



**Application for a New License**  
**Major Project – Existing Dam**

**Streamflow and Reservoir Level**  
**Compliance Monitoring Plan**

**Security Level: Public**

**Yuba River Development Project**  
**FERC Project No. 2246**

April 2014

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**List of Attachments**

None.

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# GLOSSARY – DEFINITIONS OF TERMS, ACRONYMS AND ABBREVIATIONS

ac	acre
ac-ft	acre-feet
CDEC	California Data Exchange Center
cfs	cubic feet per second
DCP	Data Collection Platform
DWR	California Department of Water Resources
FERC	Federal Energy Regulatory Commission
Forest Service	United States Department of Agriculture, Forest Service
ft	feet
MCU	Master control unit
mi	mile
MIF	minimum instream flows
NFS	National Forest System
PG&E	Pacific Gas and Electric Company
Plan	Streamflow and Reservoir Level Monitoring Plan
PNF	Plumas National Forest
Project	Yuba River Development Project, FERC Project No. 2246
sq mi	square mile
SCADA	Supervisory Control and Data Acquisition
TNF	Tahoe National Forest
USACE	United States Army Corps of Engineers
USGS	United States Geological Survey
WY	Water year
YCWA	Yuba County Water Agency

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## SECTION 1.0

# INTRODUCTION

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In April 2014, the Yuba County Water Agency (YCWA), pursuant to Section (§) 5.18 of Title 18 of the Code of Federal Regulations (C.F.R.), filed with the Federal Energy Regulatory Commission (FERC) an Application for a New License for Major Project – Existing Dam – for YCWA’s 361.9 megawatt Yuba River Development Project (Project), FERC Project Number 2246. The initial license for the Project was issued by the Federal Power Commission, FERC’s predecessor, to YCWA on May 16, 1963, effective on May 1, 1963. The Federal Power Commission’s May 6, 1966, Order Amending License changed the license’s effective date to May 1, 1966, for a term ending on April 30, 2016.

YCWA included in its Application for a New License this Streamflow and Reservoir Level Compliance Monitoring Plan (Plan).

The United States Department of Agriculture, Forest Service’s (Forest Service) Federal Power Act Section 4(e) authority only applies in this Plan to Project facilities on National Forest System (NFS) land. The Forest Service administers the Plumas National Forest (PNF) in conformance with the PNF Land and Resource Management Plan (USDA 1988), as amended, and administers the Tahoe National Forest (TNF) in conformance with TNF Land and Resource Management Plan (USDA 1990), as amended.

## 1.1 Background

### 1.1.1 Yuba River Development Project

The Project is located in Yuba, Sierra and Nevada counties, California, on the main stems of the Yuba River, the North Yuba River and the Middle Yuba River, and on Oregon Creek, a tributary to the Middle Yuba River. Major Project facilities, which range in elevation from 280 feet (ft) to 2,049 ft, include: 1) New Bullards Bar Dam and Reservoir; 2) Our House and Log Cabin diversion dams; 3) Lohman Ridge and Camptonville diversion tunnels; 4) New Colgate and Narrows 2 power tunnels and penstocks; 5) New Colgate, New Bullards Minimum Flow and Narrows 2 powerhouses; and 6) appurtenant facilities and features (e.g., administrative buildings, switchyards, roads, trails and gages). The existing Project does not include any aboveground open water conduits (e.g., canals or flumes) or any transmission lines.

In addition, the Project includes 16 developed recreation facilities. These include: 1) Hornswoggle Group Campground; 2) Schoolhouse Campground; 3) Dark Day Campground; 4) Cottage Creek Campground;<sup>1</sup> 5) Garden Point Boat-in Campground; 6) Madrone Cove Boat-in Campground; 7) Frenchy Point Boat-in Campground; 8) Dark Day Picnic Area; 9) Sunset Vista

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<sup>1</sup> Cottage Creek Campground was burned in 2010 and has not been rebuilt. YCWA is in discussions with the Forest Service regarding rebuilding the burned campground.

Point; 10) Dam Overlook; 11) Moran Road Day Use Area; 12) Cottage Creek Boat Launch;<sup>2</sup> 13) Dark Day Boat Launch, including the Overflow Parking Area; 14) Schoolhouse Trail; 15) Bullards Bar Trail; and 16) floating comfort stations.<sup>3</sup> All of the recreation facilities are located on NFS land, with the exception of the Dam Overlook, Cottage Creek Boat Launch and small portions of the Bullards Bar Trail, which are located on land owned by YCWA. All of the developed recreation facilities are located within the existing FERC Project Boundary, except for a few short segments of the Bullards Bar Trail to the east of the Dark Day Boat Launch. In addition, the Project includes two undeveloped recreation sites at Our House and Log Cabin diversion dams, both located on NFS land and within the existing FERC Project Boundary.

Figure 1.1-1 shows the Project Vicinity,<sup>4</sup> proposed Project, and proposed FERC Project Boundary.<sup>5</sup>

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<sup>2</sup> Emerald Cove Marina provides visitor services at Cottage Creek Boat Launch, including houseboat and boat rentals, boat slips and moorings, fuel and a general store. The marina is operated under a lease from YCWA by a private company.

<sup>3</sup> The Project recreation facilities included one campground that is no longer part of the Project. Burnt Bridge Campground was closed initially by the Forest Service in 1979 due to low use levels. FERC, in an August 19, 1993 Order, which approved YCWA's Revised Recreation Plan, directed YCWA to remove all improvements and restore the Burnt Bridge Campground to the condition it was in prior to development of the facility. YCWA consulted with the Forest Service and all that remains of Burnt Bridge Campground today is the circulation road and vehicle spurs; all other facilities were removed.

<sup>4</sup> For the purpose of this Plan, "Project Vicinity" refers to the area surrounding the proposed Project on the order of United States Geological Survey (USGS) 1:24,000 quadrangles.

<sup>5</sup> The FERC Project Boundary is the area that YCWA uses for normal Project operations and maintenance. The Boundary is shown in Exhibit G of YCWA's Application for New License, and may be changed by FERC with cause from time to time during the term of the new license.

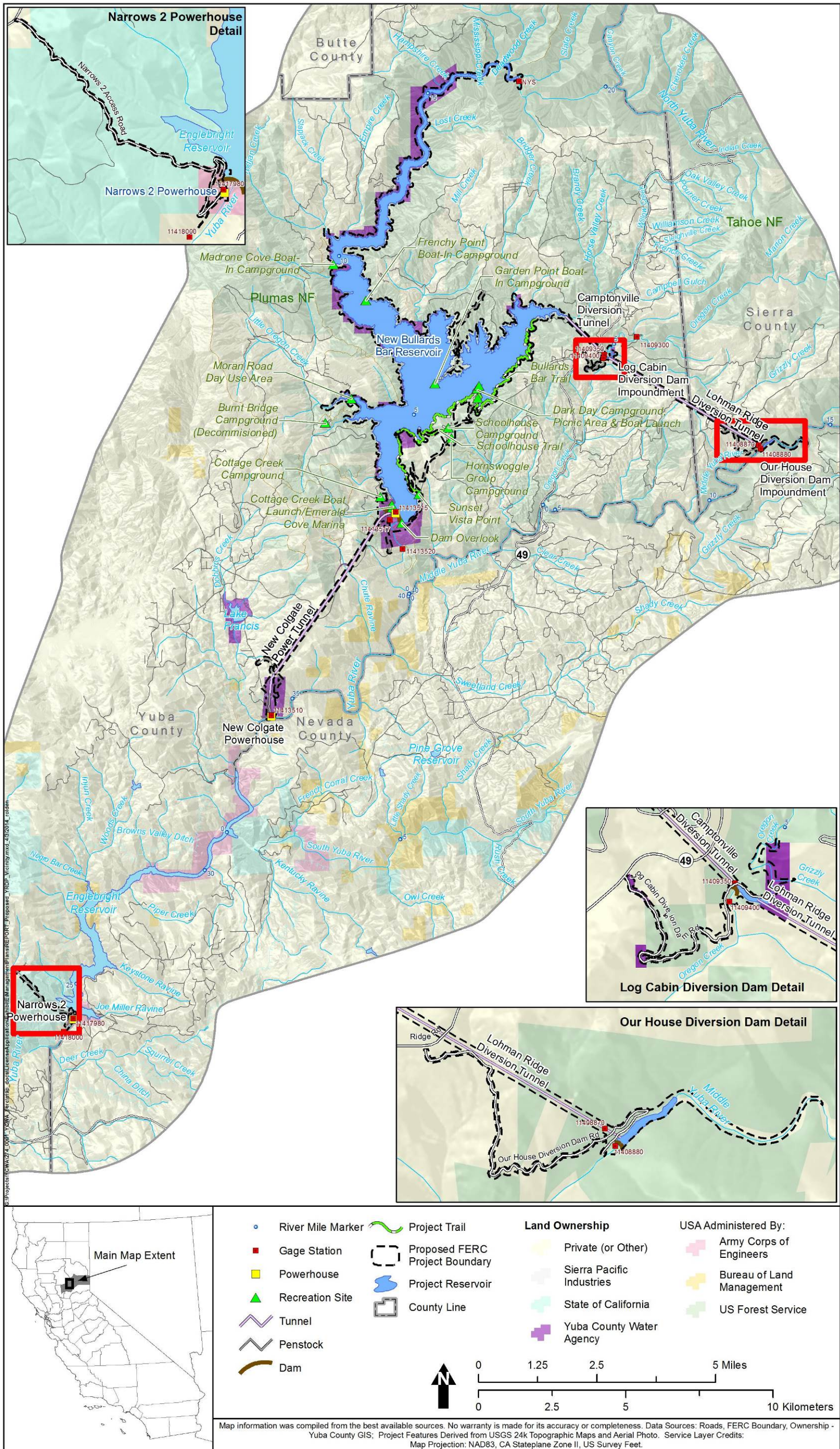


Figure 1.1-1. Yuba County Water Agency's Yuba River Development Project and Project Vicinity.

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## 1.1.2 Streamflow and Reservoir Level Compliance Monitoring Locations

YCWA’s proposed Project includes monitoring of flow requirements from four Project facilities (i.e., Our House Diversion Dam, Log Cabin Diversion Dam, New Bullards Bar Dam and Narrows 2 Powerhouse), and a proposed minimum pool in New Bullards Bar Reservoir. Table 1.1-1 provides, by Project facility, a list of the compliance monitoring locations.

**Table 1.1-1. Streamflow and reservoir level compliance monitoring locations.**

Basin	Stream	Project Facility	Requirement / Measurement	Gage Identification <sup>1</sup>	CDEC Identification <sup>2</sup>
Middle Yuba River	Middle Yuba River	Our House Diversion Dam	Minimum Flow Release	USGS 11408880	OHD
	Oregon Creek	Log Cabin Diversion Dam	Minimum Flow Release	USGS 11409400	LCB
North Yuba River	North Yuba River	New Bullards Bar Dam	Minimum Flow Release	USGS 11413517	NA <sup>3</sup>
Yuba River	Yuba River	Narrows 2 Powerhouse (Smartsville)	Minimum Flow Release	USGS 11418000	YRS
Yuba River	Yuba River	Narrows 2 Powerhouse (Marysville)	Minimum Flow Release	USGS 11421000	MRY
North Yuba River	North Yuba River	New Bullards Bar Reservoir	Reservoir Level	USGS 11413515	BUL

<sup>1</sup> USGS = United States Geological Survey.

<sup>2</sup> CDEC = California Data Exchange Center

<sup>3</sup> NA = Not Available on CDEC

With the exception of the streamflow gage at Smartsville and Marysville, all the gages are owned, operated and maintained by YCWA as part of the Project. The Smartsville gage is owned, operated and maintained by the Pacific Gas and Electric Company (PG&E). The Marysville gage is owned by YCWA, but is operated by the USGS. All of the streamflow gages, except for the North Yuba River below New Bullards Bar Dam, are rated for full flow.

In addition, for Project operations (i.e., there are no flow or stage requirements in the license), YCWA plans to monitor flows through Project facilities including the Lohman Ridge and Camptonville diversion tunnels and the New Colgate, New Bullards Bar Minimum Flow and Narrows 2 powerhouses. YCWA also plans to measure stage in the Our House and Log Cabin diversion dam pools. Table 1.1-2 provides, by Project facility, a list of these locations.

**Table 1.1-2. Facility gaging locations.**

Basin	Stream	Project Facility	Measures	Gage Identification	CDEC Identification
<b>DIVERSION TUNNELS</b>					
Middle Yuba River	Middle Yuba River	Lohman Ridge Diversion Tunnel	Diversion Flow	USGS 11408870	NA <sup>1</sup>
	Oregon Creek	Camptonville Diversion Tunnel	Diversion Flow	USGS 11409350	NA
<b>POWERHOUSES</b>					
North Yuba River	North Yuba River	New Bullards Bar Minimum Flow Powerhouse	Powerhouse Release	USGS 11413517	TBD <sup>2</sup>
Yuba River	Yuba River	New Colgate Powerhouse	Powerhouse Release	USGS 11413510	CPH

**Table 1.1-2. (continued)**

Basin	Stream	Project Facility	Measures	Gage Identification	CDEC Identification
<b>POWERHOUSES (continued)</b>					
Yuba River	Yuba River	Narrows 2 Powerhouse	Powerhouse Release	USGS 11417980	NA
<b>DIVERSION DAM IMPOUNDMENTS</b>					
Middle Yuba River	Middle Yuba River	Our House Diversion Dam	Impoundment Level	Our House Pool	NA
	Oregon Creek	Log Cabin Diversion Dam	Impoundment Level	Log Cabin Pool	NA

<sup>1</sup> NA = Not Available on CDEC

<sup>2</sup> TBD = To be determined. This gage is planned for listing on CDEC. No name currently identified.

## **1.2 Purpose of the Streamflow and Reservoir Level Compliance Monitoring Plan**

The purpose of this Plan is to describe how YCWA documents compliance with streamflow and reservoir level requirements in the FERC license.

YCWA will coordinate, to the extent appropriate, the efforts required under this Plan with other Project resource efforts, including implementation of other resource management plans and measures included in the new license.

## **1.3 Goals and Objectives of the Streamflow and Reservoir Level Compliance Monitoring Plan**

The goals of the Plan are to provide descriptions of:

- Locations where YCWA monitors compliance to the requirements in the license related to streamflows and reservoir levels.
- Equipment used by YCWA to monitor compliance to the requirements in the license related to streamflows and reservoir levels.
- How the equipment is used by YCWA to monitor compliance to the requirements in the license related to streamflows and reservoir levels is deployed, set (e.g., frequency of data collection), operated and calibrated.
- How data are retrieved from the equipment used by YCWA to monitor compliance to the requirements in the license related to streamflows and reservoir levels, including frequency of data downloads, quality assurance/quality control procedures, and data storage.
- How YCWA makes streamflow and reservoir level data available to FERC, agencies and the public.

## **1.4 Contents of the Streamflow and Reservoir Level Monitoring Plan**

This Plan includes the following:

- Section 1.0. Introduction. This section includes introductory information, including a general description of the Project; the purpose, goal and objectives; and the organizational structure of the Plan.
- Section 2.0. Existing Streamflow and Reservoir Level Gage Information. This section provides existing streamflow and reservoir level gage information.
- Section 3.0. Description of Streamflows or Reservoir Level Gages. This section describes existing streamflow and reservoir level gages.
- Section 4.0. Existing Data Storage and Data Availability. This section describes YCWA's approach to storing existing data gathered through the monitoring network and how that data is made publicly available.
- Section 5.0. Modifications to Gages and Data Availability Under the New License. This section describes YCWA's proposed changes to gages and data availability under the new license.
- Section 6.0. Reporting and Plan Revisions. This section describes how YCWA will report streamflow and reservoir level data to FERC, and update the Plan as needed in the future
- Section 7.0. References. This section provides information about references cited within the Plan.

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**SECTION 2.0**

# **EXISTING STREAMFLOW AND RESERVOIR LEVEL GAGE INFORMATION**

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This section provides historic information regarding streamflow and reservoir level monitoring in the Project vicinity.

## **2.1 Streamflow and Reservoir Level Gages in Project Vicinity**

Figure 2.1-1 shows the location of the gages listed in Tables 1.1-1 and 1.1-2 and other gages, some of which no longer function, in the Project Area. Table 2.1-1 provides for each existing or historical streamflow or reservoir gage information regarding the gage location and period of record. Table 2.1-2 provides a summary of historical flows for each gage.

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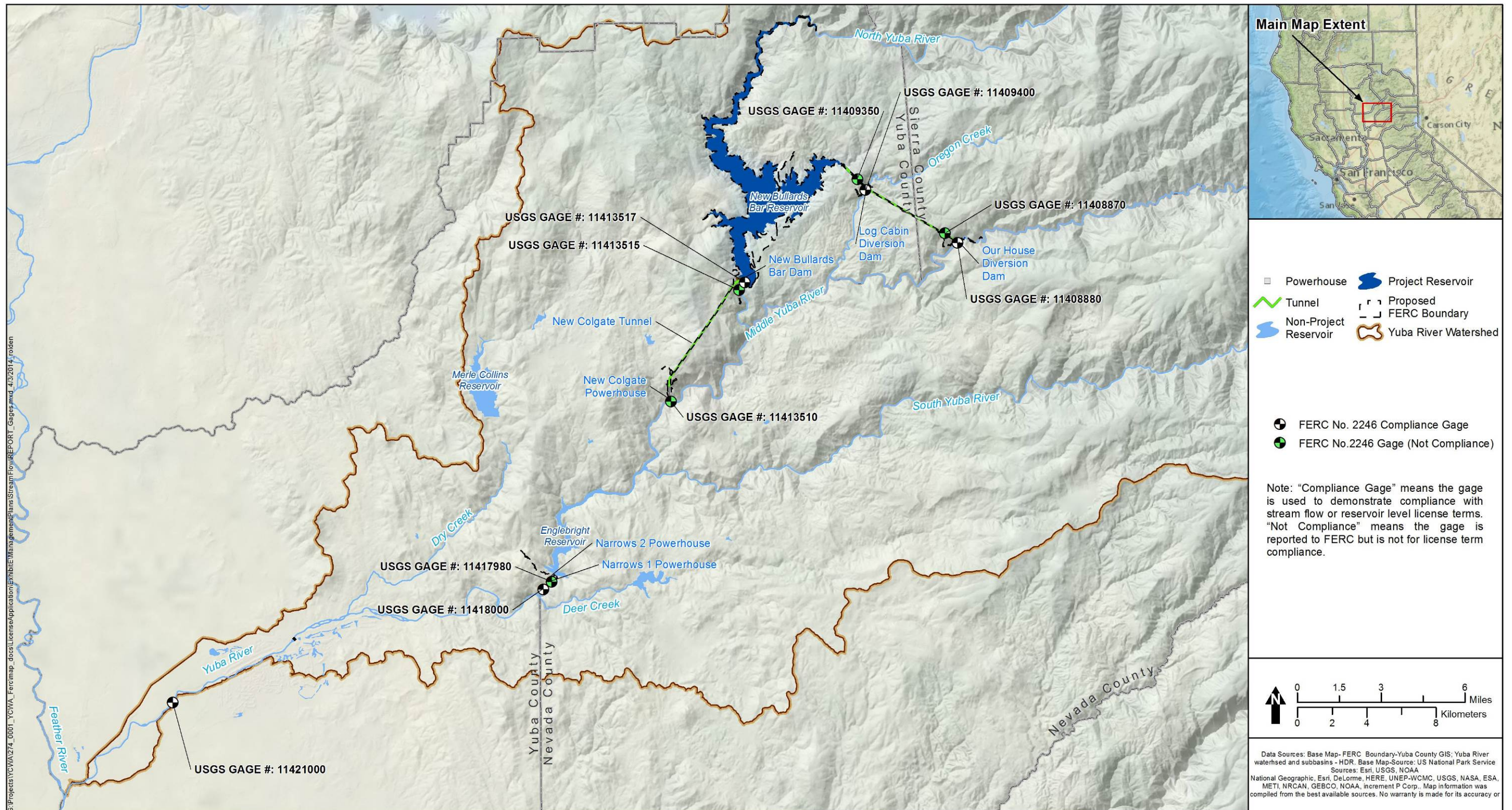


Figure 2.1-1. Historical and existing Project streamflow gages.

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**Table 2.1-1. Project streamflow, Project tunnels, Project powerhouse and reservoir gages.**

USGS Gage Number	Name	Comment	Location	Elevation <sup>1</sup> (ft)	Drainage Area (square miles)	Period of Record	
						Start	End
<b>STREAMFLOW GAGES</b>							
11408880 <sup>2</sup>	Middle Yuba River Below Our House Dam, Near Camptonville	Measures Middle Yuba River flow below the Our House Dam, including both spills and low-level outlet releases	On right bank, 300 ft downstream from Our House Dam, and 4.0 mi southeast of Camptonville	1,958	145	10/1/1968	Present
11409400 <sup>2</sup>	Oregon Creek Below Log Cabin Dam, Near Camptonville	Measures Oregon Creek flow below the Log Cabin Diversion Dam, including both spills and low-level outlet releases	On left bank, 600 ft downstream from Log Cabin Diversion Dam, 670 ft upstream from High Point Ravine, and 1.1 mi southwest of Camptonville	1,913	29	9/1 1968	Present
11413517 <sup>2</sup>	North Yuba River Low Flow Release below New Bullards Bar Dam	Measures flow in the North Yuba River below New Bullards Bar Dam. Only measures flows for compliance with FERC license, not rated for flows above 10 cfs	On right bank at old Colgate Diversion Dam, 0.2 mi downstream from dam, and 2.7 mi northwest of North San Juan which is on State Highway 49	1,350	489	10/1/2004	Present
11418000 <sup>2</sup>	Yuba River Below Englebright Dam, Near Smartsville	Measures flow in the Yuba River below the Narrows 1 and Narrows 2 powerhouses. Includes both spills and powerhouse releases	On right bank, 2,000 ft downstream from Englebright Dam, 0.5 mi upstream from Deer Creek, and 2.3 mi northeast of Smartsville	279	1,108	10/1/1941	Present
11421000 <sup>2</sup>	Yuba River Near Marysville	Measures Yuba River flow near Marysville, below Daguerrre Point Dam	On left bank, 4.2 mi northeast of Marysville, and 5 mi downstream from Dry Creek	95	1,339	10/1/1943	Present
11408870	Lohman Ridge Tunnel At Intake, Near Camptonville	Measures flow in the Lohman Ridge Tunnel below the diversion from the Our House Diversion Dam	At tunnel intake at Our House Diversion Dam, and 4.0 mi southeast of Camptonville	2,015	NA <sup>3</sup>	10/1/1988	Present
11409350	Camptonville Tunnel At Intake, Near Camptonville	Measures flow in the Camptonville Tunnel below the diversion from the Log Cabin Dam, before releasing into New Bullards Bar Reservoir	At tunnel intake, at Log Cabin Diversion Dam, 1.0 mi southwest of town of Camptonville	1,952	NA	10/1/1988	Present
<b>POWERHOUSE FLOW GAGES</b>							
11413510	New Colgate Powerhouse Near French Corral	Measures flow in the New Colgate Powerhouse	At powerhouse, on right bank of Yuba River, 0.3 mi upstream from Dobbins Creek, and 2.3 mi northwest of French Corral	565	NA	10/1/1966	Present

**Table 2.1-1. (continued)**

USGS <sup>1</sup> Gage Number	Name	Comment	Location	Elevation <sup>2</sup> (ft)	Drainage Area (square miles)	Period of Record	
						Start	End
<b>POWERHOUSE FLOW GAGES (continued)</b>							
11417980	Narrows 2 Powerhouse	Measures flow in the Narrows 2 Powerhouse	At powerhouse, 300 ft downstream from Englebright Dam	292	NA	10/1/1970	Present
<b>RESERVOIR AND IMPOUNDMENT LEVEL GAGES</b>							
11413515 <sup>2</sup>	New Bullards Bar Reservoir Near North San Juan	Measures New Bullards Bar Reservoir storage	In center of dam on North Yuba River, 2.2 mi upstream from Middle Yuba River, and 2.4 mi northwest of North San Juan	1,970	489	1/1/1969	Present

<sup>1</sup> Elevation is provided in National Geodetic Survey Datum of 1929.

<sup>2</sup> The gage is used by YCWA to document compliance with the minimum flow and reservoir stage requirements in the FERC license.

<sup>3</sup> NA means the information is not readily available.

**Table 2.1-2. Summary of historical Project streamflow, Project tunnel, and Project powerhouse gage flows.**

USGS Gage		Mean Annual Flow (cfs)				Mean Monthly Flow (cfs)		Mean Daily Flow (cfs)		Instantaneous Flow (cfs) <sup>1</sup>	
Number	Name	Mean	Median	Highest (Year)	Lowest (Year)	Highest (Month)	Lowest (Month)	Highest (Date)	Lowest (Date)	Highest	Lowest
<b>STREAMFLOW GAGES</b>											
11408880 <sup>2</sup>	Middle Yuba River Below Our House Dam, Near Camptonville	127	37	521 (1969)	26 (1977)	2,973 (Jan)	7 (Jan)	21,000 (2 Jan 1997)	2 (10 Jan 1982)	27,500 (2 Jan 1997)	NA <sup>3</sup>
11409400 <sup>2</sup>	Oregon Creek Below Log Cabin Dam, Near Camptonville	27	11	128 (1969)	4 (1977)	617 (Feb)	1 (Periodic)	5,340 (17 Feb 1986)	0.34 (18 Sept 1972)	6,400 (17 Feb 1986)	NA
11413517 <sup>2</sup>	N Yuba R Low Flow Rel B1 New Bullards Bar Dam	7	6	7 (periodic)	6 (periodic)	6 (Periodic)	8 (Periodic)	10 (17 Mar 2004)	5 (19 Mar 2011)	NA	NA
11418000 <sup>2</sup>	Yuba River Below Englebright Dam, Near Smartsville	2,449	1,653	5,251 (1982)	414 (1977)	22,351 (Jan)	41 (Nov)	134,000 (2 Jan 1997)	0 (Periodic)	171,000 (22 Dec 1964)	NA
11421000 <sup>2</sup>	Yuba River Near Marysville	2,419	1,490	5,818 (1982)	229 (1977)	26,180 (Jan)	31 (Jul)	140,000 (2 Jan 1997)	15 (Periodic)	180,000 (24 Dec 1964)	NA
<b>TUNNEL FLOW GAGES</b>											
11408870	Lohman Ridge Tunnel At Intake, Near Camptonville	180	92	377 (2011)	72 (2001)	789 (May)	0 (Periodic)	850 (20 May 2005)	0 (Periodic)	NA	NA

**Table 2.1-2. (continued)**

USGS Gage		Mean Annual Flow (cfs)				Mean Monthly Flow (cfs)		Mean Daily Flow (cfs)		Instantaneous Flow (cfs) <sup>1</sup>	
Number	Name	Mean	Median	Highest (Year)	Lowest (Year)	Highest (Month)	Lowest (Month)	Highest (Date)	Lowest (Date)	Highest	Lowest
<b>TUNNEL FLOW GAGES (continued)</b>											
11409350	Camptonville Tunnel At Intake, Near Camptonville	224	101	448 (2011)	76 (1994)	908 (Apr)	0 (Periodic)	1,090 (25 Mar 1989)	0 (Periodic)	NA	NA
<b>POWERHOUSE FLOW GAGES</b>											
11413510	New Colgate Powerhouse Near French Corral, CA	1,402	14,10	2,686 (1983)	233 (1969)	3,629 (Jun)	0 (Periodic)	4,200 (2 Jun 1971)	0 (Periodic)	NA	NA
11717980	Narrows Ph No 2 Bl Englebright Dam CA	1634	1757	2855 (1983)	122 (1977)	3,620 (Jan)	0 (Periodic)	4,650 (15 Jan 1978)	0 (Periodic)	NA	NA

<sup>1</sup> "Instantaneous Flow" refers to the peak instantaneous flow (i.e., not peak mean daily flow) for each year, as published by the USGS.

<sup>2</sup> The gage is used by YCWA to document compliance with the minimum flow and reservoir stage requirements in the FERC license.

<sup>3</sup> NA = information is not readily available.

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## SECTION 3.0

# DESCRIPTION OF STREAMFLOW AND RESERVOIR LEVEL MONITORING GAGES

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This section provides a detailed description of each streamflow and reservoir level monitoring gage listed in Tables 1.1-1 and 1.1-2.

## 3.1 Streamflow Gages

### 3.1.1 Middle Yuba River Downstream from Our House Diversion Dam

YCWA measures streamflow in the Middle Yuba River by monitoring flows downstream from Our House Diversion Dam. Instream flows downstream from Our House Diversion Dam have been monitored and reported annually to the United States Geological Survey (USGS) in a mean daily format, published as Gage 11408880, since October 1, 1968. The first stream gage was installed approximately 400 ft downstream from Our House Diversion Dam. The current gage, installed on October 1, 1987, was built with a concrete dam to create a stable control for a gage pool. A 12-foot sharp-crested weir was installed within the concrete dam on October 16, 1990. Information for this gage is listed below.

#### 3.1.1.1 Description of Gage

Gage 11408880 is located on the right bank 300 ft downstream from the Our House Diversion Dam, and 4 miles (mi) southeast of Camptonville. The gage elevation is 1,958 ft, and it is located on NFS land. There are 145 square miles (sq mi) of watershed upstream from the gage. The gage measures all flow passing the dam, including spills, flow through the fish release and low level outlet valves.

The gage is accessed via two gates from Our House Dam Road and by walking 300 ft downstream from the dam on the right bank.

The gage is composed of a Geomation Master Control Unit (MCU), a Design Analysis H355 Smart Gas Bubbler System and an H350-xl Data logger housed in a 5-ft x 5-ft x 8-ft shelter (Figure 3.1-1), which separately record stage and temperature data every 15 minutes. A bubbler line, approximately 75-ft long, is enclosed in galvanized steel conduit extending down from the shelter into the gage pool upstream of the sharp-crested weir. Compressed air is fed into the bubbler line at a rate of 60 bubbles per minute. Back pressure from the bubbler line is measured by a sensor within the H350-xl Data logger. A Design Analysis H-377 temperature probe encased in a galvanized steel conduit also extends from the shelter into the gage pool upstream of the sharp-crested weir (Figure 3.1-2). The Geomation MCU collects data every 15 minutes from the H350-xl Data logger and transmits the data by radio telemetry to Oregon Peak and then by microwave to the New Colgate Powerhouse.



**Figure 3.1-1. Middle Yuba downstream From Our House Diversion Dam gage shelter.**



**Figure 3.1-2. Middle Yuba downstream from Our House Diversion Dam gage pool and sharp-crested weir.**

### **3.1.1.2 Responsible Parties**

YCWA owns and operates this gage to document compliance with minimum streamflows required by the FERC license. YCWA reviews flow data daily via Supervisory Control and Data Acquisition (SCADA) and its hydrologic data storage and retrieval software (HYDSTRA). YCWA verifies stage accuracy using a staff gage during monthly site visits, and submits site visit records to USGS for annual review. YCWA and USGS are each required to make a minimum of two low-flow measurements per year to validate gage data.

### **3.1.1.3 Data Quality**

YCWA and USGS provide data quality control. YCWA and USGS verify the stage-to-discharge relationship by making a streamflow measurement at least twice each year. Data logger gage height is verified with outside staff gages monthly. Each year, a mean-daily flow summary station analysis and description, shift rationale, gage height corrections, current meter measurement summary, field data sheets, datum adjustments, rating tables, and hydrographs for the entire water year are submitted to USGS. Every 3 years, gage benchmarks, staff gages, point-of-zero flow, and water-surface elevation are surveyed to determine if there has been any movement in the reference elevations. YCWA generates a ratings table for the gage based on YCWA's and USGS' flow measurements during low flow, and Our House Diversion Dam spillway rating plus minimum flow release valve setting during high flow events.

Gage data are processed and stored using HYDSTRA software. HYDSTRA queries the Geomation MCU hourly to download data and converts gage heights to flow using a rating table. Rating tables are created in HYDSTRA within the software program where HYDSTRA plots stage-to-discharge relationships based on streamflow measurements made during stream gage rating checks on a log-log graph, drawing a best-fit curve, and interpolating between graphical points on the curve. Manual adjustments can be made to the software derived rating curves by the hydrographer when needed. New ratings are rare due to the stability of the concrete weir box and channel. Temporary time shift adjustments are sometimes used to adjust recorded flows when debris has lodged on the weir box or when swimmers have piled rocks in the weir.

Below 50 cfs, the gage's rating table was developed by direct stream flow measurement. Above 50 cfs, the rating table was developed based on flow over the Our House Diversion Dam spillway.

Maximum instantaneous recorded flow was 27,500 cubic feet per second (cfs) on January 2, 1997 at a gage height of 30.7 ft. Minimum daily recorded flow was 2.1 cfs on January 10, 1982. The current range of rated flows is 0 to 27,500 cfs; the current gage rating curve was extended above its previous rating of 8,600 cfs to 27,500 cfs at gage height of 30.7 ft, based on the Our House Diversion Dam spillway rating.

### **3.1.2 Oregon Creek Downstream from Log Cabin Diversion Dam**

YCWA measures streamflow in Oregon Creek downstream of the Log Cabin Diversion Dam. Flows downstream from Log Cabin Diversion have been monitored and reported annually to USGS and published in a mean daily format listed as Gage 11409400 since September 1, 1968.

Two gages and associated gage shelters have been installed approximately 500 and 600 ft downstream from the Log Cabin Diversion Dam. The first gage and shelter, located on the left bank, had a bubbler line encased in a steel conduit which extended into a pool created by a concrete dam with a 5-ft weir box. This pool was deemed too shallow for stage measurement in low-flow years, therefore a second concrete dam, shown in Figure 3.1-4 was installed approximately 600 ft below the Log Cabin Diversion Dam. The bubbler line was relocated to the new downstream pool and a new shelter was built on the right bank on the side of the paved access road to the Log Cabin Diversion Dam, to house the monitoring equipment associated with the flow gage at the downstream pool and weir. Information for this gage is listed below.

#### **3.1.2.1 Description of Gage**

USGS Gage 11409400 is located approximately 600 ft downstream from Log Cabin Diversion Dam on the right bank, at an elevation of 1,913 ft, on NFS land. There are 29.1 sq mi of watershed upstream from the gage.

The gage is accessed via a road that extends to the dam and then a path to the gaging station. The access road is off of the east side of Highway 49, 400 yards north east of the intersection with Marysville Road.

The gage is composed of a 5-ft x 5-ft x 8-ft tall metal shelter that houses a Geomation MCU, a Design Analysis H355 Smart Gas Bubbler system and a H350-xl Data logger that records river stage and temperature. A 150-ft bubbler line enclosed in a galvanized steel conduit extends down from the shelter into the gage pool (Figure 3.1-3). Compressed air is fed into the bubbler line at a rate of 60 bubbles per minute. Back pressure from the bubbler line is measured by a sensor within the H350-xl Data logger. A Design Analysis H-377 temperature probe encased in a galvanized steel conduit also extends from the shelter into the gage pool. The Geomation MCU collects data every 15 minutes from the H350-xl Data logger and transmits the data by radio telemetry to Oregon Peak and then by microwave telemetry to the New Colgate Powerhouse.



**Figure 3.1-3. Oregon Creek downstream Log Cabin measurement weir, weir box, and gage pool.**

### **3.1.2.2 Responsible Parties**

YCWA owns and operates the gage to document compliance with the FERC minimum streamflow requirements. YCWA reviews flow data daily via SCADA and HYDSTRA, verifies stage accuracy during monthly site visits, and submits records to USGS for annual review and publishing via website. YCWA and USGS each are required to make a minimum of two low-flow measurements per year to validate gage data.

### **3.1.2.3 Data Quality**

YCWA and USGS provide data quality control. YCWA and USGS verify the stage-to-discharge relationship by making a streamflow measurement at least twice per year. Data logger gage height is verified and correlated with outside staff gages monthly. Each year, a mean daily flow summary, a 15-minute gage height and discharge file, shift rationale, gage height corrections, current meter measurement summary, field data sheets, datum adjustments, rating tables, and hydrographs for the entire water year are submitted to USGS. Every 3 years, gage benchmarks, staff gages, water-surface elevation, and point of zero flow are surveyed to determine if there has been any movement in the reference elevations. YCWA generates a ratings table for the gage based on YCWA and USGS flow measurements during low flow and the Log Cabin Diversion Dam spillway rating plus minimum flow release valve during high flow.

Below 12 cfs, the gage's rating table was developed by direct stream flow measurement. Above 12 cfs, the rating table was developed based on flow over the Log Cabin Diversion Dam spillway.

Gage data are processed and stored using HYDSTRA software. HYDSTRA queries the Geomation MCU hourly and converts gage heights to flow using a rating table. Rating tables are created in HYDSTRA within the software program. HYDSTRA plots stage-to-discharge relationships based on streamflow measurements made during stream gage rating checks on a log-log graph, drawing a best-fit curve, and interpolating between graphical points on the curve. Manual adjustments can be made to the software derived rating curves by the hydrographer when needed. New ratings are rare due to the stability of the weir box and channel. Temporary time shifts are used when debris catches on the weir box.

Maximum instantaneous recorded flow was 6,400 cfs on February 17, 1986 at a gage height of 11.24 ft for the datum in use at that time. Minimum daily recorded flow was 0.34 cfs on September 18, 1972. The current rating curve was extended above 12 cfs based on flow over the spillway to a maximum flow of 5,980 cfs at a gage height of 15.7 ft for the current datum on January 1, 1997.

### **3.1.3 North Yuba River Downstream from New Bullards Bar Dam**

Streamflow is measured in the North Yuba River downstream from New Bullards Bar Dam to monitor YCWA's compliance with FERC minimum streamflow requirements. Flow on the North Yuba River downstream of New Bullards Bar Dam are measured every 15 minutes and are reported to USGS annually in a mean daily flow format and published as USGS Gage 11413517.

From October 1, 1966 through September 30, 2004, USGS Gage 11413520 was used to measure YCWA's compliance with their FERC minimum streamflow requirements. Gage 11413520 historically measured stage in a natural control approximately 3,500 ft downstream from New Bullards Bar Dam. Since monitoring of Gage 11413520 ceased at the end of water year (WY) 2004, YCWA has measured releases from the New Bullards Bar Minimum Flow Powerhouse plus dam seepage flows for compliance with FERC requirements downstream from New Bullards Bar Dam at USGS Gage 11413517.

USGS Gage 11413517 currently measures stage in a pool controlled by a 30-ft tall masonry-rock dam built in 1900. A rectangular weir was installed in the diversion dam in October 1986. A description of USGS Gage 11413517 is below.

#### **3.1.3.1 Description of Gage**

USGS Gage 11413517 is located 0.2 mi downstream from New Bullards Bar Dam on the right bank at an elevation of 1,350 ft on YCWA owned land. There are 489 sq mi of watershed upstream from the gage.

The gage is accessed via a dirt spur road off of New Bullards Bar Dam access road.

The gage, shown in Figure 3.1-4, is composed of a 4-ft diameter, corrugated pipe stilling well that shelters instrumentation including a Geomation MCU, Design Analysis H355 Smart Gas Bubbler system and a H350-xl Data logger. An approximately 30-ft long bubbler line enclosed in galvanized steel conduit extends down from the shelter into the gage pool. Compressed air bubbles are fed into the bubbler line at a rate of 60 bubbles per minute. Back pressure from the bubbler line is measured by a sensor within the H350-xl Data logger. A Design Analysis H-377 temperature probe encased in a galvanized steel conduit also extends from the shelter into the gage pool. The Geomation MCU collects stage data every 15 minutes from the H350-xl Data logger and telemeters the data by radio to the New Bullards Bar valve house and then by microwave telemetry to New Colgate Powerhouse.



**Figure 3.1-4. North Yuba River downstream from New Bullards Bar Dam gage shelter.**



**Figure 3.1-5. North Yuba River downstream from New Bullards Bar Dam flow measurement weir box.**

### **3.1.3.2 Responsible Parties**

YCWA owns and operates low flow USGS Gage 11413517 for ensuring aquatic habitat, operation of the release valve and compliance with YCWA's FERC-minimum streamflow requirements. YCWA reviews flow data daily via SCADA and HYDSTRA, verifies stage accuracy during monthly site visits, and submits records to USGS for annual review. YCWA and USGS each are required to make at least two low flow measurements per year to validate gage data.

### **3.1.3.3 Data Quality**

YCWA and USGS provide data quality control. YCWA and USGS verify the stage-to-discharge relationship by taking streamflow measurements at least twice per year at the weir box shown in Figure 3.1-5. Data logger gage height is verified with outside staff gages monthly. A mean daily flow summary, station analysis and description, shift rationale, gage height corrections, current meter measurement summary, field data sheets, datum adjustments, rating tables, and hydrographs for the entire water year are submitted to USGS annually. Every 3 years, gage benchmarks, staff gages, water-surface elevation, and point of zero flow are surveyed to determine if there has been any movement in the reference elevations. YCWA rates the gage based on YCWA and USGS flow measurements during low flows. Streamflow is not currently



measured above 10 cfs, but under the new license, YCWA will modify the weir so that the gage is capable of accurately measuring flow for the full range of minimum required flows.

Gage data are processed and stored using HYDSTRA software. HYDSTRA queries Geomation hourly and converts gage heights to flow using a rating table. Rating tables are created in HYDSTRA within the software program. HYDSTRA plots stage-to-discharge relationships based on streamflow measurements made during stream gage rating checks on a log-log graph, drawing a best-fit curve, and interpolating between graphical points on the curve. Manual adjustments can be made to the software derived rating curves by the hydrographer when needed. New ratings are rare due to the stability of the weir box and channel. Temporary time shifts may be used if debris catches on the weir box.

This gage is only rated up to 10.0 cfs.

### **3.1.4 New Bullards Bar Reservoir Spills to the North Yuba River Downstream from New Bullards Bar Dam**

The New Bullards Bar Dam spillway discharges into the North Yuba River downstream of the USGS Gage 11413517, which is described above.

The spillway is located on the left abutment adjoining the dam and is a chute-type gated structure with a crest elevation of 1,902 ft. Spillway releases are controlled by three 30-ft wide by 53-ft high tainter gates.

Spillway flow is estimated based on spillway gate opening and reservoir level for YCWA operations and is reported to the USACE. YCWA proposes to also report these flows to the California Data Exchange Center (CDEC).

YCWA's method of measuring flows for compliance with its contract number DA-04-167-CIVENG-66-94 with the USACE for flood control is discussed below.

#### **3.1.4.1 Description of Gage**

There is no gage on the New Bullards Bar spillway. The spillway gate opening and reservoir water-surface elevation are reported to the control room at the New Colgate Powerhouse, and the flow through the spillway is automatically computed based on spillway discharge rating curves included in the New Bullards Bar Flood Control Manual (USACE 1972). The spillway-discharge rating curves include a computed outflow for 5-ft increments of the elevation of the bottom of the spillway gate. The increments range from 1,905 ft to 1,935 ft; flows through gate openings at other increments are computed based on interpolation between given elevations.

#### **3.1.4.2 Responsible Parties**

YCWA is responsible for computing spills through the New Bullards Bar Dam spillway. These data are reported to the USACE for compliance with flood control regulations.

### **3.1.4.3 Data Quality**

YCWA is required to submit a daily report of elevation, storage, inflow, outflow, anticipated outflow changes at New Bullards Bar Reservoir, and precipitation at the dam and at reporting stations in or adjacent to the drainage basin to the USACE during flood periods. YCWA is also required to submit an end-of-the-month report to the USACE summarizing daily inflow, outflow, elevation and storage, daily required flood control space and precipitation.

According to the USACE spillway discharge ratings curve for New Bullards Bar Dam spillway, the maximum spillway capacity is 160,000 cfs, for a reservoir water-surface elevation of 1,965 ft. The minimum New Bullards Bar Reservoir elevation for releases through the New Bullards Bar Dam spillway is 1,902 ft. The maximum historical instantaneous spill of 50,000 cfs occurred on February 19, 1986.

### **3.1.5 Yuba River Downstream from Narrows 2 Powerhouse - Smartsville**

Streamflow in the Yuba River downstream of the Narrows 2 Powerhouse is published by USGS Gage 11418000.

The gage has monitored Yuba River flow since October 1, 1941. The gage has been moved twice; it was moved from its current location to approximately 2,000 ft downstream for the period of September 19, 1958 and September 30, 1969, after which time it was relocated to its current location. Station monitoring was discontinued by USGS on October 1, 1995 and monitoring was subsequently taken over by PG&E under general supervision of the USGS after that date. Information about this gage is included below.

#### **3.1.5.1 Description of Gage**

USGS Gage 11418000 is located 2,000 ft downstream from Englebright Dam at an elevation of 278.68 ft on PG&E-owned land. Drainage area above the gage is 1,108 sq mi.

The gage is accessed via a trail 300 feet downstream of the Narrows 2 Powerhouse. The gage is approximately a quarter-mile downstream of the trailhead.

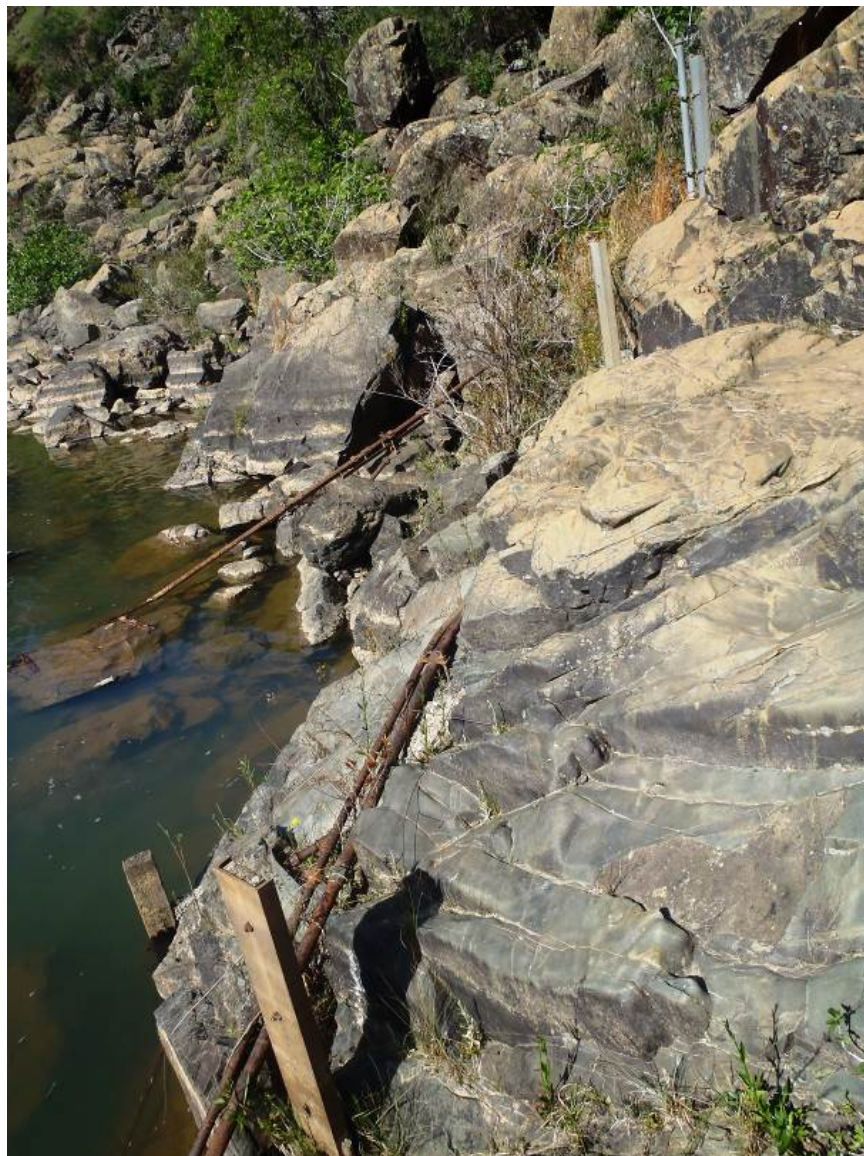
A metal 4-ft x 4-ft x 8-ft shelter located on the right bank houses the gaging equipment (Figure 3.1-6). A 140-ft long bubbler line enclosed in 1.5-inch galvanized steel conduit extends down from the shelter into the gage pool (Figure 3.1-7). The bubbler line splits inside the shelter and feeds to two measurement devices. One line goes to a Hydrologic Services 40 bubbler system and pressure sensor, which is recorded by a CR-1000 Campbell Scientific Data logger. The other line feeds into a ParoScientific pressure sensor and is recorded by a Handar 555 Data Collection Platform (DCP). A temperature probe encased in a galvanized steel conduit also extends from the shelter into the gage pool. A Geomation unit collects stage data from the CR-1000 every 15 minutes and sends data by radio to YCWA's Narrows 2 Powerhouse, which is

retransmitted by microwave telemetry to New Colgate Powerhouse for real-time operations information.

For recording purposes, YCWA's HYDSTRA software retrieves the data from the Geomation server at New Colgate Powerhouse and updates YCWA's SCADA every 15 minutes. The Handar DCP transmits stage and temperature by satellite to California Department of Water Resources (DWR) CDEC to assist in their runoff forecasting and acts as a backup to YCWA's SCADA. The CR-1000 stored data is the primary record submitted to USGS for review.



**Figure 3.1-6. Yuba River downstream from Narrows 2 Powerhouse – Smartsville gage shelter.**



**Figure 3.1-7. Yuba River downstream from Narrows 2 Powerhouse – Smartsville gage bubbler line.**

### **3.1.5.2 Responsible Parties**

PG&E owns and operates the gage. PG&E reviews flow data daily via SCADA and HYDSTRA, verifies stage accuracy monthly during site visits and submits records to USGS for annual review. PG&E and USGS each are required to make a minimum of two low-flow measurements per year. YCWA monitors gage information in real time for operations and reviews flow data daily to ensure compliance with FERC-required flows.

### **3.1.5.3 Data Quality**

PG&E and USGS provide data quality control. PG&E and USGS verify the stage-to-discharge relationship by taking streamflow measurements at least twice a year. Streamflow measurements are made from a cableway 131 ft above the streambed. Data logger gage height is verified monthly with outside staff gages. A mean-daily flow summary, a 15-minute gage height and discharge file, station analysis, gage height corrections, current meter measurement summary, field data sheets, datum adjustments, rating tables, and hydrographs for the entire water year are submitted to USGS annually. Every 3 to 5 years, gage benchmarks, staffs, water-surface elevation, and point of zero flow are surveyed to determine if there has been any movement in the reference elevations. PG&E generates a ratings table for the gage based on PG&E's and USGS' flow measurements, Englebright Dam spillway computations and Narrows 1 and 2 powerhouses' flowmeter readings.

Gage data are processed and stored using HYDSTRA software. Rating tables are created in HYDSTRA within the software program. HYDSTRA creates a stage-to-discharge relationship based on streamflow measurements made during stream gage rating checks on a log-log graph, drawing a best-fit curve, and interpolating between graphical points on the curve. Manual adjustments can be made to the software derived rating curves by the hydrographer when needed. New ratings and shifts are rare due to the stability of the channel.

The maximum instantaneous recorded flow was 171,000 cfs on December 22, 1964 based on the previous datum. Since the current gage location and datum has been in use, the peak discharge was 154,000 cfs on January 2, 1997. The current range of measured flows is 148 to 154,000 cfs; below 25,000 cfs, the ratings table is developed by calculation based on the channel geometry. The ratings curve was extended above 25,000 cfs to 154,000 cfs based on the computation of peak flow over the spillway.

## **3.1.6 Yuba River Downstream from Narrows 2 Powerhouse - Marysville**

Streamflow in the Yuba River downstream from Daguerre Point Dam is measured by USGS Gage 11421000. The gage has measured flows on the Yuba River downstream of Daguerre Point Dam since October 1, 1943. The original station was destroyed in the flood of December 1955. The gage was rebuilt on October 14, 1957 by USGS. Information about this gage is included below.

### **3.1.6.1 Description of Gage**

USGS Gage 11421000 is located 4.2 mi northeast of Marysville and 5 mi downstream from Dry Creek on the left bank on private orchard land owned by Naumes Farms. The elevation of the gage shelter is 95 ft. The original datum of the gage was zero based on the National Geodetic Vertical Datum 1929 survey. When USGS converted its gages to the North American Vertical Datum 1988 survey, elevations in California decreased between 2-3 ft; hence the current -2.95 datum.

A Design Analysis H-5522+ DCP (300-baud), H-3531 Flashlite pressure sensor, and H355 bubbler system are installed in a Buffalo shelter with a concrete floor (Figure 3.1-8). A 140-ft long bubbler line enclosed in galvanized steel conduit extends down from the shelter into the gage pool. YCWA has a Geomation MCU, which collects data from the Design Analysis H-5522 and transmits data every 15 minutes by radio to Oregon Peak and then by microwave telemetry to New Colgate Powerhouse. All equipment is connected to an alternating current power source.



**Figure 3.1-8. Yuba River downstream from Narrows 2 Powerhouse – Marysville gage shelter**

### **3.1.6.2 Responsible Parties**

YCWA owns and USGS operates the gage. YCWA monitors flow data in real-time for operations and reviews flow data daily via SCADA and HYDSTRA to ensure compliance with minimum streamflows in the FERC license. USGS verifies stage accuracy during monthly site visits and provides annual review of the data. USGS is required to make flow measurements every 6 weeks. The station was briefly taken over from USGS by YCWA during WY 2004-

2006. YCWA contracted with USGS to resume operation and maintenance of the gage beginning in WY 2007. YCWA resumed cooperation status with USGS as of WY 2008.

### **3.1.6.3 Data Quality**

USGS staff provides data quality control. USGS verifies the stage to discharge relationship by making streamflow measurements every 6 weeks. Data logger gage height is verified with outside staff gages every 6 weeks. A mean daily flow summary, a 15-minute gage height and discharge file, shift rationale, gage height corrections, current meter measurement summary, field data sheets, datum adjustments, rating tables, and hydrographs for the entire water year are maintained by the USGS annually. Every 3 years, gage benchmarks, staff gages, and water-surface elevation are surveyed to determine if there has been any movement in the reference elevations. USGS generates a ratings table for the gage based on USGS flow measurements.

Gage data are processed and stored using USGS software. An unstable gravel bar control typically causes temporary rating shifts from measurement to measurement.

A maximum instantaneous computed flow was 180,000 cfs on December 22, 1964 at a gage height of 90.15 ft on December 22, 1964. The peak flow since the current gage datum was changed was 161,000 cfs on January 2, 1997, at a gage height of 91.64 ft. The current rating table was extended above 91,000 cfs to 161,000 cfs based on a USACE flood-routing study. The minimum measured flow at the gage was 10 cfs on July 2, 1959.

## **3.2 Reservoir and Impoundment Level Gages**

### **3.2.1 New Bullards Bar Reservoir**

USGS gage 11413515 has been used to measure New Bullards Bar Reservoir storage and reported annually to USGS in a mean daily format since January 1, 1969. Information about the gage is included below.

#### **3.2.1.1 Description of Gage**

The gage is located midway along the dam crest at an elevation of 1,970 ft.

The gage is accessed by parking at the left abutment parking lot and walking on the sidewalk to the center of the dam.

The gage shelter includes an ACCU-CODER quadrature shaft encoder, abandoned punch tape recorder, Sierra Control Systems unit and Stevens Shaft Encoder and Multilogger. The Sierra Control Systems unit has an attached float pulley system connected to the ACCU-CODER. The Sierra Control Systems unit also powers the Stevens Shaft Encoder and Multilogger battery. The ACCU-CODER measures the change in rotation of the float pulley system. Geomation calculates reservoir elevation based on the ACCU-CODER measurement every 15 minutes and

then telemeters the data by microwave to New Colgate Powerhouse. The gage reports elevations to the nearest 0.01 ft.

### **3.2.1.2 Responsible Parties**

YCWA owns and operates the gage. YCWA reviews reservoir elevation data daily via SCADA and HYDSTRA for operations and to ensure storage compliance. YCWA verifies stage accuracy during monthly site visits and submits records to USGS for annual review. USGS is required to make two measurements per year to validate gage data.

### **3.2.1.3 Data Quality**

YCWA provides data quality control. Water-surface elevation is verified monthly by measuring depth to water with a sounder in an abandoned electronic tape gage stilling well. The depth to water is subtracted from the electronic tape gage reference point (1,970 ft) to obtain the water-surface elevation and compared to the Geomation water-surface elevation record. Corrections to the record are made if there is a difference of greater than 0.1 ft.

The storage-capacity table has a range of 1,000 to 1,010,074 acre-feet (ac-ft) at elevations 1,400 to 1,965 ft, respectively. The storage-capacity table was developed by the International Engineering Company in May 1969.

A maximum storage of 972,224 ac-ft was reached on June 27, 1995 at a water-surface elevation 1,957.27 ft. The minimum storage since the reservoir first filled was 178,230 ac-ft on December 29, 1980 at an elevation of 1,700 ft.

## **3.2.2 Our House Diversion Dam Impoundment**

Our House Diversion Dam stage is measured by YCWA for operations.

### **3.2.2.1 Description of Gage**

The shelter that houses the monitoring equipment is located approximately 100 ft upstream from Our House Diversion Dam on the right bank of the Middle Yuba River on NFS land. The gaging equipment is located in the same 3-ft x 3-ft x 8-ft metal shelter that houses the Lohman Ridge Tunnel stage measuring equipment. Inside the shelter, a Design Analysis H355 Smart Gas Bubbler System and an H350-xl Data logger record stage data. A bubbler line extends from the shelter approximately 75 ft into the Our House Diversion Dam impoundment. A Geomation MCU collects data from the H350-xl Data logger and transmits the data every 15 minutes by radio to Oregon Peak and then by microwave telemetry to the New Colgate Powerhouse.



### **3.2.2.2 Responsible Parties**

YCWA owns and operates the gage. This gage is not reviewed by USGS.

### **3.2.2.3 Data Quality**

YCWA provides data quality control. YCWA verifies reservoir water-surface elevation as needed. An angled staff plate is bolted to the upstream side of the dam. Staff gages were previously installed on the right bank approximately 50 ft upstream from the Lohman Ridge Tunnel inlet. However, due to hillside slumping, these staff plates have been abandoned. The Smart Gas Bubbler System records elevation on a 0.01 ft increment, and is generally considered very accurate, but without the staff plates, there is no ability to confirm its readings.

## **3.2.3 Log Cabin Diversion Dam Impoundment**

Log Cabin Diversion Dam stage is measured by YCWA for operations.

### **3.2.3.1 Description of Gage**

The stilling well is located adjacent to the Camptonville Tunnel instrument shelter. A stand-alone Handar shaft encoder float system measures stage inside a stilling well every 15 minutes. A Geomation MCU retrieves and records data from the Handar encoder every 15 minutes and transmits the data by radio to Oregon Peak and then by microwave telemetry to New Colgate Powerhouse.

### **3.2.3.2 Responsible Parties**

YCWA owns and operates this gage. This gage is not reviewed by USGS.

### **3.2.3.3 Data Quality**

YCWA provides data quality control. YCWA verifies reservoir water-surface elevation as needed. An angled staff plate is bolted to the upstream side of the dam ranging in elevation from 10 to 60 ft. At low water-surface elevations, the shaft encoder float system no longer operates and the staff plate does not cover the full range of possible water-surface elevations. The measurement system is primarily used to determine water-surface elevations during spill periods.

## **3.3 Diversion Tunnel Flow Gages**

### **3.3.1 Lohman Ridge Diversion Tunnel**

USGS Gage 11408870 has been used to measure tunnel flow on a 15-minute interval, and reported to USGS in a mean daily format since October 1, 1988. Lohman Ridge Tunnel is used

to divert Middle Yuba River flow to Oregon Creek upstream of the Log Cabin Diversion Dam impoundment. Information about this gage is included below.

### **3.3.1.1 Description of Gage**

The gage is located approximately 200 ft upstream from Our House Diversion Dam on the right bank of the Middle Yuba River on NFS land.

The tunnel can be accessed via a 5-ft x 3-ft hatch 10 ft west of the instrument shelter.

The gage records stage in the tunnel by measuring water pressure from a bubbler line that sits in a pool controlled by a broad-crested V-notch weir. The weir is 50 ft downstream from the tunnel access ladder where the concrete lined tunnel transitions to an unlined tunnel. The bubbler line connects to a 3-ft x 3-ft x 8-ft tall instrument shelter located above the tunnel. Inside the shelter, a Design Analysis H355 Smart Gas Bubbler System and an H350-xl Data logger record stage data. A Geomation MCU collects data from the H350-xl Data logger and transmits the data every 15 minutes by radio to Oregon Peak and then by microwave telemetry to the New Colgate Powerhouse.

### **3.3.1.2 Responsible Parties**

YCWA owns and operates the gage. YCWA reviews flow data daily via SCADA and HYDSTRA, verifies stage accuracy onsite monthly and submits records to USGS for annual review. YCWA and USGS each make a minimum of 2 low flow measurements per year. USGS is responsible for review and certification of the discharge record.

### **3.3.1.3 Data Quality**

YCWA and USGS provide data quality control. YCWA and USGS verify the stage-to-discharge relationship at a minimum of twice per year. Data logger gage height is verified with staff gages when the tunnel is accessible. A mean daily flow summary, a 15-minute gage height and discharge file, shift rationale, gage height corrections, current meter measurement summary, field data sheets, datum adjustments, rating tables, and hydrographs for the entire water year are submitted to USGS annually. Every 3 years, gage benchmarks, staff gages, and tunnel pool water-surface elevation are surveyed to determine if there has been any movement in reference elevations. YCWA generates a ratings table for the gage based on YCWA's and USGS flow measurements during low flow. Wading measurements are made only below a gage height of 16.90 ft. High flow measurements were historically made from a bridge lowered into the tunnel. However, as of October 2011, measurements made from the bridge have been deemed too hazardous.

Gage data are processed and stored using HYDSTRA software. Rating tables are created in HYDSTRA by plotting stage-to-discharge relationships based on streamflow measurements made during stream gage rating checks on a log-log graph, drawing a best-fit curve, and interpolating between graphical points on the curve. Manual adjustments can be made to the

software derived rating curves by the hydrographer when needed. New ratings and shifts are rare due to the stability of the weir and tunnel.

A maximum discharge of 839 cfs was recorded on March 25, 1989. Periods of no flow occur in most years. The measurement system records elevations to the nearest 0.01 ft; when combined with the staff gages and the frequent confirmation of rating, the gage is considered to be very accurate.

### **3.3.2 Camptonville Diversion Tunnel**

USGS Gage 11409350 has been used to measure tunnel flow on a 15-minute interval, and reported on a daily interval since October 1, 1988. Records of monthly diversion were published with USGS Gage 11409400 for WY 1969 to 1988.

#### **3.3.2.1 Description of Gage**

The gage is located approximately 100 ft upstream from Log Cabin Diversion Dam on the right bank of Oregon Creek on NFS land.

The tunnel is accessed via a 5-ft x 3-ft hatch 10 ft west of the instrument shelter.

The gage records stage in the tunnel by measuring water pressure from a bubbler line that sits in a pool controlled by a broad-crested V-notch weir. The original weir is 80 ft downstream from the tunnel opening and 30 ft downstream from where the concrete lined tunnel transitions to an unlined tunnel. In August 2008, a new 10.4-ft-wide broadcrested V-notch weir was installed 60 ft downstream from the tunnel opening. The tunnel height from the center of the weir is 11.7 ft. The bubbler line connects to a 3-ft x 3-ft x 8-ft tall instrument shelter located above the tunnel. Inside the shelter, a Design Analysis H355 Smart Gas Bubbler System and an H350-xl Data logger record stage data. A Geomation MCU collects data every 15 minutes from the H350-xl Data logger and transmits the data every 15 minutes via radio to Oregon Peak and then via microwave telemetry to Colgate Powerhouse.

#### **3.2.2.2 Responsible Parties**

YCWA owns and operates the gage. YCWA reviews flow data daily via SCADA and HYDSTRA, verifies stage accuracy during monthly site visits and submits records to USGS for annual review. YCWA and USGS each make a minimum of two low flow measurements per year. USGS is responsible for review and certification of the discharge record.

#### **3.3.2.3 Data Quality**

YCWA and USGS provide data quality control. YCWA and USGS verify the stage to discharge relationship at a minimum of twice per year. Bubbler pressure gage height is verified with staff gages when the tunnel is accessible. A mean daily flow summary, a 15 minute gage height and discharge file, shift rationale, gage height corrections, current meter measurement summary, field data sheets, datum adjustments, rating tables, and hydrographs for the entire water year are

submitted to USGS annually. Every 3 years, gage benchmarks, staff gages, water-surface elevation, and gage shelter are surveyed to determine if there has been any movement in reference elevations. YCWA generates a ratings table for the gage based on YCWA's and USGS's flow measurements during low flow. Wading measurements are made only below a gage height of 2.00 ft. High flow measurements were historically made from a bridge lowered into the tunnel. However, as of October 2011, measurements made from the bridge have been deemed too hazardous.

Gage data are processed and stored using HYDSTRA software. Rating tables are created in HYDSTRA by plotting a stage-to-discharge relationship based on streamflow measurements made during stream gage rating checks on a log-log graph, drawing a best-fit curve, and interpolating between graphical points on the curve. Manual adjustments can be made to the software derived rating curves by the hydrographer when needed. New ratings and shifts are rare due to the stability of the weir and tunnel.

A maximum discharge of 1,090 cfs was recorded on March 25, 1989. Periods of no flow occur in most years. The measurement system records elevations to the nearest 0.01 ft; when combined with the staff gages and the frequent confirmation of rating, the gage is considered to be very accurate.

### **3.4 Powerhouse Flow Gages**

#### **3.4.1 New Bullards Bar Minimum Flow Powerhouse**

YCWA operates a mini hydropower generation plant consisting of a pelton wheel turbine and 150 kilowatt generator at the base of New Bullards Bar Dam at approximately 1,395 ft. Minimum flow release requirements are met through this generation plant in combination with dam seepage flow that exits the dam gallery entrance. A 12-in diameter tap off of the low-level outlet feeds water through the 12-in diameter penstock to the Powerhouse. The powerhouse has a maximum capacity of 5 cfs. Combined flow rates from powerhouse releases and dam seepage are captured by USGS Gage 11413517 (see Section 3.1.3).

Flows through the Minimum Flow Powerhouse are not gaged independently of USGS Gage 11413517.

#### **3.4.2 New Colgate Powerhouse**

Flows in the New Colgate Penstock are measured by USGS Gage 11413510. The gage has been used to measure New Colgate Penstock flow since October 1, 1966.

In September 2002, a flowmeter was installed on the penstock and became the primary flow measurement for recording flow at USGS Gage 11413510. Prior to the installation of the flowmeter, mean daily discharge for this gage was calculated using an equation based on generator energy output. In total, there are four flowmeters installed from the base of New Bullards Bar Dam to the powerhouse:

- One Rosemount differential level pressure flowmeter at the base of New Bullards Bar Dam used as an alarm to control shut off of the 180-in butterfly valve located on the penstock at the dam.
- One “master” Accusonic flowmeter, 4-path wetted transducers, located where the tunnel outlet transitions to penstock approximately 50 ft upstream from the a 168-inch diameter penstock butterfly valve.
- One “slave” Accusonic flowmeter, 4-path wetted transducers, located on the penstock upstream of the Colgate Powerhouse approximately 100 ft above Colgate powerhouse access road. The master and slave flowmeters are used in conjunction to detect leaks in the penstock and as an alarm to control emergency shut down of the 168-inch butterfly valve.
- One Panamatrix flowmeter, 2-path “clamp-on” transducers, located in between the master and slave Accusonic flowmeters on the penstock. This meter is used for reporting discharge under USGS Gage 11413510 (stated accuracy of 1-2%).

#### **3.4.2.1 Description of Gage**

Since 2002, USGS Gage 11413510 recordings are based on a General Electric Panamatrix acoustic flowmeter (model 868-2-31-10100) which is housed in a 4-ft x 4-ft x 8-ft steel building with temperature control for instrument stability located off of Lake Francis Road at the New Colgate Powerhouse. The flowmeter measures velocity and uses programmed parameters to output flow. The flowmeter is a 2-path system with “clamp-on” transducers that ping a 1.0 megahertz frequency through the penstock. New transducers were installed on February 8, 2011 that ping a 0.50 megahertz frequency. Probe #1 is used to produce the primary flow measurement. Probe #2 is used as a check for Probe #1.

#### **3.4.2.2 Responsible Parties**

YCWA owns and operates the gage. YCWA reviews flow data daily via SCADA and HYDSTRA, and submits records to USGS for annual review. USGS is responsible for review and certification of the discharge record.

#### **3.4.2.3 Data Quality**

YCWA and USGS provide data quality control. Monthly data is emailed to USGS. A General Electric Panametric portable clamp-on acoustic flowmeter was used to verify gage accuracy in 2011. A mean daily flow summary for the entire water year is submitted to USGS annually.

The flow measurement from Probe #1 is converted to a linear 4 to 20 milliamp signal to a Geomation Remote Terminal Unit which retransmits a digital signal to New Colgate Powerhouse every 5 minutes. Flow data are stored in HYDSTRA for final compilation of the flow record. The Geomation Remote Terminal Unit also provides a 0 to 5 volt output to YCWA’s SCADA system. The Panamatrix flowmeter records flow to the nearest 0.01 cfs, and has a stated accuracy of 1-2 percent.

### **3.4.3 Narrows 2 Powerhouse**

Flows in the Narrows 2 penstock are measured by USGS Gage 11417980. The gage has been used to measure Narrows 2 penstock flow since October 1, 1970. The Narrows 2 Penstock serves 1) the Narrows 2 Powerhouse, 2) the Narrows 2 Partial Bypass, and 3) The Narrows 2 Full Bypass. The Partial Bypass includes a pipe off the Narrows 2 Powerhouse turbine spiral case and a 36-inch (in) valve located on the downstream face of the Narrows 2 Powerhouse above the draft tube outlet. The Partial Bypass can discharge up to 650 cfs at full head into the Yuba River. The Full Bypass includes a branch bifurcated off the Narrows 2 Penstock and a 72-in fixed-cone valve located in a separate concrete structure immediately upstream of the Narrows 2 Powerhouse. The Full Bypass can discharge up to 3,000 cfs of water at full head into the Yuba River. The Narrows 2 Powerhouse and Partial Bypass began operations in 1969, and the Full Bypass began operation in January 2007. YCWA records flow at 15-minute intervals through the Narrows 2 Penstock using an acoustic velocity meter installed in 2006 to the penstock upstream from the Full Bypass - Narrows 2 Powerhouse/Partial Bypass bifurcation. Flow in the penstock downstream of the bifurcation is not directly measured, but is computed based on recorded generation and operator's log books.

#### **3.4.3.1 Description of Gage**

USGS Gage 11417980 is located at the end of a paved access road off of Scott Forbes Road in the Narrows 2 Powerhouse, 400 ft downstream from Englebright Dam. An Accusonic 4-path, 8 wetted-transducers, flowmeter is located on the bottom floor of the powerhouse, upstream from the bifurcation, on the 14-ft diameter penstock, approximately 180 ft upstream from the Turbine Stop Valve. The flowmeter measures velocity and uses programmed parameters to output flow. The Accusonic model 7510 Plus digital readout for the flowmeter is located on the second floor of the powerhouse. A Geomation MCU retrieves data from the Accusonic flowmeter every 5 minutes and then transmits the data by microwave to New Colgate Powerhouse.

#### **3.4.3.2 Responsible Parties**

YCWA owns and operates the gage. PG&E submits the record to USGS.

#### **3.4.3.3 Data Quality**

PG&E and YCWA provide data quality control. PG&E and YCWA check flow data daily via the SCADA and HYDSTRA systems. Due to conduit tapering, check measurements are not made by USGS or PG&E because there is no section of straight conduit available to make an accurate check measurement. PG&E sends a mean daily discharge summary and hydrograph to USGS for review annually. The flowmeter records flow to the nearest 0.01 cfs, but without the ability to check flows through the Narrows 2 Powerhouse, it is not possible to know exactly how accurate the flowmeter on the Narrows 2 Powerhouse is. Accordingly, FERC minimum flow compliance is measured at the Yuba River near Smartsville Gage 11418000 just downstream from the Narrows 2 Powerhouse.

**SECTION 4.0**

**EXISTING DATA STORAGE AND DATA AVAILABILITY**

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This section describes YCWA’s approach to storing data gathered through the streamflow and reservoir level monitoring network, and how some of these data are made publicly available.

**4.1 Internal YCWA Data Storage**

Data are stored using the following methods:

- Geomation MCU: Less than a week of data may be stored for each site.
- Design Analysis H350-xl Data logger: 256 Kb or 1-2 years of stage and temperature data.
- HYDSTRA: Long term storage for all data. Historical data can be retrieved back to 2008 depending on the site. This data is stored and backed up on YCWA in-house servers.
- SCADA: Approximately 6 months to a year of data for all sites.
- Geomation Server: Historical data can be retrieved back to 1994.

**4.2 Publicly Accessible Streamflow and Reservoir Level Data**

Real-time streamflow and reservoir level data may be retrieved by the public from DWR’s CDEC for the six sites listed in Table 4.2-1. For each site, 15-minute data are automatically uploaded to the CDEC server from the Colgate Powerhouse every hour. Hourly data can be accessed at <http://www.cdec.water.ca.gov/cgi-progs/staSearch>.

**Table 4.2-1 YCWA gages available on CDEC.**

CDEC ID	Station	Operator	Existing Parameter	Proposed Parameters
BUL	USGS Gage 11413515 <sup>1</sup> New Bullards Bar Reservoir	YCWA	Res Elevation, Inflow, Outflow, Storage	Res Elevation, Inflow, Outflow, Storage, Spill, River Release
CPH	USGS Gage 11413510 New Colgate Powerhouse	YCWA	Outflow	Outflow
LCB	USGS Gage 11409400 Oregon Creek blw Log Cabin	YCWA	Stage, Flow	Stage, Flow
ORH	USGS Gage 11408880 Middle Yuba River blw Our House Dam	YCWA	Stage, Flow	Stage, Flow
YRS	USGS Gage 11418000 Yuba River near Smartsville	PG&E	Stage, Flow, Temp	Stage, Flow, Temp
MRY	USGS Gage 11421000 Yuba River near Marysville	USGS	Stage, Flow	Stage, Flow

<sup>1</sup> USGS Gage 11413515 records elevation and storage only.

In addition, by December 15 of each year, YCWA submits to USGS mean daily flow data for the previous water year. USGS typically reviews and certifies the data by late spring of the following year. Certified historical mean-daily flow data and instantaneous peak streamflow

data for the entire period of record for each gage may be retrieved via USGS at <http://waterdata.usgs.gov/nwis/>.



## SECTION 5.0

# MODIFICATIONS TO GAGES AND DATA AVAILABILITY UNDER NEW THE LICENSE

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The existing streamflow and reservoir level gages and data available to the public are adequate to monitor compliance with the minimum streamflows and reservoir elevation requirements in YCWA's proposed Project as described in its Application for New License with the modifications described below.

## **5.1**        **Modifications**

### **5.1.1**        **North Yuba River Flow Downstream from New Bullards Bar Dam**

The existing gage (USGS Gage 11413517) used to monitor YCWA's compliance with existing FERC minimum flow is rated to 10 cfs. YCWA's proposed Project includes minimum flows on the North Yuba River downstream of New Bullards Bar Dam as high as 13 cfs.

YCWA will widen the weir currently used in conjunction with a stilling well to measure flow on the North Yuba River downstream of New Bullards Bar Dam so it can accurately report YCWA's compliance with its proposed minimum flows. YCWA anticipates the gage rating will be increased from 10 cfs to at least 15 cfs.

### **5.1.2**        **Middle Yuba River Downstream from Our House Diversion Dam**

The existing gage (USGS Gage 1408880) used to monitor YCWA's compliance with existing FERC minimum flows is rated to 50 cfs for compliance-level monitoring. YCWA's proposed Project includes minimum flows on the Middle Yuba River downstream from Our House Diversion Dam as high as 80 cfs.

YCWA's will widen the existing 12-foot sharp crested weir so it can accurately reflect YCWA's compliance with its proposed minimum flows. YCWA anticipates the gage rating will be increased from 50 cfs to at least 90 cfs.

### **5.1.3**        **Oregon Creek Downstream from Log Cabin Dam**

The existing gage (USGS Gage 14109400) used to monitor YCWA's compliance with existing FERC minimum flows is rated to 12 cfs for compliance-level monitoring. YCWA's proposed Project includes minimum flows on Oregon Creek downstream of Log Cabin Diversion Dam as high as 31 cfs.

YCWA will widen the existing weir so it can accurately reflect YCWA's compliance with its proposed minimum flows. YCWA anticipates the gage rating will be increased from 12 cfs to at least 35 cfs.

#### **5.1.4 New Bullards Bar Dam - Spill**

Currently YCWA reports total New Bullards Bar Reservoir outflow to CDEC. This flow includes the releases of New Colgate Powerhouse as well as spillway and low-level outlet flows, as calculated by YCWA, and Minimum Flow Powerhouse releases and seepage as recorded by USGS Gage 11413517.

YCWA plans to separately report to CDEC the flows only from the New Bullards Bar Dam Spillway. These flows are proposed to be listed under the CDEC name "BUL" as "Spill."

#### **5.1.5 New Bullards Bar Dam - River Release**

Releases from the bottom of New Bullards Bar Dam to the North Yuba River are a result of releases from the New Bullards Bar Minimum Flow Powerhouse and dam seepage, which is measured at USGS Gage 11413517 up to its current rating of 10 cfs, and can also occur from releases from the New Bullards Bar Dam Low Level Outlet.

Releases from the Low Level Outlet happen very infrequently and are generally at much higher flow rates than the Minimum Flow Powerhouse flows. Releases from the Low Level Outlet are not gaged, but instead are estimated based on valve opening and reservoir water-surface elevation.

YCWA plans to report the flow according to USGS Gage 11413517 when flows are less than 10 cfs, and to report flow as the calculated Low Level Outlet flow when the outlet is opened. These flows are proposed to be listed under the CDEC name "BUL" as "River Release."

### **5.2 Schedule**

Where a facility must be modified or constructed, YCWA will submit applications for permits to modify or construct the facility as soon as reasonably practicable but no later than within the first 2 years of the new license term, and YCWA will complete the work as soon as reasonably practicable but no later than within 2 years after receiving all required permits and approvals for the work.

During the period before facility modifications or construction are completed, and within the first 90 days of the new license term, YCWA will make a good faith effort to provide the specified minimum streamflows within the reasonable capabilities of the existing facilities.

## SECTION 6.0

# REPORTING AND PLAN REVISIONS

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## 6.1 Reporting

By December 31 of each year, YCWA will file with FERC a streamflow and reservoir level report. The report will include the following data for the preceding water year (October 1 through September 30): 1) for each gage that monitors compliance with conditions in the FERC license, 15-minute streamflow data and end-of-day reservoir elevation in electronic format (i.e., on digital versatile disk or similar format); and 2) a description of any deviations from the streamflow and reservoir level requirements in the license.

## 6.2 Plan Revisions

YCWA will review, update, and/or revise the Plan as needed when significant changes in existing conditions occur. Any updates to the Plan would be prepared in coordination and consultation with the Forest Service for gages or reservoir level gages on or affecting NFS land. Sixty days would be allowed for the Forest Service to provide written comments and recommendations before YCWA files the updated Plan with FERC. YCWA will include all relevant documentation of coordination/consultation with the updated Plan filed with FERC. If YCWA does not adopt a particular recommendation, the filing will include the reasons for not doing so, based on Project-specific information. YCWA will implement the Plan as approved by FERC.<sup>6</sup>

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<sup>6</sup> The Plan will not be considered revised until FERC issues its approval.

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**SECTION 7.0**

**REFERENCES CITED**

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United States Army Corps of Engineers (USACE) 1972. New Bullards Bar Reservoir, Reservoir Regulation for Flood Control, Department of the Army, Sacramento District Corps of Engineers, June 1972.

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