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9.0 RIPARIAN RESOURCES

This section describes the riparian and meadow habitat along the bypass and peaking reaches, and reservoirs associated with the Middle Fork American River Project (MFP or Project). The content requirements for this section are specified in Title 18 of the Code of Federal Regulations (CFR) Chapter 1 § 5.6(d)(3)(vi).

This section provides an overview of the riparian and meadow resources along the bypass and peaking reaches, and reservoirs associated with the MFP, including a description of the existing woody riparian community distribution patterns, composition, and age class structure. In addition, historical events that potentially influence the existing riparian communities and distribution patterns, and temporal trends in riparian distribution are discussed.

For reference, riparian ecosystems are located in transitional areas between the aquatic and terrestrial landscapes regularly influenced by fresh water, and normally extend from the edges of waterbodies, including lakes and streams, to the edges of the upland communities. The term 'riparian' or 'riparian zone', as referred to in this section, includes the stream bars and banks and the areas adjacent to the channel that are inundated or saturated by the historic dominant discharge every one to three years. The riparian plant community generally transitions into an upland community when the riparian community patterns are no longer controlled by the stream hydrologic conditions, including water table elevations and overbanking flows. Riparian vegetation may also occur around water bodies, such as reservoirs. Meadows are found in moist areas that are typically seasonally or temporarily flooded.

The information presented in this section is based on data available in existing published literature and on new information developed by Placer County Water Agency (PCWA) as part of field studies conducted in 2005 and 2006, as described in the following.

9.1 INFORMATION SOURCES

Existing information regarding the riparian and meadow communities along the bypass and peaking reaches and surrounding the reservoirs associated with the MFP was collected, compiled and reviewed. Existing information sources that were examined included published reports associated with previous studies, geographic information system (GIS) data, historic and recent aerial photography, and management plans and policies that describe desired conditions for riparian systems. In general, most of the existing studies and reports provide only brief qualitative descriptions of riparian vegetation along the bypass and peaking reaches associated with the MFP. Specific information that was examined is identified in the following:

Previously Published Study Reports

- Ayres Associates. 1997. Report. American and Sacramento River, California Project. Geomorphic, Sediment Engineering, and Channel Stability Analyses. Prepared for U.S. Army Corps of Engineers.
- California Department of Fish and Game. 1979. Rubicon River Wild Trout Management Plan.
- County of Placer. 2004. Report of the Science Advisors, for the Placer County Natural Communities, Conservation and on Plan and Habitat Conservation Plan; Planning Principles, Uncertainties, and Management Recommendations.
- El Dorado County. 2001. El Dorado County River Management Plan Update, DRAFT - Environmental Impact Report. Parks and Recreation River Management Plan.
- Eldorado National Forest Georgetown Ranger District. 1973a. Rubicon River Stream Survey from Lawyer's Trail to 2 Miles Downstream.
- Eldorado National Forest Georgetown Ranger District. 1973b. Stream Survey, Rubicon River.
- Eldorado National Forest Georgetown Ranger District. 1973c. South Fork Long Canyon Creek Stream Survey from Blacksmith Flat Footbridge to National Forest Boundary.
- Eldorado National Forest Georgetown Ranger District. 1976a. Rubicon River Stream Survey near Big Grizzly Canyon.
- Eldorado National Forest Georgetown Ranger District. 1976b. Rubicon River Stream Survey Lawyer's Trail Crossing to Ralston.
- Eldorado National Forest Georgetown Ranger District. 1979. Environmental Assessment South Fork Long Canyon Creek.
- Gaos, A., and M. Bogan. 2001. A direct observation survey of the Lower Rubicon River. DFG Scientific Aides.
- Placer County Planning Department. 2003. Recognized Aquatic and Wetland Resources in Western Placer County, California. Prepared by North Fork Associates.
- PCWA. 2002. Duncan Canyon/Long Canyon Paired Watershed Study. Prepared by WRC Environmental.
- Scott, K. M., and G. C. Gravlee. 1968. Flood surge on the Rubicon River, California - Hydrology, Hydraulics, and Boulder Transport. U.S. Geological Survey, Professional Paper 422-M, Washington D.C.
- United States Department of Agriculture-Forest Service, Tahoe National Forest, Foresthill Ranger District. 2003. Middle Fork American River Watershed Assessment.

- Wilderness Conservancy. 1989. The American River - A Recreation Guide Book. Protect American River Canyons, Auburn, California.

Geographic Information System (GIS) Data

PCWA obtained GIS data from various sources, including the Eldorado National Forest (ENF) and the Tahoe National Forest (TNF). This information was reviewed for date of data collection or analyses, completeness of data record and metadata, quality and reliability of the data, and relevance to riparian resources in the bypass and peaking reaches, and reservoirs associated with the MFP. Available electronic data that may be relevant to riparian resources is summarized in Table 9-1. This table also identifies GIS data files developed as part of the riparian studies conducted by PCWA in 2005 and 2006.

Aerial Photography

Recent and historical aerial photographs were obtained to document existing and pre-Project riparian and meadow coverage, and to evaluate other resources. Three sets of historic aerial photography taken prior to construction of the MFP and one set of more recent aerial photography were obtained and reviewed (see Section 8.0, Geomorphology, Table 8-1).

9.2 RECENT STUDIES

During 2005 and 2006, PCWA conducted riparian habitat mapping studies as outlined in the 2005-2006 Existing Environment Study Plan (PCWA 2005) and 2006 Geomorphology and Riparian Habitat Characterization Study Plan (PCWA 2006a). These study plans were developed in consultation with the resource agencies and are provided in Supporting Document G (SD G) for reference. These studies focused on collecting data to describe the general distribution of riparian vegetation along the bypass and peaking reaches, reservoirs, and diversions, and to characterize the communities at specific study sites along the stream banks, bars, and floodplains, as summarized in the following.

During 2005, the riparian community was mapped and described at a landscape-scale, including the general distribution of the dominant species and age classes of the dominant woody riparian species. A combination of aerial photography, low altitude aerial video developed specifically for the MFP, helicopter surveys, and ground surveys were used to characterize the riparian vegetation. Riparian vegetation was mapped along the bypass and peaking reaches from the low water's edge to hillslope or valley walls and along the perimeters of the reservoirs. All riparian and meadow habitats that are or were historically connected by surface waters were mapped. The 2005 study methods and results are documented in PCWA's 2005 Physical Habitat Characterization Study Report (PCWA 2006b), which is provided in SD G for reference.

During 2006, data was collected at a smaller, reach scale, and focused on characterizing species distributions at specific study sites, including subdominant woody

species and herbaceous species, across the riparian zone from the stream margins to the side slopes and along the stream bank. The riparian communities were characterized using ground surveys. Data was collected across the riparian zone and along the stream banks using line-intercept surveys and vegetation plots along surveyed transects from the water's edge to the hillslopes or valley walls and greenline surveys of vegetation composition and age classes along the stream banks. Tree cores were also collected and a sub-sample was dated at selected locations on the Rubicon River and the Middle Fork American River in the peaking reach. Recent and historical aerial photographs were used to document existing and historical riparian and meadow coverage. The 2006 study methods and results are described in detail in PCWA's 2006 Physical Habitat Characterization Study Report (PCWA 2007), which is included in SD G for reference.

Data developed as part of the 2005 and 2006 studies was used as the primary source of information presented in the remainder of this report.

9.3 OVERVIEW OF RIPARIAN COMMUNITIES AND RIVER PROCESSES

The following provides an overview of the relationships between riparian communities and river processes.

Riparian community composition and structure along streams are closely connected with fluvial processes. These physical processes, which vary with valley geology and morphology, control the development and evolution of geomorphic landforms, such as bars, along a stream. Characteristics of riparian resources are strongly related to the occurrences of these landforms.

In general, mountain streams are often stable for decades. Fluvial geomorphic and hillslope processes, including landslides and debris flows, control the spatial and temporal patterns of sediment transport and deposition and nutrient dynamics. Most of the bypass and peaking reaches associated with the MFP are moderately steep gradient and entrenched mountain streams with limited landform formation, confined by narrow V-shaped valleys. The one exception is in the Middle Fork American River downstream of Ralston Afterbay where large depositional surfaces with comparatively well-developed riparian vegetation were observed. On mountain streams with narrow valley bottoms, floodplain areas are small and poorly developed, such that the development of riparian vegetation is reduced to within close proximity of the stream. Sites for establishment of seedlings, and therefore community development, often are limited to areas that are relatively wider and lower in gradient where sediments may be deposited, such as at tributary confluences, large woody debris jams, or locations of landslides.

The riparian community at any given time reflects both the recent fluvial geomorphic regime and historic flows, as they influence the substrate, species regeneration, and individual tree survival. Riparian communities are dominated by plant species, including willows and cottonwoods, which are adapted to flooding disturbance. Many can reproduce both from seed and vegetatively, such as from underground root buds and

stem and root pieces. Regeneration and successful establishment from seed, as well as from re-sprouts, have been linked to irregularly occurring high flow events and subsequent hydrologic conditions. Seedling mortality is naturally high, as a result of scouring winter and/or summer flows, inundation of seedlings on lower geomorphic surfaces, and drought on relatively higher surfaces (Douhovnikoff et al. 2005; Dixon 2003; Chapin et al. 2002; Karrenberg 2002). As a result, the age structure of riparian communities often reflects the frequency, magnitude, and timing of flooding disturbance, as well as water availability and disturbance conditions during subsequent years.

Life history characteristics of the dominant riparian species are strong indicators of how individuals may respond to changes in water availability and flow regime. These characteristics are summarized for the dominant woody riparian species in Appendix E of the 2005 Physical Habitat Characterization Study Report (PCWA 2006b) contained in SD G.

9.4 EXISTING RIPARIAN RESOURCES ASSOCIATED WITH THE BYPASS AND PEAKING REACHES

The riparian resources along the bypass and peaking reaches are described below. These descriptions of the distribution, composition, age class structure, canopy, and health of the riparian vegetation are primarily based on information collected as part of the riparian studies conducted during 2005 and 2006 and documented in the 2005 Habitat Characterization Study Report (PCWA 2006b) and the 2006 Habitat Characterization Study Report (PCWA 2007) contained in SD G. Meadows were not observed along any of the bypass and peaking reaches or around the reservoirs surveyed in 2005 and 2006.

9.4.1 Riparian Community Distribution

The distribution of the riparian vegetation was characterized along the bypass and peaking reaches at the landscape scale and at specific study sites at a reach scale, as described below.

Landscape Scale

Along the bypass and peaking reaches, riparian vegetation occurred along approximately half of the stream lengths, except along the North and South Forks of Long Canyon Creek. Along these two creeks, riparian vegetation occurred along approximately 70% to 75% of the bypass reach. The distribution patterns of the riparian vegetation along the reaches were strongly influenced by the stream morphology.

None or sparse riparian vegetation typically occurred within the confined bedrock and boulder reaches with steep, often nearly vertical, valley walls. Sparsely distributed riparian vegetation was mapped along considerable proportions (greater than 40%) of the vegetated stream lengths on Duncan Creek, Long Canyon Creek, and the Middle Fork American River from French Meadows Dam to Middle Fork Interbay. Only a small proportion of sparse vegetation was mapped along the Rubicon River and the Middle Fork American River in the peaking reach.

Discontinuous riparian vegetation corridors occurred in reaches where vegetation is distributed along multiple relatively short reach lengths over a fairly long reach. An example of a reach where discontinuous vegetation could be mapped is where a stream irregularly meanders within steep valley walls with bedrock or boulder dominant particles sizes except for small alluvial deposits that are vegetated on the inside of the meander bends. Riparian vegetation was observed to be distributed as discontinuous corridors along less than 20% of the stream lengths on the bypass and peaking reaches, except along the Middle Fork American River bypass and peaking reaches, the North Fork American River peaking reach, and the Rubicon River.

Wide and continuous narrow corridors of riparian vegetation generally were associated with long deposits/bars or along alluvial reaches. Continuous narrow corridors of riparian vegetation were observed along considerable proportions (greater than 40%) of the vegetated stream lengths on the North Fork and South Fork of Long Canyon Creek, Long Canyon Creek, Rubicon River, and the Middle Fork American River in the peaking reach. Wide corridors of riparian vegetation (at least three mature trees or shrubs wide) were uncommon (less than 10%) along Duncan Creek, South Fork Long Canyon Creek, Long Canyon Creek, and Middle Fork American River from French Meadows Dam to Middle Fork Interbay.

More detailed information about the riparian vegetation observed along the bypass and peaking reaches is available in the 2005 Physical Habitat Characterization Study Report (PCWA 2006b), as follows.

- Appendix A contains photographs illustrating examples of various riparian community types;
- Appendix E contains a description of the riparian communities present along the MFP bypass and peaking reaches; and
- Vegetation distribution data, including the community composition and age classes, are summarized in tables.

Reach Scale

At each of the study sites, the species identified along the stream banks and across the riparian zone were classified into plant associations following Potter 2005. In general, the distribution patterns of the riparian vegetation across the riparian zone and along the stream banks were influenced by the local valley shape (narrow or wide stream valley), steepness of the valley walls or side slopes, presence of seeps, presence of bars, and the dominant particles sizes of the substrate within the riparian zone or on the bars.

At the study sites with narrower stream valley widths, where the elevational and lateral distances between the low flow channel and the bankfull elevation and the valley walls were relatively small, few changes in dominant species with increased elevations and distances from the channel were observed. Wetland and upland species also were often co-dominant, and upland trees typically overhung the riparian vegetation. At the study sites located within comparatively wider reaches, shifts in dominant and

subdominant species were observed with greater elevations and distances from the channel.

Lateral (side) bars present along the Middle Fork American River in the peaking reach and in sections of the Rubicon River also influenced the distribution patterns within the riparian zone. On the Rubicon River, these bars were often comprised of large boulders, while on the Middle Fork American River in the peaking reach, the substrate on the comparatively wider bars were dominated by cobbles and sand-sized particles. These bars supported little riparian vegetation except near the stream margins, side slopes, and high flow channels within the bars where white alder, willows, blackberry, and various herbaceous species were observed.

Seeps were also common along reaches on the Middle Fork American River between French Meadows Dam and Middle Fork Interbay, Duncan Creek, and Rubicon River from the South Fork Rubicon River confluence to Ralston Afterbay. At these locations, riparian species, including alders and willows, were supported by the seeps at higher elevations above the low flow channel compared to other reaches where seeps were not observed.

Stream banks or riparian zones dominated by bedrock and/or boulder sized material were observed along portions of all the streams except the Middle Fork American River between Middle Fork Interbay and Ralston Afterbay and South Fork Long Canyon Creek. These locations supported no to minimal vegetation.

More detailed information about the riparian vegetation observed at the specific study sites in the bypass and peaking reaches is available in the 2006 Physical Habitat Characterization Study Report (PCWA 2007), as follows.

- Appendix B-1 contains a list of all the species identified during the field surveys at each of the study sites;

- Appendix B-2 contains a description of the plant associations occurring along the bypass and peaking reaches; and

- Appendix B-3 contains plots showing the distributions of the plant associations with distance and elevation above the channel along the surveyed transects across the riparian zone, oriented perpendicular to the channel, at each study site.

9.4.2 Riparian Community Composition

The 2005 and 2006 riparian studies identified nine riparian communities based on the dominant woody riparian species present along the bypass and peaking reaches and surrounding the MFP reservoirs. The communities are comprised of different combinations and dominances of alders, willows, cottonwood, and black locust, including: (1) Alder Community, (2) Willow Community, (3) Cottonwood Community, (4) Alder-Willow Community, (5) Alder-Cottonwood Community, (6) Willow-Cottonwood

Community, (7) Alder-Willow-Cottonwood Community, (8) Alder-Willow-Black Locust Community, and (9) Alder-Willow-Black Locust-Cottonwood Community. At the landscape scale, communities dominated or co-dominated by alders and willows were most common along all the bypass and peaking reaches.

Two plant associations were frequently observed along the stream margins below the estimated bankfull elevations on all the bypass and peaking reaches: the White alder/Sedge and the White alder/Indian rhubarb plant associations. Various plant associations comprised of at least one species of willow were also common nearest to the channel on the Middle Fork American River from Middle Fork Interbay to the confluence with the North Fork American River, Rubicon River from the South Fork Rubicon confluence to Ralston Afterbay, and Long Canyon Creek. In the narrower reaches, these plant associations often extended to the valley walls. On the smaller streams, including the South Fork Long Canyon Creek and Long Canyon Creek, plant associations comprised of a Douglas fir and incense cedar canopy that overhung the riparian species, often extended from the water's edge to the side slopes. Along the wider reaches and the larger streams, with increased elevation above bankfull elevations, these plant associations along the stream margins generally transitioned to plant associations that also contained various upland species, classified within the Ponderosa pine-White alder, Douglas fir-White alder, and Douglas fir-Incense cedar-White alder plant associations.

At the study sites, alder was the most common riparian species within the riparian zone. The alders tended to be rooted from the low flow channel margin to just above the bankfull elevations. In some reaches on the Rubicon River and the Middle Fork American River peaking reach, the majority of the alders were rooted at the edges of the low flow channel, often along the perimeters of large bars. In narrower reaches on the larger rivers and along the smaller tributary bypass reaches and in reaches with seeps, alders were often established to the valley walls.

The common co-dominant or subdominant species at the study sites included Indian rhubarb and various species of willows and dogwoods. Indian rhubarb was observed at study sites along all of the bypass streams in the upper watershed, and was a dominant species on Duncan Creek, North Fork Long Canyon Creek, Long Canyon Creek, and the Middle Fork American River between French Meadows Dam and Ralston Afterbay. This species occurred along the channel margins and within the channel growing among the rocks and boulders. Willows and dogwoods were observed at study sites along all the bypass reaches. At least one species of willow was dominant on all the bypass and peaking reaches, except on the North and South Forks of Long Canyon Creek. The willows tended to be established near the low flow channel, below bankfull elevations. Dogwoods were dominant at study sites on Long Canyon Creek, Duncan Creek, and the Middle Fork American River between French Meadows Dam and Middle Fork Interbay. Dogwoods were often distributed from the water's edge to the valley walls in the narrower reaches, usually at higher elevations above the channel than the willows.

Cottonwoods were a subdominant species within the riparian community in certain locations on the Middle Fork American River in the peaking reach, Long Canyon Creek, and the Rubicon River downstream of the South Fork Rubicon River. Cottonwoods were observed to have a limited distribution on the smaller bypass reaches (e.g., North and South Forks of Long Canyon Creek, Long Canyon Creek, and Duncan Creek). Cottonwood presence appeared to be associated with relatively shorter reaches (ranging from a few hundred feet to a half-mile) that were comparatively wider, shallower, and/or receive inputs of additional sediments (e.g., mass wasting events, tributary confluences, or large woody debris). They were more likely to collect sediments than the steeper and narrower bedrock/boulder segments.

At the study sites, the majority of the species within the riparian communities along the bypass and peaking reaches were wetland plants or plants typically found in wetlands, except for North Fork Long Canyon Creek where 47% of the species were hydric species. Common trees and shrubs within the communities included alders, willows, cottonwoods, and dogwoods.

An overstory commonly comprised of Douglas fir, ponderosa pine, scrub oak, white fir, Pacific madrone, California bay, Oregon ash, bigleaf maple, and/or incense cedar often overhung the riparian zone. In the wider reaches, these species occurred in the transition zone near the bases of the hillsides or side slopes. In comparison, in the narrower reaches, these species were often present in the overstory canopy throughout the riparian zone.

Few non-native species were identified at the study sites on the smaller tributary bypass reaches, with the most species (between 10 and 16 species) identified at the study sites in the Middle Fork American River peaking reach and in the Rubicon River between the South Fork Rubicon confluences and Ralston Afterbay. Few noxious weed species were encountered during the surveys at the study sites, except in the Middle Fork American River peaking reach. One non-native, noxious weed species, black locust, was a co-dominant species within the riparian community along the Middle Fork American River in the peaking reach.

9.4.3 Woody Riparian Age Class Structure

In general, a wide distribution of age classes, including seedlings or young individuals, was present within the majority of the riparian communities along the bypass and peaking reaches. Along the bypass and peaking reaches and within the study sites, the communities were comprised of a greater proportion of younger individuals than medium-aged, or mature and old individuals. Regeneration of the dominant woody riparian species, including alders, willows, and cottonwoods were observed at all the study sites.

Hundreds of seedlings were observed at the study sites on the Middle Fork American River in the peaking reach and between Middle Fork Interbay and Ralston Afterbay, Duncan Creek, and the Rubicon River between the confluence with the South Fork Rubicon River and Ralston Afterbay. The locations where high seedling and sprout

densities were observed tended to be wider, with finer alluvial substrate and more open canopies than those locations where less regeneration was observed. The winter and spring prior to the implementation of the field surveys (2006) when the regeneration data was collected was comparatively wet, with higher flows within the bypass and peaking reaches compared to most years.

In the Middle Fork American River and the Rubicon River where tree cores were dated, the lines of vegetation along the stream banks and the perimeters of the bars resulted from specific recruitment events. The ages of the trees established near the water's edge coincided with high flows that occurred between 1996 and 1998. Some trees established following high flows events in the early 1990's. Trees that were rooted at higher elevations near the estimated bankfull elevations on the Middle Fork American River between Middle Fork Interbay and Ralston Afterbay were established following high flows in the late 1960's. Another recruitment event occurred in the early to mid-1980's.

9.4.4 Structure of the Riparian Canopy

Canopy cover was typically high, as white alders were the dominant species, particularly along the North Fork and South Fork of Long Canyon Creek where almost complete canopy cover by trees was observed. Tree cover was low on the large bars in the Middle Fork American River in the peaking reach and the Rubicon River. In general, coverage by shrubs and herbaceous vegetation was low, although it was high (up to 100%) in localized areas. Tree densities were typically between 2 and 6 trees per ten square meters (m^2) (108 square feet (ft^2)), except for along the Middle Fork American River in the peaking reach, Duncan Creek, and certain reaches along Long Canyon Creek and the Rubicon River between the Long Canyon Creek confluence and Ralston Afterbay where densities were lower. Higher tree densities occurred at the locations where white alder and/or red willow trees were most dense.

9.4.5 Riparian Health

In general, the riparian vegetation was healthy, with low canopy and tree or shrub decadence observed during field surveys. At a number of locations, vegetation has been damaged or killed by recent fires (2001 Star Fire or 2006 Ralston Ridge Fire), high flows, or insect herbivory.

The 2001 Star Fire burned considerable portions of the Middle Fork American River watershed from French Meadows Dam to Middle Fork Interbay and Duncan Creek. The fire burned through the riparian zone on Duncan Creek (ENF 2002). Along these two reaches, canopy cover by the surrounding upland species was typically low. At the most severely burned locations on Duncan Creek, where most of the streamside vegetation was burned, the vegetation was considerably younger compared to locations downstream that were not as intensely burned. The 2006 Ralston Ridge Fire burned across the riparian zone on the Middle Fork American River between Middle Fork Interbay and Ralston Afterbay prior to the implementation of the field studies at the study sites. Although the fire was not as intense as the Star Fire, a considerable portion

of the herbaceous understory vegetation was burned. Dead stems, burned by the fire, were observed at the study sites.

Evidence, including abrasion and knocked down individuals, of recent high winter flows were observed on the Rubicon River from the South Fork Rubicon River confluence to Ralston Afterbay and the Middle Fork American River just downstream of French Meadows Dam. Many of these individuals have since rooted and resprouted. Adventitious roots, common for many riparian species, such as cottonwoods, willows, and alders, are an adaptive response to sediment deposition areas and wetted soil conditions to deal with burial and anoxic conditions.

Insect herbivory, particularly of alder leaves, was observed throughout the riparian zone on the Rubicon River from Hell Hole Dam to the confluence with Long Canyon Creek and Duncan Creek. Insects were also observed on some willows on the Middle Fork American River in the peaking reach, causing leaf damage.

9.5 EXISTING RIPARIAN RESOURCES ASSOCIATED WITH THE PROJECT RESERVOIRS

The distribution of riparian vegetation observed surrounding French Meadows and Hell Hole reservoirs is described below. More detailed information is available in the 2005 Physical Habitat Characterization Study Report (PCWA 2006b) and the (2006 Physical Habitat Characterization Study Report (PCWA 2007) contained in SD G.

9.5.1 Hell Hole Reservoir

Hell Hole Reservoir is surrounded by bedrock and coarse valley walls, which support no riparian vegetation. Riparian vegetation upstream of Hell Hole Reservoir along the Rubicon River begins about 0.15 miles upstream of the high water mark.

9.5.2 French Meadows Reservoir

Riparian vegetation around the perimeter of French Meadows Reservoir is sparse, with small pockets of willow-dominated communities. These communities are usually located near tributary inputs into the reservoir. The depositional area at the upstream end of the reservoir is dominated by the Alder-Willow Community. The vegetation is sparsely distributed or occurs as a discontinuous band. Young, medium-aged, and mature alders and willows were observed.

9.6 HISTORICAL EVENTS

Three historical events potentially influenced the observed riparian community characteristics and distribution patterns in the bypass and peaking reaches, including the 1964 Hell Hole Dam failure, mining activities downstream of Ralston Afterbay, and the construction of the MFP. Potential effects of MFP operations on riparian resources along bypass and peaking reaches will be evaluated during the relicensing of the MFP. An overview of the dam failure and historic mining activities is provided below.

9.6.1 Hell Hole Dam Failure and Flood Surge

A major event influencing both channel and riparian existing conditions in the Rubicon River was the failure of the partially constructed Hell Hole Dam in December 1964. The dam failure resulted in a flood surge with estimated peak flows of 260,000 cubic feet per second (cfs). Downstream on the Middle Fork American River near Foresthill, the estimated instantaneous peak discharge of the flood surge was approximately three times higher than the highest recorded peak discharge during the period of record (1959-2004).

The most dramatic and severe changes in the stream channel occurred for approximately six miles immediately downstream of Hell Hole Dam where the V-shaped channel was altered to a more U-shaped channel. More than 700,000 cubic yards of rockfill from the dam was washed downstream and deposited downstream as far as Parsley Bar, burying the stream channel. Today, most of the flow in this segment continues to be subsurface.

Farther downstream, the episodic flood surge scoured the existing riparian vegetation along the Rubicon River, particularly in the upper reaches (Scott and Gravlee 1968; CDFG 1979). Events of this scale 're-set' the riparian communities along the river by removing the majority of the existing vegetation, altering resource availability, and changing the distribution and characteristics of landforms. The 1964 flood mobilized large dam construction material (large cobbles and boulders), stream alluvium, colluvium (including landslide material), soil, and minor amounts of bedrock. Large quantities of sediment (approximately 800,000 cubic yards) were delivered to the stream from more than 70 landslides that were caused by the flood or rains during the following year.

The flood surge caused changes in channel and landform morphology downstream of the Hell Hole Dam site, including along the Middle Fork American River from the confluence of the Rubicon River to Folsom Reservoir (Scott and Gravlee 1968). Deltaic deposits at tributary confluences and riffles were also eroded. Some of these changes, such as the formation of new bars, bar deposition potentially increasing elevations of the bars relative to the stream, and increased particle sizes on bars, likely had a strong influence on the re-establishment of riparian vegetation following the flood and the existing riparian patterns.

Factors that influence seed germination and seedling establishment include suitable substrate with fresh, moist alluvium, high light availability, limited competition, water availability during the summer, and minimal scour during the first winter. Coarse substrate (e.g. boulder-sized material) deposited on bars and higher bar surfaces from deposited flood and landslide-derived materials, would likely limit the re-establishment of riparian vegetation on these surfaces. In addition, the establishment of riparian vegetation following the flood likely reflects the subsequent flow releases by the MFP, which reduced the magnitude and frequency of high flows and possibly changed base flows. Substantial establishment of willows and alders was observed within 15 years (CDFG 1979).

9.6.2 Mining Activities on the Middle Fork American River Downstream of Ralston Afterbay

The majority of the mining activities along the bypass and peaking reaches associated with the MFP occurred in the late 1800's and early 1900's on the Middle Fork American River in the peaking reach. Some mining also occurred within the other watersheds, including Duncan Creek and on the Rubicon River, including a short distance downstream of the Long Canyon Creek confluence. The volume of sediment produced and extent of mining operations on the other streams, however, were very small compared to those that occurred on the Middle and North Forks of the American River.

It is estimated that approximately 175 million cubic meters of sediment was produced in the North Fork American River and approximately 40 million cubic meters of sediment was produced in the Middle Fork American River, resulting in channel aggradation, and changes in flow stages and channel morphology (James 1999). Increased turbidity within the stream channel was observed by the miners in the late 1800's following winter storms and spring snowmelt that periodically flooded the bars and eroded the piles of mud and gravels (Swindle 2000). Every accessible bar on the Middle Fork American River in the peaking reach was mined extensively and reworked by mining operations by the late 1800's. The majority of the streambed was re-worked and completely altered. For example, between Mammoth Bar and Murderer's Bar on the Middle Fork American River, miners blasted several natural waterfalls, leaving behind rapids. In addition, extensive mining occurred along many of the tributaries to the Middle and North Forks of the American River and along the hillsides. Some mining activities continue today (Ayers Associates 1997; Swindle 2000).

The type of mining activity varied from panning to re-working the channel bed and bars to draining the stream bed with dams and flumes to hydraulic mining. Large flumes and dams were constructed in numerous places along the Middle Fork American River to redirect the river flow to expose the streambed to miners. One of the largest projects that was initiated on the Middle Fork American River occurred at Horseshoe Bar. At this location, the river flowed around a steep granite ridge. Miners blasted a tunnel through the bedrock to redirect about a half to ¾-mile of stream flow and drain the river bed at Horseshoe Bar. The project, however, was never fully completed.

Hydraulic mining was also practiced along the Middle Fork American River. For example, at Hoosier Bar, hydraulic mining was used to remove gravels from 40 feet below the Middle Fork American River (Western Living Center 2006).

More than 10,000 men have been estimated to have mined along the Middle Fork American River. Towns were established on most of the bars.

Based on the descriptions of the mining activities within the channel, on the bars, and on the adjacent hillsides, significant changes in the channel and bar morphology and substrate characteristics occurred. Although descriptions of the mining activities rarely mention that previous riparian vegetation or the removal of riparian or other hillside vegetation, based on existing photographs and descriptions of the mining activities and

towns on the bars, the riparian vegetation likely was drastically changed, if not completely denuded by mining. In addition, changes in bar morphology and substrate characteristics and streambed elevations also affected the re-establishment of riparian vegetation by altering the frequency and duration of inundation of the bars, substrate characteristics, as well as the depth to available water.

9.7 TEMPORAL TRENDS IN RIPARIAN DISTRIBUTION

Historic aerial photographs (early 1960's) were compared to more recent aerial photography (2002) and videography (2005). Four general patterns were identified along the Middle Fork American River in the peaking reach and the less entrenched sections of the Rubicon River, as briefly described in the following. These are as follows.

Change in Riparian Vegetation Position on Channel Bars. The position of riparian vegetation was observed to have shifted from comparatively higher bar surfaces with varying distances from the water's edge at summer low flow to the perimeter of bars and along channel margins at the water's edge at summer low flow. For example, on the Rubicon River and the Middle Fork American River in the peaking reach, historically the riparian vegetation was located on comparatively higher surfaces on channel bars and at varying distances from the water's edge. On the recent photography, the riparian vegetation was distributed in a line along the margins of the channel bars at the water's edge during typical summer flows.

Change in Riparian Abundance. Moderate increases in riparian abundance have occurred along the bypass and peaking reaches since the early 1960's. For example, along the Middle Fork American River in the peaking reach, reaches with split channels in 1961-1962 that supported narrow stands of riparian vegetation were wide corridors in 2005. Moderate increases in riparian abundance were also observed along the entire length of the Rubicon River.

Change in Riparian Coverage (Distribution). Riparian vegetation distribution has changed from few and shorter continuous narrow corridors and shorter, wide corridors to larger, longer, and wider continuous corridors. This pattern was observed along the Middle Fork American River from Middle Fork Interbay to Ralston Afterbay.

Minimal change in riparian vegetation was observed in the distribution patterns along the less responsive stream reaches (i.e. steeper, bedrock and boulder confined reaches), including in the Middle Fork American River from Middle Fork Interbay to Ralston Afterbay and the Rubicon River.

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TABLE

Table 9-1. Sources of Riparian Vegetation GIS Data Available for the Middle Fork American River Watershed.

Data Source	Topic	Folder Name	Contents	Type	Year	Usable	Comments	Metadata
Eldorado National Forest	VEGETATION	acge456hab	CALVEG info for Eldorado NF	Polygon	1997?	Yes	Tree size and density; productivity; WHR type, size, density and range.	No
Eldorado National Forest	VEGETATION	acge56hab	CALVEG info for Eldorado NF	Polygon	1997?	Yes	Tree size and density; productivity; WHR type, size, density and range.	No
USDA-FS Region 5	VEGETATION	USFSR5_Eveg_Poly_08_06	CALVEG info for MFAR watershed	Polygon	2000	Yes	Tree size and density; productivity; WHR type, size, density and range	Yes
PCWA Disk 1	VEGETATION	change_det	Vegetation changes	Polygon	N/A	Yes	Coverage detailing vegetation changes in the NFAR watershed, no info on changes from/to.	N/A
PCWA Disk 1	VEGETATION	eveg97	Vegetation cover	Polygon	1997	Yes	Very detailed vegetation type coverage. NIA.	Yes
PCWA Disk 1	VEGETATION	r5zone98_3	California vegetation zones	Polygon	2000	Yes	Statewide coverage of very general vegetation zones developed by USDA.	Yes

Table 9-1. Sources of Riparian Vegetation GIS Data Available for the Middle Fork American River Watershed (continued).

Data Source	Topic	Folder Name	Contents	Type	Year	Usable	Comments	Metadata
PCWA Disk 1	VEGETATION	riparian	Riparian coverage, downstream of Ralston Afterbay	Grid	N/A	Not Likely	Statewide grid of riparian area vegetation classification. Does NOT cover project area entirely.	No
PCWA Disk 1	VEGETATION	shirt_mdw	Shirt Meadow	Polygon	N/A	Yes	Two polygons of assumed meadow areas.	No
PCWA Disk 1	VEGETATION	snvmdvg00_1	Meadow vegetation	Polygon	2000	Yes	Coverage of meadow areas in Sierra National Forest.	Yes
PCWA Disk 1	VEGETATION	snvgseq98_3	Sequoia Groves	Polygon	1998	Yes	Coverage of Giant Sequoia grove boundaries. One is in NFAR watershed boundary.	Yes
PCWA Disk 2	VEGETATION	exveg80_1	Vegetation	Polygon	1980	Yes	CALVEG. Eldorado NF	Yes
PCWA Disk 2	VEGETATION	exveg97_7	Vegetation	Polygon	1996	Yes	CALVEG. Eldorado NF	Yes
PCWA Disk 2	VEGETATION	meadow	Meadows	Polygon	N/A	Possibly	Coverage of meadows with some attributes, Eldorado NF	No
PCWA Disk 2	VEGETATION	noxious	Noxious plants	Point	2002	Yes	Coverage of noxious plants with attributes, Eldorado NF	No
PCWA Disk 2	VEGETATION	sens_plant	Sensitive Plant occurrences	Point	N/A	Yes	Sensitive plant coverage, species attribute needs more information. Eldorado NF	No
PCWA Disk 2	VEGETATION	sensploc_0501	Sensitive Plant occurrences	Point	2001	Yes	Sensitive plant coverage, species attribute needs more information. Eldorado NF	No

Table 9-1. Sources of Riparian Vegetation GIS Data Available for the Middle Fork American River Watershed (continued).

Data Source	Topic	Folder Name	Contents	Type	Year	Usable	Comments	Metadata
PCWA Disk 2	VEGETATION	senssurv	Sensitive plant data	Polygon	N/A	Yes	Appears to be polygon areas of sensitive plants, needs more information. Eldorado NF	No
PCWA Disk 2	VEGETATION	vegdocs	Metadata and document report on CALVEG data	Polygon	1997	Yes		N/A
Tahoe National Forest	BOTANY	plants	Plants	Polygon	N/A	Yes		No
Tahoe National Forest	BOTANY	weed	Weeds	Polygon	N/A	No	Coded	No
Tahoe National Forest	VEGETATION	eveg00_3	CALVEG and STRATA for Tahoe FS	Polygon	2000	Yes	Tree size and density; productivity; WHR type, size, density and range.	Yes
Tahoe National Forest	VEGETATION	eveg97_4	CALVEG and STRATA for Tahoe FS	Polygon	1997	Yes	Tree size and density; productivity; WHR type, size, density and range.	Yes
Tahoe National Forest	VEGETATION	pnv	Vegetation communities	Polygon	N/A	Yes		No
Tahoe National Forest	VEGETATION	veg_own00	STRATA and CWHR	Polygon	2000	Possibly		Yes
Tahoe National Forest	VEGETATION	veg80pla94_3	STRATA and CWHR	Polygon	1980	Possibly	STRATA and CWHR data classes	Yes
Tahoe National Forest	VEGETATION	vege80_2	STRATA and CWHR	Polygon	1980	Possibly	STRATA classes	Yes

Table 9-1. Sources of Riparian Vegetation GIS Data Available for the Middle Fork American River Watershed (continued).

Data Source	Topic	Folder Name	Contents	Type	Year	Usable	Comments	Metadata
Tahoe National Forest	WATER	meadow	Meadows	Polygon	N/A	Yes	Meadow Type	No
USDA-FS Region 5	FIRE	USFS_R5_Firehistory_ID	California Fire history (1908-2004)	Polygon	2004	Yes	Fire name, size, class, month/year, watershed	Yes
USDA-FS Region 5	LAND USE	USFS_Range_alot_ID	Range allotments	Polygon	2004	Yes	Allotment IDS, watershed, acreage	Yes
USDA-FS Region 5	LAND USE	USFS_Strategically PlacedTreatments	Fuel mgt.	Polygon	2006	Yes	Treatment type (e.g. controlled burn, clear cut, etc.)	Yes
USDA-FS Region 5	LAND USE	UnsuitableForestLandAreas95_1	Timber mgt.	Polygon	N/A	Possibly	Forest lands unsuitable for timber production	No
USDA-FS Region 5	LAND USE	FACTS_AccompHarv90_05_1	Timber mgt.	Polygon	2005	Possibly	FACTS Accomplished Harvest Activities 1990-2005	Yes
ENTRIX, Inc.	VEGETATION	Increment Core Survey Sites	Tree Core sampling data	Point	2006	Yes	Locations of sampling sites	Pending
ENTRIX, Inc.	VEGETATION	InvasiveRiparian_Ln	Field data invasives	Line	2006	Yes	Type, age class, distribution	Yes
ENTRIX, Inc.	VEGETATION	InvasiveRiparian_Pt	Field data invasives	Point	2006	Yes	Type, age class, distribution	Yes
ENTRIX, Inc.	VEGETATION	Riparian_Cont_Ln_Grndtrth	Continuous riparian bands	Line	2006	Yes	Community type, age class, distribution	Yes
ENTRIX, Inc.	VEGETATION	Riparian_Disc_Ln_Grndtrth	Field data - discontinuous riparian	Line	2006	Yes	Community type, age class, distribution	Yes

Table 9-1. Sources of Riparian Vegetation GIS Data Available for the Middle Fork American River Watershed (continued).

Data Source	Topic	Folder Name	Contents	Type	Year	Usable	Comments	Metadata
			bands					
ENTRIX, Inc.	VEGETATION	Riparian_Sparse_Ln_ Grndtrth	Sparse riparian bands	Line	2006	Yes	Community type, age class, distribution	Yes
ENTRIX, Inc.	VEGETATION	Riparian_Poly_Ln_Grndtrth	Field survey - riparian areas	Poly	2006	Yes	Community type, age class, distribution	Yes