3.2.2 Water Resources

3.2.2.1 Overview

In addition to this introductory information, this section is divided into 11 subsections. Section 3.2.2.2 provides drainage area information for the Bear River sub-basins and at major Project facilities. Section 3.2.2.3 provides information such as length and gradient of stream reaches potentially affected by the Project. Section 3.2.2.4 provides morphometric information regarding Project reservoirs. Section 3.2.2.5 describes the hydrology in the Project Vicinity. Sections 3.2.2.6 and 3.2.2.7 list the existing and potential Basin Plan designated Beneficial Uses and applicable Water Quality Objectives, respectively, for stream reaches and reservoirs potentially affected by the Project. Section 3.2.2.8 provides the existing and proposed water rights potentially affected by the Project. Section 3.2.2.9 describes existing, relevant, and reasonably available water quality information upstream, within the Project, and in the lower Bear River, including water temperature and water chemistry. Section 3.2.2.10 provides a discussion of mercury issues and reports in and around the Project. Section 3.2.2.11 describes known or potential Project effects on water resources.

SSWD prepared this section based on its collection of existing, relevant and reasonably available information on water resources. Specifically, SSWD found 18 source documents regarding water resources. These are listed below and cited throughout this section:

- SWRCB 2005, 2010, 2012 and 2013
- CVRWQCB 1998
- CDFG 1991a
- Bailey 2003
- DWR 2004a
- Alpers et al. 2005 and 2008
- Davis et al. 2007 and 2009
- Hunerlach et al. 1999
- May et al. 2000
- Slotten et al. 1995
- Saiki et al. 2010
- Kuwabara et al. 2003
- OEHHA 2009
- Grenier et al. 2007

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3.2.2.2 Drainage Areas of the Bear River Sub-basins

Section 3.1.2 provides an overview of the Bear River basin, and includes a map (Figure 3.1-2). The total drainage area, including the portion of the drainage area upstream and downstream of the Project, is provided in Table 3.2.2-1.

Table 3.2.2-1. Drainage areas of Bear River basin.

Basin	Drainage Area			
	Upstream of the Project[1]	Downstream of the Project[2]		Total
	(sq mi)	(sq mi)	% of Total	(sq mi)
Bear River	281.8	192.5	40.6%	474.3

1 Upstream of the Project is considered the Bear River from its headwaters to the NMWSE of Camp Far West Reservoir.
2 Downstream of the Project is considered the Bear River from Camp Far West Dam and Powerhouse to the Bear River's confluence with the Feather River.

3.2.2.3 Stream Reaches Affected by the Project

Two stream reaches are directly, indirectly, and cumulatively affected by the Project, as described in Section 3.1.2.3. A summary description of each reach is provided in Table 3.2.2-2.

Table 3.2.2-2. Stream reaches affected by the Project.

Reach Name	Upstream Terminus	Downstream Terminus	Length (mi)	Gradient (%)
BEAR RIVER				
Camp Far West Dam Reach	Base of Camp Far West Dam (RM 18.2, El.140 ft)	Base of Diversion Dam (RM 16.9, El.120 ft)	1.3	0.29
Lower Bear River	Base of Non-Project Diversion Dam (RM 16.9, El.120 ft)	Confluence with Feather River (RM 0, El.24 ft)	16.9	0.11

3.2.2.4 Morphometric Data for Existing Project Reservoirs

Table 3.2.2-3 summarizes relevant data related to Camp Far West Reservoir, the Project's only storage reservoir, including water surface elevation, gross storage, usable storage, surface area, volume, estimated maximum depths, and shoreline length.

Table 3.2.2-3. Morphometric information regarding Project reservoirs.

Project Reservoir	Upstream Drainage Area (sq mi)	Usable Storage Capacity[1] (ac-ft)	Normal Maximum WSE[1] (ft)	Surface Area[2] (ac)	Shoreline Length[2] (mi)	Maximum Length[2] (mi)	Estimated Maximum Depth[2] (ft)
Camp Far West Reservoir	284	92,430	300	1,886	29	5.4	160

1 WSE = Water Surface Elevation
2 At NMWSE

The average hydraulic retention time of usable storage within Camp Far West Reservoir is approximately 3 months, based on long-term averages of storage and flow through the reservoir. Figure 3.2.2-1 shows the storage-area-elevation curves for Camp Far West Reservoir calculated from a 2008 bathymetric survey performed by Wood Rodgers (2008).

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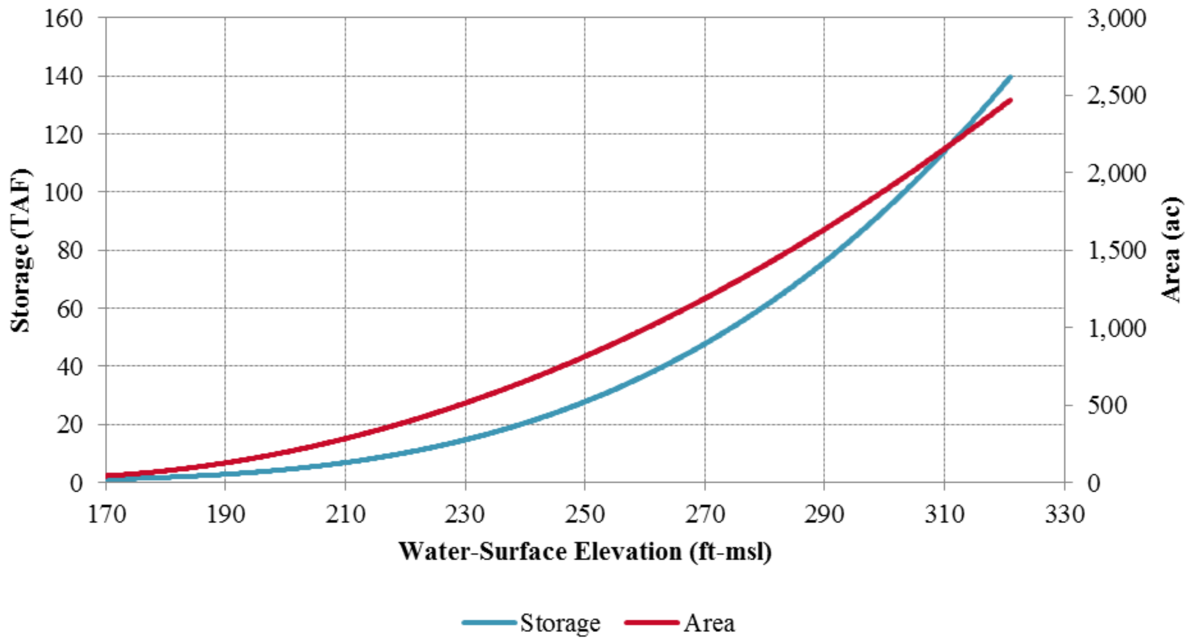

Figure 3.2.2-1. Camp Far West Reservoir storage-area-elevation curves.

3.2.2.5 Streamflow, Gage Data and Flow Statistics

For the purpose of this PAD, SSWD's historical hydrologic period of record extends from WY 1928 through WY 2014. This period includes both dry and wet periods for the Project Vicinity. Further, for the purpose of this PAD, "with-Project" hydrology refers to hydrologic conditions with both Project and non-Project facilities in the watershed, "unimpaired" hydrology refers to flows that would have occurred in the basin during the period of record if no Project or non-Project facilities were present, and "without-Project" hydrology refers to flows that would have occurred if the Project had not been developed, but all non-Project facilities[1] were present. When referring to historical flows, three distinct periods of development are referenced:

- WY 1928 through WY 1966, the period prior to the development of Camp Far West Dam;
- WY 1967 through 1984, the period prior to the development of Camp Far West Powerhouse; and
- WY 1985 through 2014, the period following the development of Camp Far West Powerhouse.

For each of these periods, historical flow data are available at the USGS Wheatland gage (11424000).

[1] Non-Project facilities upstream of the Camp Far West Hydroelectric Project include PG&E's Drum-Spaulding Project, NID's Yuba-Bear Hydroelectric Project, and NID's Lake Combie.

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All with-Project, unimpaired, and without-Project hydrology (mean daily values) as well as SSWD's methods used to estimate each flow condition are provided in Appendix F. Regulated hydrology was synthesized by SSWD from measured reservoir elevations and stream flows and is reported by the USGS and by CDEC, while unimpaired and without-Project hydrology were calculated using area-weighted flow, mass balance, and statistical regression methodologies. Appendix F also includes flow exceedance charts for all gage locations discussed in this section.

3.2.2.5.1 Streamflow and Other Gages in the Project Vicinity

Publicly-available flow and reservoir elevation and storage data for the Project Vicinity come from USGS and CDEC gages within the Bear River basin. Table 3.2.2-4 includes these gages, as well as several additional gages maintained by SSWD or SMUD for O&M purposes. These data are provided in Appendix F, unless indicated. In addition, SSWD maintains several additional non-Project seasonal flow gages for water rights compliance.

Table 3.2.2-4. Streamflow gages, Project release and reservoir gages.

USGS/CDEC Gage Number	Name	Elevation (ft)	Drainage (sq mi)	Period of Record	
				Start	End
STREAMFLOW GAGES					
--	Bear River above Camp Far West Reservoir[2]	325	NA	Seasonal	
11423800[1]	Bear River Fish Release below Camp Far West Reservoir, near Wheatland, CA	120	286	10/1/1989	Present
11424000[3]	Bear River near Wheatland, CA	72	292	10/23/1928	Present
BPG	Bear River near Pleasant Grove, CA	65	NA	1/27/2006	Present
PROJECT RELEASE GAGES					
--	Camp Far West Dam Low-Level Outlet Flowmeter	140	286	1/1/1968	Present
--	Camp Far West Powerhouse Flowmeter	140	286	1/1/1985	Present
RESERVOIR STORAGE GAGES					
11423700	Camp Far West Reservoir near Wheatland, CA	N/A	283	10/1/1966	9/30/1983
CFW	Bear River at Camp Far West Dam	260	286	11/1/1963	Present

Notes: Elevation and drainage per USGS/CDEC records.
NA: Not available
1 Gage is used by SSWD to document compliance with the minimum instream flow requirements in the existing FERC license.
2 Gage data are unavailable.
3 Also reported as CDEC Gage "BRW" since 1/24/1997.

Figure 3.2.2-2 provides a schematic view of Project facilities and gages in the Project Vicinity.

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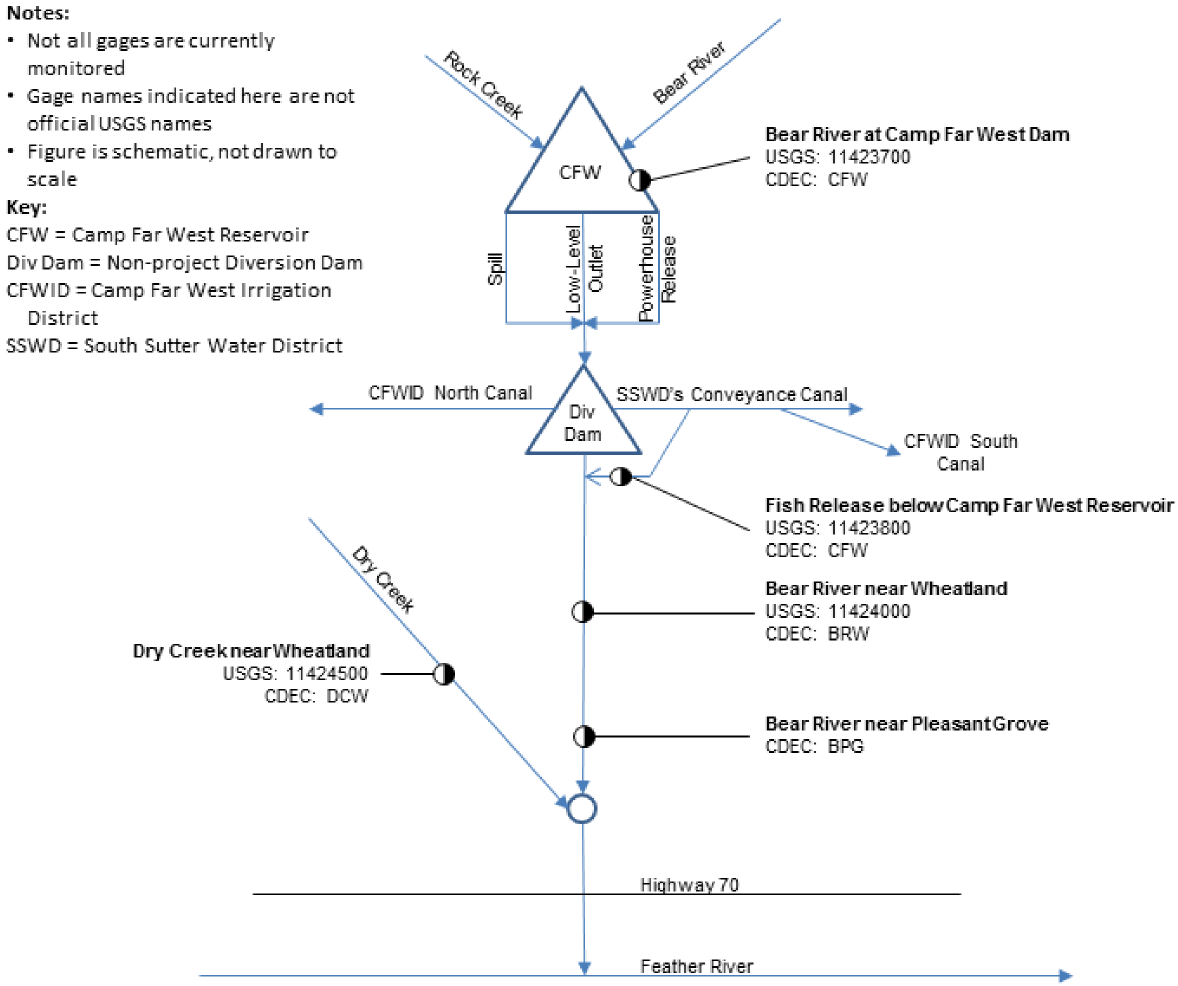

Figure 3.2.2-2. Schematic of the Project Vicinity, including public gage identification numbers.[2]

3.2.2.5.2 Regulated Hydrology Data for Project Facilities and Potentially Affected Sections of the Bear River and Tributaries

This section summarizes hydrology data available for sections of the Bear River in the Project Area, the area immediately downstream of Project facilities, and other points of interest, (e.g., USGS gage locations). Data are generally presented from upstream to downstream. SSWD's synthesized flow data for these points of interest are included with the complete hydrology data for with-Project, without-Project and unimpaired flows in Appendix F.

Flow data shown in this section include with-Project mean monthly gage flows, mean daily stream flows per year, and flow exceedance curves by tributary or facility within the Project Vicinity. Most of the figures are based on an analysis of regulated USGS gage flow data for the period of time that Camp Far West Dam has been in operation (i.e., WY 1967 through WY 2014). There are some exceptions due to new or discontinued gages, in which case a limited

[2] SSWD also collects flow data for the Bear River above Camp Far West Reservoir, Camp Far West dam low-level outlet, CFWID North Canal and the SSWD Conveyance Canal. SMUD also collects flow data for the Camp Far West Powerhouse. These data are not available to the public.

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data set was used for analysis. Mean monthly stream flows are shown as bar charts with end-point bars to represent minimum and maximum monthly flow values. Regulated mean daily flow figures help characterize daily trends and flow variability throughout the year. Flow exceedance curves represent the percentage of time a specified flow is equaled or exceeded throughout the period of record. See Appendix F for more detailed flow exceedance curves by month. The combination of the three figures for each tributary or facility provides a general description of gaged flow behaviors of these features within the Project Area.

3.2.2.5.2.1 Time Period Setting

During the pre-Project time period of WYs 1928 through 1966, no Project facilities were in place, NID's Rollins Reservoir and Dutch Flat Afterbay were not in place, and PG&E's Drum Afterbay was not in place. NID's Lake Combie was the only non-Project facility upstream. Water was being diverted from NID's Milton Diversion Dam on the Middle Yuba River into NID's Bowman Dam on Canyon Creek via the Milton-Bowman Tunnel, where water was then diverted into PG&E's Lake Spaulding on the South Yuba River via the Bowman-Spaulding Canal. Spaulding Dam then was used to divert the combined flows into the Bear River via the Drum Canal. The only development in the Project Vicinity was CFWID's Camp Far West Diversion Dam, a 50-ft high concrete gravity dam constructed in 1927 at the site of the existing Camp Far West Dam.

The Project time period of WYs 1967 through 1984 includes the operation of Camp Far West Reservoir without the presence of Camp Far West Powerhouse. Rollins Reservoir, Dutch Flat Afterbay and Drum Afterbay were completed in 1965. During this time period, the use of Bear River water, primarily through diversions at PG&E's Bear River Diversion Dam and Lake Combie, and the non-Project diversion dam downstream of Camp Far West Reservoir, increased with the expansion of irrigation systems within Yuba, Sutter, Nevada and Placer counties.

The Project time period of WYs 1985 through 2014 includes the operation of Camp Far West Reservoir with the presence of Camp Far West Powerhouse, which was constructed in WY 1985. During this time period, the use of Bear River water, primarily through diversions at PG&E's Bear River Diversion Dam and Lake Combie, and the non-Project diversion dam downstream of Camp Far West Reservoir, continued to increase with the expansion of irrigation systems within Yuba, Sutter, Nevada and Placer counties.

3.2.2.5.2.2 Comparison of Pre- and Post-Project Hydrology

Figures 3.2.2-3 through Figure 3.2.2-14 shows exceedance probabilities of mean daily flow, by month, in January through December, for Bear River at the USGS Wheatland gage. The figure includes three time periods for comparison; the pre-Project time period of WYs 1928 through 1966, as well as the Project time periods of WYs 1967 through 1984 (pre-powerhouse) and WYs 1985 through 2014 (post-powerhouse). Exceedance probability figures show the percentage of occurrences, in this case the percentage of days that a flow occurred, at or above a specific level. For example, Figure 3.2.2-3 for the month of January, the mean daily flows were at or above 500 cfs 41 percent of days for the pre-Project time period, and 47 and 30 percent of days for the Project time periods before and after hydropower development, respectively.

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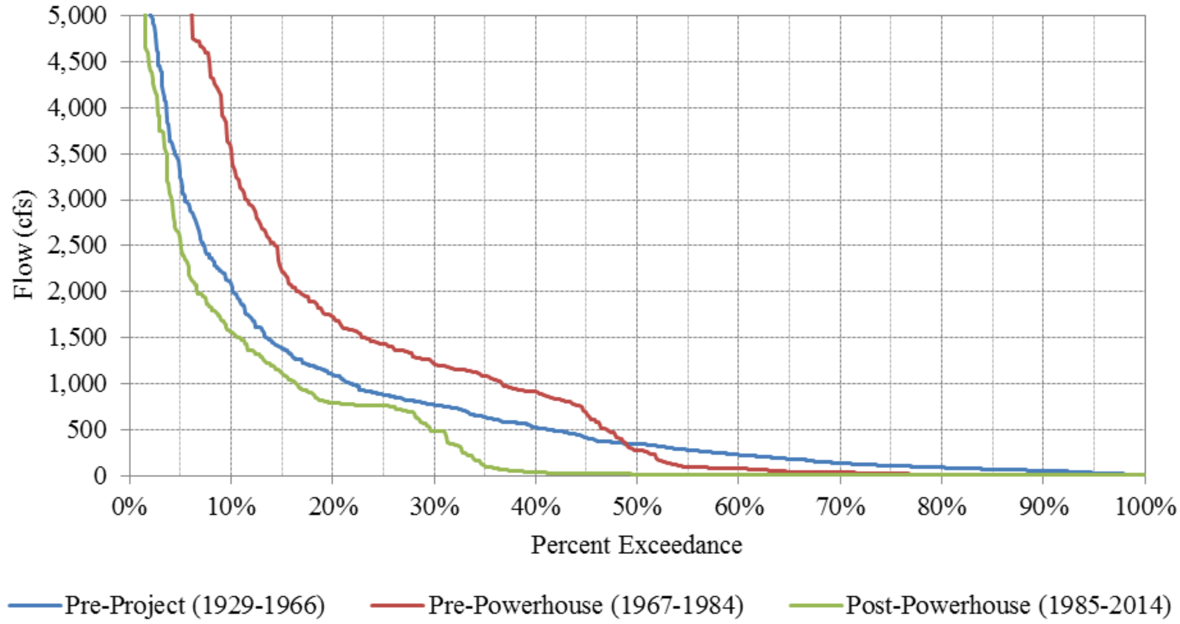

Figure 3.2.2-3. Flow exceedance of historical mean-daily streamflow at the Wheatland gage for pre-Project (WYs 1929-1966) and with-Project (WYs 1967-1984, 1985-2014) time periods – January.

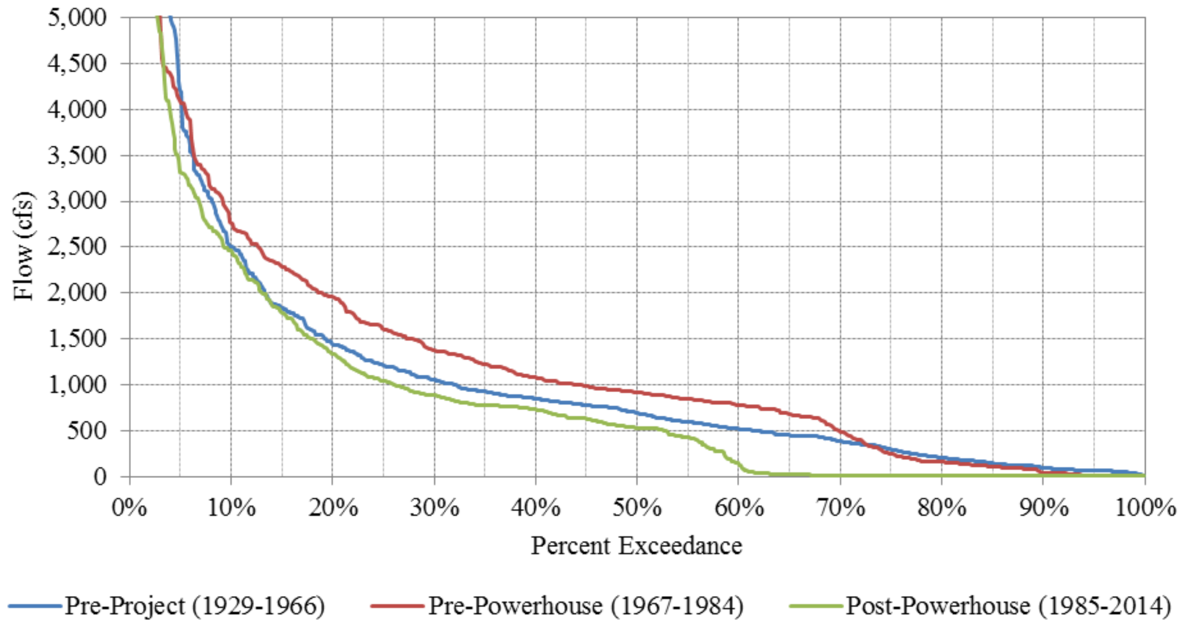

Figure 3.2.2-4. Flow exceedance of historical mean-daily streamflow at the Wheatland gage for pre-Project (WYs 1929-1966) and with-Project (WYs 1967-1984, 1985-2014) time periods – February.

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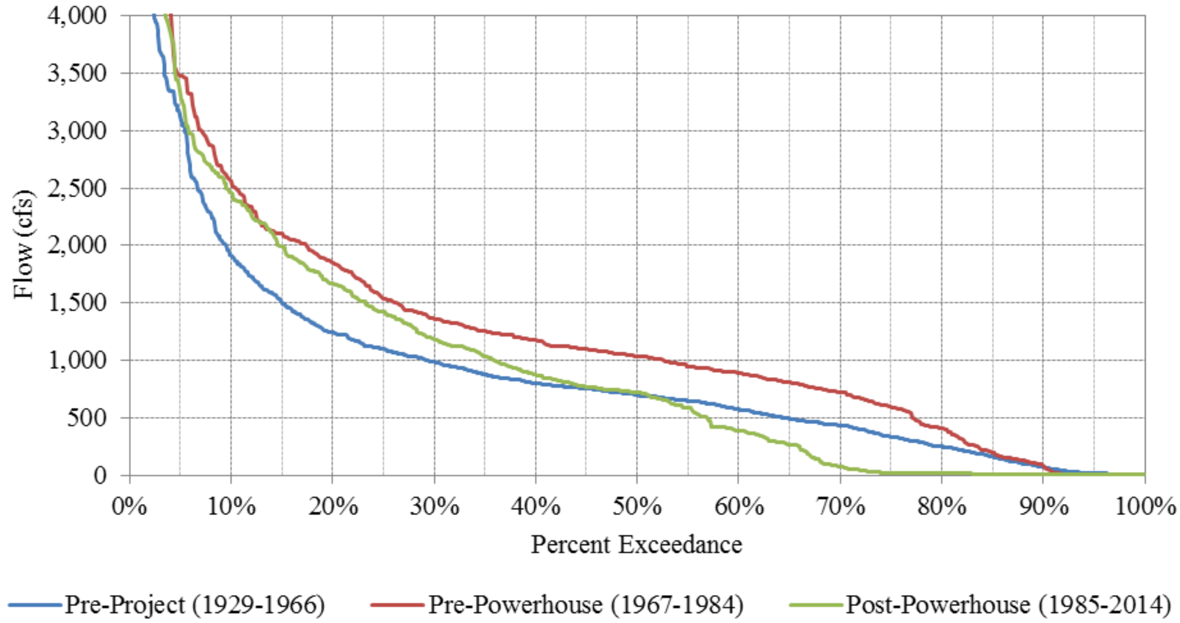

Figure 3.2.2-5. Flow exceedance of historical mean-daily streamflow at the Wheatland gage for pre-Project (WYs 1929-1966) and with-Project (WYs 1967-1984, 1985-2014) time periods – March.

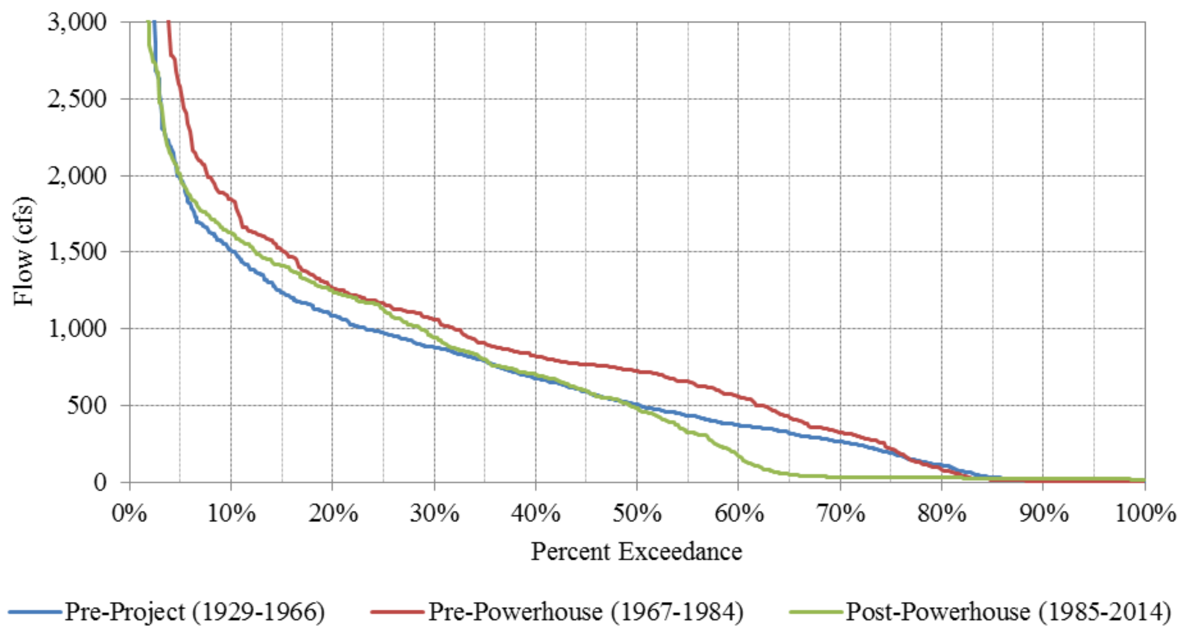

Figure 3.2.2-6. Flow exceedance of historical mean-daily streamflow at the Wheatland gage for pre-Project (WYs 1929-1966) and with-Project (WYs 1967-1984, 1985-2014) time periods – April.

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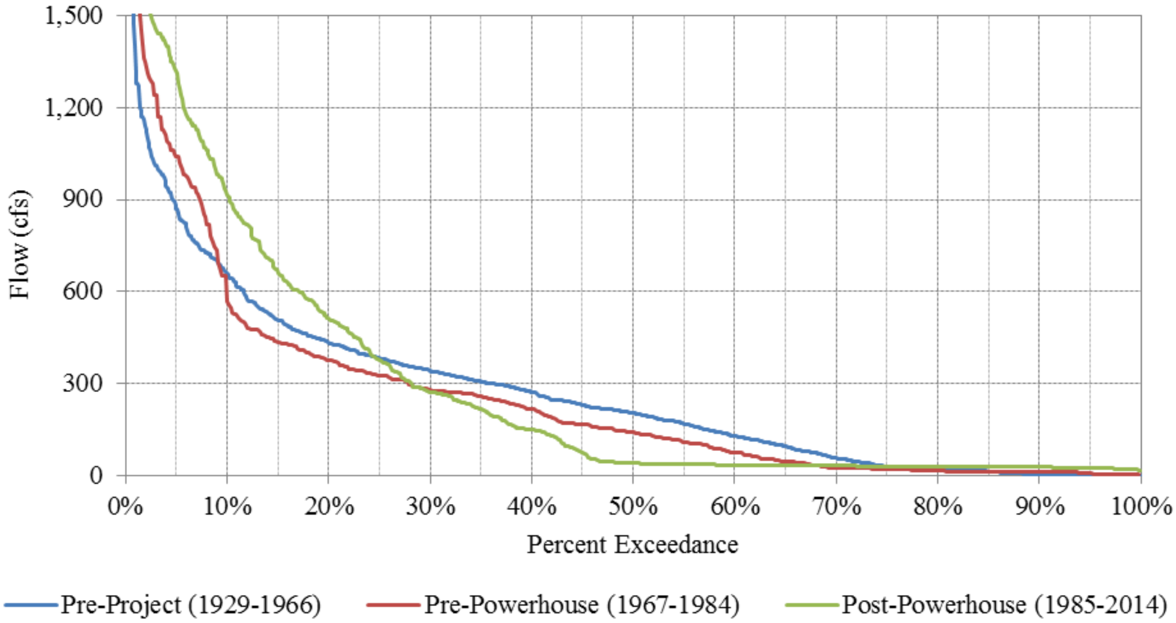

Figure 3.2.2-7. Flow exceedance of historical mean-daily streamflow at the Wheatland gage for pre-Project (WYs 1929-1966) and with-Project (WYs 1967-1984, 1985-2014) time periods – May.

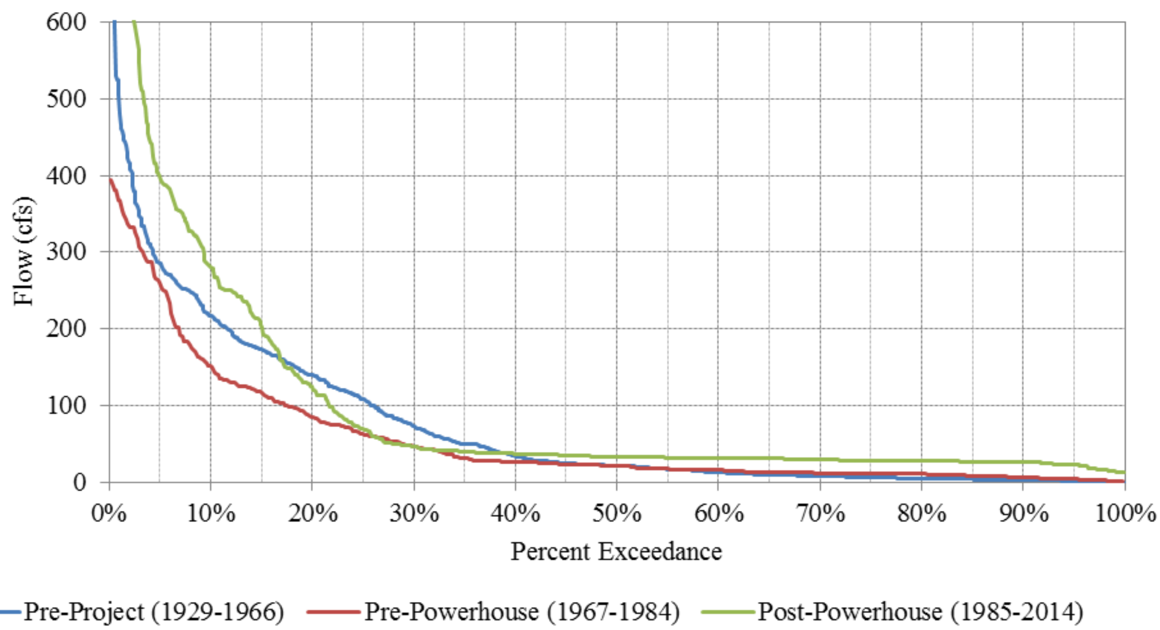

Figure 3.2.2-8. Flow exceedance of historical mean-daily streamflow at the Wheatland gage for pre-Project (WYs 1929-1966) and with-Project (WYs 1967-1984, 1985-2014) time periods – June.

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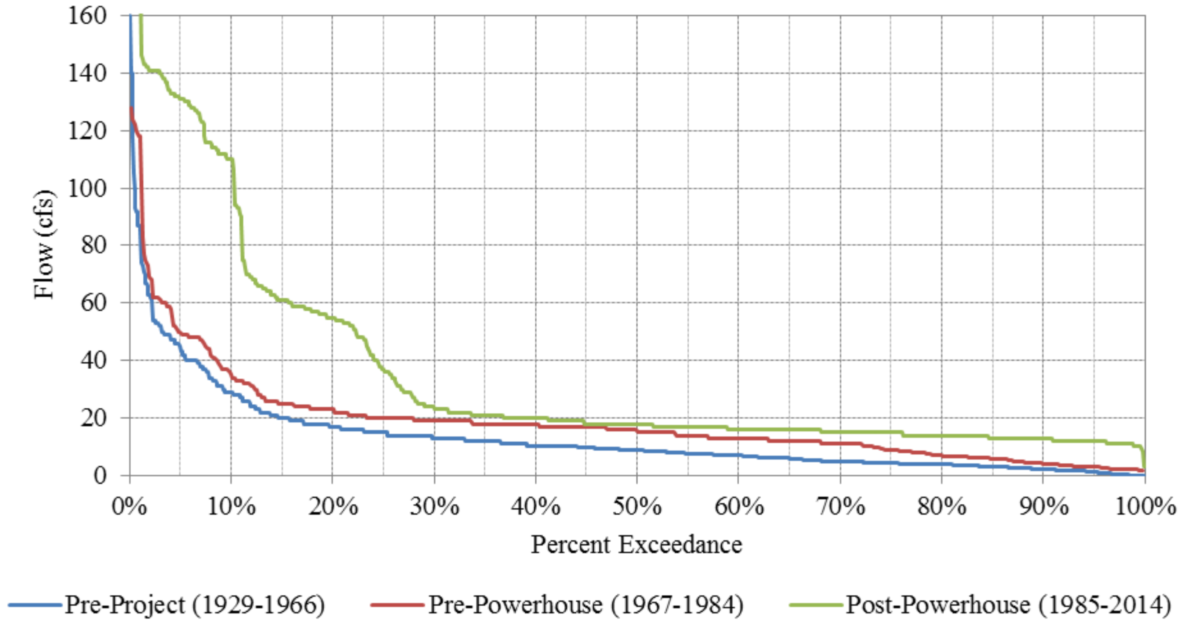

Figure 3.2.2-9. Flow exceedance of historical mean-daily streamflow at the Wheatland gage for pre-Project (WYs 1929-1966) and with-Project (WYs 1967-1984, 1985-2014) time periods – July.

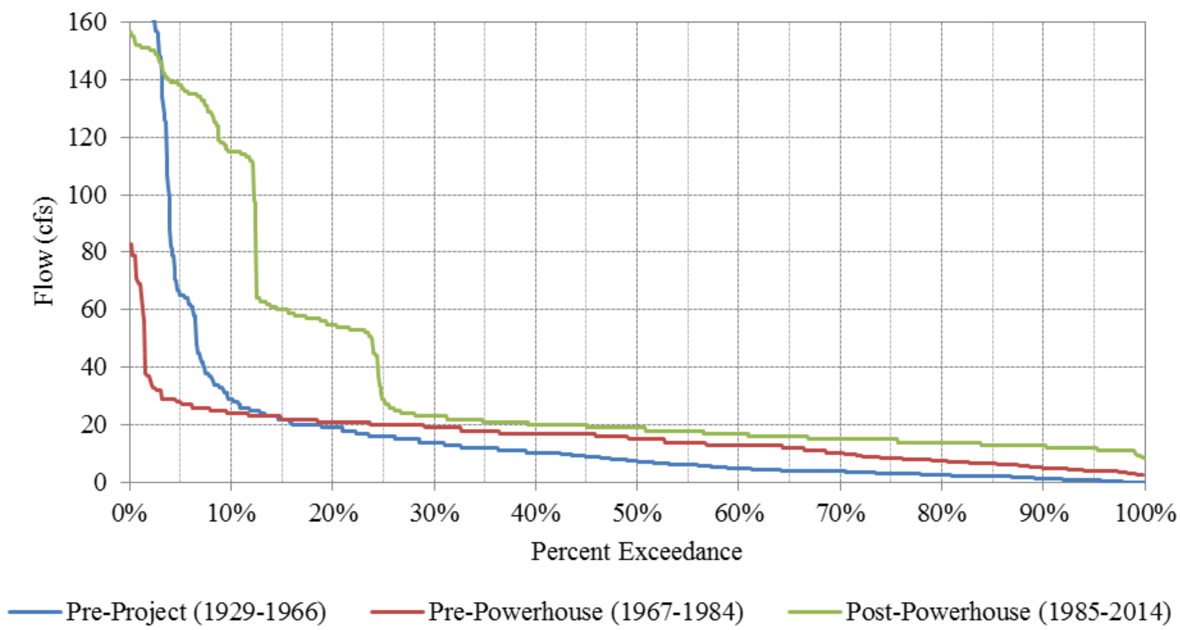

Figure 3.2.2-10. Flow exceedance of historical mean-daily streamflow at the Wheatland gage for pre-Project (WYs 1929-1966) and with-Project (WYs 1967-1984, 1985-2014) time periods – August.

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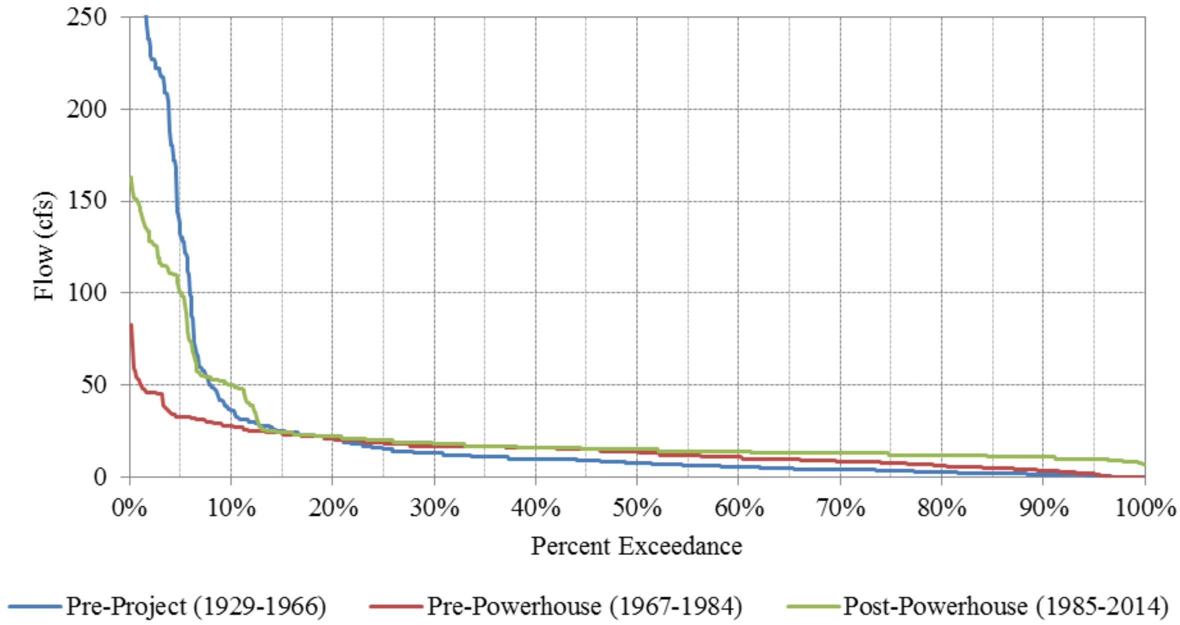

Figure 3.2.2-11. Flow exceedance of historical mean-daily streamflow at the Wheatland gage for pre-Project (WYs 1929-1966) and with-Project (WYs 1967-1984, 1985-2014) time periods – September.

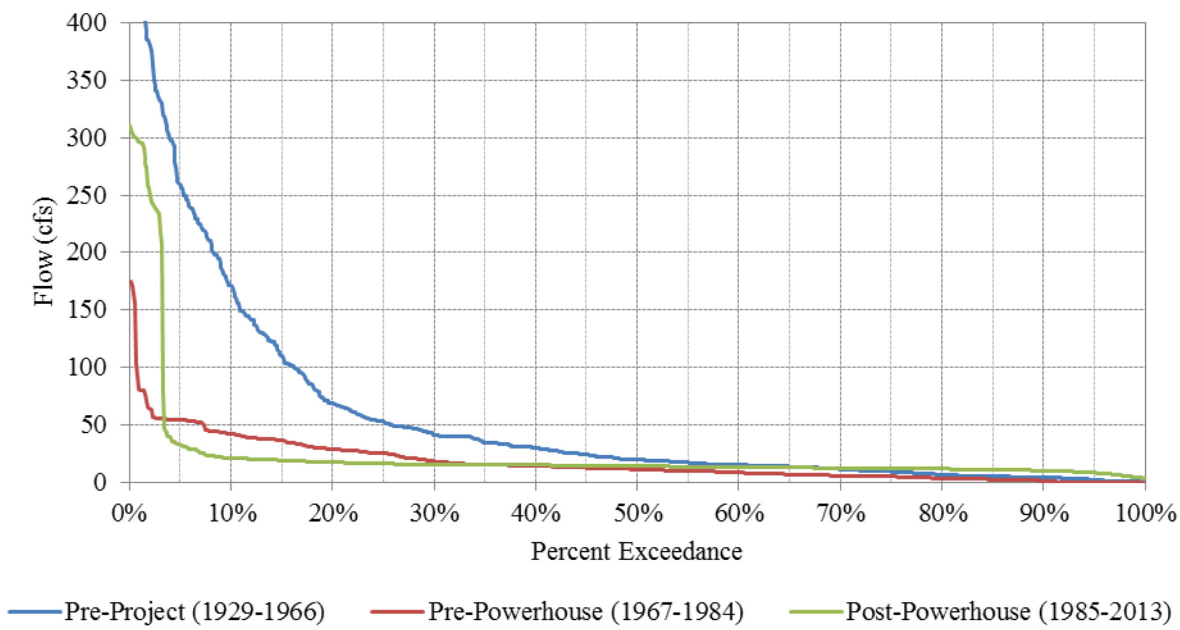

Figure 3.2.2-12. Flow exceedance of historical mean-daily streamflow at the Wheatland gage for pre-Project (WYs 1929-1966) and with-Project (WYs 1967-1984, 1985-2014) time periods – October.

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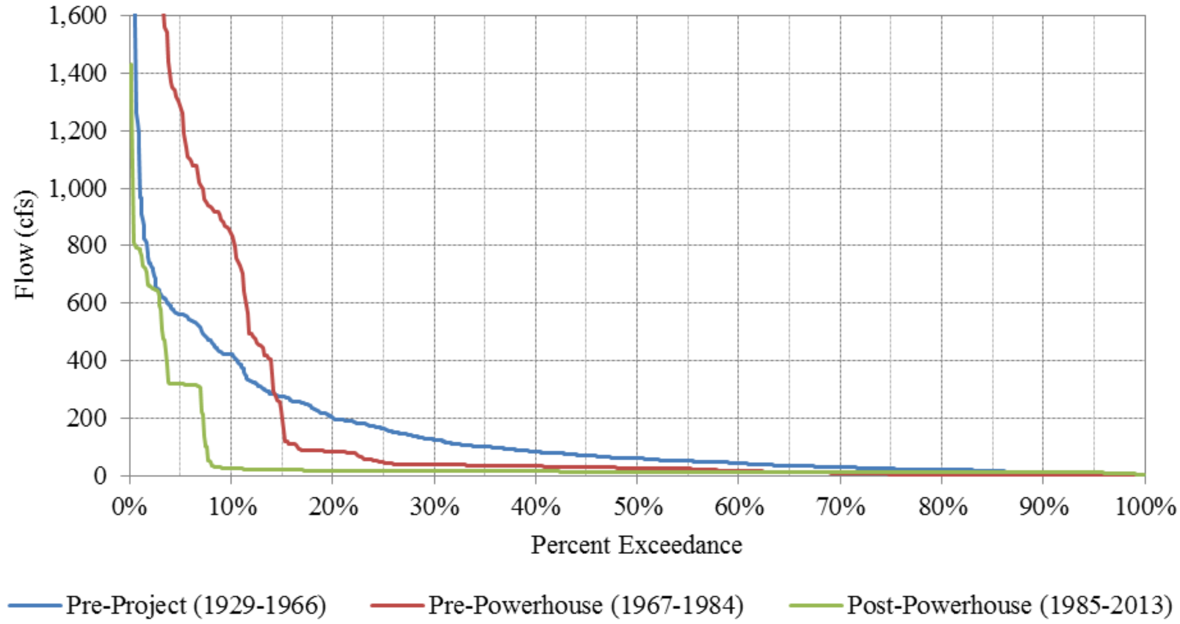

Figure 3.2.2-13. Flow exceedance of historical mean-daily streamflow at the Wheatland gage for pre-Project (WYs 1929-1966) and with-Project (WYs 1967-1984, 1985-2014) time periods – November.

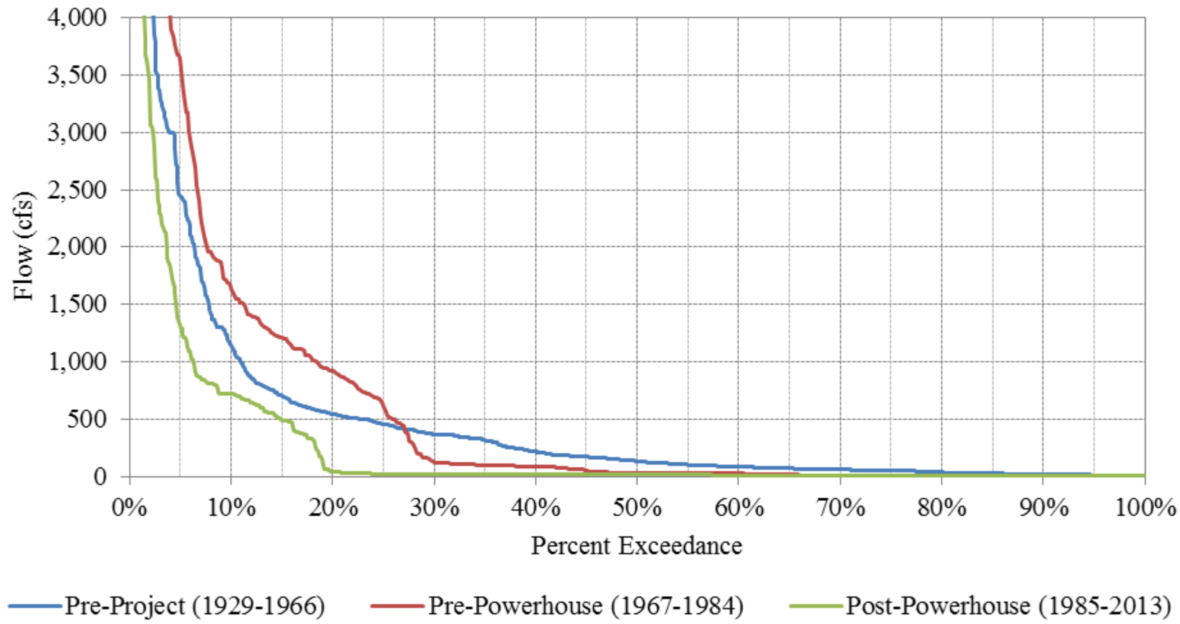

Figure 3.2.2-14. Flow exceedance of historical mean-daily streamflow at the Wheatland gage for pre-Project (WYs 1929-1966) and with-Project (WYs 1967-1984, 1985-2014) time periods – December.

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A direct comparison of mean monthly flows at the Wheatland gage between the three time periods is provided in Figure 3.2.2-15. The pre-powerhouse period experienced more basin runoff than the pre-powerhouse period, while the post-powerhouse period had less. A comparison of mean annual precipitation at Gold Run, CA for the two periods shows the pre-powerhouse period was wetter than the post-powerhouse period.[3] The post-powerhouse period was also subject to increased out-of-basin water deliveries upstream of the Project.[4]

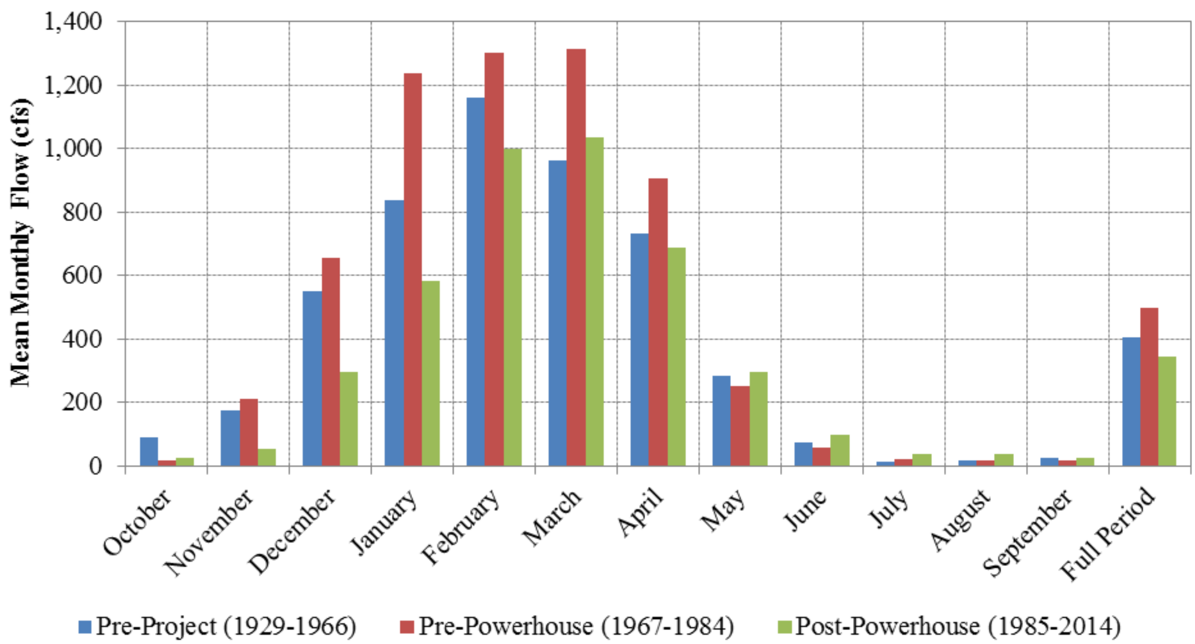

Figure 3.2.2-15. Mean monthly flows at the Wheatland gage for pre-Project (WYs 1929-1967) and with-Project (WYs 1967-1984, 1985-2014) time periods.

Project period flows are generally higher than pre-Project period flows in July through September (Figures 3.2.2-9 through 3.2.2-11). Releases from Camp Far West in these months are typically made to meet minimum instream flow requirements downstream of the dam, which tend to be higher than natural flow.

Project period flows are generally lower than pre-Project period flows in October through December (Figures 3.2.2-12 through 3.2.2-14). The majority of pre-season rainfall runoff is captured by Project and non-Project reservoir upstream. Releases from Camp Far West Dam in these months are typically made to meet minimum instream flow requirements downstream of the dam, except in the wettest of years.

As an example of conditions during the rainfall and snowmelt period, Figure 3.2.2-6 shows the exceedance probabilities of mean daily flows for the month of April. This figure shows that the Project period flows in April are similar to the pre-Project period, except during the driest third

[3] Mean annual precipitation at Gold Run, CA was 62.0 inches for the pre-powerhouse period and 50.8 inches for the post-powerhouse period (Western Region Climate Center, http://www.wrcc.dri.edu/cgi-bin/cliMAIN.pl?ca3491).

[4] Bear River diversions occur at PG&E's Bear River Diversion Dam, downstream of Rollins Reservoir, and at NID's Lake Combie.

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of years, when much of the snowmelt runoff is being captured upstream by NID's Rollins Reservoir. The months of January through March also show this trend (Figure 3.3.3-3 through 3.3.3-5). March and April flow exceedances (Figures 3.3.3-5 and 3.3.3-6) show that Project period flows are substantially higher the majority of the time. This is due to the development of storage projects in the Yuba River basin that enhance the ability of upstream diversion facilities to make releases into the Bear River. These projects, through inter-basin diversions, augment the hydrology of the Bear River during the spring months in most years.

Differences in mean daily flow exceedances are not solely related to Project operations; some of the differences in mean daily flow exceedances for January through May between the Project and pre-Project periods are due to hydrologic differences for the three periods.

3.2.2.5.2.3 Project Conditions

This section describes storage in Camp Far West Reservoir and flow conditions at three locations in the Bear River below the Project: 1) through the Camp Far West Hydroelectric Project fish release immediately below the non-Project diversion dam, which does not include spills from the diversion dam; 2) at the USGS gage at Wheatland; and 3) at the CDEC gage at Pleasant Grove.

Camp Far West Reservoir

Camp Far West Reservoir has an estimated useable storage capacity of 92,430 ac-ft at gross pool and has been measured daily at USGS Gage 11423700 from October 1966 to September 1983 and CDEC gage CFW through the present. Historically two different rating curves have been used to convert reservoir stage to reservoir storage. The first curve was used for October 1966 to December 2008, and the second curve was used for January 2009 through the present. Figure 3.2.2-16 shows average monthly storage for the Camp Far West Reservoir using the first curve and Figure 3.2.2-17 shows average monthly storage for the Camp Far West Reservoir using the second curve. The maximum average monthly storage volume of approximately 109,833 ac-ft was recorded in April 1982.

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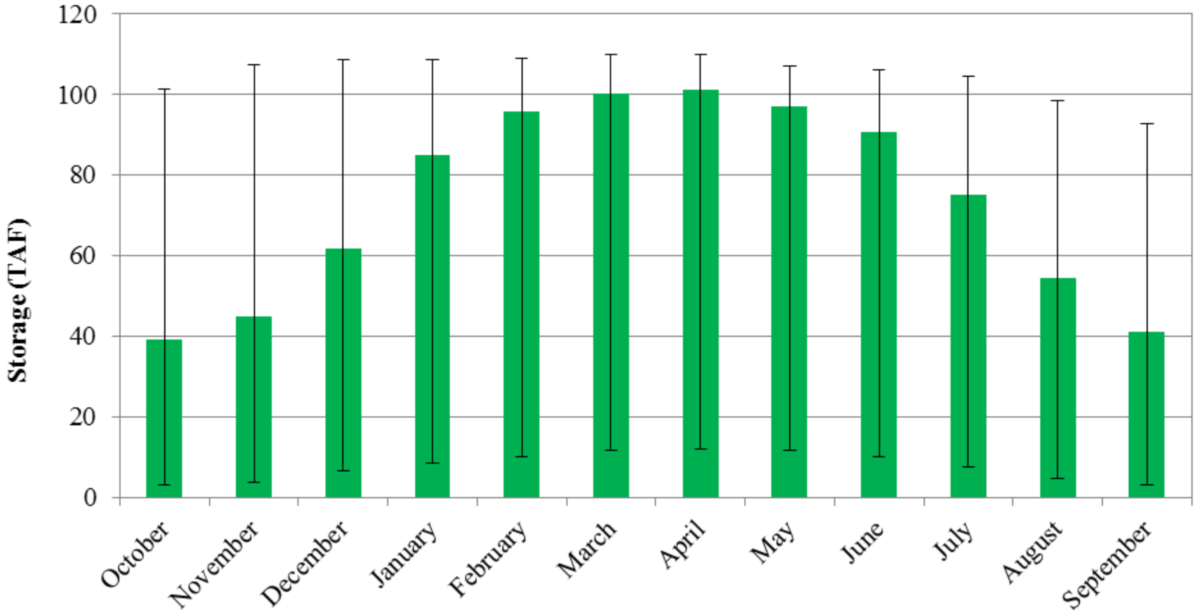

Figure 3.2.2-16. Mean monthly storage for Camp Far West Reservoir (USGS Gage 11423700 and CDEC Gage CFW) from October 1966 through December 2008. The bar shows the values for the 10 percent and 90 percent exceedances.

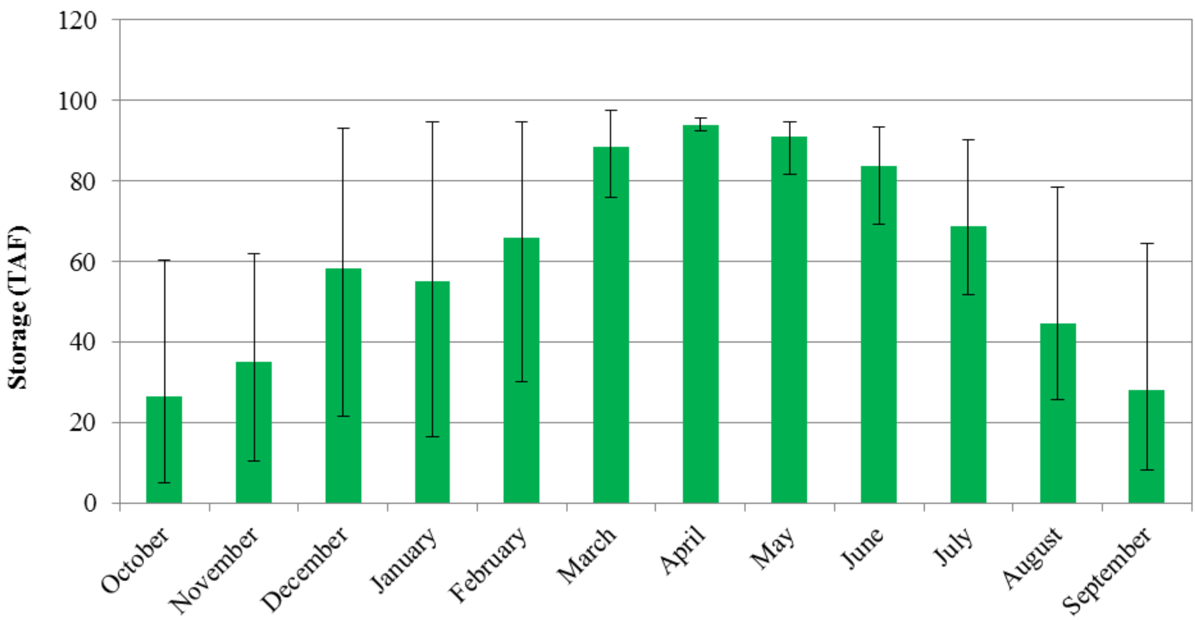

Figure 3.2.2-17. Mean monthly storage for Camp Far West Reservoir (CDEC Gage CFW) from January 2009 through September 2014. The bar shows the values for the 10 percent and 90 percent exceedances.

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Historical daily water-surface elevations for Camp Far West Reservoir are shown per year in Figure 3.2.2-18. Reservoir water level is typically at its highest in January through May, and at its lowest in September through November. The lowest water level since the reservoir first filled, 175.0 ft, occurred on October 5, 1976. The lowest maximum daily storage for the March through June time period, 222.2 ft, occurred on March 2, 1977.

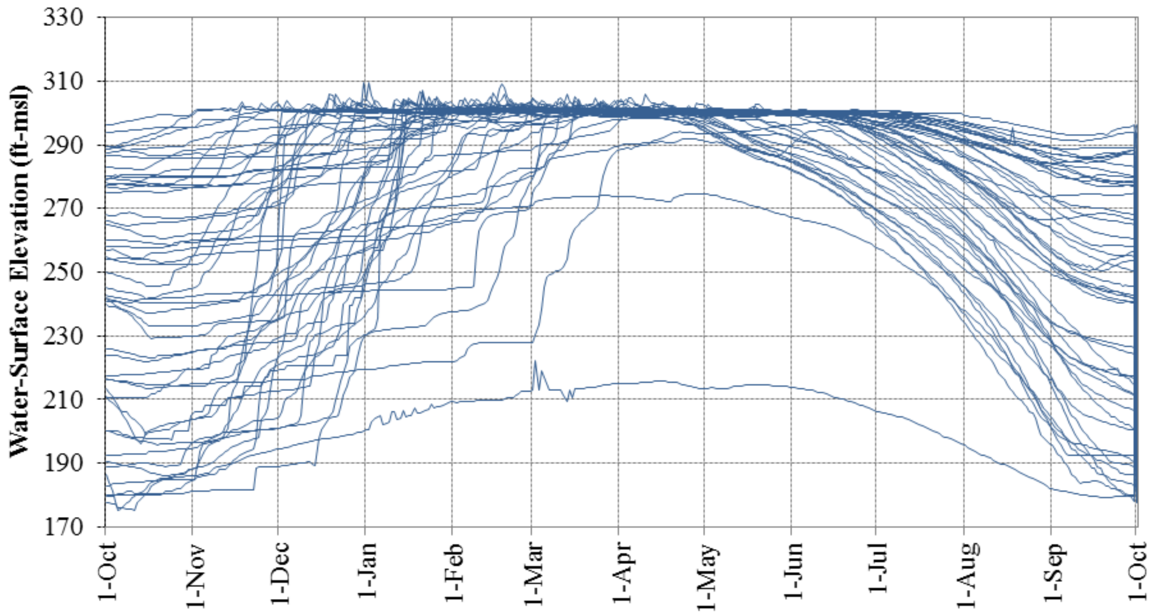

Figure 3.2.2-18. Historical daily water-surface elevation for Camp Far West Reservoir (USGS Gage 11423700 and CDEC Gage CFW), each year from WY 1967 through WY 2014. WY 1977 represents the lowest peak storage during the period of record.

A water-surface elevation exceedance curve for daily Camp Far West Reservoir water level is shown in Figure 3.2.2-19. Daily water level exceeds 301 ft 10 percent of the time during the period of record. Daily water level exceeds 290 ft 50 percent of the time and exceeds 220 ft 90 percent of the time. Reservoir storage is not reported here because two different storage curves were used across the gage period of record, as described above.

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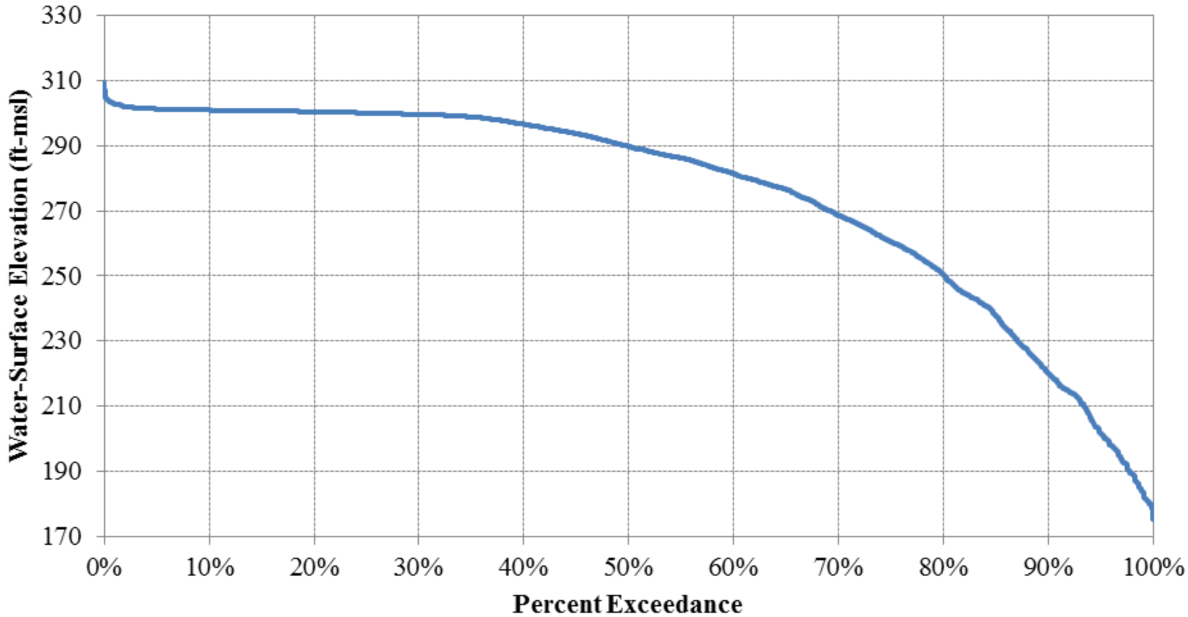

Figure 3.2.2-19. Water-surface elevation exceedance of historical daily water-surface elevation for Camp Far West Reservoir (USGS Gage 11423700 and CDEC Gage CFW) from WY 1967 through WY 2014.

<u>Bear River</u>

The Bear River watershed is primarily rainfall-runoff driven, with heavy snowpack generally only able to accumulate in a small portion of the basin's headwaters. Inflows to the basin are attributed to natural runoff in the basin and diverted water to the Bear River from NID's Jackson Meadows Reservoir and Bowman Lake, and PG&E's Lake Spaulding, all via PG&E's Drum Canal. Diversions out of the watershed upstream of the Project are taken at NID's Bear River Canal Diversion Impoundment and at NID's Lake Combie.

NID's Yuba-Bear Hydroelectric Project and PG&E's Drum-Spaulding Project affect runoff into the Project by storing water in upstream reservoirs. For a discussion of upstream storages and diversions, refer to Sections 3.1.1 and 3.1.2.5.

Camp Far West Reservoir Release to the Bear River

Releases from Camp Far West Reservoir are made to meet minimum instream flow requirements in the Bear River as measured below the non-Project diversion dam as well as water deliveries via the SSWD Conveyance Canal and CFWID North Canal. Reservoir releases are made through the Camp Far West Dam low-level outlet, the powerhouse and/or the spillway. See Sections 2.1.1.3 through 2.1.1.6 for a description of each. Figures 3.2.2-20 through 3.2.2-24 provides mean monthly flows for each of the three release structures at Camp Far West Dam.

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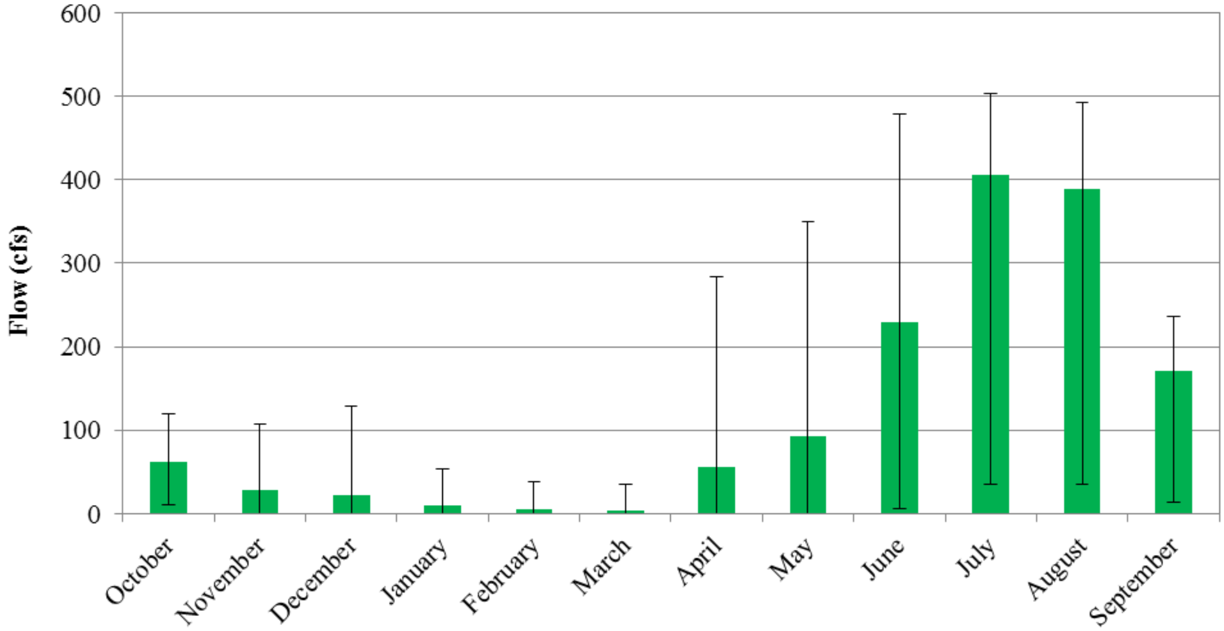

Figure 3.2.2-20. Mean monthly flow release for Camp Far West Reservoir low-level outlet from January 1968 through December 1984. The bar shows the values for the 10 percent and 90 percent exceedances.

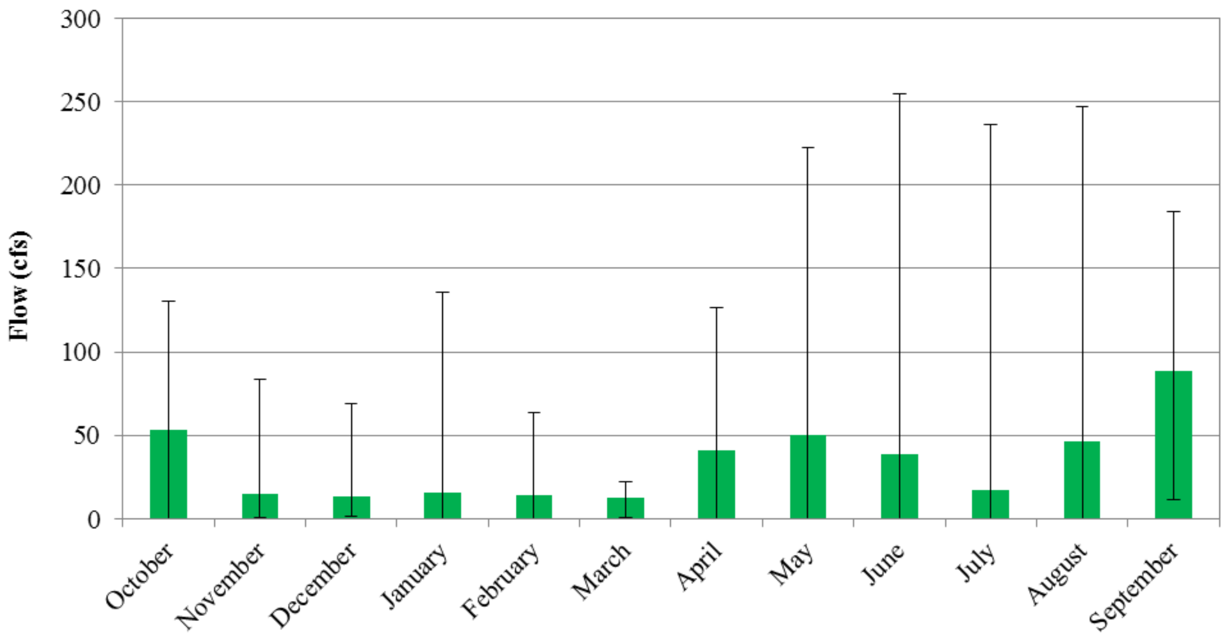

Figure 3.2.2-21. Mean monthly flow release for Camp Far West Reservoir low-level outlet from January 1985 through September 2014. The bar shows the values for the 10 percent and 90 percent exceedances.

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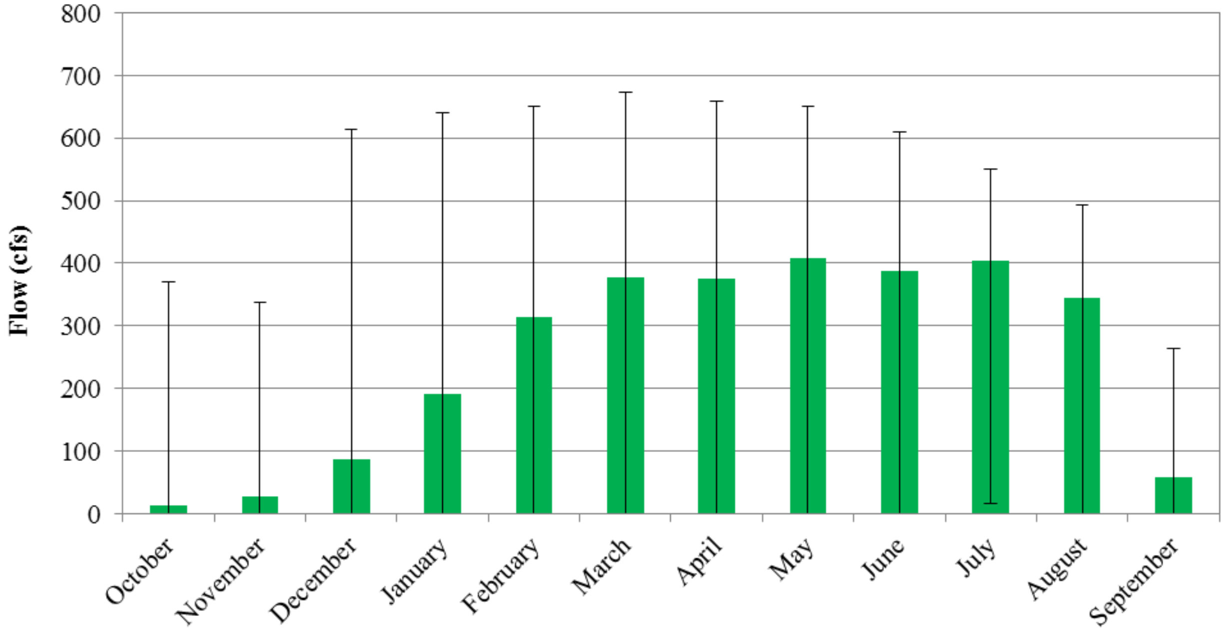

Figure 3.2.2-22. Mean monthly flow release for Camp Far West Reservoir powerhouse from January 1985 through September 2014. The bar shows the values for the 10 percent and 90 percent exceedances.

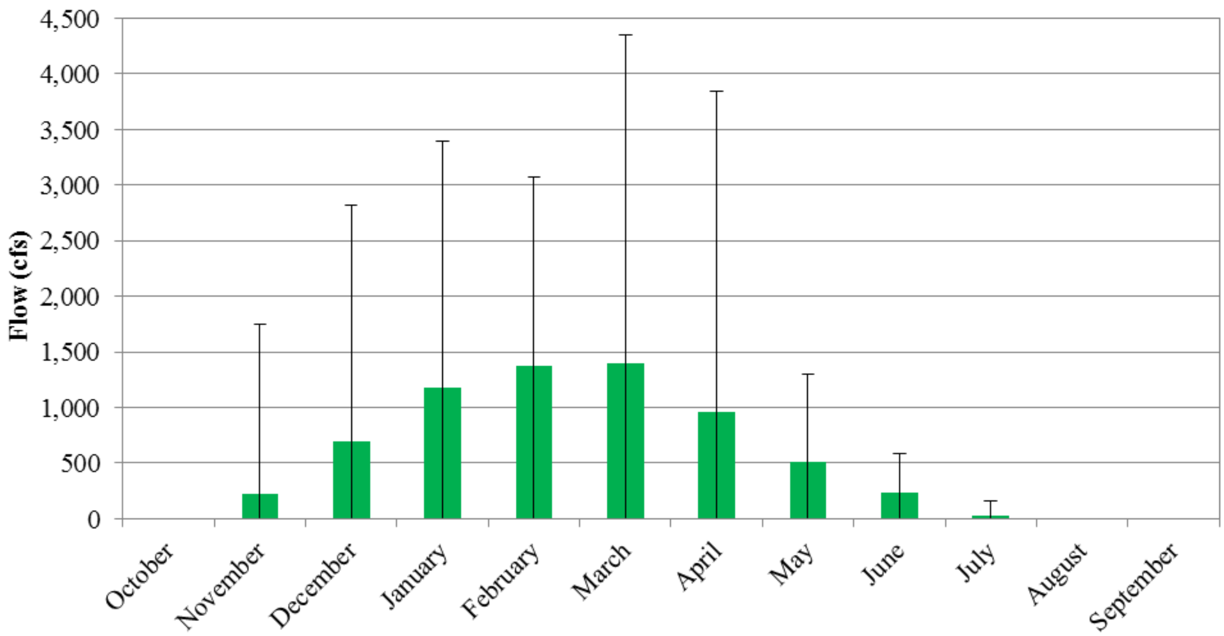

Figure 3.2.2-23. Mean monthly flow release for Camp Far West Reservoir spillway from January 1968 through December 1984. The bar shows the values for the 10 percent and 90 percent exceedances.

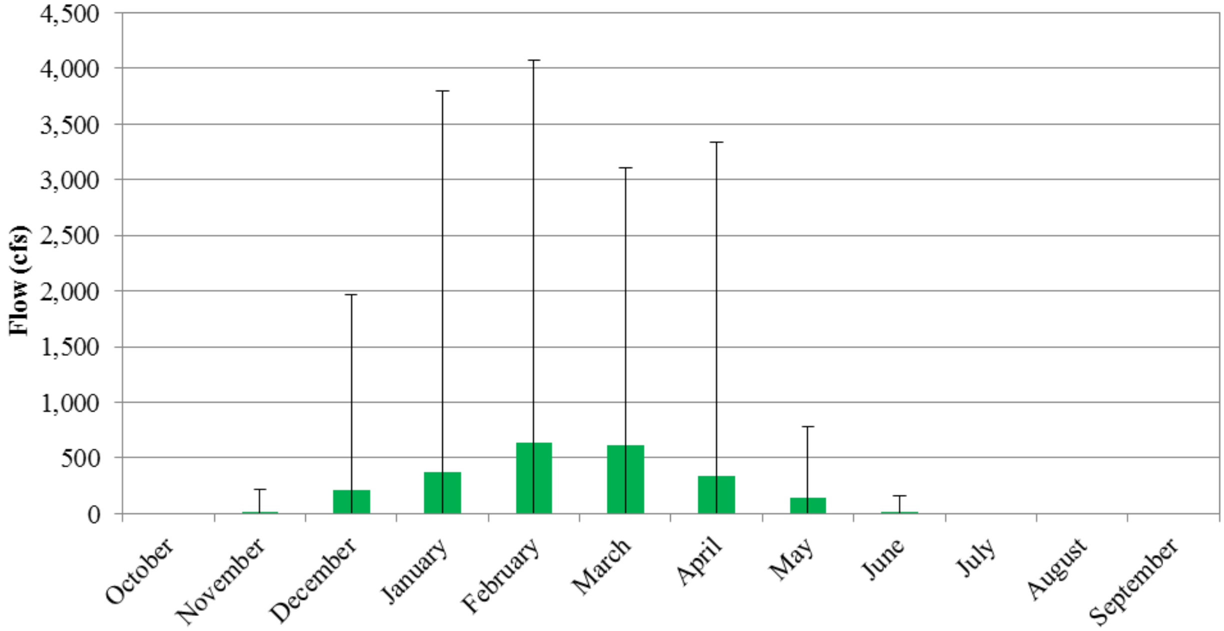

Figure 3.2.2-24. Mean monthly flow release for Camp Far West Reservoir spillway from January 1985 through September 2014. The bar shows the values for the 10 percent and 90 percent exceedances.

Downstream of Camp Far West Dam, the SSWD Conveyance Canal has the capacity to divert up to 500 cfs, and the CFWID North Canal has the capacity to divert up to 40 cfs.

Bear River Fish Release below Camp Far West Reservoir

License-required minimum flow releases are characterized by flows at the fish release gage (USGS 11423800), which is located at a structure off the non-Project diversion dam into the SSWD Conveyance Canal at the south edge of the diversion dam, approximately 1.2 mi downstream of Camp Far West Reservoir. The gage is a low-flow gage and does not measure spill from the non-Project diversion dam. The fish flow gage has been in active operation since October 1989.

Figure 3.2.2-25 shows average monthly flow as measured by the fish release. The maximum monthly average flow, approximately 36 cfs, was recorded in May 2010.

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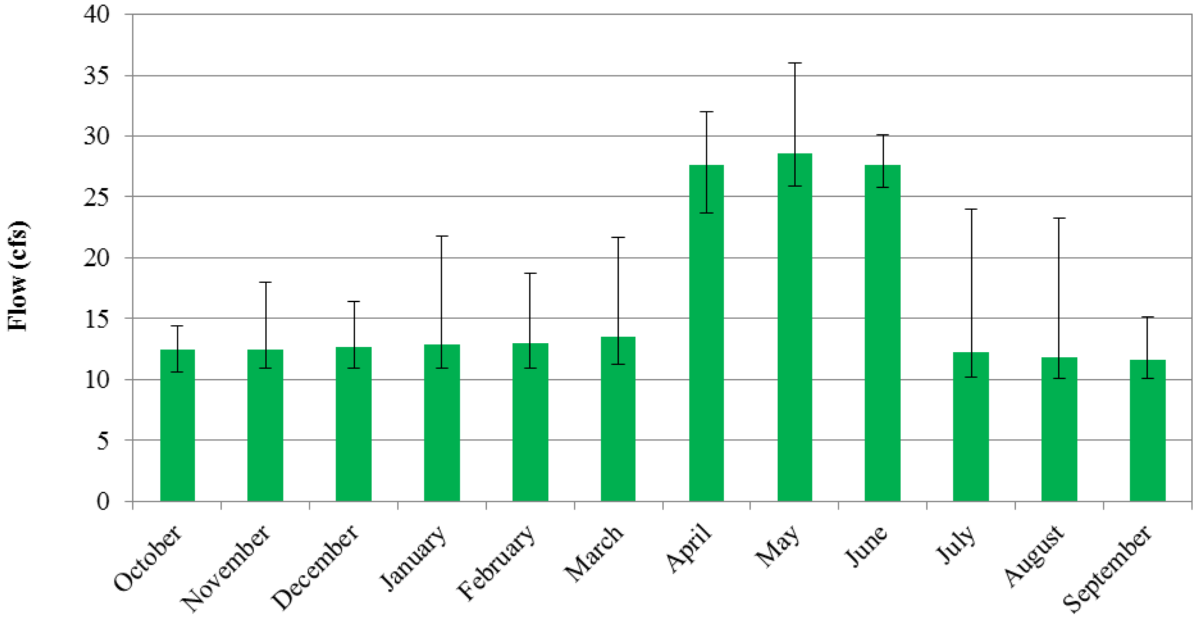

Figure 3.2.2-25. Mean monthly flow release through the Camp Far West Reservoir fish release gage (USGS Gage 11423800) from WY 1990 through WY 2014. The bar shows the values for the 10 percent and 90 percent exceedances.

Figure 3.2.2-26 shows the historical mean daily flows through the fish release. The maximum daily average flow, approximately 43 cfs, was recorded on December 4, 1994.

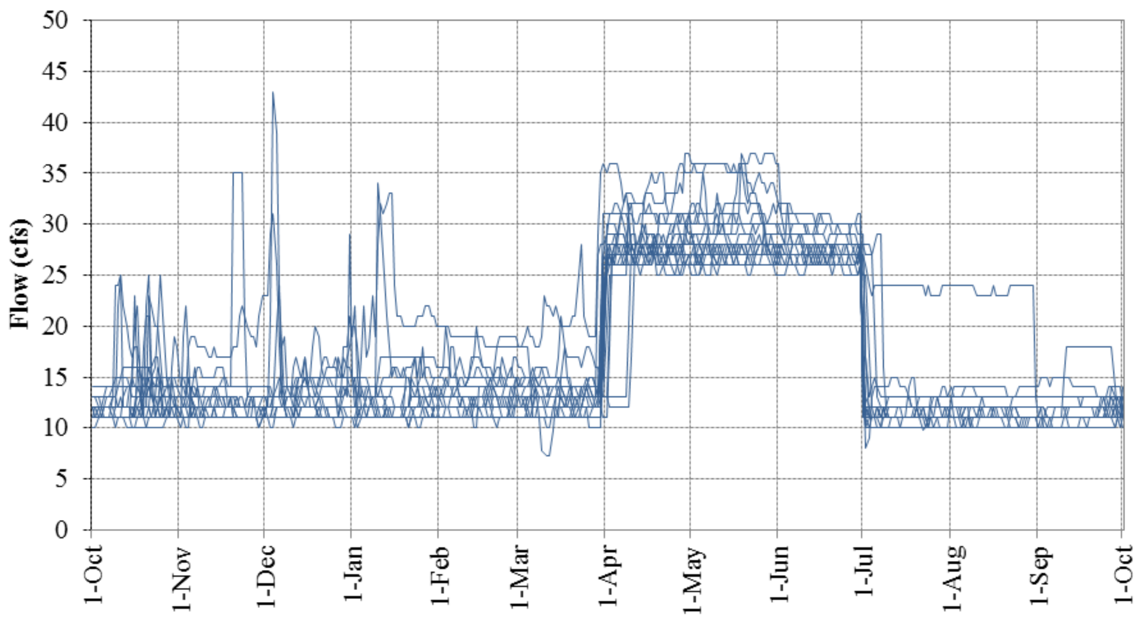

Figure 3.2.2-26. Historical mean daily flow each year for the Camp Far West Hydroelectric Project fish release gage (USGS Gage 11423800) from WY 1990 through WY 2014.

A flow exceedance curve for the Bear River fish release is shown in Figure 3.2.2-27. The gage measures license-required minimum flows, but does not measure spill from the non-Project diversion dam. Daily flow exceeds 28 cfs 10 percent of the time during the period of record. Daily flow exceeds 12 cfs 50 percent of the time and exceeds 11 cfs 90 percent of the time.

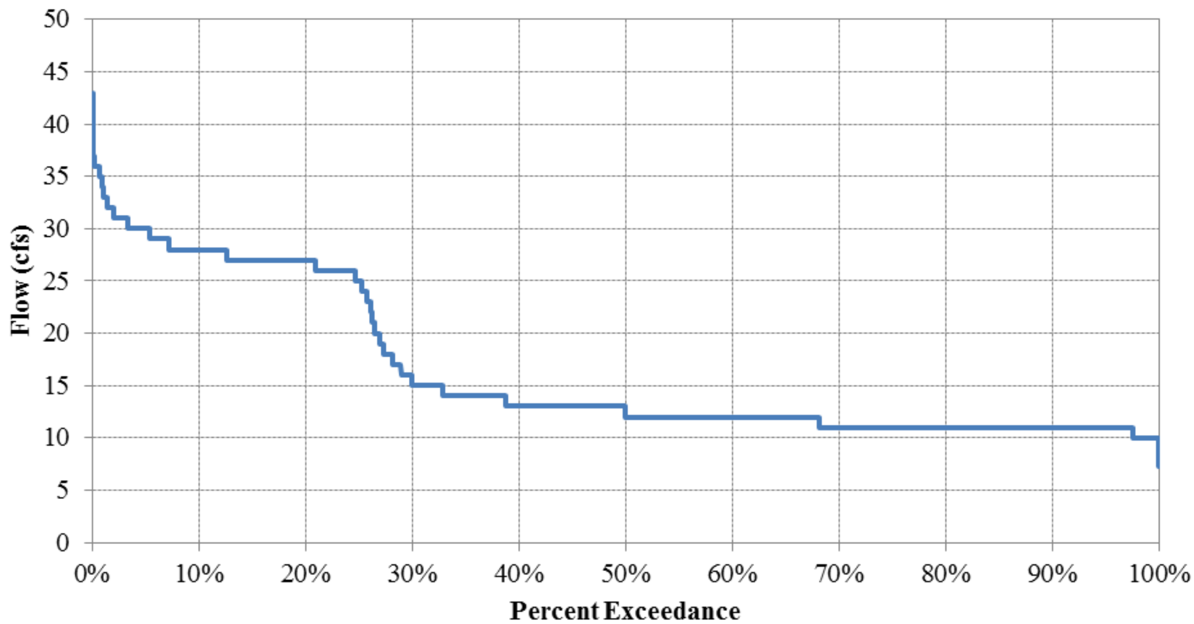

Figure 3.2.2-27. Flow exceedance of historical mean daily streamflow for the Bear River fish release below Camp Far West Reservoir gage (USGS Gage 11423800) from WY 1990 through WY 2014.

Bear River near Wheatland

The primary full-flow-rated gage used for flow characterization in the lower Bear River is the Wheatland gage (USGS 11424000), located approximately 6.5 mi downstream of Camp Far West Dam, and reflects releases from Camp Far West Reservoir through the powerhouse, low-level outlet and spills over Camp Far West Dam less diversions from the non-Project diversion dam and CFWID's diversion. The Wheatland gage has been in active operation since October 1928. Figure 3.2.2-28 shows average monthly streamflow for the Bear River near Wheatland gage for WYs 1967 through 2014. Maximum monthly flows in the Bear River are significantly higher than monthly averages because they typically represent significant precipitation events. The maximum monthly average streamflow, approximately 5,201 cfs, was recorded in February 1986.

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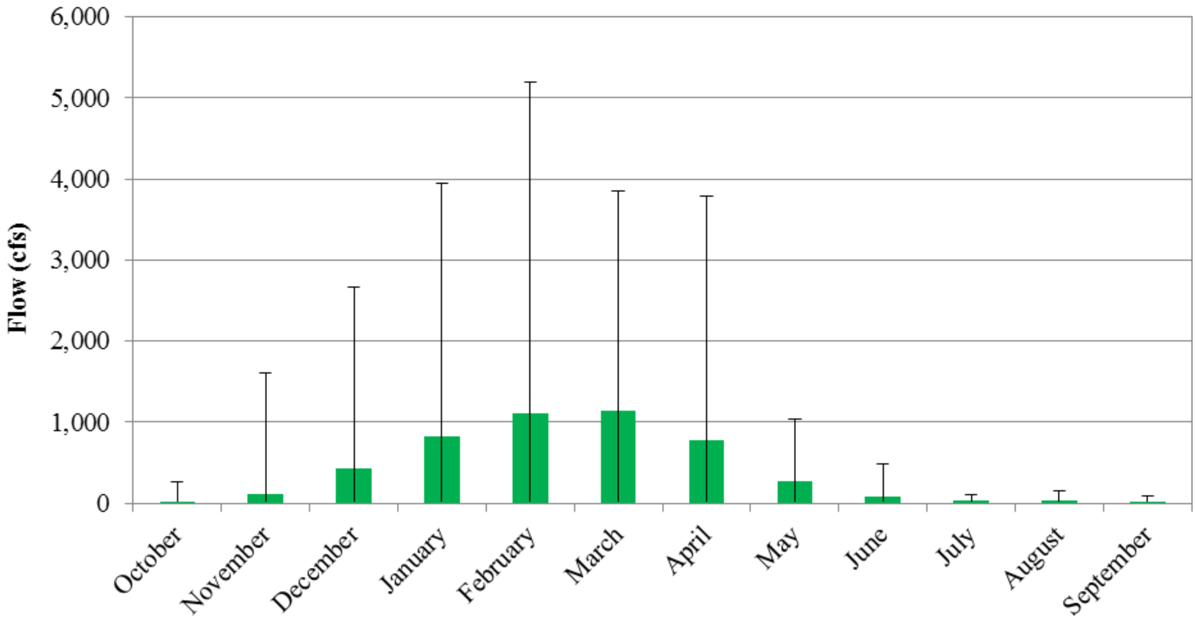

Figure 3.2.2-28. Mean monthly streamflow for the Bear River near Wheatland gage (USGS Gage 11424000) from WY 1967 through WY 2014. The bar shows the values for the 10 percent and 90 percent exceedances.

Figure 3.2.2-29 shows the historical mean daily streamflows on the Bear River near Wheatland. The maximum daily average streamflow, approximately 35,900 cfs, was recorded on February 17, 1986. The only other event in excess of 25,000 cfs was recorded on January 2, 1997.

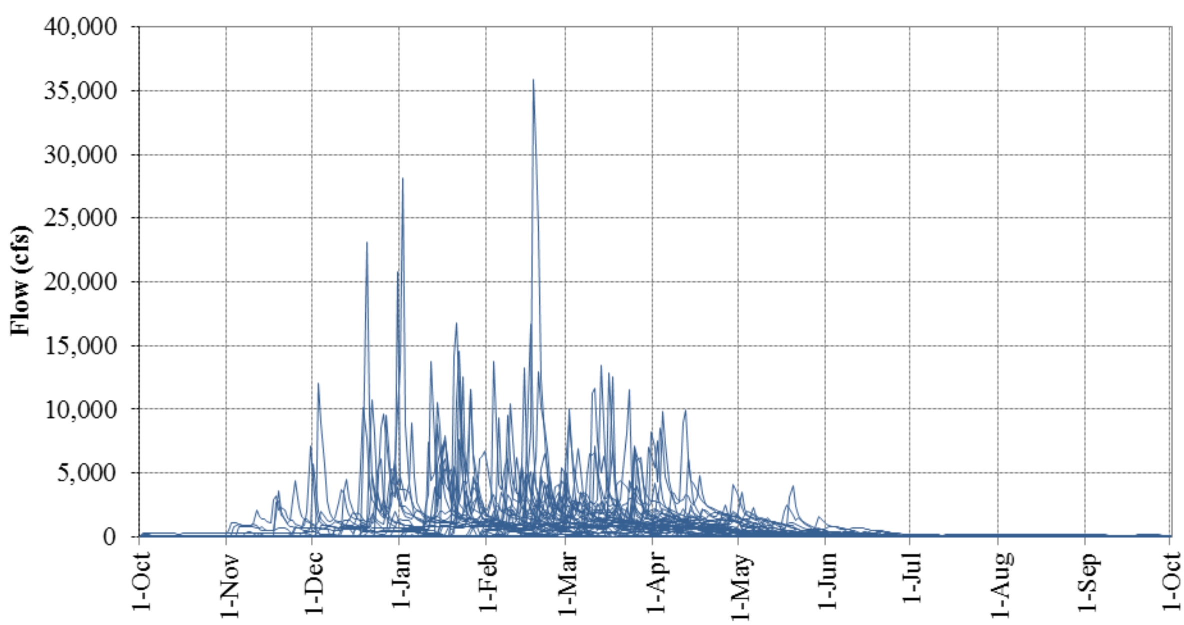

Figure 3.2.2-29. Historical mean daily streamflow each year for the Bear River near Wheatland gage (USGS Gage 11424000) from WY 1967 through WY 2014.

A flow exceedance curve for the Bear River near Wheatland is shown in Figure 3.2.2-30. Ten percent of mean daily flows during the period of record exceed 1,180 cfs; however the majority of flows are much lower. Fifty percent of mean daily flows exceed 24 cfs, and 90 percent of mean daily flows exceed 10 cfs.

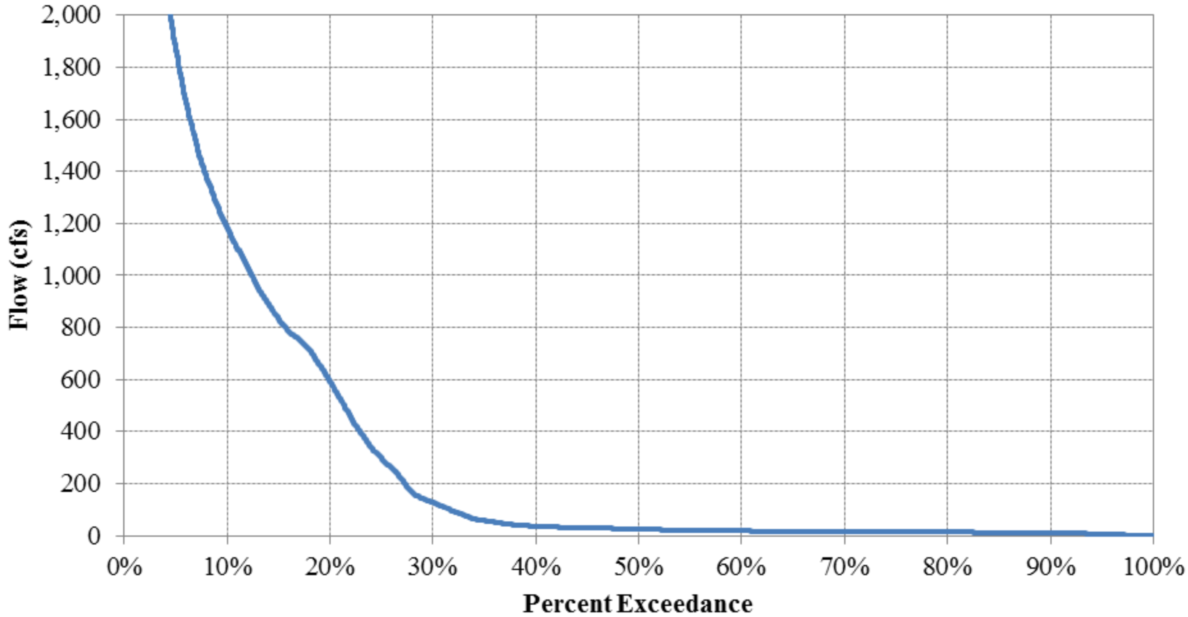

Figure 3.2.2-30. Flow exceedance of historical mean daily streamflow for the Bear River near Wheatland gage (USGS Gage 11424000) from WY 1967 through WY 2014.

Bear River near Pleasant Grove

At the lower end of the Bear River, the Pleasant Grove Gage (CDEC BPG) has measured Bear River flows approximately 6.8 mi upstream of its confluence with the Feather River since January 2006, following the early January high flow event that took place on the Bear River in that year. Flows at Pleasant Grove reflect upstream (Wheatland) flows and accretions or depletions that occur along the lower Bear River.

Figure 3.2.2-31 shows average monthly streamflow for the Bear River at Pleasant Grove. The maximum monthly average streamflow, approximately 3,711 cfs, was recorded in March 2011.

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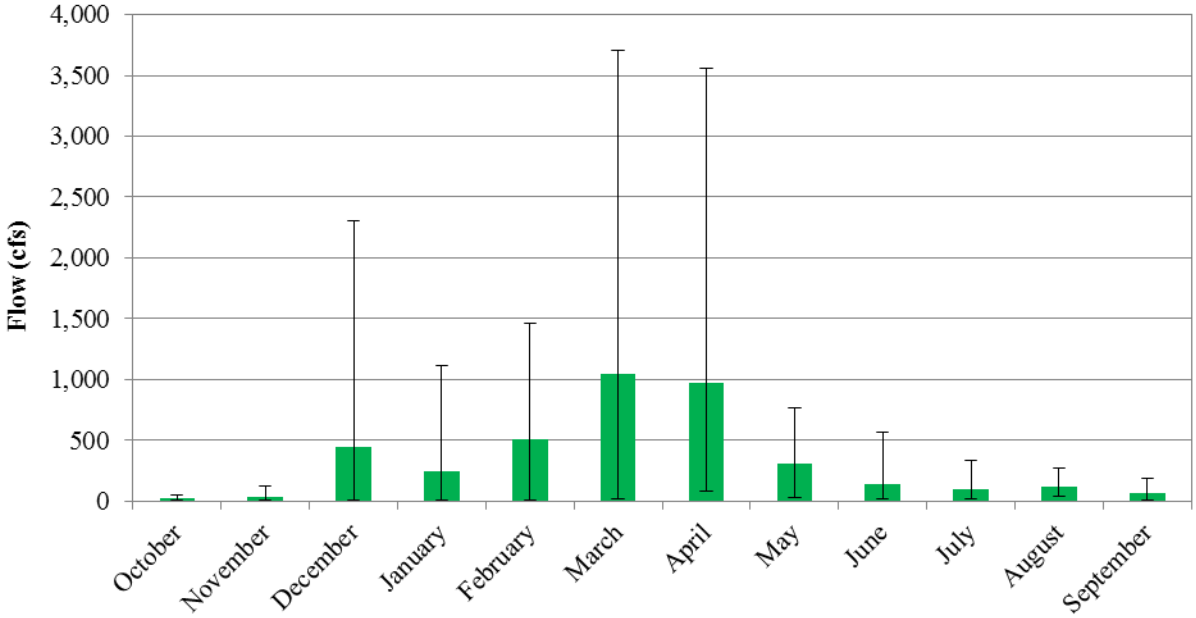

Figure 3.2.2-31. Average monthly streamflow for the Bear River at Pleasant Grove (CDEC Gage BPG) from WY 2007 through WY 2014. The bar shows the values for the 10 percent and 90 percent exceedances.

Historical mean daily streamflows per year in the Bear River at Pleasant Grove are shown in Figure 3.2.2-32. The maximum daily average streamflow, approximately 11,158 cfs, was recorded on March 17, 2012.

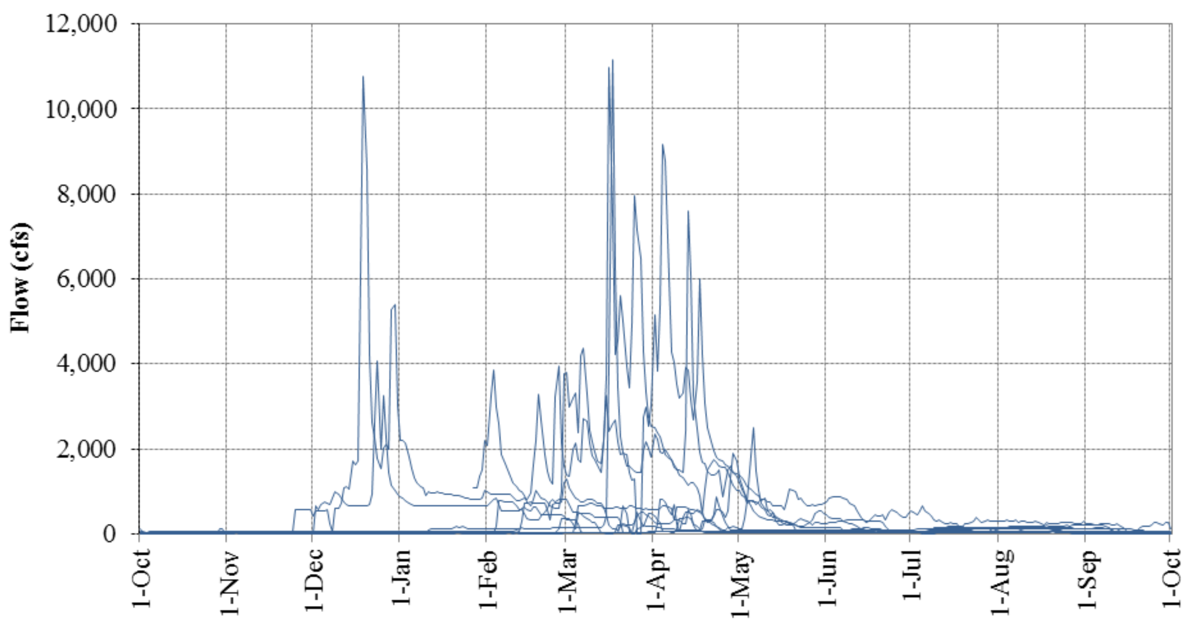

Figure 3.2.2-32. Historical mean daily streamflow each year for the Bear River at Pleasant Grove (CDEC Gage BPG) from WY 2007 through WY 2014.

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A flow exceedance curve for the Bear River at Pleasant Grove is shown in Figure 3.2.2-33. Ten percent of mean daily flows during the period of record exceed 826 cfs. Fifty percent of mean daily flows exceed 53 cfs, and 90 percent of mean daily flows exceed 9 cfs.

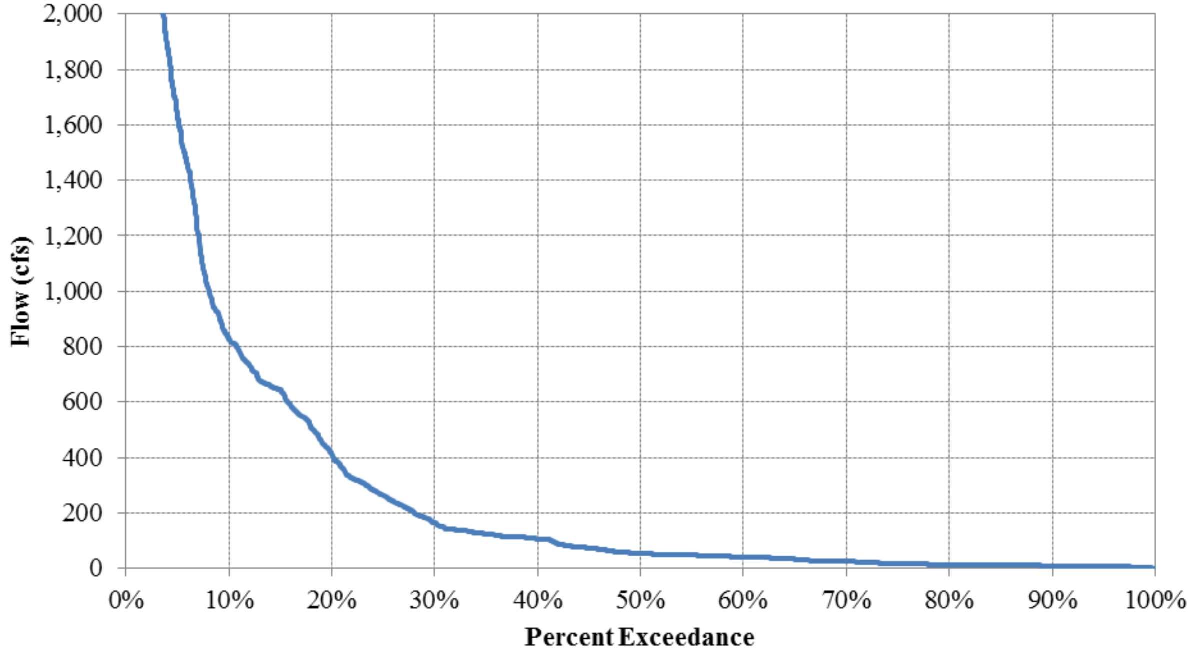

Figure 3.2.2-33. Flow exceedance of historical mean daily streamflow for the Bear River at Pleasant Grove from WY 2007 through WY 2014.

3.2.2.6 Existing Designated Beneficial Uses

As described in Section 3.1.5, Basin Plan water quality standards "consist of the designated uses of the navigable waters involved and the water quality criteria for such waters based upon such uses." [33 USC § 1313(C) (2) (A)]. Section 3.1.5 described the designated Beneficial Uses of water in the Project Vicinity. These include: 1) municipal and domestic water supply; 2) agricultural water supply (irrigation); 3) industrial service supply (power generation); 4) water contact recreation; 5) non-water contact recreation; 6) warm freshwater habitat; 7) cold freshwater habitat; and 8) wildlife habitat.

3.2.2.7 Existing Water Quality Objectives

Table 3.2.2-5 lists Water Quality Objectives described in the Basin Plan related to the designated Beneficial Uses. This list is not exhaustive and can be modified by the SWRCB to reflect site-specific information.

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Table 3.2.2-5. Basin Plan Water Quality Objectives to support designated Beneficial Uses in the Project Vicinity.

Water Quality Objective	Description
Bacteria	In terms of fecal coliform. Less than a geometric average of 200/100 ml on five samples collected in any 30-day period and less than 400/100 ml on ten percent of all samples taken in a 30-day period.
Biostimulatory Substances	Water shall not contain biostimulatory substances that promote aquatic growth in concentrations that cause nuisance or adversely affect beneficial uses.
Chemical Constituents	Waters shall not contain chemical constituents in concentrations that adversely affect beneficial uses. Specific trace element levels are given for certain surface waters, none of which include the waters in the vicinity of the Project. Electrical conductivity (at 77 ºF) shall not exceed 150 micromhos (µmhos)/cm (90 percentile) in well-mixed waters of the Feather River from the Fish Barrier Dam at Oroville to Sacramento River. Other limits for organic, inorganic and trace metals are provided for surface waters that are designated for domestic or municipal water supply. In addition, waters designated for municipal or domestic use must comply with portions of Title 22 of the California Code of Regulations. For protection of aquatic life, surface water in California must also comply with the California Toxics Rule (40 C.F.R. Part 131).
Color	Water shall be free of discoloration that causes a nuisance or adversely affects beneficial uses.
Dissolved Oxygen (DO)	Monthly median of the average daily dissolved oxygen concentration shall not fall below 85 percent of saturation in the main water mass, and the 95 percent concentration shall not fall below 75 percent of saturation. Minimum level of 7 mg/L. Specific DO water quality objectives below Oroville dam are 8.0 mg/L from September 1 to May 31, for Feather River from Fish Barrier Dam at Oroville to Honcut Creek (surface water body #40). When natural conditions lower dissolved oxygen below this level, the concentrations shall be maintained at or above 95 percent of saturation.
Floating Material	Water shall not contain floating material in amounts that cause a nuisance or adversely affect beneficial uses.
Oil & Grease	Water shall not contain oils, greases, waxes or other material in concentrations that cause a nuisance, result in visible film or coating on the surface of the water or on objects in the water, or otherwise adversely affect beneficial uses.
PH	The pH of surface waters will remain between 6.5 and 8.5, and cause changes of less than 0.5 in receiving water bodies.
Pesticides	Waters shall not contain pesticides or a combination of pesticides in concentrations that adversely affect beneficial uses. Other limits established as well.
Radioactivity	Radionuclides shall not be present in concentrations that are harmful to human, plant, animal or aquatic life nor that result in the accumulation of radionuclides in the food web to an extent that presents a hazard to human, plant, animal or aquatic life.
Sediment	The suspended sediment load and suspended-sediment discharge rate of surface waters shall not be altered in such a manner as to cause a nuisance or adversely affect beneficial uses.
Settleable Material	Waters shall not contain substances in concentrations that result in the deposition of material that causes a nuisance or adversely affects beneficial uses.
Suspended Material	Waters shall not contain suspended material in concentrations that cause a nuisance or adversely affect beneficial uses.
Tastes and Odor	Water shall not contain taste- or odor-producing substances in concentrations that impart undesirable tastes and odors to domestic or municipal water supplies or to fish flesh or other edible products of aquatic origin, or that cause nuisance, or otherwise adversely affect beneficial uses.
Temperature	The natural receiving water temperature of interstate waters shall not be altered unless it can be demonstrated to the satisfaction of the Regional Water Quality Control Board that such alteration in temperature does not adversely affect beneficial uses. Increases in water temperatures must be less than 5 ºF above natural receiving-water temperature.
Toxicity	All waters shall be maintained free of toxic substances in concentrations that produce detrimental physiological responses in human, plant, animal, or aquatic life. Compliance with this objective will be determined by analyses of indicator organisms, species diversity, population density, growth anomalies, and biotoxicity tests as specified by the CVRWQCB.
Turbidity	In terms of changes in turbidity (NTU) in the receiving water body: where natural turbidity is 0 to 5 NTUs, increases shall not exceed 1 NTU; where 5 to 50 NTUs, increases shall not exceed 20 percent; where 50 to 100 NTUs, increases shall not exceed 10 NTUs; and where natural turbidity is greater than 100 NTUs, increase shall not exceed 10 percent.

Source: CVRWQCB 1998.

Section 303(d) of the CWA requires that every 2 years each State submit to EPA a list of rivers, lakes and reservoirs in the State for which pollution control or requirements have failed to provide for water quality. The CVRWQCB and SWRCB work together to research and update the list for the Central Valley region of California. Based on a review of this list and its

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associated TMDL Priority Schedule, in the Project Vicinity, the Bear River from Combie Lake to Camp Far West Reservoir has been identified by the SWRCB as CWA Section 303(d) State Impaired for mercury. Downstream of the Project, the Bear River has been listed as CWA Section 303(d) State Impaired for mercury, copper, chlorpyrifos and diazinon (SWRCB 2010). The updated report prepared in 2012 has been partially approved by the EPA (June 2015), and includes no changes to the Bear River (SWRCB 2012).

3.2.2.8 Existing and Proposed Water Rights Potentially Affecting or Affected by the Project

Section 3.2.2.8 provides a list of water rights held by SSWD for power generation. Provided below is a description of other existing or proposed water rights potentially affecting or affected by the Project.

3.2.2.8.1 Water Rights Upstream of the Project Area That Affect the Project

Numerous water rights holders divert and store waters upstream of the Project Area. The upstream projects with significant impacts on inflows to the Project include PG&E's Drum-Spaulding Project,[5] NID's Yuba-Bear Hydroelectric Project[6] and NID's Lake Combie. Details on NID's water rights at Lake Combie are provided in Table 3.2.2-6.

Table 3.2.2-6. Summary of non-consumptive water rights held by NID for the purpose of power generation and irrigation.

Priority Date	SWRCB Designation			Source	Amount		Place of Storage or Diversion	Season of		Beneficial Use
	Application	Permit	License		cfs	ac-ft		Diversion	Storage	
11/22/21	2652A	5803	10350	Bear River	--	5,555	Combie Reservoir	--	11/30-6/1	Irrigation
6/3/81	26866	18757	--	Bear River	1,000	--	Combie Reservoir	1/1-12/31	--	Power

NID also holds senior pre-1914 water rights to the Bear River. In August 2015, NID filed an application with the SWRCB for the annual appropriation of 222,000 ac-ft of water from the Bear River, related to the development of a proposed water storage project immediately upstream of Combie Reservoir.[7]

5 Details on Drum-Spaulding Project water rights can be found in PG&E's Pre-Application Document, Section 7.2, dated April 2008.
6 Details on Yuba-Bear Hydroelectric Project water rights can be found in NID's Pre-Application Document, Section 7.2, dated April 2008.
7 Details on NID's proposed water storage project can be found at http://nidwater.com/parker-dam-and-reservoir-project.

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3.2.2.8.2 Water Rights within the Project

3.2.2.8.2.1 SSWD's Water Right for Power (No Expiration Date)

SSWD holds a post-1914 appropriative water right for the purposes of operating the Project for hydroelectric power generation. Table 3.2.2-7 provides SWRCB designations and the key terms of the post-1914 appropriative water-right permit held by SSWD for power use.

Table 3.2.2-7. Water right permit held by SSWD for operation of the Camp Far West Hydroelectric Project for power generation.

Priority (date)	SWRCB Designation (application)	SWRCB Designation (permit)	SWRCB Designation (license)	Source (Waterbody)	Amount & Place of Diversion or Storage & Season (amount & place)	Place of Use (powerhouse)
1/4/80	26162	18360	Not Issued Yet	Bear River	725 cfs Direct Diversion from 1/1 – 12/31	Camp Far West Dam Powerhouse
					103,100 ac-ft Storage from 10/1 – 6/30	

For the protection of fish and wildlife, SSWD's Permit 18360 identifies a minimum required release of 25 cfs during April 1 through June 30 and 10 cfs from July 1 through March 31. If the total inflow to Camp Far West Reservoir is less than the designated amount for a given period, SSWD shall bypass that quantity.

The time to complete beneficial use for Permit 18360 expired on December 1, 1995. SSWD submitted a request for licensing of Permit 18360 to the SWRCB Division of Water Rights on September 9, 1997 which is still pending.

SSWD operates the Project consistent with the terms and conditions of the above water right.

3.2.2.8.2.2 Water Supply Deliveries from the Bear River to SSWD's Service Area (No Expiration Date)

SSWD makes water deliveries from the Bear River and several small tributaries to its members within its service area consistent with SSWD's consumptive use water rights. Table 3.3.2-8 lists SSWD's post-1914 appropriative water-right licenses and permit for irrigation and domestic uses.

Table 3.2.2-8. Water rights held by SSWD for delivery to SSWD's members within its service area for irrigation and domestic uses.

Priority (date)	SWRCB Designation (application)	SWRCB Designation (license)	Source (Waterbody)	Purpose of Use	Amount & Place of Diversion or Storage (amount & place)	Season (period)	Place of Beneficial Use
6/13/41	10221	11120	Bear River	Irrigation, Domestic and Incidental Power[2]	250 cfs Direct Diversion	from 3/1 – 6/30 and from 9/1 – 10/31	59,000 ac within SSWD and 4,180 ac within CFWID
					40,000 ac-ft Storage	from 10/1 – 6/30	

Table 3.2.2-8. (continued)

Priority (date)	SWRCB Designation (application)	SWRCB Designation (license)	Source (Waterbody)	Purpose of Use	Amount & Place of Diversion or Storage (amount & place)	Season (period)	Place of Beneficial Use
5/2/52[1]	14804	11118	Bear River	Irrigation, Domestic and Incidental Power	330 cfs Direct Diversion	from 5/1 – 9/1	59,000 ac within SSWD and 4,180 ac within CFWID
					58,370 ac-ft Storage	from 10/1 – 6/30	
8/16/51	14430	4653	Coon Creek	Irrigation	2 cfs Direct Diversion	from 4/1 – 11/1	80 ac
4/12/65	22102	11121	East Side Canal, Coon Creek, Markham Ravine, and Auburn Ravine	Irrigation	40.3 cfs Direct Diversion 4,769 ac-ft per annum	from 4/1 – 6/1 and 9/1 – 10/31	4,000 ac
8/11/71	23838	12587	Yankee Slough	Irrigation	1.35 cfs Direct Diversion 143 ac-ft per annum	from 4/1 – 6/1 and 9/1 – 9/30	235 ac

[1] SSWD received a release from priority from Applications 5633 and 5634 for Application 14804.
[2] Incidental Power is identified as a purpose of use for Applications 10221 and 14804. The powerhouse listed in the place of use for these applications is a hydroelectric facility located along SSWD's main canal.

SSWD delivers this water from the Bear River via its Conveyance Canal, which is located on the Bear River about 1.2 mi downstream of Camp Far West Dam.

Identical to the required fish release for SSWD's power permit, Applications 10221 and 14804 identify a minimum required release of 25 cfs during April 1 through June 30 and 10 cfs from July 1 through March 31. If the total inflow to Camp Far West Reservoir is less than the designated amount for a given period, SSWD shall bypass that quantity. These required fish releases are not additive.

SSWD and CFWID entered into an Agreement in 1957 (and Supplemental Agreement in 1973) relative to the construction and subsequent enlargement of Camp Far West Reservoir. Under the Agreement SSWD provides CFWID 13,000 ac-ft of water from the Reservoir each year to satisfy CFWID's senior water rights along the Bear River.

In February 2000, SSWD, DWR and the CFWID entered into the Bear Agreement (DWR, SSWD and CFWID 2000) to settle the responsibilities of SSWD, CFWID, and all other Bear River water rights, to implement the objectives in the *Water Quality Control Plan for the San Francisco Bay/ Sacramento-San Joaquin Delta Estuary* adopted May 22, 1995 (1995 Bay-Delta Plan).

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To incorporate this agreement into SSWD's water rights, in July 2000 the SWRCB issued Order 2000-10 that amended SSWD's Water Right Licenses 11120 and 11118 to provide that:

> During releases of water in connection with the change of purpose of use and place of use of up to 4,400 acre-ft transferred to DWR during dry and critical years,[8] Licensee shall increase flows in the lower Bear River by no more than 37 cfs from July through September. To avoid stranding impacts to anadromous fish in the Bear River below Camp Far West Reservoir, Licensee shall, by the end of a release period from the reservoir in connection with said change, ramp down flows from the reservoir at a rate not to exceed 25 cfs over a 24-hour period.

The required flow volume is in addition to the minimum flow requirement in the Project license, and is measured immediately downstream of the diversion dam as spill over the diversion dam (i.e., SSWD installs notched boards on the diversion dam and controls the elevation of the diversion dam impoundment to provide the required flow).

SWRCB's Order 2000-10 states that this arrangement would terminate upon the termination of the Bear River Agreement on December 31, 2035, or sooner if the Bear River agreement was terminated sooner.

SSWD operates the Project consistent with the terms and conditions of the above water rights and agreements.

3.2.2.8.3 Water Rights Downstream of the Project Affected by the Project

As previously identified, SSWD and CFWID entered into an Agreement in 1957 (and Supplemental Agreement in 1973) to satisfy CFWID's senior water rights along the Bear River. A summary of CFWID's water rights are provided in Table 3.2.2-9. No other active water rights[9] are identified downstream of Camp Far West Dam along the Bear River.

[8] SWRCB Order 2000-10 states: *"Dry and critical years are defined, for purposes of this order, as set forth on page 23 of the Water Quality Control Plan for the San Francisco Bay/Sacramento-San Joaquin Delta Estuary (Adopted by the SWRCB in May, 1995), except that such years do not include a year in which water storage in Camp Far West Reservoir on April 1 is at or below 33,255 ac-ft ("extreme critical year")."*

[9] An Initial Statement of Water Diversion and Use was filed in 1978 in support of a riparian and pre-1914 water right claim; however, the SWRCB currently lists Statement S009549 as inactive.

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Table 3.2.2-9. Water rights held by CFWID, downstream of Camp Far West Dam.

Priority (date)	SWRCB Designation (application)	SWRCB Designation (license)	Source (Waterbody)	Purpose of Use	Amount & Place of Diversion or Storage (amount & place)	Season (period)	Place of Beneficial Use
4/1/1918	959	385	Bear River	Agricultural Use	13.24 cfs Direct Diversion	from 4/1 to 10/1	A net irrigable area of 4,445 acres within a gross area of 5,045 acres consisting of 4,732 acres within the boundaries of CFWID and 313 acres outside of CFWID
6/13/1922	2881	2266	Bear River	Irrigation	5,000 ac-ft Storage per annum[1]	from 3/1 to 5/1	
2/11/1924	3843	2267	Bear River	Irrigation	11.76 cfs Direct Diversion	from 5/1 to 10/1	
4/28/1941	10190	2740	Bear River	Irrigation	5,000 ac-ft Storage per annum[1]	from 5/1 to 6/1	

[1] The maximum annual quantity diverted under Licenses 2740 and 2266 shall not exceed 5,000 ac-ft per annum.

3.2.2.9 Existing Water Quality Data

SSWD found a considerable amount of water quality information, the most relevant of which was collected from the 1950s to the present. SSWD consulted with and reviewed the following sources of information to prepare the description of water quality in this section:

- SSWD's data
- DWR's Oroville Facilities (FERC No. 2100) relicensing
- USGS' California Water Science Center Investigations
- California Environmental Data Exchange Network Reports
- SWRCB Perennial Streams Assessment

3.2.2.9.1 Water Temperature

Data collected by SSWD in 2015 is the most comprehensive water temperature data available in Camp Far West Reservoir and in the Bear River upstream and downstream of the Project Area. Other water temperature sources described below are spot measurements or short-term recordings.

In 2015, SSWD installed a series of water temperature recorders in order to better understand conditions upstream and downstream of the Project (Table 3.2.2-10). In addition, SSWD began collecting monthly reservoir profiles at three locations (Table 3.2.2-11) in April 2015 in order to monitor changes in reservoir water temperatures. These locations are also shown on the Project Maps in Appendix E.

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Table 3.2.2-10. SSWD water temperature monitoring locations in the Bear River.

Location	River Mile[1]	Installation Date	Latitude	Longitude
UPSTREAM OF PROJECT AREA				
Bear River above Camp Far West	25.1	4/10/15	39.011685	-121.220506
Rock Creek above Camp Far West	--	8/6/15	39.063471	-121.263205
DOWNSTREAM OF PROJECT AREA				
Bear River below Powerhouse Outflow	18.0	4/10/15	39.04898	-121.31841
Bear River below CFW Spillway Channel	17.9	9/30/15	39.04719	-121.31969
Bear River below Diversion Dam	16.9	4/10/15	39.04163	-121.33235
Bear River at BRW gage, Highway 65	11.4	4/10/15	38.99901	-121.40810
Bear River at BPG gage, Pleasant Grove Bridge	7.1	4/10/15	38.98561	-121.48329
Dry Creek above Bear River	--	12/1/15	38.99596	-121.49121
Bear River near Highway 70	3.5	4/10/15	38.97249	-121.54343
Bear River above Feather River Confluence	0.1	4/10/15	38.93906	-121.57831
Feather River below Bear River Confluence	--	4/10/15	38.93802	-121.58038

Table 3.2.2-11. SSWD reservoir water temperature profile locations at Camp Far West.

Location	First Profile Date	Latitude	Longitude
Near Camp Far West Dam	4/9/15	39.05140	-121.31237
Rock Creek Arm of Reservoir	4/9/15	39.05972	-121.29323
Bear River Arm of Reservoir	4/9/15	39.03301	-121.27238

There is a limited amount of historical water temperature data. Much of the data were individual spot readings recorded during fisheries or water quality investigations. In instances where historical data was more robust, it is discussed in the sections below.

3.2.2.9.1.1 Upstream of the Project

SSWD is currently monitoring water temperature at two locations upstream of the Project; in Rock Creek and the Bear River upstream of Camp Far West Reservoir (Table 3.2.2-7). Water temperatures in Rock Creek were fairly consistent during the available monitoring period (August and September 2015) with temperatures ranging between 15 degrees Celsius (°C) and 25°C (Figure 3.2.2-34). Water temperatures in the Bear River above Camp Far West Reservoir (RM 25.1) followed the pattern expected for a lower elevation river with water temperatures around 15°C in April and warming into the upper 20°C and low 30°C during June and July before beginning to cool again (Figure 3.2.2-35).

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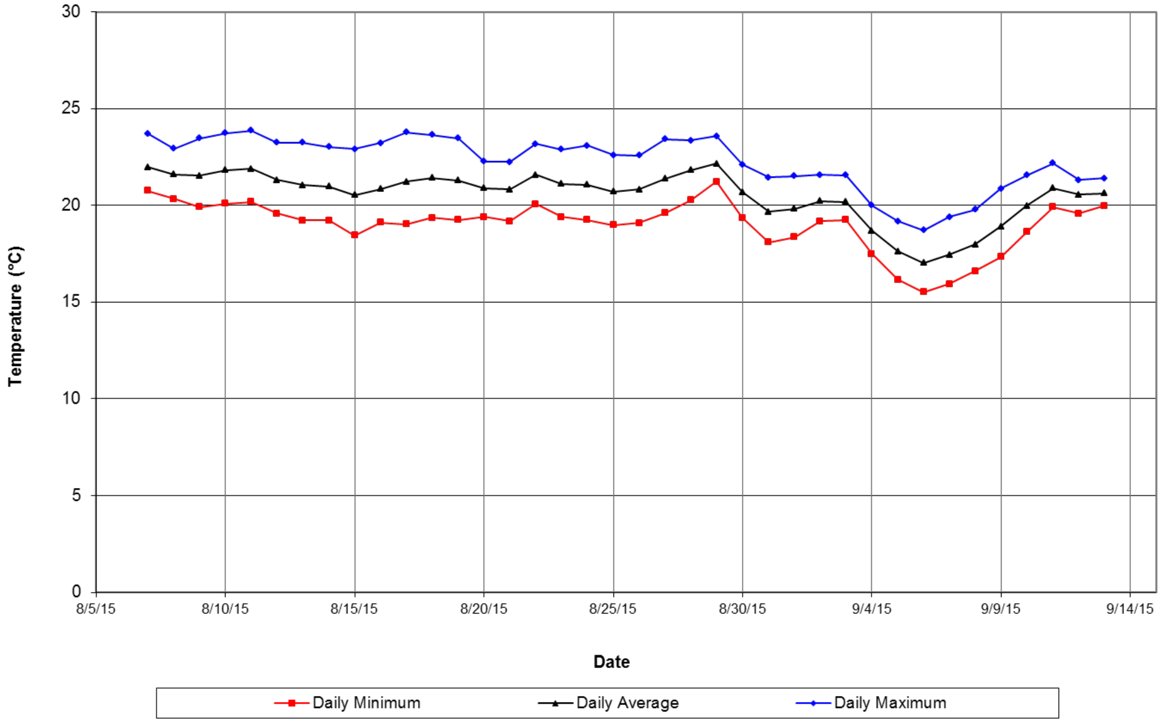

Figure 3.2.2-34. Daily minimum, average and maximum water temperature in Rock Creek upstream of Camp Far West Reservoir.

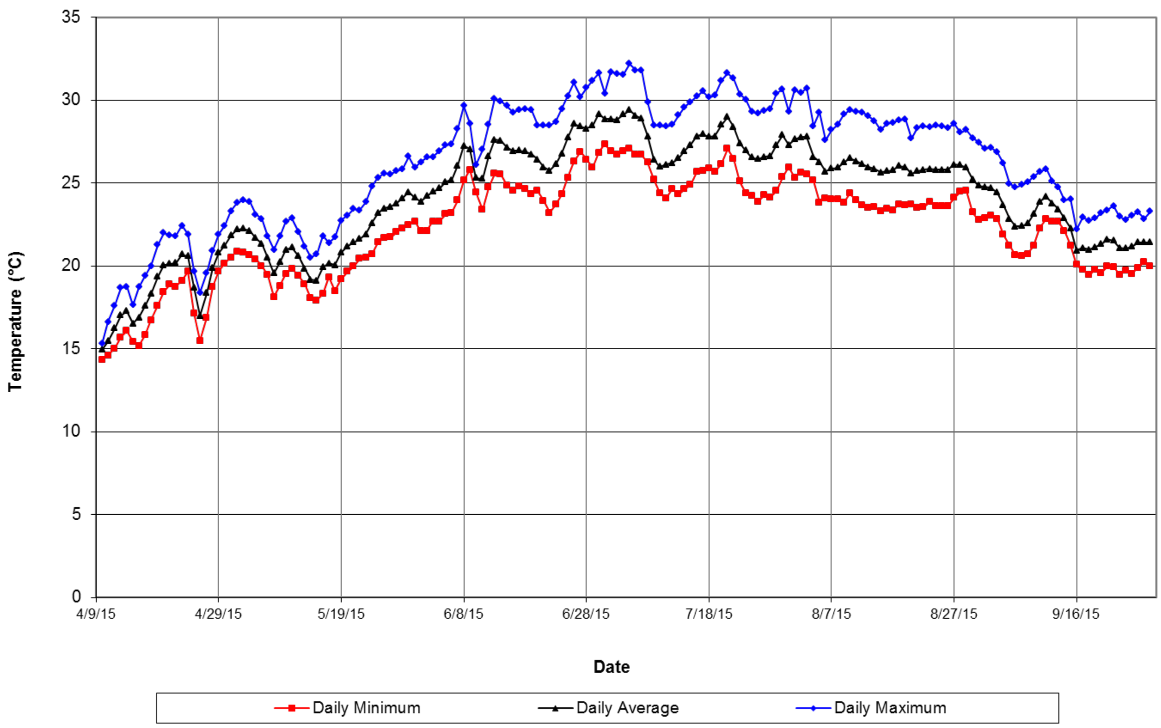

Figure 3.2.2-35. Daily minimum, average and maximum water temperature in the Bear River upstream of Camp Far West Reservoir (RM 25.1).

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SSWD found no other information regarding water temperatures immediately upstream of Camp Far West Reservoir.

3.2.2.9.1.2 Within the Project

SSWD is currently collecting monthly water temperature profiles at three locations in Camp Far West Reservoir (Table 3.2.2-8) and one location in the Bear River downstream of the Camp Far West Dam and upstream of the non-Project diversion dam (Table 3.2.2.7).

Water temperatures in Camp Far West follow the expected patterns for a reservoir of its size and depth. Surface water temperatures warm through the spring and summer as air temperatures increase while near bottom temperatures remain cooler, especially in the deeper areas near the dam. Colder water (i.e. less than 20°C) persisted for the entire monitoring period near the dam, however, the amount of cold water was greatly reduced between the April and October sampling events (Figure 3.2.2-36). The Rock Creek arm showed a weak thermocline from April through July until reservoir levels in the arm became low enough that water temperatures became almost uniform (Figure 3.2.2-37). Water temperature profiles in the Bear River arm also showed a weak thermocline from April through August until temperatures reached equilibrium with the Bear River inflow by October (Figure 3.2.2-38).

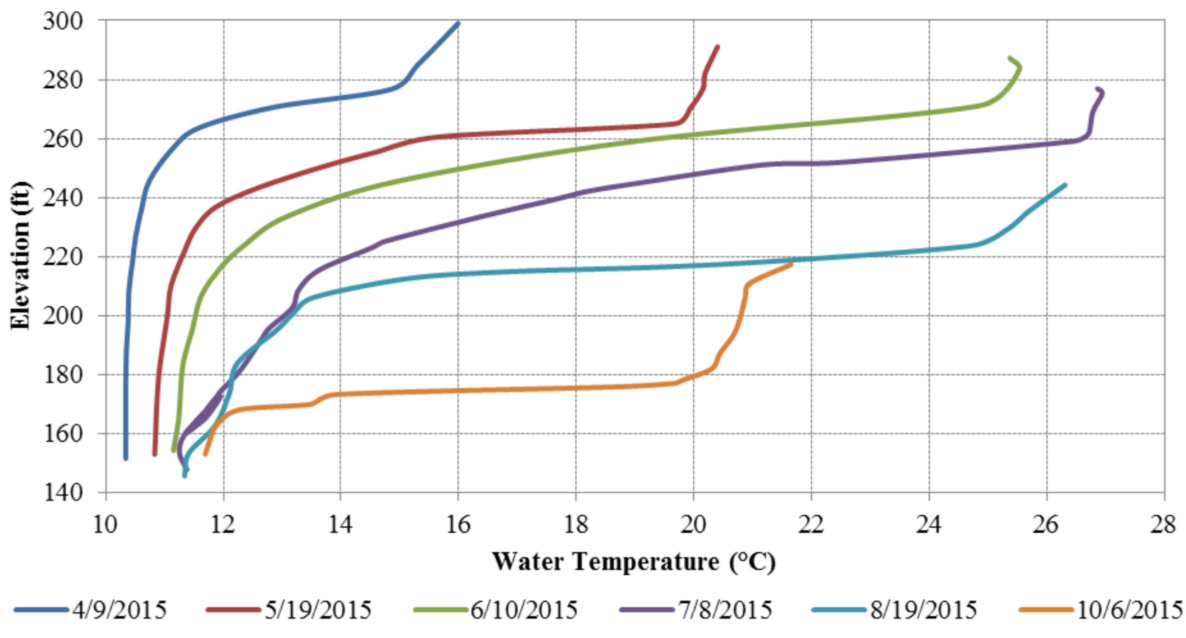

Figure 3.2.2-36. Reservoir water temperature profiles near the Camp Far West Dam.

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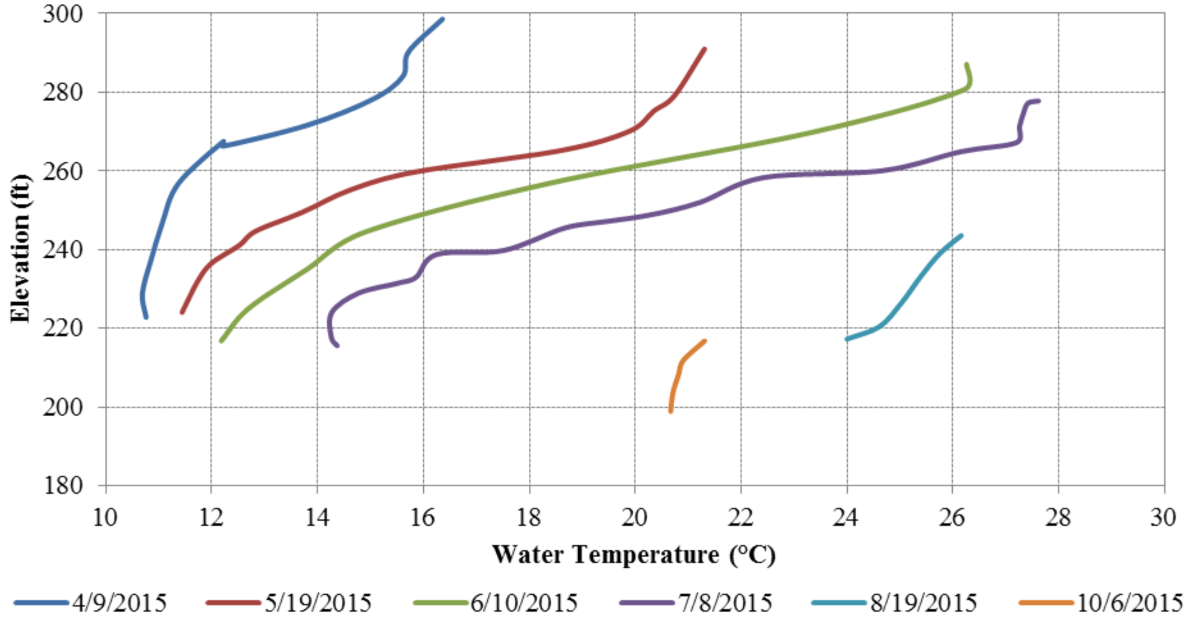

Figure 3.2.2-37. Reservoir water temperature profiles in the Rock Creek Arm of Camp Far West Reservoir.

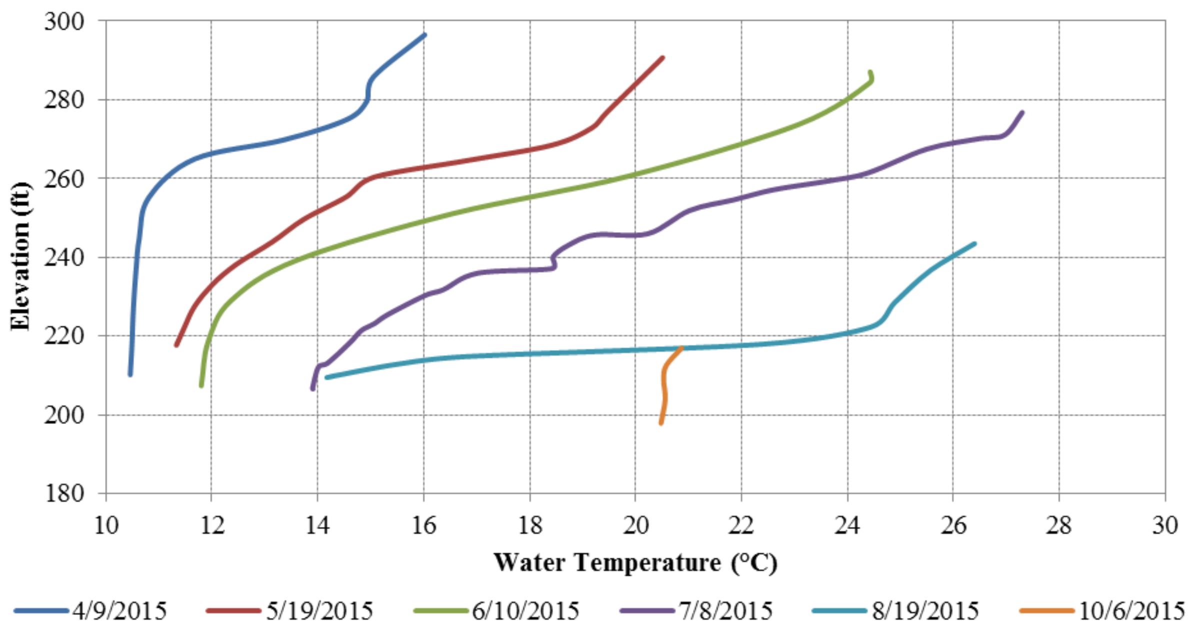

Figure 3.2.2-38. Reservoir water temperature profiles in the Bear River Arm of Camp Far West Reservoir.

Alpers et al. (2008) collected water temperature profile data in Camp Far West Reservoir at multiple locations from 2001 to 2003 during their study of environmental factors affecting mercury in the reservoir. Table 3.2.2-12 provides the minimum and maximum water

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temperatures observed by Alpers et al. during their sampling at three of the locations: 1) near the dam; 2) in the Bear River arm of the reservoir; and 3) in the Rock Creek arm of the reservoir. These locations are similar to where SSWD collected profiles in 2015. These three locations provide an overall picture of reservoir temperatures during the Alpers et al. study. In general, water temperatures observed by Alpers et al. are similar to those recorded by SSWD in 2015 during the same time periods.

Table 3.2.2-12. Minimum and maximum water temperatures recorded at three locations in Camp Far West Reservoir by Alpers et al. (2008).

Date	Near Dam (Site No. 2)		Bear River Arm (Site No. 5)		Rock Creek Arm (Site No. 7)	
	Minimum Temperature (°C)	Maximum Temperature (°C)	Minimum Temperature (°C)	Maximum Temperature (°C)	Minimum Temperature (°C)	Maximum Temperature (°C)
11/01/2001	11.2	17.3	11.2	13.0	--	--
11/28/2001	11.2	13.3	--	--	--	--
1/2/2002	8.4	10.2	--	--	--	--
2/12/2002	6.7	9.5	--	--	--	--
4/22/2002	9.1	18.4	10.0	16.6	--	--
6/18/2002	10.3	25.8	11.4	26.1	--	--
8/7/2002	10.5	26.0	12.9	27.0	25.3	26.9
9/6/2002	11.3	23.4	--	--	--	--
11/4/2002	11.0	15.1	--	--	--	--
11/6/2002	11.0	14.0	--	--	--	--
11/21/2002	12.3	13.6	--	--	--	--
12/4/2002	11.5	12.2	--	--	--	--
12/23/2002	8.6	9.9	8.9	9.9	--	--
1/17/2003	8.1	9.6	8.2	9.1	--	--
1/28/2003	8.1	12.0	8.2	11.0	--	--
3/7/2003	8.4	12.5	8.4	11.2	--	--
4/16/2003	9.6	15.7	10.0	15.5	10.6	17.0
7/7/2003	10.9	26.4	12.5	26.0	--	--
10/10/2013	11.2	21.8	20.5	21.9	--	--

Source: Alpers et al. 2008.

Water temperatures in the Bear River immediately downstream of Camp Far West Dam (RM 18.0) and upstream of the non-Project diversion dam ranged from 10°C to 15°C for most of SSWD's monitoring period. During this time, water was being released from the low-level outlet of the dam. From July 1 to September 1, releases were made from the Camp Far West Powerhouse, which has an elevated intake compared to the low-level outlet. The increased releases from the powerhouse outlet caused downstream temperatures to reach near 25°C during that period (Figure 3.2.2-39). SSWD found no other water temperature data for the Bear River between Camp Far West Dam and the non-Project diversion dam.

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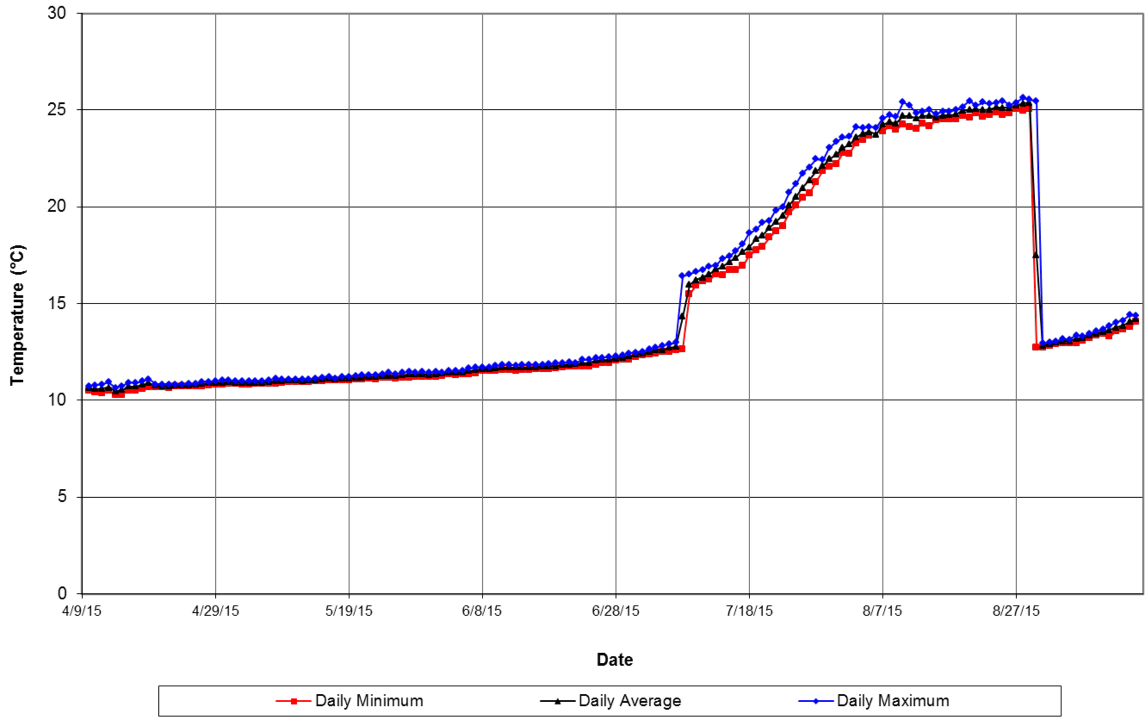

Figure 3.2.2-39. Daily minimum, average and maximum water temperature in the Bear River downstream of the Camp Far West Dam (RM 18.0).

3.2.2.9.1.3 Lower Bear River

SSWD is currently monitoring water temperatures at eight locations in the lower Bear River; six in the Bear River; one in Dry Creek; and one in the Feather River (Table 3.2.2-7). The data summarized below is generally from April to September 2015. Water temperatures at three locations downstream of the Project were not available at the time of the PAD filing: 1) Bear River downstream of the Camp Far West spillway channel; 2) Dry Creek upstream of the Bear River confluence; and 3) Feather River upstream of the Bear River confluence. These data will be included in SSWD's DLA and FLA.

Water temperatures in the Bear River downstream of the non-Project diversion dam (RM 16.9) ranged from 10°C to 17°C for most of the monitoring period. During this time, water was being released from the low-level outlet of the Camp Far West Dam. From July 1 to September 1, releases were made from the powerhouse outlet. The releases from the powerhouse outlet caused downstream temperatures to reach near 25°C during that period (Figure 3.2.2-40).

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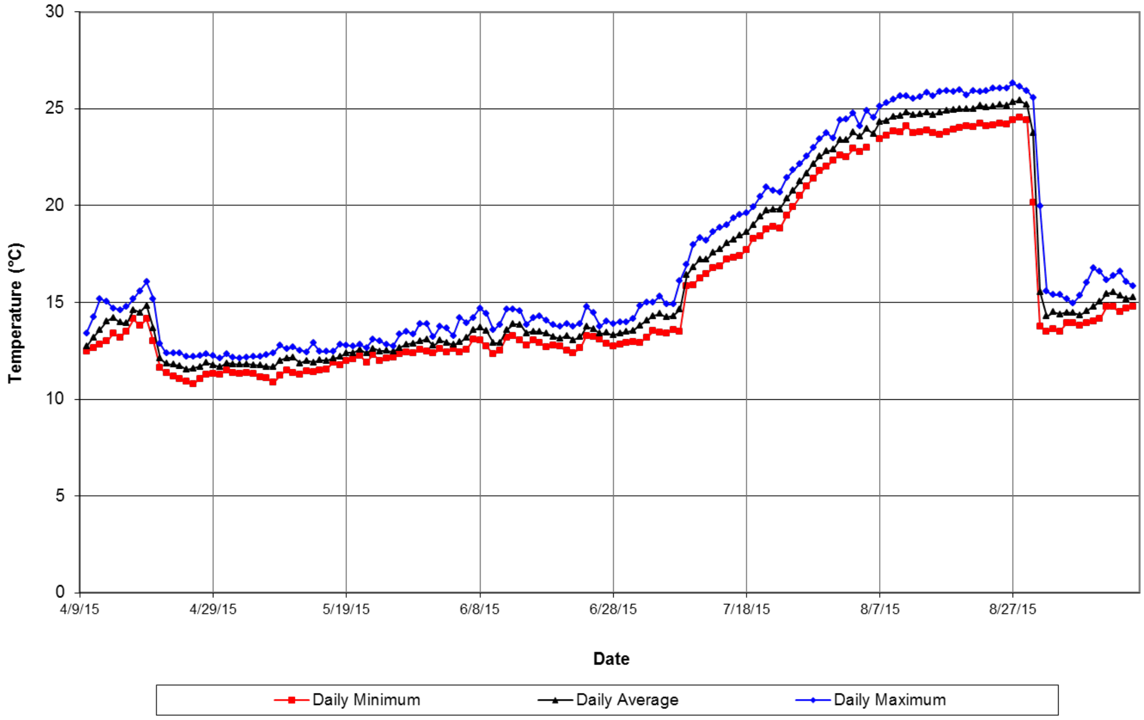

Figure 3.2.2-40. Daily minimum, average and maximum water temperature in the Bear River downstream of the SSWD Non-Project Diversion Dam (RM 16.9).

Water temperatures in the Bear River warmed while moving downstream. At the four locations between HWY 65 (RM 11.4) and the Feather River confluence (RM 0.1), water temperatures exceeded 20°C for most of the monitoring period. Each location showed a decrease in water temperatures around July 1, likely caused by the insulating effect of increased instream flows. Water temperatures began to rise in mid-July throughout the lower portion of the river as conditions approached seasonal equilibrium. Water temperatures decreased again around September 1. (Figures 3.2.2-41 through 3.2.2-44).

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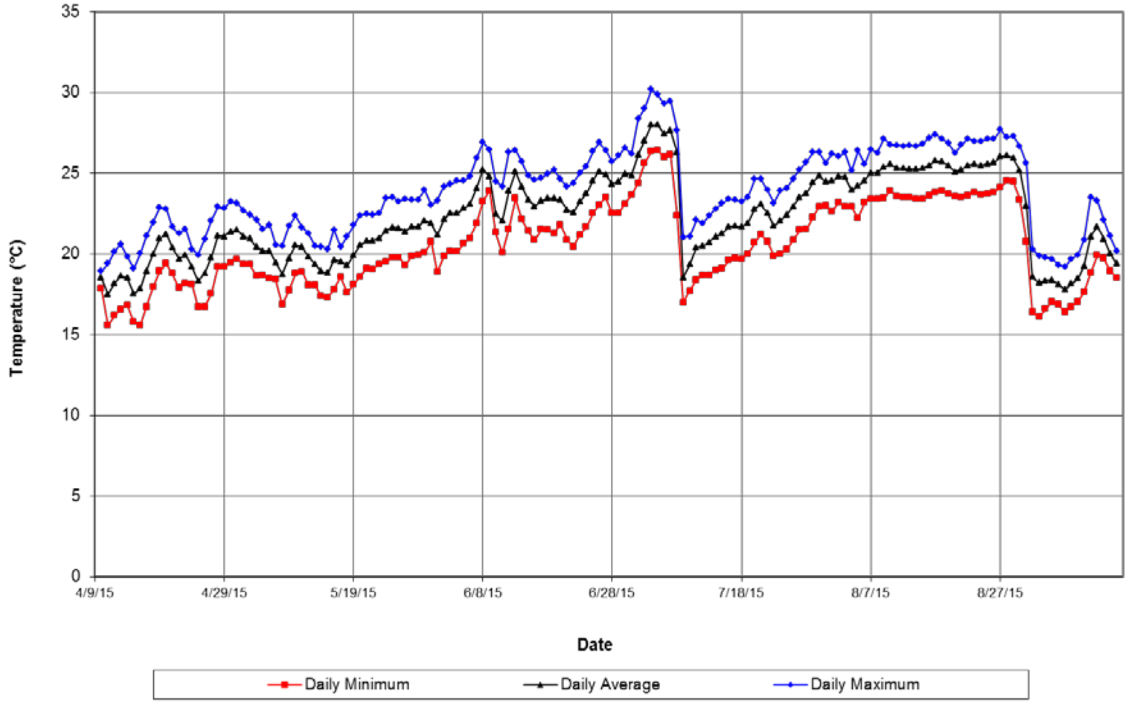

Figure 3.2.2-41. Daily minimum, average and maximum water temperature in the Bear River near the Highway 65 Bridge (RM 11.4).

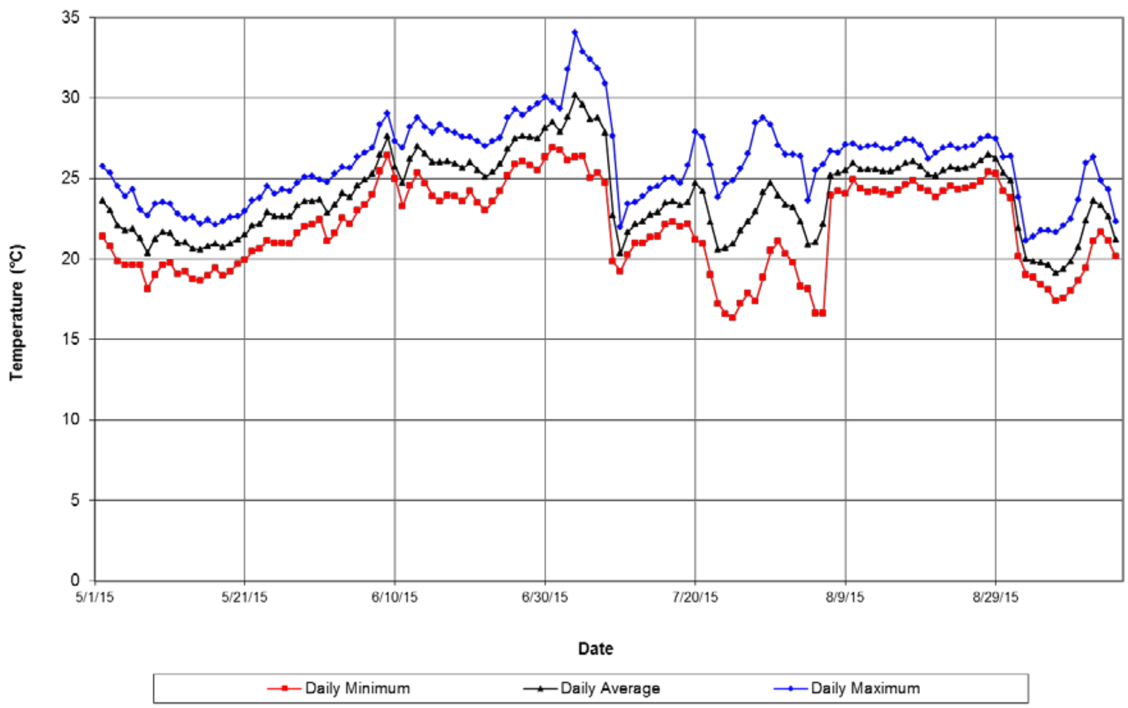

Figure 3.2.2-42. Daily minimum, average and maximum water temperature in the Bear River near the Pleasant Grove Rd. Bridge (RM 7.4)

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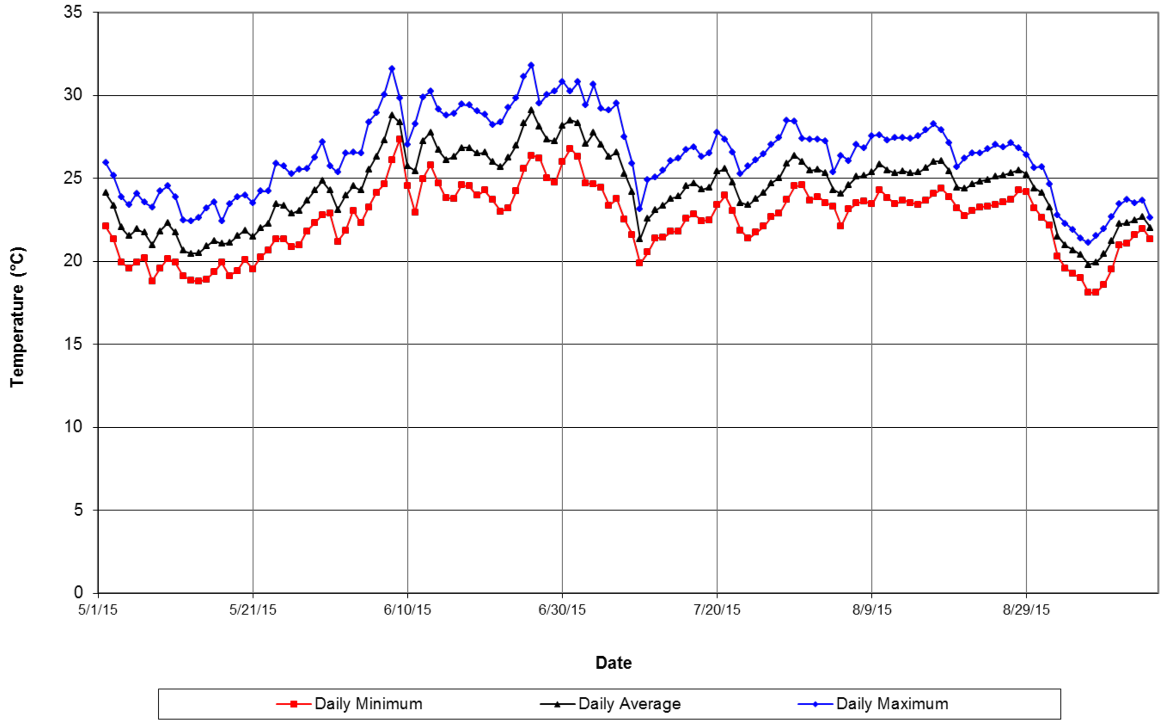

Figure 3.2.2-43. Daily minimum, average and maximum water temperature in the Bear River near the Highway 70 Bridge (RM 3.5).

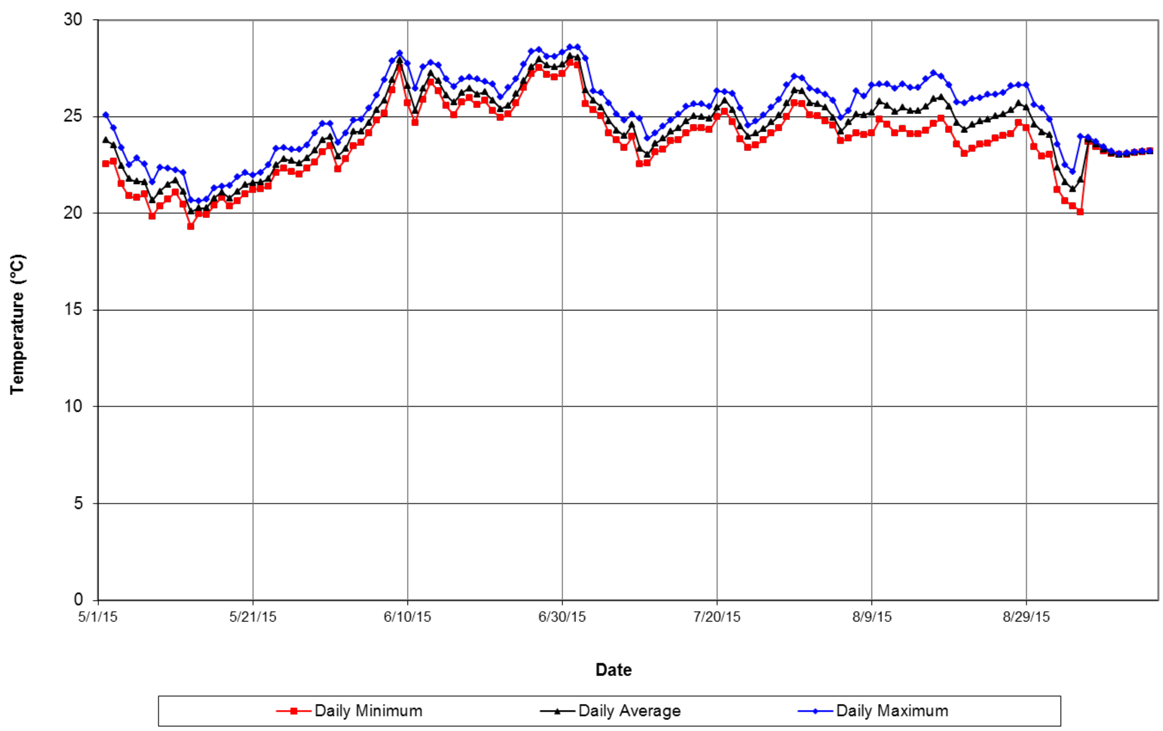

Figure 3.2.2-44. Daily minimum, average and maximum water temperature in the Bear River upstream of the Feather River confluence (RM 0.1)

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SSWD also monitored water temperature in the Feather River immediately downstream of the Bear River confluence (Figure 3.2.2-45). In general, water temperatures in the Feather River were similar to those seen in the Bear River near the confluence (Figure 3.2.2-44). These similarities are likely caused by both rivers' temperatures reaching seasonal equilibrium.

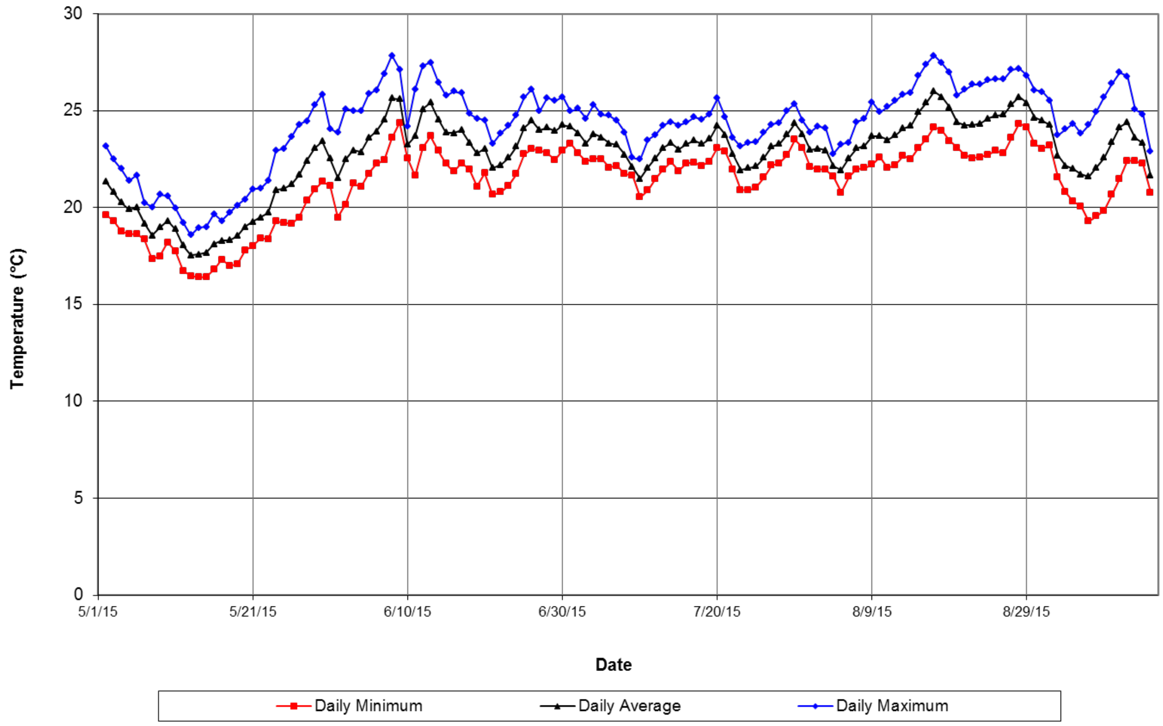

Figure 3.2.2-45. Daily minimum, average and maximum water temperature in the Feather River downstream of the Bear River confluence.

One source of long-term water temperature data available downstream of the Project was collected by DWR staff during monthly sampling from 1964 to 1987 near Wheatland, CA. While these data include only spot (i.e., once-monthly) recordings, they do show general trends in water temperature over a 24-year period (Table 3.2.2-13).

Table 3.2.2-13. Minimum, mean and maximum monthly water temperatures in the Bear River near Wheatland. Collected once monthly by California Department of Water Resources for WY 1964 through WY 1987.

Temperatures (°C)	Month											
	Oct	**Nov**	**Dec**	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**July**	**Aug**	**Sep**
Minimum	12	11	7	6	6	7	9	12	16	21	22	17
Mean	18	14	11	9	9	11	15	19	24	26	26	22
Maximum	23	16	13	11	16	16	28	31	33	33	31	29
# of Readings	17	15	19	19	20	22	22	20	19	18	17	19

Source: CDFG 1991a.

In addition, Bailey (2003) monitored water temperature at two locations near the Patterson Sand and Gravel operation: one approximately 2,000 ft downstream of the non-Project diversion dam

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(RM 16.5) and the second at the downstream end of the gravel operation (RM 15.0) (Figures 3.2.2-46 and 3.2.2-47).

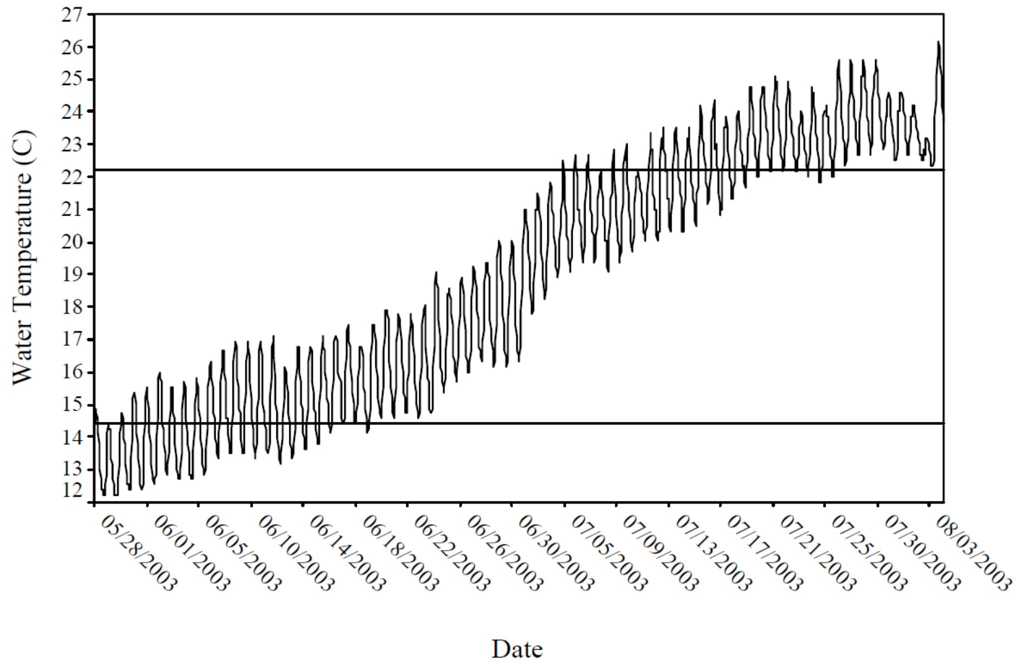

Figure 3.2.2-46. Water temperature time series from the upper Patterson Sand and Gravel site for the period of May 28 to August 4, 2003.
From: Bailey 2003, Figure 1.

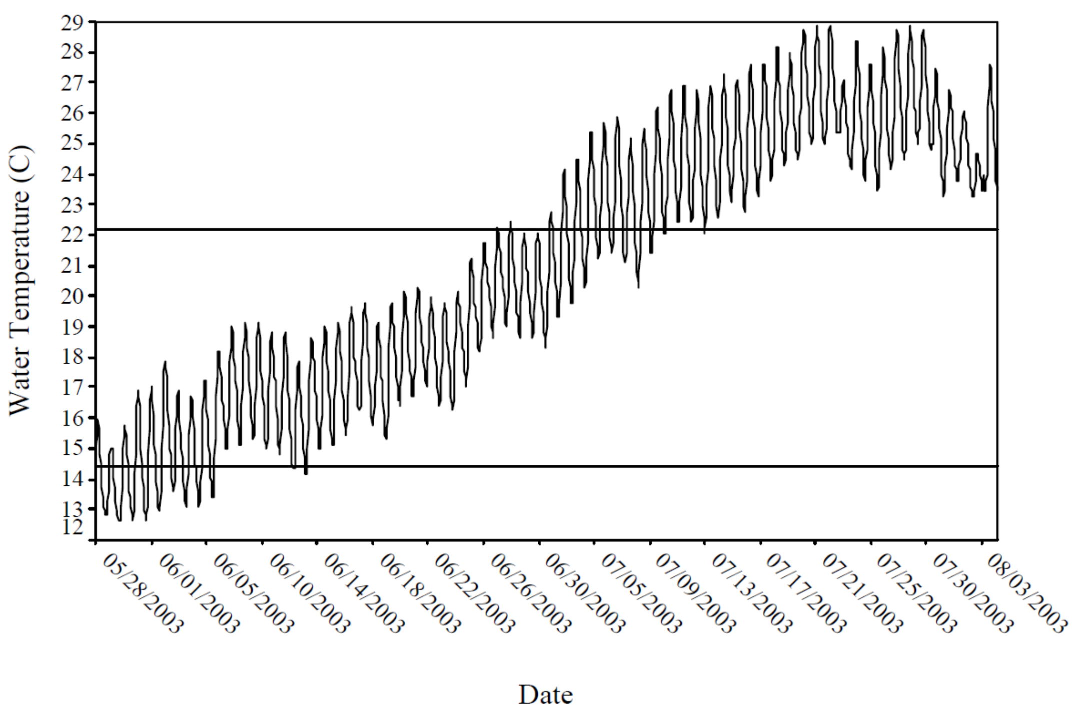

Figure 3.2.2-47. Water temperature time series from the lower Patterson Sand and Gravel site for the period of May 28 to August 4, 2003.
From: Bailey 2003, Figure 2.

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3.2.2.9.2 Water Quality

The water quality parameters discussed in this section include all parameters except water temperature (Section 3.2.2.9.1) and mercury (Section 3.2.2.10).

3.2.2.9.2.1 Upstream of the Project

Water quality was measured at one location in the Bear River as part of the SWRCB's Surface Water Ambient Monitoring Program (SWAMP) Statewide Perennial Stream Assessment (SWRCB 2013); in 2013 upstream of the Little Wolf Creek confluence (RM 24). Table 3.2.2-14 provides the results of that sampling event.

Table 3.2.2-14. Water quality measurements from the SWAMP Perennial Streams Assessment.

Analyte	Units	Bear River above Little Wolf Creek
Nitrogen, Total, Total	mg/L	0.223
Phosphorus as P, Total	mg/L	0.0139
Silica as SiO2, Dissolved	mg/L	8.9
Ammonia as N, Total	mg/L	0.0078
OrthoPhosphate as P, Dissolved	mg/L	0.0393
AFDM_Algae, Particulate	g/m2	2.45
Chlorophyll a, Particulate	mg/m2	4.05
Total Suspended Solids, Particulate	mg/L	1.4
Sulfate, Dissolved	mg/L	2.83
Chloride, Dissolved	mg/L	8.55
Hardness as CaCO3, Total	mg/L	42.8
Dissolved Organic Carbon, Dissolved	mg/L	2.65
pH	units	7.78
Turbidity, Total	NTU	0.68
Alkalinity as CaCO3, Total	mg/L	55
Oxygen, Dissolved, Total	mg/L	9.06
Specific Conductivity, Total	uS/cm	124.2
Temperature	°C	25.2

Source: SWRCB 2013

SSWD found no additional water quality data immediately upstream of the Project.

3.2.2.9.2.2 Within the Project

Water quality data within the Project are limited to information for Camp Far West Reservoir. No information is available for the reach between Camp Far West Dam and the non-Project diversion dam.

SSWD is currently collecting monthly water quality profiles at three locations in Camp Far West Reservoir (Table 3.2.2-10). In addition to temperature, which is discussed in Section 3.2.2.9.1.2, dissolved oxygen (DO), specific conductivity and pH are being recorded at approximately 10-ft intervals at each monitoring location. DO profiles are presented in Figures 3.2.2-48 through 3.2.2-50.

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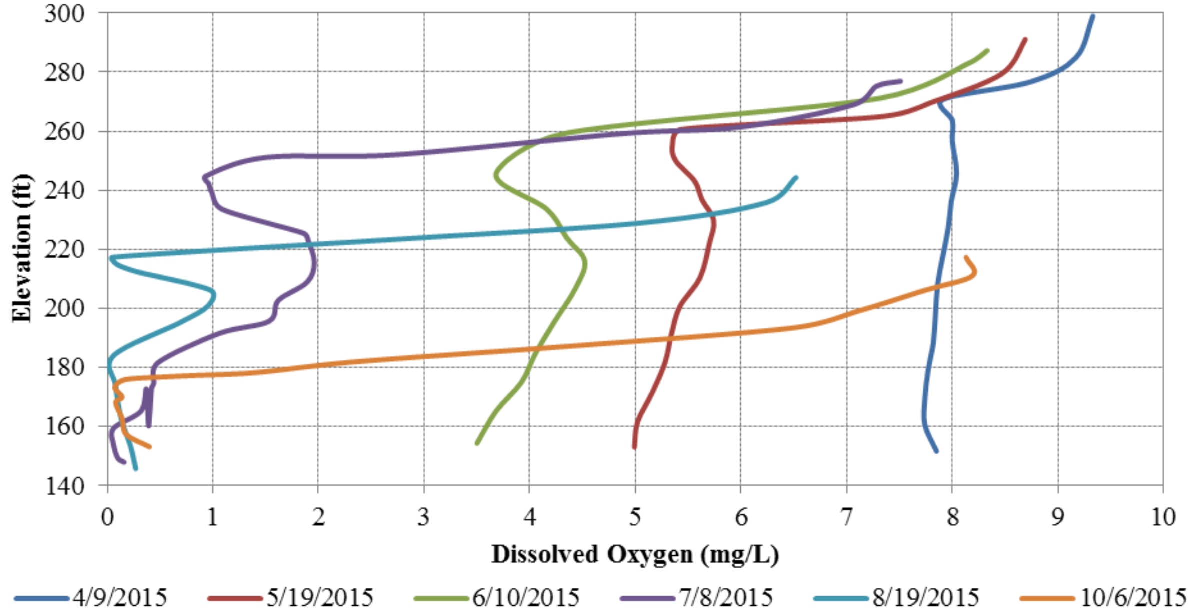

Figure 3.2.2-48. Reservoir dissolved oxygen profiles near the Camp Far West Dam.

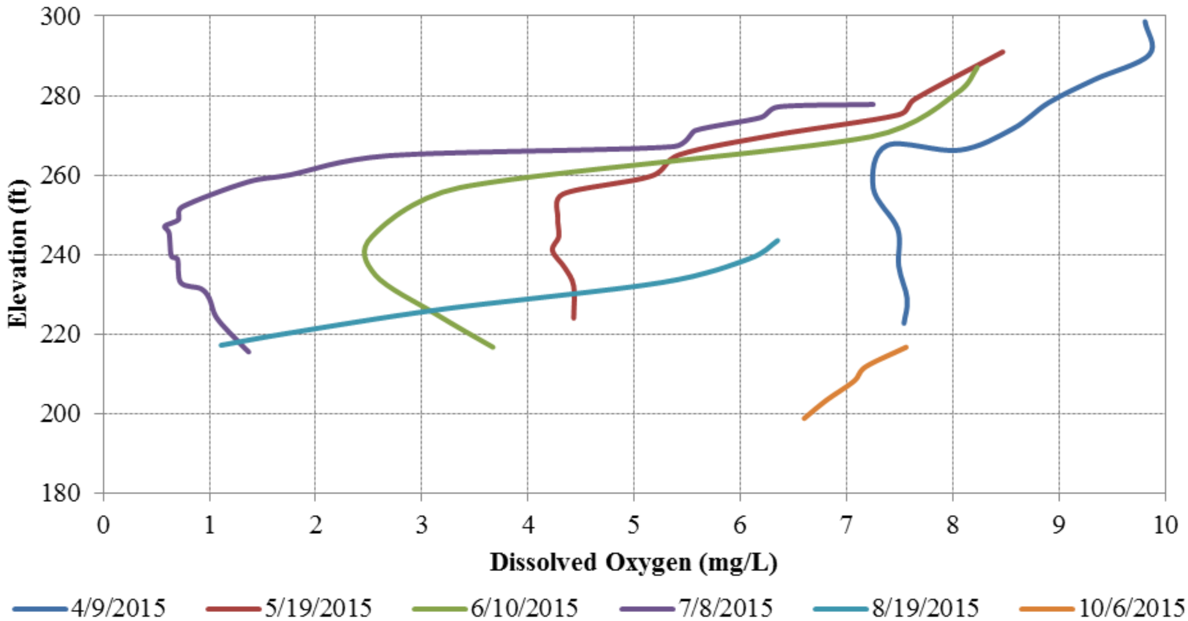

Figure 3.2.2-49. Reservoir dissolved oxygen profiles in the Rock Creek Arm of Camp Far West Reservoir.

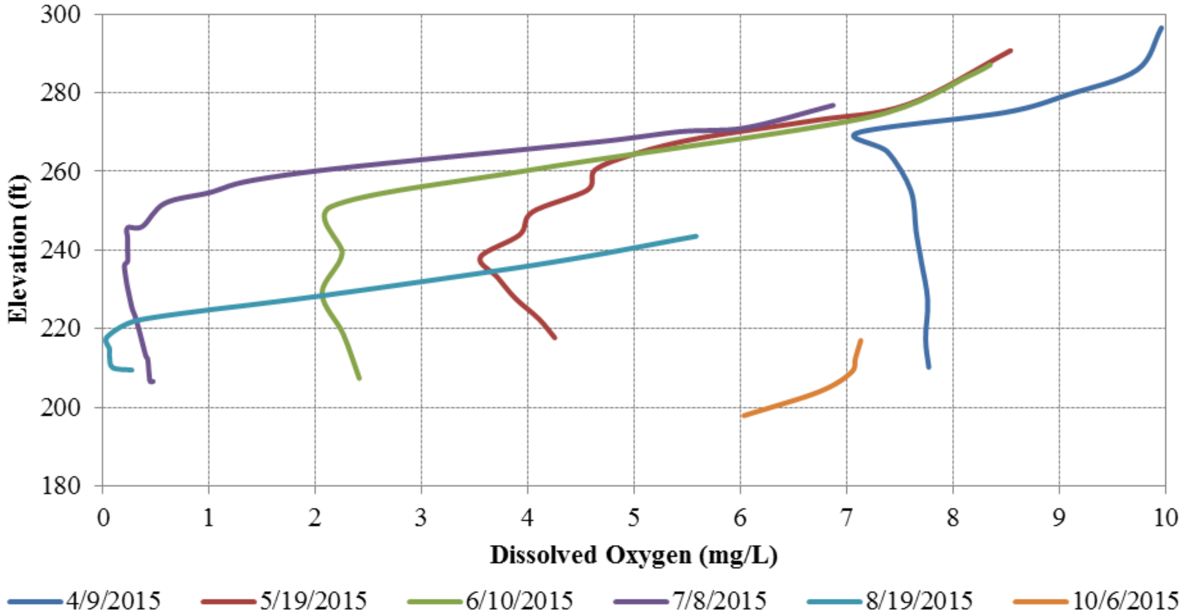

Figure 3.2.2-50. Reservoir dissolved oxygen profiles in the Bear River Arm of Camp Far West Reservoir.

The DO profiles between April and August were generally a negative heterograde curve indicating a metalimnetic oxygen minimum. DO concentrations decrease sharply in approximately the first 50 ft below the surface before beginning to increase. Profiles taken near the dam saw DO values decrease again near the bottom. DO concentrations on the surface were usually 7 mg/L or greater, whereas DO concentrations in the metalimnion were less than 1.0 mg/L. (Figures 3.2.2-48 through 3.2.2-50). The cause of the metalimnion minimum is unknown, but similar curves occur in other reservoirs. In some cases, the reason is oxidizable material that is either produced in the reservoir's epilimnion (e.g., autochthonous material, such as phytoplankton), or oxidizable material that enters the reservoir from outside sources (e.g., allochthonous material, such as leaves, twigs and insects). The material sinks in the reservoir, and the rate of sinking slows down as it encounters the more dense metalimnetic water. Here, the material has more time under more conducive (i.e., warmer) water temperatures than deeper in the reservoir, to decompose. As a result, more readily oxidizable material is decomposed in the metalimnion with a concomitant consumption of oxygen by bacterial respiration. Another potential cause of the metalimnetic oxygen minimum is very high concentrations of zooplankton microcrustaceans in the metalimnion, which due to respiratory consumption, lower DO concentrations. Reservoir profile locations in the Bear River and Rock Creek arms in October 2015 were shallow (approximately 20 ft) and DO values did not reflect the same pattern seen during other sampling events.

Specific conductivity ranged from 88 µS/cm to 150 µS/cm during the monitoring period and tended to decrease with depth. Specific conductivity values increased as water temperatures increased during the year, particularly near the surface. pH levels ranged from 6.3 to 9.1 units during the monitoring period and were highest near the surface (Table 3.2.2-15).

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Table 3.2.2-15. Conductivity and pH values for three monitoring locations at Camp Far West reservoir.

	Specific Conductivity (µS/cm)			pH (pH units)		
	Near Dam	**Rock Creek Arm**	**Bear River Arm**	**Near Dam**	**Rock Creek Arm**	**Bear River Arm**
MONTHLY RANGE						
April	88-93	88-93	88-111	6.9-7.9	6.7-7.8	6.8-7.8
May	90-103	93-103	96-112	6.5-8.5	6.8-8.6	6.7-8.6
June	--	--	--	6.9-8.6	6.8-8.9	6.7-8.4
July	--	--	--	6.6-9.1	6.8-9.0	6.7-8.6
August	96-121	120-125	122-150	6.3-7.3	6.6-7.1	6.3-7.0
September	--	--	--	--	--	--
October	112-129	126-128	127-128	6.7-7.6	7.1-7.3	6.7-7.0
OVERALL STATISTICS						
Minimum	88	88	88	6.3	6.7	6.3
Average	103.6	108.4	114.9	7.4	7.5	7.3
Maximum	129	128	150	9.1	9.0	8.6

-- = No data was collected due to equipment malfunction.

Alpers et al. (2008) reported on water quality samples collected from October 2001 through August 2003 in order to develop bioaccumulation factors (BAF) for reservoir dwelling biota. Water quality sampling sites were focused along the reservoir thalweg as well as sampling in the Rock Creek and Dairy Farm arms of the reservoir. Water quality samples were collected at approximately 3-month intervals during the duration of the Alpers et al. study for a total of eight samples. The results for six field measured parameters are provided in Figure 3.2.2-51. The data collected for temperature, DO, pH and specific conductance were similar to those observed by SSWD in 2015.

	Temperature (°C)	Dissolved oxygen (mg/L)	pH	Specific conductance (µS/cm)	Total suspended solids (mg/L)	Suspended silt plus clay (mg/L)
All samples						
Mean	14.6	8.1	7.0	164	9.8	8.4
Standard error of mean	0.78	0.44	0.13	32	1.0	0.9
Standard deviation	6.5	3.7	1.1	267	7.9	7.1
Minimum	7.0	0.0	3.0	69	0	0
25th percentile	9.6	6.6	6.8	84	5	3
Median	11.4	8.7	7.3	90	7.5	6
75th percentile	17.6	10.3	7.7	127	11	10
Maximum	27.5	14.6	8.4	1,660	30	30
n	69	69	71	71	68	68

Figure 3.2.2-51. Statistical data for field measurements and suspended solids concentrations.
From: Alpers et. al. 2008. Figure 8.

3.2.2.9.2.3 Lower Bear River

SSWD found three sources of water quality data in the lower Bear River.

Water quality was measured at two locations in the lower Bear River as part of the SWAMP Statewide Perennial Stream Assessment (SWRCB 2013); in 2011 upstream of the Pleasant Grove Bridge (RM 7.1) and in 2013 upstream of the Highway 65 Bridge (RM 11.8). Table 3.2.2-16 provides the results of those sampling events.

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Table 3.2.2-16. Water quality measurements from the SWAMP Perennial Streams Assessment.

Analyte	Units	Sampling Location: Upstream of Pleasant Grove (9/7/11)	Sampling Location: Upstream of Highway 65 (6/10/13)
Ammonia as N, Total	mg/L	--	0.0042
Chlorophyll a, Particulate	mg/m2	21.88	21.1
OrthoPhosphate as P, Dissolved	mg/L	0.0134	0.0166
Sulfate, Dissolved	mg/L	3.26	4.46
Silica as SiO2, Dissolved	mg/L	14.2	9.55
Nitrogen, Total, Total	mg/L	0.104	0.242
Total Suspended Solids, Particulate	mg/L	1	2.8
Chloride, Dissolved	mg/L	4.18	4.12
Dissolved Organic Carbon, Dissolved	mg/L	1.38	2.44
AFDM_Algae, Particulate	g/m2	9.76	4.76
Phosphorus as P, Total	mg/L	0.0092	0.0072
Hardness as CaCO3, Total	mg/L	32.8	34.3
Oxygen, Dissolved, Total	mg/L	8.72	9.92
pH	none	9.1	7.1
Alkalinity as CaCO3, Total	mg/L	41	40
Specific Conductivity, Total	uS/cm	88.6	92
Temperature	Deg C	25.9	21
Turbidity, Total	NTU	0.67	1.36

Source: SWRCB 2013

As part of the Oroville Facilities Relicensing, DWR completed an extensive water quality study which included one location in the Bear River near its confluence with the Feather River. Figures 3.2.2-52 through 3.2.2-55 provides summaries of the data collected. During the sampling, only turbidity and phosphorus levels were found to have exceeded the identified Water Quality Objective.

Bear R near Mouth (A6-5010.50)

	Dissolved Oxygen (ppm)	pH units	Conductivity (field) umhos/cm	Conductivity (lab) umhos/cm	Alkalinity mg/L	Turbidity NTU
Maximum detected	13.4	7.5	236	233	81	58
Minimum detected	6.7	6.8	84	83	31	2.2
Number of samples	28	29	28	29	28	29

Figure 3.2.2-52. Field measurements taken in the Bear River near the Feather River confluence.
From: DWR 2004a. Appendix 2c.

Bear R near Mouth (A6-5010.50)

	Ammonia		Nitrate + Nitrite	Ortho-phosphate	Phosphorus	Organic Carbon	
	T	D	D	D	T	T	D
Maximum detected	0.2	0.08	0.58	0.07	0.28	14.3	9.2
Minimum detected	<0.02	<0.01	<0.01	<0.01	0.03	2	2
Number of samples	29	28	28	29	29	28	28

Figure 3.2.2-53. Nutrient measurements taken in the Bear River near the Feather River confluence. T = total, D = dissolved.
From: DWR 2004a. Appendix 3a-3.

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Bear R near Mouth (A6-5010.50)

	Calcium		Magnesium		Sodium	Potassium	Sulfate	Chloride	Boron	Hardness	
	T	D	T	D	D	D	D	D	D	T	D
Maximum detected	13	17	8	10	16	7.0	8	21	<0.1	84	84
Minimum detected	7	6	4	3	4	0.7	3	<1.0	<0.1	30	27
Number of samples	16	29	16	29	29	29	29	29	29	29	29

Figure 3.2.2-54. Mineral measurements taken in the Bear River near the Feather River confluence. T = total, D = dissolved.
From: DWR 2004a. Appendix 3b-3.

Total and fecal coliform samples were collected by DWR at this monitoring location 36 times between March 2002 and April 2004. Total coliform counts per 100 mL ranged from 0 to 231 and fecal coliform counts per 100 mL ranged from 0 to 168 (DWR 2004a). None of the values exceeded SWRCB or State Department of Health criteria.

Total suspended solids and settleable solids were sampled 29 times during the study. Total suspended solids concentrations ranged from less than 1 mg/L to 57 mg/L and settleable solids ranged from undetectable to 0.2 mL/L (DWR 2004a).

Metals were also sampled at this location, and DWR determined six metals exceeded identified water quality criterion established by the California Environmental Protection Agency (Cal/EPA), EPA or the SWRCB during at least one sampling event: aluminum, arsenic, copper, iron, manganese and lead (Figure 3.2.2-55).

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Bear R near Mouth (A6-5010.50)

	Aluminum		Arsenic		Cadmium		Chromium		Copper		Iron		Mercury	Methyl Mercury	Manganese		Nickel		Lead		Selenium		Silver		Zinc	
	T	D	T	D	T	D	T	D	T	D	T	D	T	T	T	D	T	D	T	D	T	D	T	D	T	D
Maximum detected	1504	1203	1.57	1.320	0.034	0.009	3.46	2.22	8.36	5.82	2880	1768	0.04070	0.000934	390	284	5.40	3.73	1.57	1.01	0.33	0.370	0.55	0.035	8.11	4.23
Minimum detected	53	5.5	0.39	0.282	<0.004	<0.004	0.23	<0.02	1.52	1.12	224	35.6	0.00205	0.000056	13.2	0.33	0.51	0.38	0.070	<0.011	<0.04	<0.04	<0.006	<0.001	0.38	0.19
Number of samples	29	29	29	29	29	29	29	29	29	29	29	29	29	28	29	29	29	29	29	29	29	29	14	14	29	29
Number of samples exceeding criteria or																										
Public Health Goal[1]	9	-	-	-	0	-	-	-	0	-	-	-	0	-	0	-	0	-	0	-	-	-	-	-	-	-
Primary MCL[2]	3	-	0	-	0	-	0	-	0	-	-	-	0	-	-	-	0	-	0	-	0	-	-	-	-	-
Secondary MCL[2]	30	-	0	-	-	-	-	-	0	-	25	-	-	-	14	-	-	-	-	-	-	-	0	-	0	-
Agricultural Goal[3]	0	-	0	-	0	-	0	-	0	-	0	-	-	-	2	-	0	-	0	-	0	-	-	-	0	-
Cal/EPA Cancer Potency Factor[4]	-	-	29	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CTR[5] Humans	-	-	-	-	-	-	-	-	0	-	-	-	0	-	-	-	0	-	-	-	-	-	-	-	-	-
CTR[5] Aquatic Life	-	-	-	0	0	0	-	0	15[9]	2[9],1[10]	-	-	-	-	-	-	-	0	1[9]	1[9]	-	-	0	0	0	0
NTR[6]	-	-	-	-	-	-	0	-	-	-	-	-	-	-	-	-	-	-	-	-	0	-	-	-	-	-
NAWQC[7] Humans	-	-	29	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
NAWQC[7] Aquatic Life	28[9], 4[10]	-	-	-	-	-	-	-	-	-	8	-	0	-	-	-	-	-	-	-	-	-	-	-	-	-
USEPA IRIS Reference Dose[8]	-	-	-	-	-	-	0	-	-	-	-	-	-	0	-	-	-	-	-	-	0	-	0	-	0	-

Figure 3.2.2-55. Metals measurements taken in the Bear River near the Feather River confluence. T = total, D = dissolved.

Source: From DWR 2004a, Appendix 3c-3.

Footnotes:

1. California Environmental Protection Agency (Cal/EPA), Office of Environmental Health Hazard Assessment, *Public Health Goals for Chemicals in Drinking Water*
2. California Department of Health Services, California Code of Regulations, Title 22, Division 4, Chapter 15, Domestic Water Quality and Monitoring
3. Food and Agriculture Organization of the United Nations, 1985. Water Quality for Agriculture.
4. Cal/EPA, Office of Environmental Health Hazard Assessment, Cal/EPA Toxicity Criteria Database
5. California State Water Resources Control Board, Policy for Implementation of Toxics Standards for Inland Surface Waters, Enclosed Bays, and Estuaries of California (2 March 2003)
6. U.S. Environmental Protection Agency, Federal Register, Volume 64, No. 216 (Tuesday, 9 November 1999) [National Toxics Rule revisions]
7. U.S. Environmental Protection Agency, Quality Criteria for Water, 1986 (May 1986) [The Gold Book] plus updates (various dates)
8. U.S. Environmental Protection Agency, Integrated Risk Information System [IRIS] database
9. Chronic (4 day average)
10. Acute (1 hr average)

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The Irrigated Lands Regulatory Program (SWRCB 2005) regulates agricultural discharges into receiving waters through waste discharge requirements or waivers. The program had a single monitoring location on the Bear River near Pleasant Grove Road (RM 6.8) where four samples were taken in June and July 2005 (Table 3.2.2-17). None of the parameters sampled during the four events exceeded the identified water quality criteria established by Marshack (2015), EPA (2000) or the CVRWQCB (1998).

Table 3.2.2-17. Water quality data collected near Pleasant Grove Bridge as part of the Irrigated Lands Regulatory Program.

Analyte	Units	Sampling Dates			
		6/14/05	6/27/05	7/11/05	7/25/05
Boron, Total	mg/L	0.0046	--	0.0034	--
Arsenic, Total	ug/L	0.51	0.28	0.29	0.71
Zinc, Total	ug/L	0.63	0.32	0.15	0.5
Lead, Total	ug/L	0.06	0.05	0.05	0.04
Nickel, Total	ug/L	1.05	--	0.69	--
Copper, Total	ug/L	1.39	--	1.18	1.71
Ortho Phosphate as P, Dissolved	mg/L	0.0084	--	0.0076	0.0078
Total Organic Carbon, Total	mg/L	2.256	--	1.559	1.8
Nitrate + Nitrite as N, Dissolved	mg/L	0.0601	0.0217	--	0.0091
Ammonia as N, Total	mg/L	0.042	--	--	0.095
Phosphorus as P, Total	ug/L	--	2.47	--	2.84
Total Dissolved Solids, Dissolved	mg/L	53	53	39	63
Hardness as CaCO3, Total	mg/L	28.3	25.2	25.2	--
Specific Conductivity, Total	uS/cm	83.1	80.6	77.8	107.2
Temperature	°C	17.6	19.4	22.2	32.4
Discharge	cfs	238	217.7	146	--
Oxygen, Dissolved, Total	mg/L	7.4	9.1	9.1	7.4
pH	units	7.55	7.49	7.56	8.31
Turbidity, Total	NTU	2.1	1.5	1.7	1.2

Source: SWRCB 2005

3.2.2.10 Mercury and Related Resources

Mercury contamination is common in California aquatic food webs, affecting both the fishing and aquatic life, and beneficial uses in many areas of the state, with long-term trends indicating little change over the past few decades (Davis et al. 2007). In the Bear River watersheds, local sources of mercury, and hence of methylmercury, are a legacy of historic gold mining practices on the river, which used mercury amalgamation in the gold recovery process. Much of the mercury used was lost to the environment (Alpers et al. 2005; Hunerlach et al. 1999; May et al. 2000; Slotton et al. 1995 *IN* May et al. 2000). Regional and global atmospheric sources of mercury also substantially contribute to mercury impacts to the Sacramento–San Joaquin River system (Davis et al. 2009).

As pointed out above, the SWRCB has identified Camp Far West Reservoir and the lower Bear River, as CWA Section 303(d) State Impaired for mercury, citing fish tissue concentrations and surface water concentrations, to support their listing (SWRCB 2012).

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Currently, SSWD does not introduce mercury into Project waters, nor perform any Project O&M activity associated with the release or mobilization of mercury. SSWD does participate in the SWRCB and Regional Water Board's Owner and Operators Committee to develop a statewide water quality control program for mercury (statewide mercury program or program) that will include: 1) mercury control program for reservoirs; and 2) mercury water quality objectives. It is expected that research performed on Camp Far West Reservoir will inform the TMDL development process.

Mercury has been comprehensively studied in Camp Far West Reservoir fish tissue, surface water and sediment. A brief description of recent studies related to mercury is provided below.

3.2.2.10.1 Within the Project Area

SSWD found five sources of information related to mercury within the Project.

Saiki et al. (2010) reported on fish collected by USGS in August 2002 and August 2003 from three locations: the Bear River arm (inflow): the Rock Creek arm; and near the dam. Total mercury (reported as dry weight concentrations) in whole fish was highest in spotted bass (mean, 0.93 ppm; range, 0.16 to 4.41 ppm) and lower in bluegill (mean, 0.45 ppm; range, 0.22 to 1.96 ppm) and threadfin shad (0.44 ppm; range, 0.21 to 1.34 ppm). Spatial patterns for mercury in fish indicated high concentrations upstream in the Bear River arm and generally lower concentrations elsewhere, including downstream near the dam. These findings coincided with patterns exhibited by methylmercury in water and sediment, and the source of mercury to Camp Far Reservoir is Bear River inflows.

Davis et al. (2009) reported on fish collected by Cal Fish and Wildlife in September 2007 from two locations, the Bear River arm of the reservoir and near the dam. A total of 23 sample composites were generated from two species: spotted bass (21) and channel catfish (2). Mercury in spotted bass ranged from 0.205 to 1.55 ppm, while mercury in catfish ranged from 0.318 to 0.44 ppm.

Alpers et al. (2008) reported on water quality samples collected from October 2001 through August 2003, and developed BAFs for reservoir dwelling biota. Water quality sampling was done at approximately 3-month intervals on eight occasions at several stations in the reservoir, including a group of three stations along a flow path in the reservoir. Concentrations of total mercury (filtered and unfiltered water) were highest during fall and winter; these concentrations decreased at most stations during spring and summer. Anoxic conditions developed in deep parts of the reservoir during summer and fall in association with thermal stratification. The highest concentrations of methylmercury in unfiltered water were observed in samples collected during summer from deepwater stations in the anoxic hypolimnion. In the shallow (i.e., ≤14 m depth) oxic epilimnion, concentrations of methylmercury in unfiltered water were highest during the spring and lowest during the fall. The ratio of methylmercury to total mercury increased systematically from winter to spring to summer, largely in response to the progressive seasonal decrease in total mercury concentrations, but also to some extent because of increases in methylmercury concentrations during summer.

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Mercury BAFs were computed using data from linked studies of biota spanning a range of trophic positions: zooplankton, midge larvae, mayfly nymphs, crayfish, threadfin shad, bluegill, and spotted bass. Significant increases in total mercury in tissue with increasing organism size were observed for all three fish species and for crayfish. The BAF values were computed using the average methylmercury concentration (wet) in biota divided by the arithmetic mean concentration of methylmercury in filtered water (0.04 nanograms per liter). As expected, the BAF values increased systematically with increasing trophic position. Values of BAF were 190,000 for zooplankton; 470,000 to 930,000 for three taxa of invertebrates; 2.7 million for threadfin shad (whole body); 4.2 million for bluegill (fillet); and 10 million for spotted bass (fillet).

Kuwabara et al. (2005) conducted field and laboratory studies in April and November 2002 to provide the first direct measurements of the benthic flux of dissolved mercury species (total and methylated forms) between the bottom sediment and water column at three sampling locations within Camp Far West Reservoir: one near the Bear River inlet to the reservoir; a second at a mid-reservoir site of comparable depth to the inlet site; and the third at the deepest position in the reservoir near the dam. Results were reported in molar quantities and are not reproduced here. Kuwarbara et al. (2005) observed seasonal and spatial variation in benthic flux, and suggest the information can inform reservoir management to minimize methylmercury production.

Finally, the California Office of Environmental Health and Hazard Assessment (OEHHA 2009) implemented the following safe eating guidelines for fish in Camp Far West Reservoir based on mercury:

- Women between ages 18 to 45 and children between ages 1 to 17 should not consume more than one serving per week of bluegill or other sunfish species. OEHHA recommended that this group not consume any black bass or catfish species from the reservoir.
- Men over age 17 and women over age 45 should not consume more than three servings per week of bluegill or other sunfish. OEHHA recommended that this group not consume more than one serving per week of black bass or catfish species from the reservoir.

3.2.2.10.2 Lower Bear River

SSWD found two sources of information related to mercury in the lower Bear River.

The Oroville Project relicensing (DWR 2004a) FERC Project No. 2100 included collection of a total of 29 water samples at one location in the Bear River downstream of Camp Far West Reservoir, representing sixteen 30-day average samples. The total recoverable mercury concentrations in water ranged from 2.6 ng/l to 20.8 ng/l with an average of 0.84 ng/l for the sixteen 30-day average samples. None of the sixteen 30-day average samples exceeded the EPA (California Toxics Rule) mercury-based numeric criterion for human health.

Grenier et al. (2007) collected fish samples from various Sacramento-San Joaquin rivers and streams, including the lower Bear River. Fish were sampled for tissue analysis at one location

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from this reach, near Highway 70. A total of 5 out of 21 samples exceeded the EPA fish tissue criterion for human health. The average wet weight mercury concentration in fish tissue was 0.21 ppm for all 21 samples collected. The number of fish collected per sample, the measured mercury concentrations in fish tissue, and the number of exceedances are, by species: redear sunfish–10 samples, 0.07-0.42 ppm (average 0.14 ppm), 1 exceedance; Sacramento pikeminnow – 4 samples, 0.30-0.51 ppm (average 0.40 ppm), 4 exceedances; Sacramento sucker – 4 samples, 0.06-0.25 ppm (average 0.14 ppm), no exceedances; spotted bass – 3 samples, 0.25-0.27 ppm (average 0.26 ppm), no exceedances. All 21 samples were collected from fish with total lengths greater than 150 mm, which represent fish most commonly caught and consumed by sport fishers and their families.

3.2.2.11 Known or Potential Project Effects

Provided below is a list of known or potential Project effects on water resources. The list was developed based on responses to SSWD's PAD Information Questionnaire and SSWD's current understanding of the issues.

- From Responses to SSWD's PAD Information Questionnaire:
  - Water fluctuations in the reservoir due to Project operations may affect water temperature in the reservoir (identified by CDFW).
  - Water fluctuations in the reservoir due to Project operations may affect connectivity of the reservoir to upstream tributaries (identified by CDFW).
  - Amount of water released from the dam due to Project operations may affect water temperature in Bear River downstream of dam (identified by CDFW).
  - Amount of water released from the dam due to Project operations may affect the size and extent of the wetted channel and streambed area in the Bear River downstream of the dam (identified by CDFW).
  - Project operations and maintenance may affect water quality within the reservoir and in the Bear River and tributaries upstream and downstream of the reservoir (identified by CDFW).
  - Bioaccumulation of mercury and other toxins in reservoir and stream fish may present a public health hazard (identified by CDFW).
  - Project operations modify the flow regime below dams (identified by FWN).
  - Project operations modify the flow regime in bypass reaches and capture sediment in Project reservoirs and diversion pools making the mercury bioavailable to aquatic biota (identified by FWN).
- From SSWD:
  - Project operations may affect downstream water deliveries to SSWD and CFWID.
  - Project operations may affect SSWD's ability to continue to meet its obligations as part of the Bay-Delta Agreement.

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3.2.2.12 List of Attachments

There are no attachments to this section.

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