Placer County Water Agency

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June 20, 2006

Subject: Middle Fork American River Hydroelectric Project Relicensing
FERC Project No. 2079 - Draft Existing Resource Information Reports

Dear Stakeholder;

Placer County Water Agency (PCWA) is pleased to provide for your review and comment the enclosed "Draft Existing Resource Information Reports" for the Middle Fork American River Hydroelectric Project (MFP or Project) (FERC Project No. 2079). The report narratives, figures, tables and appendices are provided electronically on the enclosed CD. In addition, all of the maps referenced in the text are provided as 11X17 color paper copies. These maps are considered Non-Internet Public (NIP) and should not be posted on the Internet.

The draft reports summarize environmental information relevant to the relicensing of the MFP. The draft reports represent data collected from published and non-published literature sources, resource agency files and databases, and discussions with State and federal resource agency specialists. PCWA's intent in distributing the draft reports is to provide stakeholders with the opportunity to better understand the resources in the vicinity of the MFP early in the relicensing process, and to comment on the content of the material in the reports. PCWA encourages all stakeholders to identify any additional sources of information in the vicinity of the MFP for inclusion in the resource information reports. A final version of the resource reports, incorporating stakeholder comments, will be provided as Section 6.0 of the Pre-Application Document (PAD), which will be filed with FERC and distributed to the stakeholders by PCWA in late 2007.

PCWA is providing the Draft Existing Resource Information Reports to the stakeholders in two distributions. The first series of reports (enclosed) are being distributed to the relicensing stakeholders for review and comment on June 20, 2006. The second series of reports will be distributed in July 2006. The following table shows the general table of contents and distribution schedule for the Draft Existing Resource Information Reports.

Table of Contents	Distribution Date	
	June 2006	July 2006
6.0 Introduction	X	
6.1 Description of the River Basin		X
6.2 Geology and Soils	X	
6.3 Water Use		X
6.4 Water Quality		X
6.5 Fish and Aquatic Resources	X	
6.6 Wildlife and Botanical Resources	X	
6.7 Geomorphology	X	

6.8 Riparian Resources	X	
6.9 Recreation		X
6.10 Land Use		X
6.11 Aesthetics		X
6.12 Cultural Resources	X	
6.13 Tribal Resources	X	
6.14 Socioeconomics		X

The text of the reports has been provided to you in Word format so that you may provide your comments as single-text edits, which would be greatly appreciated. Electronic files are currently saved in the following example format: 6.8_Riparian Resources_Narrative_V1_Jun 06.doc. The electronic version of the document with your comments should use the same save name with your initials and/or affiliation added, for example: 6.8_Riparian Resources_Narrative_V1_June 06_PCWA_MT.doc. Remember to show your edits in track changes.

If you choose to provide your comments in another format (e.g. e-mail correspondence or letter), please be clear to differentiate general comments from specific comments or recommendations on individual reports. Comments of a technical nature should include the basis for the comment and any appropriate citations to scientific literature. When providing comments or recommendations, please identify the specific report that you are commenting on and the specific section, page or line (s). This will help PCWA to more effectively address your comments.

PCWA would like to obtain your feedback on this set of Existing Resource Information Reports within 60-days, or by August 21, 2006. Please e-mail electronic comments Relicensing@pcwa.net. You may also provide comments to Mal Toy, Director of Resource Development, at the following address:

Placer County Water Agency
P.O. Box 6570
Auburn, CA 95604

We appreciate your participation in this project and look forward to receiving your feedback. Please call me at (530) 823-4889 if you have any questions.

Sincerely,

Mal Toy

Mal Toy
Director of Resource Development

Attachment

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[Please note: The Existing Resource Information Reports will be included as Chapter 6.0 in the Pre-Application Document. Therefore, the table of contents begins with 6.0 and not 1.0.]

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401 WQC	Section 401 Water Quality Certification
ac-ft	acre-feet
ACHP	Advisory Council on Historic Preservation
ACOE	Army Corps of Engineers
ADA	Americans with Disabilities Act
ADAAG	Americans with Disabilities Act Accessibility Guidelines
Advisory Council	Advisory Council on Historic Preservation
AIR	Additional Information Request
ALP	Alternative Licensing Process
APE	Area of Potential Effect
ARB	Air Resources Board
ARPA	Archaeological Resources Protection Act
ARWG	American River Watershed Group
ASR	Additional Study Requests
BA	Biological Assessment
BACT	Best Available Control Technology
Basin	American River Basin
BIA	Bureau of Indian Affairs
BLM	Bureau of Land Management
BPR	Bureau of Public Roads
BVET	Basinwide Visual Estimation Technique
CAA	Clean Air Act
CAISO	California Independent System Operator
Cal Trout	California Trout
CCR	California Code of Regulations
CDC	California Department of Conservation
CDEC	California Data Exchange
CDFG	California Department of Fish and Game
CDMG	California Division of Mines and Geology
CEC	California Energy Commission
CEII	Critical Energy Infrastructure Information
CESA	California Endangered Species Act
CFR	Code of Federal Regulations
cfs	cubic feet per second
CHRIS	California Historical Resources Information System
CNDDB	California Natural Diversity Database
CNPS	California Native Plant Society
CO	Carbon Monoxide
CO_2	Carbon Dioxide
Commission	Federal Energy Regulatory Commission
CSC	California Species of Special Concern
CSL	California State Library
CSPS	California State Park Service
CSWRB	California State Water Rights Board
CTR	California Toxics Rule
CWA	Clean Water Act
DEA	Draft Environmental Assessment

DEIS	Draft Environmental Impact Statement
DHS	California Department of Health Services
DO	Dissolved Oxygen
DOE	Department of Energy
DOI	Department of Interior
DOQQ	digital orthorectified quarter quad
DPR	State Department of Parks and Recreation
DRG	Digital raster graphic
DWR	California Department of Water Resources
EID	El Dorado Irrigation District
EIS	Environmental Impact Statement
ENF	Eldorado National Forest
ESA	Endangered Species Act
FEIS	Final Environmental Impact Statement
FERC	Federal Energy Regulatory Commission
FOR	Friends of the River
FPA	Federal Power Act
fps	firm peaking service
FR	The Federal Register
FRI	Four Reservoir Index
FSS	Forest Service Sensitive
ft	feet
GIS	Geographic Information System
GLO	General Land Office
GPS	Global Positioning System
GPUD	Georgetown Public Utility District
GWHr	gigawatt-hour
HB	Howell Bunger
HBI	Hilsenhoff Biotic Index
hp	Horsepower
HPMP	Historic Properties Management Plan
IFIM	Instream Flow Incremental Methodology
IHA	Indicators of Hydrologic Alteration
ILP	Integrated Licensing Process
IRA	Inventoried Roadless Area
kV	kilovolt
Lat	latitude
Long	longitude
Maidu	Maidu Native American
MCL	Maximum Concentration Limits
MDL	Method Detection Limit
MFP	Middle Fork American River Hydroelectric Project
mg/l	milligrams per liter
MIS	management indicator species
Miwok	Miwok Native American
msl	mean sea level
MTRL	maximum tissue residue level

MW	Megawatt
NEPA	National Environmental Policy Act
NMFS	National Marine Fisheries Service
NGO	non-governmental organization
NHPA	National Historic Preservation Act
NOI	Notice of Intent
NOPR	Notice of Proposed Rulemaking
NPS	National Park Service
NRCS	Natural Resource Conservation Service
NRDC	Natural Resources Defense Council
NTR	National Toxics Rule
NTU	nephelometric turbidity unit
NWIS	National Water Information System
O&M	Operation and Maintenance
OHV	off-highway vehicle
PAD	Pre-Application Document
PAOT	persons at one time
PARC	Protect American River Canyons
PCWA	Placer County Water Agency
pdf	Adobe Portable Document Format
PG&E	Pacific Gas and Electric Company
PM&E	protection, mitigation and enhancement
PMF	Probable Maximum Flood
Project	Middle Fork American River Hydroelectric Project
QA/QC	Quality Assurance/Quality Control
REA	Ready for Environmental Analysis
RM	River Mile
ROD	Record of Decision
rpm	revolutions per minute
RV	recreational vehicle
SARA	Save the American River Association
SCADA	supervisory control and data acquisition
SHPO	State Historic Preservation Officer
SMUD	Sacramento Municipal Utility District
SPCC	Spill Prevention, Containment and Countermeasure Plan
SPT	sediment pass-through
SWRCB	California State Water Resources Control Board
TAF	thousand acre feet
TLP	Traditional Licensing Process
TMDL	Total Maximum Daily Load
TNF	Tahoe National Forest
UAIC	United Auburn Indian Community
UARM	Upper American River Model
UARP	Upper American River Project
USBR	United States Bureau of Reclamation
USC	United States Code
USDA	United States Department of Agriculture

USDA-FS	United States Department of Agriculture Forest Service
USDOT	United States Department of Transportation
USEPA	United State Environmental Protection Agency
USFWS	United States Fish and Wildlife Service
USGS	United States Geological Survey
Washoe	Washoe Native American
Watershed	Middle Fork American River Watershed
WTP	Water Treatment Plant
WY	Water year

6.0 INTRODUCTION

The following Draft Existing Resource Information Reports summarize environmental information relevant to the relicensing of Placer County Water Agency's (PCWA) Middle Fork American River Hydroelectric Project (MFP or Project). The draft reports represent data and information collected from published and non-published literature sources, resource agency files and databases, discussions with State and federal resource agency specialists, and Internet searches. The information provided in these reports represents information collected to date and should not be interpreted as encompassing all data sources. For example, PCWA is still consulting with the Tahoe and Eldorado National Forests to obtain additional resource information.

In many cases, only limited information is available to characterize the environmental resources within the designated Federal Energy Regulatory Commission (FERC) Project boundary or other areas in the vicinity of the MFP potentially affected by on-going Project operations and maintenance activities. As a result, PCWA has provided a broader overview of the resources by extending the discussion to include information within the entire Middle Fork American River Watershed (Watershed) when necessary to describe potential species occurrences and resource conditions.

PCWA's intent in distributing the draft reports is to provide stakeholders with an opportunity to better understand resources in the vicinity of the MFP early in the relicensing process and to comment on the content of the material in the reports. PCWA encourages all stakeholders to identify any additional sources of information pertinent to the MFP for inclusion in the resource information reports. A final version of the resource reports incorporating stakeholder comments will be provided as Section 6.0 of the Pre-Application Document (PAD), which will be filed with the FERC and distributed to the stakeholders in late 2007.

The Existing Resource Information Reports in combination with the Project Description will be used early in the relicensing process to facilitate the identification of information data gaps, potential resource issues, and Project nexus. This information will be used by the stakeholders to collaborate on the appropriate scope of additional focused technical studies necessary to understand potential Project effects and to develop appropriate future protection, mitigation and enhancement measures.

PCWA is providing the Draft Existing Resource Information Reports to the stakeholders in two distributions. The first series of reports will be distributed to the stakeholders for review and comment in June 2006. The second series of reports will be distributed in July 2006. The following provides the table of content and distribution schedule for the Draft Existing Resource Information Reports.

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6.2 GEOLOGY AND SOILS

This report describes the geology and soils in the Middle Fork American River Watershed (Watershed), as they pertain to the Middle Fork American River Hydroelectric Project (MFP or Project). The Federal Energy Regulatory Commission's (FERC's) content requirements for this report are specified in Title 18 of the Code of Federal Regulations (CFR) Chapter I § 5.6 (d) (3) (ii), as follows:

> ***Geology and soils.*** *Descriptions and maps showing the existing geology, topography, and soils of the proposed project and surrounding area. Components of the description must include:*
>
> *(A) A description of geological features, including bedrock lithology, stratigraphy, structural features, glacial features, unconsolidated deposits, and mineral resources at the project site;*
>
> *(B) A description of the soils, including the types, occurrence, physical and chemical characteristics, erodibility and potential for mass soil movement;*
>
> *(C) A description of reservoir shorelines and streambanks, including: (1) Steepness, composition (bedrock and unconsolidated deposits), and vegetative cover; and (2) Existing erosion, mass soil movement, slumping, or other forms of instability, including identification of project facilities or operations that are known to or may cause these conditions.*

The information presented in this report focuses on those aspects of the existing environment that are pertinent to hydropower facilities and/or may affect stream conditions. For example, the soils section focuses on soil stability and erodibility near Project facilities and bypass streams associated with the MFP. Potential Project-related impacts pertaining to soils and geology will be addressed as relicensing proceeds.

6.2.1 Information Sources

Existing information regarding the geology and soils in the Watershed was collected, reviewed and evaluated. Relevant information used to prepare this report includes:

- Draft 2005 Physical Habitat Characterization Study (PCWA 2006). The information contained in the Draft 2005 Physical Habitat Characterization Study Report provided an overview of the geologic conditions and soils in the Watershed.

- 1:250,000 Scale Geologic Maps of the Sacramento and Chico Quadrangles (California Department of Conservation, 1981 and 1992, respectively). These maps contain generalized information regarding the geologic formations and faults in the Watershed. For the purposes of this report, the geologic map units identified in the official state data were grouped into categories more pertinent to the MFP.

- Digital Database of Faults from the Fault Activity Map of California and Adjacent Areas (California Department of Mines and Geology, 2000). Information from this database was used to identify mapped faults in the Watershed.

- Fault Rupture Hazard Zones in California, Special Publication 42, (California Department of Conservation, Revised 1997, Supplements 1 and 2 added in 1999). This publication contains general information regarding seismic hazards and on Fault Rupture Hazard Zones in California, although none of the Project facilities are located within a mapped zone.

- Review of Seismic-Hazard Issues Associated with the Auburn Dam Project, Sierra Nevada Foothills, California, Open File Report 96-0011 (United States Geological Survey 1996). This report provided information regarding the seismic potential in the Auburn Dam area and provided specific information regarding fault systems in the foothills portion of the Watershed.

- Mineral Resource Potential of the North Fork of the American River Wilderness Study Area, Placer County, California (Miscellaneous Field Studies Map MF-1177-C) and Mineral Resource Potential of the Rubicon Roadless Area, Placer and Eldorado Counties, California (Miscellaneous Field Studies Map MF-1501-B) United States Geological Survey, 1982 and 1983, respectively). These two reports provided information on the mining history and mineral resource potential in the Watershed.

- Gold Districts of California Bulletin 193 (California Division of Mines and Geology, 1970). This report provided historical background regarding gold mining in the Watershed.

- Soil Survey of El Dorado Area, California Soil Survey of Placer County, California Western Part and Soil Survey of the Tahoe Basin Area, California and Nevada (United States Department of Agriculture Forest Service and Soil Conservation Service. Issued April 1974, 1980, and March 1974, respectively). These reports and relevant metadata provided most of the information required for the soil maps and stability review.

6.2.2 Description of Existing Conditions

The following summarizes the geologic conditions in the Watershed. The general topography of the Watershed is described first, followed by overviews of the geologic setting and history, seismic hazards, mineral resources, and soils.

6.2.2.1 Topography

The Project facilities are situated in the foothills and mountainous uplands of the western slope of the Sierra Nevada Range. As shown in Figure 6.2.1, the bypass streams associated with the MFP flow southward and then westward, from elevations ranging from a high of approximately 5,200 feet (ft) above mean seal level (msl) at the French Meadows Reservoir and Duncan Creek Diversion to approximately 1,100 ft msl at the Ralston Afterbay. The ridges surrounding French Meadows and Hell Hole reservoirs are as high as 7,000 feet msl. The streams and rivers in the Watershed are characterized by steep, deeply incised, and rugged canyons, over 3,000 feet deep.

6.2.2.2 Geologic Setting and History

This section describes the geologic formations present in the Watershed and provides an overview of the geologic history. The primary formations present in the Watershed are identified in Table 6.2-1 along with corresponding geologic dates and descriptions. A map showing the major geologic formations and mapped faults in the Watershed is provided as Figure 6.2-2.

The Sierra Nevada mountain range is a faulted and westward tilted range consisting of metamorphosed sediments of an inland sea, a number of discrete accreted terranes, volcanic and sedimentary deposits, and plutonic intrusions (USDA-FS 2006). Some of the oldest rocks in the western part of the range are Ordovician to Devonian age (360 million years before present (mybp) to 500 mybp) marine deposits, called the Shoo-fly complex. The Shoo-Fly complex is comprised of sedimentary rocks deposited in a prehistoric inland sea. These marine deposits have since been uplifted, folded, and metamorphosed. With the exception of North and South Fork Long Canyon, all of the bypass streams bisect the Shoo-Fly Complex. The steep exposures of the Shoo-Fly Complex along the stream channels appear to be responsible for significant sediment inputs in the form of rockfalls.

During the same timeframe a collection of discrete island arc and ocean floor terranes were attaching to the western margin of the North American continent as part of the subduction of a large oceanic plate. These accreted terranes are known as the Foothills Suture Zone, which are part of the Western Metamorphic Belt. The oldest rocks in this suture zone include the Calaveras complex, which occurs throughout the lower elevations of the Watershed, to the north and west of Ralston Afterbay (Figure 6.2-2). The Calaveras complex is dominated by chert, and is highly contorted and rotated with very steep to near vertical bedding surface planes (CDC 1981, 1992).

This accretion continued into the Mesozoic Era (63 to 240 mybp) with the addition of the Clipper Gap formation of chert and argillite and the Mariposa formation of slates and meta-graywacke. The Clipper Gap and Mariposa formations are present in the western-most part of the Watershed, between Canyon Creek and the North Fork American River confluence.

Each of these accreted terranes is separated by large faults. The Foothills Suture Zone contains two large potentially active fault zones; the Melones Fault Zone and the Bear Mountain Fault Zone. These faults are discussed in more detail in Section 6.2.2.3.

During the Mesozoic Era (63 to 240 mybp) the magma generated by the subduction of the oceanic plate came up as isolated plutons in the metamorphic rocks of the Shoo-Fly complex and in the accreted terranes. Gold-bearing veins were formed from the metamorphosis of marine sediments, primarily in the accreted terranes. These gold-bearing deposits were the source of gold mined throughout the region beginning in the mid 1800s. The mineral resources and mining associated with this process are discussed further in Section 6.2.2.4.

Also in the Mesozoic Era, specifically during the Tertiary Period (2 to 63 mybp), a long sequence of volcanism began. Andesitic volcanic deposits of the Mehrten Formation completely buried the bedrock topography of the western slopes northern Sierra Nevada Range. As a consequence, the prevolcanic drainage was eliminated and a new drainage evolved (Watson and Humphrey 2002). The Mehrten Formation was deposited mainly as mudflows (lahars) that consist chiefly of volcanic debris which originated on the flanks of the volcanoes. These deposits occur throughout the Watershed, generally at the ridge tops. The largest area of the Mehrten Formation extends westerly from the crest between the Middle Fork American River and the Rubicon River through the Long Canyon drainage (Figure 6.2-2). The rhyolite surrounding the French Meadows Reservoir is also associated with this volcanically active period.

This volcanic activity was followed by a long period of erosion in the Cretaceous Period (63 to 138 mybp) that eroded the overlying volcanics, exposed the underlying granitics, and deposited gold into stream channels. The granitics of the Mesozoic plutons and batholiths are exposed along the Middle Fork American River, in the vicinity of French Meadows Reservoir at various locations along the Rubicon River and Long Canyon Creek, and around Hell Hole Reservoir.

During the middle or late Pliocene (2 to 5 mybp), the Sierra Nevada Range was uplifted on its eastern margin and tilted to the west. This progressive uplift and rotation resulted in incised river canyons on the western slopes to depths of 2,000 ft to 4,000 ft or more. These incised stream channels that bisect granitic bedrock tend to be steep and confined, and consist of course bed elements such as boulders.

The Sierra Nevada Range was glaciated several times during the Pleistocene Period (2 mybp to 10,000 years bp). These events modified the topography of the Watershed, forming wide, U-shaped valleys. Glacial deposits have been mapped in the headwaters of the North Fork American River, Middle Fork American River, Rubicon River, South Fork Rubicon River, and the South Fork Long Canyon Creek, particularly in the upper reaches. All of these glacial deposits are located above Project diversions, with the exceptions of a small area on the Rubicon River below Hell Hole Dam. Erosion of glacial deposits, such as till and moraines tend to contribute gravel-sized sediment to the area streambeds.

6.2.2.3 Seismic Hazards

Figure 6.2-2 shows the faults that have been mapped in the Watershed, and estimated period of activity. The information presented in the map is based on data contained in the California Division of Mines and Geology (CDMG) digital database. As shown in Figure 6.2-2, the lower elevations of the Watershed are situated in the Foothills Suture

Zone that includes the Melones Fault Zone and the Bear Mountain Fault Zone (CDC 1981, 1992).

Most of the faults documented in the Watershed show pre-Quaternary displacement, meaning they were active more than 2 mybp. However, an area of faulting on the North Fork American River in the Melones Fault Zone shows Quaternary displacement and several areas of the Bear Mountain Fault Zone exhibit late Quaternary displacement, meaning activity within the past 10,000 years (CDMG 2000).

Because of this late Quaternary displacement in the Bear Mountain Fault Zone, several seismic hazard studies have been conducted in association with the Auburn Dam Project, a proposed dam and reservoir project unrelated to the MFP. The proposed Auburn Dam Project is located approximately 28 miles downstream of Ralston Afterbay Dam, within the Bear Mountain Fault Zone. The United States Bureau of Reclamation (USBR) has designated the Bear River Fault Zone as “indeterminate active” (USGS 1996).

In addition to this suture zone fault activity, Figure 6.2-2 also shows some minor faulting throughout the upper elevation, of the Watershed, including a concentrated area of faulting on Duncan Creek. These faults are all classified by the CDMG database as pre-Quaternary and are likely inactive.

The California Department of Conservation (CDC) defines an “Active Fault Zone” as an area of related faults that exhibit surface displacement within the last 11,000 years. According to the CDC, no active fault hazard zones have been identified in the immediate vicinity of the Project. However, the Project is located west of an active fault zone hazard area near Lake Tahoe and south of an active fault zone hazard area in Plumas County (CDC 1999).

6.2.2.4 Mineral Resources

Gold veins were produced throughout the Western Metamorphic Belt when the marine sediments of the accreted terranes were metamorphosed by the magma produced by the subduction of the oceanic plate. The Mother Lode Gold Belt is an example of this process that produced extensive amounts of lode-gold (CDMG 1970). The MFP is located immediately north of the Mother Lode Gold Belt.

In addition to the potential for lode-gold deposits, the early Tertiary channel of the American River was once a highly productive placer gold mining area (CDMG 1970). The erosional period in the Cretaceous and the uplift and incision of the river channels during the Pleistocene resulted in the deposition of gold deposits in the streams interspersed throughout the Western Metamorphic Belt (CDMG 1970).

Gold, silver, chromium, tungsten, and aggregates are the principal mineral resources in the Watershed. Most of the mineral resources mined in the Watershed are associated with the Melones Fault Zone and the accreted terranes of the Foothills Suture Zone. Historic mining activity is therefore concentrated around the area to the west and north of the Ralston Afterbay. A map showing current and historical mining operations is provided as Figure 6.2-3.

Based on a USGS study of the mineral resources in the North Fork American River Wilderness, the mineral resource potential for the North Fork American River in the vicinity of the MFP is likely high and includes gold, chromite, and silver (USGS 1982). Very little mining has been conducted along the Rubicon River. Studies in the Rubicon Roadless Area indicate a low potential for mineral resources. Only minor amounts of lead, copper, and gold were found in abandoned mines and placer deposits (USGS 1983).

6.2.2.5 Soils

This section provides a brief overview of the primary soil types identified along the stream reaches in the vicinity of the MFP. More specific discussion of the soil types, slopes, and slope stability indices is presented in Appendix 6.2-A, and are derived from the Soil Conservation Service (SCS) soil surveys. The parent rock of the soil association is also provided when the connection was discernable from the literature reviews or a comparison of the geology and soil maps. Table 6.2-2 provides SCS soil descriptions, associations, and stability designations with the correlating map code. Figures 6.2-4(a), (b), and (c) show the geographic locations of the soil types with its map code and color-coded slope stability designations. For mapping purposes, only those soil units that are adjacent to Project facilities and bypass streams that are likely to contribute sediment were delineated. Available information on vegetation supported by the soils is summarized in Table 6.2-2. In addition, vegetation present in the Watershed is discussed in detail in Sections 6.6 and 6.8.

In general, the soils surrounding the Project facilities, reservoirs and bypass streams are identified as highly erodible sandy to silty loams with steep unstable slopes. Much of the area is identified as rock outcrop or rock land with only minor amounts of soil. Soils in the upper elevations were formed from weathered volcanic rocks, plutonic rocks, and the Shoo-Fly Complex rocks. Much of the granitic bedrock is barren with no soil or vegetation (NRCS 2006). Soils in the foothills are formed from weathered slates, schists, serpentine rocks, and basic, metabasic, and acid igneous rocks. These soil associations generally consist of well-drained sandy loams (SCS and USDA-FS 1974 and 1980).

The Project reservoirs generally are surrounded by rock outcrops with steep slopes. The banks of the French Meadow Reservoir and Hell Hole Reservoir in the upland areas of the Watershed, consist primarily of granitic and volcanic rock and the soils derived from weathering of those rocks. The banks of the Ralston Afterbay and Middle Fork Interbay in the foothills area of the Watershed consist of vertically tilted schists and slates and soils derived from those rocks. The angle of vertical tilt indicates some drastic uplift and faulting has occurred in the area and may result in unstable steep slopes.

6.2.3 References

California Division of Mines and Geology (CDMG). 1970. Gold Districts of California, Bulletin 193.

CDMG. 2000. CD-ROM 2000-006. Digital database of faults from the Fault Activity Map of California and Adjacent Areas.

California Department of Conservation (CDC). 1981. Geologic Map of the Sacramento Quadrangle, Scale 1:250,000.

CDC. 1992. Geologic Map of the Chico Quadrangle, Scale 1:250,000.

CDC. 1999. Fault Rupture Hazard Zones in California, Special Publication 42, Revised 1997, Supplements 1 and 2 added in 1999.

Natural Resource Conservation Service (NRCS). 2006. Metadata for mapping and descriptions Webpage. http://www.nrcs.usda.gov Accessed on several occasions March, 2006.

Placer County Water Agency (PCWA). 2006. Draft 2005 Physical Habitat Characterization Study. Placer County Water Agency.

SCS and USDA-FS. 1974 (March). Soil Survey of the Tahoe Basin Area, California and Nevada. Issued March 1974.

Soil Conservation Service (SCS) and USDA-FS. 1974 (April). Soil Survey of El Dorado Area, California. Issued April 1974.

SCS and USDA-FS. 1980. Soil Survey of Placer County, California Western Part. Issued 1980.

United States Forest Service (USDA-FS). 2006. USDA-FS, Ecological Subregions of California Webpage. http://www.fs.fed.us/r5/projects/ecoregions/m261eh.htm. Accessed on 3/5/2006.

United States Geological Survey (USGS). 1982. Mineral Resource Potential of the North Fork of the American River Wilderness Study Area, Placer County, California. Miscellaneous Field Studies Map MF-1177-C.

USGS. 1983. Mineral Resource Potential of the Rubicon Roadless Area, Placer and Eldorado Counties, California. Miscellaneous Field Studies Map MF-1501-B.

USGS. 1996. Review of Seismic-Hazard Issues Associated with the Auburn Dam Project, Sierra Nevada Foothills, California, Open File Report 96-0011. USGS Auburn Project Review Team. USGS Webpage, accessed on 5/27/06. http://ca.water.usgs.gov/archive/reports/auburn/review.html.

Watson, C. and J.H. Humphrey, WRC Environmental. 2002. “Duncan Canyon/Long Canyon Paired Watershed Study”, Report to PCWA. December 20, 2002.

TABLES

Table 6.2-1. Primary Geologic Formation in the Watershed.

Name	Map Code	Geologic Time	Age (in mybp)	Description
Glacial Deposits	gl	Quaternary	0-2	Glacial Deposit
Talus	td	Quaternary	0-2	Talus
Mehrten	Tma	Tertiary	2-65	Andesite
Mehrten	TMc	Tertiary	2-65	Andesite Conglomerate
Tertiary Volcanic Rhyolite	TVr	Tertiary	2-65	Rhyolite
Sierra Nevada Batholith and Associated Plutons	gr	Mesozoic	63-240	Granitic rocks
Ultramafic	um	Mesozoic	63-240	Serpentine
Clipper Gap Formation	TCs	Jurassic	138-205	Chert and Argillite
Mariposa	JMm	Jurrassic	138-205	Slate, Meta-Graywacke, and Meta-Conglomerate
Undifferentiated Gabbro	gb	Paleozoic to Mesozoic	63-500	Gabbroic Rocks
Shoo-Fly Complex	DSs	Ordivician to Devonian	360-500	Marine Sediments -- Sandstone
Calaveras Complex -- Sedimentary	PCs	Paleozoic	360-500	Marine Sediments -- Chert and Argillite
Calaveras Complex -- Volcanics	PCv	Paleozoic	360-500	Marine Sediments -- Chert and Argillite

Table 6.2-2. Soil Types, Slope, and Stability Along the Streams Associated with the MFP.

Map Code	Association	Soil Description and Slope	Taxonomy	Parent Rock	Stability Designation	Vegetation
Duncan Creek						
CSF	Crozier	CROZIER-COHASSET COMPLEX, 30 TO 50 PERCENT SLOPES	Crozier -- ULTIC HAPLOXERALFS, FINE-LOAMY, MIXED, MESIC Cohasset -- Fine-loamy, mixed, mesic Ultic Haploxeralfs	Mehrten	Severe -- Slope/erodibility	Conifers and hardwoods
CTG	Crozier	CROZIER-MCCARTHY-COHASSET COMPLEX, 30 TO 75 PERCENT SLOPES	Crozier -- ULTIC HAPLOXERALFS, FINE-LOAMY, MIXED, MESIC McCarthy -- Medial-skeletal, mesic Andic Xerumbrepts Cohasset -- Fine-loamy, mixed, mesic Ultic Haploxeralfs	Mehrten	Severe to Very Severe -- Slope/erodibility	Conifers and hardwoods
CUG	Crozier	CROZIER-MARIPOSA-CRYUMBREPTS, WET COMPLEX, 30 TO 75 PERCENT SLOPES	Crozier -- ULTIC HAPLOXERALFS, FINE-LOAMY, MIXED, MESIC Mariposa -- Fine-loamy, mixed, mesic Ruptic-Lithic-Xerochreptic Haploxerults	Mehrten	Severe to Very Severe -- Slope/erodibility	Conifers and hardwoods
DDH	Deadwood	ROCK OUTCROP-DEADWOOD ASSOCIATION, 50 TO 100 PERCENT SLOPES	Loamy-skeletal, mixed, mesic Dystric Lithic Xerochrepts		Severe to Very Severe -- Slope/erodibility	
DEG	Deadwood	DEADWOOD-ROCK OUTCROP-HURLBUT COMPLEX, 30 TO 75 PERCENT SLOPES	Deadwood -- Loamy-skeletal, mixed, mesic Dystric Lithic Xerochrepts Hurlbut -- DYSTRIC XEROCHREPTS, FINE-LOAMY, MIXED, MESIC		Severe to Very Severe -- Slope/erodibility	
HUE	Hurlbut	HURLBUT-DEADWOOD-MARIPOSA COMPLEX, 2 TO 30 PERCENT SLOPES	Deadwood -- Loamy-skeletal, mixed, mesic Dystric Lithic Xerochrepts Hurlbut -- DYSTRIC XEROCHREPTS, FINE-LOAMY, MIXED, MESIC Mariposa -- Fine-loamy, mixed, mesic Ruptic-Lithic-Xerochreptic Haploxerults		Moderate to Severe -- Slope/erodibiity	
HUG	Hurlbut	HURLBUT-DEADWOOD-ROCK OUTCROP COMPLEX, 30 TO 75 PERCENT SLOPES	Deadwood -- Loamy-skeletal, mixed, mesic Dystric Lithic Xerochrepts Hurlbut -- DYSTRIC XEROCHREPTS, FINE-LOAMY, MIXED, MESIC		Severe to Very Severe -- Slope/Severely eroded	
IMG	Ledmount	LEDMOUNT-MCCARTHY-ROCK OUTCROP COMPLEX, 30 TO 75 PERCENT SLOPES	Ledmount -- LITHIC XERUMBREPTS, MEDIAL-SKELETAL, FRIGID McCarthy -- Medial-skeletal, mesic Andic Xerumbrepts		Severe to Very Severe -- Slope/Severely eroded	
JZG	Jocal	JOCAL-JOCAL VARIANT-CRYUMBREPTS, WET COMPLEX, 50 TO 75 PERCENT S LOPES	ULTIC HAPLOXERALFS, LOAMY-SKELETAL, MIXED, MESIC		Severe to Very Severe -- Slope/Severely eroded	
MAE	Mariposa	MARIPOSA-JOCAL COMPLEX, 2 TO 30 PERCENT SLOPES	Mariposa -- Fine-loamy, mixed, mesic Ruptic-Lithic-Xerochreptic Haploxerults Jocal -- ULTIC HAPLOXERALFS, LOAMY-SKELETAL, MIXED, MESIC	Mariposa	Moderate to Severe -- Slope/erodibiity	Conifers, hardwoods and brush

Table 6.2-2. Soils Summary Table (continued).

Map Code	Association	Soil Description and Slope	Taxonomy		Stability Designation	Vegetation
Duncan Creek (continued)						
MCG	McCarthy	MCCARTHY-LEDMOUNT-CROZIER COMPLEX, 30 TO 75 PERCENT SLOPES	Ledmount -- LITHIC XERUMBREPTS, MEDIAL-SKELETAL, FRIGID McCarthy -- Medial-skeletal, mesic Andic Xerumbrepts Crozier -- ULTIC HAPLOXERALFS, FINE-LOAMY, MIXED, MESIC	Mehrten	Severe to Very Severe -- Slope/Severely eroded	Conifers and hardwoods
SMG	Smokey	SMOKEY-WOODSEYE-ROCK OUTCROP COMPLEX, 30 TO 75 PERCENT SLOPES	Smokey -- DYSTRIC XEROCHREPTS, LOAMY-SKELETAL, MIXED, FRIGID Woodseye -- Loamy-skeletal, mixed, frigid Lithic Xerumbrepts		Severe to Very Severe -- Slope/erodibilty	
TBE	Tallac	TALLAC-CRYUMBREPTS, WET COMPLEX, 2 TO 30 PERCENT SLOPES	PACHIC XERUMBREPTS, LOAMY-SKELETAL, MIXED, FRIGID	Glacial	Moderate -- Slope/erodibility	Dense conifers and shrubs
TBF	Tallac	TALLAC-CRYUMBREPTS, WET COMPLEX, 30 TO 50 PERCENT SLOPES	PACHIC XERUMBREPTS, LOAMY-SKELETAL, MIXED, FRIGID	Glacial	Sever -- Slope/Erodibility	Dense conifers and shrubs
WOG	Woodseye	WOODSEYE-ROCK OUTCROP-SMOKEY COMPLEX, 30 TO 75 PERCENT SLOPES	Smokey -- DYSTRIC XEROCHREPTS, LOAMY-SKELETAL, MIXED, FRIGID Woodseye -- Loamy-skeletal, mixed, frigid Lithic Xerumbrepts		Severe to Very Severe -- Slope/erodibility	
Long Canyon						
114	Cohasset	COHASSET-MCCARTHY ASSOCIATION, RHYOLITIC SUBSTRATUM, 5 TO 30 PERCENT SLOPES	McCarthy -- Medial-skeletal, mesic Andic Xerumbrepts Cohasset -- Fine-loamy, mixed, mesic Ultic Haploxeralfs		Moderate to Severe -- Slope/erodibility	Conifers and hardwoods
115	Cohasset	COHASSET-MCCARTHY ASSOCIATION RHYOLITIC SUBSTRATUM, 30 TO 75 PERCENT SLOPES	McCarthy -- Medial-skeletal, mesic Andic Xerumbrepts Cohasset -- Fine-loamy, mixed, mesic Ultic Haploxeralfs		Very severe to severe - slope/erodibility	Conifers and hardwoods
170	Mariposa	MARIPOSA-JOCAL COMPLEX, 30 TO 75 PERCENT SLOPES	Mariposa -- Fine-loamy, mixed, mesic Ruptic-Lithic-Xerochreptic Haploxerults Jocal -- ULTIC HAPLOXERALFS, LOAMY-SKELETAL, MIXED, MESIC	Mariposa	Very severe to severe - slope/erodibility	Conifers, hardwoods and brush
172	Mariposa	MARIPOSA-MAYMEN COMPLEX, 30 TO 75 PERCENT SLOPES	Mariposa -- Fine-loamy, mixed, mesic Ruptic-Lithic-Xerochreptic Haploxerults Maymen -- Loamy, mixed, mesic Dystric Lithic Xerochrepts	Mariposa/Calaveras	Severe - Slope/erodibility	Conifers, hardwoods and brush
173	Maymen	MAYMEN-ROCK OUTCROP ASSOCIATION, 30 TO 75 PERCENT SLOPES	Maymen -- Loamy, mixed, mesic Dystric Lithic Xerochrepts	Calaveras	Very severe to severe - slope/erodibility	
174	Maymen	MAYMEN-ROCK OUTCROP ASSOCIATION, 75 TO 100 PERCENT SLOPES	Maymen -- Loamy, mixed, mesic Dystric Lithic Xerochrepts	Calaveras	Very severe to severe - slope/erodibility	
196		PITS, BORROW			Not rated	

Table 6.2-2. Soils Types (continued).

Map Code	Association	Soil Description and Slope	Taxonomy		Stability Designation	Vegetation
Long Canyon (continued)						
221	Zeibright	ZEIBRIGHT EXTREMELY GRAVELLY COARSE SANDY LOAM, 2 TO 30 PERCENT SLOPE	ENTIC XERUMBREPTS, LOAMY-SKELETAL, MIXED, MESIC		Moderate to Sever -- Slope/Stability	
222	Zeibright	ZEIBRIGHT EXTREMELY GRAVELLY COARSE SANDY LOAM, 30 TO 75 PERCENT SLOPES	ENTIC XERUMBREPTS, LOAMY-SKELETAL, MIXED, MESIC		Very severe to severe - slope/erodibility	
Middle Fork American River -- French Meadows Reservoir to Ralston Afterbay						
154	Jocal	JOCAL-MARIPOSA-UMBREPTS ASSOCIATION, 30 TO 75 PERCENT SLOPES	Mariposa -- Fine-loamy, mixed, mesic Ruptic-Lithic-Xerochreptic Haploxerults Jocal -- ULTIC HAPLOXERALFS, LOAMY-SKELETAL, MIXED, MESIC	Mariposa	Very severe to severe - slope/erodibility	
170	Mariposa	MARIPOSA-JOCAL COMPLEX, 30 TO 75 PERCENT SLOPES	Mariposa -- Fine-loamy, mixed, mesic Ruptic-Lithic-Xerochreptic Haploxerults Jocal -- ULTIC HAPLOXERALFS, LOAMY-SKELETAL, MIXED, MESIC	Mariposa	Very severe to severe - slope/erodibility	Conifers, hardwoods and brush
172	Mariposa	MARIPOSA-MAYMEN COMPLEX, 30 TO 75 PERCENT SLOPES	Mariposa -- Fine-loamy, mixed, mesic Ruptic-Lithic-Xerochreptic Haploxerults Maymen -- Loamy, mixed, mesic Dystric Lithic Xerochrepts	Mariposa/Calaveras	Severe - Slope/erodibility	Conifers, hardwoods and brush
173	Maymen	MAYMEN-ROCK OUTCROP ASSOCIATION, 30 TO 75 PERCENT SLOPES	Maymen -- Loamy, mixed, mesic Dystric Lithic Xerochrepts	Mariposa	Very severe to severe - slope/erodibility	
ACE	ahart	AHART-WACA, RHYOLITIC SUBSTRATUM, 2 TO 30 PERCENT SLOPES	Ahart -- Medial, frigid Andic Xerumbrepts Waca -- Medial-skeletal, frigid Andic Xerumbrepts		Moderate to Severe -- Slope/erodibiity	Dense conifers
ACF	ahart	AHART-WACA, RHYOLITIC SUBSTRATUM COMPLEX, 30 TO 50 PERCENT SLOPES	Ahart -- Medial, frigid Andic Xerumbrepts Waca -- Medial-skeletal, frigid Andic Xerumbrepts		Severe -- Slope/erodibility	Dense conifers
AEE	Ahart	AHART-ROCK OUTCROP-LEDMOUNT VARIANT COMPLEX, 2 TO 30 PERCENT SLOPES	Ahart -- Medial, frigid Andic Xerumbrepts		Moderate to Severe -- Slope/erodibiity	Sparse Conifers
CUG	Crozier	CROZIER-MARIPOSA-CRYUMBREPTS, WET COMPLEX, 30 TO 75 PERCENT SLOPES	Crozier -- ULTIC HAPLOXERALFS, FINE-LOAMY, MIXED, MESIC Mariposa -- Fine-loamy, mixed, mesic Ruptic-Lithic-Xerochreptic Haploxerults		Severe to Very Severe -- Slope/erodibility	Conifers and hardwoods
DDH	deadwood	ROCK OUTCROP-DEADWOOD ASSOCIATION, 50 TO 100 PERCENT SLOPES	Loamy-skeletal, mixed, mesic Dystric Lithic Xerochrepts		Severe to Very Severe -- Slope/erodibility	
DEG	Deadwood	DEADWOOD-ROCK OUTCROP-HURLBUT COMPLEX, 30 TO 75 PERCENT SLOPES	Deadwood -- Loamy-skeletal, mixed, mesic Dystric Lithic Xerochrepts Hurlbut -- DYSTRIC XEROCHREPTS, FINE-LOAMY, MIXED, MESIC		Severe to Very Severe -- Slope/erodibility	
FFE	Ponto	PONTO VARIANT-NEER COMPLEX, 2 TO 30 PERCENT SLOPES	Ponto -- ANDIC XEROCHREPTS, MEDIAL, MESIC Neer -- TYPIC VITRIXERANDS, MEDIAL-SKELETAL, MESIC		Moderate to Severe -- Slope/erodibiity	

Table 6.2-2. Soils Types (continued).

Map Code	Association	Soil Description and Slope	Taxonomy		Stability Designation	Vegetation
Middle Fork American River -- French Meadows Reservoir to Ralston Afterbay (continued)						
FFF	Ponto	PONTO VARIANT-NEER COMPLEX, 30 TO 50 PERCENT SLOPES	Ponto -- ANDIC XEROCHREPTS, MEDIAL, MESIC Neer -- TYPIC VITRIXERANDS, MEDIAL-SKELETAL, MESIC		Severe -- Slope/erodibility	
FGG3	Ponto	PONTO VARIANT-NEER-ROCK OUTCROP COMPLEX, 30 TO 75 PERCENT SLOPES , SEVERELY ERODED	Ponto -- ANDIC XEROCHREPTS, MEDIAL, MESIC Neer -- TYPIC VITRIXERANDS, MEDIAL-SKELETAL, MESIC		Severe to Very Severe -- Slope/Severely eroded	
HUE	Hurlbut	HURLBUT-DEADWOOD-MARIPOSA COMPLEX, 2 TO 30 PERCENT SLOPES	Deadwood -- Loamy-skeletal, mixed, mesic Dystric Lithic Xerochrepts Hurlbut -- DYSTRIC XEROCHREPTS, FINE-LOAMY, MIXED, MESIC Mariposa -- Fine-loamy, mixed, mesic Ruptic-Lithic-Xerochreptic Haploxerults		Moderate to Severe -- Slope/erodibiity	
HUG	hurlburt	HURLBUT-DEADWOOD-ROCK OUTCROP COMPLEX, 30 TO 75 PERCENT SLOPES	Deadwood -- Loamy-skeletal, mixed, mesic Dystric Lithic Xerochrepts Hurlbut -- DYSTRIC XEROCHREPTS, FINE-LOAMY, MIXED, MESIC		Severe to Very Severe -- Slope/Severely eroded	
HUG	Hurlbut	HURLBUT-DEADWOOD-ROCK OUTCROP COMPLEX, 30 TO 75 PERCENT SLOPES	Deadwood -- Loamy-skeletal, mixed, mesic Dystric Lithic Xerochrepts Hurlbut -- DYSTRIC XEROCHREPTS, FINE-LOAMY, MIXED, MESIC		Severe to Very Severe -- Slope/Severely eroded	
JZG	Jocal	JOCAL-JOCAL VARIANT-CRYUMBREPTS, WET COMPLEX, 50 TO 75 PERCENT S LOPES	ULTIC HAPLOXERALFS, LOAMY-SKELETAL, MIXED, MESIC		Severe to Very Severe -- Slope/Severely eroded	
MCE	McCarthy	MCCARTHY-LEDMOUNT-CROZIER COMPLEX, 2 TO 30 PERCENT SLOPES	Ledmount -- LITHIC XERUMBREPTS, MEDIAL-SKELETAL, FRIGID McCarthy -- Medial-skeletal, mesic Andic Xerumbrepts Crozier -- ULTIC HAPLOXERALFS, FINE-LOAMY, MIXED, MESIC		Moderate to Severe -- Slope/erodibiity	Conifers and hardwoods
MmF		METAMORPHIC ROCK LAND			Not Rated	
PTE	Putt	PUTT-ROCK OUTCROP-CRYUMBREPTS, WET COMPLEX, 2 TO 30 PERCENT SLOP ES	ANDIC XERUMBREPTS, LOAMY-SKELETAL, MIXED, MESIC		Moderate -- Slope/erodibility	
PVG	Putt	PUTT-ROCK OUTCROP, GRANITIC-ZEIBRIGHT COMPLEX, 30 TO 75 PERCENT SLOPES	Putt -- ANDIC XERUMBREPTS, LOAMY-SKELETAL, MIXED, MESIC Zeibright -- ENTIC XERUMBREPTS, LOAMY-SKELETAL, MIXED, MESIC		Severe to Very Severe -- Slope/erodibility	
R		RIVERWASH			Unrated	
RPG	Putt	ROCK OUTCROP, GRANITIC-PUTT COMPLEX, 30 TO 75 PERCENT SLOPES	ANDIC XERUMBREPTS, LOAMY-SKELETAL, MIXED, MESIC		Severe to Very Severe -- Slope/erodiblity	

Table 6.2-2. Soils Types (continued).

Map Code	Association	Soil Description and Slope	Taxonomy		Stability Designation	Vegetation
Middle Fork American River -- French Meadows Reservoir to Ralston Afterbay (continued)						
RVE	Waca	ROCK OUTCROP-WACA, RHYOLITIC SUBSTRATUM-LEDMOUNT VARIANT COMPLEX ,2 TO 30 PERCENT SLOPES	Waca -- Medial-skeletal, frigid Andic Xerumbrepts		Moderate to Severe -- Slope/erodibility	
TAE	Tallac	TALLAC VERY GRAVELLY SANDY LOAM, 2 TO 30 PERCENT SLOPES	PACHIC XERUMBREPTS, LOAMY-SKELETAL, MIXED, FRIGID		Moderate -- Slope/erodibility	Dense conifers and shrubs
TBE	Tallac	TALLAC-CRYUMBREPTS, WET COMPLEX, 2 TO 30 PERCENT SLOPES	PACHIC XERUMBREPTS, LOAMY-SKELETAL, MIXED, FRIGID		Moderate -- Slope/erodibility	Dense conifers and shrubs
ZEE	Zeibright	ZEIBRIGHT GRAVELLY FINE SANDY LOAM, 2 TO 30 PERCENT SLOPES	ENTIC XERUMBREPTS, LOAMY-SKELETAL, MIXED, MESIC		Severe -- Slope/erodibility	
Middle Fork American River -- Ralston Afterbay to North Fork Confluence						
170	Maymen	MAYMEN-ROCK OUTCROP COMPLEX, 50 TO 75 PERCENT SLOPES	Maymen -- Loamy, mixed, mesic Dystric Lithic Xerochrepts		Not Rated	Brush and scattered stunted conifer and harwood
178		RIVERWASH			Not Rated	
179		ROCK OUTCROP			Not Rated	Sparse grasses and stunted trees
DDH	Deadwood	ROCK OUTCROP-DEADWOOD ASSOCIATION, 50 TO 100 PERCENT SLOPES	Deadwood -- Loamy-skeletal, mixed, mesic Dystric Lithic Xerochrepts		Severe to Very Severe -- Slope/erodibility	
DEG	Deadwood	DEADWOOD-ROCK OUTCROP-HURLBUT COMPLEX, 30 TO 75 PERCENT SLOPES	Deadwood -- Loamy-skeletal, mixed, mesic Dystric Lithic Xerochrepts Hurlbut -- DYSTRIC XEROCHREPTS, FINE-LOAMY, MIXED, MESIC		Severe to Very Severe -- Slope/erodibility	
DUF	Dubakella	DUBAKELLA-DUBAKELLA VARIANT-ROCK OUTCROP COMPLEX, 30 TO 50 PERCENT	LITHIC MOLLIC HAPLOXERALFS, LOAMY-SKELETAL, SERPENTINITIC, MESIC		Severe -- Slope/erodibility	
HsE	Horseshoe	HORSESHOE GRAVELLY LOAM, 30 TO 50 PERCENT SLOPES	XERIC HAPLOHUMULTS, FINE-LOAMY, OXIDIC, MESIC		Severe -- Slope/erodibility	Conifers and hardwoods
HUE	Hurlbut	HURLBUT-DEADWOOD-MARIPOSA COMPLEX, 2 TO 30 PERCENT SLOPES	Deadwood -- Loamy-skeletal, mixed, mesic Dystric Lithic Xerochrepts Hurlbut -- DYSTRIC XEROCHREPTS, FINE-LOAMY, MIXED, MESIC Mariposa -- Fine-loamy, mixed, mesic Ruptic-Lithic-Xerochreptic Haploxerults		Moderate to Severe -- Slope/erodibiity	
HUG	Hurlbut	HURLBUT-DEADWOOD-ROCK OUTCROP COMPLEX, 30 TO 75 PERCENT SLOPES	Deadwood -- Loamy-skeletal, mixed, mesic Dystric Lithic Xerochrepts Hurlbut -- DYSTRIC XEROCHREPTS, FINE-LOAMY, MIXED, MESIC		Severe to Very Severe -- Slope/Severely eroded	
HUG3	Hurlbut	HURLBUT, THIN SURFACE-DEADWOOD-ROCK OUTCROP COMPLEX, 30 TO 75 PERCENT SLOPES, SEVERELY ERODED	Deadwood -- Loamy-skeletal, mixed, mesic Dystric Lithic Xerochrepts Hurlbut -- DYSTRIC XEROCHREPTS, FINE-LOAMY, MIXED, MESIC		Severe to Very Severe -- Slope/Severely eroded	
MbF	Mariposa	MARIPOSA VERY ROCKY SILT LOAM, 50 TO 70 PERCENT SLOPES	Mariposa -- Fine-loamy, mixed, mesic Ruptic-Lithic-Xerochreptic Haploxerults		Severe to Very Severe -- Slope/erodibility	Conifers, hardwoods and brush

Table 6.2-2. Soils Types (continued).

Map Code	Association	Soil Description and Slope	Taxonomy		Stability Designation	Vegetation
Middle Fork American River -- Ralston Afterbay to North Fork Confluence (continued)						
MmF		METAMORPHIC ROCK LAND			Not Rated	
SaF		SERPENTINE ROCK LAND			Not Rated	Chamise, grasses and Digger pines
TaD		TAILINGS			Not Rated	
North Fork American River to Folsom Reservoir						
170	Maymen	MAYMEN-ROCK OUTCROP COMPLEX, 50 TO 75 PERCENT SLOPES	Maymen -- Loamy, mixed, mesic Dystric Lithic Xerochrepts		Not rated	Brush and scattered stunted conifer and harwood
MmF		METAMORPHIC ROCK LAND			Not Rated	
SaF		SERPENTINE ROCK LAND			Not Rated	Chamise, grasses and Digger pines
Rubicon River						
106	Chaix	CHAIX COARSE SANDY LOAM, 30 TO 75 PERCENT SLOPES	DYSTRIC XEROCHREPTS, COARSE-LOAMY, MIXED, FRIGID			
109	Chaix	CHAIX-ROCK OUTCROP COMPLEX, 30 TO 75 PERCENT SLOPES	DYSTRIC XEROCHREPTS, COARSE-LOAMY, MIXED, FRIGID		Very severe to severe - slope/erodibility	Conifers and hardwoods
137	Hartless	HARTLESS-MIERUF VERY GRAVELLY LOAMS, 30 TO 50 PERCENT SLOPES	Hartless -- Loamy-skeletal, mixed, mesic Dystric Xerochrepts Mieruf -- Fine-loamy, oxidic, mesic Xeric Haplohumults		Severe - Slope/erodibility'	
138	Hartless	HARTLESS-MIERUF VERY GRAVELLY LOAMS, 50 TO 75 PERCENT SLOPES	Hartless -- Loamy-skeletal, mixed, mesic Dystric Xerochrepts Mieruf -- Fine-loamy, oxidic, mesic Xeric Haplohumults		Very severe to severe - slope/erodibility	
140	Hartless	HARTLESS-NEUNS COMPLEX, 30 TO 75 PERCENT SLOPES	Hartless -- Loamy-skeletal, mixed, mesic Dystric Xerochrepts Neuns -- Loamy-skeletal, mixed, mesic Dystric Xerochrepts		Very severe to severe - slope/erodibility	
145	Holland	HOLLAND-BIGHILL COMPLEX 30 TO 75 PERCENT SLOPES	Holland -- ULTIC HAPLOXERALFS, FINE-LOAMY, MIXED, MESIC Bighill -- Coarse-loamy, mixed, mesic Typic Xerumbrepts		Very severe to severe - slope/erodibility	
164		LITHIC XERUMBREPTS-ROCK OUTCROP COMPLEX, 15 TO 75 PERCENT SLOPES			Not rated	
170	Mariposa	MARIPOSA-JOCAL COMPLEX, 30 TO 75 PERCENT SLOPES	Mariposa -- Fine-loamy, mixed, mesic Ruptic-Lithic-Xerochreptic Haploxerults Jocal -- ULTIC HAPLOXERALFS, LOAMY-SKELETAL, MIXED, MESIC		Very severe to severe - slope/erodibility	Conifers, hardwoods and brush

Table 6.2-2. Soils Types (continued).

Map Code	Association	Soil Description and Slope	Taxonomy		Stability Designation	Vegetation
Rubicon River (continued)						
172	Mariposa	MARIPOSA-MAYMEN COMPLEX, 30 TO 75 PERCENT SLOPES	Mariposa -- Fine-loamy, mixed, mesic Ruptic-Lithic-Xerochreptic Haploxerults Maymen -- Loamy, mixed, mesic Dystric Lithic Xerochrepts		Severe - Slope/erodibility	Conifers, hardwoods and brush
173	Maymen	MAYMEN-ROCK OUTCROP ASSOCIATION, 30 TO 75 PERCENT SLOPES	Maymen -- Loamy, mixed, mesic Dystric Lithic Xerochrepts		Very severe to severe - slope/erodibility	
174	Maymen	MAYMEN-ROCK OUTCROP ASSOCIATION, 75 TO 100 PERCENT SLOPES	Maymen -- Loamy, mixed, mesic Dystric Lithic Xerochrepts		Very severe to severe - slope/erodibility	
184	Neuns	NEUNS GRAVELLY LOAM, 50 TO 75 PERCENT SLOPES	Neuns -- Loamy-skeletal, mixed, mesic Dystric Xerochrepts		Very severe to severe - slope/erodibility	
185	Neuns	NEUNS-LITHIC XERUMBREPTS-ROCK OUTCROP ASSOCIATION, 50 TO 100 PERCENT SLOPES	Neuns -- Loamy-skeletal, mixed, mesic Dystric Xerochrepts		Very severe to severe - slope/erodibility	
193	Pilliken	PILLIKEN COARSE SANDY LOAM, 30 TO 50 PERCENT SLOPES	Coarse-loamy, mixed, mesic Entic Xerumbrepts		Severe - Slope/erodibility	
195	Pilliken	PILLIKEN-ROCK OUTCROP COMPLEX, 30 TO 50 PERCENT SLOPES	Coarse-loamy, mixed, mesic Entic Xerumbrepts		Severe - Slope/erodibility	
200	Tinker	ROCK OUTCROP-TINKER ASSOCIATION, 15 TO 75 PERCENT SLOPES	ANDIC HAPLUMBREPTS, LOAMY-SKELETAL, MIXED, FRIGID		Severe - Slope/erodibility	
204	Tallac	TALLAC VARIANT-LITHIC XERUMBREPTS-ROCK OUTCROP COMPLEX, 15 TO 50 PERCENT SLOPES	PACHIC XERUMBREPTS, LOAMY-SKELETAL, MIXED, FRIGID		Moderate to Severe -- Slope/erodibility, or not rated	Dense conifers and shrubs
207	Tinker	TINKER-TALLAC COMPLEX, 50 TO 75 PERCENT SLOPES	Tallac -- PACHIC XERUMBREPTS, LOAMY-SKELETAL, MIXED, FRIGID ANDIC HAPLUMBREPTS, LOAMY-SKELETAL, MIXED, FRIGID		Very severe to severe - slope/erodibility	Dense conifers and shrubs
221	Zeibright	ZEIBRIGHT EXTREMELY GRAVELLY COARSE SANDY LOAM, 2 TO 30 PERCENT SLOPES	ENTIC XERUMBREPTS, LOAMY-SKELETAL, MIXED, MESIC		Moderate to Sever -- Slope/Stability	
222	Zeibright	ZEIBRIGHT EXTREMELY GRAVELLY COARSE SANDY LOAM, 30 TO 75 PERCENT SLOPES	ENTIC XERUMBREPTS, LOAMY-SKELETAL, MIXED, MESIC		Very severe to severe - slope/erodibility	
224	Zeibright	ZEIBRIGHT-ROCK OUTCROP ASSOCIATION, 15 TO 75 PERCENT SLOPES	ENTIC XERUMBREPTS, LOAMY-SKELETAL, MIXED, MESIC		Severe -- Slope/erodibility	
DEG	Hurlbut	HURLBUT-DEADWOOD-ROCK OUTCROP COMPLEX, 30 TO 75 PERCENT SLOPES	Deadwood -- Loamy-skeletal, mixed, mesic Dystric Lithic Xerochrepts Hurlbut -- DYSTRIC XEROCHREPTS, FINE-LOAMY, MIXED, MESIC		Severe to Very Severe -- Slope/erodibility	
HSE	Horseshoe	HORSESHOE GRAVELLY LOAM, 30 TO 50 PERCENT SLOPES	XERIC HAPLOHUMULTS, FINE-LOAMY, OXIDIC, MESIC		Severe -- Slope/erodibility	Conifers and hardwoods
HUG	Hurlbut	HURLBUT-DEADWOOD-ROCK OUTCROP COMPLEX, 30 TO 75 PERCENT SLOPES	Deadwood -- Loamy-skeletal, mixed, mesic Dystric Lithic Xerochrepts Hurlbut -- DYSTRIC XEROCHREPTS, FINE-LOAMY, MIXED, MESIC		Severe to Very Severe -- Slope/Severely eroded	
Mbf	Mariposa	MARIPOSA VERY ROCKY SILT LOAM, 50 TO 70 PERCENT SLOPES	Mariposa -- Fine-loamy, mixed, mesic Ruptic-Lithic-Xerochreptic Haploxerults		Severe to Very Severe -- Slope/erodibility	Conifers, hardwoods and brush
MMF		METAMORPHIC ROCK LAND			Not Rated	

FIGURES

Placeholder for Figures 6.2-1- 4

6.2-1 Topography in the MFAR Watershed

6.2-2 Geology in the MFAR Watershed

6.2-3 Historic and Current Mining Activity in the MFAR Watershed

6.2-4 Soil Types and Stability (3 sheets)

Non-Internet Public Information

These Figures have been removed in accordance with the Commission regulations at 18 CFR Section 388.112.

These Figures are considered Non-Internet Public information and should not be posted on the Internet. This information may be accessed from the Placer County Water Agency's (PCWA) Public Reference Room, but is not expected to be posted on PCWA's Website, except as an indexed item.

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6.5 FISH AND AQUATIC RESOURCES

This report describes the fish and aquatic resources in the reservoirs and bypass streams associated with the Middle Fork American River Project (MFP or Project), and in the streams immediately upstream of Project facilities. The content requirements for this report are specified in Title 18 of the Code of Federal Regulations (CFR) Chapter 1 § (d) (3) (iv) as follows:

> ***Fish and aquatic resources.*** *A description of the fish and other aquatic resources, including invasive species, in the project vicinity. This section must discuss the existing fish and macroinvertebrate communities, including the presence or absence of anadromous, catadromous, or migratory fish, and any known or potential upstream or downstream impacts of the project on the aquatic community. Components of the description must include:*
>
> *(A) Identification of existing fish and aquatic communities;*
>
> *(B) Identification of any essential fish habitat as defined under the Magnuson-Stevens Fishery Conservation and Management Act and established by the National Marine Fisheries Service; and*
>
> *(C) Temporal and spacial distribution of fish and aquatic communities and any associated trends with respect to:*
>
> *(1) Species and life stage composition;*
>
> *(2) Standing crop;*
>
> *(3) Age and growth data;*
>
> *(4) Spawning run timing; and*
>
> *(5) The extent and location of spawning, rearing, feeding, and wintering habitat.*

6.5.1 Information Sources

The information presented in this report was developed by acquiring, compiling, and reviewing data available in various Resource Agency files, websites and through personal communications with Resource Agency staff, as follows.

- California Department of Fish and Game (CDFG) Region II files for Placer and El Dorado counties, and the water bodies of interest;
- CDFG Region II Senior Hatchery Supervisor;
- CDFG Website (www.dfg.ca.gov);
- Tahoe National Forest (TNF), Foresthill Ranger District, files for the water bodies of interest;

- Eldorado National Forest (ENF), Georgetown Ranger District, files provided by Jann Williams, Fisheries Biologist;
- State Water Resources Control Board;
- Central Valley Regional Water Quality Control Board;
- University of California MELVYL Library Catalog; and
- General Internet searches.

In addition, previously published reports were retrieved and reviewed. Pertinent data was incorporated into this report and references cited are provided at the end of this report.

The information presented in this report also relies on data contained in two study reports prepared by the Placer County Water Agency (PCWA) in association with the relicensing of the MFP. These include:

- Draft 2005 Physical Habitat Characterization Study Report (PCWA 2006a), and
- Draft 2005 Water Temperature Study Report (PCWA 2006b).

The Draft 2005 Physical Habitat Characterization Study Report provided information on the types and distribution of aquatic habitat in many of the stream and river reaches associated with the MFP. Similarly, the 2005 Water Temperature Study Report provided water temperature information based on studies conducted in 2005. Both of these reports are referenced throughout this report and should be referred to for additional information on study methods and results.

6.5.2 Description of Existing Conditions Overview

The following provides an overview of the fish communities, benthic macroinvertebrates, and special status aquatic species in the vicinity of the MFP, including bypass reaches and Project reservoirs. Information on amphibians and aquatic reptiles is provided in Section 6.6.

6.5.2.1 Fish Community

The Sacramento-San Joaquin drainage, which includes the American River and tributaries that drain the west slope of the Sierra Nevada, historically contained the richest native fish fauna of the Sierra Nevada, with 22 taxa (Moyle et al. 1996). Fourteen of these native fishes (including 4 runs of Chinook salmon) historically may have occurred in the bypass streams associated with the MFP. Table 6.5-1 lists these native fish, their potential to occur in the Middle Fork American River Watershed (Watershed) and their current management status.

Three native anadromous species (winter steelhead, Pacific lamprey, and Chinook salmon) that historically migrated into the Watershed are currently excluded from the region by Nimbus and Folsom dams on the lower American River. Both steelhead and Chinook salmon reportedly ascended the Middle Fork American River past the Rubicon

River confluence, and the Rubicon River as far as the Pilot Creek confluence, which is approximately 5 miles upstream of the Middle Fork American River confluence (Yoshiyama et al. 1996).

Fish stocking and non-native fish introductions have modified the fish distribution and species composition in the Watershed. Ten non-native species have been stocked or established populations by means other than intentional stocking in reservoir and bypass streams associated with the MFP. In addition, rainbow trout/steelhead have been stocked outside of their historical, natural distribution (Table 6.5-2). As early as the 1800s, trout were stocked in an effort to establish populations where none previously existed (Knapp 1996). As a result, the status of native rainbow trout (which would have descended from steelhead that residualized upstream of Folsom Dam) in bypass streams is difficult to determine due to extensive genetic introgression with introduced hatchery rainbow trout (Knapp 1996). Historical fish stocking records obtained from CDFG Region II files are summarized in the tables presented in Appendix 6.5-A.

A limited amount of fish sampling (electrofishing, snorkeling, gillnetting, and angling) has been conducted in the reservoirs and bypass streams associated with the MFP by CDFG, the US Department of Agriculture, Forest Service (USDA-FS), and others. A summary of the fish sampling data is presented in Table 6.5-3. Reported quantitative fish population (fish per mile) or standing crop estimates (pounds per acre) are included by reach in Table 6.5-3 along with the approximate river mile of the sampling location and the length of the sampling reach. Qualitative data are also included in Table 6.5-3. For reference purposes, historic fish sampling data in Sierra streams indicated that the average trout standing crop was 41 pounds per acre or approximately 224 adult trout (fish over 6 inches) per mile (Gerstung 1973).

The assemblages of fish species known to occur, or with a reasonable potential to occur, in the bypass reaches and reservoirs associated with the MFP are presented in Table 6.5-4. The known occurrences and distributions of trout in the Watershed are well established relative to those of other fish species, such as hardhead. Historical electrofishing sampling results in the Watershed commonly present trout-biased data (indicating only the trout captured). It is possible that other species are present in the Watershed. The presence of fish in particular stream reaches (e.g., Table 6.5-4), therefore, may change as additional information is obtained and reviewed. A reach-by-reach description of current information on fish and fish habitat is presented in Section 6.5.3.

6.5.2.2 Benthic Macroinvertebrates

Benthic macroinvertebrates inhabit the sediment or live on the bottom substrates of rivers and streams. For reasons such as variations in elevation, climate patterns, geology, substrate, streamflow, and riparian vegetation, it is not possible to describe a typical western Sierra Nevada aquatic invertebrate assemblage (Erman 1996). Generally, however, the aquatic invertebrate fauna of the Sierra Nevada is numerous, diverse, and includes many endemic species (Erman 1996). The status or health of benthic macroinvertebrate communities is typically measured and compared using various metrics (species richness, diversity, abundance, pollution tolerance of individuals, etc.) that are combined or used individually as numerical indices. In this report, species richness, Shannon Diversity Index, Hilsenhoff Biotic Index (HBI), EPT index, and the California Tolerance Level are presented.

Limited quantitative macroinvertebrate data were obtained for the bypass streams associated with the MFP. Despite numerous Resource Agency datasheets indicating that aquatic macroinvertebrate sampling has occurred within bypass streams, only four studies provide data summaries of macroinvertebrate assemblages collected (JSA 2002, 2003, and 2005; USDA-FS 2005). Macroinvertebrate information from these studies are summarized in this report.

6.5.2.3 Special Status Aquatic Species

For the purposes of this report, special-status aquatic species are defined as aquatic species granted status by federal and state agencies. Federally listed species granted status by the U.S. Fish and Wildlife Service (USFWS) under the Endangered Species Act (ESA) include threatened (FT), endangered (FE), proposed threatened and endangered (FPT, FPE), candidate (FC) or listed species proposed for delisting (FPD).

State-listed aquatic species, which are granted status by the CDFG under the California Endangered Species Act (CESA), include threatened (ST), endangered (SE), California Fully Protected Species (CFP), and California Species of Special Concern (CSC).

USDA-FS maintains lists of Forest Service Sensitive (FSS) species and National Forest Management Indicatory Species (MIS) for each forest. FSS species are those species identified by a Regional Forester as having current or predicted downward trends in population numbers or density, or current or predicted downward trends in habitat quality that would reduce the species' current distribution.

Three special-status fish species are known to occur or potentially occur in the Watershed. The special-status fish species includes hardhead (FSS, CSC); brown trout (MIS); and rainbow trout (MIS). No ESA or CESA listed threatened or endangered fish or aquatic invertebrates are known to occur in the watershed. Brief descriptions of the life histories and habitat requirements of these species are presented in Appendix 6.5-B.

6.5.3 Description of the Fish and Macroinvertebrate Communities by Reach

The following describes the fish and macroinvertebrate communities in the vicinity of the MFP organized by river reach. Information about water temperature and habitat is also summarized. The community information was developed mainly by reviewing data contained in Resource Agency files and in published literature. The temperature and habitat information is based mainly on information documented in PCWA's Draft 2005 Physical Habitat Characterization Report (PCWA 2006a) and Draft 2005 Water Temperature Study Report (PCWA 2006b).

6.5.3.1 Middle Fork American River

Middle Fork American River above French Meadows Reservoir

The tributaries to French Meadows Reservoir generally are steep, narrow channels composed of primarily bedrock, boulders, and cobbles (TNF 2002). The primary tributary, the Middle Fork American River, had a maximum observed water temperature of 75.5°F, and a maximum daily average temperature of 68°F during 2005. The Middle Fork American River likely provides the only potential stream spawning habitat for the rainbow and brown trout that reside in French Meadows Reservoir.

Qualitative electrofishing surveys were conducted in the Middle Fork American River above French Meadows Reservoir in August 1986. Several areas were electrofished, with both brown trout and rainbow trout collected; brown trout were more numerous. The brown trout ranged in size from young-of-year to 13.5 inches, and the rainbow trout from young-of-year to 5 inches (Table 6.5-3).

Qualitative snorkel surveys performed in 1990 by TNF fisheries biologists, as part of the Middle Fork American River Trout Habitat Enhancement Project, indicate that rainbow trout, brown trout, and brook trout reside in the reach of the Middle Fork American River upstream of French Meadows Reservoir. The observed trout ranged in size from 2 to 13 inches fork length, and 2 inch brown trout were the most abundant species/size class observed.

French Meadows Reservoir

French Meadows Reservoir is a coldwater reservoir that becomes thermally stratified during the summer. Summer water temperatures remain cold throughout the majority of the Reservoir's depth (e.g., <45°F at the bottom of the reservoir in the hypolimnion to >70°F at the surface), providing suitable habitat for trout. A more detailed summary of the observed water temperature characteristics of French Meadows Reservoir is presented in the Draft 2005 Water Temperature Study Report (PCWA 2006b).

French Meadows Reservoir contains rainbow and brown trout. Although no stocking records were located, French Meadows Reservoir reportedly contains smallmouth bass, sunfish, and catfish (CDFG 2002). Fish stocking records for the Middle Fork American River around and upstream of the present day reservoir date back to the 1930s and indicate that brown trout, rainbow trout, brook trout, and steelhead all were planted. Reservoir stocking records were obtained for 1968 – 1971 and 2001 – 2005 (Appendix 6.5-A), although it is likely that French Meadows Reservoir has been stocked annually since the completion of French Meadows Dam. During the last five years, rainbow trout, Eagle Lake rainbow trout, and brown trout have been stocked in French Meadows Reservoir (Appendix 6.5-A).

Little information was found describing the trout populations (e.g., standing crop, biomass, age structure, or growth) residing in French Meadows Reservoir. Creel survey data from 1966 indicate that, although numerous, the rainbow trout caught were generally small (typically less than 10 inches). Results from subsequent creel surveys conducted between 1968 and 1971 indicate that annual angler hours ranged from 386 to 1,995 and that catch per hour varied from 0.23 to .45 fish. The majority of trout caught were rainbows. For creel surveys on three dates in 1985, catch rates varied from 0.25 to 0.59 fish per angler hour for brown trout and rainbow trout combined. Rainbow trout caught ranged from 9.5 to 13 inches, and brown trout ranged from 9.5 to 16 inches.

Gill net catch data was obtained from 1975, 1982, and 1985 (see Table 6.5-3). Rainbow trout caught in 1975 ranged from 7.5 to 11 inches in length, and brown trout ranged from 10 to 13 inches in length. In 1982, the rainbow trout ranged from 9.5 to 13 inches, and the brown trout ranged from 7 to 19 inches. The rainbow and brown trout captured in 1985 were between 6 and 7 inches in length.

Middle Fork American River from French Meadows Reservoir to Middle Fork Interbay

Water released into the Middle Fork American River from French Meadows Reservoir is generally cold because it is released from a low-level outlet. During 2005, immediately downstream of French Meadows Reservoir, the maximum observed water temperature was 57°F, and the maximum daily average temperature was 55°F (PCWA 2006b). Water temperature data collected during 2005 indicated that thermal warming during the summer and inflows from Duncan Creek increase the temperature approximately 17°F from French Meadows Reservoir downstream to immediately upstream of Middle Fork Interbay (approximately 10 river miles). The observed instantaneous maximum water temperature during 2005 of inflow into Middle Fork Interbay was 74°F and the maximum daily average was 70°F. A more detailed summary of the water temperature characteristics of the Middle Fork American River between French Meadows Dam and Middle Fork Interbay is presented in the Draft 2005 Water Temperature Study Summary Report (PCWA 2006b).

Rainbow trout, brown trout, hardhead, Sacramento sucker, and Sacramento pikeminnow reportedly occupy this reach of the Middle Fork American River (TNF 2003; ENF 1977) (Table 6.5-4). Fish stocking records indicate that the Middle Fork American River (throughout the Watershed) was stocked with as many as 60,000 rainbow trout almost annually from 1926 to 1953 (Appendix 6.5-A). Between 20,000 and 90,000 brown trout were stocked for 9 out of 10 years from 1930 to 1939. Brook trout and steelhead also were stocked on one occasion each near present day French Meadows Reservoir. More recent stocking records were not located.

No information (e.g., standing crop, biomass, age structure, or growth) was obtained regarding the populations of rainbow trout, brown trout, and hardhead residing in the Middle Fork American River between French Meadows Dam and Middle Fork Interbay.

Aquatic habitat classification results from the 2005 Aquatic Habitat Characterization Study for this reach are provided in Tables 6.5-5 and 6.5-6. Non-turbulent habitat as classified following Hawkins et al. (1993), accounts for approximately 65% of this reach, of which pool habitat accounted for approximately 43%. The most common occurring habitat types as classified following McCain et al. (1990) were Dammed Pools, Cascades, and Riffles, which accounted for over 59% of the habitat unit types and approximately 44% of the total reach length.

Middle Fork Interbay

Water in the Middle Fork Interbay is typically cold because most of the water during the warmer months is routed from Hell Hole Reservoir through the Middle Fork Powerhouse. Somewhat limited data obtained from 2005 indicated that the maximum observed water temperature was 54°F, and the maximum daily average water temperature was 50°F (PCWA 2006b).

Specific information regarding the fish and macroinvertebrate inhabiting Middle Fork Interbay were not located. Because fish can freely move between the reservoir and the river upstream, the fish assemblage in the reservoir is likely similar to that of the Middle Fork American River upstream. However, due to the influences of power operations, the water temperature regime in Middle Fork Interbay during the warmer months of the year is typically cooler than immediately upstream in the Middle Fork American River.

Middle Fork American River from Middle Fork Interbay to Ralston Afterbay

Water released into the Middle Fork American River from Middle Fork Interbay is generally cold (PCWA 2006b). Water temperature data collected in 2005 indicated that the maximum and maximum daily average water temperature below Middle Fork Interbay both were approximately 53°F. During 2005, the maximum observed water temperature at the downstream end of the reach (immediately upstream of Ralston Afterbay was 73°F, and the maximum daily average water temperature was approximately 70°F (PCWA 2006b).

Rainbow trout, brown trout, hardhead, Sacramento sucker, and Sacramento pikeminnow reportedly occupy this reach of the Middle Fork American River (TNF 2003; ENF 1977). Very little information (e.g., standing crop, biomass, age structure, or growth) was obtained regarding the populations of rainbow trout, brown trout, and hardhead. One CDFG memorandum (CDFG 1966) states that trout biomass in the Middle Fork American River downstream of Brushy Canyon Creek confluence was 20 pounds per acre (estimated using electrofishing) while the trout biomass in the river upstream of Brushy Canyon Creek confluence was 50 pounds per acre (estimated visually).

Aquatic habitat classification results from the 2005 Aquatic Habitat Characterization Study for this reach are provided in Tables 6.5-7 and 6.5-8. Non-turbulent habitat, using Hawkins classification system, accounts for approximately 62% of this reach, of which pool habitat accounted for approximately 31%. The most common occurring habitat types using McCain's classification system were Dammed Pools, Cascades, and Runs, which accounted for over 66% of the habitat unit types and approximately 56% of the total reach length.

A reach of river upstream of Ralston Afterbay was sampled for benthic macroinvertebrates in 2001, 2002, and 2004 as part of the Ralston Sediment Management Project (JSA 2002, 2003, 2005). Three riffles were sampled in June, August, and October 2001, 2002, and in August and October 2004. Figure 6.5-1 presents the benthic macroinvertebrate density results. Figure 6.5-2 presents the EPT index results. Figure 6.5-3 presents the taxa richness results. Figure 6.5-4 presents the California Tolerance Level results.

Ralston Afterbay

Ralston Afterbay receives water inputs from three sources: (1) the Rubicon River; (2) the Middle Fork American River; and, (3) the Ralston Powerhouse. Input from the Rubicon and Middle Fork American rivers is much warmer than that from the Ralston Powerhouse, which provides the bulk of the water during the warmer months of the year. Thus, Ralston Afterbay is typically cool (i.e., less than 53°F in the hypolimnion during 2005). Water temperature profiling conducted during 2005 indicated that the surface layer of Ralston Afterbay was subject to thermal warming (maximum surface temperature recorded was 65°F) (PCWA 2006b).

No data on fish composition in the Ralston Afterbay were identified during the information search. However, the fish community in Ralston Afterbay likely is representative of the species found upstream in the Middle Fork American and Rubicon rivers. Therefore, brown trout, rainbow trout, hardhead, Sacramento sucker, and Sacramento pikeminnow are expected to reside in the Ralston Afterbay.

Middle Fork American River – Ralston Afterbay Dam/Oxbow Powerhouse to the North Fork American River Confluence

Water released from Oxbow Powerhouse and Ralston Dam is typically cool. During 2005, the maximum observed water temperature of Oxbow Powerhouse release was 58°F, and the maximum daily average temperature observed was 57°F. Observed water temperatures during 2005 in this reach increased downstream due to inflow from the North Fork of the Middle Fork American River and thermal warming. Water temperature data collected during 2005 in the Middle Fork American River downstream near the confluence with the North Fork American River (approximately 23 river miles from Ralston Dam) indicated that the summer maximum water temperature was 69°F, and the maximum daily average temperature was 65°F (PCWA 2006b).

An indication of the fish assemblage in the Middle Fork American River downstream of Ralston Dam was provided when a large pool at the base of the dam was dewatered to construct a low-level outlet guard valve in 1999. The following species were collected: rainbow trout, brown trout, suckers, speckled dace, sculpin, hardhead, and pikeminnow. Of these, sucker and sculpin were the most abundant.

In addition, USFWS surveys in 1989 documented brown trout, rainbow trout, Sacramento hitch, Sacramento sucker, Sacramento pikeminnow, and riffle sculpin (USBR 1992). CDFG (1979) reports that Sacramento blackfish have been observed in the Middle Fork American River. Information regarding the populations (e.g., abundance or biomass estimates) of rainbow trout, brown trout, and hardhead residing in the Middle Fork American River downstream of Ralston Dam was not located.

Aquatic habitat classification results from the 2005 Aquatic Habitat Characterization Study for this reach are provided in Tables 6.5-9 and 6.5-10. The Middle Fork American River from Ralston Dam to the North Fork American River confluence is dominated by pool habitats, using Hawkins classification system. The most common occurring habitat type using the McCain classification system consists of mid-channel pools. Pool habitat comprises about 39% of the habitat units and 57% of the total reach length. More than 95% of the channel in this reach consists of Rosgen Level 1 F channel type.

Four reaches in the Middle Fork American River downstream of Ralston Afterbay were sampled for benthic macroinvertebrates in 2001, 2002, and 2004 as part of the Ralston Sediment Management Project (JSA 2002, 2003, 2005). Three riffles were sampled in June, August, and October 2001, 2002, and in August and October 2004. Figure 6.5-1 presents the benthic macroinvertebrate density results. Figure 6.5-2 presents the EPT index results. Figure 6.5-3 presents the taxa richness results. Figure 6.5-4 presents the California Tolerance Level results.

6.5.3.2 Duncan Creek

Temperature monitoring upstream and downstream of the Duncan Creek Diversion Dam during 2005 indicated that the maximum observed water temperature was approximately 71°F, and the maximum daily average water temperature was approximately 67°F during the warmest summer months. Water temperatures appear to cool quickly with the onset of cooler weather conditions during the fall (PCWA 2006b).

Stocking records Duncan Creek identified almost 300,000 rainbow trout were planted between 1930 and 1953. Brown trout, brook trout, and steelhead also were planted but in smaller numbers. Appendix 6.5-A details the Duncan Creek fish stocking history.

Forest Service survey datasheets from 1976 indicate that rainbow trout and brook trout were the primary species in Duncan Creek. More recent fish survey information was not located.

Physical aquatic resource and habitat data could not be located for Duncan Creek. PCWA is planning to conduct aquatic habitat mapping in Duncan Creek in 2006. The following excerpt from Tahoe National Forest's Middle Fork American River Watershed Assessment (TNF 2003) provides some general information regarding the aquatic habitat in Duncan Creek:

> *"[Duncan Creek] is predominantly a boulder and large cobble substrate [sic] and is moderately entrenched and confined. Gradients are generally greater than 4%. Side slopes are moderately to very steep. Although the channel is relatively stable, the system periodically transports large amounts of bedload as evidenced by recent cobble and gravel deposition."*

The USDA-FS (2005) prepared an aquatic invertebrate report for samples collected at the same two locations in Duncan Creek during 2002 and 2003. A number of metrics and/or ecological summaries were reported for each sampling locations, including taxa richness, abundance, EPT, Shannon Diversity Index, and HBI. Table 6.5-11 presents a few of the results from the 2002 and 2003 aquatic invertebrate sampling.

6.5.3.3 North Fork American River

North Fork American River – Middle Fork American River Confluence to the Folsom Reservoir High Water Mark

Temperature monitoring in 2005 indicated that water temperatures in the North Fork American River upstream of the Middle Fork American River were very warm during the summer (with a maximum observed water temperature of 82°F, and a maximum daily average of 80°F). Observations during the summer months of 2005 indicated that the Middle Fork American River (with a maximum observed water temperature of 69°F, and maximum daily average water temperature of 65°F) contributed substantially cooler water. Downstream of the Middle Fork American River confluence, the observed water temperatures in the North Fork American River had an instantaneous maximum of 72.5°F, and a maximum daily average of 67°F (PCWA 2006b).

The North Fork American River downstream of the Middle Fork confluence supports both warmwater and coldwater fish assemblages. Warmwater species observed in this reach include smallmouth bass, brown bullhead, and green sunfish. Other species documented include Sacramento hitch, Sacramento sucker, and riffle sculpin (USBR 2002 – Pump Station). In a letter to PCWA regarding the American River Pump Station Project, CDFG states, "*The American River upstream of Folsom Lake maintains a self-sustaining coldwater fishery including rainbow trout, brown trout, and a variety of non-game coldwater species. Adequate spawning, rearing, and holding habitat exists in the system to maintain viable populations of these resident fish. Spawning salmonids use the project area from upstream and downstream locations and provide recruitment to the American River, as well as Folsom Reservoir*" (CDFG Unpublished Memo). A survey datasheet from 1938 indicates that hardhead were observed near the Middle Fork American River confluence.

6.5.3.4 Rubicon River

Rubicon River and Five Lakes Creek Upstream of Hell Hole Reservoir

Two main tributaries, Five Lakes Creek and the Rubicon River, flow into Hell Hole Reservoir. During 2005, the maximum observed water temperature in Five Lakes Creek observed was 67°F, and the maximum daily average temperature was 62.5°F. During 2005 in the Rubicon River upstream of Hell Hole Reservoir, the maximum observed water temperature was 71°F, and the maximum daily average temperature was 67.5°F.

Rainbow trout spawners were observed in Five Lakes Creek in 1971 when CDFG observed six spawned out trout had been caught by anglers. It has been reported that a large waterfall in Five Lakes Creek approximately ¾ miles upstream of Hell Hole Reservoir is a complete migration barrier. The Rubicon River reportedly is accessible during the spring (when rainbow trout would be spawning) when the reservoir is full. During the fall, an approximately 15-foot waterfall (depending on reservoir elevation) is present where the Rubicon River enters Hell Hole Reservoir at the upstream end.

Hell Hole Reservoir

Hell Hole Reservoir is a coldwater reservoir that becomes thermally stratified during the summer. Summer water temperatures remain cold throughout the majority of the reservoir's depth, providing habitat for trout. During the summer of 2005, the hypolimnion was less than 50°F and the surface temperature was about 70°F (note that the summer thermocline was relatively gradual) (PCWA 2006b).

Hell Hole Reservoir has been stocked extensively in the past with a variety of salmonid species including rainbow trout (including Eagle Lake strain), brown trout, brook trout, cutthroat trout (and cutthroat-rainbow hybrids), lake trout, kokanee, and coho salmon. Recent management includes the stocking of brown trout, rainbow trout and kokanee (Appendix 6.5-A). Although official records of recent rainbow plants were not located, the USDA-FS reports that the reservoir is stocked annually with catchable rainbows, (ENF 2006). The lake trout, originally stocked in the 1970s, apparently are self-sustaining in Hell Hole Reservoir and are occasionally observed during gill net and angler surveys.

Periodic gill net sampling conducted in Hell Hole Reservoir also indicates the presence of tui chub and suckers (presumably Sacramento suckers). There was an apparent proliferation of tui chub shortly after Hell Hole Reservoir was completed. In 1966, no tui chub were captured during a 12-hour gill net soak. Four tui chub were captured during a 24-hour gill net soak in 1967 (see Table 6.5-3). Four years later during 1971, 539 tui chub were captured during 81 hours of gill netting. The rates of sucker catches during those samples were similar.

Gill net and angler surveys provide some information on the size of the trout in Hell Hole Reservoir. Six of seven brown trout captured in a gill net in 1974 were greater than 20 inches in length, whereas the 2 rainbow trout captured were 7.5 and 8.8 inches in length. In September 1975, the four brown trout captured by gill nets were all greater than 20 inches in length, while the one rainbow trout was 8.2 inches in length. During an April creel survey in 1985, 86 brown trout were observed ranging from 9.5 to 21.8 inches in length. The 14 rainbow trout observed during that survey ranged from 10 to 15.5 inches in length. The overall trout catch per hour was 0.15 fish for 107 anglers.

Rubicon River from Hell Hole Dam to Ralston Afterbay

Temperature monitoring during 2005 indicated that the temperature of the water released into the Rubicon River from Hell Hole Reservoir was cold (<50°F), but progressively warms in a downstream direction. During the summer, inflow of warmer water from the South Fork Rubicon River and Long Canyon Creek and presumably thermal warming along the length of the reach cause the warming trend (Pilot Creek adds cooler water). Water temperatures observed during 2005 in the lower Rubicon River (immediately upstream of Ralston Afterbay, approximately 30 river miles from Hell Hole Dam) were warm (with a maximum of 78°F and a maximum daily average of 75°F). Daily average temperatures in the lowest reach of the Rubicon River during summer 2005 exceeded 70°F for long periods of time (e.g., months) (PCWA 2006b).

The Rubicon River is a CDFG-designated Wild Trout Stream that contains populations of rainbow trout and brown trout. Other species documented to occur in the Rubicon River include Sacramento sucker, speckled dace, riffle sculpin, Sacramento pikeminnow and hardhead (CDFG 1979). Records obtained indicated that the Rubicon River was extensively stocked from 1928 through 1953 (Appendix 6.5-A). Predominantly rainbow trout and brown trout were stocked, although brook trout and steelhead also were stocked in the Rubicon River. Post-1953 Rubicon River stocking records were not located and, as under its current designation as a Wild Trout Stream, the Rubicon River is no longer stocked with trout.

Several electrofishing surveys have been conducted in the Rubicon River (see Table 6.5-3). Surveys near Ellicott Bridge in 1974 - 1975 collected 128 rainbow trout and 36 brown trout, most of which were less than 6 inches in length. A 1978 survey upstream of Hales Crossing estimated a population of 545 trout per mile (rainbow = 475; brown = 70). Of the 545 fish per mile estimated in the area, trout equal to or greater than 6 inches were estimated to account for 159 fish per mile. The total biomass of trout estimated in the area was 33 pounds per acre (rainbow = 30; brown = 3). This same survey downstream of Hales Crossing estimated a population of 3,397 trout per mile (rainbow = 3,221; brown = 176). Of which fish equal to or greater than 6 inches accounted for 493 fish per mile. The total biomass of trout estimated was 48 pound per acre (rainbow trout = 41; brown = 7) (CDFG 1979).

CDFG (1979) also provides population estimates for trout greater than 6 inches in length for six reaches, which cover the length of the Rubicon River. These estimates ranged from 50 to 900 trout per mile. It is not clear in the report (1979) what sampling methods were used to obtain these estimates.

Electrofishing surveys in 1993 estimated a total trout biomass of 64.4 pounds per acre (rainbow = 24.6; brown = 39.8) and a population of 7,058 trout per mile (rainbow = 4,675; brown = 2,383) at a site immediately upstream of the South Fork Rubicon River. The same survey found an estimated total trout biomass of 52.2 pounds per acre (rainbow = 13.9; brown = 38.3) and a population of 4,140 trout per mile (rainbow = 1,260; brown = 2,880) at a site approximately 1 mile upstream of the South Fork Rubicon River.

A similar 1994 survey near Ellicott Bridge estimated a trout biomass of 44.1 pounds per acre (rainbow = 12.6; brown = 31.5) and a population of 3,026 trout per mile (rainbow = 1,547; brown = 1,479). A 2001 snorkel survey near the Long Canyon Creek confluence estimated the following numbers of fish per mile: rainbow trout - 1,239; brown trout - 17; Sacramento sucker - 562; Sacramento pikeminnow – 953, and sculpin - 11.

CDFG (1979, p 11) provides some indication of trout growth in the Rubicon River:

> *"The growth rate of rainbow trout in the Rubicon River is slow relative to the growth rates observed in more fertile, non-granitic basin streams such as Hat Creek and the Pit River. It is comparable to those observed in other streams of the west slope of the Sierra Nevada...Rainbow trout in the Rubicon River require at least six growing seasons (Age V+) to attain 12 inches in length...[B]rown trout in the Rubicon River are often of good size...they frequently live 6 to 8 years and thus reach a much larger size."*

Angler survey boxes are maintained at two locations on the Rubicon River. Angler reported trout catch per hour ranged from about 0.60 to 2.1 during 1990 through 2004. The majority of anglers reporting were practicing catch-and-release, and fishing pressure appears to be relatively light overall.

Aquatic habitat classification results from the 2005 Aquatic Habitat Characterization Study for this reach are provided in Tables 6.5-12 and 6.5-13. Turbulent habitats, as classified using Hawkins classification system, comprise about 39% of the total habitat units and about 35% of the total reach length. Pools, as classified by Hawkins, comprise about 37% of the habitat units and about 34% of the length. Within the Rosgen B type channel downstream of Hell Hole Reservoir, about 38%, or 7,350 feet, of the channel length exhibited no surface flow. This condition is the result of the 1964 Hell Hole Dam failure.

A reach of the Rubicon River upstream of Ralston Afterbay was sampled for benthic macroinvertebrates in 2001, 2002, and 2004 as part of the Ralston Sediment Management Project (JSA 2001, 2002 and 2005). Three riffles were sampled in June, August, and October 2001, 2002, and in August and October 2004. Figure 6.5-1 presents the benthic macroinvertebrate density results. Figure 6.5-2 presents the EPT index results. Figure 6.5-3 presents the taxa richness results. Figure 6.5-4 presents the California Tolerance Level results.

6.5.3.5 Long Canyon Creek

North Fork Long Canyon Creek

Water temperatures in North Fork Long Canyon Creek below the diversion dam during 2005 were as high as 71.5°F, and the maximum observed daily average temperature was 65°F. The maximum observed water temperature (68°F) upstream of the dam was slightly lower. By early September 2005, daily average water temperatures had dropped below 55°F (PCWA 2006b).

Rainbow trout have been documented in North Fork Long Canyon Creek. Electrofishing surveys were conducted at two sites (a riffle and a pool) downstream of the North Fork Diversion Dam by CDFG in 1968. The biomass of trout in the riffle was 64 pounds per acre (population estimate 1,840 fish per mile) (Table 6.5-3). The biomass of trout in the run was 115 pound per acre (population estimates of 2,480 fish per mile) No other fish species were noted.

South Fork Long Canyon Creek

Observed water temperatures in South Fork Long Canyon Creek during 2005 were cooler than in North Fork Long Canyon Creek. The maximum observed water temperature in South Fork Long Canyon Creek upstream and downstream of the dam during 2005 was 64°F and 67°F, respectively. The maximum daily average water temperature upstream and downstream of the dam was 59°F and 57.5°F, respectively. By early September, daily average water temperatures had decreased to 50°F and colder (PCWA 2006b).

Past fish surveys on South Fork Long Canyon Creek indicate that rainbow trout are present. Scattered populations of rainbows are noted throughout the reach upstream of South Fork Diversion Dam, including observations of fry, fingerlings and sexually mature adults. Many fish passage barriers such as bedrock waterfalls were also observed.

Electrofishing results for South Fork Long Canyon downstream (Site 1) and upstream (Sites 2 and 3) were presented in an Environmental Assessment prepared by Eldorado National Forest, Georgetown Ranger District (1979) (see Table 6.5-3). For the three sites sampled, trout biomasses of 41.7 (Site 1), 142 (Site 2), and 54.6 (Site 3) pounds per acre were estimated. Adult fish per mile estimates for the three sites were 106 (Site 1), 766 (Site 2), and 276 (Site 3).

Long Canyon Creek

Water temperature monitoring results from mainstem Long Canyon Creek in 2005 indicated that the maximum water temperature observed immediately downstream of the confluence of the North and South Forks of Long Canyon Creek was 68°F, and maximum daily average water temperature was 64°F during the summer. The maximum observed water temperature in Long Canyon Creek immediately upstream from the confluence with the Rubicon River was 78°F, and the maximum daily average water temperature was 75°F (PCWA 2006b).

Results from an electrofishing survey conducted in Long Canyon Creek in 1984 indicate that rainbow trout were the only fish species captured during two visits (see Table 6.5-3). The September survey resulted in a total trout biomass estimate of 59 pounds per acre, and an adult biomass estimate of 23 pounds per acre. Fish per mile estimates were 4,505 for all trout (adults and fry), and 387 for adult trout (Enviro Hydro 1984).

Surveys from Wallace Canyon Creek, a major tributary to Long Canyon Creek, document moderate numbers of brown trout throughout Wallace Canyon Creek and three of its tributaries. A population of brook trout also was documented in Little Wallace Canyon Creek in 1992 (Unidentified Document).

6.5.4 References

California Department of Fish and Game (CDFG). Various unpublished documents.

CDFG. 1979. Rubicon River Wild Trout Management Plan. Inland Fisheries Branch. July 1979.

CDFG. 2002. Fishing California's Sacramento Valley – Central Sierra Region. October 2002.

CDFG. 2006. Brown Trout. Available at http://www.dfg.ca.gov/fishing/assets/ document. Accessed on March 30, 2006.

Eldorado National Forest (ENF). 1977. Final Environmental Statement, Volcanoville Planning Unit, Land Management Plan. U.S. Forest Service, Eldorado National Forest.

ENF. 1979. Environmental Assessment, South Fork Long Canyon Creek. Georgetown Ranger District, Eldorado National Forest.

ENF. 2006. Recreational Activities: Fishing – Hell Hole Reservoir. Available at http://www.fs.fed.us/r5/eldorado/recreation/fishing/hellhole/ Accessed on June 16, 2006.

Enviro Hydro. 1984. Instream Beneficial Use Assessment (IBUA), Appendices. Water Right Application No. 7722 for Long Canyon Creek, Placer County, CA.

Erman, N.A. 1996. Status of Aquatic Invertebrates. *In* Sierra Nevada Ecosystem Project: Final Report to Congress, vol. II, Assessments and scientific basis for management options. Davis: University of California, Centers for Water and Wildland Resources, 1996.

Gerstung, E.R. 1973. Fish population and yield estimates from California trout streams. Cal-Neva Wildlife 1973:9–19.

Hawkins, C.P., and 10 coauthors. 1993. A hierarchical approach to classifying stream habitat features. Fisheries 18(6): 3-12.

Jones & Stokes, and Associates (JSA). 2002. Water quality and aquatic resources monitoring program for the Ralston Afterbay Sediment Management Project—2001 annual report. April. Sacramento, CA. Prepared for Placer County Water Agency, Foresthill, CA.

JSA. 2003. Water quality and aquatic resources monitoring program for the Ralston Afterbay Sediment Management Project—2002 annual report. April. (J&S 02-234). Sacramento, CA. Prepared for Placer County Water Agency, Foresthill, CA.

JSA. 2005. Water quality and aquatic resources monitoring program for the Ralston Afterbay Sediment Management Project—2004 annual report. April. (J&S 02234.02). Sacramento, CA. Prepared for Placer County Water Agency, Foresthill, CA.

Knapp, R.A. 1996. Non-native Trout in Natural Lakes of the Sierra Nevada: An Analysis of Their Distribution and Impacts on Native Aquatic Biota. *In* Sierra Nevada Ecosystem Project: Final Report to Congress, vol. III, Assessments and scientific basis for management options. Davis: University of California, Centers for Water and Wildland Resources, 1996.

McCain, M., D. Fuller, L. Decker and K. Overton. 1990 . Stream habitat classification and inventory procedures for northern California. FHC Currents. No.1. U.S. Department of Agriculture Forest Service, Pacific Southwest Region.

Moyle, P.B., R.M. Yoshiyama, and R.A. Knapp. 1996. Status of Fish and Fisheries. *In* Sierra Nevada Ecosystem Project: Final Report to Congress, vol. II, Assessments and scientific basis for management options. Davis: University of California, Centers for Water and Wildland Resources, 1996.

Placer County Water Agency (PCWA). 2006a. Middle Fork American River Hydroelectric Project (FERC No. 2079), Draft 2005 Physical Habitat Characterization Study Report.

PCWA. 2006b. Middle Fork American River Hydroelectric Project (FERC No. 2079), Draft 2005 Water Temperature Study Report.

Raleigh, R.F., L.D. Zuckerman, and P.C. Nelson. 1986. Habitat Suitability Index Models and Instream Flow Suitability Curves: Brown Trout. U.S. Fish Wildl. Serv. Biol. Rep. 82(10.124).

Tahoe National Forest (TNF). 2002. Final Environmental Impact Statement, Red Star Restoration Project. U.S. Forest Service, Pacific Southwest Region, Tahoe National Forest, Foresthill Ranger District. November 2002.

TNF. 2003. Middle Fork American River Watershed Assessment. U.S. Forest Service, Pacific Southwest Region, Tahoe National Forest, Foresthill Ranger District.

Unidentified Document. Wallace Canyon Creek Watershed.

U.S. Bureau of Reclamation (USBR). 1992. Auburn State Recreation Area Interim Resource Management Plan. September 1992.

USBR and Placer County Water Agency (USBR and PCWA). 2002. American River Pump Station Project. Final Environmental Impact Statement/Environmental Impact Report. SCH# 1999062089.

U.S. Fish and Wildlife Service (USFWS). 1995. Working Paper on Restoration Needs: Habitat Restoration Actions to Double Natural Production of Anadromous Fish in the Central Valley of California. Volume 2. Stockton, CA: U.S. Fish and Wildlife Service.

U.S. Department of Agriculture Forest Service (USDA-FS). 2005. Aquatic Invertebrate Report for samples collected by the Tahoe National Forest, Foresthill Ranger District summer 2002 and 2003. Prepared by Mark Vinson, U.S.D.I Bureau of Land Management, National Aquatic Monitoring Center, Department of Aquatic, Watershed, & Earth Resources, Utah State University, Logan, Utah.

Yoshiyama, R. M., E. R. Gerstung, F. W. Fisher, and P. B. Moyle. 1996 Historical and present distribution of Chinook salmon in the Central Valley drainage of California. Sierra Nevada Ecosystem Project: Final Report to Congress, vol. III. Davis, CA: University of California, Center for Water and Wildland Resources.

Table 6.5-1. Fish Native to the Middle Fork American River Watershed.[1]

Name	Habitat	Presence	Management Status[2]
Lampreys, *Petromyzontide*			
Pacific lamprey, *Lampetra tridentata*	Anadromous, foothills, lowlands	Extirpated (Nimbus/Folsom)	
Salmon, *Salmonidae*			
Chinook salmon, *Oncorhynchus tshawytscha*			
Chinook salmon, Spring-run	Anadromous, foothills, lowlands	Extirpated (Nimbus/Folsom)	ST, FT
Chinook salmon, Winter-run	Anadromous, foothills, lowlands	Extirpated (Nimbus/Folsom)	SE, FE
Chinook salmon, Fall-run	Anadromous, lowlands	Extirpated (Nimbus/Folsom)	CSC, FSS
Chinook salmon, Late fall-run	Anadromous, foothills, lowlands	Extirpated (Nimbus/Folsom)	CSC, FSS
Trout, *Salmonidae*			
Resident rainbow trout, *O. mykiss irideus*	Foothills, High elevations	Present	MIS
Winter steelhead, *O. mykiss irideus*	Anadromous, foothills, lowlands	Extirpated (Nimbus/Folsom)	FT
Minnows, *Cyprinidae*			
Sacramento hitch, *Lavinia exilicauda excilicauda*	Lowlands, foothills	Present	
Sacramento roach, *Lavinia symmetricus symmetricus*	Foothills	Presence not documented	CSC
Sacramento blackfish, *Orthodon microlepidotus*	Lowlands	Present	
Hardhead, *Mylopharodon conocephalus*	Lowlands, foothills	Present	CSC, FSS
Sacramento pikeminnow, *Ptychocheilus grandis*	Lowlands, foothills	Present	
Sacramento speckled dace, *Rhinichthys osculus ssp.*	Lowlands, foothills	Present	

Table 6.5-1. Fish Native to the Middle Fork American River Watershed (continued).[1]

Name	Habitat	Presence	Management Status[2]
Suckers, *Catostomidae*			
Sacramento sucker, *Catostomous occidentalis*	Lowlands, foothills, high elevations	Present	
Surf Perches, *Embiotocidae*			
Sacramento tule perch, *Hysterocarpus t. traski*	Lowlands, foothills	Presence not documented	
Sculpins, *Cottidae*			
Prickly sculpin, *Cottus asper*	Lowlands, foothills	Present	
Riffle Sculpin, *Cottus gulosus*	Foothills, high elevations	Present	

[1]Table adapted from Moyle et al. 1996
[2]Status

FT = Federal Threatened
FE = Federal Endangered
ST = State Threatened
SE = State Endangered
MIS = USFS Management Indicator Species
CSC = CDFG Species of Special Concern
FSS = USFS Sensitive Species
FSC = USFWS Species of Concern

Table 6.5-2. Non-Native (Including Natives Outside of Historical Range) Fish that have been Introduced to the Middle Fork and North Fork American River Watersheds.

Name	Habitat	Location and Comments
Kokanee, *Oncorhynchus nerka*	Reservoir	Hell Hole Reservoir; Continues to be stocked annually.
Coho salmon, *O. kistuch*	Reservoir	Hell Hole Reservoir; stocked on one occasion in 1974 on an experimental basis.
Rainbow trout, *O. mykiss irideus*	Reservoir; riverine	Throughout the Middle Fork American River Watershed; Historically and annually stocked with non-endemic strains
Steelhead, *O. mykiss irideus*	Riverine	Stocked on at least one occasion in the Middle Fork American River in 1930, the Rubicon River and Duncan Creek in 1937
Cutthroat trout, *O. clarki*	Reservoir; riverine	Cutthroat trout and cutthroat-rainbow hybrids were stocked extensively in Hell Hole Reservoir from 1973 through 1976.
Brown trout, *Salmo trutta*	Reservoir; riverine	Throughout the Middle Fork American River Watershed; Stocked in French Meadows and Hell Hole Reservoirs
Brook trout, *Salvelinus fontinalis*	Reservoir; riverine	Stocked on at least one occasion in the Middle Fork American River in 1933, the Rubicon River in 1928 and 1936, and in Duncan Creek in 1934
Lake trout, *Salvelinus namaycush*	Reservoir	Self-sustaining population in Hell Hole Reservoir
Smallmouth bass, *Micropterus salmoides*	Reservoir; riverine	North Fork American River; Stocked on at least two occasions in 1951
Brown bullhead, *Ameiurus nebulosus*	Reservoir; riverine	North Fork American River
Green sunfish, *Lepomis cyanellus*	Reservoir; riverine	North Fork American River
Tui chub, *Gila bicolor*	Reservoir; riverine	Hell Hole Reservoir

Table 6.5-3. Summary of Fish Sampling that has Occurred In the Middle Fork American River Watershed.

Reservoir/ River	Location (~River Mile)	Date	Sampling Method	Sampling Area	# Passes	Species	Population Estimate (for sample reach)	Density (fish/mile)	Biomass (lbs/acre)	Minimum Length (mm)	Maximum Length (mm)	Notes
Rubicon River												
	21	1974-75	Electrofish			RBT	128[b]			38	241	Lengths approximate
	21	1974-75	Electrofish			BRN	36[b]			64	419	Lengths approximate
	22	1978	Electrofish	300 ft.		RBT		475	30			Upstream of Hales Crossing
	22	1978	Electrofish	300 ft.		BRN		70	3			Upstream of Hales Crossing
	22	1978	Electrofish	300 ft.		RBT		3,221	41			Downstream of Hales Crossing
	22	1978	Electrofish	300 ft.		BRN		176	7			Downstream of Hales Crossing
	23	10/14/1993	Electrofish	288 ft		RBT	255 ± 26	4,675	24.6	54	242	Immediately upstream of South Fork Rubicon confluence
	23	10/14/1993	Electrofish	288 ft		BRN	130 ± 13.8	2,383	39.8	70	527	Immediately upstream of South Fork Rubicon confluence
	23	10/14/1993	Electrofish	288 ft		Sculpin						Immediately upstream of South Fork Rubicon confluence
	24	10/13/1993	Electrofish	264 ft		RBT	63 ± 12	1,260	13.9	60	236	Site 1 mile upstream of South Fork Rubicon River confluence
	24	10/13/1993	Electrofish	264 ft		BRN	144 ± 9.8	2,880	38.3	65	287	Site 1 mile upstream of South Fork Rubicon River confluence
	24	10/13/1993	Electrofish	264 ft		Sculpin	8 ± 1	160	0.5	51	105	Sculpin not identified to species
	21	9/20/1994	Electrofish	232 ft		RBT	68	1,547	12.6	62	242	Near Ellicott Bridge
	21	9/20/1994	Electrofish	232 ft		BRN	65	1,479	31.5	73	527	Near Ellicott Bridge
	21	9/20/1994	Electrofish	232 ft		SS	1				47	Near Ellicott Bridge

Table 6.5-3. Summary of Fish Sampling that has Occurred In Middle Fork Project-Associated Waters (continued).

Reservoir/ River	Location (~River Mile)	Date	Sampling Method	Sampling Area	# Passes	Species	Population Estimate	Density (#/mile)	Biomass (lbs./acre)	Minimum Length (mm)	Maximum Length (mm)	Notes
Rubicon River (continued)												
	3	7/12/2001	Snorkel	959 ft.		RBT		1,239				
	3	7/12/2001	Snorkel	959 ft.		BRN		17				
	3	7/12/2001	Snorkel	959 ft.		SS		562				
	3	7/12/2001	Snorkel	959 ft.		SP		953				
	3	7/12/2001	Snorkel	959 ft.		Sculpin		11				
Long Canyon Creek												
	7	Feb-84	Electrofish	300 ft.	3	RBT	22[b]			75	180	High flows prevented popn estimation
	7	Sep-84	Electrofish	259 ft.	3	RBT	221± 4	4,505	59			Adults and fry
	7	Sep-84	Electrofish	259 ft.	3	RBT	19± 0	387	23			Adults only
Middle Fork American River												
	52	8/14/1986	Electrofish	250 ft		RBT	4[b]					Qualitative survey
	52	8/14/1986	Electrofish	250 ft		BRN	40[b]					Qualitative survey
SF Long Canyon												
	3	Aug-79	Electrofish			trout[a]	87 ± 5.2	106	41.7			Downstream of South Fork Diversion
	3.5	Aug-79	Electrofish			trout[a]	73 ± 3.8	766	142			Upstream of South Fork Diversion
	3.5	Aug-79	Electrofish			trout[a]	54 ±7.7	276	54.6			Upstream of South Fork Diversion
NF Long Canyon												
	2	5/28/1968	Electrofish	riffle	2	trout[a]	--	1,840	64			Downstream of North Fork Diversion
	2	5/28/1968	Electrofish	pool	2	trout[a]	--	2,480	115			Downstream of North Fork Diversion

Table 6.5-3. Summary of Fish Sampling that has Occurred In Middle Fork Project-Associated Waters (continued).

Reservoir/ River	Location (~River Mile)	Date	Sampling Method	Sampling Area	# Passes	Species	Population Estimate	Density (#/mile)	Biomass (lbs./acre)	Minimum Length (mm)	Maximum Length (mm)	Notes
Hell Hole Reservoir												
		5/24/1966	Gill Net			RBT	10[b]			157	318	12 hour set; one net
		5/24/1966	Gill Net			BRN	2[b]			356	394	12 hour set; one net
		5/24/1966	Gill Net			SKR	13[b]			170	272	12 hour set; one net
		9/7/1967	Gill Net			RBT	2[b]			165	185	12 hour set; two nets
		9/7/1967	Gill Net			BRN	1[b]			212		12 hour set; two nets
		9/7/1967	Gill Net			SKR	88[b]			127	279	12 hour set; two nets
		9/7/1967	Gill Net			TC	4[b]			96	152	12 hour set; two nets
		6/16/1971	Gill Net			RBT	5[b]			20	390	81 hour set; six nets
		6/16/1971	Gill Net			BRN	19[b]					81 hour set; six nets
		6/16/1971	Gill Net			SKR	228[b]					81 hour set; six nets
		6/16/1971	Gill Net			TC	539[b]					81 hour set; six nets
		11/7/1974	Gill Net			RBT	2[b]			191	224	14 hour set; two nets; across from boat ramp on east side
		11/7/1974	Gill Net			BRN	7[b]			251	597	14 hour set; two nets; across from boat ramp on east side
		11/7/1974	Gill Net			SKR	62[b]					14 hour set; two nets; across from boat ramp on east side
		11/7/1974	Gill Net			TC	20[b]					14 hour set; two nets; across from boat ramp on east side

Table 6.5-3. Summary of Fish Sampling that has Occurred In Middle Fork Project-Associated Waters (continued).

Reservoir/ River	Location (~River Mile)	Date	Sampling Method	Sampling Area	# Passes	Species	Population Estimate	Density (#/mile)	Biomass (lbs./acre)	Minimum Length (mm)	Maximum Length (mm)	Notes
Hell Hole Reservoir (continued)												
		9/15/1975	Gill Net			RBT	1[b]			208		11 hour set; two nets; west shore near power house and east shore
		9/15/1975	Gill Net			BRN	4[b]			508	610	11 hour set; two nets; west shore near power house and east shore
		9/15/1975	Gill Net			SKR	1[b]			356		11 hour set; two nets; west shore near power house and east shore
		1/25/1978	Gill Net			RBTxCT	2[b]			280	338	16.75 hour set; cove on south shore
		1/25/1978	Gill Net			BRN	4[b]			245	330	16.75 hour set; cove on south shore
		1/25/1978	Gill Net			SKR	38[b]					16.75 hour set; cove on south shore
		1/25/1978	Gill Net			TC	267[b]					16.75 hour set; cove on south shore
		1/25/1978	Gill Net			RBTxCT	1[b]			328		14 hour set; upper end of lake
		1/25/1978	Gill Net			BRN	6[b]			234	623	14 hour set; upper end of lake
		1/25/1978	Gill Net			SKR	3[b]			116	354	14 hour set; upper end of lake
		1/25/1978	Gill Net			TC	134[b]			92	274	14 hour set; upper end of lake
		6/16/1983	Gill Net			BRN	9[b]					54 hour set; three nets; near boat camps
		6/16/1983	Gill Net			SKR	219[b]					54 hour set; three nets; near boat camps
		6/16/1983	Gill Net			TC	104[b]					54 hour set; three nets; near boat camps

Table 6.5-3. Summary of Fish Sampling that has Occurred In Middle Fork Project-Associated Waters (continued).

Reservoir/ River	Location (~River Mile)	Date	Sampling Method	Sampling Area	# Passes	Species	Population Estimate	Density (#/mile)	Biomass (lbs./acre)	Minimum Length (mm)	Maximum Length (mm)	Notes
French Meadows Reservoir												
		9/16/1975	Gill Net			RBT	5[b]			190.5	279	11 hour set; two nets; west of boat ramp near first cove
		9/16/1975	Gill Net			BRN	9[b]			254	330	11 hour set; two nets; west of boat ramp near first cove
		5/24/1982	Gill Net			RBT	2[b]			254	360	14 hour set; two nets; off islands at upper end of lake
			Gill Net			BRN	3[b]			256	360	14 hour set; two nets; off islands at upper end of lake
		6/2/1982	Gill Net			RBT	5[b]			241	328	15 hour set; 5 nets
		6/2/1982	Gill Net			BRN	51[b]			178	505	15 hour set; 5 nets
		8/21/1985	Gill Net			RBT	12[b]			154	174	12 hour set; Middle Fork Arm
		8/21/1985	Gill Net			BRN	2[b]			152	180	12 hour set; Middle Fork Arm

[a] Species not specified

[b] Actual count - not an estimate

Species: RBT=Rainbow trout, BRN=Brown trout, BRK=Brook trout, CT=Cutthroat trout, SR=Sacramento roach, SH=Sacramento hitch, SB=Sacramento blackfish, HH=Hardhead, SP=Sacramento pikeminnow, SD=Speckled dace, SS=Sacramento Sucker, TP=Tule perch, SC=Prickly/Riffle Sculpin, KS=Kokanee salmon, LT=Lake trout, SMB=Smallmouth bass, BB=Brown bullhead, GS=Green sunfish, TC=Tui chub, CF=Catfish (species undefined)

Table 6.5-4. Known (●) and Suspected (○) Native and Introduced Fish Species Distribution in the Middle Fork American River Watershed.

Reach	RBT	BRN	BRK	CT	SR	SH	SB	HH	SP	SD	SS	SC	KS	LT	SMB	BB	GS	TC	CF
Duncan Creek	●	○	●						○	●	●	●							
Middle Fork American River above French Meadows	●	●	●						○	●	○	○							
French Meadows Reservoir	●	●							●	●	●	○			●		●		●
Middle Fork American River from French Meadows – Interbay	●	●						●	●		●								
Interbay Reservoir	●	●						○	●	●	●	●							
Middle Fork American River from Interbay – Ralston	●	●						●	●		●								
Middle Fork American River from Ralston – NF American	●	●				○	●	●	●	●	●	●							
NF American from Middle Fork American River – Folsom Reservoir	●	●			○	●	●	○	○	●	●	●			●	●	●		
Rubicon River above Hell Hole	●	●	○	○				○	●	●	●	●							
Hell Hole Reservoir	●	●	○	○				●	●	●	●	○	●	●				●	
Rubicon R from Hell Hole – Ralston	●	●	○	○				●	●	●	●	●							
North Fork Long Canyon Creek	●							○	○	●	●	●							
South Fork Long Canyon Creek	●							○	○	●	●	●							
Long Canyon Creek	●	○	○						○	●	●	●							

Species: RBT=Rainbow trout, BRN=Brown trout, BRK=Brook trout, CT=Cutthroat trout, SR=Sacramento roach, SH=Sacramento hitch, SB=Sacramento blackfish, HH=Hardhead, SP=Sacramento pikeminnow, SD=Speckled dace, SS=Sacramento Sucker, TP=Tule perch, SC=Prickly/Riffle Sculpin, KS=Kokanee salmon, LT=Lake trout, SMB=Smallmouth bass, BB=Brown bullhead, GS=Green sunfish, TC=Tui chub, CF=Catfish (species undefined)

Table 6.5-5. Summary of Hawkins Habitat Types for the Middle Fork American River from French Meadows Reservoir to Middle Fork Interbay.

Hawkins Habitat Type Classification	Frequency of Habitat Types	Length of Habitat Types (ft)	Relative Frequency of Habitat Types	Percentage Length of Habitat Types
Dammed Pool (DP)	142	22,240	32.2%	35.7%
Non Turbulent (NT)	96	17,022	21.8%	27.1%
Scour Pool (SP)	48	8,299	10.9%	13.2%
Turbulent (T)	155	15,052	35.1%	24.0%
Total	**441**	**62,812**	**100%**	**100%**

Table 6.5-6. Summary of Modified R5 Habitat Types for the Middle Fork American River from French Meadows Reservoir to Middle Fork Interbay.

Mod R5 Habitat Type Classification	Frequency of Habitat Types	Length of Habitat Types (ft)	Relative Frequency of Habitat Types	Percentage Length of Habitat Types
Cascade (CAS)	95	8,687	21.6%	13.9%
Cascade Pool Sequence (CPS)	3	426	0.7%	0.7%
Dammed Pool (DPL)	109	12,973	24.8%	20.7%
Mid channel Pool (MCP)	48	6,299	10.9%	13.2%
Pocket Water (POW)	47	8,399	10.7%	13.4%
Riffle (RIF)	56	5,811	12.7%	9.3%
Run (RUN)	44	7,770	10.0%	12.4%
Step Pool (SPO)	33	9,467	7.5%	15.1%
Step Run (SRN)	5	852	1.1%	1.4%
Unidentified	1	128	0.2%	0.2%
Total	**440**	**62,864**	**100%**	**100%**

Table 6.5-7. Summary of Hawkins Habitat Types for the Middle Fork American River from Interbay Dam to Ralston Afterbay.

Hawkins Habitat Type Classification	Frequency of Habitat Types	Length of Habitat Types (ft)	Relative Frequency of Habitat Types	Percentage Length of Habitat Types
Dammed Pool (DP)	88	10,069	22.7%	17.7%
Non Turbulent (NT)	119	24,358	30.7%	42.7%
Scour Pool (SP)	32	4,985	8.3%	8.7%
Turbulent (T)	134	11,909	34.6%	20.9%
Unidentified	14	5,683	3.6%	10.0%
Total	**387**	**57,004**	**100%**	**100%**

Table 6.5-8. Summary of Modified R5 Habitat Types for the Middle Fork American River from Interbay Dam to Ralston Afterbay.

Mod R5 Habitat Type Classification	Frequency of Habitat Types	Length of Habitat Types (ft)	Relative Frequency of Habitat Types	Percentage Length of Habitat Types
Cascade (CAS)	90	7,370	23.3%	12.9%
Cascade Pool Sequence (CPS)	1	249	0.3%	0.4%
Dammed Pool (DPL)	82	9,006	21.2%	15.8%
Lateral Scour Pool (LSP)	1	110	0.3%	0.2%
Mid channel Pool (MCP)	31	4,876	8.0%	8.6%
Pocket Water (POW)	27	3,457	7.0%	6.1%
Riffle (RIF)	43	4,290	11.1%	7.5%
Run (RUN)	84	18,812	21.7%	33.0%
Step Pool (SPO)	6	1,063	1.6%	1.9%
Step Run (SRN)	8	2,088	2.1%	3.7%
Unidentified	14	5,683	3.6%	10.0%
Total	**387**	**57,004**	**100%**	**100%**

Table 6.5-9. Summary of Hawkins Habitat Types for the Middle Fork American River from Ralston Afterbay Dam to the North Fork American River Confluence.

Hawkins Habitat Type Classification	Frequency of Habitat Types	Length of Habitat Types (ft)	Relative Frequency of Habitat Types	Percentage Length of Habitat Types
Dammed Pool (DP)	14	3,989	3.4%	2.8%
Scour Pool (SP)	144	77,110	35.2%	54.7%
Non Turbulent (NT)	133	41,222	32.5%	29.2%
Turbulent (T)	116	17,858	28.4%	12.7%
Culvert (CVT)	1	174	0.2%	0.1%
Unidentified	1	606	0.2%	0.4%
Total	**409**	**140,960**	**100%**	**100%**

Table 6.5-10. Summary of Modified R5 Habitat Types for the Middle Fork American River from Ralston Afterbay Dam to the North Fork American River Confluence.

Mod R5 Habitat Type Classification	Frequency of Habitat Types	Length of Habitat Types (ft)	Relative Frequency of Habitat Types	Percentage Length of Habitat Types
Backwater Pool (BWP)	5	2,110	1.2%	1.5%
Cascade (CAS)	33	4,896	8.1%	3.5%
Culvert (CVT)	1	174	0.2%	0.1%
Dammed Pool (DPL)	7	1,209	1.7%	0.9%
Lateral Scour Pool (LSP)	14	4,349	3.4%	3.1%
Mid Channel Pool (MCP)	130	72,761	31.8%	51.6%
Pocket Water (POW)	1	99	0.2%	0.1%
Riffle (RIF)	83	12,962	20.3%	9.2%
Run (RUN)	127	39,197	31.1%	27.8%
Step Pool (SPO)	2	671	0.5%	0.5%
Step Run (SRN)	4	1,811	1.0%	1.3%
Trench Chute (TRC)	1	115	0.2%	0.1%
Unidentified	1	606	0.2%	0.4%
Total	**409**	**140,960**	**100%**	**100%**

Table 6.5-11. Results from Aquatic Invertebrate Sampling at Two Sites[1] in Duncan Creek in 2002 and 2003.

Location, Year	Number of Families Observed	Dominant Family	Total Taxa Richness	Shannon Diversity Index	Hilsenhoff Biotic Index
Duncan 1, 2002	21	Chironomidae	45	2.971	3.95
Duncan 1, 2003	24	Chironomidae	51	3.269	3.25
Duncan 2, 2002	16	Chironomidae	31	1.805	5.53
Duncan 2, 2003	26	Chironomidae	56	3.111	3.92

[1] The “Duncan 1” site is located downstream of the Duncan Diversion Dam near Bloody Ravine, and “Duncan 2” is located upstream of the Duncan Diversion Dam near the Little Duncan Creek confluence

Table 6.5-12. Summary of Hawkins Habitat Types for the Rubicon River from Hell Hole Reservoir to Ralston Afterbay.

Hawkins Habitat Type Classification	Frequency of Habitat Types	Length of Habitat Types (ft)	Relative Frequency of Habitat Types	Percentage Length of Habitat Types
Dammed Pool (DP)	76	12,551	8.7%	7.2%
Non Turbulent (NT)	206	42,196	23.7%	24.3%
Scour Pool (SP)	242	46,247	27.8%	26.7%
Turbulent (T)	336	60,784	38.6%	35.0%
Dry (DRY*)	6	7,350	0.7%	4.2%
Unidentified	5	4,383	0.6%	2.5%
Total	**871**	**173,511**	**100%**	**100%**

*No surface flow present

Table 6.5-13. Summary of Modified R5 Habitat Types for the Rubicon River from Hell Hole Reservoir to Ralston Afterbay.

Mod R-5 Habitat Type Classification	Frequency of Habitat Types	Length of Habitat Types (ft)	Relative Frequency of Habitat Types	Percentage Length of Habitat Types
Bedrock Sheet (BRS)	1	37	0.1%	0.0%
Cascade (CAS)	236	42,708	27.1%	24.6%
Cascade Pool Sequence (CPS)	15	4,560	1.7%	2.6%
Dammed Pool (DPL)	58	8,320	6.7%	4.8%
Dry (DRY*)	6	7,350	0.7%	4.2%
Glide (GLD)	2	1,076	0.2%	0.6%
Lateral Scour Pool (LSP)	48	8,859	5.5%	5.1%
Mid Channel Pool (MCP)	194	37,389	22.3%	21.5%
Pocket Water (POW)	6	736	0.7%	0.4%
Riffle (RIF)	84	13,479	9.6%	7.8%
Run (RUN)	194	39,092	22.3%	22.5%
Step Pool (SPO)	18	4,231	2.1%	2.4%
Step Run (SRN)	4	1,293	0.5%	0.7%
Unidentified	5	4,383	0.6%	2.5%
Total	**871**	**173,511**	**100%**	**100%**

* No surface flow present.

FIGURES

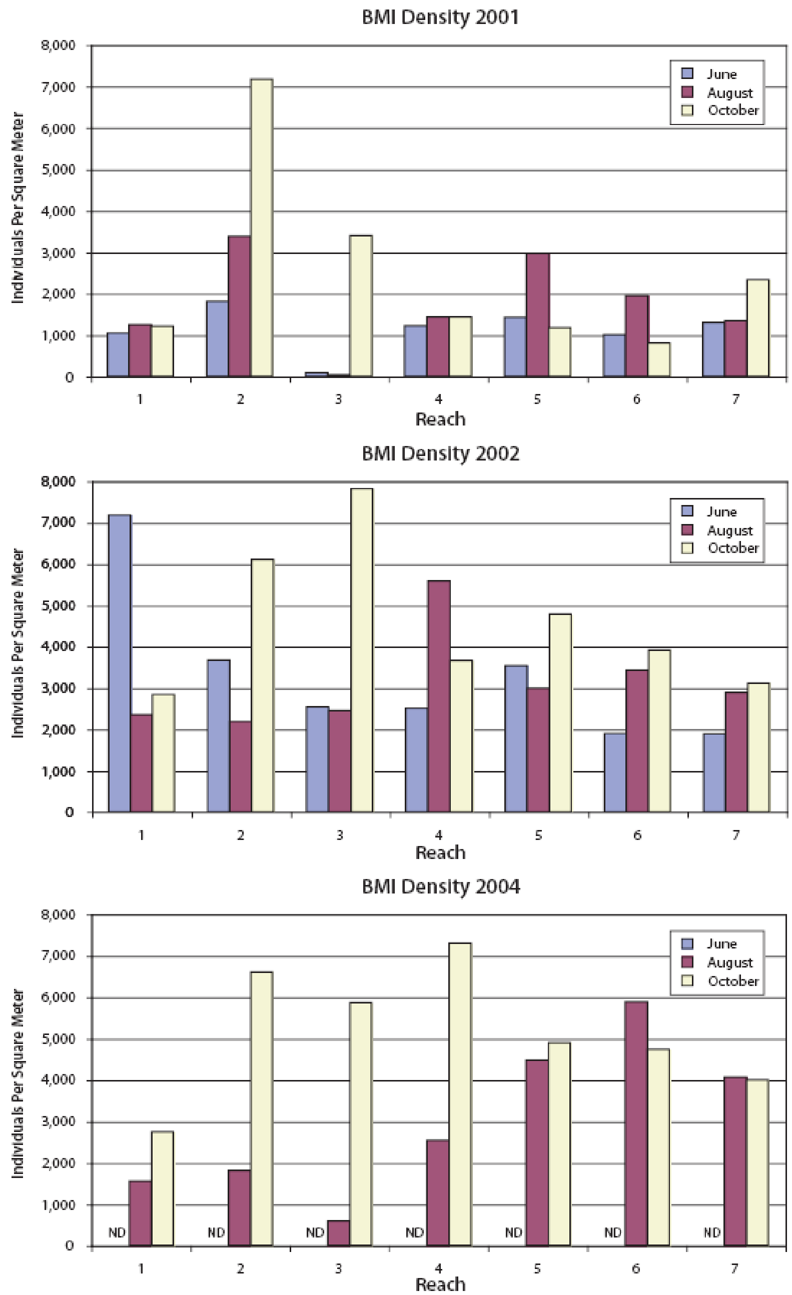

Figure 6.5-1. Benthic Macroinvertebrate Sampling Results from Five Reaches in the Middle Fork American River, One Reach in the North Fork of the Middle Fork American River, and One Reach in the Rubicon River (from JSA 2005)[1].

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[1] Reaches 1, 2, 3, and 4 are located downstream of Ralston Dam, Reach 5 is located in the Middle Fork American River upstream of Ralston Afterbay, Reach 6 is located in the NF of the Middle Fork American River, and Reach 7 is located in the Rubicon River upstream of the Ralston Powerhouse.

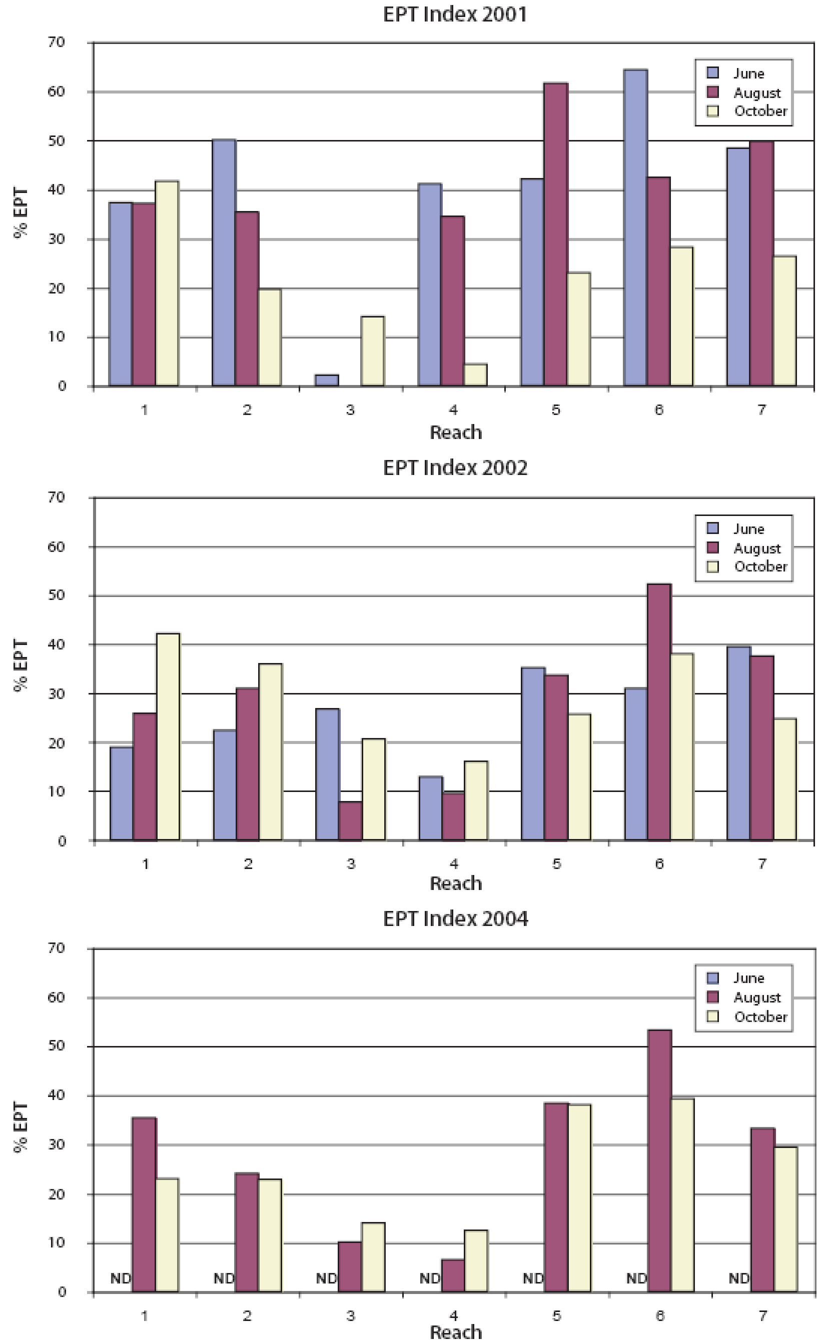

Figure 6.5-2. EPT Index Results from Five Reaches in the Middle Fork American River, One Reach in the North Fork of the Middle Fork American River, and One Reach in the Rubicon River (from JSA 2005)[1].

[1] Reaches 1, 2, 3, and 4 are located downstream of Ralston Dam, Reach 5 is located in the Middle Fork American River upstream of Ralston Afterbay, Reach 6 is located in the NF of the Middle Fork American River, and Reach 7 is located in the Rubicon River upstream of the Ralston Powerhouse.

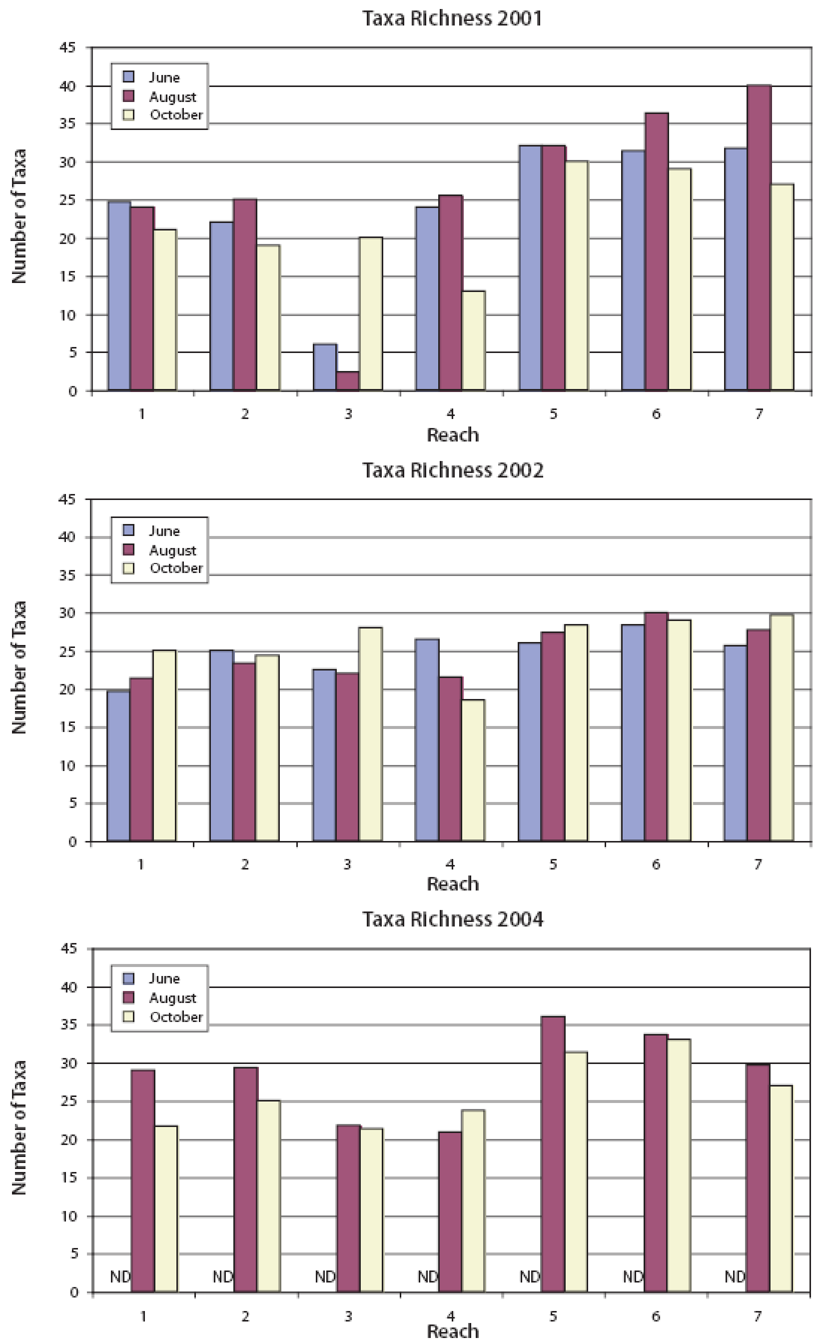

Figure 6.5-3. Taxa Richness Results from Five Reaches in the Middle Fork American River, One Reach in the North Fork of the Middle Fork American River, and One Reach in the Rubicon River (from JSA 2005)[1].

[1] Reaches 1, 2, 3, and 4 are located downstream of Ralston Dam, Reach 5 is located in the Middle Fork American River upstream of Ralston Afterbay, Reach 6 is located in the NF of the Middle Fork American River, and Reach 7 is located in the Rubicon River upstream of the Ralston Powerhouse.

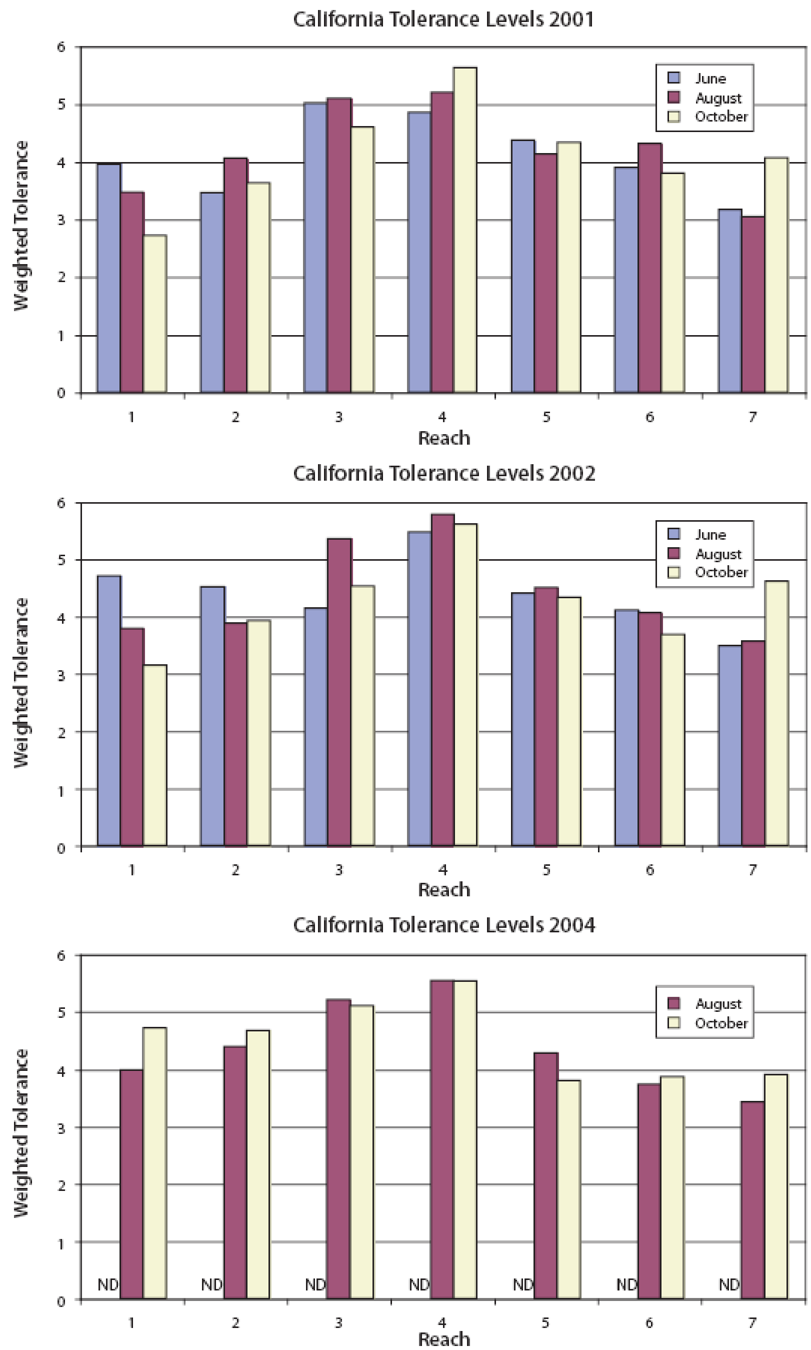

Figure 6.5-4. California Tolerance Level Results from Five Reaches in the Middle Fork American River, One Reach in the North Fork of the Middle Fork American River, and One Reach in the Rubicon River (from JSA 2005)[1].

[1] Reaches 1, 2, 3, and 4 are located downstream of Ralston Dam, Reach 5 is located in the Middle Fork American River upstream of Ralston Afterbay, Reach 6 is located in the NF of the Middle Fork American River, and Reach 7 is located in the Rubicon River upstream of the Ralston Powerhouse.

APPENDIX 6.5-A

Historical Fish Stocking Records in the Middle Fork American River Watershed

Table 6.5-A-1. Historical Fish Stocking Records in the Middle Fork American River.

Year	Rainbow Trout	Brown Trout	Brook Trout	Steelhead
1926	5,000			
1929	14,000			
1930	40,000	30,000		19,000
1931	23,000	30,000		
1932	28,000	40,000		
1933	30,000	30,000	10,000	
1934	20,000	90,000		
1935	60,000	50,000		
1936	15,000			
1937		30,000		
1938	22,600	20,900		
1939	11,750	20,100		
1940				
1941				
1942	9,000			
1943	15,000			
1944				
1945	4,000			
1946	4,000			
1947	5,000			
1948	2,500			
1949	8,000			
1950	11,376			
1951	15,518			
1952	17,002			
1953	12,627	2,240		

Table 6.5-A-2. Historical Fish Stocking Records for Hell Hole Reservoir.

Year	Rainbow Trout[1]	Brown Trout	Lake Trout	Kokanee	Coho Salmon	Cutthroat Trout[2]	Brook Trout
1967	60,000						
1968	32,386						
1969	1,855	6,500					
1970	5,040						
1971	10,780						
1972	20,500						
1973	10,200					6,000	
1974	1,000				1,000	5,004	
1975						4,950	3,740
1976		10,200				22,300	
1978			2,852				
1979			3,000				
1989				45,000			
1992				73,500			
1994				74,960			
1995				71,750			
1996				51,975			
1997				50,050			
1998				35,600			
1999				25,000			
2000				25,026			
2001		6,380		26,600			
2002		8,100		25,272			
2003		7,500		24,960			
2004		4,200		22,275			
2005	[A]	4,400		25,012			

[1] Includes 2,800 Eagle Lake rainbows planted in 1971.
[2] Including cutthroat hybrids.
[A] The USFS-Eldorado National Forest (ENF 2006) reports that Hell Hole presently is stocked with catchable rainbow trout; however, recent stocking records have not been located.

Table 6.5-A-3. Historical Fish Stocking Records for French Meadows Reservoir.

Year	Rainbow Trout	Brown Trout	Eagle Lake Trout
1968	29,938		
1969	60,255		
1970	100,600		
1971	79,480		3,000
2001	10,050	6,380	
2002	12,500		4,000
2003	9,700		
2004	5,200		
2005	5,500		

Table 6.5-A-4. Historical Fish Stocking Records for the Rubicon River.

Year	Rainbow Trout	Brown Trout	Brook Trout	Steelhead
1928		2,380	8,572	
1931		35,000		
1932		31,000		
1933		30,000		
1934	15,000	30,000		
1935		24,000		
1936	11,500	30,000	10,000	
1937		35,000		5,000
1938	4,500	30,000		
1939	30,000			
1940	60,000			
1941	60,000			
1942	27,740			
1943	44,120			
1944	41,430			
1945	28,000			
1946	33,960			
1947	10,200			
1948	28,020			
1949	13,780			
1950	20,000			
1951	18,410			
1952	18,960			
1953	20,000			

Table 6.5-A-5. Historical Fish Stocking Records for Duncan Creek

Year	Rainbow Trout	Brown Trout	Brook Trout	Steelhead
1930	10,000	10,000		
1931	10,000	10,000		
1932	5,000	15,000		
1933	10,000			
1934	15,000		10,000	
1935				
1936				
1937				20,000
1938	18,000			
1939	25,000			
1940	30,240			
1941	42,725			
1942	25,920			
1943	6,000			
1944	5,000			
1945	9,600			
1946	19,600			
1947	20,160			
1948	15,002			
1950	6,996			
1951	3,024			
1952	4,000			
1953	7,005			

APPENDIX 6.5-B

Life History and Habitat Requirements of Special Status Fish Species Known to Occur or with a Reasonable Potential to Occur in the Middle Fork American River Watershed

Overview

The information presented in this Appendix is intended to provide a brief overview of the life histories and habitat requirements of special status and recreationally-important fish species known or reasonably expected to occur in the vicinity of the MFP.

Hardhead (*Mylopharodon conocephalus*)

Hardhead are a large (occasionally exceeding 600 mm standard length [SL]), native cyprinid species that generally occurs in large, undisturbed low- to mid-elevation rivers and streams of the region (Moyle 2002 1220 /id). The species is widely distributed throughout the Sacramento-San Joaquin River system, although it is absent from the valley reaches of the San Joaquin River. Hardhead are listed as a state "species of special concern" and a USFS sensitive species.

Hardhead mature following their second year. Spawning migrations, which occur in spring smaller tributary streams, are common. The spawning season may extend into August in the foothill streams of the Sacramento River and San Joaquin River basins. Spawning behavior has not been documented, but hardhead are believed to elicit mass spawning in gravel riffles (Moyle 2002 1220 /id). It is reported that little is known about life stage specific temperature requirements of hardhead.

Hardhead are omnivores, feeding primarily on benthic invertebrates and aquatic plant material (Moyle 2002 1220 /id). In small streams, adult hardhead attain lengths of up to 11 inches and in larger river systems can obtain lengths up to 23 inches.

Brown Trout (*Salmo trutta*)

Brown trout are a non-native gamefish first introduced to California in 1893 (Moyle 2002 1220 /id). Currently, brown trout provide some of the finest wild trout angling opportunities in California (Moyle, 2002 1220 /id). Brown trout are widely distributed throughout California; however, the waters with abundant populations are relatively few (CDFG 2006). Historically, the species was planted in most California trout waters, but in recent years only a few lakes and streams have been stocked (CDFG 2006). Nevertheless, brown trout can be found in many lakes reservoirs and streams on the east and west slopes of the Sierra where they appear to spawn quite successfully (CDFG 2006).

Brown trout normally spawn from November through December in small tributaries although some successful spawning has been reported to occur in lakes (Raleigh 1986 1094 /id). Riverine spawning brown trout construct redds (nests) in gravel substrate, with diameters of 0.7 to 2.8 inches, at depths ranging from 4.8 to 36.0 inches (Raleigh 1986 1094 /id). Raleigh et al (Raleigh 1986 1094 /id) reports that water velocity may be a more important factor in selecting redd sites than water depth and that velocities of 1.3 to 2.3 fps are considered optimal. Embryo incubation normally requires seven to eight weeks depending on water temperatures with alevins emerging from the gravel three to six weeks later (Moyle, 2002 1220 /id).

Brown trout over 9 inches in length are active pursuers of large prey, particularly fish (including their own young) and active invertebrates such as crayfish. Adult brown trout largely are bottom-oriented pool dwellers in streams and rivers, but juvenile brown trout reportedly are found equally often in pools and riffles. Sexual maturity normally occurs in the second or third year (Moyle 2002 1220 /id). Brown trout generally are longer lived than rainbow trout, with a maximum recorded age in California of nine years and a maximum age on record of 38 years (Moyle 2002).

Rainbow Trout (*Oncorhynchus mykiss*)

Rainbow trout are native to California coastal streams from the Los Angeles River system north to the Klamath River. They are also native to most areas within the Sacramento-San Joaquin system (Moyle 2002 1220 /id). The species is the most popular and widely distributed gamefish in California (Moyle 2002 1220 /id). Rainbow trout and steelhead are the same species. Steelhead are differentiated from rainbow trout in having an anadromous life history. Regardless of their life history strategy, for the first year or two of life, both steelhead and rainbow trout exhibit similar juvenile life history characteristics (Moyle 2002 1220 /id).

Most wild rainbow trout spawn in the spring between February and June (Moyle 2002 1220 /id). Rainbow trout normally spawn by constructing redds in coarse gravel substrate, 0.5 to 5.1 inches in diameter, in the tail of a pool or riffle (Moyle 2002 1220 /id); preferred gravel size is reported to be 0.25 to 3.0 inches in diameter (USFWS 1995 LAR457 /id). The number of eggs per female normally depends on size of the fish at spawning, and ranges from 2,000 to 12,000 eggs (Moyle 2002 1220 /id). Most spawning is observed when water temperatures are between 46°F and 52°F in water flowing from 0.2 to 3.6 ft/sec (USFWS 1995 LAR457 /id). Water temperatures above 63°F are reportedly lethal to developing rainbow trout embryos (Moyle 2002 1220 /id). Eggs normally hatch in three to four weeks with alevins remaining in the gravel for another two to three weeks (Moyle 2002 1220 /id).

For the first year of life, juvenile rainbow trout normally inhabit cool, fast-flowing streams and rivers where riffles predominate over pools and there is cover from riparian vegetation and undercut banks (Moyle 2002 1220 /id). Older rainbow trout tend to move into deeper runs or pools (Moyle 2002 1220 /id). Rainbow trout are reportedly found where daytime water temperatures range from 32°F in the winter to 80.6°F in the summer, although 73.4°F is reportedly lethal for unacclimated fish (Moyle 2002 1220 /id). Although primarily a riverine species, suitable habitat for rainbow trout can often be found in mountain lakes and cold water reservoirs (Moyle 2002 1220 /id). In California, lake and reservoir populations are artificially maintained when access to suitable spawning habitat in tributaries is not available (Moyle 2002 1220 /id).

Rainbow trout feed mainly on insects, with fish becoming an important part of their diet when lengths exceed 11 inches (Moyle 2002 1220 /id). Rainbow trout normally become sexually mature in their second or third year and normally live to age five, although 11 year-old rainbow trout have been reported (Moyle 2002 1220 /id).

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6.6 BOTANICAL AND WILDLIFE RESOURCES

This report describes the botanical and wildlife resources (collectively referred to as terrestrial resources) in the Middle Fork American River Watershed (Watershed). The content requirements for this report are specified in Title 18 of the Code of Federal Regulations (CFR) Chapter 1 § 5.6 (d)(3)(iv), as follows.

> ***Wildlife and botanical resources****. A description of the wildlife and botanical resources, including invasive species, in the project vicinity. Components of this description must include:*
>
> *(A) Upland habitat(s) in the project vicinity, including the project's transmission line corridor or right-of-way and a listing of plant and animal species that use the habitat(s); and*
>
> *(B) Temporal or spacial distribution of species considered important because of their commercial, recreational, or cultural value.*

The Middle Fork American River Watershed includes the area providing runoff to the Middle Fork American River and Rubicon River, including their associated tributary streams. The watershed-wide scope of this report was intended to place the Middle Fork American River Hydroelectric Project (MFP or Project) within its broader terrestrial environmental context. However, particular emphasis is placed on identifying common and special-status terrestrial resources that occur or are likely to occur within the Federal Energy Regulatory Commission (FERC) Project boundary.

This report is primarily based on data from Resource Agency files, reports, and databases, published literature and to a lesser extent, applicable field studies conducted by Placer County Water Agency (PCWA) in 2005. This report will be used as a baseline to determine the additional technical studies that will be necessary to facilitate a more comprehensive analysis of potential Project impacts on terrestrial resources.

6.6.1 Information Sources for Botanical Resources

This section describes sources of information that were evaluated to characterize existing botanical resources in the Middle Fork American River Watershed.

6.6.1.1 Vegetation Alliances

Information on vegetation alliances was developed from the Classification and Assessment with LANDSAT of Visible Ecological Groupings (CalVeg) data for the Eldorado and Tahoe National Forests (ENF and TNF) (USDA-FS 1997). This information was based on 1997 data, and will be updated to include more recent (2000) CalVeg data, when it becomes available.

The CalVeg system is used to classify existing vegetation present on federally managed forestlands based on LANDSAT color infrared satellite imagery. Data are verified using soil-vegetation maps and professional guidance from various sources statewide.

The term "alliance," as used by CalVeg, corresponds closely to what plant ecologists call a community type and foresters call a forest type or stand. An alliance is characterized by the dominant species of plants that make up the overstory. This usage is consistent with standards developed by the Federal Geographic Data Committee as part of the National Vegetation Classification System.

Specific information on riparian alliances in the Watershed was based on field surveys (helicopter and ground) conducted in August, September, and October 2005 as part of PCWA's 2005-2006 Physical Habitat Characterization Study. The methods and results associated with this study are available in a recent report prepared by PCWA entitled Draft 2005 Physical Habitat Characterization Report (PCWA 2006), and are summarized in Section 6.8 of this document. Riparian community classifications described in the 2005 Physical Habitat Characterization Study Report were cross-referenced with the CalVeg classification system based on species present. Therefore, all vegetation alliances described in this report are based on the CalVeg classification system.

6.6.1.2 Special-Status Botanical Resources

Information on special-status botanical resources known to occur or potentially occurring in the Watershed was based on the following information sources:

- United States Department of Agriculture – Forest Service (USDA-FS) survey data for the Eldorado and Tahoe national forests (USDA-FS 2001a),
- California Native Plant Society's (CNPS) Electronic Inventory of Rare and Endangered Vascular Plants of California (CNPS 2006),
- California Department of Fish and Game's (CDFG) Natural Diversity Database (CDFG 2006),
- USDA-FS Regional Forester's List of Sensitive Plant and Animal Species for Region 5 (USDA-FS 1998),
- U.S. Fish and Wildlife Service Species List (USFWS 2006),
- Eldorado National Forest Land and Resource Management Plan (USDA-FS 1990a),
- Tahoe National Forest Land and Resource Management Plan (USDA-FS 1990b), and
- Sierra Nevada Forest Plan Amendment (USDA-FS 2004).

For the purposes of this document, a special-status plant is defined as any plant species that is granted protection by a federal, state, or local agency. Federally listed species granted status by USFWS under the Federal Endangered Species Act (ESA) include threatened (FT), endangered (FE), proposed threatened or endangered (FPT, FPE), candidate (FC), or listed species proposed for delisting (FPD). USDA-FS maintains lists of Forest Service Sensitive (FSS) plants for each forest. FSS plants are those identified by a Regional Forester as having current or predicted downward trends in population numbers or density, or current or predicted downward trends in habitat quality that would reduce the species' current distribution. USDA-FS develops management plans for these species to prevent a trend toward listing under the ESA, and to ensure the continued existence of viable, well-distributed populations.

State of California listed plant species, which are granted status by the CDFG under the California Endangered Species Act (CESA) include threatened (ST), endangered (SE), rare (SR), and California Species of Special Concern (CSC).

The California Native Plant Society (CNPS) also maintains a rating system for rare, threatened, or endangered plants in California. While no regulations are associated with these ratings, CNPS ratings provide valuable information regarding the status of these plants. Ratings are as follows:

- 1B (rare, threatened, or endangered in California and elsewhere);
- 2 (rare in California but more common elsewhere);
- 3 (more information needed to determine status); or
- 4 (of limited distribution (a watch list)).

CNPS listed plants are further defined as:

- _.1 (seriously endangered in California (over 80% of occurrences threatened, and a high degree and immediacy of threat));
- _.2 (fairly endangered in California (20-80% of occurrences threatened)); and
- _.3 (not very endangered in California (less than 20% of occurrences threatened or no current threats known)).

For example, a plant rated 2.1 would be rare in California, with more than 80% of occurrences threatened to a high degree, but more common elsewhere.

6.6.1.3 Noxious Weeds

Information on noxious weeds and invasive plants occurring in the Watershed was obtained through survey data provided by the ENF. Information has not yet been obtained from the TNF. Other sources reviewed include the California Invasive Plant Inventory (Cal-IPC 2006), and Noxious Weed Pest Ratings (CDFA 2004).

Noxious weed is a term used by government agencies for non-native invasive plants that have been defined as pests by law or regulation (California Department of Food and Agriculture (CDFA) 2004). Invasive plants are defined as those exotic species that are new to a region, persist without human intervention, and have serious impacts on their new environment (Simberloff et al. 1997).

6.6.2 Information Sources for Wildlife Resources

The following subsections describe the various sources of information that were evaluated to characterize existing wildlife resources in the Watershed.

6.6.2.1 Wildlife Habitats and Associated Common Species

Wildlife habitats present in the Watershed were determined by cross-referencing CalVeg vegetation alliances with the CDFG California Wildlife Habitat Relationship (CWHR) classifications. Common wildlife species potentially occurring within these habitats were determined based on a review of A Guide to Wildlife Habitats of California (Mayer and Laudenslayer 1988) and CDFG's California Wildlife Habitat Relationship System Database, Version 8 (CDFG 1999).

6.6.2.2 Special-Status Wildlife Resources

Information on USDA-FS land allocations for specific animal species and information on special-status wildlife species known to occur or potentially occurring in the Watershed was developed using the following information sources:

- USDA-FS survey data for the Eldorado and Tahoe national forests (USDA-FS 2001a);
- CDFG's Natural Diversity Database (CDFG 2006);
- USDA-FS Regional Forester's List of Sensitive Plant and Animal Species for Region 5 (USDA-FS 1998);
- U.S. Fish and Wildlife Service Species List (USFWS 2006);
- Eldorado National Forest Land and Resource Management Plan (USDA-FS 1990a);
- Tahoe National Forest Land and Resource Management Plan (USDA-FS 1990b); and
- Sierra Nevada Forest Plan Amendment (USDA-FS 2004).

For the purposes of this document, a special-status wildlife species is defined as any animal species that is granted status by a federal, state, or local agency. Federally listed species granted status by USFWS under the ESA include FT, FE, proposed threatened or endangered FPT or FPE, FC, or FPD.

USDA-FS maintains lists of FSS wildlife species, and National Forest Management Indicator Species (MIS) for each forest. FSS species are those wildlife species identified by a Regional Forester as having current or predicted downward trends in population numbers or density, or current or predicted downward trends in habitat quality that would reduce the species' current distribution. USDA-FS develops management plans for these species to prevent a trend toward listing under the ESA, and to ensure the continued existence of viable, well-distributed populations.

Additionally, the National Forest Management Act (NFMA) and the Secretary of Agriculture's implementing regulations (36 CFR 219) require selection of MIS and evaluation of effects of alternatives on the viability and diversity of plant and animal communities. MIS are used to determine the effects of management on fish and wildlife species. Some MIS species are game wildlife species.

State of California listed wildlife species, which are granted status by the CDFG under the CESA include ST, SE, California Fully Protected species (CFP), and CSC.

6.6.2.3 Game Species

Information on game species known to occur or potentially occurring in the Watershed was developed using the following information sources:

- CDFG Report of the 2004 Game Take Hunter Survey (CDFG 2004a);
- California State Fish and Game Code;
- Eldorado National Forest Land and Resource Management Plan (USDA-FS 1990a);
- Tahoe National Forest Land and Resource Management Plan (USDA-FS 1990b);
- Deer Hunting Final Environmental Document (CDFG 2004b);
- The Blue Canyon Deer Herd Management Plan (Fowler 1982); and
- The Pacific Deer Herd Management Plan (Hinz 1981).

6.6.3 Description of Existing Botanical Resources

This section describes the existing botanical resources in the Watershed, as determined using the information sources cited above. Vegetation alliances are discussed first, followed by special-status botanical resources, and noxious weeds. Special emphasis is placed on botanical resources that occur or have the potential to occur within the FERC Project boundary.

6.6.3.1 Vegetation Alliances

Information on vegetation alliances is summarized to provide a broad characterization of the kinds of trees, shrubs, and herbs that occur in the Middle Fork American Watershed. While knowledge of vegetation alliances can provide information about where special-status resources are most likely to occur, no regulatory protections are associated with the vegetation alliances themselves. Twenty-four vegetation alliances were identified as occurring within the Watershed. These include three herb-dominated alliances, six shrub-dominated alliances, and 15 tree-dominated alliances. One non-vegetated category (Barren) is also identified. Descriptions for each vegetation alliance, based on CalVeg—A Classification System for California Vegetation (USDA-FS 2005), are provided in Appendix 6.6-A. Figure 6.6-1 depicts the distribution of these vegetation alliances in the Watershed.

6.6.3.2 Special-Status Botanical Resources

This subsection summarizes special-status plants that occur within the Watershed.

A list of 47 special-status plants species was compiled from USFWS, USDA-FS, CDFG, and CNPS lists of special-status plants known to occur or potentially occurring in the Watershed and from survey data for the ENF and TNF. Of these 47 plants, three are known to be located within the FERC Project boundary of the MFP. These are detailed below:

- **Pleasant Valley mariposa lily**: USDA-FS records show a population of Pleasant Valley mariposa lily in the immediate vicinity of the Hell Hole-Middle Fork Tunnel, about 2 miles west of the North Fork Long Canyon Crossing/Removable Section. However, the Project facility (tunnel) at this location is underground.

- **Yellow burr navarretia**: USDA-FS records show a population of yellow burr navarretia at the Hell Hole-Middle Fork Tunnel Butterfly Valve House (14N55) Access Road.

- **Stebbins' phacelia**: USDA-FS records show a population of Stebbins' phacelia at the Middle Fork-Ralston Tunnel, about 0.5 mile east of the Middle Fork-Ralston Tunnel Surge Shaft, Tank, and Storage Building. However, the Project facility (tunnel) at this location is underground.

Based on an analysis of preferred habitat, known geographic and elevational range, and occurrence records of special-status plants within the watershed, it was determined that 43 of the remaining 44 plants species have the potential to occur within the FERC Project boundary. Only one species, Munroe's desert mallow, was determined to be unlikely to occur in the vicinity of the Project and is therefore not addressed further in this document. Table 6.6-1 summarizes pertinent information for all 47 special-status plant species, including status, blooming period, and preferred habitat, with notes on occurrence within the FERC Project boundary and the Watershed. Appendix 6.6-B provides life history information for all special-status plants known or potentially occurring in the Watershed.

In addition to special-status plants, CDFG's California Natural Diversity Database (CNDDB) records identify the Placer Big Tree Grove, located within the TNF in the vicinity of Mosquito Creek, at approximately 4,500 feet in elevation. This is a one-acre grove containing six old-growth giant sequoia trees, with the largest tree measuring approximately 12 feet in diameter. The grove, which represents the northernmost range limit of the species, is of particular interest because of its small size and distance from larger groves to the south. The old-growth trees in the grove are believed to be non-reproductive, although a number of sequoia saplings have been planted (CDFG 2006). The grove is open to the public. No specific regulations are associated with this grove. This grove is not within or near the FERC Project boundary and is therefore not addressed further in this document.

Figures 6.6-2a and 6.6-2b show the locations of known occurrences of special-status plants, as well as the Big Tree Grove, in the Watershed. Species occurrences are based on data currently available. Data for CNDDB are complete. Any discrepancies in USDA-FS data are noted in the figure. CNPS occurrences are not included because CNPS does not currently provide Geographic Information System (GIS) location information.

6.6.3.3 Noxious Weeds

Data on the occurrence of noxious weeds in the Watershed were available only for the ENF. These data indicate that there are populations of noxious weeds within the FERC Project boundary at the following locations: at Ralston Afterbay near the Ralston Picnic Area, and along Interbay Dam Road, approximately 1 mile to the northwest of the Interbay Dam. The populations are not identified to species. Table 6.6-2 lists noxious weed species known to occur in the Watershed, within the ENF. Figure 6.6-3 shows the locations of noxious weed occurrences in the Watershed, within the ENF.

6.6.4 Description of Existing Wildlife Resources

This section describes wildlife resources in the Watershed including wildlife habitats and associated common wildlife species. Special-status wildlife resources and game species are also described. Special emphasis is placed on wildlife resources that occur or have the potential to occur within the FERC Project boundary.

6.6.4.1 Wildlife Habitats and Associated Common Wildlife Species

Information on wildlife habitats is summarized to provide a broad characterization of the habitats and common animal species that occur in the Watershed. While knowledge of wildlife habitats may provide information about where special-status wildlife are most likely to occur, no regulatory protections are associated with the wildlife habitats themselves. Thirteen wildlife habitats were identified within the Watershed based on a “crosswalk” between USDA-FS CalVeg alliances in the Watershed and CDFG’s CWHR wildlife habitat classifications (Table 6.6-3). The CalVeg-CWHR crosswalk was developed by USDA-FS and CDFG as a way to determine which wildlife habitats are likely present based on existing vegetation communities and forest structural characteristics.

Habitats identified in the Watershed include two herb-dominated habitats, three shrub-dominated habitats, eight tree-dominated habitats, and one non-vegetated habitat. Habitat descriptions, based on A Guide to Wildlife Habitats of California (Mayer and Laudenslayer 1988), are provided in Appendix 6.6-C. The descriptions include examples of common animal species likely to occur in each habitat as determined using the CDFG CWHR database (CDFG 1999). This database uses a predictive model to determine the likelihood of the occurrence of animal species in any given geographical location based on ecological data included in the model such as the life history and known distribution of an animal, existing vegetation, percent canopy cover, presence of water, and a number of other elements including landscape features.

6.6.4.2 Special-Status Wildlife Resources

This section describes special-status wildlife resources in the Watershed. The first subsection addresses land allocations designated by the USDA-FS for the management of specific animal species including northern goshawk, California spotted owl, great gray owl, American marten, and Pacific fisher. The second subsection addresses special-status animal species that are known to or have the potential to occur in the Watershed.

USDA-FS Land Allocations

The USDA-FS has identified management areas for selected species in the Watershed. These include Protected Activity Centers (PACs) for northern goshawk, California spotted owl; and great gray owl Home Range Core Areas (HRCAs) for California spotted owl; and Forest Carnivore Den Sites for American marten and Pacific fisher. These land allocations were identified to provide direction to land managers for designing and developing fuels and vegetation management projects (USDA-FS 2001b). Activities that occur within these land allocations must be consistent with desired conditions (statements that identify a common vision for a specific land management area) and other management intents and objectives. The designation of each of these land allocations and USDA-FS desired conditions are described below based on the Sierra Nevada Forest Plan Amendment – Final Supplemental EIS (USDA-FS 2004).

<u>Protected Activity Centers</u>

Northern Goshawk

The USDA-FS designates PACs surrounding all known and newly discovered northern goshawk breeding territories on national forest lands based on the location of the most recently documented nest site and the location(s) of alternate nests. If the actual nest site is not located, the PAC designation is based on the location of territorial adult birds or recently fledged juvenile goshawks during the fledgling dependency period (USDA-FS 2004). In addition, USDA-FS desired conditions state that the PAC should include either “the best available 200-acres of forested habitat in the largest continuous patches,” or the largest possible patches of habitat within 0.5 miles of one another. Best available habitat is defined as forest land having the following characteristics:

- trees in the dominant and co-dominant crown classes averaging at least 24 inches diameter at breast height (dbh);
- at least 70% tree canopy cover in westside conifer and eastside mixed conifer forests, and at least 60% tree canopy cover in eastside pine forests; and
- non-forest vegetation (e.g., brush, meadows, etc.) should not be counted as part of the 200 acres.

Figure 6.6-4 presents the locations of the northern goshawk PACs in the Watershed. Table 6.6-4 provides detailed information on the location of northern goshawk PACs within the FERC Project boundary.

Great Gray Owl

PACs are established for great gray owl based on the location of known nests and include at least “50 acres of highest quality nesting habitat”, where highest quality habitat is defined as:

- conifer forest comprised of medium (at least 11 inches dbh) to large (at least 24 inches dbh) trees with a canopy cover of at least 60%; and
- adjacent meadow vegetation which supports a sufficiently large prey population (e.g., meadow voles) to sustain the owl through the breeding season (USDA-FS 2004).

TNF biologists report that there are currently no great gray owl PACs in the TNF within the Watershed (Triggs, pers. comm., 2006). No great gray owl data for the ENF are currently available.

California Spotted Owl

PACs for territorial California spotted owl in national forest lands are based on one of the following: the location of the most recent documented nest site or the most recent known roost site when a nest location remains unknown, or a central point based on repeated daytime detections, when neither nest or roost locations are known (USDA-FS 2004). Aerial photography interpretation and field verification are used as needed to delineate PACs. In addition, USDA-FS desired conditions state that each PAC should encompass “the best available 300 acres of habitat in as compact a unit as possible,” where best available habitat is defined as forest land having the following characteristics:

- two or more tree canopy layers;
- trees in the dominant and co-dominant crown classes averaging 24 inches dbh or greater; and
- at least 70% tree canopy cover (including hardwoods).

Figure 6.6-5 shows the locations of the California spotted owl PACs in the Watershed. Table 6.6-4 provides detailed information on the location of California spotted owl PACs within the FERC Project boundary.

<u>Home Range Core Areas</u>

California Spotted Owl

In addition to PACs, HRCAs were established surrounding each territorial California spotted owl activity center detected after 1986. The size of the HRCA is calculated as 20% of the area of the sum of average breeding pair home range size (for each forest) plus one standard error. The HRCA includes the PAC as well as the best available California spotted owl habitat in the closest proximity (within 1.5 miles) to the activity center (USDA-FS 2001b). USDA-FS desired conditions state that spotted owl HRCAs should consist of large habitat blocks that have the following characteristics:

- at least two tree canopy layers;
- at least 24 inches dbh in dominant and co-dominant trees;
- a number of very large (greater than 45 inches dbh) old trees;
- at least 50% to 70% canopy cover; and
- higher than average levels of snags and down woody material.

Data on California Spotted Owl HCRAs in the Watershed are not currently available.

Forest Carnivore Den Sites

The USDA-FS has established buffer areas to protect breeding mesocarnivores, including American marten and Pacific fisher, on national forest lands in the Watershed (USDA-FS 2004), as described in the following.

American Marten

Buffer areas are delineated for American marten based on the location of verified natal and maternal dens, and include 100-acre buffers consisting of the highest quality habitat in a compact arrangement surrounding the den site. Highest quality habitat is defined as a multi-storied forest with the dominant layer composed of large (greater than 24 inch dbh) conifer trees, and a canopy cover closure of at least 60%. In addition, USDA-FS desired conditions state that areas surrounding marten den sites should have at least two conifers per acre greater than 24 inches dbh with suitable denning cavities, more than 10 tons per acre of coarse woody debris in decay classes 1 and 2, and an average of six snags per acre on the west side Sierra Nevada, and three per acre on the east side.

TNF biologists report that there are currently no American marten den sites in the TNF within the Watershed (Triggs, pers. comm., 2006). American marten data for the ENF are not currently available.

Pacific Fisher

Buffer areas are delineated for Pacific fisher based on the location of verified natal (birthing) and maternal (kit-rearing) dens, and include a 700-acre buffer of the highest quality habitat, defined as conifer forest with medium to large trees (11 to 24 inch dbh), and a canopy cover closure exceeding 80%. In addition, USDA-FS desired conditions state that areas surrounding fisher den sites should include at least two large (greater than 40 inches dbh) conifers per acre, and one or more oaks (greater than 20 inches dbh) per acre with suitable denning cavities.

TNF biologists report that there are currently no Pacific fisher PACs in the TNF within the Watershed (Triggs, pers. comm., 2006). Pacific fisher data for the ENF are not currently available.

Special-Status Wildlife Species

A list of 37 special-status wildlife species was compiled from USFWS, USDA-FS, and CDFG lists of special-status wildlife species known to occur or potentially occurring in the Watershed. Of these 37 wildlife species, four are known to occur within the FERC Project boundary. Because wildlife species are mobile, a single sighting does not necessarily indicate that an animal is resident in the vicinity of a recorded occurrence. Therefore, the following parameters were considered in determining occurrence within the FERC Project boundary 1) the degree to which a particular animal would be restricted to the area in which the confirmed sighting occurred (e.g., amphibian populations are likely to be restricted to a watershed in which an occurrence was recorded, whereas a bird or mammal is not), and 2) presence of a nest or den site confirming probable residency of an animal for at least a portion of the year. For the purposes of this report, a buffer of 500 feet was assumed around bald eagle and osprey nests. Presence of northern goshawk and California spotted owl PACs was considered evidence of a known occurrence in a given area. The four wildlife species determined to occur within the FERC Project boundary are:

- **Foothill yellow-legged frog**: USDA-FS records show occurrences along the North Fork of the Middle Fork American River in the vicinity of the Ralston Picnic Area and along the Rubicon River in the vicinity of the Ralston Powerhouse and Switchyard.

- **Osprey**: CNDDB records indicate that a nest is present approximately 330 feet northeast of the French Meadows Dam.

- **California spotted owl**: Presence of California spotted owl is inferred by the presence of PACs. Refer to the previous section, USDA-FS Land Allocations, for the specific location of PACS in the immediate vicinity of Project facilities.

- **Northern goshawk**: Presence of northern goshawk is inferred by the presence of PACs. Refer to the previous section, USDA-FS Land Allocations, for the specific location of PACS in the immediate vicinity of Project facilities.

Based on an analysis of preferred habitat, known geographic and elevational range, and occurrence records within the watershed, it was determined that 21 of the remaining 33 wildlife species have the potential to occur within the FERC Project boundary. Twelve species were determined to be unlikely to occur in the vicinity of the Project, and are therefore not addressed further in this report. Table 6.6-5 summarizes pertinent information for all 37 special-status wildlife species, including status, habitat requirements, and potential for occurrence in the FERC Project boundary and Watershed. Appendix 6.6-D provides life history information for all special-status wildlife species known or potentially occurring in the Watershed. Figure 6.6-6 shows the locations of known occurrences of special-status wildlife in the Watershed. Species occurrences are based on data currently available. Data for CNDDB are complete. Any discrepancies in USDA-FS data are noted in the figure.

6.6.4.3 Game Species

A number of game species are known to occur or have the potential to occur in the Watershed. Hunting of game species is permitted in the Watershed within the ENF and

TNF during seasons regulated by the CDFG, except in portions of the TNF that have been designated as a State Game Refuge (Fish and Game Code §10825). Refuge boundaries extend, roughly, from the west end of French Meadows Reservoir to the northwest portion of the Granite Chief Wilderness. While the designation is intended primarily to protect habitat used by the Blue Canyon mule deer herd, California state law prohibits hunting of any species within a State Game Refuge. State law also prohibits possession or discharge of firearms, pellet guns, and bows and arrows within the Refuge.

Table 6.6-6 lists the game species potentially occurring in the Watershed, including their habitat requirements and a summary of state hunting regulations for each species. A brief summary of the game species known to occur or potentially occurring in the Watershed is provided below, including resident game birds, migratory game birds, game mammals, and fur-bearing mammals.

Resident and Migratory Game Birds

Upland birds known or likely to occur in the Watershed that meet the definition of resident game birds (California Fish and Game Code §3500) include blue grouse, wild turkey, mountain quail, and California quail. Birds that meet the definition of migratory game birds (California Fish and Game Code §3500) include Wilson's snipe, band-tailed pigeon, and mourning dove.

Game Mammals

California Fish and Game Code (§3950(a)) defines several mammals, including deer, bears, jackrabbits and hares, and tree squirrels, as game mammals. Coyotes and bobcats are considered non-game species, but are commonly hunted wildlife species, and so are included in this section. These species are discussed below.

Mule Deer

Mule deer are among the most visible and widespread wildlife species in California, and they are plentiful in the Watershed, which includes two Deer Hunt Zones, D4 and D5, and one Deer Assessment Unit, DAU 5. The combined deer population for these two zones is estimated to be over 30,000 (CDFG 2004b). In the early nineties, the average population of DAU 5 (which includes Deer Hunt Zones D3, D4, D5, and D6) was 70,000 deer, and the population was declining (USDA-FS 2001a). Threats to the deer population include fire exclusion, changes in logging practices, livestock grazing, and loss of winter range.

Deer hunting occurs in the Watershed, and is regulated by California state law through CDFG. A hunting license and a hunting tag are required to take mule deer, and only bucks with antlers with demonstrable forks (or greater) may be taken, except during special hunts. As noted previously, deer hunting is prohibited within the boundaries of the State Game Refuge in the vicinity of French Meadows Reservoir.

The following habitat areas are important to mule deer in the Watershed (USDA-FS 1990b, Fowler 1982, and Hinz 1981):

- Summer range, which is characterized as upper elevation habitat that provides cover and foraging and fawning habitat, includes moist meadows, brush-fields, seeps and springs, and riparian areas.
  - Critical summer range is a subset of summer range that consists of areas believed to be especially critical to the life cycle of migratory deer.
  - Critical fawning areas include those portions of summer range believed to be crucial for species persistence and reproduction.
- Winter range is characterized as lower elevation habitat that provides foraging and cover. Subsets of winter range include:
  - Critical winter range, which includes areas believed to be especially critical to the life cycle of migratory deer, and
  - Key winter range, defined as the portion of the yearlong range where deer congregate in response to food and/or cover during severe winter weather conditions.
- Intermediate range includes portions of the range located between summer and winter ranges that are used during migration. Summer and intermediate range often overlap depending upon annual climatic variation, and so are discussed together where applicable.
- Holding areas are where large numbers of deer congregate prior to migration.

Two deer herds, the Blue Canyon mule deer herd and the Pacific mule deer herd are present in the Watershed (CDFG 2004b, USDA-FS 1990b, Fowler 1982, and Hinz 1981). Summarized below is information on the status of each herd and the location of important habitat areas for each herd in the Watershed and within the FERC boundary.

Blue Canyon Deer Herd

The Blue Canyon mule deer herd occurs north of the Rubicon River and south of Interstate 80, on the western slope of the Sierra Nevada. The herd is primarily migratory, with a subset of non-migratory deer that occupy the Foresthill Divide area. The herd includes individuals of three subspecies: Columbian black-tailed deer, California mule deer, and Rocky Mountain mule deer. At the time the Blue Canyon Deer Herd Management Plan (Fowler 1982) was prepared, the herd had an average size of 4,500 and showed a decline trend that began in the 1960s. Low recruitment of fawns into the yearling class is believed to be a major limiting factor for this herd. Other population threats include changes in timber harvest practices, suppression of natural fires, habitat loss, overgrazing, predation, and poaching.

Figure 6.6-7 shows the locations of Blue Canyon mule deer habitats and migratory patterns in the Watershed. Table 6.6-7 summarizes Blue Canyon mule deer fawning areas, holding areas, and critical ranges within the FERC Project boundary.

Pacific Deer Herd

The Pacific deer herd occurs on the western slope of the Sierra Nevada, bounded by the Rubicon River to the north and the South Fork American River to the south. The herd consists of two subspecies of mule deer: Columbian blacktail and California mule deer. The Pacific Deer Herd Management Plan (Hinz 1981) lists the population of the Pacific herd at 3,900 deer, and declining. Poor fawn survival and recruitment are thought to be a population limiting factors. Threats to the Pacific deer herd include actions that lead to direct loss of habitat and actions that negatively affect habitat including residential development, grazing and logging practices, fire suppression, recreation, and poaching.

Figure 6.6-8 shows the locations of Pacific mule deer habitats and migratory patterns in the Watershed. Table 6.6-7 summarizes Pacific mule deer habitats that lie within the FERC Project boundary.

Other Game Mammals

Other game mammals known or potentially occurring in the Watershed include, but are not limited to, snowshoe hare, jackrabbit, western gray squirrel, coyote, black bear, and bobcat.

Table 6.6-6 provides the status, habitat requirements, and a summary of state hunting regulations for each of these species.

Fur-bearing Mammals

California Fish and Game Code (§4000) defines several mammals that are known to occur or are potentially occurring in the Watershed as fur-bearing mammals (i.e., mammals that have traditionally been hunted for their pelts). These include, but are not limited to, gray fox, raccoon, long-tailed weasel, mink, and American badger.

Table 6.6-6 provides the status, habitat requirements, and a summary of state hunting regulations for each of these species.

6.6.5 References

Beck, T.W., and J. Winter. 2000. Survey Protocol for the Great Gray Owl in the Sierra Nevada of California. U.S. Forest Service.

Best, T.L., W.M. Kiser, and P.W. Freeman. 1996. Eumops perotis. American Society of Mammalogists. *Mammalian Species* No. 534.

Bradford, D.F. 1984. Temperature modulation in a high-elevation amphibian, *Rana muscosa*. Copeia 1984: 966-976.

California Department of Fish and Game (CDFG). 1999. California Wildlife Habitat Relationship System Database, Version 8.

CDFG. 2002. Wildlife Habitat Relationships System. Sacramento, California.

CDFG. 2004a. Report of the 2004 Game Take Hunter Survey. Wildlife Programs Ranch, Sacramento, California. Available <http://www.dfg.ca.gov/hunting/gths2004.pdf>. Accessed March 2006.

CDFG. 2004b. Deer Hunting. Final Environmental Document.

CDFG. California Natural Diversity Data Base (CNDDB). 2006. RareFind 3, Version 3.0.5 (February 16, 2006). Sacramento, California.

California Department of Food and Agriculture (CDFA). 2004. Noxious Weed Pest Ratings. Division of Plant Health and Pest Protection Services. Available <http://www.cdfa.ca.gov/phpps/ ipc/encycloweedia/pdfs/noxiousweed_ratings.pdf>. Accessed March 2006.

California Invasive Plant Council (Cal-IPC). 2006. California Invasive Plant Inventory. Accessed April 2006 from http://www.cal-ipc.org/file_library/CalipcInventory2006.pdf.

California Native Plant Society (CNPS). 2001. Inventory of Rare and Endangered Plants of California (6th edition). Rare Plant Scientific Advisory Committee, David P. Tibor convening editor. California Native Plant Society.

CNPS. 2006. Inventory of Rare and Endangered Plants (online edition, v7-06a). California Native Plant Society. Sacramento, California. Available <http://www.cnps.org/inventory>. Accessed March 2006.

Camp, C.L. 1916. Descriptions of *Bufo canorus*, a new toad from the Yosemite National Park. University of California Publications in Zoology 17(6): 59-62.

Clines, Joanna. 2001. Threatened, Endangered, and Sensitive Plants of the Sierra National Forest.

Constantine, D.G. 1998. Range extensions of ten species of bats in California. Bulletin of the Southern California Academy of Sciences, 97:4975.

Davidson, C. 1994. *Bufo canorus* – Yosemite toad. Available from: <http://ice.ucdavis.edu/toads/canorus.html> Accessed October 7, 2002

Fitch, H.S. 1938. *Rana boylii* in Oregon. Copeia 1938: 148.

Fowler. 1982. The Blue Canyon Deer Herd Management Plan. California Department of Fish and Game, in cooperation with the Tahoe National Forest and Eldorado National Forest.

Hayes, M.P., and M.R. Jennings. 1989. Habitat correlates of the distribution of California red-legged frog (*Rana aurora draytonii*) and foothill yellow-legged frog (Rana boylii): implications for management. Pages 144-158 in R.E.

Hermanson, J. W., and T J. O'Shea. 1983. *Antrozous pallidus*. Mammalian Species.213:1-8.

Hickman, J.C. 1993. The Jepson Manual. University of California Press. Berkeley, California.

Hinz, D. 1981. The Pacific Deer Herd Management Plan. California Department of Fish and Game, in cooperation with Eldorado National Forest.

Holland, D.C. 1991. A synopsis of the ecology and status of the western pond turtle (*Clemmys marmorata*) in 1991. Report prepared for the United States Fish and Wildlife Service, National Ecology Research Center, San Simeon Field Station, San Simeon, California.

Jennings, M.R., and M.P. Hayes. 1994. Amphibian and Reptile Species of Special Concern in California. California Department of Fish and Game, Rancho Cordova, California.

Jennings, M.R., and M.P. Hayes. 1985. Pre-1900 overharvest of the California red-legged frog (*Rana aurora draytonii*): The inducement for bullfrog (Ranacate sbeiana) introduction. Herpetologica 41(1): 94-103.

Kagarise Sherman, C. 1980. A comparison of the natural history and mating systems of two anurans: Yosemite toads (*Bufo canorus*) and black toads (*Bufo exsul*).PhD Dissertation, University of Michigan, Ann Arbor, Michigan.

Karlstrom, E.L. 1962. The toad genus Bufo in the Sierra Nevada of California. University of California Publications in Zoology 62(1): 1-104. Karlstrom, E.L. and R.L.

Kunz, T. H., and R.A. Martin. 1982. *Plecotus townsendii*. Mammalian Species.175:1-6.

Kupferberg, S.J. 1996. Hydrologic and geomorphic factors affecting conservation of a river-breeding frog (*Rana boylii*). Ecological Applications 6(4): 1332-1344.

Lind, A. Unpublished data. U.S. Forest Service, Pacific Southwest Research Station.

Lind, A., H. Welsh, and R. Wilson. 1996. The effects of a dam on breeding habitat and egg survival of the foothill yellow-legged frog (*Rana boylii*) in northwestern California. Herpetological Review 27(2): 62-67.

Matthews, K.R. and K.L. Pope. 1999. A telemetric study of the movement patterns and habitat use of *Rana muscosa*, the mountain yellow-legged frog, in a high elevation basin in Kings Canyon National Park. Journal of Herpetology, 33(4):615-624.

Mayer, K.E., and W.F. Laudenslayer, Jr., editors. 1988. A Guide to Wildlife Habitats of California. California Department of Fish and Game, Sacramento, California.

Moyle, P.B. 1973. Effects of introduced bullfrogs, *Rana catesbeiana*, on the native frogs of the San Joaquin Valley, California. Copeia 1973: 18-22.

Mullally, D.P. 1953. Observations on the ecology of the toad *Bufo canorus*. Copeia1953 (3): 182-183.

Mullally, D.P. 1956. The relationships of the Yosemite and western toads. Herpetologica 12: 133-135.

Mullally, D.P., and J.D. Cunningham. 1956. Ecological relations of *Rana muscosa* at high elevations in the Sierra Nevada. Herpetologica 12(3): 189-198.

Nagorsen, D.W., and R.M. Brigham. 1993. Bats of British Columbia. UBC Press, University of British Columbia, Vancouver, pp. 106-117.

Nowak, R.M. 1994. Walker's Bats of The World. John Hopkins University Press, pp. 215-216, 237-239.

O'Farrell, M.J., and E.H. Studier. 1980. *Myotis thysanodes*. Mammalian Species.137:1-5.

Pierson, E.D. 1998. Tall trees, deep holes, and scarred landscapes: conservation biology of North American bats. Pp. 309-324, in (T. H. Kunz and P. A. Racey, eds.) Bats: phylogeny, morphology, echolocation, and conservation biology, Smithsonian Institution Press, Washington, D.C.

Pierson, E.D., and P.A. Heady. 1997. Unpublished telemetry study of the Western red bat on Vandenberg Air Force Base California

Placer County Water Agency (PCWA). 2005. Draft Physical Habitat Characterization Study for the Middle Fork American River Hydroelectric Project. Placer County Water Agency. Auburn, California.

Pope, K.L., and K.R. Matthews. 2001. Movement ecology and seasonal distribution of mountain yellow-legged frogs, *Rana muscosa*, in a high-elevation Sierra Nevada basin. Copeia 2001 (3): 787-793.

Reese, D.A., and H.H. Welsh. 1997. Use of terrestrial habitat by western pond turtles, *Clemmys marmorata*: implications for management. In J. Vanma (ed.), Conservation, Restoration and Management of Tortoises and Turtles-An International Conference, pp. 352-357. WCS Turtle Recovery Program and the New York Turtle and Tortoise Society, New York.

Reese, D.A., and H.H. Welsh. 1998. Habitat use by western pond turtles in the Trinity River, California. Journal of Wildlife Management 62(3): 842-853.

Sherman, C.K., and M. L. Morton. 1993. Population declines of Yosemite toads in the Eastern Sierra Nevada of California. Journal of Herpetology 27(2): 186-198.

Simberloff, D., D.C. Schmitz, and T.C. Brown. 1997. Strangers in Paradise: Impact and Management of Non-indigenous species in Florida. Island Press, Washington D.C.

Storer, T.I. 1925. A synopsis of the amphibia of California. University of California Publications in Zoology 27: 1-342.

Storer, T.I. 1930. Notes on the range and life history of the Pacific fresh-water turtle, *Clemmys marmorata*. University of California Publications in Zoology 32: 429-441.

Szaro, K.E. Severson, and D.R. Patton (technical coordinators). Proceeding of the symposium on the management of amphibians, reptiles, and small mammals in North America. USDA Forest Service, Rocky Mountain Forest and Range Experiment Station, General Technical Report RM-166, Fort Collins, Colorado, USA.

Triggs, Matt (Biologist). 2006. USDA-FS Tahoe National Forest, Nevada City, CA. April 19, 2006—telephone conversation and e-mail communication with Sara Ebrahim of Entrix regarding data for terrestrial resources in the Middle Fork American River Watershed.

United States Fish and Wildlife Service (USFWS). 1997. Guidance on site assessment and field surveys for the California red-legged frog. February 18, 1997.

USFWS. 1980. Listing the Valley Elderberry Longhorn Beetle as a Threatened Species with Critical Habitat. Federal Register45:52803-52807.

USFWS. 2001. Endangered and threatened wildlife and plants, final determinations of critical habitat for the California red-legged frog, final rule. March 13, 2001.

USFWS. 2006. Quick Endangered Species Lists. Sacramento Fish and Wildlife Offices. Available <http://www.fws.gov/sacramento/es/>. Accessed February 17, 2006.

USDA-FS. 1990a. Eldorado National Forest Land and Resource Management Plan.

USDA-FS. 1990b. Tahoe National Forest Land and Resource Management Plan.

USDA-FS. 1997. CalVeg data.

USDA-FS. 1998. Regional Forester's List of Sensitive Plant and Animal Species for Region 5 (USDA-FS June 8, 1998, appended March 6, 2001). Accessed from http://www.fs.fed.us/r5/projects/sensitive-species/.

USDA-FS. 2001a. USDA-FS survey data for the Eldorado and Tahoe National Forests.

USDA-FS. 2001b. The Sierra Nevada Forest Plan Final Environmental Impact Statement (FEIS).

USDA-FS. 2004. Sierra National Forest Plan Amendment (SNFPA) - Final Supplemental Environmental Impact Statement – Record of Decision. Pacific Southwest Region. R5-MB-046. January 2004.

USDA-FS. 2005. Vegetation Descriptions. North Sierran Ecological Province - CALVEG Zone 3. Accessed February and March 2006 from http://www.fs.fed.us/r5/rsl/projects/classification/nsierran-veg-descript.shtml.

Van Wagner, T.J. 1996. Selected life-history and ecological aspects of a population of foothill yellow-legged frogs (*Rana boylii*) from Clear Creek, Nevada county, California. Masters Thesis, California State University, Chico, California.

Wild, J. 2001. Wildlife Biologist, Endangered Species Division, U.S. Fish and Wildlife Service.

Wright, A.H., and A.A. Wright. 1949. Handbook of Frogs and Toads of the United States and Canada. Comstock Publishing Company, Inc. Ithaca, New York.

Zeiner, D., W. Laudenslayer, Jr., K. Mayer, and M. White, eds. 1988-1990. California's Wildlife Volumes I, II, and III. California Department of Fish and Game, Sacramento, California.

Zweifel, R.G. 1955. Ecology, distribution, and systematics of frogs of the *Rana boylii* group. University of California Publications in Zoology 54: 207-292.

TABLES

Table 6.6-1. Special-Status Plant Species Known or Potentially Occurring in the FERC Project Boundary and the Middle Fork American River Watershed.

Scientific Name	Common Name	Federal Status	State Status	CNPS List	Blooming Period/Fertile	Habitat	Occurrence Notes
Special-status Plants Known to Occur Within FERC Project Boundaries							
Calochortus clavatus var. *avius*	Pleasant Valley mariposa lily	FSS[3]	–	1B.2	March–June	Lower montane coniferous forests with Josephine silt loam and volcanic soils. From 1,000 to 6,300 feet in elevation.	Known to occur within FERC Project Boundaries at the Hell Hole-Middle Fork Tunnel, about 2 miles west of the North Fork Long Canyon Crossing/Removable Section. Other populations known within the watershed at the following locations: 3 populations on the north side of Long Canyon Creek, ~ 8 miles west of Ralston afterbay; 2 populations on the south side of Long Canyon Creek, ~ 10 miles west of Ralston afterbay; 4 populations on the North Fork Rubicon River, ~ 7 miles west of the confluence of the two forks; 2 populations in the vicinity of the confluence of the North and South forks of Long Canyon Creek; and 10 populations ~ 5 miles south of Hell Hole Reservoir at the junction of the North and South forks of the Rubicon River.
Navarretia prolifera ssp. *lutea*	Yellow burr navarretia	FSS[1]	–	4.3	May–July	Chaparral, cismontane woodland. Dry rocky flats near drainage channels. From 2,850 to 4,600 feet in elevation.	Known to occur within FERC Project Boundaries at the Hell Hole-Middle Fork Butterfly Valve House Access Road (14N55). Other populations known within the watershed at the following locations: 3 populations south of the Middle Fork Powerhouse in vicinity of the Hell Hole- Middle Fork Tunnel Portal Access Road and the Hell- Hole – Middle Fork Tunnel Surge Shaft Access Road; and 2 populations south of the Rubicon River at river mile 18; and 1 population at river mile 14 (.5 miles north of Stumpy Meadows Reservoir).
Phacelia stebbinsii	Stebbins' phacelia	FSS[3]	–	1B.2	June–July	Cismontane woodland, lower montane coniferous forest, riparian woodland, meadows and seeps. From 2,000 to 7,050 feet in elevation.	K Known to occur within FERC Project Boundaries nown to occur in Project vicinity at the Middle-Fork Ralston Tunnel, about .5 miles east of the Middle Fork-Ralston Tunnel Surge Shaft and Tank. Other populations known within the watershed at in the following locations: *Devil Peak USGS 7.5" quad:* In the vicinity of Leonardi Spring Waterfall; Big Grizzly Canyon Creek near junction with Rubicon River; scattered along Long Canyon Creek; scattered along Wallace Canyon Creek near junction with Long Canyon Creek; and 1 mile east of Pigeon Roost Mine. *Tunnel Hill USGS 7.5" quad:* Long Canyon Creek near junction with Rubicon River; Pilot Creek near junction with Rubicon River; and Ralston Ridge, south of powerline access road near junction with USFS Road 14N25.. *Greek Store USGS 7.5" quad:* Big Mosquito Creek near junction with Side Creek; North Fork of Middle Fork American River near junction with Deep Canyon Creek; Deep Canyon Creek near junction with Little Grizzly Creek; Grouse Creek Canyon near junction with South Branch Grouse Creek; Duncan Creek, near Trap Line Mine *Robbs Peak USGS 7.5" quad:* north of Gerle Creek dispersed camping area; west of Rubicon River, near Ellicot Bridge *Duncan Peak USGS 7.5" quad:* Manila Canyon, South of Merz Mine; near confluence of Screwauger and Antoine Canyon creeks; and Secret Canyon, south of the Foresthill Divide. *Royal Gorge USGS 7.5" quad:* Little Duncan Canyon, SW of summit of Sunflower Hill. *Bunker Hill USGS 7.5" quad:* NW of French Meadows Reservoir, before Duncan Diversion Dam. *Wentworth Springs USGS 7.5" quad:* north of Neck Meadow and Gerle Creek.

Table 6.6-1. Special-Status Plant Species Known or Potentially Occurring in the FERC Project Boundary and the Middle Fork American River Watershed (continued).

Scientific Name	Common Name	Federal Status	State Status	CNPS List	Blooming Period/Fertile	Habitat	Potential for Occurrence
Special-status Plants Potentially Occurring Within FERC Project Boundaries							
Arabis rigidissima var. *demota*	Trinity Mountain rockcress	FSS[2]	–	1B.2	August	Broad-leaved upland forest, and upper montane coniferous forest in rocky soils. From 6,750 to 7,700 feet in elevation.	May occur in appropriate habitat. FERC Project boundaries are within the known geographic and elevational range of this species.
Arctostaphylos nissenana	Nissenan manzanita	FSS[1]	–	1B.2	February–March	Open rock ridges in chaparral and closed-cone coniferous forests. From 1,450 to 3,600 feet in elevation.	May occur in appropriate habitat. FERC Project boundaries are within the known geographic and elevational range of this species. Known to occur in the watershed, near the junction of Otter Creek and the Rubicon River.
Astragalus webberi	Webber's milkvetch	FSS[2]	–	1B.2	May–July	Lower montane coniferous forest. From 2,400 to 3,700 feet in elevation.	May occur in appropriate habitat. FERC Project boundaries are within the known geographic and elevational range of this species.
Atractylocarpus flagellaceus		–	–	2.2	N/A	Cismontane woodlands. From 300 to 1,600 feet in elevation.	May occur in appropriate habitat. FERC Project boundaries are within the known geographic and elevational range of this species. Known to occur in the watershed within the USGS 7.5" quad Wentworth.
Botrychium ascendens	Triangle-lobe moonwort	FSS[1]	–	2.3	Fertile July–August	Lower montane coniferous forests near streams, grassy fields. From 4,800 to 7,300 feet in elevation.	May occur in appropriate habitat. FERC Project boundaries are within the known geographic and elevational range of this species.
Botrychium crenulatum	Scalloped moonwort	FSS[2]	–	2.2	Fertile June–July	Lower montane coniferous forests, bogs, fens, and moist meadows. From 4,900 to 10,800 feet in elevation.	May occur in appropriate habitat. FERC Project boundaries are within the known geographic and elevational range of this species. Known to occur in the watershed within the USGS 7.5" quad Wentworth.
Botrychium montanum	Mountain moonwort	FSS[2]	–	2.1	July–September	Lower montane coniferous forests. From 4,500 to 6,400 feet in elevation.	May occur in appropriate habitat. FERC Project boundaries are within the known geographic and elevational range of this species.
Cardamine pachystigma var. *dissectifolia*	Dissected-leaved toothwort	–	–	3	Feb–May	Chaparral and lower montane coniferous forests on rocky and/or serpentine soils. From 800 to 6,700 feet in elevation.	May occur in appropriate habitat. FERC Project boundaries are within the known geographic and elevational range of this species. Known to occur in the watershed within the USGS 7.5" quad Greek Store. Detailed location information not available.
Chlorogalum grandiflorum	Red Hills soaproot		–	1B.2	May–June	Cismontane woodland, chaparral, and lower montane coniferous forests on serpentine or gabbro soils. From 850 to 3,500 feet in elevation.	May occur in appropriate habitat. FERC Project boundaries are within the known geographic and elevational range of this species. Known to occur in the Project vicinity, with populations recorded in the following locations: *Tunnel Hill USGS 7.5" quad:* Rubicon River Canyon and south of the Middle Fork Rubicon River, northeast of Georgetown. *Michigan Bluff USGS 7.5" quad:* just east of the confluence of the Middle and North Fork American River, SSE of Michigan Bluff; north of the Rubicon River, east of the confluence with the Middle Fork American River, SSE of Michigan Bluff; SW of Ralston Mine, SSE of Michigan Bluff; and NW of Ralston Mine, on Hwy 23.
Clarkia biloba ssp. *brandegeeae*	Brandegee's clarkia	FSS[2]	–	1B.2	May–July	Chaparral, cismontane woodland, often roadcuts. From 950 to 3,200 feet in elevation.	May occur in appropriate habitat. FERC Project boundaries are within the known geographic and elevational range of this species. Known to occur in the watershed along Yankee Jim's Road about 1.3 miles east of Shirttail Canyon Road.
Clarkia stellata	Lake Almanor clarkia	FSS[2]	–	–		Coniferous forests from 3,200 to 4,800 feet in elevation.	May occur in appropriate habitat. FERC Project boundaries are within the known geographic and elevational range of this species.
Cypripedium fasciculatum	Clustered lady's slipper	FSS[2]	–	4.2	March–August	Lower montane coniferous forest, serpentine seeps and streambanks. From 300 to 7,800 feet in elevation.	May occur in appropriate habitat. FERC Project boundaries are within the known geographic and elevational range of this species. This species is known to occur in Placer County.
Cypripedium montanum	Mountain lady's slipper	FSS[2]	–	4.2	March–August	Broad-leaved upland and lower montane coniferous forests, on dry shaded slopes. From 750 to 7,700 feet in elevation.	May occur in appropriate habitat. FERC Project boundaries are within the known geographic and elevational range of this species.

Table 6.6-1. Special-Status Plant Species Known or Potentially Occurring in the FERC Project Boundary and the Middle Fork American River Watershed (continued).

Scientific Name	Common Name	Federal Status	State Status	CNPS List	Blooming Period/Fertile	Habitat	Potential for Occurrence
Special-status Plants Potentially Occurring Within FERC Project Boundaries							
Draba asterophora var. *asterophora*	Lake Tahoe draba	FSS[1]	–	1B.3	July–August	Subalpine coniferous forest and alpine boulder and rock fields in the high Sierra Nevada. From 8,000 to 11,500 feet in elevation.	May occur in appropriate habitat. FERC Project boundaries are within the known geographic and elevational range of this species.
Draba asterophora var. *macrocarpa*	Cup Lake draba	FSS[1]	–	1B.3	July–August	Subalpine coniferous forests and rock crevices. From 8,000 to 9,000 feet in elevation.	May occur in appropriate habitat. FERC Project boundaries are within the known geographic and elevational range of this species.
Epilobium howellii	Subalpine fireweed	FSS[3]	–	1B.3	July–August	Meadows, subalpine coniferous forest, wet meadows, mossy seeps. From 6,500 to 9,600 feet in elevation.	May occur in appropriate habitat. FERC Project boundaries are within the known geographic and elevational range of this species.
Epilobium oreganum	Oregon fireweed		–	1B.2	June–September	Bogs, fens, meadows, small streams and ditches in lower and upper montane coniferous forests. From 1,600 to 8,500 feet in elevation.	May occur in appropriate habitat. FERC Project boundaries are within the known geographic and elevational range of this species.
Erigeron miser	Starved fleabane	FSS[2]	–	1B.3	June–October	Upper montane coniferous forest, rocky soils. From 5,750 to 8,400 feet in elevation.	May occur in appropriate habitat. FERC Project boundaries are within the known geographic and elevational range of this species.
Eriogonum tripodum	Tripod buckwheat	FSS[1]	–	4.2	May–July	Chaparral, cismontane woodlands, often on serpentine outcroppings. From 650 to 5,250 feet in elevation.	May occur in appropriate habitat. FERC Project boundaries are within the known geographic and elevational range of this species. This species is known to occur in Placer County.
Eriogonum umbellatum var. *torreyanum*	Donner Pass buckwheat	FSS[3]	–	1B.2	July–September	Upper montane coniferous forests, chaparral, and meadows. Volcanic and rocky soils. From 5,850 to 8,600 feet in elevation.	May occur in appropriate habitat. FERC Project boundaries are within the known geographic and elevational range of this species.
Fritillaria eastwoodiae	Butte County fritillary	FSS[2]	–	3.2	March–May	Chaparral, cismontane woodland, lower montane coniferous forest (openings), wet and dry slopes red clay or sandy loam. From 100 to 5,300 feet in elevation.	May occur in appropriate habitat. FERC Project boundaries are within the known geographic and elevational range of this species. Known to occur within the watershed in the USGS 7.5" quad Foresthill. Exact location not disclosed due to the sensitivity of the data.
Horkelia parryi	Parry's horkelia	FSS[1]	–	1B.2	April–June	Chaparral, cismontane woodland. From 250 to 3,600 feet in elevation.	May occur in appropriate habitat. FERC Project boundaries are within the known geographic and elevational range of this species. Known to occur in the watershed Hornblende Mountains, northeast of Georgetown.
Ivesia aperta var. *canina*	Sierra Valley mousetail	FSS[2]	–	1B.1	June–August	Openings in lower montane coniferous forests and in meadows and seeps. Volcanic and rocky soils. From 5,100 to 6,500 feet in elevation.	May occur in appropriate habitat. FERC Project boundaries are within the known geographic and elevational range of this species.
Ivesia sericoleuca	Plumas mousetail	FSS[2]	–	1B.2	May–September	Great Basin scrub, lower montane coniferous forest, meadows and seeps, and vernal pools. From 4,650 to 7,000 feet in elevation.	May occur in appropriate habitat. FERC Project boundaries are within the known geographic and elevational range of this species.
Ivesia webberi	Webber's ivesia	FSS[2]	–	1B.1	May–July	Great Basin scrub, lower montane coniferous forest, in sandy or gravelly soils. From 3,200 to 6,700 feet in elevation.	May occur in appropriate habitat. FERC Project boundaries are within the known geographic and elevational range of this species.
Lewisia cantelovii	Cantelow's lewisia	FSS[3]	–	1B.2	May–October	Broadleaf upland, chaparral, cismontane woodlands, and lower montane coniferous forests. From 1,050 to 4,400 feet in elevation	May occur in appropriate habitat. FERC Project boundaries are within the known geographic and elevational range of this species.
Lewisia longipetala	Long-petaled lewisia	FSS[3]	–	1B.3	July–August	Alpine boulder and rock fields and subalpine coniferous forests, crevices in granitic rock. From 8,000 to 9,600 feet in elevation.	May occur in appropriate habitat. FERC Project boundaries are within the known geographic and elevational range of this species. Known to occur on Granite Chief Peak, on the northeast border of the watershed.

Table 6.6-1. Special-Status Plant Species Known or Potentially Occurring in the FERC Project Boundary and the Middle Fork American River Watershed (continued).

Scientific Name	Common Name	Federal Status	State Status	CNPS List	Blooming Period/Fertile	Habitat	Potential for Occurrence
Special-status Plants Potentially Occurring Within FERC Project Boundaries							
Lewisia serrata	Saw-toothed lewisia	FSS[3]	–	1B.1	May–June	Broad-leaved upland forest, lower montane coniferous forest, riparian forest. From 2,950 to 4,700 feet in elevation.	May occur in appropriate habitat. FERC Project boundaries are within the known geographic and elevational range of this species. Known to occur in within the watershed on Grouse Creek nearly Mineral Point, and in six additional locations in the Devil Peak, Greek Store, and Michigan Bluff USGS 7.5" quads. The exact locations for these six populations were not disclosed, due to the sensitivity of the data.
Lomatium stebbinsii	Stebbin's lomatium	FSS[1]	–	1B.1	March–May	Chaparral, lower montane coniferous forests. Volcanic or gravelly soils. From 3,750 to 6,450 feet in elevation.	May occur in appropriate habitat. FERC Project boundaries are within the known geographic and elevational range of this species. Known to occur within the watershed at the following locations: 1 population in the vicinity of the north side of the North Fork Long Canyon Creek, ~ 2 miles south of the French Meadows Dam; and approximately 4 populations along Nevada Point Ridge, W-NW of the confluence of the North and South forks of the Rubicon River.
Lupinus dalesiae	Quincy lupine	FSS[2]	–	1B.2	May–August	Lower and upper montane coniferous forests. From 2,300 to 8,200 feet in elevation.	May occur in appropriate habitat. FERC Project boundaries are within the known geographic and elevational range of this species.
Meesia triquetra	Three-ranked hump moss	FSS[3]	–	2.2	N/A	In acidic montane meadows. From 4,250 to 8,500 feet in elevation.	May occur in appropriate habitat. FERC Project boundaries are within the known geographic and elevational range of this species.
Meesia uliginosa	Broad-nerved hump moss	FSS[2]	–	2.2	N/A	In bogs and rock fissures, lower montane coniferous forests, and in meadows and seeps. From 4,250 to 9,500 feet in elevation.	May occur in appropriate habitat. FERC Project boundaries are within the known geographic and elevational range of this species.
Monardella folletti	Follett's mountainbalm	FSS[2]	–	1B.2	June–September	Lower montane coniferous forests in rocky, serpentine soils. From 1,650 to 6,550 feet in elevation.	May occur in appropriate habitat. FERC Project boundaries are within the known geographic and elevational range of this species.
Penstemon personatus	Close-throated beardtongue	FSS[2]	–	1B.2	June–September	Chaparral and upper and lower montane coniferous forests. From 3,400 to 7,000 feet in elevation.	May occur in appropriate habitat. FERC Project boundaries are within the known geographic and elevational range of this species.
Pseudostellaria sierrae	Sierra starwort	–	–	3.2	May–August	Chaparral, cismontane woodland, and lower and upper montane coniferous forests. From 4,000 to 6,400 feet in elevation.	May occur in appropriate habitat. FERC Project boundaries are within the known geographic and elevational range of this species. One or more records in the watershed within the USGS 7.5" quad Duncan Peak.
Pyrrocoma lucida	Sticky goldenweed	FSS[2]	–	1B.2	July–October	Great Basin scrub, lower montane coniferous forest, and meadows and seeps. May grow in alkaline clays. From 2,250 to 6,250 feet in elevation.	May occur in appropriate habitat. FERC Project boundaries are within the known geographic and elevational range of this species.
Rorippa subumbellata	Tahoe yellow cress	FC FSS[1]	SE	1B.1	May–September	Lower montane coniferous forests, meadows and seeps, sandy (granitic) lake margins. From 6,050 to 6,250 feet in elevation.	May occur in appropriate habitat. FERC Project boundaries are within the known geographic and elevational range of this species.
Scheuchzeria palustris ssp. *americana*	American scheuchzeria	FSS[2]	–	2.1	July	Bogs, fens, marshes, swamps, and lake margins. From 4,350 to 6,550 feet in elevation.	May occur in appropriate habitat. FERC Project boundaries are within the known geographic and elevational range of this species.
Scutellaria galericulata	Marsh skullcap	–	–	2.2	June–September	Lower montane coniferous forest, marshes and swamps, meadows and seeps. From 0 to 6,900 feet in elevation.	May occur in appropriate habitat. FERC Project boundaries are within the known geographic and elevational range of this species.
Senecio layneae	Layne's ragwort	FT FSS[1]	SR	1B.2	April–July	Chaparral and cismontane woodland. From 650 to 3,400 feet in elevation.	May occur in appropriate habitat. FERC Project boundaries are within the known geographic and elevational range of this species. There is a known occurrence of this species in the watershed near Bear Creek Road, 2 miles SE of Georgetown.

Table 6.6-1. Special-Status Plant Species Known or Potentially Occurring in the FERC Project Boundary and the Middle Fork American River Watershed (continued).

Scientific Name	Common Name	Federal Status	State Status	CNPS List	Blooming Period/Fertile	Habitat	Potential for Occurrence
Special-status Plants Potentially Occurring Within FERC Project Boundaries							
Vaccinium coccineum	Thinleaf huckleberry	FSS[2]	–	3.3	June–August	Lower and upper montane coniferous forests from 3,500 to 7,000feet in elevation.	May occur in appropriate habitat. FERC Project boundaries are within the known geographic and elevational range of this species.
Veronica cusickii	Cusick's veronica	–	–	4.3	July–August	Upper montane coniferous forest, alpine boulder and rock fields, meadows and seeps, subalpine coniferous forests. From 6,800 to 9,850 feet in elevation.	May occur in appropriate habitat. FERC Project boundaries are within the known geographic and elevational range of this species. Known to occur in watershed in the following locations: 2 populations ~ 1 mile north of the source of the Middle Fork American River; 1 population ~ 5 miles NE of the east end of the French Meadows Reservoir.
Sphaeralcea munroana	Munroe's desert mallow	–	–	2.2	May–June	Great Basin scrub, about 6,000 feet in elevation.	Unlikely to occur. Known from Squaw Creek in Placer County only, to the north of the watershed.

LEGEND:

Federal Status
FT = Federal Threatened
FE = Federal Endangered
FC = Federal Candidate
FSS[1] = Forest Service Sensitive, Eldorado National Forest
FSS[2] = Forest Service Sensitive, Tahoe National Forest
FSS[2] = Forest Service Sensitive, Eldorado and Tahoe National Forests

State Status
CR = listed by California as Rare
CT = California Threatened
CE = California Endangered

CNPS Status (California Native Plant Society)
1B = rare, threatened or endangered in California and elsewhere.
2 = rare in California but more common elsewhere.
3 = need more information
4 = plants of limited distribution; a watch list.
_.1 = Seriously endangered in California (over 80% of occurrences threatened / high degree and immediacy of threat)
_.2 = Fairly endangered in California (20-80% occurrences threatened)
_.3 = Not very endangered in California (<20% of occurrences threatened or no current threats known)

Table 6.6-2. Noxious Weed Species Known to Occur in the Middle Fork American River Watershed.

Scientific Name	Common Name	Cal-IPC Rating[1]	CDFA Rating[2]
Aegilops triuncialis	barbed goatgrass	High	B
Ailanthus altissima	tree of heaven	Moderate	—
Carduus pycnocephalus	Italian thistle	Moderate	C
Centaurea diffusa	diffuse knapweed	Moderate	A
Centaurea maculosa	spotted knapweed	Red Alert	A
Centaurea solstitialis	yellow star-thistle	High	C
Chondrilla juncea	skeleton weed	Moderate	A
Cytisus scoparius	scotch broom	High	C
Euphorbia oblongata	eggleaf (oblong) spurge	Limited	B
Foeniculum vulgare	fennel	High	—
Genista monspessulana	French broom	High	C
Hypericum perforatum	Klamathweed	Moderate	C
Lepidium latifolium	broadleaved pepperweed (tall whitetop)	High	B
Leucanthemum vulgare	ox-eye daisy	Moderate	—
Rubus discolor	Himalayan blackberry	High	—
Salsola tragus	Russian thistle	Limited	C
Spartium junceum	Spanish broom	High	—
Taeniatherum caput-medusae	medusahead	High	C

Cal-IPC Rating:

High - These species have severe ecological impacts on physical processes, plant and animal communities, and vegetation structure. Their reproductive biology and other attributes are conducive to moderate to high rates of dispersal and establishment. Most are widely distributed ecologically.

Moderate - These species have substantial and apparent—but generally not severe—ecological impacts on physcial processes, plant and animal communities, and vegetation structure. Their reproductive biology and other attributes are conducive to moderate to high rates of dispersal, though establishment is generally dependent upon ecological disturbance. Ecological amplitude and distribution goay range from limited to widespread.

Limited - These species are invasive but theih ecological impacts are minor on a statewide level or there was not enough information to justify a higher score. Their reproductive biology and other attributes result in low to moderate rates of invasiveness. Ecological amplitude and distribution are generally limited, but these species may be locally persistent and problematic.

CDFA Rating:

"A" - An organism of known economic importance subject to state (or commissioner when acting as a state agent) enforced action involving: eradication, quarantine, containment, rejection, or other holding action.

"B" - An organism of known economic importance subject to: eradication, containment, control or other holding action at the discretion of the individual county agricultural commissioner. OR An organism of known economic importance subject to state endorsed holding action and eradication only when found in a nursery.

"C" - An organism subject to no state enforced action outside of nurseries except to retard spread. At the discretion of the commissioner. OR An organism subject to no state enforced action except to provide for pest cleanliness in nurseries.

[1]Source: California Invasive Plant Inventory (Cal-IPC 2006).

[2]Source: Noxious Weed Pest Ratings (CDFA 2004).

Table 6.6-3. Vegetation Alliances and Associated Wildlife Habitats in the Middle Fork American River Watershed.

CalVeg Vegetation Alliance[1]	CalVeg Code[2]	CWHR Wildlife Habitat[3]
Alpine Grasses/Forbs	AC	Alpine Dwarf Shrub
Annual Grasses/Forbs	HG	Annual Grass
Barren	BA	Barren
Douglas-fir-Ponderosa Pine	DP	Douglas-Fir
Jeffrey Pine	JP	Jeffrey Pine
Lodgepole Pine	LP	Lodgepole Pine
Ceanothus Chaparral	CC	Mixed Chaparral
Huckleberry Oak	CH	Montane Chaparral
Upper Montane Mixed Shrub	CM	Montane Chaparral
Lower Montane Mixed Chaparral	CQ	Montane Chaparral
Upper Montane Mixed Chaparral	CX	Montane Chaparral
Canyon Live Oak	QC	Montane Hardwood
California Black Oak	QK	Montane Hardwood
Interior Live Oak	QW	Montane Hardwood
Black Cottonwood	QX	Montane Riparian
White Alder	QE	Montane Riparian
Willow	QO	Montane Riparian
Willow-Alder	QY	Montane Riparian
Ponderosa Pine	PP	Ponderosa Pine
Mixed Conifer - Giant Sequoia	MB	Sierran Mixed Conifer
Mixed Conifer - Fir	MF	Sierran Mixed Conifer
Mixed Conifer - Pine	MP	Sierran Mixed Conifer
Red Fir	RF	Red Fir
Mountain (Thinleaf) Alder	TA	Montane Riparian
White Fir	WF	White Fir
Wet Grass/Forbs	HJ	Wet Meadow

[1]Source: http://www.fs.fed.us/r5/rsl/projects/classification/system.shtml

[2]CalVeg codes as referenced on map legend, Figure 6.6-1.

[3]Source: http://www.dfg.ca.gov/whdab/html/wildlife_habitats.html

Table 6.6-4 Northern Goshawk and California Spotted Owl PACs within the FERC Project Boundary.

Project Facility	Northern Goshawk PCA	California Spotted Owl PAC
Large Storage Dam		
Small Dams		
Duncan Creek Diversion Dam	X	
South Fork Long Canyon Diversion Dam	X	X
Large Reservoirs		
French Meadows Reservoir	X	X
Water Conveyance Systems		
Surge Chambers and Adits		
Hell Hole-Middle Fork Tunnel Surge Shaft and Tank		X
Brushy Canyon Adit	X	X
Gatehouses and Shafts		
Duncan Creek Gatehouse and Shaft	X	
Penstocks / Butterfly Valvehouses		
Middle Fork Powerhouse Penstock and Butterfly Valve House		X
Powerhouses		
Middle Fork Powerhouse and Switchyards		X
Stream Gages and Weirs		
Duncan Canyon Creek near French Meadows Gage and Weir (USGS No. 14427700)	X	
South Fork Long Canyon below Diversion Tunnel near Volcanoville Gage (USGS No. 11433065)	X	X
Diversion Gages		
South Fork Long Canyon Diversion Tunnel near Volcanoville Gage (USGS No.11433060)	X	X
Project Communication and Powerlines		
Communication/Powerline – Middle Fork Powerhouse to Penstock Butterfly Valve House and Microwave/Radio Repeater Station		X
Powerline – Middle Fork Powerhouse to Middle Fork American River above Middle Fork Powerhouse near Foresthill Gage (USGS No. 11427760)	X	
Project Support Facilities		
Microwave Reflectors and Radio Towers		
Radio Tower and Repeater near Hell Hole-Middle Fork Surge Shaft		X
Project Roads		
Duncan Creek and French Meadows Area		
Duncan Creek Diversion Road	X	
Long Canyon Area		
Spur road to South Fork Long Canyon Diversion	X	X
Interbay Area		
Hell Hole-Middle Fork Tunnel Access Road		X
Hell Hole-Middle Fork Tunnel/Butterfly Valve House (14N55) Access Road		X
Middle Fork Penstock Access Road		X
Interbay Dam Road		X
Ralston-Oxbow Area		
Brushy Canyon Adit Access (FR 14N30)	X	X
Project Trails		
Duncan Creek Gatehouse Access Trail	X	

Table 6.6-4 Northern Goshawk and California Spotted Owl PACs within the FERC Project Boundary (continued).

	Northern Goshawk PCA	California Spotted Owl PAC
Recreation Facilities		
Coyote Group Campground	X	X
Gates Group Campground		X
Lewis Campground	X	
Poppy Campground		X
Middle Meadows Group Campground	X	X

Table 6.6-5. Special-Status Wildlife Known or Potentially Occurring in the FERC Project Boundary and the Middle Fork American River Watershed.

Scientific Name	Common Name	Federal Status	State Status	Other Status	Habitat Requirements	Occurrence Notes
Special-Status Wildlife Known to Occur Within FERC Project Boundaries						
Rana boylii	foothill yellow-legged frog	—	CSC	FSS[3]	Breeds in rocky streams with cool, clear water in a variety of habitats, including valley and foothill oak woodland, riparian forest, ponderosa pine, mixed conifer, coastal scrub, mixed chaparral, and wet meadows; occurs at elevations ranging from 0 to 6,000 feet.	Known to occur within FERC Project boundaries at the North Fork of the Middle Fork American River in the vicinity of the Ralston Picnic Area and at the Rubicon River in the vicinity of the Ralston Powerhouse and Switchyard.
Pandion haliaetus	osprey	—	CSC	—	Breeds in northern California, associated strictly with large fish-bearing waters, primarily in ponderosa pine and mixed conifer habitats.	Known to occur within FERC Project boundaries. Known nest approximately 330 feet NE of the French Meadows Dam.
Accipiter gentilis	northern goshawk	—	CSC	MIS	Prefers middle to high elevation, mature, dense conifer forests for foraging and nesting. Casual in foothills during winter, northern deserts in pinyon-juniper woodland, and low elevation riparian habitats.	Known to occur within FERC Project boundaries. Several known USFS occurrences. Mapped PACs are present near French Meadows Reservoir and Duncan Creek. Additional occurrences within the watershed ~ 1 mile of the Duncan Creek Diversion and within 3 miles of French Meadows Reservoir.
Strix occidentalis occidentalis	California spotted owl	—	CSC	FSS[3] MIS	Resides in dense, old growth, multi-layered mixed conifer, redwood, Douglas-fir, and oak woodland habitats, from sea level up to approximately 7,600 feet. Known from the Sierra National Forest.	Known to occur within FERC Project boundaries. PACs are present in the Project vicinity.
Special-Status Wildlife Potentially Occurring Within FERC Project Boundaries						
Hydromantes platycephalus	Mount Lyell salamander	—	CSC	—	High elevation rock outcrops associated with free surface water (permanent streams, waterfalls, and seeps); breeds beneath granite rocks or slabs covering moist granitic soil. Sierra to Tulare counties at elevations from 4,000 to 11,600 feet.	May occur in appropriate habitat. FERC boundaries are within the known geographic and elevational range of this species.
Rana aurora draytonii	California red-legged frog	FT	CSC	—	Breeds in quiet streams and permanent, deep, cool ponds with overhanging and emergent vegetation below 4,000 feet elevation. Known to occur adjacent to breeding habitats in riparian areas and heavily vegetated streamside shorelines, and non-native grasslands. Sierran streams historically supported populations of red-legged frog; however, these populations have been eliminated.	May occur in appropriate habitat. FERC Project boundaries are within the known geographic and elevational range of this species. The closest records for this species are ~ 1.5 miles east of the Ralston Powerhouse and ~ 2.5 miles NE of Ralston Afterbay Dam.
Rana muscosa	mountain yellow-legged frog	FC	CSC	FSS[3]	Occurs in the Sierras at elevations ranging from 4,500 to 12,000 feet; associated with streams, lakes, and ponds in montane riparian, lodgepole pine, subalpine conifer, and wet meadow habitats; breeds in shallow water in low gradient perennial streams and lakes.	May occur in appropriate habitat. FERC Project boundaries are within the known geographic and elevational range of this species.
Actinemys marmorata marmorata	northwestern pond turtle	—	CSC	FSS[3]	Perennial wetlands and slow moving creeks and ponds with overhanging vegetation up to 6,000 feet; suitable basking sites such as logs and rocks above the waterline.	May occur in appropriate habitat. FERC Project boundaries are within the known geographic and elevational range of this species. Known to occur within the watershed on the Middle Fork American River just south of Ralston Afterbay Dam.
Histrionicus histrionicus	harlequin duck	—	CSC	—	Historic breeding grounds include west slope of the Sierra Nevada along shores of swift, shallow rivers.	Potential (rare) migrant or resident in appropriate habitat. FERC Project boundaries are within the known geographic and elevational range of this species.

Table 6.6-5. Special-Status Wildlife Known or Potentially Occurring in the FERC Project Boundary and the Middle Fork American River Watershed (continued).

Scientific Name	Common Name	Federal Status	State Status	Other Status	Habitat Requirements	Occurrence Notes
Special-Status Wildlife Potentially Occurring Within FERC Project Boundaries (continued)						
Haliaeetus leucocephalus	bald eagle	FT	SE CFP	MIS	Local winter migrant to various California lakes. Most of the breeding population is restricted to more northern counties. Regular winter migrants to the region. Usually not found at high elevations in the Sierra.	Potential resident in appropriate habitat. FERC Project boundaries are within the known geographic and elevational range of this species.
Accipiter cooperii	Cooper's hawk	—	CSC	—	Breeding resident throughout most of the wooded portion of the state. Breeds in Sierra Nevada foothills, New York Mountains, Owens Valley, and other local areas in southern California. Dense stands of oak and riparian woodland for nesting and grassland for foraging up to 9,000 feet.	Potential visitor in appropriate habitat. FERC Project boundaries are within the known geographic and elevational range of this species.
Aquila chrysaetos	golden eagle	—	CSC CFP	—	Grasslands and early successional stages of forest and shrub habitats for foraging up to 11,500 feet. Secluded cliffs with overhanging ledges or large trees in open areas with unobstructed views for nesting.	Potential resident in appropriate habitat. FERC Project boundaries are within the known geographic and elevational range of this species. Known from the Tahoe National Forest.
Falco peregrinus anatum	American peregrine falcon	D	SE CFP	MIS	Very uncommon breeding resident and uncommon as a migrant. Breeds in woodlands, forests, coastal habitats, and riparian areas near wetlands, lakes, rivers, or other water on high cliffs, banks, dunes, or mounds. Active nesting sites are known along the coast, in the Sierra Nevada, and in the mountains of northern California. Migrants occur along the coast and the western Sierra Nevada in spring and fall.	Potential resident in appropriate habitat. FERC Project boundaries are within the known geographic and elevational range of this species.
Strix nebulosa	great gray owl	—	SE	FSS[3] MIS	Nests in old-growth coniferous forests and forages in montane meadows. Distribution includes high elevations of the Sierra Nevada and Cascade Ranges from 4,500 to 7,500 feet.	Potential migrant in appropriate habitat. Great gray owls are not known to breed in the vicinity of FERC Project boundaries. Breeding populations in California are concentrated in Del Norte, Humboldt, Siskiyou, and Modoc counties, with smaller, isolated breeding populations also occurring in the central Sierra Nevada.
Otus flammeolus	flammulated owl	—	—	—	A common summer resident locally in a variety of coniferous habitats from ponderosa pine to red fir forests. Breeds in the North Coast and Klamath Ranges, Sierra Nevada, and in suitable habitats in mountains in southern California. Occurs in montane regions from 6,000-10,000 feet elevation; prefers low to intermediate canopy closure. Frequents montane forests, especially ponderosa pine; favors small openings, and edges and clearings with snags for nesting and roosting.	Potential summer (breeding) resident in appropriate habitat. FERC Project boundaries are within the known geographic and elevational range of this species.
Cypseloides niger	black swift	—	CSC	—	Nests in moist crevices or caves, or on cliffs near waterfalls in deep canyons. Forages widely over many habitats; seems to avoid arid regions.	Potential summer (breeding) resident in appropriate habitat. FERC Project boundaries are within the known geographic and elevational range of this species.
Chaetura vauxi	Vaux's swift	—	CSC	—	Prefers redwood and Douglas-fir habitats with nest sites in large, hollow trees and snags, especially tall, burned-out stubs. Forages over moist terrain and habitats, preferring rivers and lakes.	Potential summer (breeding) resident in appropriate habitat. FERC Project boundaries are within the known geographic and elevational range of this species.

Table 6.6-5. Special-Status Wildlife Known or Potentially Occurring in the FERC Project Boundary and the Middle Fork American River Watershed (continued).

Scientific Name	Common Name	Federal Status	State Status	Other Status	Habitat Requirements	Occurrence Notes
Special-Status Wildlife Potentially Occurring Within FERC Project Boundaries (continued)						
Empidonax traillii (brewsteri)	willow flycatcher	—	SE	FSS[3] MIS	Wet meadow and montane riparian habitats from 2,000 to 8,000 feet. Most often occurs in broad, open river valleys or large mountain meadows with lush growth of shrubby willows.	Potential summer (breeding) resident in appropriate habitat. FERC Project boundaries are within the known geographic and elevational range of this species.
Dendroica petechia brewsteri	yellow warbler	—	CSC	—	Breeds in riparian woodlands from coastal and desert lowlands up to 8,000 feet in the Sierra Nevada. Also breeds in montane chaparral, open ponderosa pine, and mixed conifer habitats with substantial amounts of brush.	Potential summer (breeding) resident in appropriate habitat. FERC Project boundaries are within the known geographic and elevational range of this species.
Lasiurus blossevillii	Western red bat	—	—	FSS[3]	Occurs from British Columbia to South America. In California, occurs from Shasta County to the Mexican border west of the Sierra crest. Roosts solitarily in foliage in forests and woodlands from sea level up through mixed coniferous forest. In California known to roost in cottonwood and willow.	May occur in appropriate habitat. FERC Project boundaries are within the known geographic and elevational range of this species.
Corynorhinus townsendii	Townsend's big-eared bat	—	CSC	FSS[3]	Found in all but alpine and subalpine habitats; most abundant in mesic habitats. Requires caves, mines, tunnels, buildings, or other man-made structures for roosting. This species is extremely sensitive to disturbance and may abandon a roost if disturbed.	May occur in appropriate habitat. FERC Project boundaries are within the known geographic and elevational range of this species.
Aplodontia rufa californica	Sierra Nevada mountain beaver	—	CSC	—	Occurs in dense riparian and open brushy stages of most forest types. Deep, friable soils are required for burrowing along cool, moist microclimates. Live in burrows located in or near deep soils near streams and springs. Typical habitat in the Sierra is montane riparian.	May occur in appropriate habitat. FERC Project boundaries are within the known geographic and elevational range of this species. Recorded occurrence east of Duncan Peak.
Martes americana (sierrae)	American marten	—	—	FSS[3] MIS	Optimal habitats are various mixed evergreen forests with more than 40% crown closure and large trees and snags for den sites. Most commonly found in red fir and lodgepole pine forests between 4,000 and 10,600 feet elevation.	May occur in appropriate habitat. FERC Project boundaries are within the known geographic and elevational range of this species. Known to occur within the watershed. A CNDDB report (polygon) for this species includes portions of Duncan Creek Diversion Road.
Martes pennanti (pacifica)	Pacific fisher	FC	—	FSS[3] MIS	Suitable habitat consists of large areas of mature, dense forest such as red fir, lodgepole pine, ponderosa pine, mixed conifer, and Jeffery pine forests with snags and greater than 50% canopy closure. Known from 4,000 to 8,000 ft elevations in the Sierra National Forest.	May occur in appropriate habitat. FERC Project boundaries are within the known geographic and elevational range of this species. Two recorded occurrences in the vicinity of French Meadows Reservoir, including one occurrence ~ 1 mile east of French Meadows Reservoir, near the Forest Service Station.
Gulo gulo luteus	California wolverine	—	ST CFP		Mixed conifer, red fir, and lodgepole habitats, and probably sub-alpine conifer, alpine dwarf shrub, wet meadow, and montane riparian habitats. Occurs in the Sierra Nevada from 4,300 to 10,800 feet. Majority of recorded sightings are found above 8,000 feet elevation.	May occur in appropriate habitat. FERC Project boundaries are within the known geographic and elevational range of this species. However, this species is extremely rare in California.

Table 6.6-5. Special-Status Wildlife Known or Potentially Occurring in the FERC Project Boundary and the Middle Fork American River Watershed (continued).

Scientific Name	Common Name	Federal Status	State Status	Other Status	Habitat Requirements	Occurrence Notes
Special-Status Wildlife Unlikely to Occur Within FERC Project Boundaries						
Helisoma newberryi	Great Basin rams-horn (snail)	—	—	FSS[2]	Larger lakes and slow rivers, including larger spring sources and spring fed creeks. In mountain streams and lakes south to Lake Tahoe; under stones (Storer et al. 2004).[2]	Unlikely to occur. This is a relic species that is confined to large spring complexes on the periphery of the Great Basin. There are few remaining populations; one Lake Tahoe population is believed extant.
Desmocerus californicus dimorphus	valley elderberry longhorn beetle	FT	—	—	Elderberry shrubs throughout the Central Valley and foothills below 3,000 feet elevation.	Unlikely to occur. Elderberry shrubs were not detected in recent surveys conducted below 3,000 feet in elevation. (pers. comm. J. Nolan-Summers)
Bufo canorus	Yosemite toad	FC	CSC	FSS[1]	Occurs in montane meadows and forest borders; breeds in shallow pools, at lake margins, or in pools of quiet streams at elevations ranging 6,400 to 11,300 feet.	Unlikely to occur. FERC Project boundaries are outside the known elevational range of this species.
Rana pipiens	northern leopard frog	—	CSC	FSS[1]	Native range is east of the Sierra crest only. Found near permanent or semi-permanent water in a variety of habitats. Highly aquatic species. Shoreline cover, submerged and emergent aquatic vegetation are important habitat characteristics. Elevation range extends from sea level to 7000 feet.	Unlikely to occur. FERC Project boundaries are outside the known geographic range of this species.
Branta canadensis leucopareia	Aleutian Canada goose	D	—	—	(wintering) Winters on lakes and inland prairies. Forages on natural pasture or that cultivated to grain; loafs on lakes, reservoirs, ponds.	Unlikely to occur. FERC Project boundaries are outside the known geographic and elevational range of this species.
Buteo swainsoni	Swainson's hawk	—	ST	—	Uncommon breeding resident and migrant in the Central Valley, Klamath Basin, Northeastern Plateau, Lassen County, and Mojave Desert. Riparian woodlands, juniper-sage flats, and oak woodlands for nesting. Grasslands and agricultural areas for foraging.	Unlikely to occur. FERC Project boundaries are outside the known geographic range of this species.
Buteo regalis	ferruginous hawk	—	CSC	—	(wintering) Open grasslands, sagebrush flats, desert scrub, low foothills & fringes of pinyon-juniper habitats. mostly eats lagomorphs, ground squirrels, and mice. Population trends may follow lagomorph population cycles.	Unlikely to occur. FERC Project boundaries are outside the known geographic range of this species.
Athene cunicularia hypugaea	western burrowing owl	—	CSC		Year-long resident of open, dry grassland and desert habitats and in grass, forb, and open shrub stages of pinyon-juniper and ponderosa pine habitats up to 5,300 feet.	Unlikely to occur. FERC Project boundaries boundaries are outside the known geographic and elevational range of this species.
Euderma maculatum	spotted bat	—	CSC	—	Habitats range from arid deserts and grasslands through mixed conifer forests up to 10,600 feet. Prefers sites with adequate roosting habitat, such as cliffs. Often limited by the availability of cliff habitat. Feeds over water and along marshes.	Unlikely to occur. FERC Project boundaries boundaries are outside the known geographic range of this species.
Antrozous pallidus	pallid bat	—	CSC	FSS[3]	Inhabits grasslands, shrublands, woodlands, and forests from sea level up through mixed conifer forests. Typically roosts in caves, crevices, or mines. Requires open habitat for foraging.	Unlikely to occur. FERC Project boundaries boundaries are outside the known elevational range of this species.

Table 6.6-5. Special-Status Wildlife Known or Potentially Occurring in the FERC Project Boundary and the Middle Fork American River Watershed (continued).

Scientific Name	Common Name	Federal Status	State Status	Other Status	Habitat Requirements	Occurrence Notes
Special-Status Wildlife Unlikely to Occur Within FERC Project Boundaries (continued)						
Eumops perotis californicus	greater western mastiff bat	—	CSC	—	Occurs in many open, semi-arid to arid habitats, including conifer and deciduous woodlands, coastal scrub, annual and perennial grasslands, chaparral, desert scrub, and urban areas. Typically roosts in caves, crevices, or other rock formations. Requires open areas for foraging. Found mostly below 4,000 feet in elevation in the lower and upper desert scrub near cliffs, preferring rugged canyons with abundant crevices.	Unlikely to occur. FERC Project boundaries boundaries are outside the known geographic and elevational range of this species.
Vulpes vulpes necator	Sierra Nevada red fox	—	ST	MIS	Occurs throughout the Sierra Nevada at elevations above 7,000 feet in forests interspersed with meadows or alpine forests. Open areas are used for hunting, and forested habitats are used for cover and reproduction. Known from the higher elevations of the Sierra National Forest.	Unlikely to occur. FERC Project boundaries boundaries are outside the known elevational range of this species.

LEGEND:

Federal Status
FT = Federal Threatened
FE = Federal Endangered
FC = Federal Candidate
FSS1 = Forest Service Sensitive, Eldorado National Forest
FSS2 = Forest Service Sensitive, Tahoe National Forest
FSS2 = Forest Service Sensitive, Eldorado and Tahoe National Forests

State Status
CR = listed by California as Rare
CT = California Threatened
CE = California Endangered

Table 6.6-6. Game Species of the Middle Fork American River Watershed.

Species	Status	Habitat	General Season	Bag Limit	Possession Limit	Hunting Restrictions
Resident Game Birds						
Blue grouse (*Dendragapus obscurus*)	MIS	Uncommon to common permanent resident at middle to high elevations. Occurs in open, medium to mature aged stands of fir, Douglas-fir, and other conifer habitats, interspersed with medium to large openings, and available water.	The second Saturday in September extending for 31 consecutive days	2 blue grouse per day	Double the daily bag limit	Hunting license is required. No use of motor vehicles to drive birds toward target. No use of mammal (or imitation) as blind. No take of nests or eggs. No use of practice dogs on birds outside of season. Must use ten-gauge shotgun or smaller, and no shot size larger than BB.
Wild turkey (*Meleagris gallopavo*)	MIS	Found mostly in deciduous riparian, oak, and conifer-oak woodlands. Prefers rugged, hilly terrain with low to intermediate canopy, interspersed with numerous grass/forb openings, near water.	Fall season - the second Saturday in November extending for 16 consecutive days Spring Season - the last Saturday in March extending for 37 consecutive days	Fall Season: 1 either-sex turkey per day. Spring Season: 1 bearded turkey per day	Fall Season: 1 per season Spring Season: 3 per season	Hunting license is required. No use of motor vehicles to drive birds toward target. No use of mammal (or imitation) as blind. No take of nests or eggs. No use of practice dogs on birds outside of season. Must use ten-gauge shotgun or smaller, and no shot size larger than No. 2.
Mountain quail (*Oreotyx pictus*)	None	Common to uncommon resident, found typically in most major montane habitats of the state. Found seasonally in open, brushy stands of conifer and deciduous forest, woodland, and chaparral.	The second Saturday in September through the Friday prior to the third Saturday in October	10 quail in any combination of species per day	Double the daily bag limit	Hunting license is required. No use of motor vehicles to drive birds toward target. No use of mammal (or imitation) as blind. No take of nests or eggs. No use practice dogs on birds outside of season. Must use ten-gauge shotgun or smaller, and no shot size larger than BB.
California Quail (*Callipepla californica*)	None	Common, permanent resident of low and middle elevations. Found in shrub, scrub, and brush, open stages of conifer and deciduous habitats, and margins of grasslands and croplands.	The third Saturday in October through the last Sunday in January	10 quail in any combination of species per day	Double the daily bag limit	Hunting license is required. No use of motor vehicles to drive birds toward target. No use of mammal (or imitation) as blind. No take of nests or eggs. No use practice dogs on birds outside of season. Must use ten-gauge shotgun or smaller, and no shot size larger than BB.
Migratory Game Birds						
Wilson's snipe (*Gallinago delicata*)	None	Prefers wet areas with organic soil and without tall vegetation. One of the most abundant shorebirds in North America, it is a resident of central and northeastern California.	The third Saturday in October extending for 107 days	8 per day	Double the daily bag limit	Hunting license and state duck tag are required. No use of motor vehicles to drive birds toward target. No use of mammal (or imitation) as blind. No take of nests or eggs. No use practice dogs on birds outside of season. Must use ten-gauge shotgun or smaller, and no shot size larger than BB.
Band-tailed pigeon *(Columba fasciata)*	MIS	Common resident in hardwood and hardwood-conifer habitats. Inhabits lower slopes of major mountain ranges of the state.	Dec. 21 - Dec. 29	10 per day	Double the daily bag limit	Hunting license and state duck tag are required. No use of motor vehicles to drive birds toward target. No use of mammal (or imitation) as blind. No take of nests or eggs. No use of practice dogs on birds outside of season. Must use ten-gauge shotgun or smaller, and no shot size larger than BB.

Table 6.6-6. Game Species of the Middle Fork American River Watershed (continued).

Species	Status	Habitat	General Season	Bag Limit	Possession Limit	Hunting Restrictions
Migratory Game Birds (continued)						
Mourning dove (*Zenaida macroura*)	None	Open woodlands, grasslands, croplands, open hardwood, hardwood-conifer, riparian, low elevation conifer, and deserts all provide adequate habitat. Requires a nearby water source.	Sept. 1-15 and from the second Saturday in November extending for an additional 45 days	10 doves of any species per day	Double the daily bag limit	Hunting license and state duck tag are required. No use of motor vehicles to drive birds toward target. No use of mammal (or imitation) as blind. No take of nests or eggs. No use of practice dogs on birds outside of season. Must use ten-gauge shotgun or smaller, and no shot size larger than BB.
Game Mammals						
Sierra Nevada snowshoe hare (*Lepus americanus tahoensis*)	CSC	An uncommon resident at upper elevations in the Cascade Mts. south through the Sierra Nevada. In California, primarily found in montane riparian habitats with thickets of alders and willows, and in stands of young conifers interspersed with chaparral. The early seral stages of mixed conifer, subalpine conifer, red fir, Jeffrey pine, lodgepole pine, and aspen are likely habitats, primarily along edges, and especially near meadows.	July 1 through the last Sunday in January	5 per day	10 in possession	Hunting license is required. Use of coursing dogs is permitted with rabbits. Must use ten-gauge shotgun or smaller, and no shot size larger than BB.
Western white-tailed jackrabbit (*Lepus townsendii townsendii*)	CSC	Common throughout the state, except at the highest elevations. Abundant at lower elevations in herbaceous and desert-shrub areas and open, early stages of forest and chaparral habitats.	All Year	no limit	no limit	Hunting license is required. Use of coursing dogs is permitted with rabbits. Must use ten-gauge shotgun or smaller, and no shot size larger than BB.
Western gray squirrel (*Sciurus griseus*)	MIS	Fairly common locally in mature stands of most conifer, hardwood, and mixed hardwood-conifer habitats in the Klamath, Cascade, Transverse, Peninsular, and Sierra Nevada Ranges. Dependent upon mature stands of mixed conifer and oak habitats. Closely associated with oaks. Require large trees, mast, and snags.	The second Saturday in September though the last Sunday in January	4 per day	4 in possession	Hunting license is required. Must use ten-gauge shotgun or smaller, and no shot size larger than BB.
Coyote (*Canis latrans*)	None	Occurs in almost all habitats and successional stages. Frequents open brush, scrub, shrub, and herbaceous habitats. Also found in younger stands of deciduous and conifer forest and woodland with low to intermediate canopy, and shrub and grass understory.	All Year	no limit	no limit	Hunting license is required. Must use ten-gauge shotgun or smaller, and no shot size larger than BB.
Black bear (*Ursus americanus*)	MIS	Widespread, common to uncommon resident occurring from sea level to high mountain regions. Occurs in fairly dense, mature stands of many forest habitats, and feeds in a variety of habitats including brushy stands of forest, valley foothill riparian, and wet meadow.	The fourth Saturday in September until the last day in December or until all tags are filled	1 adult/season/tag	1 adult/season/tag	Requires hunting license and hunting tags. Only bucks may be taken. May use approved rifles, bow and arrow, and approved shotguns. Cubs and females accompanied by cubs may not be taken.
Mountain lion[3] *(Felis rufus)*	Specially protected mammal, CDFG Code, Chapter 10, Section 4800	Widespread, uncommon permenent resident, ranging rom sea level to alpine meadows. Found in nearly all habitats, except xeric regions of the Mojave and Colorado deserts that do not support mule deer populations. Excluded from croplands in the Central Valley. Most abundant in riparian areas and brushy stages of most habitat.	None	N/A	N/A	N/A

Table 6.6-6. Game Species of the Middle Fork American River Watershed (continued).

Species	Status	Habitat	General Season	Bag Limit	Possession Limit	Hunting Restrictions
Game Mammals (continued)						
Bobcat (*Felis rufus*)	None	Common to uncommon, permanent resident throughout most of California. Uses nearly all habitats and successional stages. Optimal habitats are brushy stages of low and mid-elevation conifer, oak, riparian, and pinyon-juniper forests, and all stages of chaparral.	Oct. 15 - Feb. 28 (hunting) Nov. 24 - Jan. 31 (trapping)	Bobcats taken under a hunting license and bobcat hunting tags: Five bobcats per season. Bobcats taken under a trapping license: No limit.	Bobcats taken under a hunting license and bobcat hunting tags: Five bobcats per season. Bobcats taken under a trapping license: No limit.	Requires hunting license and hunting tags.
Mule deer (*Odocoileus hemionus*)	MIS	Common to abundant, yearlong resident or elevational migrant with a widespread distribution throughout most of California, except in deserts and intensively farmed areas without cover. Prefer a mosaic of vegetation, providing an interspersion of herbaceous openings, dense brush or tree thickets, riparian areas, and abundant edge.	The fourth Saturday in September extending for 37 consecutive days	1 buck/ tag	1 buck/ tag	Requires hunting license and hunting tags. May use approved rifles, bow and arrow, approved shotguns, and crossbows. Only bucks with antlers with demonstratable forks (or greater) may be taken.
Furbearing Mammals						
Gray fox (*Urocyon cinereoargenteus*)	None	Uncommon to common permanent resident of low to middle elevations throughout most of the state. Frequents most shrublands, valley foothill riparian, montane riparian, and brush stages of many deciduous and conifer forest and woodland habitats. Also found in meadows and cropland areas. Suitable habitat consists of shrublands, brushy and open-canopied forests, interspersed with riparian areas, providing water.	Nov. 24 - the last day of Feb.	no limit	no limit	Hunting license is required. May use firearms, bow and arrow, poison under special permit, and approved traps with trapping permit. Dogs permitted.
Raccoon (*Procyon lotor*)	None	Widespread, common to uncommon permanent resident throughout most of the state. Occurs in all habitats except alpine, and desert types without water; marginal in Great Basin shrub types. Most abundant in riparian and wetland areas at low to middle elevations.	Nov. 16 - Mar. 31	no limit	no limit	Hunting license is required. May use firearms, bow and arrow, poison under special permit, and approved traps with trapping permit. Dogs permitted. When taking raccoon after dark, pistols and rifles not larger than .22 caliber rimfire and shotguns using shot no larger than No. BB may be used
Long-tailed weasel (*Mustela frenata*)	None	Common to uncommon, permanent resident of most habitats, except xeric brush, shrub, and scrub in the Mojave and Colorado deserts. Mostly uses intermediate cover stages of conifer and deciduous habitats, interspersed with lower seral stages and open forest, woodland areas and shrubs, from sea level to alpine meadows.	All Year	no limit	no limit	Hunting license is required. May use firearms, bow and arrow, poison under special permit, and approved traps with trapping permit. Dogs permitted.
American mink (*Mustela vison*)	None	Uncommon permanent resident, generally occurring in the northern half of the state. Semiaquatic, inhabiting most aquatic habitats, including some coastal areas. Occurs at elevations up to about 2700 m (9000 ft).	Nov. 16 - Mar. 31	no limit	no limit	Hunting license is required. May use firearms, bow and arrow, poison under special permit, and approved traps with trapping permit. Dogs permitted.
American badger (*Taxidea taxus*)	None	Badgers are most often found in open, often treeless habitats with an available food source, usually other fossorial mammals. Badgers do not occur in heavily forested areas but inhabit open grasslands, parklands, prairie and cold desert areas.	Nov. 16 - last day of Feb.	no limit	no limit	Hunting license is required. May use firearms, bow and arrow, poison under special permit, and approved traps with trapping permit. Dogs permitted.

Table 6.6-7. Blue Canyon Mule Deer Fawning Areas, Holding Areas, and Critical Ranges within the FERC Project Boundary.

	Blue Canyon Mule Deer Herd				Pacific Mule Deer Herd		
	Fawning Areas	Holding Areas	Critical Summer Range	Critical Winter Range	Fawning Areas	Critical Summer Range	Critical Winter Range
Project Roads							
Hell Hole Dam Area							
French Meadows-Hell Hole Tunnel Portal Road		X					
Interbay Area							
Hell Hole-Middle Fork Tunnel/Butterfly Valve House (14N55) Access Road		X					
Recreation Facilities							
Ahart Campground			X				
Coyote Group Campground			X				
Gates Group Campground			X				
Lewis Campground			X				
McGuire Boat Ramp			X				
McGuire Picnic Area and Beach			X				
Big Meadows Campground		X					
Hell Hole Campground						X	
Hell Hole Vista		X					

FIGURES

Placeholder for Figures 6.6-1 - 8

Non-Internet Public Information

These Figures have been removed in accordance with the Commission regulations at 18 CFR Section 388.112.

These Figures are considered Non-Internet Public information and should not be posted on the Internet. This information may be accessed from the Placer County Water Agency's (PCWA) Public Reference Room, but is not expected to be posted on PCWA's Website, except as an indexed item.

APPENDIX 6.6-A

Vegetation Alliances in the Middle Fork American River Watershed

Herb-Dominated Alliances

Alpine Mixed Grass and Forbs Alliance (AC)

The alpine mixed grass and forbs alliance occurs only in isolated high-elevation regions (peaks and ridgelines) of the Project vicinity above 9,000 feet in elevation. AC is dominated by low-growing perennials and graminoids. Due to high potential evapotranspiration, a short growing season, and abrasion and desiccation by wind, morphological adaptations by some species found in AC are similar to those in the desert. For example, several cushion-forming plants occur within rocky sites. Dominant plant species found may include sedges (*Carex* spp.), bluegrass (*Poa* spp.), and non-native grasses including Italian ryegrass (*Lolium multflorum)* and perennial ryegrass (*Lolium perenne*). Other species found in this alliance include prostrate sibbaldia (*Sibbaldia procumbens*), rockcress (*Arabis lemmonii*), mountain sorrel (*Oxyria digyna*), Indian paintbrush (*Castilleja lemmonii*), and columbine (*Aquilegia pubescens*).

Annual Grass-Forb Alliance (HG)

This alliance is dominated by introduced annual grasses in the genera *Bromus, Vulpia, Avena*, and *Lolium*. This alliance may occur as a pure patch or as an understory layer in other alliances (e.g., canyon live oak (*Quercus chysolepsis*) alliance). Native species that may occur include bluegrass, purple needlegrass (*Nassella pulchra*), Idaho fescue (*Festuca idahoensis*), and California poppy (*Eschscholzia californica*).

Wet Meadow (Grass-Sedge-Rush) Alliance (HJ)

The wet meadow alliance occurs in level or gently sloping areas that have moist soils and permanent water sources such as streams, meadows, and lakes. HJ may also occasionally occur as an understory community. Dominant species include sedges and rushes (*Juncus* spp.), as well as water-tolerant grass and forb species.

Shrub-Dominated Alliances

Ceanothus Chaparral (CC)

The ceanothus chaparral alliance occurs in the Sierra Nevada at elevations below 4,500 feet. It is dominated by shrub species of the genus *Ceanothus*. CC also may include, in minor densities, some of the more common mixed chaparral shrubs, such as whiteleaf manzanita (*Arctostaphylos viscida*), chamise (*Adenostoma fasciculatum*), silk-tassel (*Garrya fremontii*), birchleaf mountain mahogany (*Cercocarpus betuloides*), poison oak (*Toxicodendron diversilobum*), and huckleberry oak (*Quercus vaccinifolia*).

Huckleberry Oak Alliance (CH)

The huckleberry oak alliance occurs in the Sierra Nevada on very shallow, stony, or gravelly soils at elevations between approximately 3,850 and 9,000 feet. Stands may be mixed with manzanita (*Arctostaphylos* spp.), bush chinquapin (*Chrysolepis sempervirens*), mountain whitethorn (*Ceanothus cordulatus*), and bitter cherry (*Prunus emarginata*). Conifer species may include Jeffrey pine (*Pinus jeffreyi*), red fir (*Abies* *magnifica*), western white pine (*Pinus monticola*), lodgepole pine (*Pinus contorta* var. *murrayana*), and western juniper (*Juniperus occidentalis*).

Upper Montane Mixed Shrub Alliance (CM)

The upper montane mixed shrub alliance occurs within lodgepole pine and Jeffrey pine alliances on exposed ridge tops or in excessively drained soils. Elevations typically are between 6,000 and 9,000 feet. Major shrub species include huckleberry oak, creeping snowberry (*Symphoricarpus acutus*), pinemat manzanita (*Arctostaphylos nevadensis*), and bush chinquapin. Minor associates include greenleaf and whiteleaf manzanita (*Arctostaphylos patula, Arctostaphylos viscida*), bitter cherry, and mountain whitethorn.

Lower Montane Mixed Chaparral Alliance (CQ)

This low-elevation mixed shrub alliance occurs scattered in foothill areas between 750 to 6,350 feet. CQ includes a mixture of whiteleaf manzanita, common manzanita (*Arctostaphylos manzanita*), wedgeleaf ceanothus *(Ceanothus cuneatus)*, lemmon ceanothus, chaparral whitethorn, chamise, Fremont silktassel, birchleaf mountain mahogany, poison oak, various shrub oaks (*Quercus* spp.), hoary coffeeberry (*Rhamnus tomentella*) and other lower elevation shrub species.

Upper Montane Mixed Chaparral Alliance (CX)

The upper montane mixed chaparral alliance is a mixed species shrub type that occurs commonly at elevations between 2,200 and 8,900 feet. Chaparral species such as greenleaf manzanita, mountain whitethorn, snowbrush (*Ceanothus velutinus*), and deerbrush (*Ceanothus integerrimus*) are indicators of this alliance. Whiteleaf manzanita may be present on the west slope foothills at lower elevations of this type, representing a transition between the lower montane mixed chaparral alliance and this alliance.

Mountain (Thinleaf) Alder Alliance (TF)

Mountain or thinleaf alder (*Alnus tenuifolia*) is a dominant high-elevation small tree or tall shrub species, generally occurring in pure stands between 4,100 and 9,020 feet. TF occurs in large perennial grass and forb meadows where streams and coarse, shallow, or gravelly soils exist. These saturated or seasonally flooded sites are sometimes adjacent to white fir (*Abies concolor*), mixed conifer-fir, and red fir sites. Minor inclusions of tree or shrub willows (*Salix* spp.) or mountain maple (*Acer glabrum*) may occur in this type, but the density of mountain alder stands limits the growth of other species aside from some aquatic gaminoids and forbs.

Tree-Dominated Alliances

Douglas-Fir–Pine Alliance (DP)

The Douglas-fir–pine alliance occurs below 5,900 feet in elevation, and is characterized by Douglas-fir (*Pseudotsuga menziesii*) and ponderosa pine (*Pinus ponderosa*). The shrub alliance most commonly associated with the Douglas-fir–pine alliance is the lower montane mixed chaparral alliance containing wedgeleaf, whiteleaf manzanita, and poison oak.

Jeffrey Pine Alliance (JP)

The Jeffrey pine alliance occurs below approximately 4,000 feet on localized sites with granitic outcrops or on glaciated soils such as tills and outwash. Shrub species such as wedgeleaf ceanothus, whiteleaf manzanita, coffeeberry (*Rhamnus tomentella* ssp. *tomentella*), and canyon live oak (*Quercus chrysolepis* var. *nana*) are common under these conditions.

Mixed Conifer with Giant Sequoia Alliance (MB)

The mixed conifer with giant sequoia alliance includes giant sequoia (*Sequoiadendron giganteum*) and a mixed conifer overstory dominated by sugar pine (*Pinus lambertiana*), incense cedar (*Calocedrus decurrens*), Douglas-fir, ponderosa pine, and occasionally white fir. Other species may include tanbark oak (*Lithocarpus densiflorus*), mountain dogwood (*Cornus nuttallii*), and western azalea (*Rhododendron occidentale*). Refer to Special-Status Botanical Resources for more information on the occurrence of giant sequoia in the Middle Fork American River Watershed.

Mixed Conifer-Fir Alliance (MF)

The mixed conifer-fir alliance is the high elevation counterpart of the mixed conifer-pine alliance. MF occurs within an elevation range of approximately 3,700 to 8,800 feet. Three major species define this mixed conifer type: white fir, Jeffrey pine, and lodgepole pine. At lower elevations, mixed conifer pine alliance associates such as Douglas-fir and ponderosa pine may occur. As elevation increases, red fir becomes more prominent. Other associates at all elevations include sugar pine and incense cedar. The upper montane mixed chaparral and occasionally the huckleberry oak alliance are often found adjacent to this alliance.

Mixed Conifer-Pine Alliance (MP)

The mixed conifer-pine alliance occupies moist soils across a range of sites between approximately 1,900 and 7,800 feet in elevation. MP is defined by the presence of several conifer species, including ponderosa pine, incense cedar, Douglas-fir, white fir, and sugar pine, with Jeffrey pine occurring very rarely. Any one of these species may become locally dominant over small areas. Riparian habitats within this alliance are characterized by the presence of white alder, maple, and willow. Understory shrubs in this alliance include deerbrush and whiteleaf manzanita at lower elevations, and greenleaf manzanita at higher elevations.

Ponderosa Pine Alliance (PP)

The ponderosa pine alliance is defined by pure stands of ponderosa pine. It is commonly found between approximately 900 and 5,800 feet in elevation on moist western slopes in the northern Sierra Nevada. Within the Middle Fork American River Watershed, the ponderosa pine alliance is associated most commonly with the canyon live oak and black oak alliances on south-, east- and west-facing slopes and with Douglas-fir–pine and mixed conifer-pine alliances on north-facing aspects. Shrubs of lower montane areas such as whiteleaf manzanita, wedgeleaf ceanothus, and poison oak also may be commonly found within the ponderosa pine alliance.

Canyon Live Oak Alliance (QC)

Canyon live oak (*Quercus chrysolepis*) occurs in pure or mixed stands in proximity to the Douglas-fir–pine, mixed conifer-pine, ponderosa pine, and black oak alliances. QC is generally found on relatively dry soils or in steep canyons between approximately 600 and 6,500 feet elevation in the northern Sierra Nevada. A mixture of shrubs such as wedgeleaf ceanothus, deerbrush, and whiteleaf manzanita often occur in the understory of this alliance.

White Alder Alliance (QE)

White alder (*Alnus rhombifolia*) occurs in pure or mixed stands along rivers and streams. It is sometimes found in proximity to the Douglas-fir–pine and mixed conifer–pine alliances. QE is generally found below approximately 6,200 feet in elevation in association with shade tolerant species such as Pacific yew (*Taxus brevifolia*), California hazelnut (*Corylus cornuta* var. *californica*), elk clover (*Aralia californica*), columbine (*Aquilegia formosa*), and monkeyflower (*Mimulus* spp.). White alder alliances in the Middle Fork American River Watershed may also include Scouler's willow (*Salix scouleriana*), shining willow (*Salix lucida*), Gooding's willow (*Salix goodingii*) and narrow-leaved willow (*Salix exigua*).

Black Oak Alliance (QK)

The black oak (*Quercus kelloggii*) alliance is one of the most common and wide-ranging hardwood alliances in the Middle Fork American River Watershed. QK is found typically on moist soils up to approximately 7,000 feet on both west and east slopes of the Sierra Nevada. QK may occurs in pure stands or in mixed stands as an understory component within several different conifer alliances including Douglas-fir–pine, ponderosa pine, mixed conifer-pine, white fir, eastside pine, and mixed conifer-fir. Black oak often grows in mixed stands with canyon live oak creating a mixed hardwoods alliance. Bigleaf maple (*Acer macrophyllum*), dogwood (*Cornus* spp.), white alder, and California bay (*Umbellularia californica*) are common associates in shaded areas and along riparian corridors.

Willow Alliance (QO)

The willow alliance is wide-ranging, extending across an elevation range from approximately 2,100 to 8,600 feet. Species of tree and shrub willows (*Salix* spp.) dominate the hardwood mixture, and may include Scouler's willow, shining willow, Gooding's black willow, and narrow-leaved willow. QC may occur in pure stands along streams and moist canyon bottoms, or it may be mixed with conifers such as those in the mixed conifer-pine, mixed conifer-fir, and lodgepole pine alliances. Willow-aspen, white alder, and black cottonwood alliances may also be associated with the willow alliance.

Black Cottonwood Alliance (QX)

The black cottonwood (*Populus balsamifera* ssp. *trichocarpa*) alliance may occur at elevations up to approximately 9,000 feet, and is most commonly found between 3,500 and 7,900 feet. Black cottonwood requires freshly deposited alluvial materials for regeneration and stands are often even-aged as a result of episodic flood events.

Willow species, including Scouler's willow, shining willow, Gooding's willow and narrow-leaved willow, are often present in this alliance. At higher elevations black cottonwood occurs in association with white alder. Black cottonwood occurs in the higher Sierra Nevada more commonly than does Fremont cottonwood (*Populus fremontii*), but their ranges occasionally overlap.

Interior Live Oak Alliance (QW)

The interior live oak (*Quercus wislizenii*) alliance occurs in semi-open or closed stands at elevations between 700 and 3,010 feet. QW is often associated with ponderosa pine alliances and less commonly with the Douglas-fir–pine alliance. Black cottonwood and white alder are the associated riparian species.

Willow-Alder Alliance (QY)

This alliance generally is found at elevations between 3,180 and 6,950 feet. Willow species, which in this Project vicinity may include Scouler's willow, shining willow, Gooding's black willow, and narrow-leaved willow, occur together with white alder, along streams or seepage areas. Neither taxon is clearly dominant in the riparian mixture. Common associates include species of gooseberry (*Ribes* spp.) and currant (*Ribes* spp.), blackberry (*Rubus* spp.), wild rose (*Rosa* spp.), and poison oak.

Red Fir Alliance (RF)

The red fir alliance generally occurs in dense, pure stands or as an inclusion in the mixed conifer-fir alliance on both east and west slopes of the Sierra Nevada from approximately 7,000 to 9,000 ft on frigid soils. Few understory plants occur in denser RF stands, although pipsissewa (*Chimaphila menziesii*) and white-veined wintergreen (*Pyrola picta*) may be found. In more open stands or where RF intergrades with the mixed conifer-fir alliance, snowbrush, mountain whitethorn, pinemat manzanita, and greenleaf manzanita are the dominant understory shrubs. Western White Pine and Lodgepole Pine are associated conifer species. Mountain hemlock (*Tsuga mertensiana*) may occur as isolated trees in colder areas of the red fir alliance.

White Fir Alliance (WF)

Pure stands of white fir are found primarily on the west side of the northern Sierra Nevada at an elevation range of 3,900 to 8,500 feet. WF occurs typically in cool, moist, shady environments on north aspects, in riparian areas and around large lakes. WF represents an intermediate zone between the mixed conifer-pine and mixed conifer-fir alliances on south and west aspects, and between the mixed conifer-pine and red fir alliances on north and east aspects. Montane mixed chaparral and huckleberry oak alliances are commonly associated shrub types, and mountain alder, black oak, willow, quaking aspen-willow, and black cottonwood are commonly associated hardwood alliances.

Non-vegetated areas

Barren (BA)

A barren landscape is defined generally as an area devoid of vegetative cover. BA includes exposed bedrock and cliffs, but it does not include disturbed or developed areas that currently are degraded but could support vegetation under normal circumstances.

APPENDIX 6.6-B

Special-status Plant Species Known to Occur or Potentially Occurring within the FERC Project Boundary

Special-status Plants Known to Occur within the FERC Project Boundary

Pleasant Valley mariposa lily (*Calochortus clavatus* var. *avius*; FSS, CNPS 1B.2)

Pleasant Valley mariposa lily is a bulbiferous perennial herb in the lily family (Liliaceae) that blooms May through July. It occurs in lower montane coniferous forest on Josephine silt loam and volcanically derived soil, often in rocky areas, at elevations from 1,000 to 6,300 feet.

Yellow burr navarretia (Navarretia prolifera ssp. lutea; FSS, CNPS 4.3)

Yellow burr navarretia is an annual herb in the phlox family (Polemoniaceae) that blooms May through July. It occurs in chaparral and cismontane woodland in open areas of well-drained soils on primarily south-facing exposures at elevations from 2,850 to 4,600 feet.

Stebbins's phacelia (Phacelia stebbinsii; FSS, CNPS 1B.2)

Stebbin's phacelia is an annual herb in the waterleaf family (Hydrophyllaceae) that blooms June through July. It occurs in cismontane woodland, lower montane coniferous forest, meadows and seeps, and riparian woodland, among rocks and rubble on metamorphic rock benches at elevations from 2,000 to 7,050 feet.

Special-status Plants Potentially Occurring within the FERC Project Boundary

Trinity Mountain rockcress (*Arabis rigidissima* var. *demota*; FSS, CNPS 1B.2)

Trinity Mountain rockcress is a perennial herb in the mustard family (Brassicaceae) that blooms in August. It occurs in broadleaved upland forest and upper montane coniferous forest, on well drained, stony soil underlain by basic volcanic rock. It is found at elevations from 6,750 to 7,700 feet.

Nissenan manzanita (*Arctostaphylos nissenana*; FSS, CNPS 1B.2)

Nissenan manzanita is an evergreen shrub in the heath family (Ericaceae) that blooms February through March. It occurs in closed-cone coniferous forest and chaparral, usually on metamorphic substrate, in association with other chaparral species. It is found at elevations from 1,450 to 3,600 feet.

Webber's milkvetch (*Astragalus webberi*; FSS, CNPS 1B.2)

Webber's milkvetch is a perennial herb in the legume family (Fabaceae) that blooms May through July. It occurs in lower montane coniferous forest on open brushy slopes and flats in xeric areas. It is found at elevations from 2,400 to 3,700 feet.

Moss (*Atractylocarpus flagellaceus*; CNPS 2.2)

Atractylocarpus flagellaceus is a moss in the Dicranaceae family. It occurs in cismontane woodland at elevations from 300 to 1,600 feet.

Triangle-lobe moonwort (*Botrychium ascendens*; FSS, CNPS 2.3)

Triangle-lobe moonwort is a rhizomatous perennial herb in the adder's-tongue family (Ophioglossaceae) and is fertile July through August. It occurs in lower montane coniferous forest in grassy fields and near springs and creeks. It is found at elevations from 4,800 to 7,300 feet.

Scalloped moonwort (*Botrychium crenulatum*; FSS, CNPS 2.2)

Scalloped moonwort is a rhizomatous perennial herb in the adder's-tongue family (Ophioglossaceae) and is fertile June through July. It occurs in lower montane coniferous forests, and in bogs, fens, freshwater marshes, and moist meadows and near creeks. It is found at elevations from 4,900 to 10,800 feet.

Mountain moonwort (*Botrychium montanum*; FSS, CNPS 2.1)

Mountain moonwort is a rhizomatous perennial herb in the adder's-tongue family (Ophioglossaceae) and is fertile July through August. It occurs in lower montane coniferous forest, on creek banks in old-growth forest, at elevations from 4,500 to 6,400 feet.

Dissected-leaved toothwort (*Cardamine pachystigma* var. *dissectifolia*; CNPS 3)

Dissected-leaved toothwort is a rhizomatous perennial herb in the mustard family (Brassicaceae) that blooms February through May. It occurs in chaparral and lower montane coniferous forest on serpentine outcrops and gravelly serpentine talus at elevations from 800 to 6,700 feet.

Red Hills soaproot (*Chlorogalum grandiflorum*; CNPS 1B.2)

Red Hills soaproot is a bulbiferous perennial herb in the lily family (Liliaceae) that blooms May through June. It occurs in chaparral, cismontane woodland, and lower montane coniferous forest, on both serpentine and gabbro substrates, and often on "historically disturbed" sites. It is found at elevations from 800 to 3,500 feet.

Brandegee's clarkia (*Clarkia biloba* ssp. *brandegeeae*; FSS, CNPS 1B.2)

Brandegee's clarkia is an annual herb in the evening primrose family (Onagraceae) that blooms May through July. It occurs in chaparral and cismontane woodland, often in roadcuts, at elevations from 950 to 3,200 feet.

Lake Almanor clarkia (*Clarkia stellata*; FSS)

Lake Almanor clarkia is an annual herb in the evening primrose family (Onagraceae). It occurs in coniferous forest at elevations from 3,200 to 4,800 feet.

Clustered lady's slipper (*Cypripedium fasciculatum*; FSS, CNPS 4.2)

Clustered lady's slipper is a rhizomatous perennial herb in the orchid family (Orchidaceae) that blooms March through July. It occurs in lower montane coniferous forest and North Coast coniferous forest in serpentine seeps and on moist streambanks at elevations from 300 to 7,800 feet.

Mountain lady's slipper (*Cypripedium montanum*; FSS, CNPS 4.2)

Mountain lady's slipper is a rhizomatous perennial herb in the orchid family (Orchidaceae) that blooms March through August. It occurs in lower montane coniferous forest and broadleaved upland forest on dry undisturbed slopes at elevations from 750 to 7,700 feet.

Lake Tahoe draba (*Draba asterophora* var. *asterophora*; FSS, CNPS 1B.3)

Lake Tahoe draba is a perennial herb in the mustard family (Brassicaceae) that blooms July through August. It occurs in alpine boulder and rock field and subalpine coniferous forest on decomposed granite, and on open talus slopes, rock outcrops, and crevices. It is found at elevations from 8,000 to 11,500 feet.

Cup Lake draba (*Draba asterophora* var. *macrocarpa*; FSS, CNPS 1B.3)

Cup Lake draba is a perennial herb in the mustard family (Brassicaceae) that blooms July through August. It occurs in subalpine coniferous forest on relatively deep soil in the shade of granitic rocks at elevations from 8,000 to 9,000 feet.

Subalpine fireweed (*Epilobium howellii*; FSS, CNPS 1B.3)

Subalpine fireweed is a perennial herb in the evening primrose family (Onagraceae) that blooms July through August. It occurs in wet meadows and subalpine coniferous forest in mossy seeps at elevations from 6,500 to 9,600 feet.

Oregon fireweed (*Epilobium oreganum*; CNPS 1B.2)

Oregon fireweed is a perennial herb in the evening primrose family (Onagraceae) that blooms June through September. It occurs in bogs and fens, meadows, lower montane coniferous forest, and upper montane coniferous forest in and near springs and bogs, and at least sometimes on serpentine. It occurs at elevations from 1,600 to 8,500 feet.

Starved fleabane (*Erigeron miser*; FSS, CNPS 1B.3)

Starved fleabane is a perennial herb in the sunflower family (Asteraceae) that blooms June through October. It occurs in upper montane coniferous forest on rocky, granitic outcrops at elevations from 5,750 to 8,400 feet.

Tripod buckwheat (*Eriogonum tripodum*; FSS, CNPS 4.2)

Tripod buckwheat is a deciduous shrub in the buckwheat family (Polygonaceae) that blooms May through July. It occurs in chaparral and cismontane woodland on gravelly slopes and flats, often on serpentine substrate. It is found at elevations from 650 to 5,250 feet.

Donner Pass buckwheat (*Eriogonum umbellatum* var. *torreyanum*; FSS, CNPS 1B.2)

Donner Pass buckwheat is a perennial herb in the buckwheat family (Polygonaceae) that blooms July through September. It occurs in upper montane coniferous forest, chaparral, and meadows, on steep slopes and ridge tops, rocky, volcanic soils, and usually in bare or sparsely vegetated areas. It is found at elevations from 5,850 to 8,600 feet.

Butte County fritillary (*Fritillaria eastwoodiae*; FSS, CNPS 3.2)

Butte County fritillary is a bulbiferous perennial herb in the lily family (Liliaceae) that blooms March through May. It occurs in chaparral, cismontane woodland, and lower montane coniferous forest, usually on dry slopes, but it is also found in wet places. Soils can be serpentine, red clay, or sandy loam. It is found at elevations from 100 to 5,300 feet.

Parry's horkelia (*Horkelia parryi*; FSS, CNPS 1B.2)

Parry's horkelia is a perennial herb in the rose family (Rosaceae) that blooms April through June. It occurs in openings in chaparral and cismontane woodland. It is especially known from the Ione formation in Amador County. It is found at elevations from 250 to 3,600 feet.

Dog Valley mousetail (*Ivesia aperta* var. *canina*; FSS, CNPS 1B.1)

Dog Valley mousetail is a perennial herb in the rose family (Rosaceae) that blooms June through August. It occurs in lower montane coniferous forest and meadows in shallow, rocky soil of volcanic origin at elevations from 5,100 to 6,500 feet.

Plumas mousetail (*Ivesia sericoleuca*; FSS, CNPS 1B.2)

Plumas mousetail is a perennial herb in the rose family (Rosaceae) that blooms May through September. It occurs in Great Basin scrub, lower montane coniferous forest, meadows and seeps, and vernal pools, in vernally mesic areas and usually on volcanic substrates at elevations from 4,650 to 7,000 feet.

Webber's ivesia (*Ivesia webberi*; FSS, CNPS 1B.1)

Webber's ivesia is a perennial herb in the rose family (Rosaceae) that blooms May through July. It occurs in lower montane coniferous forest and Great Basin scrub in rocky, volcanic soils at elevations from 3,200 to 6,800 feet.

Cantelow's lewisia (*Lewisia cantelovii*; FSS, CNPS 1B.2)

Cantelow's lewisia is a perennial herb in the purslane family (Portulacaceae) that blooms May through October. It occurs in broadleaved upland forest, chaparral, cismontane woodland, and lower montane coniferous forest on mesic rock outcrops and wet cliffs, usually in moss or clubmoss, and on granitic or sometimes serpentine substrate. This species is found at elevations from 1,050 to 4,400 feet.

Long-petaled lewisia (*Lewisia longipetala*; FSS, CNPS 1B.3)

Long-petaled lewisia is a perennial herb in the purslane family (Portulacaceae) that blooms July through August. It occurs in subalpine coniferous forest and alpine boulder and rock field in mesic rocky sites in cracks of granite or gravelly volcanic soils at elevations from 8,000 to 9,600 feet.

Saw-toothed lewisia (*Lewisia serrata,* FSS, CNPS 1B.1)

Saw-toothed lewisia is a perennial herb in the purslane family (Portulacaceae) that blooms May through June. It occurs in broadleaved upland forest, lower montane coniferous forest, and riparian forest, on shaded north facing, moss covered, metamorphic rock cliffs. It is found at elevations from 2,950 to 4,700 feet.

Stebbin's lomatium (*Lomatium stebbinsii*; FSS, CNPS 1B.1)

Stebbins's lomatium is a perennial herb in the carrot family (Apiaceae) that blooms March through May. It occurs in chaparral and lower montane coniferous forest, in thin, gravelly volcanic clay, and grows where other vegetation is absent at elevations from 3,750 to 6,450 feet.

Quincy lupine (*Lupinus dalesiae*; FSS, CNPS 1B.2)

Quincy lupine is a perennial herb in the legume family (Fabaceae) that blooms May through August. It occurs in lower montane coniferous forest and upper montane coniferous forest on dry, open or shaded slopes, summits, and trails, often in disturbed soils at elevations from 2,300 to 8,200 feet.

Three-ranked hump moss (*Meesia triquetra*; FSS, CNPS 2.2)

Three-ranked hump moss is a moss in the Meesiaceae family. It occurs in acidic montane meadows in coniferous forest, especially in meadows with peat moss (Clines 2001), and bogs, fens, and seeps. It is found at elevations from 4,250 to 8,500 feet.

Broad-nerved hump moss (*Meesia uliginosa*; FSS, CNPS 2.2)

Broad nerved hump moss is a moss in the Meesiaceae family. It occurs in upper montane coniferous forest in meadows and seeps on damp soil at elevations from 4,250 to 9,500 feet.

Follett's mountainbalm (*Monardella folletti*; FSS, CNPS 1B.2)

Follett's mountainbalm is a shrub in the mint family (Lamiaceae) that blooms June through September. It occurs in lower montane coniferous forest on rocky, serpentine slopes at elevations from 1,650 to 6,550 feet.

Close-throated beardtongue (*Penstemon personatus*; FSS, CNPS 1B.2)

Close-throated beardtongue is a perennial herb in the figwort family (Scrophulariaceae) that blooms June through September. It occurs in lower montane coniferous forest, upper montane coniferous forest, and chaparral, usually on north-facing slopes in metavolcanic soils at elevations from 3,400 to 7,000 feet.

Sierra starwort (*Pseudostellaria sierrae*; CNPS 3.2)

Sierra starwort is a rhizomatous herb in the pink family (Caryophyllaceae) that blooms May through August. It occurs in chaparral, cismontane woodland, lower montane coniferous forest, and upper montane coniferous forest at elevations from 4,000 to 6,400 feet.

Sticky goldenweed (*Pyrrocoma lucida*; FSS, CNPS 1B.2)

Sticky goldenweed is a perennial herb in the sunflower family (Asteraceae) that blooms July through October. It occurs in Great Basin scrub, lower montane coniferous forest, and meadows and seeps on alkaline flats and clay soils at elevations from 2,250 to 6,250 feet.

Tahoe yellow cress (*Rorippa subumbellata*; FC, FSS, SE 1B.1)

Tahoe yellow cress is a rhizomatous perennial herb in the mustard family (Brassicaceae) that blooms May through September. It occurs in lower montane coniferous forest and meadows and seeps on sandy beaches, lakeside margins, and in riparian communities on decomposed granite sand at elevations from 6,050 to 6,250 feet.

American scheuchzeria (*Scheuchzeria palustris* ssp. *americana*; FSS, CNPS 2.1)

American scheuchzeria is a rhizomatous emergent perennial herb in the scheuchzeria family (Scheuchzeriaceae) that blooms in July. It occurs in bogs and fens, marshes and swamps, in sphagnum bogs and on lake margins at elevations from 4,350 to 6,550 feet.

Marsh skullcap (*Scutellaria galericulata*; CNPS 2.2)

Marsh skullcap is a rhizomatous perennial herb in the mint family (Lamiaceae) that blooms June through September. It occurs in wet places in lower montane coniferous forest, meadows and seeps, and marshes and swamps at elevations from 0 to 6,900 feet.

Layne's ragwort (*Senecio layneae*; FT, FSS, SR, 1B.2)

Layne's ragwort is a perennial herb in the sunflower family (Asteraceae) that blooms April through July. It occurs in chaparral and cismontane woodland on ultramafic soil, occasionally along streams, at elevations from 650 to 3,400 feet.

Thinleaf huckleberry (*Vaccinium coccineum*; FSS, CNPS 3.3)

Thinleaf huckleberry is a deciduous shrub in the heath family (Ericaceae) that blooms June through August. It occurs in lower montane coniferous forest and upper montane coniferous forest on rocky slopes, ridges, and bogs and often on serpentine, at elevations from 3,500 to 7,000 feet.

Cusick's veronica (*Veronica cusickii*; CNPS 4.3)

Cusick's veronica is a perennial herb in the figwort family (Scrophulariaceae) that blooms July through August. It occurs in alpine boulder and rock fields, subalpine coniferous forest, upper montane coniferous forest, and meadows and seeps on gravelly soil at elevations from 7,800 to 9,850 feet.

APPENDIX 6.6-C

Wildlife Habitats and Associated Common Species in the Middle Fork American River Watershed

Herb-dominated Habitats

Annual Grass

The annual grass habitat corresponds to the annual grasses/forbs (AG) CalVeg alliance. Many wildlife species use annual grasslands for foraging, but some require special habitat features such as cliffs, caves, ponds, or habitats with woody plants for breeding, resting, and cover. The annual grass habitat type hosts a broad diversity of amphibians, such as California slender salamander (*Batrachoseps attenuatus*) and western toad (*Bufo boreas*); reptiles such as western fence lizard (*Sceloporus occidentalis*), common garter snake (*Thamnophis sirtalis*), western rattlesnake (*Crotalus viridis*), and western skink (*Eumeces skiltonianus*); and rodents such as western harvest mouse (*Reithrodontomys megalotis*), montane vole (*Microtus montanus*), California pocket mouse (*Chaetodipus californicus*), and bushy-tailed woodrat (*Neotoma cinerea*). This diverse vertebrate assemblage attracts a high diversity of predators, particularly wide-randing raptors such as red-tailed hawk (*Buteo jamaicensis*), rough-legged hawk (*Buteo lagopus*), ferruginous hawk (*Buteo regalis*), and white-tailed kite (*Elanus leucurus*).

Grassland bird species may include blue grouse (*Dendragapus obscurus*), ring-necked pheasant (*Phasianus colchicus*), and wild turkey (*Meleagris gallopavo*); and passerines may include western kingbird (*Tyrannus verticalis*), western meadowlark (*Sturnella neglecta*), savannah sparrow (*Passerculus sandwichensis*), and grasshopper sparrow (*Ammodramus savannarum*). Mammal species that may occur in annual grass habitats include Bats (*Myotis* spp.), black-tailed jackrabbit (*Lepus californicus*), California ground squirrel (*Spermophilus beecheyi*), stripped skunk (*Mephitis mephitis*), American badger (*Taxidea taxus*), gray fox (*Urocyon cinereoargenteus*), and coyote (*Canis latrans*).

Wet Meadow

Wet meadow habitat corresponds to the wet grasses/forbs (HJ) CalVeg alliance. Wet-meadow habitat supports a large number of animal species. Common species that characterize wet meadow habitat include: Pacific chorus frog (*Pseudacris regilla*), western toad, western fence lizard, western aquatic garter snake (*Thamnophis couchii*), common kingsnake (*Lampropeltis getula*), great blue heron (*Ardea herodias*), sora (*Porzana carolina*), American coot (*Fulica americana*), Canada goose (*Branta canadensis*), northern pintail (*Anas acuta*), mallard (*Anas platyrhynchos*), common merganser (*Mergus merganser*), red-tailed hawk, black phoebe (*Sayornis nigricans*), American pipit (*Anthus rufescens*), belted kingfisher (*Ceryle alcyon*), lesser goldfinch (*Carduelis psaltria*), marsh wren (*Cistothorus palustris*), bats (*Myotis* spp.), California vole (*Microtus californicus*), dusky-footed woodrat (*Neotoma fuscipes*), deer mouse (*Peromyscus maniculatus*), American beaver (*Castor canadensis*), western river otter (*Lontra canadensis*), bobcat (*Lynx rufus*), coyote, black bear (*Ursus americanus*), and mule deer (*Odocoileus hemionus*).

Shrub-dominated Habitats

Alpine-Dwarf Shrub

Alpine-dwarf shrub habitat corresponds to the alpine grasses/forbs (AC) CalVeg alliance. This habitat occurs only in isolated high-elevation regions (peaks and ridge lines) of the Project vicinity. Alpine-dwarf shrub habitat is above timberline and is cold, dry, and windy. It supports the fewest number of animal species of all the habitats in the Middle Fork American River Watershed. Species that may occur include Pacific chorus frog, blue grouse, red-tailed hawk, Clark's nutcracker (*Nucifraga columbiana*), common raven (*Corvus corax*), mountain bluebird (*Sialia currucoides*), deer mouse (*Peromyscus maniculatus*), American pika (*Ochotona princeps*), yellow-bellied marmot (*Marmota flaviventris*), long-tailed weasel (*Mustela frenata*), coyote, mountain lion (*Felis concolor*), and mule deer (*Odocoileus hemionus*).

Mixed Chaparral

Mixed chaparral habitat corresponds to the ceanothus chaparral (CC) CalVeg alliance. Mixed chaparral habitat supports many passerines, including: ash-throated flycatcher (*Myiarchus cinerascens)*, western kingbird, warbling vireo (*Vireo gilvus)*, wrentit (*Chamaea fasciata*), oak titmouse (*Baeolophus inornatus*), California thrasher (*Toxostoma redivivum*), violet-green swallow (*Tachycineta thalassina*), western scrub jay (*Aphelocoma californica*), spotted towhee (*Pipilo maculatus*), and song sparrow (*Melospiza melodia*). Non-passerine birds that may occur include raptors, such as northern pygmy-owl (*Glaucidium gnoma*), peregrine falcon (*Falco peregrinus*), red-tailed hawk, and turkey vulture (*Cathartes aura*); hummingbirds, such as black-chinned hummingbird (*Archilochus alexandri*); and upland game birds, including band-tailed pigeon (*Columba fasciata*) and ring-necked pheasant. Other animals common to mixed chaparral include western fence lizard, alligator lizard (*Elgaria* ssp.), bats (*Myotis* spp.), brush mouse (*Peromyscus boylii*), California ground squirrel, brush rabbit (*Sylvilagus bachmani*), striped skunk, coyote, and bobcat (*Lynx rufus*).

Montane Chaparral

Montane chaparral habitat corresponds to four CalVeg alliances found in the Middle Fork American River Watershed, which are the huckleberry oak, upper montane mixed shrub, lower montane mixed chaparral, and upper montane mixed chaparral alliances. Montane chaparral includes a broad diversity of plant species and forms (i.e., may include trees in addition to shrubs). Montane chaparral habitat supports similar animal species as those listed for mixed chaparral habitat (above).

Tree-dominated habitats

Douglas-fir

Douglas-fir habitat corresponds to the Douglas-fir–ponderosa pine (DP) CalVeg alliance. Douglas-fir habitats have varied vegetative and structural composition that attracts a rich diversity of animal species, which may include California slender salamander, Pacific chorus frog, ensatina (*Ensatina eschscholtzii*), western skink, common garter snake, western rattlesnake, great horned owl (*Bubo virginianus*), chestnut-backed chickadee (*Poecile rufescens*), golden-crowned kinglet (*Regulus satrapa*), Hutton's vireo (*Hutton's vireo*), hermit warbler (*Dendroica* occidentalis), varied thrush (*Ixoreus naevius*), bats (*Myotis* spp.), Trowbridge's shrew (*Sorex trowbridgii*), deer mouse (*Peromyscus maniculatus*), raccoon (*Procyon lotor*), Pacific fisher (*Martes pennanti pacifica*), gray fox, bobcat (*Lynx rufus*), black bear (*Ursus americanus*), and mule deer (*Odocoileus hemionus*).

Jeffrey Pine

Jeffrey pine habitat corresponds to the Jeffrey pine (JP) CalVeg alliance. Jeffrey pine habitats are used by many species, including Pacific chorus frog, common garter snake, western rattlesnake, great horned owl (*Bubo virginianus*), sharp-shinned hawk (*Accipiter striatus*), mountain quail (*Oreortyx pictus*), northern flicker (*Colaptes auratus*), white-headed woodpecker (*Picoides albolarvatus*), pileated woodpecker (*Dryocopus pileatus*), olive-sided flycatcher (*Contopus cooperi*), white-breasted nuthatch (*Sitta carolinensis*), red-breasted nuthatch (*Sitta canadensis*), brown creeper (*Certhia americana*), common raven (*Corvus corax*), varied thrush (*Ixoreus naevius*), Allen's chipmunk (*Tamias senex*), northern flying squirrel (*Glaucomys sabrinus yukonensis*), striped skunk, common porcupine (*Erethizon dorsatum*), mountain lion (*Felis concolor*), bobcat (*Lynx rufus*), and mule deer (*Odocoileus hemionus*).

Lodgepole Pine

Lodgepole pine habitat corresponds to the lodgepole pine (LP) CalVeg alliance. Lodgepole pine stands have low structural diversity and have relatively low species diversity (Mayer and Laudenslayer 1988). Many animal species found in lodgepole pine stands are associated with meadow edges. Animal species typical of the Jeffrey pine habitat also are commonly associated with lodgepole pine habitat.

Montane Hardwood

Montane hardwood habitat corresponds to three CalVeg alliances found in the Middle Fork American River Watershed, which are the canyon live oak, California black oak, and interior live oak alliances. Common species that may occur include Pacific chorus frog, western fence lizard, California mountain kingsnake (*Lampropeltis zonata*), great horned owl (*Bubo virginianus*), western screech owl (*Megascops kennicottii*), Cooper's hawk (*Accipiter cooperii*), red-shouldered hawk (*Buteo lineatus*), wild turkey, band-tailed pigeon (*Columba fasciata*), downy woodpecker (*Picoides pubescens*), a high diversity of passerines, including Steller's jay (*Cyanocitta stelleri*), oak titmouse (*Baeolophus inornatus*), Townsend's solitaire (*Myadestes townsendi*), hermit thrush (*Catharus guttatus*), purple martin (*Progne subis*), spotted towhee (*Pipilo maculatus*), ruby-crowned kinglet (*Regulus calendula*), white-breasted nuthatch (*Sitta carolinensis*), fox sparrow (*Passerella iliaca*), and dark-eyed junco (*Junco hyemalis*); and mammals, including bats (*Myotis* spp.), deer mouse (*Peromyscus maniculatus*), bushy-tailed woodrat, western gray squirrel (*Sciurus griseus*), California ground squirrel, raccoon (*Procyon lotor*), porcupine (*Erethizon dorsatum*), mountain lion (*Felis concolor*), black bear (*Ursus americanus*), and mule deer (*Odocoileus hemionus*).

Montane Riparian

Montane riparian habitat is compositionally and structurally diverse and supports a large number of animal species in the Middle Fork American River Watershed. A reliable perennial water source is an important component in this habitat type, which corresponds to five CalVeg alliances found in the Middle Fork American River Watershed, which are the black cottonwood, white alder, mountain alder, willow, and willow alder alliances. Animal taxa contributing to this high alpha diversity are amphibians, reptiles, and birds. Species commonly occurring in this habitat include Pacific chorus frog, western toad, western fence lizard, western aquatic garter snake, common kingsnake, green heron (*Butorides virescens*), black-crowned night-heron (*Nycticorax nycticorax*), red-tailed hawk, red-shouldered hawk (*Buteo lineatus*), great horned owl (*Bubo virginianus*), mourning dove (*Zenaida macroura*), downy woodpecker (*Picoides pubescens*), red-breasted sapsucker (*Sphyrapicus ruber*), black phoebe (*Sayornis nigricans*), western wood-peewee (*Contopus sordidulus*), Hutton’s vireo (*Hutton’s vireo*), Steller’s jay (*Cyanocitta stelleri*), tree swallow (*Tachycineta bicolor*), belted kingfisher (*Ceryle alcyon*), lesser goldfinch (*Carduelis psaltria*), black-headed grosbeak (*Pheucticus melanocephalus*), western tanager (*Piranga ludoviciana*), ruby-crowned kinglet (*Regulus calendula*), Wilson’s warbler (*Wilsonia pusilla*), bats (*Myotis* spp.), California vole (*Microtus californicus*), dusky-footed woodrat (*Neotoma fuscipes*), deer mouse (*Peromyscus maniculatus*), American beaver (*Castor canadensis*), western river otter (*Lontra canadensis*), bobcat (*Lynx rufus*), coyote, black bear (*Ursus americanus*), and mule deer (*Odocoileus hemionus*).

Ponderosa Pine

Ponderosa pine habitat corresponds to the ponderosa pine (PP) CalVeg alliance. Ponderosa pine habitat supports species similar to those in the Jeffrey pine habitat. Ponderosa pine in some locations is a transitional or migratory habitat for deer and it can provide essential foraging habitat in migration holding areas.

Red Fir

Red fir habitat corresponds to the red fir (RF) CalVeg alliance. Red fir habitats throughout California provide food or cover for at least one season for many animals, and can be considered “very important” for 28 birds and 26 mammals (Mayer and Laydenslauer 1988). Animal species typical of the Jeffrey pine habitat also are commonly associated with red fir habitat.

Sierran Mixed Conifer

Sierran mixed conifer habitat corresponds to three CalVeg alliances found in the Middle Fork American River Watershed, which are mixed conifer-giant sequia, mixed conifer-fir, and mixed conifer-pine. Sierran mixed conifer habitat includes conifer and hardwood species, forming a multilayered, structurally diverse forest. Animal species typical of the Jeffrey pine habitat also are commonly associated with Sierran mixed conifer habitat.

White Fir

White fir habitat corresponds to the white fir (WF) CalVeg alliance. White fir habitats have cool, moist environments in which trees are susceptible to windfall and rot. This provides excellent habitat for snag- and cavity-dependent animal species, as well as insect-gleaning birds. Animal species typical of the Jeffrey pine habitat also are commonly associated with white fir habitat.

Non-Vegetated Habitats

Barren

Barren habitat corresponds to the CalVeg non-vegetated classification barren (BA). Barren habitat types are used by a relatively small number of animal species that use specific structural features of the landscape such as rock ledges and cliffs, canyon walls, rock fields, sand and gravel for cover and breeding. Animals found in this habitat may include western rattlesnake, red-tailed hawk, American kestrel (*Falco sparverius*), turkey vulture (*Cathartes aura*), rock wren (*Salpinctes obsoletus*), canyon wren (*Catherpes mexicanus*), loggerhead shrike (*Lanius ludovicianus*), bats (*Myotis* spp.), deer mouse (*Peromyscus maniculatus*), American pika (*Ochotona princeps*), yellow-bellied marmot (*Marmota flaviventris*), and ringtail (*Bassariscus astutus*).

APPENDIX 6.6-D

Special-status Wildlife Species Known to Occur

or Potentially Occurring within the FERC Project Boundary

Special-status Wildlife Species Known to Occur within the FERC Project Boundary

Amphibians

Foothill yellow-legged frog (*Rana boylii*; FSS, CSC)

The foothill yellow-legged frog (FYLF) is a stream-dwelling frog native to California and Oregon (Storer 1925, Zweifel 1955). As a stream-obligate species, adult and juvenile FYLF primarily associate with pool and riffle habitats with gently to moderately flowing water. Tadpoles are often found in shallow near-shore habitats such as eddies, backwaters, and other low velocity areas. In eastern California, FYLF ranges from the Sierra Nevada foothills to approximately 4,500 feet. Few studies have investigated the natural history of the FYLF. Jennings and Hayes (1985) quantified the habitat associations of this species in the Sierra Nevada. In a survey of 29 streams in the Sierra Nevada, the FYLF was found to be primarily associated with similar habitat, substrate, and canopy as reported for populations in streams and rivers of the Coast Range. However, they are also found in other stream habitats ranging from small, rocky, high gradient streams no more than 1.5 feet wide, to areas where small tributaries connect with large rivers in the Sierra Nevada (Van Wagner 1996).

The FYLF generally associates with low gradient streams with moderate streamflow over coarse substrates. In the Sierra Nevada, individuals have also been observed in steep gradient reaches in habitats such as cascades and bedrock waterfalls. Although such habitats are not optimal for breeding, they may be used in spring while adults migrate downstream to reach breeding habitat near the confluence with larger streams.

The FYLF primarily associates with coarse substrates in streams. Coarse material such as cobbles, boulders, and large woody debris provides suitable sites for oviposition. Larger substrates typically remain stable in spring when stream flow is high when the snowpack melts. During the summer foraging season, when flows are low, coarse material protruding above the channel bed provides optimal sites for basking and feeding. Although individuals have been found associated with finer substrates, such as sand and silt near main channel pools or around side channel pools, this association appears to be relatively low compared to coarse substrates. The canopy in streams that support this species is usually semi-open with riparian vegetation creating dappled shade, thus providing cool cover during the hottest part of the day, as well as open areas for basking (Van Wagner 1996). Fitch (1938) suggested that this species may be limited by dense canopy and Moyle (1973) reported that individuals were not found at sites with >90% canopy.

Although usually found in perennial streams, adults will inhabit isolated pools when water flow declines in summer (Fitch 1938, cited in Hayes and Jennings 1989). The movements of juveniles can be quite extensive in summer and late fall, as foraging drives individuals into diverse habitats (Van Wagner 1996). Therefore, the stream habitat used by FYLF throughout their life cycle is complex. Breeding occurs in early spring near tributary confluences in larger river systems in the Coast Range (Kupferberg

1996) and in shallow, low velocity areas in small streams in the Sierra Nevada (Van Wagner 1996). Mating occurs from March to July and egg laying occurs from April to July. Egg masses are attached to cobbles, boulders, and other instream structures at a depth of 4 to 24 inches and in slow to moderately flowing water as low as 9.8° C (Storer 1925, Zweifel 1955, Lind et al. 1996, Lind unpublished data). Hatching occurs 5 days to 3 weeks after the eggs are laid, depending on water temperature. Tadpole stage occurs from May through September.

Birds

Osprey (*Pandion haliaetus*; CSC)

The osprey occurs along seacoasts, lakes, and rivers, primarily in ponderosa pine and mixed conifer habitats. It preys mostly on fish at or below the water surface, but will also take small mammals, birds, reptiles, amphibians, and invertebrates. Large snags and open trees near large, clear, open waters are required for foraging. The osprey typically swoops from flight, hovers, or perches to catch prey. The osprey breeds primarily in northern California and typically build nests in large conifers, but may also use artificial platforms as nesting areas. The breeding season is from March to September. Nests are built on platforms of sticks at the top of large snags, dead-topped trees, on cliffs, or on human-made structures. A nest may be as much as 250 feet above ground and is usually within 1,000 feet of fish-producing water. Osprey need tall, open-branched "pilot trees" nearby for landing before approaching the nest and for use by young for flight practice. Typically, this species migrates in October south along the coast and the western slope of the Sierra Nevada to Central and South America (Zeiner et al. 1988-1990).

Northern goshawk (*Accipiter gentiles*; CSC)

The northern goshawk inhabits middle to high-elevation mature, dense coniferous forests throughout the east and west sides of the Sierra. It occurs in the foothills during winter, in northern deserts in pinyon-juniper woodland, and in low elevation riparian habitats. Optimal habitat contains trees for nesting, a closed canopy (>50%) for protection and thermal cover, and open spaces allowing maneuverability. In the Sierra Nevada, nesting occurs from 2,500 feet in ponderosa pine-mixed-conifer habitat to 10,000 feet in red pine and lodgepole pine habitat (USDA-FS 2001a). Nest areas, often in trees along drainages, are characterized by dense stands of large diameter trees with interconnected canopies. Nests are usually on north slopes near water in the densest parts of stands, but close to openings and are placed in live trees, but sometimes snags (USDA-FS 2001a). Nests in live trees are usually placed at or just below the lower portion of the canopy in a crotch (USDA-FS 2001a). Nesting season begins in March. The northern goshawk feeds mostly on birds, using snags and dead treetops as observation platforms (Zeiner et al. 1988-1990).

California spotted owl (*Strix occidentalis occidentalis*; FSS, MIS, CSC)

The California spotted owl occurs in dense, old growth, multi-layered mixed conifer, redwood, Douglas-fir, and oak woodland habitats, from sea level up to approximately 7,600 feet. In the Sierra National Forest, this species uses foothill riparian-hardwood, ponderosa pine-hardwood, mixed-conifer forest, red fir forest, and east side pine forest (USDA-FS 2001a). It prefers large trees and high canopy cover for nesting and foraging areas. Foraging is most common in intermediate to late successional forests with greater than 40% canopy cover and a mixture of tree sizes, some larger than 24 inches in dbh (USDA-FS 2001a). Nesting habitat contains a dense canopy cover (>70%) with medium to large trees and a multi-storied structure. This species prefers stands with significantly greater canopy cover, total live tree basal (base) area, basal area of hardwoods and conifers, and snag basal area for nesting and roosting (USDA-FS 2001a). Nests are located in cavities or broken treetops. Nesting season occurs from February to September.

Special-status Wildlife Species Potentially Occuring within the FERC Project Boundary

Amphibians

California red-legged frog (*Rana aurora draytonii*; FT, CSC)

The USFWS listing of the California red-legged frog (CRLF) was effective on June 24, 1996. On March 13, 2001, a final designation of critical habitat was made for the CRLF (USFWS 2001). The primary constituent elements of critical habitat for CRLF are aquatic and upland areas where suitable breeding and non-breeding habitat is interspersed throughout the landscape and is interconnected by unfragmented dispersal habitat. To be considered to possess the primary constituent elements, an area must include two (or more) suitable breeding locations, a permanent water source, associated uplands surrounding these water bodies up to 300 feet from the water's edge, all within 1.25 miles of one another and connected by a barrier-free dispersal habitat that is at least 300 feet wide.

The CRLF is threatened by a variety of human activities. These include destruction or degradation of habitat by urbanization, agriculture, construction of reservoirs, mining, livestock grazing, timber harvesting, off-road vehicle use, and predation by introduced species such as bullfrogs (*Rana catesbeiana*), African clawed frog (*Xenopus laevis*), red swamp crayfish (*Procambarus clarkii*), signal crayfish (*Pacifasticus leniusculus*), catfishes (*Ictalurus* spp.), and mosquitofish (*Gambusia affinis*) (Jennings and Hayes 1994). The CRLF is exposed to contaminants such as insecticides and herbicides used in agriculture, heavy metals from mining activities, and ozone and nitrogen oxides in air pollution. Natural threats to the CRLF include predation by raccoons (*Procyon lotor*) and garter snakes (*Thamnophis* spp.), and diseases.

Mountain yellow-legged frog (*Rana muscosa*; FE/FC, FSS, CSC)

The mountain yellow-legged frog (MYLF) is endemic to the Sierra Nevada and Transverse ranges in California (Storer 1925). This species is highly aquatic and is closely associated with low-gradient streams, meadows, ponds, and lakes from 4,500 to 12,000 feet in elevation in the Sierra Nevada. Adults are most active during the daytime and often bask in open areas (Bradford 1984). The MYLF is most often found in lakes and streams with gently sloping banks that are moderately rocky and interspersed with sedges (*Carex* spp.), grasses, and low clumps of willows (*Salix* spp.) (Mullally and Cunningham 1956). The MYLF is a pond-breeding species that associates primarily with lakes and ponds throughout its southern range and with streams throughout its northern range (Wild, pers. comm., 2001). Because of harsh winters and high spring runoff in the higher elevations of the MYLF's range, only large pools and ponds that maintain the low velocities required through metamorphosis are used for breeding. Tadpoles may transform after their second summer, thus the tadpoles require still, deep-water with fine sediments for overwintering. Adults are commonly observed basking at the edge of pools and along shallow-sloped stream margins. Like other pond-breeding frogs and toads, the MYLF is not well adapted to swift flowing water. However, individuals have been noted basking on open, sunny cobbles adjacent to gently flowing riffles during dispersal season.

In the southern Sierra Nevada, adults initially move to breeding sites at thawing lakes and ponds in late spring, and use streams for dispersal to other available aquatic habitats by mid-summer. Population density is greatest at fish-less lakes that are deeper than 3 feet (important for overwintering) and have warm water habitat along the shore (Pope and Matthews 2001). Adults exhibit a seasonal substrate preference at lakes. Matthews and Pope (1999) reported that adults associate more often with a combination of rock and silt substrates, but associated almost exclusively with rocky habitats in the fall. Other references identify stream segments with rock substrates as preferred (Mullally and Cunningham 1956).

In the northern Sierra Nevada, streams are the preferred habitat for breeding and foraging and are also important for dispersal. However, this species tends to avoid small creeks, perhaps because they are not deep enough to provide adequate habitat for breeding, foraging, and overwintering for adults and tadpoles. In late summer when streams are intermittent, adults often congregate in isolated pools. Stream segments where the bank was less than approximately 8 inches in vertical height harbored the densest population of adults (Mullally and Cunningham 1956). The MYLF often basks in areas with little to moderate canopy to raise their body temperature and elevate their general activity level. Open, sunny reaches with large exposed cobbles, boulders, or bedrock provide ideal basking sites. Because of lower average temperatures at high elevation, reaches with little to no canopy are preferred. Habitats with moderate canopy allow limited sunlight to reach the stream surface, whereas dense canopies virtually block sun penetration.

Mating and egg laying occurs from March to July. Habitat association and activity patterns of tadpoles in lakes and streams have not been investigated. Tadpoles overwinter for 2 to 3 years at high elevation sites before metamorphosis is complete (Wright and Wright 1949).

Reptiles

Western pond turtle (*Actinemys marmorata*; FSS, CSC)

The western pond turtle (WPT) ranges from Baja California to Washington and inland into western Nevada. In the Sierra Nevada, it historically occurred in most of the major drainages along the western slope. Its elevational distribution is from sea level to approximately 6,000 feet, but most populations occur below 4,000 feet (Holland 1991). Populations found between 4,500 and 6,000 are expected to be transplants (Jennings and Hayes 1994). This turtle occurs in marshes, perennial and intermittent streams, rivers, canals, ponds, vernal pools, and reservoirs, but also can be found nesting or overwintering in adjacent upland habitats (Storer 1930, Holland 1991, Reese and Welsh 1997). The presence of WPT in aquatic habitat is dependent upon several factors, including distance to the nearest natural water source with a turtle population, structure of the habitat, degree of habitat disturbance, and the presence of suitable basking sites and refugia (Holland 1991).

The WPT is almost exclusively found in pool and backwater habitats. Their life history strategy focuses entirely on still water and low velocity conditions, and individuals are not well adapted to swiftly flowing currents. In low gradient stream systems, the WPT is more often observed basking on sediments composed of fines than atop coarse materials. The presence of potential basking sites, such as large woody debris in particular, adjacent to or in deep pools with aquatic vegetation can be used to predict the presence of WPT. As with amphibians, basking is a frequent activity, and adjacent deep pools with underwater cover sites provide protection from predators. Basking is an important behavioral adaptation among reptiles that allows them to raise their body temperature to increase their general activity level. As with other reptiles, the WPT often basks in open, sunny areas. This species occurs in intermittent and perennial streams, but permanent streams support larger populations (Holland 1991). In California's Trinity River, favorable habitat for the WPT is characterized by warm, deep, slow flowing pools with underwater cover and basking sites (Reese and Welsh 1998). Holland (1991) reported that this species is often found in quiet backwater habitats in streams. Such habitats provide shelter from predators and offer basking sites for thermoregulation. The WPT is uncommon in high-gradient streams perhaps because water temperature, current velocity, food resources, or any combination may limit their local distribution (Holland 1991).

Birds

Harlequin duck (*Histrionicus histrionicus*; CSC)

The harlequin duck occurs along coasts in winter, where it dives for food in turbulent water along rocky shores, taking invertebrates from rocks or pilings. It nests along the banks of shallow, swift rivers with plentiful aquatic invertebrates. The nest is often in a recess, sheltered overhead by the stream bank, rocks, woody debris, or low shrubs, usually within 7 feet of water. Pairs form along the coast in winter or early spring. Clutch size is generally 3 to 7, and seldom more than 9. Incubation is 27 to 29 days. Young are precocial and are tended by the hen only. First breeding is at 2 years. Harlequin ducks were known historically to breed along Sierran rivers from Madera to Tuolumne counties. However, with the exception of a few rare breeding pairs and stragglers, the California wintering population of harlequin duck now migrate to breeding grounds in the northwestern U.S. and Canada, and is absent from April to September. Both breeding and wintering populations in California have declined, probably as a result of human disturbance along breeding streams, and damming of rivers (Zeiner et al. 1988-1990).

Cooper's hawk (*Accipiter cooperi*; CSC)

The Cooper's hawk occurs in dense stands of oak and riparian woodland for nesting and grassland for foraging from sea level to 9,000 feet. It is a breeding resident throughout most of the wooded portion of the state, especially in the southern Sierra Nevada foothills, New York Mountains, Owens Valley, and other local sites in southern California. It feeds on small birds, small mammals, reptiles, and August with peak activity from May through July (Zeiner et al. 1988-1990).

Golden eagle (*Aquila chrysaetos*; CSC, CFP)

The golden eagle typically occurs in grasslands and early successional stages of forest and shrub habitats for foraging, and secluded cliffs with overhanging ledges or large trees in open areas for nesting. It is an uncommon permanent resident and migrant throughout California from sea level to 11,500 feet. It eats mostly lagomorphs and rodents, but also takes other mammals, birds, reptiles, and some carrion. It nests on cliffs of all heights and in large trees in open areas by building large platform nests, often 10 feet across and 3 feet high, of sticks, twigs, and greenery. It breeds from late January through August with a peak from March through July (Zeiner et al. 1988-1990).

Bald eagle (*Haliaeetus leucocephalus*; FT, FPD, MIS (Proposed delisting on 7/6/99; nesting and wintering), SE, CFP)

The breeding range of bald eagles formerly included most of the North American Continent, but bald eagles now nest mainly in Alaska, Canada, the Pacific Northwest states, the Great Lake states, Florida, and Chesapeake Bay. The winter range of the bald eagle is similar to the breeding range, but extends mainly from southern Alaska and southern Canada southward. Bald eagles are permanent residents and uncommon winter migrants throughout the state of California. They breed primarily in Butte, Lake, Lassen, Modoc, Plumas, Shasta, Siskiyou, and Trinity counties (CDFG 2002). The breeding range is primarily in mountainous habitats next to reservoirs, in the Central Coast Range, and on Santa Catalina Island. About half of the wintering population is found in the Klamath Basin (CDFG 2002). Bald eagles forage near large aquatic ecosystems such as lakes, reservoirs, or free flowing rivers. Bald eagle nests are usually located in uneven-aged stands with old-growth components. Nesting usually occurs in large trees along shorelines in relatively remote areas. Breeding occurs February through July, with peak activity occurring in March through June. Average clutch size is 2 eggs. Incubation lasts approximately 35 days and fledging takes place at 11 to 12 weeks of age. Parental care may extend to 11 weeks after fledging. Bald eagles become sexually mature at 4 to 5 years of age.

Bald eagle populations have been on the rise over the past 25 years. There was a ten-fold increase in population from 1963 to 1999. The number of occupied breeding areas in North America increased by 462 percent from 1974 to 1994. In California, CDFG has coordinated annual statewide breeding surveys of bald eagles which have shown a long term increase in the population and range since surveys began in 1973. The breeding range increased from eight counties in 1981 to 27 counties currently (CDFG 2002).

In 1940, the Bald Eagle Protection Act (16 U.S.C. 668) was passed. This act led to a partial recovery of the species. In the late 1940s, the species population plummeted due to reproductive failure from the widespread use of DDT, loss of habitat, and disturbances related to human activities. In response to this, bald eagles in the lower 48 states were listed as endangered under the Endangered Species Protection Act of 1966 (16 U.S.C. 668aa-668cc). Populations continued to decline and in 1978 bald eagles were listed as endangered under the Endangered Species Act (16 U.S.C. 1531-1544). The USFWS released a recovery plan in 1986. Because of the increase in the bald eagle population and range, the species was downlisted to threatened status in July of 1995 (50 CFR Part 17). A proposed rule to remove the species from listing status was made in July of 1999 (50 CFR Part 17). The bald eagle is also protected under the Migratory Bird Treaty Act of 1918 (16 U.S.C. Sections 703-712) and the Bald Eagle Protection Act of 1940 (16 U.S.C. Sections 668-668d).

American peregrine falcon (*Falco peregrinus anatum*; Former FE (Delisted on 8/20/99; nesting), SE, CFP)

The American peregrine falcon breeds in woodlands, forests, coastal habitats, and riparian areas near wetlands, lakes, rivers, or other water on high cliffs, banks, dunes, or mounds. It is a very uncommon breeding resident and uncommon as a migrant in California, with active nesting areas along the coast north of Santa Barbara, in the Sierra Nevada, and in other mountains of northern California. Migrants occur along the coast and in the western Sierra Nevada in spring and fall. Its nest is a scrape on a depression or ledge in an open area, on human-made structures, and occasionally in a tree or snag cavity or old nest of other raptors. Riparian areas and coastal and inland wetlands are important habitats yearlong, especially in non-breeding seasons. It feeds on a variety of birds and occasionally takes mammals, insects, and fish. Breeding occurs from early March to late August with a clutch size of 3 to 7 eggs. Incubation is approximately 32 days.

The American peregrine falcon was listed as endangered in 1970 under the Endangered Species Conservation Act of 1969 (Public Law 91-135, 83 Stat. 275). Population declines were due to negative impacts of DDT and its metabolites on peregrine falcon reproduction and survival. The American peregrine falcon subspecies were listed as endangered throughout their respective ranges upon passage of the Endangered Species Act of 1973 (16 U.S.C. 1531 et seq.). Because of restrictions on the use of organochlorine pesticides in the United States and Canada and because of successful management activities, including the reintroduction of captive-bred and relocated wild hatchling peregrine falcons, the specie's population has increased. In 1999 the USFWS removed the peregrine falcon in North America from the Federal List of Endangered and Threatened Wildlife species (50 CFR Part 17).

Great gray owl (*Strix nebulosa*; FSS, MIS, SE)

Great gray owls nest in montane mixed conifer and red fir forests, and forage in nearby montane wet meadows, from 2,500 to 8,000 feet in elevation (Beck and Winter 2000).

Their distribution includes the Sierra Nevada, Cascade Range, and Modoc Plateau in California, but they are rare throughout California and only isolated populations are known to occur (Beck and Winter 2000). Nesting habitat of the great gray owl consists of mid- or late succession conifer forests containing large, broken-top snags in sufficient numbers to provide nest sites and areas with 60 to 100% multi-storied canopy, situated within 300 yards of montane meadows or grass/forb forage types (Beck and Winter 2000). Foraging habitat requires meadows or openings that have sufficient herbaceous cover to support pocket gophers and microtine rodents and that are at least 10 acres in size (Beck and Winter 2000). Foraging habitat includes meadows and meadow complexes consisting of small "stringer" meadows that total at least 10 acres when meadows occur within ½ mile of one another (Beck and Winter 2000). In the Sierra Nevada of California, nesting generally occurs from February to June in low elevations, March to July in middle elevations, and April to August in high elevations. Nesting chronology is dependent upon elevation, with nesting in high elevation sites occurring more than a month after low elevation sites. The courtship and incubation periods are approximately 30 days each. Great gray owls typically lay only 2 to 3 eggs per clutch, with usually only 1 to 2 chicks successfully fledging. Fledglings leave the nest 26 to 28 days after hatching (Beck and Winter 2000).

Black swift (*Cypseloides niger*; CSC)

The black swift breeds locally in the Sierra Nevada and Cascade Range; the San Gabriel, San Bernardino, and San Jacinto Mountains; and in coastal bluffs and mountains from San Mateo County south to San Luis Obispo County. It nests in moist crevices or caves on sea cliffs above the surf, or on cliffs behind, or adjacent to, waterfalls in deep canyons. It forages widely over many habitats. In migration, it is rare and irregular outside the breeding range and does not winter in California. Nests are constructed of mud mixed with moss, ferns, seaweed, or other plant materials and located in a deep, dark crevice, in a cave, or under an overhang. Nesting occurs in colonies of a few pairs. The breeding season lasts from early June to late August. Only one egg per year is laid, and incubation lasts 24 to 27 days. Altricial young leave the nest at about 45 days.

Vaux's swift (*Chaetura vauxi*; CSC)

The Vaux's swift is a summer resident of northern California, breeding is fairly common in the Coastal Range, in the Sierra Nevada, and possibly in the Cascade Range. It is a fairly common migrant throughout most of California in April, May, August, and September. It feeds high in the air over moist terrain and habitats and also feeds commonly at lower levels in forest openings, above burns, and especially above rivers and lakes. Its preferred habitat is redwood, Douglas-fir, and occasionally other coniferous forest types. Nest sites are typically built on the vertical inner wall of a large, hollow tree or snag, especially tall stubs charred by fire. The species occasionally nests in chimneys and buildings. Breeding occurs from early May to mid-August. Solitary nesting is apparently typical. Clutch size is 3 to 7 eggs, and incubation lasts 18 to 20 days. Altricial young are tended by both parents and leave the nest at about 28 days (Zeiner et al. 1988-1990).

Willow flycatcher (*Empidonax traillii brewsteri*; FSS, MIS, SE)

The willow flycatcher is a rare to locally uncommon, summer resident in wet meadow and foothill and montane riparian habitats from 2,000 to 8,000 feet in the Sierra Nevada and Cascade Range. It occurs in broad, open river valleys or large mountain meadows with lush growth of shrubby willows. Dense willow thickets are required for nesting and roosting. This species is most abundant in areas where extensive thickets of low, dense willows border wet meadows, ponds, or backwaters. It may still nest elsewhere in lowland California, as in San Diego County. It is a common spring (mid-May to early June) and fall (mid-August to early September) migrant at lower elevations, primarily in riparian habitats throughout the state exclusive of the North Coast. An open cup nest is placed in an upright fork of a willow or other shrub, or occasionally on a horizontal limb, at a height of 1.5 to 10 feet. The species is monogamous. Peak egg laying occurs in June, incubation lasts 12 to 13 days, and clutch size averages 3 to 4 eggs. It is probably single-brooded. Both sexes care for altricial young. Fledging age is 13 to 14 days (Zeiner et al. 1988-1990).

Yellow warbler (*Dendroica petechia brewsteri*; CSC)

The yellow warbler is an uncommon to common summer resident in the north, a locally common resident in the south, and a rare but regular visitor in winter in the south. It breeds and forages in riparian woodlands, montane chaparral, open ponderosa pine, and mixed conifer habitats with substantial brush, from coastal and desert lowlands up to 8,000 feet in the Sierra Nevada. It also breeds in montane chaparral, in open ponderosa pine, and mixed conifer habitats with substantial amounts of brush. It is now rare to uncommon in many lowland areas where it was formerly common. The species is usually found in riparian deciduous habitats in summer in cottonwoods, willows, alders, and other small trees and shrubs typical of low, open-canopy riparian woodland. The nest is an open cup placed 2 to 16 feet above ground in a deciduous sapling or shrub. The territory often includes tall trees for singing and foraging and a heavy brush understory for nesting. Breeding occurs from mid-April into early August with peak activity in June. The pair breeds solitarily and lays 3 to 6 eggs, which are incubated by the female for 11 days. Altricial young are tended by both parents until fledging at 9 to 12 days (Zeiner et al. 1988-1990).

MAMMALS

Western red bat (*Lasiurus blossevillii*; FSS)

Very little research has been done on the western red bat and little is known about this species. Much of the natural history is inferred from what is known about the eastern red bat, although the degree of similarity of the biology of these two species is unknown at present. The western red bat is a solitary, foliage-roosting bat. The western red bat is in the genus *Lasiurus*, the hairy-tailed bats. These bats are adapted for exposed roosting behavior with their hairy tail membrane and small ears. In California, this species is known to roost in cottonwood trees and willows, but is commonly detected in a variety of habitats, including chaparral. Roost heights range from 10 to 50 feet (Pierson and Heady 1997). The range of the western red bat is from British Columbia to Central and South America. Migration occurs throughout its range and bats of Canada move into the coastal lowlands of California, and the California population is thought to winter in Central America (Nagorsen and Brigham 1993). Mating takes place in late summer and fall, sperm is stored over winter, and fertilization occurs in early spring. Gestation period is 80 to 90 days, and one to four young are born in late May to early July. The young are born small, naked, and underdeveloped (Nowak 1994). Females leave the young at the roosting site while foraging, but will carry them when moving to a new roosting site. Young are capable of sustained flight at 6 weeks. Large moths are the primary prey of the western red bat. This bat is a fast flyer, foraging in straight flights or large circles (Nagorsen and Brigham 1993). The echolocation calls are highly variable, depending on the terrain. Though variable, these calls are very distinct.

Townsend's big-eared bat (*Corynorhinus townsendii*; FSS, CSC)

Townsend's big-eared bat is a year-round resident in California, occurring from low desert to mid-elevation montane habitats. It is found primarily in rural settings, from inland deserts to coastal redwoods, oak woodland of the inner Coast Ranges and Sierra Nevada foothills, and low to mid-elevation mixed coniferous-deciduous forests. It typically roosts during the day in caves and mines, but can roost in buildings that offer suitable conditions (Kunz and Martin 1982). Night roosts are in more open settings and include bridges. It hibernates in mixed sex aggregations of a few to several hundred individuals. Hibernation occurs for prolonged periods in colder areas and intermittently in non-freezing areas. Townsend's big-eared bat arouses periodically and moves to alternative roosts, and actively forages and drinks throughout the winter. A single young is born per year between May and July. Females form maternity colonies of 35 to 200 individuals, while males roost individually (Kunz and Martin 1982). Townsend's big-eared bat feeds primarily on small moths that are gleaned from vegetation.

Sierra Nevada snowshoe hare (*Lepus americanus tahoensis*; CSC)

The snowshoe hare is an uncommon resident at upper elevations in the Cascade Mountains, in Siskiyou and Del Norte counties south through the Sierra Nevada to Mariposa, Mono, and Madera counties. In California, it is primarily found in montane riparian habitats with thickets of alders and willows and in stands of young conifers interspersed with chaparral. The early seral stages of mixed conifer, subalpine conifer, red fir, Jeffrey pine, lodgepole pine, and aspen are likely habitats, primarily along edges, and especially near meadows. Grass, fur, or needles may line a shallow nest placed under a shrub, log, or in slash. Breeding occurs from mid-February to June or July. The gestation period is 35 to 37 days, and litter size varies from one to seven. The species is polyestrous, with two to three litters per year.

White-tailed jackrabbit (*Lepus townsendii*; CSC)

The white-tailed jackrabbit is an uncommon to rare resident of the crest and upper eastern slope of the Sierra Nevada, primarily from the Oregon border south to Tulare and Inyo counties. Its preferred habitats are sagebrush, subalpine conifer, juniper, alpine dwarf-shrub, and perennial grassland. It also uses wet meadow and early successional stages of various conifer habitats. White-tailed jackrabbits move seasonally from higher elevations in summer to lower elevations in winter. During spring though fall, grasses and herbaceous plants are eaten. The winter diet includes buds, bark, and twigs of shrubs. White-tailed rabbits breed from February to July, giving birth to litters of 1 to 6 young in shallow depressions on the ground, usually in shrubby underbrush. The gestation period lasts 30 to 42 days. White-tailed jackrabbits are known to have 3 to 4 litters per year in other states, but may not have more than one litter annually in California. Young forage for themselves soon after birth and are independent at 3 to 4 weeks. Sexual maturity is attained in the first spring. Formerly widespread throughout its range, the white-tailed jackrabbit population now is fragmented, and numbers apparently have declined drastically. Overgrazing by livestock has been cited as a principal factor, as well as cultivation and other development (Zeiner et al. 1988-1990).

Sierra Nevada mountain beaver (*Aplodontia rufa californica*; CSC)

The Sierra Nevada mountain beaver is found throughout the Cascade, Klamath, and Sierra Nevada ranges. It occurs in dense riparian-deciduous and open, brushy stages of most forest types. Typical habitat in the Sierra Nevada is montane riparian. In the Coast Ranges, most populations occur below 2,700 feet. It frequents open and intermediate-canopy coverage with a dense understory near water. Deep, friable soils are required for burrowing, along with a cool, moist microclimate. Burrows are located in deep soils in dense thickets, preferably near a stream or spring. It lines its nest with dry vegetation. Nest chambers are 1 to 4.5 feet below the ground surface. Breeding occurs from December through March (peak in February). Young are born February to June (peak March through May). There is one litter per year, gestation is 28 to 30 days, and lactation lasts up to 60 days. Litter size averages two to three.

American marten (*Martes americana*; FSS, MIS)

The American marten occurs throughout the Sierra Nevada in montane forests from 4,000 to 13,000 feet. Martens prefer coniferous forest with large diameter trees and snags, large downed logs, moderate-to-high canopy closure, and an interspersion of riparian areas and meadows (USDA-FS 2001b). Optimal habitats are various mixed evergreen forests with more than 40 percent crown closure and large trees and snags for den sites. USDA-FS (2001b) provides the following specific habitat components for westside suitable habitat in the marten core elevation range (5,500 to 10,000 feet):

- canopy cover of ≥40% for traveling and foraging and of ≥70% for denning and resting;
- ≥6 largest live conifers of 24" dbh per acre for traveling and foraging and ≥9 for denning and resting;
- live tree basal area of ≥350 sq ft/acre;
- average of 2.5 largest snags of ≥24" dbh per acre for traveling and foraging and 5 per acre for denning and resting; and
- coarse woody debris of large logs (≥15 feet long) for 5–10 tons/acre in Decay Classes 1-3 for traveling and foraging and in Decay Classes 1-2 for denning and resting.

Denning occurs from late winter through early spring. Dens are located in cavities and are lined with leaves, grass, moss, or other vegetation. Young are born in March and leave their mothers in the fall. The American marten ranges from the foothills to the higher slopes of the Sierra Nevada, including the Sierra National Forest.

Pacific fisher (*Martes pennanti pacifica*; FC, FSS, MIS)

The Pacific fisher has been a candidate for federal listing since April 2004. It is among the most habitat-specific mammals in North America (USDA-FS 2001b). Forest type is not as important as vegetative and structural habitat aspects. The Pacific fisher occurs in a variety of forest types that are generally mature, dense forest stands with snags and greater than 40% canopy closure. It is known from 3,500 to 8,000 feet elevations in the Sierra National Forest. It requires standing dead trees, downed logs, and rocky areas for denning sites. USDA-FS (2001b) lists the following key habitat features for Pacific fisher resting and denning sites in the southern Sierra:

- mean den tree dbh of 49” conifer and 27” oak;
- mean rest site tree dbh of 44” conifer and 26” oak;
- mean rest site basal area of 273 sq-ft/acre;
- mean den canopy closure of 94%; and
- mean rest site canopy closure of 93%.

The Pacific fisher dens in cavities and broken treetops and snags from winter to May.

California wolverine (*Gulo gulo luteus*; ST, CFP)

The California wolverine occurs in a variety of habitat types, such as mixed conifer, red fir, and lodgepole habitats, and probably sub-alpine conifer, alpine dwarf shrub, wet meadow, and montane riparian habitats. Wolverine denning is restricted to rocky areas free of human disturbance (USDA-FS 2001b). It occurs in the Sierra Nevada from 4,300 to 10,800 feet, but usually above 6,400 feet. Scarce sightings range from Del Norte and Trinity counties, east through Siskiyou and Shasta counties, and south through Tulare County. The wolverine feeds primarily on small mammals and carrion. Dens are located in caves, cliffs, hollow logs, cavities in the ground, under rocks, under snow, or in old beaver lodges. Denning occurs from late winter through early spring. The breeding period lasts from January to July.

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6.7 GEOMORPHOLOGY

This report summarizes the existing information regarding channel geomorphology and associated fluvial processes in the bypass streams associated with the Middle Fork American River Hydroelectric Project (MFP or Project). Channel geomorphology is a description of the channel form ("morphology") including dimensions, gradient, planform, and pattern. Fluvial processes refer to the flow, sediment supply, and sediment transport characteristics that create and maintain the channel morphology. The Federal Energy Regulatory Commission (FERC) does not specifically require a chapter on geomorphology. However, this information is integral to understanding channel maintenance processes and the distribution and availability of aquatic and riparian habitat.

The information presented in this report is based on a review of existing information, including published reports, geographic information system (GIS) data, historical and recent aerial photography, and on new information developed by the Placer County Water Agency (PCWA) in 2005 as part of a two-phase geomorphology study. The 2005 geomorphology study methods and results are documented in PCWA's Draft 2005 Physical Habitat Characterization Study Report (PCWA 2006).

6.7.1 Sources of Information

Existing information regarding the geomorphology of the streams and rivers in the Middle Fork American River Watershed was retrieved, reviewed, and evaluated. Specific information that was reviewed and evaluated is summarized in the following.

Previously Published Study Reports

Geomorphic information pertinent to the MFP were found in two previously published reports:

- Sediment Study of Ralston Afterbay Reservoir – Final Report (Bechtel Corporation 1997). This report considered issues related to management of sediment deposition in Ralston Afterbay. This report provided data pertinent to sediment load and sediment transport characteristics of the Rubicon River and the Middle Fork American River.

- Flood Surge on the Rubicon River, California – Hydrology, Hydraulics, and Boulder Transport (Scott and Gravlee 1968). This report was prepared by the United States Geological Survey (USGS) and analyzed the geomorphic effects of the failure of the partially completed Hell Hole Dam in 1964.

Aerial Photography

Existing aerial photography was retrieved and evaluated, as follows.

- Historical aerial photography taken in 1961-1962 that pre-dates development of the MFP. These aerial photographs, available as stereo pairs, include scales of 1:6000, 1:12000, and 1:15840. A summary of the date, location, and streamflow for each of the historical aerial photographs used in this analysis is provided in Table 6.7-1.

- Recent aerial photography taken in 2002 in a digital geo-referenced format with two-foot pixel size resolution prepared by AirPhoto USA, Inc. Aerial videography of bypass streams taken in 2005 was also reviewed and supplemented the recent aerial photography.

2005 Physical Habitat Characterization Study Report

During the summer of 2005, geomorphology field studies were conducted by PCWA as part of an on-going, two-phase study. The field work conducted in 2005 focused on characterizing the geomorphic conditions in the bypass streams associated with the MFP and on identifying principle sediment sources. The information developed in 2005 is documented in the Draft 2005 Physical Habitat Characterization Report (PCWA 2006). The report describes the study methods and includes discussions on stream reach classification, ranking of relative channel responsiveness, sediment supply and transport characteristics, and a comparative assessment of historic and recent era geomorphology.

The information documented in the Draft 2005 Physical Habitat Study Report (PCWA 2006) was used as the principle source of information for this Existing Resource Information Report. The work completed during 2005 will be augmented in 2006, following quantitative field studies. The information presented in the Existing Resource Information Report will be updated and revised, as needed, with the data collected in 2006.

6.7.2 Overview of Geomorphic Characterization

The following briefly explains the geomorphology information developed as part of the 2005 Physical Habitat Characterization Study, and the terminology used to describe the information.

Stream Channel Classification – Stream reaches were classified based on morphological characteristics using the Rosgen Level I and Montgomery-Buffington classification systems. These classification systems are discussed in detail in the Draft 2005 Physical Habitat Characterization Report (PCWA 2006) and are summarized in Appendices 6.7-A and 6.7-B.

Channel Responsiveness – Stream reaches were also classified using the Montgomery-Buffington (1997) framework for assessing potential channel response to alterations of natural stream flow or sediment regime based on the channel classification system. The Montgomery-Buffington classification system is explained in Appendix 6.7-B. In addition, the response potentials of the different channel types identified in the bypass streams are provided in Appendix 6.7-B.

Sediment Supply and Sediment Load/Transport Characteristics – Sediment supply and sediment load/transport characteristics were determined through ground and aerial surveys conducted as part of the 2005 Physical Habitat Characterization Study, and derived from information contained in the Sediment Study of Ralston Afterbay Reservoir (Bechtel Corporation 1997). This characteristic describes the extent and location of sediment contributions to stream channels from hillslope mass-wasting and other erosion sources and the relative capacity of bypass streams to transport and store these sediments.

Historic (1961-1962) and Recent (2002-2005) Channel Condition – Channel geomorphic conditions were compared using aerial photographs to identify differences and discernable trends between these two time periods. Large-scale geomorphic features were compared, including channel position, planform, width, and sediment storage (bars).

6.7.3 Description of Existing Geomorphology Resources

The geomorphology of bypass stream associated with the MFP is described below, by stream reach. More detailed information, including GIS-based maps, is available in the Draft 2005 Physical Habitat Characterization Report (PCWA 2006).

6.7.3.1 Middle Fork American River from French Meadows Reservoir to Ralston Afterbay

The following summarizes the geomorphic conditions along the Middle Fork American River from French Meadows Reservoir to Ralston Afterbay, organized by the descriptors defined above.

Rosgen Channel Classification

The Middle Fork American River was classified using the Rosgen Classification System. Maps showing the Rosgen channel type designations as determined through the 2005 studies are provided as Figure 6.7-1 (includes an index map and 17 detailed sheets). Additional description of the Rosgen channel types is provided in Appendix 6.7-A. Appendix 6.7-C contains photographs depicting the various channel types.

The overall gradient between French Meadows Reservoir and the Middle Fork Interbay is over 4%, with higher gradients in localized areas. Approximately 6.2 miles of the channel are identified as A-type (Appendix 6.7-C, Photo C-1). Bedrock sections often alternate with boulder-to-cobble dominated channel sections in this reach. Gravels were observed in low velocity areas such as pool tailouts. A more moderately entrenched, 2.2-mile long B-type channel reach, with a moderate width-depth ratio, is also present in the reach.

Between Middle Fork Interbay and Ralston Afterbay channel dimensions have an average gradient of approximately 2.5% with localized gradients as high as 5%. The channel in this reach is highly to moderately entrenched, with a high to moderate width-to-depth ratio. Valley walls often are comprised of exposed bedrock near the hillslope-toe/bankfull channel interface. Confining valley walls limit the potential for lateral channel migration. Due to the quality of aerial photo data available for mapping, it was unclear for most of this reach, whether the channel is best categorized as an F- or B-channel type; therefore, both types were assigned. Channel bed materials observed in this reach were most frequently comprised of boulders and cobble, with frequent bedrock outcrop exposures. Gravels were plentiful, consistently observed in pool tailouts throughout the reach, and often appeared to be co-dominant with cobble and boulders. All bed materials were represented in nearly equal proportions.

Channel Responsiveness

A total of 14.7 miles of the Middle Fork American River, from French Meadows Reservoir to Ralston Afterbay, was rated as having “low” response potential due to the extensive length of transport channel types including, bedrock, step-pool, and cascade, bed-forms. Approximately 5.2 miles was rated as having “high” response potential because the various channel reaches exhibit an intermediate-type plane-bed/forced pool-riffle morphology.

Sediment Supply and Sediment Load/Transport Characteristics

Sediment contributions to the Middle Fork American River above Ralston Afterbay come from debris slides, rock falls, and debris torrents. Each type occurs in roughly equal number. No eroding banks were observed. All of these mass-wasting sediment processes tend to occur on an infrequent, episodic basis (PCWA 2006; Bechtel 1997).

Rockfalls occur on a nearly continuous basis along the inner gorge canyon of the Middle Fork American River above Ralston Afterbay. Rockfalls primarily generate very coarse bed particle sizes (boulders), and may deliver significant amounts of material to the stream channel (Appendix 6.7-C, Photo C-2). Because rockfalls consist of very coarse sediments transported by non-fluvial processes, much of the boulder material delivered to the channel is likely not movable by the more frequently occurring flows. Two-thirds of the debris torrents located in the stream channel are found within the boundaries of the Star Fire, which burned through the area in August-September 2001 (Appendix 6.7-C, Photo C-3). The higher number of debris torrents in this area is likely related to the loss of forest vegetation either through increased occurrences or increased visibility. Sediment load transported downstream from French Meadow Reservoir is captured in Middle Fork Interbay.

Historic (1961-1962) and Recent (2002-2005) Channel Conditions

The Middle Fork American River from French Meadows Reservoir to Middle Fork Interbay is comprised of large boulders with exposed bedrock and few to no depositional features in both the historic and recent periods. At a few selected locations, bar deposits comprised of coarse material, presumably boulders were discernable in both the historical aerial photographs and in the 2005 low-altitude video, indicating little change in particle size at these locations. Boulders appear to be the dominant particle size, with scattered indefinable smaller sized sediment also present.

The Middle Fork American River between Middle Fork Interbay and Ralston Afterbay is entrenched in a narrow canyon with a dense canopy cover. Geomorphic features are also similar in this reach between the historic and recent aerial photographs along sections where the channel was clearly visible. Significant differences in sediment storage characteristics were not observed between the historical and recent eras. Visual comparisons between the photographs augmented by the low-altitude video suggest that recent channel width is similar to the width of the 1960s channel. Channel sinuosity and planform also appear similar between the historical and recent aerial photographs.

6.7.3.2 Duncan Creek

The following summarizes the geomorphic conditions along Duncan Creek, organized by the descriptors defined above. Note that a comparison of recent and historic aerial photographs was not conducted on Duncan Creek.

Rosgen Channel Classification

Duncan Creek from the Duncan Creek Diversion Dam to the Middle Fork American River Confluence was classified using the Rosgen Classification System. Maps showing the Rosgen channel type designations as determined in the 2005 studies are provided as Figure 6.7-1 (includes an index map and 17 detailed sheets). Additional description of the Rosgen channel types is provided in Appendix 6.7-A.

Duncan Creek has a wide range of gradients, from 1.4% to over 10% and low sinuosity. Most of Duncan Creek (5.0 miles) is a moderate gradient, moderately entrenched B-type channel. A total of 1.7 miles of the channel was identified as either a B- or G-channel type that could not be clearly distinguished during the 2005 study (PCWA 2006). A 0.9 mile reach of Duncan Creek is designated as a G-type, which is more highly entrenched with a lower width-depth ratio than the B-channel type. Bedrock, usually in combination with boulders, is estimated to comprise nearly half of the A-, B-, and G-channel types. Boulders, cobbles, and gravels are found in all three channel types (PCWA 2006). The one-mile reach immediately upstream of the confluence with the Middle Fork American River is a steep, highly entrenched, A-type channel type.

Channel Responsiveness

Most of Duncan Creek (9.4 miles or 65%) is designated as having a low response potential; 3.4 miles (23%) exhibits moderate response potential and 1.7 miles (12%) a high response potential. The reason for the predominantly low responsiveness rating is the prevalence of bedrock and steep-gradient step-pool and cascade channel types.

Sediment Supply and Sediment Load/Transport Characteristics

Debris slides, rock falls, and eroding banks were identified for a combined total of 11 sites along Duncan Creek. The predominant bedrock, step-pool, and cascade channel types all are considered supply-limited channel types (Montgomery and Buffington 1997).

6.7.3.3 Rubicon River

The following summarizes the geomorphic conditions along the Rubicon River, organized by the descriptors defined above.

Rosgen Channel Classification

The Rubicon River from Hell Hole Dam to the Ralston Afterbay was classified using the Rosgen Classification System. Maps showing the Rosgen channel type designations as determined in the 2005 studies are provided in Figure 6.7-1 (includes an index map and 17 detailed sheets). Additional description of the Rosgen channel types is provided in Appendix 6.7-A. Appendix 6.7-C contains photographs depicting the various channel types.

The Rubicon River channel gradient downstream of Hell Hole Dam is generally 1% to 2% except for some higher gradients (up to approximately 4%) in localized areas. Similar to most of the Middle Fork American River, the Rubicon River is a highly entrenched and confined channel. Almost all of the Rubicon River is comprised of alternating sections of either F- or G-channel types (Figure 6.7-1). The G-type channel in the Rubicon River is structurally controlled by the presence of bedrock exposures, making the channel stable. Boulders and/or cobble are the dominant bed particle size. As with the Middle Fork American River, gravels are plentiful, and continuously found throughout all reaches, particularly in pool tailouts and velocity shadows created by boulders. The F-channel type also is structurally controlled by bedrock exposures and boulders and is very stable.

The approximately four-mile reach immediately downstream of Hell Hole Dam is assigned a B-channel type (Appendix 6.7-C, Photo C-4). This section of the Rubicon River is known as the “Parsley Bar” Reach and is an alluviated valley flat that demarcates the most downstream limits of glaciation. This reach aggraded by approximately seven feet (Appendix 6.7-C, Photo C-5) with material from the 1964 dam failure (Scott and Gravlee, 1968). The dam failure also affected channel geomorphology further downstream to the lower reaches of the North Fork American River near Folsom Reservoir. The flood surge stripped hillslope colluvium from the base of the steep valley side-slopes adjoining the channel. In addition, the flood surge triggered landslides, all of which deposited into the river, resulting in a net aggradation of the thalweg, defined as the line of greatest depth in the stream channel (Scott and Gravlee 1968). Approximately six miles of the stream channel immediately downstream of Hell Hole Dam was altered from a V-shaped channel to a U-shaped channel.

Channel Responsiveness

Approximately 21 miles (70%) of the Rubicon River is designated as having a low response potential and 6.8 miles (23%) a high response potential. Most of the high response potential is in the area immediately downstream of the debris material left after the Hell Hole Dam failure in 1964. This reach of stream is located in a wider, less confined valley bottom than are other sections of the river.

Sediment Supply and Sediment Load/Transport Characteristics

Sediment contributions from 24 sites were identified, with debris slides the most common mass-wasting process. Nearly all sediment contribution occurs within the 23-mile reach downstream of the South Fork Rubicon River confluence. Although no tributaries to the Rubicon River, except for Long Canyon Creek, were examined as part of the 2005 Physical Habitat Characterization Study, the lower reaches of tributaries to the Rubicon River have been documented to exhibit evidence of landslides (Bechtel 1997).

As a result of the dam failure related flood surge, Scott and Gravlee (1968) found that over 70 landslides were triggered, either during or shortly after the flood wave. These landslides contributed significant amounts of coarse sediment to the channel. The upper reaches of the Rubicon River may be coarser today than prior to the flood surge as finer sediments are transported downstream and lag deposits of boulders from the landslides are left behind. Boulder deposits along the channel margins and on top of bars were recognized during recent field studies (PCWA 2006) and as part of the historic-present era aerial photographic assessment. The Rubicon River has been identified as the principal source of sediment to Ralston Afterbay Reservoir (Bechtel Corporation 1997), although there is no estimate of how the sediment load might be apportioned between Long Canyon Creek, the Middle Fork American River, and the Rubicon River.

Historic (1961-1962) and Recent (2002-2005) Channel Conditions

Since the 1960s, the Rubicon River has changed dramatically in channel morphology (including aggradation, channel widening, and increased sediment storage, as represented by the size and frequency of bars) immediately downstream from Hell Hole Dam. Scott and Gravlee (1968) have concluded that these changes are due to the 1964 dam failure and resulting flood surge. The most dramatic changes to the channel occurred within the approximately five-mile reach downstream of Hell Hole Dam. Scott and Gravlee (1968) estimated that material from the dam was deposited immediately downstream resulting in an increase in the thalweg elevation of seven feet or more. Channel width increased from approximately 100 feet to over 300 feet wide.

Effects that are likely associated with the flood surge also were identified much further downstream of the dam. For example, aerial photographic assessment indicates that the frequency and size of bars increased, and there have been adjustments of the channel thalweg position 2-3 miles upstream of Ralston Afterbay (PCWA 2006). The appearance of new bars and adjustments of the channel planform along the thalweg are evidence of increased sediment deposition.

6.7.3.4 North Fork and South Forks of Long Canyon Creek and Long Canyon Creek

The following summarizes the geomorphic conditions along the North and South Forks of Long Canyon Creek and Long Canyon Creek, organized by the descriptors defined above. Note that a comparison of recent and historic aerial photographs was not conducted on either the North or South Forks of Long Canyon Creek or Long Canyon Creek.

Rosgen Channel Classification

The North and South Forks of Long Canyon Creek and Long Canyon Creek to the confluence of the Rubicon River were classified using the Rosgen Classification System. Maps showing the Rosgen channel type designations as determined through the 2005 studies are provided as Figure 6.7-1 (includes an index map and 17 detailed sheets). Additional description of the Rosgen channel types is provided in Appendix 6.7-A. Appendix 6.7-C contains photographs depicting the various channel types.

North Fork Long Canyon Creek, from the diversion downstream to the confluence with South Fork Long Canyon Creek is a B-channel type with gradients of approximately 2% to 5% and is characterized by and low sinuosity (Appendix 6.7-C, Photo C-6). Bedrock exposures were frequently observed throughout the reach. Boulders, cobble, and gravel were found in roughly equal proportions on the channel bed.

South Fork Long Canyon Creek from the diversion downstream to the confluence with the North Fork Long Canyon Creek (3.3 miles) is identified as a B-channel type. Channel gradients range from approximately 2% to 5%, and channel sinuosity is low. Bedrock exposures frequently were observed throughout the reach. Boulders, cobble, and gravel usually were observed in about roughly equal proportions on the channel bed.

The upper half of Long Canyon Creek (to confluence with North and South Forks Long Canyon Creek) lies within a wide, U-shaped valley section that holds a more moderately entrenched, moderate width-depth ratio B-channel type (Appendix 6.7-C, Photo C-7). The overall channel gradient is more mild than the downstream reach (approximately 2%), but is steeper in localized areas. Short sections of bedrock exposures (500 feet or less) were frequently observed in this upper reach. Boulders and cobble usually were the co-dominant bed material size, although gravels also were equally co-dominant with boulder and cobble on occasion.

The lower half of Long Canyon Creek is characteristic of an A-channel type with a steep gradient (approximately 5%), low sinuosity, and low-width-depth ratio, and is highly entrenched. This lower seven mile long reach is confined by a V-shaped channel structurally controlled by bedrock exposures. Boulders, cobbles, and gravels commonly are present (Appendix 6.7-C, Photo C-8).

Channel Responsiveness

North Fork Long Canyon Creek is considered to have a high response potential and South Fork Long Canyon Creek is considered to have a moderate response potential. Long Canyon Creek is predominantly designated with a low response potential (69% of the reach). Approximately 28% (3.2 miles) is identified as having a moderate response potential.

Sediment Supply and Sediment Load/Transport Characteristics

Sediment contributions from 29 sites were identified on Long Canyon Creek and the North and South Forks of Long Canyon Creek (PCWA 2006). Channel types indicate that Long Canyon Creek is a supply-limited channel. Channel types on the North and South Forks Long Canyon Creek suggest that most reaches are supply-limited or transitional from supply-limited transport-limited conditions (i.e., available sediment supply is greater than the transport capacity).

6.7.3.5 Middle Fork American River from Ralston Afterbay Dam to the North Fork American River Confluence

The following summarizes the geomorphic conditions along the Middle Fork American River between Ralston Afterbay and the North Fork American River confluence, organized by the descriptors defined above.

Rosgen Channel Classification

The Middle Fork American River from Ralston Afterbay to the confluence of the North Fork American River was classified using the Rosgen Classification System. Maps showing the Rosgen channel type designations as determined in the 2005 studies are provided in Figure 6.7-1. Additional description of the Rosgen channel types is provided in Appendix 6.7-A. Appendix 6.7-C contains photographs depicting the various channel types.

The Middle Fork American River between Ralson Afterbay and the confluence of the North Fork American River is highly entrenched in a wide canyon (Appendix 6.7-C, Photo C-9). The channel has a high width-to-depth ratio, low-gradient of apparently 0.5%, and a moderate-to-high sinuosity characteristic of an F-channel type. High amplitude meanders around large point bars are common, although lateral shifts in channel planform appear to be few. This pattern indicates a stable channel, based on analysis of historic aerial photography. Bed materials range from boulders, to cobble, to gravel, with alternating dominant particle sizes in different sections of the channel, or mixtures of all three particle sizes in the same reach. Unlike the channel reaches upstream of Ralston Afterbay, no bedrock exposures are visible along the channel bottom. The downstream seven miles appear to be dominated by smaller materials, typically cobble and gravel, while much of the upper 18 miles are dominated by boulder- to cobble-sized material. Sand rarely was observed as a dominant particle size.

Channel Responsiveness

The 24-mile long pool-riffle section of the Middle Fork American River downstream of Ralston Afterbay is the most responsive channel reach of all bypass streams. With the exception of the Ruck-A-Chucky rapids, all morphologic characteristics are potentially subject to adjustment in response to changes in the flow and sediment regime.

Sediment Supply and Sediment Load/Transport Characteristics

Based on Montgomery-Buffington stream type, the reach downstream of Ralston Afterbay has a lower transport capacity compared with the upstream Middle Fork American River and Rubicon River reaches. Decreased transport capacity is generally in the downstream sequence of channel morphologies in mountainous terrain, because of the relative decrease in valley wall confinement and in channel slope. In conjunction with reduced transport capacity, total sediment supply generally increases moving downstream. This combination results in the long-term depositional patterns observed in the large bar formations downstream of the Ralston Afterbay.

Historic (1961-1962) and Recent (2002-2005) Channel Conditions

Recent sediment storage and channel geomorphic characteristics were found to be similar to historic characteristics in this reach of the Middle Fork American River (PCWA 2006). Bar-pool-riffle bedforms are common and a significant amount of sediment is stored in point bars and alternate bars. Approximately 75% of the channel bars observed in the recent photography are similar in frequency, size, and particle size composition to that observed in historic photography. At a few scattered locations (approximately 5%), bars that were present in historical aerial photographs were not observed in the recent aerial photograph. At approximately 8% of the locations, the bars in the 2002 photographs appear to be longer and/or to be of a larger particle size composition compared to the historical aerial photographs.

Channel planform and sinuosity also appear similar between the historic and recent project photographs. One relatively small change in the channel planform was observed just downstream of Ralston Afterbay where the cutbank has migrated in a southern direction. Shifts in channel bar position were identified along 12% of the stream segment, resulting in a change in the thalweg position. Overall increases or decreases in sediment storage at these locations were not observed between the historic and recent aerial photographs.

Scott and Gravlee (1968) determined that channel aggradation from the flood surge associated with the Hell Hole Dam failure in 1964 occurred as far downstream as the Middle Fork American River but the exact amount of aggradation is not known.

6.7.4 References

Bechtel Corporation. 1997. Sediment study of Ralston Afterbay Reservoir, Final Report. Prepared for CWA, May 1997

Montgomery, D. R. and J. M. Buffington. 1997. Channel reach morphology in mountain drainage basins. Geological Society of America Bulletin 109: 596-611.

PCWA. 2006. 2005 Physical Habitat Characterization Report. Prepared by Entrix, Inc.

Rosgen, D.L. 1996. Applied river morphology. Wildland Hydrology, Pagosa Springs, Colorado.

Scott, K.M. and George C. Gravlee. 1968. Flood surge on the Rubicon River, California – hydrology, hydraulics and boulder transport. U.S. Geological Survey Professional Paper 422-M.

TABLES

Table 6.7-1. Historical Aerial Photographs Obtained for the Middle Fork American River Project.

	River Mile				USGS Discharge (cfs)	
Scale	**Start**	**End**	**Date of Photo**	**Photo Numbers**	**MF American River Nr Auburn Ca (RM 1.0)**	**MF American River @ French Meadows, CA (RM 45)**
Middle Fork American River						
1:6000	16.5	20.3	7/7/1961	MK-UAB 1-1 to 1-19	181	12
1:6000	34.1	38.8	7/7/1961	MK-UAB 1-26 to 1-35	181	12
1:6000	46.5	47.1	7/7/1961	MK-UAB 2-9 to 2-16	181	12
1:12000	15.6	29.2	7/7/1961	MK-UAB 2-57 to 2-72	172	11
1:12000	22.1	30.8	8/30/1961	MKE-TL 1-63 to1-71	49	0.9
1:12000	25	31.2	8/30/1961	MKE-TL 1-56 to1-62	49	0.9
1:12000	27.9	31.2	8/30/1961	MKE-TL 1-51 to1-55	49	0.9
1:12000	33.8	37.5	8/16/1961	MKE-TL 1-16 to1-21	56	1.4
1:12000	33.8	37.5	8/30/1961	MKE-TL 1-47 to1-50	49	0.9
1:12000	35.8	39.7	8/16/1961	MKE-TL 1-22 to1-35	56	1.4
1:12000	44.8	French Meadows Res.	7/7/1961	MK-UAB 2-46 to 2-57	181	12
1:12000	47.2	53	8/15/1961	MK-UAB 3-34 to 3-40	54	1.4
1:15840	0	1.3	8/2/1962	PLA 5-19 to 5-18	90	-
1:15840	0.1	4.1	7/28/1962	PLA 2-30 to 2-32	105	-
1:15840	3	8.4	11/29/1962	PLA- 12-3 to12-2		
1:15840	5.3	10.4	8/1/1962	PLA 4-209 to 4-211	93	6.1
1:15840	9.5	12.5	8/2/1962	PLA 5-120 to5-121	90	5.9
1:15840	11.8	17.2	8/2/1962	PLA 5-124 to 5-125	90	5.9
1:15840	15.5	21	8/2/1962	PLA 5-191 to 5-193	90	5.9
1:15840	29	33.5	8/11/1962	PLA 6-53 to 6-55	86	4.3
1:15840	32.1	35.8	8/11/1962	PLA 6-39 to 6-40	86	4.3
1:15840	38	41.9	8/1/1962	PLA 4.58 to 4-62	93	6.1
1:15840	41.6	45.3	8/1/1962	PLA 4-32 to 4-.35	93	6.1

Table 6.7-1. Historical Aerial Photographs Obtained for the Middle Fork American River Project (continued).

	River Mile				USGS Discharge (cfs)
Scale	**Start**	**End**	**Date of Photo**	**Photo Numbers**	**SF Rubicon @ Georgetown (Enters Rubicon at RM 22.5)**
Rubicon River					
1:6000	0	2.1	7/7/1961	MK-UAB 1-20 to 1-25	11
1:6000	Hell Hole Dam		7/7/1961	MK-UAB 2-1 to 2-8	11
1:6000	Hell Hole Dam		7/7/1961	MK-UAB 1-36 to 1-44	11
1:12000	0	4.7	7/8/1961	MK-UAB 2-73 to 2-82	11
1:12000	25.8	Upper Watershed	7/7/1961	MK-UAB 2-22 to 2-45	11
1:12000	29.3	Hell Hole Dam	8/16/1961	MKE-TL 1-36 to 1-46	
1:15840	2	7.2	8/14/1962	PLA 7-129 to 7-131	5.2
1:15840	5.6	11.5	8/11/1962	PLA 6-46 to 6-49	6
1:15840	9.8	14	8/1/1962	PLA 4-205 to 4-206	6.6
1:15840	11.8	16.7	8/1/1962	PLA 4-152 to 4-154	6.6
1:15840	14.3	18.1	8/1/1962	PLA 4-48 to 4-49	6.6
1:15840	15.3	20.4	8/1/1962	PLA 4-45 to 4-46	6.6
1:15840	17.8	23	8/14/1962	PLA 7-174 to 7-176	5.2
1:15840	20.8	27.7	11/3/1962	PLA 11-151 to 11-154	No data

	River Mile				USGS Discharge (cfs)
Scale	**Start**	**End**	**Date of Photo**	**Photo Numbers**	**Duncan Canyon Creek near French Meadows Ca (RM 6)**
Duncan Creek					
1:12000	6.5	8.6	8/16/1961	MKE-TL 1-1 to1-10	0.5
1:12000	8.6	Upper Water-shed	8/16/1961	MKE-TL 1-11 to1-15	0.5
1:15840	0	4.7	8/1/1962	PLA 4-58 to 4-62	1.6
1:15840	0.5	7.4	8/1/1962	PLA 4-32 to 4-36	1.6

Table 6.7-1. Historical Aerial Photographs Obtained for the Middle Fork American River Project (continued).

	River Mile				USGS Discharge (cfs)
Scale	**Start**	**End**	**Date of Photo**	**Photo Numbers**	**Long Canyon Creek near French Meadows, CA (RM 11.3)**
Long Canyon Creek					
1:15840	0	3+	8/14/1962	PLA 7-129 to 7-131	0.4
1:15840	0.3	3.8	8/11/1962	PLA 6-50 to 6-51	0.4
1:15840	2.6	5.8	8/11/1962	PLA 6-43 to 6-44	0.4
1:15840	4	7.4	8/1/1962	PLA 4-200 to 4-202	1.1
1:15840	5.7	8.6	8/1/1962	PLA 4-146 to 4-148	1.1
1:15840	7.4	11.2	8/1/1962	PLA 4-55 to 4-57	1.1
1:15840	9	11.2	8/1/1962	PLA 4-37 to 4-39	1.1
North Fork Long Canyon Creek					
1:6000	2.55	Upper Watershed	7/7/1961	MK-UAB 1-45 to 1-56	No data
1:12000	0.3	Upper Watershed	8/16/1961	MKE-TL 1-36 to 1-46	No data
1:15840	0	2	8/1/1962	PLA 4-37 to 4-39	No data
South Fork Long Canyon Creek					
1:12000	2.8	Upper Watershed	8/16/1961	MKE-TL 1-36 to 1-46	No data
1:15840	0	1.5	8/1/1962	PLA 4-37 to 4-39	No data

FIGURES

Placeholder for Figures 6.7-1 -5

Non-Internet Public Information

These Figures have been removed in accordance with the Commission regulations at 18 CFR Section 388.112.

These Figures are considered Non-Internet Public information and should not be posted on the Internet. This information may be accessed from the Placer County Water Agency's (PCWA) Public Reference Room, but is not expected to be posted on PCWA's Website, except as an indexed item.

APPENDIX 6.7-A

Rosgen Level I Geomorphic Characterization of Stream Types

ROSGEN LEVEL 1 STREAM CLASSIFICATION

The following provides a brief overview of the Rosgen Level 1 stream classification system.

The Rosgen Level I classification is a broad-level delineation of stream types that are distinguished based on the following four morphometric parameters:

- **Entrenchment Ratio** – describes the degree of vertical containment of the channel in its valley. Entrenchment ratio is computed as the width of the flood prone area at an elevation twice the maximum bankfull depth divided by the top width of the bankfull channel. Low entrenchment values indicate that the channel is vertically constrained, whereas high entrenchment ratio indicate that the channel can greatly enlarge its width during high flow events.

- **Width-Depth Ratio –** is an index of the channel cross-sectional shape, and is computed as the ratio of the bankfull width/mean bankfull depth. High values indicate the channel is relatively broad and shallow, whereas low values indicate that the channel is narrow and deep. Channel shape affects the distribution of energy within the channel. Channels with a high width-depth ratio tend to develop shear stress near the banks, while low width-depth ratio indicate shear stress is more distributed across the bed.

- **Water Surface Slope** (i.e., gradient) – is the water surface gradient at bankfull discharge (usually approximated by the bed slope). Gradient is a significant factor representing the potential energy of the channel which strongly influences sediment transport capacity.

- **Sinuosity** – is a characterization of the channel planform, and is calculated as the stream length divided by the valley length. Higher sinuosity is associated wit a meandering channel planform, and lower sinuosity is associated with straighter channels. Sinuosity carries the least weight of the four parameters in the Rosgen classification system.

The Level I classification uses a discrete range of values derived from the above suite of morphologic parameters to define specific stream types. Level I is considered the coarsest-scale delineation of stream types in the Rosgen classification system. Using the morphometric parameters described above, stream reaches are classified into 7 major stream types (Aa+ through G) based on Rosgen's 1996 criteria.

Rosgen Stream Type Classifications

A description of the physical and stream process characteristics for each of the Rosgen stream types is provided below.

“Aa+” Stream Type

This stream type typically occurs in debris avalanche terrain, zones of deep deposition such as glacial tills and outwash terraces, or landforms that are structurally controlled or influenced by faults, joints, or other structural contact zones. “Aa+” channels are characterized by very high gradients (>10%), high entrenchment (low entrenchment ratio (<1.4)), low sinuosity (1.0–1.1), and a low width-to-depth ratio (<12). The bedforms associated with this stream type are typically cascade or step/pool morphology with vertical steps and deep scour pools. Aa+ channels are typically described as high energy/high sediment supply systems due to the steep channel slopes and narrow/deep channel cross-sections.

“A” Stream Type

This stream type typically occurs in areas of high relief, zones of deep deposition, or landforms that are structurally controlled. “A” channels are characterized by moderate to steep gradients (4-10%), high entrenchment (low entrenchment ratio (<1.4)), low sinuosity (1.0–1.2), and a low width-to-depth ratio (<12). The bedforms associated with this stream type are typically cascade or step/pool morphology with associated plunge or scour pools. “A” stream types typically exhibit a high energy/high sediment transport potential and a relatively low in-channel sediment storage capacity.

“B” Stream Type

This stream type primarily exists on moderately steep to gently sloped terrain in areas where structural contact zones, faults, joints, colluvial-alluvial deposits, and structurally controlled valley side-slopes limit the development of a wide floodplain. “B” channels are characterized by moderate to steep slopes (4-10%), moderate entrenchment (entrenchment ratio of 1.4–2.2), low sinuosity (>1.2), and a moderate width-to-depth ratio (>12). The bedforms associated with this stream type are typically rapids and scour pool morphology which may be influenced by debris constrictions and local confinement. Streambank erosion rates are typically low, and are generally considered to be vertically and laterally stable, particularly when the dominant bed particle size is bedrock, and boulder.

“C” Stream Type

This stream type is primarily found in narrow to wide valleys constructed by alluvial deposition. “C” channels are characterized by gentle slopes (<2%), low entrenchment (high entrenchment ratio (>2.2)), relatively high sinuosity (>1.4), and a high width-to-depth ratio (>12). The bedform associated with this stream type is typically a pool-riffle morphology that is linked to the meander geometry of the river. These channel types have well developed floodplains and characteristic point bars within the active channel. The channel aggradation/degradation and lateral extension processes are dependent on and sensitive to changes in the natural stability of streambanks, existing conditions in the upstream watershed, and the flow and sediment regime.

“D” Stream Type

This stream type is typically found in landforms and valleys consisting of steep depositional fans, steep glacial trough valleys, glacial outwash valleys, broad alluvial mountain valleys, and deltas. “D” channels consist of a multiple channel system which exhibit a braided or bar braided pattern with a very high width-to-depth ratio (>40) and relatively low gradient (<4%). These channels occur in areas where sediment supply exceeds the sediment transport capacity and in areas where the hydrology is typically “flashy”. Multiple channel features are displayed as a series of various bar types and unvegetated islands that shift positions frequently during runoff events. Adjustments to the channel patterns are related to changes in the encompassing landform, contributing watershed area, or the existing channel system.

“DA” (Anastomosed) Stream Type

This stream type is found in broad, low gradient valleys developed on or within lacustrine deposits, river deltas, and fine grained alluvial deposits. “DA” channels consist of multiple-thread channel system with a very low stream gradient (<0.5%) and low entrenchment (high entrenchment ration (>2.2)). The bedform associated with this stream type typically has a pool-riffle morphology. Stream banks are typically very stable and are often constructed of cohesive, fine-grained materials which support dense-rooted vegetation. Lateral migration rates of the individual channels are very low except for infrequent avulsion. The ratio of bedload to total sediment load is very low.

“E” Stream Type

This stream type is found in gently sloping alluvial valleys in areas ranging from high elevation alpine meadows to low elevation coastal plains. “E” channels are characterized by low stream gradient (<2%), low entrenchment (high entrenchment ratio (>2.2)), very high sinuosity (>1.5), and low width-to-depth ratio (<12). The bedform features predominately consist of riffle-pool reaches with a wide floodplain. These channels are considered highly stable, but are sensitive to changes in the natural stability of streambanks, existing conditions in the upstream watershed, and the flow and sediment regime.

“F” Stream Type

This stream type is found in gently sloping, deeply incised valleys typically consisting of highly weathered rock and/or erodible alluvial/colluvial materials. “F” channels are characterized by low stream gradient (<2%), high entrenchment (low entrenchment ratio (<1.4)), very high sinuosity (>1.4), and high width-to-depth ratio (>12). The bedform features predominately consist of riffle-pool reaches. These channels can develop very high bank erosion rates, lateral extension rates, significant bar deposition, and accelerated channel aggradation and/or degradation and provide for very high sediment supply and storage capacities.

"G" Stream Type

This stream type is found in a variety of land-types including alluvial fans, debris cones, meadows, or channels within older relic channels. The G channel type can also occur as narrow deep gorges on larger rivers when the predominant bed material is bedrock or boulder. "G" channels are characterized by moderate stream gradient (2-4%), high entrenchment (low entrenchment ratio (<1.4)), relatively low sinuosity (>1.2), and low width-to-depth ratio (<12). With the exception of those channels containing bedrock and boulder, these stream types have very high bank erosion rates and high sediment supply. Channel degradation and side-slope rejuvenation processes are typical. The "G" stream type generates high bedload and suspended sediment transport rates.

Rosgen Level I: Geomorphic Characterization

General stream type descriptions and delineative criteria for broad-level classification (Level I)

Stream Type	General Description	Entrenchment Ratio	WID Ratio	Sinuosity	Slope	Landform/ Soils/Features
Aa+	Very steep, deeply entrenched, debris transport, torrent streams.	<1.4	<12	1.0 to 1.1	»0	Very high relief. Erosional, bedrock or depositional features; debris flow potential. Deeply entrenched streams. Vertical steps with deep scour pools; waterfalls.
A	Steep, entrenched, cascading, step/pool streams. High energy/debris transport associated with depositional soils. Very stable if bedrock or boulder dominated channel.	<1.4	<12	1.0 to 1.2	.04 to .10	High relief. Erosional or depositional and bedrock forms. Entrenched and confined streams with cascading reaches. Frequently spaced, deep pools in associated step/pool bed morphology.
B	Moderately entrenched, moderate gradient, riffle dominated channel, with infrequently spaced pools. Very stable plan and profile. Stable banks.	1.4 to 2.2	>12	>1.2	.02 to .039	Moderate relief, colluvial deposition, and/or structural. Moderate entrenchment and WID ratio. Narrow, gently sloping valleys. Rapids predominate w/scour pools.
C	Low gradient, meandering, point-bar, riffle/pool, alluvial channels with broad, well defined floodplains.	>2.2	>12	>1.4	<.02	Broad 'valleys \\'/terraces, in association with floodplains, alluvial soils. Slightly entrenched with well-defined meandering channels. Riffle/pool bed morphology.
D	Braided channel with longitudinal and transverse bars. Very wide channel with eroding banks.	n/a	>40	n/a	<.04	Broad valleys with alluvium, steeper fans. Glacial debris and depositional features. Active lateral adjustment, w/abundance of sediment supply. Convergence/divergence bed features, aggradational processes, high bedload and bank erosion.
DA	Anastomosing (multiple channels) narrow and deep with extensive, well vegetated floodplains and associated wetlands. Very gentle relief with highly variable sinuosities and width/depth ratios. Very stable streambanks.	>2.2	Highly variable	Highly variable	<.005	Broad, low-gradient valleys with fine alluvium and/or lacustrine soils. Anastomosed (multiple channel) geologic control creating fine deposition w/we!l-vegetated bars that are laterally stable with broad wetland floodplains. Very low bedload, high wash load sediment.
E	Low gradient, meandering riffle/pool stream with low width/depth ratio arid little deposition. Very efficient and stable. High meander width ratio.	>2.2	<12	>1.5	<.02	Broad valley/meadows. Alluvial materials with floodplains. Highly sinuous with stable, well-vegetated banks. Riffle/pool morphology with very low width/depth ratios.
F	Entrenched meandering riffle/pool channel on low gradients with high width/depth ratio.	<1.4	>12	>1.4	<.02	Entrenched in highly weathered material. Gentle gradients, with a high width/depth ratio. Meandering, laterally unstable with high bank erosion rates. Riffle/pool morphology.
G	Entrenched "gully" step/pool and low width/depth ratio on moderate gradients.	<1.4	<12	>1.2	.02 to.039	Gullies, step/pool morphology w/moderate slopes and low width/depth ratio. Narrow valleys, or deeply incised in alluvial or colluvial materials, Le., fans or deltas. Unstable, with grade control problems and high bank erosion rates.

Source: Rosgen, 1996.

APPENDIX 6.7-B

Montgomery-Buffington Classification System

Channel Response Potential Rating Channel Transport Capacity

Montgomery-Buffington Stream Classification System

The following provides a brief overview of the Montgomery-Buffington stream classification system that was used to type the bypass streams in the vicinity of the MFP.

Channel bed form was classified based on visual observation of criteria developed by Montgomery and Buffington (1997). The Montgomery-Buffington classification synthesizes stream morphology into seven reach types based on distinctive bed morphology. The Montgomery-Buffington channel type is determined by visual observation, no measurements are required for the classification. The seven reach types can be grouped into three basic types of channels; colluvial, alluvial, and bedrock. Alluvial channels a distinguished by five types; dune-ripple, pool-riffle, plane-bed, step-pool, and cascade. Bedrock and colluvial channels may have variable bedform patterns, but they are not further sub-divided into unique channel types as are the alluvial channels by the Montgomery-Buffington classification system.

Colluvial channels are small headwater streams that flow over colluvial valley fill and exhibit weak or ephemeral fluvial transport. They are typically very steep (> 10%), and exhibit variable bedforms. Colluvial channels have none to very limited floodplain development. There are no colluvial channels within the bypass streams.

Bedrock streams can be defined as channels where a substantial proportion of the boundary is exposed bedrock, or is covered by an alluvial veneer that is largely mobilized during high flows such that the underlying bedrock geometry influences patterns of hydraulic and sediment movement (Tinkler and Wohl 1998). Bedrock channels are non-adjustable, typically confined, have a steep to moderate gradient, with little to no floodplain development. The bedform may be variable in bedrock channels. Bedrock channel types are found within the MFP bypass streams.

Alluvial streams are defined by channels that can erode, transport, and deposit sediments, such that they are self-forming and self-maintained (Dunne and Leopold 1978). The transport capacity is not capable of scouring the channel to bedrock. Alluvial channels are found over a relatively wide range of slopes, from low to high gradients, and may have very narrow to very wide floodplains. Alluvial streams are found within the MFP bypass streams.

Of the alluvial channel types, cascade type channels have the steepest slopes (>6.5%), with large particle sizes (typically boulders and cobble) relative to flow depth. The cascade type channels tend to have longitudinally and laterally disorganized bed material. Step-pools have relatively steep slopes ranging from about 3% to 6.5%, with relatively large particle sizes, usually boulder and cobble, often with some bedrock exposures. The step-pool bedform is organized into a series of channel-spanning accumulations that form a series of steps separating pools. Plane-bed channel types have moderate slopes, ranging from 1.5% to 3%. The bedform is considered featureless, with limited lateral and longitudinal bed oscillations, often typified by glides, riffles, and rapids. Cobble-gravel bed material is the typical particle size. The pool-riffle channels have low to moderate slopes, generally less than 1.5%. The bedform is organized into laterally oscillating sequence of bars, pools, and riffles. Dune-ripple types are exemplified by unconfined, low-gradient channels with sandy bed material. The dune-ripple channels have mobile bedforms such as ripples, sand waves, dunes, and anti-dunes. All of the alluvial channel type bedforms except for dune-ripple channels are present along the MFP bypass streams.

A distinct category of alluvial channel types are described as “forced morphologies”, commonly forced pool-riffle and forced step-pool channel types (Montgomery-Buffington, 1997). The forced morphologies are created by flow obstructions such as large woody debris or bedrock outcrops that force a reach morphology that differs from the free-formed morphology for similar geomorphic characteristics. Several reaches were identified as forced-pool-riffle morphologies, largely controlled by bedrock features. Large woody debris does not play a role in forcing morphologies in the bypass reaches.

Montgomery-Buffington classification of step-pool, plane-bed, and pool-riffle, alluvial channel types generally correspond to the stream types A, B, and C in the Rosgen classification, respectively. The mode of slope gradients for these Montgomery-Buffington channel types corresponds fairly well to the slope gradients assigned to the A, B, and C stream types by Rosgen. However, Rosgen’s classification may also fail to distinguish between different Montgomery-Buffington bedform classifications. For example, C channel types may include reaches with dune-ripple, pool-riffle, or plane-bed morphologies, B channel types may include plane-bed, pool-riffle, or step-pool morphologies, and A channel types may include colluvial, cascade, step-pool, or bedrock morphologies.

Channel Responsiveness

Montgomery and Buffington (1997) developed a conceptual framework for assessing potential channel response to alterations of flow or sediment regime that is based on a channel classification system keyed to bed morphology. The response potential of the seven different channel types defined by Montgomery and Buffington are shown in table below. Each of the seven channel types are rated as to the responsiveness of their morphometric parameters; width, depth, slope, particle size, sediment storage, and roughness. Roughness here refers to sinuosity, bedform, riparian vegetation and large woody debris (LWD) elements that interact with the flow, but does not include streambed particle size (which is typically considered part of the roughness characteristics of the channel); particle size is identified as a distinct geomorphic parameter.

Channel Response Potential to Moderate Changes in Sediment Supply and Discharge

	Morphology	Width	Depth	Slope	Particle Size	Sediment Storage	Roughness
Response							
	Dune-ripple[2]	+	+	+	-	+	+
	Pool-riffle	+	+	+	+	+	+
	Plane-bed	P	+	+	+	P	P
Transport							
	Step-pool	-	P	P	P	P	P
	Cascade	-	-	-	P	-	P
	Bedrock	-	-	-	-	-	-
Source							
	Colluvial[2]	P	P	-	P	+	-

\+ likely to change   P possible to change   - unlikely to change

[1] adapted from Montgomery and Buffington (1997)
[2] not found along project affected streams

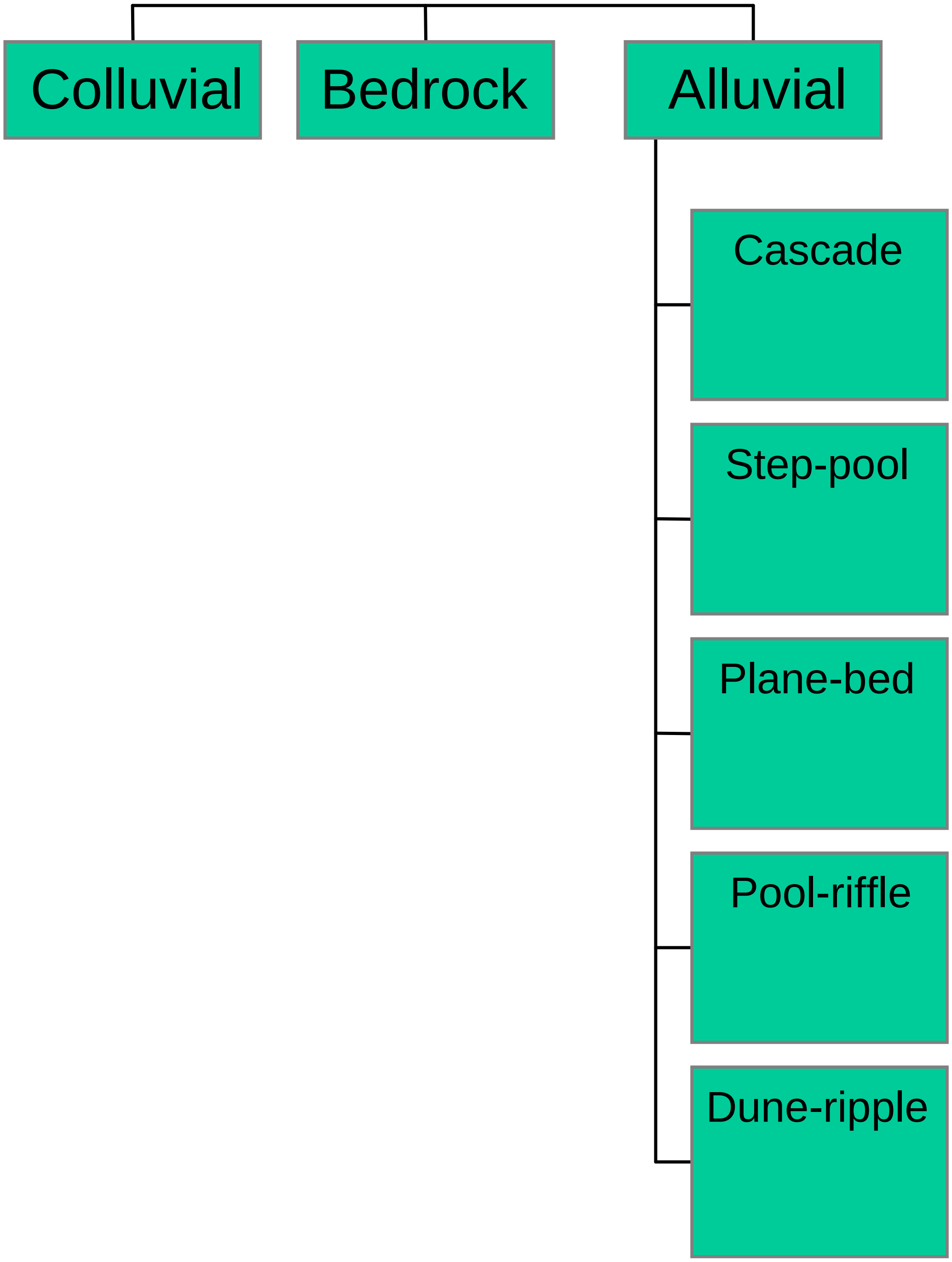
The response predictions are based on geomorphic characteristics of the channel and reach-scale fluvial processes. In reality, channel response occurs as a matter of degree within a continuum, and cannot be forecast in a straightforward "black-or-white" manner. Channel morphology can provide a general indication of response potential, but a specific response depends on the nature, magnitude and persistence of the disturbance. The physical setting in which the channel is located including; confinement, bank materials, riparian vegetation, Large Woody Debris (LWD), fires and other historical disturbances, is also important to predicting channel response. Confinement by valley walls limits the potential change to channel width and floodplain storage, but maximizes channel response to increased discharge by limiting overbank flow. Additionally, channel response will vary with the type and intensity of change in the flow or sediment regime. Multiple, concurrent changes in the flow and sediment regime may cause opposing or a synergistic channel response, depending on the direction and magnitude of change (Montgomery and Buffington 1997). For example, trapping of fine sediment by upstream reservoirs and simultaneous reduction in downstream sediment transporting flows, may work as "opposing" forces, canceling each other's effect and resulting in no net change in the amount of sediment deposited downstream and thus minimal channel response.

Bedrock, cascade, and step-pool channels are relatively insensitive to most discharge or sediment-supply alterations due to their high transport capacity, generally supply-limited conditions, and non-erodible streambed materials. Bedrock channel types are considered to be the most insensitive to perturbations. Cascade and step-pool channels are typically confined, well-entrenched, with large, immobile bed material that makes channel incision or bank cutting unlikely. Potential responses in cascade type channels are generally limited to particle size alterations. Potential responses in step-pool channels include changes in grain size, sediment storage, depth, slope, and roughness. Bedrock, cascade, and step-pool streams are all classified as a group as **Transport** type channels (see schematic illustrating relative transport capacity of stream types).

The more moderate gradient plane-bed, pool-riffle, and dune-ripple channels become progressively more responsive to altered discharge and sediment supply conditions. The lowest gradient dune-ripple channel type is most responsive. None of the bypass streams have been identified as dune-ripple channel types. The plane-bed, pool-riffle, and dune-ripple streams are all classified as **Response** type channels. Since plane-bed and pool-riffle channels occur in both confined and unconfined valley settings, they may or may not be susceptible to channel widening or changes in valley bottom sediment storage. Unconfined pool-riffle channels have a high potential for channel geometry response, and confined pool-riffle channels have a lower potential for channel geometry response. Smaller and more easily mobilized bed particles in plane-bed and pool-riffle channels have potentially greater response of bed surface texture, sediment storage, and slope compared to cascade and step-pool morphologies. Changes in all geomorphic parameters are most likely in pool-riffle channel types.

Changes in sediment storage is the dominant response of colluvial channel types due to their transport-limited capacity. Colluvial streams are classified as **Source** type channels. None of the bypass streams were identified as colluvial channel types.

The Rosgen classification system is not explicitly process-based as is the Montgomery-Buffington system, although there is a general correspondence between the A, B, and C channel types with the cascade and step-pool, plane-bed, and pool-riffle bedform classifications. Rosgen's classification does combine reach morphologies that may have different response potentials. For example, C channel types may include reaches with dune-ripple, pool-riffle, or plane-bed morphologies, B channel types may include plane-bed, pool-riffle, or step-pool morphologies, and A channel types may include colluvial, cascade, step-pool, or bedrock morphologies. The lack of a process-based methodology in the Rosgen classification system limits its usefulness as a basis for structuring channel assessments, predicting channel response, and investigating relations to ecological processes (Montgomery and Buffington, 1997).

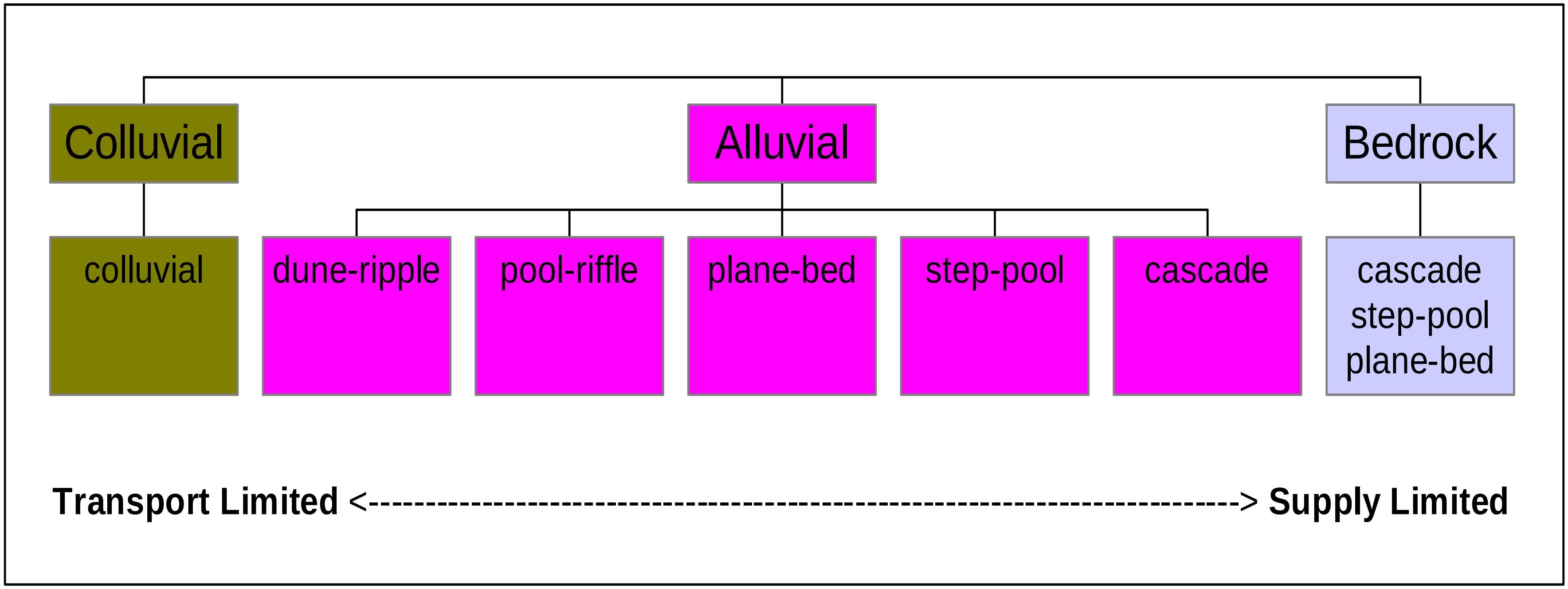


Montgomery and Buffington Channel Classification System

Diagnostic Features of the Montgomery-Buffington Channel Types

	Colluvial	Alluvial					Bedrock
		Dune-Ripple	Pool-Riffle	Plane-Bed	Step-Pool	Cascade	
Bed Material	Variable	Sand	Gravel	Gravel- cobble	Cobble-boulder	Boulder	Bedrock
Bedform Pattern	Variable	Multi-layered	Laterally oscillatory	Featureless	Vertically oscillatory	Random	Variable
Dominant Roughness	Grains, LWD	Sinuosity, banks, grains, bedforms (dunes, ripples, bars)	Bedforms (bars, pools), sinuosity, banks, grains	Grains, banks	Grains, banks	Grains, banks	Boundaries (bed and banks), Grains
Sediment Sources	Hillslopes Debris Flows	Fluvial, bank failure	Fluvial, bank failure	Fluvial, bank failure, debris flow	Fluvial, hillslope, debris flow	Fluvial, hillslope, debris flows	Fluvial Hillslope Debris Flows
Sediment Storage	Bed	Overbank, bedforms	Overbank, bedforms	Overbank	Bedforms	Lee and stoss sides of obstructions	None
Confinement	Confined	Unconfined	Unconfined	Variable	Confined	Confined	Confined
Pool spacing (channel widths)		5 to 7	5 to 7	none	1 to 4	<1	
Typical Slope	>.10	<0.001	<0.015	0.015 - 0.03	0.03 – 0.065	>0.065	Variable
Reach Type	Source	Response Transport-limited	Response may have either Supply- or Transport-limited characteristics	Response may have either Supply- or Transport-limited characteristics	Transport Supply-limited	Transport Supply-limited	Transport

Source: Montgomery-Buffington, 1997



Schematic Illustration of Transport Capacity Relative to Sediment Supply. Adapted from Montgomery and Buffington (1997)

APPENDIX 6.7-C

Photographs

Photo C-1. Middle Fork American River (RM 40) Rosgen Level 1 A-channel type is highly entrenched steep with a low width-depth ratio.

Photo C-2. Talus Slope of Active Rockfall Middle Fork American River - RM 30.2.

Photo C-3: Debris Torrent into Middle Fork American River – (RM 42.3)

Photo C-4. Rubicon River (RM 26) Rosgen Level 1 B-channel type with a moderate entrenchment and width-depth ratio

Photo C-5. Rubicon River, (RM 29) aggraded channel reach in debris field below Hell Hole Dam.

Photo C-6. North Fork Long Canyon Creek, (RM 1.9) Rosgen Level 1 B-channel type.

Photo C-7. Upper Half of Long Canyon Creek (RM 9.0) is a broad U-shaped, glaciated valley.

Photo C-8. Lower Half of Long Canyon Creek (RM 5.0) is a narrow V-sloped valley with a confined channel.

Photo C-9. Middle Fork American River (RM 13.0) Rosgen Level 1 F-channel type below Oxbow Reservoir

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6.8 RIPARIAN RESOURCES

This report describes the riparian and meadow habitat along the bypass streams associated with the Middle Fork American River Hydroelectric Project (MFP or Project). The content requirements for this report are specified in Title 18 of the Code of Federal Regulations (CFR) Chapter 1 § 5.6 (d) (3) (vi) as follows:

> ***Wetlands, riparian, and littoral habitat****. A description of the floodplain, wetlands, riparian habitats, and littoral in the project vicinity. Components of this description must include:*
>
> *(A) A list of plant and animal species, including invasive species, that use the wetland, littoral, and riparian habitat;*
>
> *(B) A map delineating the wetlands, riparian, and littoral habitat; and*
>
> *(C) Estimates of acreage for each type of wetland, riparian, or littoral habitat, including variability in such availability as a function of storage at a project that is not operated in run-of-river mode.*

This report provides an overview of the riparian and meadow resources along bypass streams associated with the MFP, and includes 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. The overview is based on a review of existing information, including previous reports and studies on the bypass streams, geographic information system (GIS) data, historical and recent aerial photography, and on new information developed as part of the riparian studies completed in 2005 and documented in Placer County Water Agency's (PCWA's) Draft 2005 Physical Habitat Characterization Study Report (PCWA 2006).

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', as referred to in this report, includes the stream bars and banks between the low and high flows 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 overbank flows. Meadows are found in moist areas that are typically seasonally or temporarily flooded.

6.8.1 Information Sources

Existing information on riparian and meadow communities along the bypass streams associated with the MFP was compiled and reviewed. This included a review of previous studies and published reports, existing GIS data, historic and recent aerial photography, and management plans and policies that describe desired conditions for riparian systems. Specific information reviewed is identified below. In general, the majority of the existing studies and reports reviewed provide only brief qualitative descriptions of riparian vegetation along bypass streams associated with the MFP (PCWA 2006). Specific information reviewed is identified in the following:

Previously Published Study Reports

- Ayres Associates. 1997. Final 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 Grizzley 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. Gravelee. 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 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 streams associated with the MFP. Available electronic data that may be relevant to riparian resources is summarized in Table 6.8-1.

Aerial Photography

Recent and historical aerial photographs were obtained to document existing and pre-Project riparian and meadow coverage, as well as to evaluate other resources. Three sets of historic aerial photography prior to construction of the MFP and one set of more recent aerial photograph were obtained and reviewed (Table 6.8-2).

2005 Physical Habitat Characterization Study Report

During the summer of 2005, riparian field studies were conducted by PCWA as outlined in the 2005-2006 Existing Environment Study Plan (PCWA 2005). The field work conducted in 2005 focused on characterizing riparian and meadow habitat along rivers and streams associated with the MFP. These streams include the Middle Fork American River from French Meadows Reservoir to the North Fork American River confluence, Duncan Creek, the Rubicon River, the South and North Forks of Long Canyon Creek, and Long Canyon Creek. The work completed during 2005 and documented in the Draft 2005 Physical Habitat Characterization Report (PCWA 2006) will be augmented by additional surveys to be conducted in 2006.

A combination of existing information, 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, including species composition and information on age class structure, was mapped along the bypass streams from the low water’s edge to hillslope or valley walls. All riparian and meadow habitats that are or were historically connected by surface waters were mapped. Recent and historical aerial photographs were used to document existing and historical riparian and meadow coverage. Detailed descriptions of specific data collection methods, as well as the initial findings, are described in the Draft 2005 Physical Habitat Characterization Study Report (PCWA 2006). Data collected as part of this study are the primary source for the descriptions of the riparian resources in the following sections.

6.8.2 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, and fluvial geomorphic and hillslope processes, including landslides and debris flows, control the spatial and temporal patterns of sediment transport and deposition and nutrient dynamics. The majority of bypass streams 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 occurs. On these types of mountain streams with narrow valley bottoms, floodplain areas are small, therefore 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, has 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 6.8-A.

6.8.3 Existing Riparian Resources Associated with the Bypass Streams

The riparian resources along the bypass streams are described below. These descriptions are based on information collected as part of the 2005 Physical Habitat Characterization Study (PCWA 2006). The distribution, extent of coverage, and woody species observed along the bypass streams are presented in the Riparian Resource Maps (Figure 6.8-1 – includes an index map and 17 detailed sheets). Riparian age class structure is presented in the 2005 Physical Habitat Characterization Study Report (PCWA 2006).

6.8.3.1 Riparian Community Distribution, Coverage and Age Class Structure

The 2005 Physical Habitat Characterization Study identified six riparian communities present along the bypass streams including:

- Alder Community
- Willow Community
- Alder-Willow Community
- Alder-Willow-Cottonwood Community
- Alder-Willow-Black Locust Community
- Alder-Willow-Black Locust-Cottonwood Community

Meadows were not observed along any stream reaches surveyed in 2005. A description of the riparian communities identified along the bypass streams is provided in Appendix 6.8-B. Photographs illustrating examples of these community types are provided in Appendix 6.8-C.

Distribution patterns of the riparian vegetation along the bypass streams are strongly influenced by the stream morphology. Along the bypass streams, sparse or discontinuous narrow corridors of riparian vegetation generally occur within the confined bedrock and boulder reaches, where floodplains are poorly developed and areas of alluvial deposits are relatively small. In comparison, wide and continuous narrow corridors of riparian vegetation generally are associated with deposits/bars or along alluvial reaches. Examples of the types of distribution patterns observed along the bypass streams are shown in Appendix 6.8-D.

The riparian communities are comprised of trees and shrubs, including willows, alders cottonwoods, and dogwood. Black locust, a non-native, invasive species occurs on the

Middle Fork American River below Ralston Afterbay. Cottonwoods, an important component of riparian forests, have a limited distribution along the smaller streams (e.g., North and South Forks of Long Canyon Creek, Long Canyon Creek, and Duncan Creek). Cottonwood presence appears to be associated with relatively shorter reaches (ranging from a few hundred feet to a half-mile) that are comparatively wider, shallower, and/or receive inputs of additional sediments (e.g., mass wasting events, tributary confluences, or large woody debris). They are more likely to collect sediments than the steeper and narrower bedrock/boulder segments. A wide distribution of age classes, including seedlings or young individuals, is present within the majority of the riparian communities along the bypass streams.

A more detailed description of the riparian resources along each of the bypass streams is provided below.

6.8.3.2 Riparian Resources along the Middle Fork American River

The description of the riparian resources along the Middle Fork American River is divided into three main reaches: French Meadows Reservoir to Middle Fork Interbay, Middle Fork Interbay to Ralston Afterbay, and Ralston Afterbay to the North Fork American River confluence. Upstream of Ralston Afterbay, the stream valley is narrower and more confined, the channel gradient is steeper, and floodplains are poorly developed compared to downstream. Below Ralston Afterbay, large depositional bar surfaces that can support extensive riparian areas are present. The riparian resources along these three segments, as well as around Middle Fork Interbay, are briefly described below.

French Meadows Reservoir to Middle Fork Interbay

The riparian community is sparsely distributed or occurs in discontinuous narrow corridors along the majority of the stream channel. The Alder-Willow-Cottonwood Community is the dominant community type for 5.2 miles downstream of French Meadows Reservoir and approximately 1 mile upstream of Middle Fork Interbay. Willows are the dominant woody species within the riparian communities along the remaining section of the reach (5.5 miles). Seedlings or young individuals are present in over 89% of the riparian communities between French Meadows Reservoir and Middle Fork Interbay.

The Middle Fork Interbay is surrounded by discontinuous and continuous narrow corridors of the Alder-Willow Community and the Alder Community.

Middle Fork Interbay to Ralston Afterbay

The riparian community for 5.3 miles downstream of Middle Fork Interbay is dominated by alders. The vegetation is sparsely distributed or occurs in discontinuous or continuous narrow corridors. For the next 3.1 miles, the willow-dominated community alternates between reaches with continuous narrow or wide riparian corridors. The community in the last 1.6 miles of the reach downstream to Ralston Afterbay is comprised of the Alder-Willow-Cottonwood Community, interspersed with shorter reaches dominated by willows or alders. Seedlings and/or young individuals are present in over 92% of the riparian communities between Middle Fork Interbay and Ralston Afterbay.

Ralston Afterbay to North Fork American River Confluence

Downstream of Ralston Afterbay, the riparian community is comprised of various assemblages of alder, willow, cottonwood, and black locust. Black locust is a co-dominant species with alders, willows, and cottonwood beginning at about 2.2 miles below Ralston Afterbay Dam and continuing to the confluence of the North Fork American River, although areas without black locust are interspersed through the stream segment. The riparian community is typically distributed as continuous narrow corridors along the stream banks and bar margins, with wide, often dense, corridors on channel bars. Coverage is sparse in areas that have experienced bank failures or mass failure events, or in bedrock reaches. Regeneration was patchy in distribution, with seedlings or young individuals observed in 44% of the riparian communities between Ralston Afterbay and the North Fork American River confluence.

6.8.3.3 Riparian Resources along Duncan Creek

Overall, riparian vegetation occurs along approximately 45% of Duncan Creek, and is primarily sparsely distributed or occurs in continuous narrow corridors of Alder-Willow Community interspersed with smaller areas of Alder Community. The riparian community is sparsely distributed along the lower 2.5 miles of the creek to the confluence with the Middle Fork American River, where the channel is steep and highly entrenched. The Alder-Willow-Cottonwood Community occurs in two reaches totaling 2.3 miles where the gradient is substantially lower than the rest of the stream channel downstream of the diversion. Seedlings or young individuals are present in almost 78% of the riparian communities along Duncan Creek. Successful recruitment appears to occur along the entire stream reach and no stands comprised solely of mature individuals were observed.

6.8.3.4 Riparian Resources along the Rubicon River

Overall, riparian vegetation occurs along approximately 52% of the Rubicon River, primarily as narrow continuous or discontinuous corridors along the channel margins, with wide corridors on some channel bars. Minimal riparian vegetation occurs for 1.6 miles downstream of Hell Hole Reservoir where river flow is subsurface. Two riparian communities, which occur in alternating bands, dominate the Rubicon River: Alder-Willow Cottonwood Community (74% of total) and Alder-Willow Community (26% of total). In general, the Alder-Willow Community occurs along the stream segments with coarser substrate (bedrock and boulder), while cottonwoods are part of the vegetation assemblage along reaches with finer substrate (boulder and cobble) and lower gradients. Seedlings and/or young individuals are present in over 81% of the riparian communities along the Rubicon River.

6.8.3.5 Riparian Resources along the North Fork Long Canyon Creek

Overall, riparian vegetation occurs along approximately 70% of North Fork Long Canyon Creek, distributed primarily in continuous narrow corridors along the channel, interspersed with shorter reaches with wide riparian corridors. The community is mainly comprised of both alders and willows (1.7 miles), with alders dominating the riparian community for 0.7 mile downstream of the diversion. The Alder-Willow-Cottonwood Community also occurs within a 0.7-mile, comparatively lower gradient reach, where mining tailings are observed. Seedlings or young individuals are present in almost 70% of the riparian communities along North Fork Long Canyon Creek.

6.8.3.6 Riparian Resources along the South Fork Long Canyon Creek

Overall, riparian vegetation occurs along approximately 76% of South Fork Long Canyon Creek, and is sparsely distributed or occurs in continuous narrow corridors. The community is a mixture of different riparian communities, including the Willow Community, Alder-Willow Community, and Alder-Willow-Cottonwood Community. The riparian community is comprised of willows and alders for 1.2 miles downstream of the diversion. Cottonwoods are a component of the riparian community for the next mile and along the lower 1.2 miles of the stream. The riparian community is sparsely distributed along the steep gradient channel and is comprised primarily of alders.

6.8.3.7 Riparian Resources along Long Canyon Creek

Overall, riparian vegetation occurs along approximately 56% of Long Canyon Creek, and is primarily either sparsely distributed or occurs in continuous narrow corridors. Wide riparian corridors occur in a few short stream reaches. The riparian communities are dominated by either alders or willows, with the exception of a short 0.3-mile segment comprised of the Willow-Alder-Cottonwood Community immediately downstream of the confluence of the North and South Forks of Long Canyon Creek. The Alder Community occurs for approximately 4.2 miles of the creek where the channel flows within a wider, U-shaped valley section. The lower half of Long Canyon Creek is a steep gradient, highly entrenched channel within a confined V-shaped valley along which the riparian community is dominated by willows. Riparian vegetation in the lower 0.9 mile of the creek is generally sparse, with primarily Alder-Willow-Cottonwood Community in the upper portion (0.2 mile) and Alder-Willow Community in the lower 0.7 mile. Seedlings and/or young individuals are present in over 72% of the riparian communities along Long Canyon Creek.

6.8.4 Historical Events

Three historical events potentially influence the existing riparian community characteristics and distribution patterns in the bypass 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 streams will be evaluated during the relicensing of the MFP. An overview of the dam failure and historic mining activities is provided below.

6.8.4.1 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 an episodic flood surge with estimated peak flows of 260,000 cfs, which is believed to be at least equal to the highest discharges that may have occurred in the past 10,000 years. 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 Gravelee 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 Gravelee 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).

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

The majority of the mining activities along the bypass streams associated with the MFP occurred in the late 1800s and early 1900s on the Middle Fork American River below Ralston Afterbay. 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 1800s 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 downstream of Ralston Afterbay was mined extensively and reworked by mining operations by the late 1800s. 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.

6.8.5 Temporal Trends in Riparian Distribution

Historic aerial photographs (early 1960s) were compared to more recent aerial photography (2002) and videography (2005). Four general patterns were identified along the Middle Fork American River below Ralston Afterbay and the less entrenched sections of the Rubicon River. These are as follows:

Change in Riparian Vegetation Position on Channel Bars. The position of riparian vegetation has 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 below Ralston Afterbay, historically the riparian vegetation was located on comparatively higher surfaces on channel bars and at varying distances from the water's edge. Currently, the riparian vegetation is 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 has occurred along the bypass streams since the early 1960s. For example, along the Middle Fork American River below Ralston Afterbay, reaches with split channels in 1961-1962 that supported narrow stands of riparian vegetation are 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 Interbay to Ralston Afterbay.

Minimal Change in Riparian Vegetation along Less Responsive Stream Reaches. 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 Interbay to Ralston Afterbay and the Rubicon River.

6.8.6 References

Anderson, Michelle D. 2001. *Salix scouleriana*. In: Fire Effects Information System, [Online]. U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station, Fire Sciences Laboratory (Producer). Available: http://www.fs.fed.us/database/feis/ [2005, December 8].

Ayres Associates. 1997. Final 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 (CDFG). 1979. Rubicon River Wild Trout Management Plan.

Chapin, D. M., R. L. Beschta, and H. W. Shen. 2002. Relationships between flood frequencies and riparian plant communities in the Upper Klamath Basin, Oregon. Journal of the American Water Resources Association 38:603-617.

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.

Dixon, M. D. 2003. Effects of flow pattern on riparian seedling recruitment on sandbars in the Wisconsin River, Wisconsin, USA. Wetlands 23:125-139.

Douhovnikoff, V., J. R. McBride, and R. S. Dodd. 2005. *Salix exigua* clonal growth and population dynamics in relation to disturbance regime variation. Ecology 86:446-452.

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 Flate Footbridge to National Forest Boundary.

Eldorado National Forest Georgetown Ranger District. 1976a. Rubicon River Stream Survey near Big Grizzley 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.

Eldorado National Forest Georgetown Ranger District. 2002. Record of Decision Star Fire Restoration.

Gaos, A., and M. Bogan. 2001. A direct observation survey of the Lower Rubicon River. DFG Scientific Aides.

Hickman, James C. (Ed). 1993. The Jepson Manual: Higher Plants of California. University of California Press, Berkeley, CA.

James, A. 1999. Time and the persistence of alluvium: River engineering, fluvial geomorphology, and mining sediment in California. Geomorphology. 31:265-290.

Karrenberg, S., P.J. Edwards, and J. Kollman. 2002. The life history of Salicaceae living in the active zone of floodplains. Freshwater Biology 47:733-748.

Placer County Planning Department. 2003. Recognized Aquatic and Wetland Resources in Western Placer County, California. Prepared by North Fork Associates. (need to add to references)

Placer County Water Agency (PCWA). 2005. 2005-2006 Existing Environment Study Package. Middle Fork American River Hydroelectric Project (FERC No. 2079).

PCWA. 2006. DRAFT 2005 Physical Habitat Characterization Study Report. Middle Fork American River Hydroelectric Project (FERC No. 2079).

Reed, William R. 1993. *Salix gooddingii* In: Fire Effects Information System, [Online]. U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station, Fire Sciences Laboratory (Producer). Available: http://www.fs.fed.us/database/feis/ [2005, December 8].

Rood, S.B., J.H. Braatne, and F.M.R. Hughes. 2003. Ecophysiology of riparian cottonwoods: stream flow dependency, water relations, and restoration. Tree Physiology 23:1113-1124. Available: http://heronpublishing.com/tree/freetext/23-1113.pdf

Scott, K. M., and G. C. Gravelee. 1968. Flood surge on the Rubicon River, California - Hydrology, Hydraulics, and Boulder Transport. U.S. Geological Survey, Professional Paper 422-M, Washington DC.

Steinberg, Peter D. 2001. *Populus balsamifera* ssp. trichocarpa. In: Fire Effects Information System, [Online]. U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station, Fire Sciences Laboratory (Producer). Available: http://www.fs.fed.us/database/feis/ [2005, December 8].

Sullivan, Janet. 1993. *Robinia pseudoacacia*. In: Fire Effects Information System, [Online]. U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station, Fire Sciences Laboratory (Producer). Available: http://www.fs.fed.us/database/feis/ [2005, December 8].

Swindle, L.J. 2000. The History of Gold Discoveries of the Northern California Mines of California's Mother Lode Gold Belt as Told by the Newspapers and Miners 1848-1875. Victoria, British Columbia: Trafford Publishing.

Tahoe National Forest. 1993. Granite Chief Wilderness Management Plan and Wilderness Implementation Schedule and Decision of Notice.

Taylor, Jennifer L. 2000. *Populus fremontii*. In: Fire Effects Information System, [Online]. U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station, Fire Sciences Laboratory (Producer). Available: http://www.fs.fed.us/database/feis/ [2005, December 8].

Uchytil, Ronald J. 1989a. *Alnus rhombifolia*. In: Fire Effects Information System, [Online]. U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station, Fire Sciences Laboratory (Producer). Available: http://www.fs.fed.us/database/feis/ [2005, December 8].

Uchytil, Ronald J. 1989b. *Salix exigua*. In: Fire Effects Information System, [Online]. U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station, Fire Sciences Laboratory (Producer). Available: http://www.fs.fed.us/database/feis/ [2005, December 8].

Uchytil, Ronald J. 1989c. *Salix lucida* ssp. lasiandra. In: Fire Effects Information System, [Online]. U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station, Fire Sciences Laboratory (Producer). Available: http://www.fs.fed.us/database/feis/ [2005, December 8].

United States Department of Agriculture Forest Service (USDA-FS). 1988. Eldorado National Forest Land and Resource Management Plan.

USDA-FS. 1990. Tahoe National Forest Land and Resource Management Plan.

USDA-FS. 1997. California Vegetation Maps (CALVEG). Pacific Southwest Region of the U.S. Forest Service. http://www.fs.fed.us/r5/rsl/clearinghouse/forest-eveg.shtml.

USDA-FS. 2004. Sierra Nevada Forest Plan Amendment Final Supplemental Environmental Impact Statement Record of Decision.

USDA-FS Foresthill Ranger District. 2003. Middle Fork American River Watershed Assessment.

United States Department of Agriculture National Resources Conservation Service (USDA-NRCS). 2005. The PLANTS Database, Version 3.5 (http://plants.usda.gov). Data compiled from various sources by Mark W. Skinner. National Plant Data Center, Baton Rouge, LA 70874-4490 USA. (Accessed: Dec 09, 2005).

United States Department of Interior Bureau of Reclamation (USBR). 1992. Auburn State Recreation Area Interim Resource Management Plan, September 1992.

United States Fish and Wildlife Service (USFWS). 1988. National list of vascular plant species that occur in wetlands. US Fish and Wildlife Biological Report 88 (24).

Western Living Center. 2006. El Dorado County, California. Mining Industry and River Mining. Available: http://www.westernlivingcenter.com/history/ch18-mining-river.htm.

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

TABLES

Table 6.8-1. 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
El Dorado National Forest	VEGETATION	acge456hab	CALVEG info for Eldorado NF	Polygon	1997?	Yes	Tree size and density; productivity; WHR type, size, density and range.	No
El Dorado National Forest	VEGETATION	acge56hab	CALVEG info for Eldorado NF	Polygon	1997?	Yes	Tree size and density; productivity; WHR type, size, density and range.	No
PCWA Disk 1	VEGETATION	change_det	Vegetation changes	Polygon		Yes	Coverage detailing vegetation changes in the NFAR watershed, no info on changes from/to.	Not needed
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 6.8-1. 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		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		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

Table 6.8-1. 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	meadow	Meadows	Polygon		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 occurences	Point		Yes	Sensitive plant coverage, species attribute needs more information. Eldorado NF	No
PCWA Disk 2	VEGETATION	sensploc_0501	Sensitive Plant occurences	Point	2001	Yes	Sensitive plant coverage, species attribute needs more information. Eldorado NF	No
PCWA Disk 2	VEGETATION	senssurv	Sensitive plant surveys?	Polygon		Yes	Appears to be polygon areas of sensitive plants, needs more information. Eldorado NF	No

Table 6.8-1. 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	vegdocs	Metadata and document report on CALVEG data	Polygon	1997	Yes		Not needed
Tahoe National Forest	BOTANY	plants	Plants	Polygon		Yes		
Tahoe National Forest	BOTANY	weed	Weeds	Polygon		No	Coded	
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		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

Table 6.8-1. 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	VEGETATION	vege80_2	STRATA and CWHR	Polygon	1980	Possibly	STRATA classes	Yes
Tahoe National Forest	WATER	meadow	Meadows	Polygon		Yes	Meadow Type	
	FIRE	firehis_pl	California Fire history	Polygon	2003	Yes		

[1] No identifying attributes.

[2] Data is for areas primarily south of MFP boundary.

Table 6.8-2. Historical Aerial Photographs Obtained for the Middle Fork American River Project.

	River Mile				USGS Discharge (cfs)	
Scale	**Start**	**End**	**Date of Photo**	**Photo Numbers**	**MF American River Nr Auburn Ca (RM 1.0)**	**MF American River @ French Meadows, CA (RM 45)**
Middle Fork American River						
1:6000	16.5	20.3	7/7/1961	MK-UAB 1-1 to 1-19	181	12
1:6000	34.1	38.8	7/7/1961	MK-UAB 1-26 to 1-35	181	12
1:6000	46.5	47.1	7/7/1961	MK-UAB 2-9 to 2-16	181	12
1:12000	15.6	29.2	7/7/1961	MK-UAB 2-57 to 2-72	172	11
1:12000	22.1	30.8	8/30/1961	MKE-TL 1-63 to1-71	49	0.9
1:12000	25	31.2	8/30/1961	MKE-TL 1-56 to1-62	49	0.9
1:12000	27.9	31.2	8/30/1961	MKE-TL 1-51 to1-55	49	0.9
1:12000	33.8	37.5	8/16/1961	MKE-TL 1-16 to1-21	56	1.4
1:12000	33.8	37.5	8/30/1961	MKE-TL 1-47 to1-50	49	0.9
1:12000	35.8	39.7	8/16/1961	MKE-TL 1-22 to1-35	56	1.4
1:12000	44.8	French Meadows Res.	7/7/1961	MK-UAB 2-46 to 2-57	181	12
1:12000	47.2	53	8/15/1961	MK-UAB 3-34 to 3-40	54	1.4
1:15840	0	1.3	8/2/1962	PLA 5-19 to 5-18	90	-
1:15840	0.1	4.1	7/28/1962	PLA 2-30 to 2-32	105	-
1:15840	3	8.4	11/29/1962	PLA- 12-3 to12-2		
1:15840	5.3	10.4	8/1/1962	PLA 4-209 to 4-211	93	6.1
1:15840	9.5	12.5	8/2/1962	PLA 5-120 to5-121	90	5.9
1:15840	11.8	17.2	8/2/1962	PLA 5-124 to 5-125	90	5.9
1:15840	15.5	21	8/2/1962	PLA 5-191 to 5-193	90	5.9
1:15840	29	33.5	8/11/1962	PLA 6-53 to 6-55	86	4.3
1:15840	32.1	35.8	8/11/1962	PLA 6-39 to 6-40	86	4.3
1:15840	38	41.9	8/1/1962	PLA 4.58 to 4-62	93	6.1
1:15840	41.6	45.3	8/1/1962	PLA 4-32 to 4-.35	93	6.1

Table 6.8-2. Historical Aerial Photographs Obtained for the Middle Fork American River Project (continued).

	River Mile				USGS Discharge (cfs)
Scale	**Start**	**End**	**Date of Photo**	**Photo Numbers**	**SF Rubicon @ Georgetown (Enters Rubicon at RM 22.5)**
Rubicon River					
1:6000	0	2.1	7/7/1961	MK-UAB 1-20 to 1-25	11
1:6000	Hell Hole Dam		7/7/1961	MK-UAB 2-1 to 2-8	11
1:6000	Hell Hole Dam		7/7/1961	MK-UAB 1-36 to 1-44	11
1:12000	0	4.7	7/8/1961	MK-UAB 2-73 to 2-82	11
1:12000	25.8	Upper Watershed	7/7/1961	MK-UAB 2-22 to 2-45	11
1:12000	29.3	Hell Hole Dam	8/16/1961	MKE-TL 1-36 to 1-46	
1:15840	2	7.2	8/14/1962	PLA 7-129 to 7-131	5.2
1:15840	5.6	11.5	8/11/1962	PLA 6-46 to 6-49	6
1:15840	9.8	14	8/1/1962	PLA 4-205 to 4-206	6.6
1:15840	11.8	16.7	8/1/1962	PLA 4-152 to 4-154	6.6
1:15840	14.3	18.1	8/1/1962	PLA 4-48 to 4-49	6.6
1:15840	15.3	20.4	8/1/1962	PLA 4-45 to 4-46	6.6
1:15840	17.8	23	8/14/1962	PLA 7-174 to 7-176	5.2
1:15840	20.8	27.7	11/3/1962	PLA 11-151 to 11-154	No data

	River Mile				USGS Discharge (cfs)
Scale	**Start**	**End**	**Date of Photo**	**Photo Numbers**	**Duncan Canyon Creek near French Meadows Ca (RM 6)**
Duncan Creek					
1:12000	6.5	8.6	8/16/1961	MKE-TL 1-1 to1-10	0.5
1:12000	8.6	Upper Water-shed	8/16/1961	MKE-TL 1-11 to1-15	0.5
1:15840	0	4.7	8/1/1962	PLA 4-58 to 4-62	1.6
1:15840	0.5	7.4	8/1/1962	PLA 4-32 to 4-36	1.6

Table 6.8-2. Historical Aerial Photographs Obtained for the Middle Fork American River Project (continued).

	River Mile				USGS Discharge (cfs)
Scale	**Start**	**End**	**Date of Photo**	**Photo Numbers**	**Long Canyon Creek near French Meadows, CA (RM 11.3)**
Long Canyon Creek					
1:15840	0	3+	8/14/1962	PLA 7-129 to 7-131	0.4
1:15840	0.3	3.8	8/11/1962	PLA 6-50 to 6-51	0.4
1:15840	2.6	5.8	8/11/1962	PLA 6-43 to 6-44	0.4
1:15840	4	7.4	8/1/1962	PLA 4-200 to 4-202	1.1
1:15840	5.7	8.6	8/1/1962	PLA 4-146 to 4-148	1.1
1:15840	7.4	11.2	8/1/1962	PLA 4-55 to 4-57	1.1
1:15840	9	11.2	8/1/1962	PLA 4-37 to 4-39	1.1
North Fork Long Canyon Creek					
1:6000	2.55	Upper Watershed	7/7/1961	MK-UAB 1-45 to 1-56	No data
1:12000	0.3	Upper Watershed	8/16/1961	MKE-TL 1-36 to 1-46	No data
1:15840	0	2	8/1/1962	PLA 4-37 to 4-39	No data
South Fork Long Canyon Creek					
1:12000	2.8	Upper Watershed	8/16/1961	MKE-TL 1-36 to 1-46	No data
1:15840	0	1.5	8/1/1962	PLA 4-37 to 4-39	No data

FIGURES

Placeholder for Figures 6.8-1-6

6.8-1 Index
6.8-2 Middle Fork American River
6.8-3 Duncan Creek
6.8-4 Rubicon River
6.8-5 North and South Forks of Long Canyon Creek
6.8-6 Long Canyon Creek

Non-Internet Public Information

These Figures have been removed in accordance with the Commission regulations at 18 CFR Section 388.112.

These Figures are considered Non-Internet Public information and should not be posted on the Internet. This information may be accessed from the Placer County Water Agency's (PCWA) Public Reference Room, but is not expected to be posted on PCWA's Website, except as an indexed item.

APPENDIX 6.8-A

Riparian Species along Bypass Reaches Associated with the MFP

The dominant woody riparian species found along the MFP bypass streams are presented in the following section. The species are discussed in terms of specific requirements including hydrology (relative degree of inundation), substrate (soil texture), and life history strategies (including timing of seed release, seed viability, and vegetative reproduction).

White Alder (*Alnus rhombifolia*)

Vegetation: White alders may be associated with other riparian species, including willows (*Salix* spp.) and American dogwood (*Cornus sericea*).

Elevation: White alder is typically found from 100 to 2,400 m (300 to 7,900 ft) elevation.

Hydrology: White alder has a relatively high water requirement for growth (USDA-NRCS 2005), and must have a continuous water supply. It is restricted to streams that have year-round water (Uchytil 1989a).

Substrate: White alder requires continuously moist, fresh alluvium, including sandbars, for seedling establishment (Uchytil 1989a).

Life History Strategies: White alder reproduces both sexually and asexually. Winged, nut-like seeds form in cones, mature in autumn, and are dispersed beginning in the fall by wind or water (Uchytil 1989a). Established stands tend to show a high level of vegetative reproduction, while seeds appear more important in colonizing new sites (Uchytil 1989a).

Willow (*Salix* spp.)

Vegetation: A mixed variety of willow species are present along the MFP streams, including Scouler's willow (*Salix scouleriana),* shining willow (*S. lucida*)*,* Goodding's black willow (*S. gooddingii*)*,* and narrow-leaved willow (*S. exigua*). Varying coverage by herbaceous species is also present depending on the density of the willows. Associated riparian species include alder and American dogwood.

Elevation: The elevation ranges for dominant willows of this community are: narrow-leaved willow*,* less than 2,700 m (8,900 ft); shining willow, less than 3,200 m (10,500 ft); and Scouler's willow, from 90 to 3,400 m (300 to 11,200 ft; (Hickman 1993)). Goodding's black willow is generally found below 500 m (1,600 ft), but can also be found from below sea level to 1,600 m (5,300 ft).

Hydrology: Narrow-leaved and shining willows are typically found immediately adjacent to the water's edge (Uchytil 1989b; Uchytil 1989c). Narrow-leaved willow is often found below the high water mark; it can survive inundation if part of its crown is above water during some of the growing season. This species requires constant moisture for seed germination and establishment (Uchytil 1989b). Shining willow is found in areas that have a high water table year round (Uchytil 1989c).

Goodding's black willow is usually found in areas with seasonal flooding and shallow water tables (Reed 1993), and requires a relatively high amount of moisture for growth (USDA-NRCS 2005).

Scouler's willow typically is found in drier environments than other willows; it occurs in swamps, meadows, and riparian areas, but is more common in dry upland areas and transitional zones between upland and riparian areas (Anderson 2001).

<u>Substrate:</u> Narrow-leaved willow is commonly found on soils derived from alluvial or fluvial parent material. Fresh alluvium is ideal since, in those sites, seeds would have constant moisture and no cover. (Uchytil 1989b).

Shining willow occurs on a variety of soil textures, but most commonly on coarse-textured alluvial deposits (Uchytil 1989c).

Sources disagree on which soil texture Goodding's black willow is typically located. USDA-NRCS (2005) indicates that this species does better on coarse and medium-grained soils, while Reed (1993) indicates it is typically found on fine-grained alluvial soil. This species tolerates alkaline desert soil (Reed 1993).

Scouler's willow requires moist mineral soil for germination and seedling establishment. Scouler's willow is found on a variety of soils, commonly on stony, silty soil (Anderson 2001).

<u>Life History Strategies:</u> Shining willow reproduces primarily through seeds, but can reproduce vegetatively. Seeds disperse in the spring or summer, by wind or water. Seeds germinate quickly on suitable substrate. Broken stem pieces sprout when on appropriate substrate and shining willow may root or crown sprout in response to disturbance (Uchytil 1989c).

Narrow-leaved willow seeds are dispersed by either wind or water. Timing of seed release is likely correlated with local flooding patterns. Seeds germinate quickly on appropriate substrate. Narrow-leaved willow reproduce vegetatively by sprouting from underground root buds, and possibly from stem and root pieces (Uchytil 1989b).

Goodding's black willow produces large amounts of seed annually, which disperse by wind or water in the spring. Germination is quick, and establishment occurs best on bare, moist, soil. Goodding's black willow can reproduce vegetatively through root crown sprouting (Reed 1993).

Scouler's willow reproduces sexually and vegetatively. Seeds disperse May through July, by wind or water. Seeds germinate quickly on appropriate substrate. In response to disturbance, Scouler's willow reproduces vegetatively through root-crown sprouting (Anderson 2001).

Cottonwood (*Populus balsamifera* ssp. t*richocarpa* and/or *Populus fremontii* ssp*. fremontii*)

Vegetation: Both black cottonwood and Fremont cottonwood occur along the MFP streams, depending on elevation. Associated riparian species include alder, willow, and American dogwood.

Elevation: Black cottonwood typically occurs at elevations below 3,050 m (10,000 ft) in northern California (Steinberg 2001). Fremont cottonwood is most commonly found at elevations below 2,000 m (6,600 ft) (Hickman 1993).

Hydrology: In most areas where black cottonwood is dominant, the water table is close to the surface (Steinberg 2001), although black cottonwood may be less dependent on stream flow than Fremont cottonwood (Rood et al. 2003). Fremont cottonwood is typically found in areas where the water table is close to the surface at least through the growing season (Taylor 2000). The life history strategies of both cottonwoods are closely tied to hydrology, as discussed below.

Substrate: Seeds of both cottonwood species germinate almost exclusively on bare, moist soil. Black cottonwood germination increases on bare, moist, mineral soil; is found most often on coarse or medium-textured, well drained soil; and has a high nutrient requirement (Steinberg 2001). Fremont cottonwood is most often found on well drained, alluvial sandy to sandy clay loam (Taylor 2000).

Life History Strategy: Seeds of both species of cottonwood are wind and water dispersed. Timing of seed dispersal for both Fremont cottonwood and black cottonwood coincides with the receding of spring floodwaters, after spring peak flows (Steinberg 2001; Taylor 2000). Seeds remain viable for only a short time after becoming wet; high flows may carry seeds until they are no longer viable (Steinberg 2001). Seeds germinate quickly on suitable substrates.

Black cottonwood reproduces vegetatively through root suckering, coppice sprouting, and cladoptosis. Suckering and sprouting occur often as a result of flood damage (Steinberg 2001). Fremont cottonwood reproduces primarily through seed but can reproduce asexually. Asexual regeneration is tied to local runoff patterns, and follows disturbance, including flood-related disturbance.

Black Locust *(Robinia pseudoacacia*)

Vegetation: The invasive and non-native plant species, black locust *(Robinia pseudoacacia*), occurs along the Middle Fork American River downstream of Oxbow Powerhouse. Associated riparian species include alder, willows, and American dogwood.

Elevation: Black locust can occur from 90 to 1,900 m (300 to 6,200 ft) elevation (Hickman 1993).

Hydrology: Black locust is tentatively designated as facultative, or as equally likely to occur in wetlands as non-wetland areas (USFWS 1988).

Substrate: Black locust prefers rich, moist, limestone-derived soils. It can tolerate a wide variety of soil textures, but does not do well on heavy or poorly drained soils (USDA-NRCS 2005; Sullivan 1993).

Life History Strategies: Black locust blooms in late spring, and produces fruit from spring to fall. Fruits are persistent, and release seeds until the following spring. Seeds are dispersed by wind and gravity. Asexual regeneration occurs through root and stump sprouts. Asexual regeneration may be more important than seedling recruitment, especially in areas with herbaceous cover (Sullivan 1993).

APPENDIX 6.8-B

Riparian Communities along Bypass Reaches associated with the MFP

The following is a description of the riparian communities present along the MFP bypass reaches. Note that all of these communities may also have American dogwood (*Cornus sericea*). The upland overstory may be comprised of several pines species, including Jeffrey pine (*Pinus jefferyi*), ponderosa pine (*P. ponderosa*), and lodgepole pine (*P. contorta*); several firs species, including white fir (*Abies concolor*) and red fir (*A. magnificia*); or incense cedar (*Calocendrus decurrens*).

Alder Community. The Alder Community is dominated by white alder (*Alnus rhombifolia*), with varying coverage by herbaceous species depending on the density of canopy cover. The proportion of white alder and willows (including Scouler's willow (*Salix scouleriana*), shining willow (*S. lucida*), Goodding black willow (*S. gooddingii*), and narrow-leaved willow (*S. exigua*)) varies by location.

Willow Community. The Willow Community is comprised of a mixed community of willow species with varying coverage by herbaceous species depending on the density of willows. The proportion of willows (including Scouler's willow, shining willow, Goodding black willow, and narrow-leaved willow) and white alder varies by location.

Alder-Willow Community. The Alder-Willow Community is co-dominated by white alder and any one of the willow species present in the Willow Community. Herbaceous species coverage varies depending on the density of the riparian overstory.

Alder-Willow-Cottonwood Community. This community is similar to the Alder-Willow Community, with the addition of either black cottonwood (*Populus balsamifera* ssp. trichocarpa) and/or Fremont cottonwood (*Populus fremontii* ssp. fremontii). The specific cottonwood species present varies, depending on elevation. Black cottonwood occurs at higher elevation (6,000 to 9,000 feet), while Fremont cottonwood occurs at lower elevations (below 6,600 feet). At some locations, both species can be present. The relative abundances of white alder and willows vary and could be dominated by either species.

Alder-Willow-Black Locust Community. This community is similar to the Alder-Willow Community, with the addition of the black locust (*Robinia pseudoacacia*), a non-native species. The relative abundance of white alder and willow vary and this community could be dominated by either species.

Alder-Willow-Black Locust-Cottonwood Community. This community is similar to the Alder-Willow Community, with addition of either black cottonwood or Fremont cottonwood, and black locust. The relative abundances of alder and willow vary and could be dominated by either species.

APPENDIX 6.8-C

Photographs of Riparian Community Types

Riparian Communities Types

Alder Community along the Rubicon River

Willow Community along the Middle Fork American River

Riparian Communities Types (continued)

Alder-Willow Community along Duncan Creek

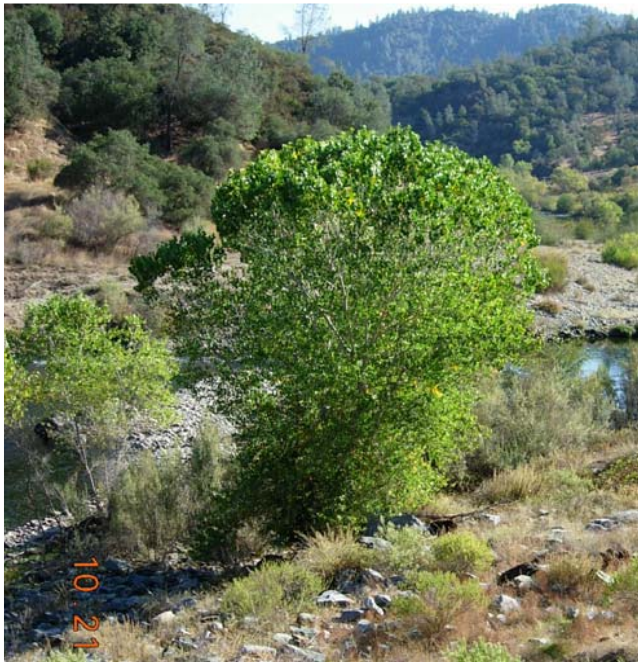
Alder-Willow Cottonwood Community along the Middle Fork American River

Riparian Communities Types (continued)

Alder-Willow-Cottonwood Community along the Rubicon River

Examples of Dominant Riparian Species Present Along MFP Bypass Streams

Cottonwood



Fremont Cottonwood (*Populus fremontii*) along the Middle Fork American River

Willow

Willow (various) (*Salix* spp.) along the Middle Fork American River

Alder

White Alder (*Alnus rhombifolia*) along Duncan Creek

APPENDIX 6.8-D

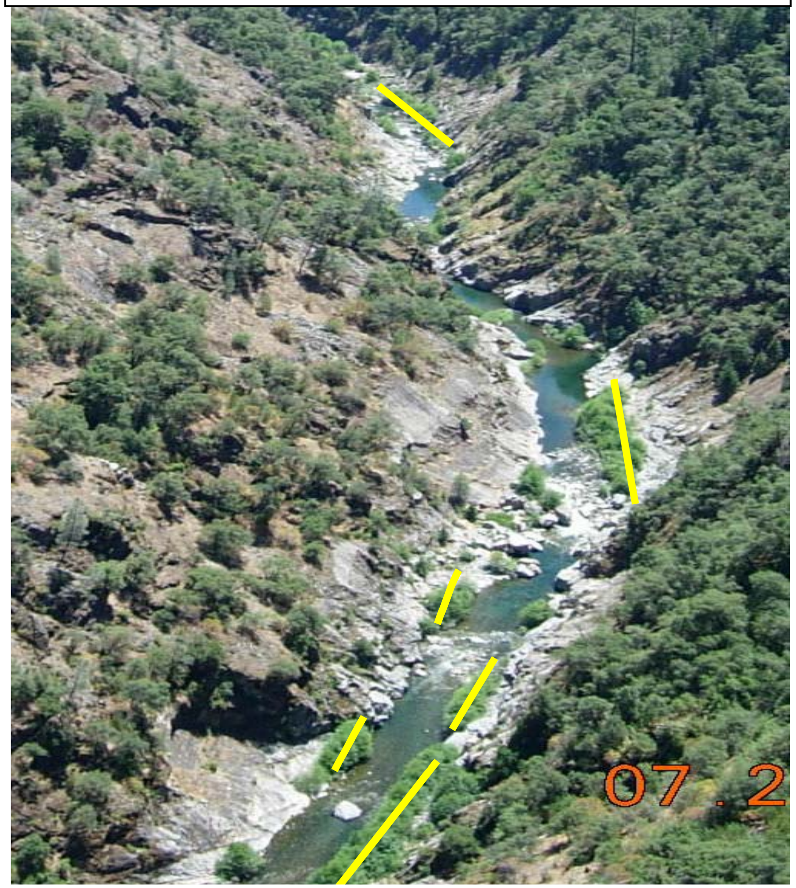
Photographs of Riparian Distribution Patterns

Examples of Sparse and Discontinuous Riparian Vegetation Along MFP Bypass Streams.

Sparse

Long Canyon Creek near confluence with Rubicon River

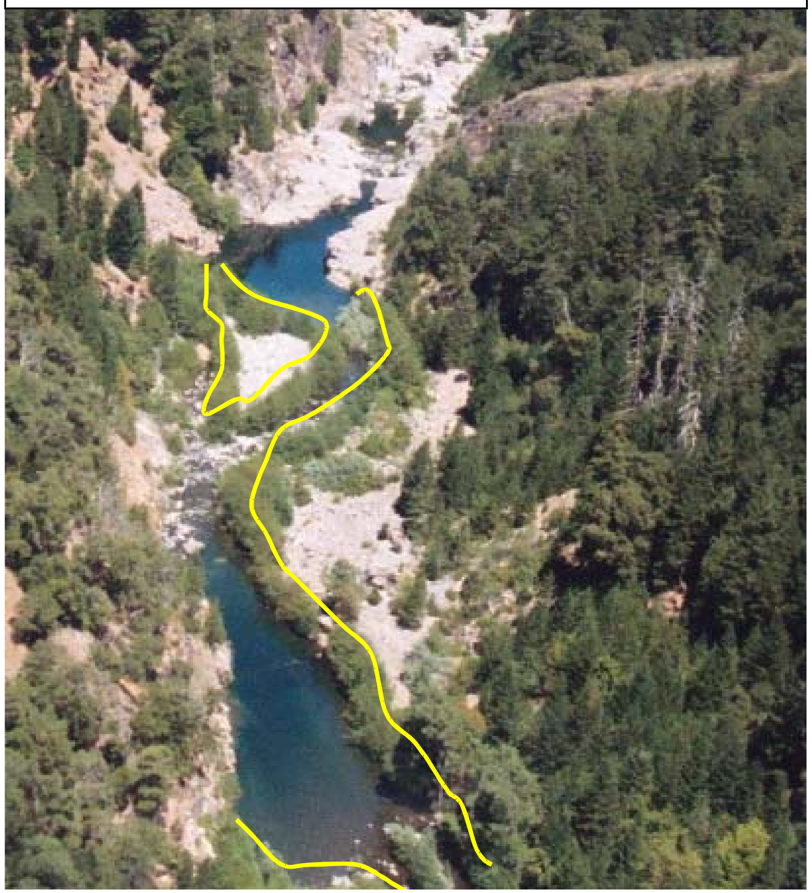
Discontinuous



Rubicon River near footbridge upstream of confluence with Long Canyon Creek

Examples of Continuous Narrow (Line) and Wide Corridors (Polygon) of Riparian Vegetation Along Bypass Streams.

Continuous



Rubicon River upstream of Forest Service Road 2 Bridge

Polygon

Rubicon River at Parsley Bar

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6.12 CULTURAL RESOURCES

This report describes the cultural resources in the vicinity of the Middle Fork American River Hydroelectric Project (MFP or Project). The Federal Energy Regulatory Commission's (FERC's) content requirements for this section are specified in Title 18 of the Code of Federal Regulations (CFR) Chapter I § 5.6 (d) (3) (x), as follows:

> ***Cultural Resources.*** *A description of the known cultural or historical resources of the proposed project and surrounding area. Components of this description include:*
>
> *(A) Identification of any historic or archaeological site in the proposed project vicinity, with particular emphasis on sites or properties either listed in, or recommended by the State Historic Preservation Officer or Tribal Historic Preservation Officer for inclusion in, the National Register of Historic Places;*
>
> *(B) Existing discovery measures, such as surveys, inventories, and limited subsurface testing work, for the purpose of locating, identifying, and assessing the significance of historic and archaeological resources that have been undertaken within or adjacent to the project boundary; and*
>
> (C) *Identification of Indian tribes that may attach religions and cultural significant to historic properties within the project boundary or in the project vicinity; as well as available information on Indian traditional cultural and religious properties, whether on or off of any federally-recognized Indian reservation (A potential applicant must delete from any information made available under this section specific site or property locations, the disclosure of which would create a risk of harm, theft, or destruction of archaeological or Native American cultural resources or to the site at which the resources are located, or would violate any Federal law, including the Archaeological Resources Protection Act of 1979, 16, U.S.C. 470w-3, and the National Historic Preservation Act of 1966, 16 U.S.C. 470hh).*

This report provides an overview of available information regarding archaeological, ethnographic, and historical resources in and near the FERC Project boundary. The information presented in this report is based on research performed in 2005 as part of a two-phase Cultural Resources Inventory Study and documented in Placer County Water Agency's (PCWA's) Draft 2005 Cultural Resources Inventory Report (PCWA 2006). PCWA is continuing to develop cultural resources information and will conduct field studies during 2006 and 2007. The information in this report will be updated as new information about cultural resources in the vicinity of the Project is developed.

6.12.1 Information Sources

Existing information regarding the cultural resources pertaining to prehistoric Native Americans, historic Native Americans, and historic Euroamericans was obtained from the following agencies, tribes, and organizations:

- United States Department of Agriculture Forest Service (USDA-FS), Eldorado National Forest (ENF)
- USDA-FS, Tahoe National Forest (TNF)
- California Historical Resources Information System (CHRIS)
- United Auburn Indian Community (UAIC)
- Shingle Springs Rancheria
- Washoe Tribe of California and Nevada
- Todd Valley Miwok-Maidu Cultural Foundation
- Colfax-Todd Valley Consolidated Tribe
- Placer County Historical Society
- California State Library (CSL)
- The Bancroft Library, University of California at Berkeley
- Miwok Tribe of the Eldorado Rancheria

Specific data sources reviewed included; historic General Land Office (GLO), United States Geological Survey (USGS), USDA-FS, and county assessors maps; land records; archaeological site records; published and unpublished local histories; unpublished and published academic theses, dissertations, and journal articles; historic aerial photographs; and oral histories. Data regarding archaeological resources will be augmented by field studies planned to be conducted in 2006 and 2007. Information from tribes and other Native American sources is preliminary and will be augmented through further tribal participation in the MFP relicensing.

6.12.2 Description of Existing Conditions

The Draft 2005 Cultural Resources Inventory Study Report (PCWA 2006) documents cultural resources known to occur in an "expanded study area", defined as the area within the FERC Project boundary plus the area within one mile of the FERC Project boundary at primary MFP facilities (Figure 6-12-1). References below to cultural resources in the "Project vicinity" are resources identified in the expanded study area for the Study Report.

The inventory of cultural resources in the Project vicinity is known to include prehistoric and historic archaeological sites and artifacts, as well as remains associated with gold mining (e.g., tailings, tunnels, mines, walls, ditches, building foundations, etc.). A deliberate inventory of cultural resources (which would include resources of interest to contemporary Native Americans and others) within the FERC Project boundary has not yet been performed.

6.12.2.1 Cultural History of the Project Vicinity

Prehistoric Period

Overviews of the archaeology and prehistory of the Foresthill Divide and Georgetown Divide areas of the American River drainage are presented in numerous archaeological reports but three significant studies are the basis for this synopsis. They include Baker et al. (1999), Jackson and Ballard (1999), and Jackson et al. (1994). While there is general consensus regarding the broad cultural patterns expressed in the archaeological record, there is less agreement among researchers regarding the interpretation of the record.

A chronological sequence of prehistoric cultural periods in the Forest Hill Divide (after Baker et al. 1999) and for Georgetown Divide (after Jackson and Ballard 1999) is summarized in Table 6-12-1. The Forest Hill Divide sequence is above the Georgetown sequence in the Culture Period and Age columns of the table. A "Late Pleistocene" period (>8000 B.C.) discussed by Jackson and Ballard (1999) is not included because as of yet, no evidence of human use of the region exists in this period. Difference in assigned ages of cultural periods derives, in part, from a greater reliance by Jackson and Ballard on obsidian hydration dating.

Ethnographic Period

The Middle Fork American River and Rubicon River canyons are situated in a vastly varied topographical area where resources were sought and procured by two major Native American groups, the Foothill Nisenan (Maidu) and the Washoe. Claimed tribal territories overlap (Figure 6-12-2). In particular, both groups used the river corridors and divides for travel to procure botanical and zoological resources and trade; occasionally the Washoe would reside over a winter in a Nisenan village or within Nisenan territory.

The Nisenan inhabited the drainages of the Yuba, Bear, and American rivers, and also the lower reaches of the Feather River, extending from the east banks of the Sacramento River on the west to the mid to high elevations of the western flank of the Sierra Nevada (Wilson and Towne 1978). Washoe historically inhabited the region east of the crest of the Sierra Nevada into Carson Valley, extending from the Walker River in the south to Honey Lake in the north, with peripheral territory extending to the mid-elevations of the west Sierra slope (d'Azevedo 1986). Both ethnographic groups fully exploited their territories following a semi-sedentary lifeway. They resided at one or two established locations during most of the year, but occupied temporary encampments during part of the year to acquire different resources across a range of elevations and environments.

There are no named ethnographic villages in the Project vicinity. Known ethnographic Nisenan village locations tend to be out of the river canyons, on benches along the canyon walls or on the summits of the divides between the rivers. Places immediately along the rivers seem to have been used seasonally.

Historic Period

Spanish Commander Gabriel Moraga and his party were the first Europeans to see the American River during their 1808 exploration of the Sacramento Valley. He named the river “Rio de las Llagas” (River of Sorrows). This name was changed to “Rio de los Americanos” (American River) by Mexican Governor Alvarado in 1837 because the river was so popular with American fur traders. Indians served as guides for fur traders and pioneer emigrants of the 1830s and 1840s, and the major trading route over the Sierra between the Nisenan of Placer County and the Washoe of Tahoe/Carson Valley area traversed the Middle Fork, approximately following the path along Mosquito Ridge (Myer 2002:15–16). Jedediah Smith may have been the first of these fur traders along the American River and also the first non-Native American credited with crossing the Sierra Nevada, sometime in the 1820s.

John Marshall’s discovery of gold at Sutter’s Mill in January, 1848 had repercussions that shook the world and of course dramatically transformed the Project vicinity. Claude Chana, a Frenchman living at Sigard’s ranch on the Bear River, discovered gold on Auburn Ravine (between today’s Ophir and old town Auburn) on May 16, 1848, while being led by Indian guides on a short-cut to Sutter’s Mill (Coloma). The North Fork Dry Diggings Company soon was formed and reports of $1,000–$1,500 daily yields spawned a rush of miners north from Coloma (Myer 2002).

Gold miners at Rector’s Bar and Stony Bar (immediately upstream from Oxbow) were operating on the Middle Fork American River in 1848. The total non-Native population of what is now known as the Forest Hill Divide in 1848 was estimated at 50 (Steele 1861). While not much placer gold was found in the higher mountain areas, prospectors in the early 1850s searched diligently. Thomas Duncan, for whom Duncan Canyon is named, hired himself out to show newly arrived miners the gold diggings he had observed crossing the Sierra in 1848.

Horseshoe Bend, located on the Middle Fork American River just downstream of the confluence with the North Fork of the Middle Fork American River, proved to be one of the most productive placer mining regions in California. The Middle Fork American River was the most productive of all the branches of the American River. By the fall of 1849, $10 million in gold already had been mined in the area (Sanborn 1974). “Mad Canyon and American Bar [Oxbow/Ralston Powerhouse area] are credited with $3 million apiece, and Horseshoe Bend ...with runs ranging down to $1 million….” (Sanborn 1974:141). The Middle Fork “stampede” of 1850 brought thousands of miners to the area, not only in the Horseshoe Bend region but up-river as well. Gold is still being mined in the area today.

Yankee Jims and Todds Valley (founded by a relative of Mary Todd Lincoln) were established in 1849 to service the lucrative placer mines of Shirttale Canyon, north of the western part of the study area. Birds Valley grew into a temporary town as a result of the 1850 stampede. Also as a result of this huge influx of humanity in 1850, Foresthill, Michigan City, and Bath were founded to serve miners along the Middle Fork American River. By 1852 there were enough miners farther upriver to stimulate the formation of two new towns, Last Chance and Deadwood. The Forest Hill Divide area was one of the most prosperous and densely inhabited in California in the 1850s, so much so that the Democratic Convention was held at Yankee Jims in 1857 (Myer 2002).

The French Meadows and Hell Hole areas were used in the 19th century primarily for seasonal grazing by valley ranches. Seasonal grazing was already underway in the 1850s as revealed in memoirs of two silver miners journeying from Nevada to California over the Washoe Trail in the winter of 1856 and 1857. The Hell Hole area is so remote and its terrain so difficult that 19th century maps show it as not surveyed.

Because the Hell Hole area is so hard to access, relatively little logging has occurred there, except in the Forest Hill Divide area, along the ridge tops, and in flats like French Meadows. During the second half of the 19th century, small scale saw mills popped up from time to time as needed to mill logs to build flumes and other mining features. In 1860, there were some 20 saws on the North and Middle Forks of the American River (Lardner 1924). But until the construction of the Forest Hill and the Mosquito Ridge roads by the Bureau of Public Roads (BPR) in the early 20th century, the higher elevation areas surrounding the Project were not logged.

Since 1905 most of the land in the upper portions of the Watershed has been administered by the USDA-FS. The USDA-FS's administrates grazing, logging, recreation and other land uses within the National Forests. USDA-FS policy largely has dictated land use in the Project vicinity since the Eldorado and Tahoe forests were created. PCWA was formed in 1957 and is charged with maintaining reliable and affordable water and energy for Placer County's present and future needs. The MFP began in 1963 and was completed in 1967. Today, PCWA owns and operates five interconnected hydroelectric power plants, four reservoirs, three smaller diversions, and 24 miles of tunnels. It is the eighth-largest public power project in California.

6.12.2.2 Cultural Resources Inventory

Previous inventories of archaeological sites in the expanded study area are limited (Table 6-12-2). Among the earliest studies in the expanded study area were those conducted for the MFP (Rackerby 1965) and for the Auburn Dam Project (e.g., True et al. 1978; True ca. 1980). Most of the existing information is derived from USDA-FS records. Known cultural resources are historic era mining-related sites, features, and artifacts, as well as Native American sites, features, and artifacts.

6.12.2.3 Recorded Cultural Resources and Historic Properties

No cultural resources or historic properties are recorded within the FERC Project boundary. Native American archaeological and gold mining related resources probably exist in the vicinity of the Project, but these have not been recorded formally or determined to be historic properties.

6.12.2.4 Current Cultural Resource Management

Current cultural resource management is consistent with the FERC license and applicable USDA-FS permits. Before conducting activities that have the potential to affect cultural resources, PCWA consults with the FERC and/or the USDA-FS to determine the appropriate course of action to identify cultural resources and, to the extent feasible, avoid impacts to cultural resources.

6.12.3 References

Baker, S.E., E. Wohlgemuth, and J.A. Parsons. 1999. The Archaeology of the Foresthill Divide: The California Forest Highway 124 Project. Volume 1: Regional Overviews and the Archaeology of CA-PLA-695/H, The Monte Verde Site. Report to the National Park Service, San Francisco, California.

d'Azevedo, W.L. 1986. Washoe. In *Great Basin,* edited by W.L. d'Azevedo, pp. 466–498. Handbook of North American Indians, Vol. 11, W.C. Sturtevant, general editor. Smithsonian Institution, Washington, D.C.

Federal Energy Regulatory Commission (FERC). 2004. Handbook for Hydroelectric Project Licensing and 5 MW Exemptions from Licensing. Federal Energy Regulatory Commission, Washington, D.C.

Jackson, R.J. and H.S. Ballard. 1999. Once upon a Micron: A Story of Archaeological Site CA-ELD-145, near Camino, El Dorado County, California. Report to the California Department of Transportation, Marysville, California.

Jackson, R.J., with T.L. Jackson, C. Miksicek, K. Roper, and D. Simons. 1994. Framework for Archaeological Research and Management: National Forests of the North-central Sierra Nevada. Report to the Eldorado National Forest, Placerville, California.

Lardner, W.B. 1924. History of Placer and Nevada counties, California, with biographical sketches of the leading men and women of the counties who have been identified with their growth and development from the early days to present. Historic Record Company, Los Angeles, California. Reprinted 1990 Placer County Historical Society, Auburn, California.

Myer, C. 2002. Placer County: An Illustrated History. Heritage Media Corporation, Carlsbad, California.

Placer County Water Agency (PCWA). 2006. *Draft 2005 Cultural Resources Inventory Study Report*. Auburn, CA.

Rackerby, F.E. 1965. The Archaeology of the Middle Fork American River Project, Placer County, California. Report to the National Park Service, San Francisco, California.

Sanborn, M. 1974. The American: River of El Dorado. Holt, Rinehart, and Winston, New York. Reprinted 2001, Homestead Publishing.

Steele, R.J., James P. Bull, and F. I. Houston. 1861. *Directory of the County of Placer for the year 1861: containing a history of the county, and of the different towns in the county; with the names of the inhabitants, and every thing appertaining to a complete directory*. Charles F. Robbin, San Francisco, California. Reprinted 1989, Placer County Historical Society, Auburn, California.

True, D.L. 1980. Cultural Resource Inventory for the Auburn Dam Project. Report to National Park Service, San Francisco, California.

True, D.L., D. Dickel, and H. Crew. 1978. Archaeological Surveys, Auburn/Folsom Survey Unit 2, Middle Fork of American River from Kanaka Gulch to End of Project. Report to Office of Environmental Quality, Bureau of Reclamation, Sacramento, California.

Wilson, N.L. and A.H. Towne. 1978. Nisenan. In *California*, edited by R.F. Heizer, pp. 387–397. Handbook of North American Indians, Vol. 8, W.C. Sturtevant, general editor. Smithsonian Institution, Washington, D.C.

TABLES

Table 6.12-1. Prehistoric Cultural Chronology of the Forest Hill and Georgetown Divides.

Culture Period	Age	Cultural Characteristics
PaleoIndian *Early Holocene*	9000 B.C. – 6500 B.C. *8000 B.C. – 6000 B.C.*	Highly mobile populations, subsistence focus on hunting
Archaic/Millingstone *Archaic*	6500 B.C. – 3500 B.C. *6000 B.C. – 1200 B.C.*	Mobile populations, diversified subsistence pattern with increase use of seed resources indicated by millingslab/ handstone tool kit
Early Sierran *Early Sierran*	3500 B.C. – 600 B.C. *1200 B.C. – 600 A.D.*	Mobile populations, diversified subsistence pattern, advent of mortar/pestle technology, evidence of more regular settlement/subsistence patterns in Sierra Nevada
Middle Sierran *Middle Sierran*	600 B.C. – A.D. 1000 *A.D. 600 – A.D. 1400*	Period of cultural fluorescence through-out the region, extensive inter-regional trade, large semi-permanent settlements, atlatl/dart technology supplemented by bow/arrow ca. A.D. 600
Late Prehistoric Sierran/ Protohistoric *Late Sierran (including Protohistoric)*	A.D. 1000 – A.D. 1500/ A.D. 1500 – A.D. 1769 *A.D. 1400 A.D – A.D. 1769*	Rapid population growth, intensification subsistence pattern, complex settlement patterns with permanent villages and seasonal camps, primary use of mortar/ pestle and bow/arrow, tribelet territories maintained, inter-regional trade declines, “monetary” shell bead exchange; European settlement indirectly affects Sierra Nevada Native American cultures

Table 6.12-2. Inventory of Previously Recorded Archaeological Sites in the Expanded Study Area.

Site Number	Forest	Description
05-17-54-01	Tahoe	Uncertain (historic?)
05-17-54-02	Tahoe	Old Stamp Mill site; mill removed
05-17-54-03	Tahoe	Foundations of 6 miners cabins
05-17-54-06	Tahoe	Lithic scatter, bedrock mortar
05-17-54-10	Tahoe	Historic tunnel
05-17-54-16	Tahoe	Rock wall cabin foundation
05-17-54-92	Tahoe	Rock outcropping with 5 bedrock mortars
05-17-54-116	Tahoe	Flake scatter (w/ projectile points and bedrock mortar)
05-17-54-117	Tahoe	Flake scatter
05-17-54-133	Tahoe	Historic mining site
05-17-54-136	Tahoe	Rock outcrop with 2 bedrock mortars
05-17-54-214	Tahoe	Historic trash dump
05-17-54-228	Tahoe	bedrock mortars w/ 13 cups
05-17-54-254	Tahoe	Small lithic scatter
05-17-54-255	Tahoe	Lithic scatter, 2 grinding slicks
05-17-54-256	Tahoe	Lithic scatter, bedrock mortars, grinding slick
05-17-54-257	Tahoe	bedrock mortar, light lithic scatter
05-17-54-265	Tahoe	Light lithic scatter
05-17-54-266	Tahoe	Small lithic scatter
05-17-54-267	Tahoe	Small lithic scatter
05-17-54-279	Tahoe	Light density lithic scatter, 3 bedrock mortars, pestles
05-17-54-308	Tahoe	2 bedrock mortars
05-17-54-322	Tahoe	Light lithic scatter
05-17-54-370	Tahoe	Sparse lithic scatter
05-17-54-400	Tahoe	bedrock mortar, flake scatter with midden
05-17-54-427	Tahoe	Historic ditch
05-17-54-432	Tahoe	Historic bridge
05-17-54-437	Tahoe	Sparse lithic scatter
05-17-54-440	Tahoe	2 bedrock mortars on a large boulder
05-17-54-441	Tahoe	2 bedrock mortars
05-17-54-442	Tahoe	2 bedrock mortars

Table 6.12-2. Inventory of Previously Recorded Archaeological Sites in the Expanded Study Area (continued).

Site Number	Forest	Description
05-17-54-443	Tahoe	Historic trash dump
05-17-54-445	Tahoe	Lambert Ditch
05-17-54-450	Tahoe	Historic mining site: 2 ditches and an artifact scatter
05-03-53-02	Eldorado	Prehistoric rock shelter
05-03-53-04	Eldorado	Prehistoric midden, historic placer mining
05-03-53-49	Eldorado	Historic homestead
05-03-53-51	Eldorado	Historic mining complex
05-03-53-64	Eldorado	bedrock mortar and lithic scatter
05-03-53-65 (Big Meadow)	Eldorado	13 bedrock mortars (39 cups, 3 slicks) petroglyphs, dense lithic scatter
05-03-53-67	Eldorado	Segment of Ralston Ditch (see Star Fire TS-12 and P-31-1304)
05-03-53-74	Eldorado	Historic log cabin, prehistoric flake scatter
05-03-53-77	Eldorado	Historic hardrock mining site and trash dump
05-03-53-78	Eldorado	Historic stamp mill/placer mine and prehistoric bedrock mortar
05-03-53-79	Eldorado	Small flake scatter
05-03-53-113	Eldorado	Lithic scatter, 2 loci, no midden
05-03-53-116	Eldorado	bedrock mortar and sparse lithic scatter
05-03-53-117	Eldorado	bedrock mortar, lithic scatter with groundstone fragments
05-03-53-119	Eldorado	bedrock mortars, 2 pestles
05-03-53-121	Eldorado	1 bedrock mortar, 1piece debitage
05-03-53-123	Eldorado	1 bedrock mortar, excavated in 2000
05-03-53-165	Eldorado	Lithic scatter with some groundstone
05-03-53-192	Eldorado	“Core reduction” site
05-03-53-199	Eldorado	Lithic scatter (1 projectile point)
05-03-53-205	Eldorado	Historic trail
05-03-53-209	Eldorado	Daggett Ditch
05-03-53-224	Eldorado	Lithic scatter
05-03-53-225	Eldorado	Lithic scatter
05-03-53-341	Eldorado	Remnants of historic camp
05-03-53-342	Eldorado	Historic camp with artifact scatter
05-03-53-237	Eldorado	Lambert Ditch (see 17-54-445)
05-03-53-284	Eldorado	Small ditch segment

Table 6.12-2. Inventory of Previously Recorded Archaeological Sites in the Expanded Study Area (continued).

Site Number	Forest	Description
05-03-55-19	Eldorado	bedrock mortar, no lithic scatter
05-03-55-122	Eldorado	Dense lithic scatter
05-03-55-201	Eldorado	2 bedrock mortars, 4 pestles, lithic scatter
05-03-55-204	Eldorado	Historic stone foundation
P-09-2204-H		Volcanoville ditch segment
P-09-2256-H		Mikalauskas Ditch
No#		Pyshora Property ditch
No#		Wood THP ditch
No#		Mt. Gregory Cemetery
P-31-1367 (CA-PLA-1058)	Eldorado	Lithic scatter, projectile point
P-31-1369 (CA-PLA-1060)	Eldorado	Lithic scatter, projectile point
P-31-1370 (CA-PLA-1061)	Eldorado	3 historic mining prospects
P-31-1371 (CA-PLA-1062)	Eldorado	1 historic mining prospect
P-31-1252	Eldorado	Grinding slick
P-31-1304	Tahoe	Ralston Ditch
No#		“Long Chip #1” large mining ditch
No#		“Long Chip #2” small ditch
FGS Co. #1		2 bedrock mortars, 1 milling slick
Lower Meadow Site		2 bedrock mortars, 1 possible milling slick
Star Fire TS-7	Tahoe	2 short segments of ditch
Star Fire TS-9	Tahoe	Hydraulic/sluice mined area
Star Fire TS-10	Tahoe	Wooden flume remnants
Star Fire TS-11	Tahoe	3 bedrock mortars, sparse lithic scatter
Star Fire TS-12	Tahoe	Remnants of ditch, may have been part of Ralston ditch (see P-31-1304)
Star Fire TS-13	Tahoe	bedrock mortar and historic debris

FIGURES

Placeholder for Figure 6.12-1

Figure 6.12-1 Cultural Resources Inventory Study Area and Expanded Study Area

Non-Internet Public Information

These Figures have been removed in accordance with the Commission regulations at 18 CFR Section 388.112.

These Figures are considered Non-Internet Public information and should not be posted on the Internet. This information may be accessed from the Placer County Water Agency's (PCWA) Public Reference Room, but is not expected to be posted on PCWA's Website, except as an indexed item.

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6.13 TRIBAL RESOURCES

This report describes the tribal resources associated with the Middle Fork American River Hydroelectric Project (MFP or Project). The Federal Energy Regulatory Commission's (FERC's) content requirements for this section are specified in Title 18 of the Code of Federal Regulations (CFR) Chapter I § 5.6 (d) (3) (xii), as follows:

> ***Tribal resources****. A description of Indian tribes, tribal lands, and interests that may be affected by the project components of this description include:*
>
> *(A) Identification of information on resources specified in paragraphs (d)(2)(ii)-(xi) of this section to the extent that existing project construction and operation affecting those resources may impact tribal cultural or economic interests, e.g., impacts of project-induced soil erosion on tribal cultural sites; and*
>
> *(B) Identification of impacts on Indian tribes of existing project construction and operation that may affect tribal interests not necessarily associated with resources specified in paragraphs (d)(3)(ii)-(xi) of this Section, e.g., tribal fishing practices or agreements between the Indian tribe and other entities other than the potential applicant that have a connection to project construction and operation.*

This section identifies Indian tribes that are known to have cultural ties or other interests associated with the MFP, and discusses the relationship of the MFP to tribal lands. Potential impacts to tribal resources and/or interests have not been identified at this time but will be addressed as the cultural resources studies proceed, in consultation with the resource agencies and Indian tribes.

No federally recognized tribal lands are within or near the FERC Project boundary. However, the Middle Fork American River and Rubicon River watersheds were part of the aboriginal culture area of Nisenan and Washoe people.

6.13.1 Indian Tribes

A "federally recognized tribe" is any tribe, band, nation, or other organized Indian group or community of Indians, including any Alaska Native Village or corporation as defined in or established by the Alaska Native Claims Settlement Act (43 USC 1601 *et seq*.), which is recognized as eligible for the special programs and services provided by the United States to Indians because of their status as Indians (see e.g., 43 CFR Part 10.2(b)(2)). A list of such tribes is maintained by the Secretary of the Interior. For the purposes of this discussion "tribe" also refers to federally unrecognized Indian groups, communities, or organizations.

To date, the following Indian tribes have expressed interest in the MFP. Federally recognized tribes are indicated by an asterisk (*).

- Colfax-Todd Valley Consolidated Tribe
- El Dorado County Indian Council
- Shingle Springs Rancheria*
- Todd Valley Miwok-Maidu Cultural Foundation
- Tsi-Akim Maidu
- United Auburn Indian Community*
- Washoe Tribe of California and Nevada*
- Miwok Tribe of the Eldorado Rancheria

6.13.2 Tribal Lands

Tribal lands are defined as all lands within the boundaries of an Indian reservation and all dependent Indian communities (36 CFR Part 800.16(x)) and any lands held in trust for any tribe by the Bureau of Indian Affairs (BIA). No federally recognized tribal lands are within or near the FERC Project boundary.

6.13.3 Tribal Interests

Members of Indian tribes have indicated that archaeological sites with Native American artifacts, deposits and features, and certain plant and animal resources in the MFP vicinity may be of cultural significance. To date, specific resources of tribal interest in the Project vicinity have not been identified but may be identified through on-going consultation. There are no known agreements between federally recognized Indian tribes and other agencies that have a connection to the operation and maintenance of the MFP apart from the trust responsibilities accorded to tribes acknowledged by agencies of the United States.