50 feet below ground surface by the early 1990s. While Subsequent reductions in groundwater pumping through the 1990s helped to recover groundwater levels to mid-1970's levels, increased pumping in more recent years has dropped water levels in some monitored wells to the deepest level on record.[33]

The estimated groundwater storage in the Sierra Valley Basin is 7,500,000 AF to a depth of 1,000 feet. In 1963 the DWR noted that the quantity of useable water as being unknown. In 1973, the DWR estimated storage capacity to be between 1 million to 1.8 million AF for the top 200 feet of sediment based on an estimated specific yield ranging from 5 to 8 percent. These estimates include the Chilcoot Sub-basin. A wide range of mineral type waters exist throughout the Sierra Valley Basin. Sodium chloride and sodium bicarbonate type waters occur south of Highway 49 and north and west of Loyalton along fault lines. Two wells contain waters that are sodium sulfate in character. In other parts of the Sierra Valley, the water is bicarbonate with mixed cationic character. Calcium bicarbonate type water is found around the rim of the basin and originates from surface water runoff.

The poorest quality groundwater is found in the central west side of the valley where fault-associated thermal waters and hot springs yield water with high concentrations of boron, fluoride, iron, and sodium. Several wells in this area also have high arsenic and manganese concentrations. Boron concentrations in thermal waters have been measured in excess of 8 mg/L. At the Basin fringes, boron concentrations are usually less than 0.3 mg/L. There is also a sodium hazard associated with thermal waters in the central portion of the basin.

[32] ---. *CASGEM Basin Summary – Sacramento Hydrologic Region, Yellow Creek Valley Groundwater Basin*. Available at: http://www.water.ca.gov/groundwater/casgem/pdfs/basin_prioritization/NRO%2084.pdf.
[33] Sierra Valley Groundwater Management District. *2012-2014 SVGMD Technical Report*; page 26. Available at: http://www.sierravalleygmd.org/updates.html

The Sierra Valley Groundwater Management District, an entity created by the Sierra Valley Groundwater Management District legislation, manages the Sierra Valley Basin. This legislation clearly defined the boundaries over which the district has authority to manage the groundwater resources. The Chilcoot Sub-basin (described below) falls within the boundaries of the Sierra Valley Groundwater District.

In 2014, DWR ranked the Sierra Valley Groundwater Basin with an overall basin priority of medium.[34] This is the only groundwater basin in the Plan Area that is elevated above "very low priority." An extensive modeling effort is currently underway in the basin to better equip overlying landowners with assessment tools for managing this large and complex basin through increasingly variable precipitation cycles.

Chilcoot Sub-Basin

The Chilcoot Sub-basin is an irregularly shaped, 7,550-acre, complexly faulted valley on the eastern side of the Sierra Valley Groundwater Basin in Plumas County. The basin is bounded to the north and east by Mesozoic granitic rocks, and to the south by Tertiary Sierran basalt and pyroclastic rocks and Paleozoic metamorphic rocks. The basin is hydrologically connected to the Sierra Valley Basin to the west in the near surface but may be discontinuous at depth due to a bedrock sill. The primary water-bearing formations in the Chilcoot Sub-basin are Holocene sedimentary deposits and silt and sand deposits, fractured and faulted Paleozoic to Mesozoic metamorphic and granitic rocks, and Tertiary volcanic rocks. As noted, the Sierra Valley Groundwater District manages the Chilcoot Sub-basin. In 2014, DWR ranked the sub-basin with an overall basin priority of very low.[35]

Mohawk Valley Groundwater Basin

The Mohawk Valley Groundwater Basin encompasses 18,990 acres and lies within an elongated valley occupying a portion of the Plumas Trench. The basin is bounded on the southwest side by the Mohawk Valley Fault and on the east side by a group of northwest trending faults that branch from the Mohawk Valley fault near Sattley. The floor of the valley consists of a narrow strip of nearly flat alluvial material overlying lake sediments. Lake sediments also underlie the upland areas of the valley. Depth to bedrock is estimated to range between 1,500 and 3,000 feet. The basin is bounded to the northeast by Pliocene volcanic rocks of Penman Peak, to the east by Miocene volcanic rocks of Beckwourth Peak, and to the west and southwest by Paleozoic metavolcanic rocks and Mesozoic granitic rocks of the Sierra Nevada. Sulphur Creek drains the southern half of the valley and enters the Middle Fork of the Feather River near the midpoint of the valley and flows northwesterly. Storage capacity for the Mohawk Valley basin is estimated to be 90,000 AF based on a specific yield of 5 percent for a depth interval of zero to 200 feet. Calcium-magnesium bicarbonate and sodium bicarbonate are the predominant groundwater types in the basin. There is a groundwater management plan for the Plumas-Eureka Community Services District. There are no other known groundwater management plans, groundwater ordinances, or basin adjudications associated with this basin. In 2014, DWR ranked the basin with an overall basin priority of very low.[36]

[34] CA Department of Water Resources, May 30, 2014. *CASGEM Basin Summary – Sacramento Hydrologic Region, Sierra Valley Groundwater Sub-basin.* Available at: http://www.water.ca.gov/groundwater/casgem/pdfs/basin_prioritization/NRO%2040.pdf

[35] CA Department of Water Resources, May 30, 2014. *CASGEM Basin Summary – Sacramento Hydrologic Region, Chilcoot Sub-basin.* Available at: http://www.water.ca.gov/groundwater/casgem/pdfs/basin_prioritization/NRO%2041.pdf

[36] ---. *CASGEM Basin Summary – Sacramento Hydrologic Region, Mohawk Valley Groundwater Basin.* Available at: http://www.water.ca.gov/groundwater/casgem/pdfs/basin_prioritization/NRO%2039.pdf

American Valley Groundwater Basin

The American Valley Groundwater Basin is a 6,800-acre basin bounded to the southwest and northeast by a northwest trending fault system. The basin is bounded to the northeast by Paleozoic metavolcanic rocks and on all other sides by Paleozoic marine sedimentary and meta-sedimentary rocks of the Sierra Nevada. Spanish Creek drains the valley and is a tributary to the North Fork Feather River to the northwest. In 1960, the DWR estimated storage capacity to be 50,000 AF for a saturated depth interval of 10 to 210 feet. No groundwater management plans, groundwater ordinances, or basin adjudications are associated with this basin. In 2014, DWR ranked the basin with an overall basin priority of very low.[37]

3.5.2 Hydrology and Surface Water Resources

The Upper Feather River drains from its headwaters in the Sierra Nevada, Cascades, and Diamond Mountains into Lake Oroville, which is the largest water storage facility in the State Water Project system. Lake Oroville has a water storage capacity of 4 million AF and generates an average of 3.2 million AF of "firm" annual water supplies to both agricultural and urban State Water Contractors, largely through export pumping from the Sacramento-San Joaquin Delta. The total estimated mean annual discharge into Lake Oroville is 3.8 million AF, based on long-term historical stream flow data. Current inputs to Lake Oroville are likely less than that, given the recent drought. Water output from the Plan Area above the 3.2 million AF "firm" supplies to State Water Contractors, if any, is discharged to the Pacific Ocean through San Francisco Bay.

The North Fork of the Feather River powers PG&E's 734 MW Stairway of Power, a complex of ten interconnected hydroelectric powerhouses; eight dams; and extensive networks of tunnels bored through canyon bedrock that collect tributary streamflows and connect upland storage reservoirs to the main stem of the river in the Feather River Canyon. The Middle Fork of the Feather River originates in the Sierra Valley–the largest valley both in the watershed and in the Sierra Nevada–and descends into the Middle Fork Canyon, 78 miles of which are designated Wild and Scenic River, before flowing into Lake Oroville.

The Upper Feather River watershed has been historically shaped and currently affected by state and federal land and water policies, uses, and conflicts. A large proportion of land is owned by the federal government and the history of large-scale water supply and hydroelectric developments is extensive. The sparse population of the headwaters region has been engaged in ongoing collaborative and conflictive relationships with downstream regions of California, an engagement that belies its physical isolation from the heavily populated regions of Southern California and the Bay Area, and the highly contentious San Francisco Bay Delta. Current hydroelectric operations are regulated by the FERC, and future operations of both PG&E's and DWR's hydroelectric dams and diversions are in various stages of review in six discrete but interrelated relicensing proceedings before the FERC: FERC No. 2100, FERC No. 2107, FERC No. 2105, FERC No. 1962, FERC No. 619, and FERC No. 803.

Two basins in the UFR watershed have water rights decrees, established in the Superior Court of California: the 1940 Sierra Valley Decree (No. 3095), the 1959 Little Last Chance Creek Decree[38], and the

[37] CA Department of Water Resources, May 30, 2014. *CASGEM Basin Summary – Sacramento Hydrologic Region, American Valley Groundwater Basin.* Available at: http://www.water.ca.gov/groundwater/casgem/pdfs/basin_prioritization/NRO%2038.pdf

[38] More information regarding the Sierra Valley Decree is available at: http://www.water.ca.gov/watermaster/ND_Watermasters/ServiceAreas/SierraValley/index.cfm

1950 Indian Creek Decree (No. 4185)[39]. The decrees identify specific beneficiaries and water rights, which remain superior in seniority to pre-1914 water rights. DWR provides watermasters for the Sierra Valley and Indian Creek areas to ensure that the water is allocated according to established water rights and to "prevent the waste or unreasonable use of water."[40]

3.5.3 Groundwater Resources

The DWR has estimated storage capacity for only five of the 14 groundwater basins in the Plan Area. The total estimated groundwater storage capacity in those five basins is 7.8 million AF, of which 7.5 million AF is estimated to be in Sierra Valley. If groundwater reserves in the Plan Area are in equilibrium, estimated groundwater reserves are at least two times the annual surface water discharge from the Plan Area. However, estimated storage capacity in groundwater basins may substantially exceed the amount of groundwater that is realistically available for (1) artificial extraction by pumping or (2) natural processes of surface water recharge. Because many of the groundwater basins in the Plan Area are located in ancient lakes and structural basins that have been largely filled with sediment, aquifers are 1,000 or more feet deep in some basins (see discussions of Sierra Valley and Mohawk Valley Groundwater Basins, above). Deep groundwater may be confined to those basins, and unavailable for either natural or artificial recharge of surface water through springs, seeps, or pumping. Groundwater pumping in Sierra Valley has markedly depleted artesian wells and artificial wells beginning in the 1970s, despite the large estimated storage capacity of the basin.

3.5.4 Runoff Generation and Water Balance

Virtually all of the water in the IRWM Plan Area arrives in the form of precipitation. The two exceptions are a diversion from the Little Truckee River that provides water to parts of Sierra Valley, and water that is delivered to the region in bottled form.[41] Precipitation is highest on the western side of the Sierra Crest and the southern slopes of Mount Lassen, and lowest in the eastern portion of Sierra Valley. Precipitation generally increases with elevation everywhere in the Plan Area. Because of the Mediterranean climate, most of the precipitation in the Plan Area comes during the winter in the form of snow at higher elevations. In this lowest elevation region of the Sierra Nevada Mountain range, snowpack and extensive groundwater storage play an important role in shaping the hydrograph of nearby and more distant streams and rivers. For example, mountain meadows, a widely distributed feature in this region compared to most of the rest of the Sierra Nevada, are places where groundwater surfaces, and then connects with local streamflows. Meadows are places where flood flows are slowed and captured during winter and spring, and gradually released as surface and subsurface flows downstream during the summer and fall in combinations of surface and groundwater flows that are specific to the soils and geology of each meadow. Restored meadows provide increased forage for wildlife and livestock, increased diversity and vigor of native plants, expanded and improved habitat connectivity for fish and wildlife, increased carbon sequestration (50 tons/acre). In some meadows, summer stream temperatures are reduced and riparian vegetation is more resilient during periods of drought. The continuity of culturally important tribal practices and recreational amenities are other benefits of restored meadows.[42] Meadows, springs, fens, bogs, riparian forests, wetlands and marshes, although a small proportion of the landscape, are biologic and cultural "hot spots."

[39] More information regarding the Indian Creek Decree is available at: http://www.water.ca.gov/watermaster/ND_Watermasters/ServiceAreas/IndianCreek/index.cfm

[40] Regents of the University of California, 2007. *Upper Feather River Watershed irrigation Discharge Management Program: Irrigated Agricultural Practices in UFRW*, March; pg 10.

[41] Plumas Co. 2009. p. 30.

[42] Ibid., p. 27.

3.5.4.1 Streamflow Averages and Extremes

Mountain meadow, headwaters of the North Fork Feather River and Lassen Peak (Source: Wikipedia)

Streamflow averages in the region have undergone a steady decline since the mid-1960s (Chapter 8 *Climate Change,* Figure 8-3). Runoff within the region is affected by cumulative annual reductions in snowpack accumulation, and melt and by rising temperatures. The prolonged dry period of the last ten years has significantly reduced flow from springs and groundwater discharge to streams that provide summer and fall stream flows.

With the concern over climate change, more variable precipitation patterns, more extreme drought and flood events, and increasing reduction in snowpack in the coming decades (Chapter 8 *Climate Change*), the restoration of groundwater and surface hydrology is pertinent and increasingly important. Restoration can be enhanced by stabilizing erosion in mountain meadows and in alluvial valleys, and by reversing the densification of uplands forests. For example, re-watering degraded meadows and floodplains has been identified as an important flood peak attenuation, water storage, and recharge adaptation to a changing precipitation regime. A 2008 study by Jones and Stokes concluded that there was in excess of 500,000 AF of "available" groundwater storage volume in de-watered meadows in the region, and that additional water storage in excess of 100,000 AF could be restored for enhanced groundwater recharge. The effect of enhanced groundwater storage on specific stream reaches is determined by soils and geology and varies with different precipitation patterns. The USGS has estimated that up to 40 percent of the annual surface flows into Lake Oroville originate from groundwater storage in the UFR watershed. In dry years, groundwater inputs to surface flows are significantly higher and groundwater sustains dry season streamflows as described in a Forest-Water Balance study (Appendix 3-2) developed as part of the Plan.[43]

3.5.5 Droughts and Floods

California's Mediterranean climate is marked by recurring droughts and historic floods, including the extended 1928-1934 drought, as well as the historic peak floods that existed as of the 1940s, 1950s and 1960s. And we continue to see new records broken for both drought and flood events.

3.5.5.1 Droughts

California's most significant historical statewide droughts were the six-year drought of 1929-34, the two-year drought of 1976-77, and the six-year event of 1987-92. These droughts stand out in the observed record due to their duration or severe hydrology. For example, the 1976-77 drought was short but very severe (1977 is still the driest year in recorded history in the state) and the 1987–94 drought was extreme in its unprecedented duration. More recently, the 2007-2009 drought was the first drought for which a statewide proclamation of emergency was issued – a proclamation that was again issued for the 2012-

[43] Bohm, Burkhard. 2016. *Forest and Water Balances, an Exploratory Study: Concepts of the Upper Feather River Basin Uplands Hydrology.*

2015 drought. The water years of 2012-2014 stand as California's driest three consecutive years in terms of statewide precipitation.[44]

The 2012-2015 drought event set other records in addition to that of driest three-year period of statewide precipitation. The drought occurred at a time of record warmth in California, with new climate records set in 2014 for statewide average temperatures. Records for minimum annual precipitation were set in many communities in calendar year 2013. Calendar year 2014 saw record-low water allocations for State Water Project and federal Central Valley Project contractors. Reduced surface water availability triggered increased groundwater pumping, with groundwater levels in many parts of the state dropping 50 to 100 feet below their previous historical lows.[45] Because of the region's degraded but significant groundwater reserves, the IRWM Plan Area suffered severe regulatory surface water irrigation curtailments and wildfire-related damages, but was spared the cataclysmic drought impacts suffered by other regions in the Sierra Nevada.

3.5.5.2 Floods

Flooding within the region can occur from three sources: (1) rainfall and runoff exceeding the capacity of local watercourses, (2) rainfall and runoff to depressions causing localized areas of shallow flooding, and (3) flooding from failure of a dam. Overall, the most significant flood hazard areas are in the Sierra Valley and the Indian Valley areas of the region. Another significant flood hazard area is located along Spanish Creek and its tributaries north of and around the community of Quincy. As previously described, the region contains an extensive network of rivers and other watercourses that flow out of higher elevations to the valley areas. The Federal Emergency Management Agency (FEMA) has identified several areas of the region as within 100- and 500-year flood zones (Figure 3-9). These areas are primarily located in or near the communities of Chester, Greenville, Crescent Mills, Taylorsville, Quincy, Vinton, City of Portola, City of Loyalton, and Graeagle.

Flooding in the region typically occurs in the winter and spring and is caused by heavy snowpack that is melted by severe rainfall events. This type of flooding rises slowly and can have lengthy runoff periods. Other flooding types include dam failure or debris flows, most likely from burned areas.

Severe flooding in the UFR IRWM region occurred in 1861-62 ("The Great Flood"), 1937-38, 1942, 1962, 1964-65, 1966-67, 1969-70, 1974, 1982-83, 1986, and 1996-97.[46] The most severe flooding in the region is typically produced by warm rainfall events on heavy snowpack. In 1986, the largest total rainfall for the period was 49.6 inches, recorded at Bucks Lake for the 10 day period between February 11 and 20. Storm totals of 20 to 30 inches were common for many locations. In the upper Feather River basin, flood peaks were the highest on record. State Highway 70, which follows the North Fork Feather River, was closed for several months because of washouts, landslides, and damaged bridges. The peak discharge of record for the Feather River, as measured at Lake Oroville, was 161,000 cfs on January 2, 1997.[47]

[44] CA Department of Water Resources. 2014. *California's Most Significant Droughts: Comparing Historical and Recent Conditions,* p. i. Available at: http://www.water.ca.gov/waterconditions/docs/California_Signficant_Droughts_2015_small.pdf.
[45] Ibid.
[46] CA DWR. FloodSafe California. 2013. *California's Flood Future: Recommendations for Managing the State's Flood Risk,* p. C-95. Available at: http://www.water.ca.gov/sfmp/resources/PRD_AttachC_History_4-3-13.pdf.
[47] Ibid., p. C-102.

Figure 3-9 Mapping of FEMA's 100-year floodplains within the Upper Feather River Region

Climate records indicate a trend toward heavy rainfall events with little to no snowpack. Additionally, increased climate temperatures increase the risk of catastrophic wildfire, which can result in debris flow floods during heavy rain events.

3.5.6 Climate Effects on Water Supply

See *Chapter 8 Climate Change* for discussion on the climate effects on water supply.

3.5.7 Water Supply and Demand

3.5.7.1 Urban Water Demands

Population in the Plan Area outside of Butte County is expected to continue its current downward trend through 2030 (Table 3-9). Population in Butte County is projected to increase by approximately 13 percent between 2015 and 2030; however, that increase is not expected in the rural portions of eastern Butte County in the Plan Area.[48] Given the expected modest declines in population in most of the Plan Area, urban water demands are not expected to increase in the next 15 years.

In Plumas County, 62 percent of urban water use is for industrial and commercial uses and the remaining 38 percent is for residential uses. In Sierra County, 75 percent of urban water use is for residential uses and 25 percent is for industrial and commercial uses. The current estimate of domestic water use for the Sacramento River Hydrologic Region is 286 gallons per capita per day; however, the rate of domestic water use in the UFR Plan Area is likely much lower than that, as domestic water use in the region is dominated by water use habits in the more urbanized areas of the Sacramento Valley. In general, factors in water consumption such as landscaping, swimming pools, and house size are likely lessened in the Plan Area compared to larger cities and suburbs.

[48] Department of Finance. 2015.

Table 3-9. Population Projections for the Upper Feather River IRWM Plan Area

County	2013 Population in the Plan Area	2030 Projected Change for the County (%)[4]	2030 Projected Population in the Plan Area
Butte[1]	9,323	--[5]	9,323
Lassen[2]	1,774	--[6]	1,762
Plumas	18,606	-0.7	18,476
Shasta	0	n.a.	0
Sierra[3]	1,496	-7.7	1,381
Tehama	0	n.a.	0
Yuba	0	n.a.	0
Total	31,199	--	30,942

[1]Concow and Oroville East CDPs
[2]Westwood and Clear Creek CDPs
[3]Calpine, Sattley, Sierraville, Loyalton, and Sierra Brooks CDPs
[4]Source: California Department of Finance
[5]Butte County is projected to increase by 12.9 percent; however, that reflects projected growth in the urban areas of the county. Concow CDP declined in population 2010-2013, and Oroville East is downstream of the Plan Area and its water use is inseparable from that of the City of Oroville, which is not analyzed in this plan
[6]Lassen County is projected to increase by 8.6 percent; however, that reflects projected growth in Susanville. The portion of Lassen County in the Plan Area is assumed to be demographically identical to Plumas County for this analysis.

3.5.7.2 Agricultural Water Demands

The most recent publicly available data on agricultural land use in California are from 2010, and the earliest are from 1998.[49] The DWR Detailed Analysis Unit (DAU) #154 – *Feather River* corresponds closely to the Upper Feather River IRWM Plan Area and data from that DAU were used in this analysis. In 2010, the Plan Area contained 61,678 acres of irrigated cropland, 72 percent of which was irrigated pasture (Table 3-10). This represented an increase of 10,678 acres (21 percent) of irrigated cropland since 1998. Irrigated cropland totals in the Plan Area fluctuated between 50,800 and 57,000 acres over the decade prior to 2008, and then increased to 61,121 acres between 2008 and 2009 when the acreage of irrigated pasture increased by 8,500 acres.

For comparison, the Plumas County Agriculture Commissioner's 2011 Annual Crop Report for Plumas and Sierra counties reported a total of 60,000 acres of irrigated agricultural land, 77 percent of which was irrigated pasture. This comparison is not exact, but is reasonably close, as the agricultural acreage in the Plan Area is zero or negligible for Shasta, Tehama, Lassen, and Butte counties, and nearly all of the agricultural land in Sierra County is in the Plan Area.

Using water application rates reported by DWR for each crop type, agriculture in the Plan Area used 185,295 AF of water for irrigation in 2010[50] (Table 3-10). Based on the most recent publicly available data, agricultural land in the Plan Area is fairly stable at 60,000 to 62,000 acres, approximately 75 percent of

[49] DWR, 2015. Annual Land and Water Use Estimates. Available at: http://www.water.ca.gov/landwateruse/anaglwu.cfm.
[50] Water Year 2010 was 107 percent of average. In Water Year 2010, November was exceptionally dry while October, January, April, and May were well above average.
DWR, 2010. *California's drought update, June 30*. Available at: http://www.water.ca.gov/pubs/drought/california's_drought_update_-_june_30__2010/droughtupdate-063010.pdf

which is irrigated pasture. Future shifts away from irrigated pasture and toward alfalfa and grain cultivation would reduce agricultural water use in the Plan Area, as those latter crop types have a lower irrigation rate. Irrigation rates may decrease in years with higher rainfall, or may increase during droughts, as natural precipitation makes up more or less of the total water demand of the crop.

Table 3-10. Agricultural Water Use in the Upper Feather River IRWM Plan Area

Crop	2010 DWR (ac.)[1]	Irrigation Rate (AF/ac.)[1]	Annual Water Use (AF)	2011 Plumas/Sierra (ac.)[2]
Grain	9,117	2.68	24,434	6,260[3]
Alfalfa	8,143	2.67	21,742	7,290
Irrigated Pasture	44,230	3.10	137,113	46,450
Truck Crops	75	2.30	1,725	--
Apples, apricots, cherries, figs, walnuts, etc.	18	3.14	57	--
Citrus, dates, avocados, olives, etc.	82	2.39	196	--
Vineyard	13	2.12	28	--
Total	61,678	--	185,295	60,000

[1]Source: DWR Agricultural Land and Water Use Estimates: http://www.water.ca.gov/landwateruse/anaglwu.cfm

[2]Source: Plumas County. Agriculture Commissioner 2011 Annual Crop Report

[3]Ibid. The report lists grain hay and meadow hay as separate categories, and includes "grain" in miscellaneous crops. For this analysis, grain hay and meadow hay are assumed to be equivalent to "grain" in the DWR reports, as the total acreage is similar.

3.5.7.3 Environmental Water Demands

Environmental waters are waters set aside or managed for environmental purposes that cannot be put to use for other purposes in locations where the water has been reserved or otherwise managed. The California Water Plan Update Bulletin 160-98 defines environmental water as the sum of the following:

1. Dedicated flows in state and federal Wild and Scenic Rivers,
2. Instream flow requirements established by water right permits, CDFW agreements, court actions, or other administrative documents,
3. Bay-Delta outflows as required by SWRCB, and
4. Applied water demands of managed freshwater wildlife areas.

Though it is important to recognize environmental uses as components of total water use, specific data for water rights, Bay-Delta outflow, and applied water demand for managed freshwater wildlife areas are not quantified in this document. Although more than 1,000 irrigation water rights or applications occur in the watershed, their volume, point of diversion, specified use, and timing of use are not quantified in this document. Without this knowledge a comprehensive environmental water demand forecast cannot be calculated. The Bay-Delta outflows will not be examined because the downstream terminus of the Plan Area is Lake Oroville; and although water from Lake Oroville is dedicated to the Bay-Delta, it is part of a forecast for the Lower Feather River Watershed and, thus, is not a part of the Upper Feather River Watershed environmental demand forecast. Finally, none of the five freshwater wetland areas in the Sacramento River Hydrologic Region are in the Plan Area. Environmental water demand presented in this chapter will focus primarily on the dedicated flows in the Middle Fork of the Feather River, which has been designated as a federal Wild and Scenic River, and on the instream flow requirements for the Feather River.

In California, flows in Wild and Scenic Rivers constitute the largest environmental water use. Designated flows for Wild and Scenic Rivers are available to downstream users. Approximately 78 miles of the Middle Fork of the Feather River in the UFR IRWM Plan Area is designated a Wild and Scenic River. Once Middle Fork Feather River water flows into Lake Oroville, it is available for other uses. In 1995, the DWR calculated the water demand for Middle Fork Feather River as 1,192 AF per year in an average year and 497 AF per year in a drought year. The DWR projected that the same flows will be available to the Middle Fork Feather River in 2020.

Instream flow is the water maintained in a stream or river for beneficial uses such as fisheries, wildlife, aesthetics, recreation, and navigation. Instream flow is a major factor that influences the productivity and diversity of California's rivers and streams. It is difficult to forecast future regulatory actions and agreements that could change existing instream flow requirements. Thus, for this environmental demand forecast, only the projected instream flow requirements for the Feather River that were calculated by the DWR are presented. The DWR states that their calculations are "simplifications of reality," as their approach undercounts applied instream flow requirements on streams having multiple requirements, such as the Feather River. The DWR calculated that the instream flow requirements of the Feather River in 1995 were 880 AF per year in an average year and 588 AF per year in a drought year. The DWR projects that the same instream flow will be required in 2020.

3.6 Water-Related Infrastructure

3.6.1 Surface Water Infrastructure

The City of Portola and Crocker Mountain receive surface water from Lake Davis. Additionally, the town of Greenville has the option to utilize surface water from Round Valley Reservoir. Local public agencies are responsible for these systems (City of Portola, Grizzly Lake Community Services District, and Indian Valley Community Services District, respectively).[51]

The State Water Project depends on a complex system of dams, reservoirs, power plants, pumping plants, canals, and aqueducts to deliver water to users (see Section 3.6.1.2 State Water Project for more detail).

3.6.1.1 Dams and Reservoirs

Major water-related infrastructure includes SWP storage facilities, along with the SWP's Grizzly Valley Pipeline running from Lake Davis to the City of Portola.[52] Additionally, the USFS operates five dams, and several small dams are owned and operated by private individuals. Altogether, there are 40 dams and diversions in the Plan Area (Table 3-11), not including the small diversion dams and points of diversions throughout the region.

The Department of Water Resources and PG&E have significant facilities in the region with a number of implications for water supply and water quality. Under the Monterey Settlement Agreement, DWR has agreed to deliver SWP water to the Plumas County Flood Control District based on the availability of water in Lake Davis, regardless of the annual statewide allocation percentage for SWP deliveries. DWR also agreed to confer with the Plumas County Flood Control District to develop strategies and actions for

[51] Plumas Co. 2009. p. 30.
[52] Ibid., p. 19.

the management, operation, and control of SWP facilities in Plumas County in order to increase water supply, recreational, and environmental benefits to Plumas.[53]

Table 3-11. Dams and Diversions in the Upper Feather River IRWM Plan Area

Dam Name	Owner	County	Stream	Capacity (AF)	Height (ft)	Year
Antelope	DWR	Plumas	Indian Ck	22,566	113	1964
Bidwell Lake	Private	Plumas	No Canyon Ck	5,200	35	1865
Bucks Diversion	PG&E	Plumas	Bucks Ck	5,843	99	1928
Bucks Storage	PG&E	Plumas	Bucks Ck	10,300	122	1928
Butt Valley	PG&E	Plumas	Butt Ck	49,800	84	1924
Caribou Afterbay	PG&E	Plumas	North Fork	2,400	164	1959
Chester Diversion	Sac-SJ Rec Board	Plumas	North Fork	75	47	1975
Concow	Thermalito Table Mtn ID	Butte	Concow Ck	6,370	94	1925
Cresta	PG&E	Plumas	North Fork	4,400	103	1949
Eureka	DPR	Plumas	Eureka Ck	220	29	1866
Faggs Debris	USFS	Plumas	Tr. Willow Ck	50	10	1900
Forbestown Diversion	South Feather Water and Power	Butte	South Fork	358	99	1962
Frenchman	DWR	Plumas	Last Chance Ck	55,477	129	1961
Grizzly Creek	Private	Plumas	Big Grizzly Ck	140	39	1915
Grizzly Creek	Private	Butte	Grizzly Ck	76	50	1964
Grizzly Forebay	PG&E	Plumas	Grizzly Ck	1,112	92	1928
Grizzly Valley	DWR	Plumas	Big Grizzly Ck	83,000	115	1966
Indian Ole	PG&E	Lassen	Hamilton Ck	24,800	26	1924
Jamison Lake	USFS	Plumas	Little Jamison Ck	300	15	1902
Lake Almanor	PG&E	Plumas	North Fork	1,308,000	130	1927
Lake Madrone	Lake Madrone Water District	Butte	Berry Ck	200	35	1931
Little Grass Valley	South Feather Water and Power	Plumas	South Fork	93,010	210	1961
Long Lake	Graeagle Water Co	Plumas	Gray Eagle Ck	1,478	12	1938
Lost Creek	South Feather Water and Power	Butte	Lost Ck	5,680	122	1924
Lower Three Lakes	PG&E	Plumas	Milk Ranch Ck	606	32	1928
Lundy Ditch	Plumas Pines Golf Course	Plumas	Jamison Creek			
Oroville	DWR	Butte	Feather River	3,537,577	742	1968
Palen	Private	Sierra	Antelope Ck	146	25	1951
Philbrook	PG&E	Butte	Philbrook Ck	5,180	85	1926
Poe	PG&E	Butte	North Fork	1,150	62	1959
Ponderosa Diversion	South Feather Water and Power	Butte	South Fork	4,750	157	1962

[53] Ibid., p. 30.

Dam Name	Owner	County	Stream	Capacity (AF)	Height (ft)	Year
Rock Creek	PG&E	Plumas	North Fork	4,660	120	1950
Round Valley	PG&E	Butte	West Branch	1,147	30	1877
Silver Lake	Soper-Wheeler Co	Plumas	Silver Ck	650	21	1906
Sly Creek	South Feather Water and Power	Butte	Lost Ck	65,050	271	1961
Smith Lake	USFS	Plumas	Wapanusie Ck	400	14	1909
Snag Lake	USFS	Sierra	Tr. Salmon Ck	106	8	1885
South Fork Diversion	South Feather Water and Power	Plumas	South Fork	88	70	1961
Spring Valley Lake	CDFW	Plumas	Rock Ck	75	11	1979
Taylor Lake	USFS	Plumas	Tr. Indian Ck	380	14	1929
Walker Mine Tailings	USFS	Plumas	Dolly Ck	1,200	30	unk

aESF, 2005, p. 4-29. Available: http://www.feather-river-crm.org/pdf/MOU/IRWMP_063005.pdf, p. 4-19

3.6.1.2 Hydroelectric Infrastructure

The other most notable infrastructure is PG&E's Stairway of Power, a series of ten hydroelectric projects on the North Fork of the Feather River stretching from Lake Almanor to Lake Oroville (Figure 3-10).[54] The East Branch of the North Fork of the Feather River serves over 4.36 million electrical customers through its hydroelectric facilities. Lake Almanor is a very popular water-based recreation destination in the West.

The PG&E operations in the Upper Feather River Region are governed largely by the terms of licenses issued by the Federal Energy Regulatory Commission. A settlement agreement and the license were completed for Project 1962 (Rock Creek/Cresta) in 2000, and a settlement agreement was completed for Project 2105 (Lake Almanor) in 2004. The license for Lake Almanor is currently under review by the State Water Resources Control Board for purposes of a Clean Water Act Section 401 water quality certification. Licenses for Project 2107 (Poe), Project 2088 (South Feather) and Project 2100 (Oroville) are also pending, and Project 619 (Bucks Lake) began relicensing in 2012.[55]

The settlement agreements for FERC Projects No. 1962, No. 2100, No. 2107, and No. 2105 are included as some of the underlying "mandatory plans" in the 2005 IRWM Plan. The FERC Project No. 1962 license established an Ecological Resources Committee (ERC), whose members serve as an adaptive management committee for license implementation in the central portion of the Feather River Canyon. Participants in the ERC meetings have typically included PG&E, the USFS, Plumas County, the CDFW, federal wildlife and fishery agencies, American Whitewater, local water recreation and trails groups, the California Sportfishing Protection Alliance, and the SWRCB. Many of these parties were also involved in the FERC No. 2100, No. 2105 licensing collaborative discussions and the FERC No. 2107 relicensing. Now they are actively engaged in the relicensing of the Bucks Lake Project (FERC No. 619).[56] Tribal representation was particularly important in the latter proceedings as tribes established their connections and asserted their land and water rights in the project-affected areas.

[54] Plumas Co. 2009. p. 19.
[55] Ibid., p. 30.
[56] Ibid., p. 31.

Related to PG&E operations, the Pacific Forest and Watershed Lands Stewardship Council[57] (Stewardship Council) is in the process of divesting PG&E lands that are not needed for hydroelectric operations by developing land conservation and management plans. The Bucks Lake Planning Unit in the Feather River Region was one of four "pilot projects" in which the Stewardship Council sought to refine its process. Six entities--Plumas National Forest, Plumas County, Greenville Rancheria, Enterprise Rancheria, Plumas Corporation, and Feather River Land Trust--submitted statements of qualification and were approved as qualified recipients to potentially receive watershed lands in fee title or to hold a conservation easement over the planning unit. Ultimately, one collaborative land conservation proposal was submitted jointly by Plumas County, Greenville Rancheria, and Enterprise Rancheria. The proposal is currently under review by the Stewardship Council.[58]

The Stewardship Council began work on the Lake Almanor, Mountain Meadows, Butt Valley, and Humbug Valley planning units in 2009. Plumas County is involved with PG&E and the Council in coordinating stakeholder meetings to identify interests and issues among a number of parties, including the Maidu Summit Consortium, the federally recognized Susanville Indian Rancheria and the Greenville Rancheria, individual Maidu leadership, the USFS, the Department of Fish and Wildlife, the Mountain Meadows Conservancy, and the Feather River Land Trust.

3.6.1.3 State Water Project

The Upper Feather River Region is the headwaters for the State Water Project, providing 3.2 million AF annually of high-quality water for irrigation, drinking water, recreation, fisheries, and energy.

The SWP depends on a complex system of dams, reservoirs, power plants, pumping plants, canals, and aqueducts to deliver water to users more than 500 miles away from this headwaters region for Lake Oroville (see Section 3.6.1.1) (Figure 3-10). The SWP infrastructure in the Feather River Watershed begins with Lake Davis, Frenchman Lake, and Antelope Lake, three small lakes on Feather River tributaries. The branches and forks of the Feather River flow into Lake Oroville and then through a complex system of power plants, down the Feather River into the Sacramento River to the Sacramento-San Joaquin Delta. In the north Delta, some water is pumped into the North Bay Aqueduct to supply Napa and Solano counties. Flows also feed the South Bay Aqueduct to serve Alameda and Santa Clara counties. The remaining water flows into the California Aqueduct to serve communities in Southern California.

Lake Oroville, created by the three major forks of the Feather River, is the largest of the SWP's storage facilities, with a storage capacity of 3.5 million AF of water/yr. The East Branch, North Fork of the Feather River, which is contained completely within the region, provides 25 percent of SWP water, which provides 48 percent of the developed municipal and industrial surface water supplies in California.

[57] The Pacific Forest and Watershed Lands Stewardship Council is a private, nonprofit foundation that was established in 2004 as part of a Pacific Gas and Electric Company (PG&E) settlement.
[58] Ibid., p. 31

Figure 3-10 Map of State Water Project facilities and hydroelectric projects

3.6.1.4 Flood Management Infrastructure

Flood control infrastructure in the region is owned by either PG&E or the DWR and is typically managed as part of operations related to hydroelectric generation and water storage facilities. Facilities include Lake Almanor, the Stairway of Power dams in the Feather River canyon that culminate in Lake Oroville, and Oroville Dam itself in the lowermost portion of the region.

A separate facility, the Chester Flood Control Channel, was constructed by the Army Corps of Engineers to address concerns over flood control in Chester. Known locally as the “super ditch,” it is located along Highway 36 and diverts excess water around Chester and directly into Lake Almanor. Another flood management infrastructure in the region consists primarily of culverts to address localized roadway flooding.

3.6.2 Groundwater Infrastructure

Municipal water supplies are based primarily on groundwater sources, which are managed by a number of local special districts (CSDs, PUDs), small private water systems, and individual well owners (Table 3-2).[59]

3.6.3 Wastewater Infrastructure

Most of the population is located in the larger communities that have community wastewater systems. The largest exception is the community of Graeagle which relies upon septic tanks. Septic tanks are also used by dispersed populations living outside the main communities.

Recent developments, such as those served by the Grizzly Ranch Community Services District and the Walker Ranch Community Services District, are designed to recycle wastewater for irrigation purposes.

3.7 Water Quality

3.7.1 Water Quality Regulations

Water resources in the Plan Area are subject to federal and state regulations (Table 3-12).

Table 3-12. Summary of Applicable Regulations for Water Resources in the Upper Feather River IRWM Plan Area

Regulation	Summary
Federal:	
Executive Order 11988	Local governments under this order are required to pass and enforce a floodplain management ordinance that specifies minimum requirements for construction within 100-year flood plains.
Clean Water Act	Establishes basic structure for regulating discharges of pollutants into “waters of the United States.” Administered by the U.S. Army Corps of Engineers.
Clean Water Act Section 303 (d) Impaired Waters List	Requires that States establish Total Maximum Daily Load (TMDL) for listed pollutants originating from point and nonpoint sources and requires levels of treatment to achieve compliance with water quality objectives.

[59] Plumas Co. 2009. p. 30.

Regulation	Summary
Safe Drinking Water Act	Ensures safe drinking water for the public.
State:	
California Department of Water Resources (DWR), Division of Safety of Dams	Places responsibility for the safety of non-federal dams and reservoirs under the jurisdiction of DWR.
Porter-Cologne Water Quality Control Act	Requires that regional water quality control boards establish water quality objectives while acknowledging that objectives may be changed as long as present and anticipated beneficial uses are not unreasonably impacted and water quality reduced.
State Water Resources Control Board	Established by the State Legislature, has authority over water resources allocation and water quality protection within the state. Note: Some water rights in the region have been established by court decree.
Central Valley Regional Water Quality Control Board	Authorized by the Porter-Cologne Act, the Central Valley RWQCB protects the quality of the waters within its jurisdiction for all beneficial uses. Plumas County is within the Central Valley RWQCB.
NPDES General Permit for Discharges of Stormwater Associated with Construction Activities	Requires a General Construction Permit and implementation of a Stormwater Pollution Prevention Plan (SWPPP) for construction activities of 1 acre or more of land.

Water quality concerns are identified when monitoring data exceeds the standards set to protect beneficial uses. Some stream segments are listed as “impaired” by various contaminants. Impairment means that a standard of water quality for beneficial uses (for example, as a source of drinking water or for recreation or industrial use) is not being met. The federal Clean Water Act requires states to maintain a listing of impaired water bodies for the purpose of establishing Total Maximum Daily Loads (TMDLs). A TMDL is a calculation of the maximum amount of a pollutant that a waterbody can receive and still meet water quality standards, and an allocation of that load among the various sources of that pollutant.

3.7.1.1 Potable Water

Potable water supplies in the Feather River Watershed come from both surface and groundwater, with the majority from surface water. During drought years, additional groundwater is pumped to compensate for reduced surface water supplies. In Sierra County, a majority of supply water is from surface sources (94 percent).

Groundwater sources, both privately owned and publicly operated, occur mostly in the valleys on the east side of the Sierra Crest. Sierra Valley, the largest valley in the watershed, contains a large aquifer (DWR Bulletin 118) as a medium priority groundwater basin subject to compliance with the recent sustainable groundwater management legislation.

State Water Project water sources comprise a large part of supplied water for the Plan Area[60] with the Feather River Watershed supplying 3.2 million AF per year for downstream urban, industrial, and agricultural use. Lake Oroville is the largest of the SWP’s storage facilities, with a storage capacity of 3.5 million AF of water per year; it provides 48 percent of the developed municipal and industrial surface

[60] ESF. 2005. p. 4-27.

water supplies in California.[61] The East Branch North Fork Feather River alone, which is contained completely in Plumas County, provides 25 percent of SWP water.

3.7.1.2 Wastewater Discharge

Wastewater service in the region is addressed in several ways including on-site septic systems, community septic systems, and community wastewater treatment plants. Public wastewater and sewer system needs have been developed for various districts in the region. All of the region's treatment plants, including those operated by municipalities or wastewater management districts, are regulated under a permit issued by the RWQCB.

The Clean Water Act established the basic structure for regulating discharges of pollutants into "waters of the United States." The act specifies a variety of regulatory and non-regulatory tools to sharply reduce direct pollutant discharges into waterways, finance municipal wastewater treatment facilities, and manage polluted runoff. Sections 303 and 304 provide for water quality standards, criteria, and guidelines.

- Section 401 requires every applicant for a federal permit or license for any activity that may result in a discharge to a water body to obtain a water quality certification that the proposed activity would comply with applicable water quality standards. Through the Waste Discharge Requirements (WDR) Program, the SWRCB regulates point discharges that are exempt from the Federal Water Pollution Control Act through issuance of NPDES permits for wastewater treatment system discharges.
- Section 402 regulates point- and nonpoint-source discharges to surface waters through the National Pollutant Discharge Elimination System (NPDES) program. In California, the State Water Resources Control Board (SWRCB) oversees the NPDES program, which is administered by the RWQCBs. The NPDES program provides for both general permits (those that cover a number of similar or related activities) and individual permits. Anti-backsliding requirements provided for under CWA Sections 402(o) (2) and 303(d) (4) prohibit slackening of discharge requirements and regulations under revised NPDES permits. With isolated/limited exceptions, these regulations require effluent limitations in a reissued permit to be at least as stringent as those contained in the previous permit.
- Section 404 of the CWA establishes a program to regulate the discharge of dredged and fill material into waters of the U.S., including some wetlands. Activities in waters of the U.S. that are regulated under this program include fills for development, water resource projects (e.g., dams and levees), infrastructure development (e.g., highways and airports), and conversion of wetlands to uplands for farming and forestry.

3.7.2 Current Water Quality Conditions

3.7.2.1 Surface Water

Overall, water quality in the Plan Area is considered good; however, most of the main stem(s) of the Feather River are currently on the Clean Water Act 303 (d) list of impaired waters (listed constituencies include copper, zinc, polychlorinated biphenyls (PCBs), temperature and toxicity; Table 3-13).[62] Impaired waters include the North Fork from Lake Almanor to Lake Oroville, the Middle Fork from Sierra Valley to Lake Oroville, and the South Fork from Little Grass Valley Reservoir to Lake Oroville. Water quality constituents of general concern include temperature, sediment, and bacteria, with most impacts resulting

[61] Ibid., p. 4-28.

[62] State Water Resources Control Board, 2010. 2010 California 303(d) List of Water Quality Limited Segments: Category 5. Available at: http://www.waterboards.ca.gov/water_issues/programs/tmdl/2010state_ir_reports/category5_report.shtml

from a variety of common land and water use practices (i.e., mining, ranching, timber harvest, road construction/maintenance and residential development). Erosion is also a legacy factor which can impact surface water quality, on the north, intermountain, and eastern portions of the Plan Area more than the western foothills.[63] Legacy methyl-mercury contamination of fish and wildlife originating from the Gold Rush in hydroelectric and SWP reservoirs is of special concern for tribes, Audubon Society members, and the Water Boards. A Mercury TMDL proceeding is planned for the region during the next five to ten years.

Table 3-13. Impaired Waters in the Upper Feather River IRWM Plan Area (Clean Water Act Section 303(d))[59]

Water Body	Pollutant (Source)	Total Maximum Daily Load (TMDL) Schedule
Little Grizzly Creek	Copper (Mill Tailings) Zinc (Mill Tailings)	Est. TMDL Completion: 2020
Fall River, Tributary to Feather River, Middle Fork	Unknown Toxicity (Source Unknown)	Est. TMDL Completion: 2021
Feather River, North Fork (below Lake Almanor)	PCBs, Temperature, Unknown Toxicity	Est. TMDL Completion: 2021
Feather River, Middle Fork (Sierra Valley to Lake Oroville)	Unknown Toxicity (Source Unknown)	Est. TMDL Completion: 2021
Feather River, South Fork (Little Grass Valley Reservoir to Lake Oroville)	PCBs and Unknown Toxicity (Sources Unknown)	Est. TMDL Completion: 2021

3.7.2.2 Groundwater Quality and Water Quality from Storage Facilities

The review of groundwater quality for the vulnerability analysis focuses on nitrate, salinity, and pesticides. Other constituents of concern are reviewed as necessary, based on documented occurrences. In the Sierra Valley, "the poorest quality groundwater is found in the central west side of the valley where fault-associated thermal waters and hot springs yield water with high concentrations of boron, fluoride, iron, and sodium. Several wells in this area also have high arsenic and manganese concentrations" (DWR 2003). In this subwatershed, groundwater quality impacts, when they occur, tend to be linked to natural geologic conditions, and not so much from agricultural impacts, due to low irrigation and fertilizer and pesticide inputs. In addition, population is sparse, and impacts due to septic systems are not expected.[64]

Lowering of summer water tables and depletion of shallow aquifers can be consequences of headcutting in streams throughout the Region where increased incision of streams in channels become hydrologically isolated from their historic floodplains. Poor retention of precipitation occurs when headcutting lowers water tables. When vegetation changes to more xeric types, active rehabilitation work on streams may restore water tables and shallow aquifers when headcutting is reversed and as riparian and upland vegetation recovers.

[63] Plumas County. 2012. *2035 Plumas County General Plan Update Draft EIR*, pp. 4.6-8. Available at: http://www.countyofplumas.com/index.aspx?NID=2248.
[64] Northern California Water Association, 2014. *Sacramento Valley Water Quality Coalition Groundwater Quality Assessment Report, June:* Pg 17-4. Available at: http://www.svwqc.org/wp-content/themes/svwqc-2015/docs/groundwater-quality-assessment-report.pdf.

However, a few portions of the Region are experiencing dry-year depletions of groundwater systems as a result of continued extraction and reduced recharge during drought periods. In these areas, a more holistic approach to integrating surface and groundwater and land management practices is being recognized and tested during in lower precipitation years. Sierra Valley is an example of a high desert groundwater basin, developed for agriculture in the late 1800s. Collection of groundwater data started in the late 1980s, which indicated the basin experienced periodic drought depletions that more recently, only partially recover during wet periods. Prior to the end of the 1970s most groundwater use in the valley was stock water from artesian wells. In the 1980s, many deep, large capacity irrigation wells were developed to grow alfalfa and hay crops. Significant groundwater declines have developed in the most heavily pumped areas during the last decade of intensifying drought. Since its inception in 1980, the Sierra Valley Groundwater Management District has monitored groundwater levels and installed flow meters to monitor pumping on all wells in the valley pumping 100 gpm or more. In order to manage the drought depletions, enhancement of upland and historic flood recharge areas on the valley floor are being investigated.

Nitrates

The Upper Feather River watershed NO_3 analysis is based on a review of the concentration of the most recent sampling at each well from 348 wells located in this watershed and for which records were readily available. Three percent of most recent wells had nitrate values above half the maximum contaminant level (MCL), while 1 percent of wells had nitrate values exceeding the primary MCL of 45 mg/L. The average concentration is 3.5 mg/L, well below half the MCL. It should be noted that these wells are not necessarily restricted to irrigated agricultural areas, but represent the general water quality of groundwater in the entire watershed.[65]

The Upper Feather River watershed has almost no MCL exceedances of nitrate and TDS, and those that have been detected are not linked to irrigated agricultural impacts. There have been no reported issues of nitrate and TDS in this watershed, and other constituents of concern are generally linked to natural subsurface conditions. High vulnerability areas are considered the areas that have high nitrate and/or salinity with increasing trends in concentrations. The well sampling data generally show low nitrate and TDS concentrations even though the hydrogeologic susceptibility is high, the effective exposure to agronomic sources is very low. This, when combined with the good groundwater quality found in the alluvial basins, suggests that the UFR watershed has a low well water vulnerability under existing land and water management conditions for all basins.[66]

Nitrate may be present in groundwater from runoff and leaching from fertilizer use; leaching from septic tanks and sewage; erosion of natural deposits[67]. The reporting standard for nitrate (as N) in drinking water changed in 2015, so it is important to distinguish between nitrate concentrations, the reporting standards, and the Maximum Contaminant Levels (MCLs). The drinking water MCL is 10.0 mg/L. The old reporting standard for Nitrate (as NO3) with a MCL of 45 mg/L ended in December 2015. Different ways of reporting the same constituent is not a lowering of the MCL.

Historically, only a few wells reported nitrate concentrations over the MCL, including a commercial well in Chilcoot and a commercial well in Beckwourth. The Chilcoot well was of unknown age and construction and was located closer to a leachfield than is allowed by current Plumas County regulations. This well has

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[65] Ibid.

[66] Ibid. pg 17-6.

[67] CA Water Board Consumer Confidence Report website.

since been taken out-of-service and a new well has been installed that meets the current construction standards and separation distances from leachfields. The replacement well has not exceeded the MCL.

Similarly, the Beckwourth well was destroyed and replaced with another well due to contamination in 2001. This elevated nitrate level may have been due to the proximity of the well to a sewer line. With this community on sanitary sewer, it seems likely this nitrate exceedance was localized in scope.[68]

The only other area which has reported nitrate concentrations at 50 percent of the MCL is East Quincy in 2009. Again, with this system on sewer and no recent detections over 50 percent of the MCL, this does not seem to be a persistent or regional issue.

Appendix 10-1 of the Plan contains a community vulnerability study that provides a methodology for assessing the nitrate pollution risks for disadvantaged communities within high groundwater areas, and applies the "DRASTIC" approach to four communities in the Sierra Valley. The DRASTIC well vulnerability assessment approach is most useful where limited data do not indicate whether a more regional nitrate problem could emerge in the future in a groundwater pollution vulnerable area if current water and land management practices change.

Arsenic

Low concentrations of arsenic are present in groundwater throughout the region. Arsenic is thought to be from naturally occurring sources in Plumas County[69]. Plumas County Environmental Health is aware of three public water systems in Plumas County that have confirmed arsenic levels above the MCL for drinking water: The City of Portola, Plumas Eureka CSD near Blairsden, and Grizzly Ranch CSD near Beckwourth. Additionally, Calpine in Sierra County is responding to an Abatement Order for arsenic in its community well.

In addition, the following areas in the county have concentrations that equal or exceed 50 percent of the arsenic maximum contaminant levels (MCL): Beckwourth, Belden, Blairsden, Chester, Clio, Crescent Mills, Cromberg, Delleker, Hamilton Branch, Humbug Valley, Johnsville, La Porte, Lake Davis, Maybe, Portola, Twain, Vinton, & West Almanor.[70]

Perchlorate

Perchlorate is an inorganic chemical used in solid rocket propellant, fireworks, explosives, flares, matches, and a variety of industries. It usually gets into drinking water as a result of environmental contamination from historic aerospace or other industrial operations that used or use, store, or dispose of perchlorate and its salts. To date there are no known detections of Perchlorate in Plumas County.[71]

Hexavalent Chromium

Hexavalent Chromium may be present in groundwater as a result of discharge from electroplating factories, leather tanneries, wood preservation, chemical synthesis, refractory production, and textile manufacturing facilities; as well as erosion of natural deposits.[72] There are a few water sources in Plumas County with trace amounts of Hexavalent Chromium found in drinking water. These systems are located

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[68] Sipe, Jerry. 2016. Plumas County Environmental Health. Personal correspondence. March 8.
[69] CA Water Board Consumer Confidence Report website
[70] Sipe, Jerry. 2016. Plumas County Environmental Health. Personal correspondence. March 8.
[71] Ibid.
[72] Source CA Water Board Consumer Confidence Report website.

across Plumas County and include Chester, Clio, Portola, Lake Almanor Peninsula, Greenville, & Cromberg. The range of detections are from 0.28 ug/L up to 1.9 ug/L. These are well below the MCL for Hexavalent Chromium which is 10 ug/L.[73]

3.7.2.3 Wastewater and Recycled Water Quality

All of the region's treatment plants, including those operated by municipalities or wastewater management districts, are regulated under a permit issued by the RWQCB. However, individual septic systems serving individual residences also have the potential to impact water quality. The individual systems are of particular concern in areas where historical development has resulted in a high concentration of older septic systems that may not have been designed and constructed using current standards or that are not regularly maintained or upgraded. Additionally, nitrate contamination of groundwater is a concern, especially in areas of permeable soils and relatively shallow groundwater. The SWRCB adopted a water quality control policy in 2012, which defines criteria for siting, design, operation, and maintenance of onsite wastewater treatment systems.[74]

Recycled water in the region is used primarily to irrigate golf courses. Recycled water is treated to industry standards prior to application.

[73] Sipe, Jerry. 2016. Plumas County Environmental Health. Personal correspondence. March 8.
[74] SWRCB, 2012. *Water Quality Control Policy for Siting, Design, Operation, and Maintenance of Onsite Wastewater Treatment Systems*, June 19. Available at: http://www.waterboards.ca.gov/water_issues/programs/owts/docs/owts_policy.pdf