INTERIM
TECHNICAL MEMORANDUM 7-11

Fish Behavior and Hydraulics Near Narrows 2 Powerhouse

Yuba River Development Project
FERC Project No. 2246

November 2012

INTERIM TECHNICAL MEMORANDUM **7-11**

EXECUTIVE SUMMARY

In 2012, Yuba County Water Agency (YCWA) conducted a series of assessments in proximity to the Narrows 2 Powerhouse, which is located downstream of the United States Army Corps of Engineers' Englebright Dam on the Yuba River. The study included numerous goals, all focusing on the interaction of the operations of the Narrows 2 Powerhouse with fall- and spring-run Chinook salmon (*Oncorhynchus tshawytscha*) and rainbow trout/steelhead (*O. mykiss*). To assess the presence, potential for exposure, and resultant behavior of salmonids proximal to the Narrows 2 Powerhouse, a series of different activities were implemented. These activities included: summarizing historical data, direct observations, and operational monitoring and characterization.

Review of historical data addressed historical operations, a three-year telemetry study, and salmonid periodicity. The review found that operations were strongly influenced by water year type. During wet years, there was a greater usage of the Narrows 2 Powerhouse and more spill events over Englebright Dam. During drier years, there was primarily usage of PG&E's Narrows 1 Powerhouse, located downstream of the Narrows 2 Powerhouse.[1] Historical periodicity showed that steelhead migration occurs from August through March, while fall-run Chinook salmon migration occurs from September through January. Spring-run Chinook salmon migrate from April through August. Telemetry monitoring of adult spring-run Chinook salmon from 2009 to 2011 found that adults reach the Narrows 2 Powerhouse as early as July, were most prevalent in August, and remained as late as October.

Species composition and behavior snorkeling data was conducted over 10 events from May through October 2012. Twice-monthly monitoring began in July 2012 and will continue through December 15, 2012, or until winter flows in the reach rise to levels that make snorkeling unsafe. Observed fish species included rainbow trout, Chinook salmon, black bass (*Micropterus sp*.), Sacramento pikeminnow (*Ptychocheilus grandis*), and Sacramento sucker (*Catostomus occidentalis*). Bass and pikeminnow, when found, were generally in the upper pool below Englebright Dam (i.e., the Dam Pool), where water temperatures were warmer. Chinook salmon and rainbow trout were most prevalent in the pool downstream of Narrows 2 Powerhouse (i.e., the Narrows 2 Pool), but were also found near the powerhouse (i.e., the Bypass Pool). No Chinook salmon or rainbow trout were observed in the Dam Pool. Snorkeling conditions were challenging and obtaining a reliable relative abundance estimate was not feasible. General behavior of salmonids was milling, with a tendency to flee field biologists when the fish observed the biologists. Fish were never observed entering the draft tubes or interacting directly with the Narrows 2 Powerhouse.

All four infrequent operational events (i.e., planned flow changes of 400 cfs or greater) were monitored. During the events, a Dual-frequency Identification Sonar (DIDSON™) camera generally was deployed and recorded one day prior, during and at least one day following the

[1] The mix of the usages of the Narrows 1 and Narrows 2 Powerhouses may change after April 30, 2016, when YCWA's present Power Purchase Contract with PG&E expires.

event. The camera performed well when water was being released through the bypass, but visibility was limited during generation. A significant amount of recorded imagery still needs to be processed, but reviewed footage shows fish displaying a general milling behavior. Fish were never observed entering the draft tubes or orienting towards the draft tube flow.

Incidental fish observations by YCWA staff and consultants from December 2011 through November 2012 identified one jumping adult (species unknown) in January and then no observations until August. Fish were again observed in late October. Observed behavior generally was fish jumping from the water surface.

Continuous monitoring provided information on water velocities in the Narrows 2 Powerhouse, water surface elevations, and water temperatures. Modeled water velocity results in the Narrows 2 Powerhouse showed that flow entering the powerhouse penstock, before the runner, is accelerated and then slows as it approaches the draft tubes. Velocities in all locations increase with increases in discharges from the powerhouse. Velocity ranges were from 2.75 ft/sec at the outlet with 900 cubic feet per second (cfs) to 48.99 ft/sec below the runners at full generational capacity (3,400 cfs). Velocity measurements below the Narrows 2 Powerhouse at three operational scenarios were collaboratively refined with the National Marine Fisheries Service and are planned for January 2013.

Water surface elevation monitoring from August 9 through October 25 showed that interstitial flow connects the Dam Pool and the Bypass Pool. As a result, water elevations in both pools are similar. The water connection at the surface between the pools was through a small crevice that was minimally wetted at flows exceeding 1,570 cfs. The potential for fish to leap over the crevice is possible, but the flow through the crevice is limited.

Water temperature monitoring indicates that, when the powerhouse is operating, the water in the Dam Pool does not substantially mix with water in the Bypass Pool, so the water temperatures in the two pools can be significantly different. Over the summer, the Dam Pool warms and reaches well over 20°C on the surface. When the bypass begins to operate (even at lower discharges), it mixes the water with the Dam Pool and reduces the temperature in the Dam Pool to below 15°C.

The study was conducted in conformance with the Federal Energy Regulatory Commission-approved Study 7.11, *Fish Behavior and Hydraulics Near Narrows 2 Powerhouse*, with three variances. First, snorkeling during infrequent operational events was deemed unsafe and therefore was not conducted. The DIDSON camera was still employed, but snorkeling was not paired with the surveys. The study plan allowed for DIDSON camera surveys to replace a twice-monthly snorkel event. Since snorkeling did not occur during the DIDSON camera surveys, it was ensured that two separate snorkel events always occurred, regardless of an infrequent operations monitoring event.

Second, water temperature profiles were expected to be collected monthly. However, operation of the full bypass truncated access to the Dam Pool and precluded monthly measurements. As a result vertical temperature profiles were collected in only two of four months; however, temperature loggers were able to generally characterize differences and the collected profiles did represent two significantly different profiles.

Third, the DIDSON camera will not be deployed in December 2012 during the annual maintenance shutdown. This decision is based on discussion with NMFS and data showing salmon are generally absent near Narrows 2 Powerhouse after November.

The study is on schedule for completion in March 2013. YCWA has the following study task to complete:

- twice-monthly snorkel surveys through December 15
- field velocity measurements
- measurements necessary for pressure calculations
- analyze DIDSON footage review
- Obtain and analyze additional historical data, if available

The above information will be included in the final technical memorandum.

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INTERIM TECHNICAL MEMORANDUM **7-11**

FISH BEHAVIOR AND HYDRAULICS NEAR NARROWS 2 POWERHOUSE[2]

Yuba County Water Agency's (YCWA) continued operation and maintenance (O&M) of the Yuba River Development Project, Federal Energy Regulatory Commission (FERC) Project Number 2246, (Project) has the potential to affect resident and anadromous salmonid fish species in the Yuba River near the Project's Narrows 2 Powerhouse and Full-Flow Bypass, which are located on the north bank of the Yuba River approximately 400 feet (ft) downstream of the United States Army Corps of Engineers' (USACE) Englebright Dam[3] and approximately 1,000 ft upstream of Pacific Gas and Electric Company's (PG&E) Narrows 1 Powerhouse, which is located on the south bank of the river.[4]

This study focused on adult resident rainbow trout (*Oncorhynchus mykiss*) that are 16 inches or longer in fork length (FL), spring-run Chinook salmon (*O. tshawytscha*), Central Valley steelhead (*O. mykiss*), and fall-run Chinook salmon (*O. tshawytscha).* Rainbow trout is not protected by federal or State of California law and has no special-status designation. Spring-run Chinook salmon and steelhead are listed as threatened under the federal Endangered Species Act (ESA). Fall-run Chinook salmon is listed as a Species of Concern by the United States Department of Commerce, National Oceanic and Atmospheric Administration, National Marine Fisheries Service (NMFS).

In its January 4, 2011, *Notice of Intent to File License Application, Filing of Pre-Application Document (PAD), Commencement of Pre-Filing Process, and Scoping; Request for Comments on the PAD and Scoping Document, and Identification of Issues and Associated Study Requests Notice,* FERC initiated informal consultation with NMFS under Section 7 of the ESA and the joint agency regulations thereunder at 50 CFR, Part 402. Further, in its notice, FERC designated YCWA as FERC's non-federal representative for carrying out informal consultation, pursuant to Section 7 of the ESA.

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[2] This technical memorandum presents the results for Study 7.11, *Fish Behavior and Hydraulics Near Narrows 2 Powerhouse.* In its August 17, 2011, Revised Study Plans, YCWA included a study plan named Study 7.11, *Assessment of Narrows 2 Powerhouse as a Barrier to Anadromous Fish Upstream Migration*. The study plan name was subsequently changed to *Fish Behavior and Hydraulics Near Narrows 2 Powerhouse*, to reflect the changed focus of the study based on consultations with FERC and NMFS. FERC modified the study on September 30, 2011 and December 28, 2011, and modified and approved the study in its July 24, 2012 Study Plan Determination. There were no modifications to Study 7.11 subsequent to FERC's July 24, 2012 Determination.

[3] Englebright Dam, which is about 260 ft high and forms Englebright Reservoir, was constructed by the California Debris Commission in 1941, 18 years before YCWA was formed and 22 years before the Federal Power Commission issued the initial Project License. The dam is owned by the United States and is not part of the Yuba River Development Project. When the California Debris Commission was decommissioned in 1986, administration of Englebright Dam and Reservoir passed to the USACE. The primary purpose of the dam is to trap and contain sediment derived from extensive historic hydraulic mining operations in the Yuba River watershed. Englebright Reservoir is about 9 miles long with a surface area of 815 acres. When the dam was first constructed in 1941, it had a gross storage capacity of 70,000 ac-ft; however, due to sediment capture, the gross storage capacity today is approximately 50,000 ac-ft (USGS 2003).

[4] The Narrows 1 Powerhouse is part of PG&E's Narrows Project. The FERC license for the Narrows Project expires on January 31, 2023.

1.0 Goals and Objectives

The purpose of the study was to determine how continued O&M of the Narrows 2 Powerhouse affects anadromous fish, especially ESA-listed species.

The overall goals of the study, as described in FERC's December 28, 2011 Resolution of Study Disputes Determination, were:

> Study 7.11 would include general provisions for: (1) documenting adult resident salmonids (16-inches-in-length or greater) and adult anadromous salmonid behavior in the vicinity of the Narrows 2 facilities; (2) identifying whether or not anadromous fish are reaching the Narrows 2 facilities; (3) determining what species and how many individuals may be potentially affected; (4) determining whether project facilities are causing injury or mortality to listed anadromous salmonids and/or delayed spawning activities; (5) describing behavioral activities by anadromous fish at all project operational conditions and during transition periods, including how Narrows 2 powerhouse operational changes influence species interaction with the Narrows 1 powerhouse; (6) documenting project operational flow conditions [discharge rate in cubic feet per second (cfs), and flow velocity] and correlating operations to behavioral observations of anadromous fish; and (7) documenting incidental observations by YCWA staff of anadromous fish interactions with the project and its operation.

2.0 Methods

The study included the use of existing and new data to document and characterize the operation of the Narrows 2 Powerhouse and its potential interaction with adult resident and anadromous salmonids. The activities required to address required study needs were: 1) defining the study area; 2) summarizing existing available information; 3) telemetry monitoring for spring-run salmon; 4) direct observation; and 5) operational monitoring and characterization. The methods used in each step are described below.

2.1 Study Area

The study area included the Yuba River from Englebright Dam downstream to the head of the pool at Narrows 1 Powerhouse. Figures 2.1-1 presents an overview of the location of the facilities on the Yuba River.

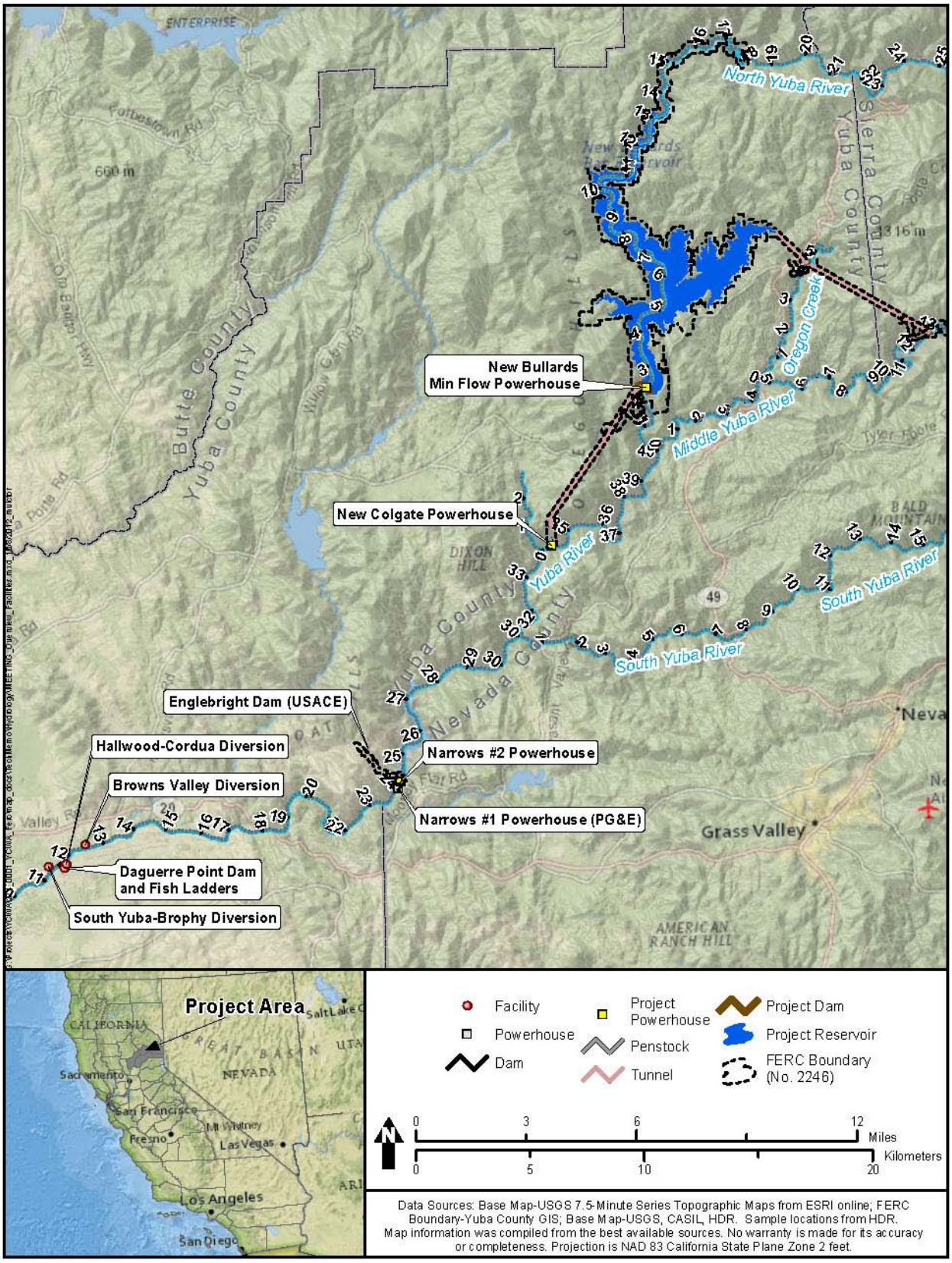

Figure 2.1-1. Overview map of the location of the Narrows 1 and 2 powerhouses.

2.2 Existing Information

The Narrows 2 Powerhouse is an indoor powerhouse consisting of one vertical axis Francis turbine with a capacity of 55 megawatts at a head of 236 ft and flow of 3,400 cfs. The powerhouse, which is located on the north bank of the Yuba River approximately 400 ft downstream of Englebright Dam, receives water from Englebright Reservoir via the Narrows 2 Powerhouse Penstock, which has a maximum flow capacity of 3,400 cfs. Typically, YCWA does not operate the powerhouse with flows less than 900 cfs.

YCWA can release water into the Yuba River past the Narrows 2 Powerhouse using one of two bypasses. The first is called the Narrows 2 Full Flow Bypass (i.e., full bypass). The full bypass is a valve and penstock branch off the Narrows 2 Penstock, which can discharge up to 3,000 cfs of water at full head into the Yuba River immediately upstream of the Narrows 2 Powerhouse through a 72-inch diameter Howell-Bunger valve. The full bypass was installed in 2008 to maintain higher minimum flows during times of full shutdown of the Narrows 2 Powerhouse. The second is called the Narrows 2 Partial Flow Bypass (i.e., partial bypass). This is a pipe off the Narrows 2 turbine scroll case, which can discharge up to 650 cfs of water at full head into the Yuba River through a 36-inch valve located on the downstream face of the powerhouse above the draft tube outlet. The partial bypass was built when the Narrows 2 Powerhouse was constructed. YCWA normally uses the partial bypass to release no more than about 300 cfs (i.e., the full bypass is used for higher flow releases). YCWA does not operate either the full or partial bypasses when Narrows 2 Powerhouse is operating, and does not operate both bypasses at the same time.

Information regarding the design data of Project facilities, including draft tube dimensions, was obtained from YCWA drawings to facilitate water velocity calculations within the Powerhouse.

The frequency of occurrence of historical flow rates (i.e., Water Year [WY] 1970 through WY 2008) emanating from the Narrows 2 Powerhouse (Gage NY 26) and Narrows 1 Powerhouse (Gage NY 13) were summarized. Also hourly operations from 2006 to 2012 from Narrows 2 Powerhouse, Narrows 1 Powerhouse, and Englebright Dam Spill (NY 25) were collected and analyzed.

Information regarding salmonid populations in the Yuba River downstream of Englebright Dam was obtained from the 2001 USACE Fish Passage Improvement Study at Daguerre Point Dam that documented species periodicity.

2.3 Telemetry Monitoring for Spring-Run Salmon

An acoustic telemetry dataset occurred from 2009 through 2011. The dataset covered the monitoring area of the Yuba River from the Narrows 1 Powerhouse to proximally below Narrows 2 Powerhouse. The information was developed based on a cooperative effort between the Lower Yuba River Accord's River Management Team (RMT) and the California Department of Fish and Game (CDFG). The study generally monitored salmon over 3 years. The

monitoring station below Narrows 2 Powerhouse was as close as practical for efficient transmitter detection. The 2009 report and preliminary data for 2010 and 2011 were reviewed.

2.4 Direct Observations

Direct observations of fish were composed of three methods: 1) species composition and behavior snorkeling surveys; 2) infrequent operations monitoring using Dual-frequency Identification Sonar (DIDSON™); and 3) incidental documentation. Methods used to collect these data are described below.

2.4.1 Species Composition and Behavior Snorkeling Surveys

Species composition and behavior assessments occurred once each month from May[5] through June 2012, and twice each month from July through October 2012.

Snorkel surveys were used to determine whether adult resident rainbow trout and anadromous fish occurred in the vicinity of the Narrows 2 Powerhouse. Prior to each snorkel survey, general habitat information was collected to characterize the habitat condition directly below Narrows 2 Powerhouse. The information included pool depth (ft), water temperature (Celsius [°C]), and dissolved oxygen (DO) (milligrams per liter, or mg/L). Pool depth was obtained from water surface recorders. Water quality measurements were taken, using a factory calibrated Hydrolab Quanta to measure water temperature (± 0.1°C) and DO (±0/1 mg/L at <8 mg/L and ±0.2 mg/L at >8 mg/L). Available flow data (i.e., Narrows 2 Powerhouse and Narrows 1 Powerhouse) from operators was reported for the day of the survey. A continuous water temperature data logger was installed downstream of the Narrows 2 Powerhouse.

Snorkel surveys were conducted utilizing two biologists. As a safety precaution, snorkeling was broken into three sections (Figure 2.4-1). The first section is approximately 385 ft long and was directly below Englebright Dam (Dam Pool). The second section was 210 ft long and was adjacent to the Narrows 2 full bypass (Bypass Pool) located between the Narrows 2 Powerhouse and the Dam Pool (Figure 2.4-1). The study safety plan implemented required line-of-sight between a safety observer on shore and the snorkeler while in the Dam and Bypass pools. The safety observer was in direct contact with Narrows 2 Powerhouse operator via 2-way radio and, if necessary, could alert the snorkeler if the unit tripped and the full bypass valve needed to be opened. In the event that the full bypass needed to be operated, all staff would vacate the area quickly. Only one snorkeler was utilized in the Dam and Bypass pools due to their small size. The third section called “Narrows 2 Pool” extended approximately 890 ft from the base of the Narrows 2 Powerhouse downstream to the pool above the Narrows 1 Powerhouse (Figure 2.4-2). The area was called Narrows 2 Pool as a working name for the area; even though additional other habitat could occur in the area depending upon flow releases. Each Narrows 2 Pool survey began at the downstream extent with two snorkelers moving upstream along the margins of opposite banks.

[5] YCWA, at its own risk, initiated the snorkeling surveys prior to FERC’s approval of the study in July 2012.

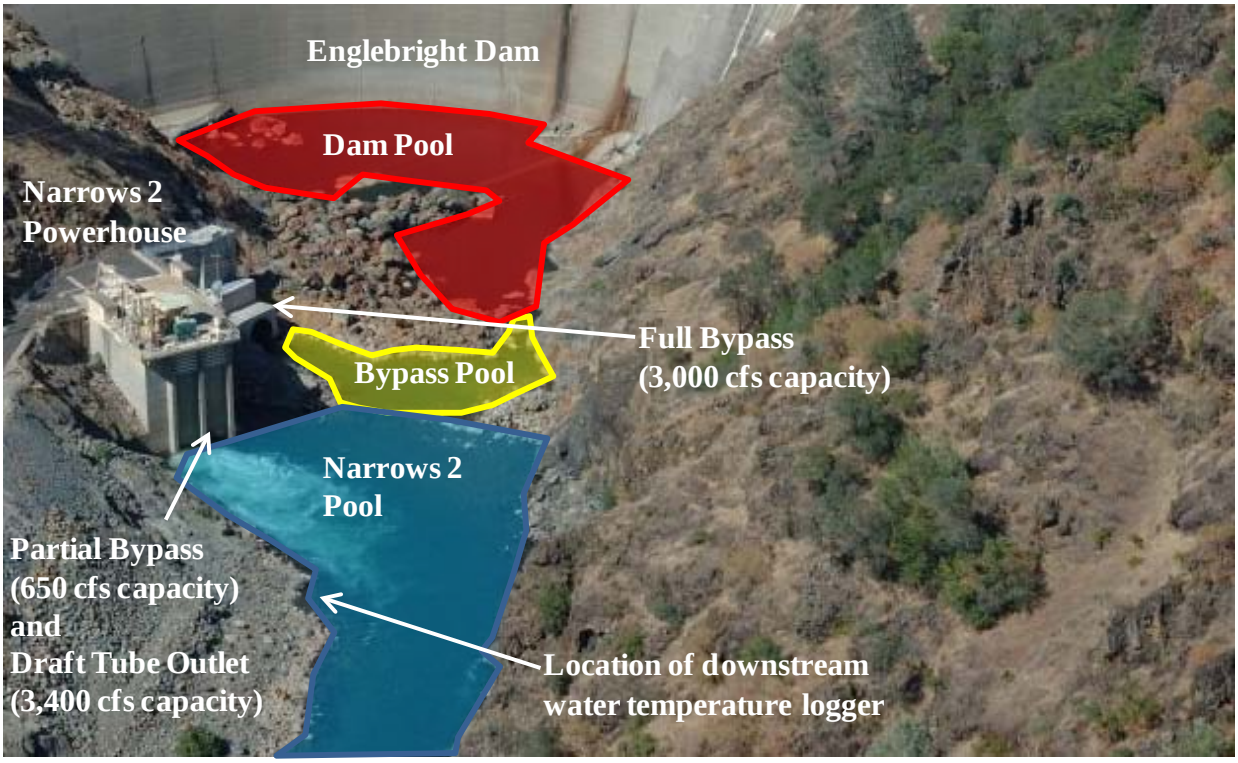

Figure 2.4-1. Looking upstream to the location of the study area in proximity to the Narrows 2 Powerhouse.

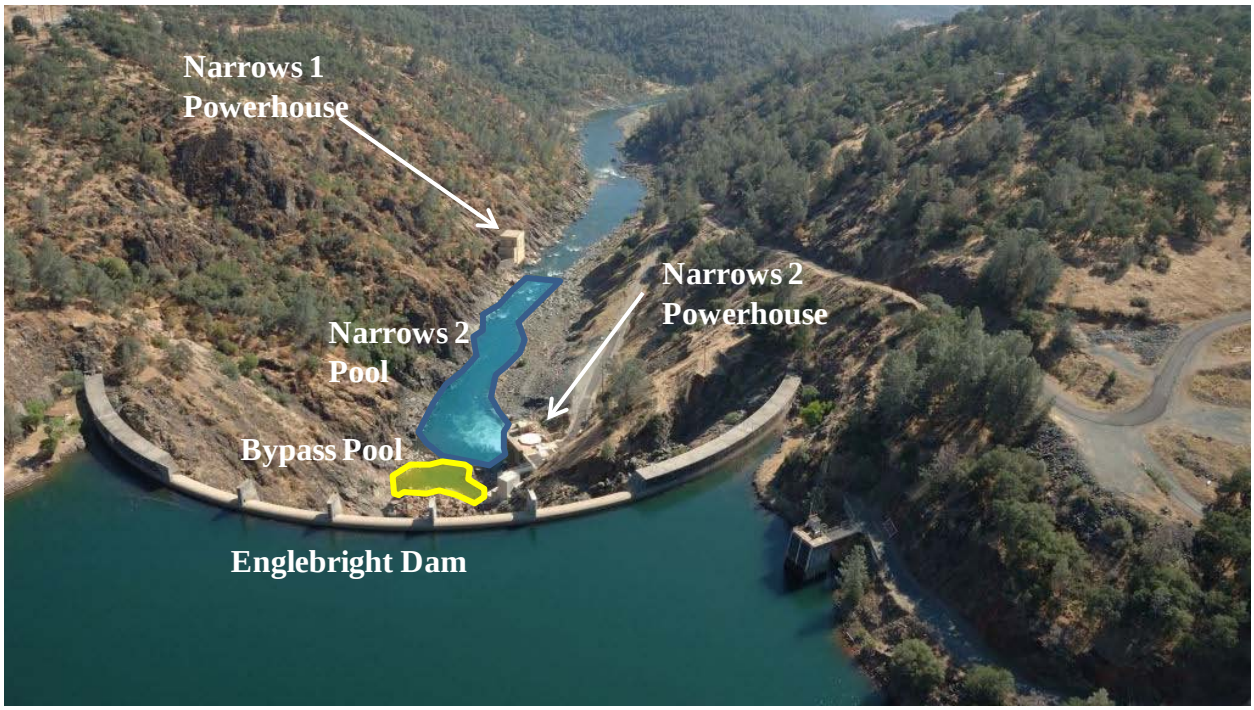

Figure 2.4-2. Looking downstream to the location of the study area in proximity to the Narrows 2 Powerhouse. The Dam Pool is not visible from this perspective.

The Narrows 2 Powerhouse outlet was fully explored, and then the snorkelers would survey the thalweg, in tandem, downstream to the pool above the Narrows 1 Powerhouse. This process was repeated so that all sections of the Narrows 2 Pool were covered twice.

Surveys occurred in all of the three sections within the same day. During the survey, biologists identified all fish present, visually estimated size of each observed fish in 2-inch bins, and collected behavioral information (e.g., holding, spawning, and attempting to ascend powerhouse effluent plume) on salmonids greater that 16 inches FL (i.e., size estimated visually at the time of the survey). Biologists coordinated in order to prevent duplicate fish observations. While not required, surveyors initially attempted use of facemask video cams with little success. These efforts were abandoned due to poor final video quality (e.g., combination of insufficient ambient light and turbidity).

2.4.2 Monitoring Planned Infrequent Operations Using DIDSON and Snorkeling

A DIDSON camera was deployed to monitor the area near the Narrows 2 Powerhouse draft tubes during planned powerhouse shutdowns and start-ups (i.e., a shutdown was defined as the period when the Narrows 2 Powerhouse goes from operating to full stop [i.e., no flow through powerhouse], and start-up was defined as the period when the Narrows 2 Powerhouse goes from shutdown to operations) or when significant up- or down-ramps to Narrows 2 Powerhouse releases occur (i.e., a significant up- or down-ramp was defined as a change in flow through the powerhouse of more than 400 cfs in a 1-day period).

The DIDSON camera was used based on consultation with FERC and Relicensing Participants. The camera uses high-intensity sound waves to create motion images of submerged objects (e.g., fish). The resulting video has a similar appearance to a sonogram. The DIDSON camera can see long distances (i.e., in some cases, over 60 ft) and is highly effective in turbid or no-light settings. The camera is significantly challenged in highly oxygenated water due to entrained air bubbles and is, therefore, hindered when the powerhouse is operating. Based on testing, it is assumed the camera can see the whole depth of the draft tube in calm conditions. When water is oxygenated during generation, the visibility reduced to less than 10 feet.

The DIDSON camera was deployed the morning prior to the operational change, the camera was installed below the powerhouse to allow for continual monitoring. The DIDSON camera generally allowed for continual monitoring the day prior, day of, and the afternoon of the day following the operational change. The goal of the effort was to monitor the draft tubes to determine fish behavior in the area.

A metal mount with a track system operated with a hand winch was constructed for deploying the DIDSON camera. During periods of high flows (i.e., discharges from the Narrows 2 Powerhouse of greater than 1,200 cfs), the metal mount was deployed in a vertical orientation and during periods of less discharge, the metal mount was deployed in an angled orientation. The orientation was changed to maintain the same monitoring location and to monitor the whole water column immediately downstream of the draft tubes.

On the day of an operational change, the study intended to have two snorkelers present. Safety concerns did not permit snorkeling to occur in conjunction with the operational change. Further, biologists found it challenging to coordinate the hour of the change-over. So, it was best to allow the DIDSON camera to record throughout the day to capture the event.

Collected DIDSON camera video footage was reviewed to document fish presence and, if possible, fish behavior in relation to Narrows 2 Powerhouse flows. A technician identified in a spreadsheet timestamps where notable behavior activity occurred and generally characterized the observation. Segmented video clips and images from the footage were extracted to allow for general examples of behavior.

The DIDSON surveys were expected to supplement and replace species composition and abundance surveys. DIDSON surveys were conducted during all planned infrequent operation events (4 total), but due to the lack of snorkeling on the day of the operational change, twice-monthly snorkel surveys were implemented regardless.

2.4.3 Incidental Observations

Incidental observations of fish and fish behavior in the vicinity of the Narrows 2 Powerhouse were collected by YCWA employees and consultant staff when they visited the powerhouse area. Observations occurred from December 2011 through November 2012. YCWA staff was provided a standard form to document the incidental observations. The form provided for documenting the date, location of the fish observed, number and species of fish observed, and the behavior of the fish (e.g., darting, jumping, and stranding). These opportunistic observations occurred from land and were not scheduled surveys or in-water snorkel efforts. In general, they occurred about every other day (i.e., approximately 13 days each month).

2.4.4 Operational Monitoring and Characterization

Several different continuous and event-based monitoring applications were conducted to describe the effects of Narrows 2 Powerhouse operations on discharge and velocity. In addition, an assessment of fish access to Englebright Dam at low flow conditions was completed. The methods employed for each of these efforts is described below.

2.4.4.1 Continuous Monitoring

YCWA monitored and documented Project operational flow conditions (i.e., discharge rate in cfs) from Narrows 2 Powerhouse generation, the partial bypass, and the full bypass from June through December 15, 2012. Velocity within the Narrows 2 Powerhouse draft tube was calculated using a model to determine the average velocity a fish is exposed to, based on discharge and draft tube dimensions (i.e., draft tube area divided by discharge). YCWA provided modeled velocity calculations at the following locations:

- The penstock entering (i.e., upstream of) the turbines
- The vertical section of the draft tube directly below the turbine units

- The end of the draft tube steel liner (a predominantly horizontal piece of pipe) where it joins what appears to be a concrete box or trapezoidal channel
- The end of the concrete box / trapezoidal channel at the exit of the concrete channel into the Yuba River (note, the concrete channel appears to expand along its length from its start at the steel draft tube joint to the exit into the Yuba River). This component was not calculated, due to varying water stage below the powerhouses. It may be recorded during velocity characterization measurements described in the next section

2.4.4.2 Velocity Characterization

Based on the range of operational flows, YCWA will conduct three Acoustic Doppler Velocity Meter (ADV) surveys during a shutdown (i.e., no flow though Narrows 2 Powerhouse) and low and moderate/high discharge levels from Narrows 2 Powerhouse. The ADV survey will measure the direction and magnitude of the water velocity within the influence of the powerhouse's releases. The methods to this approach were collaboratively revised with the NMFS and the product of that collaboration is presented in the results of this document. The actual survey is planned to occur in early December 2012.

2.4.4.3 Access and Habitat Quality Assessment Below Englebright Dam

A single survey event was conducted to measure the hydraulic controls at the downstream end of the Dam Pool at low flow conditions. A transect was established and depth and water elevation measurements taken. From these measurements, an assessment as to whether or not adult anadromous fish are able to move up or downstream in the absence of spill flow was conducted. During the time of the survey, level-loggers were deployed in the Dam Pool and Bypass Pool to record daily elevations of the pools during the monitoring period (i.e., June through December 15, 2012). Also two thermologgers were deployed to monitor water temperature (hourly) in the Dam Pool. One was installed in relatively shallow water and the other in deepwater to characterize possible difference in temperature at depth.

The monitoring loggers were maintained and downloaded periodically during other local monitoring activity. During deployment and maintenance of the loggers, a vertical DO and water temperature profile was collected within the Dam Pool to characterize levels during seasonal ambient temperature changes.

3.0 Results

3.1 Historic Data Review

3.1.1 Operations

Operational releases from the Narrows 2 Powerhouse can occur through the powerhouse draft tube (i.e., powerhouse e generating), the partial bypass (i.e., up to 650 cfs) or the full bypass (i.e., up to 3,000 cfs after 2008 when the full bypass was constructed). Figure 3.1-1 shows that from WY 1970 through WY 2008, the average monthly combined flow releases from the draft tube

and partial bypass were less than 1,500 cfs from August through November. Flow averaged over 1,500 cfs from December through July.

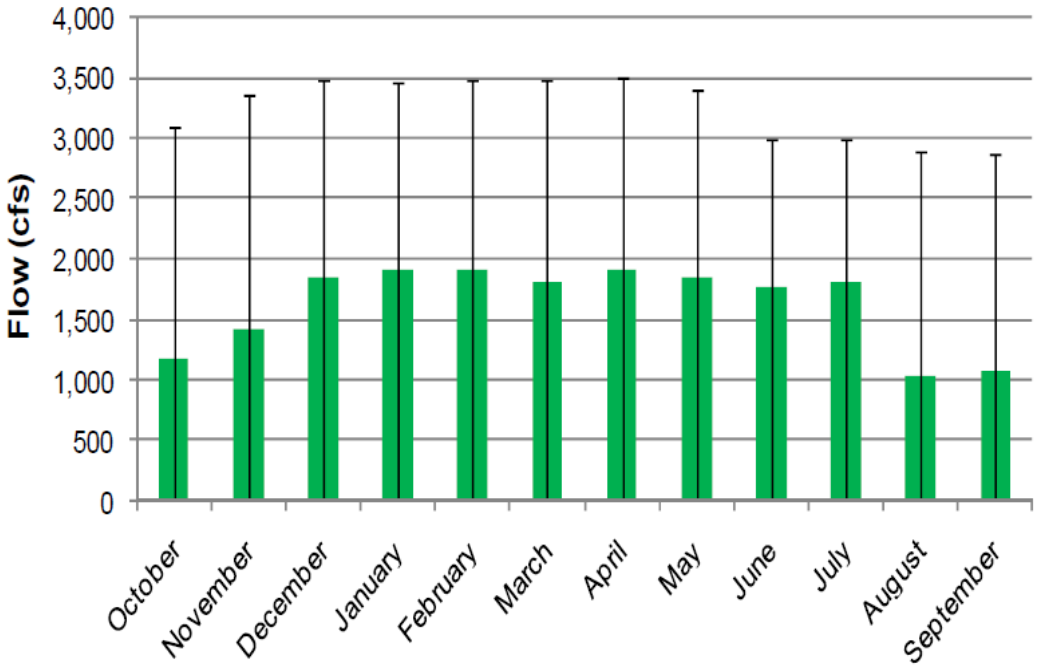

Figure 3.1-1. Average monthly flow for Narrows 2 Powerhouse releases (i.e., from draft tube and partial bypass) from WY 1970 through WY 2008.

During this period, PG&E's Narrows 1 Powerhouse generally maintained a steady release near 500 cfs - Narrows 2 Powerhouse was managed for incoming flows and therefore, fluctuated more often. Figure 3.1-2 shows that Narrows 1 Powerhouse generally operated approximately half of the year and released over 500 cfs 40 percent of the time. In comparison, Narrows 2 Powerhouse operated over 80 percent of the year and maintained flows of 2,000 cfs or less half of the time.

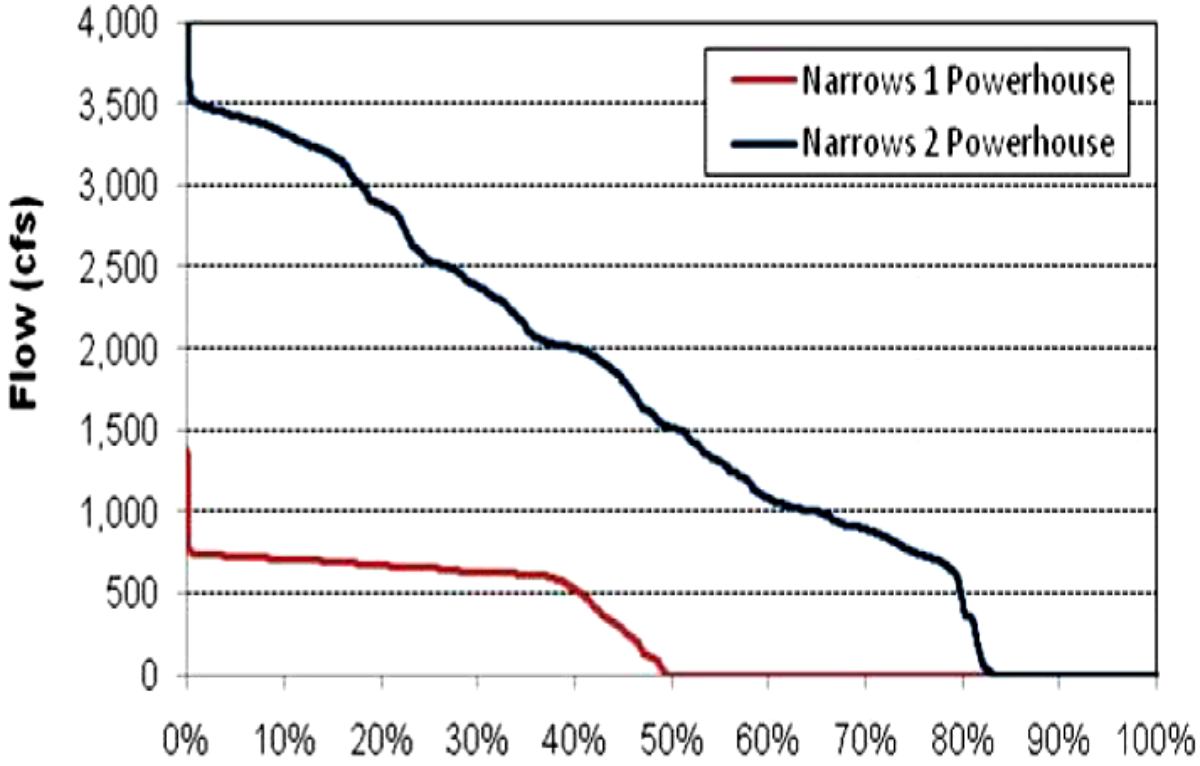

Figure 3.1-2. Flow exceedance of historical mean daily releases through the Narrows 1 and Narrows 2 powerhouses from WY 1970 through WY 2008.

Since 2009, the determination by the operators of how much of the total flow below Englebright Dam to release through each of the two powerhouses is influenced by: 1) the capacity of the two powerhouses; 2) generating unit efficiency at a given flow; 3) physical condition of the facility, such as maintenance outages; and 4) by the decisions to utilize the Narrows 1 Powerhouse to meet energy market requirements.

Table 3.1-1 provides a summary based on flow range of operations based on the criteria addressed above. Releases through the Narrows 1 Powerhouse result in energy generation that qualifies for Renewable Portfolio Standard (RPS) credit and revenue, and PG&E is required to meet a certain percentage of its total generation through RPS. Therefore, it is preferred at certain times and under certain energy market conditions to run Narrows 1 Powerhouse and to bypass flows at the Narrows 2 Powerhouse. While Narrows 2 Powerhouse could run at less than 900 cfs, the combination of inefficiency of Narrows 2 Powerhouse generation and RPS benefit at Narrows 1 Powerhouse provides an economic benefit for not running the Narrows 2 Powerhouse at less than 900 cfs. Essentially, YCWA communicates to PG&E the required flows at the USGS Smartsville streamflow gage and PG&E dispatches the operations in consideration of the four criteria listed above.

Table 3.1-1. Division of Englebright Reservoir releases by flow rate (cfs).

Flow Range (cfs)	Narrows 1 Powerhouse Release (cfs)	Narrows 2 Powerhouse Release (cfs)	Partial Bypass (cfs)	Full Bypass (cfs)	Spill (cfs)
0-730	0-730	0	0	Used to Supplement Narrows 2 Flow to Meet Minimum Flows	0
730-900	730	0	0-170	If Partial Bypass Not Used, Used to Supplement Narrows 2 Flow to Meet Minimum Flows	0
900-1,630	0-730	900	0	0	0
1,630-4,130	730	900-3,400	0	0	0
>4,130	730	3,400	0	0	All remaining flow

In relation to capacity, operations of Englebright Dam, Narrows 1, and Narrows 2 powerhouses from WY 2009, following installation of the full bypass, to the current WY 2012 depended on water quantity (Figure 3.1-3). In wet years, like WY 2011, Narrows 1 Powerhouse operated at a predictable and steady rate. The 2009 dry water year also showed relatively steady operations from Narrows 1 Powerhouse, but in WY 2010 (below normal) operations were more variable. Narrows 2 Powerhouse releases fluctuated with the upstream hydrograph, passing upstream flows, and ramping up during potential spill events. Spill events were frequent in wet years (WY 2011).

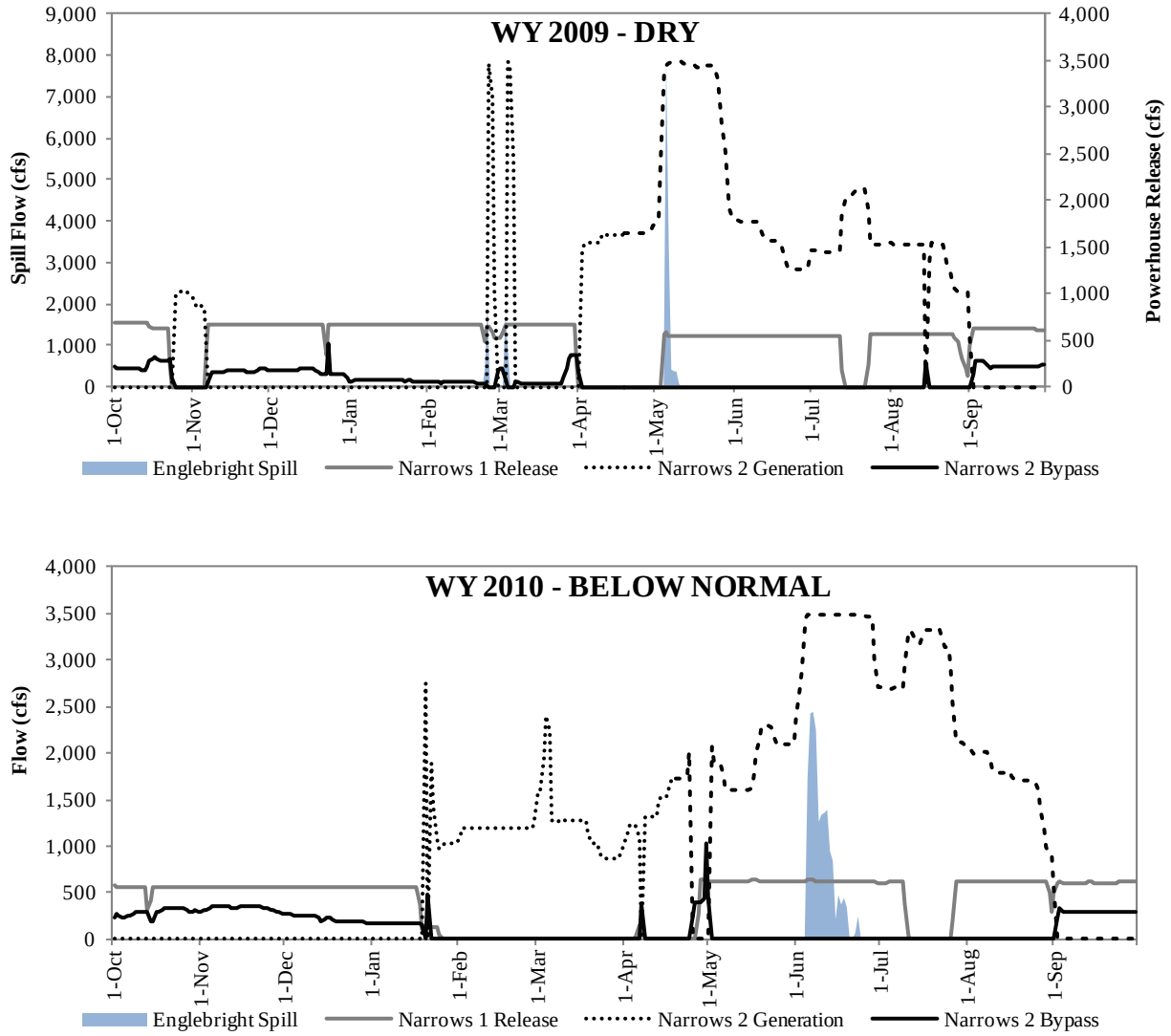

Figure 3.1-3. Daily mean release or spill from Narrows 1 and 2 powerhouses and Englebright Dam by in WYs 2009, 2010, 2011 and 2012.

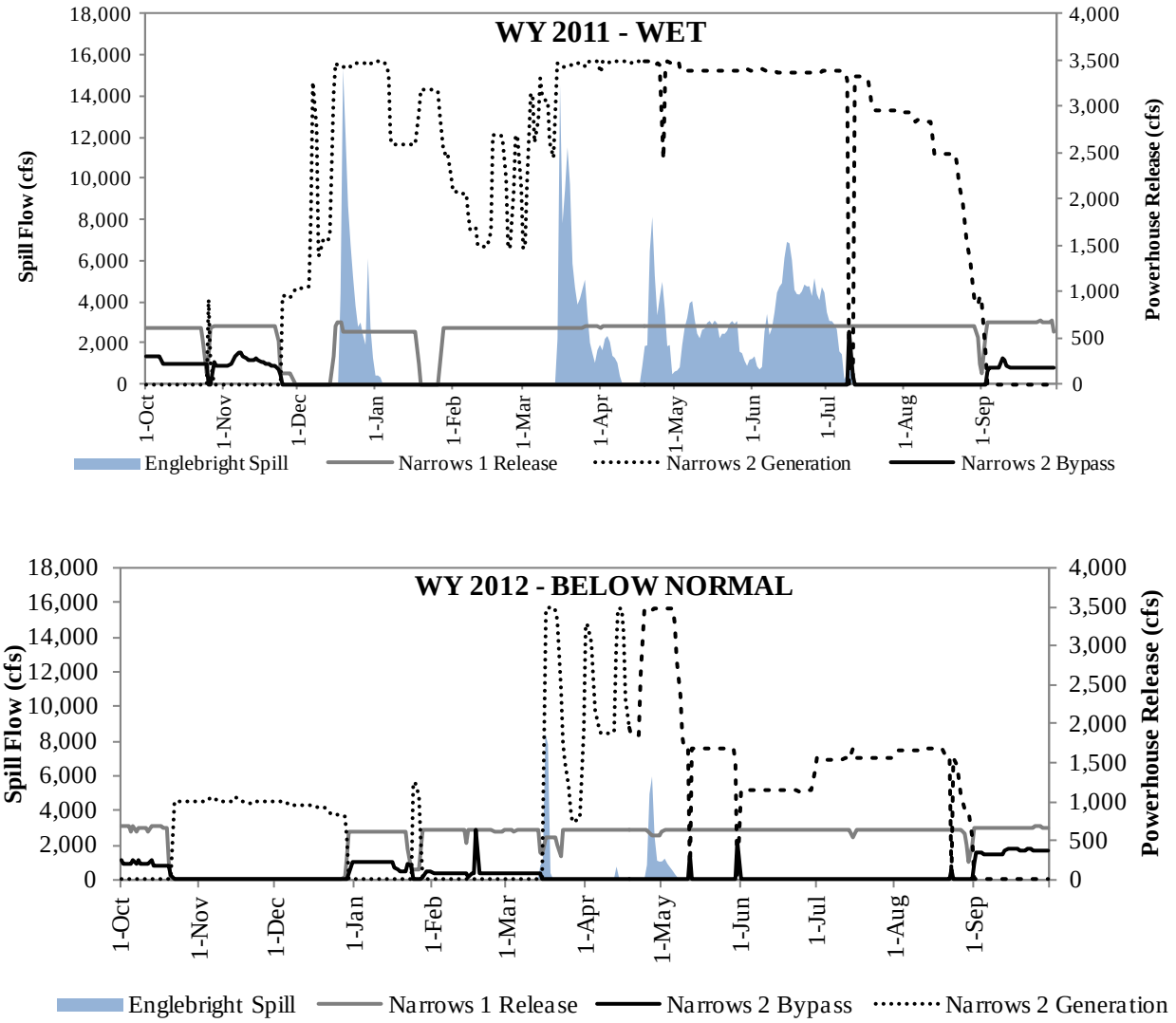

Figure 3.1-3. (continued)

Major spill events are not frequent, but can be relatively large. The five largest measured floods recorded at USGS's Marysville Gage occurred between 1955 and 1997. The peak floods were estimated at 180,000 cfs (December 22, 1964), 161,000 cfs (January 2, 1997), 146,000 cfs (February 1, 1963), 136,000 cfs (December 23, 1955), and 111,000 cfs (February 19, 1986; Entrix 2003).

Daily operational releases during WYs that are not designated as wet generally stayed within the operational capacity of the Narrows 2 Powerhouse (Figure 3.1-3). The cumulative flow downstream of Englebright and Daguerre Point dams is measured at the Marysville Gage (CDEC 2012). Water infiltration from the Yuba Goldfields may contribute additional water into the lower channel, but is considered not quantifiable within the scope of this report. When spill is

not occurring, the operational releases are generally less than 3,400 cfs (Figure 3.1-3). Frequent spill events during wet years are minimally influenced by releases at Narrows 2 Powerhouse.

In the current water year, 2012, there were two moderate spill events in March and May. The Narrows 1 Powerhouse operated frequently from January through early November 2012. The Narrows 2 Powerhouse operated at capacity several times from March through May, but otherwise remained below its full capacity. The year overall was classified as 'below normal,' meaning it was less wet than 2011 and more comparable to WY 2010.

Englebright Dam did not spill during the study.

3.1.2 Anadromous Salmonid Periodicity

Spring-run Chinook salmon, fall-run Chinook salmon and steelhead were historically and are currently present in the Yuba River downstream of Englebright Dam. Each run has a specific life history that requires unique conditions for optimal run success. The critical periods of movement into and out of the river vary by species or run. A monthly summary of lifestages and run timing (USACE 2001) for each species or run shows that movement within the river occur year-round (Table 3.1-2). The variation of migration and emigration run timing between fall- and spring-run Chinook salmon alone covers the entire 12 month calendar. In addition, steelhead rearing and emigration can occur throughout the year.

Table 3.1-2. Salmon and steelhead trout life history data for the Yuba River downstream of Englebright Dam.

Operations												
Flow Condition Description	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Seasonally High Flow	■	■	■	■	■							
General Diversion Season					■	■	■	■				
FALL-RUN CHINOOK SALMON												
Spawning Migration	■								■	■	■	■
Spawning	■									■	■	■
Egg Incubation	■	■								■	■	■
Emergence	■	■	■									■
Fry Rearing/Emigration	■	■	■									■
Juvenile Rearing/Emigration					■	■	■					
SPRING-RUN CHINOOK SALMON												
Spawning Migration				■	■	■	■	■				
Summer Holding						■	■	■				
Spawning									■	■	■	
Egg Incubation									■	■	■	■
Emergence	■										■	■
Fry Rearing/Emigration	■	■	■									■
Juvenile Rearing/Emigration				■	■	■	■					
STEELHEAD												
Spawning Migration	■	■	■					■	■	■	■	■
Spawning	■	■	■	■								
Egg Incubation	■	■	■	■	■							
Emergence	■	■	■	■	■							
Fry Rearing/Emigration	■	■	■	■	■	■	■	■	■	■	■	■
Juvenile Rearing/Emigration				■	■	■						

Source: USACE 2001

3.2 Telemetry Monitoring For Spring-Run Salmon

The RMT collaborated with participating agencies to conduct a series of telemetry studies from 2009 through 2011 from spring-run Chinook salmon. A full study report is available for the 2009 data (RMT 2009). The online link to that report is included in the references for direct access to the entire 2009 study results. Data were made available and summarized for 2010 and 2011. Reports are currently not written for 2010 and 2011 study years, but the draft data were summarized for this study. The discussion below is for study years 2009 through 2011. The methods reported in 2009 were held consistent for each study year and are, thus, applicable to 2010 and 2011 study years.

The RMT used hook-and-line sampling in the lower Yuba River near the confluence to capture 30 spring-run Chinook salmon during a 10-day period in May of each study year. Esophageal tag insertion was used to implant the tag into each individual's stomach. The fish were tracked through early December 2009. Table 3.2-1 presents a summary of all data combined from 2009 through 2011.

Table 3.2-1. Total number of unique detections from 2009 to 2011 by monitored reach for each month.

Month	2009–2011 Unique Detections by Monitored Reach (River Mile, or RM)										Total by Month
	RMs 0.0-3.1	RMs 3.1-8.0	RMs 8.0-11.0	Daguerre Point Dam	RMs 11.0-13.3	RMs 13.3-17.6	RMs 17.6-21.1	RMs 21.1-22.3	RMs 22.3-23.1	Englebright Dam	
May	14	5	358		4	4	2	0	0		387
June	18	29	793		22	63	57	38	0		1,020
July	6	33	981		8	13	98	34	26		1,199
August	8	28	1,201		54	42	126	71	59		1,589
September	4	16	470		62	119	345	359	155		1,530
October	1	3	68		37	37	160	69	47		422
November	0	0	39		20	20	26	31	0		136
December	0	0	0		0	0	0	0	0		0
Total	**51**	**114**	**3,910**		**207**	**298**	**814**	**602**	**287**		**6,283**

The study showed that fish tagged in May remained active in the river through November (Table 3.2-1). The greatest number of detections occurred in August (n=1,589) and the most by location were at RM 8.0 – 11.0 (3,910), which is downstream of Daguerre Point Dam. The site closest to the Narrows 2 Powerhouse (RM 22.3–23.1) represented only 4.6 percent of total detections. At RM 22.3–23.1, the earliest detected fish was in July 2009, but generally fish began to appear in September (Figure 3.2-1). At the RM 21.1–22.3, fish were still observed into November, but detections did not occur at the furthest upstream monitoring location.

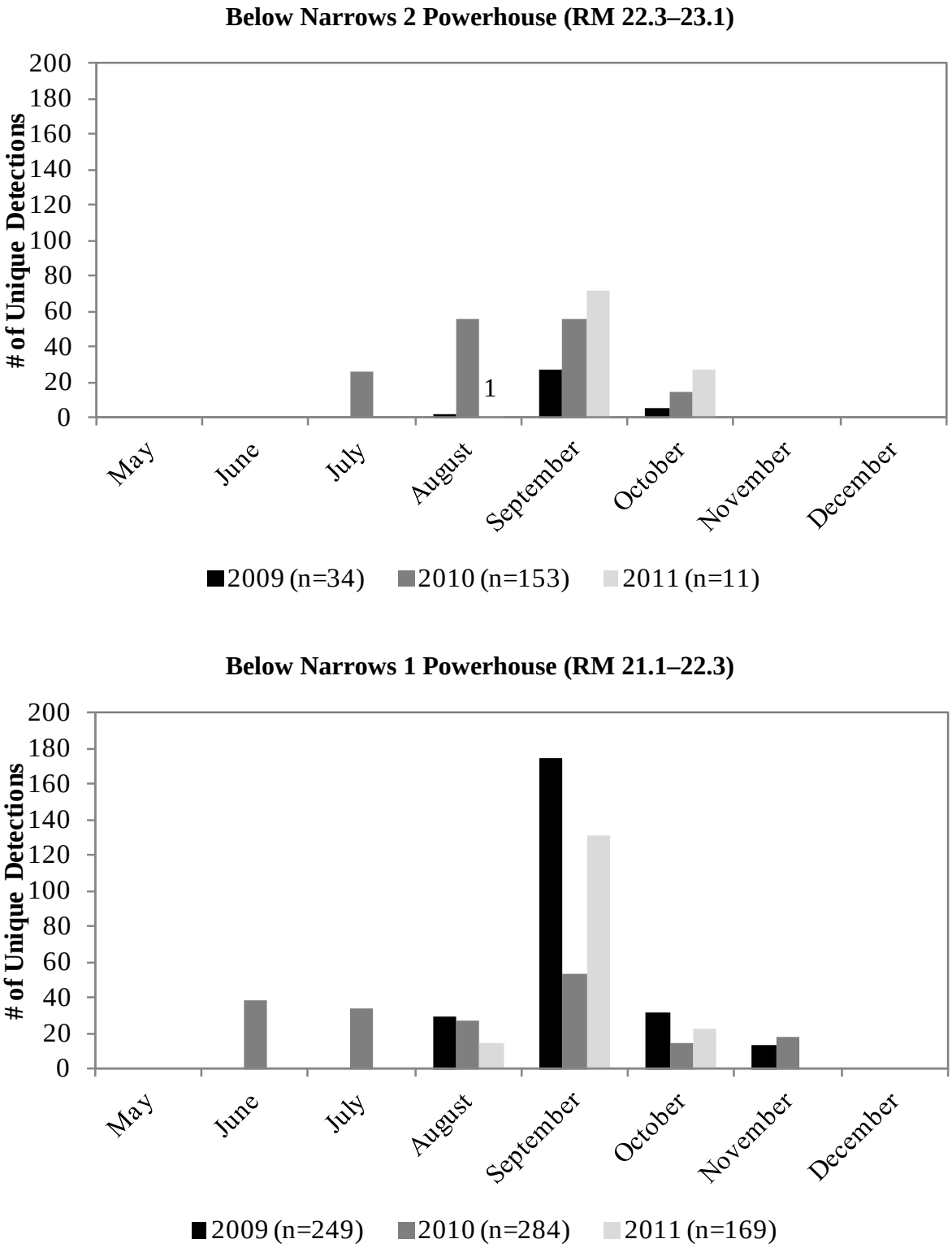

Figure 3.2-1. Series of graphs showing unique spring-run Chinook salmon detections by year, month and location. Note: detections below Narrows 2 do not include detections below Narrows 1.

The study has limitations as applied to fish presence and behavior near Narrows 2 Powerhouse. This was not the goal of the study effort. As a result, the data provide a coarse assessment of Chinook salmon timing and presence near the Narrows 2 Powerhouse. In addition, the acoustic technologies utilized in the study were challenged due to background 'noise' of the power generation facilities at the Narrows 1 and Narrows 2 powerhouses, which at times limited detection range and efficiency. Finally, the acoustic technology that the RMT used is non-directional - essentially, any detection recorded by a receiver can only be said to be generally proximate to that receiver (i.e., upstream or downstream). Nevertheless, the data showed that fish move upstream and peak around September in the upper reaches. Fish detections then significantly reduce due to lower activity or redistribution into the lower reaches.

3.3 Direct Observation

The timing of the direct observation snorkeling and DIDSON camera monitoring events relative to the Narrows 2 Powerhouse discharge is summarized in Figure 3.3-1.

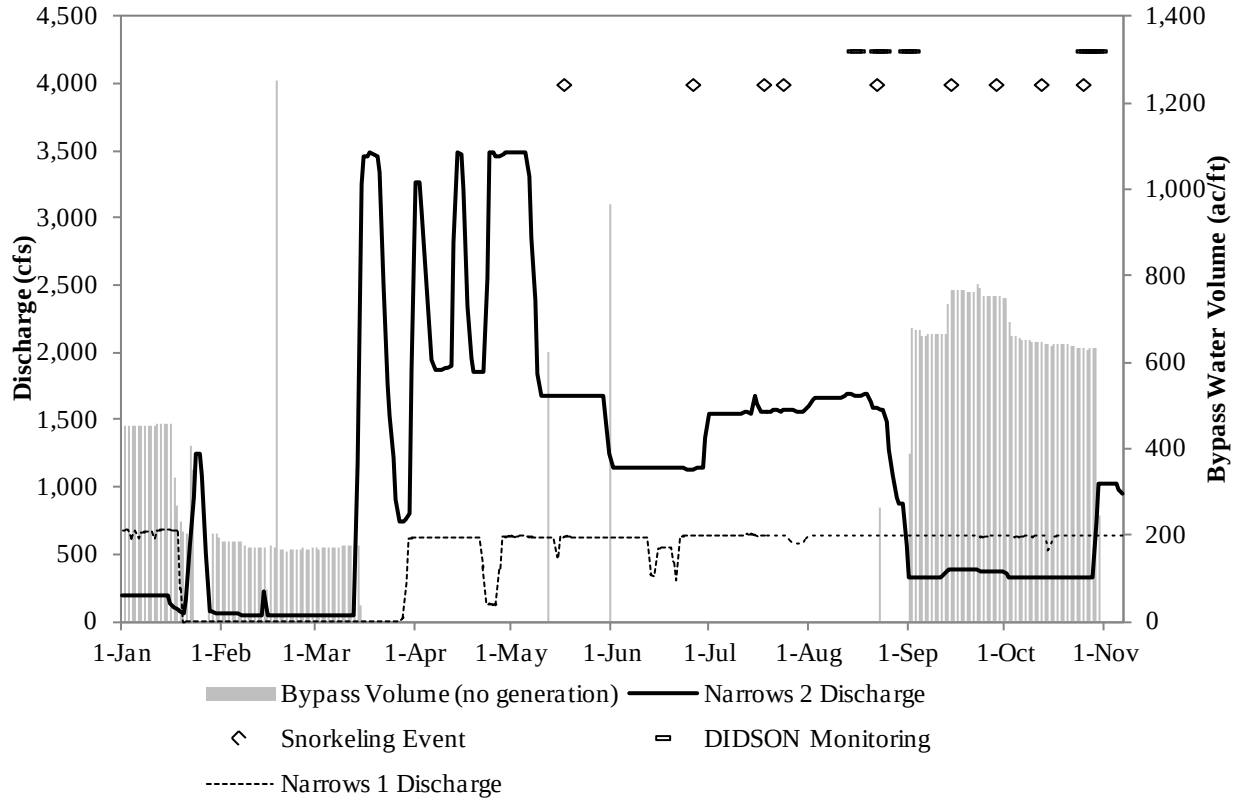

Figure 3.3-1. Summary of monitoring events based on the flow discharge at Narrows 2 Powerhouse from daily generation discharge or bypass flow volume from January through November 2012. (Bypass volume is the total volume of water passed through the full or partial bypasses, but not through the powerhouse.)

Figure 3.3-1 shows the total amount of water released from the Narrows 2 Powerhouse (i.e. bypass or generated). Where bypass water overlaps (grey vertical bars in Figure 3.3-1), limited or no generation was occurring. Bypass flows were represented by both the full and partial bypasses.[6] Water was passed through the bypasses and not generated primarily from January through early March and September through November, while powerhouse generation occurred from mid-March through September. The Narrows 1 Powerhouse was operational during the entire monitoring period.

3.3.1 Species Composition and Behavior Snorkeling

Table 3.3-1 presents general operational information and water quality for the 10 snorkeling events and Table 3.3-2 describes presence and absence of observed fish by event and location.

Table 3.3-1. Summary of species composition and relative abundance snorkeling events at Narrows 2 Powerhouse.

2012 Survey Date	Locations Surveyed	Discharge (cfs)	Est. Depth (ft)	Water Temperature (°C)[1]	Dissolved Oxygen (mg/L)[1]	Operational Condition
May 17	Dam, Bypass, and Narrows 2 pools	1,674	25	13.1	12.1	Power Generation
June 26	Dam, Bypass, and Narrows 2 pools	1,134	24	13.0	12.2	Power Generation
July 18	Dam, Bypass, and Narrows 2 pools	1,557	25	12.9	12.2	Power Generation
July 24	Dam, Bypass, and Narrows 2 pools	1,566	25	11.6	10.9	Power Generation
August 22	Narrows 2 Pool	1,587	25	12.1	11.0	Operational change from generation to full bypass
August 31	Narrows 2 Pool	561	21	12.2	10.8	Operational change from generation to full bypass
September 14	Narrows 2 Pool	381	20	10.6	12.3	No Generation - Diverting water through full bypass
September 28	Narrows 2 Pool	377	20	12.1	11.0	No Generation - Diverting water through full bypass
October 12	Narrows 2 Pool	329	20	11.8	11.3	No Generation - Diverting water through full bypass
October 25	Narrows 2 Pool	327	20	11.5	11.8	Operational change from powerhouse partial bypass to full bypass

[1] Temperature and DO recorded approximately 20 ft below Narrows 2 Powerhouse.

Table 3.3-2. Presence or absence of fish observed during snorkel surveys at Narrows 2 Powerhouse in 2012 by event and location.

2012 Survey Date	Location Surveyed	Fish Presence: Yes, No, or Not Snorkeled (ns)					
		Rainbow Trout < 16 in	Rainbow Trout > 16 in	Chinook Salmon	Black Bass	Sacramento Pikeminnow	Sacramento Sucker
May 17	Dam Pool	no	no	no	yes	no	no
	Bypass Pool	no	no	no	no	no	no
	Narrows 2 Pool	yes	no	no	no	no	no

[6] YCWA does not maintain on record a distinction of whether the full or partial bypass was used, but rather the volume of water bypassed.

Table 3.3-2. (continued)

2012 Survey Date	Location	Fish Presence: Yes, No, or Not Snorkeled (ns)					
		Rainbow Trout < 16 in	Rainbow Trout > 16 in	Chinook Salmon	Black Bass	Sacramento Pikeminnow	Sacramento Sucker
June 26	Dam Pool	no	no	no	yes	yes	no
	Bypass Pool	no	no	no	no	no	no
	Narrows 2 Pool	no	no	no	no	no	no
July 18	Dam Pool	no	no	no	yes	no	no
	Bypass Pool	yes	no	yes	no	no	no
	Narrows 2 Pool	no	yes	yes	no	no	no
July 24	Dam Pool	no	no	no	yes	no	no
	Bypass Pool	no	no	no	no	no	no
	Narrows 2 Pool	yes	no	no	no	no	no
August 22	Dam Pool	ns	ns	ns	ns	ns	ns
	Bypass Pool	ns	ns	ns	ns	ns	ns
	Narrows 2 Pool	yes	no	no	no	no	no
August 31	Dam Pool	ns	ns	ns	ns	ns	ns
	Bypass Pool	ns	ns	ns	ns	ns	ns
	Narrows 2 Pool	yes	no	yes	no	no	no
September 14	Dam Pool	ns	ns	ns	ns	ns	ns
	Bypass Pool	ns	ns	ns	ns	ns	ns
	Narrows 2 Pool	yes	yes	yes	no	yes	no
September 28	Dam Pool	ns	ns	ns	ns	ns	ns
	Bypass Pool	ns	ns	ns	ns	ns	ns
	Narrows 2 Pool	yes	yes	yes	no	no	no
October 12	Dam Pool	ns	ns	ns	ns	ns	ns
	Bypass Pool	ns	ns	ns	ns	ns	ns
	Narrows 2 Pool	yes	no	no	no	no	no
October 25	Dam Pool	ns	ns	ns	ns	ns	ns
	Bypass Pool	ns	ns	yes (observed from surface)	ns	ns	ns
	Narrows 2 Pool	yes	yes	yes	no	yes	yes

The survey did not attempt to enumerate fish in the area. The data does provide a relative degree of magnitude for fish presence, but is not consider a quantitative reporting. Additionally, high velocities often encountered in the Narrows 2 Pool resulted in very short observation times. This sometimes made it difficult for snorkelers to observe behavioral characteristics of identified fish.

If the full bypass was being operated or an operational change occurred, the Dam Pool and Bypass Pool were deemed unsafe to snorkel and snorkeling was only conducted in the Narrows 2 Pool. On dates that operational changes occurred, additional monitoring was conducted using the DIDSON camera and is further described in Section 3.3.2. In general, water quality measurements were taken in the Narrows 2 Pool before the survey began.

A summary of each event is presented below.

May 17 (Monthly Survey)

Snorkeling was conducted in the Bypass Pool by a single snorkeler and resulted in no observed fish.

The snorkeler then moved to the Dam Pool and observed one black bass (*Micropterus sp*., hereafter referred to as bass). In addition, the safety observer was able to identify several schools of bass in the Dam Pool from the surface using polarized glasses. Visibility in the Dam Pool and Bypass Pool was approximately 5 ft.

Two biologists snorkeled the Narrows 2 Pool. On the first pass (margin + thalweg), one rainbow trout (~8 in. FL) was observed in the margin and one rainbow trout (~14 in. FL) was observed in the thalweg. The trout in the margin was observed for approximately 30 seconds, but was not displaying natural behavioral characteristics; the trout appeared to be observing the snorkeler. Behavioral characteristics of the trout observed in the thalweg could not be determined due to a very short observation time from the high velocity. No fish were observed during the second pass. Visibility in the Narrows 2 Pool was approximately 5 ft during the survey.

Water temperature and DO below Narrows 2 Powerhouse were, 13.1°C and 12.1 mg/L, respectively. Discharge from the Narrows 2 Powerhouse on the day of the survey was 1,674 cfs.

June 26 (Monthly Survey)

Snorkeling began with a single snorkeler in the Dam Pool. Six bass (~8–14 in. FL) and approximately 200 (<2 in. FL) juvenile bass were observed. In addition, 10 Sacramento pikeminnow (*Ptychocheilus grandis*) (~6–8 in. FL) were observed. Instantaneous temperature and DO in the Dam Pool at the surface were 21.1°C and 8.86 mg/L, respectively.

No fish were observed during snorkeling in the Bypass Pool.

The Narrows 2 Pool was snorkeled by two biologists. No fish were observed during two complete passes. Instantaneous temperature and DO below Narrows 2 Powerhouse were 13.0°C and 12.2 mg/L, respectively. Discharge from the Narrows 2 Powerhouse on the day of the survey was 1,134 cfs.

July 18 (Bi-Monthly Survey)

A single snorkeler in the Dam Pool identified five bass (~8 in FL) and approximately 200 juvenile bass (< 2 in.).

The snorkeler moved downstream to the Bypass Pool and observed two rainbow trout (~12–14 in. FL). Both fish appeared to be fleeing, so undisturbed behavior was not apparent. The Narrows 2 Powerhouse operator observed a Chinook salmon in the Bypass Pool before the snorkeler entered. The operator based his identification on the relatively large size and dark coloration of the fish. Visibility in the Dam Pool and Bypass Pool was estimated at 15 ft.

Snorkelers entered the Narrows 2 Pool and estimated visibility at 8 ft. Two approximately 16 in. unidentified salmonids (likely rainbow trout) were observed fleeing. One Chinook salmon (~34 in FL) was observed fleeing downstream out of a deep pool just upstream of the Narrows 1 powerhouse. Snorkelers could not see the bottom of some of the deeper pools. Instantaneous temperature and DO below Narrows 2 Powerhouse were 12.9°C and 12.2 mg/L, respectively. Discharge from the Narrows 2 Powerhouse on the day of the survey was 1,557 cfs.

July 24 (Bi-Monthly Survey)

Approximately 150 juvenile bass (< 2 in.) and an additional four (~4–6 in.) bass were observed in the Dam Pool. Instantaneous temperature and DO at the surface of the Dam Pool were 22.7°C and 6.79 mg/L, respectively.

No fish were observed in the Bypass Pool.

The Narrows 2 Pool was snorkeled twice by two biologists and only one rainbow trout (~12–14 in. FL) was observed fleeing. Temperature and DO below the Narrows 2 Powerhouse were 11.6°C and 10.9 mg/L, respectively. Discharge from the Narrows 2 Powerhouse was 1,566 cfs.

August 22 (Bi-Monthly Survey)

An operational change from the Narrows 2 Powerhouse to the full bypass valve occurred during the event. Due to safety concerns, no snorkeling occurred in the Dam Pool and Bypass Pool.

Snorkeling in the Narrows 2 Pool observed one rainbow trout (~8–10 in. FL) fleeing out of a left bank eddy approximately 160 ft downstream of the powerhouse. Instantaneous water temperature and DO below the Narrows 2 Powerhouse were 12.1°C and 11.0 mg/L, respectively. Discharge from the bypass on the day of survey was 1,587 cfs.

August 31 (Bi-Monthly Survey)

An operational change from the Narrows 2 Powerhouse to the full bypass valve occurred during the event. Due to safety concerns, no snorkeling occurred in the Dam Pool and Bypass Pool. The bypass flow was 381 cfs.

No fish were observed in either the powerhouse outfall or the Bypass Pool from the powerhouse deck.

After operations stabilized, the Narrows 2 Pool snorkel survey was conducted. Six rainbow trout (~10–12 in. FL) and one Chinook salmon (~28–30 in. FL) were observed fleeing. The Chinook salmon was observed about 330 ft downstream of the powerhouse. Fish behaviors were not apparent. Water temperature and DO below the Narrows 2 Powerhouse were 12.2°C and 10.8 mg/L, respectively.

September 14 (Bi-Monthly Survey)

The full bypass was operating during the snorkeling event, therefore no snorkeling took place in the Dam Pool and Bypass Pool.

Snorkelers moved upstream along the margins of the Narrows 2 Pool. A fleeing Chinook salmon (~20–24 in. FL) was observed approximately 160 ft downstream of Narrows 2 Powerhouse on the right bank of the channel. At roughly the same location, but on the left bank, two rainbow trout (<16 in. FL) were also observed fleeing. Near the powerhouse, 17 rainbow trout (< 16 in. FL) were observed milling. Additionally, four rainbow trout (> 16 in. FL) were observed milling amongst the smaller trout. During the thalweg pass, three Chinook salmon (~20–24 in. FL) were observed fleeing 230 ft downstream of the powerhouse and two rainbow trout (<16 in. FL) were observed approximately 260 ft downstream of the powerhouse fleeing. One Sacramento pikeminnow was also observed.

Fewer fish were observed during the second pass in the Narrows 2 Pool. Snorkeling along the margins identified one rainbow trout (>16 in. FL) near the right-bank approximately 130 ft downstream of the powerhouse fleeing. Along the left-bank four rainbow trout (<16 in. FL) and five adult Sacramento pikeminnow were observed milling approximately 360 ft downstream of the Narrows 2 Powerhouse. Adjacent to the left-bank edge of the powerhouse, six rainbow trout (< 16 in. FL) and one rainbow trout (>16 in FL) were observed milling. Sunlight and shadows decreased visibility to about 6 ft near the powerhouse. During the thalweg pass, only three rainbow trout (< 16 in. FL) were observed fleeing.

Water temperature and DO below the Narrows 2 Powerhouse were 10.6°C and 12.3 mg/L, respectively. Discharge from the full bypass was 381 cfs on the day of the survey.

September 28 (Bi-Monthly Survey)

The full bypass was operating on the day of the snorkel, so only the Narrows 2 Pool was surveyed. Instantaneous temperature and DO below the Narrows 2 Powerhouse were 12.1°C and 11.0 mg/L, respectively. The full bypass was releasing 377 cfs.

The survey in the Narrows 2 Pool began with snorkelers moving upstream along the margins followed by the downstream thalweg snorkel with the two snorkelers moving in tandem. Three Chinook salmon (~26–28 in. FL) and two rainbow trout (i.e., ~10–12 in. and ~20–22 in. FL) were observed during the first pass. The smaller of the two rainbow trout appeared to be feeding; all other fish were holding in the water column. One Chinook salmon (~24–26 in. FL) was observed migrating upstream while the snorkelers were recording data between passes. The Chinook salmon was observed by the snorkelers above water. During the second pass, one Chinook salmon (~28–30 in. FL) was observed holding in the water column.

October 12 (Bi-Monthly Survey)

The full bypass was open during the snorkeling event so only the Narrows 2 Pool was surveyed. Instantaneous temperature and DO in the Narrows 2 Pool were 11.8°C and 11.3 mg/L, respectively. Discharge from the bypass valve was 329 cfs on the day of the survey.

Two full snorkel passes in the Narrows 2 Pool did not observe any Chinook salmon. The two passes resulted in observations of six rainbow trout (~10–14 in. FL) and two additional rainbow trout (~14–16 in. FL). All fish were observed holding in the water column. No other species were observed.

October 25 (Bi-Monthly Survey)

During this survey, an operational change from the partial bypass to the full bypass valve occurred. Due to safety concerns, no snorkeling occurred in the Dam Pool and Bypass Pool.

Before the operational change, approximately 25 Chinook salmon were observed in the Bypass Pool from the powerhouse deck overlooking the pool. As flow was transferred from the partial bypass to the full bypass, the water became too rough to visually observe what the Chinook salmon did in response to the flow change. Approximately an hour following the flow change from the partial bypass to the full bypass, a fresh Chinook carcass was observed approximately 5 feet on shore. Its location was above the high water line and, thus, the fish was not considered stranded. As the snorkelers were preparing to snorkel the Narrows 2 Pool, two Chinook salmon were observed breaching in the Narrows 2 Pool. The two salmon were very active and continued to breach during the survey.

Water quality was taken approximately an hour after water had been transferred from the partial bypass to the full bypass. Instantaneous temperature and DO in the Narrows 2 Pool were 11.8°C and 11.5 mg/l, respectively. Discharge from the full bypass was 327 cfs. Visibility in the Narrows 2 Pool was estimated at 10 ft.

During the first pass of the Narrows 2 Pool survey, the majority of fish were observed on the left-bank. Four Chinook salmon (one ~26–28 in., three ~28–30 in. FL) were observed holding in a deep pool by the bedrock wall approximately 100 ft downstream of the Narrows 2 Powerhouse. Twenty-four rainbow trout (four ~10–12 in., seven ~12–14 in., eleven ~14–16 in., and two ~16–18 in. FL) were observed near the powerhouse where flow from the bypass valve meets the Narrows 2 Pool. These fish appeared to be holding in a seam between two varying converging flows. On the right bank, two rainbow trout (~8–14 in. FL) were observed holding, one was located about half way up the pool and the other was observed at the face of the powerhouse. Four Sacramento pikeminnow (~14–20 in. FL) were observed in the tandem thalweg snorkel.

During the second pass, the left-bank snorkeler did not see the Chinook salmon from the first pass. This time, 20 rainbow trout (four ~10–12 in., three ~12–14 in., eleven ~14–16 in., one ~16–18 in., and one ~18–20 in. FL) were observed in the same general area as the first snorkel all holding. The right-bank snorkeler observed one rainbow trout (~8–10 in. FL), one Sacramento sucker (~16–18 in. FL), one Sacramento pikeminnow (~16–18 in. FL) and two

Chinook salmon (one ~28–30 in., one ~20–22 in. FL). During the tandem thalweg snorkel, three Sacramento pikeminnow (~14–20 in. FL) were observed.

[Relicensing Participants – The results of the November and December bi-monthly sapling will be included here in the final technical memorandum. YCWA]

3.3.2 Infrequent Operations Monitoring Using DIDSON

The DIDSON camera was targeted for deployment 24 hours prior to a planned infrequent operational change (i.e., a flow change greater than 400 cfs), and to continue the day of and the day following the operational change. Four deployments have occurred.

The first occurred on August 15 and 16. However, while a flow change was planned, it did not occur.

The second event occurred from August 22 through 24. The total volume of water being released from the combined Narrows 2 Powerhouse and full bypass during the event (i.e., 1,564 to 1,631 cfs) did not change, but the release point changed from the powerhouse to the full bypass.

During the third event, which occurred from August 31 to September 3), the water level dropped significantly (approximately 3 ft) as the discharge from Narrows 2 Powerhouse dropped from approximately 880 cfs to 320 cfs.

During the first four days (November 25–29) of the fourth event, the discharge from Narrows 2 remained low (approximately 329 cfs), but increased on October 29 to slightly over 1,000 cfs.

A preliminary review of the DIDSON camera footage from the four monitoring events showed that the imagery was dominated by bubble waves during power generation (Figure 3.3-2). Visibility of the DIDSON camera during these periods was estimated to be less than 10 ft. During periods in which water was routed through the bypass valve, the DIDSON camera footage below the powerhouse improved greatly with clear observations of fish, the downstream edge of the Narrows 2 Powerhouse, and substrate. The image visibility increased from 10 ft to almost 65 ft during full bypass operation. Of the data reviewed to date, there were no instances where fish were documented swimming into the draft tubes or orienting with flow directly into the draft tubes. Overall, the general behavior observed was random and appears to be milling.[7]

[7] A significant amount of DIDSON™ data remains to be assessed. Review of collected DIDSON™ data requires a technician to manually review hours of video footage. The data review will be completed for the final report.

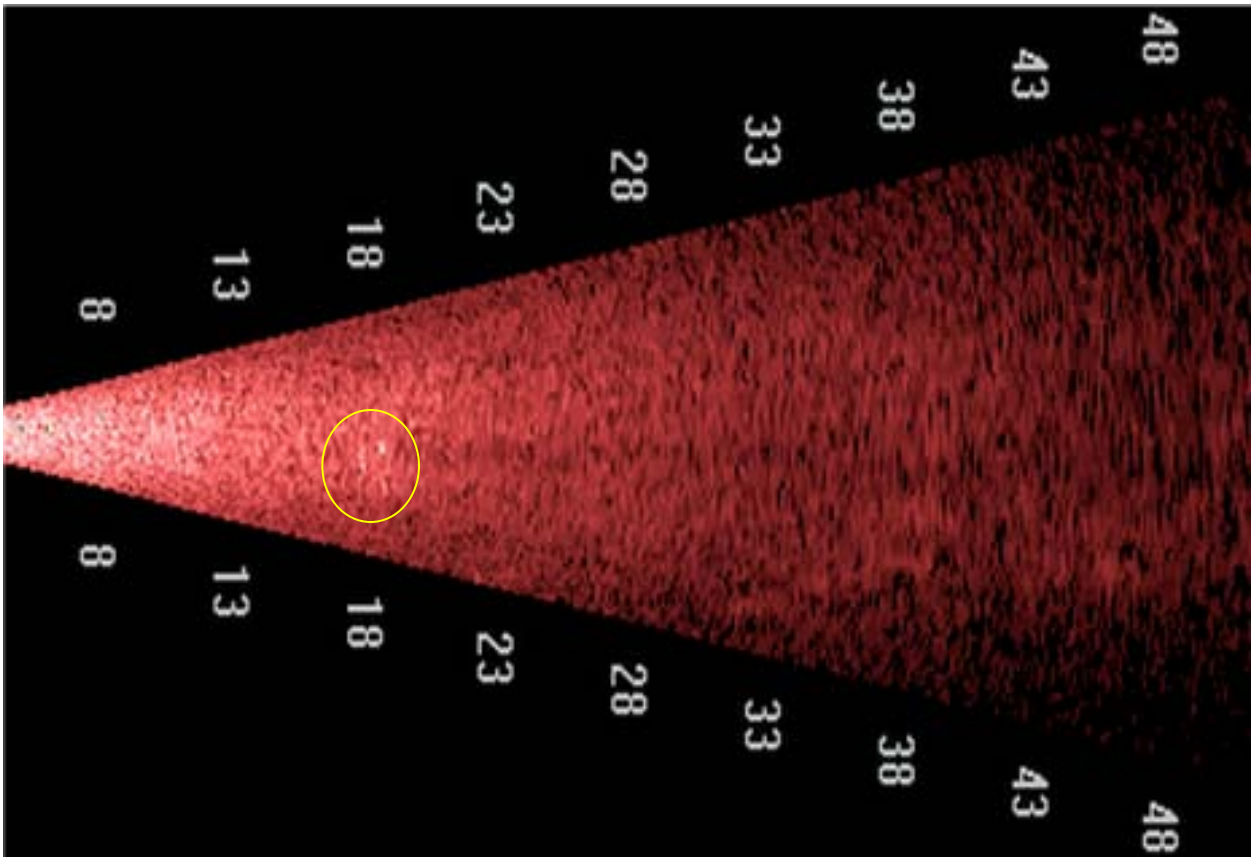

Figure 3.3-2. Example of DIDSON camera image in from bubble plume during generation. The yellow circle highlights three small fish (white flares), which were identified by behavior (schooling swim pattern) from the video. Numbers in the figure represent distance in feet from the camera.

[Relicensing Participants – This section will be completed in the final technical memorandum. YCWA]

3.3.3 Incidental Observations by YCWA Operators

Opportunistic fish observations at Narrows 2 Powerhouse were collected by YCWA employees and consultant staff. Daily log sheets were made available for staff to record fish observations while at the powerhouse. Table 3.3-3 presents a summary of YCWA's daily observations between December 20, 2011 and November 6, 2012. Since fish observations were sporadic, the table lists the frequency of observations per month. Observers did not attempt to differentiate between fish species; instead juvenile or adult was recorded based on fish size.

Table 3.3-3. Summary of incidental fish observation by YCWA staff at Narrows 2 Powerhouse between December 20, 2011 and June 7, 2012.

Year	Month	Days Observed	Adult Fish Observed	Date Fish Observed	Behavior	Location
2011	December	7	0	--	--	--
2012	January	16	1	Jan 20	jumping	361 ft below Narrows 2

Table 3.3-3. (continued)

Year	Month	Days Observed	Adult Fish Observed	Date Fish Observed	Behavior	Location
2012 (continued)	February	11	0	--	--	--
	March	13	0	--	--	--
	April	16	0	--	--	--
	May	17	0	--	--	--
	June	17	0	--	--	--
	July	15	1	July 18[1]	--	--
	August	18	2	Aug 19	holding	Bypass Pool
	September	9	0	--	--	--
	October	14	1	Oct 23	holding	Bypass Pool
	November	3	4	Nov 1, 4	dead / holding	Bypass Pool

[1] Fish behavior and location were not available for July 18 2012.

Nine fish were observed over the period. November 2012 had the most observations (n=4). All fish observed were classified as adults. One carcass was observed on October 23, 2012 on the bank near the Bypass Pool.

3.4 Operational Monitoring and Characterization

3.4.1 Continuous Monitoring

Modeled velocities within the Narrows 2 Powerhouse draft tubes were calculated addressing three areas that included upstream of the turbines, directly below the turbine, and the end of the draft tube steel liner. The calculation of flow at the end of the concrete box at the exit into the Yuba River could not be calculated due to the varying stage heights. Table 3.4-1 presents an overview of velocities at the three calculated segments for several operational scenarios. Table 3.4-2 shows the velocities for the same locations, but by monthly average from WY 1970 through WY 2010.

Table 3.4-1. Summary of modeled velocity in several locations of the Narrows 2 Powerhouse and multiple flow scenarios.

Criteria	Powerhouse Flow (cfs)	Penstock Before Runner (ft/sec)	Draft Tube Below Runner (ft/sec)	Draft Tube at Outlet (ft/sec)
Minimum Power Generation	900	5.85	12.97	2.75
2 X's Minimum Power Generation	1,800	11.69	25.94	5.50
Average from WY 1970 through WY 2010	1,859	12.08	26.79	5.68
Maximum Power Generation	3,400	22.09	48.99	10.39

Table 3.4-2. Summary of modeled velocity in several locations of the Narrows 2 Powerhouse by monthly average from WY 1970 through WY 2010.

Month	Powerhouse Flow (cfs)	Penstock Before Runner (ft/sec)	Draft Tube Below Runner (ft/sec)	Draft Tube @ Outlet (ft/sec)
January	2,221	14.43	32.01	6.79
February	2,497	16.22	35.98	7.63
March	2,450	15.92	35.30	7.49
April	1,943	12.62	27.99	5.93
May	2,271	14.75	32.72	6.94
June	2,078	13.50	29.95	6.35
July	1,492	9.69	21.50	4.56

Table 3.4-2. (continued)

Month	Powerhouse Flow (cfs)	Penstock Before Runner (ft/sec)	Draft Tube Below Runner (ft/sec)	Draft Tube @ Outlet (ft/sec)
August	1,146	7.44	16.51	3.50
September	901	5.85	12.99	2.75
October	901	5.85	12.99	2.75
November	1,753	11.39	25.26	5.35
December	2,055	13.35	29.61	6.28

The modeled results show that flow entering the penstock before the runner is accelerated and then slows as it approaches the draft tubes. Velocity also increases in all locations with greater discharge from the powerhouse. Velocity before the runner is greater than near the outlet. At low power generation (i.e. 900 cfs), velocity starts at 14.43 ft/sec above the runner, accelerates to 32.01 ft/sec below the runner, and then reduces to 6.79 ft/sec at the outlet. At maximum power generation (i.e. 3,400 cfs), the velocity starts at 22.09 ft/sec, accelerates to 48.99 ft/sec, and then reduces to 10.39 ft/sec at the outlet.

Prolonged swim speed of an adult steelhead and Chinook salmon are up to 13.7 ft/s and 10.8 ft/s, respectively (Bell 1973).

3.4.2 Velocity Characterization

[Relicensing Participants - YCWA committed to develop a velocity sampling plan in collaboration with the NMFS, prior to conducting a series of velocity measurements below the Narrows 2 Powerhouse. In general, FERC stated that point and transect data would be collected at three flows: bypass flow (~300 cfs), low powerhouse flow (~300 cfs), and moderate powerhouse flow (~600 to 800 cfs). The sampling locations and frequency of point data needed to be collaboratively agreed upon between YCWA and NMFS. YCWA created an aerial image and proposed a sampling scheme overlay to NMFS. The planning template was modified and iteratively adjusted between YCWA and NMFS. The final product is presented in Figure 3.4-1 below. This is a modification of the original sampling scheme in the study plan but represents a greater effort and broader set of data collection. The modification to the original sampling plan was to reduce transect depth measurements in shallower habitats, as four depth bins (i.e. 20%, 40%, 60% and 80% of total depth) were not necessary in shallow habitat. The reduced number of transect measurements were offset by an increase in gridded point measurements. YCWA expects that velocity measurements will occur in January 2013. YCWA]

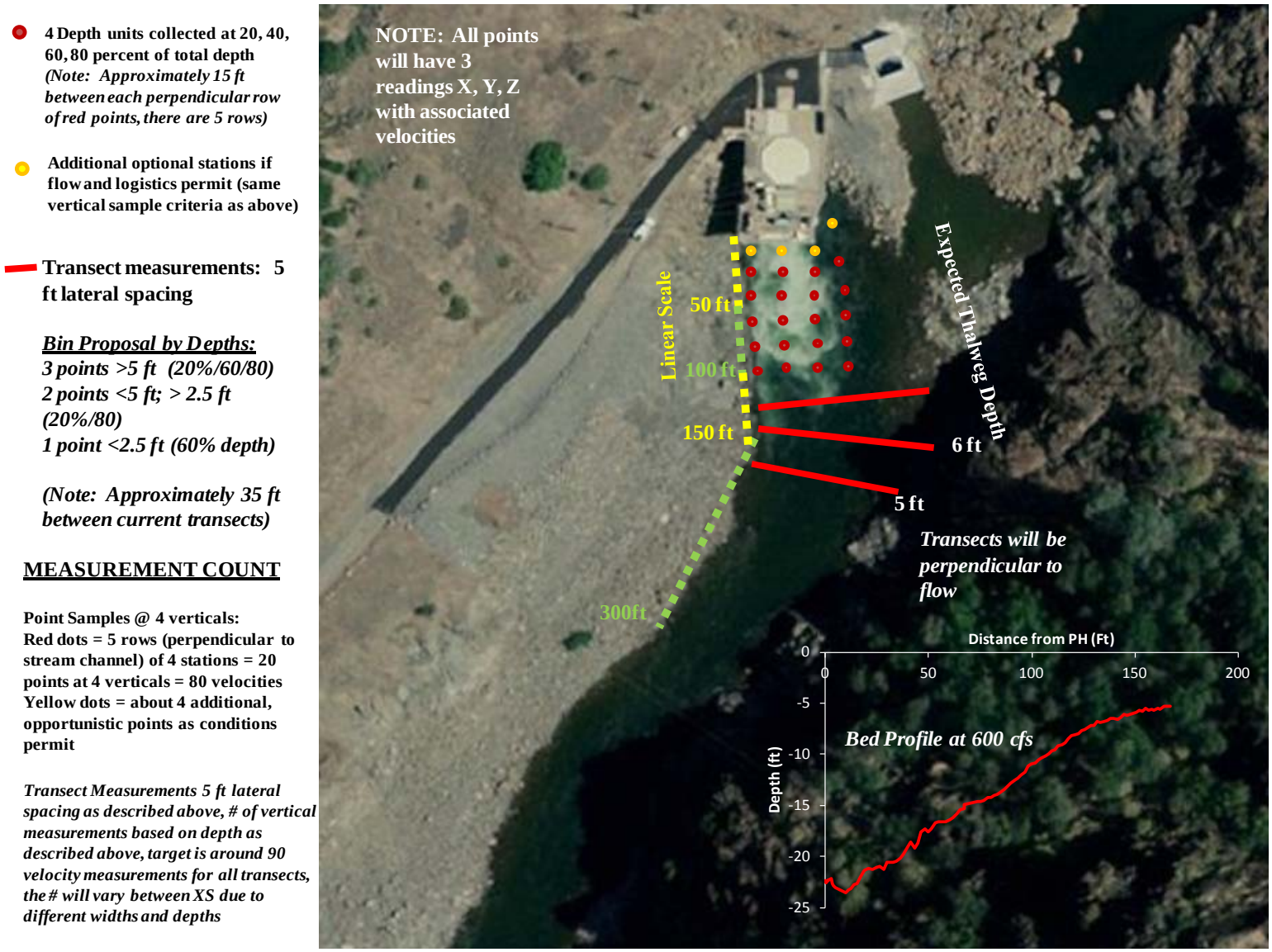

Figure 3.4-1. Velocity characterization sampling scheme.

3.4.3 Access and Habitat Quality Assessment Below Englebright Dam

A series of field data were collected to characterize access and habitat quality downstream of Englebright Dam. These field data included monitoring the water surface elevation to characterize access upstream. Also, vertical temperature and DO profiles were collected in the Dam Pool. Finally, continuous water temperature loggers were placed in multiple locations to monitor temperature changes across Project operations and time.

3.4.3.1 Water Level Recording

Water level instruments were installed in the Dam Pool, the Bypass Pool, and the Narrows 2 Pool. Water surface elevation for each pool was surveyed at the time of installation and tied to the same benchmark. The water level instruments recorded relative water surface elevation change for the period of August 9, 2012 to October 25, 2012. During this time period, the Narrows 2 Powerhouse generated through the powerhouse, the partial bypass, and through the full bypass.

The Dam Pool and Bypass Pool elevations remained nearly identical throughout the entire recording period (Figure 3.4-2). Both pools were directly influenced by the discharges from the powerhouse and releases from the full bypass. Both pools were connected by surface water at discharges above 1,570 cfs. At 1,660 cfs, the surface water channel connecting the two pools measures approximately 0.5 ft wide. Although biologists surveyed a stage at zero flow (SZF) for the Dam Pool at that channel, YCWA found that the two pools are connected through interstitial flow below the rocks and boulders which allows the Dam Pool to drain below the SZF. During a 2-day period where Narrows 2 was generating approximately 880 cfs, both pools continued to drain by almost 1 foot (Figure 3.4-2).

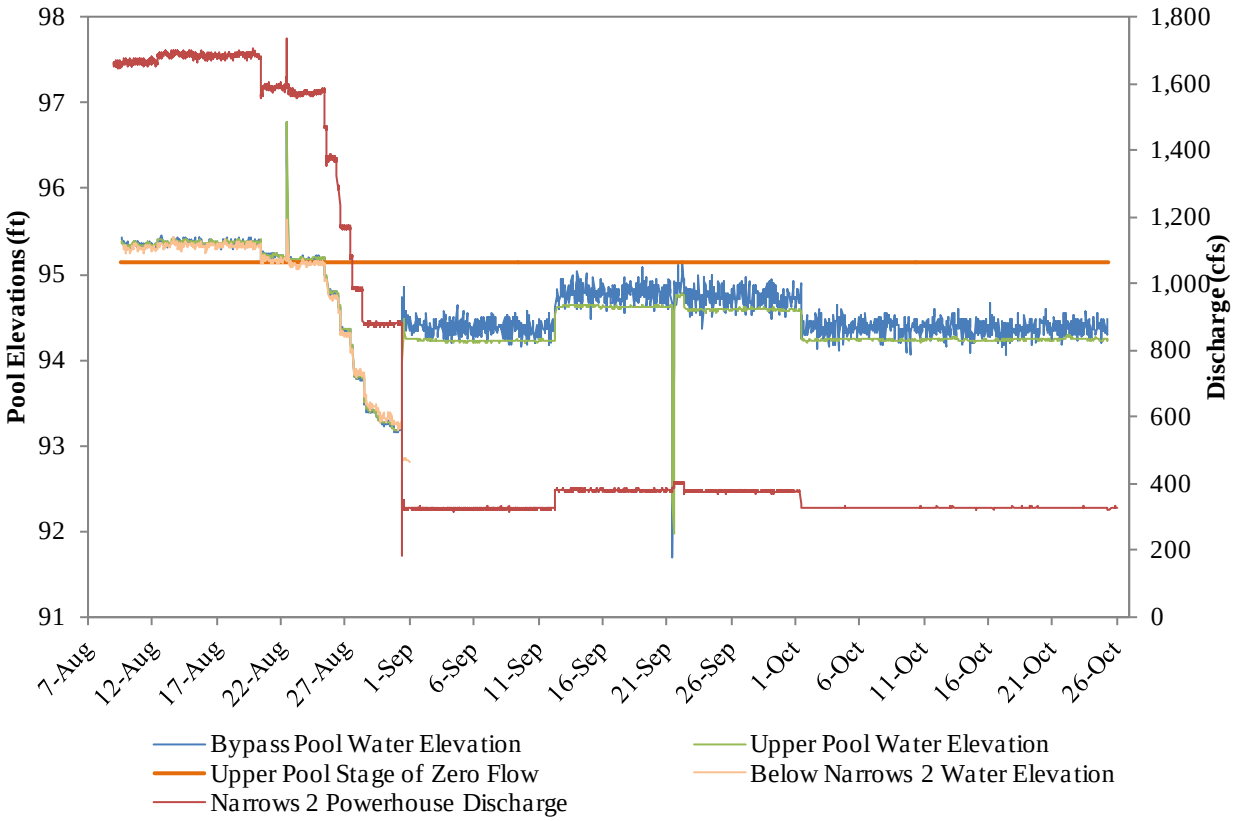

Figure 3.4-2. Discharge from the Narrows 2 Powerhouse and resultant water surface elevation at the Dam Pool, Bypass Pool and below the Narrows 2 Powerhouse.

Following August 31, the full bypass was operated (Figure 3.4-2). A release of 326 cfs from the full bypass increased the water surface elevation for the Dam and Bypass pools higher than a discharge of 880 cfs from the powerhouse. On September 21, there was a notable variation in the elevation data. This was due to a brief operational change that required flow to be routed through the partial bypass. The reroute only lasted for a few hours while a minor repair was completed, but resulted in a change to the trend in water surface elevation.

Figure 3.4-3 provides a general cross section of the Dam Pool hydraulic control. The control is weakened likely due to water seepage through large course substrate in the area. This results in milder elevation change across low to moderate water discharge.

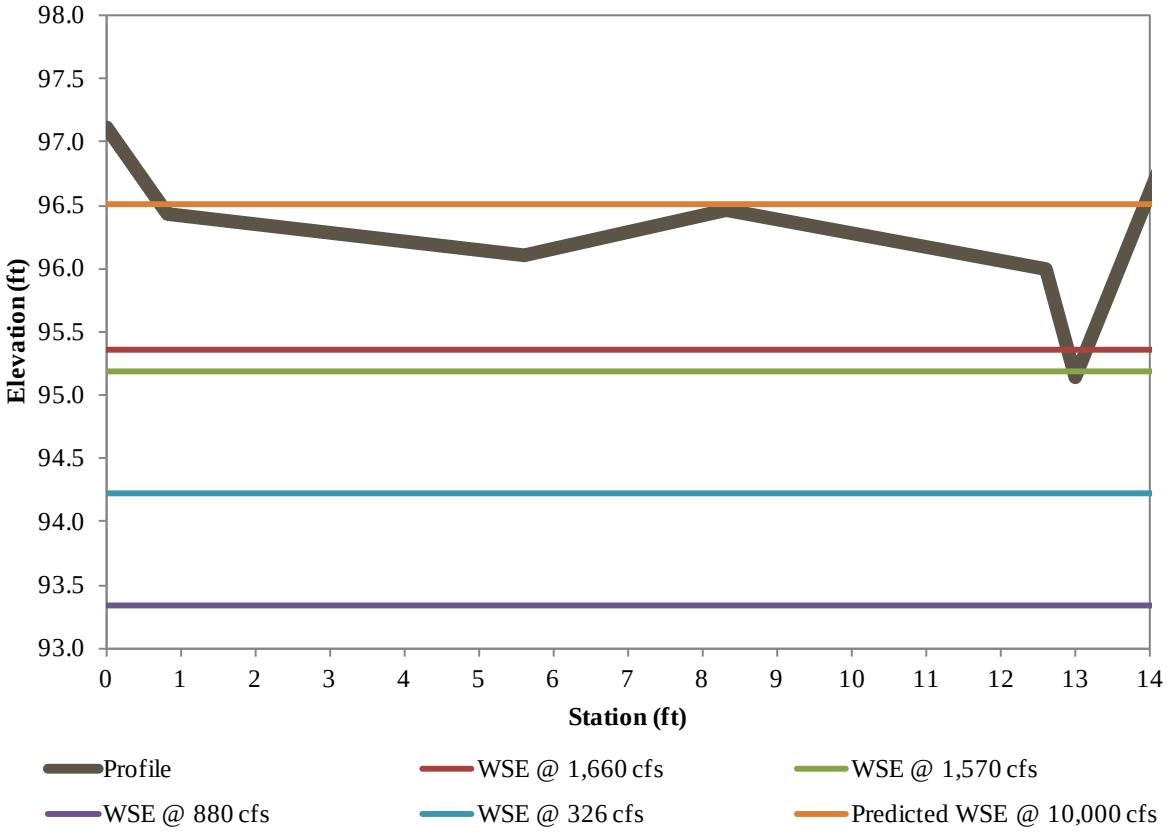

Figure 3.4-3. The cross sectional chart shows the connected channel width and water surface elevations between the Dam and Bypass pools.

3.4.3.2 Water Temperature and Dissolved Oxygen Profiles

Temperature and DO profiles were collected on August 9 and October 25, 2012. Figure 3.4-4 and Figure 3.4-5 present temperature and DO profiles, respectively, collected during level logger deployment and recovery.

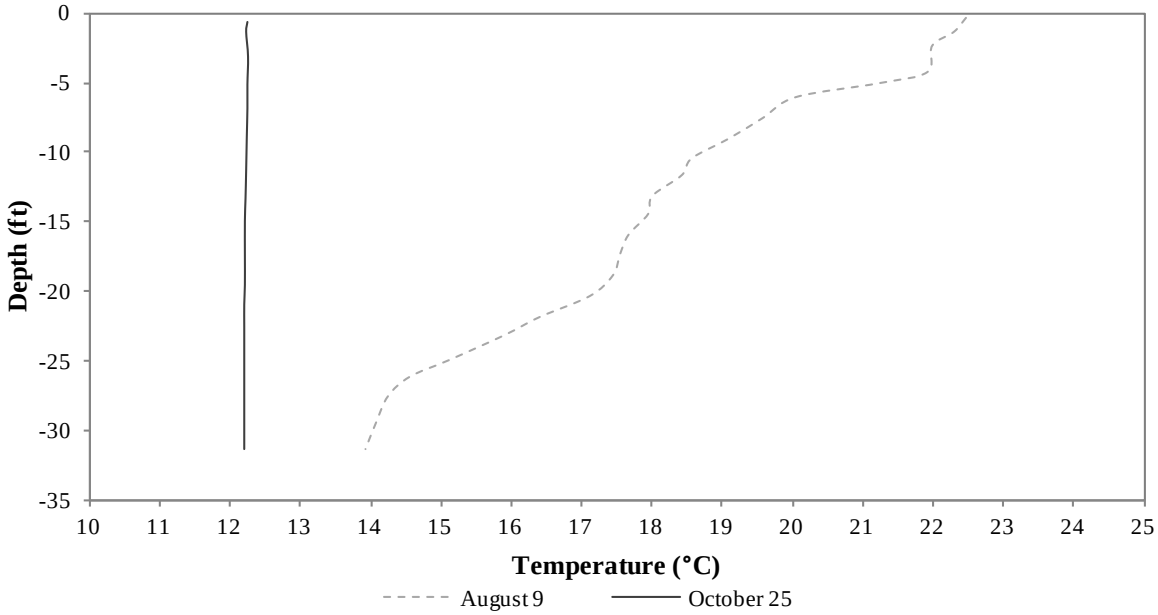

Figure 3.4-4. Profiles of water temperature in the Dam Pool on August 9 and October 25, 2012.

On August 9, 2012 instantaneous water temperature measurements collected below Englebright Dam were stratified with depth and ranged from 22.5°C near-surface to 13.9°C at the bottom of the Dam Pool. On October 25, 2012, the pool was thoroughly mixed. Instantaneous water temperature measurements ranged from 12.3–12.2°C from top to bottom of the water column, respectively.

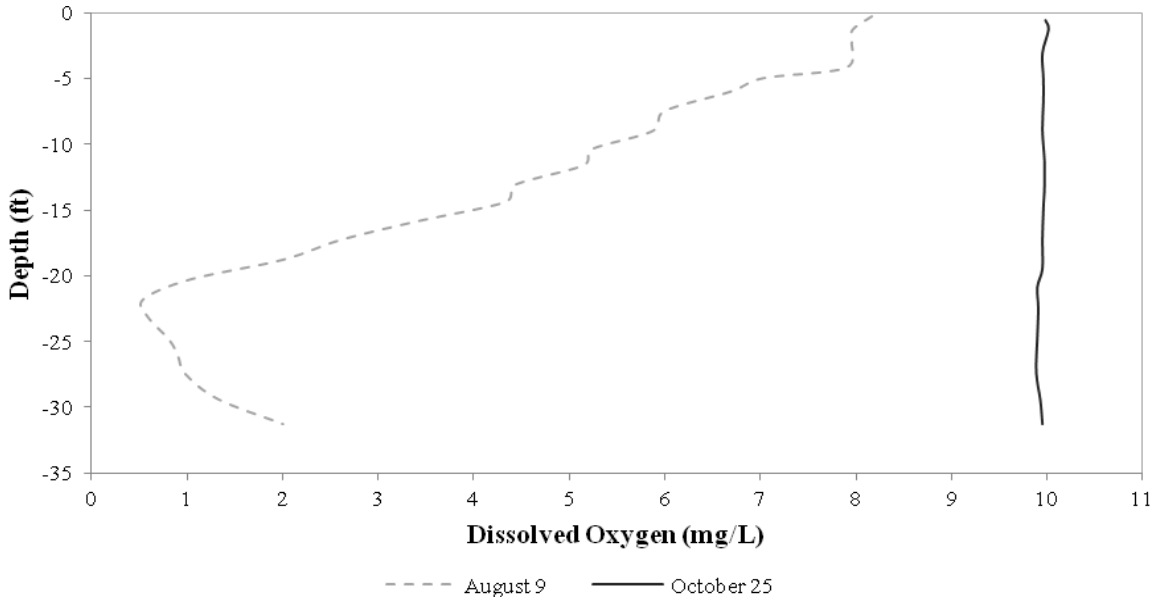

Figure 3.4-5. Profiles of DO in the Dam Pool on August 9 and October 25, 2012.

Instantaneous DO measurements captured on August 9 appeared stratified, with maximum measurements of 8.2 mg/L found near-surface. The minimum DO was located at 26.1 ft below water surface elevation (0.9 mg/L), rising slightly to 2.0 mg/L at near-bottom of the pool (31.3 ft deep). On October 25, 2012 DO levels increased as water temperatures lowered. Maximum DO was observed near-surface (10.0 mg/L) and minimum levels were found near the bottom (9.9 mg/L).

3.4.3.3 Continuous Water Temperature Monitoring

Continuous hourly temperature monitoring occurred at five locations. Two temperature loggers were deployed in the Dam Pool near-surface and at the bottom of the pool. The upper logger was tethered to a buoy and remained near-surface as the water surface elevation fluctuated. The other three loggers were located in the Bypass Pool, the penstock entering Narrows 2 Powerhouse, and approximately 100 ft downstream of the Narrows 2 Powerhouse.

Figure 3.4-6 displays hourly water temperature data for the surface and bottom of the Dam Pool. Prior to August 22 the surface profile was approximately 10°C warmer than the bottom water temperature. A decrease in surface water temperature occurred on August 22 and August 31, coinciding with transfer of flow from Narrows 2 Powerhouse to the full bypass. By September 1, top and bottom temperature were nearly identical due to backwater mixing from the full bypass.

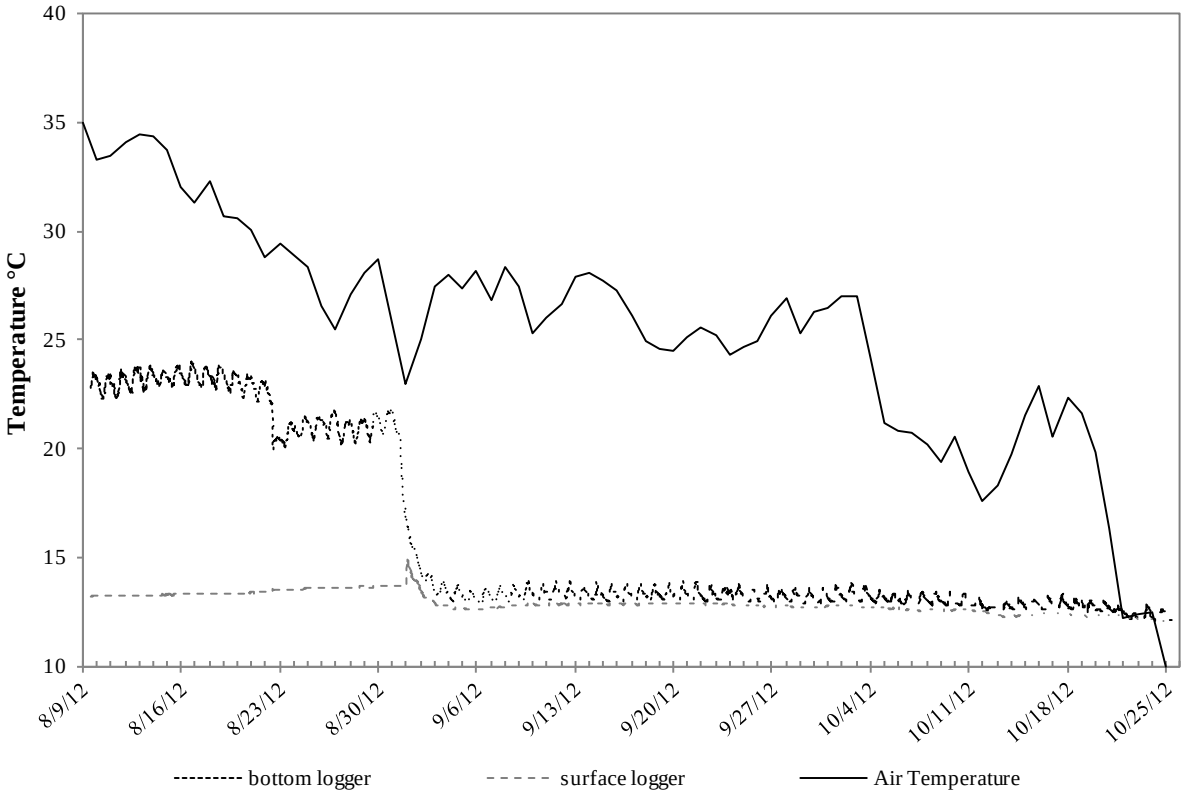

Figure 3.4-6. Hourly temperature data from the surface and bottom of the pool below Englebright Dam (i.e., Dam Pool), upstream of the Narrows 2 Powerhouse.

Figure 3.4-7 presents water temperature data from the penstock, Bypass Pool, and Narrows 2 Pool. The logger in the Narrows 2 Pool became exposed on August 31. Spikes in the Bypass Pool temperature occurred August 22 and September 21. The temperature changes were due to rapid water mixing between the Dam Pool and Bypass Pool as water surface elevation in the Bypass Pool quickly changed, causing water inflow and outflow between the two pools.

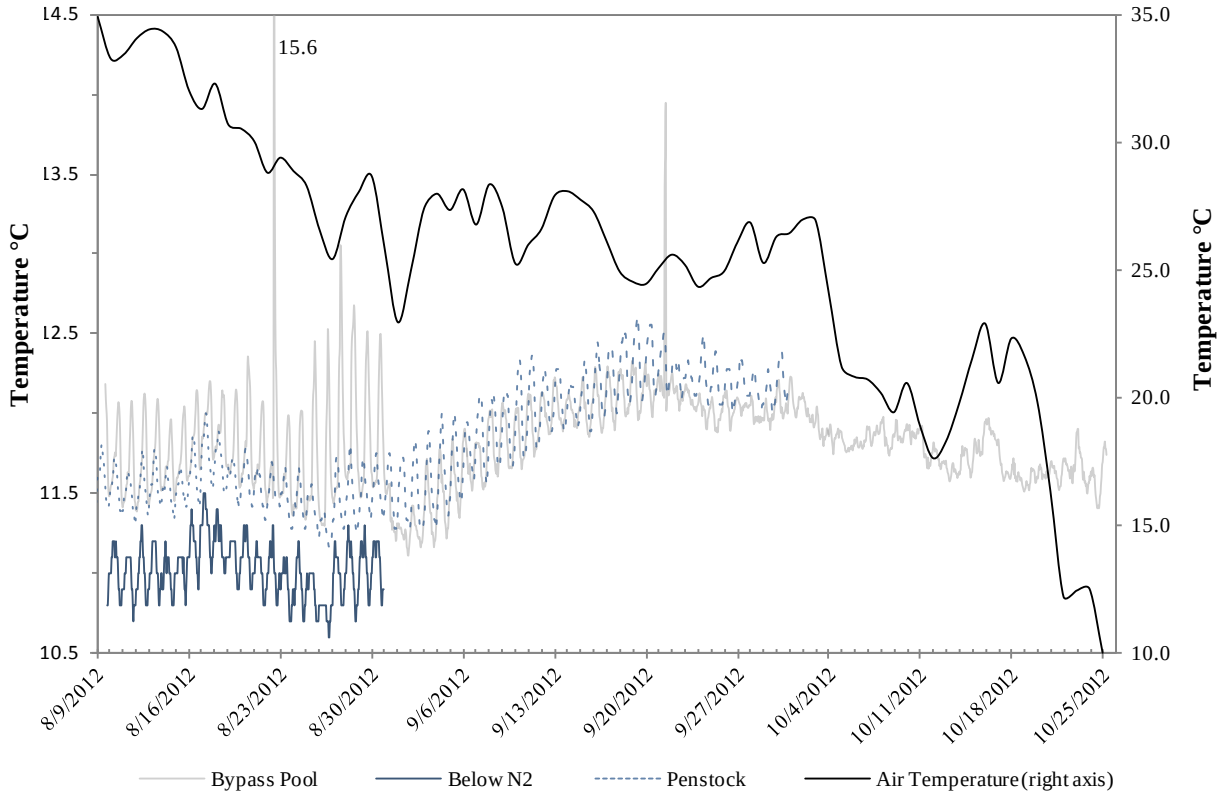

Figure 3.4-7. Hourly temperature data from the penstock, Bypass Pool, and Narrows 2 Pool.

Prior to August 31, a temperature gradient occurred between the water temperature in the Bypass Pool (Figure 3.4-7) and the surface water of the Dam Pool (Figure 3.4-6). On August 31, the full bypass began continuously operating, which allowed penstock flow to enter the Dam Pool. From August 31 through the October 25, water temperatures between the two pools remained relatively mixed.

4.0 Discussion

[Relicensing Participants – This section will be completed in the final technical memorandum. YCWA]

5.0 Study-Specific Consultation

The FERC-approved study did not include any study-specific consultation. However, YCWA committed to collaborating with the NMFS on the placement and sampling approach to the velocity characterization field effort. This collaboration was completed over a series of calls, emails, and a field visit with a NMFS representative. Section 3.4.2 describes the agreed-upon sampling scheme.

6.0 Variances

The study was performed in conformance to the FERC-approved Study 7.11, *Fish Behavior and Hydraulics Near Narrows 2 Powerhouse*, with three variances. First, snorkeling during infrequent operational events created concerns from water being moved between release components and the potential for snorkelers to be in proximity of the units during this process. The DIDSON camera was still employed during four events, but snorkeling was not paired with the operational event surveys. The study plan allowed for DIDSON camera surveys to replace a twice-monthly snorkel event. Since snorkeling did not occur during the DIDSON camera surveys, it was ensured that two separate snorkel events always occurred regardless of an infrequent operations monitoring event.

Second, water temperature profiles were expected to be collected monthly, when data downloads were to occur. Operation of the full bypass truncated access to the pool below Englebright Dam and precluded monthly measurements. As a result, only two of four months vertical profiles were collected; however, temperature loggers were able to generally characterize differences and the collected profiles did represent two significantly different profiles.

Third, DIDSON camera monitoring will not occur in December 2012. This decision is based on discussion with NMFS and data showing salmon are generally absent near Narrows 2 Powerhouse after November.

7.0 Attachments to this Technical Memorandum

This technical memorandum includes three attachments:

Attachment 7-11A Representative Photos [1 Adobe PDF file: 2 MB; 10 pages formatted to print on 8 ½ x 11 paper]

Attachment 7-11B Powerhouse Observations [1 Adobe PDF file: 4.32 MB; 20 pages formatted to print on 8 ½ x 11 paper]

8.0 References

Bell, M.C. 1973. Fisheries Handbook of Engineering Requirements and Biological Criteria. Fisheries Engineering Research Program, U.S. Army Engineering Division. North Pacific Corps of Engineers. Portland, OR.

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United States Geological Survey (USGS). 2003. Open-File Report 03-383. Bathymetric and Geophysical Surveys of Englebright Lake, Yuba-Nevada Counties, California, 2003.

Interim Technical Memorandum 7-11

Fish Behavior and Hydraulics
Near Narrows 2 Powerhouse

Attachment 7-11A

Representative Photographs

Yuba River Development Project
FERC Project No. 2246

November 2012

List of Figures

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Figure 1. Englebright Dam pool looking upstream from Narrows 2 Powerhouse.

Figure 2. Narrows 2 Powerhouse (foreground) and Englebright Dam (background).

Figure 3. Upstream view of lower survey reach with Narrows 2 Powerhouse and Englebright Dam in background.

Figure 4. Downstream view of Narrows 2 Pool with Narrows 1 Powerhouse in background.

Figure 5. Full bypass valve looking upstream from Narrows 2 Powerhouse.

Figure 6. Operation of full bypass valve looking upstream from Narrow 2 Powerhouse.

Figure 7. View of bypass pool (background) during operation of bypass valve.

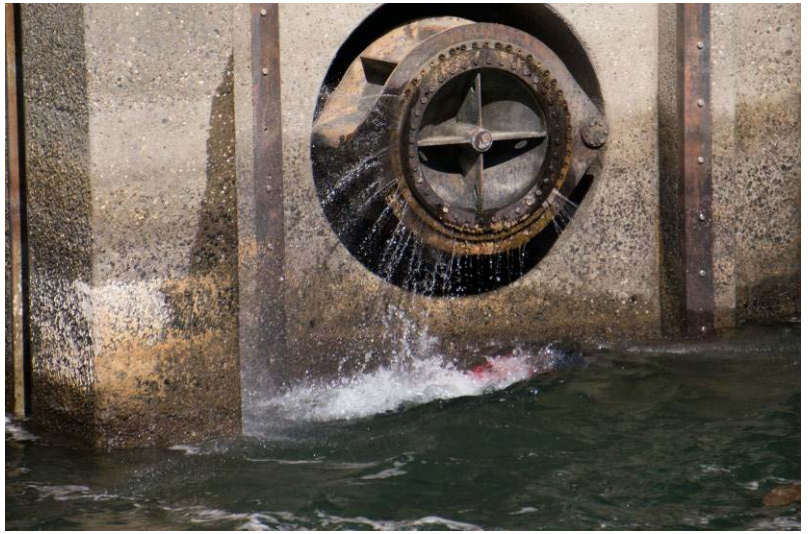

Figure 8. View of partial bypass valve at Narrows 2 Powerhouse.

Figure 9. Narrows 2 Powerhouse during operation of partial bypass valve.

Figure 10. Narrows 2 Powerhouse during normal powerhouse generation (1,674 cfs).

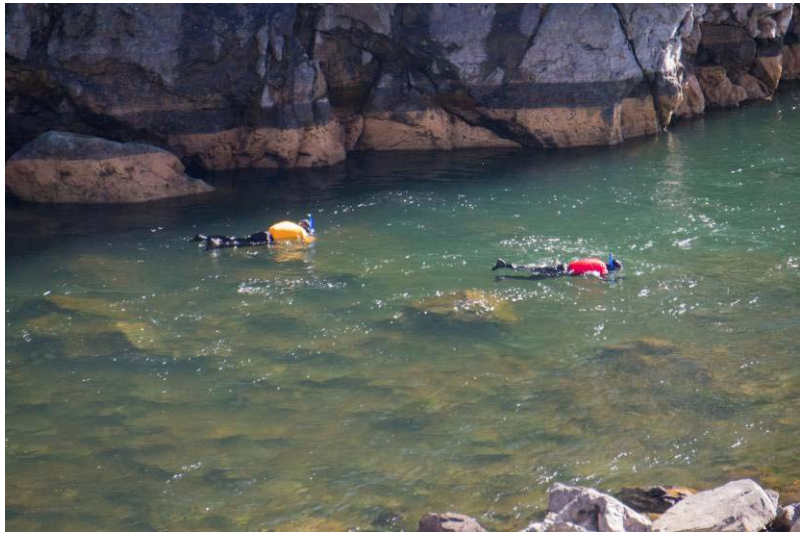

Figure 11. Tandem snorkeling of the thalweg of Narrows 2 Pool.

Figure 12. Snorkeling the margins of the Narrows 2 Pool.

Figure 13. Snorkeling the Narrows 2 pool during bypass operation.

Figure 14. Snorkeling around Narrows 2 Powerhouse.

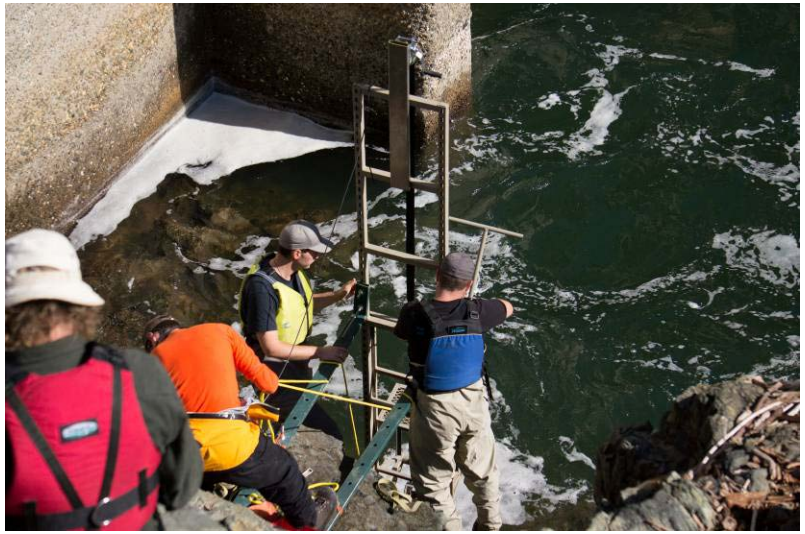

Figure 15. Installation of DIDSON camera below Narrows 2 Powerhouse.

Figure 16. Operation of DIDSON camera at Narrows 2 Powerhouse.

Figure 17. Temperature and dissolved oxygen profiles at the Englebright Dam Pool.

Figure 18. Temperature loggers attached to buoy (near-surface and pool bottom) at Englebright Dam Pool.

Figure 19. Water level logger location in the Dam Pool.

Figure 20. Installation of water level logger in the Bypass Pool.

Figure 21. Water level logger location at tailout of Narrows 2 Pool.

Figure 22. Blockage between dam pool and Bypass Pool (1,660 cfs).

Figure 23. Accessibility at 1,660 cfs.

Figure 24. Survey of hydraulic control between Bypass Pool and Narrows 2 Pool.

Interim Technical Memorandum 7-11

Fish Behavior and Hydraulics
Near Narrows 2 Powerhouse

Attachment 7-11B

Powerhouse Observations

Yuba River Development Project
FERC Project No. 2246

November 2012

Fish Observation Record

Date	Time	Number of fish	Operator
12-20-11	1301	Ø	RK
12-21-11	1030	Ø	RK
12-25-11	1445	Ø	RK
12-27-11	1420	Ø	RK
12-28-11	1315	Ø	ACD
12/29/11	1350	Ø	ACD
12-30-11	1000	Ø	RK
1-1-12	1030	Ø	ACD
1-3-12	1480	0	RK
1-7-12	1300	0	JBH
1-9-12	1430	0	RK
1-10-12	1400	0	JBH
1-13-12	0900	0	RK
1-15-12	1445	0	ACD
1-17-12	1430	0	JBH
1-19-12	1130	0	RK
1-20-12	1100	0	RK
1-23-12	1030	0	RK
1-24-12	1410	0	ACD
1-27-12	1100	0	RK
1-29-12	1435	0	ACD
1-30-12	1415	0	RK
1-31-12	1430	0	RK
2-4-12	1400	0	JBH
2-6-12	1400	0	RK
2-7-12	1017	0	ACD
2-14-12	0730	0	RK
2-17-12	1430	0	RK
2-20-12	1345	0	JBH
2-21-12	1400	0	RK

Narrows 2 Fish Observation Record

For no fish observed
Note fish observed on separate form

Date	Time	No Fish Observed	Operator
2-24-12	0730	✓	RK
2-26-12	1355	✓	ACD
2-28-12	1322	✓	JBH
2-29-12	1345	✓	RK
3-4-12	1400	✓	JBH
3-6-12	1230	✓	RK
3-11-12	1440	✓	ACD
3-12-12	1200	✓	RK
3-13-12	1000	✓	JBH
3-15-12	1440	✓	ACD
3-20-12	1500	✓	JBH
3-21-12	1445	✓	ACD
3-26-12	1400	✓	ACD
3-27-12	1330	✓	JBH
3-28-12	1430	✓	JBH
3-29-12	0900	✓	JBH
3-31-12	1445	✓	RK
4-1-12	1410	✓	JBH
4-3-12	1400	✓	ACD
4-5-12	1400	✓	JBH
4-9-12	1400	✓	ACD
4-10-12	0900	✓	JBH
4-11-12	1400	✓	RK
4-12-12	0900	✓	JBH
4-15-12	1400	✓	JBH
4-17-12	1130	✓	ACD
4-19-12	1330	✓	ACD
4-20-12	0700	✓	RK
4-22-12	1410	✓	ACD
4-23-12	1440	✓	RK
4-24-12	0700	✓	JBH
4-25-12	1430	✓	ACD
4-29-12	1315	✓	JBH
5-1-12	1400	✓	JBH
5-2-12	1500	✓	RK
5-3-12	1040	✓	ACD

FORMS.XLS
N2 fish count

Narrows 2 Fish Observation Record

For no fish observed
Note fish observed on separate form

Date	Time	No Fish Observed	Operator
5-8-12	1400	0	JBH
5-9-12	1500	0	JBH
5-10-12	1435	0	ACD
5-11-12	0800	0	JBH
5-13-12	1330	0	JBH
5-15-12	1415	0	JBH
5-16-12	1442	0	ACD
5-18-12	1410	0	ACD
5-20-12	1350	0	ACD
5-21-12	1450	0	ACD
5-22-12	1330	0	JBH
5-25-12	0730	✓	RK
5-26-12	1400	0	JBH
5-31-12	1330	0	JBH
6-1-12	1435	0	ACD
6-4-12	1430	✓	RK
6-5-12	1100	0	JBH
6-7-12	1530	✓	JBH

FORMS
N2 fish count

Narrows 2 Fish Observation Record

For no fish observed ✓
Note fish observed on separate form

Date	Time	No Fish Observed	Operator
6-11-12	1420	✓	RK & TH
6-12-12	1500	✓	DBA
6-13-12	1430	✓	DBL
6-15-12	1440	✓	RK
6-17-12	1515	✓	RK
6-19-12	1430	✓	DBH
6-21-12	0700	✓	RK
6-22-12	1445	✓	RK
6-24-12	1410	✓	RK
6-25-12	1435	✓	RK
6-26-12	0830	✓	ACD
6-27-12	1400	✓	ACD
6-28-12	1430	✓	ACD
7-1-12	1410	✓	ACD
7-3-12	1455	✓	RK
7-4-12	1500	✓	RK
7-5-12	0900	✓	DBH
7-8-12	1430	✓	DBA
7-16-12	1405	✓	ACD
7-12-12	0815	✓	ACD
7-14-12	1130	✓	RK
7-17-12	1430	✓	DBN
7-18-12	0840	✓	DBH
7-20-12	1330	✓	DBL
7-22-12	1320	✓	DBL
7-23-12	1430	✓	DBA
7-24-12	1640	✓	ACD
7-29-12	1400	✓	ACD
8-1-12	0730	✓	RK
8-5-12	1500	✓	RK
8-6-12	1400	✓	DBN
8-7-12	0730	✓	RK
8-8-12	1500	✓	RK
8-9-12	1100	✓	ACD
8-10-12	1428	✓	ACD
8-13-12	0700	✓	RK

FORMS.XLS
N2 fish count

Narrows 2 Fish Observation Record

For no fish observed
Note fish observed on separate form

Date	Time	No Fish Observed	Operator
8-14-12	0730	✓	JBH
8-16	1410	✓	ALD
8-19	1300	2	JBH
8-21	1430	✓	ALD
8-23	1130	✓	ALD
8-24	0958	✓	ALD
8-26	1400	✓	ALD
8-28	1400	✓	PK
8-29	1100	✓	JBH
8-31	0700	✓	JBH
9-3	1445	✓	JBH
9-5	1245	✓	ALD
9-6	0800	✓	ALD
9-11	1415	✓	JBH
9-14	0700	✓	PK
9-15	1430	✓	JBH
9-18	1430	✓	ALD
9-19	1445	✓	PK
9-25	1500	✓	JBH
10-1	0900	✓	PK
10-2	1340	✓	ALD
10-3	1430	✓	JBH
10-6	1410	✓	ALD
10-9	1450	✓	ALD
10-10	1500	✓	JBH
10-13	1420	✓	JBH
10-16	1440	✓	JBH
10-18	1430	✓	ALD
10-22	1400	✓	PK
10-23	1400	1	JBH
10-24	1400	✓	JBH
10-28	1340	✓	JBH
10-31	1430	✓	JBH
11-1	1400	3	JBH
11-4	1420	1	ALD
11-6	1500	✓	JBH

Please call if you see fish. Joel would like to take photos. (Primarily if they are in the calm FCV pool)
Joel Passovoy 530-798-3193

FORMS.XLS
N2 fish count

YCWA: Incidental observation of fish at Narrows #2

Data Collection

Date:	Time:	Staff:
1-20-12	1215	Kundson

Release at (circle):	Nar #2	Bypass	Flow:	General Weather:
Action (circle):	Startup	Shutdown	60cfs	Rain

circle one in each box

Water Clarity			Size of Fish	
Good	Fair	Poor	Juveniles	Adults (?)

# of Fish			Behavior		
0 to 5 (1)	5 to 10	10 +	Swimming/ Holding	Injured	Dead

Jumping

Additional comments:

Mark the map on the back with your location and the general locations and numbers of fish

YCWA: Incidental observation of fish at Narrows #2

Mark the map with your location and
the general locations and numbers of fish

YCWA: Incidental observation of fish at Narrows #2
Data Collection

Date: 7-18-12		**Time:** 0840		**Staff:** YCWA OPS
Release at (circle):	Nar #2	Bypass	**Flow:** 1550cfs	**General Weather:** Clear
Action (circle):	Startup	Shutdown		
circle one in each box				
Water Clarity			**Size of Fish**	
Good	Fair	Poor	Juveniles	small Adults
#1 **# of Fish**			**Behavior**	
0 to 5	5 to 10	10 +	Swimming/ Holding	Injured Dead

Additional comments: HDR River study crew was in water today at the same time.

HDR said they saw 1 adult down river from N2.

Mark the map on the back with your location and the general locations and numbers of fish

YCWA: Incidental observation of fish at Narrows #2
Mark the map with your location and
the general locations and numbers of fish

YCWA: Incidental observation of fish at Narrows #2
Data Collection

Date: 8-19-12		**Time:** 1300		**Staff:** Herman	
Release at (circle):	Nar #2	Bypass	**Flow:** 1650	**General Weather:** Clear	
Action (circle):	Startup	Shutdown			
circle one in each box					
Water Clarity			**Size of Fish**		
Good	**Fair**	**Poor**	**Juveniles**		**Adults**
# of Fish			**Behavior**		
0 to 5	**5 to 10**	**10 +**	**Swimming/ Holding**	**Injured**	**Dead**
Additional comments: Pool in front of FCV/Bypass					

Mark the map on the back with your location and the general locations and numbers of fish

YCWA: Incidental observation of fish at Narrows #2

Mark the map with your location and
the general locations and numbers of fish

YCWA: Incidental observation of fish at Narrows #2
Data Collection

Date: 10-23-12		**Time:** 1400		**Staff:** Herman
Release at (circle):	Nar #2	(Bypass)	**Flow:** 315 cfs	**General Weather:** PC
Action (circle):	Startup	Shutdown		
circle one in each box				
Water Clarity			**Size of Fish**	
(Good)	Fair	Poor	Juveniles	(Adults)
# of Fish			**Behavior**	
(0 to 5) 1	5 to 10	10 +	Swimming/ Holding	Injured (Dead)
Additional comments:				

Mark the map on the back with your location and the general locations and numbers of fish

YCWA: Incidental observation of fish at Narrows #2

Mark the map with your location and
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YCWA: Incidental observation of fish at Narrows #2
Data Collection

Date: 11-1-12		**Time:** 1400		**Staff:** Herman	
Release at (circle):	Nar #2	Bypass	**Flow:** 1000	**General Weather:** PC	
Action (circle):	Startup	Shutdown			
circle one in each box					
Water Clarity			**Size of Fish**		
Good	Fair	Poor	Juveniles		Adults
# of Fish			**Behavior**		
0 to 5	5 to 10	10 +	Swimming/ Holding	Injured	Dead
Additional comments:					

Mark the map on the back with your location and the general locations and numbers of fish

YCWA: Incidental observation of fish at Narrows #2

Mark the map with your location and
the general locations and numbers of fish

YCWA: Incidental observation of fish at Narrows #2
Data Collection

Date: 11-10-12			**Time:** 1220		**Staff:** JBK
Release at (circle):	Nar #2	Bypass	**Flow:** 930		**General Weather:** Pcldy
Action (circle):	Startup	Shutdown			
circle one in each box					
Water Clarity			**Size of Fish**		
Good	Fair	Poor	Juveniles		Adults
3 **# of Fish**			**Behavior**		
0 to 5	5 to 10	10 +	Swimming/ Holding	Injured	Dead
Additional comments:					

Mark the map on the back with your location and the general locations and numbers of fish

YCWA: Incidental observation of fish at Narrows #2

Mark the map with your location and
the general locations and numbers of fish

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