Placer County Water Agency
Middle Fork American River Project
(FERC Project No. 2079)

2005 PHYSICAL HABITAT CHARACTERIZATION STUDY REPORT

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Foreward

This report entitled *2005 Physical Habitat Characterization Study Report* is one of several reports which are being prepared to describe existing environmental conditions within the watershed of Placer County Water Agency's (PCWA) Middle Fork American River Project (MFP). The Physical Habitat Characterization Study Report includes three components: a geomorphology study report, riparian habitat characterization study report, and an aquatic habitat characterization report. A second Physical Habitat Characterization report will be prepared in late 2006 following another season of data collection and analysis.

The title of the other report in this series is:

- *2005 Water Temperature Study Report*

The information in these reports will be used by PCWA during preparation of the Pre-Application Document (PAD). The PAD will be submitted in September 2007 to the Federal Energy Regulatory Commission (FERC) to initiate the regulatory process for relicensing the MFP. They will also be used to develop Draft Technical Study Plans by a collaborative of jurisdictional agencies, tribes, non-governmental organizations and the public. The Draft Technical Study Plans will also be included in the PAD submitted to the FERC.

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1.0 INTRODUCTION

This report presents the results of the first year (Phase 1) of Placer County Water Agency's (PCWA's) Physical Habitat Characterization studies. The Physical Habitat Characterization studies were carried out as outlined in PCWA's 2005-2006 Existing Environment Study Plan Package (Study Plan Package), which was developed in coordination with the resource agencies and distributed in June 2005. This report documents the results of field work and analyses conducted during 2005. The information contained in this report was used as a basis for refining additional (Phase 2) studies to be conducted in 2006.

The Physical Habitat Characterization studies included three primary components: a geomorphology study, riparian habitat mapping, and aquatic habitat mapping, all of which are addressed in this report. These three interrelated study components rely on similar information and were intentionally integrated to aid in the synthesis and interpretation of data. The goals of the Physical Habitat Characterization studies were to characterize geomorphic conditions; identify and describe riparian and meadow habitat; and characterize the existing aquatic habitat in the streams upstream and downstream of the dams and diversions associated with the Middle Fork American River Project (MFP or Project).

1.1 STUDY AREA

The MFP is located on the Middle Fork American River, the Rubicon River, and several tributaries in Placer and El Dorado counties, California. The principal Project features are shown on Map 1-1 and include two primary storage reservoirs, five smaller impoundments, five powerhouses, and water conveyance facilities. An introductory level description of the MFP and its operation was included in the Study Plan Package (PCWA 2005). More detailed information about the MFP facilities and operations is available in the comprehensive Draft Project Description, which was distributed to the resource agencies and other stakeholders on June 20, 2006.

The Physical Habitat Characterization studies focused on the primary rivers and streams, upstream and downstream of the MFP dams and reservoirs, as shown on Map 1-1. For the purposes of the Physical Habitat Characterization studies, the Study area (also referred to as Study streams or Study rivers) is defined as follows:

- Middle Fork American River from upstream of French Meadows Dam to its confluence with the North Fork American River;
- North Fork American River to Folsom Reservoir;
- Rubicon River from upstream of Hell Hole Dam to its confluence of Middle Fork American River at Ralston Afterbay;
- Duncan Creek from upstream of the Duncan Creek Diversion to its confluence with the Middle Fork American River;

- North Fork Long Canyon Creek from upstream of the North Fork Long Canyon Diversion to its confluence with Long Canyon Creek;
- South Fork Long Canyon Creek from upstream of the South Fork Long Canyon Diversion to its confluence with Long Canyon Creek; and
- Long Canyon Creek from the confluence of North and South Forks of Long Canyon creeks downstream to its confluence with the Rubicon River.

Note that this report sometimes refers to the Project area or MFP area, particularly when discussing regional conditions or events. These terms are not meant to define a specific area. They are used to facilitate the discussion of conditions or events involving the land surrounding the MFP facilities and/or nearby streams or rivers.

1.1.1 River Mileage Stationing System

A river mileage (RM) stationing system was established along each of these study reaches and others in the vicinity of the MFP. As shown on Map 1-2, the river mileage stationing system begins at 0.0 at Folsom Dam, a point that is unlikely to change in the future. The river miles then ascend upstream following the North Fork of the American River. Every tributary confluence is designated as 0.0 and river miles ascend upstream along each tributary. Using a common river mileage stationing system is an important part of documenting, integrating, and conveying study data.

1.1.2 Potential Reference Reaches

The Phase 1 studies focused on the streams and river reaches located downstream of the primary MFP facilities. Some preliminary data was also collected on stream and river reaches upstream of the Project facilities. Additional information will be collected on the streams and rivers upstream of the Project facilities during the Phase 2 studies conducted in 2006. Eventually, it may be necessary to compare conditions on the Study streams to conditions on other, unregulated streams and rivers. The best comparison streams (also referred to as “reference reaches” or “reference streams”) are preferably unimpaired by water diversions.

1.1.3 Access Limitations

The MFP is located in an area characterized by steep canyons and rugged terrain. Several paved roads provide the primary access to the MFP area. These include: the Mosquito Ridge Road, Ralston Ridge Road, Blacksmith Flat Road and Soda Springs Riverton Road. Access to more remote locations, including specific locations along the Study streams, is possible using ancillary roads and trails associated with either the United States Department of Agriculture Forest Service (USDA-FS) Transportation System or the Auburn State Recreation Area (Auburn SRA). At most locations, movement upstream or downstream along the streams is restricted by the presence of large boulders and/or cascades, deep pools, and/or the proximity of steep canyon walls.

Access is further constrained when carrying field equipment. Similarly, areas that are seemingly accessible by helicopter are not accessible due to unsafe landing conditions.

The Physical Habitat Characterization studies were designed with respect to the access limitations and constraints. A variety of study methods were utilized to accommodate the fact that most of the Study streams and rivers could not be accessed on foot. Specifically, the geomorphology and riparian studies were performed using a combination of aerial photography, aerial videography, and ground reconnaissance surveys, as summarized in Section 1.3 below. Aquatic habitat mapping was performed using aerial photography and aerial videography.

1.2 WATERSHED CONDITIONS THAT MAY INFLUENCE STUDY RESULTS

The channel morphology and riparian and aquatic habitat conditions associated with the Study streams and rivers may be influenced by a variety of factors, including historic and recent land and water uses and naturally occurring events, such as fires and floods. The following is a preliminary list of activities and events that may have influenced the stream morphology and habitat conditions associated with the Study streams:

- Large fires, including the Star Fire, which occurred in 2001 and burned 16,000 acres of forest lands surrounding the MFP facilities and reservoirs;
- Failure of the partially completed Hell Hole Dam in 1964 and the associated flood surge;
- Natural high flow events such as that which occurred in 1997;
- Mining-related activities, for example dredging which has occurred in the vicinity of Ralston Afterbay since the mid-1800s;
- Livestock grazing;
- Timber management;
- Recreation uses, particularly off-highway vehicle (OHV) use;
- Fluctuating flows on the Middle Fork American River downstream of Oxbow Powerhouse; and
- Sediment management associated with the MFP.

A more comprehensive list of activities and events that may have or may be influencing stream morphology and habitat conditions will be developed in consultation with the resource agencies. Detailed information about the watershed conditions that may affect stream morphology and habitat will be presented in the Pre-Application Document (PAD), which will be distributed in the Fall of 2007.

1.3 GENERAL APPROACH

Information about the riparian habitat and stream geomorphology was developed using a combination of existing information, aerial photography, helicopter surveys, aerial videography, and ground reconnaissance surveys. Aquatic habitat mapping was accomplished using aerial photography and aerial videography. The timing and coordination of data collection and analysis under each study element were sequenced to allow for integration of information across resource disciplines, while minimizing data collection redundancy among the disciplines. This approach is expected to streamline future data collection efforts. Each of these study elements is briefly summarized in the following sections. More detailed discussions of specific data collection methods are described in the individual study reports.

1.3.1 Review of Existing Information

Existing information provided by the resource agencies and available in published reports was reviewed and pertinent information was used as a starting point for these studies. The existing information was then supplemented with data developed through a combination of review and analysis of aerial photographs, helicopter surveys, review of low altitude video developed specifically for this Project, and ground surveys at accessible locations.

1.3.2 Aerial Photography

Four sets of existing historical aerial photography covering the following years were obtained and reviewed: pre-Project photography taken in 1961 (1:6,000 and 1:12,000 scales), pre-Project photography taken in 1962 (1:15,840 scale), and recent photography taken in 2002 (2-foot resolution). At this time aerial photography for the years between 1962 and 2002 has not been obtained.

The 2002 aerial photography was printed and initially evaluated in the office. Obvious geomorphic features and riparian habitat were preliminary mapped directly onto the 2002 aerial photos. This information was then taken into field and used along with United States Geological Survey (USGS) 7.5 minute topographic quadrangles to map geomorphic channel types and to map riparian habitat. Information developed using the aerial photographs was cross-referenced with low altitude aerial video and on the ground surveys at specific locations. The aerial photography was of limited use on the smaller streams and in the narrow, deeply entrenched reaches of the larger streams due to dense vegetation cover and shadows caused by the steep canyon walls. In these cases, ground surveys were conducted, access permitting.

The 2002 aerial photo set was also used in conjunction with the aerial video to map aquatic habitat along the Rubicon River and the Middle Fork American River. The resolution of the photographs was not suitable for detailed aquatic habitat mapping along certain stream segments, particularly North and South Forks of Long Canyon Creek, Duncan Creek, and portions of the Middle Fork American River.

The historic aerial photographs were examined with respect to the recent aerial photographs to ascertain whether stream morphology and riparian habitat have changed over time. Observed differences are noted in this report, as appropriate. Any observed differences are likely due to a variety of complex and interrelated factors that will be addressed in conjunction with future studies, including, among other things, flood events and fires.

1.3.3 Helicopter Surveys

Riparian habitat and geomorphology were observed and mapped from a helicopter during July and August, 2005. Riparian habitat, channel morphology and larger scale features such as landslides were mapped from the helicopter directly onto the 2002 aerial photographs and/or USGS 7.5-minute topographic quadrangles. Information developed through helicopter surveys was used to augment and refine information apparent on the aerial photographs and to identify the overall Middle Fork American River Watershed (Watershed) conditions. It was not possible to map channel features or riparian habitat from the helicopter along narrow or deeply entrenched stream reaches or where dense vegetation was present. In these cases, data was developed through ground surveys, access permitting. Visibility conditions from the air as they pertain to the geomorphology and riparian studies were rated on a scale of 1 (poor) to 5 (good) and are shown on Map 1-3. Helicopter surveys were not performed for the aquatic habitat studies, but will be a component of the studies to be conducted during 2006.

1.3.4 Aerial Video

PCWA developed a high resolution, digital video of Study streams in 2005. The video was taken from a helicopter during September and October of 2005, when streamflows were relatively low so that the video could be used to aid in aquatic habitat mapping and stream channel typing. The resulting video is included with this report for reference and includes five Digital Video Disks (DVDs) organized as follows:

- DVD 1 – Middle Fork American River from Folsom Reservoir to Ralston Afterbay (taken at two flows).
- DVD 2 – Middle Fork American River from Ralston Afterbay to 5.5 miles upstream of French Meadows Reservoir.
- DVD 3 – Rubicon River from confluence with Middle Fork American River to 5.8 miles upstream of Hell Hole Reservoir.
- DVD 4 – Long Canyon Creek and Duncan Creek.
- DVD 5 – Primary Project Facilities.

Each of these DVDs includes both low altitude views of the stream corridor and overviews of the surrounding watersheds.

The video was used as a tool to refine map products developed through helicopter and ground surveys as part of the geomorphology and riparian studies. During filming, some segments of the streams were obscured by dense vegetation or shadows. In these cases, the video could not be used as a verification or mapping tool.

The video was also used as a tool to map aquatic habitat along the Rubicon River and portions of the Middle Fork American River. Because aquatic habitat mapping requires an unobstructed view of the stream channel, the video could not be used to map aquatic habitat along Duncan Creek, North and South Forks of Long Canyon creeks, or Long Canyon Creek due to the presence of shadows and trees.

1.3.5 Ground Reconnaissance Surveys

Ground surveys were performed along selected stream segments to verify and augment the geomorphology and riparian information developed using the aerial photographs and the aerial video, and to map riparian habitat and channel types in areas that were not visible from the air. The riparian and geomorphology ground surveys were completed together during August, September, and October 2005. Ground surveys were limited to those areas that could be accessed on foot or by helicopter. Ground surveys were not performed in association with the aquatic habitat studies in 2005 but will be during studies to be conducted in 2006.

1.3.6 Consistency between Study Methods

The study approach relied on a combination of study methods, each of which can be used to augment and refine the other. Used in combination, the aerial photography and aerial videography was suitable to accurately map riparian habitat and channel types, except along certain segments of Study streams. Ground surveys were conducted to verify conditions as observed from the air, refine map products developed via helicopter surveys and using aerial photographs, and to collect more specific information, for example channel bankfull measurements. In general, no major discrepancies were noted and there was good agreement between observations made from the air versus those made on the ground.

1.4 WORK PRODUCTS

Aside from the information presented in this body of this report, the primary work products developed as a result of the 2005 Physical Habitat Studies are Geographic Information System (GIS)-based maps depicting the following information:

- Sedimentation and Related Geology
- Channel Types – Rosgen Level 1 Classification
- Channel Types – Montgomery Buffington Classification
- Channel Response Potential

- Riparian Community Coverage and Channel Bars
- Riparian Age Classes and Channel Bars
- Non-native Riparian Species and Channel Bars
- Aquatic Habitat – Hawkins Classification
- Aquatic Habitat – Modified R-5 Habitat with Hawkins Classification

The GIS information was originally presented on two Interactive Compact Disks (CDs) that were included with the Draft report. Two formats were developed for resource agency review and consideration. The geomorphology and riparian data were presented as layers on a Digital Raster Graphic (DRG) background and the aquatic habitat data were presented on a two-foot resolution orthophoto image taken in 2002. The information contained on each CD and the advantages and disadvantages of each format are briefly discussed below.

The geomorphology and riparian data were displayed on a DRG, which provides the viewer with topographic information and landmarks for orientation. For the Draft report, the riparian and geomorphology data were presented on three sheets as shown on Map 1-4. Each sheet can be printed as an “E” size map. Alternatively, the viewer can examine the data on screen, zooming in and out, as needed. The viewer will notice occasional “pop ups” on Sheet 2 containing photographs and captions. These pop-up photographs are mentioned throughout the report and copies are provided in Appendices H and N, for reference.

Aquatic habitat was mapped in increments as small as 0.01 miles and was provided on the Interactive CD on an orthophoto background. The information was presented on an orthophoto background to better illustrate sources used to delineate aquatic habitat units. For the Draft report, the aquatic habitat data are presented along with the Rosgen Level I channel breaks on 42 sheets as shown on Map 1-5. Each sheet can be printed as an 11 x 17-size map. Alternatively, the viewer can examine the data on screen, zooming in and out, as needed.

In their comments on the Draft report and during follow up meetings held on April 18, 2006 and June 1, 2006, the resource agencies stated that they would also like the GIS data displayed in color on 11 x 17 maps at a scale similar to that used for the Mokelumne River relicensing project. Accordingly, the information originally presented on the Interactive CDs was converted and scaled to print out on 11 x 17 paper. Paper and electronic copies of the resulting maps are contained in the Map Package (available upon request).

1.5 Synopsis of Study Results and Key Findings

A synopsis of the study results and key findings as determined through the Phase 1 studies are described below. The geomorphic conditions are described first, followed by the riparian and aquatic habitat characterizations.

1.5.1 Geomorphic Conditions

- The majority of study channels are moderately steep gradient (2% to 4%), entrenched and confined by narrow V-shaped valleys with frequent bedrock exposures. This type of channel morphology has a very limited capacity for lateral adjustments or change in channel width due to alterations of the flow or sediment regime.

- Based on the Rosgen classification, only the A, B, G, and F channel types are present along the Study streams. These channel types are defined as highly to moderately entrenched and confined with no adjacent floodplains.

- The Middle Fork American River below Ralston Afterbay is a pool-riffle bedform that is considered to be highly responsive according to the Montgomery-Buffington classification system.

- Approximately 16.5 miles of the Study streams are best characterized as mixed bedrock-alluvial channel types, which are found on all of the Study streams. The mixed bedrock-alluvial channel types in the Study streams have frequent bedrock exposures, usually coarse riffles (boulders and cobble), with cobble and gravel particle sizes in the pool tail-outs.

- About half (approximately 53 miles) of the Study streams are described as transport channel types (i.e., have a high sediment transport capacity relative to the sediment supply). According to the Montgomery-Buffington classification, these are either bedrock channels, or have a step-pool or cascade alluvial bedform.

- About half (approximately 54 miles) of the Study streams are described as channel types that are transitional between supply-limited (i.e., transport capacity is much greater than the sediment supply) and transport-limited (i.e., the transport capacity is much less than the sediment supply) morphologies. These are either plane-bed or pool-riffle channel types according to the Montgomery-Buffington classification.

- The channel types that are most responsive to alterations of flow and sediment regimes have pool-riffle and plane-bed channel forms. Approximately 41.1 miles of highly responsive channel types were identified in the Study area. The longest channel reach with a high responsiveness rating is the 23.5 miles of the Middle Fork American River downstream of Ralston Afterbay. Other high response potential channel types were identified on the Middle Fork American River upstream of Ralston Afterbay (5.2 miles), the Rubicon River downstream of Hell Hole Dam (6.8 miles), and North Fork Long Canyon Creek (2.7 miles), with a few shorter reaches on Duncan Creek, South Fork Long Canyon Creek, and mainstem Long Canyon Creek.

- Approximately 12.2 miles of channel are rated as having a moderate response potential, and 55.1 miles were rated as having a low response potential. Duncan Creek, Rubicon River, Long Canyon Creek, and the Middle Fork American River above Ralston Afterbay have a predominantly low channel response rating. The South Fork Long Canyon Creek has a predominantly moderate channel response rating.

- Glaciers created wide, U-shaped valleys in the upper watersheds of some of the Study streams. The most prominent are as follows:

  - Long Canyon Creek from the headwaters to approximately RM 7.0

  - North and South Forks of Long Canyon Creek

  - Rubicon River from upstream of Hell Hole Reservoir to approximately 1 mile downstream of Parsley Bar (RM 27.0)

- Hillslope processes, such as mass wasting events (e.g., debris slides, rockfalls, and debris torrents), are substantial sources of sediment to the Study streams below their respective diversion locations. A portion of the sediments delivered by mass-wasting processes to the inner gorge areas of nearly all the Study streams are comprised of boulder sized material, which rarely, if ever, are mobilized by streamflow.

- The Study streams are frequently comprised of gravel, cobble, boulder, and bedrock particle sizes, often in roughly equal proportions.

- Although bank erosion does occur, it does not appear to be as significant a sediment delivery process as mass-wasting to the Study streams.

- Fine sediments (sand) were never observed to be a dominant bed particle size, and sediment accumulations were almost never observed at tributary junctions within the Study streams. These observations suggest that sediment-transporting flows have occurred at least in the recent past.

- Examination of historic aerial photographs (early 1960s) did not reveal substantial alterations in channel morphology in the Rubicon River as compared with recent aerial photography (2002) and videography (2005). The most dramatic and obvious channel alteration occurred as a result of the Hell Hole Dam failure and resulting flood surge in 1964, which substantially effected the channel morphology for a distance approximately 5 miles below the dam. It appears that sediment storage has also increased on parts of the Rubicon River near the Long Canyon Creek confluence, and this, too, is likely associated with the dam failure.

1.5.2 Riparian Habitat Characterization

- The riparian communities were comprised of riparian trees and shrubs, including willows (*Salix* spp.), alders (*Alnus rhombifolia*), cottonwoods (*Populus fremontii* and *Populus balsamifera* ssp. *trichocarpa*), and dogwood (*Cornus sericea*). Black locust (*Robinia pseudoacacia*) occurs on the Middle Fork American River below Ralston Afterbay.

- A distribution of age classes, including seedlings or young individuals, was present within the majority of the riparian communities along the Study streams.

- Patterns of riparian vegetation are influenced by the distribution of sediment and bar deposits along the Study streams, as they are the locations for colonization, establishment, and development.

  - Sparse or discontinuous narrow corridors of riparian vegetation generally occur within the reaches classified as bedrock channel types, which may be in combination with other alluvial channel types.

  - Wide and continuous narrow corridors of riparian vegetation are generally associated with deposits/bars or along reaches classified as alluvial channel types.

- Cottonwoods, an important component of riparian forests, have a limited distribution along the smaller streams (South and North 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) that are more likely to collect sediments than the steeper and narrower bedrock/boulder segments.

- Meadows were not observed along the Study streams.

- Examination of historic aerial photographs (early 1960s) revealed four general patterns in riparian distribution along the Middle Fork American River below Ralston Afterbay and the less entrenched sections of the Rubicon River along the stream sections with good visibility when compared with recent aerial photography (2002 and 2005 videography), as follows:

  - 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;

- Minimal change in riparian vegetation was observed in the distribution patterns along the less responsive stream reaches;
- Riparian vegetation distribution has changed from few and shorter continuous narrow corridors and shorter, wide corridors to larger, longer, and wider continuous corridors; and
- Current photographs indicate a moderate increase in riparian abundance along the Study streams since the early 1960's.

1.5.3 Aquatic Habitat Characterization

- Habitat types were identified based on Hawkins habitat types and, to the extent feasible, to modified R5 habitat types based on helicopter videography.
  - Habitat units were mapped to aerial photographs using GIS.
  - Habitat units were tabulated by habitat classification and strata.
  - Habitat units to be field checked during 2006 also were identified.
- The Middle Fork American River and Rubicon River were divided into reaches based on Project features and major tributary confluences, respectively.
  - Each of the reaches of each river was further stratified by Rosgen Level I channel type.
- The three reaches of the Middle Fork American River are:
  - North Fork American River confluence upstream to Ralston Afterbay;
  - Middle Fork American River from Ralston Afterbay to the Middle Fork Interbay; and
  - Middle Fork American River from the Middle Fork Interbay to French Meadows Reservoir.
- The Middle Fork American River, from the North Fork American River confluence upstream to Ralston Afterbay is dominated (in terms of length) by pool habitats, followed by non turbulent (runs and pocket waters) habitats, and a smaller percentage of turbulent habitats (riffles and cascades).
- The Middle Fork American River, from Ralston Afterbay to the Middle Fork Interbay is dominated by non turbulent habitats, followed by pools, and turbulent

habitats. Turbulent habitats are more abundant than in the reach between the North Fork American River confluence and Ralston Afterbay.

- The Middle Fork American River, from Middle Fork Interbay to French Meadows Reservoir is dominated by pools with near equal lengths of non turbulent and turbulent habitats.
- The Rubicon River from Ralston Afterbay to Hell Hole Reservoir is divided into the following three reaches:
  - Ralston Afterbay to confluence with Long Canyon Creek;
  - Confluence of Long Canyon Creek to confluence of South Fork Rubicon River; and
  - Confluence of South Fork Rubicon River to Hell Hole Reservoir.
- The Rubicon River from Ralston Afterbay to confluence with Long Canyon Creek has similar percentages of turbulent, non turbulent, and scour pool habitats. Total pool length comprises a larger percentage than the other habitat types.
- The Rubicon River from the confluence of Long Canyon Creek to the confluence of the South Fork Rubicon River is the longest of the three Rubicon River reaches. Turbulent habitats, comprised primarily of cascades, and pool habitats were the most abundant habitats.
- The Rubicon River from the confluence of the South Fork Rubicon River to Hell Hole Reservoir has larger portions of non turbulent and pool habitats with a smaller portion of turbulent habitat than downstream reaches.

1.6 CONSULTATION AND NEXT STEPS

The Draft 2005 Physical Habitat Characterization Study report was distributed to the resource agencies for review and comment on January 30, 2006. The resource agencies provided written comments on the Draft Report by e-mail on March 27, 2006. PCWA subsequently prepared a Draft Response to Comments (RTC) table, which was used as a discussion tool during a meeting held with the resource agencies on April 18, 2006. This Final report addresses all comments expressed by the resource agencies in their letter, in follow up e-mail correspondence, during the April 18, 2006 meeting, and during a follow up meeting held on June 1, 2006.

PCWA is currently conducting Phase 2 of the two-year Physical Habitat Characterization Study. The Phase 2 studies were refined in consultation with the resource agencies and are designed to build upon the work completed in 2005. The 2006 study results will be documented in a detailed report, which PCWA plans to distribute to the resource agencies in early 2007 for review and comment. Combined, the 2005 and 2006 study results will be used a basis for future relicensing studies.

2.0 GEOMORPHOLOGY STUDY

2.1 OBJECTIVES

The purpose of the geomorphology study is to characterize geomorphic conditions of the river channel upstream and downstream of Project dams and diversions. The information developed as part of this study will be augmented with information developed in 2006 and will be used as a basis for developing future quantitative geomorphology studies to be conducted during the course of relicensing. The Phase 1 study objectives were to:

- Classify and organize bypass reaches (river reaches downstream of Project dams and/or diversions) into distinct reaches based on stream morphology.
- Distinguish the relative responsiveness (i.e. "sensitivity") of river reaches to alterations of flow and sediment regimes.
- Conduct a screening-level reconnaissance describing geomorphic conditions of river reaches immediately upstream of Project facilities and in the vicinity of the Middle Fork American River Project (MFP or Project) to evaluate their suitability to serve as reference reaches in later study phases.
- Provide the framework for organizing future survey efforts.

2.2 APPROACH

As outlined in the 2005-2006 Existing Environment Study Plan Package (Study Plan), the geomorphology study is being conducted in two phases. Phase 1 was completed in 2005 and consisted of completing a Rosgen Level I and a Montgomery-Buffington classification on stream reaches upstream and downstream from Project dams and diversions. Stream classification was accomplished using data collected from aerial and ground surveys, and from data derived from existing topographic and geologic maps. Supporting the stream classification tasks was a review and description of general watershed conditions that influence channel geomorphology including geology and soil types, streambank erodibility, and relative abundance of sediment recruitment to channels from hillslope erosion processes. Watershed conditions were evaluated using existing reports and data, aerial photography, and the low-altitude aerial survey. The responsiveness of river reaches to alterations in the flow and sediment regime was determined from the stream classification and from a comparison of historic and present-day aerial photography.

2.3 PHASE 1 METHODOLOGY

Phase 1 consisted of two primary study components: collecting, compiling, and reviewing existing information and; characterizing geomorphic conditions along the streams and rivers upstream and downstream of the Project diversions. The methods used for each of these study components are described in the following sections.

2.3.1 Review of Existing Data and Information

Existing data, reports, and maps relevant to the geomorphology study were collected and reviewed. These information sources included documentation on geology, soils, topography, hydrology, and sediment supply characteristics. Appendix A includes a bibliography listing the data, reports, and maps reviewed. Relevant information has been incorporated into this report and referenced, as appropriate.

2.3.2 Geomorphic Characterization Methods

The geomorphic characterization methods included aerial photo interpretation, low-altitude helicopter surveys, low-altitude video surveys, and ground surveys. Each study method is described below.

Study streams were classified using the Rosgen Level I stream classification system and the Montgomery-Buffington classification system. Study streams were stationed in increments of 0.1 miles using Geographic Information System (GIS) to establish a standardized spatial reference. For each stream, river stationing begins at the confluence (River Mile (RM) 0.0) with the next higher order channel and extends upstream of Project diversions to the limit of the digitized stream segment (Map 1-2). River stationing was extended through Project impoundments to maintain continuous river stationing sequence.

A brief summary of the Rosgen Level I stream classification system is provided in Appendix B. A brief summary of the Montgomery-Buffington Stream Classification system including a discussion on channel responsiveness and sensitive channel reaches is provided in Appendix C. The Montgomery-Buffington stream classification explicitly groups channel types according to their potential for responsiveness to alterations of the flow or sediment regime. Channel responsiveness according to the Montgomery-Buffington is discussed in Section 2.4.2.5.

2.3.2.1 Aerial Photograph Interpretation Methods

Recent (2002) digital aerial photography and historical (early 1960s) aerial photography was used to support several analytical studies, including:

- Classification of channel geomorphology;
- Characterization of the extent and location of sediment contribution to stream channels from hillslope mass-wasting and other erosion sites; and
- Comparative assessment of channel geomorphology between historical and recent eras.

Channel geomorphic classification and characterization of sediment contribution to stream channels was based on the recent photography, low-altitude helicopter surveys, ground surveys, and aerial videography. The following subsections provide a more detailed description of how these surveys were used to perform the channel geomorphic classification and characterization of sediment supply conditions. The remainder of this section focuses on describing how the recent and historical aerial photography was used for the comparative assessment of channel geomorphology.

Geomorphic characteristics of the study streams were evaluated and compared using historical and recent aerial photography. The historical aerial photography was taken in 1961-1962 and pre-dates development of the hydropower facilities. The recent aerial photography was taken in 2002. Aerial videography of study streams from 2005 was used to supplement the recent aerial photography.

Geomorphic characteristics compared between the pre- and post-Project periods include channel planform (i.e., position and sinuosity), channel width, sediment storage represented by the presence or lack of channel bar deposits (bar type, size, and frequency), bed particle size, and channel bedform type (pool-riffle, step-pool, bedrock, cascade, etc.). The comparative analysis relies predominantly on visual recognition of these geomorphic features. In addition, channel width was measured at selected locales, using the distance across the valley bottom (valley wall to valley wall), or across the wetted width of the channel bottom for comparison. The location and size of channel bars and particle size on the bars were noted wherever feasible.

The historical aerial photographs vary in scale from 1:6000, 1:12000 and 1:15840. A summary of the date and location of the historical aerial photographs used in this analysis is provided in Appendix D. The historical aerial photographs were available as stereo-pairs, which enables viewing in 3-dimensions. A SOKIA MS27 stereoscope was used to visually assess in 3-dimension the geomorphic features within the historic channel. A scaled lupe with 10x magnification was also used to view the historic photographs and to measure (+/- 0.1 mm) selected features observed in the photographs. The 2002 aerial photography was provided in a digital geo-referenced format (with 2-foot pixel size resolution) by AirPhoto USA, Inc. ArcGIS was used to view the geo-referenced imagery. The 2005 low-altitude video included real-time GPS coordinates to quickly identify the location of the stream reach. The aerial video was reviewed to supplement the 2002 photography.

Some channel segments were not visible and some geomorphic features were not clearly identifiable using the historic and recent aerial photography. Limited visibility was associated with various factors including dense riparian or upland vegetation, and topographic shading. The photographic scale, angle, and contrast also limited the ability to discern details of geomorphic features at some locations. The relatively large scale of the photography and the lack of photographic contrast limited the capacity to distinguish bed and bar material smaller than boulders. Changes in the vertical height of bars or the active channel that might indicate aggradation or degradation was not detectable due to the scale of the historic photography and because the recent photography was not available as stereo-pairs. Measurements of channel width were often not feasible due to the factors described above.

When comparing photography from recent and historic periods, the size and appearance of geomorphic features can appear to be very different due solely to differences in the magnitude of streamflow. Streamflow was estimated using United States Geological Survey (USGS) gaging station data. The USGS streamflow data corresponding with the date of the aerial photographs is summarized in Appendix D. On the Middle Fork American River, historical streamflow varied along the lower reaches below Ralston Afterbay (RM 25.0) depending upon the date of the aerial photo. Streamflow ranged from 49 cfs to 377 cfs in the historical aerial photos, while streamflow in the recent aerial photos was estimated at 677 cfs. Some features in the recent aerial photos such as the size of channel bars may appear smaller or may be completely obscured because of the higher flows.

Streamflow along the Rubicon River, Duncan Creek, and Long Canyon Creek, including the North Fork and the South Fork, was similar between the historical and recent aerial photos. On the Rubicon River, streamflow varied between 5-11 cfs in the historical photos and 22 cfs in the recent photos. Flow in Duncan Creek was approximately 12 cfs in the historical photos and was estimated to be approximately 20 cfs for the recent aerial photos. Long Canyon Creek flow was estimated to be 1 cfs or less for both the historical and recent aerial photos.

Several stream reaches were selected for comparing between the historic and recent channel conditions. The selected historic photos were scanned and georeferenced to the recent aerial photography using ArcGIS, and then the images were referenced and scaled to the same size enabling a reasonably accurate visual comparison.

2.3.2.2 Low-Altitude Helicopter Survey Methods

Low-altitude helicopter surveys were conducted from 75 to 250 feet above the stream channel in July and August 2005. Approximately 110 river miles were surveyed, including reaches upstream and downstream of MFP diversions. Stream channels were classified and mapped using the Rosgen Level I and Montgomery-Buffington channel typing systems. Channel types were mapped directly onto the 2002 aerial photography and/or topographic maps. Channel types were determined based on visual identification of geomorphic features pertinent to each of the classification systems. Photographs and video obtained during the helicopter surveys were later reviewed, and supplemented with ground surveys to make a final determination of stream types. In addition to the Rosgen Level I classification, initial information on dominant bed particle size, channel meander type, and presence of large woody debris was collected for the Rosgen Level II classification, which will be further developed with additional surveys as part of the Phase 2 studies next year. Rosgen (1996) describes the use of aerial photography, topographic maps, and helicopter surveys to perform the Level I and II stream classification.

Sediment contributions to the study streams visible during the aerial and ground surveys were identified and mapped. The locations of mass-wasting and bank erosion sites were mapped on aerial photo base maps. Any erosion site visible from the top ridgelines of canyons bounding the river valley to the toe (bottom) of the canyon walls where it adjoins the valley floor (e.g., flowing channel area) was included in the survey. The assessment was limited to the streams and rivers immediately upstream and downstream of Project facilities. Tributaries streams were not included in this assessment. Because some streambank/hillslope areas had low visibility during the aerial surveys, and ground surveys covered only a portion of the study streams, it is assumed that not all sediment production sites were identified. Sediment production sites were classified as active or inactive. Photographs and video obtained during the helicopter surveys were later reviewed, and supplemented with ground surveys to assist with identifying the locations and describing the types of hillslope processes delivering sediment to stream channels within the study area.

Dense upland canopies and topographic shading reduced the visibility of the channel in some locations, which made it difficult to discern details of the channel geomorphology. Stream segment visibility during the aerial surveys was rated from low to high, as shown in Map 1-3. Locations with limited visibility during the helicopter surveys were later assessed by ground survey.

2.3.2.3 Low-Altitude Video Survey Methods

The study streams were videotaped during low-altitude helicopter flights in September and October 2005. An ecologist accompanied the videographer to identify geographic features and river location. The video was flown either in an upstream or downstream direction at an elevation of 200 to 300 feet above the stream channel at air speeds between 15-25 mph. The helicopter pilot attempted to keep the camera above the center of the channel to minimize visual distortions caused by an oblique camera angle, while the videographer attempted to videotape the full channel width at an angle that minimized visual distortions. The video includes real-time Global Positioning System (GPS) coordinates to identify the helicopter location during video playback.

2.3.2.4 Ground Survey Methods

Ground surveys of geomorphic conditions were conducted in September and October 2005. The purpose of the ground reconnaissance was to classify stream types wherever visibility of the channel was limited during the helicopter surveys. A portion of the ground surveys also overlapped with study streams that had good visibility during the aerial surveys. The ground surveys performed in these high-visibility reaches provided an opportunity to verify, and if necessary modify, Rosgen Level I and Montgomery-Buffington channel types. Ground survey locations are provided in Table 2-1 and in Map 2-1. Teams of geomorphologists and riparian ecologists walked selected reaches and identified changes in valley confinement, entrenchment, channel slope, bed and bar sediment, bedforms, and typical channel widths and depths. Air photo field maps and GPS receivers were used to record field locations and measure distance traveled along the channel.

At a few selected and representative locations within a study reach, a hand level, stadia rod, clinometer, and measuring tape were used to make measurements necessary for Rosgen Level I classification. The field measurements were conducted to verify and calibrate visual observations, and to assist with classifying channel types. Field measurements included several parameters:

- Bankfull Width – the width of the channel between the left and right bankfull elevations. Field identification of bankfull elevations were based on geomorphic indicators such as change in bar sediment, change in riparian vegetation, bank undercutting, and water stains.

- Maximum Bankfull Depth – the difference in elevation between the bankfull elevation and the deepest part of the channel.

- Average Bankfull Depth – the average depth of the channel at bankfull flow.

- Floodprone Width – the width of the channel between the left and right floodprone elevations, which equal two times the maximum bankfull depth.

- Channel Reach Slope – determined by measuring with a clinometer the channel slope over a distance of several channel widths.

- Median Bed Grain Diameter – determined by visually assessing the average size of the bed sediment.

Detailed topographic surveys using an engineer's level and standard protocols were not performed for this Phase 1 assessment, but will be conducted during the Phase 2 studies at locations selected in consultation with the resource agencies. Information on bed particle size associated with Rosgen stream types is not presented in this report, except as an overall general characterization. Detailed information on bed particle size will be collected as part of the Level II Rosgen classification.

In addition to recording Rosgen channel types, observations of the dominant channel bed forms (e.g., pool-riffle, plane bed, step-pool, cascade) along with periodic clinometer measurements of channel slope were made to assist with assigning Montgomery and Buffington channel types throughout the study reaches.

Channel classifications as determined by the aerial surveys were usually positively validated by the ground reconnaissance where these overlapped. Greater weight was not given to any individual source of channel classification information. Rather, aerial surveys and aerial photography, topographic maps, and ground surveys were all given equal consideration in the designation of channel types.

Bank erodibility and stability were evaluated during the ground surveys to assess the potential contribution of sediment from streambanks. Streambank erodibility was categorized using a combination of aerial and ground surveys as either "erodible," "semi-erodible," or "non-erodible" based on the streambank composition and susceptibility to erosion or scour. In general, the "erodible" category encompassed those areas where the bank material consisted of cobble and finer grained material or mixtures of boulder and finer grained material that appeared susceptible to erosion.

The "non-erodible" category included banks composed of bedrock and/or boulders. The "semi-erodible" category was predominantly "non-erodible" with isolated areas of "erodible" streambanks. It should be noted that channel areas rated as erodible are not necessarily actively eroding; these banks have the potential to be eroded by streamflow.

2.4 PHASE 1 STUDY RESULTS

The Phase 1 study results are summarized in the following sections. The existing data and information summary is presented first, followed by the geomorphic characterization results.

2.4.1 Existing Data and Information Summary

Pertinent information from existing sources that facilitated the characterization of geomorphic resources addressed in the Phase 1 studies are included by reference in the appropriate result sections. Other information contained in existing reports and articles cited in Appendix A will be used in the development and interpretation of Phase 2 studies and subsequent quantitative studies to be conducted later in the relicensing process.

2.4.2 Geomorphic Characterization Results

2.4.2.1 Geologic Setting

The Sierra Nevada is a fault block mountain range and one of the largest batholiths in the western United States. The Sierra Nevada batholith is believed to have formed from magma generated from the partial melting of the continental crust and is composed chiefly of quartz-bearing granitic rocks intruded with masses of older plutonic rocks and remnants of metamorphosed sedimentary and volcanic rocks (Bailey 1966).

At some time in the middle or late Pliocene time, the Sierra Nevada was uplifted on its eastern margin and tilted to the west. This progressive uplift and rotation resulted in incising the river canyons on the western slopes to depths of 2,000 to 4,000 feet. The present landscape is characterized by features formed during three different ages: pre-volcanic topography that was never buried or has been exhumed from beneath the volcanic cover; younger, relatively plane surfaces developed on the volcanic rocks; and steep modern canyons, incised into both volcanic cover and bedrock.

The study area is characterized by crystalline basement bedrock exposed along the central watercourses through the downstream portions of the watersheds with much of the side slopes and upper headwater portions of the watersheds composed of various volcanic and superjacent sedimentary materials. The dominant rock types found in the study area upstream of Ralston Afterbay are Paleozoic marine deposits (Shoo Fly complex), Pliocene volcanic deposits (Mehrten formation), and granitic rocks. The portion of the MFP downstream of Ralston Afterbay consists of metamorphosed sedimentary and volcanic rocks of Mesozoic age. The dominant formations are the Calaveras Complex, Clipper Gap Formation, and the Mariposa Formation. Sporadic glacial deposits occur throughout the upper portion of the Project area. The locations of these formations in the study area are shown on the Sedimentation and Related Geology maps included in the Map Package (available upon request). The more important formations and/or rock types are briefly discussed in the following.

Shoo Fly Complex

The Shoo Fly Complex is comprised of sedimentary rocks deposited in a prehistoric inland-sea, which have since been uplifted, folded, and metamorphosed. The Shoo Fly Complex is dominated by chert and is highly contorted and rotated with very steep to near vertical bedding surface planes. With the exception of the North and South Forks of Long Canyon Creek, the study 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.

Mehrten Formation

Andesitic volcanic deposits along the western slopes completely buried the bedrock topography of the northern Sierra Nevada. As a consequence, the pre-volcanic drainage was entirely obliterated and a new drainage was developed (Watson, C. and J. H. Humphrey 2002). The andesite was deposited mainly as mudflows (lahars) consisting chiefly of volcanic debris that originated on the flanks of the volcanoes. These deposits are mapped as the Mehrten Formation and occur throughout the study area. The largest area of the Mehrten Formation extends westerly from the crest between the Middle Fork American River and the Rubicon River down through the Long Canyon Creek drainage.

Granitics

Granitic rocks are exposed along the crests of the southeast portion of the study area and along Rubicon River, Middle Fork American River, and Long Canyon Creek. The exposure along the these watercourses is a result of the uplifting and tilting that eroded the overlying volcanics, rejuvenated streams, and incised the present day stream channels. The stream channels that bisect granitic bedrock tend to be steep and confined, and consist of course bed elements such as boulders.

Glaciation

The Sierra Nevada was glaciated several times during the Pleistocene. These events modified the topography of the watershed, as evidenced by the presence of wide, U-shaped valleys in the study area. Glacial striations and glacially shaped assymetrical bosses on the bedrock surface indicate that the Rubicon River Canyon was glaciated downslope to at least an elevation of 3,975 feet (RM 27.0). The Rubicon Canyon glacier extended into the South Fork Long Canyon and North Fork Long Canyon.

Glaciation is evident on the 2005 aerial photographs of Long Canyon Creek. The photographs indicate that Long Canyon Creek downstream from the confluence with the North and South Forks was glaciated to about RM 7.0. Upstream from RM 7.0, the valley is wide and U-shaped, whereas downstream it is narrower and V-shaped. The narrower V-shaped valley is more highly entrenched and confined than the U-shaped reach upstream.

A smaller glacier is suspected of originating on the north slope of Little Bald Mountain, although clear evidence has not been documented. This glacier scoured the terrain and deposited lateral moraines downstream of Robinson Flat (RM 9.5) in the Duncan Creek Watershed.

Glaciation introduced till and moraine material, both of which are present-day sediment sources. Glacial deposits are evident in the Project area, particularly in the upper portions of the study area. Glacial deposits have been mapped in the headwaters of the North Fork of the Middle Fork American River, the Middle Fork American River, the Rubicon River, the South Fork Rubicon River, and South Fork Long Canyon Creek. These glacial deposits are located upstream of Project diversions except for a small area on the Rubicon River downstream of Hell Hole Dam. The erosion of glacial deposits tends to contribute gravel-sized sediment to the system.

2.4.2.2 Sediment Supply Characteristic Results

Sediment sources to the study streams that were visible during the aerial and ground surveys are summarized in Table 2-2 and are presented in the Sedimentation and Related Geology maps included in the Map Package (available upon request). A total of 84 features were identified. Because some streambank/hillslope areas had low visibility during the aerial surveys, and ground surveys covered only a portion of the MFP streams, it is assumed that not all sediment production sites were identified. However, the purpose of this analysis was to describe the sediment production processes and to characterize general sediment distribution in the study area rather than to identify all sediment production sites.

Results from the aerial and ground surveys show that mass-wasting processes may play an important role in contributing sediment to the study streams. The majority of sediment supplied to study streams is derived from the steep canyon walls in the form of overburden and weathered rock. Smaller materials enter the streams from the canyon walls by sheetwash during rainfall. In addition, episodic inputs of material from debris slides and rock falls may contribute a substantial portion of sediment. The sediment size classes provided to the streams range from sand size particles to large boulders. While some mass-wasting features may fall into subcategories or exhibit several processes, for the purpose of this study, mass-wasting features were divided into four categories: debris slides, rock falls, debris torrents, and bank erosion. These mass wasting features are discussed below followed by a discussion of bank and hillslope erodibility.

Debris Slides

Debris slides occur when a mass of unconsolidated material breaks loose and slides over the underlying bedrock surface. Debris slides are especially common where thin, unconsolidated sediment mantling sloping bedrock surfaces become saturated and separate from the underlying rock surface (Selby 1993). During the Phase 1 studies, debris slides were not differentiated from rock slides. A total of 29 debris slides were identified throughout the study area and were present in all of the sub-watersheds except South Fork Long Canyon Creek. The largest slide observed was on Long Canyon Creek at RM 10.5. Although this slide was classified as a debris slide, it is possible that it is a debris torrent that may have initiated in the headwaters of a tributary stream and broke loose in a more fluid condition.

The Rubicon River drainage contained 41% of the inventoried debris slides (Appendix E, Photo E-1). The Rubicon River has been identified as the principal source of sediment for Ralston Afterbay Reservoir (Bechtel Corporation 1997), and contains the highest number of debris slides within the study area. A significant number of slides were triggered by the flood surge that occurred when the partially completed Hell Hole Dam failed during construction in 1964. However, some of these slides may have existed prior to the failure, and the removal of detritus from the toe of the slide allowed renewal of movement (Scott and Gravlee 1968). This study did not analyze the extent to which debris slides were triggered from the dam failure and flood surge, but it may be possible to do so using historic photography that pre-dates the dam failure, if such an analysis is warranted. A large debris slide was observed on the Rubicon River at RM 9.3. This slide is believed to have been initiated by the flood surge associated with the failure of the partially completed Hell Hole Dam in 1964. This slide remains active as the slide scarp evolves to a more stable angle of repose (Appendix E, Photo E-1).

Rockfalls

Rockfalls are most prevalent on steep slopes where the parent rock is well jointed, providing many joint-bounded blocks, which are free to move upon removal of support. Undercutting of the rock by excavation of material at the base of a slope accelerates the process. Many of the rockfalls created talus slopes. Talus slopes consist of an accumulation of loose fragments in cones or aprons at the base of steep slopes produced by continued rockfall and reflecting the input of fragments from above (Easterbrook 1993). Thirty active rock falls were identified in the MFP watersheds. A large majority of rock falls, 57%, occurred in the Long Canyon Creek drainage. Rockfalls were identified on a nearly continuous basis along the inner gorge of the Rubicon River, the Middle Fork American River (except downstream of Ralston Afterbay), and Long Canyon Creek, making identification of discrete rockfalls sites very difficult. Where the channel was confined by steep bedrock slopes, especially in the jointed bedrock outcrops of the Shoo Fly Formation, it was unfeasible to count, and almost impossible to distinguish, one individual rockfall from another (Appendix E, Photo E-2). Because rockfalls consist of very coarse sediments delivered by non-fluvial processes, much of the boulder material delivered to the channel is likely not movable by the more frequently occurring flows. Coarse material in the channel at locations of rockfalls (Appendix E, Photo E-3) and the existence of talus slopes (Appendix E, Photo E-4) were used as identifiers for mapping active rockfalls. Rockfalls primarily generate very coarse bed particle sizes (boulders), and deliver significant amounts of material to the Rubicon River, the Middle Fork American River, and Long Canyon Creek channels.

Debris Torrents

Debris torrents are a special type of debris flow occurring in main drainage channels caused by short debris avalanches in steep-walled tributary gullies (Swanston 1970). Many small tributaries in the study area have been formed by debris torrents, as witnessed by the straight channels that run from top to bottom of the ridge with little or no sinuosity (Watson and Humphrey 2002). A total of nine debris torrents were identified in the study area. Two-thirds of the debris torrents were located in the Middle Fork American River within the boundaries of the Star Fire (Appendix E, Photo E-5). Several raw channels were observed throughout the Star Fire area. The higher number of debris torrents may be related to increased visibility, a consequence of the denudation of the vegetation. Removal of the forest vegetation decreases or eliminates interception of rainfall and evapotranspiration, which results in higher over-land (Hortonian) flow which may trigger or accelerate debris torrents by increasing peak discharges and destabilizing streambanks from vegetation removal.

Debris flow deposits were also observed in the South Fork Long Canyon Creek upstream of the South Fork Diversion. Lateral levees of poorly graded, loose, unconsolidated material were observed along the margins of the stream channel. Debris flows from the smaller, high-gradient tributaries are likely to be a significant contributor of sediment into Project streams.

Bank Erosion

Bank-cutting is a common process that supplies sediment to stream channels. Areas that are currently being eroded or recently have been eroded were identified and categorized as eroding banks (Appendix E, Photo E-6). These areas exhibited raw, exposed, and vertical banks. A total of 16 eroding banks were identified in the MFP watersheds. Eroding banks were identified in all of the watersheds except in Long Canyon Creek and Middle Fork American River. The sediment input to the study streams appears to be dominated by mass-wasting features such as debris slides, rockfalls, and debris torrents rather than by bank erosion.

Bank and Hillslope Erodibility

The majority of the study area is characterized by steep, V-shaped canyons with unstable hillslopes. The majority of soils have erosion ratings of high to very high (USDA-FS 2003a and 2003b). Although these conditions would suggest a high level of sediment contribution, the study streams appear to be “supply-limited”. “Supply-limited” is a condition whereby the channel capacity to transport sediment greatly exceeds the sediment supply. It does not necessarily mean that there is no or a small sediment supply. The presence of bedrock type channels and steep-gradient alluvial channels are strong indicators of supply-limited conditions (Montgomery and Buffington 1997). Conversely, the steep, high-energy channels (bedrock, step-pool, cascade) recover quickly from sediment deposition events such as debris flows because of their high transport capacity (Montgomery and Buffington 1998). Another indicator of supply-limited conditions in the study area is the lack of alluvial deposits at the confluence of tributaries. Alluvial deposits were not observed at the tributary confluences during the aerial and ground surveys. This is evidence that flows on the study streams are capable of transporting the sediments supplied by the tributary streams.

Overall, 42% of the surveyed streams in the study area were classified as "non-erodible" and 44% were classified as "semi-erodible". The "semi-erodible" streambanks were located in reaches where isolated pockets of erodible material were interspersed in bedrock reaches. In total, 86% of the study streams surveyed are dominated by exposed bedrock at the hillslope toe adjacent to the bankfull channel. The remaining 14% of the study streams are classified as "erodible". These reaches are located on the Middle Fork American River downstream of Ralston Afterbay and on portions of the North and South Forks of Long Canyon Creek.

The lower reach of the Middle Fork American River downstream of Ralston Afterbay has areas of "erodible" and "semi-erodible" banks. However, no discrete areas of erosion were identified in the aerial or ground surveys. This may be a result of the high width/depth ratio, low gradient, and well vegetated banks that characterize the Middle Fork American River downstream of Ralston Afterbay. The river's energy may be expended in reworking bars rather than eroding banks during higher than average flows.

2.4.2.3 Channel Classification Results

The streams and rivers upstream and downstream of the MFP dams and diversions were classified according to two stream classification systems, Rosgen and Montgomery-Buffington. The Rosgen classification results are discussed first, followed by a discussion of the Montgomery-Buffington classification results.

Rosgen Level I Stream Types

The study streams were classified according to Rosgen and entered into a GIS database that was then used as a basis for the analyses presented in this report. The resulting GIS-based maps are included in the Map Package (available upon request). The following is an overview of Rosgen classification results.

- Most of the study streams are highly entrenched (low floodprone width/bankfull width ratio) and confined by relatively narrow canyons.
- With the exception of the Middle Fork American River downstream of Ralston Afterbay, bedrock outcrops are commonly observed, and provide structural control on the vertical and lateral adjustment potential for most channel reaches.
- Channel types identified in the study area include A, B, G, and F.
- Channel gradients are 2% to 4% on a reach-scale for most of the study streams, although local gradients can be higher. The Middle Fork American River

downstream of Ralston Afterbay is the lowest gradient stream reach (approximately 0.5%) and is almost entirely a F-channel type.

- Because most of the channels are highly entrenched, with a few moderately entrenched stream reaches (B-channel type), floodplains are nearly non-existent along most of the study area, or limited to a very narrow width (i.e., floodprone width is not substantially wider than the bankfull width).

- The B-channel type is primarily found in the North and South Forks of Long Canyon Creek and the upper half of the Long Canyon Creek mainstem. A few reaches of Duncan Creek, the Middle Fork American River, and the Rubicon River are a B-channel type.

- The Rubicon River is identified as F- and G-channel types, except for the reach near Hell Hole Dam. This reach was identified as a B-channel type, and was aggraded during the failure of the partially completed Hell Hole Dam in 1964 and the associated flood surge.

- Duncan Creek is predominantly comprised of B- and G-channel types. A 1-mile reach upstream of the confluence with the Middle Fork American River is a steep, highly-entrenched, A-channel type.

- Boulders, cobble, and gravel were commonly observed in all of the study streams, often in about equal mixtures. Sand size material was never observed to be a dominant particle size.

For some reaches the determination of Rosgen Level I stream type was not conclusive because one or more of the parameters appeared to be near the break between, or fall within, two different stream types. Where the channel classification category was not clear, more than one possible stream type was designated for a reach (e.g., F or G). Phase 2 studies that use a more detailed Rosgen Level II analysis based on measured and surveyed data collection techniques will be used to verify the Rosgen Level I stream classifications.

Many of the Rosgen Level I parameters were determined from topographic and landform maps, and from aerial photography (Rosgen 1996). Channel slope was derived from topographic maps. Longitudinal profiles of the MFP streams are plotted for Duncan Creek (Figure 2-1), the North and South Forks of Long Canyon Creek (Figure 2-2), Long Canyon Creek (Figure 2-3), the Middle Fork American River (Figure 2-4), and the Rubicon River (Figure 2-5). Table 2-3 is a summary of channel gradient for selected reaches and significant transition points for each of the study streams. Table 2-4 provides a summary of sinuosity values for selected reaches of the study streams.

Entrenchment and width-depth ratio were estimated based on visual observations during the helicopter and ground surveys. Measurements of entrenchment, width-depth ratio, and slope (in addition to slopes derived from the topographic maps), were taken at a few selected locations during the ground surveys. These measurements were obtained to help guide the channel classification work, but were given no greater weight than the visual observations because the data were collected with "approximate" measuring techniques. The ground-based survey data are provided in Table 2-5. In addition to the Level I classification, the valley type (Rosgen, 1996) is also identified and described.

The following provides a summary of the Rosgen Level I classification and valley type results, organized by study stream.

Duncan Creek

Duncan Creek has a wide range of gradients, from 1.4% to over 10% (Table 2-3) and a low sinuosity (Table 2-4). The downstream-most 1-mile reach just upstream from the confluence with the Middle Fork American River is a steep, highly-entrenched, A-channel type (Table 2-6). This lowermost 1-mile section of Duncan Creek is a Type I valley.

Most of Duncan Creek upstream from the A-type reach (5 miles) is identified as a moderate gradient, moderately entrenched B-channel type. The valley is predominantly Type II, although there are sections that are likely Type I. There are 1.7 miles identified as either a B- or G-channel type that could not be clearly distinguished during the Level I study. 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 probably comprises nearly half of the A, B, and G-channel types. Boulders in combination with cobble size material, and usually including a substantial portion of gravels, are also found in all three channel types.

North Fork Long Canyon Creek

North Fork Long Canyon Creek has very similar geomorphic characteristics as the South Fork, with the entire length upstream to the diversion identified as a B-channel type (Appendix F, Photo F-1). The channel has gradients of approximately 2% to 5% (Table 2-3) and a low sinuosity (Table 2-4). Bedrock exposures were frequently observed throughout the reach. Boulders, cobble, and gravel were usually found in about equal proportions on the channel bed. North Fork Long Canyon Creek is in a Type II valley.

South Fork Long Canyon Creek

South Fork Long Canyon Creek from the confluence with the North Fork to the diversion (3.3 miles) is identified as a B-channel type. Channel gradients range from approximately 2% to 5% (Table 2-3), and channel sinuosity is low (Table 2-4). Bedrock exposures were frequently observed throughout the reach. Boulders, cobble, and gravel were usually observed in about equal proportions on the channel bed. South Fork Long Canyon Creek is in a Type II valley.

Long Canyon Creek

Characteristic of an A-channel type, the lower half of Long Canyon Creek from RM 0.0 (confluence with the Rubicon River) to RM 7.0 has a steep gradient (about 5%), low sinuosity, and low-width-depth ratio, and is highly entrenched (Table 2-7). This lower 7-mile long reach is confined by a V-shaped channel that is structurally controlled by bedrock exposures, with boulders, cobbles, and gravels commonly present (Appendix F, Photo F-2). This section of Long Canyon Creek is predominantly a Type I valley.

The upper half of Long Canyon Creek from RM 7.0 to RM 11.4 (confluence with North and South Forks Long Canyon Creek) lies within a relatively wider, U-shaped valley section which holds a more moderately entrenched, moderate width-depth ratio that is characteristic of a B-channel type (Appendix F, Photo F-3). 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 were usually the co-dominant bed material size, and sometimes gravels were also equally co-dominant with boulder and cobble. This upper half of Long Canyon Creek is a Type II valley, with moderate relief and side slopes, and less than 4% longitudinal gradient.

Middle Fork American River

The Middle Fork American River between the North Fork American River confluence and Ralston Afterbay (RM 0.0-RM 24.7) is highly entrenched in a wide canyon (Appendix F, Photo F-4) that is defined as a Valley Type IV. Valley Type IV is a meandering, entrenched (i.e., deeply incised) and confined alluvial landform, commonly described as canyons and gorges, with valley gradients less than 2% (Rosgen, 1996). The Valley Type IV is usually structurally controlled (bedrock outcrops were observed in this reach) and incised in highly weathered materials. The channel has a high width-to-depth ratio, low-gradient (0.5%), and a moderate-to-high sinuosity, (Table 2-4) that are characteristic of a F-channel type (Table 2-8). High amplitude meanders around large point bars are common. The F-channel types tend to laterally migrate, although lateral shifts in channel planform appear to be few, indicating 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 observed in the same reach. The downstream-most 7 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 size material. Sand was rarely observed as a dominant particle size.

The channel dimensions in the Middle Fork American River between Ralston Afterbay and Middle Fork Interbay (RM 25.7-RM 35.6) are smaller than downstream (due to smaller contributing drainage area), with higher average gradients (approximately 2.5%) (Table 2-3), and with localized gradients as high as 5%. The channel in this reach is highly-to-moderately entrenched, with a high-to-moderate width-depth ratio. The valley walls are often comprised of exposed bedrock near the hillslope toe-bankfull channel interface. The confining valley walls limit the potential for lateral channel migration. The channel is predominantly contained within a Valley Type II but sometimes alternates with sections of Valley Type I. The Valley Type II has moderate relief and side slope gradients and valley floor slopes less than 4%, with the B-stream type most commonly found (Rosgen, 1996) in this setting. The Valley Type I is V-shaped, confined, and often structurally controlled. Elevational relief is high, valley floor slopes are greater than 2%. Valley materials vary from bedrock to residual soils occurring as colluvium, landslide debris, glacial till, and other depositional materials. Stream channel erosional processes in Valley Type I vary from very low and stable to highly erodible with debris torrents or avalanches.

For most of this reach, it was unclear whether or not the channel is best categorized as an F or B Level I channel type, so both were assigned at this time. The difference between the two channel types is that the F-type is more highly entrenched, with a higher width-to-depth ratio. The Fb variant (Table 2-8) indicates that the channel gradient is greater than 2% up to about 4%. Channel bed materials observed 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 represented in nearly equal proportions.

The overall gradient in the Middle Fork American River between Middle Fork Interbay and French Meadows Reservoir (RM 36.0-RM 47.2) is over 4%, with higher localized gradients. Much of the channel (6.2 miles) is identified as an A-type (Appendix F, Photo F-5). The A-type stream is a stable, steep, high-energy, highly entrenched, and confined channel. Bedrock sections often alternate with boulder-to-cobble dominated channel sections in this reach. Gravels were also consistently observed in low velocity areas such as pool tailouts. A 2.2 mile long B-type channel reach that is more moderately entrenched, with a moderate width-depth ratio is located between RM 42.0 and RM 44.2 (Table 2-8). It was unclear if the F-channel or A-channel type should be designated between RM 37.4 and RM 39.7, so both are assigned at this time. Both channel types are highly entrenched, but the A-type has a lower width-depth ratio. Valley types are predominantly Type II, but occasionally alternate with Type I as described above for the reach between Ralston Afterbay and Middle Fork Interbay.

Rubicon River

Overall, the Rubicon River channel gradient downstream of Hell Hole Dam is 1% to 2%, which is lower than most of the Middle Fork American River upstream of Ralston Afterbay (Table 2-3). Gradients were higher (up to approximately 4%) in localized areas along the Rubicon River. 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. The G-channel type is highly entrenched, similar to the F- and A-channel types, but has a lower width-to-depth ratio than the F-type. In places where the canyon walls are further apart and the river is wider, the channel was identified as F-type. In reaches where the canyon walls are close together, causing the river to be more narrow with greater increases in depth rather than width (i.e., low width-depth ratio) at bankfull flow, the channel is a G-type (Appendix F, Photo F-6). In several reaches both channel types are identified because it was not clear if the width-depth ratio was within the range of values appropriate for a F- or G- channel type (Table 2-9). The G-type channel in the Rubicon River is structurally controlled by the presence of bedrock exposures, which makes 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 is also structurally controlled by bedrock exposures and boulders and is very stable. Valley types are predominantly Type II, but occasionally alternate with Valley Type I.

The approximately 4 mile Rubicon River reach immediately downstream of Hell Hole Dam is assigned a B-channel type (Appendix F, Photo F-7). This section of the Rubicon River is known as the "Parsley Bar" Reach (Appendix F, Photo F-8) and is an alluviated valley flat that demarcates the most downstream limits of glaciation (about RM 27.0). This reach aggraded by approximately seven feet with material from the 1964 dam failure (Scott and Gravelee 1968). The channel geomorphology was also affected further downstream, throughout the entire Rubicon River and apparently to the Middle Fork American River and 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 (Scott and Gravelee 1968). The cross-section profile of the river was altered from a V-shaped channel to a U-shaped channel. Valley Type V, which has moderately steep side slopes, "U"shaped valley form, and longitudinal slopes less than 4%, is most indicative of this 4 mile reach.

There was no obvious evidence of channel thalweg aggradation below Parsley Bar during field observations in 2005; the Rubicon River may have down-cut through aggradational deposits since the Scott and Gravelee study was conducted. However, unusual depositional features on top of existing bar deposits, and very coarse-material boulder bars were noted during field surveys as far downstream as the Long Canyon Creek confluence. These depositional features and coarse boulder-bars are likely due to the effects of the 1964 flood surge.

Montgomery-Buffington Stream Types

All of the study streams were classified according to Montgomery-Buffington and entered into GIS. The GIS data were then used as a basis for the analyses presented in this report. The resulting GIS-based maps are included in the Map Package (available upon request). The following provides an overview of the Montgomery-Buffington classification results.

- At a regional scale, all of the study streams can be characterized as mixed bedrock-alluvial channel types, with the exception of Middle Fork American River downstream of Ralston Afterbay.

- The Middle Fork American River downstream of Ralston Afterbay is identified as a pool-riffle channel type, exemplified by bar-pool-riffle sequences throughout nearly all of its 24.7 mile length. There are very few areas of free-formed pool riffle bedforms in any of the other reaches of the Middle Fork American River, or any of the other study streams.

- A forced pool-riffle morphology is found on the Middle Fork American River upstream of Ralston Afterbay, almost always in combination with other bedform types. The forced pool-riffle morphology also characterizes a substantial proportion of the Rubicon River. The forced pool-riffle bedform is associated with large pools that are formed by scour of the channel against bedrock outcrops.

- Approximately 32.4 miles of the study streams were assigned channel types that include either the cascade or step-pool bedform, or in combination with any other bedforms (except bedrock and plane-bed). These are alluvial channel types that are associated with higher gradient, coarse bed material, with high sediment transport capacity.

- There are approximately 29 miles of forced pool-riffle, plane-bed, or plane-bed in combination with pool-riffle (both free and forced) types in the study streams. These channel types tend to be transitional between supply-limited (i.e., the transport capacity is much greater than the sediment supply) and transport-limited (i.e., the transport capacity is much less than the sediment supply) morphologies.

- Bedrock channel types in combination with the other alluvial channel types, usually cascade or step-pool alluvial bedforms, represent about 16.5 miles of the study streams. About one-half of Long Canyon Creek has a mixed bedrock-alluvial channel type. Mixed bedrock-alluvial sections are also identified on Duncan Creek.

The results of the Montgomery-Buffington channel classification are discussed below, organized by study stream.

<u>Duncan Creek</u>

Step-pool, plane-bed, cascade, and bedrock types are found in various combinations on Duncan Creek. Step-pool/plane bed is the most frequently observed channel type (Appendix G, Photo G-1), representing 2.9 miles (Table 2-10). This is an intermediate bedform, with small “steps” of random boulders comprising a predominant portion of the channel material. The steps are not as pronounced as in a classic step-pool channel, and thus this channel type has elements of the plane-bed form which does not have significant vertical oscillations, hence the term “plane-bed”. This bedform has sometimes been referred to as a “riffle-step” (Montgomery-Buffington 1997). The plane-bed channel type also comprises about 1.7 miles of channel. Bedrock is commonly present as a combined intermediate bedform with either step-pools or cascades, representing a total of 3.5 miles in these various combinations.

North Fork Long Canyon Creek

A step-pool/plane-bed/pool-riffle channel type is assigned to most (2.5 miles) of the North Fork Long Canyon Creek study reach (Table 2-11). Characteristics of all three Montgomery-Buffington channel types are found in close proximity. Approximately 0.5 mile of the stream reach is characterized as a bedrock channel type.

South Fork Long Canyon Creek

The plane-bed channel type in combination with either step-pool or pool-riffle is designated as an intermediate channel type for most of the South Fork Long Canyon Creek (Table 2-12). The step-pool/plane-bed type was assigned to the higher gradient sections, comprising approximately 2 miles of the stream. The plane-bed/pool-riffle type is assigned to the lower gradient sections, comprising approximately 0.9 miles. Bedrock channel sections were identified for 0.4 mile of stream.

Long Canyon Creek

Plane-bed, step-pool, and bedrock in various combinations make up Long Canyon Creek channel types (Table 2-13). Bedrock is a substantial component of 5.9 miles of the Long Canyon Creek channel. The step-pool form is nearly always present as part of the channel type along the entire stream length (Appendix G, Photo G-2).

Middle Fork American River

The Middle Fork American River downstream of Ralston Afterbay is almost entirely an alluvial pool-riffle type channel, except along the Ruck–A-Chucky Rapids section (Table 2-14). The pool-riffle channels have an undulating bed surface that is defined by a sequence of bars, pools, and riffles. Lateral bedform oscillation (meandering channel formed by bars) distinguishes this channel type from other channel types.

Upstream of Ralston Afterbay, the Middle Fork American River bedform changes in response to a higher gradient and narrow valley that confines the channel. The forced pool-riffle morphology commonly occurs as part of a defined intermediate channel type in combination with either step-pool, cascade, or plane-bed types. The forced pool-riffle bedform was almost always created by flow impinging against a bedrock valley wall or outcrop that provides a “hard-point” where the sheer force of high-flows could work against the channel bed, scouring a pool (Appendix G, Photo G-3). Where the gradient is locally higher, cascades or step-pools form the “riffles” in between the forced pools. Bars, where present in this reach, are much smaller than the type of free-formed pool-riffle-bar morphology downstream of Ralston Afterbay. Bedrock exposures were common but not of sufficient length (about 0.2 mile for the minimum mapping unit in this study) to be identified as a bedrock type channel reach, except between RM 33.0 and RM 33.4.

Upstream of Middle Fork Interbay, the Middle Fork American River bed transitions to bedforms more typical of higher gradient channels; predominantly step-pool, cascade, and bedrock, usually as a combined, intermediate form that is not one distinct channel type. Longer bedrock channel reaches were more commonly observed in this reach, totaling approximately 4.2 miles as bedrock reaches (Appendix G, Photo G-4) or as an intermediate type in combination with step-pools. A 2.2 mile reach is characterized by an intermediate plane-bed/forced pool riffle morphology.

Rubicon River

The forced pool-riffle morphology commonly occurs in the Rubicon River as part of a defined intermediate channel type usually in combination with cascades, which form the "riffles" in steeper gradient sections between the forced pools (Appendix G, Photo G-5). The forced pool-riffle is almost always created by flow impinging against a bedrock valley wall or outcrop. The forced-pool-riffle/cascade channel type makes up almost 19 miles of the Rubicon River channel type (Table 2-15). As with the Middle Fork American River, bedrock exposures were common but not of sufficient length to be identified as a bedrock type channel reach. The uppermost aggraded reach that encompasses Parsley Bar to Hell Hole Dam (RM 27.3-RM 30.3) is designated a plane-bed channel type.

2.4.2.4 Results of Historic Channel Conditions Analysis

The following presents a comparison of pre- and post-Project channel conditions along the Middle Fork American River and the Rubicon River, organized by study reach. The findings are based on analysis of aerial photographs and the low-altitude video. Note that the aerial photographs and video could not be used to conduct this analysis on Duncan Creek, North and South Fork Long Canyon Creeks or on Long Canyon Creek.

Middle Fork American River

The following summarizes the general conclusions that can be made regarding the Middle Fork American River when comparing the recent photography and videography to photography taken in the early 1960s.

- Channel planform downstream of Ralston Afterbay (RM 0.0-RM 24.0) is a sinuous bar-pool-riffle bedform, with little observed change since the 1960s.

- Sediment storage on the Middle Fork American River has also changed very little since the 1960s based on bar size and frequency.

- The frequency, distribution, and size of depositional features such as mid-channel bars has not substantially changed since the 1960s.

- Geomorphic channel features were difficult to discern along the upper most reach of the river (RM 37.0-RM 47.2), but observed features and channel morphology appear to be similar.

- Although localized changes were observed along the Middle Fork American River, none of these differences were considered to be substantial.

Observations regarding specific reaches along the Middle Fork American River are summarized in the following.

Confluence with North Fork American River Upstream to Ralston Afterbay (RM 0.0–RM 24.0)

Pre- and post-project sediment storage and channel geomorphic characteristics were found to be similar in this reach of the Middle Fork American River. This reach also has a distinctive cascading pool-riffle bedform that is easily recognizable from RM 9.0 to RM 11.0, and very similar in both the historic and recent aerial photographs. Bar-pool-riffle bedforms are also common along this reach, with a significant amount of sediment 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 the historic photography. At a few scattered locations, approximately 5% in length of the stream reach, bars were present in the historical aerial photographs that 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 have increased particle size composition compared to the historical aerial photographs.

Channel planform and sinuosity also appear similar throughout this reach between the historic and recent project photographs. One relatively small change in the channel planform was observed just downstream of Ralston Afterbay at RM 23.0 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 (the line of greatest depth in the stream channel). Overall increases or decreases in sediment storage at these locations were not observed between the historic and recent aerial photographs.

Two locations were chosen along this reach of the river to illustrate the differences and similarities observed between the historical and recent aerial photographs. First, shifts in thalweg position are illustrated with an example comparing channel geomorphology at Poverty Bar (RM 6.4-RM 7.1), and second, reaches with minimal change in bar position and size are illustrated with an example from RM 18.5 to RM 19.4.

At Poverty Bar (Figure 2-6), the thalweg shifted from the inside of the channel to the outside along the cutbank. The thalweg shift changed the location of the channel bars, but the total amount of sediment stored (based on the bar surface area) remains similar. Channel width at this location also appears to remain similar with an average width of 409 feet in the historical photograph compared to an average width of 435 feet in the recent photograph. The small difference in channel width could simply be a result of the level of error present in measuring channel width. Particle size could not be discerned from either the historical or recent photographs at this location.

Further upstream between RM 18.6 and RM 19.4, several alternate and point bars were identified in both the historical and recent aerial photographs (Figure 2-7). Two bars along the north side of the channel are clearly depicted in the historical and recent aerial photographs and appear similar in size, shape, and particle size composition. Two additional bars observed along the south side of the channel in the historical photograph are obscured by shadows in the recent aerial photograph. The 2005 video was used to confirm the presence of these two bars, which were determined to be similar in size to those in the historical aerial photograph. Although particle size composition could not be definitively determined, both bars appear similar in texture. Channel width along this reach is also similar between historical and recent aerial photographs. An average width of 366 feet was measured in the historical photographs and an average width of 346 feet was measured in the recent photographs. Again the small discrepancies between the historical and recent channel widths are within the standard error of measurement.

Ralston Afterbay Upstream to Middle Fork Interbay (RM 26.0-RM 36.5)

Compared to the reach downstream of Ralston Afterbay, the Middle Fork American River between Ralston Afterbay and Middle Fork Interbay is entrenched in a narrow canyon with a denser canopy cover that obscures clear viewing of some channel sections. Regardless of visual limitations, geomorphic features were found to be similar in this reach between the historic and recent photographs along the sections where the channel was clearly visible. Significant differences in sediment storage characteristics along this reach of the river were not observed between the historical and recent aerial photographs. The 2005 low-altitude video of this river reach was also used to compare with the historical aerial photographs when the 2002 aerial photograph did not provide a clear view of the channel.

The coarse scale of the historical aerial photograph limits the observations along this reach, but the overall morphology is similar to that observed in the video. Periodic channel width measurements were also taken using the historic aerial photography. Accurate and representative channel widths from the recent aerial photography were not possible due to the angle of the photograph and the dense vegetation surrounding the channel. However, visual comparisons between the photographs augmented by the low-altitude video suggest that recent channel width is similar to the width of the 1960’s channel.

Channel bars were also observed along this reach of the river. Mid-channel bars were identified in both the historical and recent aerial photographs between RM 28.8 and RM 29.1, including a point bar identified at RM 28.8 (Figure 2-8). The similar depositional pattern of the point bar indicates little difference in sediment storage and bar position between the historic and recent photographs. The mid-channel bars between RM 28.9 and RM 29.1 have changed position and surface area. The mid-channel bar at RM 29.0 appears similar in size, while the two bars directly to the south appear to have developed into one large bar. The long alternate bar on the north side of the channel appears smaller in the recent photograph. Channel sinuosity and planform also appear similar between the historical and recent aerial photographs. Channel width was measured at RM 29.0 and estimated to be 290 feet wide in the historical aerial photograph. A similar measurement of 280 feet was estimated in the recent aerial photograph.

Middle Fork Interbay Upstream to French Meadows Reservoir (RM 37.0-RM 47.2)

Exposed bedrock is common along much of this reach, which has a high reflectivity in the black and white photographs, making it difficult to distinguish bedrock from exposed, poorly vegetated bars. In addition, the channel was often obscured in the recent aerial photograph by vegetation or by shadows created by the oblique angle of the photograph. Therefore, the 2005 video was used to identify and describe recent features.

Overall, this reach of the river 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, likely boulders, were discernable in both the historical aerial photographs and in the 2005 video, indicating little change in particle size at these locations.

Coarse sediment was discernable on both the historical and recent aerial photographs and confirmed by the 2005 video at RM 46.1. From visual comparisons between the photographs, boulders appear to be the dominant particle size, with scattered indefinable smaller sized sediment also present. Due to the coarse scale of the historical photograph, accurate channel width measurements could not be acquired at this location.

Just upstream from this location between RM 46.6 and RM 47.2, small changes to the geomorphic features in the channel were observed (Figure 2-9). A large pool at RM 47.1 was observed in the recent aerial photograph, where only large boulders were observed in the historical aerial photograph. Small changes are most likely attributed to the construction associated with French Meadows Dam and Reservoir, located just upstream at RM 47.2.

Rubicon River

Since the 1960s, the Rubicon River has dramatically changed in channel morphology (including aggradation, channel widening, and sediment storage, as represented by the size and frequency of bars) immediately downstream from Hell Hole Dam. Other researchers (Scott and Gravlee 1968) have concluded that these changes are due to failure of the partially completed Hell Hole Dam in 1964 and the accompanying flood surge. The most dramatic changes to the channel occurred within the approximately 5 mile reach downstream of Hell Hole Dam, but failure effects were observed 10 miles downstream of the dam. The frequency and size of bars increased along the Rubicon River reach from RM 2.0 to RM 3.0. This thalweg change and increase in channel bars is most likely a result of the flood surge. Changes to the channel further upstream may have occurred, but partial visibility along RM 6.0 to RM 20.0 limited direct comparisons of historic and recent photography.

Rubicon River - Ralston Afterbay (RM 0.0) Upstream to RM 20.0

Increases in sediment deposition between the historic and recent photographs were observed along the downstream-most 20 miles of the Rubicon River. The appearance of new bars and adjustments of the channel planform along the thalweg are evidence of increased sediment deposition.

An example of an increase in sediment storage and change in channel morphology was observed between RM 3.4 and RM 3.7, which is shown in Figure 2-10. Several new bars are identified in the recent aerial photograph at RM 3.4, RM 3.5, and RM 3.7. Also, two bars observed in the historical aerial photograph from RM 3.5 to RM 3.6 appear to form one large bar in the recent aerial photograph. The surface area of the small bar identified in the historical aerial photograph at the confluence with Long Canyon Creek (RM 3.65) has enlarged. The thalweg has also shifted position in the reach between RM 3.4 and RM 3.7. A new mid-channel bar at RM 3.5 in the recent photograph has caused the flow path to shift from the outside to the center of the channel.

The additional bars and sediment observed in the recent aerial photograph might be a result of the flood surge that occurred as a result of the Hell Hole Dam failure. Scott and Gravlee (1968) determined that channel aggradation occurred as far downstream as the Middle Fork American River as a result of the flood surge, but the exact amount of aggradation is not known. Visual accounts from pre- and post-flood surge mention an increase in channel sediment, most notably with the coarser sediments (Scott and Gravlee 1968).

Further upstream from RM 11.0 to RM 20.0, the larger scale of the historical photographs limited the ability to detect small changes in channel bar surface area or particle size. However, the alternate bars in the historical photograph appear similar in size to recent photography.

One noticeable change along this reach is an increase in the amount of coarse sediment scattered along the sides and within the channel. Large boulders were frequently observed along this reach in the recent aerial photographs but were not observed in the historical aerial photographs. These observations are confirmed by the Scott and Gravlee (1968) study, which states that as a result of the flood surge, over 70 landslides were initiated either during or shortly after the flood wave. As a result of the landslides, significant amounts of coarse sediment were delivered to the channel. Thus, it appears that the upper reaches of the Rubicon River may be coarser today than prior to the dam failure and flood surge in 1964.

<u>Rubicon River - RM 20.0 Upstream to Hell Hole Dam (RM 30.0)</u>

The failure of the partially completed Hell Hole Dam in 1964 caused a substantial increase in sediment supplied to the river resulting in dramatic changes to the channel morphology for a distance of approximately 5 miles downstream of the dam. The most direct effects from the dam failure are clearly evident in the 2.5 mile reach immediately downstream of the dam where significant channel aggradation, widening, and an increase in the bed particle size is discernable from the aerial photography (Figure 2-11). Scott and Gravlee (1968) estimated that material from the dam was deposited immediately downstream (RM 28.7) from the dam failure site resulting in a greater than 7-foot increase in thalweg elevation. Channel width near RM 29.0

increased from approximately 100 feet to over 300 feet wide. As a result of this widening and aggradation, the V-shaped channel observed prior to the flood surge became more U-shaped in profile. Scott and Gravlee (1968) also documented this change in channel shape.

Between RM 25.0 and RM 26.0, increases in channel width, bar length, sediment storage, and particle size are discernable (Figure 2-12). The channel width increased from 75 feet wide to over 200 feet wide, and the amount of coarse sediment delivered to the channel also appears to increase. The frequency of bars in the channel has also increased. Within this one mile reach of the river, four smaller bars were identified in the historical aerial photographs. The recent aerial photograph indicates that increased sediment deposition resulted in two large, almost continuous alternate bars with several smaller alternate bars scattered throughout this reach.

A few miles downstream at RM 21.0, there is limited visibility of the channel using the historical aerial photographs due to the shadows present as a result of the oblique angle of the photograph. However, measurements by Scott and Gravlee (1968) indicate that 1.5 feet of channel aggradation occurred here, and the thalweg has also changed position, which is also a potential indicator of aggradation. The observations possible at this location support Scott and Gravlee's (1968) findings. The small alternate bar observed at RM 21.0 in the historical photograph has increased in surface area and appears to be a point bar in the recent photograph, indicating channel aggradation and change in thalweg position. Observations of changes in particle size are not possible due to the high reflectivity in the historical black and white photograph.

2.4.2.5 Channel Responsiveness

Appendix C explains how the Montgomery-Buffington stream classification provides a basis for assessing potential channel response to alterations of the flow or sediment regime. Using the channel potential response matrix (Table 2-16) as a guide, this study groups the potential for channel response into "Low", "Moderate", and "High" categories. The low category includes the three transport type channels: bedrock, cascade, and step-pool. These channel types are resilient to most discharge or sediment supply perturbations because of their high transport capacities and generally supply-limited conditions (Montgomery and Buffington 1997). The high response potential category includes the pool-riffle and plane-bed response type channels (there are no dune-ripple channel types in the study streams). The moderate category is designated for any of the combination of transport and response type channels. For example, a step-pool/plane-bed channel type is categorized in the moderate category. Forced pool-riffle type channels are also included in the moderate category, because they are formed by geomorphic and hydraulic conditions that are distinct from free-formed pool-riffle channel types.

The following provides an overview of channel responsiveness in the study area. The channel response potential of the study streams is depicted on the Channel Response Potential maps included in the Map Package (available upon request). The channel response ratings for each of the study reaches are shown in Table 2-16.

- A total of 55.1 miles of the study streams were rated as having a low response potential, 12.2 miles were rated as having a moderate response potential, and 41.1 miles were rated as having a high response potential.

- The most responsive channel reach in the study area is in the 24-mile long pool-riffle section of the Middle Fork American River downstream of Ralston Afterbay. The Ruck-A-Chucky rapids is not included in this high response potential area. Upstream of Ralston Afterbay, the majority of the channel is designated as having a low response potential, and 25% as having a high response potential.

- Approximately 21 miles (70%) of the Rubicon River is designated as having a low response potential and 6.8 miles (23%) has a high response potential. Most of the high response potential area is in the 5 miles downstream of Hell Hole Dam.

- Most of Duncan Creek, 9.4 miles (65%) is designated as having a low response potential, 3.4 miles (23%) is designated as having a moderate response potential, and 1.7 miles (12%) is designated as having a high response potential.

- Long Canyon Creek is predominantly designated as having a low response potential (69%). Approximately 28% (3.2 miles) is identified as having a moderate response potential.

- North Fork Long Canyon Creek has a predominantly high response potential and South Fork Long Canyon Creek has a predominantly moderate response potential.

2.5 2006 STUDIES

This report documents the Phase 1 studies conducted during 2005. Phase 2 studies will be carried out as described in the June 2005 Existing Environment Study Plan Package, and will focus on developing quantitative data at select sites chosen in consultation with the resource agencies. The Phase 2 studies will build on the Phase 1 study results and will consist primarily of developing Rosgen Level II Stream Classification and Level III Stream Condition and Departure information at resource agency-approved sites.

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3.0 RIPARIAN HABITAT CHARACTERIZATION STUDY

3.1 OBJECTIVES

This report describes the first year (Phase 1) of a two year riparian habitat characterization study. The purpose of the Riparian Habitat Characterization Study is to identify, map, and describe the riparian and meadow habitat upstream and downstream of the Project dams and diversions. The information collected as part of this study will be used in combination with information developed as part of the geomorphology study as a basis for developing quantitative riparian studies. The 2005 study objectives were to:

- Identify the locations of riparian and meadow habitat along the streams and rivers upstream and downstream of the MFP dams and reservoirs;
- Qualitatively describe riparian and meadow habitats;
- Identify unregulated streams in the vicinity of the Middle Fork American River Project (MFP or Project) that could serve as comparison reaches for subsequent studies; and
- Identify potential historical and existing activities that may have or are currently affecting the development of riparian habitat.

The first two study objectives were accomplished in 2005. The latter two will be completed in 2006, along with quantitative studies described in the June 2005 Existing Environment Study Plan Package.

3.2 GENERAL APPROACH

The work completed in 2005 focused on developing qualitative information regarding the riparian habitat in the study streams. The general study approach used a combination of existing information, aerial photography, helicopter surveys, low altitude videography, and ground surveys. Riparian habitat was mapped along the study streams and rivers from the low water's edge to the hillslope or valley walls where riparian vegetation could be influenced by flooding or elevated water tables. All riparian and meadow habitats that are or were historically connected by surface waters were mapped. Recent and historical aerial photographs were obtained to document existing and historic riparian and meadow coverage. The information developed in 2005 will be used as a basis for focusing quantitative work to be completed in 2006 and for future relicensing studies.

3.3 PHASE 1 METHODOLOGY

3.3.1 Review of Existing Data and Information

Existing information relevant to riparian vegetation on the study streams was collected and reviewed. In addition, information regarding riparian vegetation and physical processes in other geographic regions was collected and reviewed, including information specific to western slope Sierra streams. Specific documents evaluated as part of the 2005 study effort are identified below:

- County of Placer. 2004. Report of the Science Advisors, For the Placer County Natural Communities, Conservation 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. 1973. Rubicon River Stream Survey from Lawyer's Trail to 2 Miles Downstream.
- Eldorado National Forest Georgetown Ranger District. 1973. Stream Survey, Rubicon River.
- Eldorado National Forest Georgetown Ranger District. 1973. South Fork Long Canyon Creek Stream Survey from Blacksmith Flate Footbridge to National Forest Boundary.
- Eldorado National Forest Georgetown Ranger District. 1976. Rubicon River Stream Survey near Big Grizzley Canyon.
- Eldorado National Forest Georgetown Ranger District. 1976. 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.
- Hickman, J.C. 1993. The Jepson Manual. University of California Press. Berkeley, California.
- PCWA. 2002. Duncan Canyon/Long Canyon Paired Watershed Study. Prepared by WRC Environmental.
- Sawyer, J.O. and T. Keeler-Wolf. 1995. A Manual of California Vegetation. California Native Plant Society. Sacramento, California.
- 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.

- Soil Survey Staff, N.R.C.S., United States Department of Agriculture. Accessed 9/5/2005. Soil Survey Geographic (SSURGO) Database for Lake Tahoe Basin, CA. http://tahoe.usgs.gov/soil.html.

- United States Department of Fish and Game. 1979. Rubicon River Wild Trout Management Plan.

- USDA 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.

3.3.2 Riparian Habitat Characterization Methods

Riparian habitat, including habitat distribution, species, and age class structure, was characterized using a combination of aerial photograph interpretation, low altitude helicopter surveys, and helicopter videography, depending upon visibility, and ground surveys, as summarized below for each of the study streams.

- Middle Fork American River below Ralston Afterbay - aerial photograph interpretation, low altitude helicopter surveys, helicopter videography, and ground surveys.

- Middle Fork American River between French Meadows and Ralston Afterbay - low altitude helicopter surveys, helicopter videography, and ground surveys.

- Rubicon River - aerial photograph interpretation (less entrenched stream segments), low altitude helicopter surveys, helicopter videography, and ground surveys.

- Duncan Creek - helicopter videography, low altitude helicopter surveys and ground surveys.

- Long Canyon Creek - helicopter videography, low altitude helicopter surveys and ground surveys.

- North and South Forks of Long Canyon Creek - low altitude helicopter surveys and ground surveys.

Visibility was moderate to poor in the aerial photographs and/or during the helicopter surveys along the majority of the North and South Forks of Long Canyon Creek and Duncan Creek and along portions of Long Canyon Creek and the Middle Fork American River between French Meadows and Ralston Afterbay. Ground surveys were completed along reaches with fairly good to excellent visibility from the helicopter to verify information collected during the helicopter surveys and to collect additional channel and vegetation information.

Specific methods used to map and characterize the riparian habitat along the study streams are described in the following.

3.3.2.1 Aerial Photograph Interpretation Methods

Riparian habitat coverage was mapped along the study streams, where feasible, using recent geo-referenced aerial photography (November 2002, Airphoto USA). This photography was used as a base for mapping the riparian communities by helicopter and during the field reconnaissance surveys. Visibility of the channel and riparian tree and shrub canopy layer was limited along deeply entrenched reaches of the larger streams and sections of the smaller streams with closed forest canopies. Active channel bars were identified, mapped, and digitized using the 2002 aerial photography.

Historical and Recent Aerial Photography Comparison

The historic distribution of riparian habitat along the study streams was documented in aerial photography taken in the early 1960's prior to construction of the MFP. To conduct a comparison of the historical and recent riparian vegetation distribution, a first-level assessment of the channel, geomorphic features (i.e. bars and deposits), and riparian vegetation was completed to determine the stream reaches with adequate visibility on both photograph sets. Along some stream segments, the channel was not visible, or geomorphic features or vegetation were not clearly identifiable, in the historic and/or recent aerial photography. Upland and riparian vegetation were difficult to distinguish and certain distribution patterns, particularly sparse vegetation, were difficult to see in some areas. Visibility was limited by:

- Dense upland vegetation and topographic shading,
- Photographic scale, camera angle, and/or contrast, and/or
- Relatively large scale of the photography.

Following this assessment, the distribution and coverage of the riparian habitat and geomorphic channel features on photograph pairs were compared to identify potential trends. Several stream reaches were selected as examples to illustrate the trends in riparian coverage and geomorphic conditions in the historical and recent photography. These historical photographs were scanned, geo-referenced, and incorporated into Geographic Information System (GIS) to allow for a direct comparison with the 2002 photography. The historic aerial photographs were viewed as stereo-pairs to identify the location and distribution patterns of riparian vegetation, while a scaled lupe with 10x magnification was used to make measurements (+/- 0.1 mm).

3.3.2.2 Low Altitude Helicopter Aerial Survey Methods

The riparian communities were mapped along a total of 112 river miles (RM) during low altitude helicopter surveys (75 to 250 feet above the stream channel). The surveys were completed in July and August 2005 in coordination with the Geomorphology

Study. The location of the riparian vegetation was mapped on the 2002 aerial photography and/or topographic maps. To the extent visible, riparian species and age classes were identified and mapped. This information was then digitized into GIS. Dense upland canopies along some stream segments obstructed the view of the riparian vegetation, which made it difficult to discern the details of the riparian community. The stream segments with limited visibility of the stream channel and riparian vegetation are shown in Map 1-3. In addition to native riparian species, locations of exotic and invasive riparian vegetation, including Himalayan blackberry (*Rubus discolor*), tall whitetop (*Lepidium latifolium*), giant cane (*Arundo donax*), tamarisk (*Tamarix chinensis*), tree of heaven (*Ailanthus altissima*), and black locust (*Robinia pseudoacacia*) were also identified and mapped. These locations were subsequently digitized in GIS.

3.3.2.3 Low Altitude Video Survey Methods

The study streams were videotaped from a helicopter in September and October 2005. An ecologist accompanied the videographer to identify geographic features, river location, and to monitor air speed. The helicopter was flown either in an upstream or downstream direction at an elevation of 200 to 300 feet above the stream channel, at speeds ranging from 15 to 25 mph. The pilot attempted to keep the helicopter above the center of the channel while the videographer videotaped the full channel width at an angle that minimized visual distortions.

The video includes real-time Global Positioning System (GPS) coordinates to identify the helicopter location during video playback. The video quality is generally good for riparian mapping, except in some reaches where dense upland and/or riparian canopies obscured the stream channel, particularly on the South and North Forks of Long Canyon Creek (Map 1-3). Visibility along certain segments of the Middle Fork American River between French Meadows Reservoir and the Middle Fork Powerhouse was poor due to a dense vegetation canopy. The low altitude helicopter-based video of the MFP streams was also used to verify and refine the riparian habitat mapping completed solely from the helicopter surveys.

3.3.2.4 Ground Survey Methods

The field reconnaissance surveys, conducted by riparian and botanical specialists and geomorphologists in August, September, and October 2005, concentrated on the stream segments where the visibility of the channel and riparian vegetation was limited in the aerial photographs and helicopter surveys. In addition, ground surveys were completed on reaches with good visibility during the aerial helicopter surveys to verify the habitat information collected during the helicopter aerial surveys. Data collected during the helicopter surveys on riparian distribution, species, and age class structure was highly consistent with observations made during the ground surveys. The helicopter surveys in general, were more useful for mapping the distribution of the riparian habitats along the streams than the ground surveys due to the larger perspective and scale of the streams. A total of approximately 20.7% of the river miles that were mapped by helicopter were ground surveyed, including upstream of diversions. The total number of miles ground surveyed along a particular stream was often limited by inaccessible terrain. The stream reaches that were ground surveyed are shown in Map 2-1.

From the ground, the riparian vegetation was mapped according to the same parameters that were used in the helicopter-based mapping efforts. Locations of exotic and invasive riparian vegetation, including Himalayan blackberry, tall whitetop, giant cane, tamarisk, tree of heaven, and black locust were identified and mapped.

3.3.2.5 Characterizing Community Composition and Coverage

Existing classification systems for California vegetation, including Hickman (1993) and Sawyer and Keeler-Wolf (1995), were reviewed to develop a list of riparian communities potentially occurring along the study streams. Riparian communities and coverage along each study stream were subsequently identified and mapped using a combination of methods including photographic and video interpretation, low altitude helicopter surveys, and ground surveys. Riparian coverage was mapped as polygon areas, continuous lines, discontinuous lines, or single points (if only individual trees or sparse coverage was present). Information on both riparian community composition and coverage along each of the study streams was incorporated into GIS. Appendix I presents photographs of riparian community types found along the study streams. Appendix J presents photographs of riparian distribution patterns observed along the study streams. Appendix K presents photographs of non-native invasive species observed along the study streams.

3.3.2.6 Characterizing Age Class Distribution

The distribution of age classes of riparian communities present along each of the study streams was also identified and mapped. Three age class categories were established to characterize the riparian communities as follows:

- Young/Seedlings: Shrubs with less than 10 stems per individual, or trees with diameters (diameter at breast height (DBH) less than 3 inches). The canopy diameter is less than 0.75 meters.

- Medium-Aged: Shrubs with between 10 and 60 stems per individual, trees with DBHs between 3 and 9 inches, and the canopy diameter is between 0.75 and 2 meters.

- Mature/Old: Shrubs with more than 60 stems per individual, trees with DBH's greater than 9 inches, and the canopy diameter is greater than 2.5 meters.

After the identification of individual age classes in each community during the surveys, the information was combined using GIS into four general age categories to characterize riparian habitat along the study streams including:

- Only Seedling/Young Individuals Present

- Seedling/Young Individuals Present, in Addition to Other Age Classes
- Only Medium-Aged or Medium Aged and Mature Age Class Individuals Present – No Seedlings or Young Individuals
- Only Mature/Old Individuals are Present

3.4 PHASE 1 RESULTS

3.4.1 Existing Data Sources

Existing information on the MFP rivers and streams relevant to riparian vegetation was collected and reviewed. In general, the majority of the reports are focused on aquatics, fishery, and geomorphic resources. In addition, information regarding riparian vegetation and physical processes on western slope Sierra streams or pertinent riparian literature from other geographic regions was reviewed. Brief qualitative descriptions of the surrounding vegetation community were sometimes present, and occasionally included species present, relative coverage, height, and the condition of the vegetation. A few reports included generalized descriptions of the community types present within the watershed(s). The information contained in these reports and articles was used in the development of the Phase 2 studies and will be used to develop future quantitative studies. In addition, it will be used to compare, interpret and evaluate data collected along the study streams during the 2006 riparian studies and future studies to be conducted later in the relicensing process.

3.4.2 Riparian Habitat Characterization Results

The location, species assemblage, and age class structure of riparian vegetation along the study streams were mapped during low altitude helicopter surveys and ground surveys. This information was refined using the low altitude videography. Riparian coverage is shown as polygons, lines and points, with community types and age class structure identified. The resulting GIS-based maps are included in the Map Package (available upon request). Other data collected during the Habitat Characterization Study, including geomorphology, and assembled from other sources can also be viewed with the riparian data. No meadow areas that are hydrologically connected to the study streams were identified during the 2005 studies. The riparian data is summarized by river mile in Appendix L.

3.4.2.1 Riparian Community Composition

Existing classification systems for California riparian vegetation, including Hickman (1993) and Sawyer and Keeler-Wolf (1995) did not adequately describe the species assemblage comprising the riparian communities along the study streams. Therefore, for this study, several riparian community classes were developed and utilized to characterize riparian resources. In developing these community classifications, consideration was given to woody riparian species assemblages with different regeneration and growth strategies (such as timing of seed release, seed viability, and vegetative reproduction); water and soil needs; and responses to disturbance and/or habitat quality. These attributes are summarized for the dominant woody riparian species within each riparian community in Appendix M. These attributes influence the distribution of species and structural complexity of the riparian communities along a stream channel.

Several features are common to all the riparian communities in the study area. First, American dogwood (*Cornus sericea)* may be present in each of the riparian communities. Second, 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*). A description of the riparian communities identified in the study area is provided below.

- Alder Community (A) 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 (W) 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 (AW) 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 layer.

- Alder-Willow-Cottonwood Community (AWC) This community is similar to the Alder-Willow Community, with the addition of 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 were identified. The relative abundance of white alder and willows vary and could be dominated by either species.

- Alder-Willow-Black Locust Community (AWL) 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 could be dominated by either species.

- Alder-Willow-Black Locust-Cottonwood Community (AWLC) This community is similar to the Alder-Willow Community, with addition of either black cottonwood or Fremont cottonwood, and the non-native species, black locust. The relative abundance of alder and willow varies and could be dominated by either species.

3.4.2.2 Riparian Community Distribution, Coverage and Age Class Structure

Information on riparian community distribution and coverage in the study streams is summarized in Tables 3-1, 3-2, and 3-3. Table 3-1 presents riparian community composition and overall coverage along each of the study streams based on percentage of overall stream miles occupied. Table 3-2 summarizes the relative proportion (percent composition) of each riparian community present along the individual study stream. Table 3-3 presents a detailed breakdown of riparian coverage by community type along each of the study streams. Detailed information on riparian community distribution and coverage in one-tenth of a mile increments for each of the study stream is provided in Appendix L. This information, presented with the distribution of channel bars along the study streams, is shown on the Community Coverage and Channel Bar maps contained in the Map Package (available upon request).

The distribution of age classes in each riparian community along the study streams is also provided in detail in Appendix L and summarized in Table 3-4. The distribution of age class structure along the study reaches is shown on the Age-classes and Channel Bar maps contained in the Map Package (available upon request). Photographs showing examples of the riparian habitat along the study streams are included in Appendix N. An overview of the key findings for each study stream is provided below.

Duncan Creek

<u>Duncan Creek to Confluence with the Middle Fork of the American River</u>

- Overall, riparian habitat occurs along approximately 45% of Duncan Creek, primarily as either sparse or continuous narrow corridors (continuous lines) of Alder-Willow Community interspersed with smaller areas of Alder Community, with two exceptions.
  - First, Alder-Willow-Cottonwood Community is the predominate riparian community at two locations along Duncan Creek including: one reach near the Duncan Creek Diversion (RM 8.5-RM 8.9) and a second reach along a 1.9 miles section of the creek between RM 6.0 and RM 7.9.
  - Second, riparian habitat along the lower 2.5 miles of the creek is generally sparse.
- Seedlings or young individuals were present in almost 78% of the riparian communities along Duncan Creek. Successfull recruitment appears to be occurring along the entire stream reach, as no stands comprised solely of mature individuals were observed.

Long Canyon Creek

North Fork Long Canyon Creek to Confluence with the South Fork Long Canyon Creek

- Overall, riparian habitat occurs along approximately 70% of North Fork Long Canyon Creek primarily as continuous narrow corridors of Alder-Willow Community, interspersed with smaller areas of Alder Community, with two exceptions.
  - First, the Alder-Willow-Cottonwood Community is the predominate riparian community within a continuous narrow riparian corridor between RM 0.9 and RM 1.6, and within a 1.8 acre-sized wide riparian corridor (polygon).
  - Second, two other sections of the creek contain wide corridors of riparian habitat located between RM 2.2 and RM 2.6 (total 3.1 acres consisting of Alder and Alder-Willow Communities) and between RM 0.4 and RM 0.7 (total 1.8 acres, consisting of Alder-Willow Community).
- Seedlings or young individuals were present in almost 70% of the riparian communities along North Fork Long Canyon Creek. Successful recruitment appears to be occurring along the entire stream reach except in the Alder-Willow Community in the lower 1-mile of the stream (RM 0.0-RM 1.0).

South Fork Long Canyon Creek to Confluence with the North Fork Long Canyon Creek

- Overall, riparian habitat occurs along approximately 76% of South Fork Long Canyon Creek primarily as sparse or continuous narrow corridors of a mixture of alternating riparian communities.
- A sparse band of the Willow Community occurs just upstream of the diversion (RM 3.6-RM 4.0) and near the confluence with Long Canyon Creek.
- The Alder-Willow Community occurs in sparse to continuous narrow corridors of riparian vegetation from the diversion to downstream approximately 1.2 miles (RM 2.1-RM 3.3).
- The Alder-Willow-Cottonwood Community is the predominate riparian community along a 1 mile section of the creek between RM 1.1 and RM 2.1 occurring primarily as a continuous narrow corridor and a 1.1 acre wide corridor.
- Riparian habitat is generally sparse Alder Community in the lower 1.2 miles of the creek.
- Seedlings or young individuals were present in almost all the riparian communities along South Fork Long Canyon Creek, except near the confluence with the North Fork Long Canyon Creek.

Long Canyon Creek to Confluence with Rubicon River

- Overall, riparian habitat occurs along approximately 56% of Long Canyon Creek primarily as either sparse or continuous narrow corridors of Alder or Willow Communities.

- The Willow and Alder-Willow-Cottonwood Communities occupy a small area of the creek (RM 11.0-RM 11.3) just downstream of the confluence of North and South Fork of Long Canyon creeks. One wide corridor of Willow Community occurs at the confluence (total 0.50 acres).

- The Alder Community occurs in sparse to continuous narrow corridors of riparian vegetation for approximately 4.2 miles of the creek between RM 6.5 and RM 10.7. A few wide corridors of the Alder Community occur in this reach, totaling 1.5 acres.

- The Willow Community is the predominate riparian community along a 5.8 mile section of the creek between RM 0.8 and RM 6.7, alternating between patches of sparse and continuous narrow corridors of riparian. This section of the creek also contains eight different wide corridors of Willow Community, totaling 2.4 acres.

- Riparian habitat in the lower 0.9 miles of the creek is generally sparse with primarily Alder-Willow-Cottonwood Community in the upper portion (0.2 miles) and Alder-Willow Community in the lower 0.7 miles.

- Seedlings or young individuals were present in over 72% of the riparian communities along Long Canyon Creek. Successful recruitment appears to be occurring along the majority of the stream reach.

Middle Fork American River

- The channel morphology, valley width, and gradient changes with downstream distance from French Meadow Reservoir, as described in the Geomorphology Study. Riparian community composition and coverage changes in response to these differences.

- In general, the riparian communities upstream of Ralston Afterbay are comprised of three communities (Alder-Willow-Cottonwood, Alder, and Willow), while the Alder-Willow-Cottonwood Community, with the addition of black locust in certain areas, is most prevalent downstream of Ralton Afterbay.

- Riparian coverage also changes with downstream distance. Specifically, riparian coverage upstream of Middle Fork Interbay ranges from sparse to discontinuous narrow corridors. However, riparian coverage becomes considerably denser, ranging from continuous narrow to extensive wide corridors of riparian, starting at approximately the mid-point between Middle Fork Interbay and Ralston Afterbay downstream and continuing to the confluence with the North Fork American River.

The following describes riparian habitat in each reach of the Middle Fork American River between French Meadows Reservoir and the confluence with the North Fork American River.

French Meadows Reservoir Downstream to Middle Fork Interbay

- The Alder-Willow-Cottonwood Community occurs in sparse to discontinuous narrow corridors in two sections of this reach: immediately downstream of French Meadows Reservoir for a distance of 4.3 miles (RM 42.9–RM 47.2) and just upstream of the Middle Fork Interbay for 0.9 miles (RM 36.5–RM 37.4). Several wide corridors of riparian occur in these two areas totaling 0.9 acres and 0.2 acres, respectively.

- The remainder of the reach (5.5 miles) is comprised primarily of sparse to discontinuous narrow corridors of Willow Community (RM 37.4–RM 42.6).

- Seedlings or young individuals were present in over 89% of the riparian communities between French Meadows Reservoir and Middle Fork Interbay.

Middle Fork Interbay to Ralston Afterbay

- The Middle Fork Interbay area is surrounded by a continuous narrow corridor of Alder-Willow Community and a discontinuous narrow band of the Alder Community.

- The Alder Community predominates in the first 5.3 miles downstream of Middle Fork Interbay (RM 30.6-RM 35.9) with coverage primarily ranging from sparse to lines of riparian vegetation. Approximately 1.1 acres of wide riparian corridors occur in this reach.

- The Willow Community then becomes the dominant community for the next 3.1 miles (RM 27.3-RM 30.4), alternating between areas of continuous narrow bands of riparian to areas of dense riparian wide corridors. Almost 10 acres of wide riparian corridors occur in this reach.

- The Alder-Willow-Cottonwood Community, occupies the last 1.6 miles of the reach downstream to the confluence with Ralston Afterbay (RM 25.6-RM 27.2), interspersed with smaller areas of Alder Community and Willow Community. Approximately 11.2 acres of wide corridors of Alder-Willow Community occur in this reach.

- Seedlings or young individuals were present in over 92% of the riparian communities between Middle Fork Interbay and Ralston Afterbay.

Ralston Afterbay to Confluence with North Fork American River

- The Alder-Willow-Cottonwood Community, with the addition of black locust in selective areas, is the predominate riparian community in the Middlle Fork American River downstream of the Ralston Afterbay. The riparian community is typically distributed as continuous narrow corridors along the channel and bar margins, with wide corridors (polygons) on channel bars.

- Riparian coverage is sparse in areas that have experienced bank failures or other mass wasting events or in areas with bedrock exposed along the channel bank.

- Black locust, a non-native species, is a co-dominant species with alders, willows, and cottonwood beginning at RM 22.8 and continuing to the confluence of the North Fork American River, although areas without black locust are interspersed through the stream segment.

- Extensive areas of dense riparian vegetation (polygons) on channel bars are present throughout the reach. Overall, approximately 138 acres of dense riparian habitat was present in the reach, with most being comprised of Alder-Willow-Cottonwood Community (40.5 acres), Alder-Willow-Locust Community (17.3 acres), and Alder-Willow-Locust-Cottonwood Community (65.9 acres).

- Seedlings or young individuals were present in only 44% of the riparian communities between Ralston Afterbay to the North Fork American River confluence. Successful recruitment was observed throughout the reach and within each riparian community, however, recruitment was patchy in distribution.

Rubicon River

Hell Hole Reservoir to Ralston Afterbay

- Overall, riparian habitat occurs along approximately 52% of Rubicon River, primarily as narrow continuous or discontinuous corridors along the channel margins, with wide corridors (polygons) on some channel bars. Riparian habitat is dominated by two riparian communities: Alder-Willow Cottonwood Community (74% of total) and Alder-Willow Community (26% of total).

- No riparian vegetation exists for 1.6 miles downstream of Hell Hole Reservoir (RM 28.9–RM 30.5) where the streamflow is subsurface.

- The two riparian communities occur in alternating bands along the Rubicon River. The Alder-Willow-Cottonwood Community predominated in four sections of the river: between RM 0.0 and RM 6.9, RM 10.0 and RM 14.6, RM 17.0 and RM 24.9, and RM 25.9 and RM 28.9. The Alder-Willow Community is dominant between RM 6.2 and RM 9.9, RM 14.7 and RM 17.0, and RM 24.9 and RM 25.9. In general, the Alder-Willow Community occurs along the stream segments with coarser substrate (bedrock and boulder), while cottonwoods are part of the assemblage along reaches with finer substrate (boulder and cobble) and lower gradients.

- Seedlings or young individuals were present in over 81% of the riparian communities along the Rubicon River. Successful recruitment appears to be occurring along most of the Rubicon River with one exception. Seedling or young individuals were rarely observed along a 4.3-mile reach between RM 5.6 and RM 9.9.

3.4.2.3 Riparian Vegetation Health

Riparian vegetation, in general, was healthy along the majority of the stream reaches. However, during helicopter surveys conducted during the week of July 25-29, 2005, one area of obvious alder leaf damage was observed in a 1-mile reach downstream of Hell Hole Reservoir (RM 24.0–RM 25.0). During field reconnaissance surveys conducted during the week of September 19-23, 2005, alder leaf damage was also observed on the Rubicon River upstream and downstream of FS Road 2 (RM 18.8-RM 21.9). Beetles and larvae were observed on the leaves; eating the leaf material such that only the leaf skeletons remained (Appendix O, Photos 1 through 4). These insects are believed to be Alder Flea Beetles. The literature indicates that these insects only feed on alders and they do not harm the alders as they feed shortly before leaf-off in the fall.

3.4.2.4 Sensitive Plant and Invasive Species

No sensitive plant species were observed during the ground surveys. Two non-native invasive species were observed along the study streams. *Ailanthus altissima* (tree of heaven, see photograph in Appendix K) was identified along the Middle Fork American River from RM 1.17 to RM 1.9 and at RM 4.5. *Robinia pseudpacacia* (black locust, see photograph in Appendix K), a non-native species, was also observed along the Middle Fork American River, beginning at RM 22.8 and continuing downstream. The occurrences of these non-native invasive species are shown on the Non-native Riparian Species and Channel Bars maps contained in the Map Package (available upon request).

3.4.2.5 Changes in Historic Distribution of Riparian and Meadow Habitat

Riparian and meadow vegetation present along the study streams in the early 1960's was evaluated and compared to current distribution in selective locations in the study area using historic and recent aerial photographs. No meadow habitat was identified in either the historic or recent photographs. Changes in riparian habitat distribution over time are discussed below.

Preliminary results of the interpretation of the historic and recent aerial photography are primarily based upon observations from the Middle Fork American River and the Rubicon River. The North and South Forks of Long Canyon Creek, Long Canyon Creek, and Duncan Creek have limited visibility in the historic aerial photography due to the relatively large scale of the photos. In the historic photographs, the channel and vegetation along the Middle Fork American River are clearly visible downstream of the Ralston Afterbay. Visibility decreases upstream and the distribution patterns of the riparian vegetation become more difficult to evaluate. This is due to the large scale of the photography and the decreased channel width upstream of Ralston Afterbay, which makes it more difficult to discern between upland and riparian vegetation and between bars and bedrock. The Rubicon River historic photography is generally more difficult to discern patterns from than the lower sections of the Middle Fork American River and is comparable to those sections upstream of the Ralston Afterbay.

Four general patterns in riparian distribution were identified through the examination of historic aerial photographs (1961-1962) and information collected during survey work completed in 2005.

Change in Riparian Vegetation Position on Channel Bars

- Historically, riparian vegetation was located on comparatively higher surfaces on channel bars and was found at varying distances from the water's edge at typical summer flows. In comparison, currently the riparian vegetation is typically distributed as a line along the margins of the channel bars at the water's edge at typical summer flows. This pattern was most apparent on the Middle Fork American River downstream of Oxbow powerhouse, but was also observed along the Rubicon River.

Changes in Riparian Abundance

- Historically, there was less riparian vegetation than was found during the current surveys. Figure 3-1 shows a representative reach of the Rubicon River from RM 3.3 to RM 3.7 that has moderate increases in riparian vegetation. This pattern was observed along the entire length of the Middle Fork American River and the Rubicon River.

- Areas with split channels and moderate quantities of riparian vegetation in the 1961-1962 photography, are wide corridors of riparian vegetation in the 2005 photography. Figure 3-2 shows an area on the Middle Fork American River from RM 28.7 to RM 29.1 where the riparian vegetation is currently a large wide corridor in comparison to a narrow corridor that historically lined the channel bars.

Change in Riparian Coverage (Distribution)

- In general, historic riparian vegetation was distributed in fewer and shorter continuous narrow corridors and as smaller and shorter wide corridors. Figure 3-3 shows an example of how riparian distribution currently is often distributed in larger and longer continuous corridors and wide corridors. Preliminary observations indicate that the proportion of river channel with wide corridors and continuous narrow corridors has increased. Note that the channel position has also changed in this figure. In addition, a polygon of young vegetation that was observed in the 2005 low-altitude video is shown in this figure, but was not present in the 2002 aerial photography.

Minimal Change in Riparian Vegetation along Less Responsive Stream Reaches

- Areas with sparse or no riparian vegetation lining the channel in the historic photography often maintained a similar pattern in recent surveys.

Sensitive Reaches

Certain stream segments are more likely than others to respond to changes in hydrologic or sediment regimes. Channel responsiveness for the study streams is discussed in detail in the 2005 Geomorphology Study Report. The channel shape, size, and/or overall morphology of the stream can change depending upon factors such as underlying geology, stream gradient, and substrate particle size.

Changes in stream morphology, resulting from hydrologic and sediment regime changes can, in turn, affect the distribution of riparian species. The distribution of riparian vegetation and species assemblages are, in part, controlled by valley morphology and fluvial geomorphic processes, as they affect and interact with riparian resources, including regeneration, composition, structure, and encroachment. Specifically, the distribution of riparian individuals is strongly related to the occurrences of geomorphic landforms (e.g. bars) and the differences in hydroperiod (inundation timing, frequency, and duration) along a channel. The development and evolution of these landforms are controlled, in part by fluvial geomorphic processes, as well as other watershed attributes such as valley geology. Changes in hydrologic and/or sediment regime may change the distribution, size, and elevation of bars, as well as bar particle sizes. Riparian vegetation along more responsive stream segments may also have the potential for greater change than vegetation located along less responsive, steep, narrow, bedrock controlled stream segments.

The relationship between geomorphic processes and riparian distribution is evident on the maps included in the Map Package (available upon request). For example, riparian coverage is shown with respect to channel bars.

3.5 2006 STUDIES

This report documents the Phase 1 study elements completed in 2005. Some Phase 1 study elements will continue in 2006, as follows:

- Identify unregulated streams in the vicinity of the MFP that could serve as comparison reaches for subsequent studies, and

- Identify historical and existing activities that may have or are currently affecting the development of riparian habitat along the study streams.

These Phase 1 elements will be carried out in consultation with the resource agencies.

Phase 2 studies will be carried out as described in the June 2005 Existing Environment Study Plan Package. The Phase 2 studies will focus on developing quantitative data at select sites chosen in consultation with the resource agencies. The Phase 2 studies will be completed during 2006, in coordination with the Phase 2 Geomorphology studies, as summarized below:

- Data on riparian vegetation will be collected at selected Rosgen Level II classification sites.
- Data will be collected along the transects surveyed for the geomorphology studies, as feasible, in order to relate riparian habitat characteristics to elevation and distance from the channel, and inundation (if feasible) during later phases of the relicensing process.
- Plots will be sampled at varying elevations and distances along the transect to evaluate changes in riparian characteristics along these gradients.
- A botanist/riparian ecologist will collect quantitative information on the riparian community, including graminoids and other herbaceous and woody plant species composition, percent cover, height and canopy structure, relative density, size classes present, riparian width, observations of encroachment and recruitment, and evidence of unusual mortality, and land use.
- Observations of bank instability, channel type and substrate will also be noted. The botanist/riparian ecologist will also collect additional vegetation information, as appropriate, for the Rosgen Level II and III classification surveys and for the aquatic habitat surveys.
- The reaches will be photo-documented.

Work completed in 2006 will be documented in a report that will be provided to the resource agencies in early 2007 for review and comment.

References

Hickman, James C. (Ed). 1993. The Jepson Manual: Higher Plants of California. University Press, Berkeley, California.

Sawyer, J.O., and T. Keeler-Wolf. 1995. A Manual of California Vegetation. California Native Plant Society, Sacramento, California.

4.0 AQUATIC HABITAT CHARACTERIZATION

4.1 OBJECTIVES

The purpose of the Aquatic Habitat Characterization Study is to develop information regarding the types and distribution of aquatic habitats in the stream and river reaches upstream and downstream of the Middle Fork American River Project (MFP or Project) dams and reservoirs. Habitat information is important in developing an understanding of the factors that influence the distribution and abundance of fish and other stream organisms. Information developed in 2005 will be used as a foundation for the 2006 studies and to design future technical studies involving aquatic resources.

4.2 GENERAL APPROACH

The study streams and rivers are situated in an area that is characterized by steep and rugged terrain that is difficult to access and traverse. The Study Plan recognized these conditions and outlined an approach that relied on a combination of methods to characterize aquatic habitat in the study streams and rivers, including the use of existing aerial photography for habitat mapping. For the 2005 studies, aquatic habitat was primarily mapped using recent aerial photography and aerial videography. Ground truthing was not performed in 2005 but will be during 2006, following consultation with the resource agencies regarding imagery limitations and access constraints. Specific study elements accomplished in 2005 included:

Existing reports, topographic maps, geological maps and other available materials were reviewed.

- Aquatic habitats in the study streams were stratified and classified based on review of existing information, Rosgen Level I geomorphologic classifications, topographic maps, and aerial imagery.
- Aquatic habitats and strata along the Middle Fork American River and the Rubicon River were classified using low altitude videography and aerial photography.
- Stream reaches with limited visibility from the air were identified and will likely require ground surveys to adequately map aquatic habitat.

Study elements to be completed in 2006 include:

- Habitats characterized using videography and/or aerial photography interpretation will be evaluated and verified through helicopter reconnaissance surveys.
- The present habitat stratification will be re-evaluated using Rosgen Level II geomorphology information to be collected during 2006.
- Representative lengths of major strata that were classified in 2005 will be ground truthed.

- River and stream reaches that were not classified using aerial photographs or video due to visibility limitations will be mapped during ground surveys.

The level of ground truthing and ground surveys to be conducted will be determined in consultation with the resource agencies in 2006. Access will be an important consideration during the selection of sites to be ground truthed.

4.3 PHASE 1 STUDY METHODOLOGY

Phase 1 consisted of two primary study components: collecting, compiling and reviewing existing information; and, characterizing aquatic habitat conditions along the streams and rivers upstream and downstream of the Project diversions. The methods used for each study component are described in the following subsections.

4.3.1 Review of Existing Data and Information

Existing information on the rivers and streams relevant to aquatic habitat characterization was collected and reviewed. These materials included aerial photography, satellite imagery, topographic maps, geological maps, and the results of the geomorphology study performed as part of this investigation. Specific reports reviewed include the following:

- Eldorado National Forest Georgetown Ranger District. 1979. Environmental Assessment South Fork Long Canyon Creek.
- Flosi, G. S. Downie, J. Hopelain, M. Bird, R. Coey, and B. Collins. 1998. California Salmonid Stream Habitat Restoration Manual. CDFG.
- Gaos, A., and M. Bogan. 2001. A direct observation survey of the Lower Rubicon River.
- Devine Tarbell and Associates, Inc. and Stillwater Sciences. 2005. Sacramento Municipal Utility District Upper American River Project (FERC Project No. 2101) and Pacific Gas and Electric Company Chili Bar Project (FERC Project No. 2155) Stream Habitat Mapping Technical Report.
- Wilderness Conservancy. 1989. The American River - A Recreation Guide Book. Protect American River Canyons, Auburn, California.

Relevant information has been incorporated into this report and referenced, as appropriate.

4.3.2 Aquatic Habitat Characterization Methods

Aquatic habitat was characterized using a combination of recent aerial photography and aerial videography. Each of these methods and a summary of the visual classification methods used for the 2005 studies are described in the following subsections.

4.3.2.1 Aerial Photography

Available imagery used in Phase 1 studies consisted of recent geo-referenced aerial photography (November 2002, Airphoto USA). The aerial photography was reviewed to determine its suitability for identification of aquatic habitat units. There were two main issues with the aerial imagery that made it unsuitable for use as the primary source for the identification of habitat units. First, the aerial photographs of certain locations were of insufficient resolution to definitively identify habitat units. Second, trees, shading and other topographic features obstructed views of the streams at some locations preventing habitat delineation. Aerial photography could not be used to adequately map aquatic habitat along the small tributary study streams including Duncan Creek, North and South Forks of Long Canyon Creek, and Long Canyon Creek.

The aerial photography was used along reaches of the Middle Fork American River and Rubicon River in conjunction with low-altitude videography to locate and digitize aquatic habitat units. This photography was used as a base for mapping aquatic habitats in these areas. Digital orthorectified quarter quads (DOQQs), consisting of high altitude imagery used by United States Geological Survey (USGS) for preparation of topographic maps, also were used to supplement Airphoto USA photo imagery for some sections of the stream reaches with obstructed or blurred images.

Publicly available satellite imagery also was considered, but resolution was generally much less than that of the photo imagery or DOQQs, about 6-meter pixel resolution for the sources reviewed. This source of imagery was not used.

4.3.2.2 Low Altitude Helicopter Videography

Low altitude video (videography) taken from a helicopter during September 2005 was used as the primary source for habitat classification in Phase 1. The video provided substantially higher resolution along the study streams than the existing aerial photography.

The videography provided the necessary resolution to identify habitat types based on the Hawkins *et al*. (1993) approach for the Middle Fork American River downstream of French Meadows Reservoir and the Rubicon River downstream of Hell Hole Reservoir. However, unlike orthorectified still images, videography could not be used to reliably determine the length and specific location of habitat units. Therefore, the habitat units identified from videography were mapped to the orthorectified aerial photography in order to determine habitat location and length.

The videography could not be used to map aquatic habitat along the small tributary study streams including Duncan Creek, North and South Forks of Long Canyon Creek, and Long Canyon Creek. Tree canopy, the small size of the streams, shading, and helicopter speed resulting in limited resolution generally limited the use of video for habitat identification and location. These creeks will need to be evaluated by ground-level habitat surveys.

4.3.2.3 Visual Classification Methods

Visual mesohabitat typing was performed following the general criteria of Hawkins *et al*. (1993). This type of mesohabitat typing yields a general description of the quantity of available aquatic habitats and is generally more amenable to visual classification than other approaches. Hawkins *et al.* (1993) outlines a hierarchy for types of aquatic habitats (Table 4-1). First, the aquatic habitats are divided into fast and slow water types. Second, the fast water types are grouped into turbulent or non-turbulent types and slow water types are grouped into dammed pool or scour pool types. The initial habitat classification of the Phase 1 study used this classification approach. Geographic Information System (GIS) was used to assist with the illustration and analysis of the distribution of these habitats along the Middle Fork American River and Rubicon River.

Table 4-1. Hawkins *et al*. (1993) Level I and Level II Habitat Classifications.

Fast Water (Riffle/Run)		Slow Water (Pool)	
Turbulent (T)	**Non-Turbulent (NT)**	**Scour Pool (SP)**	**Dammed Pool (DT)**
Riffle Habitat – High Turbulence – Caused by geomorphological differences (i.e. gradient, bed roughness, and/or step development	Run Habitat - Non-Turbulent – Caused by geomorphological differences (i.e. gradient, bed roughness, and/or step development	Pool Habitat – Formed by Scour - Pool created by erosion of stream bank, boulder, bedrock, etc.	Pool Habitat – Formed by Dam - Pool created by water blockage due to debris, landslide, beaver dam, large boulders, etc.

Because videography was relied upon as the primary medium for typing habitats, habitat types could be identified at a more detailed level than from still aerial photography. Therefore, during Phase 1 studies, aquatic habitats viewed from videography were further classified using a subset of the habitat types adapted from McCain *et al.* (1990) (Table 4-2). These habitats are identified as Modified R-5 habitat types (referring to United States Forest Service Region 5) in the analyses. In general, due to the uncertainty associated with determining gradient and degree of turbulence from the air, riffles were not always identified to gradient type (low or high). Similarly, a reduced number of pool types was used. Due to the frequent presence of cascade pool sequences, this was utilized as an additional habitat type for ease of recording.

Figure 4-1 presents an example of a composite capture of an individual digital frame from the low-level videography. This example shows habitats identified from the video image for the riffle-pool habitat sequence.

Table 4-2. Habitat Types and Codes Adapted from McCain *et al.* (1990).[1]

Riffle	
Low Gradient Riffle	LGR
High Gradient Riffle	HGR
Cascade	
Cascade	CAS
Bedrock Sheet	BRS
Flatwater	
Pocket Water	POW
Glide	GLD
Run	RUN
Step Run	SRN
Trench Chute	TRC
Edgewater	EDW
Pool	
Mid channel pool	MCP
Lateral Scour Pool	LSP
Corner Pool	CRP
Secondary Channel Pool	SCP
Dammed Pool	DPL
Backwater Pool	BWP
Step Pool	SPO
Plunge Pool	PLP
Channel Confluence Pool	CCP
Additional Unit Designations	
Cascade Pool Sequence	CPS
Dry	DRY
Road-Crossing	RDC
Culvert	CVT
Concrete Box Culvert	CBC

[1]Not all of these habitat types were applied in this phase of the study. Identified as Modified R-5 habitat types in the text.

4.4 PHASE 1 STUDY RESULTS

The Phase 1 study results are summarized in the following sections. The existing data and information summary is presented first, followed by the aquatic habitat characterization results.

4.4.1 Review of Existing Information

Pertinent information available from existing sources relative to the aquatic habitat characterization has been incorporated into this report by reference. Other information contained in the existing literature will be used in the development and interpretation of Phase 2 studies and subsequent quantitative studies to be conducted later in the relicensing process.

4.4.2 Aquatic Habitat Characterization results

During Phase 1 studies, aquatic habitat mapping, using both the Hawkins *et al.* (1993) and a modified McCain *et al.* (1990) habitat classification systems, was completed along the Middle Fork American River from French Meadows Dam to the North Fork American River confluence and along the Rubicon River from Hell Hole Dam to Ralston Afterbay. The study stream reaches were initially stratified in Phase 1 based on the location of Project facilities and major hydrological features. The results of Rosgen Level I classification were then used to further divide the study stream reaches into preliminary sub-reaches.

For the purposes of this study, the Middle Fork American River was separated into three stream reaches, based on Project features, as follows:

- Middle Fork American River from the North Fork American River confluence to Ralston Afterbay (approximately 24.6 river miles (RM));
- Middle Fork American River from Ralston Afterbay to Middle Fork Interbay (approximately 10.8 RM); and
- Middle Fork American River from Middle Fork Interbay to French Meadows Dam (approximately 11.1 RM).

For the Rubicon River, three stream reaches were identified based on the location of major hydrological features (i.e., river confluences) as follows:

- Rubicon River from Ralston Afterbay (Middle Fork American River confluence) to the Long Canyon Creek confluence (approximately 3.6 RM);
- Rubicon River from the Long Canyon Creek confluence to the South Fork Rubicon River confluence (approximately 19 RM); and
- Rubicon River from the South Fork Rubicon River confluence to Hell Hole Dam (approximately 7.7 RM).

Each of these river reaches was further divided into sub-reaches corresponding to geomorphological channel differences using Rosgen Level I channel types. Rosgen channel types and features used to identify the stream reaches and sub-reaches are depicted on the Geomorphology Study Maps included in the Map Package (available upon request). Rosgen Level I channel types also are presented with stream habitats on GIS-based maps included in the Map Package (available upon request). Counts of habitats were derived by habitat type and relative frequency for each major stream reach and sub-reach (Rosgen Level I channel type). The sum of habitat length by habitat type and the percentage of total length were also calculated.

GIS-based maps showing the occurrence of habitats along the Middle Fork American and Rubicon rivers are included in the Map Package (available upon request). The maps are organized into 42 sheets each for the Hawkins and Modified R5 habitat types, as shown on Map 1-5. A listing of habitat types and lengths for the Middle Fork American River and the Rubicon River are provided in Appendix P, Tables P1 and P2, respectively. A summary of habitat mapping results by stream reach is provided in the following sections.

4.4.2.1 Middle Fork American River

Aquatic habitat classification results for the Middle Fork American River from the North Fork American River confluence to French Meadows Dam are provided in Tables 4-3 through 4-6 and are summarized as follows:

- The Middle Fork American River downstream of French Meadows Dam contains a large percentage of pools. This includes 38% of the habitat units and 49% of the stream length. Turbulent and non turbulent habitat types, comprise 33% and 28% of the habitat units and 17% and 32% of the stream length, respectively. The relative abundance of turbulent habitat units when compared with the relatively small percentage of stream length they occupy indicates that turbulent habitats are relatively short in length.

- Among the individual Modified R-5 habitat types, mid-channel pools and runs are abundant comprising 33% and 25% of habitat length, respectively.

- Rosgen channel types for this reach are comprised of entrenched to moderately entrenched types (Rosgen 1996), including A, B, F, Fb, “F or B”, and “Fb or G”.

North Fork American River Confluence Upstream to Ralston Afterbay

The Middle Fork American River reach between the North Fork American River confluence and Ralston Afterbay is approximately 24.6 miles in length. Aquatic habitat classification results for this reach are provided in Tables 4-7 through 4-10 and are summarized as follows:

- This reach is dominated by pool habitats, which comprise about 38% of the habitat units and 57% of the reach length.

- Non-turbulent (run and pocket water) habitats comprise about 35% of the habitat units and 29% of the reach length.

- Turbulent habitats (riffles and cascades) comprise about 28% of the habitat units and 13% of the habitat length, indicating that the turbulent habitat units are relatively short in length.

- The channel in this reach consists primarily of Rosgen Level I F channel type.
  - About 95.5% of the stream segment consists of Rosgen F channel type and the remaining 4.5% consists of Rosgen “F or B” channel type.

Middle Fork American River from Ralston Afterbay to Middle Fork Interbay

The Middle Fork American River reach between Ralston Afterbay and Middle Fork Interbay is approximately 10.8 miles in length. Aquatic habitat classification results for this reach are provided in Tables 4-11 through 4-14 and are summarized as follows:

- Non-turbulent habitats dominate this reach in terms of length representing about 42% of the total.
  - There are relatively similar frequencies of pools, non-turbulent, and turbulent habitats (this trend also is reflected in the Modified R-5 habitats).
- Rosgen channel types were characterized as Fb, “Fb or B”, and “F or B”.
  - Rosgen Level I Fb channel type represents over 47% of the reach length and ”Fb or B” channel type represents about 36% of the reach length.
  - In the Fb channel type, non turbulent habitats comprise about 50% of the length. In the ”Fb or B” channel type, there are similar lengths of non turbulent, pools, and turbulent habitats.

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

The Middle Fork American River reach between Middle Fork Interbay and French Meadows Dam is approximately 11.1 miles in length. Aquatic habitat classification results for this reach are provided in Tables 4-15 through 4-18 and are summarized as follows:

- In this reach there are relatively high percentages of pool habitats (dammed pools and scour pools combined) comprising 43% of the habitat units and 49% of the reach length, respectively.
- Turbulent habitats had a relative frequency of 35% but tended to be short in length, comprising 24% of the reach length.
- Modified R5 habitats indicate that dammed pools and step pools comprise about 36% of the length. For turbulent habitats, cascades are present in greater relative frequency and slightly more stream length than riffles.
- Rosgen channel types are characterized as A, B, F, “Fb or A”, and “Fb or G”.
  - Rosgen A channel type is the major channel type present comprising about 54% of the reach length.
  - This channel type is dominated by pools comprising 54% of the A channel type reach length

4.4.2.2 Rubicon River

Aquatic habitat classification results for the Rubicon River from Hell Hole Dam to Ralston Afterbay are provided in Tables 4-19 through 4-22 and are summarized as follows:

- Turbulent habitats and pools dominate the Rubicon River downstream of Hell Hole Dam.
  - Turbulent habitats make up about 39% of the habitat units and 35% of the reach length.
  - Pools comprise about 36% of the habitat units and 33% of the reach length.
- Turbulent habitats along the Rubicon River comprise a greater proportion of the stream length than in the Middle Fork American River between French Meadows Dam and the North Fork American River confluence, while the relative frequencies of these habitats was similar, but slightly lower for the Middle Fork American River.
- Among the individual Modified R-5 habitat types, cascades, mid-channel pools, and runs are of similar total length (21% to 25% of habitat length) and relative frequency.
- Rosgen channel types for this reach are comprised of entrenched to moderately entrenched types (Rosgen 1996), including B, F, G, “F or B”, and “F or G”.
- The B channel downstream of Hell Hole Dam is characterized by an aggraded channel with about 38% of its length showing no surface flow.
  - The B channel type also contains relatively little pool habitat length, about 10% by length.

The individual reaches derived based on the confluence of tributaries are discussed below.

<u>Rubicon River from Ralston Afterbay to the Long Canyon Creek Confluence</u>

The Rubicon River reach between Ralston Afterbay and the Long Canyon Creek confluence is a relatively short reach of approximately 3.6 miles in length. Aquatic habitat classification results for this reach are provided in Tables 4-23 through 4-26 and are summarized as follows:

- Relatively similar frequencies of turbulent, non turbulent, and scour pool habitats are present in this reach.
- Lengths of pool, non turbulent, and turbulent habitats are relatively similar ranging from about 36% to 31% of the reach.

- Runs and mid-channel pools are the most abundant individual R-5 habitat types.
- This reach includes Rosgen F, G and "F or G" channel types.
  - The F channel type represents more of the stream length than the other two types, G the least.
  - A greater proportion of turbulent and scour pool habitats are associated with the F channel than the G channel. However, this difference may be affected by the relatively large percentage of the reach length classified "F or G," which has an intermediate proportion of turbulent habitats.
  - Turbulent habitats located in the F channel type consist of cascades and riffles, whereas the turbulent habitats in the G channel consist of riffles. The "F or G" channel type includes both.

Rubicon River from the Long Canyon Creek Confluence to the South Fork Rubicon River Confluence

The Rubicon River reach between the Long Canyon Creek confluence and the South Fork Rubicon River confluence is a relatively long reach of approximately 19 miles in length. The aquatic habitat classification results for this reach are provided in Tables 4-27 through 4-30 and are summarized as follows:

- The most abundant habitats in this reach are turbulent and pool habitats by both frequency and length.
  - The turbulent habitats are comprised primarily of cascade habitats and the most abundant pool habitats are mid-channel pools.
- This reach contains Rosgen F, G, and "F or G" channel designations. The G channel type is more abundant than either the F or "F or G" types.
  - The G channel contains a greater proportion of pool habitats and a lower percentage of turbulent habitat types than the other channel types.
- In each channel type, cascade habitats are the dominant form of turbulent habitat.

Rubicon River from the South Fork Rubicon River Confluence to Hell Hole Dam

The Rubicon River reach between the South Fork Rubicon River confluence and Hell Hole Dam is about 7.7 miles long and includes the aggraded rockfill section downstream of Hell Hole Dam. The aquatic habitat classification results for this reach are provided in Tables 4-31 through 4-34 and are summarized as follows:

- Non turbulent habitats (primarily runs), followed by pools (primarily mid-channel pools), comprise a larger percentage of the reach length than other types.
- Turbulent habitats are less abundant than in the reach immediately downstream.

- Channel types present include Rosgen B, F, G, “F or B”, and “F or G.”
  - The B and “F or B” channel classifications make up about 75% of the stream length in this reach.
  - Run habitat in the B and “F or B” channel classifications makes up the longest percentage length among wetted habitats.

4.5 2006 STUDIES

This report documents the Phase 1 study elements completed in 2005. Some Phase 1 study elements will continue in 2006, as follows.

- Conduct helicopter surveys to verify habitat mapping at distinct locations, and locations where mesohabitat units could not be definitively designated using the existing aerial photography or video.

- Conduct ground-level data acquisition of habitat information for portions of North Fork and South Fork Long Canyon Creek, Long Canyon Creek, and Duncan Creek that could not be habitat typed or mapped from aerial imagery. Select areas to be surveyed based on consultation with the resource agencies.

Phase 2 studies will be carried out as described in the June 2005 Existing Environment Study Plan Package. The Phase 2 studies will focus on ground truthing and developing more detailed habitat data at selected locations. Phase 2 activities will specifically include:

- Incorporate Rosgen Level II information for finalization of strata.

- Select habitats to be ground truthed that were mapped in 2005 using aerial photography and videography.

- Conduct ground truthing surveys.

The strata and sites to be ground truthed will be chosen in consultation with the resource agencies after completion of Phase 1 studies and Rosgen Level II geomorphic classification. Access will be an important consideration during the selection of sites to be ground truthed. The Phase 2 studies will be completed during 2006. Work completed in 2006 will be documented in a report that will be provided to the resource agencies for review and comment.

References

Hawkins, C. P., J. L. Kershner, P. A. Bisson, M. D. Bryant, L. M. Decker, S. V. Gregory, D. A. McCullough, C. K. Overton, G. H. Reeves, R. J. Steedman, and M. K. Young. 1993. A hierarchical approach to classifying habitats in small streams. Fisheries. 18(6): 3-12.

McCain, M., D. Fuller, L. Decker, and K. Overton. 1990. Stream habitat classification and inventory procedures for northern California. FHR Currents: R-5's fish habitat relationships technical bulletin. No. 1. US Dept. of Agriculture, Forest Service, Pacific Southwest Region, Arcata, California.

TABLES

Table 2-1. Geomorphology and Riparian Ground Survey Summary

	Survey Length (mi)	Total Length[1] (mi)	% Ground Surveyed
Duncan Creek	3.6	9.5	37.9
North Fork Long Canyon	1.8	3.8	47.4
South Fork Long Canyon	2.0	4.5	44.4
Long Canyon Creek	3.7	11.2	33
Middle Fork American River	9.1	47.2	19.3
Rubicon River	3.1	36.2	8.6
Total	**23.3**	**112.4**	**20.7**

[1] Total survey length includes distance ground surveyed above diversions

Table 2-2. Sediment Contribution Summary

	Debris Slides	Rock Falls	Debris Torrents	Eroding Banks
Duncan Creek	6	3	0	3
North Fork Long Canyon	3	0	0	4
South Fork Long Canyon	0	0	0	3
Long Canyon Creek	1	17	0	0
Middle Fork American River	7	6	7	0
Rubicon River	12	4	2	6
Total	**29**	**30**	**9**	**16**

Table 2-3. Summary of Channel Gradients in the Study Streams

Duncan Creek	**Gradient**	
RM 0.0 to RM 1.1	10.1%	Middle Fork American River confluence to 1.1 miles upstream
RM 1.2 to RM 1.9	2.9%	
RM 1.9 to RM 3.1	4.5%	Big Bar
RM 3.1 to RM 5.6	3.1%	Lower Glenn Mine
RM 5.6 to RM 6.5	6.0%	Below Rd 96 Bridge crossing
RM 6.5 to RM 7.4	1.4%	Rd 96 Bridge crossing
RM 7.4 to RM 8.6	3.8%	Duncan Creek Diversion
North Fork Long Canyon		
RM 0.0 to RM 0.9	4.1%	
RM 0.9 to RM 1.4	1.9%	Mining tailings
RM 1.4 to RM 2.3	5.1%	
RM 2.3 to RM 3.1	3.4%	North Fork Long Canyon Creek Diversion
South Fork Long Canyon		
RM 0.0 to RM 0.8	5.2%	
RM 1.0 to RM 1.6	2.8%	
RM 1.7 to RM 2.7	1.8%	Lower Meadow Reach
RM 2.8 to RM 3.3	4.8%	South Fork Long Canyon Creek Diversion
Long Canyon Creek		
RM 0.0 to RM 4.9	5.5%	
RM 5.0 to RM 7.1	4.8%	Blacksmith Flat Footbridge; estimated downstream glaciation limit
RM 7.1 to RM 7.7	1.7%	0.9 mile downstream from Ramsey Crossing
RM 7.8 to RM 9.5	2.7%	0.9 mile upstream from Ramsey Crossing
RM 9.5 to RM 11.3	2.3%	Confluence North and South Forks Long Canyon Creek
Middle Fork American River		**Reference Points**
RM 0.0 to RM 24.5	0.5%	North Fork American River confluence to Ralston Afterbay
RM 25.7 to RM 35.5	2.5%	Ralston Afterbay to Middle Fork Interbay
RM 35.9 to RM 47.1	4.2%	Middle Fork Interbay to French Meadow Reservoir
Rubicon River		
RM 0.0 to RM 3.6	1.1%	Ralston Afterbay to Long Canyon Creek confluence
RM 3.6 to RM 22.6	2.1%	Long Canyon confluence to South Fork Rubicon River confluence
RM 22.6 to RM 27.0	2.0%	South Fork Rubicon River confluence to Parsley Bar
RM 27.0 to RM 30.3	1.5%	Parsely Bar to Hellhole Reservoir

Table 2-4. Summary of Sinuosity in Study Streams

Duncan Creek	Sinuosity	Reference Points
RM 0.0 to RM 4.0	1.18	Middle Fork American River confluence to Blue Eyes Canyon
RM 4.0 to RM 8.6	1.07	Blue Eyes Canyon to Duncan Creek Diversion
North Fork Long Canyon		
RM 0.0 to RM 3.1	1.01	North Fork Long Canyon Creek confluence to Long Canyon Creek Diversion
South Fork Long Canyon		
RM 0.0 to RM 3.3	1.0	Long Canyon Creek confluence to South Fork Long Canyon Creek Diversion
Long Canyon Creek		
RM 0.0 to RM 11.3	1.13	Rubicon River confluence to North and South Fork Long Canyon Creek confluence
Middle Fork American River		
RM 0.0 to RM 7.0	1.28	Confluence with North Fork American River to Cherokee Bar
RM 7.0 to RM 11.0	1.09	Cherokee Bar through Ruck-A-Chucky Rapids
RM 11.0 to RM 21.8	1.41	
RM 21.8 to RM 24.7	1.76	Gray Eagle Bar to Ralston Afterbay
RM 25.7 to RM 30.7	1.18	
RM 30.7 to RM 38.5	1.34	
RM 38.5 to RM 47.1	1.17	Below Duncan Creek confluence to French Meadow Reservoir
Rubicon River		
RM 0.0 to RM 5.6	1.40	Ralston Afterbay to 2 mi. above Long Canyon Creek confluence
RM 5.6 to RM 20.0	1.30	2.5 mi. below South Fork Rubicon River confluence
RM 20.0 to RM 30.3	1.10	Hell Hole Dam

Table 2-5. Ground Survey Measurements of Morphometric Parameters for Rosgen Level I

Stream Name	River Mile	Maximum Depth (feet)	Average Depth (feet)	Bankfull Width (feet)	Flood Prone Width (feet)	Width/Depth Ratio	Entrenchment	Gradient	Sinuosity	Level I Type	Other Possible Level I
Duncan Creek	6.8	2.6	2.3	37	65	16.1	1.8	2.8	1.15	B	
North Fork Long Canyon Creek	1.9	2.2	2.0	22	40	11.0	1.8	3.3	1.13	B	
North Fork Long Canyon Creek	2.3	2.3	2.0	31	49	15.5	1.6	2.9	1.13	B	
North Fork Long Canyon Creek[b] [a]	3.3	3.5	3.0	35	57	11.7	1.6	7.6	1.13	B	
South Fork Long Canyon	1.3	2.3	2.0	30	48	15.0	1.6	3.8	1.08	B	
South Fork Long Canyon	1.5	2.0	1.5	35	60	23.3	1.7	2.9	1.08	B	
South Fork Long Canyon [b]	4.3	3.0	2.6	27	50	10.4	1.9	2.4	1.08	B	
Long Canyon Creek	8.3	3.1	3.0	63	75	21.0	1.2	3.4	1.10	Fb	B
Long Canyon Creek	9.7	3.1	2.6	55	67	21.2	1.2	1.8 [a]	1.14	F	B
Long Canyon Creek	10.9	6.5	6.0	38	65	6.3	1.7	2.2	1.14	B	G
Middle Fork American River	1.6	6.6	5.0	239	270	47.7	1.1	0.0	1.28	F	
Middle Fork American River	3.8	9.1	7.0	393	413	56.1	1.1	0.0	1.28	F	
Middle Fork American River	27.7	6.2	4.5	89	136	19.8	1.5	2.8 [a]	1.21	B	Fb
Middle Fork American River	28.2	2.1	1.4	115	149	82.1	1.3	1.4	1.21	F	Bc
Middle Fork American River	34.5	4.8	3.5	84	106	24.0	1.3	3.6	1.27	Fb	B
Middle Fork American River	35.0	5.9	4.0	71	88	17.8	1.2	2.5	1.27	Fb	B
Rubicon River	3.5	5.2	3.5	138	164	39.4	1.2	2.1	1.03	F	B
Rubicon River	20.2	3.5	2.5	83	136	33.2	1.6	1.8	1.07	Bc	F

[a] Local gradient measured with a clinometer in the field was 2%
[b] Location is upstream from diversion

Table 2-6. Duncan Creek Rosgen Level I Stream Types

Upstream Station	Downstream Station	Incremental Distance (mi)	Rosgen Level I Classification
8.6	7.9	0.7	B or G
7.9	5.0	2.9	B
5.0	4.0	1.0	B or G
4.0	3.1	0.9	G
3.1	1.0	2.1	B
1.0	0.0	1.0	A

Table 2-7. Long Canyon Creek Rosgen Level I Stream Types

Upstream Station	Downstream Station	Incremental Distance (mi)	Rosgen Level I Classification
11.4	7.0	4.4	B
7.0	0.0	7.0	A

Table 2-8. Middle Fork American River Rosgen Level I Stream Types

Upstream Station	Downstream Station	Incremental Distance (mi)	Rosgen Level I Classification
47.2	44.2	3.0	A
44.2	42.0	2.2	B
42.0	39.7	2.3	A
39.7	37.4	2.3	Fb or A
37.4	36.5	0.9	A
36.5	36.0	0.5	Fb or G
36.0	35.6	0.4	Middle Fork Interbay
35.6	33.4	2.2	Fb or B
33.4	29.1	4.3	Fb
29.1	27.7	1.4	F or B
27.7	26.1	1.6	Fb or B
26.1	25.7	0.4	Fb
25.7	24.7	1.0	Ralston Afterbay
24.7	10.8	13.9	F
10.8	9.6	1.2	F or B
9.6	0.0	9.6	F

Table 2-9. Rubicon River Rosgen Level I Stream Types

Upstream Station	Downstream Station	Incremental Distance (mi)	Rosgen Level I Classification
30.3	27.5	2.8	B (aggraded)
27.5	24.7	2.8	F or B
24.7	24.2	0.5	G
24.2	23.4	0.8	F
23.4	22.5	0.9	F or G
22.5	21.9	0.6	G
21.9	19.7	2.2	F
19.7	17.6	2.1	F or G
17.6	14.6	3.0	G
14.6	13.5	1.1	F or G
13.5	8.7	4.8	G
8.7	6.1	2.6	F or G
6.1	5.6	0.5	G
5.6	4.4	1.2	F
4.4	3.7	0.7	G
3.7	3.3	0.4	F
3.3	2.1	1.2	F or G
2.1	0.8	1.3	F
0.8	0.3	0.5	G

Table 2-10. Duncan Creek Montgomery-Buffington Channel Types

Upstream Station	Downstream Station	Incremental Distance (mi)	Montgomery-Buffington Channel Type
9.5	9.1	0.4	Bedrock/Step-Pool
9.1	8.7	0.4	Plane-Bed
8.7	7.4	1.3	Step-Pool/Plane-Bed
7.4	6.1	1.3	Plane-Bed
6.1	4.5	1.6	Step-Pool/Plane-Bed
4.5	4.0	0.5	Bedrock/Step-Pool
4.0	3.1	0.9	Bedrock/Cascade
3.1	2.5	0.6	Step-Pool/Plane-Bed
2.5	1.0	1.5	Bedrock/Step-Pool/Cascade
1.0	0.2	0.8	Step-Pool/Cascade
0.2	0.0	0.2	Bedrock

Table 2-11. North Fork Long Canyon Creek Montgomery-Buffington Channel Types

Upstream Station	Downstream Station	Incremental Distance (mi)	Montgomery-Buffington Channel Type
3.1	1.75	1.35	Step-Pool/Plane Bed/Pool-Riffle
1.75	1.6	0.15	Bedrock
1.6	1.4	0.2	Plane Bed
1.4	0.3	1.1	Step-Pool/Plane Bed/Pool-Riffle
0.3	0.0	0.3	Bedrock

Table 2-12. South Fork Long Canyon Creek Montgomery-Buffington Channel Types

Upstream Station	Downstream Station	Incremental Distance (mi)	Montgomery-Buffington Channel Type
3.3	3.2	0.1	Step-Pool/Plane Bed
3.2	3.1	0.1	Bedrock
3.1	2.7	0.4	Step-Pool/Plane Bed
2.7	1.8	0.9	Plane Bed/Pool Riffle
1.8	1.6	0.2	Bedrock
1.6	0.1	1.5	Step-Pool/Plane Bed
0.1	0.0	0.1	Bedrock

Table 2-13. Long Canyon Creek Montgomery-Buffington Channel Types

Upstream Station	Downstream Station	Incremental Distance (mi)	Montgomery-Buffington Channel Type
11.4	10.8	0.6	Plane-Bed/Step-Pool
10.8	10.5	0.3	Plane-Bed
10.5	8.3	2.2	Plane-Bed/Step-Pool
8.3	7.4	0.9	Bedrock/Step-Pool
7.4	7.0	0.4	Plane-Bed/Step-Pool
7.0	6.7	0.3	Bedrock
6.7	2.0	4.7	Bedrock/Step-Pool
2.0	0.0	2.0	Step-Pool

Table 2-14. Middle Fork American River Montgomery-Buffington Channel Types

Upstream Station	Downstream Station	Incremental Distance (mi)	Montgomery-Buffington Channel Type
47.2	44.2	3.0	Bedrock/Step-Pool
44.2	42.0	2.2	Plane-Bed/Forced Pool Riffle
42.0	40.8	1.2	Plane-Bed/Step-Pool
40.8	40.0	0.8	Bedrock
40.0	38.4	1.6	Step-Pool/Cascade
38.4	38.0	0.4	Bedrock
38.0	37.4	0.6	Step-Pool/Cascade
37.4	36.5	0.9	Bedrock
36.5	36.0	0.5	Step-Pool/Cascade
36.0	35.6	0.4	Interbay
35.6	34.8	0.8	Forced Pool Riffle/Cascades
34.8	34.2	0.6	Plane-Bed/Forced Pool Riffle
34.2	33.4	0.8	Step-Pool/Cascade
33.4	33.0	0.4	Bedrock
33.0	29.8	3.2	Step-Pool/Forced Pool-Riffle
29.8	27.8	2.0	Plane-Bed/Forced Pool-Riffle
27.8	26.1	1.7	Forced Pool-Riffle/Cascades
26.1	25.7	0.4	Plane-Bed/Pool-Riffle
25.7	24.7	1.0	Oxbow Reservoir
24.7	10.8	13.9	Pool-Riffle
10.8	9.6	1.2	Forced Pool-Riffle/Cascades
9.6	0.0	9.6	Pool-Riffle

Table 2-15. Rubicon River Montgomery-Buffington Channel Types

Downstream Station	Upstream Station	Incremental Distance (mi)	Montgomery-Buffington Channel Type
0.3	2.1	1.8	Forced Pool-Riffle
2.1	3.3	1.2	Forced Pool-Riffle/Plane-Bed
3.3	3.9	0.6	Forced Pool-Riffle
3.9	8.6	4.7	Forced Pool-Riffle/Cascade
8.6	9.7	1.1	Step-Pool/Cascade
9.7	15.0	5.3	Forced Pool-Riffle/Cascade
15.0	15.2	0.2	Bedrock
15.2	21.9	6.7	Forced Pool-Riffle/Cascade
21.9	22.5	0.6	Bedrock/Step-Pool
22.5	24.7	2.2	Forced Pool-Riffle/Cascade
24.7	27.4	2.7	Forced Pool-Riffle/Plane-Bed
27.4	30.3	2.9	Plane-Bed

Table 2-16. Channel Responsiveness Rating

	Channel Response Rating (mi.)		
	High	***Moderate***	***Low***
Middle Fork American River below Oxbow	23.5	0	1.2
Middle Fork American River above Oxbow	5.2	1.2	14.7
Rubicon River	6.8	2.4	21
Duncan Creek	1.7	3.4	9.4
Long Canyon Creek	.3	3.2	7.9
North Fork Long Canyon Creek	2.7	0	.5
South Fork Long Canyon Creek	.9	2	.4
Total	**41.1**	**12.2**	**55.1**

Table 3-1. Riparian Community Composition and Overall Coverage along Each Study Stream based on Percentage of Overall Stream Miles Occupied.

Community Type	Percentage of Stream Length Occupied (%)					
	Duncan Creek	North Fork Long Canyon Creek	South Fork Long Canyon Creek	Long Canyon Creek	Middle Fork American River	Rubicon River
Alder Dominant	9.6	9.1	8.0	24.0	12.6	0.0
Willow Dominant	0.0	0.0	8.3	27.7	16.2	0.0
Alder/Willow Co-Dominant	25.7	47.1	35.3	2.0	1.2	13.4
Alder/Willow/ Cottonwood	10.0	14.0	24.7	2.3	17.7	38.2
Alder/Willow/Black Locust	0.0	0.0	0.0	0.0	6.6	0.0
Alder/Willow/Black Locust/Cottonwood	0.0	0.0	0.0	0.0	9.1	0.0
Total percent coverage	**45.2**	**70.3**	**76.4**	**56.0**	**63.4**	**51.6**

Table 3-2. Relative Proportion (Percent Composition) of Each Riparian Community Present along the Study Stream.

Community Type	Percentage of Total Riparian Length by Community Type (%)					
	Duncan Creek	North Fork Long Canyon Creek	South Fork Long Canyon Creek	Long Canyon Creek	Middle Fork American River	Rubicon River
Alder Dominant	21.1	13.0	10.5	42.9	19.9	0.0
Willow Dominant	0.0	0.0	10.9	49.5	25.6	0.0
Alder/Willow Co-Dominant	56.8	67.1	46.2	3.5	1.9	26.0
Alder/Willow/ Cottonwood	22.1	19.9	32.4	4.1	27.8	74.0
Alder/Willow/Black Locust	0.0	0.0	0.0	0.0	10.4	0.0
Alder/Willow/Black Locust/Cottonwood	0.0	0.0	0.0	0.0	14.3	0.0

Table 3-3. Riparian Coverage by Community Type along Each of the Study Streams based on the Length of Stream (ft.) Occupied.

Duncan Creek

	Riparian Coverage (Stream length occupied in feet)				
Community Type	**Sparse Line (ft)**	**Discontinuous Line (ft)**	**Continuous Line (ft)**	**Polygon Length (ft)**	**Polygon Area (acres)**
Alder Dominant	3,113	3,248	2,822	0	0
Willow Dominant	0	0	0	0	0
Alder/Willow Co-Dominant	14,748	661	9,246	1,053	1.43
Alder/Willow/ Cottonwood	2,442	3,924	3,220	1,752	3.55
Alder/Willow/Black Locust	0	0	0	0	0
Alder/Willow/Black Locust/Cottonwood	0	0	0	0	0
Total	**20,303**	**7,833**	**15,288**	**2,805**	**4.98**
Percent of Total Riparian Coverage	**44%**	**17%**	**33%**	**6%**	

North Fork Long Canyon Creek

	Riparian Coverage (Stream length occupied in feet)				
Community Type	**Sparse Line (ft)**	**Discontinuous Line (ft)**	**Continuous Line (ft)**	**Polygon Length (ft)**	**Polygon Area (acres)**
Alder Dominant	1,032	0	2,154	1,530	2.32
Willow Dominant	0	0	0	0	0
Alder/Willow Co-Dominant	3,445	0	12,985	1,648	2.62
Alder/Willow/ Cottonwood	550	0	4,332	1,171	1.83
Alder/Willow/Black Locust	0	0	0	0	0
Alder/Willow/Black Locust/Cottonwood	0	0	0	0	0
Total	**5,027**	**0**	**19,471**	**4,349**	**6.76**
Percent of Total Riparian Coverage	**17%**	**0%**	**68%**	**15%**	

Table 3-3. Riparian Coverage by Community Type along Each of the Study Streams based on the Length of Stream (ft.) Occupied (continued).

South Fork Long Canyon Creek					
	Riparian Coverage (Stream length occupied in feet)				
Community Type	Sparse Line (ft)	Discontinuous Line (ft)	Continuous Line (ft)	Polygon Length (ft)	Polygon Area (acres)
Alder Dominant	3,979	0	0	0	0
Willow Dominant	4,136	0	0	0	0
Alder/Willow Co-Dominant	4,345	3,422	9,766	0	0
Alder/Willow/ Cottonwood	2,390	0	9,876	659	1.12
Alder/Willow/Black Locust	0	0	0	0	0
Alder/Willow/Black Locust/Cottonwood	0	0	0	0	0
Total	**14,850**	**3,422**	**19,643**	**659**	**1.12**
Percent of Total Riparian Coverage	**38%**	**9%**	**51%**	**2%**	

Long Canyon Creek					
	Riparian Coverage (Stream length occupied in feet)				
Community Type	Sparse Line (ft)	Discontinuous Line (ft)	Continuous Line (ft)	Polygon Length (ft)	Polygon Area (acres)
Alder Dominant	13,388	658	14,587	1,664	1.30
Willow Dominant	20,180	0	12,846	2,174	3.14
Alder/Willow Co-Dominant	1,746	0	614	0	0.24
Alder/Willow/ Cottonwood	1,802	0	949	91	0.000
Alder/Willow/Black Locust	0	0	0	0	0.000
Alder/Willow/Black Locust/Cottonwood	0	0	0	0	0.000
Total	**37,116**	**658**	**28,996**	**3,929**	**4.68**
Percent of Total Riparian Coverage	**52%**	**1%**	**41%**	**6%**	

Table 3-3. Riparian Coverage by Community Type along Each of the Study Streams based on the Length of Stream (ft.) Occupied (continued).

Middle Fork of the American River					
	Riparian Coverage (Stream length occupied in feet)				
Community Type	**Sparse Line (ft)**	**Discontinuous Line (ft)**	**Continuous Line (ft)**	**Polygon Length (ft)**	**Polygon Area (acres)**
Alder Dominant	10,928	27,831	24,101	3,045	6.61
Willow Dominant	44,442	14,420	22,096	12,346	16.09
Alder/Willow Co-Dominant	0	4,399	1,690	3,401	4.82
Alder/Willow/ Cottonwood	30,616	22,438	34,958	30,758	46.41
Alder/Willow/Black Locust	0	17,658	15,279	9,632	17.33
Alder/Willow/Black Locust/Cottonwood	2,567	13,633	29,037	51,670	65.86
Total	**88,553**	**100,380**	**127,161**	**110,851**	**157.11**
Percent of Total Riparian Coverage	**21%**	**23%**	**30%**	**26%**	

Rubicon River					
	Riparian Coverage (Stream length occupied in feet)				
Community Type	**Sparse Line (ft)**	**Discontinuous Line (ft)**	**Continuous Line (ft)**	**Polygon Length (ft)**	**Polygon Area (acres)**
Alder Dominant	0	0	0	0	0
Willow Dominant	0	0	0	0	0
Alder/Willow Co-Dominant	0	10,537	32,700	8,570	8.81
Alder/Willow/ Cottonwood	0	34,165	88,743	23,125	32.58
Alder/Willow/Black Locust	0	0	0	0	0
Alder/Willow/Black Locust/Cottonwood	0	0	0	0	0
Total	**0**	**44,702**	**121,443**	**31,696**	**41.39**
Percent of Total Riparian Coverage	**0%**	**23%**	**61%**	**16%**	

Table 3-4. Relative Proportion (%) of Age Classes Present within Riparian Communities Along the Study Streams.

Age Class	Percentage of Total Riparian Length (%)					
	Duncan Creek	North Fork Long Canyon Creek	South Fork Long Canyon Creek	Long Canyon Creek	Middle Fork American River	Rubicon River
Mature Vegetation	0.0	0.0	1.5	11.0	0.8	3.6
Medium-Aged and Mature Vegetation	3.9	30.7	0.0	7.2	20.4	12.6
Medium-Aged Vegetation	18.3	0.0	0.0	9.7	12.6	2.4
Young and Medium-Aged Vegetation	59.5	16.3	56.0	59.4	38.2	51.0
Young Vegetation/ Seedlings	10.1	0.0	0.0	0.0	2.2	8.6
Young, Medium-Aged, and Mature Vegetation	8.1	53.0	42.5	12.7	25.7	21.9

Table 4-3. Summary of Hawkins Habitat Types for the Middle Fork American River from the Confluence with the North Fork American River to French Meadows Reservoir*.

Hawkins Habitat Type Classification	Frequency of Habitat Types	Length of Habitat Types (ft)	Relative Frequency of Habitat Types	Percentage Length of Habitat Types
Culvert (CVT)	1	174	0.1%	0.1%
Dammed Pool (DP)	244	36,498	19.7%	14.0%
Non Turbulent (NT)	348	82,602	28.1%	31.7%
Scour Pool (SP)	224	90,394	18.1%	34.7%
Turbulent (T)	405	44,839	32.7%	17.2%
Unidentified	15	6,289	1.2%	2.4%
Total	**1,237**	**260,796**	**100%**	**100%**

* Reservoirs are not included in the summary.

Table 4-4. Summary of Modified R-5 Habitat Types for the Middle Fork American River from the Confluence with the North Fork American River to French Meadows Reservoir*.

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
Backwater Pool (BWP)	5	2,110	0.4%	0.8%
Cascade (CAS)	218	20,953	17.6%	8.0%
Cascade Pool Sequence (CPS)	4	675	0.3%	0.3%
Culvert (CVT)	1	174	0.1%	0.1%
Dammed Pool (DPL)	198	23,187	16.0%	8.9%
Lateral Scour Pool (LSP)	15	4,459	1.2%	1.7%
Mid Channel Pool (MCP)	209	85,936	16.9%	33.0%
Pocket Water (POW)	75	11,956	6.1%	4.6%
Riffle (RIF)	182	23,082	14.7%	8.9%
Run (RUN)	255	65,779	20.6%	25.2%
Step Pool (SPO)	41	11,201	3.3%	4.3%
Step Run (SRN)	17	4,751	1.4%	1.8%
Trench Chute (TCH)	1	115	0.1%	0.0%
Unidentified	16	6,418	1.3%	2.5%
Total	**1,237**	**260,796**	**100%**	**100%**

* Reservoirs are not included in the summary.

Table 4-5. Summary of Hawkins Habitat Types by Rosgen Level 1 Classification for the Middle Fork American River from the Confluence with the North Fork American River to French Meadows Reservoir*.

Rosgen Level 1 Classification	Hawkins Habitat Type Classification	Frequency of Habitat Types	Length of Habitat Types (ft)	Relative Frequency of Habitat Types	Percentage Length of Habitat Types
A	Dammed Pool (DP)	98	14,228	38.0%	42.0%
A	Non Turbulent (NT)	47	6,977	18.2%	20.6%
A	Scour Pool (SP)	24	4,277	9.3%	12.6%
A	Turbulent (T)	89	8,407	34.5%	24.8%
Total A		**258**	**33,890**	**100%**	**100%**
B	Dammed Pool (DP)	22	3,161	25.6%	24.9%
B	Non Turbulent (NT)	25	5,358	29.1%	42.1%
B	Scour Pool (SP)	10	1,727	11.6%	13.6%
B	Turbulent (T)	29	2,472	33.7%	19.4%
Total B		**86**	**12,718**	**100%**	**100%**
F	Culvert (CVT)	1	174	0.3%	0.1%
F	Dammed Pool (DP)	6	2,551	1.6%	1.9%
F	Non Turbulent (NT)	1	606	0.3%	0.4%
F	Scour Pool (SP)	133	42,070	34.4%	30.9%
F	Turbulent (T)	139	73,525	35.9%	54.1%
F	Unidentified	107	17,066	27.6%	12.5%
Total F		**387**	**135,992**	**100%**	**100%**
F or B*	Dammed Pool (DP)	10	1,731	18.2%	11.1%
F or B	Non Turbulent (NT)	3	1,524	5.5%	9.7%
F or B	Scour Pool (SP)	17	6,472	30.9%	41.4%
F or B	Turbulent (T)	7	4,070	12.7%	26.0%
F or B	Unidentified	18	1,840	32.7%	11.8%
Total F or B		**55**	**15,637**	**100%**	**100%**

Table 4-5. Summary of Hawkins Habitat Types by Rosgen Level 1 Classification for the Middle Fork American River from the Confluence with the North Fork American River to French Meadows Reservoir(continued).**

Rosgen Level 1 Classification	Hawkins Habitat Type Classification	Frequency of Habitat Types	Length of Habitat Types (ft)	Relative Frequency of Habitat Types	Percentage Length of Habitat Types
Fb	Dammed Pool (DP)	43	4,649	21.0%	17.1%
Fb	Non Turbulent (NT)	5	945	2.4%	3.5%
Fb	Scour Pool (SP)	71	13,657	34.6%	50.3%
Fb	Turbulent (T)	20	2,781	9.8%	10.2%
Fb	Unidentified	66	5,116	32.2%	18.8%
Total Fb		**205**	**27,148**	**100%**	**100%**
Fb or A*	Dammed Pool (DP)	19	4,505	25.0%	36.6%
Fb or A	Non Turbulent (NT)	19	3,195	25.0%	26.0%
Fb or A	Scour Pool (SP)	9	1,476	11.8%	12.0%
Fb or A	Turbulent (T)	29	3,117	38.2%	25.4%
Total Fb or A		**76**	**12,293**	**100%**	**100%**
Fb or B*	Dammed Pool (DP)	43	5,127	28.3%	25.0%
Fb or B	Non Turbulent (NT)	6	3,214	3.9%	15.7%
Fb or B	Scour Pool (SP)	33	4,553	21.7%	22.2%
Fb or B	Turbulent (T)	10	1,720	6.6%	8.4%
Fb or B	Unidentified	60	5,894	39.5%	28.7%
Total Fb or B		**152**	**20,508**	**100%**	**100%**

Table 4-5. Summary of Hawkins Habitat Types by Rosgen Level 1 Classification for the Middle Fork American River from the Confluence with the North Fork American River to French Meadows Reservoir(continued).**

Rosgen Level 1 Classification	Hawkins Habitat Type Classification	Frequency of Habitat Types	Length of Habitat Types (ft)	Relative Frequency of Habitat Types	Percentage Length of Habitat Types
Fb or G*	Dammed Pool (DP)	3	546	16.7%	20.9%
Fb or G	Non Turbulent (NT)	3	319	16.7%	12.2%
Fb or G	Scour Pool (SP)	5	818	27.8%	31.3%
Fb or G	Turbulent (T)	7	928	38.9%	35.5%
Total Fb or G		**18**	**2,611**	**100%**	**100%**

* Specific Rosgen Channel type will be determined at a later phase of geomorphology study.

** Reservoirs are not included in the summary.

Table 4-6. Summary of Modified R-5 Habitat Types by Rosgen Level 1 Classification for the Middle Fork American River from the Confluence with the North Fork American River to French Meadows Reservoir.**

Rosgen Level 1 Classification	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
A	Cascade (CAS)	60	5,352	23.3%	15.8%
A	Cascade Pool Sequence (CPS)	3	426	1.2%	1.3%
A	Dammed Pool (DPL)	77	8,941	29.8%	26.4%
A	Mid channel Pool (MCP)	24	4,277	9.3%	12.6%
A	Pocket Water (POW)	28	4,524	10.9%	13.3%
A	Riffle (RIF)	26	2,629	10.1%	7.8%
A	Run (RUN)	16	2,073	6.2%	6.1%
A	Step Pool (SPO)	21	5,287	8.1%	15.6%
A	Step Run (SRN)	3	381	1.2%	1.1%
Total A		**258**	**33,890**	**100%**	**100%**
B	Cascade (CAS)	14	1,059	16.3%	8.3%
B	Dammed Pool (DPL)	18	2,159	20.9%	17.0%
B	Mid channel Pool (MCP)	10	1,727	11.6%	13.6%
B	Pocket Water (POW)	12	2,844	14.0%	22.4%
B	Riffle (RIF)	15	1,413	17.4%	11.1%
B	Run (RUN)	12	2,299	14.0%	18.1%
B	Step Pool (SPO)	4	1,001	4.7%	7.9%
B	Step Run (SRN)	1	215	1.2%	1.7%
Total B		**86**	**12,718**	**100%**	**100%**

Table 4-6. Summary of Modified R-5 Habitat Types by Rosgen Level 1 Classification for the Middle Fork American River from the Confluence with the North Fork American River to French Meadows Reservoir (continued).**

Rosgen Level 1 Classification	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
F	Backwater Pool (BWP)	5	2,110	1.3%	1.6%
F	Cascade (CAS)	24	4,017	6.2%	3.0%
F	Culvert (CVT)	1	174	0.3%	0.1%
F	Lateral Scour Pool (LSP)	14	4,349	3.6%	3.2%
F	Mid channel Pool (MCP)	125	69,176	32.3%	50.9%
F	Pocket Water (POW)	1	99	0.3%	0.1%
F	Riffle (RIF)	82	12,920	21.2%	9.5%
F	Run (RUN)	127	40,046	32.8%	29.4%
F	Step Pool (SPO)	1	441	0.3%	0.3%
F	Step Run (SRN)	4	1,811	1.0%	1.3%
F	Trench Chute (TCH)	1	115	0.3%	0.1%
F	Unidentified	2	735	0.5%	0.5%
Total F		**387**	**135,992**	**100%**	**100%**
F or B*	Cascade (CAS)	11	1,105	20.0%	7.1%
F or B	Dammed Pool (DPL)	9	1,502	16.4%	9.6%
F or B	Mid channel Pool (MCP)	7	4,070	12.7%	26.0%
F or B	Pocket Water (POW)	1	53	1.8%	0.3%
F or B	Riffle (RIF)	7	735	12.7%	4.7%
F or B	Run (RUN)	15	6,198	27.3%	39.6%
F or B	Step Pool (SPO)	1	229	1.8%	1.5%
F or B	Step Run (SRN)	1	221	1.8%	1.4%
F or B	Unidentified	3	1,524	5.5%	9.7%
Total F or B				**100%**	**100%**

Table 4-6. Summary of Modified R-5 Habitat Types by Rosgen Level 1 Classification for the Middle Fork American River from the Confluence with the North Fork American River to French Meadows Reservoir (continued).**

Rosgen Level 1 Classification	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
Fb	Cascade (CAS)	49	3,583	23.9%	13.2%
Fb	Dammed Pool (DPL)	42	4,420	20.5%	16.3%
Fb	Lateral Scour Pool (LSP)	1	110	0.5%	0.4%
Fb	Mid Channel Pool (MCP)	19	2,672	9.3%	9.8%
Fb	Pocket Water (POW)	19	2,802	9.3%	10.3%
Fb	Riffle (RIF)	17	1,532	8.3%	5.6%
Fb	Run (RUN)	46	9,255	22.4%	34.1%
Fb	Step Pool (SPO)	1	228	0.5%	0.8%
Fb	Step Run (SRN)	6	1,601	2.9%	5.9%
Fb	Unidentified	5	945	2.4%	3.5%
Total Fb		**205**	**27,148**	**100%**	**100%**
Fb or A*	Cascade (CAS)	17	1,739	22.4%	14.1%
Fb or A	Dammed Pool (DPL)	13	1,749	17.1%	14.2%
Fb or A	Mid Channel Pool (MCP)	9	1,476	11.8%	12.0%
Fb or A	Pocket Water (POW)	7	1,032	9.2%	8.4%
Fb or A	Riffle (RIF)	12	1,378	15.8%	11.2%
Fb or A	Run (RUN)	11	1,906	14.5%	15.5%
Fb or A	Step Pool (SPO)	6	2,756	7.9%	22.4%
Fb or A	Step Run (SRN)	1	257	1.3%	2.1%
Total Fb or A		**76**	**12,293**	**100%**	**100%**

Table 4-6. Summary of Modified R-5 Habitat Types by Rosgen Level 1 Classification for the Middle Fork American River from the Confluence with the North Fork American River to French Meadows Reservoir (continued).**

Rosgen Level 1 Classification	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
Fb or B*	Cascade (CAS)	39	3,561	25.7%	17.4%
Fb or B	Cascade Pool Sequence (CPS)	1	249	0.7%	1.2%
Fb or B	Dammed Pool (DPL)	38	4,292	25.0%	20.9%
Fb or B	Mid Channel Pool (MCP)	10	1,720	6.6%	8.4%
Fb or B	Pocket Water (POW)	7	603	4.6%	2.9%
Fb or B	Riffle (RIF)	20	2,083	13.2%	10.2%
Fb or B	Run (RUN)	25	3,684	16.4%	18.0%
Fb or B	Step Pool (SPO)	5	834	3.3%	4.1%
Fb or B	Step Run (SRN)	1	267	0.7%	1.3%
Fb or B	Unidentified	6	3,214	3.9%	15.7%
Total Fb or B		**152**	**20,508**	**100%**	**100%**
Fb or G*	Cascade (CAS)	4	536	22.2%	20.5%
Fb or G	Dammed Pool (DPL)	1	123	5.6%	4.7%
Fb or G	Mid Channel Pool (MCP)	5	818	27.8%	31.3%
Fb or G	Riffle (RIF)	3	392	16.7%	15.0%
Fb or G	Run (RUN)	3	319	16.7%	12.2%
Fb or G	Step Pool (SPO)	2	423	11.1%	16.2%
Total Fb or G		**18**	**2,611**	**100%**	**100%**

*Specific Rosgen Channel type will be determined at a later phase of geomorphology study.
** Reservoirs are not included in the summary.

Table 4-7. Summary of Hawkins Habitat Types for the Middle Fork American River from the Confluence with the North Fork American River 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)	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	17,877	28.4%	12.7%
Culvert (CVT)	1	174	0.2%	0.1%
Unidentified	1	606	0.2%	0.4%
Total	**409**	**140,979**	**100%**	**100%**

* Reservoirs are not included in the summary.

Table 4-8. Summary of Modified R5 Habitat Types for the Middle Fork American River from the Confluence with the North Fork American River 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
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	12,981	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**	**140,979**	**100%**	**100%**

* Reservoirs are not included in the summary.

Table 4-9. Summary of Hawkins Habitat Types by Rosgen Level 1 Classification for the Middle Fork American River from the Confluence with the North Fork American River to Ralston Afterbay.**

Rosgen Level 1 Classification	Hawkins Habitat Type Classification	Frequency of Habitat Types	Length of Habitat Types (ft)	Relative Frequency of Habitat Types	Percentage Length of Habitat Types
F	Culvert (CVT)	1	174	0.3%	0.1%
F	Dammed Pool (DP)	6	2,551	1.6%	1.9%
F	Non Turbulent (NT)	131	40,898	34.1%	30.4%
F	Scour Pool (SP)	139	73,525	36.2%	54.6%
F	Turbulent (T)	106	16,937	27.6%	12.6%
F	Unidentified	1	606	0.3%	0.5%
Total F		**384**	**134,691**	**100%**	**100%**
F or B*	Dammed Pool (DP)	8	1,438	32.0%	22.9%
F or B	Non Turbulent (NT)	2	324	8.0%	5.2%
F or B	Scour Pool (SP)	5	3,585	20.0%	57.0%
F or B	Turbulent (T)	10	940	40.0%	15.0%
Total F or B		**25**	**6,288**	**100%**	**100%**

* Specific Rosgen Channel type will be determined at a later phase of geomorphology study.
** Reservoirs are not included in the summary.

Table 4-10. Summary of Modified R5 Habitat Types by Rosgen Level 1 Classification for the Middle Fork American River from the Confluence with the North Fork American River to Ralston Afterbay.**

Rosgen Level 1 Classification	Mod R5 Habitat Type Classification	Frequency of Habitat Types	Length of Habitat Types (ft)	Relative Frequency of Habitat Types	Percentage Length of Habitat Types
F	Backwater Pool (BWP)	5	2,110	1.3%	1.6%
F	Cascade (CAS)	24	4,017	6.3%	3.0%
F	Culvert (CVT)	1	174	0.3%	0.1%
F	Lateral Scour Pool (LSP)	14	4,349	3.6%	3.2%
F	Mid Channel Pool (MCP)	125	69,176	32.6%	51.4%
F	Pocket Water (POW)	1	99	0.3%	0.1%
F	Riffle (RIF)	82	12,920	21.4%	9.6%
F	Run (RUN)	125	38,873	32.6%	28.9%
F	Step Pool (SPO)	1	441	0.3%	0.3%
F	Step Run (SRN)	4	1,811	1.0%	1.3%
F	Trench Chute (TCH)	1	115	0.3%	0.1%
F	Unidentified	1	606	0.3%	0.5%
Total F		**384**	**134,691**	**100%**	**100%**
F or B*	Cascade (CAS)	9	880	36.0%	14.0%
F or B	Dammed Pool (DPL)	7	1,209	28.0%	19.2%
F or B	Mid Channel Pool (MCP)	5	3,585	20.0%	57.0%
F or B	Riffle (RIF)	1	61	4.0%	1.0%
F or B	Run (RUN)	2	324	8.0%	5.2%
F or B	Step Pool (SPO)	1	229	4.0%	3.6%
Total F or B		**25**	**6,288**	**100%**	**100%**

* Specific Rosgen Channel type will be determined at a later phase of geomorphology study.

** Reservoirs are not included in the summary.

Table 4-11. Summary of Hawkins Habitat Types for the Middle Fork American River from Ralston Afterbay to the 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)	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%**

* Reservoirs are not included in the summary.

Table 4-12. Summary of Modified R5 Habitat Types for the Middle Fork American River from Ralston Afterbay to the 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)	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%**

* Reservoirs are not included in the summary.

Table 4-13. Summary of Hawkins Habitat Types by Rosgen Level 1 Classification for the Middle Fork American River from Ralston Afterbay to the Middle Fork Interbay.**

Rosgen Level 1 Classification	Hawkins Habitat Type Classification	Frequency of Habitat Types	Length of Habitat Types (ft)	Relative Frequency of Habitat Types	Percentage Length of Habitat Types
F or B*	Dammed Pool (DP)	2	293	6.7%	3.1%
F or B	Non Turbulent (NT)	15	6,147	50.0%	65.8%
F or B	Scour Pool (SP)	2	484	6.7%	5.2%
F or B	Turbulent (T)	8	900	26.7%	9.6%
F or B	Unidentified	3	1,524	10.0%	16.3%
Total F or B		**30**	**9,348**	**100%**	**100%**
Fb	Dammed Pool (DP)	43	4,649	21.0%	17.1%
Fb	Non Turbulent (NT)	71	13,657	34.6%	50.3%
Fb	Scour Pool (SP)	20	2,781	9.8%	10.2
Fb	Turbulent (T)	66	5,116	32.2%	18.8%
Fb	Unidentified	5	945	2.4%	3.5%
Total Fb		**205**	**27,148**	**100%**	**100%**
Fb or B*	Dammed Pool (DP)	43	5,127	28.3%	25.0%
Fb or B	Non Turbulent (NT)	33	4,553	21.7%	22.2%
Fb or B	Scour Pool (SP)	10	1,720	6.6%	8.4%
Fb or B	Turbulent (T)	60	5,894	39.5%	28.7%
Fb or B	Unidentified	6	3,214	3.9%	15.7%
Total Fb or B		**152**	**20,508**	**100%**	**100%**

* Specific Rosgen Channel type will be determined at a later phase of geomorphology study.
** Reservoirs are not included in the summary.

Table 4-14. Summary of Modified R5 Habitat Types by Rosgen Level 1 Classification for the Middle Fork American River from Ralston Afterbay to the Middle Fork Interbay.**

Rosgen Level 1 Classification	Mod R5 Habitat Type Classification	Frequency of Habitat Types	Length of Habitat Types (ft)	Relative Frequency of Habitat Types	Percentage Length of Habitat Types
F or B*	Cascade (CAS)	2	225	6.7%	2.4%
F or B	Dammed Pool (DPL)	2	293	6.7%	3.1%
F or B	Mid Channel Pool (MCP)	2	484	6.7%	5.2%
F or B	Pocket Water (POW)	1	53	3.3%	0.6%
F or B	Riffle (RIF)	6	675	20.0%	7.2%
F or B	Run (RUN)	13	5,873	43.3%	62.8%
F or B	Step Run (SRN)	1	221	3.3%	2.4%
F or B	Unidentified	3	1,524	10.0%	16.3%
Total F or B		**30**	**9,348**	**100%**	**100%**
Fb	Cascade (CAS)	49	3,583	23.9%	13.2%
Fb	Dammed Pool (DPL)	42	4,420	20.5%	16.3%
Fb	Lateral Scour Pool (LSP)	1	110	0.5%	0.4%
Fb	Mid Channel Pool (MCP)	19	2,672	9.3%	9.8%
Fb	Pocket Water (POW)	19	2,802	9.3%	10.3%
Fb	Riffle (RIF)	17	1,532	8.3%	5.6%
Fb	Run (RUN)	46	9,255	22.4%	34.1%

Table 4-14. Summary of Modified R5 Habitat Types by Rosgen Level 1 Classification for the Middle Fork American River from Ralston Afterbay to the Middle Fork Interbay (continued).**

Rosgen Level 1 Classification	Mod R5 Habitat Type Classification	Frequency of Habitat Types	Length of Habitat Types (ft)	Relative Frequency of Habitat Types	Percentage Length of Habitat Types
Fb	Step Pool (SPO)	1	228	0.5%	0.8%
Fb	Step Run (SRN)	6	1,601	2.9%	5.9%
Fb	Unidentified	5	945	2.4%	3.5%
Total Fb		**205**	**27,148**	**100%**	**100%**
Fb or B*	Cascade (CAS)	39	3,561	25.7%	17.4%
Fb or B	Cascade Pool Sequence (CPS)	1	249	0.7%	1.2%
Fb or B	Dammed Pool (DPL)	38	4,292	25.0%	20.9%
Fb or B	Mid Channel Pool (MCP)	10	1,720	6.6%	8.4%
Fb or B	Pocket Water (POW)	7	603	4.6%	2.9%
Fb or B	Riffle (RIF)	20	2,083	13.2%	10.2%
Fb or B	Run (RUN)	25	3,684	16.4%	18.0%
Fb or B	Step Pool (SPO)	5	834	3.3%	4.1%
Fb or B	Step Run (SRN)	1	267	0.7%	1.3%
Fb or B	Unidentified	6	3,214	3.9%	15.7%
Total Fb or B		**152**	**20,508**	**100%**	**100%**

*Specific Rosgen Channel type will be determined at a later phase of geomorphology study.
** Reservoirs are not included in the summary.

Table 4-15. Summary of Hawkins Habitat Types for the Middle Fork American River from the Middle Fork Interbay* to French Meadows Reservoir.

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	22,440	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%**

* Reservoirs are not included in the summary.

Table 4-16. Summary of Modified R5 Habitat Types for the Middle Fork American River from the Middle Fork Interbay* to French Meadows Reservoir.

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**	**62,684**	**100%**	**100%**

* Reservoirs are not included in the summary.

Table 4-17. Summary of Hawkins Habitat Types by Rosgen Level 1 Classification for the Middle Fork American River from the Middle Fork Interbay to French Meadows Reservoir.**

Rosgen Level 1 Classification	Hawkins Habitat Type Classification	Frequency of Habitat Types	Length of Habitat Types (ft)	Relative Frequency of Habitat Types	Percentage Length of Habitat Types
A	Dammed Pool (DP)	98	14,228	38.0%	42.0%
A	Non Turbulent (NT)	47	6,977	18.2%	20.6%
A	Scour Pool (SP)	24	4,277	9.3%	12.6%
A	Turbulent (T)	89	8,407	34.5%	24.8%
Total A		**258**	**33,890**	**100%**	**100%**
B	Dammed Pool (DP)	22	3,161	25.6%	24.9%
B	Non Turbulent (NT)	25	5,358	29.1%	42.1%
B	Scour Pool (SP)	10	1,727	11.6%	13.6%
B	Turbulent (T)	29	2,472	33.7%	19.4%
Total B		**86**	**12,718**	**100%**	**100%**
Fb or A*	Dammed Pool (DP)	19	4,505	25.0%	36.6%
Fb or A	Non Turbulent (NT)	19	3,195	25.0%	26.0%
Fb or A	Scour Pool (SP)	9	1,476	11.8%	12.0%
Fb or A	Turbulent (T)	29	3,117	38.2%	25.4%
Total Fb or A		**76**	**12,293**	**100%**	**100%**

Table 4-17. Summary of Hawkins Habitat Types by Rosgen Level 1 Classification for the Middle Fork American River from the Middle Fork Interbay to French Meadows Reservoir (continued).**

Rosgen Level 1 Classification	Hawkins Habitat Type Classification	Frequency of Habitat Types	Length of Habitat Types (ft)	Relative Frequency of Habitat Types	Percentage Length of Habitat Types
Fb or G*	Dammed Pool (DP)	3	546	16.7%	20.9%
Fb or G	Non Turbulent (NT)	3	319	16.7%	12.2%
Fb or G	Scour Pool (SP)	5	818	27.8%	31.3%
Fb or G	Turbulent (T)	7	928	38.9%	35.5%
Total Fb or G		**18**	**2,611**	**100%**	**100%**
F	Non Turbulent (NT)	2	1,173	66.7%	90.1%
F	Turbulent (T)	1	128	33.3%	9.9%
Total F		**3**	**1,301**	**100%**	**100%**

*Specific Rosgen Channel type will be determined at a later phase of geomorphology study.
** Reservoirs are not included in the summary.

Table 4-18. Summary of Modified R5 Habitat Types by Rosgen Level 1 Classification for the Middle Fork American River from the Middle Fork Interbay to French Meadows Reservoir.**

Rosgen Level 1 Classification	Mod R5 Habitat Type Classification	Frequency of Habitat Types	Length of Habitat Types (ft)	Relative Frequency of Habitat Types	Percentage Length of Habitat Types
A	Cascade (CAS)	60	5,352	23.3%	15.8%
A	Cascade Pool Sequence (CPS)	3	426	1.2%	1.3%
A	Dammed Pool (DPL)	77	8,941	29.8%	26.4%
A	Mid Channel Pool (MCP)	24	4,277	9.3%	12.6%
A	Pocket Water (POW)	28	4,524	10.9%	13.3%
A	Riffle (RIF)	26	2,629	10.1%	7.8%
A	Run (RUN)	16	2,073	6.2%	6.1%
A	Step Pool (SPO)	21	5,287	8.1%	15.6%
A	Step Run (SRN)	3	381	1.2%	1.1%
Total A		**258**	**33,890**	**100%**	**100%**
B	Cascade (CAS)	14	1,059	16.3%	8.3%
B	Dammed Pool (DPL)	18	2,159	20.9%	17.0%
B	Mid Channel Pool (MCP)	10	1,727	11.6%	13.6%
B	Pocket Water (POW)	12	2,844	14.0%	22.4%
B	Riffle (RIF)	15	1,413	17.4%	11.1%
B	Run (RUN)	12	2,299	14.0%	18.1%
B	Step Pool (SPO)	4	1,001	4.7%	7.9%
B	Step Run (SRN)	1	215	1.2%	1.7%
Total B		**86**	**12,718**	**100%**	**100%**

Table 4-18. Summary of Modified R5 Habitat Types by Rosgen Level 1 Classification for the Middle Fork American River from the Middle Fork Interbay to French Meadows Reservoir (continued).**

Rosgen Level 1 Classification	Mod R5 Habitat Type Classification	Frequency of Habitat Types	Length of Habitat Types (ft)	Relative Frequency of Habitat Types	Percentage Length of Habitat Types
Fb or A*	Cascade (CAS)	17	1,739	22.4%	14.1%
Fb or A	Dammed Pool (DPL)	13	1,749	17.1%	14.2%
Fb or A	Mid Channel Pool (MCP)	9	1,476	11.8%	12.0%
Fb or A	Pocket Water (POW)	7	1,032	9.2%	8.4%
Fb or A	Riffle (RIF)	12	1,378	15.8%	11.2%
Fb or A	Run (RUN)	11	1,906	14.5%	15.5%
Fb or A	Step Pool (SPO)	6	2,756	7.9%	22.4%
Fb or A	Step Run (SRN)	1	257	1.3%	2.1%
Total Fb or A		**76**	**12,293**	**100%**	**100%**
Fb or G*	Cascade (CAS)	4	536	22.2%	20.5%
Fb or G	Dammed Pool (DPL)	1	123	5.6%	4.7%
Fb or G	Mid Channel Pool (MCP)	5	818	27.8%	31.3%
Fb or G	Riffle (RIF)	3	392	16.7%	15.0%
Fb or G	Run (RUN)	3	319	16.7%	12.2%
Fb or G	Step Pool (SPO)	2	423	11.1	16.2%
Total Fb or G		**18**	**2,611**	**100%**	**100%**
F	Run (RUN)	2	1,173	66.7%	90.1%
F	Unidentified	1	128	33.3%	9.9%
Total F		**3**	**1,301**	**100%**	**100%**

*Specific Rosgen Channel type will be determined at a later phase of geomorphology study.
** Reservoirs are not included in the summary.

Table 4-19. Summary of Hawkins Habitat Types for the Rubicon River from Ralston Afterbay to Hell Hole Reservoir*.

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)	75	12,551	8.6%	6.6%
Non Turbulent (NT)	206	42,196	23.7%	24.6%
Scour Pool (SP)	242	46,247	27.8%	26.4%
Turbulent (T)	336	60,784	38.6%	35.2%
Dry (DRY)	7	7,350	0.8%	4.6%
Unidentified	5	4,383	0.6%	2.5%
Total	**871**	**173,511**	**100%**	**100%**

* Reservoirs are not included in the summary.

Table 4-20. Summary of Modified R-5 Habitat Types for the Rubicon River from Ralston Afterbay to Hell Hole Reservoir*.

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%	24.8%
Cascade Pool Sequence (CPS)	15	4,560	1.7%	2.6%
Dammed Pool (DPL)	57	7,113	6.5%	4.1%
Dry (DRY)	7	7,908	0.8%	4.6%
Glide (GLD)	2	1,076	0.2%	0.6%
Lateral Scour Pool (LSP)	48	8,222	5.5%	4.8%
Mid Channel Pool (MCP)	194	37,349	22.3%	21.7%
Pocket Water (POW)	6	736	0.7%	0.4%
Riffle (RIF)	84	13,479	9.6%	7.8%
Run (RUN)	194	39,358	22.3%	22.8%
Step Pool (SPO)	18	4,231	2.1%	2.5%
Step Run (SRN)	4	1,293	0.5%	0.7%
Unidentified	5	4,383	0.6%	2.5%
Total	**871**	**172,45**	**100%**	**100%**

* Reservoirs are not included in the summary.

Table 4-21. Summary of Hawkins Habitat Types by Rosgen Level 1 Classification for the Rubicon River from Ralston Afterbay to Hell Hole Reservoir.**

Rosgen Level 1 Classification	Hawkins Habitat Type Classification	Frequency of Habitat Types	Length of Habitat Types (ft)	Relative Frequency of Habitat Types	Percentage Length of Habitat Types
B (aggraded)	Non Turbulent (NT)	9	6,700	28.1%	32.0%
B (aggraded)	Scour Pool (SP)	9	2,168	28.1%	10.4%
B (aggraded)	Turbulent (T)	5	1,099	15.6%	5.2%
B (aggraded)	Dry (DRY)	7	7,908	21.9%	37.8%
B (aggraded)	Unidentified	2	3,058	6.3%	14.6%
Total B		**32**	**20,933**	**100%**	**100%**
F	Dammed Pool (DP)	11	1,490	6.6%	4.6%
F	Non Turbulent (NT)	43	8,262	25.9%	25.4%
F	Scour Pool (SP)	45	8,886	27.1%	27.4%
F	Turbulent (T)	67	13,845	40.4%	42.6%
Total F		**166**	**32,483**	**100%**	**100%**
F or B*	Dammed Pool (DP)	3	511	4.8%	3.6%
F or B	Non Turbulent (NT)	20	5,949	31.7%	41.6
F or B	Scour Pool (SP)	22	5,035	34.9%	35.2%
F or B	Turbulent (T)	18	2,812	28.6%	19.7%
Total F or B		**63**	**14,307**	**100%**	**100%**

Table 4-21. Summary of Hawkins Habitat Types by Rosgen Level 1 Classification for the Rubicon River from Ralston Afterbay to Hell Hole Reservoir (continued).**

Rosgen Level 1 Classification	Hawkins Habitat Type Classification	Frequency of Habitat Types	Length of Habitat Types (ft)	Relative Frequency of Habitat Types	Percentage Length of Habitat Types
F or G*	Dammed Pool (DP)	21	3,481	8.3%	7.6%
F or G	Non Turbulent (NT)	63	9,439	24.8%	20.7%
F or G	Scour Pool (SP)	69	12,109	27.2%	26.5%
F or G	Turbulent (T)	101	20,642	39.8%	45.2%
Total F or G		**254**	**45,671**	**100%**	**100%**
G	Dammed Pool (DP)	40	5,862	11.2%	9.9%
G	Non Turbulent (NT)	71	12,112	19.9%	20.5%
G	Scour Pool (SP)	97	17,374	27.2%	29.4%
G	Turbulent (T)	145	22,386	40.7%	37.9%
G	Unidentified	3	1,324	0.8%	2.2%
Total G		**356**	**59,058**	**100%**	**100%**

*Specific Rosgen Channel type will be determined at a later phase of geomorphology study.

** Reservoirs are not included in the summary.

Table 4-22. Summary of Modified R-5 Habitat Types by Rosgen Level 1 Classification for the Rubicon River from Ralston Afterbay to Hell Hole Reservoir.**

Rosgen Level 1 Classification	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
B (aggraded)	Cascade (CAS)	3	633	9.4%	3.0%
B (aggraded)	Dry (DRY)	7	7,908	21.9%	37.8%
B (aggraded)	Glide (GLD)	1	973	3.31%	4.6%
B (aggraded)	Lateral Scour Pool (LSP)	3	532	9.4%	2.5%
B (aggraded)	Mid Channel Pool (MCP)	6	1,635	18.8%	7.8%
B (aggraded)	Riffle (RIF)	2	465	6.3%	2.2%
B (aggraded)	Run (RUN)	8	5,727	25.0%	27.4%
B (aggraded)	Unidentified	2	3,058	6.3%	14.6%
Total B		**32**	**20,933**	**100%**	**100%**
F	Cascade (CAS)	43	8,873	25.9%	27.3%
F	Cascade Pool Sequence (CPS)	2	702	1.2%	2.2%
F	Dammed Pool (DPL)	9	1,255	5.4%	3.9%
F	Lateral Scour Pool (LSP)	8	1,284	4.8%	4.0%
F	Mid channel Pool (MCP)	37	7,603	22.3%	23.4%
F	Riffle (RIF)	22	4,269	13.3%	13.1%
F	Run (RUN)	40	7,439	24.1%	22.9%
F	Step Pool (SPO)	2	235	1.2%	0.7%
F	Step Run (SRN)	3	823	1.8%	2.5%
Total F		**166**	**32,483**	**100%**	**100%**

Table 4-22. Summary of Modified R-5 Habitat Types by Rosgen Level 1 Classification for the Rubicon River from Ralston Afterbay to Hell Hole Reservoir (continued).**

Rosgen Level 1 Classification	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
F or B*	Cascade (CAS)	8	1,140	12.7%	8.0%
F or B	Dammed Pool (DPL)	2	227	3.2%	1.6%
F or B	Lateral Scour Pool (LSP)	4	783	6.3%	5.5%
F or B	Mid channel Pool (MCP)	18	4,252	28.6%	29.7%
F or B	Riffle (RIF)	10	1,672	15.9%	11.7%
F or B	Run (RUN)	20	5,949	31.7%	41.6%
F or B	Step Pool (SPO)	1	284	1.6%	2.0%
Total F or B		**63**	**14,307**	**100%**	**100%**
F or G*	Cascade (CAS)	72	15,042	28.3%	32.9%
F or G	Cascade Pool Sequence (CPS)	5	1,971	2.0%	4.3%
F or G	Dammed Pool (DPL)	18	2,737	7.1%	6.0%
F or G	Lateral Scour Pool (LSP)	14	2,018	5.5%	4.4%
F or G	Mid Channel Pool (MCP)	55	10,090	21.7%	22.1%
F or G	Pocket Water (POW)	3	413	1.2%	0.9%
F or G	Riffle (RIF)	24	3,629	9.4%	7.9%
F or G	Run (RUN)	59	8,557	23.2%	18.7%
F or G	Step Pool (SPO)	3	744	1.2%	1.6%
F or G	Step Run (SRN)	1	470	0.4%	1.0%
Total F or G		**254**	**45,671**	**100%**	**100%**

Table 4-22. Summary of Modified R-5 Habitat Types by Rosgen Level 1 Classification for the Rubicon River from Ralston Afterbay to Hell Hole Reservoir (continued).**

Rosgen Level 1 Classification	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
G	Bedrock Sheet (BRS)	1	37	0.3%	0.1%
G	Cascade (CAS)	110	17,019	30.9%	28.8%
G	Cascade Pool Sequence (CPS)	8	1,887	2.2%	3.2%
G	Dammed Pool (DPL)	29	2,893	7.9%	4.9%
G	Glide (GLD)	1	102	0.3%	0.2%
G	Lateral Scour Pool (LSP)	19	3,605	5.3%	6.1%
G	Mid channel pool (MCP)	78	13,769	21.9%	23.3%
G	Pocket Water (POW)	3	323	0.8%	0.5%
G	Riffle (RIF)	26	3,443	7.3%	5.8%
G	Run (RUN)	67	11,687	18.8%	19.8%
G	Step Pool (SPO)	12	2,969	3.4%	5.0%
G	Unidentified	3	1,324	0.8%	2.2%
Total G		**356**	**59,059**	**100%**	**100%**

*Specific Rosgen Channel type will be determined at a later phase of geomorphology study.
** Reservoirs are not included in the summary.

Table 4-23. Summary of Hawkins Habitat Types for the Rubicon River from the Confluence with the Middle Fork American River to Long Canyon Creek*.

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)	2	195	2.3%	1.1%
Non Turbulent (NT)	26	6,603	30.2%	35.9%
Scour Pool (SP)	28	5,830	32.6%	31.7%
Turbulent (T)	30	5,784	34.9%	31.4%
Total	**86**	**18,413**	**100%**	**100%**

*Reservoirs are not included in the summary.

Table 4-24. Summary of Modified R-5 Habitat Types for the Rubicon River from the Confluence with the Middle Fork American River to Long Canyon Creek*.

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
Cascade (CAS)	15	2,938	17.4%	16.0%
Cascade Pool Sequence (CPS)	1	425	1.2%	2.3%
Dammed Pool (DPL)	2	195	2.3%	1.1%
Lateral Scour Pool (LSP)	6	1,394	7.0%	7.6%
Mid channel pool (MCP)	22	4,436	25.6%	24.1%
Pocket Water (POW)	1	187	1.2%	1.0%
Riffle (RIF)	14	2,421	16.3%	13.2%
Run (RUN)	24	6,188	27.9%	33.6%
Step Run (SRN)	1	227	1.2%	1.2%
Total	**86**	**18,413**	**100%**	**100%**

*Reservoirs are not included in the summary.

Table 4-25. Summary of Hawkins Habitat Types by Rosgen Level 1 Classification for the Rubicon River from the Confluence with the Middle Fork American River to Long Canyon Creek.**

Rosgen Level 1 Classification	Hawkins Habitat Type Classification	Frequency of Habitat Types	Length of Habitat Types (ft)	Relative Frequency of Habitat Types	Percentage Length of Habitat Types
F	Dammed Pool (DP)	2	195	4.8%	2.2%
F	Non Turbulent (NT)	14	2,745	33.3%	30.6%
F	Scour Pool (SP)	11	2,801	26.2%	31.3%
F	Turbulent (T)	15	3,216	35.7%	35.9%
Total F		**42**	**8,958**	**100%**	**100%**
F or G*	Non Turbulent (NT)	10	2,020	25.0%	30.2%
F or G	Scour Pool (SP)	16	2,733	40.0%	40.9%
F or G	Turbulent (T)	14	1,933	35.0%	28.9%
Total F or G		**40**	**6,685**	**100%**	**100%**
G	Non Turbulent (NT)	2	1,838	50.0%	66.4%
G	Scour Pool (SP)	1	297	25.0%	10.7%
G	Turbulent (T)	1	635	25.0%	22.9%
Total G		**4**	**2,770**	**100%**	**100%**

* Specific Rosgen Channel type will be determined at a later phase of geomorphology study.
** Reservoirs are not included in the summary.

Table 4-26. Summary of Modified R-5 Habitat Types by Rosgen Level 1 Classification for the Rubicon River from the Confluence with the Middle Fork American River to Long Canyon Creek.**

Rosgen Level 1 Classification	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
F	Cascade (CAS)	9	1,942	21.4%	21.7%
F	Dammed Pool (DPL)	2	195	4.8%	2.2%
F	Lateral Scour Pool (LSP)	1	418	2.4%	4.7%
F	Mid channel pool (MCP)	10	2,383	23.8%	26.6%
F	Riffle (RIF)	6	1,275	14.3%	14.2%
F	Run (RUN)	13	2,518	31.0%	28.1%
F	Step Run (SRN)	1	227	2.4%	2.5%
Total F		**42**	**8,958**	**100%**	**100%**
F or G*	Cascade (CAS)	6	996	15.0%	14.9%
F or G	Cascade Pool Sequence (CPS)	1	425	2.5%	6.4%
F or G	Lateral Scour Pool (LSP)	5	976	12.5%	14.6%
F or G	Mid channel pool (MCP)	11	1,757	27.5%	26.3%
F or G	Riffle (RIF)	7	511	17.5%	7.7%
F or G	Run (RUN)	10	2,020	25.0%	30.2%
Total F or G		**40**	**6,685**	**100%**	**100%**
G	Mid channel pool (MCP)	1	297	25.0%	10.7%
G	Pocket Water (POW)	1	187	25.0%	6.8%
G	Riffle (RIF)	1	635	25.0%	22.9%
G	Run (RUN)	1	1,651	25.0%	59.6%
Total G		**4**	**2,770**	**100%**	**100%**

* Specific Rosgen Channel type will be determined at a later phase of geomorphology study.
** Reservoirs are not included in the summary.

Table 4-27. Summary of Hawkins Habitat Types for the Rubicon River from the Confluence with Long Canyon Creek to the South Fork Rubicon River.

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)	62	9,312	9.6%	8.7%
Non Turbulent (NT)	143	21,362	22.2%	20.0%
Scour Pool (SP)	170	29,304	26.4%	27.4%
Turbulent (T)	265	46,617	41.2%	42.7%
Unidentified	3	1,324	0.5%	1.2%
Total	**643**	**106,919**	**100%**	**100%**

Table 4-28. Summary of Modified R-5 Habitat Types for the Rubicon River from the Confluence with Long Canyon Creek to the South Fork Rubicon River.

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	0.2%	0.0%
Cascade (CAS)	195	33,742	30.3%	31.6%
Cascade Pool Sequence (CPS)	13	3,438	2.0%	3.2%
Dammed Pool (DPL)	47	5,929	7.3%	5.5%
Glide (GLD)	1	102	0.2%	0.1%
Lateral Scour Pool (LSP)	35	5,513	5.4%	5.2%
Mid Channel Pool (MCP)	135	23,790	21.0%	22.3%
Pocket Water (POW)	5	549	0.8%	0.5%
Riffle (RIF)	56	8,400	8.7%	7.9%
Run (RUN)	134	19,645	20.8%	18.4%
Step Pool (SPO)	15	3,383	2.3%	3.2%
Step Run (SRN)	3	1,065	0.5%	1.0%
Unidentified	3	1,324	0.5%	1.2%
Total	**643**	**106,919**	**100%**	**100%**

Table 4-29. Summary of Hawkins Habitat Types by Rosgen Level 1 Classification for the Rubicon River from the Confluence with Long Canyon Creek to the South Fork Rubicon River.

Rosgen Level 1 Classification	Hawkins Habitat Type Classification	Frequency of Habitat Types	Length of Habitat Types (ft)	Relative Frequency of Habitat Types	Percentage Length of Habitat Types
F	Dammed Pool (DP)	6	883	5.7%	4.6%
F	Non Turbulent (NT)	24	4,378	22.9%	22.7%
F	Scour Pool (SP)	29	5,215	27.6%	27.0%
F	Turbulent (T)	46	8,845	43.8%	45.8%
Total F		**105**	**19,321**	**100%**	**100%**
F or G*	Dammed Pool (DP)	19	3,227	9.6%	9.5%
F or G	Non Turbulent (NT)	52	7,321	26.3%	21.4%
F or G	Scour Pool (SP)	48	7,863	24.2%	23.0%
F or G	Turbulent (T)	79	15,732	39.9%	46.1%
Total F or G		**198**	**34,144**	**100%**	**100%**
G	Dammed Pool (DP)	37	5,202	10.9%	9.7%
G	Non Turbulent (NT)	67	9,663	19.7%	18.1%
G	Scour Pool (SP)	93	16,225	27.4%	30.4%
G	Turbulent (T)	140	21,040	41.2%	39.4%
G	Unidentified	3	1,324	0.9%	2.5%
Total G		**340**	**53,455**	**100%**	**100%**

*Specific Rosgen Channel type will be determined at a later phase of geomorphology study.

Table 4-30. Summary of Modified R-5 Habitat Types by Rosgen Level 1 Classification for the Rubicon River from the Confluence with Long Canyon Creek to the South Fork Rubicon River.

Rosgen Level 1 Classification	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
F	Cascade (CAS)	29	5,611	27.6%	29.0%
F	Cascade Pool Sequence (CPS)	2	702	1.9%	3.6%
F	Dammed Pool (DPL)	4	648	3.8%	3.4%
F	Lateral Scour Pool (LSP)	7	865	6.7%	4.5%
F	Mid Channel Pool (MCP)	22	4,350	21.0%	22.5%
F	Riffle (RIF)	15	2,531	14.3%	13.1%
F	Run (RUN)	22	3,782	21.0%	19.6%
F	Step Pool (SPO)	2	235	1.9%	1.2%
F	Step Run (SRN)	2	596	1.9%	3.1%
Total F		**105**	**19,321**	**100%**	**100%**
F or G*	Cascade (CAS)	60	11,823	30.3%	34.6%
F or G	Cascade Pool Sequence (CPS)	3	849	1.5%	2.5%
F or G	Dammed Pool (DPL)	16	2,483	8.1%	7.3%
F or G	Lateral Scour Pool (LSP)	9	1,043	4.5%	3.1%
F or G	Mid Channel Pool (MCP)	39	6,820	19.7%	20.0%
F or G	Pocket Water (POW)	3	413	1.5%	1.2%
F or G	Riffle (RIF)	16	3,060	8.1%	9.0%
F or G	Run (RUN)	48	6,439	24.2%	18.9%
F or G	Step Pool (SPO)	3	744	1.5%	2.2%
F or G	Step Run (SRN)	1	470	0.5%	1.4%
Total F or G		**198**	**34,144**	**100%**	**100%**

Table 4-30. Summary of Modified R-5 Habitat Types by Rosgen Level 1 Classification for the Rubicon River from the Confluence with Long Canyon Creek to the South Fork Rubicon River (continued).

Rosgen Level 1 Classification	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
G	Bedrock Sheet (BRS)	1	37	0.3%	0.1%
G	Cascade (CAS)	106	16,308	31.2%	30.5%
G	Cascade Pool Sequence (CPS)	8	1,887	2.4%	3.5%
G	Dammed Pool (DPL)	27	2,799	7.9%	5.2%
G	Glide (GLD)	1	102	0.3%	0.2%
G	Lateral Scour Pool (LSP)	19	3,605	5.6%	6.7%
G	Mid Channel Pool (MCP)	74	12,620	21.8%	23.6%
G	Pocket Water (POW)	2	136	0.6%	0.3%
G	Riffle (RIF)	25	2,808	7.4%	5.3%
G	Run (RUN)	64	9,424	18.8%	17.6%
G	Step Pool (SPO)	10	2,404	2.9%	4.5%
G	Unidentified	3	1,324	0.9%	2.5%
Total G		**340**	**53,455**	**100%**	**100%**

*Specific Rosgen Channel type will be determined at a later phase of geomorphology study.

Table 4-31. Summary of Hawkins Habitat Types for the Rubicon River from the Confluence with the South Fork Rubicon River to Hellhole Reservoir.

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)	11	1,837	7.7%	3.9%
Non Turbulent (NT)	37	14,498	26.1%	30.8%
Scour Pool (SP)	44	10,438	31.0%	22.2%
Turbulent (T)	41	9,382	28.9%	19.9%
Dry (DRY)	7	7,908	4.9%	16.8%
Unidentified	2	3,058	1.4%	6.5%
Total	**142**	**47,121**	**100%**	**100%**

Table 4-32. Summary of Modified R5 Habitat Types for the Rubicon River from the Confluence with the South Fork Rubicon River to Hellhole Reservoir.

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
Cascade (CAS)	26	6,028	18.3%	12.8%
Cascade Pool Sequence (CPS)	1	697	0.7%	1.5%
Dammed Pool (DPL)	8	988	5.6%	2.1%
Dry (DRY)	7	7,908	4.9%	16.8%
Glide (GLD)	1	973	0.7%	2.1%
Lateral Scour Pool (LSP)	7	1,315	4.9%	2.8%
Mid Channel Pool (MCP)	37	9,123	26.1%	19.4%
Riffle (RIF)	14	2,657	9.9%	5.6%
Run (RUN)	36	13,525	25.4%	28.7%
Step Pool (SPO)	3	849	2.1%	1.8%
Unidentified	2	3,058	1.4%	6.5%
Total	**142**	**47,121**	**100%**	**100%**

Table 4-33. Summary of Hawkins Habitat Types by Rosgen Level 1 Classification for the Rubicon River from the Confluence with the South Fork Rubicon River to Hellhole Reservoir.

Rosgen Level 1 Classification	Hawkins Habitat Type Classification	Frequency of Habitat Types	Length of Habitat Types (ft)	Relative Frequency of Habitat Types	Percentage Length of Habitat Types
B (aggraded)	Non Turbulent (NT)	9	6,700	28.1%	32.0%
B (aggraded)	Scour Pool (SP)	9	2,168	28.1%	10.4%
B (aggraded)	Turbulent (T)	5	1,099	15.6%	5.2%
B (aggraded)	Dry (DRY)	7	7,908	21.9%	37.8%
B (aggraded)	Unidentified	2	3,058	6.3%	14.6%
Total B		**32**	**20,933**	**100%**	**100%**
F	Dammed Pool (DP)	3	412	15.8%	9.8%
F	Non Turbulent (NT)	5	1,139	26.3%	27.1%
F	Scour Pool (SP)	5	870	26.3%	20.7%
F	Turbulent (T)	6	1,783	31.6%	42.4%
Total F		**19**	**4,204**	**100%**	**100%**
F or B*	Dammed Pool (DP)	3	511	4.8%	3.6%
F or B	Non Turbulent (NT)	20	5,949	31.7%	41.6%
F or B	Scour Pool (SP)	22	5,035	34.9%	35.2%
F or B	Turbulent (T)	18	2,812	28.6%	19.7%
Total F or B		**63**	**14,307**	**100%**	**100%**

Table 4-33. Summary of Hawkins Habitat Types by Rosgen Level 1 Classification for the Rubicon River from the Confluence with the South Fork Rubicon River to Hellhole Reservoir (continued).

Rosgen Level 1 Classification	Hawkins Habitat Type Classification	Frequency of Habitat Types	Length of Habitat Types (ft)	Relative Frequency of Habitat Types	Percentage Length of Habitat Types
F or G*	Dammed Pool (DP)	2	254	12.5%	5.2%
F or G	Non Turbulent (NT)	1	98	6.3%	2.0%
F or G	Scour Pool (SP)	5	1,513	31.3%	31.2%
F or G	Turbulent (T)	8	2,977	50.0%	61.5%
Total F or G		**16**	**4,842**	**100%**	**100%**
G	Dammed Pool (DP)	3	660	25.0%	23.3%
G	Non Turbulent (NT)	2	611	16.7%	21.6%
G	Scour Pool (SP)	3	853	25.0%	30.1%
G	Turbulent (T)	4	711	33.3%	25.1%
Total G		**12**	**2,834**	**100%**	**100%**

*Specific Rosgen Channel type will be determined at a later phase of geomorphology study.

Table 4-34. Summary of Modified R5 Habitat Types by Rosgen Level 1 Classification for the Rubicon River from the Confluence with the South Fork Rubicon River to Hellhole Reservoir.

Rosgen Level 1 Classification	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
B (aggraded)	Cascade (CAS)	3	633	9.4%	3.0%
B (aggraded)	Dry (DRY)	7	7,908	21.9%	37.8%
B (aggraded)	Glide (GLD)	1	973	3.1%	4.6%
B (aggraded)	Lateral Scour Pool (LSP)	3	532	9.4%	2.5%
B (aggraded)	Mid Channel Pool (MCP)	6	1,635	18.8%	7.8%
B (aggraded)	Riffle (RIF)	2	465	6.3%	2.2%
B (aggraded)	Run (RUN)	8	5,727	25.0%	27.4%
B (aggraded)	Unidentified	2	3,058	6.3%	14.6%
Total B		**32**	**20,933**	**100%**	**100%**
F	Cascade (CAS)	5	1,321	26.3%	31.4%
F	Dammed Pool (DPL)	3	412	15.8%	9.8%
F	Mid channel Pool (MCP)	5	870	26.3%	20.7%
F	Riffle (RIF)	1	463	5.3%	11.0%
F	Run (RUN)	5	1,139	26.3%	27.1%
Total F		**19**	**4,204**	**100%**	**100%**

Table 4-34. Summary of Modified R5 Habitat Types by Rosgen Level 1 Classification for the Rubicon River from the Confluence with the South Fork Rubicon River to Hellhole Reservoir (continued).

Rosgen Level 1 Classification	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
F or B*	Cascade (CAS)	8	1,140	12.7%	8.0%
F or B	Dammed Pool (DPL)	2	227	3.2%	1.6%
F or B	Lateral Scour Pool (LSP)	4	783	6.3%	5.5%
F or B	Mid channel Pool (MCP)	18	4,252	28.6%	29.7%
F or B	Riffle (RIF)	10	1,672	15.9%	11.7%
F or B	Run (RUN)	20	5,949	31.7%	41.6%
F or B	Step Pool (SPO)	1	284	1.6%	2.0%
Total F or B		**63**	**14,307**	**100%**	**100%**
F or G*	Cascade (CAS)	6	2,223	37.5%	45.9%
F or G	Cascade Pool Sequence (CPS)	1	697	6.3%	14.4%
F or G	Dammed Pool (DPL)	2	254	12.5%	5.2%
F or G	Mid Channel Pool (MCP)	5	1,513	31.3%	31.2%
F or G	Riffle (RIF)	1	57	6.3%	1.2%
F or G	Run (RUN)	1	98	6.3%	2.0%
Total F or G		**16**	**4,842**	**100%**	**100%**

Table 4-34. Summary of Modified R5 Habitat Types by Rosgen Level 1 Classification for the Rubicon River from the Confluence with the South Fork Rubicon River to Hellhole Reservoir (continued).

Rosgen Level 1 Classification	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
G	Cascade (CAS)	4	711	33.3%	25.1%
G	Dammed Pool (DPL)	1	95	8.3%	3.3%
G	Mid channel pool (MCP)	3	853	25.0%	30.1%
G	Run (RUN)	2	611	16.7%	21.6%
G	Step Pool (SPO)	2	565	16.7%	19.9%
Total G		**12**	**2,834**	**100%**	**100%**

*Specific Rosgen Channel type will be determined at a later phase of geomorphology study.

FIGURES

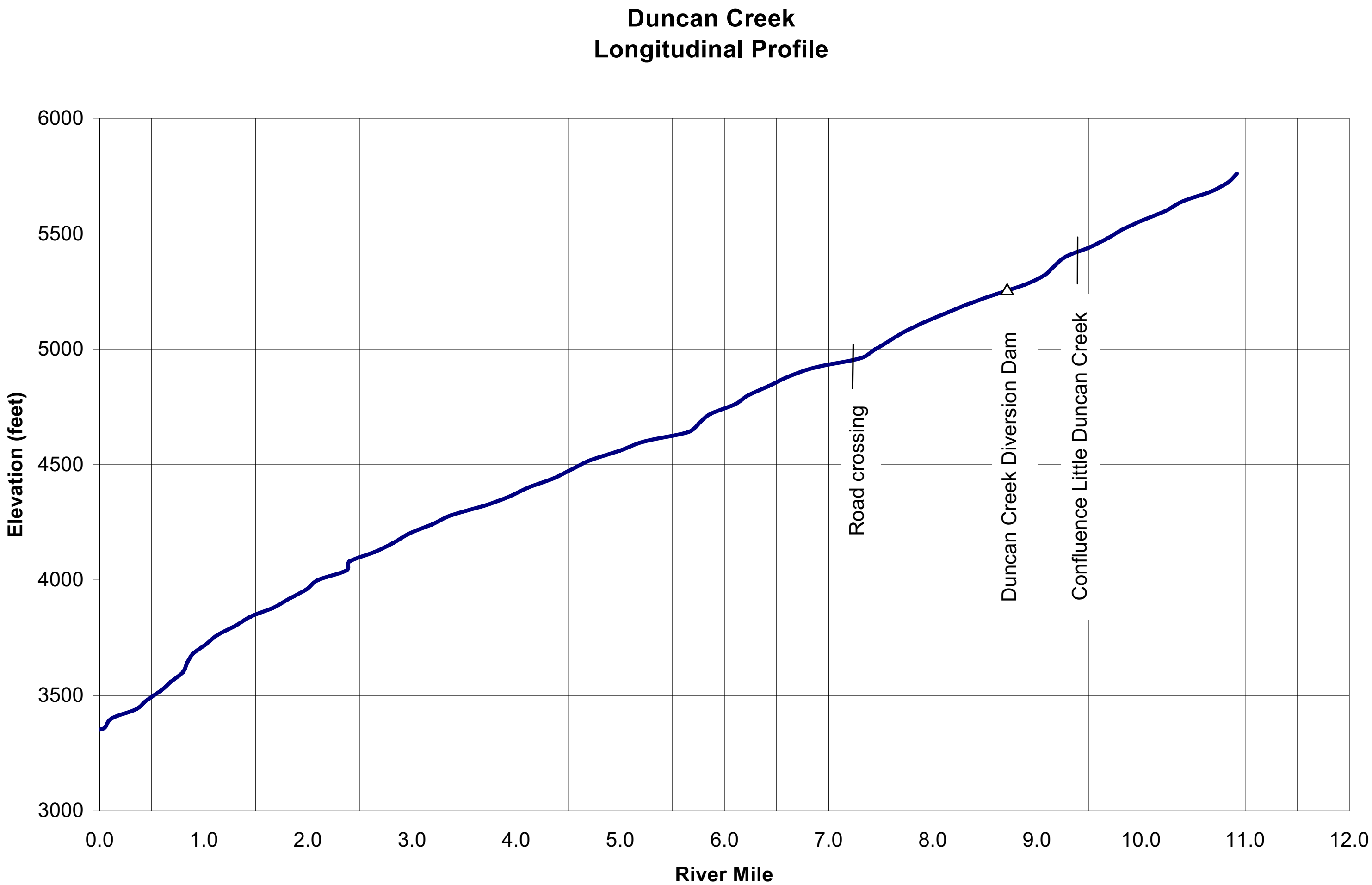

Figure 2-1. Duncan Creek Longitudinal Profile

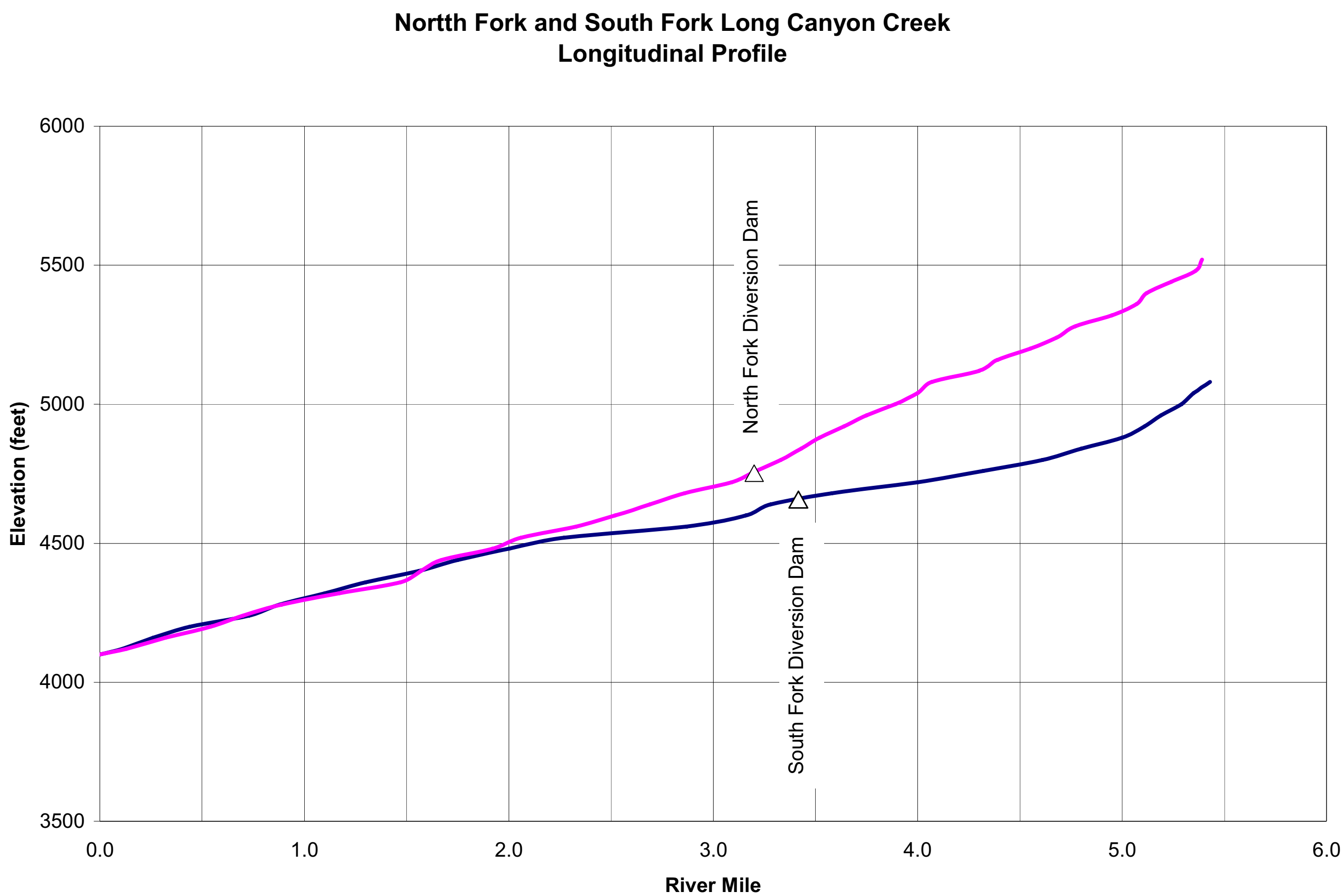

Figure 2-2. North and South Fork of Long Canyon Creek Longitudinal Profile

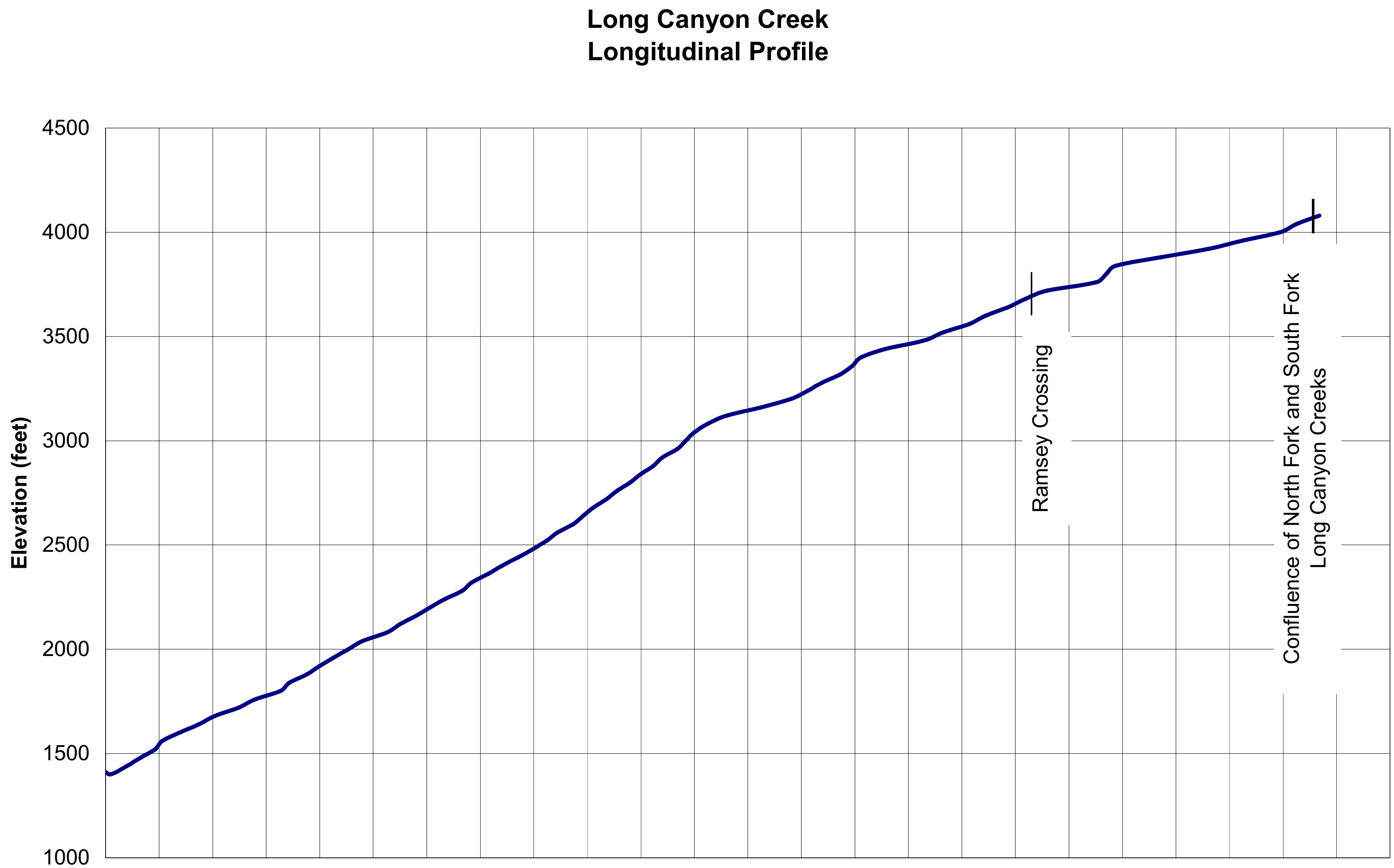

Figure 2-3. Long Canyon Creek Longitudinal Profile.

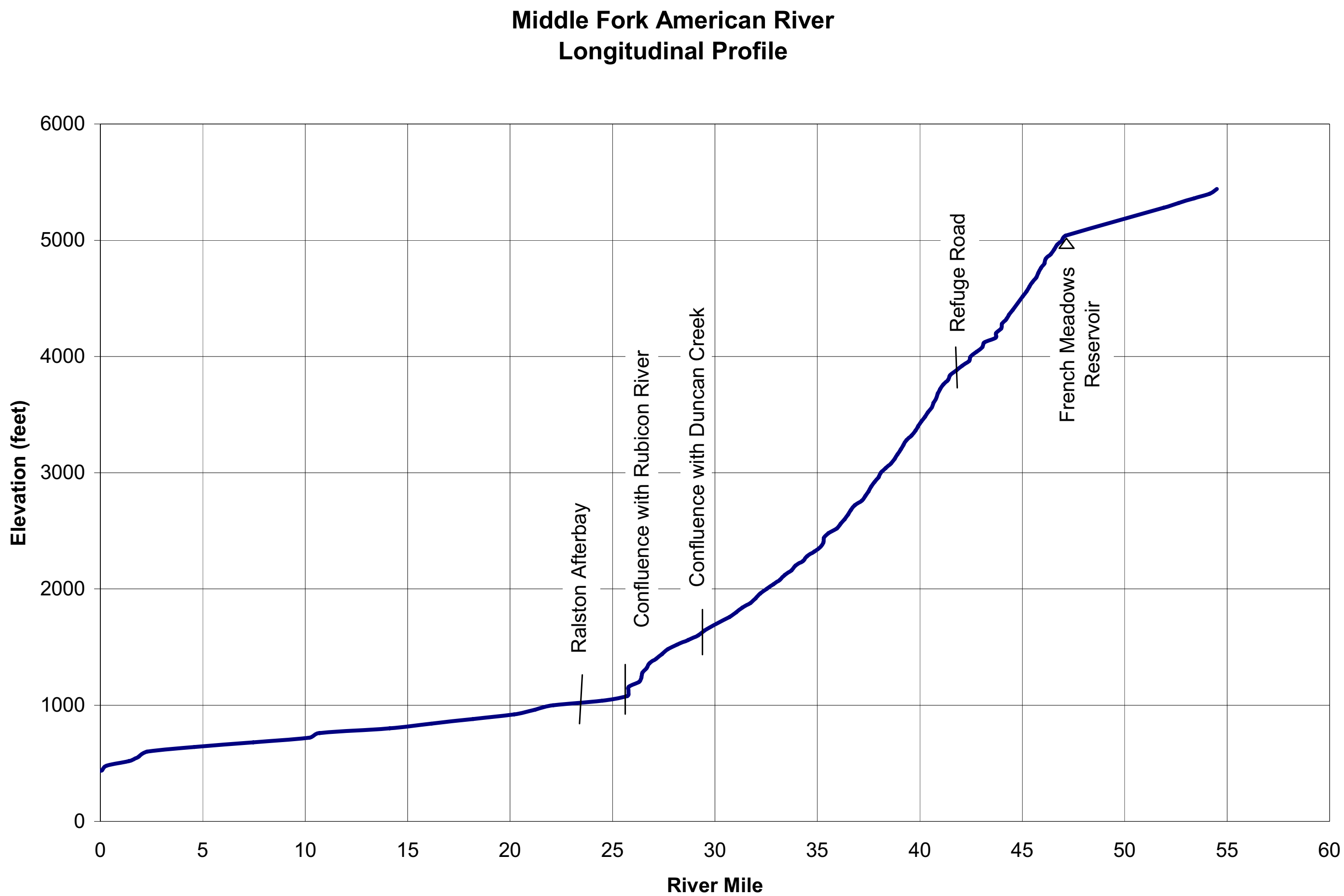

Figure 2-4. Middle Fork American River Longitudinal Profile

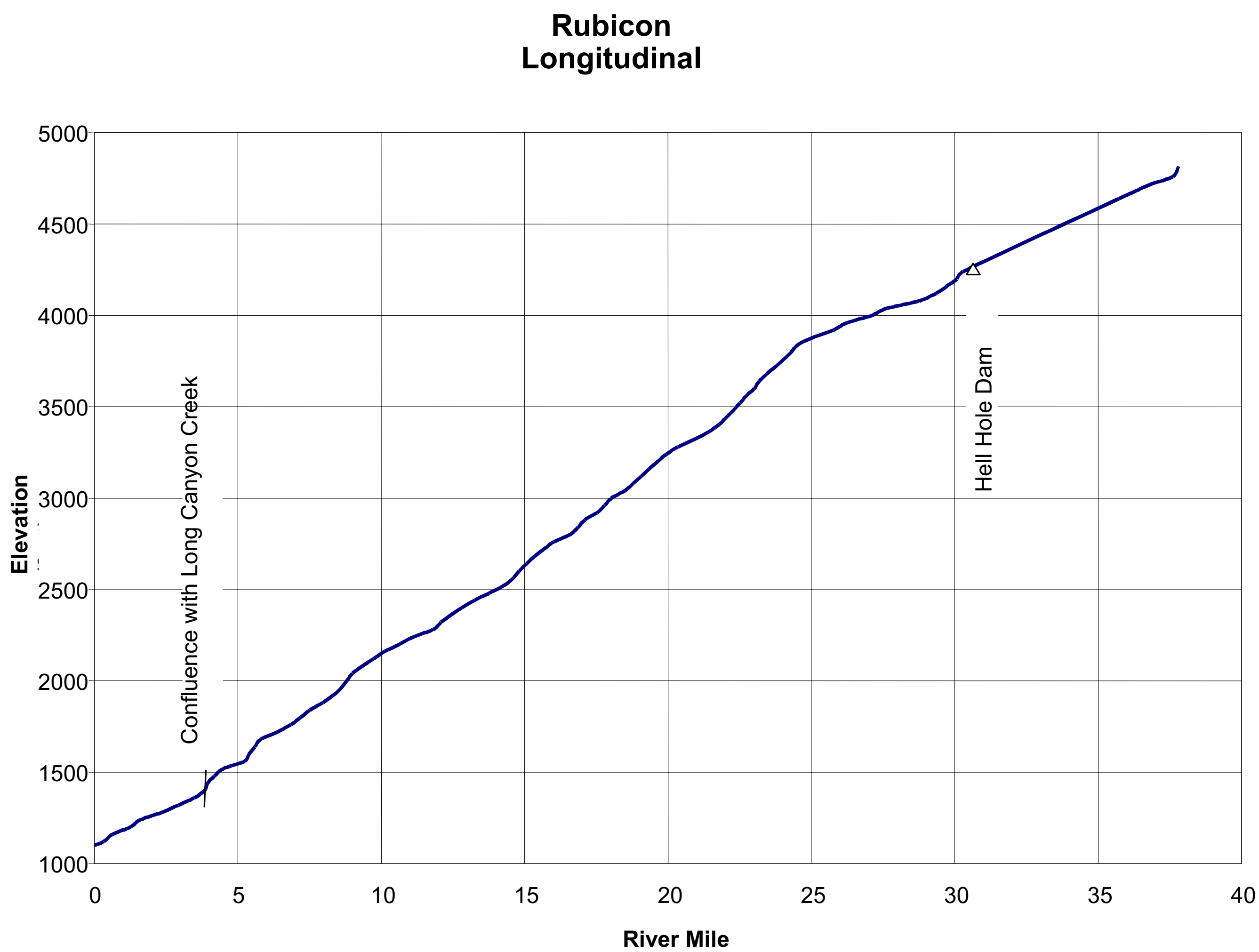

Figure 2-5. Rubicon River Longitudinal Profile

Placer County Water Agency - Middle Fork American River Project

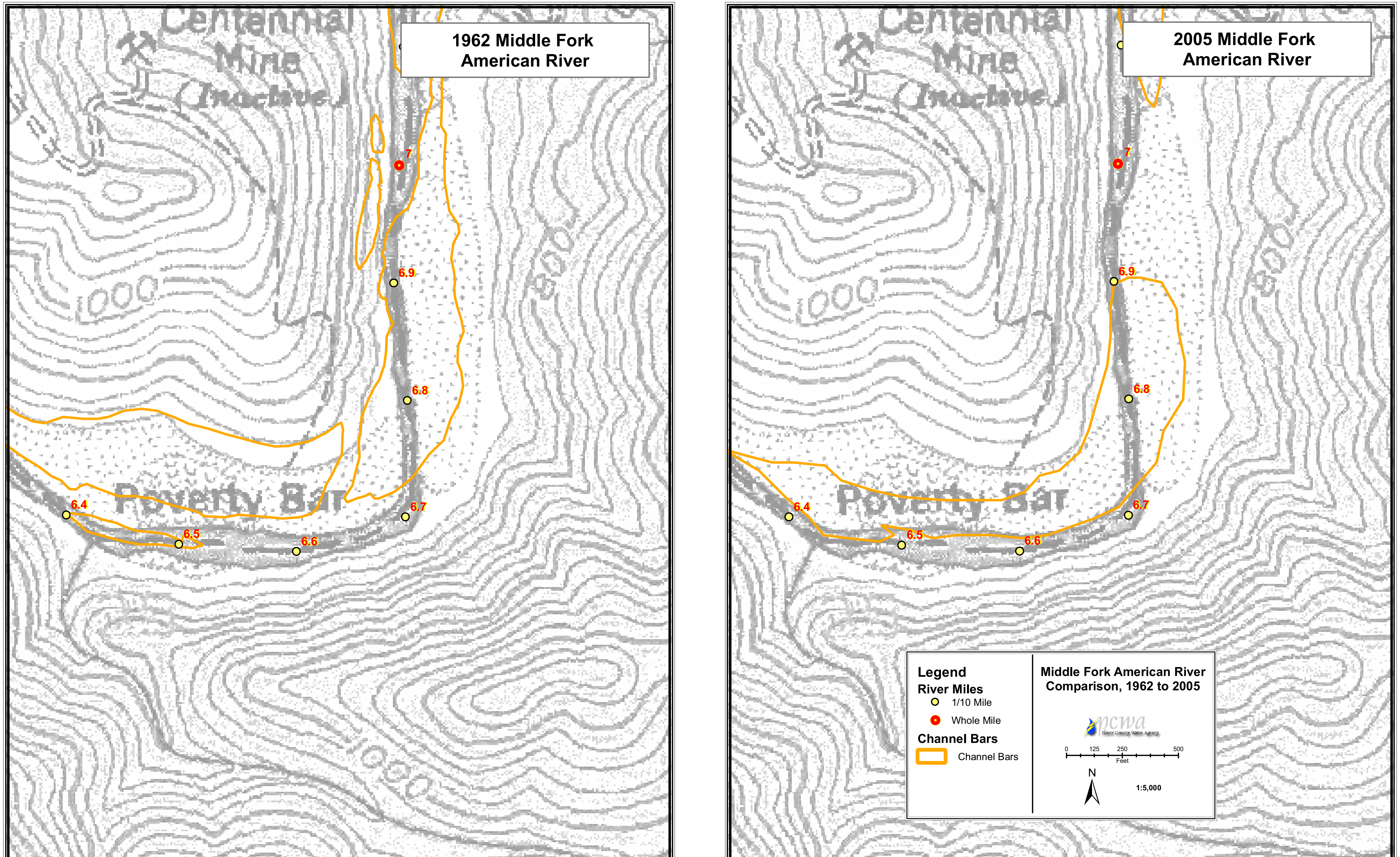

Figure 2-6 - Historical channel conditions, Middle Fork American River (RM 6.4-RM 7.1)

Placer County Water Agency - Middle Fork American River Project

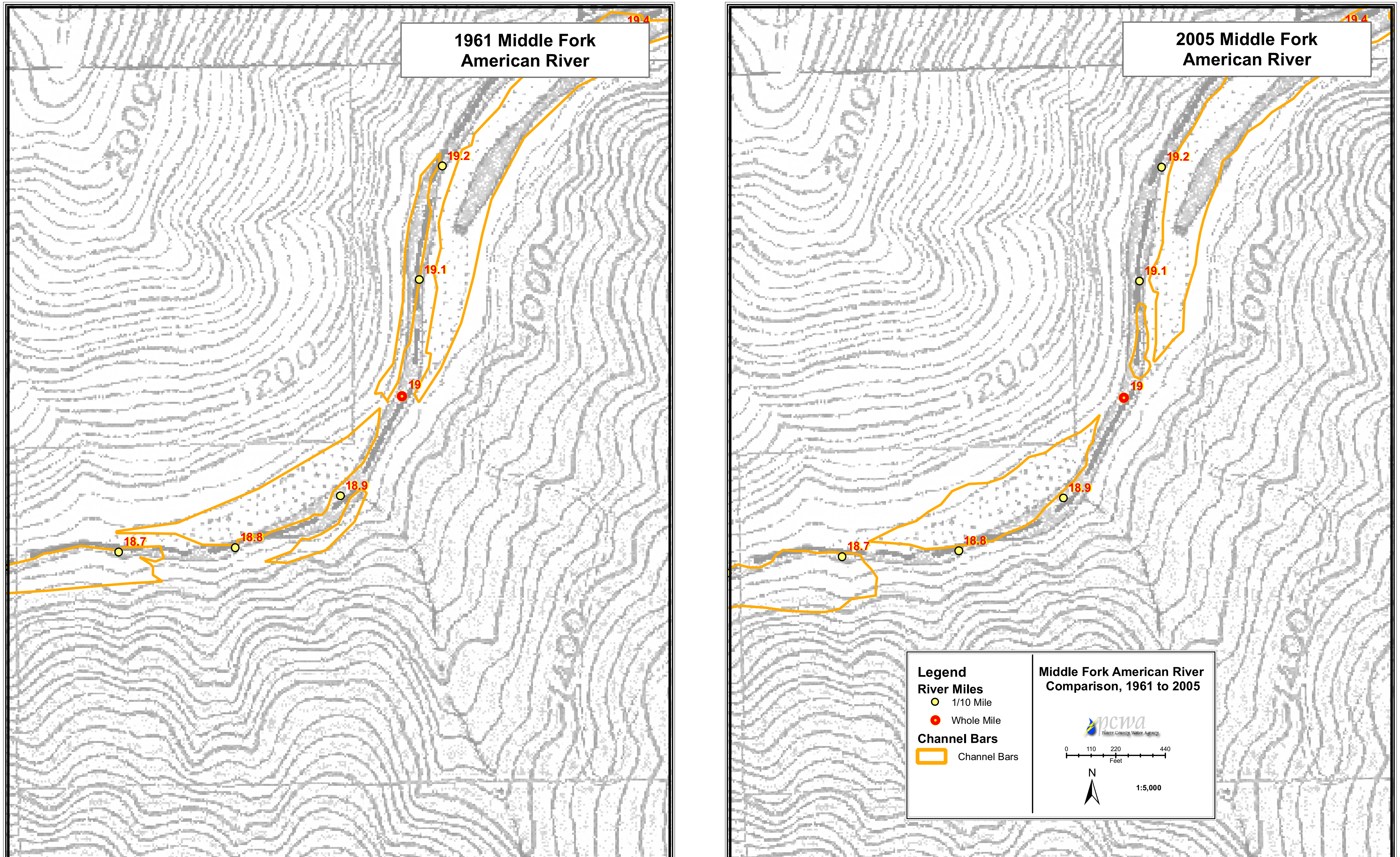

Figure 2-7 - Historical channel conditions, Middle Fork American River (RM 18.6-RM 19.4)

Placer County Water Agency - Middle Fork American River Project

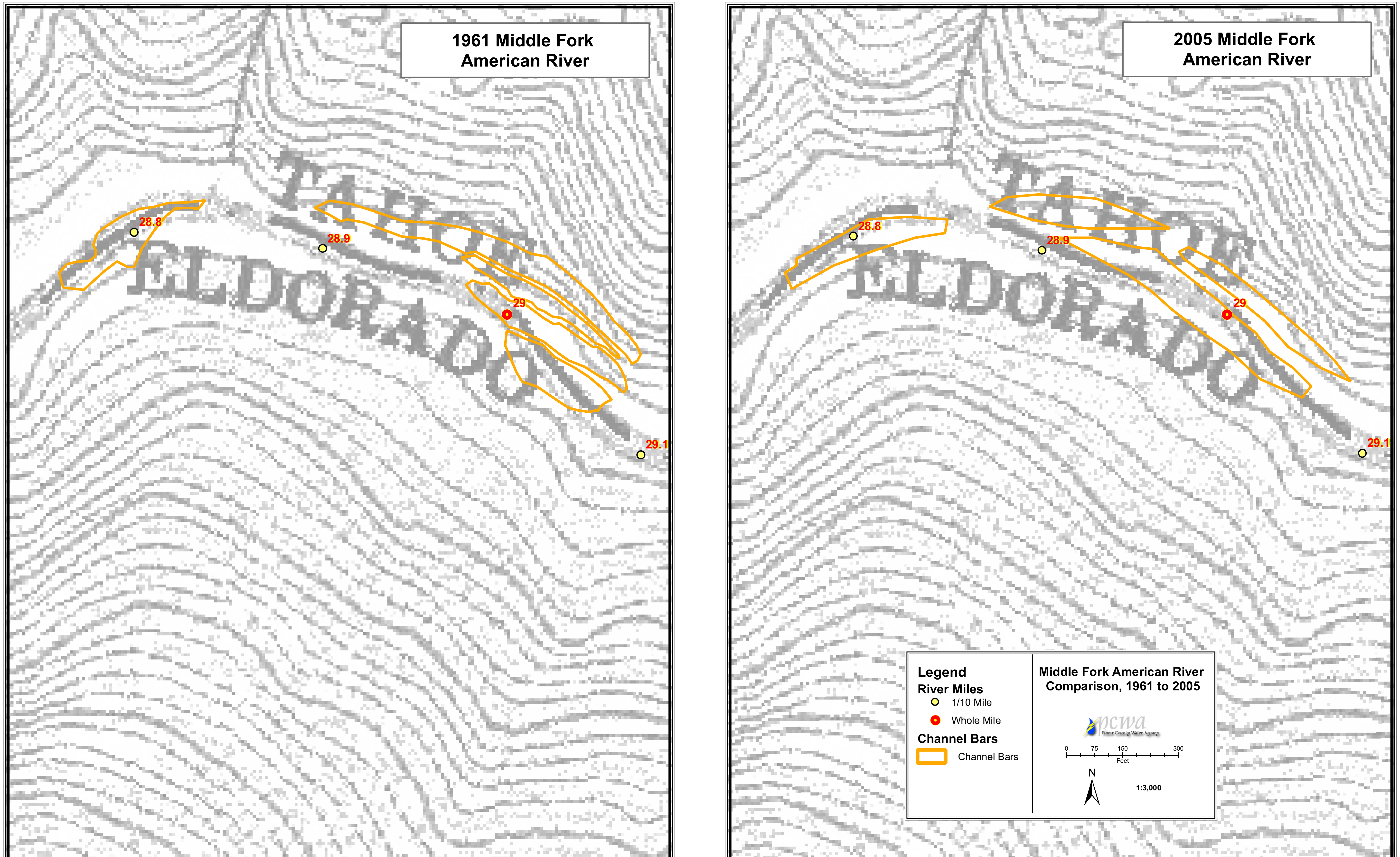

Figure 2-8 - Historical channel conditions, Middle Fork American River (RM 28.8-RM 29.1)

Placer County Water Agency - Middle Fork American River Project

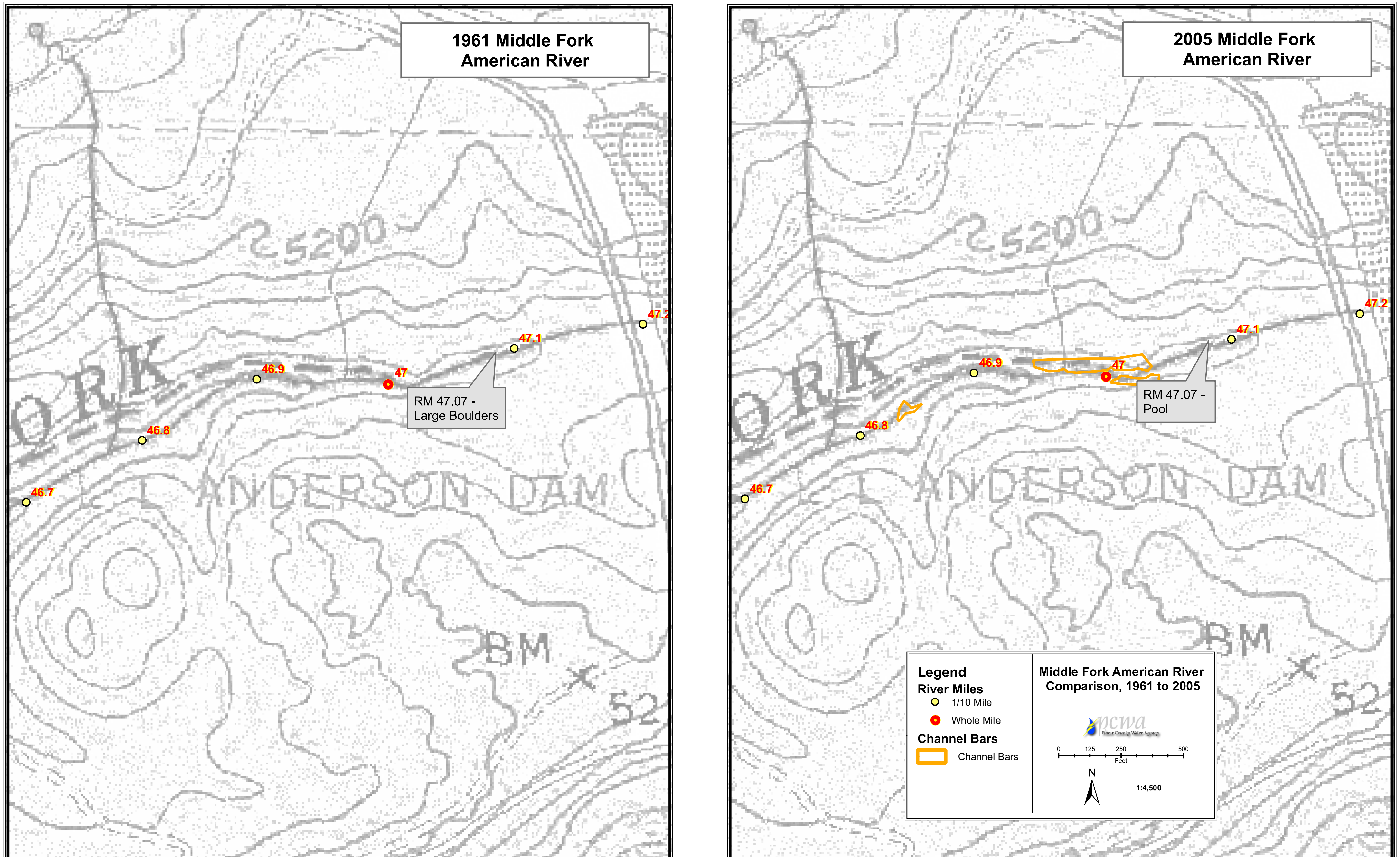

Figure 2-9 - Historical channel conditions, Middle Fork American River (RM 46.7-RM 47.2)

Placer County Water Agency - Middle Fork American River Project

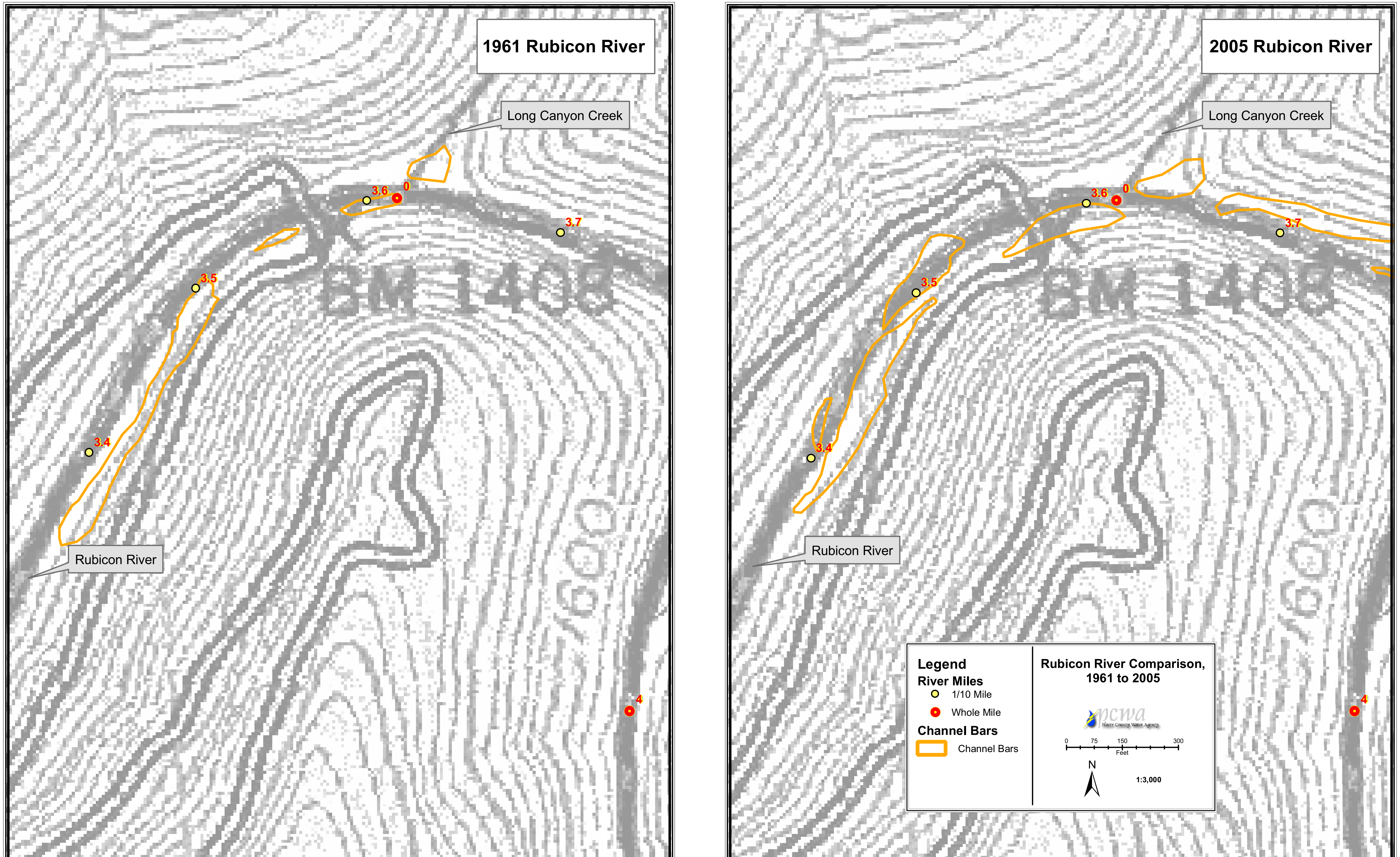

Figure 2-10 - Historical channel conditions, Rubicon River (RM 3.4-RM 3.7)

Placer County Water Agency - Middle Fork American River Project

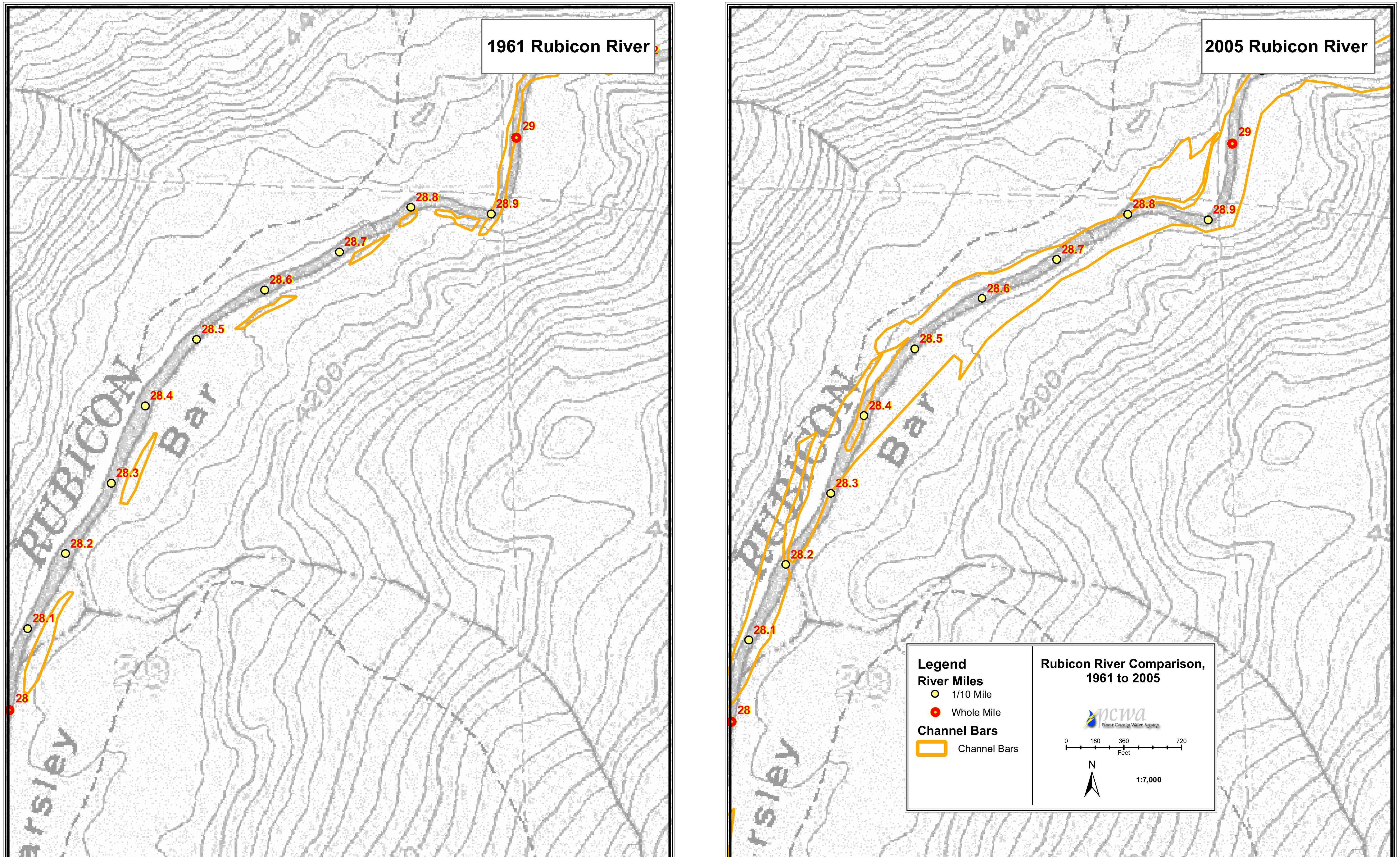

Figure 2-11 - Historical channel conditions, Rubicon River (RM 28.0-RM 29.0)

Placer County Water Agency - Middle Fork American River Project

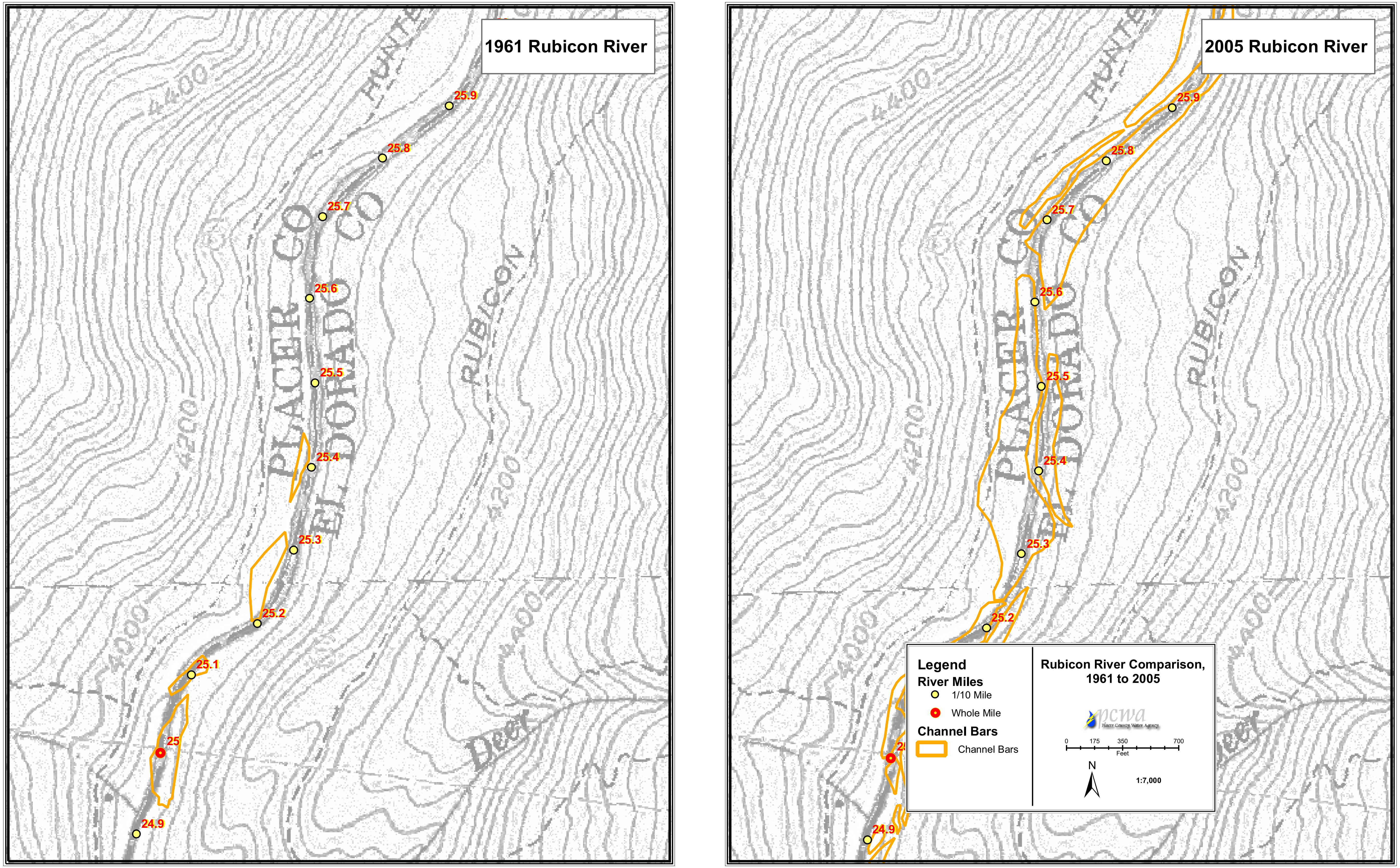

Figure 2-12 - Historical channel conditions, Rubicon River (RM 25.0-RM 26.0)

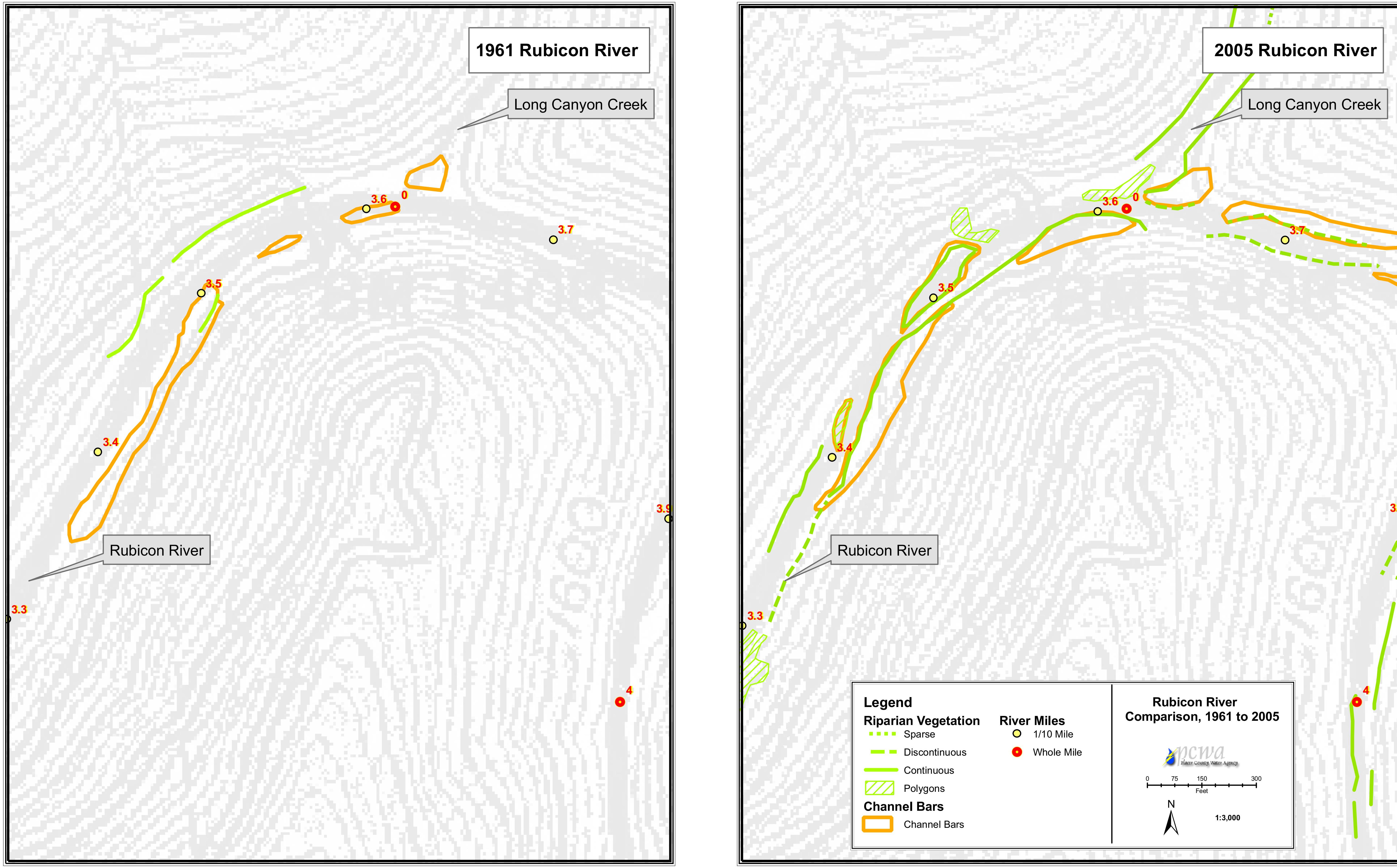

Figure 3-1. Change in Riparian Abundance between 1961 to 2005, Rubicon River (RM 3.3-RM 3.7)

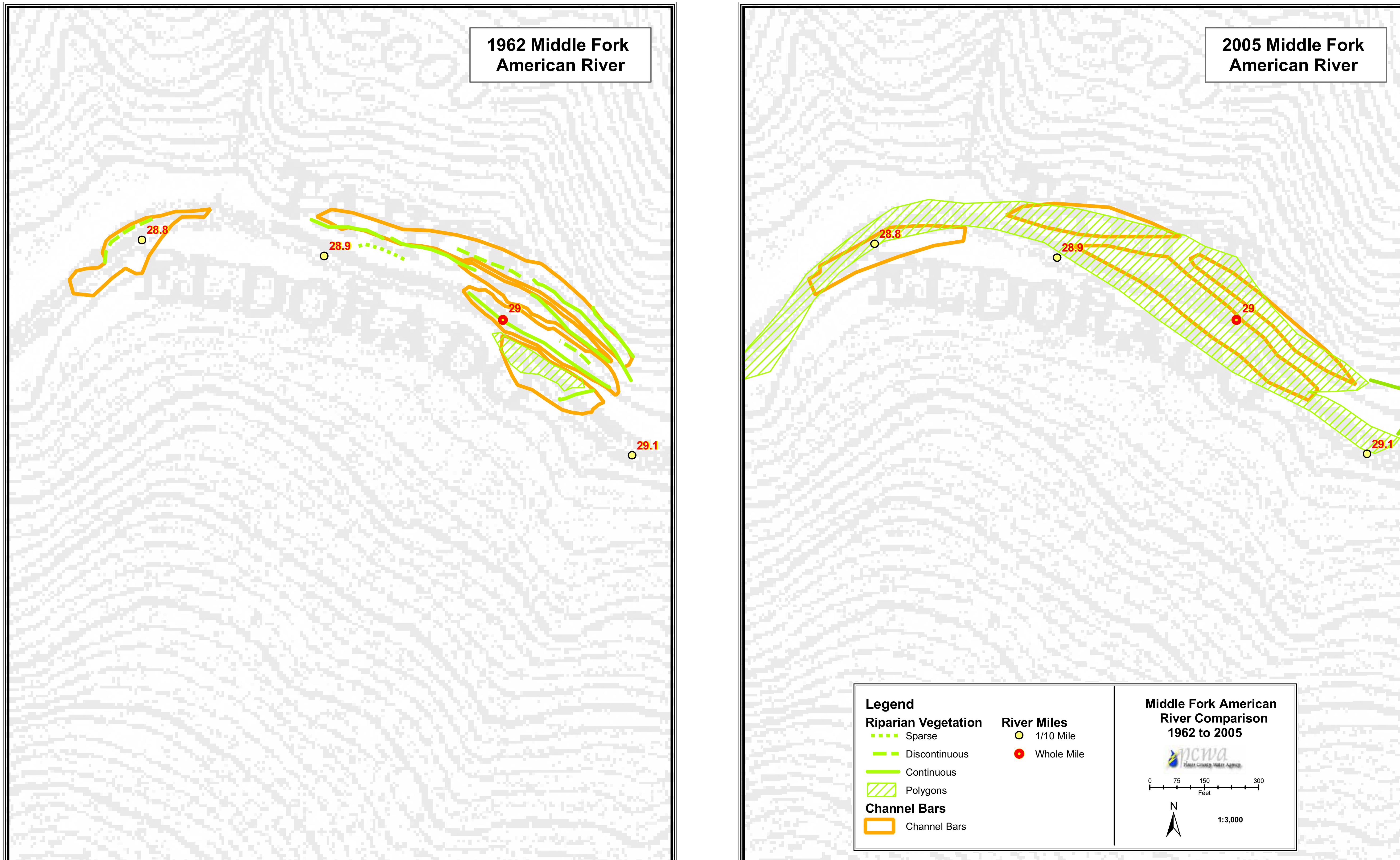

Figure 3-2. Changes in Riparian Abundance, between 1961 and 2005, Middle Fork American River (RM 28.7-RM 29.1)

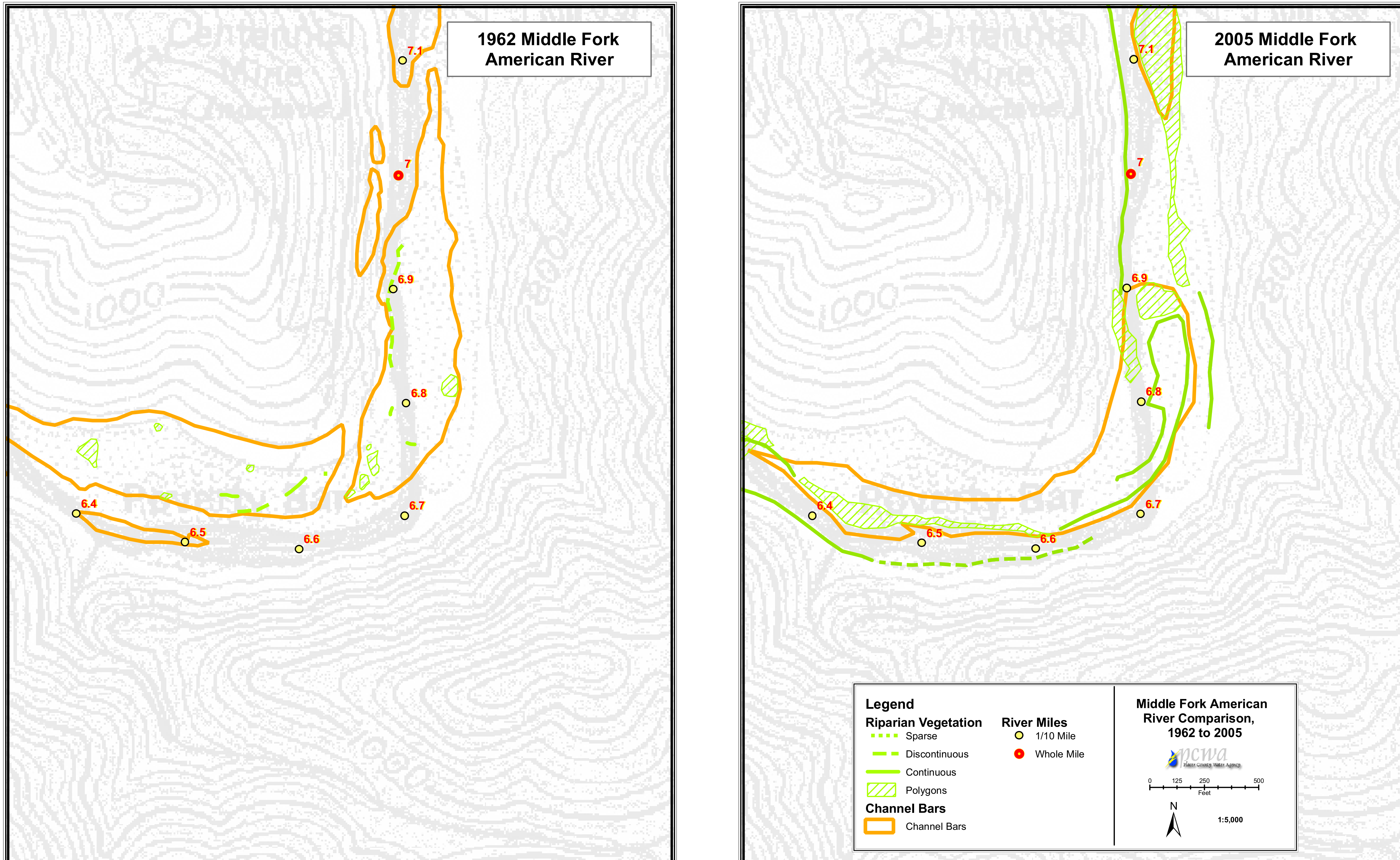

Figure 3-3. Changes in Riparian Coverage (Distribution), between 1961 and 2005, Middle Fork American River (RM 6.4-RM 7.1)

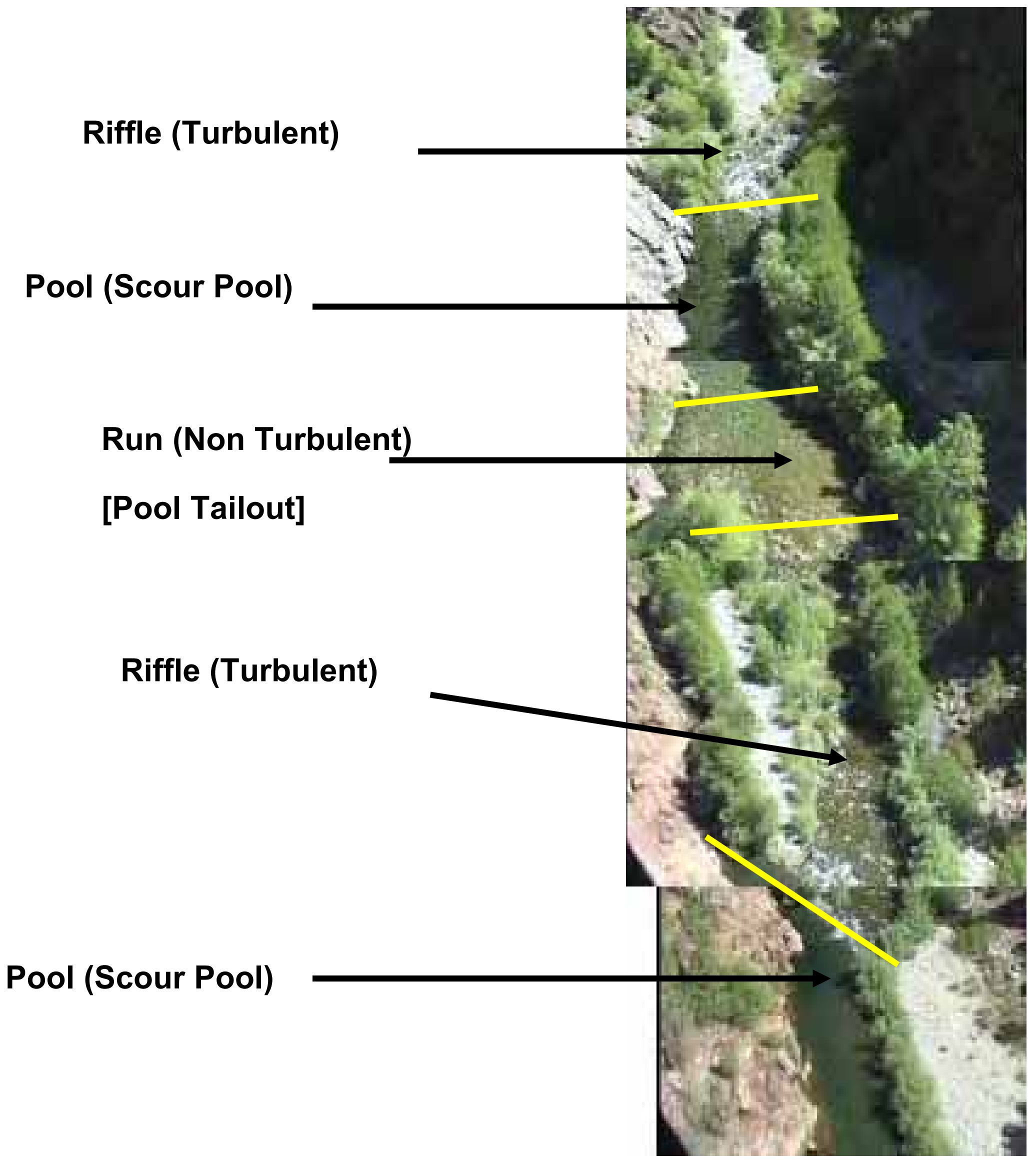

Figure 4-1. Example of Habitat Identified from Low Level Helicopter Videography (Riffle-Pool Habitats).

MAPS

APPENDIX A

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APPENDIX B

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 used to type the study stream.

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 C

Montgomery-Buffington Classification System

Montgomery-Buffington Stream Classification System

The following provides a brief overview of the Montgomery-Buffington stream classification system that was used to type the study steams.

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 study 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 study 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 study 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 in the study area.

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 in the study area 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 study area.

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 Table Appendix F-1. 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

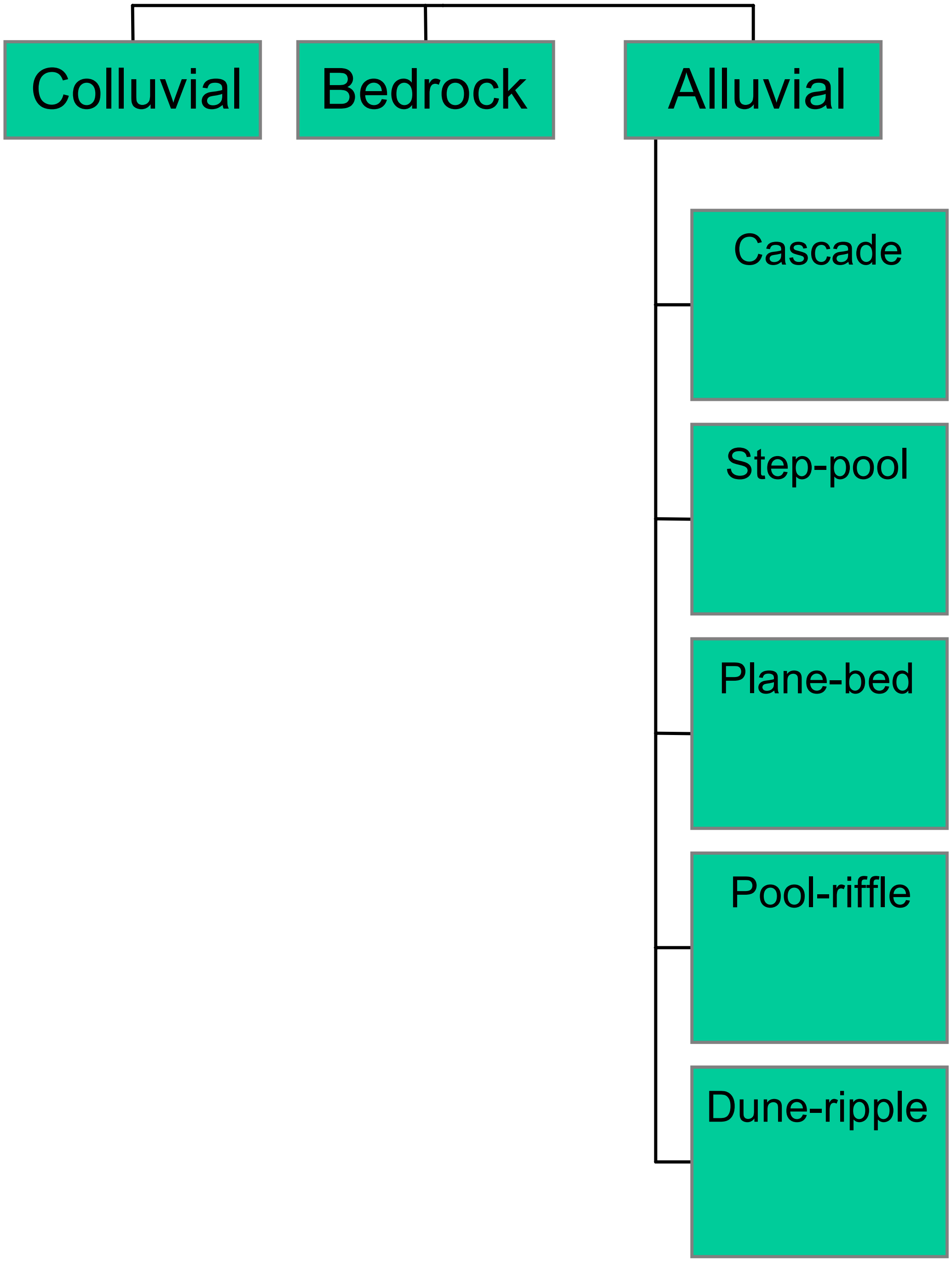
The response predictions are based on geomorphic characteristics of the channel and reach-scale fluvial processes. In reality, channel response occurs as a matter of degree within a continuum, and cannot be forecast in a straightforward "black-or-white" manner. Channel morphology can provide a general 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 Table Appendix F-1).

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. No study 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 study 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				
		Dune-Ripple	Pool-Riffle	Plane-Bed	Step-Pool	Cascade
Bed Material	Variable	Sand	Gravel	Gravel- cobble	Cobble-boulder	Boulder
Bedform Pattern	Variable	Multi-layered	Laterally oscillatory	Featureless	Vertically oscillatory	Random
Dominant Roughness	Grains, LWD	Sinuosity, banks, grains, bedforms (dunes, ripples, bars)	Bedforms (bars, pools), sinuosity, banks, grains	Grains, banks	Grains, banks	Grains, banks
Sediment Sources	Hillslopes Debris Flows	Fluvial, bank failure	Fluvial, bank failure	Fluvial, bank failure, debris flow	Fluvial, hillslope, debris flow	Fluvial, hillslope, debris flows
Sediment Storage	Bed	Overbank, bedforms	Overbank, bedforms	Overbank	Bedforms	Lee and stoss sides of obstructions
Confinement	Confined	Unconfined	Unconfined	Variable	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
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

Source: Montgomery-Buffington, 1997

APPENDIX D

Summary of Aerial Photography and USGS Gaging Station Streamflow Data by Study Stream

Middle Fork American River

		River Mile			USGS Discharge (cfs)		
River	Scale	Start	End	Date of Photo	MF American River Nr Auburn Ca (RM 1.0)	Oxbow Power House Nr Foresthill CA (below junction) (RM 24.3)	MF American River @ French Meadows, CA (RM 47)
Middle Fork American River	1:6000	16.5	20.3	7/7/1961	181	No data	12
Middle Fork American River	1:6000	34.1	38.8	7/7/1961	181	No data	12
Middle Fork American River	1:6000	46.5	47.1	7/7/1961	181	No data	12
Middle Fork American River	1:12000	15.6	29.2	7/7/1961	172	No data	11
Middle Fork American River	1:12000	22.1	30.8	8/30/1961	49	No data	0.9
Middle Fork American River	1:12000	25	31.2	8/30/1961	49	No data	0.9
Middle Fork American River	1:12000	27.9	31.2	8/30/1961	49	No data	0.9
Middle Fork American River	1:12000	33.8	37.5	8/16/1961	-	No data	1.4
Middle Fork American River	1:12000	33.8	37.5	8/30/1961	-	No data	0.9
Middle Fork American River	1:12000	35.8	39.7	8/16/1961	-	No data	1.4
Middle Fork American River	1:12000	44.8	French Meadows Reservoir	7/7/1961	-	No data	12
Middle Fork American River	1:12000	47.2	53	8/15/1961	-	No data	1.4
Middle Fork American River	1:15840	0	1.3	8/2/1962	90	No data	-
Middle Fork American River	1:15840	0.1	4.1	7/28/1962	105	No data	-
Middle Fork American River	1:15840	3	8.4	11/29/1962	377	No data	-
Middle Fork American River	1:15840	5.3	10.4	8/1/1962	93	No data	-
Middle Fork American River	1:15840	9.5	12.5	8/2/1962	90	No data	-
Middle Fork American River	1:15840	11.8	17.2	8/2/1962	90	No data	-
Middle Fork American River	1:15840	15.5	21	8/2/1962	90	No data	5.9
Middle Fork American River	1:15840	29	33.5	8/11/1962	86	No data	4.3
Middle Fork American River	1:15840	32.1	35.8	8/11/1962	-	No data	4.3
Middle Fork American River	1:15840	38	41.9	8/1/1962	-	No data	6.1
Middle Fork American River	1:15840	41.6	45.3	8/1/1962	-	No data	6.1
Middle Fork American River	NA	0	24.3	11/14/2002	No data	670	-
Middle Fork American River	NA	25	47	11/14/2002	No data	-	12

-: Flow data not applicable for that location
NA: Not applicable
No Data: Flow data not available for that location

Rubicon River

		River Mile			USGS Discharge (cfs)	
River	Scale	Start	End	Date of Photo	SF Rubicon @ Georgetown (Enters Rubicon at RM 22.5)	Rubicon River Below Hell Hole Dam, Ca (RM 30.5)
Rubicon	1:6000	0	2.1	7/7/1961	11	No data
Rubicon	1:6000	Hell Hole Dam		7/7/1961	11	No data
Rubicon	1:6000	Hell Hole Dam		7/7/1961	11	No data
Rubicon	1:12000	0	4.7	7/8/1961	11	No data
Rubicon	1:12000	25.8	Upper Watershed	7/7/1961	11	No data
Rubicon	1:12000	29.3	Hell Hole Dam	8/16/1961	-	No data
Rubicon	1:15840	2	7.2	8/14/1962	5.2	No data
Rubicon	1:15840	5.6	11.5	8/11/1962	6	No data
Rubicon	1:15840	9.8	14	8/1/1962	6.6	No data
Rubicon	1:15840	11.8	16.7	8/1/1962	6.6	No data
Rubicon	1:15840	14.3	18.1	8/1/1962	6.6	No data
Rubicon	1:15840	15.3	20.4	8/1/1962	6.6	No data
Rubicon	1:15840	17.8	23	8/14/1962	5.2	No data
Rubicon	1:15840	20.8	27.7	11/3/1962	No data	No data
Rubicon	NA	0	20.5	11/14/2002	No data	22

-: Flow data not applicable for that location
NA: Not applicable
No Data: Flow data not available for that location

Long Canyon Creek (incl. North and South Fork Long Canyon Creeks)

		River Mile			USGS Discharge (cfs)		
River	Scale	Start	End	Date of Photo	Long Canyon Creek near French Meadows, CA (RM 11.3)	NF Long Canyon Creek Diversion Tunnel Nr Volcanoville Ca (RM 3.3)	SF Long Canyon Creek Diversion Tunnel Nr Volcanoville Ca (RM 2)
Long Canyon	1:15840	0	3+	8/14/1962	0.4	-	-
Long Canyon	1:15840	0.3	3.8	8/11/1962	0.4	-	-
Long Canyon	1:15840	2.6	5.8	8/11/1962	0.4	-	-
Long Canyon	1:15840	4	7.4	8/1/1962	1.1	-	-
Long Canyon	1:15840	5.7	8.6	8/1/1962	1.1	-	-
Long Canyon	1:15840	7.4	11.2	8/1/1962	1.1	-	-
Long Canyon	1:15840	9	11.2	8/1/1962	1.1	-	-
North Fork Long Canyon	1:6000	2.55	Upper Watershed	7/7/1961	No data	-	-
North Fork Long Canyon	1:12000	0.3	Upper Watershed	8/16/1961	No data	-	-
North Fork Long Canyon	1:15840	0	2	8/1/1962	No data	-	-
North Fork Long Canyon	NA	0	3.3	11/14/2002	No data	0	-
South Fork Long Canyon	1:12000	2.8	Upper Watershed	8/16/1961	No data	-	-
South Fork Long Canyon	1:15840	0	1.5	8/1/1962	No data	-	-
South Fork Long Canyon	NA	0	2	11/14/2002	No data	-	0

-: Flow data not applicable for that location
NA: Not applicable
No Data: Flow data not available for that location

Duncan Creek

		River Mile			USGS Discharge (cfs)	
River	Scale	Start	End	Date of Photo	Duncan Canyon Creek near French Meadows Ca (RM 6)	Duncan Canyon Creek Bl Diversion Dam Nr French Meadows CA (RM 6)
Duncan Creek	1:12000	6.5	8.6	8/16/1961	0.5	No Data
Duncan Creek	1:12000	8.6	Upper Watershed	8/16/1961	0.5	No Data
Duncan Creek	1:15840	0	4.7	8/1/1962	1.6	No Data
Duncan Creek	1:15840	0.5	7.4	8/1/1962	1.6	No Data
Duncan Creek	NA	0	6	11/14/2002	23	15

-: Flow data not applicable for that location
NA: Not applicable
No Data: Flow data not available for that location

APPENDIX E

Photographs of Features Providing Sediment Contributions to Study Streams

Appendix E – Features Providing Sediment Contributions to Study Streams

Photo E-1: Debris Slides into Rubicon River – (RM 8.0-RM 9.3)

Photo E-2: Rockfalls from Jointed Block Shoo-Fly Formation into Middle Fork American River – (RM 37.6)

Appendix E – Features Providing Sediment Contributions to Study Streams (continued)

Photo E-3: Coarse Material in Channel at Base of Active Rockfall in Middle Fork American River – (RM 30.2)

Appendix E – Features Providing Sediment Contributions to Study Streams (continued)

Photo E-4: Talus Slope of Active Rockfall Middle Fork American River – (RM 30.2)

Photo E-5: Debris Torrent into Middle Fork American River – (RM 42.3)

Appendix E – Features Providing Sediment Contributions to Study Streams (continued)

Photo E-6: Eroding Bank in Rubicon River – (RM 28.3)

APPENDIX F

Photographs of Rosgen Level 1 Stream Types in Study Streams

Appendix F – Rosgen Level 1 Stream Types in Study Streams

Photo F-1: North Fork Long Canyon Creek, (RM 1.9) Rosgen Level 1 B-channel type

Photo F-2: Lower Half of Long Canyon Creek (RM 5.0) is a narrow V-sloped valley with a confined channel

Appendix F – Rosgen Level 1 Stream Types in Study Streams (continued)

Photo F-3: Upper Half of Long Canyon Creek (RM 9.0) is a broad U-shaped, glaciated valley

Photo F-4: Middle Fork American River (RM 13.0) Rosgen Level 1 F-channel type below Oxbow Reservoir

Appendix F – Rosgen Level I Stream Types in Study Streams (continued)

Photo F-5: Middle Fork American River (RM 40.0) Rosgen Level 1 A-channel type is highly entrenched steep with a low width-depth ratio

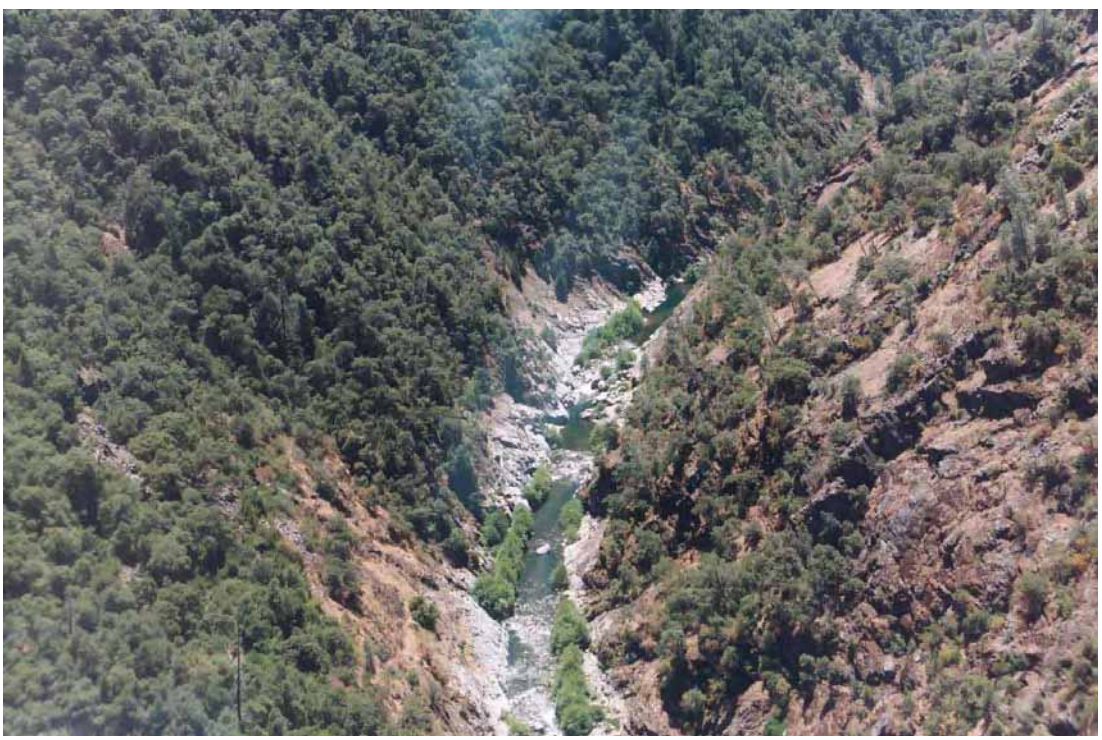


Photo F-6: Rubicon River (RM 0.3) Rosgen Level 1 G-channel type

Appendix F – Rosgen Level I Stream Types in Study Streams (continued)

Photo F-7: Rubicon River (RM 26.0) Rosgen Level 1 B-channel type with a moderate entrenchment and width-depth ratio

Appendix F – Rosgen Level I Stream Types in Study Streams (continued)

Photo F-8: Rubicon River, (RM 29.0) aggraded channel reach in debris field below Hell Hole Dam

APPENDIX G

Photographs of Montgomery-Buffington Stream Types in Study Streams

Appendix G – Montgomery-Buffington Stream Types in Study Streams

Photo G-1: (RM 7.4) Duncan Creek, Montgomery-Buffington step-pool/plane-bed channel type (also known as "riffle-step")

Photo G-2: Long Canyon Creek (RM 6.9) Montgomery-Buffington, step-pool/bedreach channel type. This is an example of a mixed alluvial-bedrock channel type. Note the alluvial gravel material in pool in left foreground

Appendix G – Montgomery-Buffington Stream Types in Study Streams (continued)

Photo G-3: Middle Fork American River (RM 34.7) Montgomery-Buffington, forced pool-riffle channel type. Pool is scoured against bedrock valley wall

Photo G-4: Middle Fork American River (RM 45.2) Montgomery-Buffington, bedrock channel

Appendix G – Montgomery-Buffington Stream Types in Study Streams (continued)

Photo G-5: Rubicon River (RM 4.0) Montgomery-Buffington, cascade section of forced pool-riffle sequence

APPENDIX H

Featured Geomorphology Sites from Interactive GIS CD

Middle Fork American River

River Mile 13

Middle Fork of the American River below Oxbow Reservoir as viewed from helicopter, showing Rosgen "F" channel type.

Middle Fork American River

River Mile 34.7

Downstream view of the Middle Fork of the American River, showing Montgomery-Buffington "Forced Pool-Riffle" channel type. Note how the pool is scoured against the bedrock valley wall.

Middle Fork American River

River Mile 45.2

Upstream view of the Middle Fork of the American River, showing a Montgomery-Buffington "Bedrock" channel type.

Duncan Creek

River Mile 7.4

Downstream view of Duncan Creek, showing a Montgomery-Buffington "Step-Pool/Plane-Bed" channel type (also known as "Riffle-Step").

Rubicon River

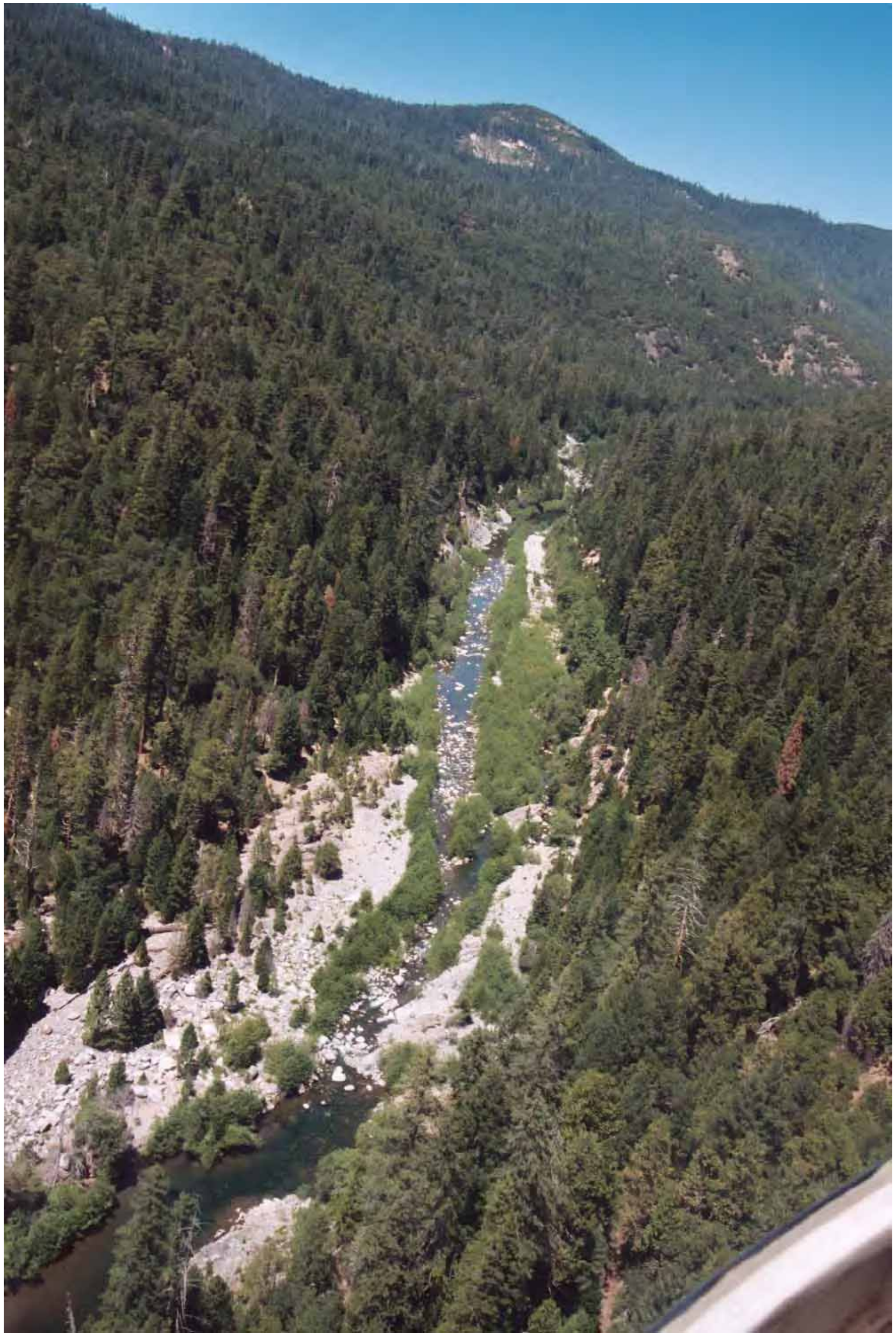
River Mile 0.3

Rubicon River as viewed from helicopter, showing Rosgen "G" channel type.

Rubicon River

River Mile 4.0

Downstream view of the Rubicon River, showing a cascade section of a Montgomery-Buffington "Forced Pool-Riffle" sequence.



Rubicon River

River Mile 26

Rubicon River as viewed from helicopter, showing Rosgen "B" channel type. This channel type exhibits moderate entrenchment and a moderate width-to-depth ratio.

Rubicon River

River Mile 29

Rubicon River downstream of Hell-Hole Dam as viewed from helicopter, showing aggraded channel reach.

Long Canyon

River Mile 5

Lower half of Long Canyon as viewed from helicopter. Note that this portion of Long Canyon is a narrow V-shaped valley, with a confined channel, as opposed to the upper half of the canyon which is U-shaped.

Long Canyon

River Mile 9

Upper half of Long Canyon as viewed from a helicopter. Note how this portion of Long Canyon is a broad U-shaped, glaciated valley, as opposed to the lower half of the canyon which is V-shaped.

Long Canyon Creek

River Mile 6.9

Long Canyon Creek, showing a Montgomery-Buffington "Step-Pool/Bedrock" channel. This is an example of a mixed alluvial-bedrock channel type. Note the alluvial gravel material in pool tailout in left foreground.

North Fork Long Canyon Creek

River Mile 1.9

North Fork Long Canyon Creek, exhibiting a Rosgen "B" channel type.

South Fork Long Canyon Creek

River Mile 3.7

This section of S.F. Long Canyon Creek has experienced a debris flow, as indicated by the levee of sediments at right-center of photo. Also note the bank erosion caused by the debris flow.

APPENDIX I

Photographs of Riparian Community Types

Appendix I - Riparian Communities Types

Alder Community along the Rubicon River

Willow Community along the Middle Fork American River

Appendix I - Riparian Communities Types (continued)

Alder-Willow Community along Duncan Creek

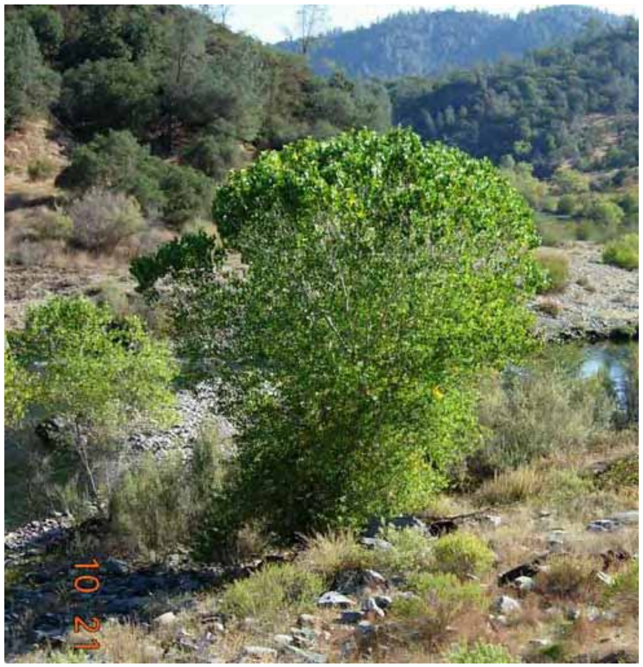
Alder-Willow Cottonwood Community along the Middle Fork American River

Appendix I - Riparian Communities Types (continued)

Alder-Willow-Cottonwood Community along the Rubicon River

Appendix I - Examples of Dominant Riparian Species Present Along Study Streams

Cottonwood

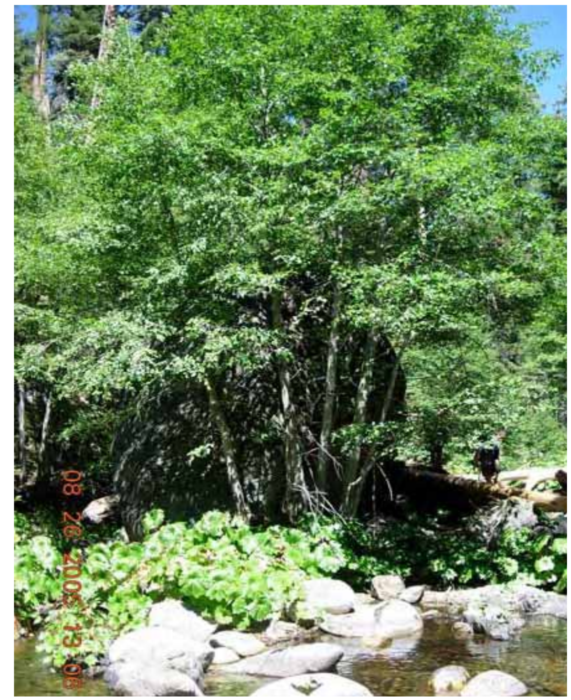


Fremont Cottonwood (*Populus fremontii*) along the Middle Fork American River

Willow

Willow (various) (*Salix,* spp) along the Middle Fork American River

Alder



White Alder (*Alnus rhombifolia*) along Duncan Creek

APPENDIX J

Photographs of Riparian Distribution Patterns

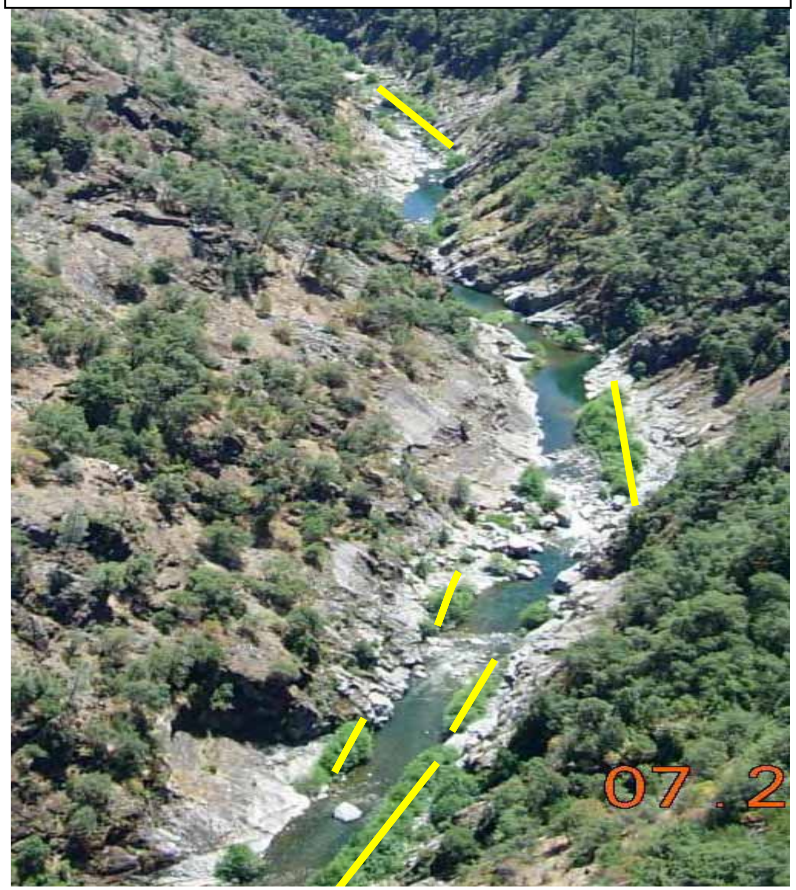
Appendix J - Riparian Distribution Patterns

Examples of Sparse and Discontinuous Riparian Vegetation along Study Stream MFP Streams.

Sparse

Long Canyon Creek near confluence with Rubicon River

Discontinuous



Rubicon River near footbridge upstream of confluence with Long Canyon Creek

Appendix J - Riparian Distribution Patterns(continued)

Examples of Continuous Narrow (Line) and Wide Corridors (Polygon) of Riparian Vegetation Along Study Streams.

Continuous

Rubicon River upstream of Forest Service Road 2 Bridge

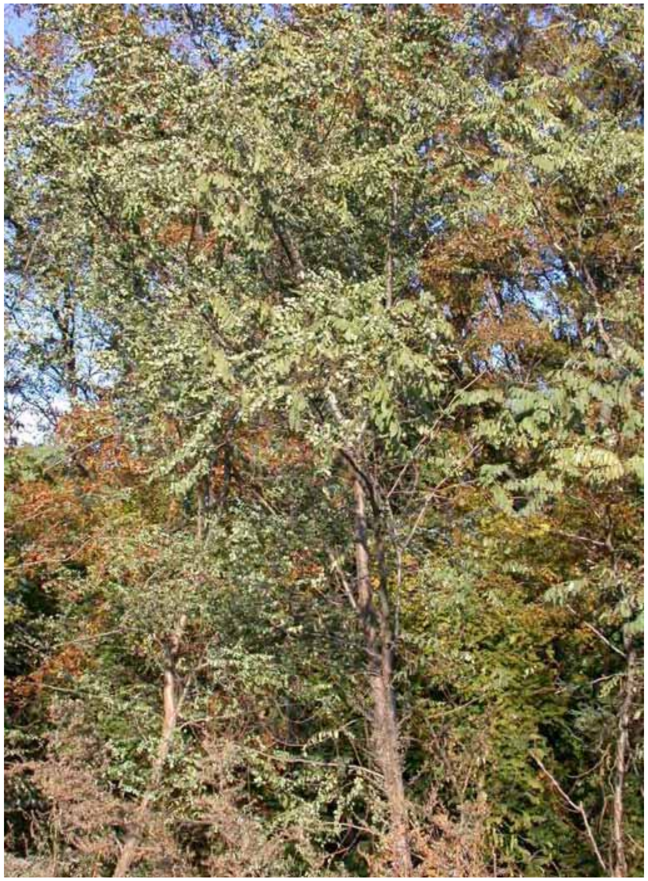
Polygon

Rubicon River at Parsley Bar

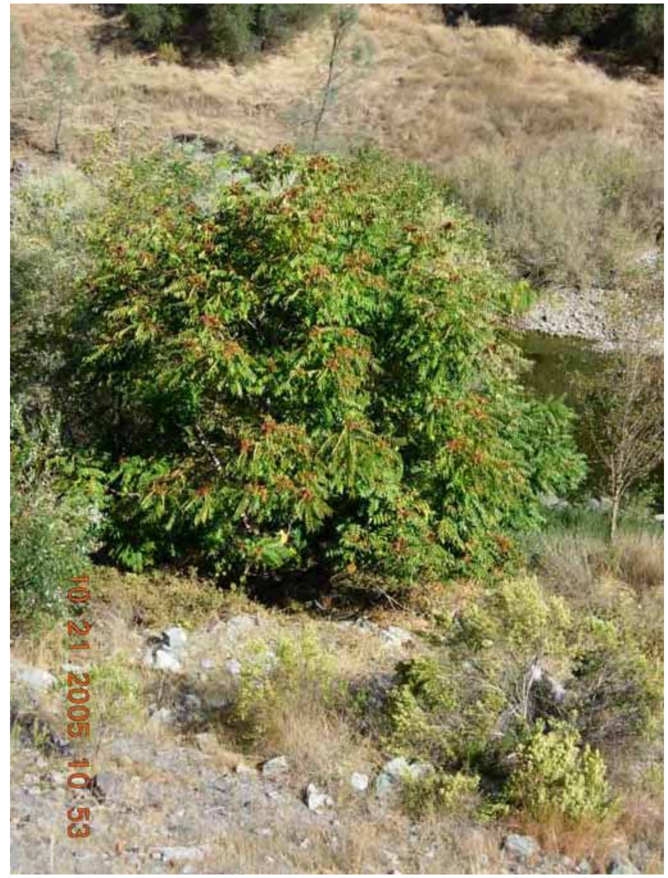
APPENDIX K

Photographs of Non-Native Invasive Species

Appendix K - Non-Native Invasive Species Observed along Study Streams



Black Locust (*Robinia pseudoacacia*) along the lower reach of the Lower Middle Fork American River



Tree of Heaven (*Ailanthus altissima*) along the lower reach of the Lower Middle Fork American River

APPENDIX L

Riparian Community Types, Distribution Patterns, and Age Class Structures Along Study Streams by River Mile

Appendix L-1. Riparian Community Types, Distributions Patterns, and Age Class Structures along Study Streams by River Mile

Definitions

The following designations are used in the Appendix D Tables to define the riparian community, age class structure; and distribution;

Riparian Community Designation	**Riparian Community Structure**
A	Alder Dominant
W	Willow Dominant
AW	Alder/Willow Co-Dominant
AWC	Alder/Willow/Cottonwood
AWL	Alder/Willow/Black Locust
AWLC	Alder/Willow/Black Locust/Cottonwood

Age Class Designation	**Age Class Structure**
Y	Young vegetation/Saplings [1]
M	Medium-aged Vegetation [2]
O	Old/Mature Vegetation [3]

Riparian Distribution Designations	**Distribution Structure**
Polygons	Wide Riparian Corridor: An area of woody riparian vegetation that occupies an area greater than three mature trees/shrubs long and two trees/shrubs wide.
Continuous	Narrow Riparian Corridor: Woody riparian vegetation is less than two mature trees/shrubs wide, without breaks in the canopy greater than the width of the line of trees/shrubs.
Discontinuous	Discontinuous Riparian Corridor: Woody riparian vegetation is less than two mature trees/shrubs wide with breaks in the canopy cover that are greater than the width of the line of trees/shrubs, but are no less than six times the width of the line of trees.
Sparse	Sparse Cover: Woody riparian vegetation is present in smaller quantities than discontinuous lines. This distribution class generally describes longer reaches of stream channel when vegetation is present where no line is distinguishable. Individual trees/shrubs are included in this category.

Footnotes:

1. Young: Seedlings, shrubs with less than 10 stems per individual, or trees with diameters (diameter at breast height (DBH)) less than 3 inches. The canopy diameter is less than 0.75 meters.
2. Medium-Aged: Shrubs with between 10 and 60 stems per individual, trees with DBH's between 3 and 9 inches, and the canopy diameter is between 0.75 and 2 meters.
3. Mature/Old: Shrubs with more than 60 stems per individual, trees with DBH's greater than 9 inches, and the canopy diameter is greater than 2.5 meters.

Appendix L-1 Duncan Creek - Riparian Community Type, Distribution Patterns, and Age Class Distribution by River Mile.

RM-Start	RM-End	Length (ft)	Community Type	Distribution	Age Class	Area (Acres)
9.4	9.4	82.9	AW	Sparse	Y, M, O	
9.4	9.4	87.6	AW	Sparse	Y, M, O	
9.0	9.0	268.8	AW	Sparse	Y, M	
9.0	9.0	198.5	AW	Sparse	Y, M	
8.9	8.9	95.6	AWC	Discontinuous	Y, M, O	
8.9	8.9	50.2	AWC	Discontinuous	Y, M, O	
8.7	8.9	1,419.8	AWC	Discontinuous	Y, M, O	
8.7	8.9	1,416.6	AWC	Discontinuous	Y, M, O	
8.6	Duncan Creek Diversion					
8.5	8.5	24.8	AWC	Continuous	Y, M, O	
8.3	8.3	43.3	A	Sparse	Y, M	
8.3	8.3	37.5	A	Sparse	Y, M	
8.3	8.5	901.3	AW	Continuous	Y, M	
8.3	8.5	1,000.6	AW	Polygon	Y, M	1.00
8.1	8.3	899.2	A	Continuous	Y, M	
8.1	8.3	883.3	A	Continuous	Y, M	
7.9	7.9	65.5	A	Sparse	Y, M	
7.9	8.0	69.7	A	Continuous	Y, M	
7.7	7.9	949.9	AWC	Sparse	Y, M	
7.7	7.9	941.4	AWC	Discontinuous	Y, M	
7.5	7.7	974.7	A	Sparse	Y, M	
7.2	7.4	996.9	AWC	Continuous	Y, M	
7.2	7.4	993.7	AWC	Continuous	Y, M	
7.0	7.2	1,450.9	AWC	Polygon	Y, M	2.47
6.7	6.7	122.0	AWC	Continuous	Y, M	
6.7	6.7	57.6	AWC	Sparse	Y, M	
6.7	6.7	89.8	AWC	Continuous	Y, M	
6.7	7.0	1,188.0	AW	Sparse	M	
6.7	6.9	1,156.8	AW	Sparse	M	
6.6	6.7	465.7	AWC	Continuous	Y, M	
6.5	6.5	158.4	AWC	Sparse	M	
6.5	6.6	631.5	AW	Sparse	Y, M	
6.1	6.1	301.5	AWC	Polygon	Y, M, O	1.08
6.1	6.4	1,282.0	AW	Sparse	Y	
6.1	6.4	1,276.2	AWC	Sparse	M	
6.0	6.1	527.5	AWC	Continuous	Y, M, O	
5.8	5.8	72.9	AW	Continuous	M	
5.8	6.1	1,425.6	AW	Continuous	M, O	
5.7	5.7	127.2	AW	Sparse	M	
5.7	5.7	163.2	AW	Sparse	M	
5.7	5.8	164.7	AW	Continuous	M	
5.5	5.5	242.4	AW	Sparse	M	
5.5	5.5	193.8	AW	Sparse	M	
5.4	5.5	347.4	AW	Sparse	M	
5.4	5.5	298.8	AW	Sparse	M	
5.2	5.2	73.4	AW	Continuous	M, O	
5.2	5.2	28.0	AW	Continuous	M, O	

Appendix L-1 Duncan Creek - Riparian Community Type, Distribution Patterns, and Age Class Distribution by River Mile (continued).

RM-Start	RM-End	Length (ft)	Community Type	Distribution	Age Class	Area (Acres)
5.1	5.1	231.8	AW	Sparse	Y	
5.1	5.1	6.3	AW	Continuous	Y, M	
4.9	4.9	119.9	A	Continuous	M	
4.9	4.9	207.0	AW	Continuous	Y, M	
4.9	5.1	850.1	A	Continuous	Y	
4.8	4.8	157.9	AW	Sparse	M	
4.7	4.8	200.1	AW	Continuous	M	
4.5	4.5	20.6	AW	Continuous	M	
4.5	4.6	764.5	AW	Sparse	Y, M	
4.5	4.6	758.2	AW	Sparse	Y, M	
4.4	4.4	52.3	AW	Polygon	M	0.43
4.2	4.2	80.8	AW	Sparse	Y, M	
4.2	4.3	411.8	AW	Sparse	Y	
3.8	3.8	298.3	AW	Continuous	Y, M	
3.8	4.1	2,001.6	AW	Continuous	Y, M	
3.7	3.7	251.9	A	Sparse	M	
3.7	3.7	227.6	A	Sparse	M	
3.6	3.7	578.7	AW	Sparse	Y, M	
3.1	3.1	159.5	AW	Continuous	M	
3.1	3.3	779.3	AW	Sparse	M	
3.0	3.1	528.0	AW	Continuous	Y, M	
3.0	3.1	482.1	AW	Continuous	Y, M	
2.8	2.9	540.1	AW	Sparse	Y, M	
2.8	2.9	474.1	AW	Sparse	Y, M	
2.6	2.8	1,377.6	AW	Continuous	Y, M	
2.6	2.8	1,298.9	AW	Continuous	Y, M	
2.4	2.5	186.4	AW	Sparse	Y	
2.2	2.2	79.7	AW	Sparse	Y, M	
2.2	2.3	199.1	AW	Sparse	Y	
2.1	2.1	114.0	A	Sparse	Y	
2.0	2.1	497.9	AW	Sparse	Y, M	
2.0	2.1	520.1	AW	Sparse	Y, M	
1.8	1.8	81.8	AW	Sparse	Y	
1.8	1.9	393.9	AW	Sparse	Y, M	
1.7	1.8	328.4	AW	Discontinuous	M	
1.7	1.8	332.6	AW	Discontinuous	M	
1.5	1.6	430.8	AW	Sparse	Y	
1.0	1.3	1,615.2	A	Discontinuous	Y, M	
1.0	1.3	1,633.1	A	Discontinuous	Y, M	
0.7	0.7	26.4	A	Sparse	Y, M	
0.7	0.8	337.4	AW	Sparse	Y, M	
0.7	0.8	299.4	AW	Sparse	Y, M	
0.5	0.5	79.2	A	Sparse	Y	
0.5	0.5	103.0	A	Sparse	Y	
0.2	0.2	92.9	AW	Sparse	Y, M	
0.2	0.3	164.2	AW	Sparse	Y, M	
0.1	0.2	520.1	A	Sparse	Y, M	

Appendix L-1 Duncan Creek - Riparian Community Type, Distribution Patterns, and Age Class Distribution by River Mile (continued).

RM-Start	RM-End	Length (ft)	Community Type	Distribution	Age Class	Area (Acres)
0.0	0.0	171.6	AW	Sparse	Y	
0.0	0.0	246.0	AW	Sparse	Y	
0.0	0.2	670.0	A	Sparse	Y, M	
0.0	Confluence with Middle Fork of the American River					

[1] **Abbreviations:**
Community Type

Appendix L-2 North Fork Long Canyon Creek - Riparian Community Type, Distribution Patterns, and Age Class Distribution by River Mile.

RM-Start	RM-End	Length (ft)	Community Type	Distribution	Age Class	Area (Acres)
3.05	North Fork Long Canyon Creek Diversion					
2.9	3.2	1,446.7	AW	Sparse	Y, M	
2.9	3.2	1,398.7	AW	Sparse	Y, M	
2.8	2.9	501.1	A	Sparse	Y, M, O	
2.8	2.9	530.6	A	Sparse	Y, M, O	
2.6	2.8	1,066.6	A	Continuous	Y, M, O	
2.5	2.8	1,087.2	A	Continuous	Y, M, O	
2.3	2.6	1,530.1	A	Polygon	Y, M, O	2.31
2.2	2.3	343.7	AW	Polygon	Y, M, O	0.84
1.8	2.3	2,197.0	AW	Continuous	Y, M, O	
1.8	2.3	2,201.8	AW	Continuous	Y, M, O	
1.7	1.7	64.9	AW	Sparse	Y, M	
1.7	1.8	534.9	AW	Sparse	Y, M	
1.6	1.6	258.7	AWC	Sparse	Y, M	
1.6	1.6	290.9	AWC	Sparse	Y, M	
1.6	1.7	523.2	AW	Continuous	Y, M, O	
1.6	1.7	541.2	AW	Continuous	Y, M, O	
1.2	1.6	2,106.2	AWC	Continuous	Y, M, O	
1.0	1.4	2,226.0	AWC	Continuous	Y, M, O	
0.9	1.2	1,171.1	AWC	Polygon	Y, M, O	1.83
0.7	1.0	1,482.1	AW	Continuous	M, O	
0.7	1.0	1,469.4	AW	Continuous	M, O	
0.4	0.7	1,304.2	AW	Polygon	O	1.78
0.0	0.4	2,267.2	AW	Continuous	M, O	
0.0	0.4	2,303.1	AW	Continuous	M, O	
0.0	Confluence with South Fork Long Canyon Creek					

Appendix L-3 South Fork Long Canyon Creek - Riparian Community Type, Distribution Patterns, and Age Class Distribution by River Mile.

RM-Start	RM-End	Length (ft)	Community Type	Distribution	Age Class	Area (Acres)
4.2	4.7	2,713.4	AWC	Continuous	Y, M, O	
4.2	4.8	2,741.4	AWC	Continuous	Y, M, O	
4.0	4.2	1,176.4	AW	Continuous	Y, M	
3.9	4.2	1,516.9	AW	Continuous	Y, M	
3.7	4.0	1,890.2	W	Sparse	Y, M	
3.6	3.9	1,693.8	W	Sparse	Y, M	
3.3	South Fork Long Canyon Creek Diversion					
3.3	3.6	1,915.6	AW	Continuous	Y, M	
3.3	3.6	1,887.6	AW	Continuous	Y, M	
2.9	3.2	1,694.9	AW	Discontinuous	Y, M	
2.9	3.2	1,727.6	AW	Discontinuous	Y, M	
2.6	2.9	1,688.0	AW	Continuous	Y, M	
2.6	2.9	1,581.9	AW	Continuous	Y, M	
2.1	2.5	2,184.9	AW	Sparse	Y, M	
2.1	2.6	2,160.0	AW	Sparse	Y, M	
1.9	2.1	1,374.4	AWC	Continuous	Y, M, O	
1.9	2.1	1,233.4	AWC	Continuous	Y, M, O	
1.3	1.3	368.0	AWC	Sparse	Y, M, O	
1.3	1.3	332.6	AWC	Sparse	Y, M, O	
1.3	1.5	936.7	AWC	Continuous	Y, M, O	
1.3	1.5	877.0	AWC	Continuous	Y, M, O	
1.1	1.3	658.9	AWC	Polygon	Y, M, O	1.12
1.0	1.2	1,043.3	A	Sparse	Y, M, O	
1.0	1.1	745.5	A	Sparse	Y, M, O	
0.7	1.0	1,689.6	AWC	Sparse	Y, M, O	
0.7	0.8	473.6	A	Sparse	Y, M, O	
0.6	0.6	128.3	A	Sparse	Y, M	
0.5	0.6	399.2	A	Sparse	Y, M, O	
0.5	0.6	101.4	A	Sparse	Y, M, O	
0.4	0.4	51.2	A	Sparse	Y, M, O	
0.3	0.4	134.6	A	Sparse	Y, M, O	
0.3	0.4	76.0	A	Sparse	Y, M, O	
0.2	0.2	119.9	A	Sparse	Y, M, O	
0.1	0.1	232.3	A	Sparse	Y, M, O	
0.1	0.2	473.6	A	Sparse	Y, M, O	
0.0	Confluence with North Fork Long Canyon Creek					
-0.1	0.0	551.8	W	Sparse	M, O	

Appendix L-4 Long Canyon Creek - Riparian Community Type, Distribution Patterns, and Age Class Distribution by River Mile.

RM-Start	RM-End	Length (ft)	Community Type	Distribution	Age Class	Area (Acres)
11.3	Confluence with the North and South Fork Long Canyon Creek					
11.3	11.3	403.4	W	Polygon	Y, M, O	0.50
11.2	11.4	1,316.8	W	Sparse	Y, M, O	
11.2	11.3	284.6	W	Sparse	Y, M	
11.1	11.1	208.0	AWC	Sparse	Y, M, O	
11.1	11.2	311.5	AWC	Continuous	Y, M, O	
11.0	11.1	637.8	AWC	Continuous	Y, M, O	
10.7	10.7	143.6	A	Sparse	M, O	
10.7	10.8	550.2	A	Continuous	M, O	
10.5	11.0	2,593.0	A	Continuous	M, O	
10.5	10.7	662.1	W	Continuous	M, O	
10.3	10.5	658.4	A	Discontinuous	O	
10.3	10.5	572.9	W	Polygon	Y, M	0.21
10.2	10.3	667.4	A	Polygon	M, O	0.40
9.9	9.9	212.3	A	Sparse	Y, M	
9.9	10.2	1,434.0	A	Continuous	Y, M	
9.9	10.3	2,104.1	A	Continuous	M	
9.8	9.9	996.9	A	Polygon	M, O	0.90
9.7	9.8	428.7	A	Continuous	Y, M	
9.5	9.9	1,916.1	A	Continuous	Y, M	
9.5	9.6	124.6	A	Sparse	Y, M	
9.4	9.5	493.2	A	Continuous	Y, M	
9.2	9.5	1,591.4	A	Continuous	M	
9.0	9.1	792.5	A	Continuous	Y, M, O	
8.9	9.2	1,303.1	A	Continuous	Y, M, O	
8.9	8.9	157.3	A	Continuous	Y, M, O	
8.8	8.8	108.8	A	Sparse	Y, M	
8.8	8.8	95.0	A	Sparse	Y, M	
8.8	8.8	61.8	A	Continuous	Y, M	
8.8	8.8	12.7	A	Continuous	Y, M	
8.8	8.9	386.0	A	Sparse	Y, M	
8.6	8.6	122.5	W	Sparse	M	
8.5	8.8	1,085.6	A	Sparse	Y, M	
8.3	8.4	225.5	A	Sparse	M	
8.2	8.3	896.5	A	Sparse	Y, M	
7.7	7.8	622.5	A	Sparse	Y, M	
7.5	8.2	3,368.6	A	Sparse	Y, M	
7.5	7.6	144.7	A	Sparse	M	
7.0	7.4	2,438.3	A	Sparse	Y, M	
7.0	7.4	2,265.6	A	Sparse	Y, M	
6.8	7.0	1,148.9	A	Continuous	M	
6.5	6.7	1,157.9	A	Sparse	M	
6.3	6.7	2,342.2	W	Sparse	M	
6.1	6.1	98.7	W	Sparse	M	
6.0	6.3	1,626.2	W	Continuous	Y, M	
5.7	5.8	789.4	W	Sparse	Y, M	

Appendix L-4 Long Canyon Creek - Riparian Community Type, Distribution Patterns, and Age Class Distribution by River Mile (continued).

RM-Start	RM-End	Length (ft)	Community Type	Distribution	Age Class	Area (Acres)
5.7	5.7	111.4	W	Polygon	O	0.27
5.6	5.7	425.6	W	Continuous	Y, M	
5.2	5.3	422.4	W	Sparse	Y, M	
5.1	5.1	189.6	W	Continuous	Y, M	
5.1	5.2	539.1	W	Continuous	Y, M	
5.0	5.1	669.0	W	Sparse	Y, M	
4.9	4.9	51.2	W	Continuous	Y, M	
4.6	4.9	1,550.2	W	Sparse	Y, M	
4.6	5.0	1,916.6	W	Sparse	Y, M	
4.5	4.5	31.2	W	Sparse	Y, M	
4.4	4.4	112.5	A	Sparse	M	
4.3	4.4	831.1	W	Sparse	Y, M	
4.2	4.3	107.2	W	Continuous	O	
4.2	4.4	958.3	W	Continuous	Y, M	
4.1	4.2	692.2	W	Sparse	Y, M	
4.1	4.2	486.3	AWC	Sparse	O	
4.0	4.1	497.9	W	Sparse	Y, M	
3.8	4.1	1,618.3	W	Sparse	Y, M	
3.6	3.8	797.3	W	Sparse	M	
3.5	3.5	42.8	W	Sparse	Y, M	
3.5	3.5	46.5	W	Continuous	Y, M, O	
3.5	3.5	55.4	W	Polygon	Y, M, O	0.10
3.5	3.5	39.1	W	Polygon	Y, M, O	0.10
3.5	3.5	105.6	W	Continuous	Y, M, O	
3.4	3.5	748.7	W	Continuous	Y, M, O	
3.2	3.2	69.7	W	Sparse	M, O	
3.2	3.2	68.1	W	Sparse	M, O	
3.1	3.1	40.7	W	Sparse	Y, M	
3.1	3.1	58.1	AWC	Polygon	Y, M	0.13
3.1	3.1	32.7	AWC	Polygon	Y, M	0.11
2.9	2.9	64.4	W	Sparse	Y, M	
2.9	2.9	101.4	W	Sparse	Y, M	
2.7	2.7	83.4	W	Sparse	Y, M	
2.6	2.7	633.1	W	Continuous	Y, M	
2.6	2.6	136.2	W	Continuous	Y, M	
2.4	2.4	192.7	W	Sparse	Y, M	
2.4	2.4	192.7	W	Sparse	Y, M	
2.2	2.2	5.8	W	Sparse	Y, M	
2.2	2.2	81.3	W	Sparse	Y, M	
2.0	2.1	166.8	W	Sparse	Y, M	
1.9	1.9	70.8	W	Sparse	Y, M	
1.9	2.0	400.8	W	Continuous	Y, M	
1.8	2.1	1,233.4	W	Sparse	Y, M	
1.8	1.9	546.0	W	Continuous	Y, M	
1.4	1.7	1,593.5	W	Sparse	Y, M	
1.4	1.8	2,288.9	W	Continuous	O	

Appendix L-4 Long Canyon Creek - Riparian Community Type, Distribution Patterns, and Age Class Distribution by River Mile (continued).

RM-Start	RM-End	Length (ft)	Community Type	Distribution	Age Class	Area (Acres)
1.3	1.4	319.4	W	Polygon	Y, M	0.83
1.3	1.4	286.7	W	Continuous	O	
1.1	1.3	876.5	W	Continuous	M, O	
1.0	1.1	928.8	W	Continuous	Y, M, O	
0.9	1.0	293.6	W	Sparse	Y, M	
0.9	1.1	1,288.8	W	Continuous	Y, M, O	
0.8	0.9	572.9	W	Polygon	Y, M, O	0.81
0.8	0.9	99.3	W	Polygon	Y, M, O	0.34
0.7	0.9	751.9	AWC	Sparse	Y, M	
0.7	0.8	355.3	AWC	Sparse	Y, M	
0.4	0.4	192.2	AW	Sparse	Y, M	
0.1	0.4	1,553.9	AW	Sparse	Y, M	
0.0	0.0	211.2	AW	Continuous	Y, M, O	
0.0	0.0	250.8	AW	Continuous	Y, M, O	
0.0	0.1	152.1	AW	Continuous	Y, M, O	
0.0	0.4	1,898.7	W	Sparse	Y, M	
0.0	Confluence with the Rubicon River					

Appendix L-5 Middle Fork American River - Riparian Community Type, Distribution Patterns, and Age Class Distribution by River Mile.

RM-Start	RM-End	Length (ft)	Community Type	Distribution	Age Class	Area (Acres)
47.2			French Meadows Reservoir			
47.1	47.2	598.8	AWC	Polygon	Y, M	0.62
46.7	47.0	1,754.5	AWC	Sparse	Y, M	
46.6	46.7	165.3	AWC	Continuous	Y, M	
46.5	46.6	547.5	AWC	Sparse	Y, M	
45.9	46.5	3,163.8	AWC	Sparse	Y, M	
45.8	47.0	6,339.7	AWC	Sparse	Y, M	
45.7	45.8	403.4	AWC	Sparse	Y, M	
45.4	45.7	1,218.1	AWC	Sparse	Y, M	
45.4	45.7	1,212.8	AWC	Sparse	Y, M	
44.0	45.3	7,374.6	W	Sparse	Y, M	
44.0	45.4	7,418.9	W	Sparse	Y, M	
43.7	44.0	1,532.8	AWC	Discontinuous	Y, M	
43.4	43.4	46.5	AWC	Discontinuous	Y, M	
43.4	43.7	1,530.1	AWC	Sparse	Y, M	
43.4	43.4	3.7	AWC	Discontinuous	Y, M	
43.4	43.7	1,666.9	AWC	Sparse	Y, M	
43.1	43.4	1,571.9	AWC	Sparse	Y, M, O	
43.0	43.1	196.9	AWC	Polygon	Y, M	0.26
42.9	43.1	680.1	AWC	Sparse	Y, M, O	
42.9	43.4	2,250.3	AWC	Sparse	Y, M, O	
42.6	42.6	236.0	W	Discontinuous	Y, M	
42.6	42.6	240.8	W	Discontinuous	Y, M	
42.6	42.9	1,557.1	W	Sparse	Y, M, O	
42.6	42.9	1,615.2	W	Sparse	Y, M, O	
42.3	42.6	1,306.8	W	Sparse	M, O	
42.3	42.6	1,287.8	W	Sparse	M, O	
42.0	42.0	43.8	W	Polygon	Y, M	0.22
42.0	42.3	1,847.5	AWC	Discontinuous	Y, M	
42.0	42.3	1,835.3	AWC	Discontinuous	Y, M	
41.9	42.0	245.5	W	Discontinuous	Y, M	
41.7	42.0	1,430.4	W	Sparse	M, O	
41.7	41.9	1,197.0	W	Sparse	M, O	
41.3	41.4	601.9	W	Sparse	M, O	
41.1	41.2	670.6	W	Sparse	Y, M	
41.0	41.0	26.4	W	Sparse	M, O	
41.0	41.3	1,691.2	W	Sparse	Y, M	
40.6	41.0	2,285.2	AWC	Sparse	Y, M	
40.6	41.0	2,158.5	AWC	Sparse	Y, M	
40.1	40.4	1,785.2	W	Sparse	Y, M	
40.1	40.4	1,657.4	W	Sparse	Y, M	
40.0	40.0	5.3	W	Sparse	M, O	
39.7	40.0	1,359.6	W	Sparse	Y, M	
39.7	40.0	1,287.8	W	Sparse	Y, M	
39.7			Confluence with Duncan Creek			
39.3	39.5	1,016.4	W	Sparse	Y, M	

Appendix L-5 Middle Fork American River - Riparian Community Type, Distribution Patterns, and Age Class Distribution by River Mile (continued).

RM-Start	RM-End	Length (ft)	Community Type	Distribution	Age Class	Area (Acres)
38.9	39.5	2,913.5	W	Sparse	Y, M	
38.9	39.2	1,582.4	W	Sparse	Y, M	
38.7	38.9	1,093.5	W	Sparse	Y, M	
38.7	38.9	1,080.8	W	Sparse	Y, M	
38.3	38.6	1,400.3	AWC	Sparse	Y	
38.2	38.6	1,943.0	W	Sparse	Y, M, O	
38.1	38.2	553.9	W	Sparse	Y, M	
37.7	37.7	266.1	W	Sparse	Y, M	
37.7	37.9	1,337.4	W	Sparse	Y, M	
37.5	37.5	154.2	W	Sparse	M	
37.5	37.5	103.5	W	Continuous	Y, M, O	
37.5	37.7	799.9	A	Continuous	Y, M	
37.5	37.7	721.8	A	Continuous	Y, M	
37.4	37.4	142.0	W	Sparse	Y, M, O	
37.2	37.2	186.9	AWC	Sparse	Y, M, O	
37.2	37.4	1,089.8	AWC	Sparse	Y, M, O	
37.2	37.4	727.1	AWC	Sparse	Y, M, O	
37.0	37.0	14.8	AWC	Polygon	Y, M	0.10
37.0	37.0	3.2	AWC	Polygon	Y, M	0.09
37.0	37.1	429.3	AWC	Sparse	Y, M	
36.6	36.6	76.6	AWC	Discontinuous	Y, M	
36.6	36.6	50.7	AWC	Discontinuous	Y, M	
36.5	36.6	381.7	AWC	Discontinuous	Y, M	
36.1	36.1	46.5	A	Continuous	Y, M	
36.1	36.1	75.0	A	Polygon	Y, M	0.05
36.1	36.6	2,375.5	A	Sparse	Y, M	
36.1	36.1	79.7	A	Polygon	Y, M	0.05
36.0	Middle Fork Powerhouse					
35.8	35.9	615.6	AW	Continuous	Y, M	
35.7	35.9	1,081.3	A	Discontinuous	M	
35.5	Middle Fork Interbay Diversion					
35.4	35.6	950.4	A	Discontinuous	Y, M	
35.3	35.6	1,478.4	A	Continuous	Y	
35.2	35.5	1,613.0	A	Sparse	Y, M	
35.0	35.2	1,014.8	A	Sparse	Y, M	
34.8	34.8	99.8	W	Continuous	Y, M, O	
34.8	34.8	90.8	W	Continuous	Y, M, O	
34.8	34.8	13.2	A	Polygon	Y, M	0.02
34.7	34.8	887.0	A	Discontinuous	Y, M	
34.5	34.5	208.0	W	Continuous	Y, M, O	
34.5	34.6	818.4	W	Continuous	Y, M, O	
34.4	34.4	442.5	AWC	Discontinuous	Y, M	
34.3	34.5	745.5	AWC	Discontinuous	Y, M	
34.0	34.2	1,088.7	W	Discontinuous	Y, M, O	
34.0	34.1	518.5	W	Discontinuous	Y, M, O	
33.6	33.9	1,954.1	A	Sparse	Y, M	

Appendix L-5 Middle Fork American River - Riparian Community Type, Distribution Patterns, and Age Class Distribution by River Mile (continued).

RM-Start	RM-End	Length (ft)	Community Type	Distribution	Age Class	Area (Acres)
33.2	33.9	3,837.5	A	Sparse	Y, M, O	
32.8	33.2	2,062.9	A	Discontinuous	Y, M, O	
32.8	33.2	1,986.3	A	Discontinuous	Y, M, O	
32.2	32.8	3,317.4	A	Continuous	Y, M, O	
32.2	32.8	3,228.2	A	Continuous	Y, M, O	
32.1	32.1	142.6	W	Polygon	M, O	0.28
32.1	32.2	417.1	A	Discontinuous	Y, M, O	
31.9	32.2	1,579.8	A	Discontinuous	Y, M, O	
31.2	31.2	58.1	AWC	Continuous	Y, M, O	
31.1	31.9	4,403.5	AWC	Discontinuous	Y, M, O	
31.1	31.9	4,431.0	AWC	Discontinuous	Y, M, O	
31.1	31.2	328.9	AWC	Polygon	Y, M, O	0.67
30.8	31.1	1,349.0	A	Discontinuous	Y, M	
30.8	31.1	1,333.2	A	Discontinuous	Y, M, O	
30.7	30.8	729.2	W	Continuous	Y, M, O	
30.6	30.7	418.7	A	Discontinuous	Y, M, O	
30.6	30.6	4.2	A	Polygon	Y, M	0.12
30.6	30.7	247.1	A	Discontinuous	Y, M	
30.4	30.4	95.6	W	Continuous	M, O	
30.4	30.6	922.9	W	Polygon	Y, M, O	0.16
30.2	30.2	60.7	W	Polygon	Y, M, O	0.02
30.2	30.2	79.2	W	Polygon	Y, M, O	0.03
30.2	30.2	101.4	W	Polygon	Y, M, O	0.06
30.2	30.4	895.5	W	Continuous	M, O	
30.1	30.1	158.4	W	Polygon	Y, M, O	0.03
30.1	30.1	277.2	W	Polygon	Y, M, O	0.06
30.1	30.1	173.2	W	Polygon	Y, M, O	0.03
30.1	30.2	127.8	W	Polygon	Y, M, O	0.04
30.1	30.2	75.5	W	Polygon	Y, M, O	0.03
30.0	30.0	95.6	W	Continuous	Y, M, O	
30.0	30.1	701.7	W	Continuous	Y, M, O	
29.6	29.7	765.1	W	Continuous	M, O	
29.6	30.6	5,201.9	W	Continuous	Y, M, O	
29.5	29.6	410.3	W	Continuous	Y, M, O	
29.5	29.6	116.7	W	Continuous	M, O	
29.3	29.5	1,233.9	W	Polygon	Y, M	0.50
29.3	29.5	1,136.8	W	Polygon	Y, M	0.46
29.2	29.3	854.3	W	Continuous	Y, M, O	
29.2	29.3	759.3	W	Continuous	M, O	
28.7	29.2	2,349.6	W	Polygon	Y, M, O	6.22
28.6	28.7	592.4	W	Continuous	Y, M, O	
28.5	28.6	761.4	W	Polygon	Y, M	0.68
28.4	28.7	1,779.4	A	Continuous	Y, M	
28.4	28.5	153.6	W	Continuous	Y, M	
28.3	28.3	191.7	A	Continuous	Y, M	
28.3	28.4	571.3	W	Polygon	Y, M	0.27

Appendix L-5 Middle Fork American River - Riparian Community Type, Distribution Patterns, and Age Class Distribution by River Mile (continued).

RM-Start	RM-End	Length (ft)	Community Type	Distribution	Age Class	Area (Acres)
28.3	28.4	370.7	W	Polygon	Y, M	0.36
28.1	28.3	1,171.1	AWC	Polygon	Y, M	1.92
28.0	28.0	400.8	W	Continuous	M, O	
28.0	28.3	1,405.0	A	Continuous	Y, M, O	
27.9	28.0	581.3	W	Discontinuous	Y, M	
27.6	27.9	1,267.2	W	Continuous	Y, M	
27.5	27.5	154.7	A	Continuous	Y, M	
27.5	27.6	551.8	W	Discontinuous	Y, M	
27.5	28.0	2,720.3	A	Continuous	Y, M, O	
27.4	27.5	443.5	W	Continuous	Y, M, O	
27.3	27.4	537.0	W	Polygon	Y, M	0.73
27.3	27.4	353.2	A	Polygon	Y, M	0.28
27.2	27.3	397.6	AWC	Continuous	Y, M	
27.0	27.3	1,412.9	AWC	Continuous	Y, M	
26.9	27.2	1,652.6	AWC	Polygon	Y, M, O	0.76
26.8	26.9	306.2	AWC	Discontinuous	Y, M, O	
26.4	26.4	128.8	A	Polygon	Y, M	0.15
26.4	26.4	108.2	W	Continuous	Y, M	
26.4	26.4	229.2	AWC	Polygon	Y, M, O	0.21
26.4	26.9	2,691.7	AWC	Continuous	Y, M, O	
26.0	26.0	48.0	A	Polygon	Y, M	0.23
26.0	26.4	1,978.4	W	Continuous	Y, M	
26.0	26.4	1,917.2	W	Continuous	Y, M	
25.9	26.0	647.3	AWC	Continuous	Y, M, O	
25.9	26.0	427.7	W	Continuous	Y, M	
25.7	25.9	1,104.0	AWC	Continuous	Y, M, O	
25.7	25.9	1,127.8	AWC	Continuous	Y, M, O	
25.6			Confluence with Ralston Afterbay			
25.6	25.7	247.6	AWC	Continuous	Y, M, O	
25.5	25.7	634.1	A	Polygon	Y, M, O	1.85
24.7			Ralston Afterbay Diversion			
24.6	24.7	242.4	AWC	Continuous	Y, M	
24.5	24.8	1,502.7	AWC	Polygon	Y, M	0.88
24.5	24.6	212.3	AWC	Polygon	Y, M	0.42
24.4			Oxbow Powerhouse			
24.3	24.4	291.5	AWC	Polygon	Y, M	1.27
24.2	24.6	1,804.2	AWC	Polygon	Y, M	4.98
24.2	24.3	452.0	AWC	Continuous	Y, M	
23.7	24.2	2,729.2	A	Discontinuous	Y, M	
23.5	23.6	518.0	AWC	Polygon	M, O	2.72
23.4	24.6	6,427.9	AWC	Continuous	M	
23.3	23.5	913.4	AWC	Polygon	M, O	1.14
23.0	23.0	246.0	A	Discontinuous	M	
23.0	23.4	1,834.3	AWC	Continuous	Y, M	
23.0	23.0	53.9	A	Polygon	Y, M	0.33
23.0	23.0	88.7	AWC	Continuous	Y, M, O	

Appendix L-5 Middle Fork American River - Riparian Community Type, Distribution Patterns, and Age Class Distribution by River Mile (continued).

RM-Start	RM-End	Length (ft)	Community Type	Distribution	Age Class	Area (Acres)
23.0	23.3	1,496.9	A	Discontinuous	Y	
22.8	22.9	802.0	AWC	Continuous	M	
22.8	22.8	154.7	A	Polygon	Y, M	0.12
22.8	22.9	96.6	AWLC	Polygon	Y, M, O	0.71
22.3	22.9	2,907.7	A	Continuous	M	
22.2	22.3	776.7	A	Discontinuous	M	
22.1	22.2	462.0	A	Polygon	M, O	1.03
21.9	21.9	66.5	A	Sparse	M, O	
21.9	22.8	4,896.7	AWLC	Polygon	Y, M	7.65
21.9	21.9	93.5	A	Discontinuous	M, O	
21.9	21.9	18.0	A	Polygon	Y, M	0.07
21.9	22.1	1,138.9	AWC	Continuous	Y, M	
21.8	21.9	624.1	AWLC	Discontinuous	Y, M	
21.6	21.8	1,336.9	W	Polygon	O	1.10
21.4	21.6	836.9	W	Discontinuous	O	
21.3	21.4	727.1	AWC	Polygon	O	0.73
21.1	21.3	968.4	A	Discontinuous	O	
21.1	21.8	3,411.9	AWLC	Polygon	Y, M	2.77
21.0	21.1	504.8	AWL	Polygon	O	0.77
21.0	21.1	518.0	AWLC	Continuous	Y, M	
20.5	20.7	1,263.0	W	Discontinuous	M, O	
20.5	21.0	2,425.6	AWLC	Polygon	Y, M	3.08
20.4	20.5	756.1	AWL	Discontinuous	M	
20.3	20.3	289.3	AWLC	Continuous	M	
20.3	20.4	311.0	AWLC	Polygon	M	0.94
20.3	20.4	266.6	AWL	Polygon	M, O	0.45
20.2	20.3	549.1	AWC	Discontinuous	M	
20.1	20.2	579.7	AWLC	Polygon	M, O	0.67
20.1	20.1	121.4	AWLC	Polygon	Y, M	0.13
20.1	20.3	1,081.9	W	Discontinuous	M	
20.0	20.1	88.2	AWLC	Continuous	M, O	
19.8	20.1	1,303.6	A	Discontinuous	Y	
19.6	19.8	1,215.5	A	Continuous	Y	
19.6	20.0	2,102.0	AWL	Discontinuous	M, O	
19.4	19.6	1,219.2	AWC	Polygon	M, O	2.27
19.3	19.6	1,405.5	AWC	Polygon	M, O	2.60
19.0	19.4	2,259.3	AWLC	Discontinuous	Y, M	
19.0	19.3	1,277.8	AWLC	Discontinuous	M, O	
18.9	19.4	2,836.4	AWC	Polygon	M, O	2.86
18.7	18.9	1,031.2	AWLC	Polygon	M, O	2.25
18.1	18.7	3,596.2	AWL	Discontinuous	M, O	
18.1	18.8	3,805.8	AWLC	Discontinuous	M	
17.9	18.1	615.6	AWLC	Polygon	M, O	1.48
17.6	17.9	1,958.4	AWLC	Continuous	M, O	
17.6	17.7	371.7	AWC	Polygon	Y, M	0.52
17.5	18.1	3,194.4	AWC	Discontinuous	Y, M	

Appendix L-5 Middle Fork American River - Riparian Community Type, Distribution Patterns, and Age Class Distribution by River Mile (continued).

RM-Start	RM-End	Length (ft)	Community Type	Distribution	Age Class	Area (Acres)
17.1	17.5	1,969.4	AWLC	Discontinuous	Y, M	
17.0	17.4	2,152.7	AWC	Polygon	Y, M	1.52
16.9	17.0	691.2	AWLC	Continuous	Y, M	
16.7	16.9	1,179.0	AWL	Polygon	Y, M, O	1.73
16.7	17.1	1,911.9	AW	Polygon	M, O	2.10
16.6	16.7	860.6	AWLC	Discontinuous	M, O	
16.6	16.7	626.7	W	Continuous	Y, M, O	
16.5	16.7	1,101.9	AWLC	Continuous	Y, M	
16.4	16.5	509.0	AWLC	Polygon	Y, M	0.53
16.3	16.6	1,215.5	AWLC	Polygon	M, O	1.32
16.0	16.3	1,634.2	AWLC	Polygon	Y, M	0.84
16.0	16.3	1,588.8	A	Discontinuous	Y, M	
15.9	16.0	514.8	AWLC	Discontinuous	Y, M	
15.9	16.0	560.7	AWL	Polygon	Y, M	0.87
15.6	15.9	1,697.0	AWLC	Polygon	M, O	0.57
15.5	15.6	699.6	AWLC	Continuous	M	
15.4	15.9	2,605.2	AWL	Discontinuous	M	
15.3	15.4	639.9	AWLC	Continuous	M	
15.2	15.3	70.8	AWLC	Continuous	M	
15.1	15.2	686.4	AWL	Discontinuous	Y, M	
15.1	15.2	507.4	AWLC	Continuous	M	
14.8	14.8	169.0	AW	Polygon	Y, M	0.24
14.8	15.0	1,031.7	AWLC	Polygon	M, O	0.56
14.7	14.8	709.1	AWLC	Continuous	M	
14.5	14.7	1,173.7	AWLC	Polygon	M, O	1.23
14.4	15.1	3,766.8	AWLC	Continuous	M, O	
14.4	14.4	128.3	AW	Polygon	M	0.49
14.4	14.4	321.0	AW	Discontinuous	M	
14.2	14.3	562.8	AWLC	Continuous	M	
13.7	14.2	2,825.9	AWLC	Polygon	M, O	5.06
13.6	14.4	4,112.1	AWLC	Polygon	Y, M, O	5.37
13.2	13.2	15.8	AWC	Polygon	M	0.14
13.2	13.7	2,358.6	AWLC	Continuous	M	
13.2	13.6	1,852.2	AW	Discontinuous	Y, M	
13.1	13.2	754.5	AWL	Continuous	M	
13.1	13.1	216.0	AW	Continuous	Y, M	
13.1	13.2	604.6	AWLC	Polygon	Y, M, O	1.90
13.0	13.1	530.6	W	Polygon	Y, M	1.04
12.7	12.7	278.8	AWL	Polygon	M, O	0.40
12.5	13.1	3,166.9	AWLC	Polygon	Y, M, O	3.03
12.4	12.8	2,031.2	AWL	Continuous	M, O	
12.2	12.5	1,626.8	AWLC	Continuous	Y, M, O	
12.2	12.4	1,225.5	AWLC	Polygon	Y, M, O	3.01
12.1	12.2	518.0	AWL	Polygon	M	0.52
11.7	12.1	2,122.0	AWL	Continuous	M, O	
11.7	12.2	2,491.6	AWLC	Polygon	Y, M, O	2.59

Appendix L-5 Middle Fork American River - Riparian Community Type, Distribution Patterns, and Age Class Distribution by River Mile (continued).

RM-Start	RM-End	Length (ft)	Community Type	Distribution	Age Class	Area (Acres)
11.4	11.5	262.4	AWLC	Continuous	Y, M, O	
11.4	11.7	1,170.6	AWLC	Polygon	Y, M, O	1.46
11.1	11.7	3,284.7	AWLC	Continuous	Y, M, O	
11.1	11.4	2,010.6	AWLC	Polygon	Y, M, O	1.51
11.1	11.1	5.3	W	Polygon	Y, M	0.10
11.0	11.1	223.9	AWC	Polygon	Y, M, O	0.42
10.8	11.1	1,377.0	AWLC	Polygon	Y, M, O	3.30
10.7	11.0	1,508.0	A	Discontinuous	M	
10.6	10.7	455.1	AWL	Continuous	Y, M, O	
10.4	10.6	1,296.2	A	Discontinuous	M	
10.3	10.5	1,147.3	AWLC	Discontinuous	Y, M	
10.3	10.4	349.0	AWLC	Polygon	M	0.34
10.1	10.3	1,020.6	AWC	Continuous	M	
10.1	10.3	834.8	AWC	Continuous	M, O	
9.9	10.1	1,025.9	AWLC	Discontinuous	M, O	
9.2	10.1	4,493.8	AWL	Discontinuous	M, O	
8.8	9.6	4,312.7	W	Discontinuous	M, O	
8.5	9.1	3,509.1	AWLC	Polygon	M, O	2.18
8.5	8.8	1,550.2	AWLC	Continuous	Y, M, O	
8.3	8.4	837.4	AWC	Polygon	M	1.71
8.3	8.5	858.0	AW	Continuous	M, O	
8.2	8.3	684.8	A	Discontinuous	O	
8.1	8.2	750.8	AWC	Polygon	M	1.31
8.0	8.2	880.7	AWC	Polygon	Y, M, O	1.92
7.6	7.8	947.8	AWC	Polygon	M	1.10
7.2	7.6	2,455.7	AWC	Continuous	M	
7.1	8.0	4,872.4	AWLC	Polygon	Y, M, O	7.35
6.8	6.8	142.6	AWL	Polygon	M, O	0.56
6.8	7.1	1,596.1	AWC	Continuous	M, O	
6.8	7.2	1,967.3	AWC	Polygon	M	3.88
6.7	6.8	543.3	AWL	Continuous	M, O	
6.7	6.8	290.9	AWC	Continuous	M	
6.7	6.8	348.5	AWL	Polygon	M, O	0.57
6.6	6.7	722.8	AWC	Discontinuous	M	
6.5	6.7	972.0	AWLC	Polygon	Y, M, O	1.22
6.4	6.4	205.9	AW	Polygon	M	0.29
6.4	6.4	161.0	AW	Polygon	M	0.26
6.4	6.5	169.0	AWL	Polygon	M, O	0.26
6.4	6.5	578.2	AWC	Continuous	M	
6.0	6.4	1,955.2	AWC	Continuous	M	
5.8	6.0	1,228.1	AWLC	Polygon	M	1.37
5.8	6.5	3,588.8	AWL	Continuous	M, O	
5.7	5.8	666.3	AWL	Polygon	M, O	1.68
5.4	5.7	1,965.2	AWL	Polygon	Y, M	1.71
5.2	5.4	988.9	AWL	Discontinuous	Y, M	
5.2	5.7	2,429.9	AWL	Discontinuous	M, O	

Appendix L-5 Middle Fork American River - Riparian Community Type, Distribution Patterns, and Age Class Distribution by River Mile (continued).

RM-Start	RM-End	Length (ft)	Community Type	Distribution	Age Class	Area (Acres)
5.1	5.2	586.6	AWL	Polygon	M, O	4.17
5.0	5.1	570.2	AWL	Continuous	M, O	
4.9	5.2	1,379.1	AWL	Continuous	Y, M	
4.9	5.0	558.1	A	Polygon	Y, M, O	2.31
4.8	4.9	792.0	AWL	Polygon	Y, M	1.30
4.5	4.8	1,538.6	AWL	Continuous	Y, M	
4.4	4.5	443.0	AWL	Polygon	Y, M	0.74
4.4	4.9	2,584.0	A	Continuous	Y, M, O	
4.3	4.4	624.6	W	Continuous	Y, M	
4.3	4.4	616.2	AWL	Continuous	Y, M	
4.3	4.4	456.2	W	Polygon	Y, M	1.34
4.2	4.4	826.8	W	Polygon	Y, M, O	1.84
4.1	4.2	476.8	AWL	Polygon	Y, M	0.59
4.1	4.2	400.2	AWL	Continuous	Y, M	
4.0	4.0	328.4	AWC	Polygon	O	0.32
4.0	4.1	421.3	AWL	Polygon	Y, M	0.53
4.0	4.0	274.0	AWC	Polygon	M, O	0.31
4.0	4.2	969.9	AWL	Continuous	M, O	
3.9	4.0	309.4	AWL	Continuous	Y, M	
3.7	3.7	57.0	W	Continuous	M, O	
3.7	3.7	163.7	AW	Discontinuous	Y, M	
3.7	3.9	1,114.6	AWC	Continuous	M, O	
3.7	3.7	3.7	AW	Polygon	M, O	0.32
3.7	4.0	1,421.9	W	Discontinuous	M, O	
3.5	3.6	458.8	W	Continuous	M, O	
3.4	3.4	47.0	AWC	Polygon	O	0.11
3.4	3.7	1,094.5	W	Continuous	M, O	
3.3	3.7	2,104.1	AWLC	Continuous	M, O	
3.1	3.1	273.5	AWC	Polygon	Y, M	0.46
3.1	3.1	263.5	AWC	Continuous	M, O	
3.1	3.4	1,758.8	AWC	Discontinuous	M, O	
3.1	3.2	332.1	AWC	Polygon	M, O	0.54
3.0	3.1	278.3	AWC	Polygon	Y, M, O	0.23
3.0	3.1	396.0	AWC	Polygon	O	1.07
2.9	3.0	726.0	AWC	Polygon	Y, M, O	1.07
2.7	3.0	1,874.4	AWC	Polygon	O	2.23
2.6	2.7	566.5	AWC	Continuous	M, O	
2.5	2.6	673.2	AW	Polygon	O	0.97
2.5	2.9	1,912.4	AWC	Polygon	Y, M, O	1.81
2.4	2.5	147.8	AW	Polygon	M, O	0.16
2.3	2.5	1,071.8	A	Continuous	M, O	
2.2	2.4	1,003.7	AWLC	Polygon	M, O	1.44
1.9	2.3	2,062.4	AW	Discontinuous	Y, M, O	
1.9	2.3	1,876.0	A	Discontinuous	M	
1.7	1.7	478.4	A	Continuous	M, O	
1.7	1.8	511.1	AWC	Polygon	M, O	1.07

Appendix L-5 Middle Fork American River - Riparian Community Type, Distribution Patterns, and Age Class Distribution by River Mile (continued).

RM-Start	RM-End	Length (ft)	Community Type	Distribution	Age Class	Area (Acres)
1.4	1.8	2,566.6	AWLC	Sparse	Y, M, O	
1.2	1.6	2,252.4	AWC	Continuous	M, O	
0.9	1.2	1,344.8	AWLC	Continuous	Y, M	
0.9	1.4	2,300.5	AWLC	Continuous	Y, M, O	
0.8	0.8	148.4	AWLC	Discontinuous	M, O	
0.8	0.9	207.5	AWL	Polygon	M, O	0.27
0.8	0.9	292.0	AWLC	Continuous	Y, M	
0.7	0.8	185.3	W	Discontinuous	Y	
0.5	0.5	105.6	AWL	Polygon	Y, M	0.18
0.5	0.8	1,626.8	AWLC	Continuous	Y, M	
0.4	0.8	2,410.8	AWC	Continuous	M, O	
0.3	0.3	66.5	W	Polygon	Y, M	0.47
0.3	0.4	86.1	W	Sparse	Y, M	
0.3	0.5	683.2	AWLC	Continuous	Y, M	
0.2	0.2	213.3	AWC	Continuous	Y, M	
0.2	0.2	30.6	AWC	Polygon	M, O	0.17
0.2	0.3	567.1	AWC	Continuous	Y, M	
0.1	0.2	109.3	AWC	Discontinuous	Y, M, O	
0.0	Confluence with North Fork American River					

Appendix L-6 Rubicon River - Riparian Community Type, Distribution Patterns, and Age Class Distribution by River Mile.

RM-Start	RM-End	Length (ft)	Community Type	Distribution	Age Class	Area (Acres)
30.5				Hell Hole Reservoir		
28.9	30.5			Subsurface flow below Hell Hole Reservoir		
28.6	28.9	1,614.1	AWC	Continuous	Y, M	
28.3	28.4	599.3	AWC	Polygon	Y, M	1.19
28.3	28.6	1,506.4	AWC	Continuous	Y, M	
28.2	28.4	1,006.9	AWC	Polygon	Y, M	2.19
28.2	28.2	192.2	AWC	Continuous	Y, M	
28.1	28.9	4,052.9	AWC	Continuous	Y, M	
28.1	28.2	444.0	AWC	Polygon	Y, M	0.46
28.0	28.1	778.3	AWC	Polygon	Y, M	0.88
27.9	28.1	1,039.1	AWC	Continuous	Y, M	
27.7	28.0	1,472.1	AWC	Polygon	Y, M	1.02
27.6	27.7	781.4	AWC	Polygon	Y, M	1.48
27.6	27.7	534.3	AWC	Polygon	Y, M	0.53
27.5	27.5	209.6	AWC	Continuous	Y, M	
27.5	27.6	267.2	AWC	Continuous	Y, M	
27.5	27.6	222.8	AWC	Polygon	Y, M	2.45
27.3	27.5	1,407.1	AWC	Polygon	Y, M	2.94
27.3	27.3	367.0	AWC	Continuous	Y, M	
27.3	27.6	1,725.5	AWC	Continuous	Y, M	
27.3	27.5	910.8	AWC	Polygon	Y, M	2.21
27.2	27.3	317.9	AWC	Continuous	Y, M	
27.2	27.2	18.0	AWC	Polygon	Y, M	0.15
27.1	27.1	76.0	AWC	Polygon	Y, M	0.09
26.9	27.1	1,400.3	AWC	Continuous	Y, M	
26.9	27.2	1,669.5	AWC	Continuous	Y, M	
26.9	27.1	1,269.3	AWC	Continuous	Y, M	
26.8	26.9	835.3	AWC	Polygon	Y, M	1.47
26.7	26.8	292.5	AWC	Discontinuous	Y, M	
26.7	26.8	163.7	AWC	Discontinuous	Y, M	
26.5	26.7	1,151.6	AWC	Continuous	Y, M	
26.3	26.6	1,672.2	AWC	Continuous	Y, M	
26.2	26.3	411.3	AWC	Continuous	Y, M	
26.1	26.2	787.2	AWC	Continuous	Y, M	
25.9	25.9	138.9	AW	Polygon	Y, M	0.17
25.9	26.1	1,057.1	AWC	Continuous	Y, M	
25.9	25.9	5.8	AW	Continuous	Y, M	
25.9	25.9	37.0	AWC	Continuous	Y, M	
25.9	26.1	778.8	AWC	Polygon	Y, M	1.31
25.8	25.9	503.7	AW	Continuous	Y, M	
25.6	25.6	187.4	AW	Continuous	Y, M	
25.6	25.8	923.5	AW	Continuous	Y, M	
25.5	25.9	2,038.6	AW	Continuous	Y, M	
25.3	25.4	877.5	AW	Continuous	Y, M	
25.3	25.3	174.2	AW	Polygon	Y, M	0.24
25.2	25.2	87.1	AW	Continuous	Y, M	
25.2	25.5	1,478.4	AW	Continuous	Y, M	

Appendix L-6 Rubicon River - Riparian Community Type, Distribution Patterns, and Age Class Distribution by River Mile (continued).

RM-Start	RM-End	Length (ft)	Community Type	Distribution	Age Class	Area (Acres)
25.2	25.3	485.2	AW	Discontinuous	Y, M	
25.1	25.4	1,461.0	AW	Polygon	Y, M	2.41
25.0	25.0	266.1	AW	Continuous	Y, M	
25.0	25.2	1,071.8	AW	Continuous	Y, M	
25.0	25.2	964.7	AW	Continuous	Y, M	
24.9	25.0	407.6	AW	Discontinuous	Y, M	
24.9	25.0	587.1	AW	Polygon	Y, M	0.50
24.8	24.9	552.3	AWC	Discontinuous	Y, M	
24.7	24.7	158.4	AWC	Continuous	Y, M	
24.7	24.7	248.7	AWC	Continuous	Y, M	
24.7	24.8	119.9	AWC	Continuous	Y, M	
24.7	24.8	96.6	AWC	Continuous	Y, M	
24.6	24.6	191.7	AWC	Discontinuous	Y, M	
24.6	24.7	356.9	AWC	Polygon	Y, M	0.43
24.5	24.5	219.6	AWC	Discontinuous	Y, M	
24.5	24.5	52.3	AWC	Polygon	Y, M	0.03
24.5	24.5	201.7	AWC	Continuous	Y, M	
24.3	24.3	374.9	AWC	Polygon	Y, M	0.99
24.3	24.4	164.2	AWC	Discontinuous	Y, M	
24.2	24.2	307.8	AWC	Polygon	Y, M	0.35
24.2	24.4	789.9	AWC	Discontinuous	Y, M	
24.2	24.2	23.2	AWC	Discontinuous	Y, M	
24.1	24.2	331.6	AWC	Continuous	Y, M	
24.1	24.2	327.9	AWC	Discontinuous	Y, M	
24.0	24.1	576.0	AWC	Continuous	Y, M	
24.0	24.2	830.5	AWC	Polygon	Y, M	0.87
23.9	23.9	57.0	AWC	Continuous	Y, M	
23.7	23.8	373.3	AWC	Polygon	Y, M	0.32
23.7	23.9	1,090.3	AWC	Continuous	Y, M	
23.6	23.7	134.6	AWC	Polygon	Y, M	0.11
23.5	23.6	694.8	AWC	Discontinuous	Y, M	
23.4	23.4	430.8	AWC	Discontinuous	Y, M	
23.4	23.4	425.0	AWC	Discontinuous	Y, M	
23.4	23.5	167.9	AWC	Polygon	Y, M	0.13
23.3	23.4	142.0	AWC	Polygon	Y, M	0.09
23.2	23.3	561.3	AWC	Discontinuous	Y, M	
23.2	23.3	537.5	AWC	Discontinuous	Y, M	
23.0	23.0	75.0	AW	Continuous	Y, M	
23.0	23.0	181.6	AW	Discontinuous	Y, M	
23.0	23.0	134.1	AW	Continuous	Y, M	
22.9	22.9	24.3	AW	Discontinuous	Y, M	
22.9	23.0	477.3	AW	Continuous	Y, M	
22.8	22.8	0.5	AW	Discontinuous	Y, M	
22.6	22.7	273.5	AW	Continuous	Y, M	
22.6	Confluence with South Fork Rubicon River					
22.5	22.5	19.0	AWC	Continuous	Y, M	
22.5	22.5	194.3	AWC	Continuous	Y, M	

Appendix L-6 Rubicon River - Riparian Community Type, Distribution Patterns, and Age Class Distribution by River Mile (continued).

RM-Start	RM-End	Length (ft)	Community Type	Distribution	Age Class	Area (Acres)
22.4	22.5	419.8	AW	Discontinuous	O	
22.4	22.4	231.3	AW	Discontinuous	O	
22.4	22.5	69.2	AW	Polygon	Y, M	0.07
22.1	22.2	312.6	AW	Discontinuous	Y	
21.8	21.9	246.0	AWC	Continuous	Y, M, O	
21.8	21.9	205.4	AWC	Continuous	Y, M, O	
21.8	21.9	150.0	AWC	Polygon	Y, M, O	0.18
21.7	21.7	152.1	AWC	Polygon	Y, M, O	0.16
21.7	21.9	667.9	AWC	Continuous	Y, M, O	
21.6	21.7	314.2	AWC	Discontinuous	Y, M, O	
21.6	21.7	238.1	AWC	Discontinuous	Y, M, O	
21.1	21.1	135.2	AWC	Continuous	Y, M	
21.1	21.1	262.9	AWC	Discontinuous	Y, M	
21.1	21.6	2,333.8	AWC	Continuous	Y, M	
21.1	21.4	1,268.8	AWC	Continuous	Y, M	
21.1			Forest Service Road 2 Bridge			
21.0	21.1	98.7	AWC	Continuous	Y, M	
20.8	20.8	11.1	AWC	Polygon	Y, M	0.14
20.8	20.9	581.3	AWC	Continuous	Y, M	
20.8	20.9	432.4	AWC	Continuous	Y, M	
20.6	20.8	961.5	AWC	Continuous	Y, M	
20.4	20.6	1,108.8	AWC	Discontinuous	Y, M	
20.2	20.2	517.4	AWC	Continuous	Y, M	
20.2	20.4	794.1	AWC	Continuous	Y, M	
20.2	20.3	51.7	AWC	Continuous	Y, M	
20.0	20.0	149.4	AWC	Polygon	Y, M	0.48
20.0	20.0	279.8	AWC	Continuous	Y, M	
20.0	20.0	148.4	AWC	Polygon	Y, M	0.16
20.0	20.2	826.8	AWC	Discontinuous	Y, M	
20.0	20.1	176.9	AWC	Discontinuous	Y, M	
19.8	19.9	464.6	AWC	Discontinuous	Y, M	
19.8	19.9	519.0	AWC	Continuous	Y, M	
19.8	19.9	249.2	AWC	Polygon	Y, M	0.55
19.7	19.8	774.0	AWC	Discontinuous	Y, M	
19.3	19.3	193.8	AWC	Discontinuous	Y, M	
19.3	19.7	1,950.4	AWC	Continuous	Y, M	
19.2	19.3	155.8	AWC	Continuous	Y, M, O	
19.0	19.2	825.8	AWC	Discontinuous	Y, M	
19.0	19.2	991.6	AWC	Discontinuous	Y, M	
18.9	18.9	192.7	AWC	Polygon	Y, M, O	0.03
18.9	18.9	292.0	AWC	Polygon	Y, M, O	0.71
18.9	19.0	189.6	AWC	Discontinuous	Y, M, O	
18.8	18.8	217.5	AWC	Discontinuous	Y, M, O	
18.8	18.9	399.2	AWC	Discontinuous	Y, M, O	
18.8	18.9	134.6	AWC	Polygon	Y, M, O	0.02
18.7	18.8	236.5	AWC	Continuous	Y, M, O	
18.5	18.5	457.8	AWC	Continuous	Y, M, O	

Appendix L-6 Rubicon River - Riparian Community Type, Distribution Patterns, and Age Class Distribution by River Mile (continued).

RM-Start	RM-End	Length (ft)	Community Type	Distribution	Age Class	Area (Acres)
18.5	18.7	1,069.7	AWC	Discontinuous	Y, M, O	
18.4	18.4	1.6	AWC	Continuous	Y, M, O	
18.4	18.4	60.7	AWC	Continuous	Y, M, O	
18.4	18.4	41.7	AWC	Discontinuous	Y, M, O	
18.4	18.4	39.1	AWC	Discontinuous	Y, M, O	
18.1	18.4	1,712.3	AWC	Continuous	Y, M, O	
18.1	18.1	136.8	AWC	Polygon	Y, M, O	0.28
18.1	18.4	1,678.5	AWC	Continuous	Y, M, O	
18.0	18.1	145.2	AWC	Continuous	Y, M, O	
17.9	18.1	1,093.0	AWC	Discontinuous	Y, M, O	
17.9	18.0	902.9	AWC	Discontinuous	Y, M, O	
17.8	17.8	221.8	AWC	Discontinuous	Y, M, O	
17.8	17.8	271.9	AWC	Discontinuous	Y, M, O	
17.3	17.4	551.2	AWC	Continuous	Y, M, O	
17.1	17.1	112.5	AWC	Discontinuous	Y, M, O	
17.0	17.1	350.1	AWC	Discontinuous	Y, M, O	
16.9	17.0	169.5	AW	Continuous	Y, M	
16.8	16.9	532.8	AW	Continuous	Y, M	
16.7	16.9	892.8	AW	Continuous	Y, M	
16.2	16.6	2,051.8	AW	Discontinuous	Y, M	
16.2	16.3	173.7	AW	Discontinuous	Y, M	
16.1	16.2	365.9	AW	Continuous	Y, M	
16.0	16.0	41.7	AW	Polygon	Y, M	0.04
16.0	16.1	732.3	AW	Discontinuous	Y, M	
16.0	16.2	788.8	AW	Discontinuous	Y, M	
15.9	15.9	169.0	AW	Continuous	Y, M	
15.9	15.9	154.7	AW	Continuous	Y, M	
15.9	15.9	22.2	AW	Continuous	Y, M	
15.9	15.9	65.5	AW	Continuous	Y, M	
15.8	15.8	463.6	AW	Continuous	Y, M	
15.7	15.7	153.6	AW	Discontinuous	Y, M	
15.5	15.7	1,049.1	AW	Continuous	Y, M	
15.3	15.4	426.1	AW	Discontinuous	Y, M	
15.1	15.1	108.8	AW	Discontinuous	Y, M	
15.1	15.1	1.1	AW	Continuous	Y, M	
14.9	15.1	1,024.3	AW	Polygon	Y, M	0.28
14.7	14.7	258.2	AW	Continuous	Y, M	
14.7	14.7	128.3	AW	Discontinuous	Y, M	
14.6	14.6	165.8	AWC	Polygon	Y, M	0.39
14.6	14.6	1.6	AWC	Continuous	Y, M	
14.6	14.6	7.4	AWC	Continuous	Y, M	
14.6	14.6	139.4	AWC	Continuous	Y, M	
14.6	14.6	163.2	AWC	Continuous	Y, M	
14.6	14.6	117.7	AWC	Continuous	Y, M	
14.6	14.6	146.3	AWC	Continuous	Y, M	
14.6	14.6	141.0	AWC	Continuous	Y, M	
14.6	14.7	248.2	AWC	Continuous	Y, M	

Appendix L-6 Rubicon River - Riparian Community Type, Distribution Patterns, and Age Class Distribution by River Mile (continued).

RM-Start	RM-End	Length (ft)	Community Type	Distribution	Age Class	Area (Acres)
14.3	14.3	364.3	AWC	Continuous	Y, M	
14.3	14.3	306.8	AWC	Continuous	Y, M	
14.2	14.2	431.9	AWC	Continuous	Y, M	
14.2	14.2	155.8	AWC	Continuous	Y, M	
14.2	14.3	183.7	AWC	Continuous	Y, M	
14.2	14.3	169.5	AWC	Discontinuous	Y, M	
14.1	14.2	256.1	AWC	Discontinuous	Y, M	
14.1	14.2	449.3	AWC	Discontinuous	Y, M	
14.0	14.1	590.3	AWC	Continuous	Y, M	
13.9	13.9	371.2	AWC	Continuous	Y, M	
13.8	13.9	382.8	AWC	Continuous	Y, M	
13.7	13.8	311.5	AWC	Continuous	Y, M	
13.6	13.6	185.9	AWC	Discontinuous	Y, M	
13.6	13.6	96.1	AWC	Continuous	Y, M	
13.6	13.7	385.4	AWC	Continuous	Y, M	
13.5	13.6	359.0	AWC	Continuous	Y, M	
13.3	13.3	231.3	AWC	Discontinuous	Y, M	
13.3	13.3	190.6	AWC	Discontinuous	Y, M	
13.3	13.5	1,169.5	AWC	Continuous	Y, M	
13.3	13.5	1,200.7	AWC	Discontinuous	Y, M	
13.2	13.2	116.7	AWC	Continuous	Y, M	
13.2	13.3	303.6	AWC	Polygon	Y, M	0.27
13.1	13.1	52.8	AWC	Discontinuous	Y, M	
13.1	13.1	212.8	AWC	Continuous	Y, M	
13.1	13.1	47.5	AWC	Continuous	Y, M	
12.9	12.9	289.9	AWC	Continuous	Y, M	
12.9	13.1	644.2	AWC	Discontinuous	Y, M	
12.8	12.8	60.7	AWC	Continuous	Y, M	
12.8	12.9	376.5	AWC	Continuous	Y, M	
12.7	12.8	190.6	AWC	Continuous	Y, M	
12.7	12.8	42.8	AWC	Discontinuous	Y, M	
12.6	12.6	45.4	AWC	Discontinuous	Y, M	
12.6	12.6	341.1	AWC	Continuous	Y, M	
12.6	12.7	361.2	AWC	Discontinuous	Y, M	
12.6	12.7	279.3	AWC	Discontinuous	Y, M	
12.5	12.5	122.5	AWC	Discontinuous	Y, M	
12.5	12.6	338.4	AWC	Discontinuous	Y, M	
12.3	12.5	1,282.5	AWC	Continuous	Y, M	
12.2	12.2	60.2	AWC	Continuous	Y, M	
12.2	12.2	61.2	AWC	Discontinuous	Y, M	
12.2	12.2	262.4	AWC	Discontinuous	Y, M	
12.2	12.2	192.2	AWC	Discontinuous	Y, M	
12.2	12.3	293.6	AWC	Discontinuous	Y, M	
12.2	12.3	492.1	AWC	Continuous	Y, M	
12.1	12.1	62.3	AWC	Continuous	Y, M	
12.0	12.1	542.8	AWC	Continuous	Y, M	
11.9	11.9	80.8	AWC	Continuous	Y, M	

Appendix L-6 Rubicon River - Riparian Community Type, Distribution Patterns, and Age Class Distribution by River Mile (continued).

RM-Start	RM-End	Length (ft)	Community Type	Distribution	Age Class	Area (Acres)
11.9	11.9	58.1	AWC	Continuous	Y, M	
11.9	11.9	63.9	AWC	Polygon	Y, M	0.18
11.9	12.0	226.5	AWC	Continuous	Y, M	
11.9	12.0	446.7	AWC	Continuous	Y, M	
11.7	11.9	1,089.3	AWC	Continuous	Y, M	
11.7	11.9	984.7	AWC	Continuous	Y, M	
11.5	11.7	1,320.0	AWC	Continuous	Y, M	
11.5	11.7	1,323.2	AWC	Continuous	Y, M	
11.3	11.3	172.1	AWC	Continuous	Y, M	
11.3	11.3	234.4	AWC	Polygon	Y, M	0.57
11.3	11.3	84.0	AWC	Polygon	Y, M	0.10
11.3	11.3	122.0	AWC	Polygon	Y, M	0.08
11.3	11.3	79.7	AWC	Polygon	Y, M	0.05
11.2	11.2	113.5	AWC	Discontinuous	Y, M	
11.2	11.2	145.2	AWC	Discontinuous	Y, M	
11.2	11.3	262.4	AWC	Discontinuous	Y, M	
11.1	11.2	346.9	AWC	Discontinuous	Y, M	
11.1	11.1	162.1	AWC	Discontinuous	Y, M	
11.0	11.1	586.6	AWC	Continuous	Y, M	
11.0	11.1	437.2	AWC	Discontinuous	Y, M	
10.9	10.9	225.5	AWC	Continuous	Y, M	
10.9	11.0	327.9	AWC	Continuous	Y, M	
10.8	10.9	505.3	AWC	Continuous	Y, M	
10.6	10.7	824.2	AWC	Discontinuous	Y, M	
10.5	10.7	786.2	AWC	Discontinuous	Y, M	
10.3	10.5	1,123.6	AWC	Discontinuous	Y, M	
10.2	10.2	66.0	AWC	Continuous	Y, M	
10.2	10.2	184.3	AWC	Discontinuous	Y, M	
10.2	10.3	427.2	AWC	Continuous	Y, M	
10.2	10.5	1,594.6	AWC	Discontinuous	Y, M	
10.1	10.2	486.8	AWC	Continuous	Y, M	
10.1	10.2	335.3	AWC	Discontinuous	Y, M	
10.0	10.1	594.5	AWC	Polygon	Y, M	0.26
10.0	10.1	711.7	AWC	Polygon	Y, M	0.40
9.9	9.9	99.8	AW	Discontinuous	M	
9.9	10.0	436.7	AW	Continuous	M	
9.9	9.9	240.8	AW	Continuous	M	
9.8	9.9	200.6	AW	Discontinuous	M	
9.7	9.8	562.3	AW	Continuous	M	
9.7	9.8	483.1	AW	Discontinuous	M	
9.6	9.7	740.8	AW	Continuous	M	
9.5	9.6	105.1	AW	Continuous	M	
9.4	9.6	706.5	AW	Continuous	M	
9.2	9.2	295.7	AW	Continuous	M	
9.2	9.2	251.3	AW	Discontinuous	M	
9.2	9.4	1,091.9	AW	Discontinuous	M	
9.0	9.0	138.3	AW	Discontinuous	M	

Appendix L-6 Rubicon River - Riparian Community Type, Distribution Patterns, and Age Class Distribution by River Mile (continued).

RM-Start	RM-End	Length (ft)	Community Type	Distribution	Age Class	Area (Acres)
9.0	9.0	177.4	AW	Continuous	M	
9.0	9.0	77.6	AW	Continuous	M	
9.0	9.0	74.4	AW	Polygon	M	0.25
9.0	9.0	208.0	AW	Discontinuous	M	
8.9	8.9	377.0	AW	Polygon	M	0.64
8.9	8.9	264.5	AW	Continuous	M	
8.9	8.9	124.1	AW	Continuous	M	
8.9	9.0	218.1	AW	Discontinuous	M	
8.9	9.0	125.7	AW	Discontinuous	M	
8.8	8.8	126.7	AW	Discontinuous	M	
8.8	8.9	457.8	AW	Continuous	M	
8.6	8.6	296.7	AW	Discontinuous	M	
8.6	8.6	164.7	AW	Discontinuous	M	
8.6	8.7	344.3	AW	Continuous	M	
8.5	8.5	95.0	AW	Discontinuous	M	
8.5	8.5	49.6	AW	Continuous	M	
8.5	8.6	455.7	AW	Continuous	M	
8.5	8.6	294.1	AW	Continuous	M	
8.3	8.3	136.8	AW	Discontinuous	M	
8.3	8.3	138.3	AW	Discontinuous	M	
8.3	8.5	922.9	AW	Polygon	M	0.22
8.3	8.5	707.5	AW	Continuous	M	
8.2	8.2	81.3	AW	Polygon	M	0.16
8.2	8.2	133.1	AW	Continuous	M	
8.2	8.3	206.4	AW	Continuous	M	
8.1	8.1	38.5	AW	Polygon	M	0.12
8.1	8.1	78.7	AW	Discontinuous	M	
8.1	8.2	646.8	AW	Polygon	M	0.53
8.1	8.2	396.5	AW	Polygon	M	0.33
8.1	8.2	239.2	AW	Polygon	M	0.20
7.9	7.9	241.3	AW	Continuous	M	
7.9	8.1	1,216.5	AW	Polygon	M	0.81
7.8	7.8	84.0	AW	Polygon	M	0.27
7.8	7.8	46.5	AW	Continuous	M	
7.8	7.9	106.1	AW	Continuous	M	
7.8	7.8	10.6	AW	Discontinuous	M	
7.8	7.9	82.9	AW	Polygon	M	0.33
7.8	7.8	45.9	AW	Discontinuous	M	
7.7	7.7	92.9	AW	Polygon	M	0.08
7.7	7.8	567.6	AW	Continuous	M	
7.5	7.5	122.0	AW	Polygon	M	0.22
7.5	7.6	312.0	AW	Polygon	M	0.40
7.5	7.8	1,306.3	AW	Continuous	M	
7.5	7.6	238.7	AW	Continuous	M	
7.3	7.3	53.9	AW	Polygon	M	0.10
7.2	7.6	1,976.3	AW	Continuous	M	
7.1	7.5	2,575.6	AW	Continuous	M	

Appendix L-6 Rubicon River - Riparian Community Type, Distribution Patterns, and Age Class Distribution by River Mile (continued).

RM-Start	RM-End	Length (ft)	Community Type	Distribution	Age Class	Area (Acres)
7.1	7.2	480.5	AW	Continuous	M	
7.0	7.1	333.2	AW	Polygon	M	0.43
6.9	7.0	182.2	AW	Continuous	M, O	
6.8	6.9	869.1	AWC	Polygon	M, O	0.59
6.8	7.0	1,428.8	AW	Continuous	M, O	
6.7	6.7	256.6	AWC	Polygon	M, O	0.36
6.7	6.8	239.7	AW	Continuous	M, O	
6.5	6.7	1,306.8	AW	Continuous	M, O	
6.5	6.6	571.3	AW	Continuous	M, O	
6.4	6.4	90.8	AWC	Polygon	M, O	0.55
6.4	6.5	245.5	AW	Continuous	M, O	
6.4	6.5	177.9	AW	Continuous	M, O	
6.2	6.2	44.4	AWC	Polygon	M, O	0.04
6.2	6.2	5.8	AW	Continuous	M, O	
6.2	6.3	279.8	AWC	Discontinuous	Y, M, O	
6.2	6.4	1,114.1	AW	Continuous	M, O	
6.0	6.0	123.6	AWC	Discontinuous	Y, M, O	
6.0	6.2	962.0	AWC	Discontinuous	Y, M, O	
6.0	6.2	731.8	AWC	Discontinuous	Y, M, O	
5.9	5.9	161.6	AWC	Continuous	M, O	
5.8	5.9	191.7	AWC	Polygon	M, O	0.21
5.7	5.8	382.3	AWC	Polygon	M, O	0.54
5.7	5.8	288.3	AWC	Continuous	M, O	
5.7	5.8	354.3	AWC	Continuous	M, O	
5.6	5.7	874.4	AWC	Continuous	M, O	
5.5	5.5	64.4	AWC	Polygon	Y, M, O	0.11
5.5	5.7	1,279.3	AWC	Continuous	M, O	
5.5	5.5	158.4	AWC	Continuous	Y, M, O	
5.5	5.5	65.5	AWC	Discontinuous	Y, M, O	
5.5	5.5	61.8	AWC	Continuous	Y, M, O	
5.3	5.5	1,256.6	AWC	Continuous	Y, M, O	
5.2	5.6	2,084.0	AWC	Continuous	Y, M, O	
5.2	5.3	513.7	AWC	Continuous	Y, M, O	
5.1	5.1	199.6	AWC	Continuous	Y, M, O	
5.1	5.1	151.0	AWC	Continuous	Y, M, O	
5.1	5.2	349.0	AWC	Continuous	Y, M, O	
5.0	5.0	166.8	AWC	Continuous	Y, M, O	
5.0	5.0	37.5	AWC	Continuous	Y, M, O	
4.9	5.1	620.4	AWC	Continuous	Y, M, O	
4.8	4.8	182.7	AWC	Continuous	Y, M	
4.8	4.9	78.1	AWC	Continuous	Y, M	
4.7	4.7	106.7	AWC	Continuous	Y, M	
4.7	4.7	157.9	AWC	Discontinuous	Y, M	
4.7	4.7	258.7	AWC	Continuous	Y, M	
4.5	4.6	233.9	AWC	Discontinuous	Y	
4.5	4.6	206.4	AWC	Discontinuous	Y	
4.3	4.3	227.6	AWC	Continuous	Y, M, O	

Appendix L-6 Rubicon River - Riparian Community Type, Distribution Patterns, and Age Class Distribution by River Mile (continued).

RM-Start	RM-End	Length (ft)	Community Type	Distribution	Age Class	Area (Acres)
4.2	4.2	150.5	AWC	Continuous	Y, M, O	
4.2	4.2	96.6	AWC	Continuous	Y, M, O	
4.1	4.1	327.4	AWC	Continuous	Y, M, O	
4.1	4.2	317.9	AWC	Continuous	Y, M, O	
3.9	3.9	57.6	AWC	Discontinuous	Y, M	
3.9	3.9	33.8	AWC	Discontinuous	Y, M	
3.9	3.9	78.7	AWC	Discontinuous	Y, M	
3.9	4.1	964.7	AWC	Discontinuous	Y, M, O	
3.9	4.1	924.0	AWC	Discontinuous	Y, M, O	
3.7	3.9	1,101.9	AWC	Polygon	Y, M, O	0.15
3.7	3.9	732.3	AWC	Continuous	Y, M, O	
3.6			Confluence with Long Canyon Creek			
3.5	3.5	135.7	AWC	Polygon	Y, M, O	0.13
3.4	3.5	295.7	AWC	Continuous	Y, M, O	
3.3	3.3	303.1	AWC	Continuous	Y, M, O	
3.3	3.9	3,130.0	AWC	Continuous	Y, M	
3.3	3.4	109.3	AWC	Polygon	Y, M, O	0.07
3.2	3.2	199.1	AWC	Polygon	Y, M, O	0.35
3.2	3.2	67.6	AWC	Polygon	Y, M, O	0.07
3.2	3.3	352.2	AWC	Discontinuous	Y, M, O	
3.1	3.2	780.9	AWC	Continuous	Y, M, O	
3.1	3.1	160.0	AWC	Continuous	Y, M, O	
3.0	3.1	440.9	AWC	Continuous	Y, M, O	
2.9	3.0	591.9	AWC	Continuous	Y, M, O	
2.9	3.0	247.6	AWC	Polygon	Y, M, O	0.18
2.8	2.9	304.1	AWC	Continuous	Y, M, O	
2.8	3.0	884.4	AWC	Continuous	Y, M, O	
2.7	2.8	473.6	AWC	Continuous	Y, M, O	
2.6	2.8	1,192.2	AWC	Continuous	Y, M, O	
2.5	2.5	49.6	AWC	Continuous	Y, M, O	
2.5	2.5	23.2	AWC	Continuous	Y, M, O	
2.5	2.5	96.6	AWC	Polygon	Y, M, O	0.08
2.5	2.6	449.3	AWC	Continuous	Y, M, O	
2.5	2.6	583.4	AWC	Continuous	Y, M, O	
2.4	2.4	223.3	AWC	Polygon	Y, M, O	0.20
2.4	2.5	45.4	AWC	Continuous	Y, M, O	
2.3	2.4	531.2	AWC	Continuous	Y, M, O	
2.3	2.4	199.6	AWC	Discontinuous	Y, M, O	
2.2	2.3	619.9	AWC	Continuous	Y, M, O	
2.1	2.2	403.9	AWC	Continuous	Y, M, O	
2.1	2.2	69.7	AWC	Discontinuous	Y, M, O	
2.0	2.0	41.7	AWC	Continuous	Y, M, O	
2.0	2.1	645.7	AWC	Continuous	Y, M, O	
2.0	2.1	390.2	AWC	Polygon	Y, M, O	0.37
1.9	2.0	870.7	AWC	Continuous	Y, M, O	
1.9	2.0	399.2	AWC	Continuous	Y, M, O	
1.8	1.9	481.5	AWC	Continuous	Y, M, O	

Appendix L-6 Rubicon River - Riparian Community Type, Distribution Patterns, and Age Class Distribution by River Mile (continued).

RM-Start	RM-End	Length (ft)	Community Type	Distribution	Age Class	Area (Acres)
1.8	1.9	172.1	AWC	Polygon	Y, M, O	0.13
1.8	1.9	468.9	AWC	Polygon	Y, M, O	0.33
1.7	1.7	228.1	AWC	Continuous	Y, M, O	
1.6	1.6	88.7	AWC	Discontinuous	M, O	
1.6	1.7	551.8	AWC	Continuous	Y, M, O	
1.5	1.5	349.0	AWC	Polygon	Y, M, O	0.45
1.5	1.6	311.0	AWC	Continuous	Y, M, O	
1.4	1.5	930.3	AWC	Continuous	M, O	
1.4	1.5	361.7	AWC	Continuous	Y, M, O	
1.3	1.3	170.0	AWC	Continuous	M, O	
1.2	1.2	71.8	AWC	Discontinuous	M, O	
1.2	1.4	603.5	AWC	Continuous	Y, M, O	
1.2	1.3	237.1	AWC	Polygon	Y, M, O	0.11
1.1	1.1	172.1	AWC	Continuous	M, O	
1.1	1.1	224.4	AWC	Discontinuous	M, O	
1.1	1.2	375.4	AWC	Continuous	M, O	
1.1	1.2	366.4	AWC	Continuous	M, O	
1.0	1.1	510.0	AWC	Polygon	Y, M, O	0.56
1.0	1.1	562.8	AWC	Continuous	M, O	
0.9	0.9	287.8	AWC	Continuous	M, O	
0.9	1.0	354.8	AWC	Continuous	M, O	
0.9	1.0	239.2	AWC	Polygon	Y, M, O	0.22
0.8	0.8	289.3	AWC	Continuous	M, O	
0.8	0.8	183.2	AWC	Discontinuous	M, O	
0.8	0.9	97.2	AWC	Polygon	Y, M, O	0.11
0.4	0.4	81.8	AWC	Continuous	Y, M, O	
0.0	Confluence with Ralston Afterbay					

APPENDIX M

Riparian Communities on Middle Fork Project Streams

Classification System

The plant communities found along the study streams are presented in the following section. The dominant plant species observed in each plant community is discussed in term of specific species requirements including hydrology (relative degree of inundation), substrate (soil texture), and life history strategies (including timing of seed release, seed viability, and vegetative reproduction) are discussed.

Alder Dominant (A)

Vegetation: White alders are the dominant species in this community. Associated riparian species may include 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 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 Dominant (W)

Vegetation: Willows are the dominant species in this community. A mixed variety of willow species are present 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 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).

Substrate: 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 (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).

Life History Strategies: Shining willow reproduces primarily through seeds, but can reproduce vegetatively. Seeds disperse 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 also 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 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).

Alder-Willow Co-Dominant (AW)

Vegetation: the relative proportion of white alder and willows is approximately equal in this community. American dogwood may also be present.

Elevation range, hydrology, substrate, and life history strategies for white alder and willow are discussed in sections above.

Alder-Willow-Cottonwood (AWC)

Vegetation: This community is similar to the Alder-Willow community, with the addition of black cottonwood or Fremont cottonwood (*Populus balsamifera* ssp. t*richocarpa* and/or *Populus fremontii* ssp*. fremontii*), depending on the elevation, to the community. American dogwood may also be present. Elevation range, hydrology, substrate, and life history strategies for white alder and willow are discussed in sections above. Both cottonwood species as discussed below

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 streamflow 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.

Alder-Willow-Black Locust (AWL)

Vegetation: This community is similar to the AW Co-Dominant community, with the addition of the invasive and non-native plant species, black locust *(Robinia pseudoacacia*), to the community. American dogwood may also be present. Elevation range, hydrology, substrate, and life history strategies for white alder and willow are discussed in sections above.

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 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).

Alder-Willow-Black Locust-Cottonwood (AWLC)

Vegetation: This community is similar to the Alder-Willow community, with the addition of cottonwood (either black cottonwood or Fremont cottonwood) and the invasive and non-native plant species, black locust, to the community. American dogwood may also be present.

Elevation range, hydrology, substrate, and life history strategies for dominant species of this community are discussed in sections above.

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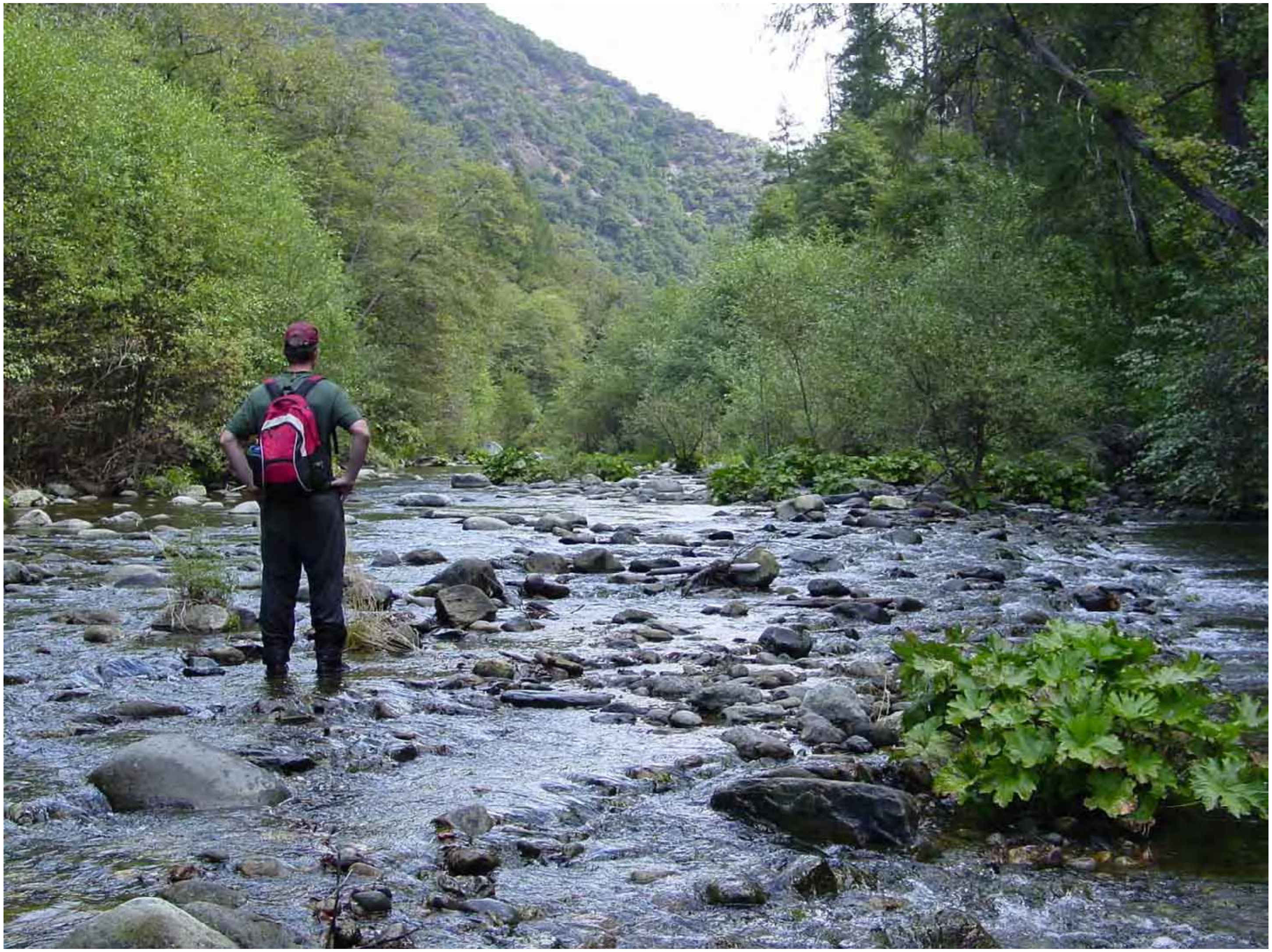
APPENDIX N

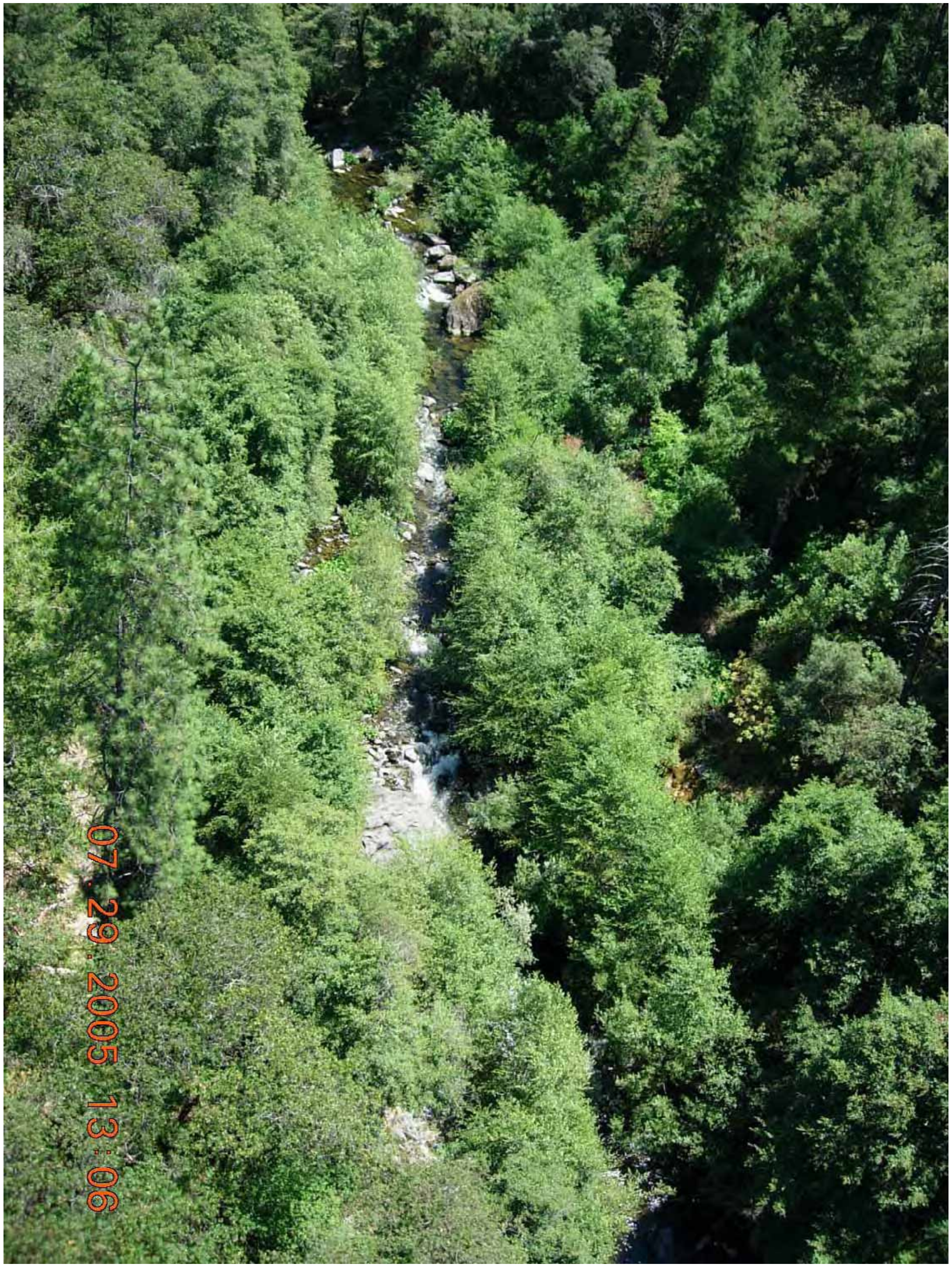
Featured Riparian Sites from Interactive GIS CD

Middle Fork American River

River Mile 27.85

View of Middle Fork American River looking upstream, showing a willow dominated narrow riparian corridor.





Middle Fork American River

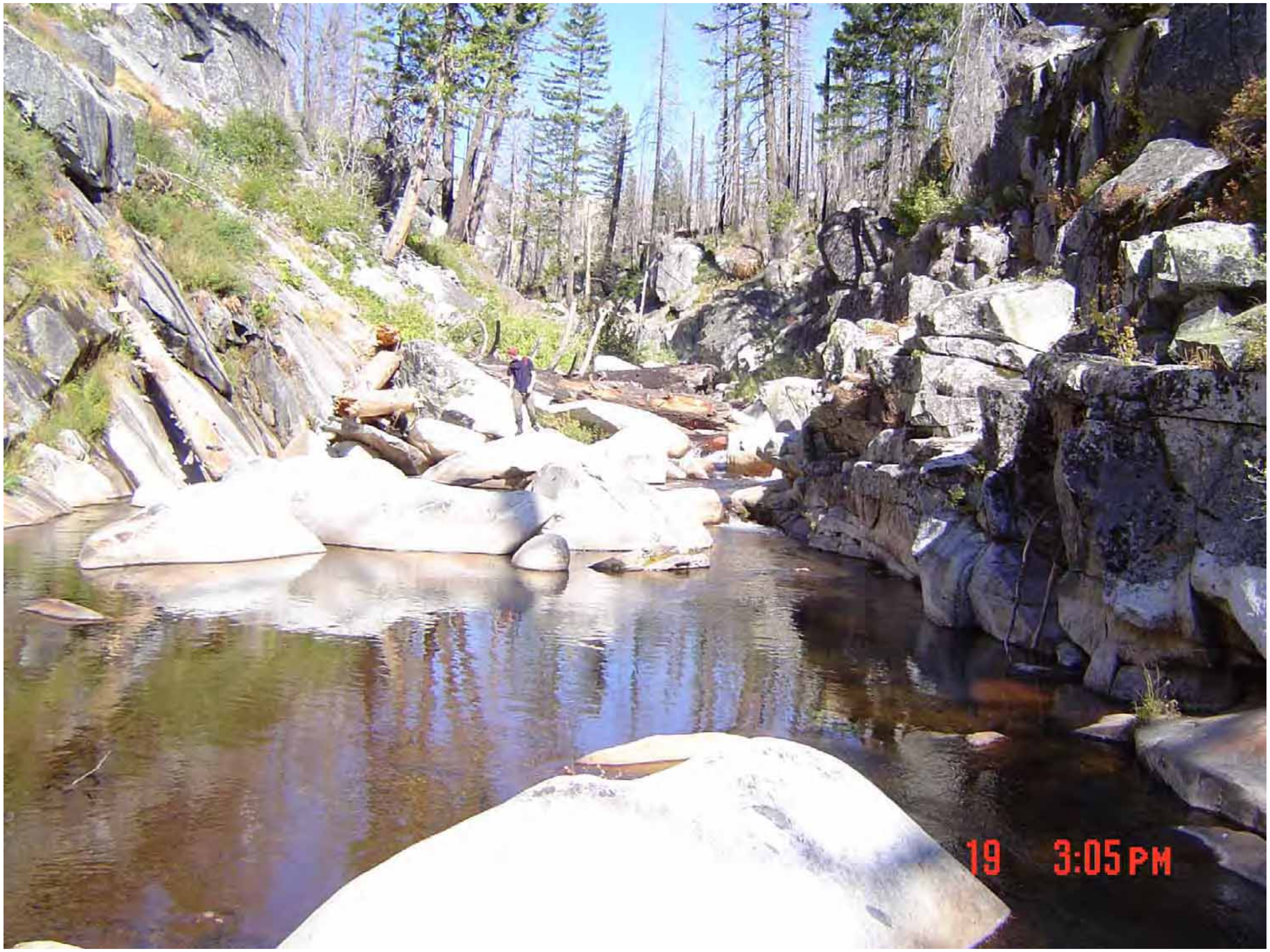
River Mile 29

Middle Fork American River as viewed from helicopter, showing a wide alder-willow-cottonwood riparian corridor.

Middle Fork American River

River Mile 46.9

Middle Fork American River looking upstream, showing sparse coverage of alder-willow-cottonwood community in a bedrock-boulder dominated reach.



Duncan Creek

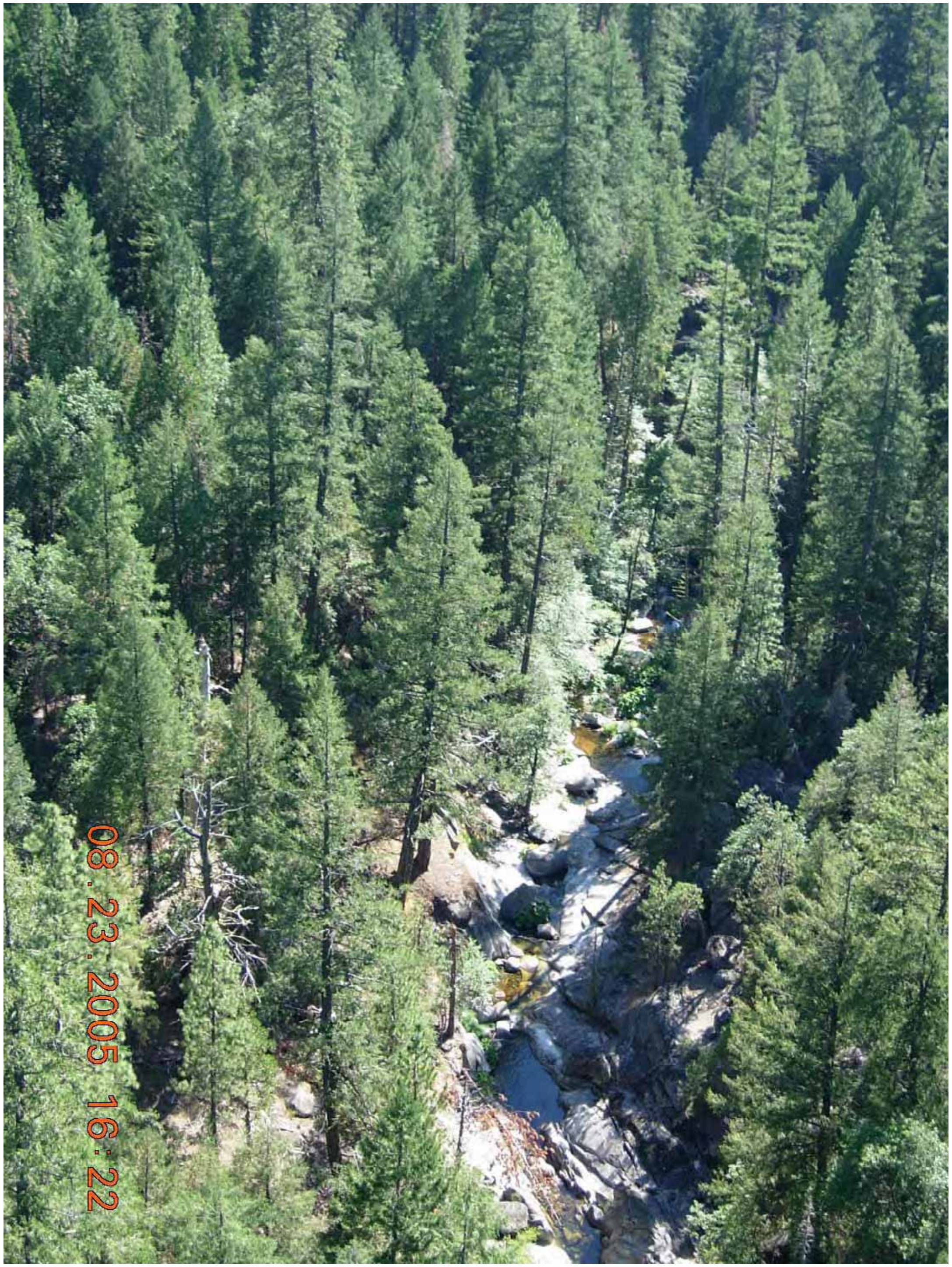
River Mile 2.3

Duncan Creek as viewed from helicopter, showing sparse alders and willows.

Long Canyon

River Mile 9.7

Long Canyon looking upstream showing a narrow alder dominated riparian corridor.



South Fork Long Canyon

River Mile 0.85

South Fork Long Canyon as viewed from helicopter, showing sparse alder-willow-cottonwood community in a bedrock-boulder dominated reach.

APPENDIX O

Photographs of Alder Leaf Damage, Rubicon River

Appendix O: Photographs of Alder Leaf Damage, Rubicon River.

Alder Leaf Beetles on White Alder Leaves

Damage to Alder Leaves on Rubicon River

Appendix O: Photographs of Alder Leaf Damage, Rubicon River (continued).

View of Alder Leaf Damage from Insects on Rubicon River during Field Surveys

Appendix O: Photographs of Alder Leaf Damage, Rubicon River (continued).

View of Alder Leaf Damage from Insects on Rubicon River from the Helicopter

APPENDIX P

Initial Habitat Results for the

Middle Fork American River and the Rubicon River

Appendix P Table P1 Middle Fork American River Initial Habitat Results

Habitat Unit No.	RM	Rosgen Level I Channel Type	Hawkins Habitat Type	Modified R5 Habitat Type	Hab. Length (ft)
1	0.00	F	SP	MCP	251
2	0.05	F	NT	RUN	261
3	0.09	F	T	RIF	132
4	0.12	F	SP	MCP	183
5	0.16	F	T	CAS	64
6	0.17	F	SP	MCP	124
7	0.18	F	T	CAS	58
8	0.20	F	NT	RUN	92
9	0.23	F	NT	RUN	196
10	0.23	F	SP	LSP	229
11	0.25	F	NT	RUN	338
12	0.32	F	SP	LSP	157
13	0.35	F	NT	RUN	156
14	0.37	F	T	RIF	63
15	0.38	F	NT	RUN	94
16	0.39	F	SP	MCP	1537
17	0.68	F	NT	RUN	177
18	0.68	F	T	RIF	82

Habitat Unit No.	*RM*	*Rosgen Level I Channel Type*	*Hawkins Habitat Type*	*Modified R5 Habitat Type*	*Hab. Length (ft)*
19	0.70	F	SP	LSP	120
20	0.71	F	NT	RUN	186
21	0.71	F	T	RIF	167
22	0.73	F	SP	MCP	406
23	0.81	F	NT	RUN	82
24	0.83	F	SP	MCP	286
25	0.88	F	T	RIF	66
26	0.89	F	SP	MCP	444
27	0.97	F	NT	RUN	163
28	1.00	F	SP	LSP	911
29	1.17	F	NT	RUN	127
30	1.19	F	SP	MCP	174
31	1.23	F	T	RIF	37
32	1.24	F	NT	RUN	47
33	1.25	F	SP	LSP	413
34	1.31	F	SP	LSP	197
35	1.36	F	NT	RUN	52
36	1.37	F	SP	MCP	262
37	1.42	F	T	RIF	76
38	1.43	F	SP	MCP	586
39	1.54	F	T	CAS	70

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Habitat Unit No.	*RM*	*Rosgen Level I Channel Type*	*Hawkins Habitat Type*	*Modified R5 Habitat Type*	*Hab. Length (ft)*
40	1.55	F	SP	MCP	271
41	1.59	F	T	RIF	74
42	1.60	F	NT	RUN	152
43	1.63	F	T	RIF	184
44	1.66	F	SP	MCP	452
45	1.66	F	SP	MCP	457
46	1.74	F	NT	RUN	256
47	1.78	F	SP	MCP	327
48	1.85	F	NT	POW	99
49	1.87	F	SP	MCP	253
50	1.91	F	DP	SPO	441
51	1.99	F	T	CAS	63
52	2.00	F	NT	TCH	115
53	2.02	F	T	RIF	238
54	2.06	F	SP	MCP	169
55	2.10	F	T	CAS	45
56	2.11	F	SP	MCP	81
57	2.13	F	T	CAS	36
58	2.14	F	T	RIF	365
59	2.20	F	SP	LSP	351
60	2.27	F	T	RIF	160

Habitat Unit No.	RM	Rosgen Level I Channel Type	Hawkins Habitat Type	Modified R5 Habitat Type	Hab. Length (ft)
61	2.29	F	NT	RUN	120
62	2.31	F	SP	MCP	498
63	2.40	F	NT	RUN	200
64	2.42	F	T	RIF	75
65	2.44	F	SP	MCP	365
66	2.51	F	NT	RUN	167
67	2.53	F	SP	MCP	295
68	2.56	F	NT	RUN	196
69	2.60	F	T	RIF	199
70	2.64	F	SP	MCP	473
71	2.74	F	T	RIF	62
72	2.75	F	NT	RUN	233
73	2.80	F	SP	MCP	353
74	2.86	F	NT	RUN	152
75	2.88	F	T	RIF	104
76	2.90	F	SP	MCP	1061
77	3.11	F	NT	RUN	190
78	3.14	F	SP	LSP	228
79	3.16	F	NT	RUN	163
80	3.19	F	SP	MCP	469
81	3.29	F	NT	RUN	86

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Habitat Unit No.	*RM*	*Rosgen Level I Channel Type*	*Hawkins Habitat Type*	*Modified R5 Habitat Type*	*Hab. Length (ft)*
82	3.30	F	SP	MCP	304
83	3.30	F	SP	MCP	319
84	3.39	F	SP	MCP	362
85	3.42	F	T	RIF	101
86	3.44	F	NT	RUN	126
87	3.45	F	SP	MCP	570
88	3.54	F	T	RIF	85
89	3.56	F	SP	MCP	350
90	3.64	F	NT	RUN	70
91	3.65	F	SP	MCP	97
92	3.66	F	T	RIF	156
93	3.68	F	SP	MCP	99
94	3.68	F	DP	BWP	115
95	3.70	F	SP	MCP	790
96	3.85	F	NT	RUN	133
97	3.87	F	T	RIF	196
98	3.91	F	T	RIF	86
99	3.93	F	NT	RUN	1205
100	4.15	F	SP	MCP	680
101	4.25	F	T	RIF	93
102	4.27	F	NT	RUN	431

Habitat Unit No.	RM	Rosgen Level I Channel Type	Hawkins Habitat Type	Modified R5 Habitat Type	Hab. Length (ft)
103	4.36	F	T	RIF	103
104	4.38	F	NT	RUN	169
105	4.38	F	DP	BWP	491
106	4.40	F	SP	LSP	234
107	4.45	F	SP	MCP	1118
108	4.65	F	NT	RUN	361
109	4.73	F	T	RIF	110
110	4.75	F	NT	RUN	290
111	4.80	F	SP	MCP	586
112	4.91	F	NT	RUN	1131
113	5.12	F	SP	MCP	439
114	5.20	F	NT	RUN	127
115	5.22	F	SP	MCP	735
116	5.37	F	NT	RUN	146
117	5.41	F	SP	MCP	131
118	5.43	F	T	CAS	166
119	5.46	F	SP	MCP	617
120	5.57	F	NT	RUN	221
121	5.61	F	T	RIF	152
122	5.63	F	NT	RUN	132
123	5.65	F	SP	MCP	336

Habitat Unit No.	*RM*	*Rosgen Level I Channel Type*	*Hawkins Habitat Type*	*Modified R5 Habitat Type*	*Hab. Length (ft)*
124	5.71	F	T	RIF	154
125	5.74	F	NT	RUN	832
126	5.90	F	SP	MCP	439
127	5.99	F	T	RIF	77
128	6.00	F	SP	MCP	869
129	6.17	F	T	RIF	134
130	6.19	F	NT	RUN	169
131	6.23	F	T	RIF	436
132	6.31	F	NT	RUN	116
133	6.33	F	SP	MCP	275
134	6.38	F	NT	RUN	55
135	6.39	F	T	RIF	369
136	6.45	F	NT	RUN	370
137	6.54	F	SP	MCP	734
138	6.67	F	T	RIF	326
139	6.72	F	NT	RUN	382
140	6.80	F	SP	MCP	645
141	6.86	F	T	RIF	105
142	6.88	F	T	CAS	92
143	6.90	F	SP	MCP	1261
144	7.15	F	T	RIF	403

Habitat Unit No.	*RM*	*Rosgen Level I Channel Type*	*Hawkins Habitat Type*	*Modified R5 Habitat Type*	*Hab. Length (ft)*
145	7.15	F	NT	SRN	410
146	7.20	F	SP	MCP	1306
147	7.46	F	NT	RUN	438
148	7.55	F	SP	MCP	970
149	7.73	F	NT	RUN	261
150	7.78	F	T	RIF	216
151	7.82	F	NT	RUN	282
152	7.87	F	SP	MCP	373
153	7.95	F	NT	RUN	133
154	7.98	F	SP	MCP	211
155	8.01	F	T	RIF	96
156	8.03	F	NT	RUN	237
157	8.07	F	SP	MCP	172
158	8.11	F	T	RIF	207
159	8.15	F	NT	RUN	101
160	8.16	F	T	RIF	50
161	8.17	F	NT	RUN	237
162	8.22	F	SP	MCP	943
163	8.40	F	SP	MCP	953
164	8.60	F	T	RIF	295
165	8.65	F	NT	RUN	222

Habitat Unit No.	*RM*	*Rosgen Level I Channel Type*	*Hawkins Habitat Type*	*Modified R5 Habitat Type*	*Hab. Length (ft)*
166	8.70	F	SP	MCP	408
167	8.77	F	NT	SRN	431
168	8.85	F	SP	MCP	1142
169	9.07	F	T	CAS	98
170	9.09	F	SP	MCP	483
171	9.19	F	T	CAS	126
172	9.21	F	SP	MCP	1764
173	9.54	F	T	RIF	96
174	9.55	F	NT	RUN	204
175	9.60	F or B	SP	MCP	926
176	9.77	F or B	T	CAS	122
177	9.79	F or B	SP	MCP	947
178	9.98	F or B	NT	RUN	113
179	9.99	F or B	T	CAS	47
180	10.00	F or B	DP	DPL	140
181	10.03	F or B	DP	DPL	90
182	10.05	F or B	T	RIF	61
183	10.07	F or B	NT	RUN	212
184	10.10	F or B	T	CAS	209
185	10.14	F or B	SP	MCP	306
186	10.19	F or B	T	CAS	60

Habitat Unit No.	RM	Rosgen Level I Channel Type	Hawkins Habitat Type	Modified R5 Habitat Type	Hab. Length (ft)
187	10.21	F or B	SP	MCP	1058
188	10.40	F or B	T	CAS	95
189	10.42	F or B	DP	SPO	229
190	10.46	F or B	DP	DPL	289
191	10.52	F or B	DP	DPL	121
192	10.54	F or B	T	CAS	48
193	10.55	F or B	DP	DPL	90
194	10.56	F or B	T	CAS	62
195	10.57	F or B	DP	DPL	275
196	10.62	F or B	T	CAS	55
197	10.63	F or B	DP	DPL	203
198	10.68	F or B	T	CAS	182
199	10.71	F or B	SP	MCP	348
200	10.76	F	T	CAS	203
201	10.81	F	SP	MCP	978
202	10.99	F	NT	RUN	401
203	11.06	F	SP	MCP	1226
204	11.28	F	NT	RUN	155
205	11.31	F	SP	MCP	514
206	11.42	F	NT	RUN	338
207	11.42	F	NT	RUN	343

Habitat Unit No.	RM	Rosgen Level I Channel Type	Hawkins Habitat Type	Modified R5 Habitat Type	Hab. Length (ft)
208	11.47	F	SP	MCP	376
209	11.47	F	SP	MCP	481
210	11.53	F	NT	RUN	109
211	11.56	F	NT	RUN	542
212	11.66	F	SP	MCP	650
213	11.78	F	NT	RUN	499
214	11.87	F	SP	MCP	179
215	11.90	F	NT	RUN	308
216	11.96	F	SP	MCP	282
217	12.01	F	NT	RUN	182
218	12.01	F	NT	RUN	190
219	12.03	F	NT	RUN	405
220	12.03	F	NT	RUN	436
221	12.10	F	NT	RUN	90
222	12.13	F	SP	MCP	746
223	12.26	F	NT	RUN	607
224	12.38	F	SP	LSP	355
225	12.45	F	NT	RUN	1154
226	12.67	F	SP	MCP	740
227	12.81	F	T	RIF	165
228	12.84	F	NT	RUN	556

Habitat Unit No.	*RM*	*Rosgen Level I Channel Type*	*Hawkins Habitat Type*	*Modified R5 Habitat Type*	*Hab. Length (ft)*
229	12.95	F	SP	MCP	1051
230	13.13	F	T	RIF	89
231	13.15	F	SP	MCP	780
232	13.30	F	NT	RUN	138
233	13.33	F	SP	MCP	597
234	13.45	F	NT	RUN	231
235	13.48	F	SP	MCP	878
236	13.63	F	NT	RUN	225
237	13.68	F	T	RIF	194
238	13.72	F	NT	RUN	196
239	13.75	F	T	RIF	107
240	13.77	F	SP	MCP	775
241	13.91	F	NT	RUN	95
242	13.93	F	SP	MCP	226
243	13.97	F	NT	RUN	243
244	14.02	F	T	RIF	276
245	14.05	F	SP	MCP	663
246	14.17	F	NT	RUN	199
247	14.22	F	SP	MCP	801
248	14.39	F	NT	RUN	461
249	14.46	F	SP	MCP	192

Habitat Unit No.	RM	Rosgen Level I Channel Type	Hawkins Habitat Type	Modified R5 Habitat Type	Hab. Length (ft)
250	14.50	F	NT	RUN	308
251	14.56	F	T	RIF	70
252	14.57	F	NT	RUN	642
253	14.57	F	NO ID	NO ID	606
254	14.68	F	NT	RUN	107
255	14.71	F	SP	MCP	1161
256	14.92	F	T	CAS	135
257	14.95	F	NT	RUN	1686
258	15.28	F	SP	LSP	335
259	15.33	F	NT	RUN	302
260	15.39	F	SP	MCP	671
261	15.52	F	NT	RUN	405
262	15.60	F	SP	MCP	473
263	15.69	F	T	CAS	138
264	15.71	F	SP	MCP	763
265	15.86	F	T	RIF	43
266	15.87	F	NT	RUN	135
267	15.89	F	T	RIF	77
268	15.91	F	NT	RUN	323
269	15.97	F	T	RIF	85
270	15.99	F	NT	RUN	448

Habitat Unit No.	RM	Rosgen Level I Channel Type	Hawkins Habitat Type	Modified R5 Habitat Type	Hab. Length (ft)
271	16.06	F	SP	MCP	627
272	16.19	F	T	RIF	244
273	16.24	F	NT	RUN	172
274	16.27	F	SP	MCP	265
275	16.31	F	NT	RUN	256
276	16.37	F	T	RIF	109
277	16.38	F	NT	RUN	254
278	16.42	F	T	CAS	94
279	16.44	F	NT	RUN	325
280	16.51	F	SP	MCP	464
281	16.51	F	DP	BWP	720
282	16.60	F	T	RIF	196
283	16.63	F	NT	RUN	79
284	16.65	F	SP	MCP	261
285	16.70	F	NT	RUN	361
286	16.76	F	SP	MCP	370
287	16.84	F	T	RIF	294
288	16.89	F	NT	RUN	902
289	17.06	F	SP	MCP	443
290	17.15	F	NT	RUN	812
291	17.30	F	T	RIF	97

Habitat Unit No.	RM	Rosgen Level I Channel Type	Hawkins Habitat Type	Modified R5 Habitat Type	Hab. Length (ft)
292	17.32	F	NT	RUN	175
293	17.35	F	SP	MCP	675
294	17.48	F	NT	RUN	997
295	17.67	F	NT	RUN	939
296	17.67	F	SP	MCP	417
297	17.75	F	NT	RUN	511
298	17.84	F	NT	RUN	335
299	17.90	F	SP	MCP	273
300	17.96	F	NT	RUN	564
301	18.06	F	SP	LSP	281
302	18.12	F	NT	RUN	403
303	18.19	F	SP	MCP	764
304	18.34	F	NT	RUN	262
305	18.38	F	SP	MCP	319
306	18.45	F	NT	RUN	478
307	18.54	F	NT	SRN	472
308	18.63	F	T	RIF	420
309	18.70	F	NT	RUN	258
310	18.75	F	SP	MCP	554
311	18.86	F	NT	RUN	274
312	18.91	F	T	RIF	101

Habitat Unit No.	RM	Rosgen Level I Channel Type	Hawkins Habitat Type	Modified R5 Habitat Type	Hab. Length (ft)
313	18.93	F	NT	RUN	272
314	18.97	F	SP	LSP	131
315	19.00	F	T	RIF	117
316	19.02	F	NT	RUN	312
317	19.08	F	SP	MCP	151
318	19.11	F	T	RIF	61
319	19.13	F	SP	MCP	117
320	19.15	F	T	RIF	152
321	19.17	F	NT	RUN	86
322	19.19	F	SP	MCP	669
323	19.31	F	T	RIF	72
324	19.32	F	NT	RUN	140
325	19.35	F	T	RIF	291
326	19.40	F	NT	RUN	471
327	19.48	F	SP	MCP	1880
328	19.85	F	T	RIF	117
329	19.87	F	NT	RUN	101
330	19.89	F	SP	MCP	408
331	19.96	F	T	RIF	127
332	19.99	F	SP	MCP	85
333	20.00	F	T	RIF	86

Habitat Unit No.	RM	Rosgen Level I Channel Type	Hawkins Habitat Type	Modified R5 Habitat Type	Hab. Length (ft)
334	20.02	F	SP	MCP	676
335	20.15	F	T	RIF	130
336	20.17	F	NT	RUN	541
337	20.28	F	T	CAS	206
338	20.28	F	NT	RUN	268
339	20.31	F	SP	LSP	408
340	20.40	F	SP	MCP	471
341	20.49	F	T	CAS	186
342	20.53	F	NT	RUN	243
343	20.57	F	NT	SRN	498
344	20.67	F	T	RIF	243
345	20.71	F	SP	MCP	1039
346	20.89	F	NT	RUN	84
347	20.91	F	T	RIF	230
348	20.96	F	SP	MCP	1446
349	21.22	F	T	RIF	209
350	21.26	F	SP	MCP	584
351	21.38	F	T	CAS	143
352	21.40	F	SP	MCP	601
353	21.51	F	NT	RUN	223
354	21.55	F	T	RIF	116

Habitat Unit No.	*RM*	*Rosgen Level I Channel Type*	*Hawkins Habitat Type*	*Modified R5 Habitat Type*	*Hab. Length (ft)*
355	21.58	F	NT	RUN	682
356	21.70	F	SP	MCP	338
357	21.76	F	T	RIF	83
358	21.77	F	SP	MCP	340
359	21.84	F	NT	RUN	127
360	21.86	F	T	RIF	90
361	21.87	F	SP	MCP	564
362	21.98	F	T	RIF	132
363	22.00	F	NT	RUN	140
364	22.03	F	T	CAS	91
365	22.04	F	SP	MCP	391
366	22.11	F	T	RIF	240
367	22.15	F	NT	RUN	230
368	22.15	F	NT	RUN	240
369	22.20	F	SP	MCP	582
370	22.31	F	T	RIF	88
371	22.33	F	SP	MCP	286
372	22.33	F	DP	BWP	322
373	22.37	F	T	CAS	292
374	22.37	F	T	RIF	294
375	22.41	F	SP	MCP	827

Habitat Unit No.	*RM*	*Rosgen Level I Channel Type*	*Hawkins Habitat Type*	*Modified R5 Habitat Type*	*Hab. Length (ft)*
376	22.61	F	SP	MCP	637
377	22.61	F	DP	BWP	462
378	22.69	F	SP	MCP	506
379	22.79	F	CVT	CVT	174
380	22.82	F	SP	MCP	69
381	22.83	F	T	CAS	183
382	22.86	F	SP	MCP	226
383	22.90	F	T	CAS	147
384	22.93	F	SP	MCP	289
385	22.98	F	T	RIF	83
386	23.00	F	NT	RUN	447
387	23.08	F	SP	MCP	540
388	23.19	F	T	RIF	137
389	23.23	F	NT	RUN	411
390	23.30	F	T	RIF	171
391	23.34	F	NT	RUN	171
392	23.36	F	T	CAS	356
393	23.43	F	SP	MCP	683
394	23.55	F	T	RIF	208
395	23.59	F	NT	RUN	176
396	23.63	F	SP	MCP	336

Habitat Unit No.	*RM*	*Rosgen Level I Channel Type*	*Hawkins Habitat Type*	*Modified R5 Habitat Type*	*Hab. Length (ft)*
397	23.69	F	T	RIF	62
398	23.70	F	NT	RUN	222
399	23.73	F	SP	MCP	442
400	23.82	F	T	RIF	248
401	23.86	F	SP	MCP	724
402	24.01	F	T	RIF	72
403	24.02	F	SP	MCP	872
404	24.20	F	T	CAS	530
405	24.30	F	SP	MCP	334
406	24.35	F	T	RIF	364
407	24.42	F	SP	MCP	772
408	24.57	F	T	CAS	497
409	24.63	F	SP	MCP	401
410	25.64	Fb	DP	RESERVOIR	1766
411	25.95	Fb	NT	RUN	714
412	26.08	Fb	T	RIF	44
413	26.09	Fb or B	NT	RUN	163
414	26.12	Fb or B	NO ID	NO ID	176
415	26.15	Fb or B	T	CAS	72
416	26.16	Fb or B	NT	RUN	73
417	26.17	Fb or B	T	RIF	99

Habitat Unit No.	RM	Rosgen Level I Channel Type	Hawkins Habitat Type	Modified R5 Habitat Type	Hab. Length (ft)
418	26.19	Fb or B	NT	RUN	158
419	26.23	Fb or B	T	RIF	106
420	26.25	Fb or B	NT	RUN	114
421	26.27	Fb or B	T	RIF	106
422	26.29	Fb or B	NT	RUN	399
423	26.36	Fb or B	NO ID	NO ID	267
424	26.41	Fb or B	NT	RUN	60
425	26.42	Fb or B	T	CAS	47
426	26.43	Fb or B	NT	POW	118
427	26.45	Fb or B	DP	DPL	164
428	26.48	Fb or B	T	RIF	161
429	26.52	Fb or B	DP	DPL	82
430	26.53	Fb or B	T	CAS	62
431	26.54	Fb or B	DP	DPL	110
432	26.56	Fb or B	NO ID	NO ID	590
433	26.66	Fb or B	T	CAS	141
434	26.69	Fb or B	NT	POW	88
435	26.71	Fb or B	DP	DPL	161
436	26.74	Fb or B	DP	DPL	104
437	26.76	Fb or B	T	CAS	146
438	26.79	Fb or B	NO ID	NO ID	602

Habitat Unit No.	RM	Rosgen Level I Channel Type	Hawkins Habitat Type	Modified R5 Habitat Type	Hab. Length (ft)
439	26.90	Fb or B	T	CAS	68
440	26.92	Fb or B	NT	POW	83
441	26.94	Fb or B	NT	RUN	120
442	26.95	Fb or B	SP	MCP	114
443	26.97	Fb or B	NT	RUN	150
444	27.00	Fb or B	DP	DPL	160
445	27.03	Fb or B	T	CAS	152
446	27.06	Fb or B	NT	POW	87
447	27.08	Fb or B	T	CAS	60
448	27.09	Fb or B	NT	RUN	186
449	27.12	Fb or B	T	CAS	49
450	27.13	Fb or B	NT	RUN	86
451	27.15	Fb or B	DP	DPL	129
452	27.17	Fb or B	T	RIF	41
453	27.18	Fb or B	DP	DPL	98
454	27.20	Fb or B	T	CPS	249
455	27.26	Fb or B	DP	DPL	66
456	27.27	Fb or B	T	CAS	83
457	27.28	Fb or B	SP	MCP	98
458	27.29	Fb or B	NO ID	NO ID	75
459	27.30	Fb or B	T	CAS	47

Habitat Unit No.	RM	Rosgen Level I Channel Type	Hawkins Habitat Type	Modified R5 Habitat Type	Hab. Length (ft)
460	27.31	Fb or B	NO ID	NO ID	1504
461	27.59	Fb or B	NT	RUN	432
462	27.66	Fb or B	T	CAS	43
463	27.67	Fb or B	NT	RUN	136
464	27.70	F or B	SP	MCP	114
465	27.72	F or B	T	CAS	93
466	27.74	F or B	T	RIF	82
467	27.77	F or B	NT	RUN	1231
468	27.98	F or B	T	RIF	169
469	28.01	F or B	NO ID	NO ID	187
470	28.05	F or B	NT	RUN	205
471	28.09	F or B	T	RIF	60
472	28.10	F or B	NT	RUN	221
473	28.15	F or B	T	RIF	118
474	28.05	F or B	NO ID	NO ID	821
475	28.16	F or B	NT	RUN	239
476	28.21	F or B	NT	RUN	1565
477	28.50	F or B	DP	DPL	111
478	28.52	F or B	NT	RUN	442
479	28.60	F or B	SP	MCP	370
480	28.66	F or B	NT	RUN	174

Habitat Unit No.	*RM*	*Rosgen Level I Channel Type*	*Hawkins Habitat Type*	*Modified R5 Habitat Type*	*Hab. Length (ft)*
481	28.70	F or B	DP	DPL	182
482	28.72	F or B	T	CAS	133
483	28.75	F or B	NT	RUN	180
484	28.78	F or B	NT	POW	53
485	28.79	F or B	T	RIF	131
486	28.82	F or B	NT	RUN	115
487	28.84	F or B	NT	SRN	221
488	28.87	F or B	NT	RUN	134
489	28.90	F or B	NT	RUN	94
490	28.92	F or B	T	RIF	114
491	28.94	F or B	NT	RUN	275
492	28.99	F or B	NO ID	NO ID	516
493	28.90	F or B	NT	RUN	998
494	29.09	Fb	DP	DPL	59
495	29.11	Fb	T	RIF	29
496	29.12	Fb	NT	RUN	157
497	29.14	Fb	T	CAS	46
498	29.15	Fb	NT	RUN	218
499	29.19	Fb	T	CAS	54
500	29.20	Fb	NT	RUN	127
501	29.23	Fb	T	CAS	39

Habitat Unit No.	*RM*	*Rosgen Level I Channel Type*	*Hawkins Habitat Type*	*Modified R5 Habitat Type*	*Hab. Length (ft)*
502	29.24	Fb	DP	DPL	384
503	29.30	Fb	T	RIF	82
504	29.31	Fb	NT	RUN	201
505	29.35	Fb	NT	RUN	94
506	29.37	Fb	T	RIF	47
507	29.35	Fb	NO ID	NO ID	200
508	29.38	Fb	NO ID	NO ID	69
509	29.39	Fb	SP	MCP	69
510	29.40	Fb	NT	RUN	93
511	29.40	Fb	NT	RUN	95
512	29.41	Fb	SP	MCP	317
513	29.47	Fb	T	CAS	38
514	29.48	Fb	DP	DPL	207
515	29.51	Fb	NT	RUN	789
516	29.67	Fb	SP	MCP	143
517	29.69	Fb	SP	LSP	110
518	29.71	Fb	T	CAS	47
519	29.72	Fb	NT	POW	344
520	29.78	Fb	NT	RUN	106
521	29.80	Fb	NT	POW	165
522	29.83	Fb	DP	DPL	81

Habitat Unit No.	*RM*	*Rosgen Level I Channel Type*	*Hawkins Habitat Type*	*Modified R5 Habitat Type*	*Hab. Length (ft)*
523	29.84	Fb	T	RIF	276
524	29.89	Fb	DP	DPL	81
525	29.91	Fb	DP	DPL	99
526	29.93	Fb	T	CAS	100
527	29.95	Fb	NT	POW	126
528	29.98	Fb	T	CAS	90
529	29.99	Fb	NT	RUN	412
530	29.95	Fb	NT	RUN	642
531	30.07	Fb	DP	DPL	89
532	30.09	Fb	NT	SRN	159
533	30.11	Fb	DP	DPL	91
534	30.13	Fb	T	CAS	55
535	30.14	Fb	NT	RUN	381
536	30.22	Fb	T	CAS	87
537	30.23	Fb	T	RIF	182
538	30.26	Fb	NT	POW	89
539	30.28	Fb	T	RIF	90
540	30.30	Fb	NT	RUN	315
541	30.37	Fb	T	RIF	149
542	30.37	Fb	NT	SRN	516
543	30.39	Fb	NT	SRN	401

Habitat Unit No.	*RM*	*Rosgen Level I Channel Type*	*Hawkins Habitat Type*	*Modified R5 Habitat Type*	*Hab. Length (ft)*
544	30.47	Fb	NT	RUN	24
545	30.48	Fb	T	CAS	30
546	30.48	Fb	DP	DPL	113
547	30.49	Fb	NT	RUN	337
548	30.55	Fb	SP	MCP	114
549	30.57	Fb	DP	DPL	186
550	30.60	Fb	T	CAS	70
551	30.61	Fb	DP	DPL	64
552	30.62	Fb	NT	SRN	86
553	30.61	Fb	DP	DPL	233
554	30.64	Fb	DP	DPL	85
555	30.66	Fb	NT	RUN	152
556	30.69	Fb	T	CAS	57
557	30.70	Fb	NT	RUN	67
558	30.71	Fb	SP	MCP	103
559	30.73	Fb	NT	POW	61
560	30.74	Fb	T	RIF	52
561	30.75	Fb	NT	RUN	73
562	30.75	Fb	T	CAS	39
563	30.76	Fb	NT	POW	56
564	30.77	Fb	T	CAS	33

Habitat Unit No.	*RM*	*Rosgen Level I Channel Type*	*Hawkins Habitat Type*	*Modified R5 Habitat Type*	*Hab. Length (ft)*
565	30.78	Fb	NT	RUN	57
566	30.80	Fb	T	RIF	43
567	30.81	Fb	NT	RUN	65
568	30.82	Fb	T	RIF	62
569	30.83	Fb	NT	POW	35
570	30.84	Fb	NT	RUN	48
571	30.85	Fb	T	CAS	84
572	30.86	Fb	DP	DPL	96
573	30.91	Fb	T	CAS	141
574	30.92	Fb	NT	RUN	34
575	30.93	Fb	T	CAS	79
576	30.94	Fb	DP	DPL	39
577	30.95	Fb	SP	MCP	133
578	30.96	Fb	T	CAS	30
579	30.97	Fb	NT	RUN	62
580	30.98	Fb	DP	DPL	118
581	31.00	Fb	T	CAS	56
582	31.01	Fb	DP	DPL	63
583	31.02	Fb	T	CAS	34
584	31.03	Fb	NT	POW	108
585	31.05	Fb	NT	RUN	233

Habitat Unit No.	RM	Rosgen Level I Channel Type	Hawkins Habitat Type	Modified R5 Habitat Type	Hab. Length (ft)
586	31.09	Fb	NT	POW	93
587	31.11	Fb	NT	SRN	310
588	31.11	Fb	NO ID	NO ID	353
589	31.16	Fb	NT	RUN	290
590	31.17	Fb	NT	RUN	247
591	31.22	Fb	NT	RUN	128
592	31.24	Fb	SP	MCP	259
593	31.29	Fb	T	CAS	157
594	31.24	Fb	T	CAS	200
595	31.28	Fb	NT	POW	269
596	31.34	Fb	NO ID	NO ID	279
597	31.31	Fb	NT	RUN	456
598	31.39	Fb	SP	MCP	131
599	31.40	Fb	T	CAS	53
600	31.41	Fb	DP	DPL	69
601	31.42	Fb	SP	MCP	53
602	31.43	Fb	T	CAS	101
603	31.44	Fb	NT	RUN	116
604	31.48	Fb	SP	MCP	64
605	31.49	Fb	NT	RUN	68
606	31.50	Fb	T	CAS	64

Habitat Unit No.	RM	Rosgen Level I Channel Type	Hawkins Habitat Type	Modified R5 Habitat Type	Hab. Length (ft)
607	31.51	Fb	NT	RUN	51
608	31.52	Fb	DP	DPL	52
609	31.54	Fb	NT	RUN	144
610	31.56	Fb	T	CAS	65
611	31.57	Fb	T	RIF	87
612	31.58	Fb	NT	POW	143
613	31.61	Fb	SP	MCP	131
614	31.63	Fb	DP	DPL	93
615	31.64	Fb	T	CAS	81
616	31.65	Fb	NT	RUN	121
617	31.68	Fb	DP	DPL	115
618	31.71	Fb	T	CAS	70
619	31.72	Fb	DP	DPL	133
620	31.74	Fb	T	CAS	60
621	31.75	Fb	DP	DPL	123
622	31.78	Fb	NT	RUN	305
623	31.85	Fb	DP	DPL	108
624	31.86	Fb	DP	DPL	125
625	31.88	Fb	DP	DPL	127
626	31.91	Fb	T	CAS	43
627	31.93	Fb	DP	DPL	73

Habitat Unit No.	RM	Rosgen Level I Channel Type	Hawkins Habitat Type	Modified R5 Habitat Type	Hab. Length (ft)
628	31.94	Fb	T	CAS	65
629	31.95	Fb	DP	DPL	96
630	31.96	Fb	NT	POW	49
631	31.97	Fb	DP	DPL	66
632	31.98	Fb	NT	POW	212
633	32.02	Fb	NT	RUN	276
634	32.07	Fb	NT	POW	138
635	32.09	Fb	T	CAS	65
636	32.11	Fb	DP	DPL	88
637	32.13	Fb	T	CAS	58
638	32.14	Fb	NO ID	NO ID	44
639	32.15	Fb	DP	DPL	64
640	32.16	Fb	DP	DPL	115
641	32.18	Fb	T	CAS	52
642	32.19	Fb	NT	RUN	96
643	32.21	Fb	T	RIF	70
644	32.22	Fb	DP	DPL	52
645	32.23	Fb	T	RIF	140
646	32.26	Fb	SP	MCP	94
647	32.27	Fb	T	CAS	93
648	32.28	Fb	DP	DPL	144

Habitat Unit No.	RM	Rosgen Level I Channel Type	Hawkins Habitat Type	Modified R5 Habitat Type	Hab. Length (ft)
649	32.31	Fb	NT	POW	259
650	32.35	Fb	NT	RUN	140
651	32.38	Fb	T	CAS	82
652	32.39	Fb	NT	RUN	68
653	32.40	Fb	SP	MCP	144
654	32.43	Fb	T	CAS	26
655	32.44	Fb	SP	MCP	61
656	32.45	Fb	T	CAS	162
657	32.48	Fb	NT	RUN	160
658	32.51	Fb	T	CAS	90
659	32.53	Fb	NT	RUN	118
660	32.55	Fb	SP	MCP	72
661	32.57	Fb	NT	SRN	127
662	32.59	Fb	T	RIF	54
663	32.60	Fb	NT	RUN	115
664	32.63	Fb	SP	MCP	97
665	32.65	Fb	T	CAS	46
666	32.66	Fb	T	RIF	78
667	32.66	Fb	NT	POW	38
668	32.66	Fb	T	CAS	39
669	32.67	Fb	NT	POW	43

Habitat Unit No.	*RM*	*Rosgen Level I Channel Type*	*Hawkins Habitat Type*	*Modified R5 Habitat Type*	*Hab. Length (ft)*
670	32.68	Fb	T	RIF	47
671	32.69	Fb	DP	DPL	103
672	32.71	Fb	DP	DPL	60
673	32.72	Fb	T	CAS	43
674	32.73	Fb	DP	DPL	127
675	32.76	Fb	NT	RUN	257
676	32.81	Fb	T	CAS	222
677	32.85	Fb	NT	RUN	64
678	32.86	Fb	T	CAS	60
679	32.87	Fb	NT	RUN	370
680	32.95	Fb	SP	MCP	503
681	33.04	Fb	T	CAS	61
682	33.05	Fb	DP	DPL	85
683	33.06	Fb	T	CAS	47
684	33.07	Fb	DP	DPL	97
685	33.09	Fb	DP	SPO	228
686	33.13	Fb	T	CAS	80
687	33.15	Fb	NT	POW	137
688	33.17	Fb	DP	DPL	109
689	33.20	Fb	NT	POW	434
690	33.28	Fb	NT	RUN	174

Habitat Unit No.	*RM*	*Rosgen Level I Channel Type*	*Hawkins Habitat Type*	*Modified R5 Habitat Type*	*Hab. Length (ft)*
691	33.31	Fb	SP	MCP	59
692	33.32	Fb	T	CAS	146
693	33.35	Fb	DP	DPL	61
694	33.36	Fb	T	CAS	43
695	33.37	Fb	SP	MCP	125
696	33.39	Fb	DP	DPL	47
697	33.40	Fb or B	T	CAS	192
698	33.44	Fb or B	DP	DPL	49
699	33.45	Fb or B	DP	DPL	83
700	33.47	Fb or B	DP	SPO	119
701	33.49	Fb or B	DP	DPL	122
702	33.51	Fb or B	T	CAS	44
703	33.52	Fb or B	DP	DPL	52
704	33.53	Fb or B	T	CAS	51
705	33.54	Fb or B	DP	DPL	47
706	33.55	Fb or B	T	CAS	52
707	33.56	Fb or B	DP	DPL	53
708	33.57	Fb or B	T	CAS	50
709	33.58	Fb or B	NT	RUN	51
710	33.59	Fb or B	SP	MCP	319
711	33.65	Fb or B	T	RIF	68

Habitat Unit No.	*RM*	*Rosgen Level I Channel Type*	*Hawkins Habitat Type*	*Modified R5 Habitat Type*	*Hab. Length (ft)*
712	33.66	Fb or B	T	CAS	52
713	33.67	Fb or B	NT	RUN	61
714	33.68	Fb or B	T	CAS	112
715	33.70	Fb or B	DP	DPL	75
716	33.70	Fb or B	T	CAS	77
717	33.71	Fb or B	NT	RUN	57
718	33.72	Fb or B	SP	MCP	182
719	33.76	Fb or B	T	CAS	88
720	33.78	Fb or B	DP	SPO	149
721	33.81	Fb or B	DP	DPL	52
722	33.82	Fb or B	T	CAS	109
723	33.84	Fb or B	NT	RUN	258
724	33.89	Fb or B	DP	SPO	178
725	33.92	Fb or B	DP	DPL	295
726	33.97	Fb or B	T	CAS	132
727	34.00	Fb or B	DP	DPL	94
728	34.02	Fb or B	T	CAS	88
729	34.04	Fb or B	NT	POW	73
730	34.05	Fb or B	T	CAS	78
731	34.06	Fb or B	DP	DPL	89
732	34.07	Fb or B	T	CAS	79

Habitat Unit No.	RM	Rosgen Level I Channel Type	Hawkins Habitat Type	Modified R5 Habitat Type	Hab. Length (ft)
733	34.09	Fb or B	DP	DPL	102
734	34.11	Fb or B	T	CAS	48
735	34.12	Fb or B	NT	RUN	59
736	34.13	Fb or B	T	CAS	64
737	34.14	Fb or B	NT	RUN	416
738	34.21	Fb or B	DP	DPL	94
739	34.23	Fb or B	T	RIF	105
740	34.25	Fb or B	NT	RUN	107
741	34.27	Fb or B	DP	DPL	198
742	34.31	Fb or B	NT	RUN	54
743	34.32	Fb or B	T	RIF	53
744	34.33	Fb or B	DP	DPL	51
745	34.34	Fb or B	T	RIF	53
746	34.35	Fb or B	NT	POW	53
747	34.36	Fb or B	T	RIF	52
748	34.37	Fb or B	NT	RUN	52
749	34.38	Fb or B	SP	MCP	37
750	34.39	Fb or B	T	RIF	47
751	34.40	Fb or B	NT	RUN	52
752	34.41	Fb or B	DP	DPL	103
753	34.43	Fb or B	T	CAS	52

Habitat Unit No.	*RM*	*Rosgen Level I Channel Type*	*Hawkins Habitat Type*	*Modified R5 Habitat Type*	*Hab. Length (ft)*
754	34.44	Fb or B	DP	DPL	51
755	34.45	Fb or B	T	CAS	52
756	34.46	Fb or B	DP	DPL	93
757	34.48	Fb or B	T	RIF	90
758	34.50	Fb or B	SP	MCP	420
759	34.57	Fb or B	T	CAS	81
760	34.58	Fb or B	NT	RUN	335
761	34.63	Fb or B	T	RIF	74
762	34.64	Fb or B	NT	RUN	55
763	34.65	Fb or B	SP	MCP	199
764	34.69	Fb or B	T	RIF	204
765	34.73	Fb or B	NT	POW	102
766	34.75	Fb or B	SP	MCP	91
767	34.77	Fb or B	T	CAS	218
768	34.80	Fb or B	DP	DPL	204
769	34.82	Fb or B	NT	SRN	267
770	34.89	Fb or B	T	RIF	217
771	34.93	Fb or B	SP	MCP	158
772	34.96	Fb or B	NT	RUN	50
773	34.97	Fb or B	T	CAS	61
774	34.98	Fb or B	DP	DPL	52

Habitat Unit No.	RM	Rosgen Level I Channel Type	Hawkins Habitat Type	Modified R5 Habitat Type	Hab. Length (ft)
775	34.99	Fb or B	T	CAS	65
776	35.00	Fb or B	DP	DPL	157
777	35.03	Fb or B	T	CAS	104
778	35.05	Fb or B	DP	DPL	79
779	35.06	Fb or B	T	CAS	80
780	35.07	Fb or B	DP	DPL	149
781	35.10	Fb or B	T	RIF	52
782	35.11	Fb or B	DP	DPL	151
783	35.14	Fb or B	T	RIF	136
784	35.17	Fb or B	DP	DPL	101
785	35.19	Fb or B	T	RIF	71
786	35.20	Fb or B	SP	MCP	102
787	35.22	Fb or B	DP	SPO	209
788	35.25	Fb or B	T	CAS	101
789	35.27	Fb or B	DP	DPL	160
790	35.30	Fb or B	T	CAS	212
791	35.33	Fb or B	DP	DPL	162
792	35.35	Fb or B	T	CAS	251
793	35.40	Fb or B	DP	DPL	156
794	35.42	Fb or B	T	RIF	245
795	35.48	Fb or B	DP	SPO	180

Habitat Unit No.	*RM*	*Rosgen Level I Channel Type*	*Hawkins Habitat Type*	*Modified R5 Habitat Type*	*Hab. Length (ft)*
796	35.52	Fb or B	T	RIF	104
797	35.54	Fb or B	DP	DPL	143
798	35.56	F	DP	RESERVOIR	922
799	35.73	F	NT	RUN	1007
800	35.94	F	T	NO ID	128
801	35.96	F	NT	RUN	166
802	35.99	Fb or G	SP	MCP	243
803	36.04	Fb or G	T	RIF	222
804	36.08	Fb or G	NT	RUN	158
805	36.11	Fb or G	T	RIF	53
806	36.12	Fb or G	NT	RUN	83
807	36.14	Fb or G	SP	MCP	155
808	36.17	Fb or G	T	CAS	114
809	36.19	Fb or G	DP	SPO	189
810	36.22	Fb or G	SP	MCP	149
811	36.25	Fb or G	DP	SPO	234
812	36.29	Fb or G	T	CAS	84
813	36.31	Fb or G	DP	DPL	123
814	36.33	Fb or G	T	CAS	172
815	36.36	Fb or G	NT	RUN	78
816	36.37	Fb or G	SP	MCP	111

Habitat Unit No.	RM	Rosgen Level I Channel Type	Hawkins Habitat Type	Modified R5 Habitat Type	Hab. Length (ft)
817	36.40	Fb or G	T	CAS	165
818	36.42	Fb or G	SP	MCP	160
819	36.45	Fb or G	T	RIF	117
820	36.46	A	SP	MCP	375
821	36.54	A	NT	SRN	126
822	36.54	A	T	RIF	131
823	36.57	A	NT	RUN	118
824	36.58	A	SP	MCP	75
825	36.59	A	T	RIF	82
826	36.60	A	NT	RUN	53
827	36.61	A	SP	MCP	113
828	36.63	A	DP	SPO	122
829	36.64	A	T	CAS	78
830	36.65	A	DP	DPL	240
831	36.69	A	T	CAS	145
832	36.72	A	T	RIF	125
833	36.74	A	DP	DPL	95
834	36.76	A	T	CAS	56
835	36.77	A	SP	MCP	196
836	36.82	A	DP	SPO	364
837	36.88	A	DP	DPL	141

Habitat Unit No.	RM	Rosgen Level I Channel Type	Hawkins Habitat Type	Modified R5 Habitat Type	Hab. Length (ft)
838	36.91	A	DP	DPL	167
839	36.94	A	T	CAS	81
840	36.95	A	DP	DPL	190
841	36.99	A	T	CAS	73
842	37.01	A	DP	DPL	125
843	37.05	A	DP	SPO	226
844	37.10	A	DP	DPL	283
845	37.15	A	DP	SPO	179
846	37.18	A	T	RIF	110
847	37.20	A	SP	MCP	154
848	37.23	A	T	CAS	32
849	37.24	A	DP	DPL	182
850	37.28	A	NT	SRN	103
851	37.29	A	T	CAS	108
852	37.30	A	DP	DPL	165
853	37.34	A	DP	SPO	203
854	37.37	A	NT	POW	58
855	37.38	A	T	CAS	59
856	37.39	Fb or A	NT	POW	35
857	37.40	Fb or A	DP	DPL	118
858	37.42	Fb or A	T	CAS	45

Habitat Unit No.	RM	Rosgen Level I Channel Type	Hawkins Habitat Type	Modified R5 Habitat Type	Hab. Length (ft)
859	37.43	Fb or A	DP	DPL	122
860	37.45	Fb or A	T	CAS	290
861	37.48	Fb or A	NT	RUN	105
862	37.50	Fb or A	DP	SPO	273
863	37.55	Fb or A	DP	DPL	212
864	37.59	Fb or A	NT	RUN	288
865	37.64	Fb or A	T	RIF	36
866	37.65	Fb or A	NT	RUN	110
867	37.67	Fb or A	SP	MCP	97
868	37.69	Fb or A	DP	SPO	364
869	37.77	Fb or A	T	CAS	155
870	37.78	Fb or A	NT	POW	72
871	37.81	Fb or A	T	CAS	38
872	37.82	Fb or A	NT	POW	117
873	37.83	Fb or A	SP	MCP	239
874	37.88	Fb or A	T	CAS	49
875	37.89	Fb or A	DP	SPO	178
876	37.94	Fb or A	DP	DPL	110
877	37.96	Fb or A	T	CAS	102
878	37.98	Fb or A	DP	DPL	289
879	38.02	Fb or A	DP	SPO	1141

Habitat Unit No.	*RM*	*Rosgen Level I Channel Type*	*Hawkins Habitat Type*	*Modified R5 Habitat Type*	*Hab. Length (ft)*
880	38.23	Fb or A	SP	MCP	68
881	38.24	Fb or A	T	CAS	47
882	38.25	Fb or A	T	RIF	52
883	38.26	Fb or A	DP	DPL	119
884	38.28	Fb or A	NT	RUN	126
885	38.30	Fb or A	T	CAS	51
886	38.31	Fb or A	NT	POW	148
887	38.34	Fb or A	T	CAS	48
888	38.35	Fb or A	NT	RUN	88
889	38.37	Fb or A	SP	MCP	97
890	38.39	Fb or A	T	RIF	83
891	38.40	Fb or A	NT	RUN	105
892	38.42	Fb or A	T	RIF	105
893	38.44	Fb or A	NT	POW	103
894	38.46	Fb or A	NT	SRN	257
895	38.51	Fb or A	T	CAS	245
896	38.56	Fb or A	T	RIF	328
897	38.61	Fb or A	NT	POW	438
898	38.69	Fb or A	T	RIF	148
899	38.71	Fb or A	NT	RUN	392
900	38.79	Fb or A	T	CAS	178

Habitat Unit No.	*RM*	*Rosgen Level I Channel Type*	*Hawkins Habitat Type*	*Modified R5 Habitat Type*	*Hab. Length (ft)*
901	38.83	Fb or A	DP	DPL	152
902	38.84	Fb or A	T	CAS	87
903	38.87	Fb or A	T	RIF	73
904	38.88	Fb or A	DP	DPL	96
905	38.90	Fb or A	T	RIF	61
906	38.91	Fb or A	NT	RUN	92
907	38.93	Fb or A	SP	MCP	105
908	38.96	Fb or A	T	CAS	58
909	38.97	Fb or A	SP	MCP	142
910	38.99	Fb or A	DP	DPL	61
911	39.00	Fb or A	T	RIF	75
912	39.01	Fb or A	DP	SPO	565
913	39.13	Fb or A	SP	MCP	220
914	39.17	Fb or A	T	CAS	191
915	39.20	Fb or A	NT	RUN	376
916	39.27	Fb or A	DP	DPL	181
918	39.30	Fb or A	DP	SPO	236
919	39.35	Fb or A	T	CAS	53
920	39.36	Fb or A	DP	DPL	105
921	39.37	Fb or A	T	CAS	52
922	39.38	Fb or A	DP	DPL	131

Habitat Unit No.	*RM*	*Rosgen Level I Channel Type*	*Hawkins Habitat Type*	*Modified R5 Habitat Type*	*Hab. Length (ft)*
923	39.41	Fb or A	T	RIF	130
924	39.43	Fb or A	SP	MCP	289
925	39.49	Fb or A	NT	RUN	133
926	39.51	Fb or A	T	CAS	50
927	39.52	Fb or A	NT	POW	119
928	39.55	Fb or A	T	RIF	72
929	39.56	Fb or A	NT	RUN	94
930	39.58	Fb or A	T	RIF	215
931	39.62	Fb or A	SP	MCP	218
932	39.67	A	DP	SPO	422
933	39.74	A	T	CAS	141
934	39.77	A	DP	DPL	193
935	39.80	A	NT	RUN	148
936	39.83	A	T	RIF	107
937	39.85	A	SP	MCP	75
938	39.86	A	T	CAS	91
939	39.88	A	NT	RUN	169
940	39.91	A	T	CAS	501
941	40.00	A	NT	RUN	90
942	40.02	A	DP	DPL	115
943	40.04	A	DP	SPO	215

Habitat Unit No.	*RM*	*Rosgen Level I Channel Type*	*Hawkins Habitat Type*	*Modified R5 Habitat Type*	*Hab. Length (ft)*
944	40.08	A	DP	DPL	97
945	40.09	A	T	CAS	55
946	40.11	A	DP	DPL	119
947	40.13	A	T	CAS	48
948	40.14	A	DP	DPL	80
949	40.15	A	T	CAS	41
950	40.16	A	DP	DPL	79
951	40.17	A	DP	SPO	128
952	40.20	A	SP	MCP	178
953	40.23	A	T	CAS	51
954	40.24	A	SP	MCP	102
955	40.26	A	T	CPS	218
956	40.30	A	NT	POW	103
957	40.32	A	DP	DPL	52
958	40.33	A	T	CPS	104
959	40.35	A	SP	MCP	154
960	40.38	A	DP	SPO	51
961	40.39	A	SP	MCP	165
962	40.42	A	T	CAS	168
963	40.45	A	DP	DPL	190
964	40.49	A	NT	RUN	219

Habitat Unit No.	*RM*	*Rosgen Level I Channel Type*	*Hawkins Habitat Type*	*Modified R5 Habitat Type*	*Hab. Length (ft)*
965	40.53	A	T	CAS	51
966	40.54	A	NT	RUN	52
967	40.55	A	SP	MCP	155
968	40.58	A	NT	POW	112
969	40.60	A	T	CAS	104
970	40.62	A	T	CPS	104
971	40.64	A	DP	DPL	106
972	40.66	A	T	CAS	170
973	40.69	A	SP	MCP	234
974	40.73	A	T	CAS	53
975	40.74	A	DP	SPO	479
976	40.83	A	T	CAS	208
977	40.87	A	NT	RUN	100
978	40.89	A	DP	DPL	103
979	40.91	A	T	CAS	53
980	40.92	A	NT	RUN	102
981	40.94	A	SP	MCP	258
982	40.99	A	T	CAS	148
983	41.01	A	DP	DPL	180
984	41.04	A	T	RIF	51
985	41.05	A	NT	POW	315

Habitat Unit No.	*RM*	*Rosgen Level I Channel Type*	*Hawkins Habitat Type*	*Modified R5 Habitat Type*	*Hab. Length (ft)*
986	41.12	A	DP	DPL	51
987	41.13	A	T	CAS	67
988	41.14	A	T	RIF	97
989	41.15	A	DP	DPL	154
990	41.18	A	NT	POW	231
991	41.22	A	NT	RUN	110
992	41.24	A	SP	MCP	180
993	41.27	A	T	CAS	51
994	41.28	A	DP	DPL	96
995	41.31	A	NT	POW	279
996	41.36	A	T	CAS	55
997	41.37	A	DP	DPL	81
998	41.38	A	T	RIF	83
999	41.40	A	NT	RUN	312
1000	41.46	A	SP	MCP	111
1001	41.48	A	T	CAS	52
1002	41.49	A	DP	DPL	78
1003	41.51	A	T	CAS	52
1004	41.52	A	DP	DPL	80
1005	41.53	A	T	CAS	48
1006	41.54	A	DP	DPL	99

Habitat Unit No.	RM	Rosgen Level I Channel Type	Hawkins Habitat Type	Modified R5 Habitat Type	Hab. Length (ft)
1007	41.56	A	DP	SPO	105
1008	41.58	A	DP	DPL	105
1009	41.60	A	T	CAS	81
1010	41.62	A	DP	DPL	66
1011	41.63	A	T	RIF	55
1012	41.64	A	SP	MCP	76
1013	41.66	A	T	CAS	68
1014	41.67	A	NT	POW	54
1015	41.68	A	DP	DPL	75
1016	41.70	A	T	RIF	70
1017	41.71	A	DP	DPL	89
1018	41.72	A	NT	RUN	114
1019	41.73	A	SP	MCP	100
1020	41.75	A	T	RIF	87
1021	41.77	A	NT	POW	124
1022	41.79	A	T	RIF	133
1023	41.82	A	SP	MCP	170
1024	41.85	A	T	RIF	56
1025	41.86	A	NT	SRN	152
1026	41.89	A	T	RIF	53
1027	41.90	A	SP	MCP	180

Habitat Unit No.	*RM*	*Rosgen Level I Channel Type*	*Hawkins Habitat Type*	*Modified R5 Habitat Type*	*Hab. Length (ft)*
1028	41.93	A	NT	POW	173
1029	41.96	A	DP	DPL	91
1030	41.97	A	T	CAS	131
1031	41.99	B	SP	MCP	247
1032	42.04	B	T	CAS	103
1033	42.05	B	NT	POW	248
1034	42.08	B	T	RIF	164
1035	42.11	B	NT	RUN	220
1036	42.14	B	T	RIF	39
1037	42.15	B	DP	DPL	44
1038	42.16	B	T	RIF	65
1039	42.17	B	DP	DPL	69
1040	42.18	B	T	CAS	115
1041	42.21	B	DP	DPL	62
1042	42.22	B	NT	SRN	215
1043	42.25	B	NT	RUN	270
1044	42.31	B	SP	MCP	62
1045	42.32	B	NT	RUN	73
1046	42.33	B	SP	MCP	54
1047	42.34	B	T	CAS	79
1048	42.36	B	NT	POW	796

Habitat Unit No.	*RM*	*Rosgen Level I Channel Type*	*Hawkins Habitat Type*	*Modified R5 Habitat Type*	*Hab. Length (ft)*
1049	42.51	B	SP	MCP	171
1050	42.54	B	T	CAS	42
1051	42.55	B	NT	POW	68
1052	42.56	B	DP	DPL	203
1053	42.60	B	DP	SPO	482
1054	42.69	B	T	CAS	57
1055	42.70	B	DP	DPL	56
1056	42.71	B	DP	SPO	102
1057	42.74	B	SP	MCP	200
1058	42.77	B	NT	POW	84
1059	42.78	B	DP	DPL	97
1060	42.80	B	T	CAS	35
1061	42.81	B	NT	POW	401
1062	42.88	B	T	CAS	115
1063	42.89	B	NT	RUN	94
1064	42.91	B	T	CAS	38
1065	42.92	B	DP	DPL	50
1066	42.93	B	T	RIF	133
1067	42.94	B	NT	RUN	144
1068	42.97	B	T	RIF	64
1069	42.98	B	NT	POW	232

Habitat Unit No.	RM	Rosgen Level I Channel Type	Hawkins Habitat Type	Modified R5 Habitat Type	Hab. Length (ft)
1070	43.03	B	T	RIF	39
1071	43.04	B	DP	DPL	105
1072	43.05	B	T	CAS	60
1073	43.06	B	NT	RUN	150
1074	43.09	B	SP	MCP	213
1075	43.13	B	NT	POW	234
1076	43.18	B	DP	SPO	289
1077	43.23	B	NT	RUN	139
1078	43.25	B	T	RIF	277
1079	43.29	B	SP	MCP	245
1080	43.33	B	T	CAS	72
1081	43.34	B	NT	RUN	290
1082	43.38	B	T	RIF	85
1083	43.41	B	NT	RUN	197
1084	43.44	B	T	RIF	150
1085	43.48	B	DP	DPL	119
1086	43.49	B	T	RIF	62
1087	43.50	B	SP	MCP	115
1088	43.51	B	T	RIF	70
1089	43.53	B	NT	RUN	180
1090	43.56	B	SP	MCP	59

Habitat Unit No.	RM	Rosgen Level I Channel Type	Hawkins Habitat Type	Modified R5 Habitat Type	Hab. Length (ft)
1091	43.57	B	T	CAS	97
1092	43.58	B	DP	DPL	55
1093	43.59	B	NT	RUN	285
1094	43.63	B	T	CAS	82
1095	43.64	B	NT	RUN	259
1096	43.68	B	T	RIF	63
1097	43.70	B	DP	DPL	209
1098	43.74	B	T	RIF	59
1099	43.75	B	DP	DPL	146
1100	43.76	B	T	RIF	54
1101	43.77	B	SP	MCP	362
1102	43.83	B	NT	POW	114
1103	43.86	B	DP	DPL	196
1104	43.89	B	NT	POW	265
1105	43.94	B	DP	DPL	160
1106	43.98	B	NT	POW	146
1107	44.00	B	T	RIF	89
1108	44.02	B	T	CAS	83
1109	44.03	B	DP	DPL	265
1111	44.07	B	T	CAS	83
1112	44.09	B	NT	POW	131

Habitat Unit No.	*RM*	*Rosgen Level I Channel Type*	*Hawkins Habitat Type*	*Modified R5 Habitat Type*	*Hab. Length (ft)*
1113	44.11	B	DP	DPL	151
1114	44.14	B	NT	POW	126
1115	44.16	B	DP	DPL	105
1116	44.18	B	DP	SPO	128
1117	44.20	A	NT	POW	78
1118	44.22	A	DP	SPO	440
1119	44.30	A	T	RIF	82
1120	44.31	A	SP	MCP	221
1121	44.35	A	NT	POW	55
1122	44.36	A	DP	DPL	57
1123	44.37	A	T	CAS	83
1124	44.39	A	NT	POW	327
1125	44.44	A	SP	MCP	199
1126	44.47	A	NT	POW	358
1127	44.54	A	T	RIF	70
1128	44.56	A	DP	SPO	1019
1129	44.74	A	SP	MCP	242
1130	44.77	A	T	CAS	104
1131	44.79	A	DP	DPL	204
1132	44.82	A	T	CAS	97
1133	44.84	A	DP	DPL	337

Habitat Unit No.	RM	Rosgen Level I Channel Type	Hawkins Habitat Type	Modified R5 Habitat Type	Hab. Length (ft)
1134	44.91	A	T	CAS	61
1135	44.92	A	DP	DPL	72
1136	44.93	A	T	RIF	67
1137	44.94	A	DP	DPL	55
1138	44.95	A	T	RIF	41
1139	44.96	A	DP	DPL	35
1140	44.97	A	T	RIF	45
1141	44.98	A	DP	DPL	70
1142	44.99	A	T	RIF	72
1143	45.01	A	DP	DPL	111
1144	45.02	A	T	RIF	56
1145	45.03	A	DP	DPL	44
1146	45.04	A	T	CAS	43
1147	44.05	B	DP	DPL	68
1148	45.06	A	T	CAS	50
1149	45.07	A	DP	DPL	76
1150	45.08	A	NT	POW	108
1151	45.09	A	DP	DPL	92
1152	45.10	A	NT	POW	90
1153	45.11	A	DP	DPL	45
1154	45.12	A	NT	POW	248

Habitat Unit No.	*RM*	*Rosgen Level I Channel Type*	*Hawkins Habitat Type*	*Modified R5 Habitat Type*	*Hab. Length (ft)*
1155	45.16	A	DP	SPO	345
1156	45.23	A	DP	DPL	141
1157	45.26	A	T	CAS	43
1158	45.27	A	DP	DPL	63
1159	45.28	A	T	CAS	38
1160	45.29	A	DP	DPL	70
1161	45.30	A	T	CAS	33
1162	45.31	A	SP	MCP	336
1163	45.37	A	T	CAS	165
1300	45.40	A	NT	POW	186
1301	45.43	A	T	CAS	64
1302	45.44	A	DP	DPL	128
1303	45.46	A	T	CAS	74
1304	45.47	A	DP	DPL	52
1305	45.48	A	T	CAS	67
1306	45.50	A	DP	DPL	52
1307	45.51	A	NT	POW	52
1308	45.52	A	DP	DPL	102
1309	45.54	A	DP	SPO	123
1310	45.57	A	T	CAS	51
1311	45.58	A	NT	RUN	103

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Habitat Unit No.	*RM*	*Rosgen Level I Channel Type*	*Hawkins Habitat Type*	*Modified R5 Habitat Type*	*Hab. Length (ft)*
1312	45.59	A	T	CAS	151
1313	45.61	A	DP	DPL	90
1314	45.63	A	NT	POW	216
1315	45.67	A	DP	DPL	75
1316	45.68	A	T	RIF	66
1317	45.69	A	DP	DPL	247
1318	45.74	A	T	CAS	108
1319	45.76	A	DP	DPL	164
1320	45.78	A	DP	DPL	101
1321	45.80	A	T	RIF	547
1322	45.91	A	DP	DPL	65
1323	45.92	A	T	CAS	234
1324	45.95	A	DP	DPL	262
1325	46.03	A	DP	SPO	158
1326	46.04	A	DP	DPL	44
1327	46.05	A	NT	POW	91
1328	46.06	A	T	RIF	114
1329	46.08	A	DP	DPL	114
1330	46.10	A	T	CAS	133
1331	46.13	A	DP	SPO	141
1332	46.16	A	DP	DPL	62

Habitat Unit No.	RM	Rosgen Level I Channel Type	Hawkins Habitat Type	Modified R5 Habitat Type	Hab. Length (ft)
1333	46.17	A	DP	DPL	99
1334	46.19	A	T	CAS	52
1335	46.20	A	DP	DPL	75
1336	46.21	A	T	RIF	71
1337	46.23	A	DP	DPL	168
1338	46.24	A	DP	DPL	81
1339	46.25	A	NT	POW	73
1340	46.27	A	NT	RUN	93
1341	46.29	A	T	CAS	92
1342	46.31	A	NT	POW	177
1343	46.34	A	DP	DPL	158
1344	46.37	A	T	CAS	64
1345	46.38	A	DP	SPO	48
1346	46.39	A	T	CAS	56
1347	46.40	A	DP	DPL	80
1348	46.41	A	T	CAS	40
1349	46.42	A	DP	DPL	71
1350	46.43	A	DP	SPO	238
1351	46.48	A	DP	DPL	127
1352	46.50	A	DP	SPO	163
1353	46.53	A	T	CAS	74

Habitat Unit No.	RM	Rosgen Level I Channel Type	Hawkins Habitat Type	Modified R5 Habitat Type	Hab. Length (ft)
1354	46.54	A	DP	SPO	117
1355	46.56	A	DP	DPL	74
1356	46.58	A	NT	POW	124
1357	46.60	A	DP	DPL	246
1358	46.64	A	T	CAS	64
1359	46.65	A	NT	POW	247
1360	46.70	A	T	CAS	126
1361	46.73	A	DP	DPL	145
1362	46.75	A	NT	POW	269
1363	46.80	A	DP	DPL	151
1364	46.83	A	NT	POW	118
1365	46.84	A	DP	DPL	37
1366	46.86	A	T	CAS	22
1367	46.86	A	DP	DPL	174
1368	46.88	A	NT	POW	110
1369	46.91	A	DP	DPL	193
1370	46.94	A	T	RIF	157
1371	46.96	A	NT	RUN	160
1372	47.00	A	NT	POW	151
1373	47.03	A	DP	DPL	65
1374	47.04	A	T	CAS	40

Habitat Unit No.	*RM*	*Rosgen Level I Channel Type*	*Hawkins Habitat Type*	*Modified R5 Habitat Type*	*Hab. Length (ft)*
1375	47.05	A	NT	RUN	130
1376	47.07	A	SP	MCP	227
1400	38.95	Fb or A	DP	DPL	51