April 30, 2012

Filed via Electronic Submittal (E-File)

Honorable Kimberly D. Bose, Secretary
Federal Energy Regulatory Commission
888 First Street, NE
Washington, DC 20426

SUBJECT: Yuba River Development Project
FERC Project No. 2246-058
Yuba Salmon Forum Fish Passage Study Report

Dear Secretary Bose:

During the November 30, 2011, technical conference for the resolution of study disputes related to Yuba County Water Agency's (YCWA) Yuba River Development Project relicensing, YCWA committed to filing with the Federal Energy Regulatory Commission (FERC) a Fish Passage Study Report that, at the time, was in development by the Yuba Salmon Forum.

The Yuba Salmon Forum's February 2012 Fish Passage Study Report is attached.

If you have any questions regarding this letter, please contact me.

Sincerely,

YUBA COUNTY WATER AGENCY

Curt Aikens

Curt Aikens
General Manager

Attachment: Yuba Salmon Forum February 2012 Fish Passage Study Report

cc: Alan Mitchnick – FERC
Kenneth Hogan – FERC
Relicensing Participants via E-Mail

YUBA SALMON FORUM

FISH PASSAGE STUDY REPORT

Prepared by:

HDR Engineering, Inc.
In Collaboration with
The Yuba Salmon Forum Technical Working Group

February 2012

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Summary

To provide useful information to the Yuba Salmon Forum, in summer 2011, potential barriers to upstream migration of adult Chinook salmon (*Oncorhynchus tshawytscha*) and Central Valley steelhead (*Oncorhynchus mykiss*) in the mainstem stream reaches of the Yuba River upstream of the United States Army Corps of Engineers (USACE) Englebright Dam and in 38 tributaries to the North Yuba River upstream of New Bullards Bar Reservoir were assessed. Chinook salmon and steelhead do not occur in the Yuba Basin upstream of Englebright Dam.

The assessment included both desktop exercises and measurements in the field. Desktop exercises utilized low altitude aerial video, topographic mapping software, aerial photographs, drainage area, available hydrological data, and other existing information to identify locations for ground assessments. Ground assessments were performed to confirm the presence or absence of potential barriers. Suspected potential barriers physical characteristics were measured and assessed using criteria from Powers and Orsborn (1985).

From the desktop exercise, 15 instream features in the mainstem reaches were identified that could be potential barriers to upstream migration of anadromous salmonids. This included: three features on the Yuba River between River Miles (RM) 34.6 and 38.0; one feature on the Middle Yuba River downstream of Our House Diversion Dam at RM 0.4; six features on the North Yuba River upstream of New Bullards Bar Dam between RM 26.1 and 46.8; and five features on Oregon Creek downstream of Log Cabin Diversion Dam between RM 0.6 and 4.2.

Further investigation was performed at 11 of the 15 features. All of the seven features on the Middle and North Yuba rivers and the most downstream feature on Oregon Creek were investigated by ground assessments; and the three features on the Yuba River were investigated by helicopter reconnaissance. The four upper features on Oregon Creek were not investigated because the most downstream feature, which was visited, is a very large waterfall, which would be a complete block to anadromous fish upstream migration.[1] Based on these surveys, YSF Study Team's fish biologists believe two of the features may be potential barriers to the upstream migration of Chinook salmon and steelhead: the large waterfall on Oregon Creek located at RM 0.6; and one on the Middle Yuba River at RM 0.4. Other potential barriers to the upstream migration of Chinook salmon and steelhead in mainstem reaches were not identified.

Thirty-eight tributaries to the North Yuba River upstream of New Bullards Bar Reservoir were identified for assessment. Of the 38 tributaries: 20 were determined to provide little to no Chinook salmon or steelhead spawning habitat (i.e. insufficient water or steep gradient). Potential barriers to Chinook salmon and steelhead within the study area were found at eight tributaries. Complete barriers were not identified during partial surveys on five tributaries, where private property, unsafe terrain, or other logistical issues limited access to the full survey area. Only five of the accessed tributaries were fully surveyed, had significant usable habitat, and offered access for Chinook and steelhead at moderate to high flow.

[1] If the most downstream barrier did not exist, recent existing habitat mapping data (YCWA 2011a) indicates that four additional upstream features may be potential barriers to the upstream migration of Chinook salmon and steelhead.

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1.0 Introduction

The Yuba Salmon Forum (YSF) is a collaborative effort of a diverse group of stakeholders including Yuba County Water Agency (YCWA); United States Department of Agriculture, Forest Service (Forest Service); United States Department of Interior, Fish and Wildlife Service (USFWS); United States Department of Commerce, National Marine Fisheries Service (NMFS); United States Army Corps of Engineers (USACE); California Department of Fish and Game (CDFG); California State Water Resources Control Board (SWRCB); Placer County Water Agency (PCWA); Pacific Gas & Electric (PG&E); and numerous non-governmental organizations (NGO). The purpose of the YSF is to identify, evaluate, recommend, and seek to achieve implementation of effective near-term and long-term actions to achieve viable salmonid populations in the Yuba River watershed to contribute to recovery goals, while also considering other beneficial uses of water resources and habitat values in neighboring watersheds, as part of Central Valley salmonid recovery actions.

In order to effectively conduct a preliminary screening of potentially viable introduction actions in the watershed, the YSF utilizes data from several sources including historic studies (e.g., from the Upper Yuba River Studies Program, or UYRSP, and Lower Yuba River Accord Resource Management Team, or RMT, programs), ongoing proceedings (e.g., relicensing processes for Nevada Irrigation District's, or NID, Yuba-Bear Hydroelectric Project and PG&E Drum-Spaulding Project, and YCWA's Yuba River Development Project), data and anecdotal observations from resource agencies (e.g., primarily Forest Service, CDFG and NMFS), and new data collection activities.

The YSF adopted the Draft Yuba River Salmon Forum Studies (Draft Studies) on June 24, 2011. The Draft Studies included six studies designed to provide information to YSF members that may be useful in making decisions regarding the introduction of anadromous salmonids (i.e., Chinook salmon (*Oncorhynchus tshawytscha*) and central Valley steelhead (*Oncorhynchus mykiss*)[2] into the Yuba River basin upstream of the USACEs' Englebright Dam. The studies included:

- Study 1.0 - Habitat Mapping
- Study 1.1 - Water Temperature
- Study 1.2 - Fish Barriers
- Study 1.3 - North Yuba River Spawning Habitat Evaluation
- Study 1.4 - Rearing
- Study 1.5 - Holding

This report summarizes the goals and objectives, methods and results of Study 1.2 - Fish Barriers (Study). The Study was funded by YCWA and PCWA, and performed by HDR Engineering, Inc., in collaboration with the YSF Technical Working Group. The Technical Working Group included representatives of YSF members.

[2] Chinook salmon and steelhead do not occur in the Yuba Basin upstream of Englebright Dam.

1.1 Goals and Objectives

The goal of the Fish Barriers Study was to assess the limitations of upstream passage of adult Chinook salmon and steelhead in mainstem and tributary stream habitat.

The study objectives were to:

- Assess mainstem barriers to upstream migration of Chinook salmon and steelhead per methods described in Section 2.4.1 of PG&E/NID's Technical Memorandum 3-16 – Fish Barriers (PG&E/NID 2011) in the North Yuba River, and in Oregon Creek and the Middle Yuba River between Yuba River Development Project facilities and the normal maximum water surface elevation (NMWSE) of Englebright Reservoir. Pertinent methods from Section 2.4.1 are quoted in Attachment 1.2D.

- Perform a desktop assessment of tributaries to the North Yuba River upstream of the NMWSE of New Bullards Bar Reservoir to determine streams potentially accessible to the upstream migration of Chinook salmon and steelhead, and survey accessible tributaries identified using methods described in Section 2.2 in PG&E/NID's Technical Memorandum 3-4 – Fish Passage (PG&E/NID 2010). Pertinent methods from Section 2.2 are quoted in Attachment 1.2D.

- Instead of rainbow trout leaping and swimming criteria used by NID/PG&E in the above referenced methods, use Chinook salmon and steelhead leaping and swimming criteria from Powers and Orsborn (1985) for all identified potential barriers.

2.0 Methods

YSF Study Team used existing information in combination with topographic mapping software (Terrain Navigator Pro© V. 7), aerial photographs, drainage area, available hydrological data, aerial videos (CDWR 2002, YCWA 2009a, and YCWA 2009b) and on-the-ground surveys to assess potential barriers to the upstream migration of Chinook salmon and steelhead. Field surveys were conducted from August through September 2011 (i.e., low-flow conditions in the reaches examined) to maximize access, safety, and allow for better evaluation of potential barrier dimensions. The analysis was conducted at the flow present at the time of the survey. Flows were not modified for hydraulic modeling purposes.

An analysis of water temperature suitability for anadromous salmonids was not addressed in this Study; however, information on water temperatures for streams in the study area can be found in the Study 1.1, Water Temperature Report.

2.1 Study Area

The study area included the following mainstem stream reaches:

- **Yuba River -** From the NMWSE of Englebright Reservoir (RM 32.2) upstream to the confluence of the North Yuba River and Middle Yuba River (RM 39.7), where the Yuba River begins.
- **Middle Yuba River** - From the confluence with the Yuba River (RM 0.0) upstream to Our House Diversion Dam (RM 12.0).
- **Oregon Creek** - From the confluence with the Middle Yuba River (RM 0.0) upstream to Log Cabin Diversion Dam (RM 4.1).
- **North Yuba River** - From the confluence with the Middle Yuba River (RM 0.0) upstream to New Bullards Bar Dam (RM 2.3), and from the NMWSE of New Bullards Bar Reservoir (RM 17.5) upstream to Loves Falls (RM 51.0), which is a known barrier to anadromous fish upstream migration.

In addition, the study area included the following North Yuba River tributaries:

- Slate Creek (17.6)
- Quayle Ravine (18.1)
- Cassidy Ravine (19.5)
- Canyon Creek (20.1)
- Brummel Ravine (20.4)
- Cherokee Creek (21.5)
- Indian Creek (22.4)
- Fiddle Creek (24.3)
- Humbug Creek (26.2)
- St. Catherine Creek (28.7)
- Devils Canyon (30.3)
- Ramshorn Creek (30.5)
- Goodyears Creek (32.0)
- Rock Creek (32.2)
- Woodruff Creek (32.2)
- Rosassco Ravine (34.7)
- Coyote Ravine (35.4)
- Slug Canyon (35.8)
- Downie River (36.3)
- Hungry Mouth Canyon (37.0)
- Slate Castle Creek (37.0)
- New York Ravine (38.7)
- Secret Canyon (39.1)
- Jim Crow Creek (39.4)
- San Juan Canyon (39.4)
- Mobile Ravine (40.7)
- Shaughnessy Ravine (41.2)
- Gold Point Ravine (42.5)
- Ladies Canyon (43.5)
- Little Ladies Canyon (43.5)
- Negro Canyon (43.9)
- Charcoal Ravine (44.9)
- Keystone Ravine (46.3)
- Loganville Tributary (46.8 unnamed)
- Big Avalanche Ravine (47.4)
- Sierra City Tributary (48.6 unnamed)
- Hackmans Ravine (49.2)
- Haypress Creek (50.1)

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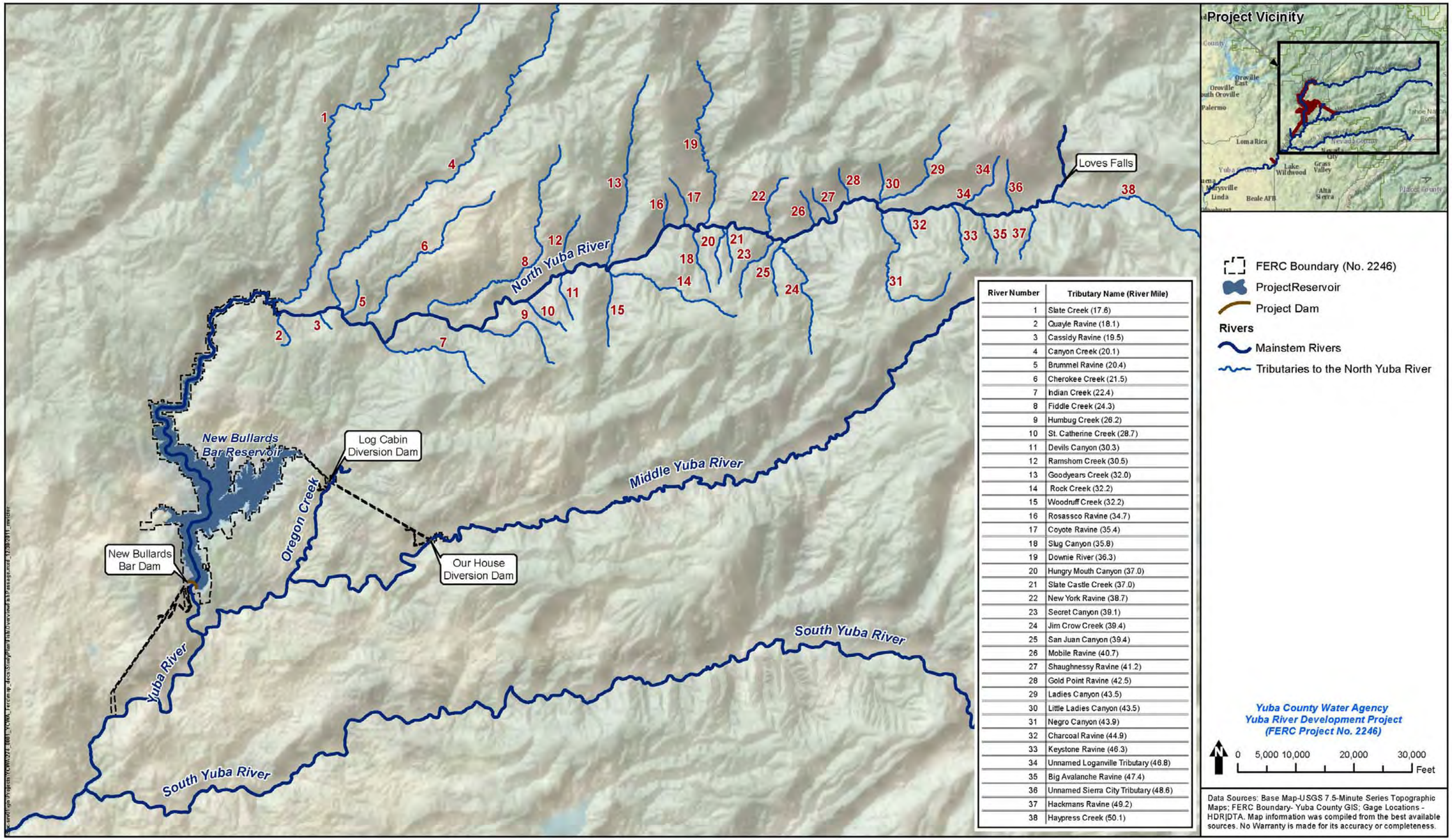

River Number	Tributary Name (River Mile)
1	Slate Creek (17.6)
2	Quayle Ravine (18.1)
3	Cassidy Ravine (19.5)
4	Canyon Creek (20.1)
5	Brummel Ravine (20.4)
6	Cherokee Creek (21.5)
7	Indian Creek (22.4)
8	Fiddle Creek (24.3)
9	Humbug Creek (26.2)
10	St. Catherine Creek (28.7)
11	Devils Canyon (30.3)
12	Ramshorn Creek (30.5)
13	Goodyears Creek (32.0)
14	Rock Creek (32.2)
15	Woodruff Creek (32.2)
16	Rosassco Ravine (34.7)
17	Coyote Ravine (35.4)
18	Slug Canyon (35.8)
19	Downie River (36.3)
20	Hungry Mouth Canyon (37.0)
21	Slate Castle Creek (37.0)
22	New York Ravine (38.7)
23	Secret Canyon (39.1)
24	Jim Crow Creek (39.4)
25	San Juan Canyon (39.4)
26	Mobile Ravine (40.7)
27	Shaughnessy Ravine (41.2)
28	Gold Point Ravine (42.5)
29	Ladies Canyon (43.5)
30	Little Ladies Canyon (43.5)
31	Negro Canyon (43.9)
32	Charcoal Ravine (44.9)
33	Keystone Ravine (46.3)
34	Unnamed Loganville Tributary (46.8)
35	Big Avalanche Ravine (47.4)
36	Unnamed Sierra City Tributary (48.6)
37	Hackmans Ravine (49.2)
38	Haypress Creek (50.1)

Figure 2.1-1. Overview map presenting the study area and notable tributaries, rivers, and Yuba River Development Project features.

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2.2 Salmon and Steelhead Leaping and Swimming Criteria

Analysis of potential upstream anadromous fish barriers was conducted using criteria developed by Powers and Orsborn (1985) for Chinook salmon and steelhead. According to Powers and Orsborn (1985), successful upstream passage is dependant on a number of factors, most notably barrier geometry, stream hydrology, and fish physical capabilities. Primary factors affecting adult fish capabilities include both the species and the maturity of the fish. Maturity (i.e. time in freshwater) is inversely correlated with fish condition.

Powers and Orsborn (1985) relate fish maturity to a coefficient of fish condition (Cfc) based on values of: 1.00 representing brightly-colored fish (i.e., fresh out of salt water with spawning colors not developed); 0.75 representing fish in good condition (i.e., in the river a short time with spawning colors apparent, but still migrating upstream); and 0.50 representing fish in poor condition (i.e., in the river a long time with spawning colors developed and close to spawning grounds). In general, steelhead are better leapers than Chinook salmon and fish with a higher Cfc are better leapers than fish with a low Cfc. Other factors affecting leaping ability include the trajectory of the fish attempting to pass over a barrier and the depth of the pool being exited. Shallow pools reduce the trajectory and limit jumping height. These primary factors and other more detailed components are further discussed by Powers and Orsborn (1985).

For purposes of this study, a Cfc of 0.75 was applied to represent the expected general condition of Chinook salmon and steelhead by the time they would have traveled (or been transported) upstream to the study area. Upstream travel would be a significant distance originating from the Bay-Delta, through the Sacramento River, through the lower Feather River, and finally to the upstream terminus of the Yuba River. Figure 2.2-2 illustrates the leaping abilities of Chinook salmon and steelhead for a Cfc of 0.75 (i.e., dashed line).

Given that a species' leaping abilities, Cfc rating, and hydraulics are primary influences on upstream fish passage, the ability for a fish to pass a barrier is variable and can change seasonally. Spring flow events may increase plunge pool depths and reduce barrier height, but may only be available to a certain species or a select portion of a fish population (e.g., when the fish are actively migrating, or running upstream).

Differences in migration characteristics between adult Chinook salmon and steelhead play a large part in passage success due to timing coinciding with higher stream flows versus that of lower flows. Run timing can vary significantly among different cohorts of Chinook salmon (i.e., spring or fall) and steelhead. Chinook salmon generally enter streams from the ocean coinciding with high flow events and generally hold for an extended period before spawning which may expose them to low flow periods. Steelhead enter streams from the ocean coinciding with higher spring flows, move high in the watershed, hold, and spawn during elevated flows (Moyle 2002). The extent to which either species would ascend upstream in the study area during elevated flows is an unknown factor that makes it difficult to determine at what flow a species would encounter a potential barrier.

This study was conducted in late summer 2011, which is low–flow period. Therefore, results and conclusions are based on instantaneous measurements from this period. Due to the high

variability in the factors affecting successful passage at a potential barrier, the application of an instantaneous measurement of barrier characteristics to determine fish upstream passage success provides an estimate of the actual ability of a fish to pass a potential barrier. The extent to which conclusions are made that some potential barriers may be passable at higher flows is based on best professional judgment by staff knowledgeable about fish passage and hydrologic stream conditions.

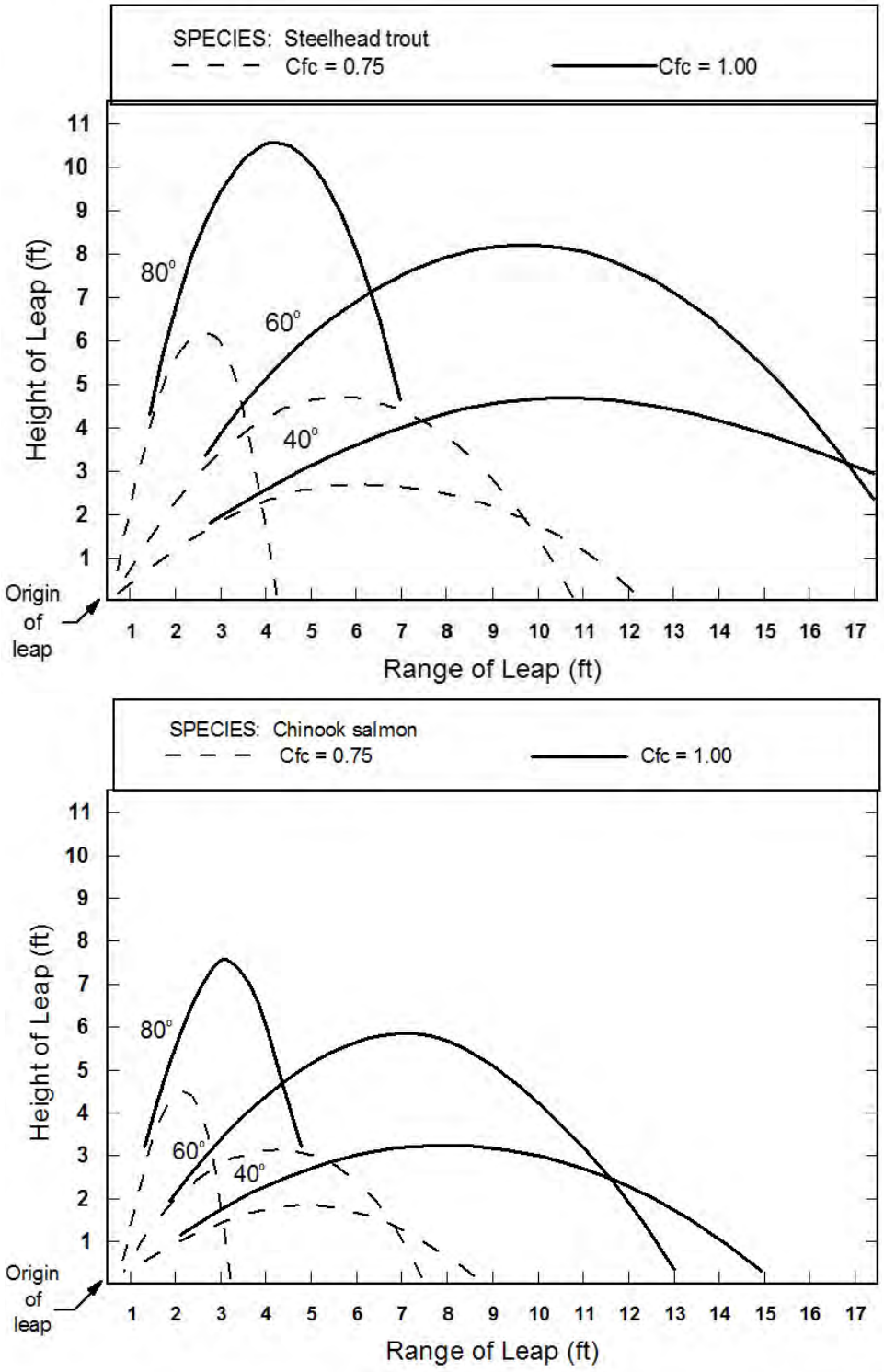

Figure 2.2-2. Chinook salmon and steelhead leaping capabilities based on coefficient of fish condition (Cfc). Cfc = 1 corresponds to a fish in bright condition fresh out of salt water, Cfc = 0.75 corresponds to a fish in the river a short time with spawning colors apparent and still migrating upstream (Vogel 2006 as adapted from Powers and Orsborn 1985).

2.3 Mainstem Surveys

Existing information in combination with the aerial videos (UYRSP 2002, YCWA 2009a, and YCWA 2009b) were used to identify the presence and location of stream features that could be potential barriers to anadromous fish upstream migration in the mainstem reaches identified in Section 2.1. Once identified, field staff conducted on-the-ground visits to each feature to determine if additional measurement was warranted. Features that could not be conservatively ruled out as a potential barrier based on professional judgment were measured. Barrier measurements followed the methods described in the Yuba-Bear and Drum-Spaulding relicensing Fish Barrier Study 3-16 Section 2.4.1, which is presented verbatim in Attachment 1.2D. Collected measurements were then assessed utilizing the criteria of Powers and Orsborn (1985) for Chinook salmon and steelhead. All sites that were prioritized for on-the-ground measurements were successfully accessed and surveyed.

All collected field data were entered onto a Fish Passage Assessment Field Data Form (Attachment 1.2E). Data collected at each mainstem stream feature included: photographs, Universal Transverse Mercator (UTM) coordinates in North American Datum 83 (NAD 83), estimated flow in cubic feet per second (cfs), water temperature (°C), and general site descriptions. Dimension measurements of the feature included: plunge pool depth (leaping pool); the long profile of the barrier from the plunge pool to the barrier crest (horizontal distance); wetted width; and the depth, configuration, and orientation of the crest (landing zone). All dimensional measurements were collected in feet (ft). Leaping heights were determined by surveying along the crest of the potential barrier with an auto level. All survey points were referenced to an arbitrary benchmark. In some instances, utilization of an auto level was not feasible due to access issues and instead a clinometer was used to measure leaping height.

2.4 North Yuba Tributary Surveys

A preliminary desktop assessment of tributaries listed in Section 2.1 was conducted using topographic mapping software (Terrain Navigator Pro© V.7), aerial video (YCWA 2009b), aerial photographs, drainage area, and available hydrological data. The purpose of the assessment was to identify which tributaries were accessible and potentially capable of supporting Chinook salmon and steelhead spawning.

Tributaries identified that did not provide spawning habitat for Chinook salmon and steelhead based on professional judgment and tributary attributes (i.e., flow was not perennial or excessively steep gradient) were summarily described and no further assessment was conducted. Tributaries that were determined to have potential Chinook salmon and steelhead spawning habitat were visited on-the-ground, and the tributary was walked for 0.5 mile upstream, starting from the confluence of the North Yuba River. If a potential barrier was identified prior to reaching 0.5 mile, the survey did not progress further. The majority of tributaries to the North Yuba River identified for ground assessment were visited and assessed (29 of 34). A small number of identified locations (5 of 34) were partially surveyed, but could not be fully accessed due to private property, unsafe terrain, or other safety concerns. Partially surveyed streams were identified within the results and summarized with available collected data.

All collected field data were entered onto a Fish Passage Assessment Field Data Form (Attachment 1.2E). Photographs, estimated flow (cfs), water temperature (°C), and general site descriptions (e.g., description of the confluence, channel characteristics, etc.) were documented. Dimension measurements of identified potential barriers included: plunge pool depth (leaping pool); the long profile of the barrier from the plunge pool to the barrier crest (horizontal distance); wetted width; and the depth of the crest (landing zone). All dimensional measurements were collected in ft. Leaping height was measured using a clinometer. All potential barriers and survey starting and ending points were marked with UTM coordinates (NAD 83). These methods were consistent with the Yuba-Bear and Drum-Spaulding relicensing Fish Passage Study 3-4 Section 2.2 and are presented verbatim in Attachment 1.2D.

3.0 Results

Section 3.0 presents the results of mainstem and tributary surveys. Photos of visited sites are displayed in Attachment 1.2A, collected data are presented in Attachment 1.2B, and maps showing study areas with survey outcomes are available in Attachment 1.2C.

3.1 Mainstem Surveys

The desktop assessment using aerial video (UYRSP 2002, YCWA 2009a, and YCWA 2009b) and other existing information identified 15 instream features that could be potential barriers to Chinook salmon and steelhead. The potential barriers were identified in the following stream reaches: three locations on the Yuba River; one location on the Middle Yuba River downstream of Our House Diversion Dam; six locations on the North Yuba River; and five locations on Oregon Creek downstream of Log Cabin Diversion Dam. Survey results and location of each identified instream feature are available in Table 3.1-1.

Table 3.1-1. Survey results, photo references, and location of instream features identified from mainstem reaches in 2011.

Stream	Feature No.	River Mile	Photo Attachment 1.2A Reference (Photo #)	Data Attachment 1.2B Reference[1] (Sheet #)	Summary of Survey Results
Yuba River	1	34.6	1, 2	NS	Helicopter access only, site flown on October 17, 2011 at flow of approximately 50 cfs. Photos taken, feature determined not to be a barrier.
	2	36.0	3-6	NS	Helicopter access only, site flown on October 17, 2011 at flow of approximately 50 cfs. Photos taken, feature determined not to be a barrier.
	3	38.0	7, 8	NS	Helicopter access only, site flown on October 17, 2011 at flow of approximately 50 cfs. Photos taken, feature determined not to be a barrier.
Middle Yuba River	1	0.4	9-13	1	Bedrock formed waterfall, site visit on September 21, 2011 at flow of approximately 45 cfs determined that feature is a low flow barrier, but would likely be passable at higher flows.

Table 3.1-1. (continued)

Stream	Feature No.	River Mile	Photo Attachment 1.2A Reference (Photo #)	Data Attachment 1.2B Reference[1] (Sheet #)	Summary of Survey Results
Oregon Creek	1	0.6	14, 15	2	Bedrock formed waterfall, site visit on September 20, 2011 at a flow of approximately 9 cfs determined that feature is a total barrier.
	2	1.0	16	NS	Documented on September 12, 2009 at a flow of approximately 2 cfs by YCWA (2011a). Identified series of falls with heights of 6 ft, 4 ft, 3ft, and 3ft.
	3	3.7	17	NS	Documented on October 4, 2009 at a flow of approximately 2 cfs by YCWA (2011a). Identified a 6 ft tall falls spilling over bedrock.
	4	4.1	18, 19	NS	Documented on October 4, 2009 at a flow of approximately 2 cfs by YCWA (2011a). Identified a 10 ft tall falls spilling over bedrock with a weir across the top of the crest.
	5	4.2	20	NS	Documented on October 4, 2009 at a flow of approximately 2 cfs by YCWA (2011a). Identified a 4 ft tall falls with a weir across the top of the crest.
North Yuba River	1	26.1	21-23	NS	Bedrock constricted channel creates a rapid. Site visit on September 22, 2011 at flow of approximately 190 cfs determined that feature is not a barrier.
	2	27.3	24, 25	NS	Bedrock constricted chute with side channel around left bank looking downstream. Site visit on September 22, 2011 at flow of approximately 190 cfs determined that feature is not a barrier.
	3	34.8	26-28	NS	Series of three falls located within 0.1 mile with deep leaping pools and estimated heights of 3-4 ft. Site visit on September 22, 2011 at flow of approximately 190 cfs determined that feature is not a barrier.
	4	43.2	29, 30	NS	Bedrock formed waterfall with deep leaping pool and estimated height of 3.5 ft. Site visit on September 22, 2011 at flow of approximately 140 cfs determined that feature is not a barrier.
	5	43.7	31	NS	Bedrock constricted channel with bedrock falls with estimated height of 3 ft. Site visit on September 22, 2011 at flow of approximately 140 cfs determined that feature is not a barrier.
	6	46.8	32-34	NS	Gillespie Dam site, YCWA (2011b) notes and photos from August 18, 2011 at a flow of approximately 200 cfs were reviewed and feature determined not to be a barrier, reported as 4.2 ft high.

[1] NS denotes no data sheet available because a site visit or available feature information determined that the feature was not a Chinook salmon or steelhead barrier and measurements were not needed.

3.1.1 Yuba River

Three locations on the Yuba River were identified as potential barriers to upstream anadromous salmonid passage. They were located at RMs 34.6, 36.0, and 38.0. The Yuba River between Englebright Reservoir and the confluence with the Middle Yuba River is primarily located in the bottom of a remote canyon with minimal access and steep canyon walls. Walking within the stream channel is dangerous and often impassable due to large "house-sized" boulder obstacles and sheer, vertical cliff channel margins.

A helicopter was utilized to safely assess fish passage at the three identified stream features from the air, but not from the ground. Field staff flew very close to the features and collected still photographs using a telephoto lens. At the time of assessment, flow in the Yuba River was visually estimated to be 50 cfs. The photos were subsequently used to visually characterize and estimate the dimensions of the features. From this aerial assessment, YSF Study Team's fishery biologists conservatively determined that each of the features did not pose fish passage barriers

to Chinook salmon and steelhead. As such, additional attempts to obtain ground-based measurements were not warranted.

3.1.2 Middle Yuba River

One location at RM 0.4 on the Middle Yuba River below Our House Diversion Dam was identified for further assessment. This feature was previously identified by Vogel (2006) as a potential barrier to upstream passage of anadromous salmonids. The potential barrier consisted of two falls spilling over bedrock, with the lower falls creating the potential barrier. Access to this feature was extremely difficult and required swimming sections of confined bedrock canyon pools. Additionally, there was no access above the feature. For these reasons, an auto level could not be utilized to make measurements of the leaping height of the potential barrier. Alternatively, the leaping height of this feature was measured using a clinometer.

Flow at the time of survey was estimated to be 45 cfs (CDEC 2011). The lower falls spilled over bedrock into a 5.5-ft-deep leaping pool. The lower falls were split into two separate falls each with a height of 8.5 ft. The left bank channel and right bank channel had a horizontal distance of 10.0 ft and 6.0 ft respectively, looking downstream. The majority of the flow was in the left bank channel. Given the measurements collected at the flow during the survey (i.e., 45 cfs), the feature is expected to be a barrier to Chinook salmon and steelhead based on leaping abilities from Powers and Orsborn (1985).

Although the feature appears to be a barrier at the relatively low flow during the time of survey, YSF Study Team's fishery biologists believe higher flows may allow passage of Chinook salmon and steelhead. Investigation of the plunge pool below the falls identified a strong hydraulic control at the tailout of the pool that would create a damming effect at higher flows. The damming effect would raise the pool level considerably and minimize the leaping distance required for successful Chinook salmon and steelhead passage.

3.1.3 Oregon Creek

The desktop assessment of Oregon Creek relied primarily upon existing survey data. This approach was necessary because dense tree canopy obstructed viewing the stream channel from the helicopter video (YCWA 2009a). The entire reach from the confluence with the Middle Yuba River upstream to Log Cabin Diversion Dam was walked by field staff during a previous habitat mapping study (YCWA 2011a). Based on results of YCWA (2011a), five features were identified as potential barriers to upstream migration of anadromous salmonids. For this study, only the furthest downstream feature on Oregon Creek located at RM 0.6 was prioritized for further investigation. Given the furthest downstream barrier was determined to be a total barrier, the remaining upstream features were not visited. Existing data from habitat mapping surveys (YCWA 2011a) were used to generally characterize the other four upstream barriers that were not visited during the current assessment.

At the time of survey, flow was estimated to be 9 cfs (CDEC 2011). The feature located at RM 0.6 consisted of a 10.8 ft-tall waterfall spilling onto bedrock. The location of the leaping pool was a horizontal distance of 16.5 ft from the barrier crest and had a depth of 3.3 ft. At the

flow during the time of survey (i.e., 9 cfs), the feature was considered to be a total barrier to upstream Chinook salmon and steelhead migration based on leaping abilities from Powers and Orsborn (1985). Given the combined height of the falls and the horizontal distance, YSF Study Team's fish biologists believe it is unlikely that Chinook salmon or steelhead could pass upstream of the feature at higher flows.

Upstream of the feature at RM 0.6, Oregon Creek passes through a bedrock-constricted canyon at approximately RM 0.9, where a series of falls create potential barriers (YCWA 2011a). Three more potential barriers were identified in the prior survey upstream of RM 0.9 that included another waterfall (RM 3.7) and two manmade weirs (RM 4.1 and 4.2) (YCWA 2011a). See Table 3.1-1 for descriptions of these features, which were not visited in the current survey because of the complete barrier at RM 0.6. Photos of the additional potential barriers are available in Attachment 1.2A.

3.1.4 North Yuba River

Coverage of the North Yuba River by the helicopter videos (YCWA 2009a and YCWA 2009b) provided an effective means to assess potential barriers to upstream anadromous salmonid migration; however, footage of the last 0.9 mile of the study area (i.e., upstream of the Haypress Creek confluence) was not available. Field staff attempted to walk this section of stream to confirm the presence or absence of potential fish barriers and were able to cover 0.7 mile of the distance safely. A bedrock-confined canyon prevented access to the last 0.2 mile. Flow was visually estimated at 22 cfs. Numerous falls between 3 and 4 ft high were encountered within the accessible 0.7 mile section, but no upstream migration barriers to Chinook salmon and steelhead were observed. Photos of typical habitat encountered during the survey are available in Attachment 1.2A (Photo #35-37), along with notes in Attachment 1.2B (Sheet 3).

Review of the helicopter video (YCWA 2009a) did not identify any potential barriers in the North Yuba River from the confluence of the Middle Yuba River to New Bullards Bar Dam. Upstream of New Bullards Bar Reservoir review of the helicopter video (YCWA 2009b) identified five features on the North Yuba River that were prioritized for further assessment. These features were located at RM 26.1, 27.3, 34.8, 43.2, and 43.7. Additionally, YSF's study 1.0 (YCWA 2011b) documented Gillespie Dam at RM 46.8 as a potential barrier.

Flow at many features varied due to tributary input and timing of the survey. Flow at the potential barriers located at RM 26.1 to 34.8 was estimated to be 190 cfs (below Downie River). At RM 43.2 and 43.7 (above Downie River), flow decreased to an estimated 140 cfs. Flow at Gillespie Dam (RM 46.8) was estimated to be 200 cfs (YCWA 2011b), but that was a result of the timing of the survey occurring earlier in the year during higher flows.

Site visits to the five features and a review of photos and notes from YCWA (2011b) of Gillespie Dam determined that none of the locations would prevent upstream migration of Chinook salmon and steelhead based on leaping abilities from Powers and Orsborn (1985). Further measurements were not warranted. See Table 3.1-1 for descriptions of the features.

3.2 North Yuba Tributary Surveys

As a summary, YSF Study Team found that the 38 tributaries to the North Yuba River listed in Section 2.1 could be divided into four categories:

- Twenty tributaries had minimal or no Chinook salmon and steelhead spawning habitat based on insufficient flow, excessively steep gradient, or a potential barrier located in close proximity of the confluence with the North Yuba River. Sixteen of these tributaries were examined in the field to make the determination and the remaining four were determined to not warrant site visits based on excessively steep gradient and relatively small watersheds.

- Eight tributaries had site visits conducted where field staff encountered a potential barrier to Chinook salmon and steelhead upstream migration within the first 0.5 mile upstream of the confluence.

- Five tributaries had site visits conducted and were determined to have Chinook salmon and steelhead habitat available within the area that could be accessed, although each of these tributaries was not fully accessible to field staff 0.5 mile upstream of the confluence due to private property or inaccessible/unsafe terrain.

- Five tributaries had site visits conducted within the full 0.5 mile upstream of the confluence and Chinook salmon or steelhead habitat was available.

Each of these categories is discussed below.

3.2.1 Tributaries with Minimal or No Chinook Salmon or Steelhead Habitat

The 20 tributaries that were found with minimal or no Chinook salmon or steelhead habitat generally had estimated flows less than 1 cfs and gradients greater than 15 percent. The goal of the study was not to assess habitat quality, but in many cases these streams were not usable for salmon or steelhead. So, it was necessary to identify if the stream provided usable habitat that warranted for a barrier assessment to be conducted.

The extent to which data was collected on tributaries that were determined not to have Chinook salmon or steelhead habitat varied. For tributaries that did not warrant site visits, photos and datasheets were not created. General notes were summarized from the topographic desktop assessment and are presented below (Table 3.2-1). Tributaries that did have site visits conducted were assessed in one of two ways, depending on the stream conditions found (e.g., flow and gradient). Tributaries showing no apparent usable habitat at the confluence were photographed and summarized with general notes (Table 3.2-1). Streams showing minimal available habitat were walked to the first significant potential barrier, where photos and measurements were collected. For all walked streams, there was very little available habitat. Table 3.2-1 provides location, photo reference, data reference, and a summary of results of all tributaries that were found to have minimal or no Chinook salmon or steelhead habitat.

Table 3.2-1. Location, attachment references, and summary of results for tributaries to the North Yuba River that were surveyed in 2011 and provided minimal or no Chinook salmon and steelhead habitat.

Tributary Name	Location		Photo Attachment 1.2A Reference[2] (Photo #)	Data Attachment 1.2B Reference[3] (Sheet #)	Summary of Results
	Enters LB or RB LDS[1]	River Mile			
Quayle Ravine	LB	18.1	NP	NS	No site visit warranted based on >20% gradient and small watershed size determined from topographic mapping software.
Cassidy Ravine	LB	19.5	NP	NS	No site visit warranted based on >30% gradient and small watershed size determined from topographic mapping software.
Brummel Ravine	RB	20.4	NP	NS	No site visit warranted based on >30% gradient and small watershed size determined from topographic mapping software.
St. Catherine Creek	LB	28.7	38, 39	4	Site visit conducted on August 16, 2011. Estimated flow at 0.25 cfs. Barrier in the form of a boulder and cobble pile with water flowing interstitially through the pile located 30 ft upstream of confluence.
Devils Canyon	LB	30.3	40-42	5	Site visit conducted on August 16, 2011. Estimated flow at 1.0 cfs. Barrier in the form of bedrock falls located 50 ft upstream of confluence. Additional barrier falls observed upstream.
Ramshorn Creek	RB	30.5	43-46	6	Site visit conducted on August 16, 2011. Estimated flow at 2.0 cfs. Barrier in the form of perched culvert under Hwy 49 located 500 ft upstream of confluence.
Rosassco Ravine	RB	34.7	47, 48	NS	Site visit conducted on August 17, 2011. Estimated flow at 1.0 cfs. No habitat available due to steep gradient and lack of flow.
Coyote Ravine	RB	35.4	NP	NS	Site visit conducted on August 17, 2011. Estimated flow at 0.5 cfs. No habitat available due to steep gradient and lack of flow.
Hungry Mouth Canyon	LB	37.0	49	NS	Site visit conducted on August 17, 2011. Estimated flow at 0.5 cfs. No habitat available due to steep gradient and impassable waterfalls observed 100 ft upstream of confluence.
Slate Castle Creek	LB	37.1	50-52	7	Site visit conducted on August 17, 2011. Estimated flow at 0.5 cfs. Barrier in the form of sheet flow over bedrock located 100 ft upstream of confluence.
New York Ravine	RB	38.7	53-56	NS	Site visit conducted on August 18, 2011. Estimated flow at 2.5 cfs. No habitat due to numerous impassable falls within 200 ft upstream of confluence and also box culvert under Hwy 49 would hinder passage.
Secret Canyon	LB	39.1	57, 58	8	Site visit conducted on August 18, 2011. Estimated flow at 3.0 cfs. Potential barrier in the form of bedrock falls located 30 ft upstream of confluence. Additional impassable falls observed within 200 ft upstream of confluence.
Mobile Ravine	RB	40.7	59, 60	NS	Site visit conducted on August 18, 2011. Estimated flow at 0.5 cfs. No habitat due to three perched culverts under Hwy 49 that would block passage and numerous impassable falls within 100 ft upstream of Hwy 49.
Shaughnessy Ravine	RB	41.2	61	NS	Site visit conducted on August 18, 2011. Estimated flow at 0.5 cfs. No habitat due to 10 ft high perched culvert under Hwy 49 that would block passage and steep gradient between confluence upstream to Hwy 49.
Gold Point Ravine	RB	42.5	62, 63	NS	Site visit conducted on August 18, 2011. Estimated flow at 0.25 cfs. No habitat due to 8-ft-high perched culvert under Hwy 49 that would block passage and steep gradient between confluence upstream to Hwy 49.
Charcoal Ravine	LB	44.9	NP	NS	No site visit warranted based on >20% gradient and small watershed size determined from topographic mapping software.
Keystone Ravine	LB	46.3	64-66	9	Site visit conducted on August 18, 2011. Estimated flow at 1.0 cfs. At flow available when assessed boulder and cobble delta at confluence create fish passage blockage due to a lack of channel connectivity. Additionally, a potential barrier in the form of boulder falls was located approximately 700 ft upstream with additional impassable boulder falls upstream. Overall lack of flow and steep gradient provide little to no habitat between confluence and potential barrier.

Table 3.2-1. (continued)

Tributary Name	Location		Photo Attachment 1.2A Reference[2] (Photo #)	Data Attachment 1.2B Reference[3] (Sheet #)	Summary of Results
	Enters LB or RB LDS[1]	River Mile			
Loganville Tributary (unnamed)	RB	46.8	NP	NS	Site visit conducted on August 19, 2011. Tributary was dry.
Big Avalanche Ravine	LB	47.4	67-70	10	Site visit conducted on August 19, 2011. Estimated flow at 3.5 cfs. At flow available when assessed overall high gradient of 10-15% and low flow would not provide habitat. Additionally, potential barrier in the form of boulder falls located approximately 300 ft upstream.
Sierra City Tributary (unnamed)	RB	48.6	71-73	NS	Site visit conducted on August 19, 2011. Estimated flow at 1.5 cfs. Approximately 100 ft upstream of confluence, impassable 30% grade concrete flue stops fish passage.

[1] LB = Left Bank, RB = Right Bank, LDS = Looking Down Stream.
[2] NP denotes no photo available due to either no site visit conducted or dense vegetation prevented photo opportunity.
[3] NS denotes no data sheet available as a site visit was not conducted or site visit determined that no Chinook salmon or steelhead habitat was available.

3.2.2 Tributaries with a Potential Chinook Salmon or Steelhead Barrier

The amount of accessible stream available to Chinook salmon and steelhead varied considerably among the eight tributaries where potential barriers were found. Humbug Creek, Slug Canyon, Negro Canyon, and Hackman's Ravine all had potential barriers identified within the first 600 ft upstream of the confluence with the North Yuba River. Additionally, the dimensions recorded at potential barriers on these tributaries were much greater than the leaping abilities of Chinook salmon and steelhead and, therefore, YSF Study Team's fish biologists believe these barriers would likely be total barriers even at higher flows.

Other tributaries had potential barriers, but offered significant habitat leading up to the potential barrier. Cherokee Creek, Fiddle Creek, Woodruff Creek, and Rock Creek were all accessible for both Chinook salmon and steelhead for well over 1,000 ft upstream of the confluence with the North Yuba River. The potential barriers identified in those streams were considered not passable at the flows during the time of survey; however, YSF Study Team's fish biologists believe it is possible that the potential barriers in Cherokee Creek, Woodruff Creek, and Rock Creek could be passable to steelhead and, in some cases, possibly to Chinook salmon at higher flows. Table 3.2-2 provides a location, photo reference, data reference, and a summary of results of all tributaries that had a potential Chinook salmon and steelhead barrier.

Table 3.2-2. Location, attachment references, and summary of results for tributaries to the North Yuba River that were surveyed in 2011 and were found to have a potential barrier to Chinook salmon and steelhead.

Tributary Name	Location		Photo Attachment 1.2A Reference (Photo #)	Data Attachment 1.2B Reference (Sheet #)	Summary of Results
	Enters LB or RB LDS[1]	River Mile			
Cherokee Creek	RB	21.5	74-76	11	Survey conducted on September 14, 2011. Flow estimated at 5 cfs. Potential barrier in the form of falls over bedrock located approximately 1,300 ft upstream of confluence consisting of a 6.0-ft-deep leaping pool with a height of 7.0 ft and a horizontal distance of 7.0 ft. Would not be passable at the flow at time of survey based on criteria from Powers and Orsborn (1985), but could be passable to steelhead and possibly Chinook salmon at higher flows. Gradient picks up considerably upstream of potential barrier and additional potential barriers are likely a short distance upstream.
Fiddle Creek	RB	24.3	77-80	12	Survey conducted on August 16, 2011. Flow estimated at 4 cfs. Potential barrier in the form of falls over bedrock located approximately 2,600 ft upstream of confluence consisting of a 7.0-ft-deep leaping pool with a height of 18.0 ft and a horizontal distance of 12.0 ft. Would be a total barrier to Chinook salmon and steelhead at any flow based on criteria from Powers and Orsborn (1985).
Humbug Creek	LB	26.2	81, 82	13	Survey conducted on August 16, 2011. Flow estimated at 3.5 cfs. Potential barrier in the form of falls over bedrock located approximately 600 ft upstream of confluence consisting of a 1.0-ft-deep leaping pool with a height of 10.5 ft and a horizontal distance of 14.0 ft. Would be a total barrier to Chinook salmon and steelhead at any flow based on criteria from Powers and Orsborn (1985).
Rock Creek	LB	32.2	83-85	14	Survey conducted on August 17, 2011. Stream merges with Woodruff Creek approximately 750 ft upstream of confluence with North Yuba River. Flow estimated at 4.5 cfs. Potential barrier in the form of cement diversion dam located approximately 1,700 ft upstream of the North Yuba River confluence consisting of a 2.8-ft-deep leaping pool with a height of 4.0 ft and a horizontal distance of 2.5 ft. Based on criteria from Powers and Orsborn (1985), Chinook salmon and steelhead leaping abilities are within the dimensions of the diversion dam, although the shallow leaping pool depth would likely prevent successful passage at the observed flow. Higher flows would likely allow passage of Chinook salmon and steelhead.
Woodruff Creek	LB	32.2	86-90	15	Survey conducted on August 17, 2011. Stream merges with Rock Creek approximately 750 ft upstream of confluence with North Yuba River. Flow estimated at 4 cfs above the Rock Creek confluence. Two potential barriers in the form of diversion dams located at 1,600 ft and 2,600 ft upstream of the North Yuba River confluence. The first diversion dam consists of a 2.5-ft-deep leaping pool with a height of 5.5 ft and a horizontal distance of 2.0 ft. The second diversion dam consists of a 3.5 ft deep leaping pool with a height of 4.5 ft and a horizontal distance of 2.0 ft. There is a fish ladder built into the upper diversion dam for resident fish, but is likely undersized for Chinook salmon or steelhead passage. Based on criteria from Powers and Orsborn (1985), steelhead leaping abilities are within the dimensions of both diversion dams, although the shallow leaping pool depth at the lower dam would likely prevent successful passage at the flow during observations. Higher flows would likely allow passage of steelhead over both dams and possibly Chinook salmon.
Slug Canyon	LB	35.8	93	16	Survey conducted on August 17, 2011. Flow estimated at 3.0 cfs. Potential barrier in the form of falls over boulder and large woody debris (LWD) located approximately 300 ft upstream of confluence consisting of a 2.3-ft-deep leaping pool with a height of 9.0 ft and a horizontal distance of 13.0 ft. Expected to be a total barrier at any flow based on criteria from Powers and Orsborn (1985).

Table 3.2-2. (continued)

Tributary Name	Location		Photo Attachment 1.2A Reference (Photo #)	Data Attachment 1.2B Reference (Sheet #)	Summary of Results
	Enters LB or RB LDS[1]	River Mile			
Negro Canyon	LB	43.9	94-98	17	Survey conducted on August 18, 2011. Flow estimated at 4.5 cfs. Two falls over bedrock creating potential barriers located at 400 ft and 500 ft upstream of the North Yuba River confluence. The first consists of a 4.0-ft-deep leaping pool with a height of 5.0 ft and a horizontal distance of 9.0 ft. The second consists of a 10.0-ft-deep leaping pool with a height of 8.4 ft and a horizontal distance of 5.0 ft. Based on criteria from Powers and Orsborn (1985), steelhead leaping abilities are at the upper limit of the dimensions of the lower potential barrier. Chinook leaping abilities are inadequate. If steelhead could pass the lower potential barrier, it is likely that the upper potential barrier would prevent further passage except possibly at the highest flows. Additionally a high gradient bedrock canyon above the second potential barrier would likely prevent further passage at any flow.
Hackmans Ravine	LB	49.2	99-102	18	Survey conducted on September 23, 2011. Flow estimated at 1.5 cfs. Two potential barriers located at 400 ft and 600 ft upstream of the North Yuba River confluence. The first consists of a bedrock chute with a 0.9-ft-deep leaping pool a height of 5.8 ft and a horizontal distance of 18.0 ft. The second consists of a 1.0-ft-deep leaping pool with a height of 9.0 ft and a horizontal distance of 18 ft. Both potential barriers are expected to be total barriers at any flow to Chinook salmon and steelhead based on criteria from Powers and Orsborn (1985).

[1] LB = Left Bank, RB = Right Bank, LDS = Looking Down Stream.

3.2.3 Tributaries That Could Not Be Fully Surveyed

Five tributaries could not be fully surveyed to 0.5 mile upstream of the confluence with the North Yuba River. In four of the tributaries (i.e., Jim Crow Creek, San Juan Canyon, Ladies Canyon, and Little Ladies Canyon), private property was encountered and the surveys were halted short of the goal of 0.5 mile upstream of the confluence. An attempt to contact landowners was not successful. On Canyon Creek, field staff encountered an inaccessible bedrock canyon and could not proceed with the survey safely.

Although surveys were stopped short of the study goal of 0.5 mile in these five tributaries, considerable areas of most of the tributaries were surveyed. In Canyon Creek, the field crew was able to access over 1,000 ft, and in Jim Crow Creek and San Juan Canyon they accessed almost 2,000 ft. Habitat for Chinook salmon and steelhead in the surveyed area of these three streams was good. Based on topographic mapping software, relatively low gradient in the stream channels would make a potential barrier within 0.5 mile of the confluence unlikely. In Ladies Canyon and Little Ladies Canyon (tributary to Ladies Canyon), the field crew was unable to access any of the stream due to private property posted at the confluence. Table 3.2-3 provides a location, photo reference, data reference, and a summary of results of all tributaries that could not be fully surveyed to 0.5 mile upstream of the confluence.

Table 3.2-3. Location, attachment references, and summary of results for tributaries to the North Yuba River that were surveyed in 2011 that could not be fully surveyed to 0.5 mile upstream of the confluence.

Tributary Name	Location		Photo Attachment 1.2A Reference[2] (Photo #)	Data Attachment 1.2B Reference[3] (Sheet #)	Summary of Results
	Enters LB or RB LDS[1]	River Mile			
Canyon Creek	RB	20.1	103-106	19	Survey conducted on September 14, 2011. Flow estimated at 30 cfs. Field crew was able to survey from the confluence upstream approximately 1,300 ft to an inaccessible bedrock constricted canyon with a potential barrier located at the base in the form of falls over bedrock. Measurements were estimated as field staff could not access the potential barrier. Estimates of the potential barrier dimensions consisted of a 4-ft-deep leaping pool with a height of 6 ft and a horizontal distance of 5 ft. Based on criteria from Powers and Orsborn (1985), steelhead leaping abilities are within the dimensions of the feature and would likely pass. Higher flows would also likely allow passage of Chinook salmon.
Jim Crow Creek	LB	39.4	107-109	20	Survey conducted on August 18, 2011. Stream merges with San Juan Canyon approximately 1,500 ft upstream of the confluence with the North Yuba River. Flow estimated at 8 cfs upstream of San Juan Canyon and 12 cfs downstream. Field crew was able to survey from the confluence with the North Yuba River upstream approximately 1,740 ft to a point where private property prevented further access. Habitat to this point was good and no potential barriers would be expected to occur up to the 0.5 mile point based on low gradient observed from topographic mapping software.
San Juan Canyon	LB	39.4	110, 111	21	Survey conducted on August 18, 2011. Stream merges with Jim Crow Creek approximately 1,500 ft upstream of confluence with the North Yuba River. Flow estimated at 4 cfs upstream of Jim Crow Creek and 12 cfs downstream. Field crew was able to survey from the confluence of the North Yuba River upstream approximately 1,900 ft to a point where private property prevented further access. Habitat to this point was good and no potential barriers would be expected to occur up to the 0.5 mile point based on low gradient observed from topographic mapping software.
Ladies Canyon	RB	43.5	112, 113	NS	Site accessed on September 22, 2011. Flow estimated at 5 cfs. Stream merges with Little Ladies Canyon approximately 830 ft upstream of confluence with the North Yuba River. Private property is posted on the stream bank at Hwy 49 crossing. Field crew was able to see from the confluence with the North Yuba River upstream approximately 200 ft. The stream flows under a bridge at Hwy 49 and three passable falls were observed upstream from the confluence. Based on gradient from topographic mapping software it is likely that a potential barrier could occur within 0.5 mile upstream of the confluence.
Little Ladies Canyon	RB	43.5	NP	NS	Site could not be accessed due to private property. Stream merges with Ladies Canyon approximately 830 ft upstream of confluence with the North Yuba River. Based on gradient from topographic mapping software and the limited size of the watershed it is likely that the stream provides limited, if any, Chinook salmon and steelhead habitat. Also, a potential barrier could be located downstream on Ladies Canyon that would prevent any access to the stream.

[1] LB = Left Bank, RB = Right Bank, LDS = Looking Down Stream.
[2] NP denotes no photo available because field staff could not access stream due to private property issues.
[3] NS denotes no data sheet available because field staff could not access stream due to private property issues.

3.2.4 Fully Accessed Tributaries with Available Habitat

Five tributaries were fully surveyed to 0.5 mile upstream of the North Yuba River confluence. These tributaries all had a relatively large stream channel, low gradient, and substantial flow. Chinook salmon and steelhead habitat within these streams was good and spawning gravels were available. Table 3.2-4 provides a location, photo reference, data reference, and a summary of results.

Table 3.2-4. Location, attachment references, and summary of results for tributaries to the North Yuba River that were surveyed in 2011 and had Chinook salmon or steelhead habitat 0.5 mile upstream of the confluence with the North Yuba River.

Tributary Name	Location		Photo Attachment 1.2A Reference (Photo #)	Data Attachment 1.2B Reference (Sheet #)	Summary of Results
	Enters LB or RB LDS[1]	River Mile			
Slate Creek	RB	17.6	114-117	22	Survey conducted on September 20, 2011. Flow estimated at 20 cfs. Field crew was able to survey from the confluence upstream to the 0.5 mile end point. No fish barriers were observed. The stream gradient ranged from 2 to 4% with many deep and long bedrock formed pools. Spawning gravels were available. Kokanee and trout were observed in the stream.
Indian Creek	LB	22.4	118-121	23	Survey conducted on September 16, 2011. Flow estimated at 3.5 cfs. Field crew was able to survey from the confluence upstream to the 0.5 mile end point. No fish barriers were observed. The stream gradient averaged 5% with boulder and cobble step pools and runs with good holding pools. Spawning gravels were not abundant.
Goodyears Creek	RB	32	122-123	24	Survey conducted on August 16, 2011. Flow estimated at 7.5 cfs. Field crew was able to survey from the confluence upstream to the 0.5 mile end point. No fish barriers were observed. The stream gradient ranged from 2 to 4%. Spawning gravels were available.
Downie River	RB	36.3	124-125	25	Survey conducted on August 16, 2011. Flow estimated at 20 cfs. Field crew was able to survey from the confluence upstream to the 0.5 mile end point. No fish barriers were observed. The stream gradient averaged 2%. Spawning gravels were available.
Haypress Creek	LB	50.1	126-130	26	Survey conducted on August 19, 2011. Flow estimated at 30 cfs. The stream gradient averaged 3%. Field crew was able to survey from the confluence upstream to the 0.5 mile end point. One stream feature in the form of falls over bedrock with a 10-ft-deep leaping pool was located 600 ft upstream of the confluence. The falls had unique geometry that included a step from which fish could make a second leap. The largest leap consisted of a height of 4 ft and a horizontal distance of 7 ft. Based on criteria from Powers and Orsborn (1985), steelhead leaping abilities are within the dimensions of the falls and would likely pass at the relatively low flow during the time of survey. Chinook salmon leaping abilities are inadequate at the flow during the survey, but higher flows would likely allow passage.

[1] LB = Left Bank, RB = Right Bank, LDS = Looking Down Stream.

4.0 Discussion

The YSF Study Team reviewed existing literature to compare current findings to existing research or literature. For this exercise, the YSF Study Team included historical barrier information available for the South Yuba River to be comprehensive; however, the South Yuba was not included within the scope of this Study. The YSF Study Team identified four previous studies that addressed, at least in part, fish passage on the Middle and/or South Yuba River. Other than the fish passage data previously summarized from the Oregon Creek habitat mapping

study YCWA (2011a), no other fish passage studies were identified on Oregon Creek. Previous fish passage studies were not identified for the Yuba River, and the North Yuba River.

Three of the four identified studies employed fish passage criteria that were not comparable to the current assessment. The criteria were based on passage of adult resident rainbow trout and, therefore, do not identify potential barriers to adult Chinook salmon or steelhead. However, these studies still provide valuable information about potential instream features that can inhibit fish passage in the mainstems and tributaries to the Middle Yuba and South Yuba rivers. A description of each of these three studies is provided below:

- *Middle and South Yuba Rainbow Trout (Oncorhynchus mykiss) Distribution and Abundance Dive Counts August 2004 – Appendix G of CDWR (2007)* (Gast et al. 2005). As part of the study, potential migration barriers to trout were identified when encountered during surveys in the Middle Yuba and South Yuba rivers and their principal tributaries.
- *Technical Memorandum 3-4 Fish Passage* (PG&E and NID 2010a). In this study, surveys were conducted in principal tributaries to the Middle Yuba and South Yuba rivers 0.5 miles upstream of the confluence with the Middle and South Yuba rivers or to the first impassable resident trout barrier, whichever was encountered first.
- *Technical Memorandum 3-16 Fish Barriers* (PG&E and NID 2011). In this study, a hydraulic analysis was conducted to determine if resident rainbow trout could pass upstream of three barriers located on the lower South Yuba River.

The fourth study did identify potential barriers to adult Chinook salmon and steelhead. *This study focused on the mainstems of* the Middle and South Yuba rivers and is titled, *Assessment of Adult Anadromous Salmonid Migration Barriers and Holding Habitats in the Upper Yuba River – Appendix C of CDWR (2007)* (Vogel 2006). For this study, Vogel (2006) identified potential barriers from a helicopter in 2002 and then conducted field assessments to some of the more accessible barriers in August 2003 and August 2005. The report provides an inventory of the location and geometry of larger salmon and steelhead barriers. The general assessment was hypothetical, as salmon and steelhead do not currently occur in these rivers. In general, Vogel (2006) applied the physical parameters of Powers and Orsborn (1985) to determine how each potential barrier may affect upstream salmon and steelhead passage. As a reconnaissance-level survey, the features of potential barriers were estimated.

Vogel (2006) identified eight sites on the mainstem of the Middle Yuba River to be barriers to salmon and steelhead upstream passage: six were considered barriers only during low-flow conditions, and two were considered to be total barriers regardless of flow conditions. These sites are described in Table 4.0-1.

While Vogel (2006) surveyed the entire Middle Yuba River, the current assessment surveyed to YCWA's Our House Diversion Dam (RM 12.0). In the survey area that overlapped (RM 0.0 – 12.0), similar findings were documented. Only one barrier was identified by Vogel (2006) and the current assessment at RM 0.4. This barrier was determined by both studies as a low flow barrier, but passable at higher flows based on professional judgment.

Table 4.0-1. Potential barriers to upstream passage by salmon and steelhead in the mainstem of the Middle Yuba River identified by Vogel (2006).

Location (River Mile)	Feature	Comments
0.4	low-flow barrier	site visit, 2 falls in series, lower falls 9 feet, upper falls 6 feet, shallow (< 3 feet) plunge pool
12.0	low and high-flow barrier	site visit, est. dam height at spillway approx. 52 feet high, total barrier
32.7	low-flow barrier	est. falls 8-10 feet high, plunge pool appears to have some blocking boulders, may be a low-flow barrier but not a high-flow barrier
32.9	low-flow barrier	est. falls 8-10 feet high, plunge pool appears to have some blocking boulders, may be a low-flow barrier but not a high-flow barrier
34.4	low & high-flow barrier	low-flow-barrier more than 10 feet high, large landslide, probably a high-flow-barrier
36.8	low-flow barrier	possible low-flow barrier, falls appears about 8-10 feet high, probably not a high-flow barrier
37.9	low-flow barrier	very difficult to see but appear falls may be at least 10 feet tall, probably low-flow barrier but not high-flow barrier
38.9	low-flow barrier	very difficult to see but appear falls may be at least 10 feet tall, probably low-flow barrier but not high-flow barrier

Vogel (2006) identified fourteen sites on the mainstem of the South Yuba River to be barriers to salmon and steelhead upstream passage: three were considered barriers only during low-flow conditions, and eleven were considered to be total barriers regardless of flow conditions. These sites are described in Table 4.0-2.

Table 4.0-2. Potential barriers to upstream passage by salmon and steelhead in the mainstem of the South Yuba River identified by Vogel (2006).

Location (River Mile)	Feature	Comments
5.1	low-flow barrier	est. height about 9 feet, complex falls/cascades over large boulders/bedrock with poor plunge pool, possible low-flow barrier but not high-flow barrier
5.9	low-flow barrier	site visit, 9.5-ft height, boulder at critical location in plunge pool, low-flow barrier but not high-flow barrier
19.6	low-flow barrier	site visit, low-flow barrier, not a barrier during high flows, measured height of 8 feet
35.4	low- & high-flow barrier	site visit, two falls, lower fall 13 feet, upper fall 7.5 feet, lower plunge pool very deep, depth of second plunge pool undetermined, both low and high-flow barrier
36.0	low- & high-flow barrier	site visit, measured height 17 feet, total (low and high-flow) barrier
37.9	low- & high-flow barrier	est. height more than 10 feet, poor plunge pool, cascades over bedrock, est. total barrier
38.4	low- & high-flow barrier	est. height of lower falls 15 feet, upper falls, 10 feet, total barrier
39.4	low- & high-flow barrier	est. height over 15 feet, poor plunge pool, total barrier
39.4	low- & high-flow barrier	est. height over 15 feet, poor plunge pool, falls and cascades over bedrock, total barrier
39.5	low- & high-flow barrier	est. height over 15 feet, poor plunge pool, falls and cascades over bedrock, total barrier
39.6	low- & high-flow barrier	est. height over 10 feet, total barrier
39.6	low- & high-flow barrier	est. height over 10 feet, total barrier
39.6	low- & high-flow barrier	complex series of falls est. height over 15-20 feet, cascades over bedrock, total barrier
39.8	low- & high-flow barrier	est. height over 10 feet, total barrier

5.0 List of Attachments

There are five attachments to this report:

- Attachment 1.2A Fish Passage Photographs [1 Adobe PDF file: 10.5 MB; 62 pages formatted to print double sided on 8 ½ by 11 paper.]
- Attachment 1.2B Fish Passage Data [1 Adobe PDF file: 334 kB; 40 pages formatted to print double sided on 8 ½ by 11 paper.]

- Attachment 1.2C — Fish Passage Maps [1 Adobe PDF file: 5.82 MB; 2 pages formatted to print double sided on 8 ½ by 11 paper and 9 pages formatted to print double sided on 11x17.]
- Attachment 1.2D — Excerpt of Methods from PG&E/NID's Fish Passage Assessments (PG&E/NID 2011 and PG&E/NID 2010) [1 Adobe PDF file: 22 kB; 4 pages formatted to print double sided on 8 ½ by 11 paper.]
- Attachment 1.2E — Field Data Form [1 Adobe PDF file: 114 kB; 3 pages formatted to print double sided on 8 ½ by 11 paper.]

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____. 2009b. Aerial video of the North Yuba River above New Bullards Reservoir Stream flow gaging station to Haypress Falls (Flow = 100 cfs at gaging station). October 6, 2009, by HDR.

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Yuba Salmon Forum
Fish Passage Study Report

Attachment 1

Fish Passage Photos

This photo log contains images of general habitat and potential barriers identified by YCWA during fish passage assessments conducted for the Fish Passage Study in support of the Yuba Salmon Forum Fish Passage Study Report. Mainstem photos are presented first followed by tributary photos. Photos were not available for all tributaries that were assessed during this study due to one of the following reasons: no site visit conducted, private property issues, or dense vegetation prevented a photo opportunity. When more than one feature was encountered within a stream, it was labeled with a feature number, which corresponds to the order in which the barrier was encountered within the stream moving in an upstream direction (i.e. 1, 2, 3). When more than one photo was taken at a feature, the photos are differentiated by consecutive letters of the alphabet (i.e. barrier1a, barrier 1b). All references to left or right bank are oriented looking downstream.

List of Photos

List of Photos (continued)

List of Photos (continued)

List of Photos (continued)

Yuba River

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Photo 1. Yuba R. feature 1a far view looking upstream

Photo 2. Yuba R. feature 1b far view looking upstream

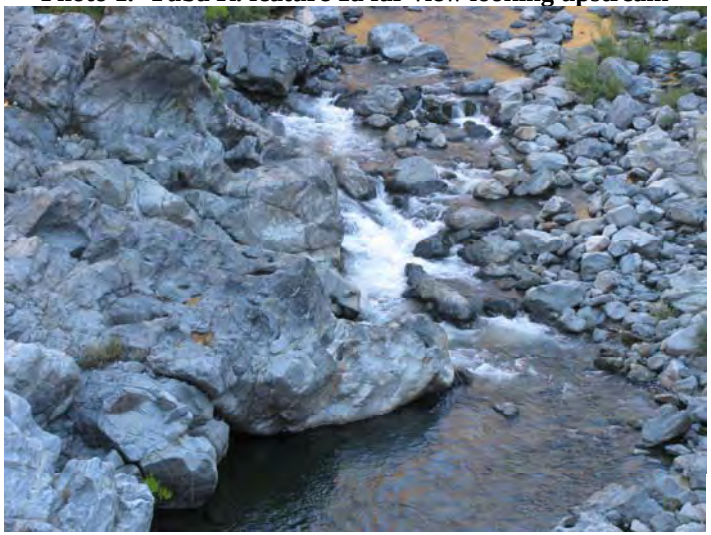

Photo 3. Yuba R. feature 2a far view looking upstream

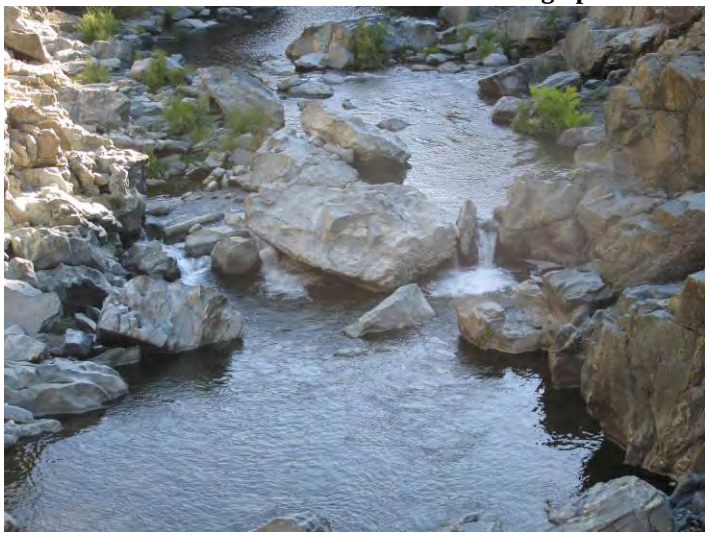

Photo 4. Yuba R. feature 2b far view looking upstream

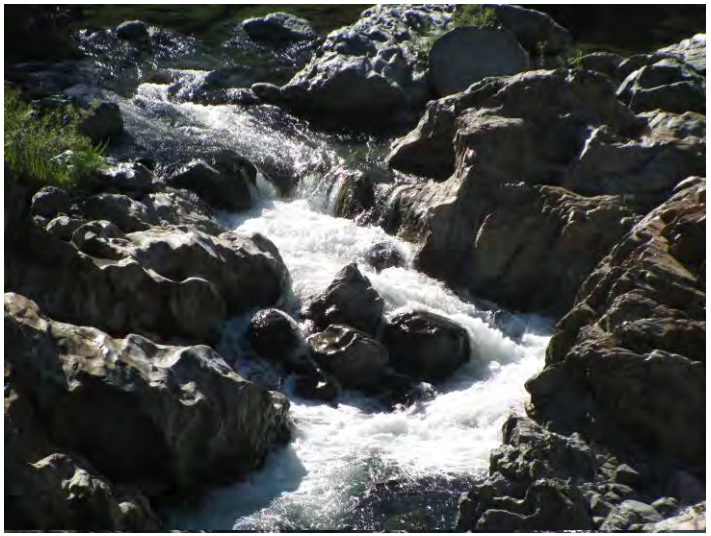

Photo 5. Yuba R. feature 2c close view looking upstream

Photo 6. Yuba R. feature 2d far view looking upstream

Photo 7. Yuba R. feature 3a close view looking upstream

Photo 8. Yuba R. feature 3b close view looking upstream

Middle Yuba River

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Photo 9. Middle Yuba R. feature 1a looking at right bank.

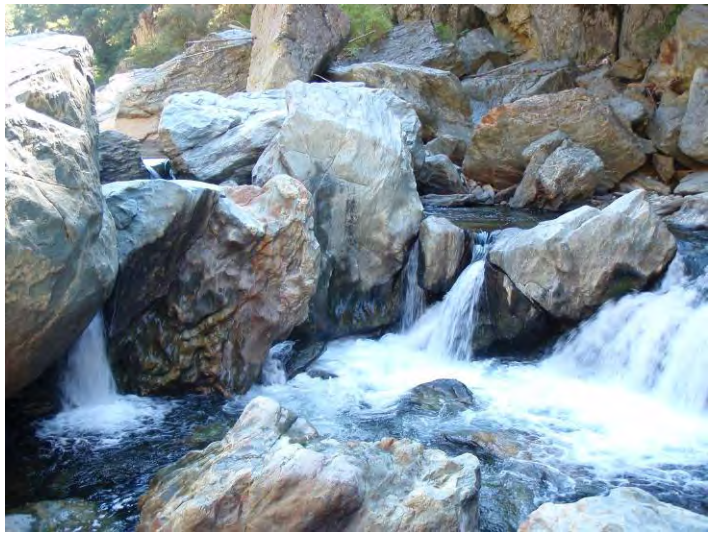

Photo 10. Middle Yuba R. feature 1b looking at center.

Photo 11. Middle Yuba R. feature 1c looking at landing pool.

Photo 12. Middle Yuba R. feature 1d looking at right bank

Photo 13. Middle Yuba R. feature 1e looking at hydraulic control

Oregon Creek

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Photo 14. Oregon Creek looking upstream at feature 1a.

Photo 15. Oregon Creek looking upstream at feature 1b.

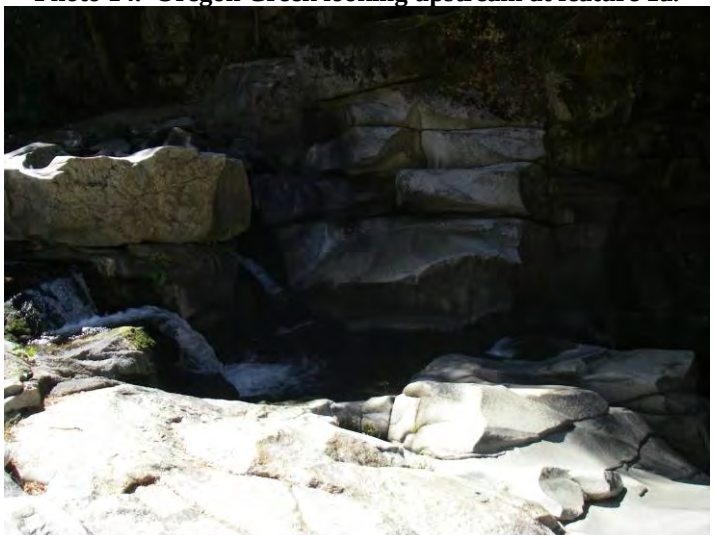

Photo 16. Oregon Creek looking at feature 2

Photo 17. Oregon Creek feature 3 looking upstream

Photo 18. Oregon Creek feature 4a looking upstream

Photo 19. Oregon Creek feature 4b looking upstream

Photo 20. Oregon Creek feature 5 looking upstream

North Yuba River

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Photo 21. North Yuba feature 1a

Photo 22. North Yuba feature 1b.

Photo 23. North Yuba feature 1c

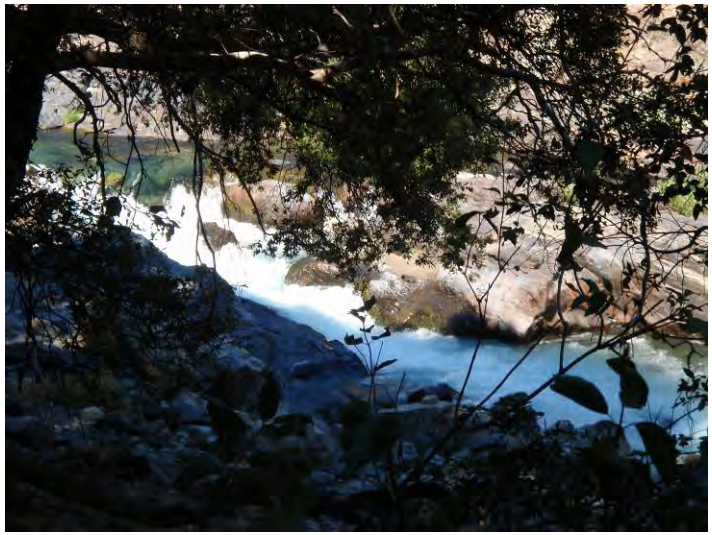

Photo 24. North Yuba Feature 2a at chute

Photo 25. North Yuba R. feature 2b side channel looking downstream

Photo 26. North Yuba R. feature 3a farthest downstream falls

Photo 27. North Yuba R. feature 3b farthest upstream falls

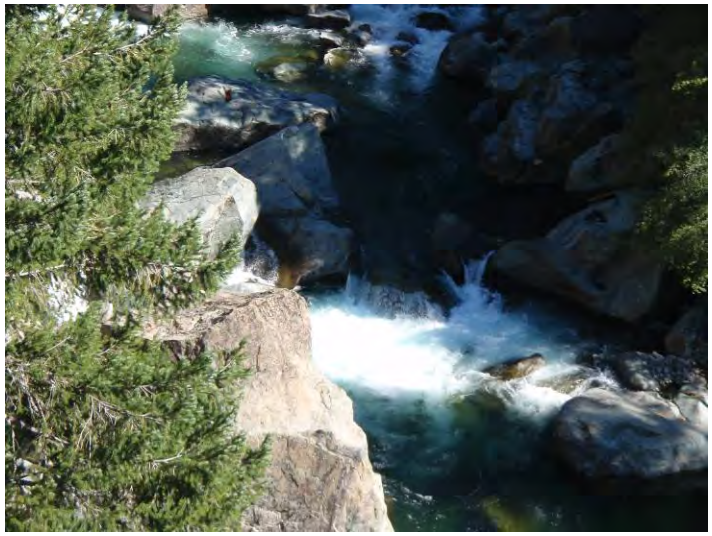

Photo 28. North Yuba R. feature 3c middle falls

Photo 29. North Yuba R. feature 4a far

Photo 30. North Yuba R. feature 4b close

Photo 31. North Yuba R. feature 5 looking upstream

Photo 32. North Yuba R. feature 6a Gillespie Dam

Photo 33. North Yuba R. feature 6b Gillespie Dam

Photo 34. North Yuba R. feature 6c Gillespie Dam

Photo 35. North Yuba R. looking upstream typical habitat

Photo 36. North Yuba R. looking upstream at end point a

Photo 37. North Yuba R. looking upstream at end point b

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Tributaries with Minimal or No Chinook Salmon or Steelhead Habitat

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Photo 38. St. Catherine Cr. at confluence

Photo 39. St. Catherine Cr. barrier 1

Photo 40. Devils Canyon looking downstream at confluence

Photo 41. Devils Canyon looking upstream at confluence

Photo 42. Devils Canyon barrier 1

Photo 43. Ramshorn Cr. looking downstream at confluence

Photo 44. Ramshorn Cr looking upstream at confluence

Photo 45. Ramshorn Cr. barrier 1a

Photo 46. Ramshorn Cr barrier 1b at culvert mouth

Photo 47. Rossasco Ravine downstream of Hwy 49

Photo 48. Rossasco Ravine typical habitat upstream of Hwy 49

Photo 49. Hungry Mouth Canyon looking upstream at confluence

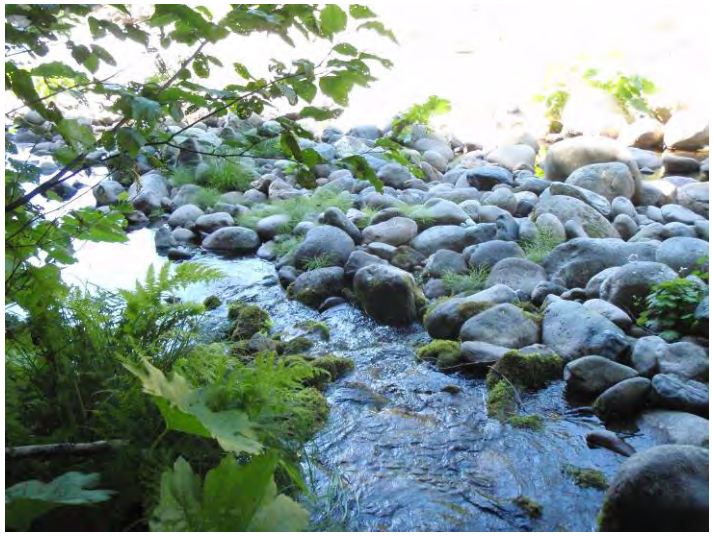

Photo 50. Slate Castle Cr. looking downstream at confluence

Photo 51. Slate Castle Cr. looking upstream at confluence

Photo 52. Slate Castle Cr. barrier 1

Photo 53. New York Ravine looking downstream at confluence

Photo 54. New York Ravine looking upstream at confluence

Photo 55. New York Ravine at falls 1

Photo 56. New York Ravine at falls 2

Photo 57. Secret Canyon looking downstream at confluence

Photo 58. Secret Canyon barrier 1

Photo 59. Mobile Ravine looking upstream at confluence

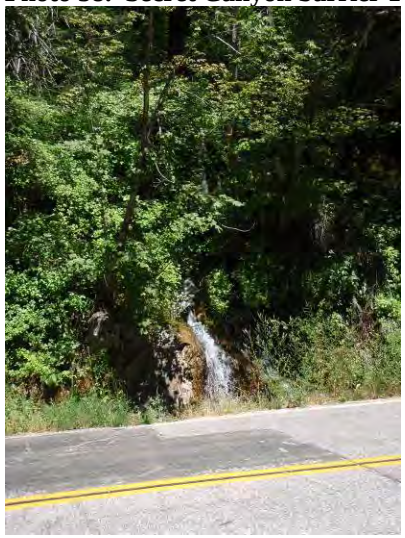

Photo 60. Mobile Ravine at falls upstream of Hwy 49

Photo 61. Shaughnessy Ravine looking downstream at culvert

Photo 62. Gold Point Ravine looking upstream at culvert

Photo 63. Gold Point Ravine looking upstream of Hwy 49

Photo 64. Keystone Ravine looking downstream at confluence

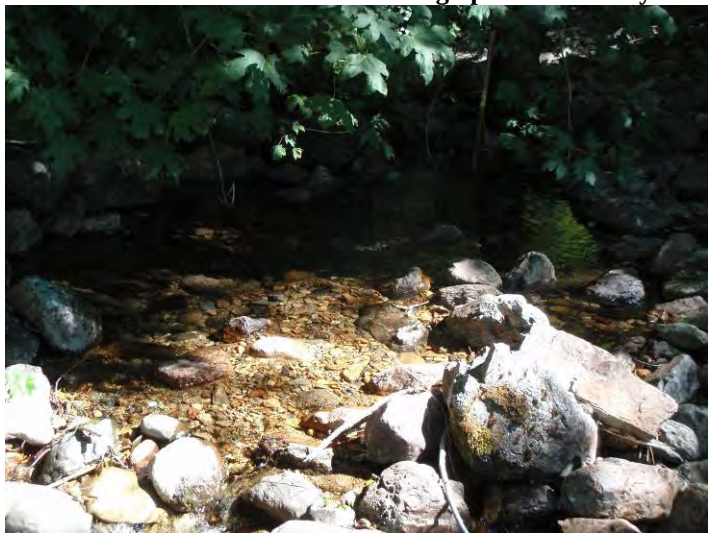

Photo 65. Keystone Ravine looking upstream confluence

Photo 66. Keystone Ravine barrier 1

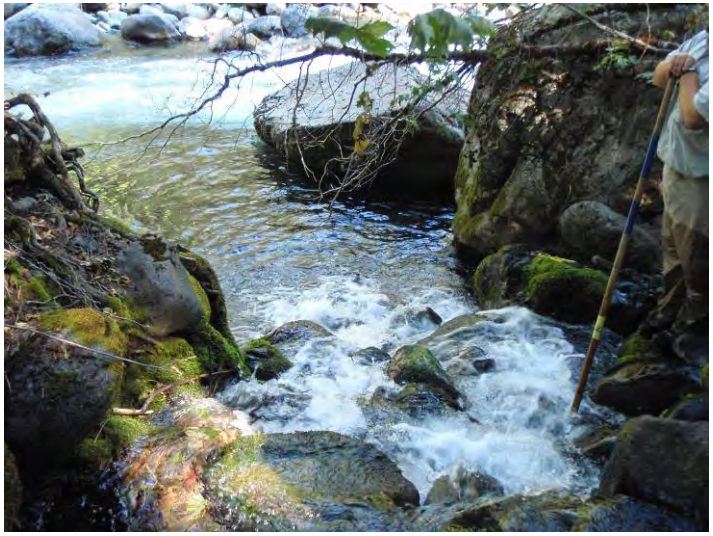

Photo 67. Big Avalanche Ravine looking downstream at confluence

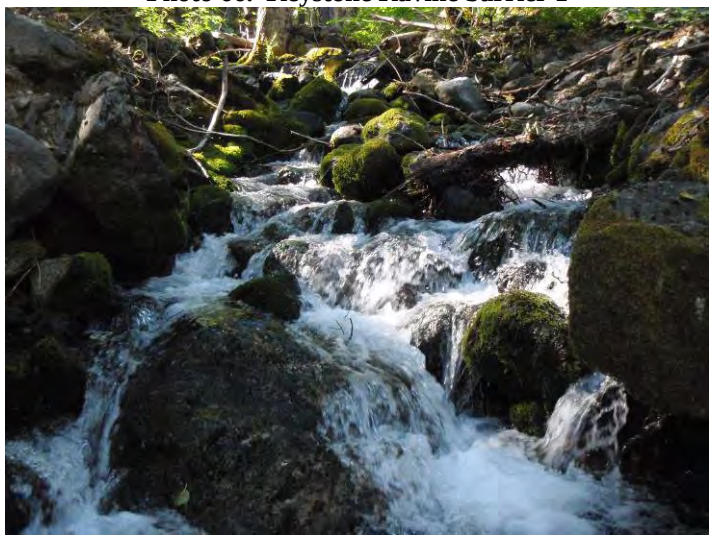

Photo 68. Big Avalanche Ravine looking upstream at confluence

Photo 69. Big Avalanche Ravine barrier 1

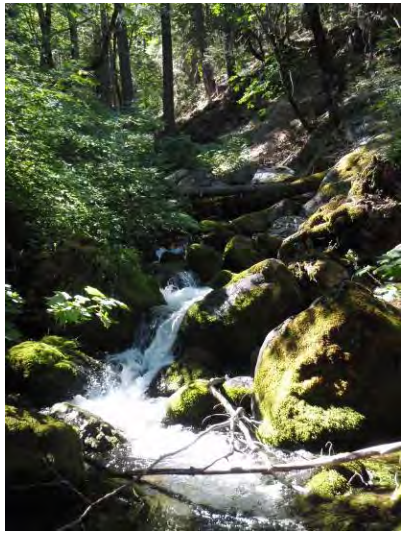

Photo 70. Big Avalanche Ravine looking upstream at end

Photo 71. Sierra City Trib. (unnamed) looking downstream at flue

Photo 72. Sierra City Trib. (unnamed) looking downstream of flue

Photo 73. Sierra City Trib. (unnamed) looking upstream of Hwy 49

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Tributaries that had a Potential Chinook Salmon or Steelhead Barrier

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Photo 74. Cherokee Cr. looking downstream at confluence

Photo 75. Cherokee Cr. looking upstream at confluence

Photo 76. Cherokee Cr. barrier 1

Photo 77. Fiddle Cr. Looking downstream at confluence

Photo 78. Fiddle Cr. barrier 1a

Photo 79. Fiddle Cr. barrier 1b

Photo 80. Fiddle Cr. barrier 1c

Photo 81. Humbug Cr. at confluence

Photo 82. Humbug Cr. barrier 1

Photo 83. Rock Cr. barrier 1a

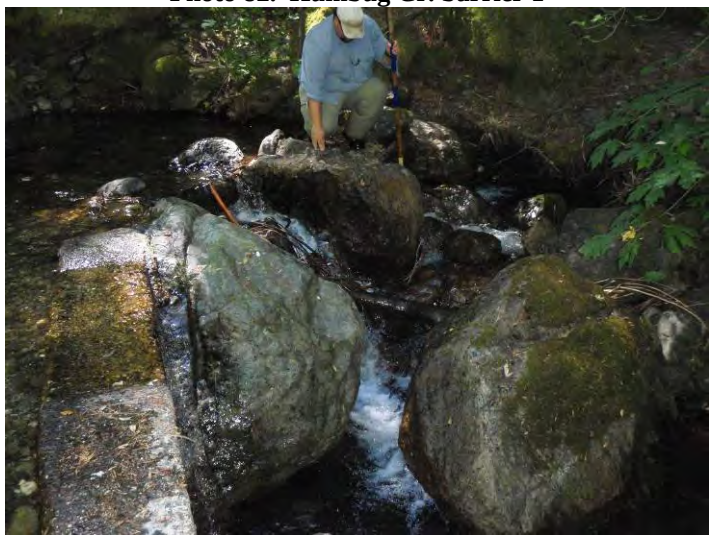

Photo 84. Rock Cr. barrier 1b at left bank

Photo 85. Rock Cr. looking upstream at end point

Photo 86. Woodruff Cr. at confluence with Rock Cr.

Photo 87. Woodruff Cr. barrier 1a

Photo 88. Woodruff Cr. barrier 1b looking at left bank

Photo 89. Woodruff Cr. barrier 2a

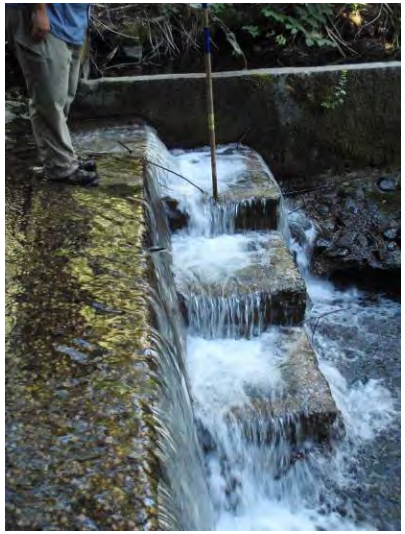

Photo 90. Woodruff Cr. barrier 2b looking at left bank

Photo 91. Slug Canyon at confluence looking downstream

Photo 92. Slug Canyon at confluence looking upstream

Photo 93. Slug Canyon barrier 1

Photo 94. Negro Canyon looking upstream at confluence

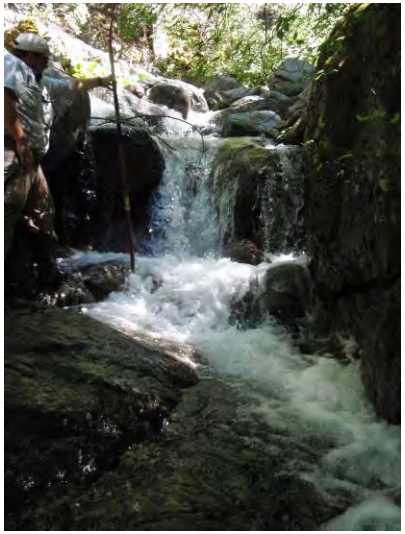

Photo 95. Negro Canyon barrier 1

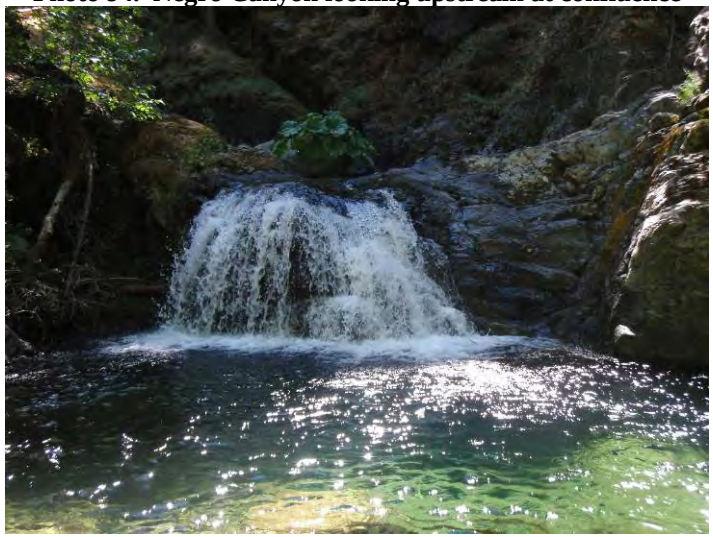

Photo 96. Negro Canyon barrier 2

Photo 97. Negro Canyon bedrock canyon upstream of barrier 2 far

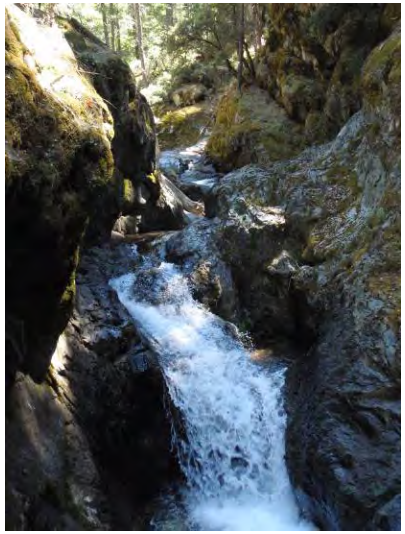

Photo 98. Negro Canyon bedrock canyon upstream of barrier 2 close

Photo 99. Hackmans Ravine looking upstream at confluence

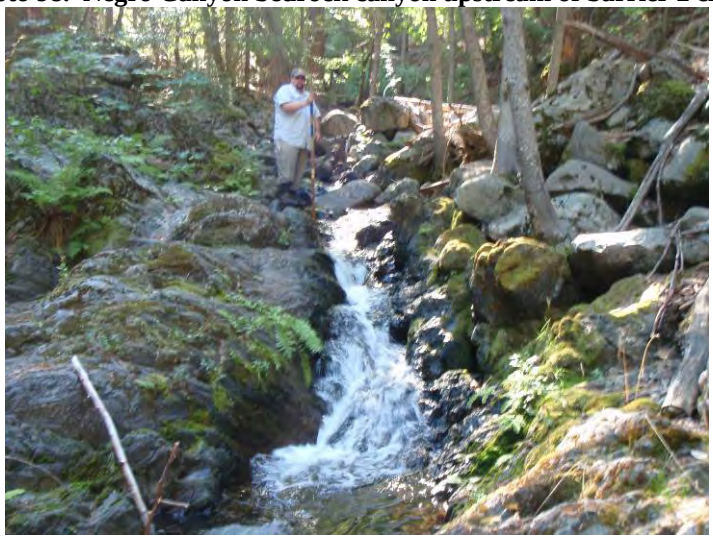

Photo 100. Hackmans Ravine barrier 1

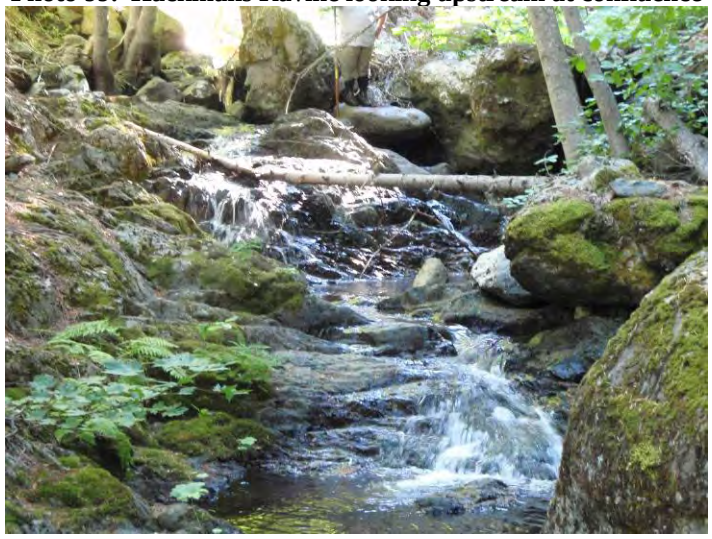

Photo 101. Hackmans Ravine barrier 2

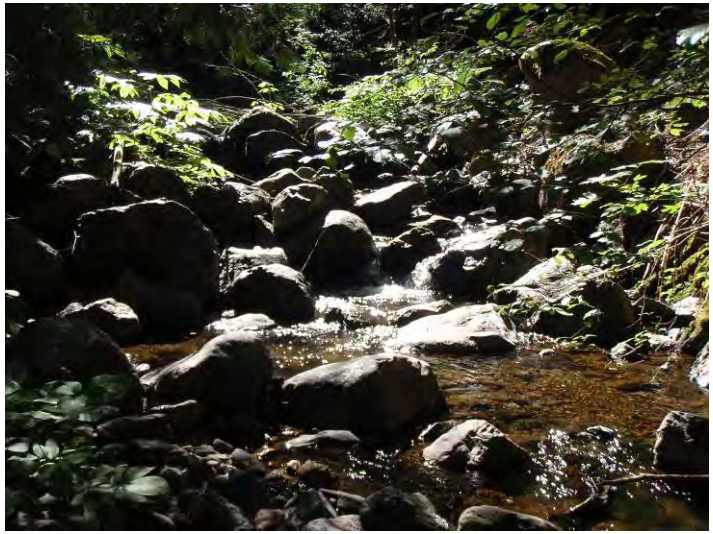

Photo 102. Hackman Ravine typical habitat looking upstream

Tributaries that Could Not Be Fully Surveyed

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Photo 103. Canyon Cr. looking downstream at confluence

Photo 104. Canyon Cr. looking upstream at confluence

Photo 105. Canyon Cr. barrier 1

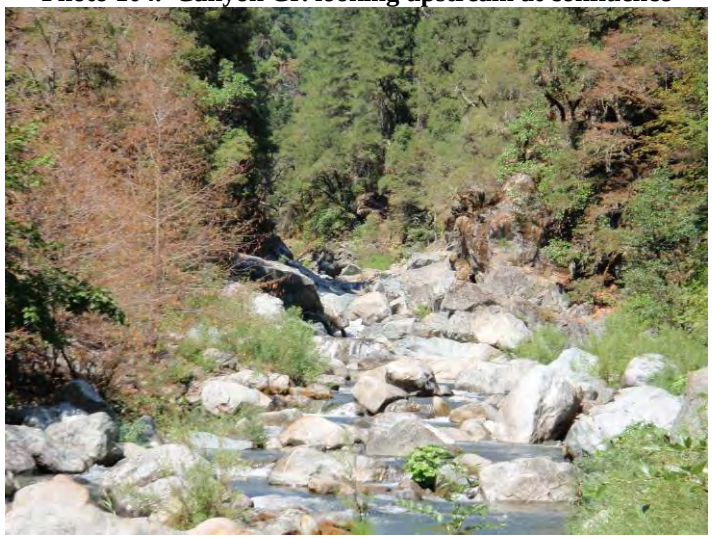

Photo 106. Canyon Cr. Typical habitat and additional falls looking upstream of barrier 1

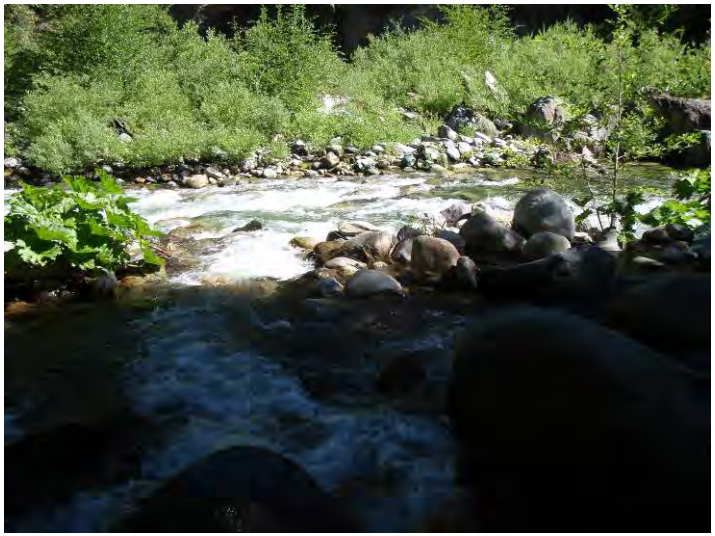

Photo 107. Jim Crow Cr. Looking downstream at confluence

Photo 108. Jim Crow Cr. Looking upstream at confluence

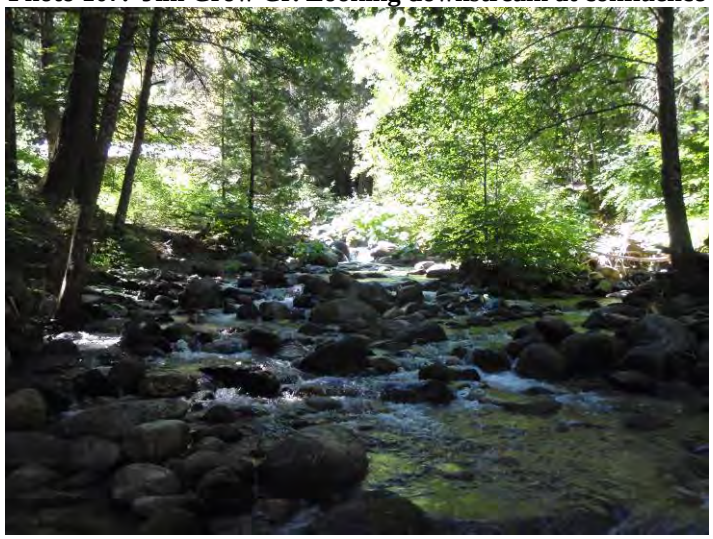

Photo 109. Jim Crow Cr. Looking upstream at end point

Photo 110. San Juan Cr. at confluence with Jim Crow Cr.

Photo 111. San Juan Cr. Looking upstream at end point

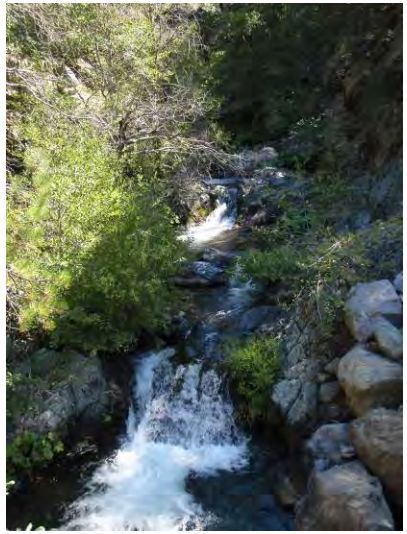

Photo 112. Ladies Canyon looking upstream at confluence a

Photo 113. Ladies Canyon looking upstream at confluence b

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Fully Accessed Tributaries with Available Habitat

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Photo 114. Slate Cr. looking downstream at confluence

Photo 115. Slate Cr. looking upstream at confluence

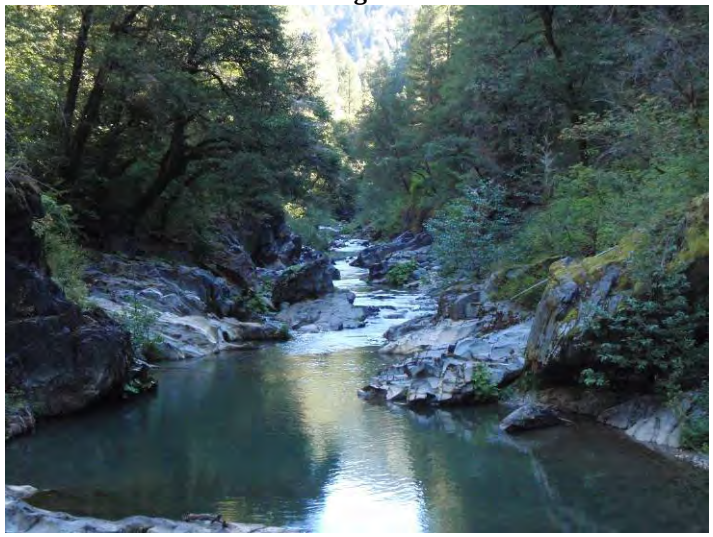

Photo 116. Slate Cr. looking upstream at end point

Photo 117. Slate Cr. looking downstream at end point

Photo 118. Indian Cr. looking downstream at confluence

Photo 119. Indian Cr. looking upstream at confluence

Photo 120. Indian Cr. looking downstream at end point

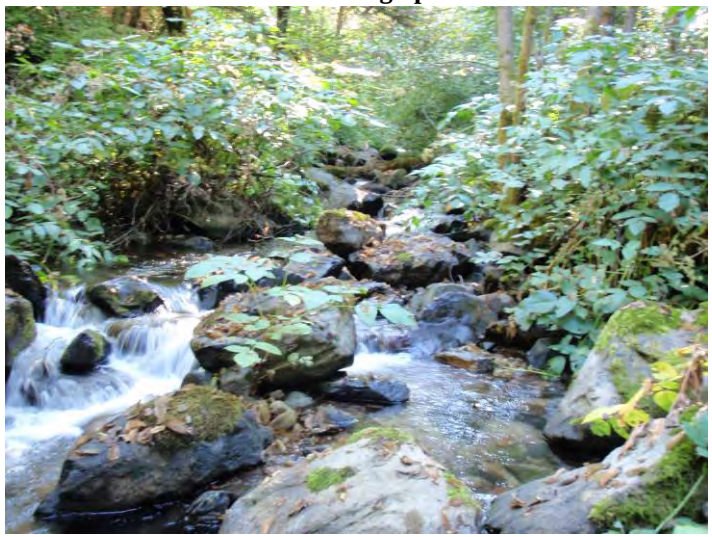

Photo 121. Indian Cr. looking upstream at end point

Photo 122. Goodyear Cr. Looking downstream at confluence

Photo 123. Goodyear Cr. Looking upstream at confluence

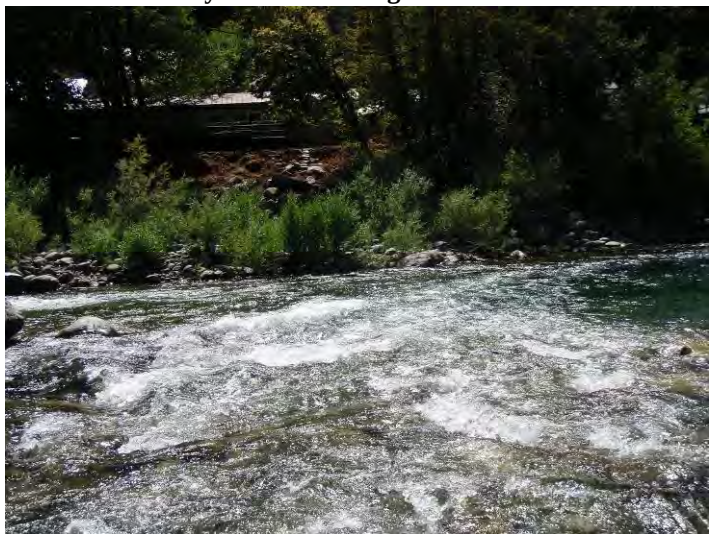

Photo 124. Downie R. looking downstream at confluence

Photo 125. Downie R. looking upstream at confluence

Photo 126. Haypress Cr. Looking downstream at confluence

Photo 127. Haypress Cr. barrier 1a

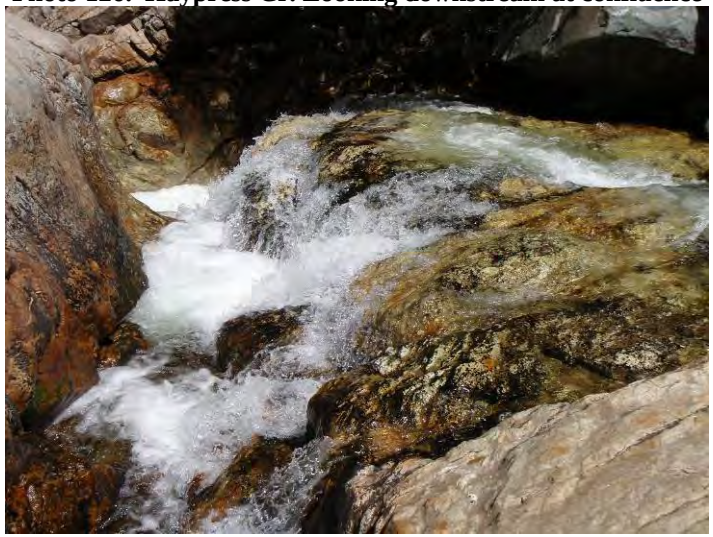

Photo 128. Haypress Cr. barrier 1b at step in falls

Photo 129. Haypress Cr. looking downstream at end point

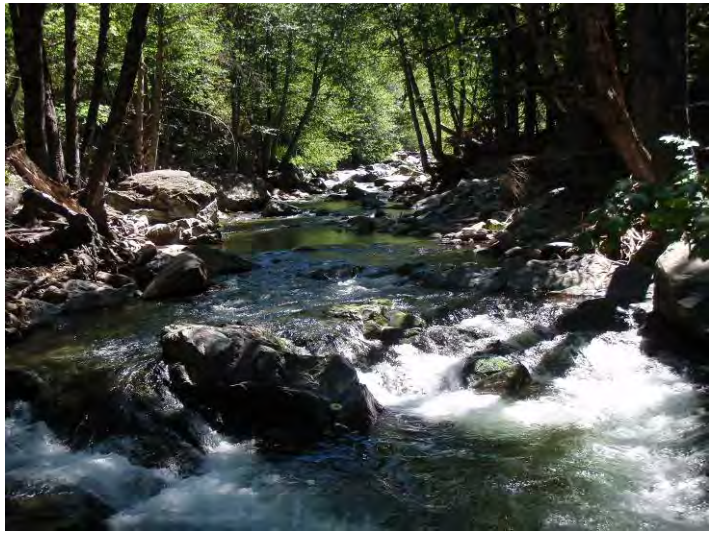

Photo 130. Haypress Cr. looking upstream at end point

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Yuba Salmon Forum
Fish Passage Study Report

Attachment 2

2011 Fish Passage Data Report

The following data have been entered, QA/QC, and analyzed by trained biological staff. However, HDR considers these data preliminary until the completion of this study. HDR is confident the data are accurate for review, but reserves the right to modify the presented analyses prior to the final study report submission.

List of Sheets

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Middle Yuba River

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Sheet 1. Middle Yuba Mainstem

Stream/ Tributary: Middle Yuba Mainstem	**Crew:** RA, CV	**Temp (C°):** 16.7	**Date:** 9/21/11
Estimated Discharge (cfs): 45	**UTM Start/Description:** 0660530 E / 4359323 N at Yuba Confluence	**UTM End/Description:** 0660878 E / 4359509 N at barrier	

Comments:
Bedrock falls that are split into two at current flow. At current flow fish could not pass. At higher flow hydraulic control at leaping pool tail out would create damming and raise water level many feet and allow passage.

Potential Barrier Measurements (ft)

Point ID	Leap Pool Depth	Land Pool Depth	Vertical Height	Crest Width	Horizontal Length	Substrate		UTM		Comments
						Dom.	Sub.	East	North	
1	5.5	1	8.5	7.5	10	BED	BED	0660878	4359509	Measurements of left bank downstream falls, landing pool depth estimated
1	5.0	1	8.5	1.6	6	BED	BED	0660878	4359509	Measurements of right bank downstream falls, landing pool depth estimated

Substrate Codes: Organic Debris = **ODB**, Sand = **SND**, Gravel = **GRV**, Cobble = **COB**, Boulder = **BLD**, Bed Rock = **BED**

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Oregon Creek

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Sheet 2. Oregon Creek

Stream/ Tributary: Oregon Creek	**Crew:** CV, RA	**Temp (C°):** NA[1]	**Date:** 9/20/11
Estimated Discharge (cfs): 9	**UTM Start/Description:** 0665413 E / 4363100 N	**UTM End/Description:** 0665413 E / 4363100 N	
Comments: Possible low flow barrier located 70' DS of Point ID 1, insignificant compared to Point ID 1. [1] Temperature logger data is available.			

Potential Barrier Measurements (ft)

Point ID	Leap Pool Depth	Land Pool Depth	Vertical Height	Crest Width	Horizontal Length	Substrate		UTM		Comments
						Dom.	Sub.	East	North	
1	3.3	0.9	10.8	6.5	16.5	BED	BED	0665413	4363100	Bedrock falls create total barrier at any flow.

Substrate Codes: Organic Debris = **ODB**, Sand = **SND**, Gravel = **GRV**, Cobble = **COB**, Boulder = **BLD**, Bed Rock = **BED**

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North Yuba River

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Sheet 3. N. Yuba Mainstem / Upstream of Haypress

Stream: N. Yuba, upstream of Haypress	**Crew:** RA, CV	**Temp (C°):** 9.4	**Date:** 9/22/11
Estimated Discharge (cfs): 22	**UTM Start/Description:** 0704823 E / 4382559 N at Haypress Creek confluence	**UTM End/Description:** 0705401 E / 4383534 N	

Comments:
Walked upstream to bedrock confined canyon where numerous 3-4 ft. falls were observed that were not barriers. Stopped at bedrock confined pool that could not be passed by humans due to safety concerns.

Potential Barrier Measurements (ft)

Point ID	Leap Pool Depth	Land Pool Depth	Vertical Height	Crest Width	Horizontal Length	Substrate		UTM		Comments
						Dom	Sub	East	North	
None										

Substrate Codes: Organic Debris = **ODB**, Sand = **SND**, Gravel = **GRV**, Cobble = **COB**, Boulder = **BLD**, Bed Rock = **BED**

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Tributaries with no Chinook Salmon or Steelhead Habitat

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Sheet 4. St. Catherine Creek

Stream/ Tributary: N. Yuba / St. Catherine Creek	**Crew:** RA, CV	**Temp (C°):** 13.9	**Date :** 8/16/11
Estimated Discharge (cfs): 0.25	**UTM Start/Description:** 0677288 E / 4377103 N	**UTM End/Description:** 0677288 E / 4377103 N	
Comments: Barrier is located 30 ft. upstream of confluence and is a 6 ft pile of boulder and cobble with water flowing intermittently through the pile. More flow would not change the pass ability of the barrier.			

Potential Barrier Measurements (ft)

Point ID	Leap Pool Depth	Land Pool Depth	Vertical Height	Crest Width	Horizontal Length	Substrate		UTM		Comments
						Dom	Sub	East	North	
1	0.2	0.2	6.0	2.0	12.0	BLD	COB	0677288	4377103	Water amount very small. Just a trickle flows under boulder subsurface.

Substrate Codes: Organic Debris = **ODB**, Sand = **SND**, Gravel = **GRV**, Cobble = **COB**, Boulder = **BLD**, Bed Rock = **BED**

Sheet 5. Devils Canyon

Stream/ Tributary: N. Yuba / Devils Canyon	**Crew:** RA, CV	**Temp (C°):** 13.7	**Date :** 8/16/11
Estimated Discharge (cfs): 1.0	**UTM Start/Description:** 0679091 E/ 4378434 N	**UTM End/Description:** 0679103 E / 4378413 N	
Comments: From first significant barrier, stream flows over numerous bedrock falls and chutes that create additional barriers.			

Potential Barrier Measurements (ft)

Point ID	Leap Pool Depth	Land Pool Depth	Vertical Height	Crest Width	Horizontal Length	Substrate		UTM		Comments
						Dom	Sub	East	North	
1	2.75	0.5	6.0	2.0	6.5	BED	BED	0679103	4378413	Vertical falls over bedrock, with boulder in center, located 50 ft upstream of confluence

Substrate Codes: Organic Debris = **ODB**, Sand = **SND**, Gravel = **GRV**, Cobble = **COB**, Boulder = **BLD**, Bed Rock = **BED**

Sheet 6. Ramshorn Creek

Stream/ Tributary: N. Yuba / Ramshorn Creek	**Crew:** RA / CV	**Temp (C°):** 13.9	**Date :** 8/16/11
Estimated Discharge (cfs): 2	**UTM Start/Description:** 0679308 E / 4378550 N	**UTM End/Description:** 0679347 E / 4378652 N At end of culvert	
Comments: Hwy 49 culvert creates a 10ft barrier, culvert has 12% grade and depth of 0.2 ft with wetted width of 1.5ft. Culvert is 8ft diameter and 160ft long, barrier is approximately 500ft upstream of North Yuba confluence.			

Potential Barrier Measurements (ft)

Point ID	Leap Pool Depth	Land Pool Depth	Vertical Height	Crest Width	Horizontal Length	Substrate		UTM		Comments
						Dom	Sub	East	North	
1	2.5	0.3	10.0	1.0	10.0	BLD	COB	0679355	4378561	Barrier, perched 10 ft culvert spilling onto BLD

Substrate Codes: Organic Debris = **ODB**, Sand = **SND**, Gravel = **GRV**, Cobble = **COB**, Boulder = **BLD**, Bed Rock = **BED**

Sheet 7. Slate Castle Creek

Stream/ Tributary: N. Yuba / Slate Castle Creek	**Crew:** RA, CV	**Temp (C°):** 10.7	**Date** : 8/17/11
Estimated Discharge (cfs): 0.5	**UTM Start/Description:** 0687758 E / 4380911 N	**UTM End/Description:** 0687769 E / 4380884 N	
Comments: No decent salmon habitat between confluence and barrier. Little flow trickling over BLD and BED.			

Potential Barrier Measurements (ft)

Point ID	Leap Pool Depth	Land Pool Depth	Vertical Height	Crest Width	Horizontal Length	Substrate		UTM		Comments
						Dom	Sub	East	North	
1	1.9	0.5	7.5	13	14	BED	BED	0687769	4380884	Sheet flow over BED creating total barrier approximately 100ft upstream of from confluence

Substrate Codes: Organic Debris = **ODB**, Sand = **SND**, Gravel = **GRV**, Cobble = **COB**, Boulder = **BLD**, Bed Rock = **BED**

Sheet 8. Secret Canyon

Stream/ Tributary: N. Yuba / Secret Canyon	**Crew:** RA, CV	**Temp (C°):** 10.4	**Date :** 8/18/11
Estimated Discharge (cfs): 3.0	**UTM Start/Description:** 0690788 E / 4380361 N	**UTM End/Description:** 0690788 E / 4380361 N	
Comments: Additional falls that qualify as barriers were observed 200 ft. upstream of Point ID 1.			

Potential Barrier Measurements (ft)										
Point ID	**Leap Pool Depth**	**Land Pool Depth**	**Vertical Height**	**Crest Width**	**Horizontal Length**	**Substrate**		**UTM**		**Comments**
						Dom	**Sub**	**East**	**North**	
1	1.5	0.4	5.0	2.5	13.0	BED	BED	0690188	4380361	Bedrock falls/chute barrier located 30 ft upstream of the confluence.

Substrate Codes: Organic Debris = **ODB**, Sand = **SND**, Gravel = **GRV**, Cobble = **COB**, Boulder = **BLD**, Bed Rock = **BED**

Sheet 9. Keystone Ravine

Stream/ Tributary: N. Yuba / Keystone Ravine	**Crew:** RA, CV	**Temp (C°):** 12.3	**Date :** 8/18/11
Estimated Discharge (cfs): 1.0	**UTM Start/Description:** 0699430 E / 4382254 N	**UTM End/Description:** 0699631 E / 4382146 N	
Comments: Stream has boulder/cobble delta at mouth which creates fish passage issues at flow at time of survey due to poor connectivity. Upstream of Point ID 1 the gradient increases 15-20% and numerous boulder falls would stop any further passage. Entire stream is not anadromous fish habitat unless the flows are higher. Numerous low-flow barriers from the confluence up to Point ID 1.			

Potential Barrier Measurements (ft)										
Point ID	**Leap Pool Depth**	**Land Pool Depth**	**Vertical Height**	**Crest Width**	**Horizontal Length**	**Substrate**		**UTM**		**Comments**
						Dom	**Sub**	**East**	**North**	
1	1.5	0.9	5.0	6.0	6.0	BLD	COB	0699631	4382146	series of two falls over BLD, leaping pool in center all measurements of upper falls

Substrate Codes: Organic Debris = **ODB**, Sand = **SND**, Gravel = **GRV**, Cobble = **COB**, Boulder = **BLD**, Bed Rock = **BED**

Sheet 10. Big Avalanche Ravine

Stream/ Tributary: N. Yuba / Big Avalanche Ravine	**Crew:** RA, CV	**Temp (C°):** 8.7	**Date :** 8/19/11
Estimated Discharge (cfs): 3.5	**UTM Start/Description:** 0701141 E / 481770 N	**UTM End/Description:** 0701176 E / 4381686 N (at gradient barrier)	

Comments:
Overall gradient is 10-15%. Little to no spawning habitat available throughout due to steep gradient. Survey ended due to increasing gradient and limited pass ability. No passage would be available at the flow during survey.

Potential Barrier Measurements (ft)

Point ID	Leap Pool Depth	Land Pool Depth	Vertical Height	Crest Width	Horizontal Length	Substrate		UTM		Comments
						Dom	Sub	East	North	
1	3.5	0.5	5.0	3	5.0	BLD	BLD	070138	4381723	Falls spilling over boulders, would likely stop salmon.

Substrate Codes: Organic Debris = **ODB**, Sand = **SND**, Gravel = **GRV**, Cobble = **COB**, Boulder = **BLD**, Bed Rock = **BED**

Tributaries that had a Potential Chinook Salmon and Steelhead Barrier

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Sheet 11. Cherokee Creek

Stream/ Tributary: N. Yuba / Cherokee Creek	**Crew:** CV, MA	**Temp (C°):** 16.7	**Date:** 9/14/11
Estimated Discharge (cfs): 5	**UTM Start/Description:** 668914 E / 4375746 N	**UTM End/Description:** 668950 E / 4376088 N	
Comments: It appears the gradient increases rapidly passed the falls so additional barriers would be likely a short distance upstream.			

Potential Barrier Measurements (ft)										
Point ID	**Leap Pool Depth**	**Land Pool Depth**	**Vertical Height**	**Crest Width**	**Horizontal Length**	**Substrate**		**UTM**		**Comments**
						Dom	**Sub**	**East**	**North**	
1	6	1.5	7	10	7	BED	BED	668950	4376088	Bedrock falls, at current flow unlikely steelhead could pass, no Chinook passage. Could not access the top of falls or nearby due to bedrock constricted canyon. Measurements estimated by field staff to characterize falls.

Substrate Codes: Organic Debris = **ODB**, Sand = **SND**, Gravel = **GRV**, Cobble = **COB**, Boulder = **BLD**, Bed Rock = **BED**

Sheet 12. Fiddle Creek

Stream/ Tributary: N. Yuba / Fiddle Creek	**Crew:** RA, CV	**Temp (C°):** 13.3	**Date :** 8/16/11
Estimated Discharge (cfs): 4	**UTM Start/Description:** 672114 E / 4376298 N	**UTM End/Description:** 0672444 E / 4377003 N	
Comments: Point ID 1 located just upstream of Forest Service road bridge. Barrier falls over BED 0.5 mile upstream of confluence. Nice fish habitat throughout, BED, BLD formed pools throughout with 2-7% gradient.			

Potential Barrier Measurements (ft)										
Point ID	**Leap Pool Depth**	**Land Pool Depth**	**Vertical Height**	**Crest Width**	**Horizontal Length**	**Substrate**		**UTM**		**Comments**
						Dom	**Sub**	**East**	**North**	
1	7.0	2.0	18.0	20.0	12.0	BED	BED	0672444	4377003	Total BED barrier.

Substrate Codes: Organic Debris = **ODB**, Sand = **SND**, Gravel = **GRV**, Cobble = **COB**, Boulder = **BLD**, Bed Rock = **BED**

Sheet 13. Humbug Creek

Stream/ Tributary: N. Yuba/ Humbug Creek	**Crew:** RA, CU	**Temp (C°):** 14.9	**Date :** 8/16/11
Estimated Discharge (cfs): 3.5	**UTM Start/Description:** 0674808 E / 4375544 N	**UTM End/Description:** 0674836 E /4375365 N end at barrier, 100 ft. downstream of foot bridge	
Comments: Overall bedrock and boulder dominated channel. Numerous bedrock falls observed upstream of first significant barrier that would also be barriers. Average 6% gradient.			

Potential Barrier Measurements (ft)										
Point ID	**Leap Pool Depth**	**Land Pool Depth**	**Vertical Height**	**Crest Width**	**Horizontal Length**	**Substrate**		**UTM**		**Comments**
						Dom	**Sub**	**East**	**North**	
1	1.0	0.3	10.5	13.0	14.0	BED	BED	0674836	4375365	Bedrock with sheet flow into small pool near base with additional 3 ft drop to larger pool with 2.5 ft depth, all measurements made from small pool near base.

Substrate Codes: Organic Debris = **ODB**, Sand = **SND**, Gravel = **GRV**, Cobble = **COB**, Boulder = **BLD**, Bed Rock = **BED**

Sheet 14. Rock Creek

Stream/ Tributary: N. Yuba / Rock Creek	**Crew:** RA, CV	**Temp (C°):** 12.8 above Woodruff	**Date :** 8/17/11
Estimated Discharge (cfs): 4.5 upstream of Woodruff	**UTM Start/Description:** 0681708 E / 4378479 N at confluence with Woodruff Creek	**UTM End/Description:** 0682128 E / 4378409 N (Stopped 500 ft. upstream of UTM point)	
Comments: Tributary to Woodruff Creek. Stream is 2-5% grade with lots of boulder and cobble. Good fish habitat with spawning gravel available. [1]CEM = cement			

Potential Barrier Measurements (ft)										
Point ID	**Leap Pool Depth**	**Land Pool Depth**	**Vertical Height**	**Crest Width**	**Horizontal Length**	**Substrate**		**UTM**		**Comments**
						Dom[1]	**Sub**	**East**	**North**	
1	2.8	1.75	4.0	10	2.5	CEM	BLD	0681999	4378355	Boulder falls down left bank side. Salmon could likely pass by jumping face at a higher flow. Passage through boulder falls would be unlikely due to spilling onto boulders.

Substrate Codes: Organic Debris = **ODB**, Sand = **SND**, Gravel = **GRV**, Cobble = **COB**, Boulder = **BLD**, Bed Rock = **BED**

Sheet 15. Woodruff Creek

Stream/ Tributary: N. Yuba / Woodruff Creek	**Crew:** RA, CV	**Temp (C°):** 12.5 (downstream of fork) 11.7 (upstream of fork)	**Date :** 8/17/11
Estimated Discharge (cfs): 4 upstream of Rock Creek	**UTM Start/Description:** 0681566 E / 437868 N at confluence with N Yuba River	**UTM End/Description:** 0681729 E / 4377888 N	
Comments: Tributary to Rock Creek, [1]WD = wood, [2]CEM = cement			

Potential Barrier Measurements (ft)

Point ID	Leap Pool Depth	Land Pool Depth	Vertical Height	Crest Width	Horizontal Length	Substrate		UTM		Comments
						Dam	Sub	East	North	
1	2.5	1.0	5.5	18	2.0	WD[1]	WD	0681722	4378216	Diversion Dam likely passable at higher flows salmon would jump the face. Small step on right bank does not allow passage
2	3.5	0.8	4.5	22	2.0	CEM[2]	CEM	0681729	4377888	Diversion dam with fish ladder. Right bank with 4 steps from 1.5-1.0ft high with 2x2ft pools in steps 1ft deep, likely not large enough for salmon. Possibly passable at higher flows by leaping face.

Substrate Codes: Organic Debris = **ODB**, Sand = **SND**, Gravel = **GRV**, Cobble = **COB**, Boulder = **BLD**, Bed Rock = **BED**

Sheet 16. Slug Canyon

Stream/ Tributary: N. Yuba / Slug Canyon	**Crew:** RA, CV	**Temp (C°):** 13.1	**Date :** 8/17/11
Estimated Discharge (cfs): 3	**UTM Start/Description:** 0686120 E / 4380763 N	**UTM End/Description:** 0686125 E / 4380744	
Comments:			

Potential Barrier Measurements (ft)										
Point ID	**Leap Pool Depth**	**Land Pool Depth**	**Vertical Height**	**Crest Width**	**Horizontal Length**	**Substrate**		**UTM**		**Comments**
						Dom.	**Sub.**	**East**	**North**	
1	2.3	0.8	9.0	14.0	13.0	BLD	ODB	0686125	4380744	BLD falls with wood jam at top. Small step 5.5ft. up the falls, but not large enough for salmon to make second jump. Considered total barrier.

Substrate Codes: Organic Debris = **ODB**, Sand = **SND**, Gravel = **GRV**, Cobble = **COB**, Boulder = **BLD**, Bed Rock = **BED**

Sheet 17. Negro Canyon

Stream/ Tributary: Negro Canyon	**Crew:** RA, CV	**Temp (C°):** 13.2	**Date :** 8/18/11
Estimated Discharge (cfs): 4.5	**UTM Start/Description:** 0695914 E / 4381881 N	**UTM End/Description:** 0695880 E / 4381760 N	
Comments: Point ID2 may be passable in high flow conditions with healthy fish, but BED canyon beyond (upstream) is impassable. Stream has 5-8 % gradient with lots of boulder and suitable pool habitat.			

Potential Barrier Measurements (ft)										
Point ID	**Leap Pool Depth**	**Land Pool Depth**	**Vertical Height**	**Crest Width**	**Horizontal Length**	**Substrate**		**UTM**		**Comments**
						Dom.	**Sub.**	**East**	**North**	
1	4.0	0.8	5.0	6.0	9.0	BLD	BED	0695909	4381811	Falls spill onto rocks, but 4 ft leaping pool occurs below the spill falls. Created by boulder wedged between the bedrock. Chinook barrier, steelhead likely passable at higher flow.
2	10.0+	1.4	8.4	7.0	5.0	BED	BED	0695893	4381835	Falls spill over bedrock, likely not passable.

Substrate Codes: Organic Debris = **ODB**, Sand = **SND**, Gravel = **GRV**, Cobble = **COB**, Boulder = **BLD**, Bed Rock = **BED**

Sheet 18. Hackmans Ravine

Stream/ Tributary: N. Yuba / Hackmans Ravine	**Crew:** RA, CV	**Temp (C°):** 10.6	**Date:** 9/23/11
Estimated Discharge (cfs): 1.5	**UTM Start/Description:** 0703640 E / 4382125 N	**UTM End/Description:** 0703749 E / 4382000 N	

Comments:
Boulder delta disperses flow and would block passage at current flow. At current flow no anadromous habitat due to numerous low flow leaping barriers and overall high gradient. Average 4% near confluence and picks up to 8-10% after Point ID #1. Overall, no good habitat due to low flow and high gradient. Fry observed below Point ID #1.

Potential Barrier Measurements (ft)

Point ID	Leap Pool Depth	Land Pool Depth	Vertical Height	Crest Width	Horizontal Length	Substrate		UTM		Comments
						Dom.	Sub.	East	North	
1	0.9	0.3	5.8	3.0	18	BED	BED	0703692	4382017	Long bedrock chute with small pool in center at a horizontal distance of 10ft and a rise of 2.8ft. Would likely stop fish at any flow.
2	1.0	0.2	0.9	25	18	BED	BLD	0703749	4382000	Falls over BED, total barrier.

Substrate Codes: Organic Debris = **ODB**, Sand = **SND**, Gravel = **GRV**, Cobble = **COB**, Boulder = **BLD**, Bed Rock = **BED**

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Tributaries that could not be Fully Surveyed to 0.5 Mile Upstream of the North Yuba River Confluence

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Sheet 19. Canyon Creek

Stream/ Tributary: N. Yuba / Canyon Creek	**Crew:** CV, MA	**Temp (C°):** 18.1	**Date:** 9/14/11
Estimated Discharge (cfs): 30	**UTM Start/Description:** 667314 E / 4376582 N	**UTM End/Description:** 667509 E / 4376872 N	
Comments: Gradient below falls was low. No access above point ID 1 due to safety. Canyon above falls appeared to narrow but could not see the gradient upstream. [1]NA = not available.			

Potential Barrier Measurements (ft)										
Point ID	**Leap Pool Depth**	**Land Pool Depth**	**Vertical Height**	**Crest Width**	**Horizontal Length**	**Substrate**		**UTM**		**Comments**
						Dom	**Sub**	**East**	**North**	
1	4	NA[1]	6	15	5	BED	BED	667509	4376841	bedrock falls, no access to take measurements so all are estimated, steelhead would pass, Chinook would likely pass at higher flows.

Substrate Codes: Organic Debris = **ODB**, Sand = **SND**, Gravel = **GRV**, Cobble = **COB**, Boulder = **BLD**, Bed Rock = **BED**

Sheet 20. Jim Crow Creek

Stream/ Tributary: N. Yuba / Jim Crow Creek	**Crew:** RA, CV	**Temp (C°):** 9.9	**Date :** 8/18/11
Estimated Discharge (cfs): 12 at confluence with North Yuba, 8 upstream of confluence with San Juan	**UTM Start/Description:** 0690665 E / 4380347 N	**UTM End/Description:** 0690523 E / 4379955 N 900' short of 0.5 mile point	
Comments: Tributary to San Juan Canyon, Crew did not fully assess to 0.5 mi upstream due to potential trespass issues. No barriers observed in surveyed area. Good habitat available with good spawning gravels.			

Potential Barrier Measurements (ft)										
Point ID	**Leap Pool Depth**	**Land Pool Depth**	**Vertical Height**	**Crest Width**	**Horizontal Length**	**Substrate**		**UTM**		**Comments**
						Dom	**Sub**	**East**	**North**	
None										

Substrate Codes: Organic Debris = **ODB**, Sand = **SND**, Gravel = **GRV**, Cobble = **COB**, Boulder = **BLD**, Bed Rock = **BED**

Sheet 21. San Juan Creek

Stream/ Tributary: San Juan / N. Yuba	**Crew:** RA, CV	**Temp (C°):** 9.6 upstream of Jim Crow	**Date :** 8/18/11
Estimated Discharge (cfs): 4 upstream of Jim Crow Creek	**UTM Start/Description:** 0690519 E / 4379993 N at confluence with Jim Crow Creek	**UTM End/Description:** 0690472 E / 4379916 N 500' short of 0.5 mile point	
Comments: Private property postings occur 500ft downstream of 0.5 mile point so end survey short. No barriers were observed. Good habitat for fish.			

Potential Barrier Measurements (ft)										
Point ID	**Leap Pool Depth**	**Land Pool Depth**	**Vertical Height**	**Crest Width**	**Horizontal Length**	**Substrate**		**UTM**		**Comments**
						Dom	**Sub**	**East**	**North**	
None										

Substrate Codes: Organic Debris = **ODB**, Sand = **SND**, Gravel = **GRV**, Cobble = **COB**, Boulder = **BLD**, Bed Rock = **BED**

Tributaries where Field Staff Assessed to 0.5 Mile Upstream of the North Yuba River Confluence and Chinook Salmon or Steelhead Habitat was Available

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Sheet 22. Slate Creek

Stream/ Tributary: N. Yuba / Slate Creek	**Crew:** RA, CV	**Temp (C°):** 15.0	**Date:** 9/20/11
Estimated Discharge (cfs): 20	**UTM Start/Description:** 0664003 E / 4376865 N	**UTM End/Description:** 0664719 E / 4376740 N	

Comments:
Great habitat with nice spawning gravels and deep long pools. Trout and kokanee observed. A lot of bedrock formed pools, with a 2-4% gradient average.

Potential Barrier Measurements (ft)

Point ID	Leap Pool Depth	Land Pool Depth	Vertical Height	Crest Width	Horizontal Length	Substrate		UTM		Comments
						Dom	Sub	East	North	
None										

Substrate Codes: Organic Debris = **ODB**, Sand = **SND**, Gravel = **GRV**, Cobble = **COB**, Boulder = **BLD**, Bed Rock = **BED**

Sheet 23. Indian Creek

Stream/ Tributary: N. Yuba / Indian Creek	**Crew:** CV, MA	**Temp (C°):** 12.7	**Date:** 9/16/11
Estimated Discharge (cfs): 3.5	**UTM Start/Description:** 669938 E/ 4374728 N	**UTM End/Description:** 670335 E / 4374335 N	

Comments:
1. Cobble/boulder piles at the confluence could be a barrier at extreme low flows but otherwise passable.
2. At end point, no visible barriers for another 0.1 mile upstream with similar gradient and boulder/cobble step pools, and run habitat. Gradient is approximately 5% on average.
3. Log jam present at about 0.2 mile which could be a barrier during low flow if more logs gather at this site.
4. There is not a lot of good spawning gravel but decent holding pools exist.

Potential Barrier Measurements (ft)

Point ID	Leap Pool Depth	Land Pool Depth	Vertical Height	Crest Width	Horizontal Length	Substrate		UTM		Comments
						Dom	Sub	East	North	
None										

Substrate Codes: Organic Debris = **ODB**, Sand = **SND**, Gravel = **GRV**, Cobble = **COB**, Boulder = **BLD**, Bed Rock = **BED**

Sheet 24. Goodyear Creek

Stream/ Tributary: N. Yuba / Goodyear Creek	**Crew:** RA, CV	**Temp (C°):** 13.7	**Date :** 8/16/11
Estimated Discharge (cfs): 7.5	**UTM Start/Description:** 0681468 E / 4378951 N	**UTM End/Description:** 0681795 E / 4379688 N	
Comments: Gradient averaged 2-4%. BLD, COB, BED substrate dominated. No barrier observed within 0.5 mile. From bridge upstream of 0.5 mile no barriers in site. Nice habitat with available spawning gravel.			

Potential Barrier Measurements (ft)										
Point ID	**Leap Pool Depth**	**Land Pool Depth**	**Vertical Height**	**Crest Width**	**Horizontal Length**	**Substrate**		**UTM**		**Comments**
						Dom	**Sub**	**East**	**North**	
None										

Substrate Codes: Organic Debris = **ODB**, Sand = **SND**, Gravel = **GRV**, Cobble = **COB**, Boulder = **BLD**, Bed Rock = **BED**

Sheet 25. Downie River

Stream/ Tributary: N. Yuba / Downie River	**Crew:** RA, CV	**Temp (C°):** 14.2	**Date :** 8/17/11
Estimated Discharge (cfs): 20	**UTM Start/Description:** 0686527 E / 4381136 N	**UTM End/Description:** end at 0.5 mile upstream of confluence	
Comments: No barriers. Great habitat. No passage problems, spawning gravels available.			

Potential Barrier Measurements (ft)										
Point ID	**Leap Pool Depth**	**Land Pool Depth**	**Vertical Height**	**Crest Width**	**Horizontal Length**	**Substrate**		**UTM**		**Comments**
						Dom	**Sub**	**East**	**North**	
None										

Substrate Codes: Organic Debris = **ODB**, Sand = **SND**, Gravel = **GRV**, Cobble = **COB**, Boulder = **BLD**, Bed Rock = **BED**

Sheet 26. Haypress Creek

Stream/ Tributary: N. Yuba / Haypress Creek	**Crew:** RA, CV	**Temp (C°):** 11.9	**Date : 8**/19/11
Estimated Discharge (cfs): 30	**UTM Start/Description:** 0704823 E / 4382559 N	**UTM End/Description:** 0705551 E / 4382332 N At 0.5 mile upstream of confluence	

Comments:
Step provides fish access above the falls. Overall, site is good fish habitat with boulder, cobble, and gravel mixed substrate.

Potential Barrier Measurements (ft)

Point ID	Leap Pool Depth	Land Pool Depth	Vertical Height	Crest Width	Horizontal Length	Substrate		UTM		Comments
						Dom.	Sub.	East	North	
1	10+	2.5	4	2	7	BED	BED	0704961	4382533	falls with step in center on left bank that would provide access to fish to make second leap in center, all measurements from leaping pool to step.

Substrate Codes: Organic Debris = **ODB**, Sand = **SND**, Gravel = **GRV**, Cobble = **COB**, Boulder = **BLD**, Bed Rock = **BED**

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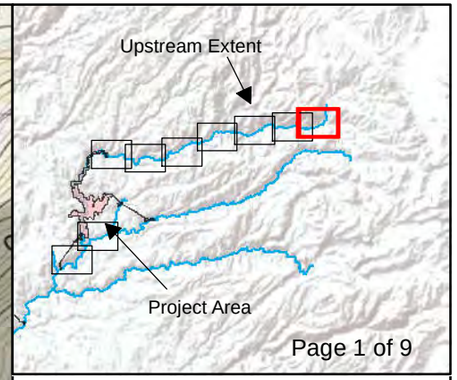
Yuba Salmon Forum
Fish Passage Study Report

Attachment 3

Fish Passage Maps



Mainstem Reaches

- Passable
- Likely Passable at Higher Flows
- Not Passable
- River Miles

North Yuba River Tributaries *

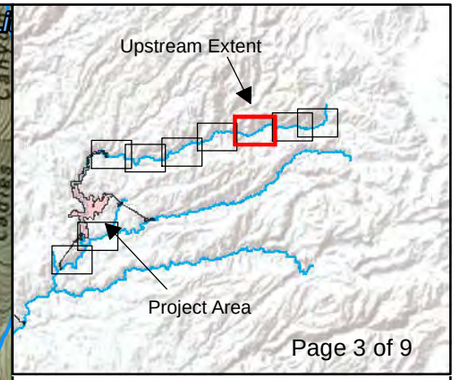
- North Yuba Tributaries
- * Habitat Available
- * Habitat Available, but Limited Survey Access
- * Potential Barrier Identified
- * No Habitat Available

Yuba County Water Agency
Yuba River Development Project
(FERC Project No. 2246)

0 1,000 2,000 4,000
Feet

Data Sources: Base Map-USGS 7.5-Minute Series Topographic Maps; FERC Boundary- Yuba County GIS; Gage Locations - HDR|DTA. Map information was compiled from the best available sources. No Warranty is made for its accuracy or completeness.


Little Ladies Canyon
Ladies Canyon
Black Canyon
Sovereign Mine
Prospects
Columbo Mine
Loganville
Loganville Trib (Unnamed)
Sierra City Trib (Unnamed)
TAHOE
NATIONAL FOREST
North Yuba River Feat. #5
North Yuba River Feat. #6
North Yuba River
44
45
46
47
48
Fournier Ranch
Romano Ranch
Gillespie Dam
Charcoal Ravine
Keystone Ravine
Keystone Mine
Lucky Boy Mine
Big Avalanche Ravine
Negro Canyon
Cleveland Mine
Sierra Buttes Mine
The Cups
Upstream Extent
Project Area
Page 2 of 9
Mainstem Reaches
Passable
Likely Passable at Higher Flows
Not Passable
River Miles
North Yuba River Tributaries *
North Yuba Tributaries
Habitat Available
Habitat Available, but Limited Survey Access
Potential Barrier Identified
No Habitat Available
Yuba County Water Agency
Yuba River Development Project
(FERC Project No. 2246)
N
0
1,000
2,000
4,000
Feet
Data Sources: Base Map-USGS 7.5-Minute Series Topographic Maps; FERC Boundary- Yuba County GIS; Gage Locations - HDR|DTA. Map information was compiled from the best available sources. No Warranty is made for its accuracy or completeness.



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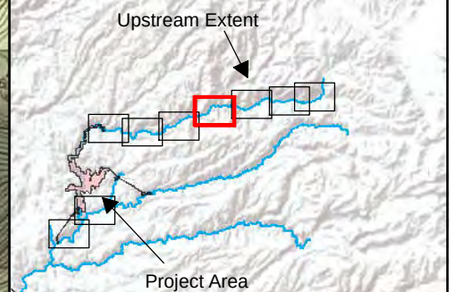

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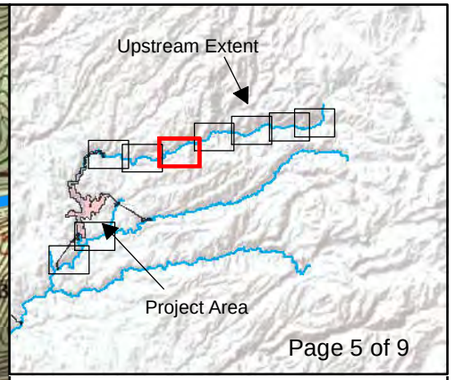

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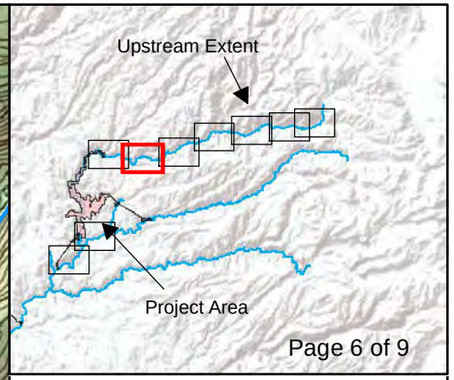

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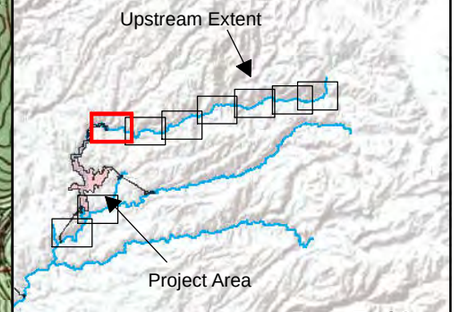

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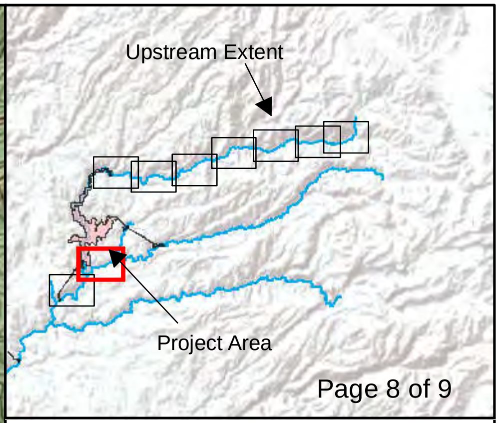

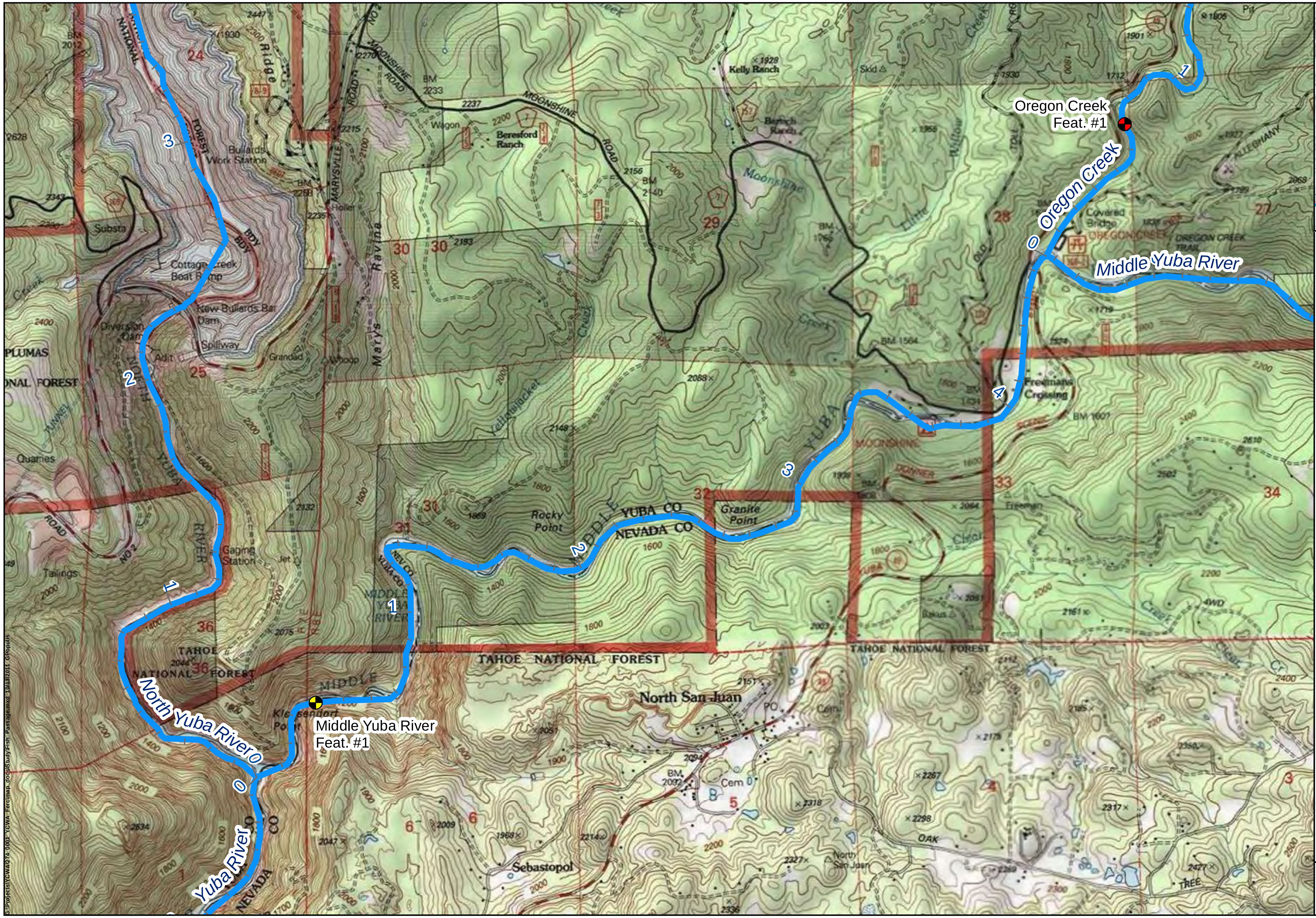

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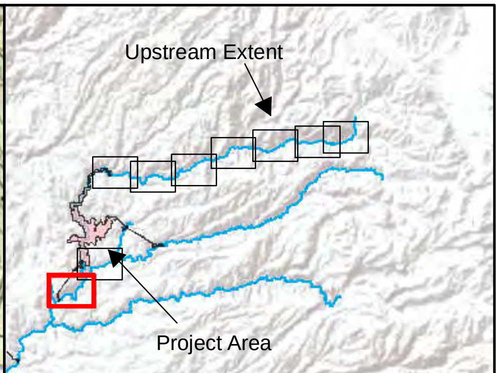

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Yuba Salmon Forum
Fish Passage Study Report

Attachment 4

PG&E and NID's Fish Passage Assessment

Quoted Excerpt From the Study Cited Below (Pgs 3-4)

Pacific Gas and Electric Company (PG&E) and Nevada Irrigation District (NID). 2010. Study 2.3.16 – Fish Barriers. Prepared by NID and PG&E for the Relicensings of PG&E's Drum-Spaulding Project (FERC Project No. 2310) and NID's Yuba-Bear Hydroelectric Project (FERC Project No. 2266). August 2010.

Licensees followed the same general barrier evaluation method for completing steps 1-3 of the study plan. To begin, Licensees determined if potential fish barriers in the study area had recently (i.e., last 10 years) been assessed by others. Two studies were found: Gast et al. (2005) and Vogel (2006). If existing information was available, the assessment for that area was summarized including barrier type, fall height, photographs, and field observations. If exiting information was not available, Licensees used existing field mapping, aerial photographs, and the relicensing helicopter video to examine the streams. If these sources provided adequate coverage, the potential for barriers was summarized, and pertinent still-shots from the helicopter video were made. If existing material was not adequate, Licensees visited the tributary to perform the assessment.

Field assessment was primarily conducted on the ground, but in three cases streams were assessed by helicopter due to remoteness and safety concerns. For streams that were assessed by helicopter, the study area was flown at low altitude. The locations of potential barriers were documented, and photographs were taken with a high-resolution camera with a telephoto lens.

Field assessments on the ground included entering data onto Fish Passage Assessment Field Data Forms. A description of the starting point was recorded including Universal Transverse Mercator (UTM) coordinates and photographs. Surveyors collected water temperature and calculated a discharge in a suitable location of the tributary using a flow meter. If flow was too low or too high to measure, it was estimated using professional judgment. Throughout the length of the survey, general characteristics including stream gradient, substrate, fish observations, and fish habitat were recorded. For reservoir assessments, reservoir pool elevations on the field study days were obtained from the project's operators. If a potential barrier was encountered, plunge pool depth, landing pool depth, height, wetted width, and horizontal distance were measured and recorded on the data sheet. UTM coordinates of all potential barriers were recorded using a handheld Global Positioning System (GPS) unit. Photos and observational notes were also taken to document all potential barriers.

Quoted Excerpt From the Study Cited Below (Pgs 3-4)

Pacific Gas and Electric Company (PG&E) and Nevada Irrigation District (NID). 2008. Study 2.3.4 – Fish Passage. Prepared by NID and PG&E for the Relicensings of PG&E's Drum-Spaulding Project (FERC Project No. 2310) and NID's Yuba-Bear Hydroelectric Project (FERC Project No. 2266). July 2008

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Yuba Salmon Forum Studies
Fish Passage

Attachment 5

2011 Field Data Form

Fish Passage Form

Stream:	**Crew:**	**Temperature (F°)**	**Date:**
Estimated Discharge (cfs):	**UTM Start E:** **N:**	**UTM End E:**	**N:**

Potential Barrier Measurements (ft)

Point ID	Lower Pool Depth	Upper Pool Depth	Height	Wet Width	Length	Substrate		UTM		Photos/Comments
						Dom	Sub	East	North	

Comments:

Substrate Codes: Organic Debris=**ODB,** Sand=**SND,** Gravel=**GRV,** Cobble=**COB,** Boulder=**BLD,** Bed Rock=**BED**
Data Entry ID_____ (1 person) **Data Entry Record#_____** **Data QA/QC_____ (2 person)**

If found please contact HDR (360-671-1150)

Yuba Salmon Forum
Fish Passage Study Report

Attachment 6

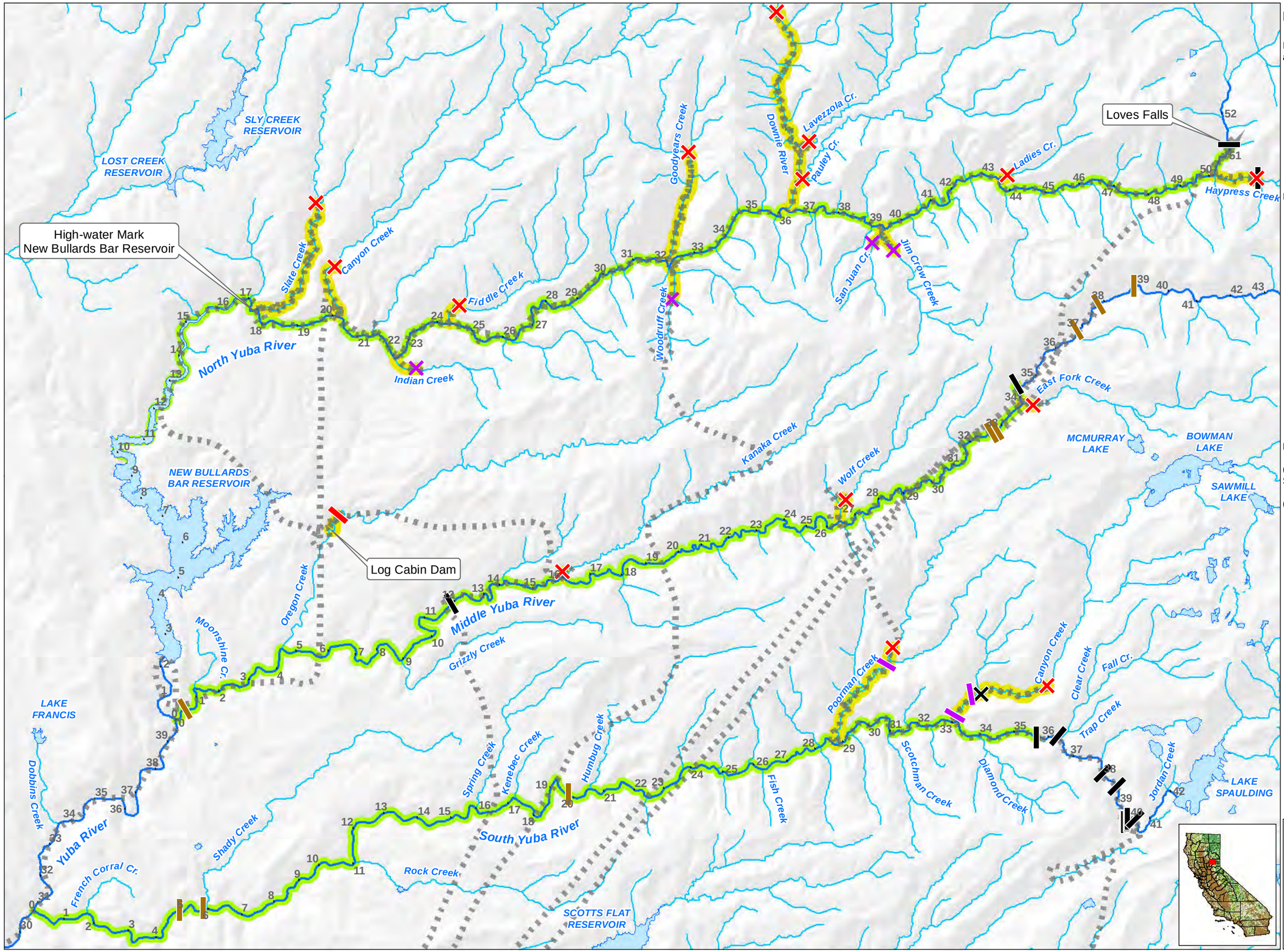
Helicopter Survey

An aerial survey was conducted by helicopter on November 15, 2011, to assess the extent of potential steelhead and salmon habitat on the North, Middle and South Yuba Rivers (Craig Addley of Entrix, Andy Fecko and Ben Ransom of PCWA). The primary goal was to assess several tributaries that had been identified as potential steelhead and/or salmon habitat. The helicopter flights provided the opportunity to visually assess stream reaches for potential migration, holding, spawning, and rearing habitat.

For the larger tributaries that were visible from the air, it was relatively easy to identify where the habitat became too steep, confined, and filled with barriers to provide anadromous salmonid habitat. These locations are identified in Map 1 as "end of potential habitat." Large upstream migration barriers were easily identifiable. Smaller barriers were identified as "potential barriers" that require further ground surveys to confirm whether or not they are actual barriers.

Some of the tributaries were very small and visibility was poor from the air due to vegetation. These were identified as "small stream requiring foot surveys" to assess the habitat.

The aerial surveys should be characterized reconnaissance level assessments. In all cases, ground based surveys are needed to better confirm and refine the length of anadromous habitat.



Legend

Information Based Upon Previous and Ongoing Studies (1) and (2):

- 28 River Miles (Whole)
- Total Barrier
- Low-flow Barrier
- Mainstem Potential Habitat

Information Based Upon Helicopter Survey

- Total Barrier
- Potential Barrier
- Tributary Potential Habitat
- Potential End of Habitat (Small Stream with Heavy Vegetation - Requires Foot Survey)
- Potential End of Habitat
- End of Habitat
- Helicopter Flight Path

NOTES:

(1) Upper Yuba River Watershed Chinook Salmon and Steelhead Habitat Assessment

(2) Ongoing Yuba River Salmon Forum Studies

Yuba River Basin
Holding Habitat Assessment

Map 1

November 15, 2011
Helicopter Survey of
Steelhead and Salmon Habitat

Date: 2/9/2012

Projection: UTM Zone 10 N
Datum: NAD 83

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