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Modesto Irrigation District
The Power to Grow

January 29, 2014
Via Electronic Filing

UL11-1-000
La Grange

The Honorable Kimberly D Bose
Federal Energy Regulatory Commission
888 First Street NE
Washington DC 20426

RE: La Grange Project FERC No. UL11-1-000
Filing of Pre-Application Document
Commencement of Project Licensing

Dear Ms. Bose:

Turlock Irrigation District ("TID") and Modesto Irrigation District ("MID") (collectively, the "Districts"), co-owners of the La Grange diversion dam located on the Tuolumne River, are herewith filing their Pre-Application Document ("PAD") to commence the licensing proceedings for an original license for the project. The Districts are proposing to use the Traditional Licensing Process ("TLP") for the following reasons:

- Most of the studies needed to inform the development of license conditions have already been conducted as part of the on-going Don Pedro Project (FERC No. 2299) relicensing;

- Studies not yet conducted and specific to the La Grange development are not expected to be complex and the Districts anticipate being able to cooperatively develop these study scopes with interested parties; and

- The TLP should be less demanding on all parties in the first year of the process and this is especially worthwhile given the number and scope of other FERC-related relicensing activities currently underway in California.

The PAD was prepared in accordance with Section 5.5 of FERC's regulations. By this letter, the Districts also request to be designated as the Commission's non-federal representative for purposes of consultation under Section 7 of the federal Endangered Species Act and the joint agency regulations thereunder at 50 CFR Part 402, Section 305(b) of the Magnuson Stevens Fishery Conservation and Management Act. Likewise, the Districts request authorization to initiate consultation under Section 106 of the National Historic Preservation Act.

The Districts have developed an initial Licensing Participants Contact List, which is included in Appendix A of the PAD. A public website has been established to facilitate licensing communications at www.lagrange-licensing.com.

The Districts look forward to working with Commission staff and all interested parties throughout the licensing process.

Sincerely,

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cc: Licensing Participants Contact List

Enc: La Grange PAD with Appendices A, B, C, and D

LA GRANGE PROJECT

PRE-APPLICATION DOCUMENT

Prepared by:
Turlock Irrigation District
Turlock, California
and
Modesto Irrigation District
Modesto, California

January 2014

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ACRONYM LIST

ac-ft	acre-feet
APE	Area of Potential Effects
Basin Plan	Central Valley Regional Water Quality Control Board's (CVRWQCB) Water Quality Control Plan
BLM	Bureau of Land Management
CCIC	Central California Information Center
CCSF	City and County of San Francisco
CD	Compact Disc
CDFA	California Department of Food and Agriculture
CDFG	California Department of Fish and Game (as of January 2013, CDFW)
CDFW	California Department of Fish and Wildlife
CDPR	California Department of Parks and Recreation
CDMG	California Division of Mines and Geology
CDSOD	California Division of Safety of Dams
CDWR	California Department of Water Resources
CEII	Critical Energy Infrastructure Information
CESA	California Endangered Species Act
CFR	U.S. Code of Federal Regulations
cfs	cubic feet per second
CGS	California Geological Survey
CMAP	California Monitoring and Assessment Program
CNDDB	California Natural Diversity Database
CNPS	California Native Plant Society
CORP	California Outdoor Recreation Plan
CSAS	Central Sierra Audubon Society
CVRWQCB	Central Valley Regional Water Quality Control Board
DLA	Draft License Application
DO	dissolved oxygen
DOI	U.S. Department of Interior
DPRA	Don Pedro Recreation Agency
DPS	Distinct Population Segment
EFH	Essential Fish Habitat
ESA	Endangered Species Act
FE	Federally Endangered
FERC	Federal Energy Regulatory Commission
FFS	Foothills Fault System
FLA	Final License Application
FP	fully protected
FPA	Federal Power Act
FT	Federally Threatened
GLO	General Land Office Maps
HHWP	Hetch Hetchy Water and Power
HPMP	Historic Properties Management Plan
ILP	Integrated Licensing Process
ITA	Indian Trust Assets
kv	kilovolt
kW	Kilowatt

LGP	La Grange Project
M&I	municipal and industrial
mg/L	milligrams per liter
MID	Modesto Irrigation District
mm	millimeters
msl	mean sea level
MW	megawatt
MWh	megawatt hour
mya	million years ago
NAHC	Native American Heritage Commission
NEPA	National Environmental Policy Act
NGO	Non-governmental organization
NHPA	National Historic Preservation Act
NMFS	National Marine Fisheries Service
NRHP	National Register of Historic Properties
O&M	operation and maintenance
PAD	Pre-Application Document
POAOR	Public Opinions and Attitudes in Outdoor Recreation
ppt	Parts per trillion
PSP	Proposed Study Plan
RM	River Mile
RSP	Revised Study Plan
RTE	rare, threatened, and endangered
SD1	Scoping Document 1
SD2	Scoping Document 2
SE	State Endangered
SFP	California State listed as Fully Protected
SHPO	State Historic Preservation Officer
SR	California State listed as Rare
SRA	State Recreation Area
SSC	Species of Special Concern
SSJNWA	Sierra-San Joaquin Noxious Weeds Alliance
ST	State Threatened
TAC	Technical Advisory Committee
TCP	Traditional Cultural Property
TID	Turlock Irrigation District
TLP	Traditional Licensing Process
USACE	U.S. Army Corps of Engineers
USDA	U.S. Department of Agriculture
USFS	U.S. Department of Agriculture, Forest Service
USFWS	U.S. Fish and Wildlife Service
USGS	U.S. Geological Survey
USR	Updated Study Report
WRCC	Western Regional Climate Center
WSNMB	Western Sierra Nevada Metamorphic Belt
YOY	young-of-year

1.0 BACKGROUND

On December 19, 2012[1], the Federal Energy Regulatory Commission (FERC) issued an order from the Director of the Division of Hydropower and Administration finding that the La Grange Project (LGP) was subject to FERC's licensing jurisdiction under Part I of the Federal Power Act (FPA). On January 18, 2013, Turlock Irrigation District (TID) and Modesto Irrigation District (MID) (collectively, the Districts) filed a timely request for rehearing and stay of the jurisdictional order. FERC subsequently issued on July 19, 2013[2] an order affirming the original December 19, 2012 jurisdictional order. On September 13, 2013, the Districts filed an appeal of this decision in the Court of Appeals for the District of Columbia Circuit.

The jurisdictional order requires, in part, that the Districts file within 90 days of the order date, a schedule for submitting a license or exemption application for the LGP within 36 months of the December 19, 2012 order. The Districts filed the required process plan and schedule on March 18, 2013 targeting a filing date of July 29, 2013 for the Pre-Application Document (PAD). On June 27, 2013[3] FERC issued an Order Modifying and Granting Extension of Time that extended the deadlines of the December 19, 2012 jurisdictional order by six months, establishing the new PAD filing deadline as January 29, 2014.

The Districts have prepared and issued this Pre-Application Document to commence the licensing process for their La Grange Project. The PAD contains existing information about the LGP and also relies heavily on information contained in or provided in the relicensing proceedings for the Districts' upstream Don Pedro Project (FERC No. 2299).

[1] 141 FERC ¶ 62,211 (2012)
[2] 144 FERC ¶ 61,051 (2012)
[3] 143 FERC ¶ 62,223 (2013)

2.0 LICENSING PROCESS PLAN, SCHEDULE, AND COMMUNICATIONS GUIDELINES

2.1 Description of Turlock Irrigation District and Modesto Irrigation District

Turlock Irrigation District (TID) and Modesto Irrigation District (MID) (collectively, the Districts) are public agencies with headquarters located in Turlock and Modesto, California, respectively, organized under the laws of the State of California to provide water and retail electric services to their respective service territories. TID was established in June 1887 and was California's first publicly owned irrigation district. TID provides irrigation water to 150,000 acres of land and serves approximately 100,000 electric customers in a 662-square-mile electric service area (TID 2010). MID was established in July 1887. MID provides irrigation water to almost 60,000 acres of land and serves approximately 111,000 electric customers in a 560-square-mile electric service area (MID 2010). MID also supplies treated municipal water to the City of Modesto (population 210,000) and the Districts jointly provide treated water to the community of La Grange.

Together, the Districts own the La Grange diversion dam located on the Tuolumne River in Tuolumne County, California. Ownership of the diversion dam is shared by the Districts: 31.54 percent MID and 68.46 percent TID. The Districts use the La Grange diversion dam to withdraw water from the Tuolumne River to irrigate approximately 210,000 acres of Central Valley farmland (TID/MID 2010). A power station owned by TID alone, with a capacity of less than 5 megawatts (MW), is situated on the south side of the Tuolumne River with an intake located just upstream of the TID Upper Main Canal headworks.

2.2 Process Plan and Schedule

2.2.1 Licensing Schedule

With this PAD filing, the Districts are requesting FERC approval to use the Traditional Licensing Process (TLP) to license the LGP instead of the default Integrated Licensing Process (ILP). Support for this request is provided in the PAD transmittal letter which documents that the TLP is a better process fit for the La Grange original licensing due to the amount of existing data from the ongoing Don Pedro relicensing that will be used to support this application and the likelihood that most of the resource issues that involve the lower Tuolumne River are being evaluated through the ongoing Don Pedro project relicensing proceeding. FERC regulations at Title 18 of the U.S. Code of Federal Regulations (18 CFR), Part 4, Section 4.38 establish the schedule of activities and milestone dates to which the Districts, FERC, federal and state resource agencies, local governments, Native American tribes, members of the public, and all parties interested in the licensing are responsible for meeting.

Table 2.2.1-1 provides the major regulatory milestones and associated deadlines for the La Grange licensing process under the TLP. The Districts developed the table using the time frames set forth in 18 CFR §4.38, which represents a revision to the proposed schedule filed with FERC on March 18, 2013, under Docket No. UL11-1.

Table 2.2.1-1 LGP proposed TLP process plan and schedule.

18 CFR §	Lead	Activity	Time Frame	Date[4]
First Stage Consultation				
5.3 and 5.6	TID/MID	File PAD and Request to Use TLP	Filing deadline established by FERC on June 27, 2013	1/29/14
5.3(d)(2)	TID/MID	Publish notice of PAD filing in daily newspaper	Concurrent with PAD filing	1/29/14
5.3(d)(1)	Licensing Participants	Comments on request to use the TLP due	30 days from PAD and TLP request filing	2/28/14
5.8(a)	FERC	FERC Issues Notice of Commencement of Proceeding and decision on use of TLP	Within 60 days of filing PAD (up to day 60)	3/30/14
(b)(2)	FERC	FERC Request to Initiate Informal Consultation under Section 7 of the ESA and Section 106 of the NHPA	Within 60 days of filing PAD (up to day 60)	
4.38(b)(3)(i)	TID/MID	Notify FERC and the Public of Joint Meeting Details	At least 15 days prior to meeting date	4/14/14
4.38(b)(3)(i)	TID/MID	Joint Meeting and Site Visit	Between 30 and 60 days of FERC approving use of TLP	5/28/14 & 5/29/14
4.38(b)(5)	Licensing Participants	File Comments on PAD and submit Study Requests	Within 60 days of Joint Meeting	7/28/14
Second Stage Consultation[5]				
4.38(c)	TID/MID	Develop Draft Study Plans for Review and Comment by Licensing Participants	After comments on PAD and study request deadline has passed	August – September 2014
4.38(c)	TID/MID	Distribute Draft Study Plans for Review and Comment		September 2014
4.38(c)	Licensing Participants	Comments filed on Draft Study Plans	No regulatory timeframes specified. Proposed schedule would provide for a 60-day comment period.	November 2014
NA	TID/MID	Study Plan Negotiation Meeting (if needed)	Voluntary	December 2014
4.38(c)	TID/MID	Final Study Plans Distributed if revisions to Draft Study Plans are needed.	No regulatory deadline under TLP	January 2015
4.38(c)	TID/MID	Conduct one season of Field Studies and finalize Study Reports to distribute as part of Draft License Application	Scheduled to fit field seasons as identified in study plans	March 2015 – October 2015
4.38(c)(4)	TID/MID	Develop and distribute Draft License Application for review and comment	Approximately 6 months before Final License Application is Due	December 2015
4.38(c)(5)	Licensing Participants	File Comments on Draft License Application	Within 90 days following filing of DLA	March 2016
4.38(c)(6)	TID/MID	Hold Joint Substantive Disagreement Meeting (if needed)	Within 60 days of DLA comment deadline.	April 2016

[4] Any deadlines that fall on a non-business day for FERC are extended to the next business day.
[5] First stage consultation ends 60 days after the Joint Meeting unless extended by FERC to address any study disputes filed, which will result in schedule modifications.

18 CFR §	Lead	Activity	Time Frame	Date[4]
4.38(d)	TID/MID	Deadline to File Final License Application[6]	FLA filing deadline established by FERC in its 12/19/12 Order and extended 6 months on 6/27/13	06/19/2016

Table 2.2.1-1 shows that the Joint Public Meeting and Site Visit is scheduled to occur on May 28 and 29, 2014. This date may be adjusted by FERC and the schedule shown is subject to minor adjustments throughout the licensing proceeding. The Districts have posted the above schedule on the licensing website (www.lagrange-licensing.com) and will update the schedule regularly.

2.2.2 Proposed Location and Dates of Joint Public Meeting and Site Visit

The Districts are proposing to conduct the Joint Public Meeting and Site Visit as required under 18 CFR § 4.38(b)(3)(A). As shown on the above process schedule, the joint public meeting and site visit are proposed to occur on May 28 and May 29, 2014. The Districts propose the following:

- **Proposed Site Visit** - Wednesday, May 28, 2014 from 10am to 3pm at La Grange diversion dam.
- **Proposed Joint Public Meetings** – Wednesday, May 28, 2014 from 7pm to 10pm in Turlock, California and on Thursday, May 29, 2014 from 9am to 12pm in Modesto, California.

A detailed agenda for the site visit and meetings will be issued by April 28, 2014.

2.3 Communications Guidelines

2.3.1 Licensing Contact List

The Districts have established and will maintain a Licensing Participants Contact List (Contact List) of all participants who express to the Districts an interest in the licensing and who have provided to the Districts an e-mail address for contact. Appendix A to this PAD contains the initial Contact List derived from the Don Pedro proceeding without any email addresses.

Besides an e-mail address, the Districts will request that each agency, tribe, and non-governmental organization (NGO) provide appropriate information (i.e., name, title, affiliation, mailing address, and telephone and fax numbers) for their designated contacts. The Districts assume that those designated contacts will keep the appropriate members of their agency, tribe, or NGO advised of licensing activities. Also, the Districts anticipate that each agency, tribe, and NGO will notify the Districts if contact information for its designated contact changes.

To keep the Contact List current, the Districts intend to periodically issue an e-mail to all those on the list asking for each contact to confirm he or she wishes to remain on the Contact List. The Districts will assume that those who do not respond are no longer interested in the licensing and may delete those individuals from the Contact List.

[6] The post-filing third stage consultation under the TLP begins with the filing of the Final License Application.

Because the Districts understand that many people are uncomfortable if their contact information is made available on the Internet, the Districts will not post participants' e-mail addresses, phone numbers, or personal residence addresses on the licensing website.

2.3.2 Licensing Website

The Districts have established and will make reasonable efforts to update a publicly accessible Internet website. The website will serve as a convenient means of making information available regarding the licensing to participants. Examples of information on the website include FERC filings, FERC orders regarding the licensing, and licensing documents such as any proposed study plans, revised study plans, and license application as they are developed.

The website will also provide a schedule of events and activities, including meeting dates, meeting agendas, and alerts to future anticipated filings or document distribution. The Districts' project licensing website can be accessed at www.lagrange-licensing.com.

2.3.3 Meetings

The Districts anticipate that meetings sponsored by another party (e.g., FERC or a licensing participant other than the Districts) will be organized, noticed, run by, and followed up on by that other party. The guidelines the Districts will follow for Districts-sponsored meetings are provided below.

2.3.3.1 Meeting Locations and Start Time

Meeting locations, including those for regularly scheduled meetings, and start times will be selected by the Districts. Meeting start times and locations will be posted on the licensing website event calendar described below.

2.3.3.2 Event Calendar

An event calendar that includes scheduled meetings will be maintained on the licensing website. The calendar will provide details such as location and a notice/agenda for the meeting. After a meeting has occurred, the calendar will provide the notice/agenda, the completed sign-in sheet, and any formal presentations made by the Districts or other parties at the meeting.

2.3.3.3 Meeting Notice/Agenda

The Districts will provide a notice for meetings that they conduct. The Districts will make a good-faith effort to issue an e-mail to the Licensing Participants Contact List giving those on the list early notice that the meeting has been scheduled.

It is the Districts' goal to issue to licensing participants an e-mail indicating that a meeting is scheduled and that an agenda, meeting details, and meeting materials are available on the website, all in advance of the meeting. If the notice/agenda changes, the Districts will make a good faith effort to issue an e-mail to licensing participants describing the change.

To the extent appropriate, standard items on each meeting agenda will include:

- Introductions
- Purpose of meeting
- Review of agenda
- Administrative items, if any
- Status reports, if any
- Set date and agenda for next meeting

Also, those who plan to attend a Districts-sponsored meeting should understand that those at the meeting may re-organize the agenda or proceed through agenda items at a quicker or slower pace than anticipated when the agenda was developed.

2.3.3.4 Telephone Access to Meetings

The Districts believe that participation in a meeting in-person rather than by telephone is more effective. However, to accommodate constrained schedules, to encourage participation, and to make meetings as accessible as possible to meeting participants, the Districts will attempt to arrange a telephone call-in line for a licensing participant (if the meeting room has such capabilities) if requested at least three days in advance of the meeting. The quality of the phone connection is not guaranteed, nor is the licensing participant ensured that all material reviewed at the meeting will be made available or forwarded to the person(s) calling in to the meeting. "Live Meeting" service may be available at certain meetings.

2.3.3.5 Meetings

The Districts are committed to conducting an open process with a free exchange of information and interests among all licensing participants. The Districts will lead and facilitate Districts-sponsored licensing meetings and will make a good-faith effort to ensure that all meeting participants have adequate opportunity to express ideas, concerns, and opinions. The Districts request that all licensing participants make a good-faith effort to arrive at meetings on time, read background information provided before each meeting, and be prepared to discuss topics on the meeting agenda. The Districts will promote professionalism, courtesy, and respect at all meetings.

2.3.3.6 Meeting Action Items

Licensing meetings may result in action items and/or decisions. To capture these meeting results, Action Items will be recorded and provided in a meeting summary. Detailed meeting notes will not be provided by the Districts.

The Districts will endeavor to update and post the meeting summary on the website in a timely fashion after each meeting.

2.3.3.7 Confidential Information

Some meetings and information prepared for or shared during a meeting may be confidential. For example, information on Native American resources and locations of sensitive environmental and cultural resources are considered confidential material with restrictions on their distribution. Any licensing participant providing confidential information under applicable law or regulations must identify the information as confidential in advance of disclosure.

2.4 Documents

FERC's regulations identify a number of documents that will be prepared as part of the licensing process. In accordance with relevant regulations, either FERC, the applicant, or in some instances another party may be responsible for producing these documents.

2.4.1 FERC's Documents

For documents issued by FERC, FERC will distribute the documents in accordance with FERC's protocols. All documents issued or received by FERC will be posted and publicly available in the e-Library on FERC's website at www.ferc.gov. To register, a licensing participant should go to FERC's website, click on "Documents and Filing," and then "eSubscription." FERC's website provides further instructions.

2.4.2 Non-Licensee Generated Documents

Any licensing participant that creates, files with FERC, or distributes a document including correspondence is responsible for the distribution of the document as may be required or appropriate. A licensing participant should not assume that by using the "Reply All" function in a Districts-generated e-mail that all licensing participants will receive her or his e-mail.

2.4.3 Documents Prepared by TID/MID

The Districts anticipate using FERC's e-Filing whenever possible for documents filed with FERC, and the Districts anticipate also distributing documents by e-mail or Compact Disc (CD), as appropriate. The distribution will also go to FERC's Service List after FERC establishes a formal Service List. Documents will also be uploaded to the licensing website and an e-mail distributed to the Contact List to notify licensing participants. The Districts plan to use e-mail for distribution of informal documents it initiates, and will post on the licensing website all public documents (e.g., letters addressed to the Districts) regarding the licensing. Routine e-mail communications will not be posted to the licensing website; however, e-mails that are transmitting comments on draft or final documents will be posted.

2.4.4 Availability of Information in the PAD

In accordance with 18 CFR 5.6(c)(2) and 5.2, the Districts will provide source documents on the existing environment and on known or potential resource impacts described in the PAD to anyone who requests the information and will make a good faith effort to provide the document within 20 days of receipt of request. The document may be provided electronically (e.g., by e-mail or on CD) unless the requester asks for the information in hard copy. Except for agencies, the Districts may charge a reasonable cost for copying and postage for the requested material.

2.5 Interparty Communications

The Districts understand that all licensing participants are at liberty to communicate with each other; however, all parties are encouraged to share relevant communications with all licensing participants as appropriate. Telephone calls among licensing participants will be treated informally, with no specific documentation.

3.0 PROJECT FACILITIES AND OPERATIONS

This section of the PAD provides details about the ownership, history, facilities, and operation of the La Grange diversion dam and powerhouse.

3.1 Project Ownership

Turlock Irrigation District (TID) and Modesto Irrigation District (MID) are public agencies with headquarters located in Turlock and Modesto, California, respectively. Both Districts are organized under the laws of the State of California to provide water supplies and retail electric services. Together, the Districts own the La Grange diversion dam located on the Tuolumne River in Tuolumne County, California. Ownership of the diversion dam is shared by the Districts: 31.54 percent MID and 68.46 percent TID. The Districts use the La Grange diversion dam to withdraw water from the Tuolumne River to irrigate approximately 210,000 acres of Central Valley farmland (TID/MID 2010). TID owns and operates the La Grange powerhouse.

TID was established in June 1887 and was California's first publicly owned irrigation district. TID provides irrigation water to 150,000 acres of land and serves approximately 100,000 electric customers in a 662-square-mile electric service area (TID 2010). MID was established in July 1887. MID provides irrigation water to almost 60,000 acres of land and serves approximately 111,000 electric customers in a 560-square-mile electric service area (MID 2010). MID also supplies treated municipal water to the City of Modesto, and the Districts provide treated drinking water to the community of La Grange.

3.2 Project Purpose

Originally constructed between 1891 and 1893, the purpose of the dam is to raise the level of the Tuolumne River to permit the diversion of water from the Tuolumne River for irrigation of Central Valley farmland, and municipal and industrial (M&I) water supply. The La Grange diversion dam is jointly owned by the Districts, which combined forces to build the diversion dam to divert stream flows the Districts had rights to in the Tuolumne River. The La Grange diversion dam replaced the Wheaton dam built by other parties in the early 1870s. La Grange diversion dam was constructed at the downstream end of a narrow, steep-sided canyon, the walls of which contain the pool formed by the diversion dam.

3.3 Project Location

The La Grange diversion dam is located on the Tuolumne River near the border of Stanislaus and Tuolumne counties in central California at River Mile (RM) 52.2. The intakes for the TID powerhouse are located just upstream of TID's Upper Main Canal headworks.

3.4 Project Facilities

The current La Grange Project (LGP) can be considered to include the diversion dam, impoundment, two penstock intakes, TID's sluiceway, two penstocks, a powerhouse, excavated tailrace, and substation. The general site arrangement is depicted in Figure 3.4-1 and individual descriptions of the primary facilities of the LGP are provided below.

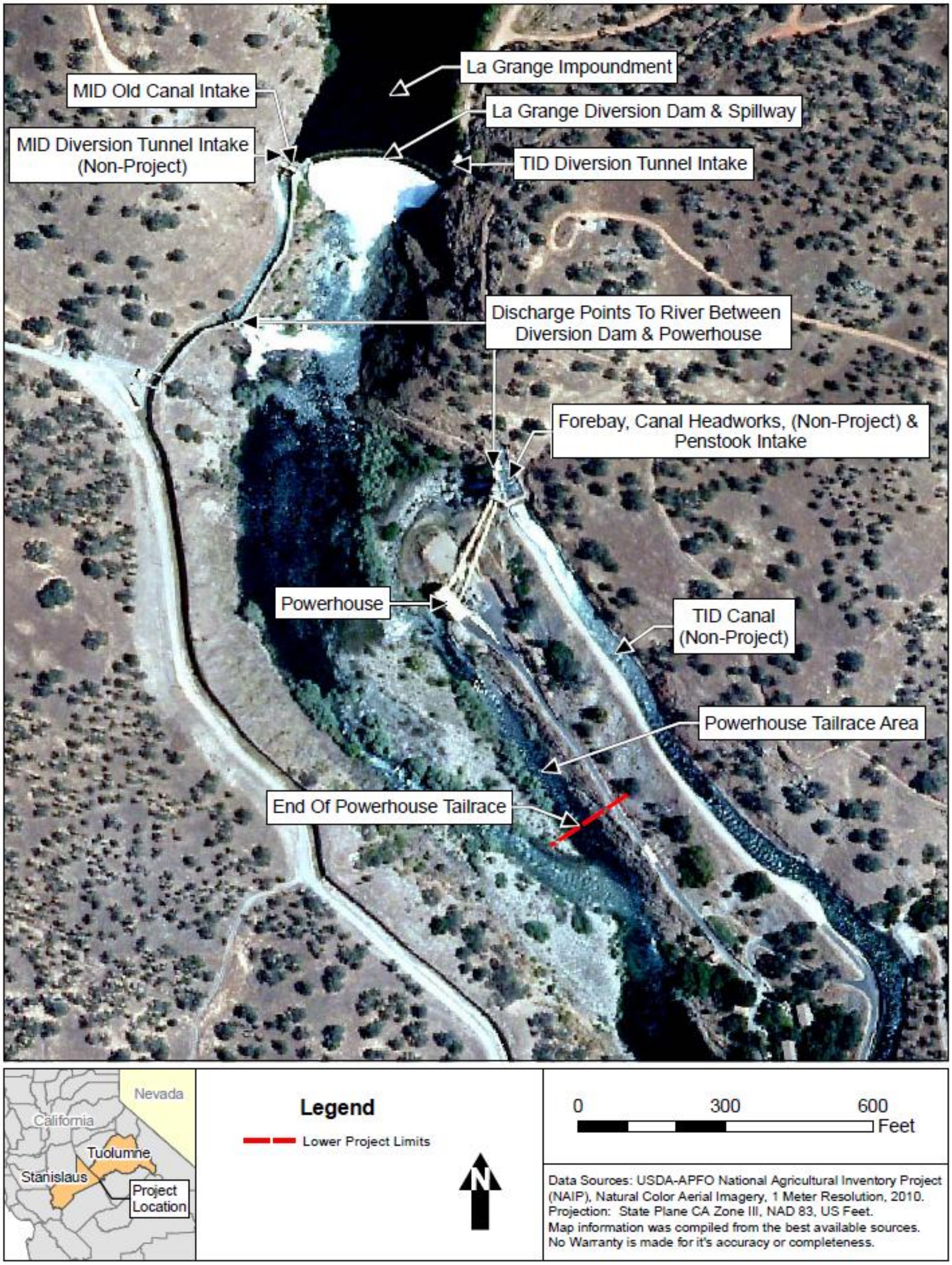

Figure 3.4-1 La Grange site plan.

3.4.1 Diversion Dam and Spillway

Construction of La Grange diversion dam started in the fall of 1891 and was completed in December 1893. The original 127.5-foot-high arched dam was constructed of boulders set in concrete and faced with roughly-dressed stones from a nearby quarry. In 1923, an 18-inch-high concrete cap was added, and in 1930 an additional 24-inch-high concrete cap was added, resulting in the final and current height of 131 feet. The two raises to the crest elevation were for the purpose of increasing the flows that could be diverted to each of the Districts' irrigation canals.

The dam was constructed such that the top of the dam is almost entirely a spillway. The spillway crest is at elevation 296.5 feet (all elevations are referenced to 1929 National Geodetic Vertical Datum) and has a length of 310 feet. A rating curve for the spillway is presented in Table 3.4.1-1.

Table 3.4.1-1 Rating table for La Grange spillway.

Reservation Elevation	Discharges in CFS			
ft.	0.00	0.25	0.50	0.75
296	-	-	10	120
297	320	600	980	1,350
298	1,800	2,280	2,780	3,400
299	4,010	4,680	5,380	6,150
300	6,900	7,720	8,560	9,410
301	10,310	11,300	12,300	13,350
302	14,500	15,590	16,680	17,900
303	19,100	20,290	21,500	22,700
304	23,900	25,050	26,800	28,400

There have been no significant modifications to La Grange diversion dam and spillway since 1930, except for routine maintenance and repairs (Figures 3.4.1-1 and 3.4.1-2).

Figure 3.4.1-1 La Grange diversion dam from old MID irrigation canal on right bank.

Figure 3.4.1-2 La Grange diversion dam from TID intake on left bank. Note water flow from MID old canal to river below.

3.4.2 Impoundment

The drainage area of the Tuolumne River upstream of the La Grange diversion dam is approximately 1,550 square miles. Flows from the drainage area above La Grange diversion dam are controlled by four upstream reservoirs: Hetch Hetchy, Lake Eleanor, Cherry Lake, and Don Pedro. Don Pedro is owned jointly by the Districts, and the other three dams are owned by the City and County of San Francisco (CCSF). Inflow to the LGP is the sum of releases from the Don Pedro Project (FERC No. 2299) located 2.3 miles upstream, and minor contributions from small intermittent streams. Under normal river flows, the pool formed by the La Grange diversion dam extends for approximately one mile upstream. The diversion dam was constructed for the purpose of raising the level of the Tuolumne River to a height which enabled gravity flow of diverted water into the Districts' irrigation systems. When not in spill mode, the water level above the diversion dam is between 294 feet and 296 feet approximately 90 percent of the time. Within that two feet, the pool storage is estimated to be less than 100 acre-feet of water.

3.4.3 Intakes and Tunnels

As mentioned above, La Grange diversion dam was constructed to permit the diversion of irrigation water and M&I water into the Districts' water delivery systems. MID's system is located on the north (right, looking downstream) side of the river and TID's is on the south (left) side. Water released from the upstream Don Pedro Project is either diverted by TID or MID at the La Grange diversion dam or passes to the lower Tuolumne River. MID's tunnel intake is located on the north end of the dam, and TID's tunnel intake is located on the south end of the diversion dam. The Districts' irrigation canals were constructed such that approximately 68 percent of diverted flow was routed to the TID system and 32 percent to the MID system. Annual water diversions and streamflows are provided in Table 3.4.3-1.

The intake to the MID tunnel is located in the face of a cliff on the right bank about 100 feet upstream of La Grange diversion dam. The MID tunnel and intake are considered non-project facilities as they are not used in any way in conjunction with power generation at the LGP. The following information on these facilities is being provided for information purposes only. The invert of the MID tunnel is at elevation 277.4 feet. Flow is conveyed through the 15-foot, 6-inch-diameter tunnel for 895 feet to a control structure. Flow is then conveyed through a 5,300-foot-long tunnel to an outlet structure which controls flow to the MID non-project Main Canal. The design flow rate for this tunnel is approximately 2,000 cubic feet per second (cfs). Due to continuing maintenance and repair issues experienced along its upper Main Canal, MID constructed the second tunnel in 1987/1988 to replace the upper section of the Main Canal. The MID intake and tunnel provide water to MID's non-project irrigation and M&I water systems (Figure 3.4.3-1).

Table 3.4.3-1 Flows downstream of La Grange diversion dam, water deliveries to TID and MID, and total Don Pedro Project outflows, 1997-2009.

Month	Mean Monthly Flow (cfs)*													Mean Monthly Flow (cfs)	Highest Mean Monthly Flow (cfs)	Lowest Mean Monthly Flow (cfs)
	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009			
USGS 11289650 – Tuolumne River Below La Grange diversion dam Near La Grange, CA (River in-stream flow only)																
Jan	13,070	2,114	1,247	324	325	177	184	223	187	4,456	353	171	165	1,769	13,070***	165
Feb	8,116	6,168	4,903	2,284	1,273	172	185	220	1,823	2,373	358	173	168	2,170	8,116***	168
Mar	2,443	5,407	3,285	4,602	615	165	182	1,098	3,875	4,234	357	172	169	2,046	5,407	165
Apr	1,457	5,392	2,034	1,548	558	665	685	1,010	4,524	7,436	487	533	372	2,054	7,436	372
May	953	3,621	1,697	1,164	706	419	477	412	4,868	7,847	385	680	687	1,840	7,847	385
Jun	269	4,433	284	340	54	97	234	127	3,809	4,657	127	95	149	1,129	4,657	54
Jul	290	2,845	287	421	89	88	243	108	1,913	834	114	93	107	572	2,845	88
Aug	287	1,019	259	603	110	86	236	106	773	584	110	99	102	336	1,019	86
Sep	285	1,423	294	473	112	68	250	110	328	412	89	97	106	311	1,423	68
Oct	465	628	424	412	189	202	297	209	464	449	141	174	In	338	628	141
Nov	380	316	338	347	184	191	231	186	369	379	174	161	WY	271	380	161
Dec	330	1,321	336	334	177	187	226	178	1,285	352	169	164	2010	422	1,321	164
USGS 11289000 – Modesto Canal Near La Grange, CA																
Jan	6	117	66	237	72	40	76	87	83	143	9	27	31	76	237	6
Feb	168	56	47	72	142	67	58	44	204	135	113	45	29	91	204	29
Mar	642	121	301	231	213	434	328	355	260	142	348	346	219	303	642	121
Apr	601	250	630	586	607	720	325	720	450	249	483	575	474	513	720	249
May	872	310	697	659	773	724	605	653	665	716	682	656	573	660	872	310
Jun	701	655	769	733	802	791	801	751	695	802	763	646	716	740	802	646
Jul	962	787	781	915	905	891	894	825	1,043	846	803	748	791	861	1,043	748
Aug	813	869	927	878	767	707	825	704	827	824	781	793	721	803	927	704
Sep	550	482	566	474	567	583	525	461	604	594	411	506	474	523	604	411
Oct	347	344	334	293	387	358	380	270	299	304	321	301	In	328	387	270
Nov	78	73	195	44	36	105	172	84	141	173	162	100	WY	114	195	36
Dec	26	86	72	75	72	58	13	43	126	8	9	18	2010	50	126	8
USGS 11289500 – Turlock Canal Near La Grange, CA																
Jan	387	69	506	0	91	27	6	25	316	299	164	4	82	152	506	0
Feb	599	326	313	0	8	6	323	302	339	529	257	101	151	250	599	0
Mar	1,457	454	623	603	595	1,023	637	1,035	872	644	1,113	1,132	601	830	1,457	454
Apr	1,222	699	1,304	1,135	1,110	1,249	771	1,272	1,184	529	1,082	866	1,013	1,034	1,304	529
May	1,710	800	1,321	1,246	1,455	1,121	1,073	1,336	1,256	1,339	1,166	1,136	1,021	1,229	1,710	800

Month	Mean Monthly Flow (cfs)*													Mean Monthly Flow (cfs)	Highest Mean Monthly Flow (cfs)	Lowest Mean Monthly Flow (cfs)
	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009			
Jun	1,445	1,243	1,525	1,725	1,664	1,483	1,639	1,552	1,504	1,624	1,599	1,310	1,525	1,526	1,725	1,243
Jul	2,081	1,817	1,938	1,898	1,805	1,817	1,883	1,840	1,917	2,000	1,816	1,572	1,899	1,868	2,081	1,572
Aug	1,587	1,681	1,796	1,784	1,526	1,489	1,516	1,510	1,706	1,674	1,494	1,314	1,482	1,581	1,796	1,314
Sep	812	977	952	1,063	825	736	714	617	991	936	631	571	793	817	1,063	571
Oct	505	613	566	527	445	358	742	577	259	379	305	129	In	450	742	129
Nov	30	0	59	24	4	22	1	1	3	8	35	2	WY	16	59	0
Dec	109	0	301	173	12	94	36	12	27	1	45	149	2010	80	301	0
USGS 11289651 – Combined Flow Tuolumne River + Modesto Canal + Turlock Canal (~total Don Pedro Project outflow)*																
Jan	13,630	2,301	1,818	561	489	244	266	335	585	4,897	525	203	278	2,010	13,630	203
Feb	8,885	6,551	5,262	2,355	1,424	245	565	566	2,365	3,038	728	320	348	2,512	8,885	245
Mar	4,544	5,983	4,210	5,435	1,423	1,622	1,146	2,487	5,005	5,020	1,818	1,651	989	3,179	5,983	989
Apr	3,280	6,341	3,968	3,269	2,276	2,634	1,781	3,001	6,158	8,211	2,052	1,973	1,860	3,600	8,211	1,781
May	3,535	4,732	3,714	3,067	2,935	2,263	2,155	2,402	6,790	9,902	2,234	2,472	2,280	3,729	9,902	2,155
Jun	2,415	6,332	2,579	2,796	2,519	2,371	2,672	2,430	6,009	7,083	2,488	2,049	2,391	3,395	7,083	2,049
Jul	3,333	5,448	3,006	3,234	2,798	2,795	3,021	2,772	4,872	3,678	2,732	2,414	2,798	3,300	5,448	2,414
Aug	2,687	3,569	2,982	3,264	2,403	2,281	2,578	2,319	3,305	3,082	2,385	2,205	2,304	2,720	3,569	2,205
Sep	1,647	2,882	1,812	2,009	1,504	1,386	1,489	1,188	1,922	1,942	1,130	1,175	1,371	1,651	2,882	1,130
Oct	1,318	1,584	1,324	1,231	1,021	917	1,419	1,055	1,021	1,133	766	604	In	1,116	1,584	604
Nov	489	389	592	415	224	318	404	270	513	559	371	263	WY	401	592	224
Dec	466	1,407	709	582	261	339	275	233	1,437	361	223	330	2010	552	1,437	223

*Values Calculated using USGS NWIS monthly statistics module: http://waterdata.usgs.gov/nwis/nwisman/?site_no=11289650&agency_cd=USGS,
http://waterdata.usgs.gov/nwis/nwisman/?site_no=11289000&agency_cd=USGS,
http://waterdata.usgs.gov/nwis/nwisman/?site_no=11289500&agency_cd=USGS, and
http://waterdata.usgs.gov/nwis/nwisman/?site_no=11289651&agency_cd=USGS
** Some values rounded by USGS - sum of individual gage monthly mean flows may not precisely equal combined gage monthly mean flows.
***The flood of record occurred in January, 1997, with high reservoir releases continuing on into February, 1997. These values skew the January and February mean monthly flow averages for the 1997 to 2009 period. Without 1997 values, the mean monthly flow in January is 827 cfs and February is 1,675, compared to 1,769 and 2,170 cfs, respectively.

Figure 3.4.3-1 Abandoned MID main canal on right bank.

The TID intake and tunnel is located on the left bank of the La Grange spillway just upstream of the diversion dam and consists of two separate structures. The first part of the intake contains two 8-foot by 11-foot, 10-inch-high control gates driven by electric motor hoists. The second part, located to the left of the first part, contains a single 8-foot by 12-foot control gate (Figure 3.4.3-2).

Figure 3.4.3-2 TID diversion tunnel entrance on left bank.

The second part of the intake was added in 1980 for the purpose of increasing the delivery capability to TID's irrigation canal system by reducing head losses through the single intake and lowering the tunnel invert. Flows from the intake control gates are conveyed to a 600-foot-long tunnel to the 110-foot-long forebay for the TID non-project Main Canal. The forebay was also modified in 1980. Flows to TID's irrigation system are regulated at the non-project canal headworks consisting of six slide gates, each 5-foot-wide by 8-foot, 4-inch-tall.

3.4.4 Forebay, Canal Headgates, and Powerhouse Intake

Flow from the TID tunnel discharges nearly 600 feet downstream from the intake into a concrete forebay that contains the TID non-project irrigation canal headworks and, separately, the penstock intake structure. At the tunnel outlet portal, the forebay invert is approximately 18 feet wide and gradually expands to 39 feet wide at the face of the irrigation canal headworks facility. The forebay runs 118 feet along the centerline of flow and is constructed with a gradual bend to the south as it enters the TID non-project Upper Main Canal.

The original invert of the forebay was constructed at an elevation of approximately 281.2 feet, but was excavated and rebuilt at a lower elevation of nearly 278 feet as a result of the 1980 work to improve the delivery capacity to the TID Upper Main Canal.

At the west side of the canal a trashrack structure and three 7.5-feet-wide by 14-feet-tall concrete intake bays make up the powerhouse intake structure. There are no automatic gates to control these bays. Manually-operated steel gates are used to shut off flows through these intakes. Immediately upstream and adjacent to the penstock intakes are two automated 5-feet-high by 4-feet-wide sluice gates that discharge water over a steep rock outcrop to the tailrace channel just upstream of the powerhouse.

The TID irrigation canal headworks structure was originally constructed with five 5-feet-wide by 8-feet, 4-inch-tall outlets which are all controlled by fabricated steel gates. In 1980, a sixth gate was added as part of the rehabilitation of the forebay. The sixth gate that was added matches the original gate dimensions. All of the 1980 modifications were performed to improve the control of flows as part of improvements to the TID irrigation system (Figure 3.4.4-1).

Figure 3.4.4-1 TID forebay and penstock intake. Flow is being discharged at the forebay sluice gates.

3.4.5 Canals

Since the late 1800s, the Districts have made, over time, improvements to their irrigation water delivery systems extending from La Grange diversion dam to Turlock Lake and Modesto Reservoir and throughout their service territories. These changes were performed by the Districts in their role as responsible managers of the irrigation and M&I water supply provided to their respective service territories. These improvements enabled the Districts to more effectively control flows in their irrigation canals. These improvements included tunnel improvements in 1980 and irrigation canal, forebay, and headgate improvements in 1988/1989. As required as responsible water resource managers, canal system modifications will continue to occur in the future. None of these changes modified the power-generating capability or equipment of the La Grange power plant and none were undertaken for the purpose of changing power plant output, nor did they affect power plant output.

The La Grange diversion dam diverts water to both the TID and MID Main Canals which provide water to serve the Districts' irrigation and M&I customers. Water flows approximately 12 miles through the MID Main Canal to Modesto Reservoir. Based on records from the U.S. Geological Survey (USGS) Gage 11289000 located on the MID canal, the highest mean monthly flow for the MID canal since 1997 occurred in July 2005 and was 1,043 cfs. (Table 3.4.3-1).

The TID Upper Main Canal is controlled by the canal headgate structure and flows nearly 8 miles downstream to Turlock Lake. Downstream of Turlock Lake, the TID Main Canal begins to branch off for water deliveries through the Highline Canal, Ceres Main Canal, and Turlock Main Canal.

In 1980, portions of the TID Main Canal between the forebay and Turlock Lake were modified to increase irrigation flow capacity to approximately 3,000 cfs to enable TID to better manage its irrigation water supply. Since 1997, the highest mean monthly flow for the canal occurred in July 1997 at 2,081 cfs (Table 3.4.3-1).

3.4.6 Powerhouse

The La Grange powerhouse is located approximately 0.2 miles downstream of the La Grange diversion dam on the south (left) bank of the Tuolumne River. The power plant is owned and operated by TID. Water diverted through the TID intake and tunnel to the Upper Main Canal forebay can flow from the irrigation canal forebay into two penstocks that deliver flow to the powerhouse. The 2-unit powerhouse was built in 1924. The powerhouse is a 72-foot by 29-foot structure with a reinforced concrete substructure and steel superstructure. The intakes for the two penstocks are located in the right side of the forebay. The penstock for Unit 1 is a 235-foot-long, 5-foot-diameter riveted steel pipe. The penstock for Unit 2 is a 212-foot-long, 7-foot-diameter riveted steel pipe.

There have been no modifications to the penstock intakes, penstocks, or powerhouse since its original construction in 1924 except for routine maintenance and repairs or changes made to accommodate TID's irrigation system improvements (Figure 3.4.6-1).

Figure 3.4.6-1 Penstock, powerhouse, tailrace, and switchyard.

3.4.7 Turbines, Generators, and Accessory Equipment

The La Grange powerhouse contains two turbine-generator units originally installed circa 1924/1925 (Bechtel Civil 1987). The turbine of the smaller unit contains a Voith runner rated, at its cavitation limit, at 1,650 horsepower at 140 cfs and 115 feet of net head. The larger unit also contains a Voith runner rated, at its cavitation limit, at 4,950 horsepower at 440 cfs and 115 feet of net head. The actual net head at the plant varies with flow; the net head affects flow capacity and unit output. The runners in the original 65-year-old, turbine-generator units were replaced with the current Voith runners in 1989.

Historically, the flow capacity of the original 1924 units exceeded 600 cfs (Bechtel Civil 1987). The units with the Voith replacement runners have a combined capacity of about 570 cfs at the guaranteed maximum capacity (i.e., their cavitation limit). The original Unit 1 design was an unconventional configuration, even for the 1910/1920s, consisting of a single horizontal Francis turbine coupled to two 500-kilowatt (kW) generators, one on each side of the turbine (Bechtel Civil 1987).

This two-generator configuration was replaced with an industry-standard single-generator configuration as part of the 1989/1990 rehabilitation work. The original Unit 2 design was a conventional configuration consisting of a single vertical Francis turbine coupled to a single 3,750 kW generator (Bechtel Civil 1987).

3.4.8 Substation and Transmission Line

There are no FERC-jurisdictional transmission lines associated with the LGP. The transmission line connecting the LGP to the grid originates at the 4.16/69 kilovolt (kV) transformer in the substation located on the east side of the powerhouse. This transmission line connects to both TID’s Tuolumne Line No. 1 and its’ Hawkins Line. In the event that the Project powerhouse is decommissioned in the future, this transmission line would need to be retained to provide power needed to operate the gates associated with the irrigation canal systems. Therefore, under FERC’s transmission line jurisdictional criteria, the transmission line currently serves as part of the existing distribution/transmission grid and is, therefore, not under FERC jurisdiction. A single-line diagram of the grid connection is provided in Figure 3.4.8-1.

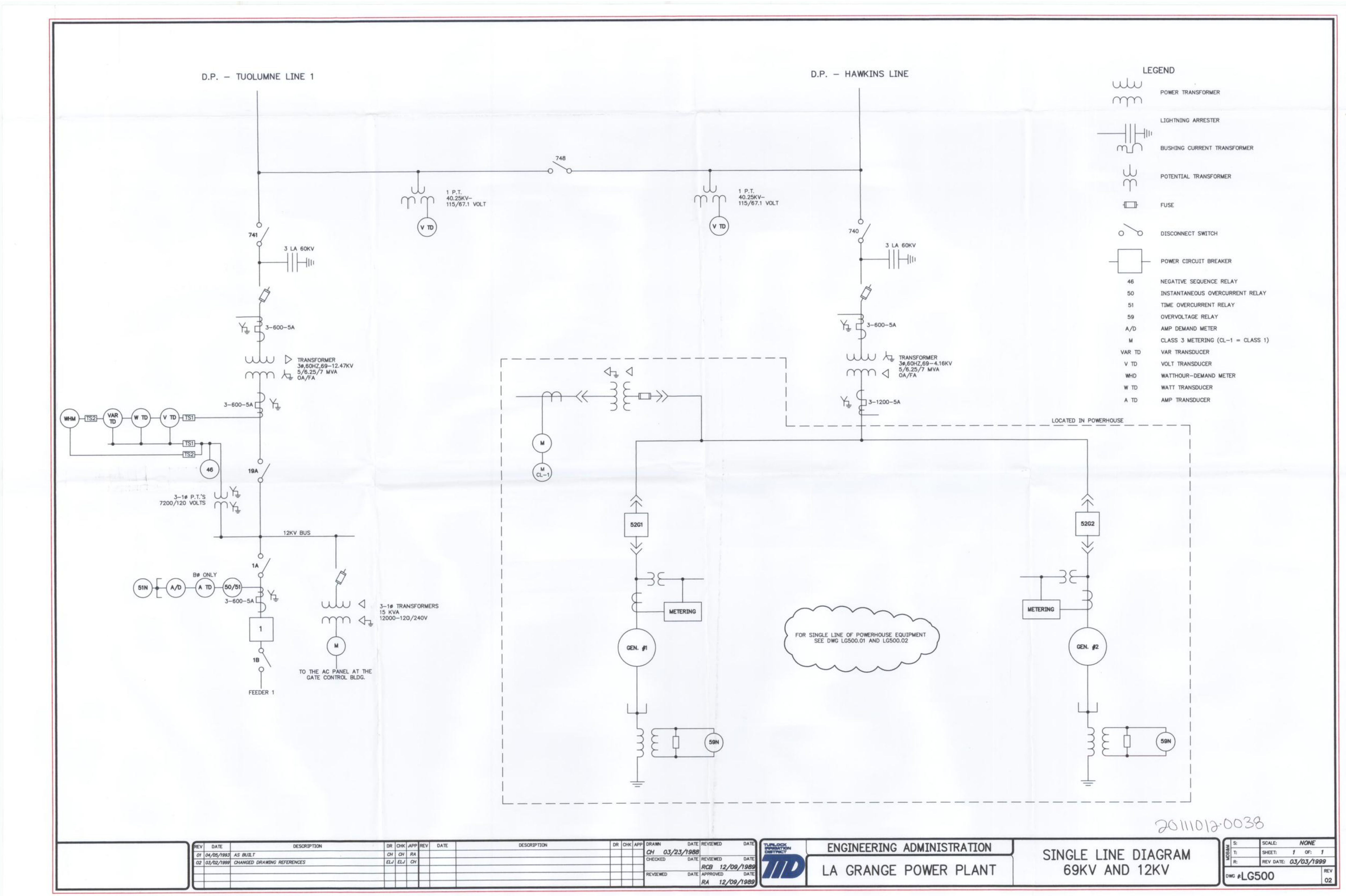

Figure 3.4.8-1 Single line diagram showing grid connection.

3.4.9 Recreation facilities

There are no designated recreation facilities associated with the LGP.

3.5 LGP Operations

The LGP operates in a run-of-river mode. As mentioned previously, it was originally constructed in 1891-1893 to raise the level of the Tuolumne River so as to permit the diversion and delivery of water by gravity means to TID's and MID's irrigation and M&I systems. The diversion dam is located at the exit of a narrow canyon and the impounded water provides little to no active storage.

Therefore, the La Grange diversion dam acts as a diversion dam delivering flow through its tunnel intakes to the TID and MID canal systems. Combined, these canals provide water to over 200,000 acres of prime Central Valley farmland and the City of Modesto for M&I uses.

All flows released from the Don Pedro Project, located upstream of La Grange diversion dam, either are diverted by TID and/or MID, or are spilled over the La Grange spillway. Diverted water can be delivered to the Districts' irrigation water delivery systems or flow to the Tuolumne River below La Grange diversion dam. On the MID side of the river, sluice gates can deliver water to the river approximately 400 feet downstream of the dam. Normally, a flow of 25 cfs is discharged from these gates to the river. On the TID side of the river, diverted water can flow to the river through either two 5-feet-wide by 4-feet-high sluice gates located adjacent to the penstock intakes or through the La Grange powerhouse.

In 1996, FERC approved the Don Pedro Project Settlement Agreement (Settlement Agreement) for the upstream Don Pedro Project among the Districts, resource agencies, and conservation groups wherein the Districts agreed, as part of its Don Pedro Project operations, to provide increased flows in the lower Tuolumne River to be measured at a location downstream of the La Grange diversion dam. The FERC-required minimum flows are normally passed at La Grange diversion dam through the TID intake and tunnel, then via the penstocks and powerhouse. Turbine discharges at the La Grange powerhouse flow into a tailrace that joins the lower Tuolumne River about one-half mile below La Grange diversion dam. The two sluice gates in the canal forebay can also discharge flows into the tailrace. A description of La Grange flow-related operations was provided in the Districts' January 6, 2014, Updated Study Report filing as part of the Don Pedro Project and is provided as Appendix D to this PAD.

From 1980 to 1996, the average annual generation at the La Grange powerhouse was 15,608 megawatt hours (MWh), and ranged from a low of 514 MWh during the drought year of 1989 to a high of 38,150 MWh during the wet year of 1983. Subsequent to the 1996 implementation of the Settlement Agreement, the average annual generation at the La Grange powerhouse has been 19,638 MWh, with a low of 9,384 MWh in 2009 (dry year) and a high of 34,439 MWh in 2006 (wet year).

3.6 Flood Control Benefits

Since the LGP has no substantive usable storage capacity, this facility does not provide flood control benefits for downstream property owners or municipalities.

3.7 Proposed LGP Operations, Upgrades, or Changes in Operations

The Districts are not proposing any upgrades to the facilities or changes to the current operational mode of the LGP.

3.8 Proposed Project Boundary

The Districts will develop a proposed Project Boundary during development of the Draft License Application. In its filings made to date on the jurisdictional status of the LGP, the Districts have provided backwater modeling, analysis, and field survey information that demonstrates that the upper end of the La Grange impoundment, in accordance with FERC regulations, terminates approximately 5,400 feet above the La Grange diversion dam under normal river flows (TID 2011*b*).

The downstream portion of the proposed Project Boundary will be defined by metes and bounds that will encompass the primary LGP features related to hydropower generation and include only those lands needed and necessary to safely operate and maintain the FERC-jurisdictional aspects of the LGP and to provide adequate protection of affected shoreline resources. The upstream portion of the proposed Project Boundary will be defined as contour elevation consistent with the reservoir's normal high water elevation.

3.9 Project Drawings

Appendix B to this PAD provides a set of drawings showing details of the primary LGP facilities.

4.0 GENERAL DESCRIPTION OF RIVER BASIN

The 150-mile-long Tuolumne River begins at the confluence of the Dana Fork and the Lyell Fork in the Tuolumne Meadows area of Yosemite National Park. After traversing nearly 8,600 feet of elevation drop, the Tuolumne River flows into the San Joaquin River in the Central Valley region of California. The Tuolumne's route initially passes through high mountain valleys and deeply incised canyons, then through the foothills of the Sierra Mountains, thence out into and through the eastern side of the low-lying Central Valley. The 1,960-square-mile watershed can be subdivided into three river reaches—the upper Tuolumne River above roughly RM 80, the foothills reach between RM 54 and 80, and the valley reach from the mouth to RM 54. Figure 4.0-1 shows the Tuolumne River and its primary subbasins.

4.1 Lower Tuolumne River

The lower Tuolumne River watershed, the subbasin from RM 0 to 54, covers approximately 430 square miles of drainage area and contains one major tributary, Dry Creek. Other contributions come from Peaslee Creek as well as McDonald Creek (via Turlock Lake) primarily during and after storm events. In this reach, the Tuolumne River extends from about elevation 35 feet at the confluence with the San Joaquin River to elevation 300 feet at the tailrace of the Don Pedro powerhouse. The lower Tuolumne River watershed is long and narrow and is dominated by irrigated farmland and the urban/suburban areas associated with the City of Modesto, Waterford, and Ceres. Flows in the lower Tuolumne River are significantly controlled by La Grange diversion dam, a 131-foot-high diversion dam originally constructed in 1893 and jointly owned by the Districts, which divert flows from the Tuolumne River for irrigation, municipal, and industrial water supply purposes.

4.2 Geography and Topography of the Lower Tuolumne River

The Tuolumne River exits the Don Pedro Reservoir and enters the lower Tuolumne River area. This area of the watershed transitions from gently rolling hills near its easterly reaches to uniformly flat floodplain and terrace topography in the downstream direction. Soils are deep and fertile and irrigated agriculture and urban land use dominates the landscape.

The Tuolumne River downstream of La Grange diversion dam flows 52 river miles to its confluence with the San Joaquin River. The Tuolumne River leaves its steep and confined bedrock valley and enters the eastern Central Valley downstream of La Grange diversion dam near La Grange Regional Park, where hillslope gradients in the vicinity of the river corridor are typically less than five percent. From this point to the confluence with the San Joaquin River, the modern Tuolumne River corridor lies in an alluvial valley. Within the alluvial valley, the river can be divided into two geomorphic reaches defined by channel slope and bed composition: a gravel-bedded reach that extends from La Grange diversion dam (RM 52) to Geer Road Bridge (RM 24); and a sand-bedded reach that extends from Geer Road Bridge to the confluence with the San Joaquin River (McBain & Trush 2000). The gravel- and sand-bedded zones have been further subdivided into seven reaches based on present and historical land uses, the extent and influence of urbanization, valley confinement from natural and anthropogenic causes, channel substrate and slope, and salmonid use (McBain & Trush 2000).

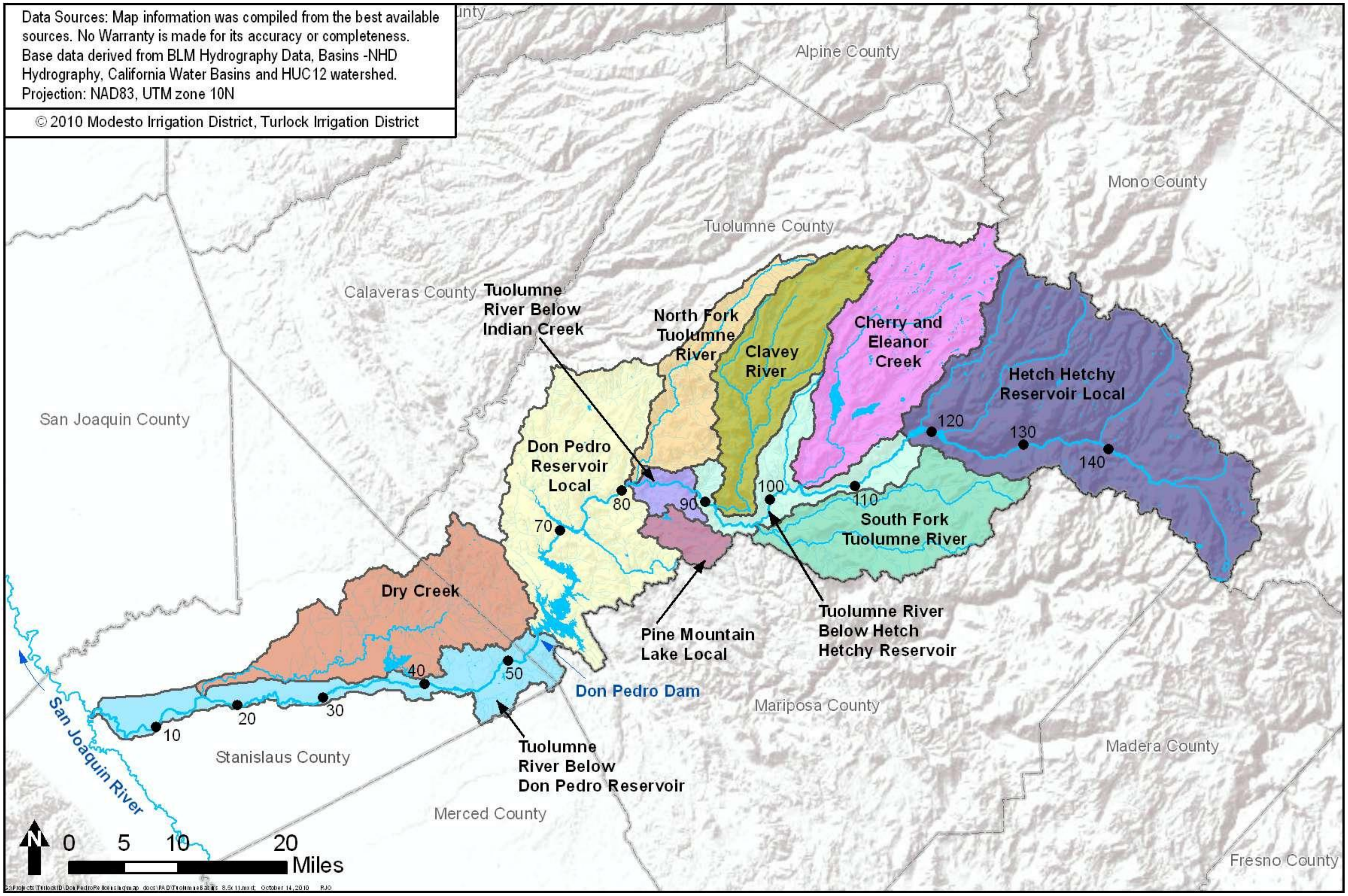

Figure 4.0-1 **Subbasins of the Tuolumne River watershed.**

The major reaches are:

- Reach 1 (RM 0-10.5): Lower sand-bedded reach,
- Reach 2 (RM 10.5-19.3): Urban sand-bedded reach,
- Reach 3 (RM 19.3-24.0): Upper sand-bedded reach,
- Reach 4 (RM 24.0-34.2): In-channel gravel mining reach,
- Reach 5 (RM 34.2-40.3): Gravel mining reach,
- Reach 6 (RM 40.3-45.5): Dredger tailing reach, and
- Reach 7 (RM 45.5-52.1): Dominant salmon spawning reach.

Large-scale anthropogenic changes have occurred to the lower Tuolumne River corridor since the California Gold Rush in 1848. Gold mining, grazing, and agriculture encroached on the lower Tuolumne River channel before the first aerial photographs were taken by the Soil Conservation Service in 1937. Excavation of bed material for gold and aggregate to depths below the river thalweg eliminated active floodplains and terraces and created large in- and off-channel pits. Agricultural and urban encroachment in combination with reduction in coarse sediment supply and high flows has resulted in a relatively static channel within a narrow floodway confined by dikes and agricultural fields.

Although the tailing piles are primarily the legacy of gold mining abandoned in the early 20th century, gravel and aggregate mining continued alongside the river for a number of miles, particularly upstream of the town of Waterford around RM 32 (Tuolumne River TAC 2000). Downstream of Waterford, the Tuolumne River continues an increasingly-sinuous path across the agricultural lands of the Central Valley, through the City of Modesto. The Tuolumne River finds its confluence with the San Joaquin River approximately 15 river miles beyond Modesto, along the axis of California’s Central Valley.

4.3 Climate and Hydrology

The Tuolumne River watershed covers a total of approximately 1,960 square miles and encompasses a wide range of climates and hydrologic conditions, from the snowy high Sierra Mountains to the mild, Mediterranean climate and hot summers of California’s Central Valley. Precipitation varies substantially from year to year, as winter storms are driven by large-scale atmospheric disturbances originating in the Aleutian Island area of Alaska (U.S. Army Corps of Engineers [USACE] 1972). Larger streams are primarily snowmelt-driven, as rivers carry snowmelt runoff from the high Sierra down across the Central Valley, and normally receive only a relatively small proportion of their flows from rain-driven tributaries in the lower elevations. Small- to moderate-size drainages in the region are often ephemeral or intermittent, going dry or having only subterranean flow in most years during California’s parched summer and early-fall seasons.

4.3.1 Climate

The climate of the Tuolumne River basin varies considerably over the river’s 150-mile-long journey. Its western portion in the low-lying Central Valley is semi-arid and the high-peaks region at its eastern edge in the Sierra Mountains is wet.

The Tuolumne River area in the Sierra Nevada foothills where the LGP is located has what is often described as a Mediterranean-type climate: cool, wet winters with snow only rarely and hot, dry summers. From the foothills westward into the Central Valley, winter precipitation occurs mostly in the form of rain from the months of December through April. In the higher elevations of the Tuolumne River watershed, precipitation consists largely of snow in the winter with significant accumulation in the higher elevations from December through April, and seasonal snowmelt typically April through July. At these higher elevations, the occasional rain-on-snow events may cause large amounts of runoff in a short period of time during winter months. Annual precipitation in the Tuolumne River watershed ranges from 12 inches in the Central Valley to over 60 inches in the high mountain areas. Table 4.3.1-1 demonstrates the range of temperatures and precipitation in the basin.

Table 4.3.1-1 Monthly climatological data for the Tuolumne River area.

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Downstream of Don Pedro Project												
MODESTO, CALIFORNIA (WRCC Station No. 045738)												
Period of Record : 1/ 1/1931 to 12/31/2005, Approx. Elevation: 90 ft												
Avg. High (°F)	54°	61°	67°	73°	81°	88°	94°	92°	88°	78°	64°	54°
Avg. Low (°F)	38°	41°	44°	47°	52°	56°	60°	59°	56°	50°	42°	38°
Mean (°F)	46°	51°	55°	60°	66°	72°	77°	75°	72°	64°	53°	46°
Avg. Rainfall (in)	2.4	2.1	2.0	1.1	0.5	0.1	0	0	0.2	0.6	1.3	2.1
Avg. snowfall (in)	0	0	0	0	0	0	0	0	0	0	0	0
Near Don Pedro Project Area												
SONORA Ranger Station, CALIFORNIA (WRCC Station No. 048353)												
Period of Record : 1/11/1931 to 12/31/2005, Approx. Elevation: 1,750 ft												
Avg. High (°F)	55°	58°	62°	68°	77°	87°	95°	94°	88°	77°	64°	56°
Avg. Low (°F)	33°	35°	38°	41°	47°	52°	58°	57°	53°	45°	37°	33°
Mean (°F)	44°	47°	50°	55°	62°	69°	77°	75°	70°	61°	51°	45°
Avg. Precip. (in)	6.1	5.7	4.8	2.7	1.2	0.3	0.1	0.1	0.5	1.7	3.6	5.5
Avg. snowfall (in)	1.6	0.8	0.4	0.2	0	0	0	0	0	0	0	0.5
Upper Tuolumne River Basin												
HETCH HETCHY, CALIFORNIA (WRCC Station No. 043939)												
Period of Record : 1/ 7/1931 to 12/31/2005, Approx. Elevation: 3,780 ft												
Avg. High (°F)	48°	52°	57°	63°	70°	78°	86°	86°	81°	71°	58°	49°
Avg. Low (°F)	29°	30°	33°	37°	43°	50°	56°	55°	51°	42°	34°	30°
Mean (°F)	38°	41°	45°	50°	57°	64°	71°	71°	66°	57°	46°	39°
Avg. Precip. (in)	6.0	5.7	5.2	3.3	1.9	0.8	0.2	0.2	0.7	2.0	4.2	5.9
Avg. snowfall (in)	15.2	12.9	14.7	6.3	0.3	0	0	0	0	0.1	2.7	11.7
High-Sierra Nevada Climate (north of Tuolumne River watershed)												
TWIN LAKES, CALIFORNIA (WRCC Station No. 049105)												
Period of Record : 7/ 1/1948 to 8/31/2000, Approx. Elevation: 8,000 feet												
Avg. High (°F)	38°	40°	41°	47°	54°	63°	71°	70°	65°	56°	45°	39°
Avg. Low (°F)	16°	16°	18°	22°	29°	36°	43°	42°	39°	31°	23°	18°
Mean (°F)	27°	28°	30°	34°	42°	49°	57°	56°	52°	44°	34°	29°
Avg. Precip. (in)	9.0	7.3	6.7	3.9	2.5	1.1	0.7	0.7	1.2	2.6	6.1	7.8
Avg. snowfall (in)	79.5	73.3	75.9	36.6	14.5	2.3	0	0.2	1.1	10.3	40.9	66.4

Source: Western Regional Climate Center (WRCC) 2006; 2010

4.3.2 Hydrology

The hydrologic characteristics of the Tuolumne River and its tributaries vary significantly from its headwaters to its terminus at the San Joaquin River. As indicated by the climate data, the Tuolumne River spans two distinct hydrologic regimes: the snowmelt-driven system of the Sierra Nevada, present at the high elevations; and the rain-driven streams present at lower elevations.

4.3.3 Project Area within the Lower Tuolumne River

At Don Pedro dam, water flows from the powerhouse or outlet works and eventually into the reach of the Tuolumne River impounded by the La Grange diversion dam. From the La Grange impoundment, water is either diverted into MID's canal system to the north of the Tuolumne River and into TID's canal system to the south of the Tuolumne River, or flows into the lower Tuolumne River downstream of La Grange diversion dam.

Downstream of the LGP, the Tuolumne River becomes a lower gradient stream on its journey to the San Joaquin River. In this low-elevation area, the vast majority (around 75 percent) of local runoff occurs during winter rainstorms between December and March. Also contributing to flows within this region are natural inflows from Dry Creek and Peaslee Creek, as well as urban and agricultural runoff and operational spills from irrigation canals. Some of the streamflow in this area, however, is derived from groundwater inflow, and the lower Tuolumne River is generally considered to be a gaining stream (TID/MID 2013*g*). This groundwater contribution to the lower Tuolumne has not been well quantified.

4.4 Water Use in Lower Tuolumne River

Primary water uses in the lower Tuolumne River subbasin include irrigation, M&I, recreation, and protection and enhancement of anadromous fisheries. Annual average consumptive water use by the Districts is approximately 900,000 ac-ft. In addition, fish flows released by the Districts at Don Pedro dam vary from 94,000 to 301,000 ac-ft per year depending on water year type. The number of riparian water users and their consumptive use of Tuolumne River is unknown.

4.5 Designated Beneficial Uses of Tuolumne River Water

Beneficial use designations for the LGP and the rest of the Tuolumne River are established in Central Valley Regional Water Quality Control Board's (CVRWQCB) Water Quality Control Plan (Basin Plan) for the Sacramento and San Joaquin Rivers, the fourth edition of which was initially adopted in 1998 and most recently revised in 2011 (CVRWQCB 1998). The CVRWQCB identifies beneficial uses for the Tuolumne River water in three specific areas—from the source to Don Pedro Reservoir, at Don Pedro Reservoir, and from Don Pedro dam to the San Joaquin River. Table 4.5-1 provides the beneficial uses as specified by CVRWQCB for these three areas.

Table 4.5-1 Beneficial uses of Tuolumne River water.

Stream Reach	Designated Beneficial Uses E = existing beneficial use, P = potential beneficial use
Upper Tuolumne River	Municipal & Domestic Supply (MUN, E); Irrigation, Stock Watering (AGR, E); Power (POW, E); Contact recreation, Canoeing & Rafting[1] (REC-1, E); Other non-contact recreation (REC-2, E); Warm and Cold Freshwater Habitat (WARM, E; COLD, E); Wildlife Habitat (WILD, E)
Project Area	Municipal & Domestic Supply (MUN, P); Power (POW, E); Contact recreation (REC-1, E); Other non-contact recreation (REC-2, E); Warm and Cold Freshwater Habitat[2] (WARM, E; COLD, E); Wildlife Habitat (WILD, E)

Stream Reach	Designated Beneficial Uses E = existing beneficial use, P = potential beneficial use
Lower Tuolumne River	Municipal & Domestic Supply (MUN, P); Irrigation, Stock Watering (AGR, E); Contact recreation, Canoeing & Rafting[1] (REC-1, E); Other non-contact recreation (REC-2, E); Warm and Cold Freshwater Habitat[2] (WARM, E; COLD, E); Cold-water migration (MIGR COLD[4], E); Warm and Cold Spawning (SPWN WARM[3] and SPWN COLD[4], E); Wildlife Habitat (WILD, E)

1 Shown for streams and rivers only with the implication that certain flows are required for this beneficial use.

2 Resident does not include anadromous. Any segments with COLD and WARM beneficial use designations will be considered COLD water bodies for the application of water quality objectives.

3 Striped bass, sturgeon, and shad.

4 Salmon and steelhead.

Source: CVRWQCB 1998.

4.6 Tributary Information

The Tuolumne River originates in the high Sierra in Yosemite National Park. The Tuolumne River has several major tributaries upstream of the Project and very few tributaries downstream of the Project. Table 4.6-1 provides a list of the larger tributaries to the Tuolumne River from upstream to downstream and any known water regulating facilities on these tributaries.

Table 4.6-1 Major tributaries and secondary tributaries to the Tuolumne River.

Major Tributaries	Major Secondary Tributaries[1]	Dams, Lakes or Diversion Dams on Stream[2]
Upper Tuolumne River		
Lyell Fork	Rafferty Creek Ireland Creek Kuna Creek Maclure Creek	None known
Dana Fork	Parker Pass Creek	None known
Cathedral Creek	----	None known
Return Creek	Regulation Creek Matterhorn Creek Spiller Creek	None known
On Tuolumne River mainstem: Hetch Hetchy Reservoir	Immediate tributaries to Hetch Hetchy: Falls Creek TilTill Creek Rancheria Creek	CCSF’s O’Shaugnessy Dam - forms Hetch Hetchy Reservoir (360,400 ac-ft)
South Fork Tuolumne	Middle Fork Tuolumne Big Creek Crane Creek	None known
Cherry Creek	Granite Creek Eleanor Creek West Fork Cherry Creek North Fork Cherry Creek	CCSF’s Cherry Creek Dam - forms Lake Lloyd (274,300 ac-ft) CCSF’s Eleanor Dam - forms Lake Eleanor (26,110 ac-ft)
Jawbone Creek	----	None known
Clavey River	Bear Spring Creek Cottonwood Creek Reed Creek Hull Creek Trout Creek Bourland Creek Reynolds Creek Rock Creek Bell Creek	None known

Major Tributaries	Major Secondary Tributaries[1]	Dams, Lakes or Diversion Dams on Stream[2]
Indian Springs Creek	----	None known
Big Creek	----	Pine Mountain Lake (7,700 ac-ft, privately owned)
North Fork	Hunter Creek Duckwal Creek	None known
Turnback Creek	----	None known
Middle Tuolumne River		
Hatch Creek	First Creek Second Creek	None known
Moccasin Creek	----	Moccasin Creek tunnel (creek is diverted under CCSF's Moccasin Afterbay during all but largest storms and is usually tributary only to Don Pedro Project[3])
Grizzly Creek	----	None known
Rough and Ready Creek	----	None known
Sullivan Creek	----	Phoenix Reservoir (612 ac-ft, privately owned)
Woods Creek	----	None known
Big Creek	----	None known
West Fork Creek	----	None known
Lower Tuolumne River		
Twin Gulch	Gasburg Creek	Receives spillway water from Don Pedro Project
Dry Creek	----	None known

Notes:
1 USDOI, USGS 1:24,000 Scale Topographical maps.
2 USGS 1999.
3 CCSF 2006; Pers. Comm. B. McGurk, CCSF Hetch Hetchy Water and Power (HHWP) to J. Garza, HDR, Sept 2010.

The lower Tuolumne River contains very few tributaries. The only major tributary is Dry Creek, which joins the mainstem Tuolumne River from the north at the City of Modesto. Dry Creek is not gaged by the USGS; but during storm events the Districts consider inflows from Dry Creek and other sources to the lower Tuolumne River in accordance with flood control guidelines at the 9th Street Bridge in Modesto. In addition to Dry Creek and the smaller Peaslee and McDonald Creeks, the mainstem Tuolumne River gains flow from groundwater, local runoff, and agricultural return flows.

4.7 Basin Dams

There are several dams in the Tuolumne River watershed (the mainstem Tuolumne River and its tributaries), some of which are used for storage purposes and some of which are primarily diversion dams. Table 4.7-1 lists the owners of the known dams and diversion facilities in the Tuolumne River basin, generally from upstream to downstream, including the associated capacities where known. Table 4.7-2 provides information on known hydropower facilities in the Tuolumne River basin, including both small-hydro and conventional hydroelectric generation facilities.

Table 4.7-1 Owners and capacities of known dams or diversion facilities and their associated reservoirs in the Tuolumne River basin.

Owner	FERC Project No.	Stream	Dam or Diversion Dam	Reservoir or Impoundment Name (date completed)	Capacity (ac-ft)
CCSF	None	Tuolumne River	O'Shaughnessy Dam / diversion to Mountain Tunnel	Hetch Hetchy Reservoir (1923)	360,360 (USGS 1999)
CCSF	None	Eleanor Creek	Eleanor Dam	Lake Eleanor (1918)	26,146 (USGS 1999)
CCSF	None	Cherry Creek	Cherry Dam	Lake Lloyd (sometimes called Cherry Lake, 1960)	274,2520 (USGS 1999)
CCSF	None	Tuolumne River	Early Intake (facility used only for emergency diversions from Cherry Creek)	n/a (1924)	<100
CCSF	None	Off-stream	Priest Dam	Priest Forebay (1923)	1,500
CCSF	None	Off-stream (Moccasin Creek and all local runoff diverted under or around impoundment)	Moccasin Dam	Moccasin Afterbay	Approx. 500
Private	None	Big Creek	Pine Mountain Dam	Pine Mountain Lake (1969)	7,700 (USGS 1999)
Private	None	Sullivan Creek (receives diversion from SF Stanislaus)	Phoenix Dam	Phoenix Lake (1880)	612 (USGS 1999)
TID MID	2299	Tuolumne River	Don Pedro Dam	Don Pedro Reservoir (1971)	2,033,000
TID MID	None	Tuolumne River	La Grange Diversion Dam	La Grange Diversion Dam impoundment (1893)	<100
MID	None	Off-stream	Modesto Reservoir Dam	Modesto Reservoir (1911)	28,000
TID	None	Off-stream	Turlock Lake Dam	Turlock Lake (1914)	48,000
TID	None	Off-stream	Dawson Dam	Dawson Lake	Unknown

Source: USGS 1999; CCSF 2006.

Table 4.7-2 Hydropower generation facilities in the Tuolumne River watershed.

Owner	FERC Project No.	Powerhouse	Location / Description
CCSF	None	Robert C. Kirkwood Powerplant	124 MW; Completed 1967; water diverted from Hetch Hetchy Reservoir to powerhouse via Canyon Tunnel (CCSF 2006)
CCSF	None	Dion R Holm Powerplant	169 MW; Completed 1960; water diverted from Lake Lloyd via Cherry Power Tunnel (CCSF 2006)
CCSF	None	Moccasin Powerhouse (off-stream)	110 MW; water diverted to powerhouse via CCSF Mountain Tunnel by way of Priest Forebay (CCSF 2006)
MID TID	2299	Don Pedro Powerhouse	Immediately downstream of Don Pedro Dam; 4 units, authorized capacity 168 MW.
TID	None	La Grange Powerhouse	<5 MW Powerhouse; water source is TID Upper Main Canal.
TID	4450	Dawson Power Plant (off-stream)	5.5 MW; Small hydro located on TID Upper Main Canal between La Grange diversion dam and Turlock Lake
TID	3261	Turlock Lake (off-stream)	3.3 MW; Small hydro located at the outflow of the Districts' Turlock Lake
MID	290	Stone Drop (off stream)	230 kW; small hydro located on the MID main canal just below Modesto Reservoir
TID	1000	Hickman (off stream)	1,100 kW; Completed 1979, located on the TID Main Canal

5.0 DESCRIPTION OF ENVIRONMENTAL CONDITIONS

This section of the PAD contains a review of the existing environmental conditions and environmental resources in the general area of the La Grange Project (LGP). It is worth noting that the lower Tuolumne River has been the subject of a substantial amount of research and study over the past 40 years. More than 200 individual studies of fish and aquatic resources have been completed. Annual monitoring and investigation of aquatic resources continues, with the publication of eight additional studies in March 2010. In total, these studies provide a wealth of useful data and information and can only briefly be summarized herein. A literature reference list is provided in Section 6.0 of this PAD.

As part of the ongoing Don Pedro Project relicensing proceeding, the National Marine Fisheries Service (NMFS) requested information on the existing LGP facilities that influence flow allocation at the La Grange diversion dam. The Don Pedro Project Initial Study Report filed on January 16, 2013 included a section that identified existing information on the reach of the Tuolumne River from La Grange diversion dam to USGS gage no. 11289650. In the same section of the ISR, the Districts provided an analysis of the hydrologic effects of the LGP operations on flows in the Tuolumne River between La Grange diversion dam and USGS gage no. 11289650. The Districts also provided additional responses to NMFS study requests related to the LGP in the Don Pedro January 6, 2014 Updated Study Report. Appendix D of this PAD provides this additional information on the LGP filed as part of the Updated Study Report that addresses study requests NMFS-1, Elements 3 and 6 and NMFS-4.

5.1 Geology and Soils

5.1.1 Topography

The lands in the vicinity of the LGP are characterized as sloping with moderate to steep topography. The typical elevations of the LGP area range from approximately 175 to 300 feet above mean sea level (msl).

5.1.2 Geologic Setting

The LGP is located in the Western Sierra Nevada Metamorphic Belt (WSNMB), which is contained within the Sierra Nevada Block, a tilted fault block approximately 400 miles long that trends north-northwest, is 40 to 80 miles wide, and includes a broad region of foothills along the western slope of the Sierra Nevada Range (Harden 2004 *as cited in* TID/MID 2011). The eastern face of the tilted Sierra Nevada Block is high and rugged, consisting of multiple fault scarps (Eastern Sierra Nevada Frontal Shear Zone) separating it from the Basin and Range Province. This contrasts with the gentle western slope that disappears under sediments of the Great Valley. The Sierra Nevada block continues under the Great Valley and is bounded on the west by an active fold and thrust belt that marks the eastern boundary of the Coast Range Province (Wentworth and Zoback 1989 *as cited in* TID/MID 2011). The northern boundary of the tilted fault block is marked by the disappearance of typical Sierra bedrock under the volcanic cover of the Cascade Range. The southern boundary of the fault block is along the Garlock Fault located in the Tehachapi Mountains approximately 210 miles southeast of the LGP where characteristic rocks of the Sierra Nevada are abruptly truncated by this east-west fault system.

5.1.2.1 Geologic Rock Units

The Western Sierra Nevada Metamorphic Belt in the general vicinity of the LGP is composed of rocks of Paleozoic and early Mesozoic age (138 to 540 million years ago [mya]). The bedrock units include metamorphosed igneous and sedimentary rocks of oceanic origin intruded by younger Mesozoic age (65 to 138 mya) plutonic rocks and related dikes and vein deposits. The belt is the product of Mesozoic accretion (addition of crustal material) of oceanic terranes to the western North American margin (Dickinson 1981; Burchfiel and Davis 1982 *as cited in* TID/MID 2011). The metamorphic rocks are intruded to the south and east by granitic rocks of the Sierra Nevada Batholith. They are overlain to the west by Cretaceous and Tertiary sediments of the Great Valley Sequence and are overlain to the north by Tertiary and Quaternary volcanic rocks of the Cascade Mountains.

The whole Western Sierra Nevada Metamorphic Belt is divided into three lithotectonic subunits, designated the Western, Central, and Eastern belts (Schweickert and Cowan 1975; Day et al. 1985 *as cited in* TID/MID 2011). The LGP area is situated within the Central Belt. The Western and Central belts are composed of Paleozoic and Mesozoic serpentinized peridotite (ultramafic rock) and metamorphosed volcanic and sedimentary sequences. Both belts represent oceanic terranes (Schweickert and Cowan 1975; Bogen 1985; Tobisch et al. 1987 *as cited in* TID/MID 2011).

5.1.2.2 Faulting

The three lithotectonic subunits of the Western Sierra Nevada Metamorphic Belt are separated by steeply dipping major faults collectively referred to as the Foothills Fault System (FFS) (Clark 1960; Clark and Huber 1975 *as cited in* TID/MID 2011). The FFS is a zone of complex deformation developed during the Nevadan orogeny (mountain building) episode approximately 123 to 160 mya. The dominant sense of shear along the FFS is east over west (reverse faulting) with a small component of left-lateral offset (Clark 1960; Day et al. 1985; Newton 1986; Paterson et al. 1987; Schweickert et al. 1988; Gefell et al. 1989 *as cited in* TID/MID 2011). Right-lateral shear along the system occurred during the late stages of the Nevadan orogeny and during the early Cretaceous (Glazner 1991; Carlson et al. 1997; Unruh et al. 2003; Oldow 2003; Carlson et al. 2005 *as cited in* TID/MID 2011). Some of the fault segments in the system were reactivated during the Cenozoic Era (<65 mya), and some as recently as during the Quarternary (0-1.8 Ma). One segment was reactivated in the recent past (Cleveland Hills Fault located approximately 134 miles northwest of the LGP; Lake Oroville earthquake of August 1, 1975) (TID/MID 2011).

5.1.3 Geology

The area upstream of the LGP along the Tuolumne River is underlain by a series of bedrock and surficial deposits. From the base of Don Pedro dam, the river runs westerly in metavolcanic rock of the Jurassic age Gopher Ridge Formation, through which windows of underlying Cretaceous-age granitic rock crop out locally. To the west of the Gopher Ridge Formation, through most of the area above La Grange diversion dam, the river runs in slates of the Jurassic age Salt Springs and Merced Falls formations. West of the Salt Springs and Merced Falls slates, the river is underlain by the alluvium of Holocene Age and is locally flanked by historical dredge tailings. Most of the riverbed between La Grange Regional Park and the confluence with the San Joaquin River runs in alluvium of Holocene Age that overlies the Riverbank, Turlock Lake, and Modesto Formations of Pleistocene age. These units are in turn generally underlain by Cenozoic valley fill (TID/MID 2011).

Several unnamed faults related to the Bear Mountains Fault Zone cross the river in the LGP vicinity, striking northeasterly (Figure 5.1.3-1). These faults are considered conditionally active by the California Division of Safety of Dams (CDSOD). None of these faults are classified by the California Geological Survey (CGS) as active within Holocene time (movement within the last 11,400 years), but are considered potentially active by CGS (TID/MID 2011).

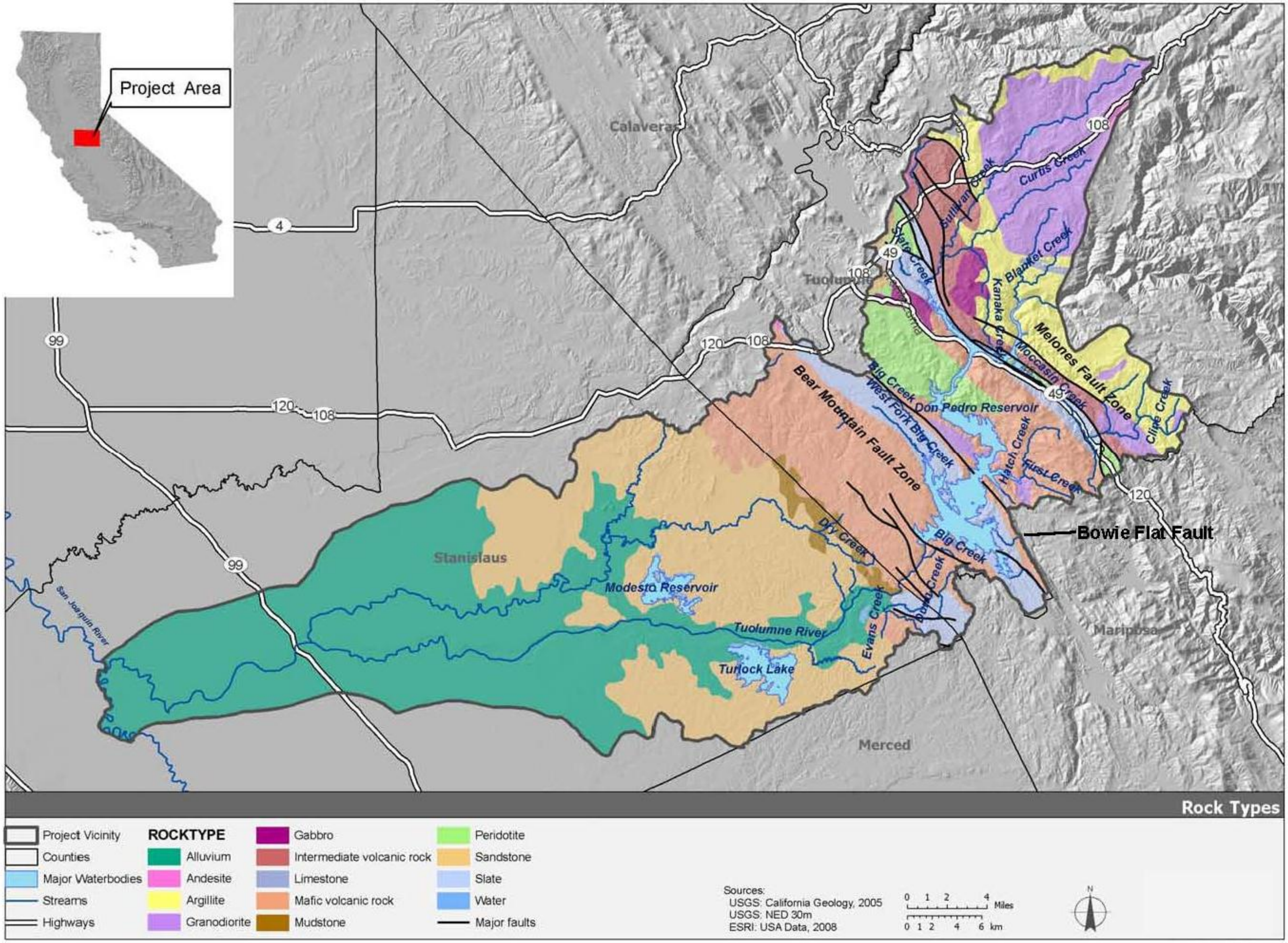

Figure 5.1.3-1 Geological map of the LGP vicinity showing major rock types and fault zones.

5.1.4 Tectonic History and Seismicity

The structural features within the Western Sierra Nevada Metomorphic Belt record deformation related to at least three orogenic (mountain building) events during the Devonian, Permian-Triassic, and Jurassic (Dickinson 1981 *as cited in* TID/MID 2011). The dominant northwest-trending structural grain of this Belt was imposed during the late Jurassic Nevadan orogeny (Schweickert 1981; Varga and Moores 1981; Schweickert et al. 1984; Day et al. 1985 *as cited in* TID/MID 2011). This deformation produced the FFS, the northwest-trending folds, a variably developed fabric in the rocks, and regional greenschist-facies metamorphism. Present studies show an upward movement of the Sierran block of 20 to 30 inches per century (Avendian 1978 *as cited in* TID/MID 2011). Most of the elevation of the Sierra Nevada range is due to late Cenozoic uplift and tilting associated with fault activity along the eastern margin (Wakabayashi and Sawyer 2001 *as cited in* TID/MID 2011). The range slopes gently westward from the crest and slopes abruptly eastward from the crest.

Near the western margin of the Sierra Nevada range in the vicinity of the LGP, the FFS is a dominant structural feature. This fault system is an anastomosing (braided or interwoven) complex of north-northwest-striking fault-related structures with serpentinized or mineralized zones and sheared contacts between rocks (Clark 1960 *as cited in* TID/MID 2011). There is one major fault zone in the FFS that crosses the Tuolumne River near the LGP vicinity (i.e., Bear Mountain Fault Zone) as shown in Figure 5.1.3-1 above. The Bear Mountain Fault Zone is oriented northwest/southeast and is located to the northeast of the LGP area (Figure 5.1.3-1). It is believed that the Bear Mountain Fault Zone represents a splay of the Melones Fault zone and that the two merge at depth. The California Division of Mines and Geology (CDMG) open File Report 84-52 (1994) reports that the Bear Mountain Fault zone did not warrant zoning as an active fault because it is poorly defined at the surface or lacks evidence of Holocene (recent) displacement (TID/MID 2011). The LGP vicinity has experienced seismic activity due to numerous earthquake events (Figure 5.1.4-1 below).

5.1.5 Mineral Resources

Past and present mines in the vicinity of the LGP are shown on Figure 5.1.5-1. The chief mineral commodity in the vicinity is gold. The immensely rich placers of Columbia and Springfield northwest of the Project produced approximately $55,000,000 in gold prior to 1899. The pocket mines of Sonora, Bald Mountain, and vicinity have also been highly productive and exceptionally long-lived (TID/MID 2011).

Marble and limestone products have been next to gold in value. The Columbia marble beds northwest of the LGP had a long history of production prior to 1941, and two plants are at present processing the stone from these deposits (TID/MID 2011).

California leads the nation in aggregate production and virtually all is removed from alluvial deposits (Kondolf 1995). As of 1994, sand and gravel mining exceeded the economic importance of gold mining in the state. Large-scale, in-channel aggregate mining began in the Tuolumne River corridor in the 1940s when aggregate mines extracted sand and gravel directly from large pits located within the active river channel. Off-channel aggregate mining along the Tuolumne River has also been extensive. Aggregate in Stanislaus County is currently classified

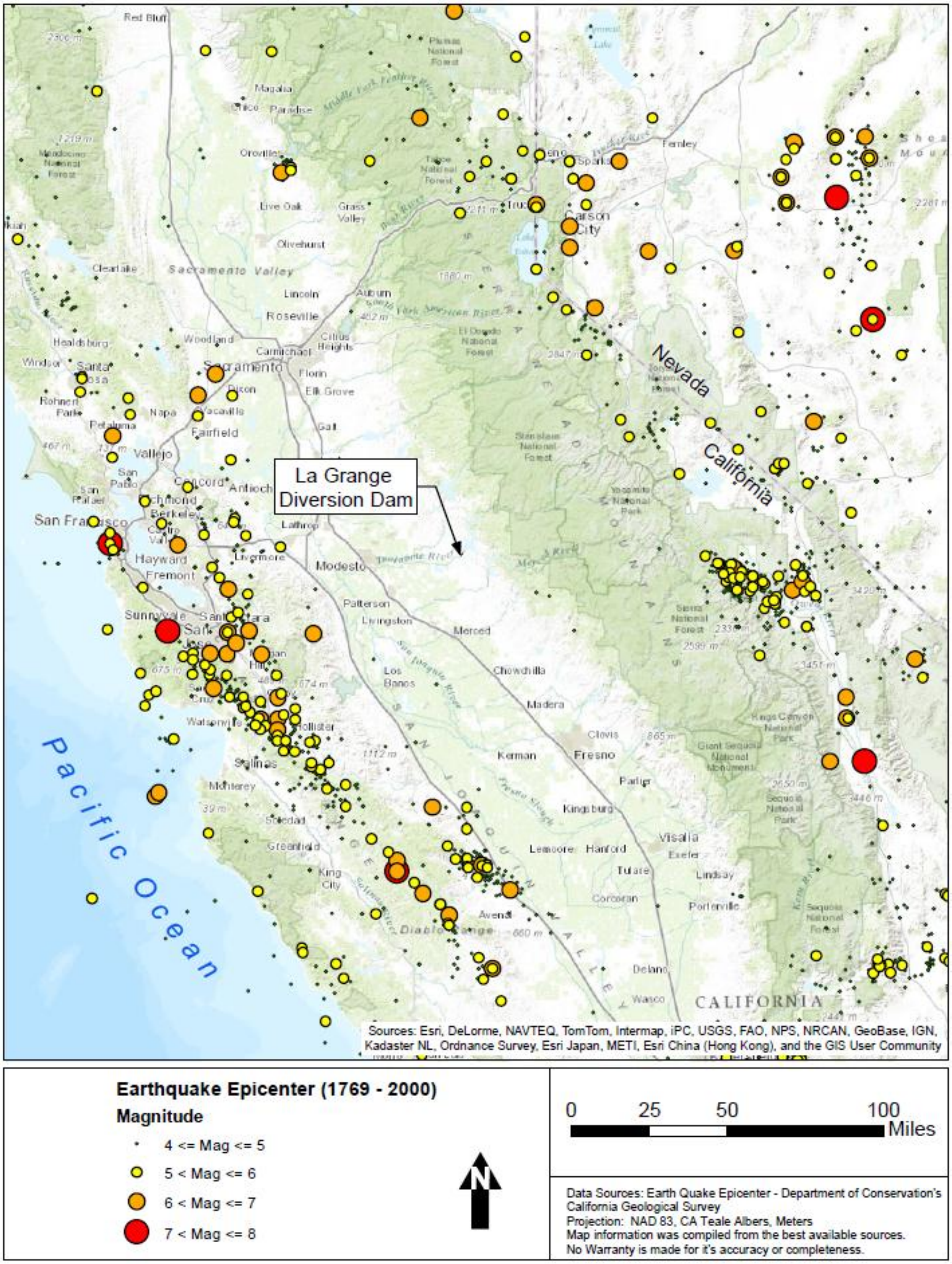

Figure 5.1.4-1 Historical seismicity.

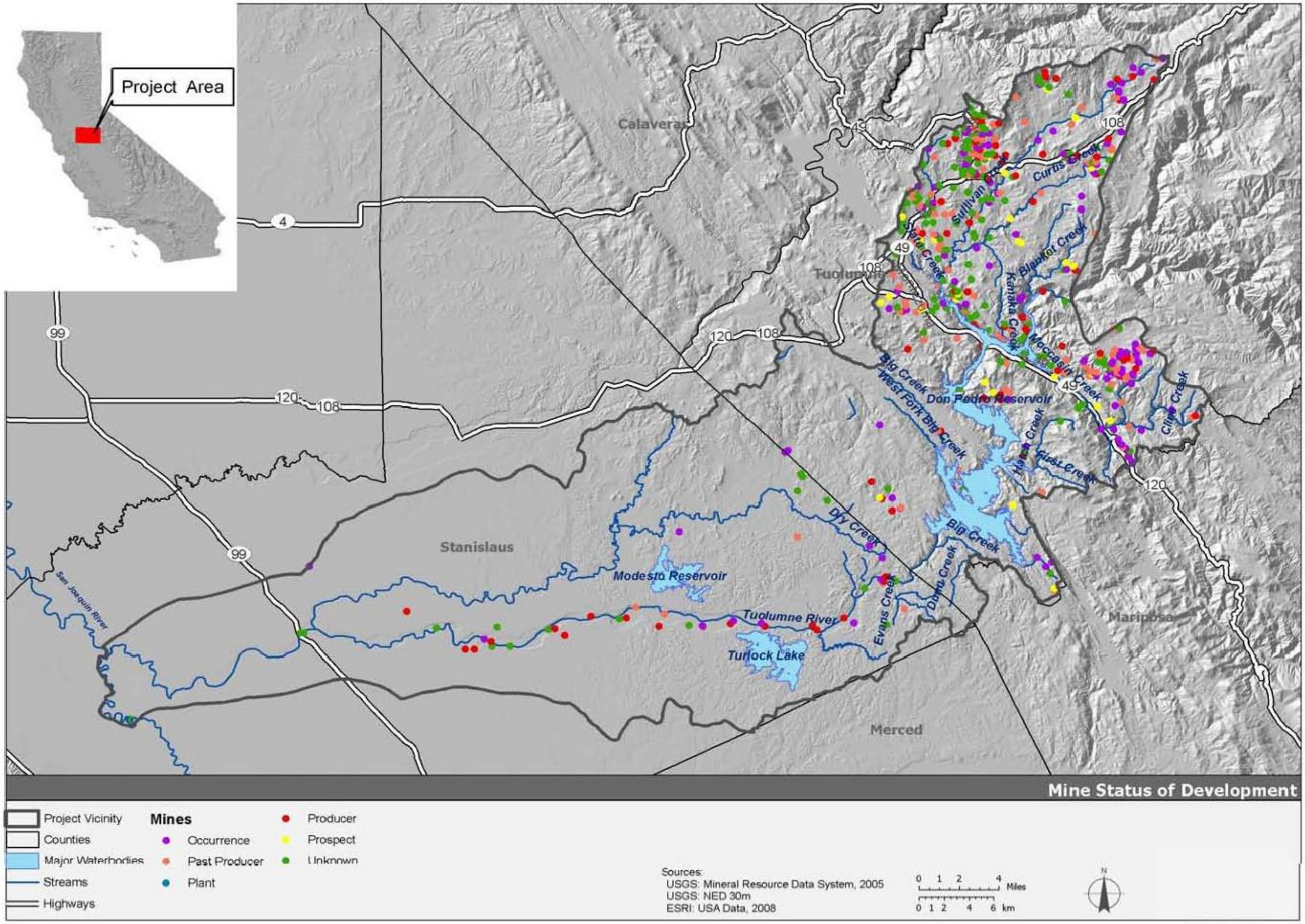

Figure 5.1.5-1 Past and present mines in the general LGP vicinity.

as Aggregate Resources (potentially useable aggregate that may be mined in the future but for which no mining permit has been granted) and Aggregate Reserves (aggregate resources for which mining and processing permits have been granted) (Higgins and Dupras 1993 *as cited in* TID/MID 2011). An estimated 540 million tons (338 million cubic yards) of Aggregate Resources are located in six different geographic areas of Stanislaus County (Higgins and Dupras 1993 *as cited in* TID/MID 2011).

5.1.6 Geomorphology

The Tuolumne River leaves a steep and confined bedrock valley and enters the eastern Central Valley downstream of La Grange diversion dam near La Grange Regional Park where hillslope gradients in the vicinity of the river corridor are typically less than five percent (TID/MID 2011). From the La Grange diversion dam to the San Joaquin River, the Tuolumne River can be divided into two broad geomorphic reaches defined by channel slope and bed composition: a gravel-bedded reach that extends from La Grange diversion dam (RM 52.1) to Geer Road Bridge (RM 24); and a sand-bedded reach that extends from Geer Road Bridge to the confluence with the San Joaquin River (McBain & Trush 2000 *as cited in* TID/MID 2011). The gravel-bedded and sand-bedded zones have been further subdivided into seven reaches based on present and historical land uses, the extent and influence of urbanization, valley confinement from natural and anthropogenic causes, channel substrate and slope, and salmonid use (McBain & Trush 2000 *as cited in* TID/MID 2011).

Surveys of the channel downstream of La Grange diversion dam indicate channel downcutting, widening, armoring, and depletion of sediment storage features (e.g., lateral bars and riffles) due to sediment trapping in upstream reservoirs, mining, and other land use changes (CDWR 1994; McBain & Trush 2004 *as cited in* TID/MID 2011). Bedload impedance reaches, defined as locations where current hydraulic conditions are insufficient to transport coarse bed material (>4 millimeters [mm]) through the reach, were identified from La Grange diversion dam to the confluence of the San Joaquin River (McBain & Trush 2000 *as cited in* TID/MID 2011). These reaches are associated with long scour pools and former instream aggregate extraction and gold dredger pits (TID/MID 2011).

5.1.7 Soils

The LGP is located within the foothills of the Sierra Nevada near the Bear Mountain Fault Zone. The soils in the vicinity are derived from a variety of parent materials including schist, serpentine (ultramafic rocks), metavolcanic, and metasedimentary rocks (TID/MID 2011). Many of the soils are shallow, and associations with “rock outcrop” cover virtually the entire LGP vicinity. However, one soil association (i.e., Whiterock-Rock outcrop-Auburn [s818]) dominates the LGP area and is discussed below.

5.1.7.1 Whiterock-Rock Outcrop-Auburn Association

The Whiterock-rock outcrop-Auburn association is one of the more extensive associations in the foothills of the Sierra Nevada, and it typically develops in tilted slate, amphibolite schist, and partially metamorphosed sandstone formations. Whiterock soils tend to be shallower and less weathered than those of the Auburn series. Whiterock soils are shallow soils formed on bedrock.

The parent material gets an R designation because it is consolidated. Whiterock soils are located on foothills at elevations of 160 to 2,500 feet. Slopes are 3 to 60 percent. The soils formed in material weathered from slate and partially metamorphosed sandstone (TID/MID 2011).

The Bear Mountains Fault Zone which runs northwest to southeast near the LGP has serpentinized ultramafic rock in many areas along the zone. The areas underlain by these utramafic rocks are reflected by the presence of the Henneke and Delpiedra series which are often shallow and poorly developed as indicated by the large amount of "rock outcrop" in the association (TID/MID 2011).

5.1.8 Shoreline

The shoreline upstream of the La Grange diversion dam consists of relatively steep slopes with sparse vegetative cover consisting of grasses and shrub species. Rocky outcrops, cobbles, and rocks are present; however, some shrub and herbaceous layers are sporadically located along the shoreline. Soil types are Exchequer rocky loam soils occurring on 30 to 60 percent slopes[7] (USDA 2012). These soils occur along slopes, are somewhat excessively drained, and have a depth to water table of more than 80 inches. The parent material is dominated by residuum weathered from metavolcanics (USDA 2012).

5.1.9 Potential LGP Effects and Resource Issues

5.1.9.1 Potential Effects

The Districts utilized available information on the geologic resources within the LGP vicinity to characterize the baseline condition and consider potential effects of the LGP. As previously described in this application, the LGP operates in a run-of-river mode. The diversion dam was originally constructed in 1891-1893 to raise the level of the Tuolumne River so as to permit the diversion and delivery of water by gravity means to TID's and MID's irrigation systems. The diversion dam is located at the exit of a narrow canyon and there is little to no active storage in the La Grange pool.

As mentioned above, the shoreline consists of relatively steep slopes with sparse vegetative cover consisting of grasses and shrub species. Rocky outcrops, cobbles, and rocks are present; however, some shrub and herbaceous layers are sporadically located along the shoreline. Very little shoreline erosion has occurred along the La Grange pool, likely due to the fact that the LGP operates in a run-of-river fashion and that many areas immediately adjacent to the pool are composed of rocky outcrops, cobbles, and rocks.

The Districts are not proposing any changes to current operations. LGP operations do not affect shoreline erosion, geology, or geomorphology of the LGP area. Powerhouse flows do not affect shorelines below the LGP. Therefore, no effects on geologic, geomorphic, and soil resources are anticipated as a result of LGP operations.

[7] According to the USDA (2012), only partial soil data occurs for the LGP area.

5.1.9.2 Resource Issues

No specific resource issues pertaining to geology and soils at the LGP have been identified at this time.

5.2 Water Resources

5.2.1 Water Quality

State Water Quality Standards

Beneficial use designations for the LGP area are established in the CVRWQCB's Basin Plan for the Sacramento and San Joaquin Rivers, the fourth edition of which was initially adopted in 1998 and most recently revised in 2011 (CVRWQCB 1998). The LGP is located in Hydro Unit 535 and encompasses the Tuolumne River from the Don Pedro dam to the confluence with the San Joaquin River. The designated beneficial uses associated with this reach of stream are provided in Table 5.2.1-1.

Table 5.2.1-1 Designated Beneficial Use for HU 535 Don Pedro dam to San Joaquin River.

Designated Beneficial Use Description from Basin Plan, Table II-1		
Municipal and Domestic Supply (MUN)	municipal and domestic supply	Potential
Agricultural Supply (AGR)	irrigation	Existing
	stock watering	Existing
Industrial Process Supply (PRO)	process	-----
Industrial Service Supply (IND)	service supply	-----
	power	-----
Water Contact Recreation (REC-1)	contact	Existing
	canoeing and rafting[1]	Existing
Non-Contact Water Recreation (REC-2)	other non-contact	Existing
Warm Freshwater Habitat (WARM)	warm[2]	Existing
Cold Freshwater Habitat (COLD)	cold[2]	Existing
Migration of Aquatic Organisms (MGR)	warm[3]	-----
	cold[4]	Existing
Spawning (SPWN)	warm[3]	Existing
	cold[4]	Existing
Wildlife Habitat (WILD)	wildlife habitat	Existing

1 Shown for streams and rivers only with the implication that certain flows are required for this beneficial use.
2 Resident does not include anadromous. Any segments with COLD and WARM beneficial use designations will be considered COLD water bodies for the application of water quality objectives.
3 Striped bass, sturgeon, and shad.
4 Salmon and steelhead.
Source: CVRWQCB 1998 and amendments

The Basin Plan sets forth existing and potential designated beneficial uses and water quality criteria necessary to attain these uses for the Tuolumne River. For example, a numerical criterion is established for dissolved oxygen (DO) of 8 milligrams per liter (mg/L) specifically for the Tuolumne River below La Grange diversion dam between October 15 and June 15 for the protection of spawning, incubation, and early life stages of salmon. Please refer to the Don Pedro PAD for additional information on water quality standards in this region (TID/MID 2011).

Existing Water Quality Data

Numerous water quality studies have been conducted on the Tuolumne River and are described in Section 5.2.1 of the Don Pedro PAD (TID/MID 2011) and updated in the recently-filed Don Pedro Draft License Application (TID/MID 2013*h*). Many of these studies focused on water temperature, which is an important water quality parameter in the lower Tuolumne River. The Districts and the California Department of Fish and Wildlife (CDFW) have been collecting water temperature data in the lower Tuolumne River downstream of the La Grange diversion dam since 1977. Figure 5.2.1-1 provides recent average seasonal water temperature data collected at various locations within and downstream of the LGP area on the lower Tuolumne River.

In 2012, the Districts also collected DO data (among other parameters) during the 2012 Water Quality Study during summer, low-flow conditions on the lower Tuolumne River for Don Pedro Hydroelectric Project relicensing efforts. DO measurements in the LGP area were all above the numerical limits established in the Basin Plan. Overall, the study indicates that water quality in the LGP area is very good (TID/MID 2013*f*).

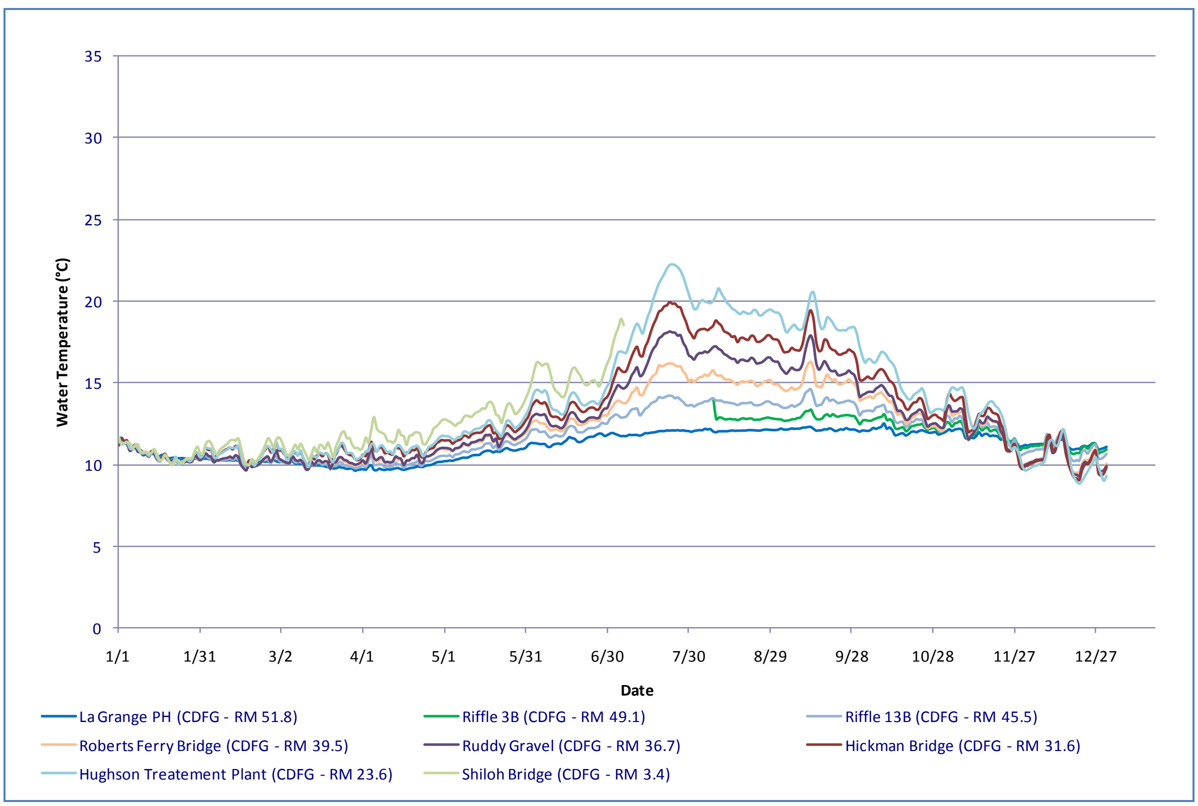

Figure 5.2.1-1 Average water temperature of the lower Tuolumne River in 2006.

5.2.2 Water Quantity

The La Grange diversion dam is used to raise the water level of the Tuolumne River to allow diversion of flows by means of gravity into the TID and MID irrigation conveyance systems. The drainage area of the Tuolumne River upstream of the La Grange diversion dam is approximately 1,550 square miles. Flows from the drainage area above La Grange diversion dam are controlled by four upstream reservoirs: Hetch Hetchy, Lake Eleanor, Cherry Lake, and Don Pedro.

Total river flows at La Grange diversion dam are computed from three distinct locations whose data are then combined to estimate total flow (USGS Gage 11289651). The mean flow at this location as reported by USGS is 2,300 cfs for water years 1975-2012. Mean monthly flows are provided in Table 5.2.2-1. Flow duration curves based on daily data for these locations and flow duration curves for releases from the Don Pedro Project are provided in Appendix C.

Table 5.2.2-1 Mean monthly flows for the water years 1975-2012 for lower Tuolumne River.

Month	Below La Grange diversion dam (cfs)	Modesto Canal near La Grange (cfs)	Turlock Canal near La Grange (cfs)
Jan	1,491	74	140
Feb	1,812	66	183
Mar	1,952	267	604
Apr	1,962	543	1,069
May	1,790	660	1,211
Jun	1,034	786	1,474
Jul	537	878	1,798
Aug	327	782	1,568
Sep	481	513	786
Oct	618	288	400
Nov	348	174	196
Dec	881	122	208

Source: USGS 11289650, USGS 11289000, and USGS 11289500.

Based on hydraulic modeling submitted to FERC by the Districts in Docket UL11-1, the upper end of the pool formed by the La Grange diversion dam terminates approximately one mile above the diversion dam. This creates a shoreline length of approximately two miles and a surface area of approximately 29.2 acres. The pool has a maximum depth of 35 feet, a mean depth of approximately 11 feet, a gross storage capacity of approximately 340 acre-feet, and a usable storage capacity of less than 100 acre-ft.

Inflow to the LGP is the sum of releases from the Don Pedro Project located 2.3 miles upstream and minor contributions from two small intermittent drainages. The LGP operates in run-of-river mode and, when not spilling, operates between elevation 294 feet and 296 feet approximately 90 percent of the time. The approximate storage volume between these operating levels is less than 100 acre-feet, which is used to balance flows between the two canal systems. Any flows not diverted at the La Grange diversion dam to the Districts' canal systems flow downstream to the lower Tuolumne River. The La Grange powerhouse generates renewable energy with flows being passed downstream up to a capacity of approximately 580 cfs.

5.2.3 Potential Project Effects and Resource Issues

5.2.3.1 Water Quantity

Originally constructed between 1891 and 1893, the purpose of the La Grange diversion dam is to raise the level of the Tuolumne River to permit the diversion of water from the Tuolumne River for irrigation of Central Valley farmland and M&I water supply. Any flows not diverted at the La Grange diversion dam to the Districts' canal systems flow downstream to the lower Tuolumne River. The La Grange powerhouse is one of the facilities used to pass water downstream. Since the Districts are not proposing any changes to current LGP operations, there will be no effect to the existing water flows. No resource issues related to water quantity at the LGP have been identified at this time. While the operation of the Districts' canal systems affect the quantity of flows in the Tuolumne River downstream of the LGP, those affects are not properly attributable to the LGP.

5.2.3.2 Water Quality

Numerous water quality studies have been conducted on the Tuolumne River. Based on available water quality data, the LGP is in compliance with the current Basin Plans and associated water quality standards. Since the Districts are not proposing any changes to current LGP operations, there will be no adverse effect to the existing water quality as a result of ongoing hydro project operations. No resource issues related to water quality at the LGP have been identified at this time.

5.3 Aquatic Resources

A substantial amount of information exists on the aquatic communities in the lower Tuolumne River, especially downstream of La Grange diversion dam (RM 52.2). A total of 34 fish species have been reported in the lower Tuolumne River from La Grange diversion dam (RM 52.2) to the confluence with the San Joaquin River (RM 0) (Table 5.3-1).

Eight native resident fishes still occupy the lower river including the Sacramento sucker, Sacramento pikeminnow, Sacramento splittail, hardhead, hitch, Sacramento blackfish, tule perch, and riffle sculpin (Ford and Brown 2002). The Sacramento sucker is the most abundant and widespread native fish species found in the lower Tuolumne River. Most of the native resident fish species are riffle spawners and are generally more abundant in the gravel-bedded upper reach of the lower Tuolumne River.

Twenty-one species of introduced fishes occur in the lower river including threadfin shad, bullhead, white and channel catfish, common carp, fathead minnow, golden shiner, goldfish, redshiner, striped bass, largemouth bass, smallmouth bass, western mosquitofish, and inland silversides. Sunfish species (e.g., bluegill, redear sunfish, green sunfish) appear to be the most abundant and widespread non-native fish species in the lower Tuolumne River. Non-native fishes are present throughout the lower Tuolumne River, but are typically most abundant in the sand-bedded reach and the lower six to seven miles of the gravel-bedded reach (Ford and Brown 2001).

Table 5.3-1 Fishes documented in the lower Tuolumne River.

Family/ Common Name	Scientific Name	Native (N) Or Introduced (I)	Resident (R) Or Migratory (M)
Lampreys (petromyzontidae)			
Pacific lamprey	*Lampetra tridentate*	N	M
Shad and Herring (clupeidae)			
Threadfin shad	*Dorosoma petenense*	I	R
Salmon and Trout (salmonidae)			
Chinook salmon	*Oncorhynchus tshawytscha*	N	M
Rainbow trout/steelhead	*Oncorhynchus mykiss*	N	R/M
Minnows (cyprinidae)			
Common carp	*Cyprinus carpio*	I	R
Fathead minnow	*Pimephales promelas*	I	R
Golden shiner	*Notemigonus crysoleucas*	I	R
Goldfish	*Carassius Auratus*	I	R
Hardhead	*Mylopharodon Conocephalus*	N	R
Hitch	*Lavinia Exilicauda*	N	R
Red shiner	*Cyprinella lutrensis*	I	R
Sacramento blackfish	*Orthodon microlepidotus*	N	R
Sacramento splittail	*Pogonichthys macrolepidotus*	N	M
Sacramento pikeminnow	*Ptychocheilus grandis*	N	R
Suckers (catostomidae)			
Sacramento sucker	*Catostomus occidentalis*	N	R
Catfish (ictaluridae)			
Black bullhead	*Ameiurus melas*	I	R
Brown bullhead	*Ameiurus nebulosus*	I	R
Channel catfish	*Ictalurus punctatus*	I	R
White catfish	*Ameiurus catus*	I	R
Livebearers (poeciliidae)			
Western mosquitofish	*Gambusia affinis*	I	R
Silversides (atherinidae)			
Inland silverside	*Menidia beryllina*	I	R
Temperate Basses (percichthyidae)			
Striped bass	*Morone saxatilis*	I	M
Basses and Sunfish (centrarchidae)			
Black crappie	*Pomoxis nigromaculatus*	I	R
Bluegill	*Lepomis Macrochirus*	I	R
Green sunfish	*Lepomis cyanellus*	I	R
Largemouth bass	*Micropterus salmoides*	I	R
Redear sunfish	*Lepomis microlophus*	I	R

Family/ Common Name	Scientific Name	Native (N) Or Introduced (I)	Resident (R) Or Migratory (M)
Smallmouth bass	*Micropterus dolomieu*	I	R
Warmouth	*Lepomis Gulosus*	I	R
White crappie	*Pomoxis annularis*	I	R
Perch (percidae)			
Bigscale logperch	*Percina macrolepida*	I	R
Surf Perch (embiotocidae)			
Tule perch	*Hysterocarpus traski*	N	R
Sculpins (cottidae)			
Prickly sculpin	*Cottus asper*	N	R
Riffle sculpin	*Cottus gulosus*	N	R

Sources: Ford and Brown 2001; TID/MID 2009, Reports 2009-3, 2009-4, and 2009-5.

Less information exists on the fish community upstream of La Grange diversion dam and no known stocking has occurred (TID/MID 2013*a*). In 2012, the Districts conducted a study on the fish community from the Don Pedro dam to the La Grange diversion dam (TID/MID 2013*a*). During the study, a total of 133 fish were collected, which included 86 rainbow trout (*Oncorhynchus mykiss*) and 47 prickly sculpin (*Cottus asper*). Both species were found throughout the study reach and exhibited multiple age classes, which suggests natural reproduction occurs.

5.3.1 Anadromous Fish

Fall-Run Chinook Salmon

Adult Chinook salmon spawn from late October to early January soon after entering freshwater and have a relatively short juvenile rearing period before emigrating back to the ocean (Moyle 2002). Spawning occurs in the gravel-bedded reach (upstream of RM 24) where suitable spawning habitat exists.

The lower Tuolumne River supports Central Valley fall-run Chinook salmon. A Chinook salmon population estimate study was conducted by the Districts from 2008 to 2011 (TID/MID 2012). In 2011 the survey was conducted from RM 51.8 to 35.0 and population estimates for young-of-year (YOY)/juveniles were 24,299 (TID/MID 2012). These estimates were higher than the 2008 and 2010 estimates, but slightly lower than 2009 estimates (TID/MID 2012). A number of additional surveys have been conducted to study the Chinook salmon population in the lower Tuolumne River. Since 1971, the CDFW has conducted annual salmon spawning surveys. In addition to the CDFW, the Districts have studied Chinook salmon on the lower Tuolumne River through annual seine surveys since 1986 and annual snorkel surveys since 1982.

Rainbow trout/steelhead (O. mykiss)

The species *O. mykiss* exhibits two life history forms: a resident form commonly known as rainbow trout, and an anadromous form commonly known as steelhead. Central Valley steelhead begin to enter fresh water in August and peak spawning occurs from December through April. After spawning, adults may survive and emigrate back to the ocean. Steelhead progeny will rear for one to three years in fresh water before they emigrate to the ocean where most of their growth occurs. Spawning by resident rainbow trout in the Central Valley coincides with steelhead and interbreeding is possible, with progeny displaying either anadromous or resident life history traits.

A population estimate study of *O. mykiss* in the lower Tuolumne River was conducted by the Districts from 2008 to 2011 (TID/MID 2012). In 2011, the survey was conducted from RM 51.8 to 35.0 and population estimates for juveniles/YOY and adults were 47,432 and 9,541, respectively (TID/MID 2012). These estimates were higher than those from previous years (TID/MID 2012). Although low numbers of anadromous O. mykiss have been documented in the Tuolumne River (Zimmerman et al. 2008), there is no empirical scientific evidence of a self-sustaining "run" or population of steelhead currently in the Tuolumne River. Additional information has been collected by the Districts during annual seine surveys and annual snorkel surveys since the 1980s.

5.3.2 Macroinvertebrates

Benthic macroinvertebrate monitoring has been conducted by the Districts in the lower Tuolumne River since 1987 (TID/MID 2010). Data has been collected from RM 6.0 to RM 48.8 and showed the river supports a diverse macroinvertebrate community. Recent macroinvertebrate data collected in riffle habitat at RM 51.6 is provided below in Table 5.3.2-1.

Table 5.3.2-1 Selected CMAP[8] metrics for historical kick-net samples collected at riffle habitat at RM 51.6 in the lower Tuolumne River from 2007 to 2009.

	Year		
	2007	**2008**	**2009**
Taxonomic richness	25	24	27
EPT Taxa	9	7	5
Ephemeroptera Taxa	5	3	2
Plecoptera Taxa	0	0	0
Trichoptera Taxa	4	4	3
Abundance (total in sample)	306	296	4,720
Density (No./m^2)	537	520	8,280

Source: TID/MID 2010

5.3.3 Potential LGP Effects and Resource Issues

The LGP potentially affects both impoundment and river fisheries. Numerous studies have been conducted on the fish community in the general area of the LGP. Since the La Grange diversion dam has existed for over 120 years, the LGP's associated fish community is well established. The Districts are not proposing any changes to current facilities or operations and there will be no effect to the existing baseline fishery resources at the LGP. Fish passage at La Grange has been identified as a resource issue during the Don Pedro relicensing and is likely to be of interest to the agencies during the LGP licensing proceeding.

[8] California Monitoring and Assessment Program

5.3.4 Potential Cumulative Effects

According to the Council on Environmental Quality's regulations for implementing the National Environmental Policy Act (NEPA) (50 CFR §1508.7), cumulative effects to a resource are the result of the combined influence of past, present, and reasonably foreseeable future actions within a specified geographical range (FERC 2008), regardless of what agency (federal or non-federal) or person undertakes such actions. Cumulative effects may be positive or adverse. Resources of the Tuolumne River may be cumulatively affected by individually minor but collectively significant actions taking place over a period of time. Activities contributing to cumulative effects to the Tuolumne and San Joaquin rivers may include hydropower operations, water storage and diversions for irrigation and municipal and industrial (M&I) water supply, historical and ongoing gravel and gold mining activities, riparian diversions, urbanization, other land and water development activities, the introduction of non-native species to the watershed, channel modification by levees and for shipping, recreation, flood control operations, wastewater treatment plant discharges, climate change, and a host of other potential activities.

There are eight dams and reservoirs on the Tuolumne River and its tributaries with a combined storage capacity of about 2,777,000 ac-ft. Seven of these dams are located upstream of the LGP.

5.3.4.1 Summary of Chronology of In-Basin and Out-of-Basin Actions

In accordance with the requirements of cumulative effects assessments provided in accordance with NEPA guidelines, the initial step of performing the analysis is to identify significant past, present, and foreseeable future actions which contribute to cumulative effects. The Tuolumne and San Joaquin river basins have been affected by substantial resource management and land and water use activities over the past 150 years. Table 5.3.4-1 summarizes a chronology of the in-basin and out-of-basin actions that are likely to contribute to cumulative effects to the specific resource areas of the lower Tuolumne River.

Table 5.3.4-1 Chronology of actions in the San Joaquin River Basin and Delta contributing to cumulative effects (partial list)

Action	Date
Dams, Diversions, Flow Regulation	
Tuolumne River Basin	
Wheaton Dam	1871
La Grange Mining Ditch (Indian Bar Diversion)	1871
Phoenix Dam	1880
La Grange diversion dam	1893
Irrigation diversion begins	1901
Modesto Reservoir Dam	1911
Turlock Lake Dam	1914
Eleanor Dam	1918
Old Don Pedro Dam	1923
O'Shaughnessy Dam (Hetch Hetchy) (206,000 ac-ft)	1923
Priest Dam	1923
Early Intake	1924

Action	Date
Hetch Hetchy Aqueduct completed; exports to San Francisco begin	1934
Dennet Dam	1934
O’Shaughnessy Dam raised (360,000 ac-ft)	1938
Cherry Lake	1956
Pine Mountain Dam	1969
New Don Pedro Dam	1971
Riparian water diversions along the lower Tuolumne River	1870s - present
San Joaquin River Basin and Delta (excluding Tuolumne River)	
<u>Central Valley Project</u>	
Old Melones Dam	1926
Friant Dam, completed in 1942	1942
Madera Canal completed in 1945	1945
Friant-Kern Canal completed in 1951	1951
Jones Pumping Plant	1951
Delta-Mendota Canal	1951
Delta Cross-Channel	1951
Hidden and Buchanan Projects	1962
Los Banos Detention Dam	1965
Little Panoche Detention Dam	1966
B.F. Sisk Dam	1967
O’Neill Pumping Plant	1967
William R. Gianelli Pumping-Generating Plant	1967
San Luis Drain	Halted in 1975
New Melones Dam	1983
San Felipe Division	1964 - 1987
<u>State Water Project</u>	
Harvey O. Banks Pumping Plant	1968
Edmonston Pumping Plant	1971
Pyramid Dam	1973
Castaic Dam	1973
Warne Powerplant	1982
Alamo Powerplant	1986
Coastal Branch Aqueduct	1997
Upper San Joaquin River	
Mendota Dam	1871
Sack Dam (seasonal 1870s-1945)	1946
Merced River Basin	
Robla Canal Company begin diverting Merced River	1870
Merced Canal and Irrigation Company forms	1883
Merced Falls Diversion Dam	1901
Crocker-Huffman Dam	1910
Exchequer Dam	1926
New Exchequer Dam	1967

Action	Date
Stanislaus River Basin	
Big Dam	1856
Herring Creek, Upper Strawberry, and Lower Strawberry reservoirs	1856
Lyons Reservoir	1898
Sand Bar Diversion Dam	1908
OID/SJID purchase Tulloch water rights/distribution system	1910
Relief Dam	1910
Goodwin Dam	1913
Philadelphia Diversion Dam	1916
Lower Strawberry Reservoir	1917
Old Melones Dam (also in CVP section)	1926
Spicer Meadow Dam	1929
Lyons Reservoir enlarged	1930
Tri-Dam Project (Donnells, Beardsley, and Tulloch dams)	1958
New Melones Dam (also in CVP section)	1983
New Spicer Dam	1989
In-Channel and Floodplain Mining	
Tuolumne River Basin	
Placer mining	1848-1890
Hydraulic mining (La Grange)	1871-c. 1900
Dredge mining of the lower Tuolumne River (gold)	1908-1942, 1945-1951
Gravel and aggregate mining of the lower Tuolumne River	1940s to present
San Joaquin River Basin and Delta (excluding Tuolumne River)	
Sand and gravel mining from Bay floor shoals begins	1915
Channel Alteration	
Begin large-scale construction of levees in San Joaquin River basin and Delta	1850s
Stockton Deep Water Ship Channel	1930s
San Joaquin River and Tributaries Project (> 100 miles of levees and bypasses)	1950s - 1960s
Non-Native Fish Species	
18 fish species introduced in Tuolumne River basin by state/federal agencies	1874 - 1954
4 additional fish species introduced in Tuolumne River basin	After 1954
Hatchery Practices	
CDFW begins stocking fish in the inland waters of California	Late 1800s
CDFW begins large-scale supplementation of anadromous fish stocks	1945
California's hatcheries at times use out-of-basin broodstocks/move fry to other basins	Before 1980s
Salmon from Central Valley hatcheries released in San Francisco Bay	Ongoing
Commercial and Sport Harvest	
Commercial salmon fishing begins in California	Early 1850s
Gill net salmon fisheries well established in lower San Joaquin River	1860
Well developed canning industry (20 canneries)	1880
12 million pounds of salmon landed and processed	1882
Ocean troll fishery dominates harvest	1917
Last inland cannery shutdown due to decline of inland fishery	1919

Action	Date
Last commercial river salmon fishery closed in Sacramento-San Joaquin basin	1957
Agriculture, Livestock, and Timber Harvest	
Timber operations begin in upper watersheds	Mid 1800s
Large-scale agriculture and livestock grazing begins in region	Mid 1800s

5.3.4.2 LGP Operations

At La Grange diversion dam water is diverted into MID's canal system on the north side of the Tuolumne River and into TID's canal system on the south side of the Tuolumne River. Flows greater than the Districts' irrigation and M&I needs continue on to the lower Tuolumne River by passing over the diversion dam's spillway, through TID's La Grange powerhouse located off the TID main canal, or through other sluice gates associated with the La Grange facilities.

The La Grange diversion dam is operated as a run-of-river facility with little fluctuation of its pool. Flows over the spillway occur about 30 percent of the time. When not in spill mode, the LGP operates between elevation 296 feet and 294 feet about 90 percent of the time. The amount of storage in this two-foot operating band is less than 100 ac-ft of water. Flows in the lower Tuolumne River are recorded at the USGS' La Grange gage located about 0.3 miles below the La Grange diversion dam.

The operation of La Grange diversion dam to deliver water to the Districts' canal systems for consumptive use purposes effects streamflows in the lower Tuolumne River and has since 1893. The operation of TID's hydro project does not effect flows in the lower Tuolumne River. Absent TID's hydro project, diverted and non-diverted flows would continue to occur substantially as they do now.

While overall operations of the La Grange diversion dam may at times contribute to cumulative effects to water resources, aquatic resources, Essential Fish Habitat (EFH), and geomorphological resources, the operation of TID's hydro plant is unlikely to affect these resources. Also, during solely flood management periods, LGP does not contribute to either direct or cumulative effects on water or aquatic resources of the lower Tuolumne River.

5.4 Wildlife and Botanical Resources

5.4.1 Wildlife Resources

5.4.1.1 Mammals

The vegetative community types associated with the LGP provide suitable habitat for a variety of wildlife species. Although dominated by annual grasses and forbs and blue oak vegetation associations (described in Section 5.4.2 below), the occurrence of wetland, as well as riverine systems, increases the diversity of wildlife habitats available for indigenous and transient mammal species in the Project vicinity. Table 5.4.1-1 provides those mammalian species that may exist or may utilize habitat in the vicinity of the LGP.

Table 5.4.1-1 Partial list of mammals potentially occurring in the vicinity of the LGP.

Common Name	Scientific Name
Virginia opossum	*Didelphis virginiana*
Pallid bat	*Antrozous pallidus*
Townsend's bigeared bat	*Corynorhinus townsendii*
Spotted bat	*Euderma maculatum*
Western mastiff bat	*Eumops perotis*
Western red bat	*Lasiurus blossevillii*
Western smallfooted myotis	*Myotis ciliolabrum*
Long-eared myotis	*Myotis evotis*
Fringed myotis	*Myotis thysanodes*
Yuma myotis	*Myotis yumanensis*
Black-tailed jackrabbit	*Lepus californicus*
Beaver	*Castor canadensis*
Porcupine	*Erethizon dorsatum*
Brush mouse	*Peromyscus boylii*
Dusky-footed woodrat	*Neotoma fuscipes*
Bushy-tailed woodrat	*Neotoma cinerea*
Muskrat	*Ondatra zibethicus*
Western gray squirrel	*Sciurus griseus*
Coyote	*Canis latrans*
Red fox	*Vulpes vulpes*
Gray fox	*Urocyon cinereoargenteus*
Black bear	*Ursus americanus*
Raccoon	*Procyon lotor*
Short-tailed weasel	*Mustela erminea*
Long-tailed weasel	*Mustela frenata*
Mink	*Mustela vison*
Spotted skunk	*Spilogale putorius*
Striped skunk	*Mephitis mephitis*
Bobcat	*Lynx rufus*
Elk	*Cervus elaphus*
Mule deer	*Odocoileus hemionus*
Brush rabbit	*Sylvilagus bachmani*
Desert cottontail	*Sylvilagus audubonii*
American badger	*Taxidea taxus*
Wild pig	*Sus scrofa*

Sources: American Society of Mammalogists 2013; TID/MID 2011; TID/MID 2013*b*.

5.4.1.2 Commercially Valuable Game Species

Table 5.4.1-2 includes wildlife species with the potential to occur in the area surrounding the Project that are listed as commercially harvested by the CDFW (TID/MID 2011).

Table 5.4.1-2 Commercially valuable wildlife species potentially occurring in the LGP vicinity.

Common Name	Scientific Name
Canada goose	*Branta canadensis*
Wood duck	*Aix sponsa*
Northern pintail	*Anas acuta*
Mallard	*Anas platyrhynchos*
Cinnamon teal	*Anas cyanoptera*
Northern shoveler	*Anas clypeata*

Common Name	Scientific Name
Green-winged teal	*Anas crecca*
Ring-necked pheasant	*Phasianus colchicus*
Wild turkey	*Meleagris gallopavo*
Blue grouse	*Dendragopus obscures*
Virginia opossum	*Didelphis virginiana*
Brush rabbit	*Sylvilagus bachmani*
Desert cottontail	*Sylvilagus audubonii*
Black-tailed jackrabbit	*Lepus californicus*
American beaver	*Castor canadensis*
Coyote	*Canis latrans*
Gray fox	*Urocyon cinereoargenteus*
Raccoon	*Procyon lotor*
Black bear	*Ursus americanus*
American badger	*Taxidea taxus*
Mule deer	*Odocoileus hemionus*
Bobcat	*Felis rufus*
Wild pig	*Sus scrofa*

Source: TID/MID 2011

5.4.1.3 Birds

A list of birds documented by the Tuolumne County Birders is provided below in Table 5.4.1-3. The bird species listed in Table 5.4.1-3 have the potential to exist within the LGP vicinity.

Table 5.4.1-3 Partial list of bird species documented by the Tuolumne County Birders.

Greater white-fronted goose	Peregrine falcon	California thrasher
Snow goose	Killdeer	Cedar waxwing
Ross’s goose	Spotted sandpiper	Orange-crowned warbler
Canada goose	Greater yellowlegs	Yellow warbler
Wood duck	Wilson’s snipe	Yellow-rumped warbler
Gadwall	Mourning dove	Townsend’s warbler
American wigeon	Barn owl	Wilson’s warbler
Mallard	Western screech owl	Western tanager
Cinnamon teal	Great horned owl	Spotted towhee
Northern shoveler	Northern saw-whet owl	California towhee
Northern pintail	White-throated swift	Chipping sparrow
Green-winged teal	Black-chinned hummingbird	Lark sparrow
Canvasback	Anna’s hummingbird	Fox sparrow
Ring-necked duck	Rufous hummingbird	Song sparrow
Lesser scaup	Belted kingfisher	White-throated sparrow
Bufflehead	Lewis’s woodpecker	Dark-eyed junco
Common goldeneye	Acorn woodpecker	Black-headed grosbeak
Barrow’s goldeneye	Williamson’s sapsucker	Red-winged blackbird
Hooded merganser	Red-breasted sapsucker	Western meadowlark
Common merganser	Downy woodpecker	Pine grosbeak
Ruddy duck	Hairy woodpecker	Purple finch
White-tailed ptarmigan	Black-backed woodpecker	House finch
Sooty grouse	Northern flicker	Red crossbill
Wild turkey	Pileated woodpecker	Pine siskin
Mountain quail	Olive-sided flycatcher	Lesser goldfinch
California quail	Western wood-peewee	Lawrence’s goldfinch
Common loon	Willow flycatcher	American goldfinch
Pied-billed grebe	Hammond’s flycatcher	Evening grosbeak
Eared grebe	Black phoebe	House sparrow

Western grebe	Ash-throated flycatcher	Cliff swallow
Clark's grebe	Western kingbird	Chestnut-backed chickadee
Great blue heron	Loggerhead shrike	Oak titmouse
Great egret	Steller's jay	Red-breasted nuthatch
Turkey vulture	Western scrub jay	White-breasted nuthatch
Osprey	American crow	Rock wren
Bald eagle	Common raven	Western bluebird
Northern harrier	Tree swallow	Mountain bluebird
Sharp-shinned hawk	Red-shouldered hawk	American kestrel
Cooper's hawk	Red-tailed hawk	Merlin
Northern goshawk	Golden eagle	Ferruginous hawk

Source: Central Sierra Audubon Society 2013.

5.4.2 Botanical Resources

Vegetative cover and species composition varies with elevation, moisture, slope, and aspect. California supports a variety of botanical resources, including vegetation communities and individual species that provide regional biodiversity, wildlife habitats, and other services (TID/MID 2013*h*). The varied terrain of California provides a high diversity of species and vegetative cover types. Areas immediately adjacent to the La Grange pool are in a natural condition and dominated by various grass species and scattered trees and underbrush. Based on review of aerial photography, a site visit conducted in 2013, and information derived from the U.S. Department of Agriculture, Forest Service (USFS) CalVeg mapping system (USFS 2004), vegetation types in the LGP vicinity are dominated by Blue Oak, Annual Grasses and Forbs, and Chamise (Figure 5.4.2-1). Descriptions of these vegetation alliances are provided below.

- ***Blue Oak Alliance*** **-** This alliance is dominated by blue oak (*Quercus douglasii*), which naturally occurs in an oak-grass association on well-drained, gentle slopes. Blue oak and gray pine (*Arceuthobium occidentale*) are the major trees in this hillside alliance. Blue oak may be the only hardwood species, although interior live oak (*Q. wislizeni*), valley oak (*Quercus lobata*) and/or California buckeye (*Aesculus californica*) may also be present. Chaparral shrubs such as wedgeleaf ceanothus, manzanitas (*Arctostaphylos* spp.), coffeeberry (*Rhamnus* spp.), birchleaf mountain mahogany (*Cercocarpus montanus* var. *glaber*), and poison oak (*Toxicodendron diversilobum*) are also part of this alliance. The understory of the blue oak alliance is dominated by annual grasses such as wild oats (*Avena* spp.) and cheatgrass (*Bromus* spp.). This alliance generally occurs below about 3,900 feet in the Project vicinity (TID/MID 2011).

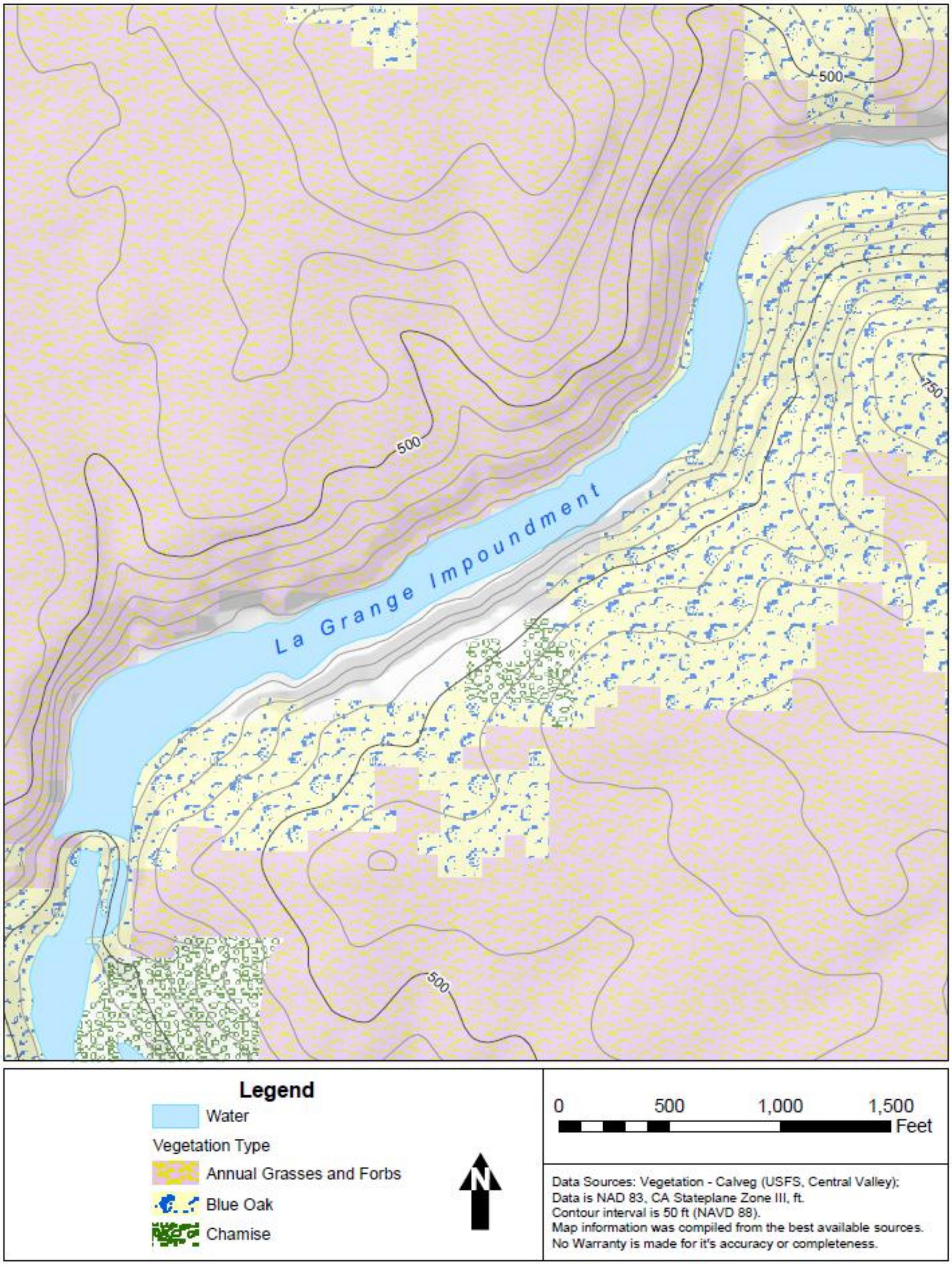

Figure 5.4.2-1 USFS CalVeg map of the LGP vicinity.

- ***Annual Grasses and Forbs Alliance -*** Annual grasslands are very abundant in the Project vicinity generally occurring between urban/agricultural developments and foothill woodlands. Dominant species in this vegetation alliance include ripgut brome (*Bromus diandrus*), Italian ryegrass (*Lolium multiflorum*), soft chess (*Bromus hordeaceus*), wild oats (*Avena barbata*), and silver hairgrass (*Aira carophyllea*). The invasive Bermudagrass (*Cynodon dactylon*) is common in this alliance. Vernal pools (small depressions often containing hardpan soil layers) occur throughout the Annual Grasses and Forbs Alliance. Species within these vernal pools include downingia (*Downingia* spp.), meadowfoam (*Limnanthes douglasii*), goldfields (*Lasthenia chrysostoma*), water atarwart (*Callitriche marginata*), popcorn flower (*Plagiobothrys* spp.), Johnny-tuck (*Orthocarpus erianthus*), bur medic (*Medicago hispida*), and linanthus (*Linanthus* spp.) (TID/MID 2011).

- ***Chamise Alliance -*** Relatively pure stands of chamise (*Adenostoma fasciculatum*) occupy xeric sites at elevations up to about 4,000 feet and often are found in upper ridge slope positions. Chaparral shrubs such as wedgeleaf ceanothus, whiteleaf manzanita (*Arctostaphylos manzanita*) and birchleaf mountain mahogany are associated shrubs. Scattered gray pine and interior live oak are found in this alliance (TID/MID 2011).

As previously discussed in this PAD, multiple studies have been performed by the Districts within the LGP vicinity as part of the Don Pedro Project relicensing activities. Additional information describing botanical resources in the LGP vicinity can be found in the Districts' Draft License Application (DLA) Don Pedro Project, FERC No. 2299 (TID/MID 2013*h*) as well as described in the Districts' *Special-Status Plants Study Report, Don Pedro Project, FERC No. 2299* (Special-Status Plant Study Report) (TID/MID 2013*c*). Specifically, Attachment A of the Special-Status Plant Study Report presents a complete plant list of over 700 vascular plant species identified in the LGP vicinity by the Districts during their botanical resource studies associated with the relicensing of the Don Pedro Project.

5.4.2.1 Noxious Weeds

For the purpose of this PAD, noxious weeds are defined as those plant species listed as such by the California Department of Food and Agriculture (CDFA) (CDFA 2012) and the Sierra-San Joaquin Noxious Weeds Alliance (SSJNWA) (SSJNWA 2003). Based on these sources, 27 noxious weeds were determined to have a reasonable potential to occur within the Project vicinity (Table 5.4.2-1). State-designated noxious weeds are typically assigned one of three ratings: (1) A-list species are mandated for eradication or control; (2) B-list species are widespread plants that Agricultural Commissioners can nevertheless designate for local control efforts; and (3) C-list species are considered too widespread for funding of control efforts (CDFA 2013).

Non-native invasive species and noxious weeds are typically prolific pioneering species that have the ability to quickly outcompete native vegetation. They grow rapidly, mature early, and effectively spread seeds that can survive for significant periods in the soil until site conditions are favorable for growth. Invasive plants often form vast single-species communities that are less suitable to birds and wildlife than native communities and can compromise native ecosystems by altering soil and water resources on a site. The introduction of non-indigenous invasive aquatic plant species to the United States has been escalating with widespread destructive consequences.

Potential noxious weed occurrences are listed in Table 5.4.2-1 (SSJNWA 2003; CDFA 2010). As previously discussed in this PAD, multiple studies have been performed by the Districts within the LGP vicinity as part of the Don Pedro Project relicensing activities. Additional information describing noxious weeds occurring in the LGP vicinity can be found in the Districts' DLA Don Pedro Project FERC No. 2299 (TID/MID 2013*h*) as well as described in the Districts' *Noxious Weeds Study Report Don Pedro Project FERC No. 2299* (Noxious Weeds Study Report) (TID/MID 2013*d*). Specifically, 12 noxious weed species were observed and mapped in the LGP vicinity as part of the Don Pedro Project relicensing activities. However, of these 12 noxious weed species occurring in the LGP vicinity, the following noxious weed species are known to occur near the eastern edge of the La Grange pool: Bermudagrass (*Cynodon dactylon*) and medusahead grass (*Elymus caput-medusae*) (TID/MID 2013*d*).

Table 5.4.2-1 Noxious weeds potentially occurring in the vicinity of the Project.

Common Name	Scientific Name	CDFA Status[1]
Russian knapweed	*Acroptilon repens*	B
Barbed goat grass	*Aegilops triuncialis*	B
Tree-of-heaven	*Ailanthus altissima*	C
Giant reed	*Arundo donax*	B
Lens-pod whitetop	*Cardaria chalepensis*	B
Hoarycress	*Cardaria* spp.	B
Italian thistle	*Carduus pycnocephalus*	C
Distaff thistle	*Carthamus* spp.	A, B
Purple starthistle	*Centaurea calcitrapa*	B
Diffuse knapweed	*Centaurea diffusa*	A
Iberian starthistle	*Centaurea iberica*	A
Yellow starthistle	*Centaurea solstitialis*	C
Spotted knapweed	*Centaurea stobe* ssp. *micranthos*	A
Rush skeletonweed	*Chondrilla juncea*	A
Canada thistle	*Cirsium arvense*	B
Bermudagrass	*Cynodon dactylon*	C
Scotch broom	*Cytisus scoparius*	A
Medusahead	*Taeniatherum caput-medusae*	C
Oblong spurge	*Euphorbia oblongata*	B
Klamath weed	*Hypericum perforatum*	C
Dyer's woad	*Isatis tinctoria*	B
Perennial pepperweed	*Lepidium latifolium*	B
Purple loosestrife	*Lythrum salicaria*	B
Russian thistle	*Salsola tragus*	C
White horsenettle	*Solanum elaeagnifolium*	B
Tamarisk	*Tamarix* spp.	B
Puncturevine	*Tribulus terrestris*	C

Source: TID/MID 2013*d*

1 CDFA Noxious Weed Rating: A-rated weeds are highest priority for eradication in the State, followed by B- and then C-rated.

5.4.3 Wetland, Riparian, and Littoral Habitat

Wetlands are commonly understood to be transitional lands that occur between uplands and aquatic systems. However, wetlands include certain shallow aquatic areas and are more accurately defined according to the following attributes (Cowardin et al. 1979):

1) at least periodically, the land supports predominantly hydrophytes (i.e., vegetation associated with moist soil conditions);
2) the substrate is predominantly un-drained hydric soil (i.e., soils characterized by anaerobic conditions); and
3) the substrate is non-soil and is saturated with water or covered by shallow water at some time during the growing season of each year.

Wetlands along the Tuolumne River in the LGP vicinity are primarily confined to narrow bands immediately adjacent to the river, or small isolated wetlands adjacent to the river channel. The wetlands directly surrounding the LGP are considered lacustrine wetlands with an unconsolidated bottom, riverine wetlands with an unconsolidated bottom, and palustrine wetlands with an unconsolidated shore (Figure 5.4.3-1).

Palustrine wetlands, often called fens, swamps, marshes, or bogs, are nontidal wetlands. These wetlands are dominated by trees, shrubs, and/or persistent plants/mosses. These wetlands may also be composed of shallow, open-water ponds (Cowardin et al. 1979).

Based on the classification system described by Cowardin et al, wetlands identified by the U.S. Fish and Wildlife Service's (USFWS) National Wetland Inventory (NWI) maps in the LGP vicinity consists of three types: lacustrine unconsolidated bottom, riverine unconsolidated bottom, and palustrine unconsolidated shore. Each of these wetland types is described below:

- Lacustrine unconsolidated bottom permanently flooded (L1UBH) wetlands have the following characteristics: (1) situated in a topographic depression or a dammed river channel; (2) lacking trees, shrubs, persistent emergents, emergent mosses or lichens with greater than 30% areal coverage; and (3) the total area exceeds 20 acres. These wetlands have at least 25 percent cover of particles smaller than stones (less than 6-7 centimeters), and a vegetative cover less than 30 percent. These wetlands are permanently flooded and water covers the land surface throughout the year in all years (Cowardin et al. 1979).

- Riverine unconsolidated bottom permanently flooded (R3UBH) wetlands are wetlands and deepwater habitats contained in natural or artificial channels periodically or continuously containing flowing water or which forms a connecting link between the two bodies of standing water. Upland islands or palustrine wetlands may occur in the channel, but they are not part of the riverine system. These wetlands have at least 25 percent cover of particles smaller than stones (less than 6-7 centimeters), and a vegetative cover less than 30 percent. These wetlands are permanently flooded and water covers the land surface throughout the year in all years (Cowardin et al. 1979).

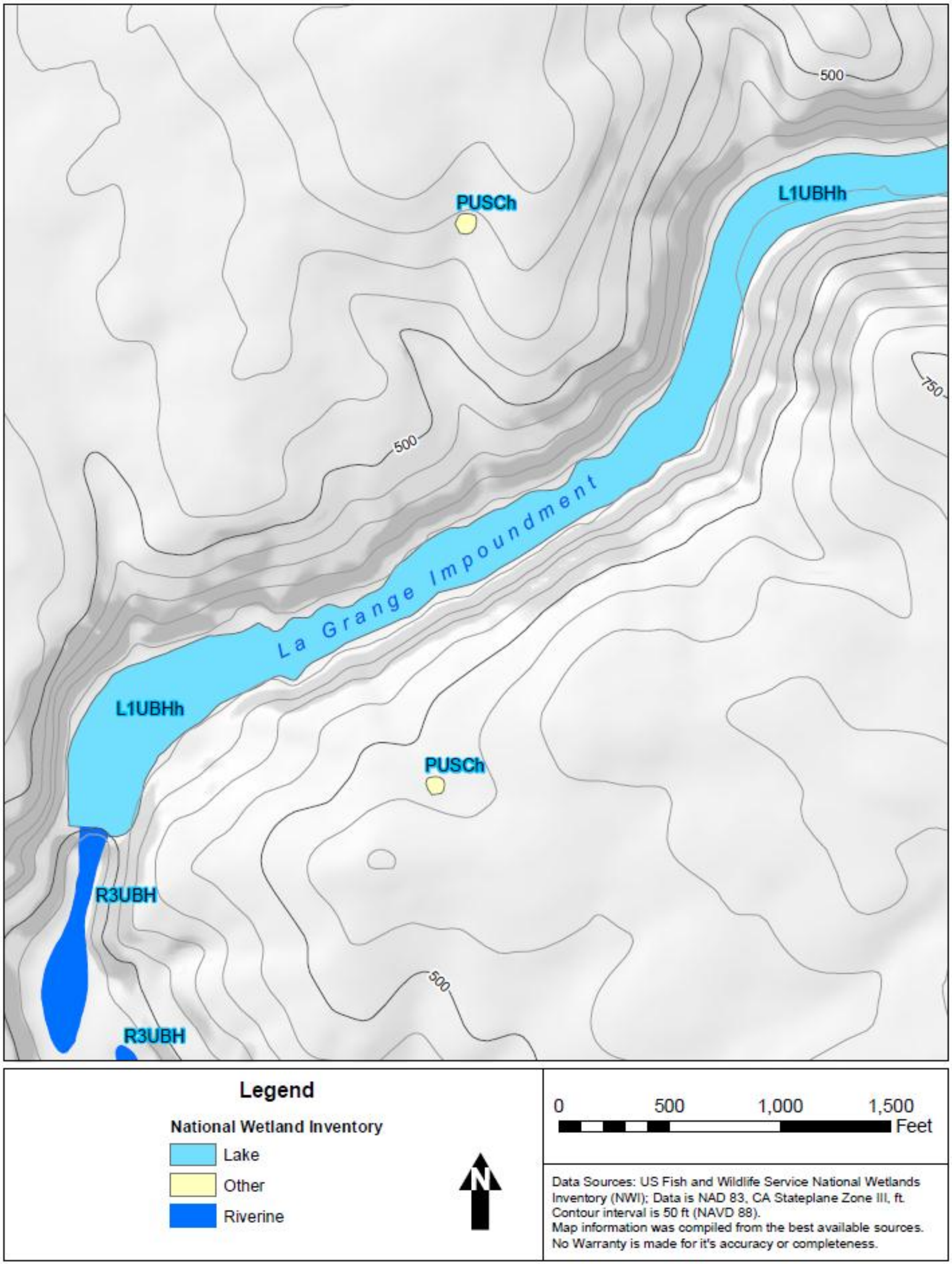

Figure 5.4.3-1 LGP vicinity national wetland inventory map.

- Palustrine unconsolidated shore seasonally flooded (PUSC) wetlands include all nontidal wetlands dominated by trees, shrubs, emergents, mosses or lichens, and all such wetlands that occur in tidal areas where salinity due to ocean-derived salts is below 0.5 parts per trillion (ppt). Wetlands lacking such vegetation are also included if they exhibit all of the following characteristics: (1) are less than 20 acres; (2) do not have an active wave-formed or bedrock shoreline feature; (3) have at low water a depth less than 6.6 feet in the deepest part of the basin; and (4) have a salinity due to ocean-derived salts of less than 0.5 ppt. The unconsolidated shore class includes all wetland habitats having two characteristics: (1) unconsolidated substrates with less than 75 percent areal cover of stones, boulders, or bedrock and; (2) less than 30 percent areal cover of vegetation. Landforms such as beaches, bars, and flats are included in the unconsolidated shore class. These wetlands have surface water present for extended periods especially early in the growing season, but is absent by the end of the growing season in most years. The water table after flooding ceases is variable, extending from saturated to the surface to a water table well below the ground surface (Cowardin et al. 1979).

5.4.3.1 Wetland and Riparian Vegetation

No formal surveys of wetland vegetation have been completed for the LGP. However, the Districts performed a wetland study (i.e., *Wetland Habitats Associated with Don Pedro Reservoir Study Report, Don Pedro Project, FERC No. 2299* (TID/MID 2013*e*) as part of the relicensing of the Don Pedro Project and Table 5.4.3-1 (TID/MID 2013*e*) below provides a partial list of wetland and riparian plants that occur in the LGP vicinity based on the results of the Districts wetland study conducted within the Don Pedro Project area.

Table 5.4.3-1 Partial list of wetland and riparian plants that occur in the LGP vicinity.

Common Name	Scientific Name
California barley	*Hordeum brachyantherum*
Rabbitfoot grass	*Polypogon monspeliensis*
Seepspring monkeyflower	*Mimulus guttatus*
Hedge nettle	*Stachys stricta*
Naked sedge	*Carex nudata*
Curly dock	*Rumex crispus*
Narrow leaf milkweed	*Asclepias fascicularis*
Red willow	*Salix laevigata*
Mountain rush	*Juncus balticus*
Leather root	*Hoita macrostachya*
Greensheath sedge	*Carex feta*
Spicebush	*Calycanthus occidentalis*
Western blue-eyed grass	*Sisyrinchium bellum*
Poison hemlock	*Conium maculatum*
Narrowleaf willow	*Salix exigua*
Field mint	*Mentha arvensis*
Oregon ash	*Fraxinus latifolia*

Common rush	*Juncus effusus*
Leather root	*Hoita macrostachya*
Alder	*Alnus incana*
Western sycamore	*Platanus racemosa*
Water buttercup	*Ranunculus aquatilis*
Rosella	*Helenium puberulum*
Tall flatsedge	*Cyperus eragrostis*
Broadleaf cattail	*Typha latifolia*
Lady's thumb	*Persicaria maculosa*
Yellow watercress	*Rorippa nasturtiumaquaticum*

Source: TID/MID 2013*e*

5.4.3.2 Wetland and Riparian Wildlife

Lists of specific wildlife known to occur in wetland and riparian habitats in the proposed LGP vicinity are not available; however, many of the species likely to occur typically use wetland or riparian habitats at some time during their lives. Great blue herons, common mergansers, and mallards likely use the wetland and riparian habitats in the vicinity of the LGP on a limited/seasonal basis. Many of the amphibians and reptiles including California toad (*Anaxyrus boreas halophilus*), American bullfrog (*Lithobates catesbeianus*), western yellow-bellied racer (*Coluber constrictor mormon*), Pacific gopher snake (*Pituophis catenifer catenifer*), and valley gartersnake (*Thamnophis sirtalis fitchi*) may occur in the LGP vicinity. Other species likely to occur in the wetland or riparian habitats include raccoon, mule deer, mink, and coyote (California Herps 2013; American Society of Mammalogists 2013).

5.4.3.3 Wetland, Riparian Zone, and Littoral Maps

A wetland, riparian zone, and littoral map for the LGP vicinity (Figure 5.4.3-1) was compiled from a USFWS National Wetland Inventory map.

5.4.3.4 Estimates of Wetland, Riparian, and Littoral Habitat Acreage

No formal surveys of wetland habitat have been completed for the LGP. As discussed in greater detail in Section 3.8, the Districts will develop a proposed Project Boundary during development of the Draft License Application. Estimates of wetland, riparian, and littoral habitat acreage will be provided following development of an appropriate FERC boundary for the LGP.

5.4.4 Potential LGP Effects and Resource Issues

5.4.4.1 Potential Effects

<u>LGP Operation and Maintenance Effects on Botanical Resources</u>

The Districts utilized available information to describe botanical and wildlife resources occurring within the LGP vicinity to characterize the baseline condition and consider potential effects of the LGP. As previously described in this PAD, the LGP operates in a run-of-river mode. The La Grange diversion dam was originally constructed in 1891-1893 to raise the level of the

Tuolumne River so as to permit the diversion and delivery of water by gravity means to TID's and MID's irrigation systems. The diversion dam is located at the exit of a narrow canyon and there is no active storage in the La Grange impoundment. Therefore, the La Grange diversion dam acts as a diversion dam, delivering flow through its tunnel intakes to the TID and MID canal systems (TID 2011*a*).

The operation of the LGP has very little effect on the terrestrial communities that border La Grange impoundment. The occurrence and distribution of terrestrial vegetation cover types in the study area is generally unrelated to LGP operations. The botanical resources located adjacent to the LGP have developed under the current operating regime. The only potential impacts to terrestrial resources associated with the LGP include vegetation management along the perimeter of TID hydro project facilities and the maintenance of related access ways.

Current practices conducted by the Districts include vegetation maintenance around facilities using mostly mechanical vegetation removal techniques (e.g., mowing, trimming of brush). The degree of impact resulting from this vegetation management is minor relative to other land uses that occur in the region (e.g., agricultural practices). These effects are very minor in nature and likely have a minimal effect on botanical and wildlife resources within the LGP vicinity.

Based on field visits to the site and multiple studies undertaken by the Districts in the area as part of the Don Pedro Project relicensing activities, there is no evidence of any on-going adverse effects to botanical resources due to LGP operations.

<u>Invasive Species</u>

Land management activities, ground disturbance, and the operation of the LGP have the theoretical potential to enhance the establishment and spread of invasive plant species. Non-native invasive plant species can impact both human and environmental resources. Areas where vegetation and soils have been disturbed are more susceptible to invasion by invasive weeds than undisturbed environments. Aggressive invasive weeds crowd out native vegetation and alter the natural environment and habitat for wildlife species, as well as affecting agricultural water-use efficiency, and recreational land values. They can adversely affect native plant species, plant communities, and wildlife habitat through competition.

The Districts' operation and maintenance (O&M) practices include occasional use of roadways in the LGP vicinity and periodic maintenance of facilities located near the powerhouse. Current practices conducted by the Districts include vegetation maintenance around LGP facilities using mostly mechanical vegetation removal techniques. Some of the invasive species discussed above can be located along roadways and other areas, and may be dispersed into new areas by LGP and non-LGP-related activities. However, non-LGP land uses (e.g., agricultural practices) adjacent to the LGP area likely determine the level of ground disturbance and expected weed ecology at these sites, because these uses are substantially greater in scope, frequency, and duration than those undertaken by the Districts. As a result, the effects of LGP operation and maintenance activities on the spread of invasive plant species are minimal.

Wetland and Riparian Habitat

Based on field visits to the site and multiple studies undertaken by the Districts in the vicinity of the LGP as part of the Don Pedro Project relicensing activities, there is no evidence of any on-going adverse effects to wetland resources due to hydro power operations.

Wildlife Resources

The operation of the LGP has very little impact on the wildlife resources within and bordering the LGP. The occurrence and distribution of wildlife resources adjacent to the LGP is generally unrelated to j operations. Based on field visits to the site and multiple studies undertaken by the Districts in the LGP vicinity as part of the Don Pedro Project relicensing activities, there is no evidence of any on-going adverse effects to wildlife resources due to hydro power operations.

5.4.4.2 Resource Issues

At this time, no specific terrestrial resource issues of concern have been identified.

5.5 Rare, Threatened, and Endangered Species

This section discusses plant, aquatic, and wildlife species in the vicinity of the LGP that are listed as threatened or endangered under either the federal Endangered Species Act (ESA), the California Endangered Species Act (CESA), or both, or are designated as fully protected[9] under state law. Species afforded other special protection by a federal or state agency are referred to as "special-status species" in this PAD and are also described below.

As previously discussed in this PAD, multiple studies have been performed by the Districts within the LGP vicinity as part of the Don Pedro Project relicensing activities. Additional information describing rare, threatened, and endangered species, as well as special-status species potentially occurring in the LGP vicinity can be found in the Districts' DLA for the Don Pedro Project (TID/MID 2013*h*) as well as described in the Districts various Don Pedro Project study reports. It should be noted that the Districts' study area for some rare, threatened, and endangered species and special-status species surveys for the Don Pedro Project extended one quarter mile outside the Don Pedro Project Boundary and therefore were in the immediate LGP vicinity.

5.5.1 Federal ESA-Listed Species

In May 2013, the Districts generated an official list of ESA-listed species for the La Grange 7.5-minute USGS topographic quadrangle which includes the LGP area, via the on-line request service available at the USFWS's website at http://www.fws.gov/sacramento/es_species/

[9] In addition to the CESA, CDFW affords special protection to some fish and wildlife species, referring to them as "fully protected" (FP). Fishes are authorized under the California Fish and Game Code § 5515 and California Code of Regulations, Title 14, Division 1, Chapter 2, Article 4, Section 5.93. FP designations for amphibians and reptiles are authorized under § 5050 of the California Fish and Game Code.

Lists/es_species_lists.cfm. The list included 11 species[10] (three invertebrates, four fish, two amphibians, one mammal, and one plant)[11].

The Districts eliminated from further consideration three fish species (Delta smelt, *Hypomesus transpacificus;* Central Valley spring-run Chinook salmon, *Oncohynchus tschawytscha*; and winter-run Chinook salmon, *O. tschawytscha)* and one invertebrate species (Conservancy fairy shrimp, *Branchinecta conservatio*) because these species are not known to occur at the LGP (TID/MID 2011).

Following removal of species that do not occur in the vicinity of the LGP, seven species on USFWS's September 2011 list remained. Two of the species are Federally Endangered (FE) and five are Federally Threatened (FT):

- **ESA Endangered:**
  – Hartweg's golden sunburst (*Pseudobahia bahiifolia*)
  – San Joaquin kit fox (*Vulpes macrotis mutica*)

- **ESA Threatened:**
  – Valley elderberry longhorn beetle (*Desmocerus californicus dimorphus*)
  – Vernal pool fairy shrimp (*Branchinecta lynchi*), Critical Habitat
  – California tiger salamander, Central Valley Distinct Population Segment (DPS) (*Ambystoma californiense*), Critical Habitat
  – California red-legged frog (*Rana draytonii*)
  – Steelhead, California Central Valley DPS (*Oncorhynchus mykiss irideus),* Critical Habitat

The Districts then searched a number of sources to compile information for each of the ESA-listed species, including: (1) a description of habitat requirements, (2) any known occurrences of the species within or adjacent to the Project, and (3) references to any recovery plans or status reports pertaining to the ESA-listed species. For plants, the sources were California Natural Diversity Database (CNDDB) and the U.S. Department of Agriculture's (USDA) PLANTS database, which is available at http://plants.usda.gov/java/. The California Native Plant Society (CNPS) database was also used to query the Project quadrangle map. This database is available at http://www.cnps.org/inventory. For fish and wildlife, the information sources included CDFW's CNDDB, USFWS' online database and Recovery Plans. The result of the search is shown in Table 5.5.1-1.

[10] Note that *Oncorhynchus tshawytscha* consists of the Central Valley spring-run Chinook salmon (Threatened – National Marine Fisheries Service [NMFS]) and the winter-run Chinook salmon, Sacramento River (Endangered - NMFS).

[11] The USFWS query results provided an overall species list for the entire La Grange quadrangle.

Table 5.5.1-1 Federal and State of California threatened or endangered species, and state rare or fully protected species occurring or potentially occurring in the vicinity of the LGP.

Common Name / Scientific Name	Status[1,2]	Suitable Habitat Type	Known Occurrence in LGP Vicinity	Status Reports, Recovery Plans Relevant to LGP Vicinity
Plants				
Hartweg's golden sunburst *Pseudobahia bahiifolia*	FE, SE	Cismontane woodland, valley and foothill grassland (CNDDB 2009)	Occurs within La Grange quad (CNPS 2010). Three occurrences found on CNDDB within La Grange quad (CNDDB 2009). Reported on the USFWS species list for the Project quadrangle (USFWS 2013).	5-Year Review (USFWS 2007*a*)
Succulent owl's clover *Castilleja campestris* ssp. *succulent*	SE	Vernal pools (CNPS 2010)	Reported to occur in Stanislaus County (USDA 2013). Not identified on La Grange quadrangle as federally endangered or threatened species (USFWS 2013).	Recovery Plan (USFWS 2005)
Colusa grass *Neostapfia colusana*	SE	Vernal pools (CNPS 2010)	Reported to occur in Stanislaus County (USDA 2013). Not identified on La Grange quadrangle as federally endangered or threatened species (USFWS 2013).	Recovery Plan (USFWS 2005) 5-Year Review (USFWS 2008)
Hairy orcutt grass *Orcuttia pilosa*	SE	Vernal pools (CNPS 2010)	Reported to occur in Stanislaus County (USDA 2013). Not identified on La Grange quadrangle as federally endangered or threatened species (USFWS 2013).	Recovery Plan (USFWS 2005) 5-Year Review (USFWS 2009)
Chinese Camp brodiaea *Brodiaea pallid*	SE	Ultramafic, valley and foothill grassland, cismontane woodland, vernal streambeds, often serpentine (CNPS 2010)	Reported to occur in Tuolumne County (USDA 2013). Not identified on La Grange quadrangle as federally endangered or threatened species (USFWS 2013).	5-Year Review (USFWS 2007*b*)
Red Hills vervain *Verbena californica*	ST	Cismontane woodland, valley and foothill grassland, usually serpentine seeps and creeks (CNPS 2010)	Reported to occur in Tuolumne County (USDA 2013). Not identified on La Grange quadrangle as federally endangered or threatened species (USFWS 2013).	5-Year Review (USFWS 2007*c*)
Layne's ragwort *Packera layneae*	SR	Chaparral, cismontane woodland, serpentine or gabbroic, rocky (CNPS 2010)	Reported to occur in Tuolumne County (USDA 2013). Not identified on La Grange quadrangle as federally endangered or threatened species (USFWS 2013).	Recovery Plan (USFWS 2002)

Common Name / Scientific Name	Status[1,2]	Suitable Habitat Type	Known Occurrence in LGP Vicinity	Status Reports, Recovery Plans Relevant to LGP Vicinity
Greene's tuctoria *Tuctoria greenei*	SR	Vernal pools (CNPS 2010)	Reported to occur in Stanislaus County (USDA 2013). Not identified on La Grange quadrangle as federally endangered or threatened species (USFWS 2013).	Recovery Plan (USFWS 2005) 5-Year Review (USFWS 2007*d*)
Invertebrates				
Valley elderberry longhorn beetle *Desmocerus californicus dimorphus*	FT	Occurs only in the Central Valley and adjacent foothills up to 3,000 feet elevation in association with Blue elderberry.	Reported on the USFWS species list for the Project quadrangle (USFWS 2013).	Recovery Plan (USFWS 1984)
Vernal pool fairy shrimp *Branchinecta lynchi*	FT	Occurs mostly in vernal pools although it also inhabits a variety of natural and artificial seasonal wetland habitats, such as alkali pools, ephemeral drainages, stock ponds, roadside ditches, vernal swales, and rock outcrop pools (NatureServe 2012).	Reported on the USFWS species list for the Project quadrangle (USFWS 2013).	Recovery Plan (USFWS 2005)
Amphibians				
California tiger salamander, Central Valley DPS *Ambystoma californiense*	FT, ST	Breeds in seasonal ponds (or permanent ponds where fish are absent) and occasionally in intermittent streams. Occurs terrestrially in vacant or mammal-occupied burrows, occasionally other underground retreats, throughout most of the year; in grassland, savanna, or open woodland habitats (NatureServe 2012).	Five occurrences found on CNDDB within La Grange quad (CNDDB 2009). Reported on the USFWS species list for critical habitat within the Project quadrangle (USFWS 2013).	None

Common Name / Scientific Name	Status[1,2]	Suitable Habitat Type	Known Occurrence in LGP Vicinity	Status Reports, Recovery Plans Relevant to LGP Vicinity
California red-legged frog *Rana aurora draytonii*	FT	Suitable habitat is located in deep (>2.3 feet), still or slow-moving water within dense, shrubby riparian and upland habitats (Jennings and Hayes, 1994).	Reported on the USFWS species list within the Project quadrangle (USFWS 2013). The nearest known occurrence is at Piney Creek, where CRLF was last documented in 1984 at locations ranging from 0.96 mi east to 1.06 mi east of the Don Pedro Project Boundary (Basey, pers. comm., 2010, Jennings, pers. comm. 2010 *as cited in* TID/MID 2011).	Recovery Plan (USFWS 2002)
Fish				
Steelhead, California Central Valley DPS *Oncorhynchus mykiss irideus*	FT	Spawning occurs within the Sacramento and San Joaquin rivers and their tributaries; majority of native, natural production occurs in upper Sacramento River tributaries below Red Bluff Diversion Dam (NatureServe 2012).	Reported on the USFWS species list for critical habitat within the Project quadrangle (USFWS 2013).	Restoration and Management Plan (CDFG 1996) Public Draft Recovery Plan for Sacramento River Winter-run Chinook Salmon, Central Valley Spring-run Chinook Salmon and Central Valley Steelhead (NMFS 2009)
Birds				
Bald eagle *Haliaeetus leucocephalus*	SE	Breeding habitat usually includes areas close to coastal areas, bays, rivers, lakes, or other bodies of water that reflect the general availability of primary food sources. Preferentially roosts in conifers or other sheltered sites in winter in some areas (NatureServe 2012).	One occurrence within La Grange quad (CNDDB 2009).	Status Report (CDFG 2005)
Golden eagle *Aquila chrysaetos*	SFP	Generally open country, in prairies, arctic and alpine tundra, open wooded country, and barren areas, especially in hilly or mountainous regions. Nests on rock ledge of cliffs or in large trees (NatureServe 2012).	Observed during the Bureau of Land Management (BLM) and Central Sierra Audubon Society (CSAS) mid-winter eagle surveys on Don Pedro Reservoir. They were observed during surveys in 1997 and each year between 1999 and 2009.	None

Common Name / Scientific Name	Status[1,2]	Suitable Habitat Type	Known Occurrence in LGP Vicinity	Status Reports, Recovery Plans Relevant to LGP Vicinity
Mammals				
San Joaquin kit fox *Vulpes macrotis mutica*	FE, ST	Alkali sink, valley grassland, foothill woodland. Hunts in areas with low sparse vegetation that allows good visibility and mobility (NatureServe 2012).	One occurrence found on CNDDB within La Grange quad (CNDDB 2009). Reported on the USFWS species list for critical habitat within the Project quadrangle (USFWS 2013).	Recovery Plan (USFWS 1998)

[1] Status Codes:
FE: - Federally Endangered: Any species that is in danger of extinction throughout all or a significant portion of its range.
FT: - Federally Threatened: Any species likely to become endangered within the near future.
SE: - State Endangered: California State listed as Endangered.
ST: - State Threatened: California State listed as Threatened.
SFP: - California State listed as Fully Protected.
SR: - California State listed as Rare.
[2] Endangered or threatened species reported by the USFWS (2013) for the La Grange quadrangle are reported above. Note that state-listed species reported above may have a federal listing status but the federal listing status of species occurring outside of the La Grange quadrangle have not been included.

5.5.2 CESA – Rare and Fully Protected Species

To prepare a formal list of CESA-listed plants and animals and California State-listed Fully Protected (SFP) species with a potential to occur in or adjacent to the LGP, the Districts used the CNDDB database for animals and the CNPS database for plants. The Districts then referred to the CNDDB and other appropriate sources described above to determine the potential occurrence of these species in or adjacent to the LGP.

To identify CESA-listed animals, the Districts reviewed the CDFW January 2013 list of *State and Federally Listed Endangered and Threatened Animals of California* (CDFW 2013*a*). The list includes 155 fish and wildlife species of which 50 are listed under both the ESA and CESA, 75 are listed only under the ESA, and 32 are listed only under the CESA. The Districts also reviewed the State of California, CDFW List of State Fully Protected Animals. The list includes 37 fish and wildlife species.

To identify CESA-listed plants, the Districts reviewed the CDFW April 2013 list of *State and Federally Listed Endangered, Threatened, and Rare Plants of California* (CDFW 2013*b*). The list includes 134 plant species that are state-listed as endangered, 22 that are state-listed as threatened, 139 listed as federally endangered, 47 listed as federally threatened, and 125 that are both state and federally listed.

Based on review of the above information, 11 species (eight plants, two birds, and one amphibian) protected under the CESA, Rare or Fully Protected under state law may potentially occur in the vicinity of the LGP. These species are:

- **CESA Endangered:**
  – Succulent owl's-clover (*Castilleja campestris* ssp. *succulenta*)
  – Hartweg's golden sunburst (*Pseudobahia bahiifolia)*
  – Colusa grass (*Neostapfia colusana*)
  – Hairy orcutt grass (*Orcuttia pilosa*)
  – Chinese Camp brodiaea (*Brodiaea pallida)*
  – Bald eagle (*Haliaeetus leucocephalus*)
- **CESA Threatened:**
  – Red Hills vervain (*Verbena californica*)
  – California tiger salamander, Central Valley DPS (*Ambystoma californiense*)
- **State Rare:**
  – Layne's ragwort (*Packera layneae*)
  – Greene's tuctoria (*Tuctoria greenei*)
- **State Fully Protected:**
  – Golden eagle (*Aguila chrysaetos*)

Table 5.5.1-1 described each species' habitat requirements, any known occurrences within or adjacent to the Project, and references to any recovery plans or status reports pertaining to a CESA-listed species.

5.5.3 Special-Status Species

The CDFW's CNDDB program lists all species or natural communities that have been documented by the CNDDB according to USGS quadrangles. As identified in Table 5.5.1-1 above, several species are listed as state threatened and endangered by the CNDDB in the La Grange quadrangle. In addition to species listed as state threatened or endangered by the CNDDB, the CNDDB also lists species of special concern and special-status species. Table 5.5.3-1 below lists all of the species or natural communities that have been documented in the La Grange USGS quadrangle (CDFW Undated)[12]. Extensive agency consultation on special-status species occurred during the relicensing efforts of the Don Pedro Project (FERC No. 2299). Please refer to the Don Pedro PAD and DLA for additional information on special-status species in this region (TID/MID 2011, TID/MID 2013*h*).

[12] Federal or state listed endangered or threatened species and fully protected species have been removed from Table 5.5.3-1 because these species are identified on Table 5.5.1-1.

Table 5.5.3-1 The CNDDB list of species or natural communities that have been documented in the La Grange USGS quad (CDFW Undated)[4].

Common Name	Scientific name	California Department Fish and Game Designation[1]	California Native Plant Society Rank[2]
California tiger salamander	*Ambystoma californiense*	SSC	
Bald eagle	*Haliaeetus leucocephalus*	SSC	
Tricolored blackbird	*Agelaius tricolor*	SSC	
American badger	*Taxidea taxus*	SSC	
Spiny-sepaled button-celery	*Eryngium spinosepalum*		1B.2
Hoover's calycadenia	*Calycadenia hooveri*		1B.3
Hartweg’s golden sunburst	*Pseudobahia bahiifolia*		1B.1
Mariposa cryptantha	*Cryptantha mariposae*		1B.3
Dwarf downingia	*Downingia pusilla*		2.2
Merced monardella	*Monardella leucocephala*		1A
Knotted rush	*Juncus nodosus*		2.3

[1] SSC = Species of Special Concern
[2] 1A = Plants presumed extinct in CA, 1B = Plants rare, threatened, or endangered in CA and elsewhere, 2 = Plants rare, threatened, or endangered in CA but more common elsewhere, 3 = Additional information needed for plants.

5.5.4 Life Histories of Threatened, Endangered, and Fully Protected Species

Life histories of the threatened, endangered and fully protected species identified in Table 5.5.1-1 are provided in Section 5.5.4 of Volume II of the *Don Pedro Project, FERC No. 2299, Pre-Application Document* (TID/MID 2011).

5.5.5 Biological Opinions, Status Reports, and Recovery Plans

Table 5.5.1-1 lists identified biological opinions, status reports, and recovery plans for the listed threatened, endangered, and fully protected species.

5.5.6 Critical Habitat

The USFWS has designated critical habitat for steelhead (*Oncorhynchus mykiss*) to the base of the La Grange diversion dam. Please refer to the Don Pedro PAD for additional information on critical habitat in this region (TID/MID 2011).

5.5.7 Temporal and Spatial Distribution of Rare, Threatened, and Endangered Species

In addition to the temporal and spatial distribution of rare, threatened, and endangered species discussed above, please refer to the *Don Pedro Project, FERC No. 2299, Pre-Application Document* (TID/MID 2011) for additional information regarding the temporal and spatial distribution of the rare, threatened, and endangered species discussed in this section.

5.5.8 Potential LGP Resource Issues

5.5.8.1 Potential Effects

The Districts utilized available information to describe rare, threatened, and endangered (RTE) species occurring within the LGP vicinity to characterize the baseline condition and consider potential effects of the operation and maintenance of the TID hydro project.

The operation of the LGP has very little effect on the terrestrial and aquatic species that occur within the LGP area. The occurrence and distribution of terrestrial and aquatic species in the LGP area is unrelated to hydro project operations. Since the Districts are not proposing any changes to existing LGP facilities or operation and maintenance practices, the existing baseline conditions of any terrestrial and aquatic habitat within the LGP area will not change under a FERC license.

Although no RTE species have been documented within the LGP area as part of the Districts' background data collection and analysis, suitable habitat may be present. However, the continued LGP operations are expected to maintain the terrestrial and aquatic habitats occurring in the LGP vicinity, and, therefore, not affect potential RTE species habitat that exists in the LGP area.

5.5.8.2 Resource Issues

At this time, no specific resource issues have been identified.

5.6 Recreation and Land Use

5.6.1 Overview

Tuolumne County was incorporated in 1850 as one of the original 27 counties in the State of California. Extending from the foothills to the crest of the Sierra Nevada Mountains, Tuolumne County is a popular recreation area. The County contains historical gold mining towns, the Emigrant Wilderness area, Yosemite National Park, and numerous lakes and rivers, including the Wild and Scenic Tuolumne River (Tuolumne County 2005 *as cited in* TID/MID 2011).

Since the incorporation of Tuolumne County, the region has been a prominent area for industry and recreation visitors. The principal industries were originally related to mining and timber. Early recreational visitors to Tuolumne County were primarily focused on Yosemite National Park. As transportation improved, many locations that were once inaccessible became places for various recreation activities such as hiking, camping, gold panning, fishing, swimming, picnicking, climbing, and general river recreation activities (TID/MID 2011).

Stanislaus County is situated in the San Joaquin Valley within a hundred miles of San Francisco Bay. According to Bramhall (1914), Stanislaus County is pre-eminently a great dairy county, while also a region of varied and diversified agriculture, in grain, fruits, and vegetables, and in live stock of all kinds. Some of the recreational opportunities in the county include fishing, hunting, public recreation areas, community parks, access to reservoirs, and other forms of active and passive recreation opportunities (Stanislaus County undated).

5.6.2 Land Use

Lands in the LGP vicinity are within Tuolumne and Stanislaus Counties and are subject to the Tuolumne County and Stanislaus County General Plans and zoning ordinances. Primary land uses in the LGP vicinity are single-family residential, non-irrigated farmland, and irrigated (by groundwater) farmland.

Land use downstream of the LGP is predominately irrigated agriculture and related uses, urban/suburban, and rural residential. The Districts serve over 200,000 acres of high value farmland in the Central Valley. Crop percentages vary year to year, but representative averages are:

- Fruit and Nut Orchards - 35 percent
- Grains - 43 percent
- Pasture - 7 percent
- Alfalfa - 7 percent
- Other - 8 percent

As discussed earlier in Section 3.8, the Districts will develop an appropriate Project Boundary as part of the development of the Draft License Application and once the boundary is defined, maps showing LGP land use will be developed for inclusion in the license application.

5.6.3 Existing Recreation Facilities and Opportunities in the LGP Vicinity

Recreation opportunities abound in the general vicinity of the LGP. Upstream of the Don Pedro Project, the Tuolumne River is designated as a National Wild and Scenic River all the way to its source (except for the Hetch Hetchy Reservoir), a total of some 80 miles. Yosemite National Park and Stanislaus National Forest are prominent features of the watershed above the Don Pedro Project. Below the LGP, the Tuolumne River provides fishing, swimming, and boating opportunities (TID/MID 2011).

The headwaters of the Tuolumne River are located in Yosemite National Park. Cherry and Eleanor Creek, Clavey River, and the North, Middle, and South Forks of the Tuolumne all flow into the upper Tuolumne located northeast of the Project area (TID/MID 2011). Once the Tuolumne leaves Yosemite National Park, it enters into Stanislaus National Forest and is soon joined by Cherry Creek, followed by the South Fork of the Tuolumne, and then the Clavey River. Along the border of Stanislaus National Forest, the upper Tuolumne is joined by the North Fork of the Tuolumne and from there flows through the Don Pedro Reservoir and then through the Project area. Camping, fishing, and whitewater boating are the primary recreational activities along the upper Tuolumne River (TID/MID 2011).

In addition to the recreational opportunities located along the upper Tuolumne River, the Don Pedro Reservoir also provides various recreational opportunities. Don Pedro Reservoir is the sixth largest reservoir in California and is formed by the Don Pedro Dam. Primary access to the reservoir is by County Road J-59 from the southwest; State Highway 120 and 49 and Jacksonville Road from the north; Kelly-Grade, Marshes Flat Road, and Blanchard Road from the east; State Highway 132 from the southeast; and Bonds Flat Road from the south. The public has access to the entire shoreline from the high-water line down and has vehicle access through a variety of small roads outside the main recreation areas (TID/MID 2011).

The Districts have developed three major recreation areas at Don Pedro Reservoir. Management of these facilities is undertaken by the Don Pedro Recreation Agency (DPRA). Together, the three areas include 559 campsites of various types, 43 picnic sites within the three designated picnic areas, three boat launch facilities, two full-service marinas, a houseboat dock and repair yard, and one swimming lagoon (DPRA Recreation Facilities and Operations 2010).

Don Pedro Reservoir supports year-round fishing and offers abundant populations of rainbow, brown, and brook trout; largemouth, smallmouth, spotted, and black bass; kokanee, silver, and Chinook salmon; black and white crappie; bluegill perch; channel, white, and black bullhead catfish; and green sunfish for anglers. Day use visitors have access to fishing opportunities both along the shoreline and via boating access. The many forks of the Don Pedro reservoir also afford the opportunity for isolated and quiet settings for fishing. DPRA, in conjunction with the Tuolumne County Sheriff's office, enforces a boating five-mile-per-hour, no-wake and/or no-ski zones to regulate many of these forks (TID/MID 2011).

There are no recreation facilities located along the reach of the Tuolumne River between Don Pedro and La Grange dams. Access to LGP is limited due to private property ownership of the adjacent lands. Public lands in this reach are also relatively inaccessible. Boating above the La Grange diversion dam is made difficult by infeasibility of portage at the spillway because the dam's abutments are vertical canyon walls, and the spillway spans directly between the two Districts canal intakes, making for hazardous conditions.

Downstream of the LGP, the Tuolumne River continues through farmland in the Central Valley before finally joining with the San Joaquin River. The main recreational activity downstream of the LGP area takes place at Turlock Lake and Modesto Reservoir, followed by fishing and flat-water/swift water canoeing/kayaking on the lower Tuolumne (TID/MID 2011).

Turlock Lake State Recreation Area (SRA) is located in eastern Stanislaus County approximately six miles from the LGP, and houses the only developed camping facilities along the Tuolumne River downstream of the LGP. It is open year-round and features camping, picnicking, fishing, swimming, boating, and water skiing. Bounded on the north by the Tuolumne River and on the south by Turlock Lake, the recreation area provides an ideal setting for water-oriented outdoor activities. Picnicking, day-use, and boat launch ramps are available as well as overnight camping on the south bank of the Tuolumne River (CDPR 2013).

Modesto Reservoir Regional Park is located a few miles east of the town of Waterford off Highway 132. This regional park offers 3,240 acres of land and 2,800 acres of reservoir for recreation and camping. Campsites are available on a "first-come first-serve basis." Recreation opportunities include swimming, fishing, boating, water/jet skiing, bird watching, waterfowl hunting (with permit during specific times of year), archery, and radio-control airplane flying (TID/MID 2011).

There are no commercial whitewater boating opportunities directly downstream of the LGP. However, the Tuolumne River from La Grange diversion dam to the San Joaquin River offers a place for recreation enthusiasts to float in kayaks, rafts, and tubes with a few Class I-II rapids (TID/MID 2011).

From below the La Grange tailrace down to the Basso Bridge boat ramp, the Tuolumne is scenic and a beginner run. This approximately two-mile section of river is primarily flat, generally wide with several small riffles, and even a small ledge drop. Turns are all fairly gradual. From Basso Bridge to Turlock Lake State Park, which is approximately six miles in length, the river alternates between flat wide slow water and narrow channels that are fast and twisty (American Whitewater 2013). Most people take out at Turlock Lake, as there is limited river access and parking options further downstream (TID/MID 2011).

The Tuolumne River downstream of the LGP provides fishing opportunities with special regulations for trout and salmon fishing. From La Grange diversion dam to the mouth of the San Joaquin River, no trout or salmon may be taken from the Tuolumne. Turlock Lake is stocked with trout, black bass, crappie, bluegill, and catfish. Anglers fish from boats on the reservoir or from the shoreline as well as along the lower Tuolumne River (TID/MID 2011).

There is limited developed river and fishing access along the lower Tuolumne River outside of Turlock Lake SRA. The two most common public access points are at Basso Bridge and Fox Grove. Basso Bridge is located off Route 132 west of the town of La Grange. Basso Bridge is part of the La Grange Regional Park, and river access is approximately two acres in size. The Regional Park includes a parking lot, restrooms, informal boat launch, gravel beach area for swimming, trails and pathways, barbecues, picnic tables, and handicapped access. Fishing is permitted with only barbless hooks, synthetic baits, and tackles. Trout may not be taken and must be released. Basso Bridge Fishing Access is closed from October 16 through December 31 due to the Chinook salmon run (Stanislaus County 2010 *as cited in* TID/MID 2011).

5.6.4 Current Recreational Facilities on LGP Lands and Waters

There are no developed recreational facilities associated with the LGP.

5.6.5 Existing Shoreline Buffer Zones

As discussed earlier in Section 3.8, the Districts will develop an appropriate proposed Project Boundary during development of the draft license application. In its filings made to date on the jurisdictional status of the LGP, the Districts have provided backwater modeling, analysis, and field survey information that demonstrates that the upper end of the La Grange pool terminates approximately 5,400 feet above the La Grange diversion dam (TID 2011*b*).

The downstream portion of the Project Boundary will be defined by metes and bounds that will encompass the LGP features and facilities. The upstream portion of the Project Boundary will be defined as contour elevation established to provide an adequate shoreline buffer.

5.6.6 Recreation Needs Identified in Management Plans

Management plans that cover recreation resources within the general vicinity of the LGP include the California Department of Parks and Recreation’s California Outdoor Recreation Plan (CORP), including the Survey on Public Opinions and Attitudes in Outdoor Recreation; the U.S. Department of Interior (DOI), USFWS Recreational Fisheries Policy; the Tuolumne County General Plan; and the Stanislaus County General Plan. Below is a summary of the recreation needs identified in the management plans applicable to the LGP vicinity.

5.6.6.1 California Outdoor Recreation Plan

The 2008 CORP, among other things, identifies and prioritizes outdoor recreation opportunities and constraints most critical in California. The plan lists the following seven major priority areas that comprise the state's strategy for meeting California's outdoor recreation needs:

- Projects that provide opportunities for the top 15 outdoor recreation activities identified in the latent demand scoring in the survey of Public Opinions and Attitudes on Outdoor Recreation in California (see Table 5.6.6-1 below).
- Projects that provide or improve outdoor recreation opportunities in the geographic region.
- Projects that provide outdoor recreation activities for children.
- Projects that provide outdoor recreation opportunities for those underserved communities.
- Projects that support the wetland priorities being pursued by the state's wetland preservation organizations.
- Projects that support the goals of California's Recreation Policy of (a) adequacy of recreation; (b) opportunities; (c) leadership in recreation management; (d) recreation's role in a healthier California; (e) preservation of natural and cultural resources; and (f) accessible recreation experiences.
- Projects that develop the trail corridors identified in the 2002 California Recreational Trails Plan and its scheduled update.

Table 5.6.6-1 California's recreation activities with high latent demand.

Rank	Activity	Rank	Activity
1	Walking for fitness or pleasure	9	Attending outdoor cultural events
2	Camping in developed sites with facilities such as toilets and tables	10	Off-highway vehicle use
3	Bicycling on paved surfaces	11	Driving for pleasure, sightseeing, driving through natural scenery
4	Day hiking on trails	12	Camping at primitive sites
5	Picnicking in picnic areas	13	Swimming in a pool
6	Beach activities	14	Wildlife viewing, bird watching, viewing natural scenery
7	Visiting outdoor nature museums, zoos, gardens, or arboretums	15	Outdoor photography
8	Visiting historical or cultural sites		

Source: California Department of Parks and Recreation 2013

5.6.6.2 Survey on Public Opinions and Attitudes in Outdoor Recreation in California 2009

The 2009 Survey on Public Opinions and Attitudes in Outdoor Recreation in California (POAOR), an element of the CORP, identify the following as the top five recreational activities in California with the highest latent demand (Table 5.6.6-1). These are activities that Californians would participate in, from a statewide perspective, if more facilities and opportunities were provided. The summary provides an overview of the results from the adult and youth surveys and also includes a section on Hispanic and regional differences and overall recommendations.

In addition, the 2009 POAOR identified the following types of park and recreation facilities and services as the most important for Californian adults:

1. Play activity areas for tots and young children.
2. Wilderness type areas where no vehicles or development are allowed.
3. Areas and facilities for environmental and outdoor education programs.
4. Multi-use turf areas for field sports such as softball, baseball, soccer, and/or football.
5. Picnic sites for large groups.
6. Trails for multiple, non-motorized activities such as hiking, mountain biking, or horseback riding.
7. Hard surface trails for biking, jogging, and fitness walking.

5.6.6.3 Tuolumne County General Plan

The Tuolumne County General Plan (1996) is made up of two categories - the seven mandated elements and an unlimited number of optional elements. The mandatory elements are: Land Use, Circulation, Housing, Conservation and Open Space, Noise, and Safety. Currently, the General Plan encompasses the following sections under optional elements: Cultural Resource, Economic Development, Agricultural, Recreation, Community Identity, Air Quality, and Public Facilities and Services (TID/MID 2011).

The Recreation Element focuses on the needs associated with its visitors and local residents as well as identifying acquisition funding sources and developing and maintaining parks and recreational facilities. Implementation of the Recreation Element revolves around the following seven key goals:

- Provide an adequate supply and equitable distribution of recreation facilities for residents;
- Cooperate with other public agencies and private enterprise to provide park and recreation facilities;
- Further the goals of other General Plan elements in the acquisition and development of lands for recreation facilities and opportunities;
- Address the impacts of new developments on the County's recreational facilities;
- Acquire, manage, and develop recreational lands according to principles which protect private property rights, maximize cost efficiency, promote accessibilities by all residents, advocate safety, and encourage public participation;
- Develop a broad-based financing program with a wide variety of revenue sources which equitably distributes and/or reduces the cost of providing new recreation facilities; and
- Provide for the ongoing acquisition, construction, and maintenance of recreation facilities.

5.6.6.4 Stanislaus County General Plan

The Stanislaus County General Plan (1994) consists of seven mandatory elements and as many optional elements as the local jurisdiction deems desirable. The mandatory elements include Land Use, Circulation, Housing, Open Space, Conservation, Safety, and Noise. Since the Open Space and Conservation Elements have overlapping requirements, they have been combined in the Stanislaus County General Plan. The County has also adopted one optional element, the Agricultural Element (Stanislaus County 1994).

The Land Use Element focuses on the general distribution and general location and extent of the uses of the land for housing, business, industry, open space, including agriculture, natural resources, recreation, and enjoyment of scenic beauty, education, public buildings and grounds, solid and liquid waste disposal facilities, and other categories of public and private uses of land. The following goals are pertinent to the LGP area:

- Provide for diverse land use needs by designating patterns which are responsive to the physical characteristics of the land as well as to environmental, economic, and social concerns of the residents of Stanislaus County.
- Foster stable economic growth through appropriate land use policies.
- Ensure that an effective level of public service is provided in unincorporated areas.

5.6.7 Potential LGP Effects and Resource Issues

As previously discussed, no developed recreational facilities are owned and maintained by the Districts at the LGP. No adverse environmental effects on recreation and land use are expected from continued operation of the hydro power facilities. The Districts do not propose to duplicate or add to the wide availability of recreational opportunities in the LGP vicinity.

In comments filed by participants in the La Grange jurisdictional proceeding under Docket UL11-1, boating interests have expressed an interest in having public access to the LGP, but current landownership, topography, lack of safe escape routes for boaters near the dam and spillway, and other factors greatly complicate this potential. Additional discussions about this resource issue will be conducted during the three-stage licensing consultation process.

5.7 Aesthetic Resources

This section of the PAD provides a description of the existing visual resources found within the LGP.

5.7.1 Project Facilities

The La Grange diversion dam is located on the Tuolumne River near the border of Stanislaus and Tuolumne counties in Central California. It was originally constructed between 1891 and 1893 at the downstream end of a narrow, steep-sided canyon. La Grange diversion dam replaced the Wheaton dam built by other parties in the early 1870s. The original 127.5-foot-high arched dam was constructed of boulders set in concrete and faced with roughly-dressed stones from a nearby quarry. In 1923, an 18-inch-high concrete cap was added, and in 1930, an additional 24-inch-high concrete cap was added, resulting in the final and current height of 131 feet (Figure 5.7.1-1).

The La Grange pool extends approximately one mile upstream of the diversion dam and is contained in the narrow, steep-sided canyon (Figure 5.7.1-2). The La Grange powerhouse is a 72-foot by 29-foot structure with reinforced concrete substructure and steel superstructure located approximately 0.2 miles downstream of the diversion dam on the south bank of the Tuolumne River. Figure 5.7.1-3 is a photo of the penstock and powerhouse looking across the river from the MID canal system. Project facilities and features are described in greater detail in Section 3 of this document.

Figure 5.7.1-1 La Grange diversion dam.

Figure 5.7.1-2 La Grange impoundment.

Figure 5.7.1-3 Penstock and powerhouse viewed from the MID canal.

5.7.2 Potential LGP Effects and Resource Issues

The La Grange diversion dam has existed for over 120 years and scenic intrusions and topographical alterations resulting from the original LGP construction have long since disappeared with the LGP now integrated with the environmental and visual setting of the surrounding area. Since the Districts are not proposing any changes to current LGP facilities or operations, there will be no effect to the existing, baseline aesthetic resources. No resource issues related to aesthetic resources at the LGP have been identified at this time.

5.8 Cultural and Tribal Resources

This section presents initial information summarizing available research regarding historical and prehistoric cultural resources in the vicinity of the LGP. The licensing of the LGP is considered a federal undertaking (36 CFR 800.16(y) and, therefore, must comply with Section 106 of the National Historic Preservation Act (NHPA) of 1966, as amended. Section 106, and its implementing regulations found in 36 CFR 800, requires federal agencies to take into account the effects of their actions on historical properties. To accomplish this, significant cultural resources within the Area of Potential Effects (APE) must be identified, potential effects to these resources must be assessed, and options for treating effects on significant sites must be considered. This section, representing the first step of this process, provides the results of data gathering using existing information to identify potential significant cultural resources currently documented in the LGP area.

5.8.1 Nomenclature and Synonymy

Certain terms and concepts used throughout this section warrant definition as follows:

- **Historical Property.** As defined under 36 CFR 800.16, "historical property" refers to any prehistoric or historical district, site, building, structure, object, or Traditional Cultural Property (TCP) included in or eligible for inclusion in the National Register of Historic Properties (NRHP) [36 CFR 800.16(1)].
- **Traditional Cultural Property.** A TCP is a place that is associated with cultural practices of beliefs of a living community that are (a) rooted in that community's history and (b)

important in maintaining the continuing cultural identify of the community. Specially, TCPs are:

- Locations associated with the traditional beliefs of a Native American group about its origins, its cultural history, or the nature of the world.
- A rural community whose organization, buildings, and structures, or patterns of land use reflect the cultural traditions valued by its long-term residents.
- An urban neighborhood that is the traditional home of a particular cultural group and that reflects its beliefs and practices.
- Locations where Native American religious practitioners have historically gone and are known or thought to go to today, to perform ceremonial cultural rules of practice.
- Locations where a community has traditionally carried out economic, artistic, or other cultural practices important in maintaining its' historical identity.

■ **Cultural Resource.** For the purpose of this document, the term "cultural resource" is used to discuss any prehistoric or historical district, site, building, structure, or object, regardless of its National Register eligibility. Information specific to TCPs is provided in Section 5.8.5, Tribal Resources.

■ **Area of Potential Effects.** As defined in 36 CFR 800.16(d), the APE is "...the geographic area or areas within which an undertaking may directly or indirectly cause changes in the character or use of historical properties, if any such properties exist." Geographic areas within the APE need not be contiguous, but rather reflect one or more locations where Project-related activities may disturb or affect historical properties. Under 36 CFR 800.4(a)(1), the APE must be delineated and documented during the historic properties identification stage. The APE is ultimately defined by the lead federal agency of the project undertaking in consultation with the State Historic Preservation Officer (SHPO).

■ **Data Gathering Area.** For the purpose of this document, the term "Data Gathering Area" refers to the geographic area included in the cultural literature and records searches, as well as for other pre-field efforts used to obtain all pertinent existing, relevant, and reasonably available information. Data gathering areas are generally larger than the APE to allow for flexibility in Project planning, and are not intended to define or infer the location of project boundaries, the APE, or potential field studies. The data gathering area used for this Project includes all lands within the APE plus an additional 0.25-mile buffer beyond.

5.8.2 Area of Potential Effects

Consistent with past FERC practice and policy, the LGP APE, as described above, will be defined as all lands proposed for inclusion within the FERC Project Boundary. The APE may be modified after consultation with interested parties if the consultation results in the identification of additional LGP-related activities occurring outside the proposed FERC Project Boundary.

The Districts will develop a proposed APE during development of the cultural resources study plan.

5.8.3 Data Gathering Methods

Significant background research was conducted for the ongoing Don Pedro relicensing to identify historical properties in the vicinity of the Don Pedro Project. The records search focused on previously recorded cultural resources and previous cultural studies documented within the Don Pedro APE. The area researched included a 0.25-mile buffer around the Don Pedro Project APE to assure adequate coverage.

The July 2010 Central California Information Center (CCIC) record search included a review of cultural resources records and site location maps, previously conducted cultural resources investigations, historical USDOI, BLM General Land Office Maps (GLO), the NRHP, the California Register of Historic Resources, the Office of Historic Preservation Historic Property Directory, California State Historic landmarks (1996), California Inventory of Historic Resources (1976), and the Caltrans Bridge Inventory.

Additional research will be conducted to identify known historic properties within the LGP APE in accordance with the resulting study plan collaboratively developed with licensing participants.

5.8.4 Data Gathering Results

5.8.4.1 Previous Cultural Resources Investigations

The above-described records search identified 43 previous cultural resource investigations within 0.25 mile of the Don Pedro Project APE. The investigations occurred between the 1960s and 2009, and were conducted prior to a variety of different undertakings to include proposed water control/treatment facilities, utilities, housing developments, mining activities, road/highway construction, recreation facilities, and grazing leases. Two of the previous investigations are articles from The Quarterly of the Tuolumne Historical Society, and one is comprised of documentation of monuments and plaques of the E Clampus Vitus organization. Table 5.8.4-1 presents an overview of the studies identified within 0.25 miles of the Don Pedro APE.

Table 5.8.4-1 Previous studies within 0.25 mile of the Don Pedro APE.

Author/Year	CCIC Report #	Report Name
Allan, J., 2008	6800	Archaeological Survey and Cultural Resources Assessment for the Moccasin Effluent Pond Project in Moccasin, Tuolumne County, California
Allan, J., 2008	6973	Archaeological Survey and Assessment for the Moccasin Effluent Pond Project in Moccasin, Tuolumne County, California
Balen, B., 1986	3957	Cultural Resource Inventory Report, Bloss Ranch, La Grange, California
Balen, B.,1983	960	Archeological Reconnaissance Report and Evaluation, California Gold Project, Tuolumne, California
Barnes, J., 2004	5660	Section 110/640 Acre Inventory Requirement
Barnes, J., 2004	5667	Section 106 Review for the Ritts Grazing Lease Renewal, Tuolumne County
Barnes, J., 2007	6812	Section 110/640-acre Inventory Requirement, Tuolumne County
Barnes, J., 2008	6813	TID Test Trenches Land Use Permit
Barnes, J., 2008	6824	Engler Grazing Lease Renewal
Barnes, J., 2009	7096	Section 106 Compliance for the Hope, Gaiser, and Banks Grazing Lease Renewals, Tuolumne County
Bevill, R., and Nilsson E., 2000	4027	Cultural Resources Inventory of the South Shore Club Development Project Tuolumne and Mariposa Counties, California
Bloomfield, A., 1993	2236	Chinese Camp Cultural Resources Inventory
California Department of Transportation	3152	Ce-section 106 Checklist/Memo to File
Creighton, W., 2002	4849	Documentation of Monuments and Plaques Representing Estanislao Chapter No. 58 E Clampus Vitus
Davis-King, S. et al., 1992	1560	Further Cultural-Resources Investigations for the Proposed Clavey River Project (FERC 10081), Eastside Storage Reservoir Survey, Ethnographic Study, Portions of Transmission Line Survey

Author/Year	CCIC Report #	Report Name
Decker, D., 1986	3874	Additional R/W for Highway 120
Decker, D., 1992	1423	Wallin Mining Plan of Operations
Decker, D., 2000	4050	Filiberti Grazing Lease Renewal
Decker, D., 2002	4732	Fehr Grazing Lease Renewal
Decker, D., 2005	5984	Lackey DG Sale
Decker, D., 2007	6489	Salambo Mine Vehicle Closure
Flemming, E., 1965	5369	William S. Smart, Pioneer (Article from The Quarterly, of the Tuolumne Historical Society, Sonora, CA, Vol.4, No. 4, April-June 1965)
Francis, C., 2000	4134	Cultural Resources Survey Report of the Lake Don Pedro Moccasin Point Parking Lot and Access Road (Negative)
Gilbert, C., 1993	2181	5100 Rural Forest Improvement, 5180 Archeology, Archaeological Review of the Bird CFIP
Hibbard, C., 2001	4229	State of California, Department of Transportation, District 10, Negative Archaeological Survey Report
Isaacs, P., 1983	1147	Historic Resources Survey & Evaluation, California Gold Project
Jensen, P. & Jensen, S., 2003	5261	Archaeological Inventory Survey, Bonds Flat Electrical Transmission Line Upgrade Project, c. 11 Miles of Linear Corridor Along an Existing Transmission Line, Stanislaus and Tuolumne Counties, California
Jensen, P.M., 2005	5965	Sierra Foothills Residential Subdivision Project, c. 400 acres at Lake Don Pedro, Tuolumne County
Jones & Stokes., 1986	965	Draft Environmental Impact Report for the South Shore Club at Lake Don Pedro
Knutson, 1968	4505	Bright Memories of a Pioneer Family. The Quarterly of the Tuolumne Historical Society, Sonora, California. Vol.7, No.4, April-June 1968.
Leach-Palm et al., 2004	5498	Cultural Resources Inventory of Caltrans District 10, Rural Conventional Highways, Volume I: Summary of Methods and Findings
Leach-Palm et al., 2004	5505	Cultural Resources Inventory of Caltrans District 10, Rural Conventional Highways, Volume II H: Tuolumne County
Moratto, M., 1971 (editor)	1176	A Study of Prehistory in the Tuolumne River Valley, California, Treganza Anthropology Museum Papers, Number 9
Moratto, M., 1980	3904	New Don Pedro Recreation Agency
Napton, 1992	1601	Clavey Rive Project (License Application No. 10081) Cultural Resources Reconnaissance of the Proposed 230 KV Transmission Line Corridor Preferred Route, Stanislaus and Tuolumne Counties, California
Napton, L., 1976	1218	Archaeological Survey of the Moccasin Sewage Treatment Facilities
Napton, L., 1989	1236	Cultural Resource Investigation of the Moccasin Spillway Addition, Tuolumne County, California
Romano, M., Moratto, M., 1992	3702	Cultural Resources Overview and Management Plan, Sonora Mining Corporation, Jamestown Mine
Rosenthal and Meyer, 2004	5501	Cultural Resources Inventory of Caltrans District 10, Rural Conventional Highways, Volume III: Geoarchaeological Study, Landscape Evolution and the Archaeological Record of Central California
Slaymaker, C., 1971	1371	The Wards Ferry Site: Anglo-Indian Interaction Along the Tuolumne River
Varner, D., 2006	1322	A Cultural Resource Study for the Don Pedro View Subdivision in Mariposa County, California
Varner, D., 2006	6174	A Cultural Resource Study for the Don Pedro View Subdivision in Mariposa County, California
Werner, R., 1999	3585	Cultural Resources Investigation of the Proposed Jenkins Hill Estates Subdivision near La Grange, Tuolumne County, California

5.8.4.2 Previously Recorded Cultural Resources

An assessment of previously recorded cultural resources within the LGP APE will be completed once a proposed Project Boundary and APE are defined.

5.8.5 Tribal Resources

This section provides information regarding TCPs in the vicinity of the LGP. As described above in Section 5.8, the Project licensing is a federal undertaking and, therefore, must comply with Section 106 of the NHPA. As such, the licensing process must take into account the effects of the LGP on historical properties, which could include TCPs. One of the first steps in the Section 106 process is to identify historical properties within the APE.

5.8.5.1 Background Research

To gather the necessary information to identify known or potential TCPs in the LGP vicinity, the Districts completed a records search and archival research at federal, State of California, and local repositories in California in support of the relicensing of the upstream Don Pedro Project. In addition to identifying potentially-affected Indian Tribes and TCPs, this research also served to obtain background information pertinent to understanding the history and ethnohistory of the area and to identify potential gaps in information that may potentially be addressed through additional studies.

Identification of Potentially-Affected Indian Tribes

To initiate the tribal consultation process, the Districts have identified a number of Indian Tribes that may have an interest in licensing based on the proximity of these groups' traditional territories to the Project APE. The list compiled by the Districts is provided in Table 5.8.5-1 below and is proposed for use again to initiate Section 106 consultation for the La Grange licensing effort. Additional groups that might be identified by FERC or the California Native American Heritage Commission (NAHC) subsequent to issuance of this PAD will be added and contacted by the Districts.

Following issuance of this PAD and formal initiation of government-to-government consultation between FERC and potentially interested Indian Tribes under Section 106 of the National Historic Preservation Act, the Districts will send letters to the identified Tribal contacts inviting them to participate in the LGP licensing along with a request for information that may be relevant to the LGP licensing. The Tribal contacts will also be referred to the public licensing website and given the names and contact information for the Districts.

Table 5.8.5-1 Initial Tribal contacts list compiled by the Districts.

Buena Vista Rancheria Roselynn Lwenya, Ph.D Environmental Resources Director 1418 20th Street, Suite 200 Sacramento, CA 95811	Buena Vista Rancheria Rhonda Morningstar Pope Chairperson 1418 20th Street, Suite 200 Sacramento, CA 95811
Central Sierra Me-Wuk Cultural & Historic Reba Fuller, Spokesperson PO Box 699 Tuolumne, CA 95379	Chicken Ranch Rancheria of Me-Wuk Lloyd Mathiesen, Chairperson P.O. Box 1159 Jamestown, CA 95327
Chicken Ranch Rancheria of Me-Wuk Melissa Powell, Cultural Resources Coordinator P.O. Box 1159 Jamestown, CA 95327	Picayune Rancheria of the Chukchansi Indians Nancy Ayala, Chairperson 46575 Road 417 #A Coarsegold, CA 93614

Picayune Rancheria of the Chukchansi Indians Mary Motola, Cultural Specialist 46575 Road 417 #A Coarsegold, CA 93614	Southern Sierra Miwuk Nation Jay Johnson, Spiritual Leader 5235 Allred Road Mariposa, CA 95338
Southern Sierra Miwuk Nation Lois Martin, Chairperson P.O. Box 1200 Mariposa, CA 95338	Southern Sierra Miwuk Nation Les James, Spiritual Leader P.O. Box 1200 Mariposa, CA 95338
Southern Sierra Miwuk Nation Anthony Brochini, Cultural Resources Representative P.O. Box 1200 Mariposa, CA 95338	Tuolumne Band of Me-Wuk Indians Kevin Day, Chairperson P.O. Box 699 Tuolumne, CA 95379
Tuolumne Band of Me-Wuk Indians Stanley Rob Cox, Cultural Resources Department P.O. Box 699 Tuolumne, CA 95379	Tuolumne Band of Me-Wuk Indians Vicki Stone, Cultural Coordinator P.O. Box 699 Tuolumne, CA 95379
Tuolumne Band of Me-Wuk Indians Reba Fuller, Spokesperson P.O. Box 699 Tuolumne, CA 95379	

Identification of Known Indian Trusts and Traditional Cultural Properties

The Districts performed a record search in July 2010 at the CCIC of the California Historical Resources Information System at California State University, Stanislaus (CSU, Stanislaus) in support of the Don Pedro relicensing. The CCIC record search included a review of cultural resources records and site location maps, historic GLO plats, historic topographic maps, NRHP listings, California Register of Historic Resources listings, Office of Historic Preservation Historic Property Directory, 1996 California State Historic landmarks, 1976 California Inventory of Historic Resources, and Caltrans Bridge Inventory.

The records search included all lands within the Don Pedro Project APE and a 0.25-mile buffer beyond, but this assessment did not cover the downstream LGP area. A similar assessment will be conducted for the LGP once a proposed Project Boundary and APE is developed for this original licensing, as discussed above in Sections 3.8 and 5.8.2. The purpose of the record search will be to identify any previously recorded TCPs that may be in the APE or in the vicinity of the APE, and to identify other resource types previously identified within the APE and vicinity that may help in the preparation of an ethnographic context for the area and/or any potential TCP documentation.

5.8.6 Potential LGP Effects and Resource Issues Related to Cultural Resources

Activities such as ground disturbance, water surface fluctuation, and recreation may have a potential to affect cultural resources. Routine O&M could potentially directly affect cultural sites through ground disturbance, such as by foot traffic, grading of a road, or other physical disturbances. Recreation activities can lead to disturbance of intact cultural deposits, increased erosion, or deterioration of sites, and unauthorized artifact collection, as well as more severe vandalism and looting if the sites are in proximity to the recreation areas. Over time, wind, rain, and other climatic conditions can slowly deteriorate a site, particularly historical surface features like shelters, bridges, and canals. Because weathering to a site occurs independently of LGP activity, this form of erosion is not considered a project-related effect.

While existing information is useful, the Districts anticipate that additional information regarding LGP effects on cultural resources will be needed. Also, if historic properties are found within the APE, this information will be useful for developing a Historic Properties Management Plan (HPMP) in consultation with the SHPO, BLM, and tribes for implementation under the original license. A study plan to collect and assess existing information regarding previously identified historic properties within the La Grange APE will be developed as part of the licensing consultation process.

5.8.7 Potential LGP Effects on Traditional/Tribal Spiritual Areas and Other Traditional Uses in the FERC Project Boundary

As with other cultural resources, activities such as ground disturbance and recreation have the potential to affect TCPs. The effect may be direct (e.g., result of ground-disturbing activities), indirect (e.g., public access to project areas) or cumulative (e.g., caused by a project activity in combination with other past, present, and reasonably foreseeable future projects).

While existing information is useful, additional consultation with potentially affected tribes is needed to address this issue. Also, this information may be useful in developing a HPMP in consultation with SHPO, BLM, and tribes for inclusion in the new license should TCPs be identified within the APE. A study plan to collect and assess existing information regarding TCPs within the La Grange APE will be developed as part of the licensing consultation process.

5.9 Socioeconomic Resources of the LGP Area

Socioeconomic benefits of the LGP extend to water users in the LGP area and in the respective areas served by each of the irrigation districts. The MID and TID were formed in 1887 and are the oldest irrigation districts in California. Today their service areas total approximately 210,000 acres of orchards, vines, row, and forage crops each year (Figures 5.9-1 and 5.9-2). The water resources are essential to the local agricultural economy and the communities dependent on this economy.

The Districts have conducted an in-depth assessment of the socioeconomic resources in the vicinity of the LGP as part of the ongoing Don Pedro relicensing proceeding which is summarized in the Don Pedro Draft License Application filed in November 2013 (TID/MID 2013*h*). More detailed information is available in the Socioeconomic Study Report filed with the Districts' Updated Study Report in January 2014 (TID/MID 2014).

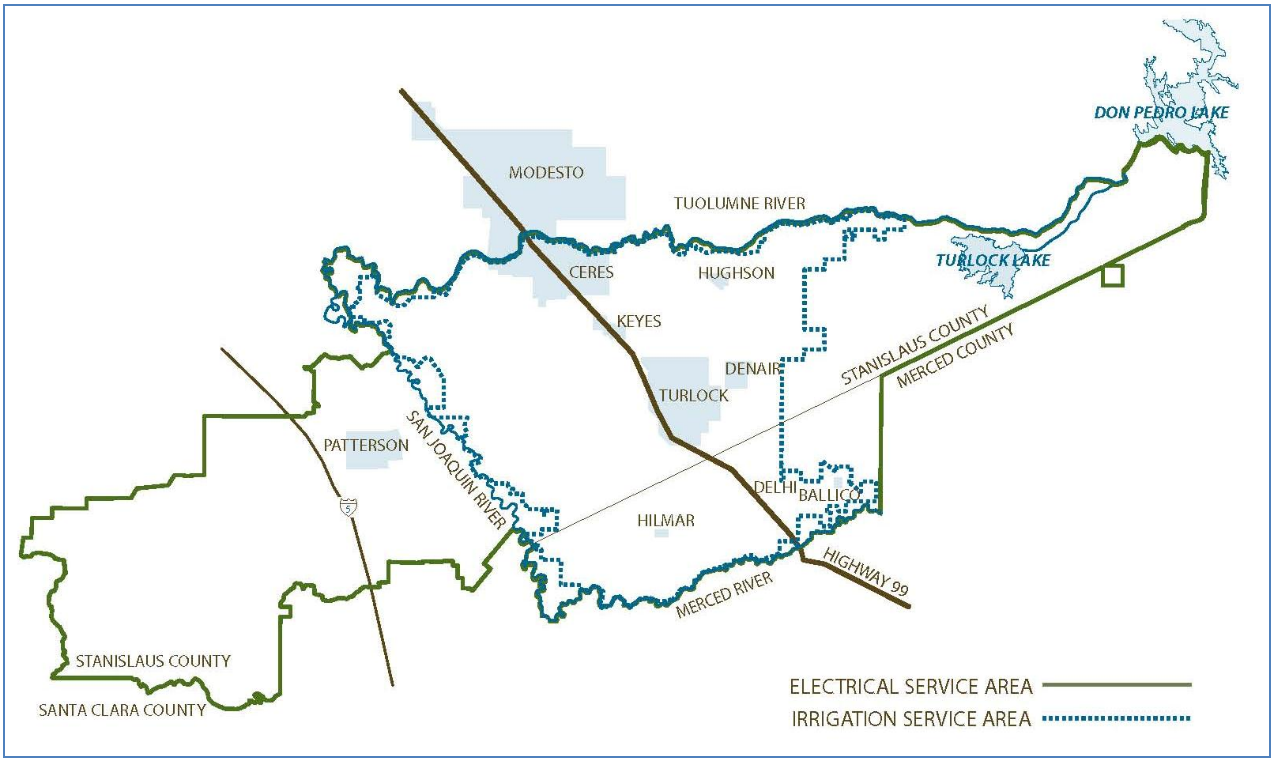

Figure 5.9-1 TID service area map.

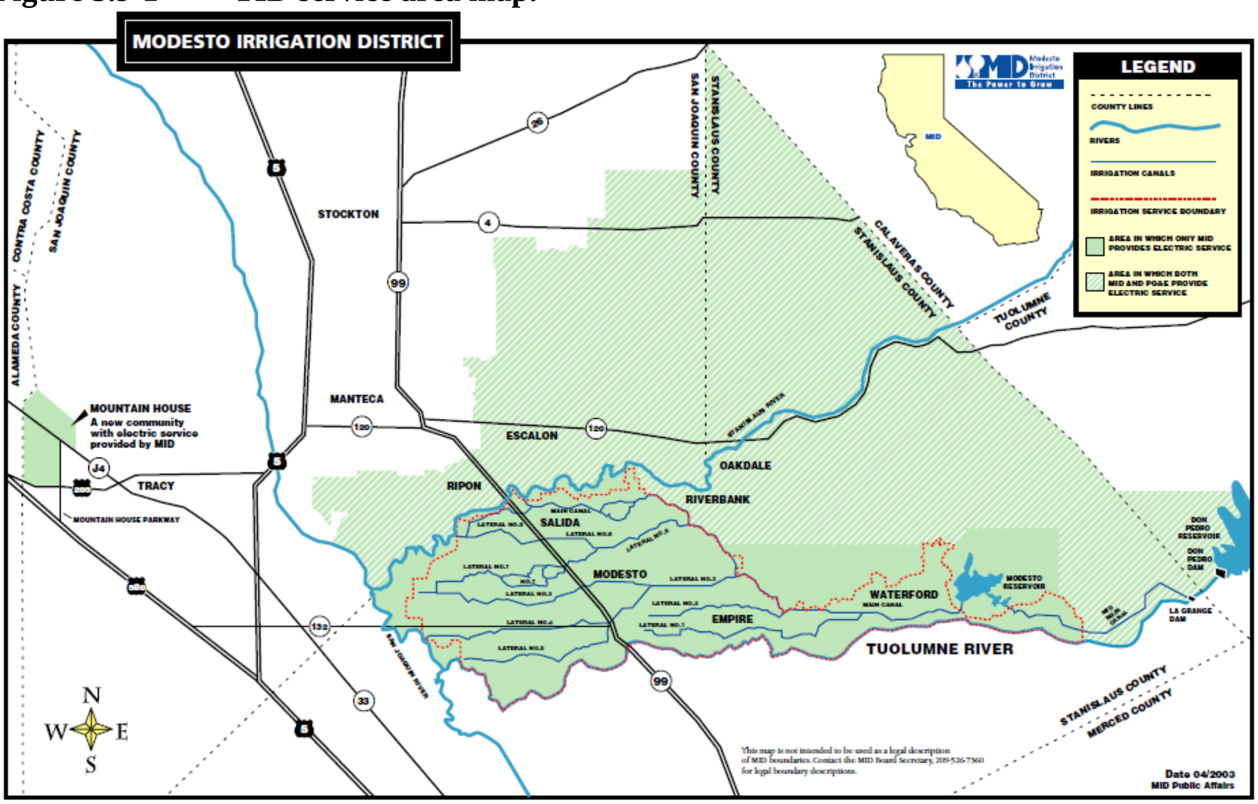

Figure 5.9-2 MID service area map.

5.9.1 Potential LGP Effects and Resource Issues

Originally constructed between 1891 and 1893, the primary purpose of the diversion dam is to raise the level of the Tuolumne River to permit the diversion of water from the Tuolumne River for irrigation of Central Valley farmland and M&I water supply. The La Grange diversion dam has been serving that purpose for approximately 120 years. Use of Tuolumne River water affects socioeconomic conditions in the Districts' service areas and is essential to the local agricultural economy and the communities dependent on this economy. The operation and maintenance of the hydro power facilities provides renewable energy to TID. Loss of that energy may result in increased cost and carbon emissions.

5.10 Consistency with Comprehensive Plans

This section describes applicable comprehensive plans that Section 10(a) of the Federal Power Act (FPA) requires FERC to consider in their licensing determination. These plans are referred to as Qualifying Comprehensive Plans.

Section 10(a) of the FPA requires FERC to consider the extent to which a project is consistent with federal and state comprehensive plans for improving, developing, or conserving a waterway or waterways affected by the Project. On April 27, 1988, FERC issued Order No. 481-A which revised Order No. 481, issued October 26, 1987, establishing that FERC will accord FPA Section 10(a)(2)(A) comprehensive plan status to any federal or state plan that meets the following three criteria:

- Is a comprehensive study of one or more of the beneficial uses of a waterway or waterways;
- Specifies the standards, the data, and the methodology used to develop the plan; and
- Is filed with FERC.

A review of FERC's Revised List of Comprehensive Plans shows that of the 74 comprehensive plans specific to California (FERC 2013), 17 may be applicable to the LGP, as listed below by resource area. The LGP license application will discuss whether the licensing of the LGP is consistent with these plans.

5.10.1 Water Resources

- The California Water Plan: Projected Use and Available Water Supplies to 2010. (CDWR 1983).
- California Water Plan Update (CDWR 1994).
- Final Programmatic Environmental Impact Statement/Environmental Impact Report for the CALFED Bay-Delta Program (CDWR 2000).
- Water Quality Control Plan Report (CSWRCB 1995).
- Water Quality Control Plans and Policies Adopted as Part of the State Comprehensive Plan (CSWRCB 1999).
- Water quality control plan for the San Francisco Bay/Sacramento-San Joaquin Delta Estuary (CSWRCB 2006).

5.10.2 Aquatic Resources

- Strategic plan for trout management: A plan for 2004 and beyond (CDFG 2003).
- Habitat restoration plan for the lower Tuolumne River corridor (CDFG 2000).

5.10.3 Wildlife Resources

- Central Valley Habitat Joint Venture Implementation Plan (USFWS 2006).
- North American Waterfowl Management Plan (USFWS 1986).

5.10.4 Threatened, Endangered, and Fully Protected Species

- Restoring the Balance: 1988 Annual Report (California Advisory Committee on Salmon and Steelhead Trout 1988).
- Central Valley Salmon and Steelhead Restoration and Enhancement Plan (CDFG 1990).
- Restoring Central Valley Streams: A Plan for Action (CDFG 1993).
- Steelhead Restoration and Management Plan for California (CDFG 1996).
- Final Restoration Plan for Anadromous Fish Restoration Program (USFWS 2001).

5.10.5 Recreation and Land Use

- California Outdoor Recreation Plan (CDPR 1994).
- Public Opinions and Attitudes on Outdoor Recreation in California (CDPR 1998).
- Recreation Needs in California (California Resources Agencies 1983).
- The Recreational Fisheries Policy of the USFWS (USFWS 1989).
- The Nationwide Rivers Inventory (NPS 1982).

5.11 Development of Proposed Study Plans

As discussed earlier in Section 5.0, the lower Tuolumne River has been the subject of substantial research and study over the past 40 years. More than 200 individual studies of fish and aquatic resources have been completed. Annual monitoring and investigation of aquatic resources continues, with the publication of eight additional studies in March 2010. In total, these studies provide a wealth of useful data and information to support an application for license for the LGP. Additional information on the LGP's role in flow allocation to the lower Tuolumne River and effects on hydrology for anadromous fish was recently filed as part of the Don Pedro Project USR filed on January 6, 2014 and is attached to this PAD as Appendix D.

The Districts propose to meet with the licensing participants to review existing information on the LGP to discuss and scope additional studies needed to support the license application for the LGP. The study plan development process and time frames will also be affected by whether or not FERC grants the Districts' requested use of the Traditional Licensing Process for the LGP in lieu of the default Integrated Licensing Process filed as part of the Pre-Application Document.

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APPENDICES

APPENDIX A

LICENSING PARTICIPANTS CONTACT LIST

La Grange Licensing Participants Contact List

Name	Affiliation
Alves, Jim	City of Modesto
Amerine, Bill	Moaz Amerine & Associates
Asay, Lynette	Newman-Romano LLC
Ayala, Nancy	Picayune Rancheria of the Chukchansi Indians
Barnes, James	Bureau of Land Management
Barnes, Peter	State Water Resources Control Board
Barrera, Linda	California Department of Fish & Wildlife-Office of General Counsel
Blake, Martin	
Bond, Jack	City of Modesto
Boucher, Allison	Tuolumne River Conservancy
Boucher, Dave	Tuolumne River Conservancy
Bowes, Stephen	National Park Service
Bowman, Art	CWRMP Citizens Plan Review Committee
Boyd, Steve E	Turlock Irrigation District
Brathwaite, Anna	Modesto Irrigation District
Brenneman, Beth	Bureau of Land Management
Brochini, Anthony	Southern Sierra Miwuk Nation
Buckley, John	Central Sierra Environmental Resource Center
Buckley, Mark	
Burke, Steve	
Burke, Susan	Cardno Entrix
Burt, Charles	Cal Poly State University
Byrd, Tim	
Cadagan, Jerry	
Calvin, Bill	
Carlin, Michael	City & County of San Francisco
Carlson, Jennifer	Manufacturers Council of the Central Valley
Charles, Cindy	Golden West Women's Flyfishers
Cooke, Michael	City of Turlock
Cowan, Jeffrey	
Cox, Stanley Rob	Tuolumne Band of Me-Wuk Indians
Cranston, Peggy	Bureau of Land Management
Cremeen, Rebecca	Central Sierra Environmental Resource Center
Damin, Nicole	Environmental Resources
Day, Kevin	Tuolumne Band of Me-Wuk Indians
Day, Peter	Morrison & Foerster
Derwin, Maryann Moise	City of Portola Valley
Dias, Greg	Modesto Irrigation District
Dowd, Maggie	U.S. Forest Service
Drake, Emerson	
Drekmeier, Peter	Tuolumne River Trust
Duval, Jim	City of Hughson
Edmondson, Steve	National Marine Fisheries Service
Eicher, James	Bureau of Land Management
Ellis, Steven	

Name	Affiliation
Esther, Chris	Petrulakis Law & Advocacy
Fargo, James	Federal Energy Regulatory Commission
Ferranti, Annee	California Department of Fish & Wildlife
Ferrari, Chandra	Trout Unlimited
Findley, Timothy	Hanson Bridgett (for Bay Area Water Supply & Conservation Agency)
Fisher, Robert	SCSD
Fleming, Mike	
Fuller, Andrea	FISHBIO
Fuller, Reba	1. Central Sierra Me-Wuk 2. Tuolumne Band of Me-Wuk Indians
Furman, Donn W	City and County of San Francisco
Ganteinbein, Julie	Water & Power Law Group
Giglio-Willoughby, Deborah	U.S. Fish & Wildlife Service
Godwin, Arthur F	Mason, Robbins, Browning & Godwin, LLP
Gordus, Andy	California Department Fish & Wildlife
Gorman, Elaine	Sierra Club
Grader, Zeke	
Guignard, Jason	FISHBIO
Gutierrez, Monica	National Marine Fisheries Service
Hackamack, Bob	Tuolumne River Trust
Hastreiter, James	Federal Energy Regulatory Commission
Hatch, Jenny	California Trout Unlimited
Hayden, Ann	
Hellam, Anita	Habitat for Humanity
Heyne, Tim	California Department of Fish & Wildlife
Holland, John	Modesto Bee
Holley, Thomas	National Marine Fisheries Service
Holm, Lisa	Bureau of Reclamation
Horn, Jeff	Bureau of Land Management
Horn, Timi	Tuolumne River Trust / Riverdale Homeowners
Hudelson, Bill	Stanislaus Food Products
Hughes, Noah	
Hughes, Robert	California Department of Fish & Wildlife
Hume, Noah	Stillwater Sciences
Hurley, Michael	Bay Area Water Supply & Conservation Agency
Jackson, Zac	U.S. Fish & Wildlife Service
James, Les	Southern Sierra Miwuk Nation
Jauregui, Julie	Gestamp Solar
Jennings, William	California Sportsfishing Protection Alliance
Jensen, Laura	The Nature Conservancy
Johannis, Mary	Bureau of Reclamation
Johnson, Brian	Trout Unlimited
Johnson, Jay	Southern Sierra Miwuk Nation
Johnston, William R	
Jones, Christy	U.S. Army Corps of Engineers
Keating, Janice	
Kempton, Kathryn	National Marine Fisheries Service
Kinney, Teresa	

Name	Affiliation
Knapp, Jonathan	City and County of San Francisco
Koepele, Patrick	Tuolumne River Trust
Levin, Ellen	City and County of San Francisco
Linkard, David	Tuolumne River Trust / Riverdale Homeowners
Lwenya, Roselynn	Buena Vista Rancheria
Lyons, Bill	Mapes Ranch
Manji, Annie	California Department of Fish & Wildlife
Marko, Paul	
Martin, Lois	Southern Sierra Miwuk Indians
Martin, Michael	Merced Fly Fishing Club
Mathiesen, Lloyd	Chicken Ranch Rancheria of Me-Wuk
Marston, Dean	California Department of Fish & Wildlife
McDaniel, Dan	
McDevitt, Ray	Hanson Bridgett (Bay Area Water Supply & Conservation Agency)
McDonnell, Marty	Sierra Mac River Rafting Trips
Mein, Janis	Environmental Resources
Mills, John	T.U.D.
Moreno, Marco	Latino Community Roundtable
Motola, Mary	Picayune Rancheria of the Chukchansi Indians
Murphy, Gretchen	California Department Fish & Wildlife
O'Brien, Jennifer	California Department Fish & Wildlife
Orvis, Tom	Stanislaus County Farm Bureau
Ott, Bob	
Ott, Chris	Ott Farms
Paris, William	O'Laughlin & Paris LLP
Pool, Richard	
Pope, Rhonda Morningstar	Buenva Vista Rancheria
Porter, Ruth	Hogan Lovells USLLP (for Restore Hetch Hetchy)
Powell, Melissa	Chicken Ranch Rancheria of Me-Wuk
Puccini, Stephen	California Department Fish & Wildlife
Raeder, Jessie	Tuolumne River Trust
Ramirez, Tim	City and County of San Francisco
Rea, Maria	National Marine Fisheries Service
Reed, Rhonda	National Marine Fisheries Service
Reynolds, Garner	City of Turlock
Richardson, Daniel	Tuolumne County
Richardson, Kevin	U.S. Army Corps of Engineers
Ridenour, Jim	City of Modesto
Riggs, Tracie	Tuolumne County
Robbins, Royal	
Romano, David	Newman-Romano LLC
Roos-Collins, Richard	Water & Power Law Group
Rosekrans, Spreck	Restore Hetch Hetchy
Roseman, Jesse	Tuolumne River Trust
Rothert, Steve	American Rivers
Sandkulla, Nicola	Bay Area Water Supply & Conservation Agency
Saunders, Jenan	
Schutte, Allison	Hanson Bridgett (for San Francisco Bay Area

Name	Affiliation
	Water Users Association)
Sears, William	City and County of San Francisco
Shakal, Sarah	
Shipley, Robert	
Shumway, Vern	U.S. Forest Service
Shutes, Chris	California Sportsfishing Protection Alliance
Sill, Todd	
Simsiman, Theresa	American Whitewater
Slay, Ron	CA National Resources Foundation
Smart, Herb	Turlock Irrigation District
Smith, Jim	Moccasin Point Marina LLC
Stapley, Garth	Modesto Bee
Steindorf, Dave	American Whitewater
Steiner, Dan	
Stender, John	NAES
Stone, Vicki	Tuolumne Band of Me-Wuk Indians
Stork, Ron	Friends of the River
Stratton, Susan	
Taylor, Mary Jane	California Department of Fish & Wildlife
Terpstra, Thomas	Law Office of Thomas H Terpstra (for LTF)
TeVelde, George	
Thompson, Larry	National Marine Fisheries Service
Ulibarri, Nicola	Sanford University
Verkuil, Colette	Morrison Foerster
Vierra, Chris	City of Ceres
Villalobos, Amber	State Water Resources Control Board
Wantuck, Richard	National Marine Fisheries Service
Warren, Joy	Modesto Irrigation District
Welch, Steve	ARTA River Trips
Wenger, Jake	
Wesselman, Eric	Friends of the River
Wetzel, Jeff	State Water Resources Control Board
Wheeler, Dan	
Wheeler, Dave	
Wheeler, Douglas	Hogan Lovells US LLP
Wilcox, Scott	Stillwater Sciences
Williamson, Harry	
Willy, Allison	U.S. Fish & Wildlife Service
Wilson, Bryan	Morrison Foerster
Winchell, Frank	Federal Energy Regulatory Commission
Wooster, John	National Marine Fisheries Service
Workman, Michelle	U.S. Fish & Wildlife
Yoshiyama, Ron	UC-Davis
Zipser, Wayne	Stanislaus Farm Bureau

APPENDIX B

PROJECT DRAWINGS

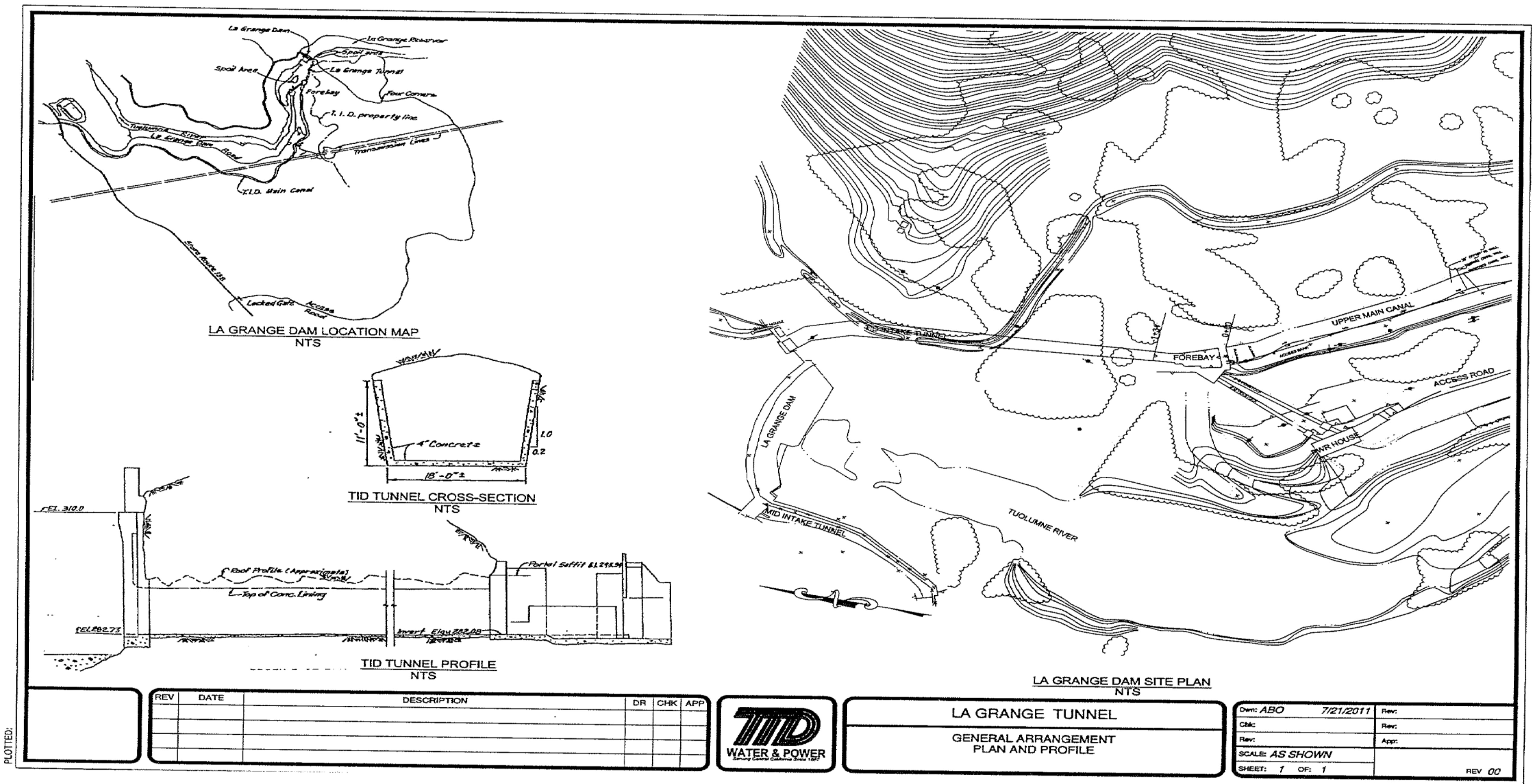


Figure 1. Site plan of La Grange diversion dam and facilities showing diversion dam, TID tunnel intake, tunnel location, penstocks, powerhouse, and Upper Main Canal.

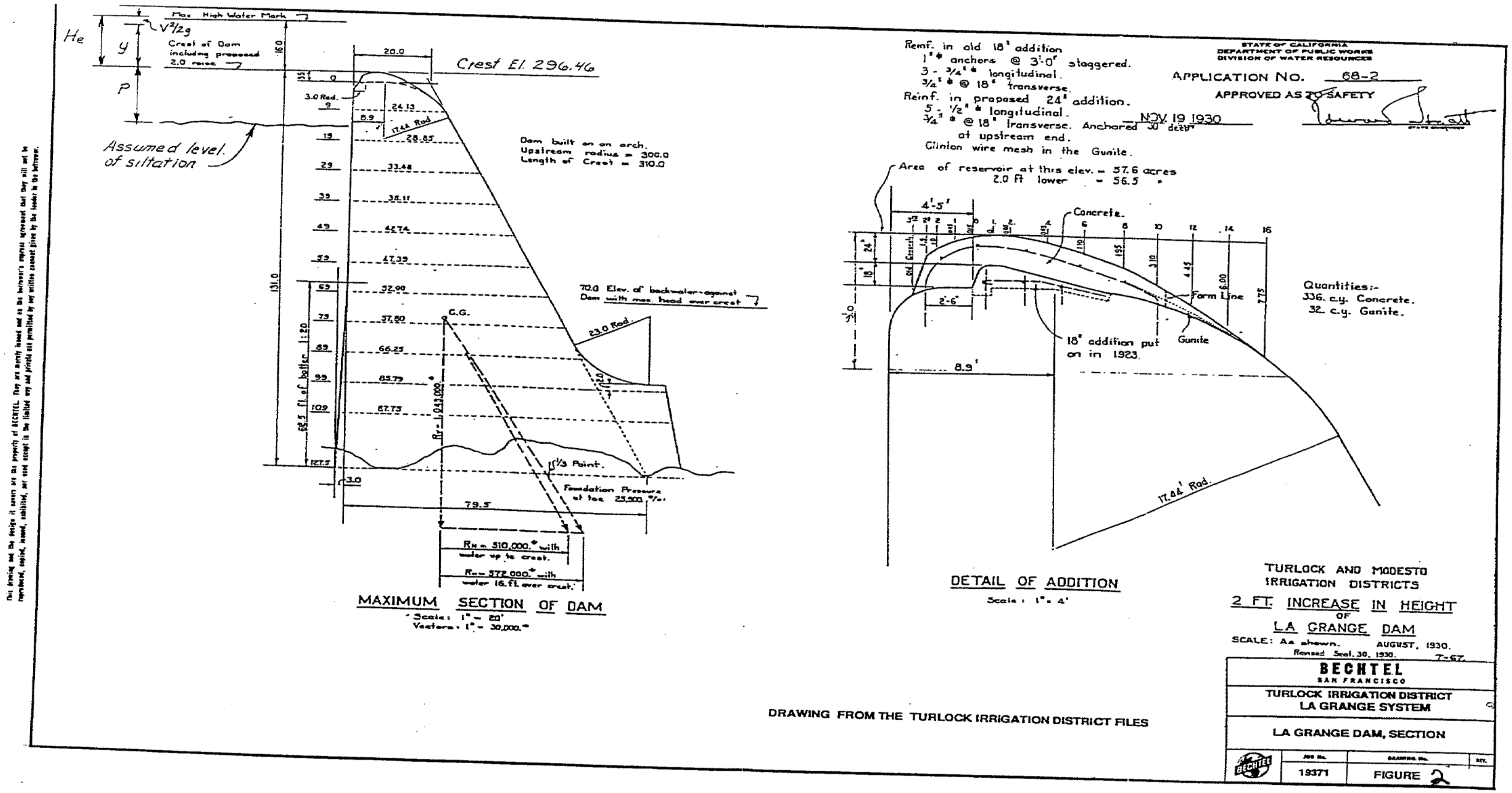


Figure 2. La Grange spillway section showing original crest and crest modification to present elevation of 296.5 feet.

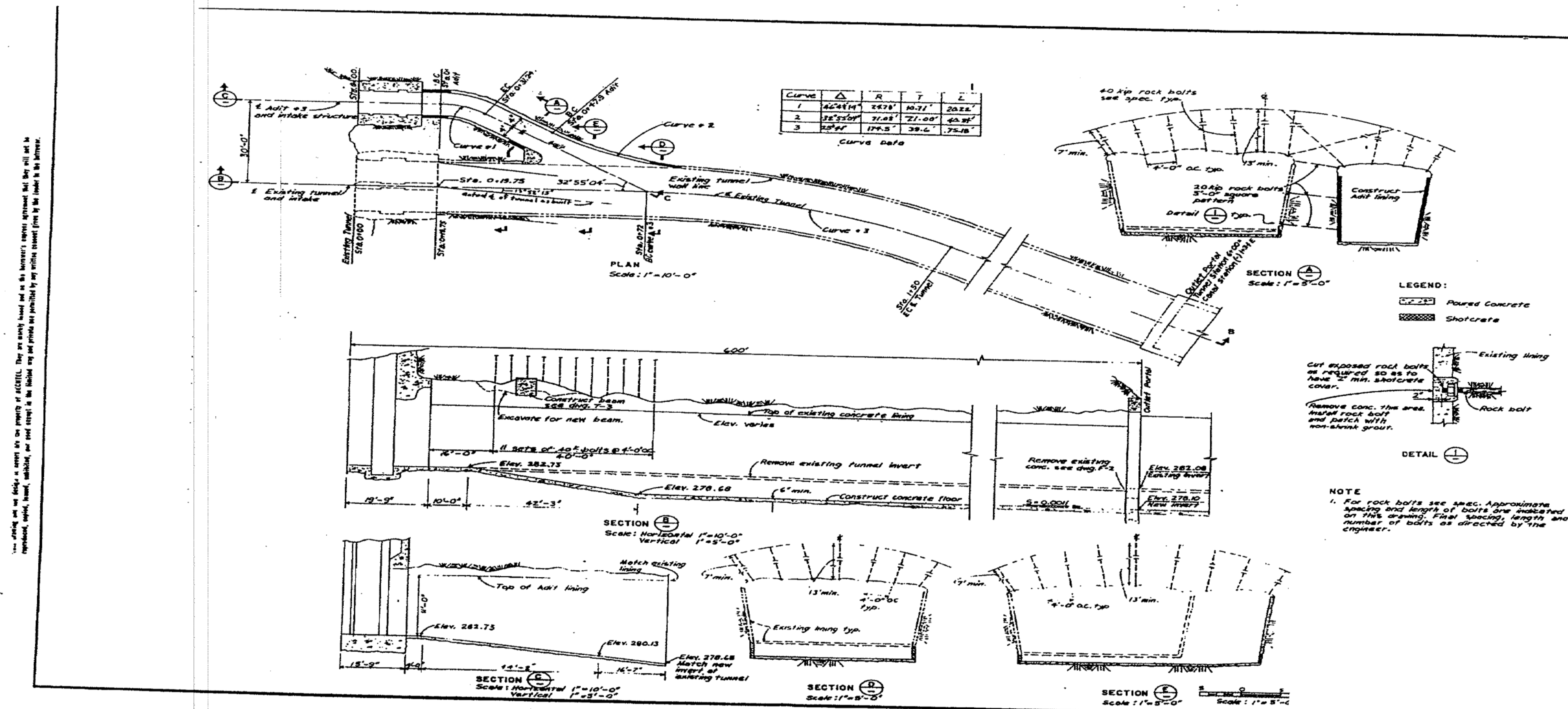


Figure 3. TID intake tunnel portals site plan and profile.

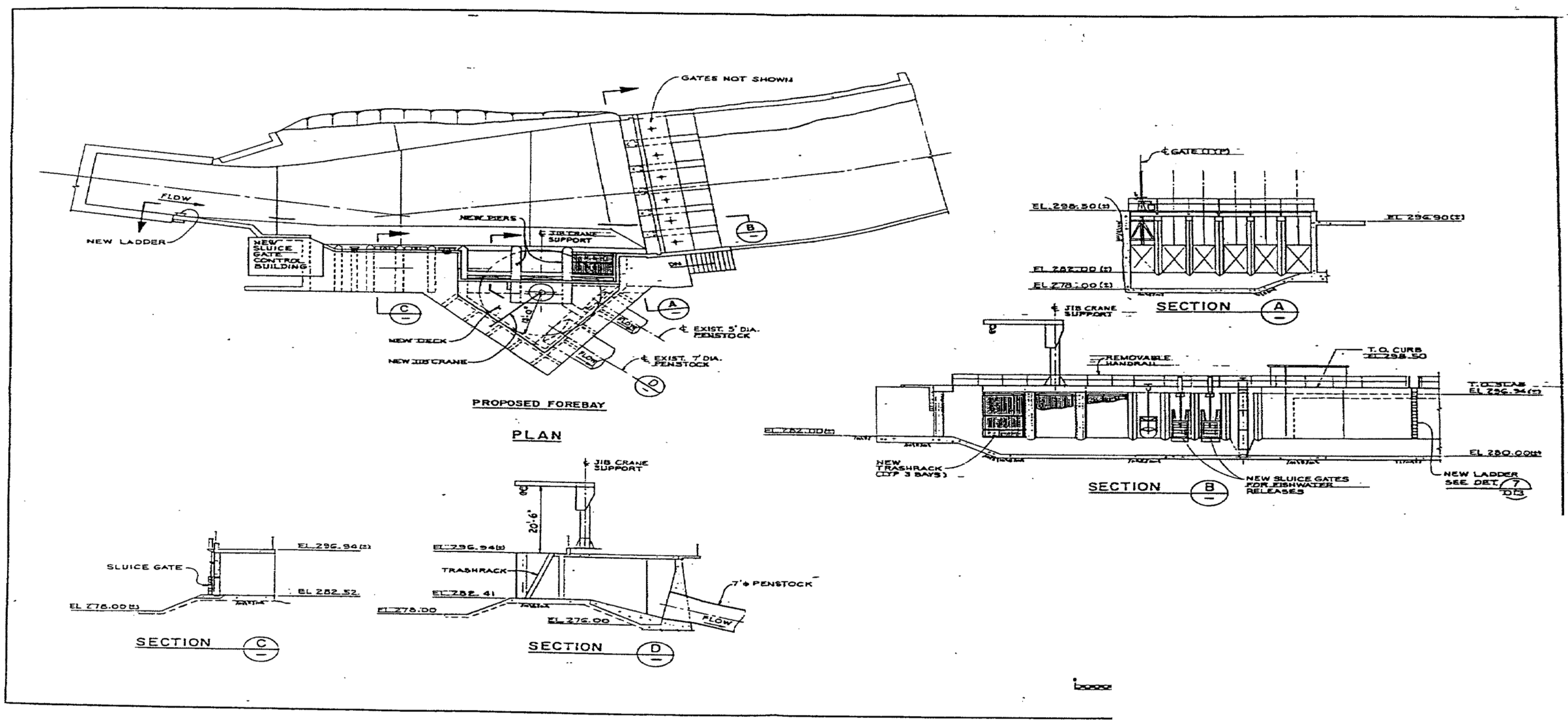


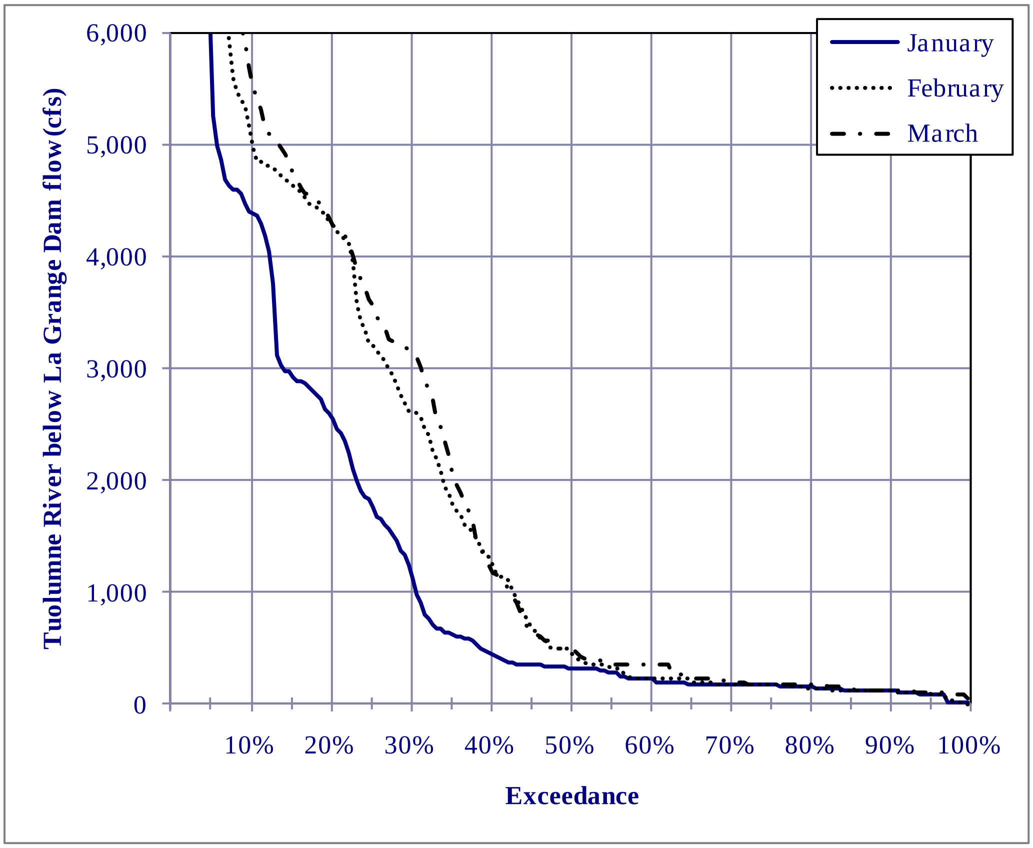
Figure 4. TID tunnel exit, forebay, and Upper Main Canal and powerhouse intakes.

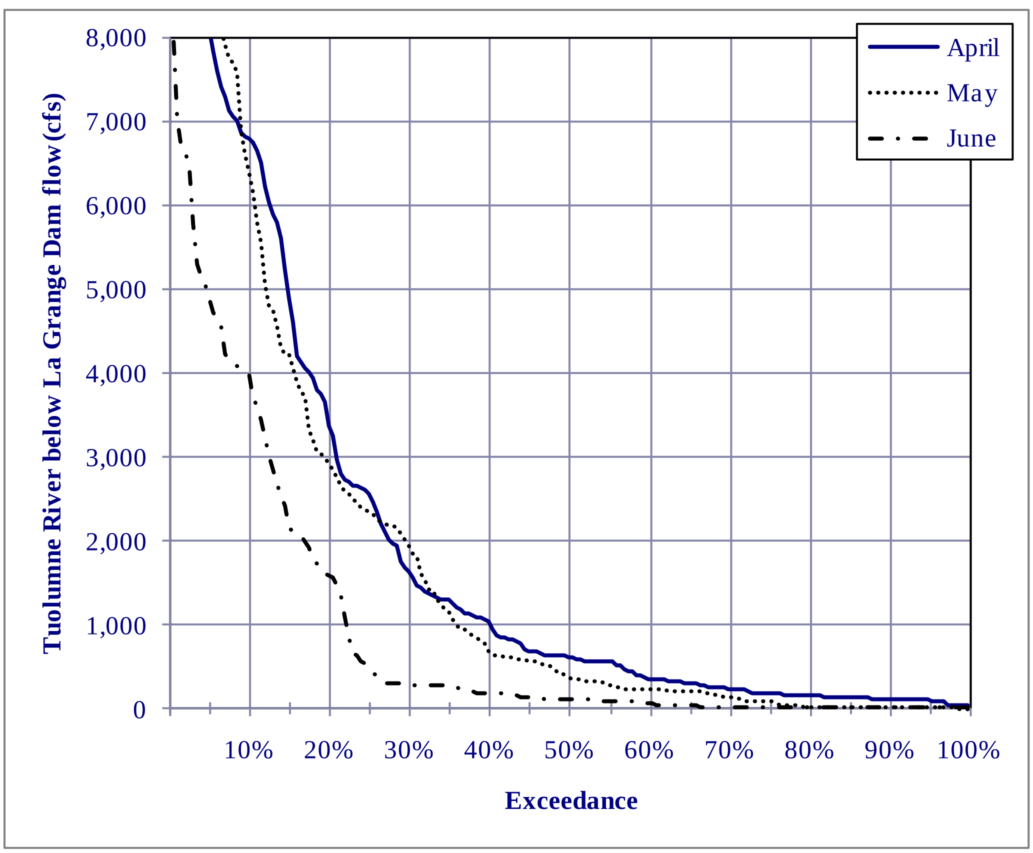
APPENDIX C
FLOW DURATION CURVES

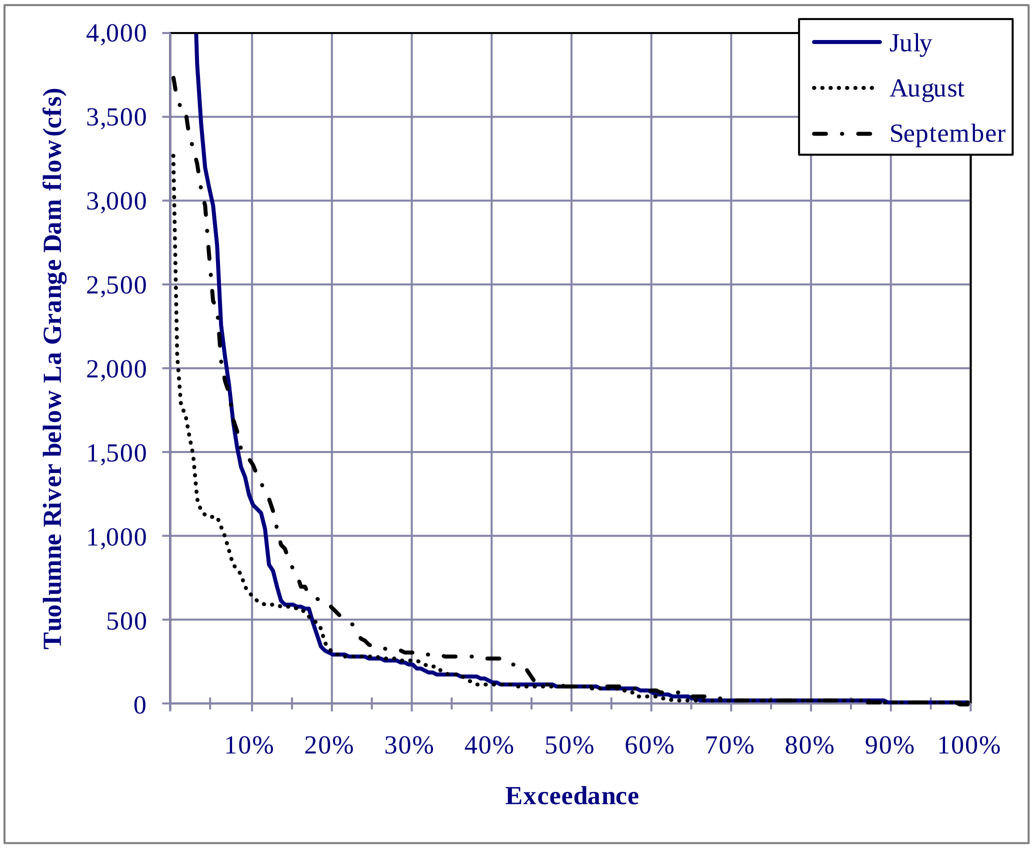
Monthly flow duration data are provided herein for the following locations:

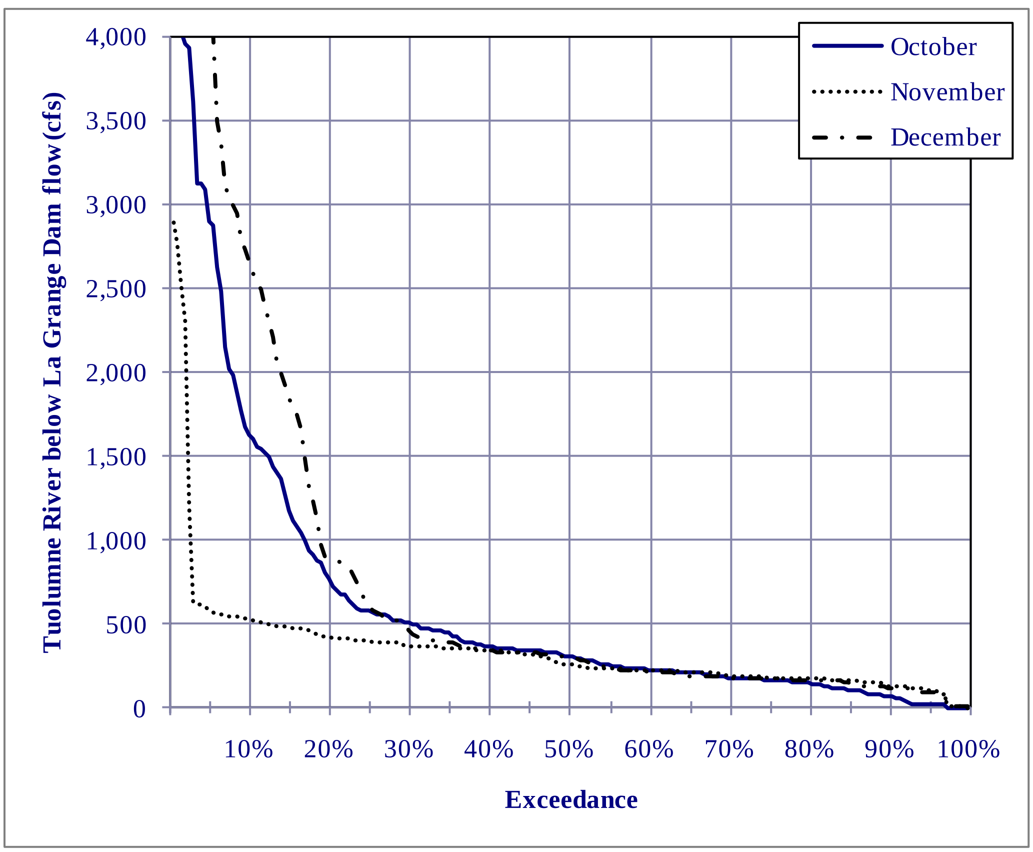
- Tuolumne River below La Grange diversion dam
- Turlock Canal at La Grange diversion dam
- Modesto Canal at La Grange diversion dam
- Don Pedro Project releases

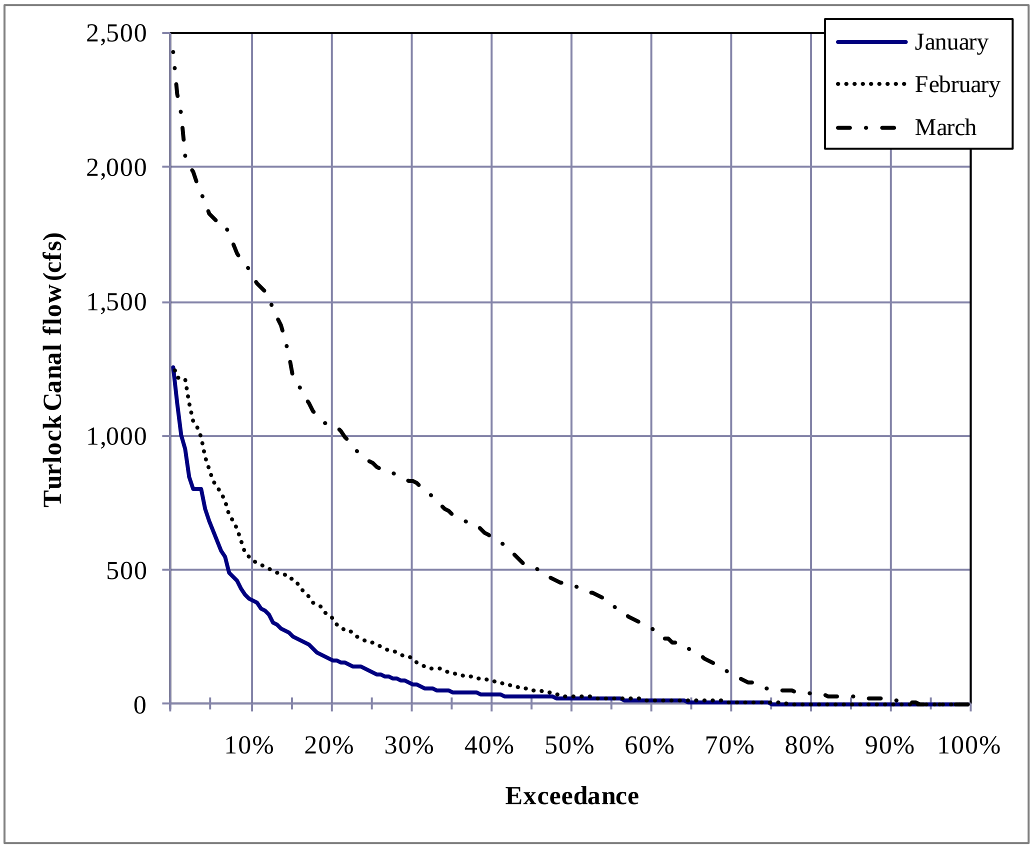
Curves are based on mean daily flows for the period: Water Year 1975 to 2009.

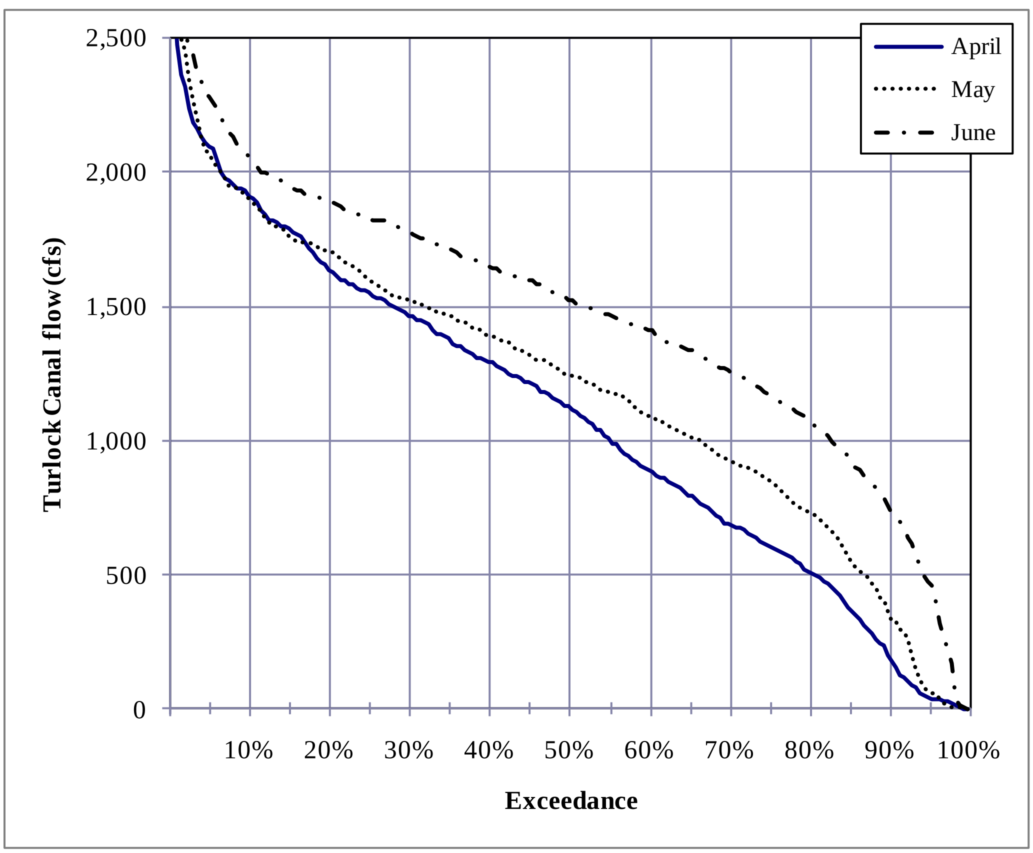

January
February
March
6,000
5,000
4,000
3,000
2,000
1,000
0
10%
20%
30%
40%
50%
60%
70%
80%
90%
100%
Tuolumne River below La Grange Dam flow (cfs)
Exceedance

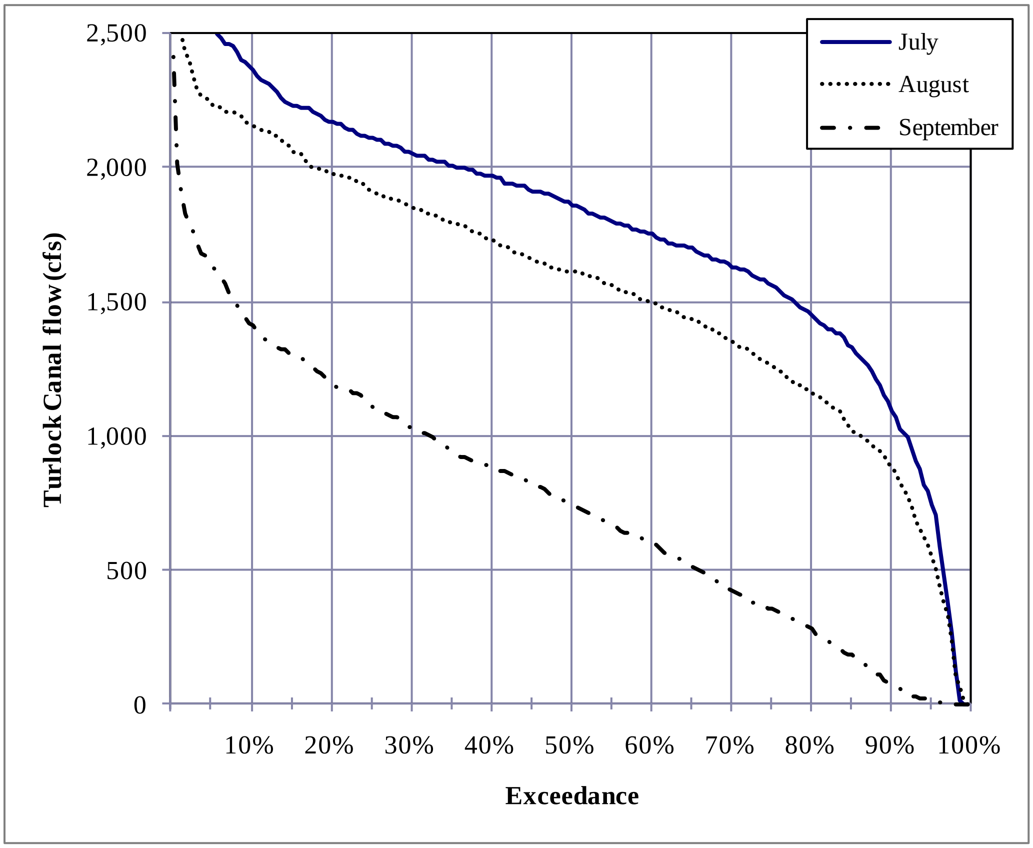

April
May
June
8,000
7,000
6,000
5,000
4,000
3,000
2,000
1,000
0
10%
20%
30%
40%
50%
60%
70%
80%
90%
100%
Tuolumne River below La Grange Dam flow (cfs)
Exceedance


July
August
September
Tuolumne River below La Grange Dam flow (cfs)
4,000
3,500
3,000
2,500
2,000
1,500
1,000
500
0
10%
20%
30%
40%
50%
60%
70%
80%
90%
100%
Exceedance

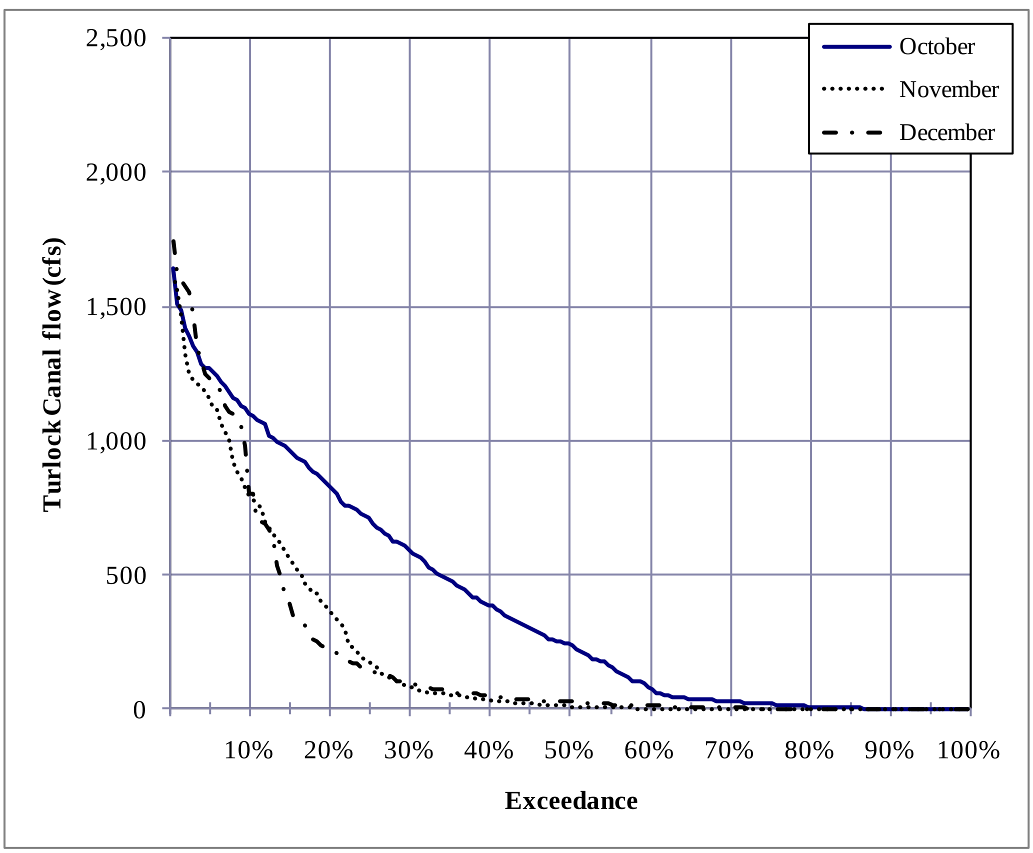

October
November
December
Tuolumne River below La Grange Dam flow (cfs)
4,000
3,500
3,000
2,500
2,000
1,500
1,000
500
0
10%
20%
30%
40%
50%
60%
70%
80%
90%
100%
Exceedance


January
February
March
Turlock Canal flow (cfs)
2,500
2,000
1,500
1,000
500
0
10%
20%
30%
40%
50%
60%
70%
80%
90%
100%
Exceedance

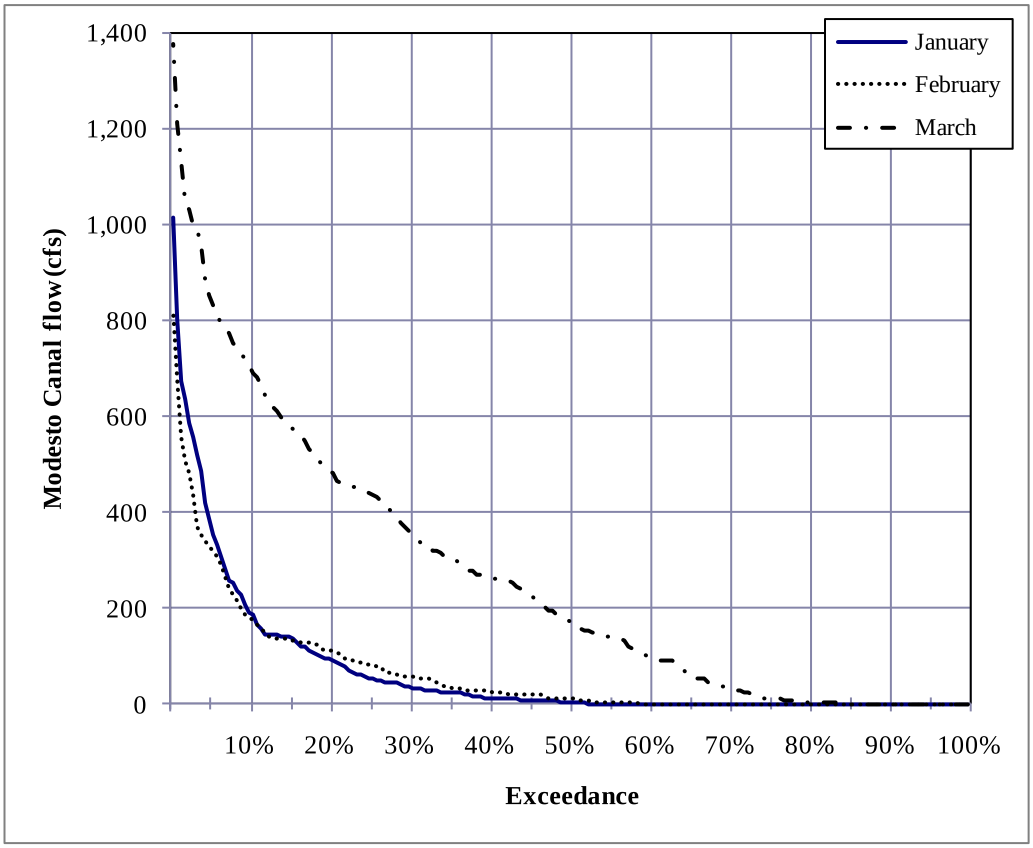

April
May
June
Turlock Canal flow (cfs)
2,500
2,000
1,500
1,000
500
0
10%
20%
30%
40%
50%
60%
70%
80%
90%
100%
Exceedance

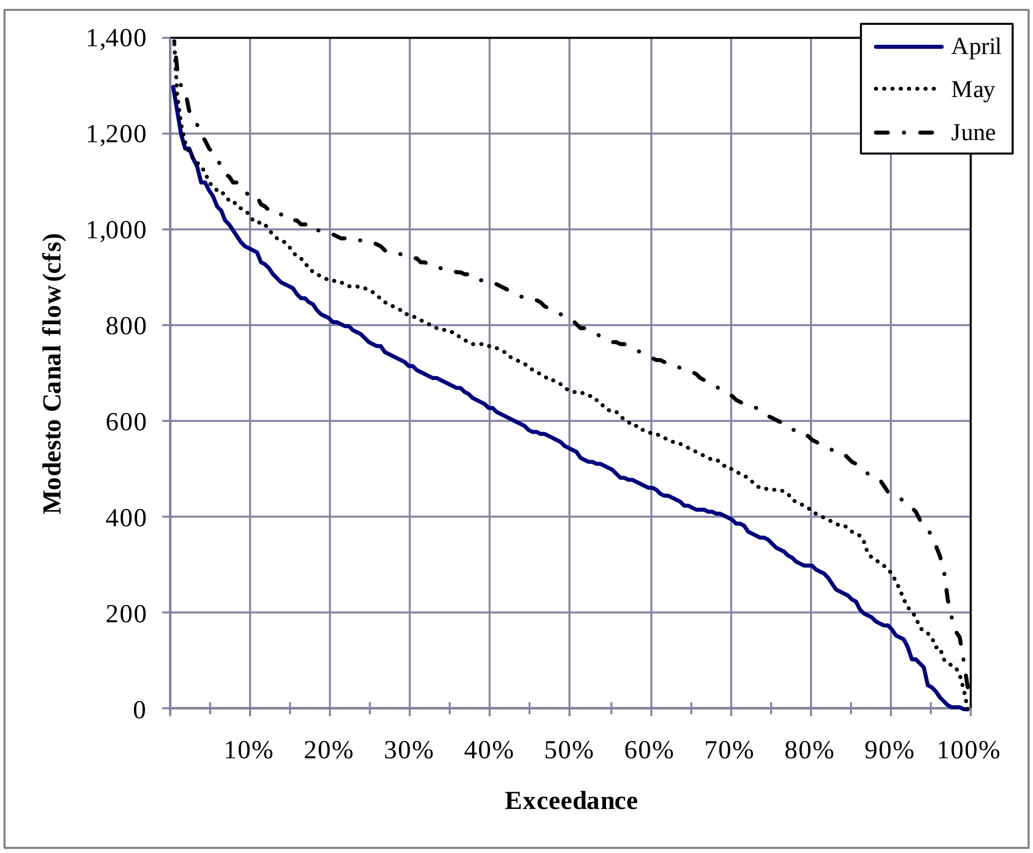


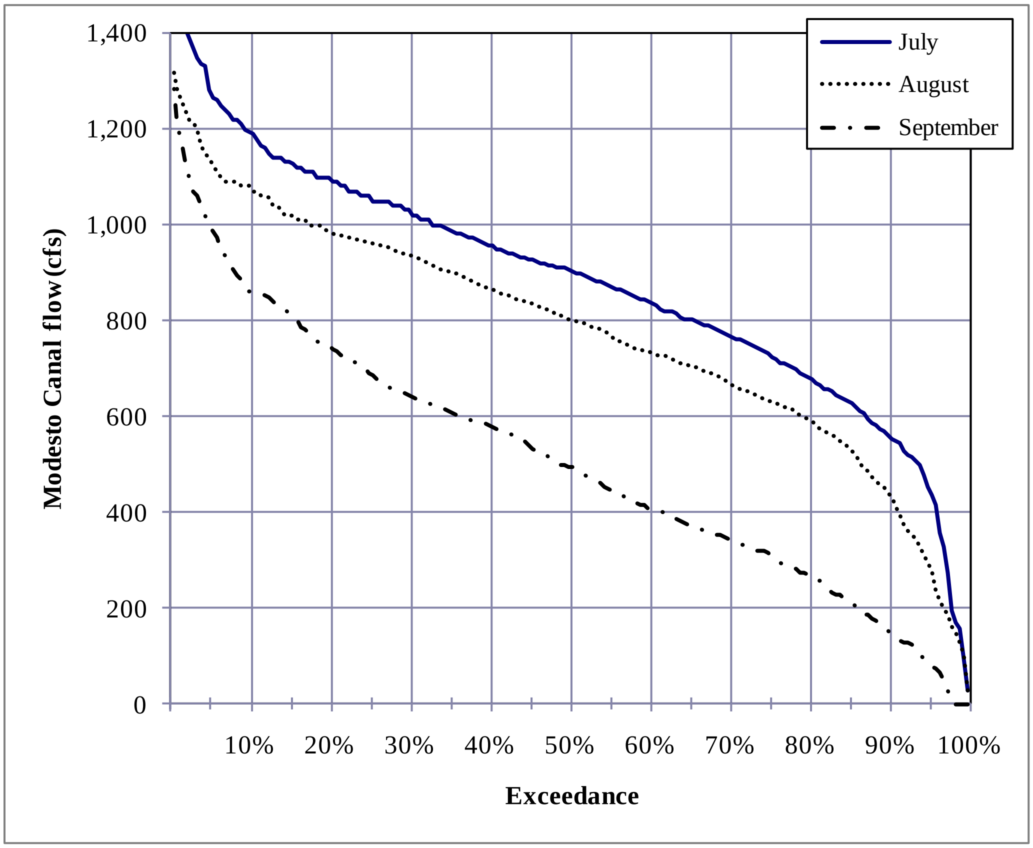
July
August
September
2,500
2,000
1,500
1,000
500
0
Turlock Canal flow (cfs)
10%
20%
30%
40%
50%
60%
70%
80%
90%
100%
Exceedance



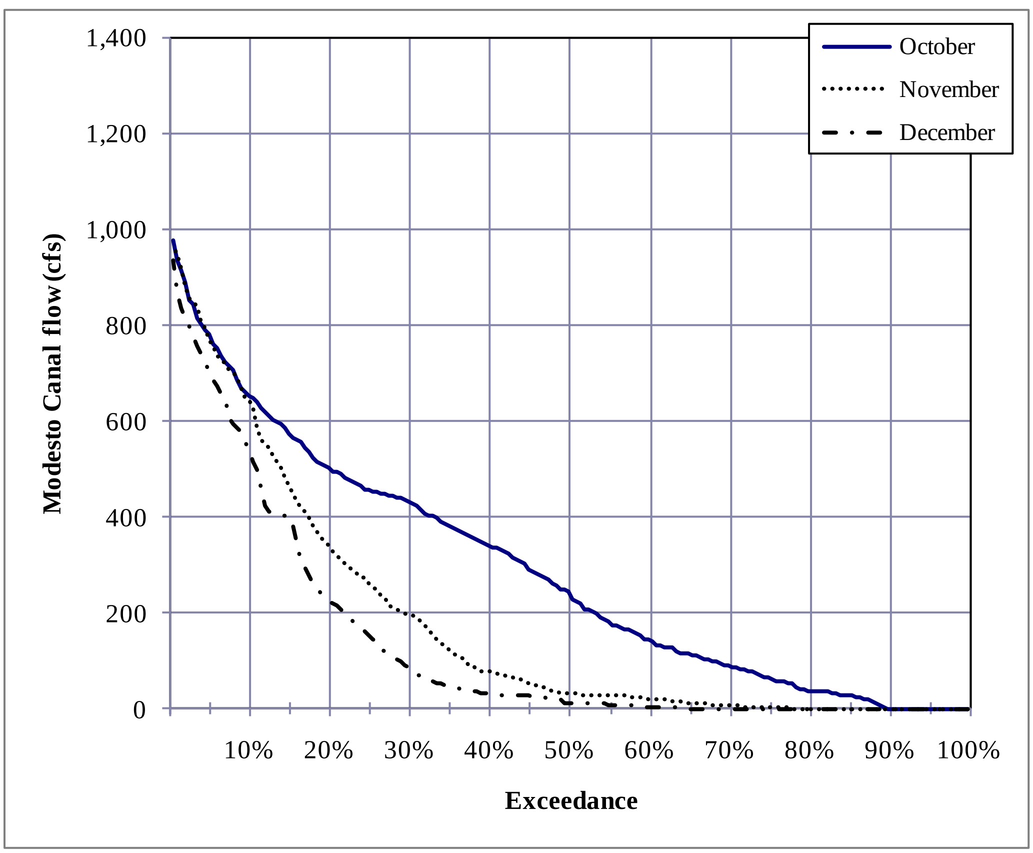
October
November
December
2,500
2,000
1,500
1,000
500
0
Turlock Canal flow (cfs)
10%
20%
30%
40%
50%
60%
70%
80%
90%
100%
Exceedance


January
February
March
Modesto Canal flow (cfs)
1,400
1,200
1,000
800
600
400
200
0
10%
20%
30%
40%
50%
60%
70%
80%
90%
100%
Exceedance

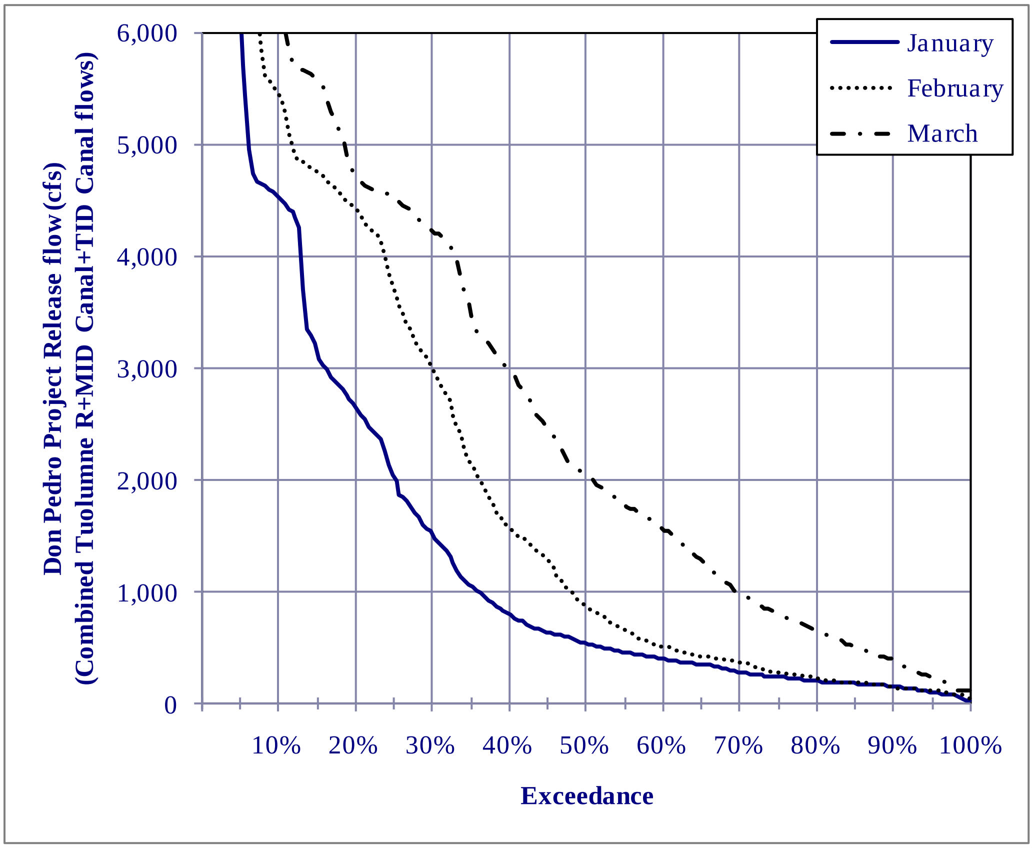

April
May
June
Modesto Canal flow (cfs)
1,400
1,200
1,000
800
600
400
200
0
10%
20%
30%
40%
50%
60%
70%
80%
90%
100%
Exceedance

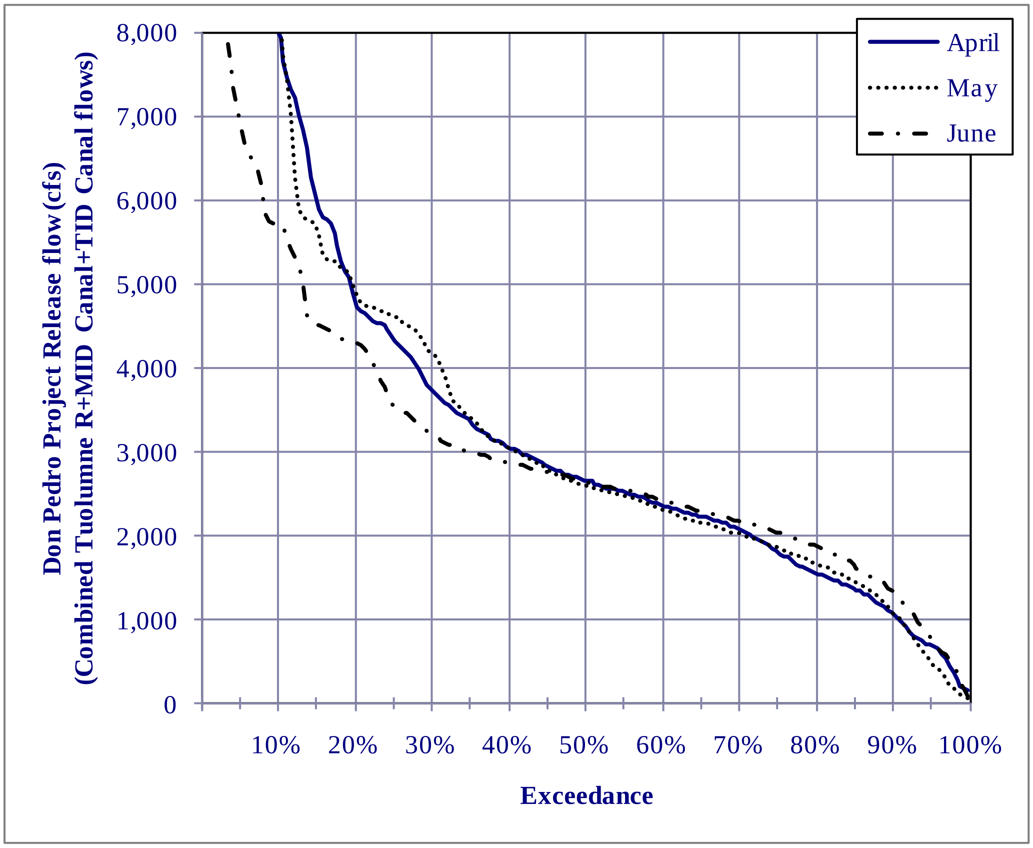


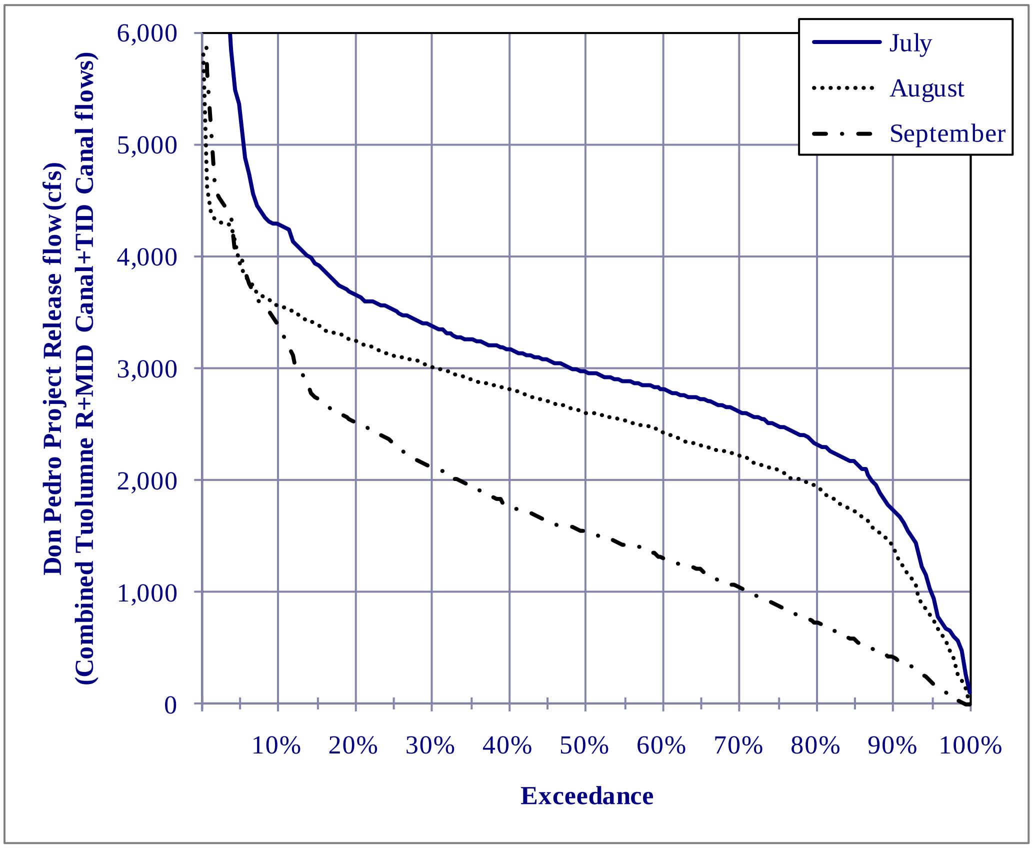
July
August
September
Modesto Canal flow (cfs)
1,400
1,200
1,000
800
600
400
200
0
10%
20%
30%
40%
50%
60%
70%
80%
90%
100%
Exceedance

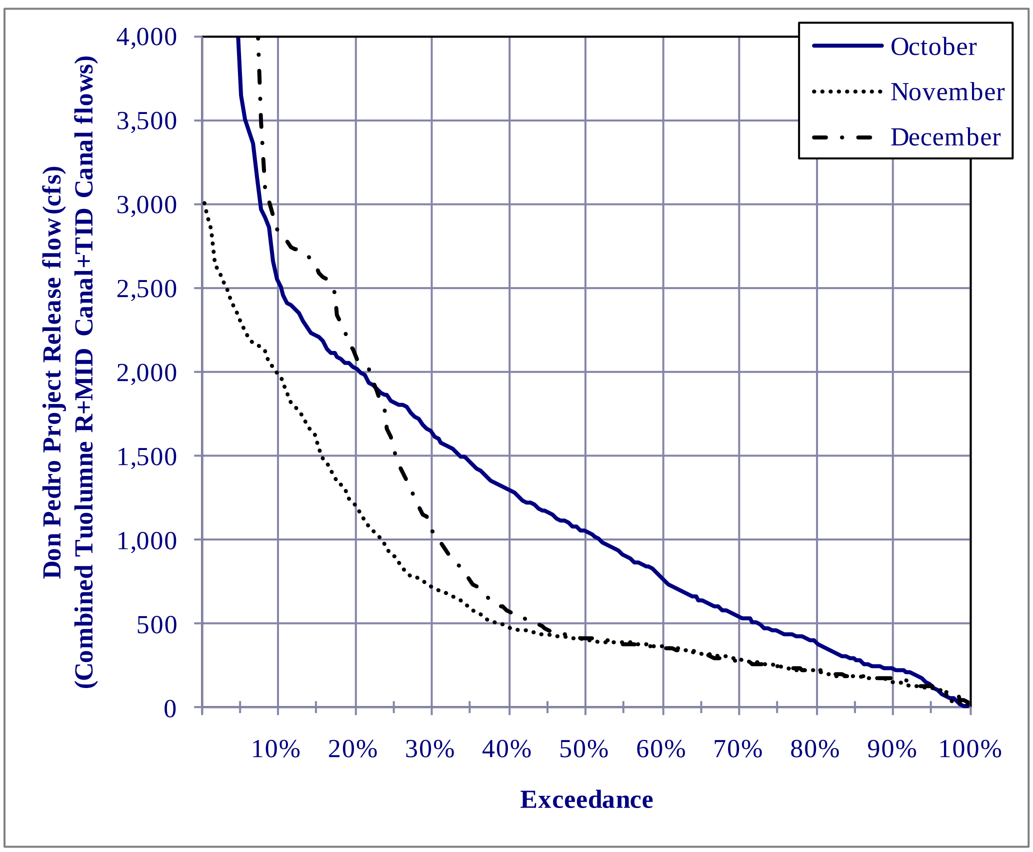


October
November
December
Modesto Canal flow (cfs)
1,400
1,200
1,000
800
600
400
200
0
10%
20%
30%
40%
50%
60%
70%
80%
90%
100%
Exceedance


January
February
March
Don Pedro Project Release flow (cfs)
(Combined Tuolumne R+MID Canal+TID Canal flows)
6,000
5,000
4,000
3,000
2,000
1,000
0
10%
20%
30%
40%
50%
60%
70%
80%
90%
100%
Exceedance


April
May
June
Don Pedro Project Release flow (cfs)
(Combined Tuolumne R+MID Canal+TID Canal flows)
8,000
7,000
6,000
5,000
4,000
3,000
2,000
1,000
0
10%
20%
30%
40%
50%
60%
70%
80%
90%
100%
Exceedance


Don Pedro Project Release flow (cfs)
(Combined Tuolumne R+MID Canal+TID Canal flows)
6,000
5,000
4,000
3,000
2,000
1,000
0
10%
20%
30%
40%
50%
60%
70%
80%
90%
100%
Exceedance
July
August
September


Don Pedro Project Release flow (cfs)
(Combined Tuolumne R+MID Canal+TID Canal flows)
4,000
3,500
3,000
2,500
2,000
1,500
1,000
500
0
10%
20%
30%
40%
50%
60%
70%
80%
90%
100%
Exceedance
October
November
December

APPENDIX D

DISTRICTS' RESPONSE FILED ON JANUARY 6, 2014 IN THE DON PEDRO UPDATED STUDY REPORT TO:

NMFS-1, Elements 3 and 6 – La Grange Development Affected Environment

and

NMFS-4, Elements 1 through 6 – Effects of Don Pedro Project and Related Facilities on Hydrology for Anadramous Fish: Magnitude, Timing, Duration and Rate of Change

Districts' Response to NMFS-1, Elements 3 and 6:
La Grange Development Affected Environment

1.0 Background

On June 10, 2011, the National Marine Fisheries Service ("NMFS") filed a number of requests for studies in connection with the relicensing of the Don Pedro Project, FERC No. 2299. NMFS's Study Request 1 ("NMFS-1") contained six subsections, referred to as "elements."

In the Study Plan Determination ("SPD") issued December 22, 2011, FERC staff recommended that Turlock Irrigation District ("TID") and Modesto Irrigation District ("MID") (collectively, the "Districts") provide a description of existing facilities at their La Grange development which influence flow allocation at the La Grange diversion dam. NMFS and other agencies subsequently filed a Notice of Study Dispute on January 11, 2012 contesting parts of FERC's SPD. FERC convened a Dispute Resolution Panel which filed its findings on May 4, 2012, and on May 24, 2012, FERC issued the Director's Study Dispute Determination.

As part of the Dispute Determination, FERC directed the Districts to identify and provide in their Initial Study Report ("ISR") existing information for NMFS-1, Elements 3 and 6, and to further consult with NMFS and other agencies using the Workshop Consultation protocols to provide and analyze certain flow-related information contained in NMFS Study Request 4 ("NMFS-4")[1].

The Districts filed the ISR on January 16, 2013, and held an ISR Meeting on January 30 and 31, 2013. The ISR included a section that identified existing information on the reach of the Tuolumne River from La Grange diversion dam to USGS gage no. 11289650. In the same section of the ISR, the Districts provided an analysis of the hydrologic effects of the La Grange project operations on flows in the Tuolumne River between La Grange diversion dam and USGS gage no. 11289650.

On March 11, 2013, NMFS filed comments on the Districts' ISR stating that the Districts did not address the full requirements of NMFS-1, Elements 3 and 6. The Districts filed response comments on April 9, 2013; and on May 21, 2013, FERC issued its Determination on Requests for Study Modifications and New Studies in which the Districts were directed to provide in the Updated Study Report ("USR") additional information on each of the items identified in NMFS-1, Elements 3 and 6, and to provide a description of the La Grange project's potential impacts to anadromous fish.

This report fulfills the requirements of FERC's May 21, 2013 Determination.

[1] The Districts' response to NMFS-4 is provided under separate cover in the Updated Study Report document.

2.0 General Description of La Grange Project

FERC directed the Districts to provide a description of the La Grange facilities, including those affecting flow allocation. The La Grange diversion dam is located on the Tuolumne River near the border of Stanislaus and Tuolumne counties in central California at River Mile ("RM") 52.2. Originally constructed between 1891 and 1893, the primary purpose of the diversion dam is to raise the level of the Tuolumne River to permit the diversion of water from the Tuolumne River for irrigation of Central Valley farmland and municipal and industrial ("M&I") water supply.

The La Grange diversion dam is jointly owned by the Districts, which combined forces to build the diversion dam to divert stream flows the Districts had rights to in the Tuolumne River. The La Grange diversion dam has been serving that purpose for approximately 120 years, having replaced the Wheaton Dam which was built by other parties in the early 1870s. La Grange diversion dam was constructed at the downstream end of a narrow, steep-sided canyon. The canyon walls contain the pool formed by the present day La Grange diversion dam.

The Districts' La Grange development includes the dam, impoundment, two intakes and diversion tunnels, forebays, sluiceways, two penstocks, powerhouse, excavated tailrace, substation, and short transmission line. Facilities on the north side of the river are owned by MID and facilities on the south side of the river are owned by TID. The general site arrangement is depicted in Figure 1. Individual descriptions of the primary facilities of the La Grange project are provided below.

2.1 La Grange Diversion Dam and Spillway

Construction of La Grange diversion dam started in the fall of 1891 and was completed in December 1893. The original 127.5-foot-high arched diversion dam was constructed of boulders set in concrete and faced with roughly-dressed stones from a nearby quarry. In 1923, an 18-inch-high concrete cap was added, and in 1930, an additional 24-inch-high concrete cap was added, resulting in the final and current height of 131 feet. The two raises to the crest elevation were for the purpose of increasing the flows that could be diverted to each of the Districts' irrigation canals.

The diversion dam was constructed such that the top is almost entirely a spillway. The spillway crest is at elevation 296.5 feet (all elevations are referenced to 1929 National Geodetic Vertical Datum) and has a length of 310 feet. A rating table for the La Grange spillway is presented in Table 1. A cross-section through the spillway is shown in Figure 2. There have been no modifications to the height or crest of the La Grange diversion dam and spillway since 1930, except for routine maintenance and repairs.

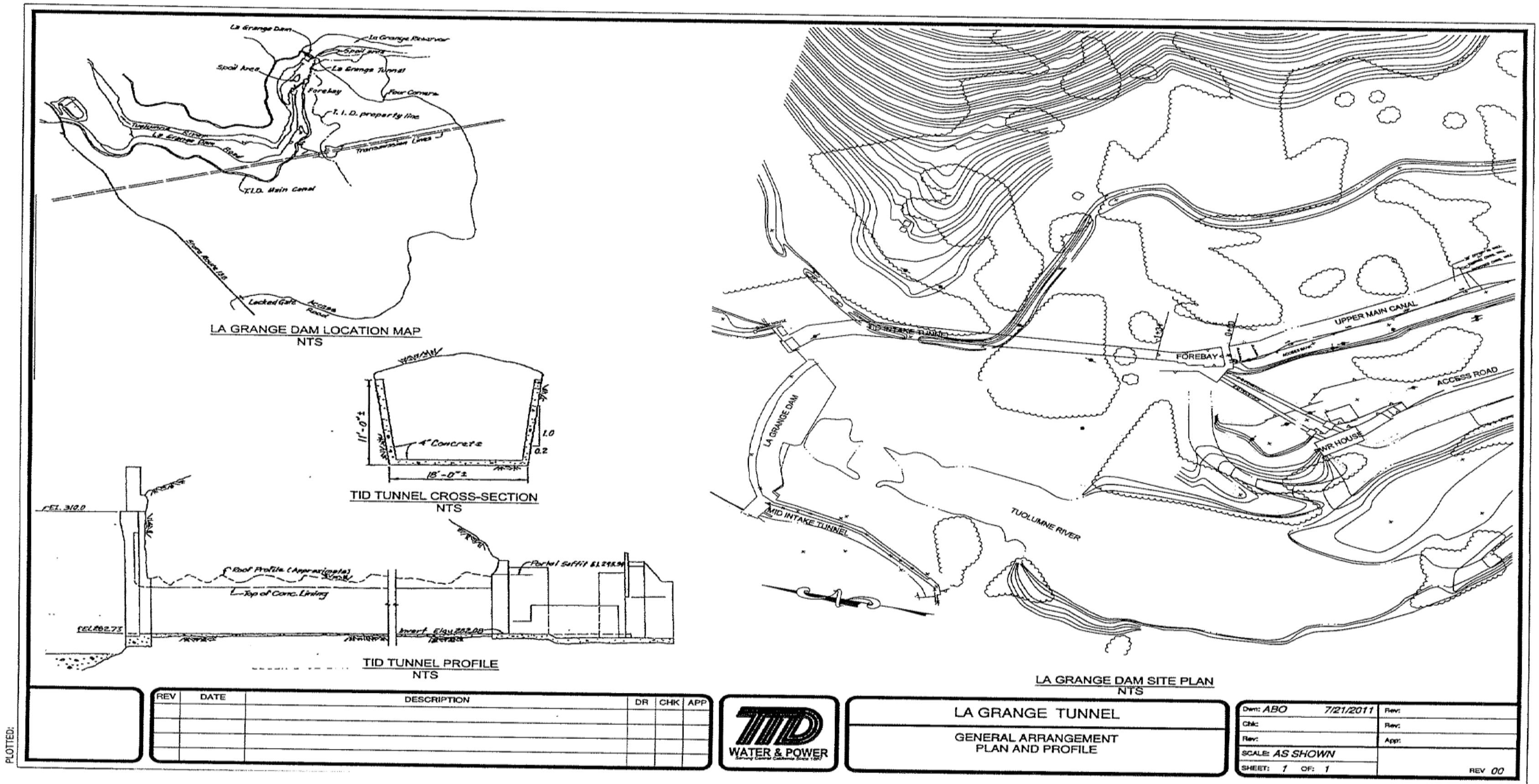


Figure 1. Site plan of La Grange diversion dam and facilities showing diversion dam, TID tunnel intake, tunnel location, penstocks, powerhouse, and TID's Upper Main Canal.

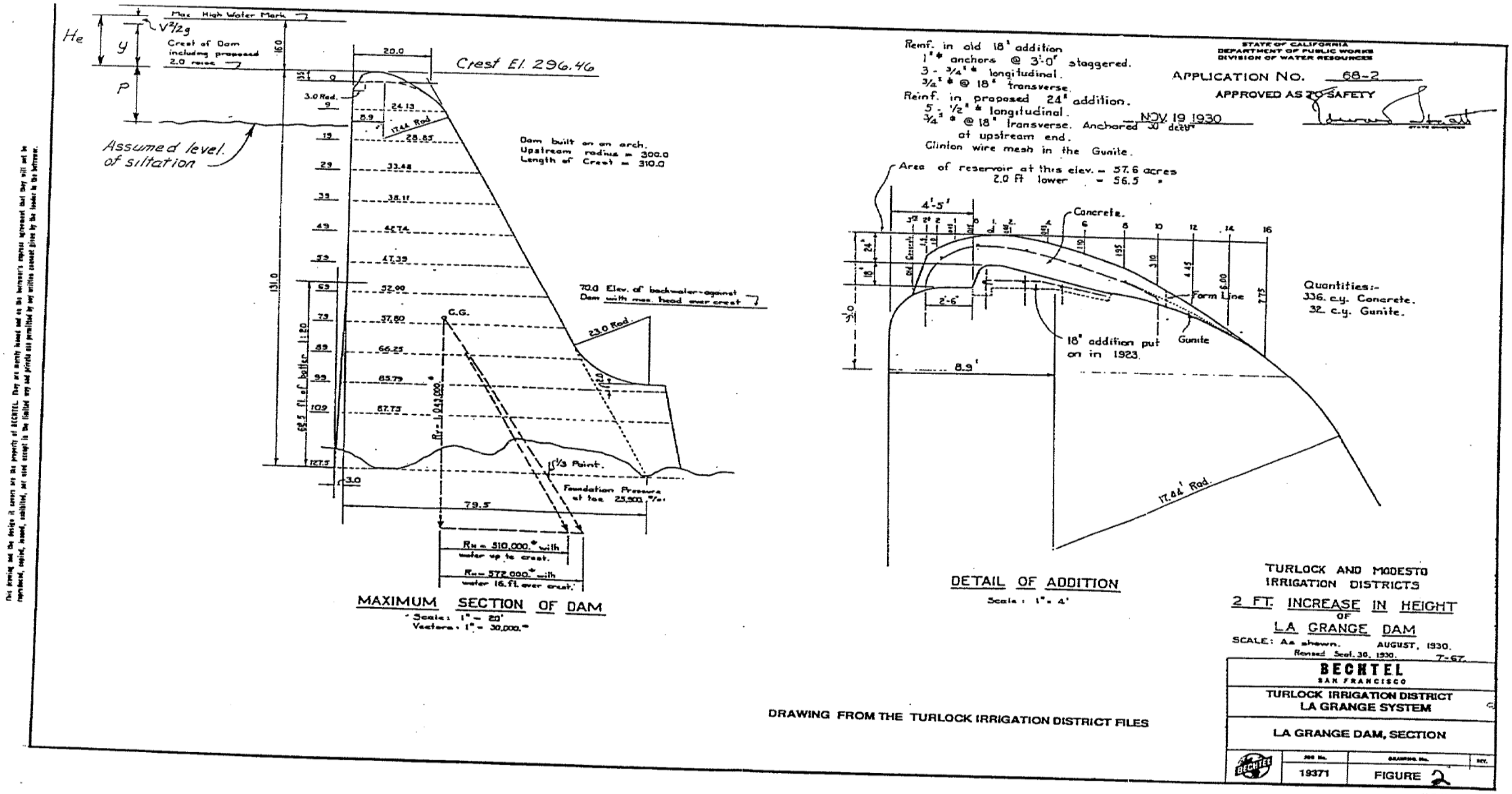


Figure 2. La Grange spillway section showing original crest and crest modification to present elevation of 296.5 ft.

Table 1. Estimated spillway rating table for La Grange diversion dam.

Reservation Elevation	Discharges in CFS			
ft.	0.00	0.25	0.50	0.75
296	-	-	10	120
297	320	600	980	1350
298	1800	2280	2780	3400
299	4010	4680	5380	6150
300	6900	7720	8560	9410
301	10310	11300	12300	13350
302	14500	15590	16680	17900
303	19100	20290	21500	22700
304	23900	25050	26800	28400

2.2 La Grange Impoundment

The drainage area of the Tuolumne River upstream of the La Grange diversion dam is approximately 1,550 square miles. Flows from the drainage area above La Grange diversion dam are regulated by four upstream reservoirs: Hetch Hetchy, Lake Eleanor, Cherry Lake, and Don Pedro. Don Pedro is owned jointly by TID and MID, and the other three dams are owned by the City and County of San Francisco. Inflow to the La Grange project is the sum of releases from the Don Pedro Project located 2.3 miles upstream and minor contributions from two small intermittent drainage channels. As mentioned above, the pool formed by La Grange diversion dam is contained within a narrow, steep-sided canyon. It extends for approximately one mile upstream of the dam at normal river flows. The active storage is less than 100 acre-feet ("AF"). The diversion dam was constructed for the purpose of raising the level of the Tuolumne River to a height which enabled gravity flow of diverted water into the TID and MID irrigation systems, and not for any water storage purpose.

2.3 Intakes and Tunnels

As mentioned above, La Grange diversion dam was constructed to permit the diversion of irrigation water and M&I water into the TID and MID water delivery systems. MID's system is located on the north (right, looking downstream) side of the river and TID's is on the south (left) side.

Water released from the upstream Don Pedro Project is either diverted by TID or MID at La Grange diversion dam or flows downstream to the lower Tuolumne River. MID's tunnel intake is located on the north end of the diversion dam, and TID's tunnel intake is located on the south end of the diversion dam. The Districts' irrigation canals were constructed such that approximately 68% of diverted flow would be routed to the TID system and 32% to the MID system.

Annual water diversions and streamflows are provided in Table 2. These flow records provide the existing volumes of water used for irrigation and M&I purposes; the Districts are not currently proposing any change in uses of diverted waters (see NMFS-1, Element 3b).

Due to continuing maintenance and repair issues experienced at its upper Main Canal, MID constructed a new diversion tunnel in 1987/1988 to replace the upper section of its Main Canal. The intake to the MID tunnel is located in the face of a cliff on the right bank about 100 feet upstream of La Grange diversion dam. The invert of the tunnel is at elevation 277.4 feet. Flow is conveyed through the 15-foot 6-inch diameter tunnel 895 feet to a control structure. Flow is then conveyed through a 5,300-foot-long tunnel to an outlet structure which controls flow to the MID Main Canal. The MID intake and tunnel provide water to MID's irrigation and M&I water systems.

A TID intake and diversion tunnel is located on the left bank of the La Grange diversion dam and consists of two separate structures. As shown in Figure 3, the first intake tunnel portal contains two 8-foot by 11-foot 10-inch high control gates driven by electric motor hoists. The second intake tunnel portal, located to the left of the first portal, contains a single 8-foot by 12-foot control gate.

The second part of the intake was added in 1980 for the purpose of decreasing headloss and increasing the flow delivery capability to the TID irrigation canal system. Flows from the intake control gates are conveyed to the 600-foot-long tunnel to the 110-foot-long forebay upstream of the TID Upper Main Canal. The Upper Main Canal headworks were modified in 1980. Flows to TID's irrigation system are controlled by six slide gates, each 5-foot by 8-foot 4-inch.

2.4 Forebay, Canal Headworks, and Powerhouse Intake

Flow from the TID tunnel discharges nearly 600 feet downstream from the intake into a concrete forebay which contains the TID irrigation canal headworks and, separately, a penstock intake structure. At the tunnel outlet portal, the forebay invert is approximately 18-foot wide and gradually expands to 39-foot wide at the face of the irrigation canal headworks facility. The forebay is 118 feet long along the centerline of flow and is constructed with a gradual bend to the south as it enters the TID Upper Main Canal.

The original invert of the forebay was constructed at an elevation of approximately 281.2 feet, but was excavated and rebuilt at a lower elevation of nearly 278 feet as a result of the 1980 work to improve the delivery capacity to the TID Upper Main Canal.

At the west side of the canal, a trash rack structure and three 7.5-foot wide by 14-foot high concrete intake bays make up the powerhouse intake structure. There are no automatic gates to control these bays. Manually-operated steel gates are used to shut off flows to the penstocks.

Table 2. Flows downstream of La Grange diversion dam, water deliveries to TID and MID, and total Don Pedro Project outflows, 1997-2009.

Month	Mean Monthly Flow (cfs)*													Mean Monthly Flow (cfs)	Highest Mean Monthly Flow (cfs)	Lowest Mean Monthly Flow (cfs)
	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009			
USGS 11289650 - Tuolumne River Below La Grange Diversion Dam Near La Grange, CA (River in-stream flow only)																
Jan	13,070	2,114	1,247	324	325	177	184	223	187	4,456	353	171	165	1,769	13,070***	165
Feb	8,116	6,168	4,903	2,284	1,273	172	185	220	1,823	2,373	358	173	168	2,170	8,116***	168
Mar	2,443	5,407	3,285	4,602	615	165	182	1,098	3,875	4,234	357	172	169	2,046	5,407	165
Apr	1,457	5,392	2,034	1,548	558	665	685	1,010	4,524	7,436	487	533	372	2,054	7,436	372
May	953	3,621	1,697	1,164	706	419	477	412	4,868	7,847	385	680	687	1,840	7,847	385
Jun	269	4,433	284	340	54	97	234	127	3,809	4,657	127	95	149	1,129	4,657	54
Jul	290	2,845	287	421	89	88	243	108	1,913	834	114	93	107	572	2,845	88
Aug	287	1,019	259	603	110	86	236	106	773	584	110	99	102	336	1,019	86
Sep	285	1,423	294	473	112	68	250	110	328	412	89	97	106	311	1,423	68
Oct	465	628	424	412	189	202	297	209	464	449	141	174	In	338	628	141
Nov	380	316	338	347	184	191	231	186	369	379	174	161	WY	271	380	161
Dec	330	1,321	336	334	177	187	226	178	1,285	352	169	164	2010	422	1,321	164
USGS 11289000 - Modesto Canal Near La Grange, CA																
Jan	6	117	66	237	72	40	76	87	83	143	9	27	31	76	237	6
Feb	168	56	47	72	142	67	58	44	204	135	113	45	29	91	204	29
Mar	642	121	301	231	213	434	328	355	260	142	348	346	219	303	642	121
Apr	601	250	630	586	607	720	325	720	450	249	483	575	474	513	720	249
May	872	310	697	659	773	724	605	653	665	716	682	656	573	660	872	310
Jun	701	655	769	733	802	791	801	751	695	802	763	646	716	740	802	646
Jul	962	787	781	915	905	891	894	825	1,043	846	803	748	791	861	1,043	748

Month	Mean Monthly Flow (cfs)*													Mean Monthly Flow (cfs)	Highest Mean Monthly Flow (cfs)	Lowest Mean Monthly Flow (cfs)
	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009			
Aug	813	869	927	878	767	707	825	704	827	824	781	793	721	803	927	704
Sep	550	482	566	474	567	583	525	461	604	594	411	506	474	523	604	411
Oct	347	344	334	293	387	358	380	270	299	304	321	301	In WY 2010	328	387	270
Nov	78	73	195	44	36	105	172	84	141	173	162	100		114	195	36
Dec	26	86	72	75	72	58	13	43	126	8	9	18		50	126	8
USGS 11289500 - Turlock Canal Near La Grange, CA																
Jan	387	69	506	0	91	27	6	25	316	299	164	4	82	152	506	0
Feb	599	326	313	0	8	6	323	302	339	529	257	101	151	250	599	0
Mar	1,457	454	623	603	595	1,023	637	1,035	872	644	1,113	1,132	601	830	1,457	454
Apr	1,222	699	1,304	1,135	1,110	1,249	771	1,272	1,184	529	1,082	866	1,013	1,034	1,304	529
May	1,710	800	1,321	1,246	1,455	1,121	1,073	1,336	1,256	1,339	1,166	1,136	1,021	1,229	1,710	800
Jun	1,445	1,243	1,525	1,725	1,664	1,483	1,639	1,552	1,504	1,624	1,599	1,310	1,525	1,526	1,725	1,243
Jul	2,081	1,817	1,938	1,898	1,805	1,817	1,883	1,840	1,917	2,000	1,816	1,572	1,899	1,868	2,081	1,572
Aug	1,587	1,681	1,796	1,784	1,526	1,489	1,516	1,510	1,706	1,674	1,494	1,314	1,482	1,581	1,796	1,314
Sep	812	977	952	1,063	825	736	714	617	991	936	631	571	793	817	1,063	571
Oct	505	613	566	527	445	358	742	577	259	379	305	129	In WY 2010	450	742	129
Nov	30	0	59	24	4	22	1	1	3	8	35	2		16	59	0
Dec	109	0	301	173	12	94	36	12	27	1	45	149		80	301	0
USGS 11289651 - Combined Flow Tuolumne River + Modesto Canal + Turlock Canal (~ total Don Pedro Project outflow) *																
Jan	13,630	2,301	1,818	561	489	244	266	335	585	4,897	525	203	278	2,010	13,630	203
Feb	8,885	6,551	5,262	2,355	1,424	245	565	566	2,365	3,038	728	320	348	2,512	8,885	245
Mar	4,544	5,983	4,210	5,435	1,423	1,622	1,146	2,487	5,005	5,020	1,818	1,651	989	3,179	5,983	989
Apr	3,280	6,341	3,968	3,269	2,276	2,634	1,781	3,001	6,158	8,211	2,052	1,973	1,860	3,600	8,211	1,781
May	3,535	4,732	3,714	3,067	2,935	2,263	2,155	2,402	6,790	9,902	2,234	2,472	2,280	3,729	9,902	2,155

Month	Mean Monthly Flow (cfs)*													Mean Monthly Flow (cfs)	Highest Mean Monthly Flow (cfs)	Lowest Mean Monthly Flow (cfs)
	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009			
Jun	2,415	6,332	2,579	2,796	2,519	2,371	2,672	2,430	6,009	7,083	2,488	2,049	2,391	3,395	7,083	2,049
Jul	3,333	5,448	3,006	3,234	2,798	2,795	3,021	2,772	4,872	3,678	2,732	2,414	2,798	3,300	5,448	2,414
Aug	2,687	3,569	2,982	3,264	2,403	2,281	2,578	2,319	3,305	3,082	2,385	2,205	2,304	2,720	3,569	2,205
Sep	1,647	2,882	1,812	2,009	1,504	1,386	1,489	1,188	1,922	1,942	1,130	1,175	1,371	1,651	2,882	1,130
Oct	1,318	1,584	1,324	1,231	1,021	917	1,419	1,055	1,021	1,133	766	604	In WY 2010	1,116	1,584	604
Nov	489	389	592	415	224	318	404	270	513	559	371	263		401	592	224
Dec	466	1,407	709	582	261	339	275	233	1,437	361	223	330		552	1,437	223

*Values Calculated using USGS National Water Information System (NWIS) monthly statistics module:
http://waterdata.usgs.gov/nwis/nwisman/?site_no=11289650 &agency_cd=USGS,
http://waterdata.usgs.gov/nwis/nwisman/?site_no=11289000&agency_cd=USGS,
http://waterdata.usgs.gov/nwis/nwisman/?site_no=11289500 &agency_cd=USGS, and
http://waterdata.usgs.gov/nwis/nwisman/?site_no=11289651&agency_cd=USGS

** Some values rounded by USGS - sum of individual gage monthly mean flows may not precisely equal combined gage monthly mean flows.

***The flood of record occurred in January, 1997, with high reservoir releases continuing on into February, 1997. These values skew the January and February mean monthly flow averages for the 1997 to 2009 period. Without 1997 values, the mean monthly flow in January is 827 cfs and February is 1,675, compared to the values in the table 1,769 and 2,170 cfs, respectively.

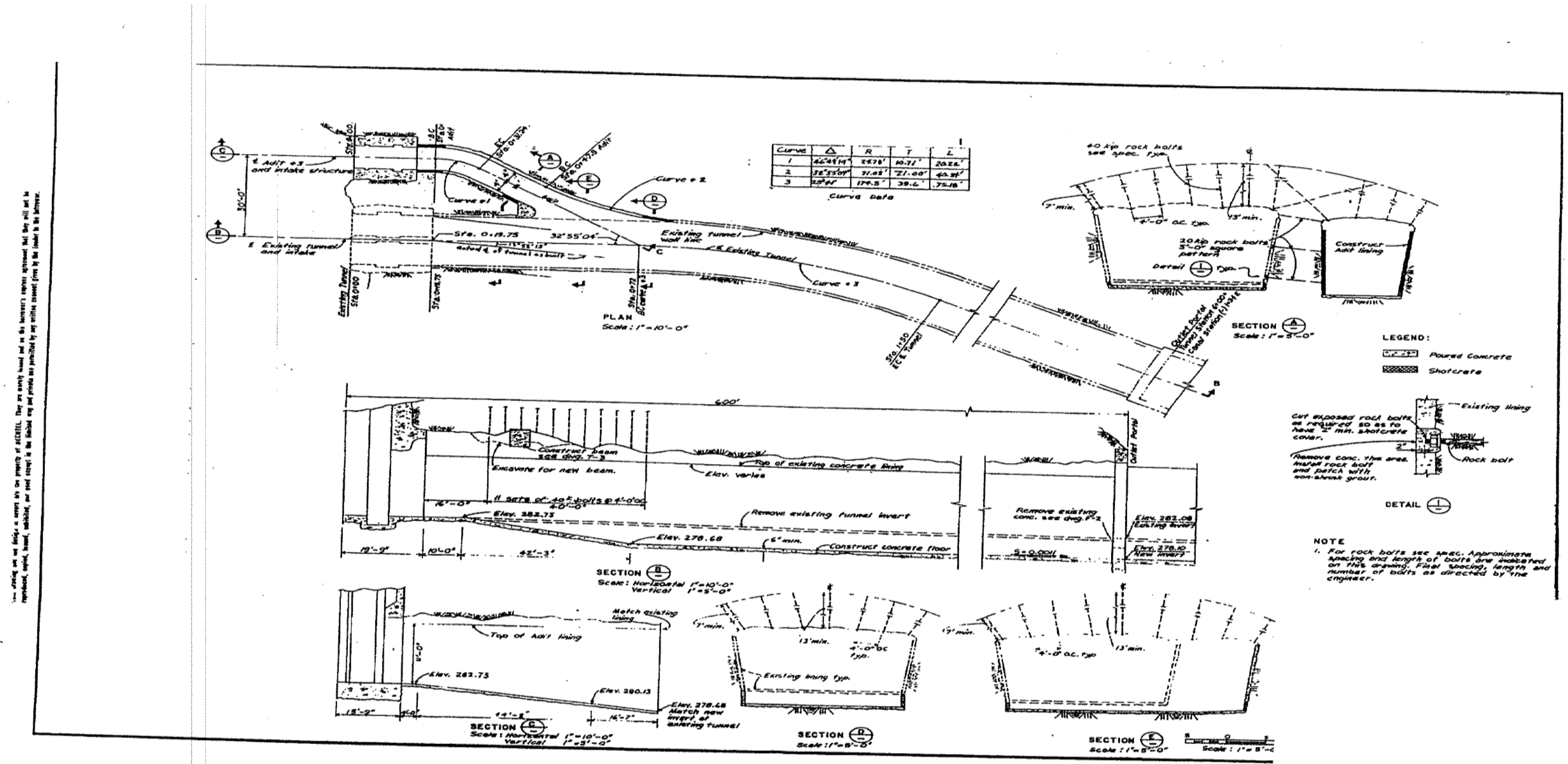


Figure 3. TID intake tunnel portals site plan and profile.

The TID irrigation canal headworks structure was originally constructed with five 5-foot-wide by 8-foot 4-inch-high outlets which are all controlled by fabricated steel gates. In 1980, a sixth gate was added. The sixth gate that was added matches the original gate dimensions. The invert of all outlets was built to an elevation of 281.2 feet and the top of the outlet training walls were at elevation 294 feet.

2.5 Canals

The La Grange diversion dam enables the diversion of water to both TID and MID Main Canals which provide water to serve the Districts' irrigation and M&I customers. Water flows approximately 12 miles through the MID Main Canal to Modesto Reservoir. Based on records from USGS Gage No. 11289000 located on the MID canal, the highest mean monthly flow for the MID canal since 1997 occurred in July 2005 and was 1,043 cfs (Table 2).

The TID Upper Main Canal is controlled by the canal headworks structure and flows nearly eight miles downstream to Turlock Lake. Downstream of Turlock Lake, the TID Main Canal begins to branch off to provide water deliveries through the Highline Canal, Ceres Main Canal, and Turlock Main Canal.

In 1980, portions of the TID Upper Main Canal between the canal headworks and Turlock Lake were modified to increase irrigation water delivery capacity to approximately 3,000 cfs to enable TID to better manage its irrigation water supply. Since 1997, the highest mean monthly flow for the canal occurred in July 1997 at 2,081 cfs (Table 2).

2.6 Powerhouse

The La Grange powerhouse is located approximately 0.2 miles downstream of the La Grange diversion dam on the south (left) bank of the Tuolumne River. The power plant is owned and operated by TID. Water diverted through the TID intake and tunnel to the Upper Main Canal forebay may flow into two penstocks that deliver flow to the powerhouse. The 2-unit powerhouse was built in 1924. The powerhouse is a 72-foot by 29-foot structure with a reinforced concrete substructure and steel superstructure. As shown in Figure 4, the intakes for the two penstocks are located in the right side of the forebay. The penstock for Unit 1 is a 235-foot-long 5-foot diameter riveted steel pipe. The penstock for Unit 2 is a 212-foot-long 7-foot diameter riveted steel pipe.

There have been no modifications to the penstock intakes, penstocks, or powerhouse since its original construction in 1924 except for routine maintenance and repairs or changes made to accommodate TID's irrigation canal improvements.

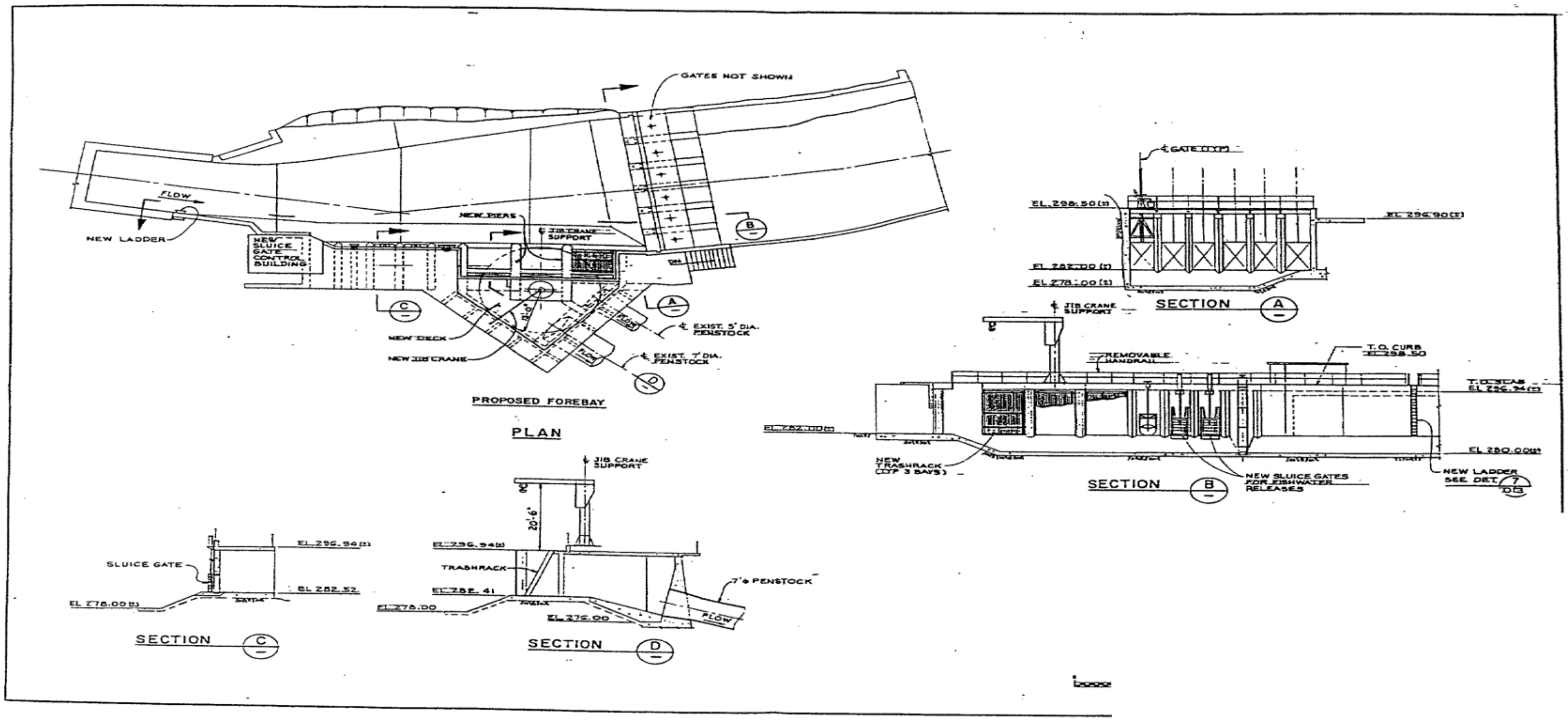


Figure 4. TID tunnel exit, forebay, and Upper Main Canal and powerhouse intakes.

2.7 Turbines, Generators, and Accessory Equipment

The La Grange powerhouse contains two turbine-generator units originally installed circa 1924/1925 (Bechtel Civil 1987). The turbine of the smaller unit contains a Voith runner rated, at its cavitation limit, at 1,650 horsepower at 140 cfs and 115 feet of net head. The larger unit also contains a Voith runner rated, at its cavitation limit, at 4,950 horsepower at 440 cfs and 115 feet of net head. The actual net head at the plant varies with flow; the net head affects flow capacity and unit output. The runners in the original 65-year old turbine-generator units were replaced with the current Voith runners in 1989. Historically, the flow capacity of the original 1924 units exceeded 600 cfs (Bechtel Civil 1987). The units with the Voith replacement runners have a combined capacity of about 570 cfs at the guaranteed maximum capacity (i.e., their cavitation limit). The original Unit 1 design was an unconventional configuration, even for the 1910/1920s, consisting of a single horizontal Francis turbine coupled to two generators, one on each side of the turbine (Bechtel Civil 1987). This two-generator configuration was replaced with the industry-standard single generator configuration as part of the 1989/1990 rehabilitation work. The original Unit 2 design is a conventional configuration consisting of a single vertical Francis turbine coupled to a single, nominal 3,750 kW generator (Bechtel Civil 1987).

2.8 Substation and Transmission

The substation is located on the east side of the powerhouse and is equipped with a 4.16 kV/69 kV transformer. The outgoing transmission line can be interconnected to either TID's Tuolumne Line 1 or its Hawkins Line (Attachment A).

2.9 Tailwater

The tailwater elevation at the powerhouse varies with powerhouse flow and upstream releases into the river but generally ranges between elevation 175 and 180 feet.

2.10 Lands

Under normal river flows, all lands occupied by the La Grange development are privately owned either by the Districts or by other private landowners.

3.0 La Grange Project Operations

The La Grange project operates in a run-of-river mode. As mentioned previously, it was originally constructed in 1891-1893 to raise the level of the Tuolumne River so as to permit the diversion and delivery of water by gravity means to TID's and MID's canals. The diversion dam is located at the exit of a narrow canyon. There is little to no active storage. When not in spill mode, the La Grange pool operates between elevation 294 ft and 296 ft approximately 90 percent of the time. This 2-ft operating band contains about

100 acre-feet of water. La Grange Dam acts as a diversion dam, delivering flow through its tunnel intakes to the TID and MID canal systems. Combined, these irrigation canals serve over 200,000 acres of prime Central Valley farmland each year with over 800,000 acre-feet of water. MID also provides potable water to the City of Modesto's population of 250,000 people.

Flows released from the Don Pedro Project located upstream of La Grange diversion dam are either diverted into the TID canal system and/or the MID canal system, or are passed downstream. Diverted water can be delivered to the Districts' irrigation water delivery systems or passed back to the Tuolumne River below La Grange diversion dam. On the MID side of the river, sluice gates can deliver water back to the river approximately 400 feet downstream of the diversion dam. MID reports that control gates located at the upper and lower end of the old canal headworks are opened to pass about 25 cfs to the river into the large pool below the diversion dam. On the TID side of the river, diverted flows can also be passed to the river through either two 5-foot-wide by 4-foot-high sluice gates located adjacent to the penstock intakes or through the La Grange powerhouse.

In 1996, FERC approved a settlement agreement for the upstream Don Pedro Project among the Districts, resource agencies, and conservation groups wherein the Districts agreed, as part of its Don Pedro Project operations, to provide increased flows in the lower Tuolumne River to be measured at a location downstream of the La Grange diversion dam. These flows to protect anadromous fish are normally passed at La Grange diversion dam through the TID intake and tunnel, then via the penstocks and powerhouse. Turbine discharges at the La Grange powerhouse flow into a tailrace that joins the lower Tuolumne River about one-half mile below La Grange diversion dam. The two sluice gates in the canal forebay can also discharge flows into the tailrace. In addition, a small 4-ft by 6-ft sluice gate is located in the main spillway on the MID side of La Grange diversion dam. This gate is normally closed, but can be used during periods of maintenance on the spillway crest. Records of its operation are not maintained.

The flows under the 1996 Don Pedro Project Settlement Agreement are normally discharged to the river at La Grange via the La Grange powerhouse and turbines. From 1980 to 1996, the average annual generation at the La Grange powerhouse was 15,608 MWh, and ranged from a low of 514 MWh during the drought year of 1989 to a high of 38,150 MWh during the wet year of 1983. Subsequent to the 1996 implementation of the Settlement Agreement, the average annual generation at the La Grange powerhouse has been 19,638 MWh, with a low of 9,384 MWh in 2009 (dry year) and a high of 34,439 MWh in 2006 (wet year). The dependable capacity of the La Grange powerhouse is approximately 400 kW, corresponding to the lowest minimum flow required to be provided by the Don Pedro Project to the lower Tuolumne River of 50 cfs (see NMFS-1, Element 3a).

As a run-of-river facility with no significant active storage, the La Grange diversion dam plays no role in flood control on the Tuolumne River. All flows released to comply with

FERC flow requirements of the Don Pedro Project are scheduled at and made by controlled releases from Don Pedro Reservoir. Flows not diverted at La Grange diversion dam for the Districts' irrigation or M&I purposes are normally passed downstream through the La Grange powerhouse. If the powerhouse is out of service for maintenance purposes, flows pass the La Grange project over the spillway or through a sluice gate depending on amount of flow and real-time river and project conditions. Except for flows through the TID powerhouse and to the two canal systems, no other flow records at the La Grange facilities are normally collected or maintained.

4.0 General Description of Affected Environment in the Vicinity of the La Grange Project

This section provides a description of the existing physical and biological information available for the reach of the Tuolumne River extending from below Don Pedro Dam (circa RM 54) to the La Grange USGS gage at RM 51.7 near the town of La Grange, CA (see NMFS-1, Elements 3e through 3h). The Districts have previously provided to all relicensing participants involved in the Don Pedro relicensing a copy of their water rights, and this information continues to be publicly available on the Don Pedro relicensing website at www.donpedro-relicensing.com (see NMFS-1, Element 3d). Other than the Tuolumne River, there are no other perennial streams between RM 51.7 and Don Pedro Dam (see NMFS-1, Element 3c). Two small intermittent drainages enter the Tuolumne River about one mile above the La Grange diversion dam at approximately RM 53.3.

4.1 Flow and Water Temperature Information

Tuolumne River flow downstream of the Don Pedro Dam (Station DNP) is reported as reservoir outflow (cfs) by the California Data Exchange Center ("CDEC") website dating back to October 1993 (http://cdec.water.ca.gov).

Also available at the CDEC website are records of flow diverted into both the TID canal (Station TID) and MID canal (Station MID) at the La Grange diversion dam dating back to October 1997. Discharge downstream of the La Grange project is measured at the La Grange gage (USGS Station 11289650). Records of average daily discharge (cfs) dating back to October 1970 are available at the USGS website (http://nwis.waterdata.usgs.gov). Water temperature data recorded at this same station is recorded as daily minimum and maximum over the same period of record (Figure 5).

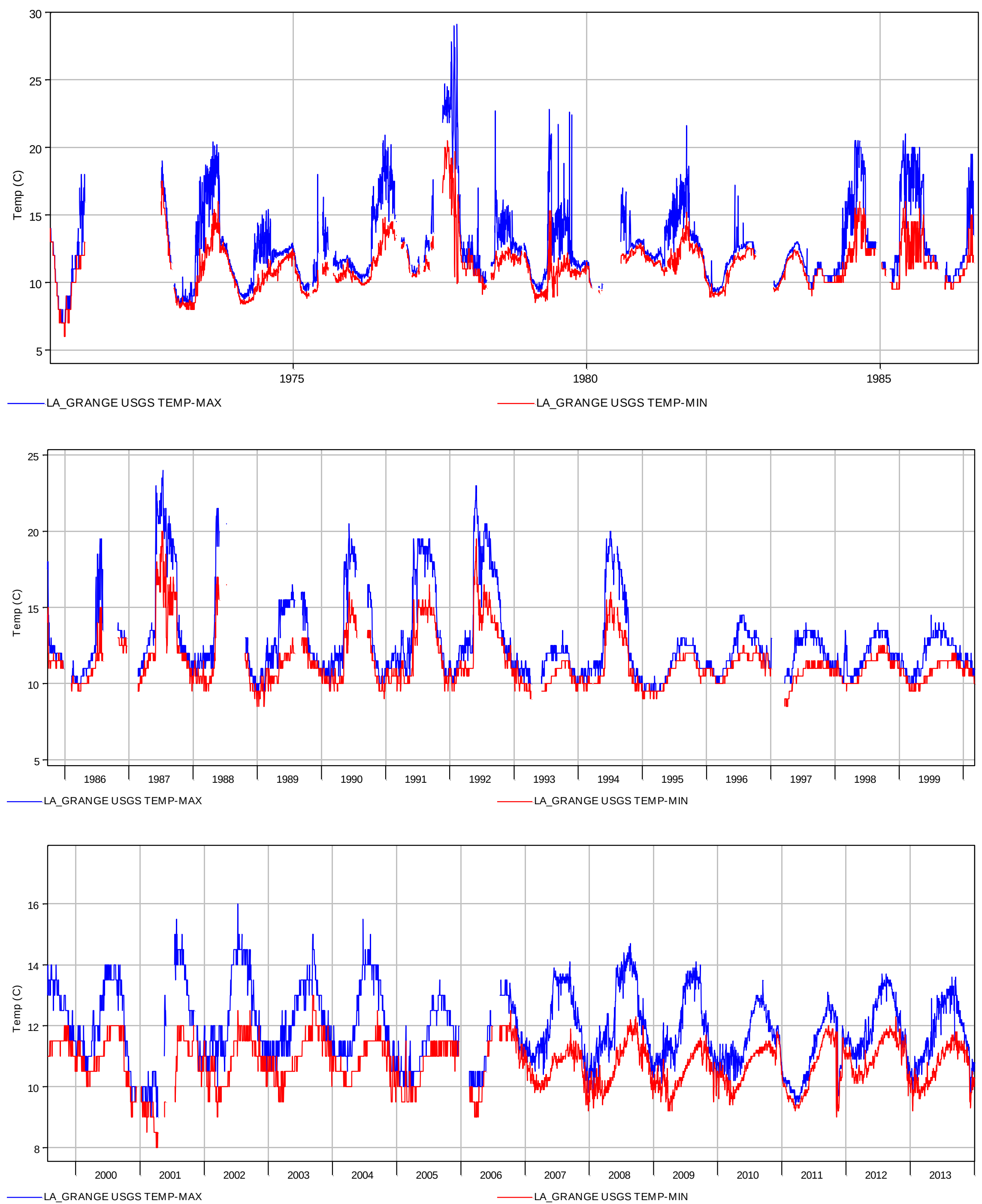


Figure 5. Daily minimum and maximum temperatures at USGS La Grange gage, 1971-2013.

4.2 Water Quality Information

Available water quality information (NMFS-1, Elements 3e and 3f) associated with the La Grange project is summarized in the PAD (TID/MID 2011) as well as the Don Pedro Water Quality Study (TID/MID 2013a, Study W&AR-01) at sampling sites below Don Pedro Reservoir (RM 54.6) and at the La Grange gage (RM 51.7). Water quality profile data collected as part of a mercury fish tissue assessment in the fall of 2008 indicates that water column conditions within the pool formed by the La Grange diversion dam are uniform with depth (Stillwater Sciences 2009a). Review of the information sources above show that water entering and exiting the La Grange development meets all applicable water quality objectives for designated beneficial uses under the Basin Plan (CVRWQCB 2011). The Districts' Pre-Application Document for Don Pedro Project (TID/MID 2011) also provides information on the designated beneficial uses of Hydro Unit 535, which encompasses the reach discussed in this report (see pg 3-22, Table 3.5.4-1, pgs 5-33 to 5-40, and Tables 5.2.1.10 and 5.2.1.11).

4.3 River Channel Geomorphology and Habitat Types

The Tuolumne River is confined by a steep bedrock valley comprised of shallow soils and rock outcrop between Twin Gulch (RM 53.2) and La Grange diversion dam (RM 52.2). Channel geometry and bathymetry (see NMFS-1, Element 3g) is characterized by channel depths of 2–10 feet within riverine habitats along the channel thalweg downstream of Twin Gulch, to 5–20 feet in the lacustrine habitats found upstream of La Grange diversion dam (TID/MID 2013a, Don Pedro Study W&AR-13). Twin Gulch (RM 53.2) was identified as being a major source of fine sediment during the January 1–2, 1997 flood event (McBain & Trush 2004). The gulch was estimated to be scoured down to bedrock as a result of the flood, with most of the suspended sediment passing over La Grange diversion dam and much of the coarse sediment trapped by the diversion dam. A bathymetry survey was performed by the Districts in 2012 and is provided in Attachment B to this report.

Downstream of La Grange diversion dam (RM 52.2), the Tuolumne River channel consists of a bedrock pool at the base of the dam extending to near the La Grange powerhouse at RM 52.0. LiDAR information collected in March 30, 2012 at a discharge of approximately 320 cfs was used in conjunction with in-channel bathymetry surveys to develop a longitudinal bed profile downstream of the La Grange diversion dam (TID/MID 2013a, Don Pedro Study W&AR-04). The depth of the plunge pool downstream of La Grange diversion dam is estimated to be approximately 14–18 feet.

Gravel deposits near the La Grange powerhouse tailrace have been mapped as two relatively small riffle areas near RM 51.9 and RM 51.7 (TID/MID 2013a, Don Pedro Study W&AR-04). These areas were both mapped in 1988, with the downstream area near RM 51.7 remapped in 2001 as part of ongoing studies related to Chinook salmon spawning habitat in the lower Tuolumne River (Table 3). The tailrace from the La

Grange powerhouse forms an eastern channel and enters the main channel near RM 51.9. A separate discussion of dewatering of the tailrace during 2008 is provided under Chinook salmon aquatic resources discussion for Chinook salmon below. Downstream of the tailrace channel, the main Tuolumne River channel becomes pool habitat extending to the small riffle area at RM 51.7 near the USGS gage.

Table 3. Gravel areas mapped near the La Grange tailrace, 1988 and 2001.

Mapped gravel areas (ft^2)	1988	2001
RM 51.9	7,603	--
RM 51.7	2,965	3,989

Fine sediment deposits downstream of La Grange diversion dam (RM 52.2) were mapped as discreet patches of fine bed material (FBM, <2 mm) deposited in one of six different geomorphic units: pool bottom, pool margin, other channel margin, alcove/backwater, side channel, and captured gravel pit (Table 4). The dominant surface texture along with the depth of the deposit was recorded for each patch.

Table 4. Fine sediment deposits mapped between the La Grange powerhouse and La Grange gage, 2012.

Fine bed material mapped in 2012	FBM deposit number	Texture	Average Depth (ft)	Area within 600 cfs (ft^2)	Area within 300 cfs (ft^2)
Pool margin at RM 51.9	2	Sand	1.0	976	693
Pool margin at RM 51.7	1	Sand	1.0	1,419	1,398
Pool margin at RM 51.7	3	Sand	1.9	4,068	2,583

A study focused on *O. mykiss* habitat distribution, abundance, and quality in the lower Tuolumne River emphasizing the availability of LWD was conducted in 2012 and showed no occurrence of LWD in habitats sampled within the Tuolumne River from La Grange diversion dam to the USGS gage (TID/MID 2013a, Don Pedro Study W&AR-12). Estimates of LWD trapped within the Don Pedro Reservoir were made as part of the study, but no data is available to determine how much of the LWD would deposit and persist in the lower Tuolumne River.

4.4 Description of Fish Communities and Aquatic Resources Upstream of La Grange Diversion Dam

Fish communities and aquatic resources (see NMFS-1, Element 3h) upstream of La Grange diversion dam include resident *O. mykiss* as well as prickly sculpin (*Cottus asper*) (TID/MID 2013a, Don Pedro Study W&AR-13). Although no ESA-listed species or designated critical habitat occur upstream of La Grange diversion dam, sampling was conducted within the portions of the TID and MID canal systems near La Grange to document the presence of resident *O. mykiss* that have been reported during annual inspections of the canal system by District employees (Stillwater Sciences 2004). Due to structural fish passage barriers that would prevent anadromous fish from reaching the canals from downstream, it is believed that these are resident *O. mykiss*. The presence of several age classes of *O. mykiss* in surveys upstream of La Grange diversion dam suggests that a self-sustaining population of rainbow trout exists in this reach (TID/MID 2013a, Don Pedro Study W&AR-13). The resident *O. mykiss* upstream of La Grange diversion dam may potentially recruit to the downstream population during high flow events that result in flow over La Grange diversion dam.

4.5 Description of Fish Communities and Aquatic Resources Downstream of La Grange Diversion Dam

Downstream of La Grange diversion dam, resident and anadromous fish communities and aquatic resources in the lower Tuolumne River have been extensively studied over the years as part of the Don Pedro Project (FERC No. 2299) and are summarized in the PAD (TID/MID 2011). The lower Tuolumne River is known to support Central Valley fall-run Chinook salmon. ESA-designated critical habitat for Central Valley steelhead occurs in the lower Tuolumne River within the area under consideration in this report downstream of La Grange diversion dam[2]. Surveys conducted in portions of the Tuolumne River upstream of the La Grange gage (RM 51.7) include annual Chinook spawning surveys conducted by CDFW since 2001, targeted snorkel surveys as part of *O. mykiss* monitoring conducted in 2008–2010 (Stillwater Sciences 2008, 2009b, 2011), as well as *O. mykiss* angling and scale collection surveys in 2012 (TID/MID 2013a, Don Pedro Study W&AR-20).

4.6 Chinook salmon

Under the Magnuson-Stevens Fishery Conservation and Management Act, essential fish habitat (EFH) is defined as those waters and substrate necessary to fish for spawning, breeding, feeding, or growth to maturity. Based upon the above information summaries as well as related Don Pedro relicensing studies conducted for habitats downstream of RM 51.7, Chinook salmon EFH between the La Grange diversion dam and the USGS La Grange gage is characterized by adequate depths, flows and water temperatures for spawning, incubation, juvenile rearing, and emigration.

Suitable substrate for Chinook salmon spawning in the riffle area near the La Grange powerhouse was mapped in 2012 (TID/MID 2013a, Don Pedro Study W&AR-04). Annual salmon spawning surveys have been conducted by CDFW in the lower Tuolumne River since 1971 to estimate total escapement and provide biological information pertaining to the run (TID/MID 2013a, Don Pedro Study W&AR-05). Chinook salmon

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[2] Critical habitat was designated for CV steelhead on September 2, 2005 (70 FR 52488). The designated critical habitat for CV steelhead in the Tuolumne River extends from La Grange diversion dam downstream to the confluence with the San Joaquin River and laterally to the edge of the bankfull channel.

spawning in the lower Tuolumne River typically begins in October and continues through December each year. Annual Chinook runs are typically comprised of two- to five-year-old fish, with three-year-old fish usually contributing the highest percentage of the run. The percentage of females in the 1971–2010 runs has ranged from 25% in 1983 to 67% in 1978 and 2005 (TID/MID 2013b, Report 2012-2). Beginning in 2001, CDFW spawning surveys included a foot survey of the riffle area downstream of the La Grange diversion dam near RM 51.9. Annual spawning survey reports produced by CDFW include an annual maximum redd count by riffle, summarized for the riffle area near the La Grange powerhouse in Table 5 below.

Table 5. Maximum Chinook salmon redd counts for the riffle area located near RM 51.9, 2001–2009.

Maximum redd counts recorded by CDFW at RM 51.9	2001	2002	2003	2004	2005	2006	2007	2008	2009
	7	7	1	10	5	6	4	7	1

Although CDFW annual reports do not report redd counts in the La Grange powerhouse tailrace channel and the adjacent riffle area at RM 51.9 separately, a forced outage of the La Grange powerhouse in 2008 resulted in the dewatering of isolated redds in the tailrace (TID/MID 2010, Report 2009-1). Because of the isolated occurrence of this incident and the fact that the Districts do not vary the discharge from La Grange powerhouse for power peaking, it is unlikely that redd dewatering incidents will occur in the future or otherwise contribute to direct Chinook salmon mortality (TID/MID 2013a, Don Pedro Study W&AR-05)[3]. Under current operations, if a forced outage of either or both units occurs, the adjacent automated sluice gates immediately open to pass flow downstream.

Although no other information specific to Chinook salmon within the vicinity of the La Grange project was identified, life history timing of Chinook salmon is similar to that found in other sub-reaches of the lower Tuolumne River downstream of the La Grange gage (TID/MID 2013a, Don Pedro Study W&AR-05). Following Chinook salmon egg incubation during early winter, fry emergence begins in January and typically peaks in mid-February (TID/MID 2013a, Don Pedro Study W&AR-05). Springtime juvenile rearing as well as smolt outmigration continues through May in most years, with over-summering of low numbers of juvenile Chinook salmon documented in annual snorkel surveys at locations downstream of the La Grange gage (RM 51.7).

4.7 Central Valley Steelhead

Based upon the above information summaries as well as related relicensing studies conducted for habitats downstream of RM 51.7, Central Valley steelhead habitat in the vicinity of the La Grange project is characterized by adequate depths, flows and water

[3] The Districts evaluated the historical occurrence of changes in river stage as part of NMFS-4, Element 4. This report is provided under separate cover in the USR document.

temperatures for spawning, incubation, juvenile rearing as well as smolt emigration. This is further discussed in the sections below.

Little information concerning Central Valley steelhead occurrence in the lower Tuolumne River exists beyond the low numbers of individuals analyzed by Zimmerman et al (2008) showing maternal anadromy. As such, there is no actual data or information regarding steelhead migration or spawning in the lower Tuolumne River. Based upon general life history timing of Central Valley steelhead, spawning in the Tuolumne River may potentially occur from December through April (TID/MID 2013a, Don Pedro Study W&AR-05). Although this is similar to redd construction timing for *O. mykiss* documented in 2012, no redds were found upstream of the La Grange gage in 2012/2013 surveys (TID/MID 2013a, TID/MID 2013c, Don Pedro Study W&AR-08). Water quantity and quality information discussed above, as well as documentation of substrate (TID/MID 2013a, TID/MID 2013c, Don Pedro Study W&AR-04), support the potential for *O. mykiss* spawning in the vicinity of the La Grange project.

Freshwater rearing sites for any Central Valley steelhead in the Tuolumne River are available in the vicinity of the La Grange project. Based upon general life history timing information for Central Valley steelhead (TID/MID 2013a, Don Pedro Study W&AR-05) as well as historical monitoring of juvenile *O. mykiss* in seine and RST monitoring (Ford and Kirihara 2010), peak *O. mykiss* fry emergence is typically seen during March and April in the Tuolumne River. Downstream of La Grange diversion dam, *O. mykiss* observations are limited to targeted sampling related to scale collection surveys in 2012 (TID/MID 2013a, Don Pedro Study W&AR-20) as well as snorkel survey data near the La Grange gage (Stillwater Sciences 2008, 2009b, 2011) (Table 6). Benthic macroinvertebrate (BMI) food resources (TID/MID 2011) as well as natural cover for rearing *O. mykiss* (TID/MID 2013a, Don Pedro Study W&AR-12) have been characterized for the lower Tuolumne River downstream of the La Grange gage.

Table 6. *O. mykiss* observations within the La Grange Project vicinity, 2008–2010.

O. mykiss observations	July 2008		July 2009		March 2010		August 201	
	< 150 mm	≥ 150 mm	< 150 mm	≥ 150 mm	< 150 mm	≥ 150 mm	< 150 mm	≥ 150 mm
Pool habitat near RM 51.8	0	5	0	14	1	1	0	6

The documented presence of rearing *O. mykiss* in snorkel surveys near the La Grange gage (Stillwater Sciences 2008, 2009b, 2011), as well as periodic RST captures of smolt sized *O. mykiss* between 1999–2009 (Ford and Kirihara 2010), suggests that flow and water temperature conditions for smolt emigration are provided during the general January–May smolt emigration period summarized from the Stanislaus River (TID/MID 2013a, Don Pedro Study W&AR-05). Water flow and temperature information discussed above, as well as information related to food resources, and other in-channel habitat assessments provided for downstream habitats are sufficient to characterize primary constituent elements of Critical Habitat for any Central Valley steelhead emigrating from habitats in the vicinity of the La Grange project.

5.0 Resource Impacts of the La Grange Project

NMFS-1, Element 6, requested that the Districts provide a description of "known or potential adverse impacts to anadromous fishes associated with the construction, operation or maintenance" of the La Grange facilities, including cumulative impacts. FERC's May 2013 Determination directed the Districts to provide this assessment using existing information.

5.1 Construction-Related Impacts

The La Grange facilities were originally constructed between 1891 and 1893. Changes to the spillway were made in 1923 and 1930. The Districts were not able to locate any existing information about actual or potential construction-related impacts. As La Grange diversion dam replaced Wheaton Dam built in the 1870s, the construction of La Grange diversion dam did not result in any incremental impacts to the upstream or downstream migration of salmon or *O.mykiss.* According to newspaper reports at the time as reported in Paterson (2004), Wheaton Dam prevented the upstream migration of salmon.

5.2 O&M-Related Impacts

Aside from the single incident identified above in Section 4.6, there are no known direct impacts to anadromous fish due to the operation and maintenance of the La Grange project. La Grange diversion dam does act as a barrier to the upstream migration of anadromous fish to the reach between the La Grange diversion dam and Don Pedro Dam. Habitat suitability of the La Grange impoundment to support Chinook or *O.mykiss* life stages is unknown. Impoundments are generally not suitable habitat for Chinook or *O.mykiss* spawning; however, as noted above, recent studies found multiple year classes of *O.mykiss* in the reach between La Grange diversion dam and Don Pedro Dam.

The La Grange project passes flow released at Don Pedro intended to meet Don Pedro minimum flows required by its FERC license. The diversion of water out of the Tuolumne River potentially contributes to direct and/or cumulative effects to anadromous fish below the La Grange tailrace. MID and TID diversions create a bypassed reach between La Grange diversion dam and the La Grange tailrace. MID passes 25 cfs through its abandoned headwater canal to this bypass reach. There is no existing information on impacts due to this operation. As discussed above, adequate conditions to support life stages of Chinook salmon and *O.mykiss* exist in the vicinity of the La Grange project. Temperature data collected as part of the Don Pedro relicensing indicate that the La Grange project has little effect on water temperature and there is no evidence that La Grange pool thermally stratifies.

5.3 Description of Existing or Proposed Actions to Protect and Enhance Anadromous Fish

The La Grange project diverts Tuolumne River flows for the beneficial use of irrigation and M&I purposes. Flows greater than those needed for irrigation and M&I purposes are passed downstream. The Districts pass approximately 25 cfs through the MID abandoned main canal to the bypass reach and this may potentially protect salmon or *O.mykiss* that enter the pool immediately below La Grange diversion dam. The Districts are not planning any changes to La Grange diversion dam that might adversely or beneficially affect Chinook salmon or *O.mykiss* in the vicinity of the La Grange project or the lower Tuolumne River below the USGS La Grange gage.

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Stillwater Sciences. 2009b. March and July 2009 population size estimates of Oncorhynchus mykiss in the lower Tuolumne River. Prepared by Stillwater Sciences, Berkeley, California for Turlock Irrigation District and Modesto Irrigation District.

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Turlock Irrigation District and Modesto Irrigation District (TID/MID) 2010. 2009 Lower Tuolumne River Annual Report. Report 2009-1. 2009 Spawning Survey Report. Turlock Irrigation District and Modesto Irrigation District. March 2010.

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TID/MID 2013b. 2012 Lower Tuolumne River Annual Report. Report 2012-2. 2012 Spawning Survey Summary Update. Turlock Irrigation District and Modesto Irrigation District. March 2013.

TID/MID 2013c. Updated Study Report. Pedro Project, FERC No. 2299. January 2014.

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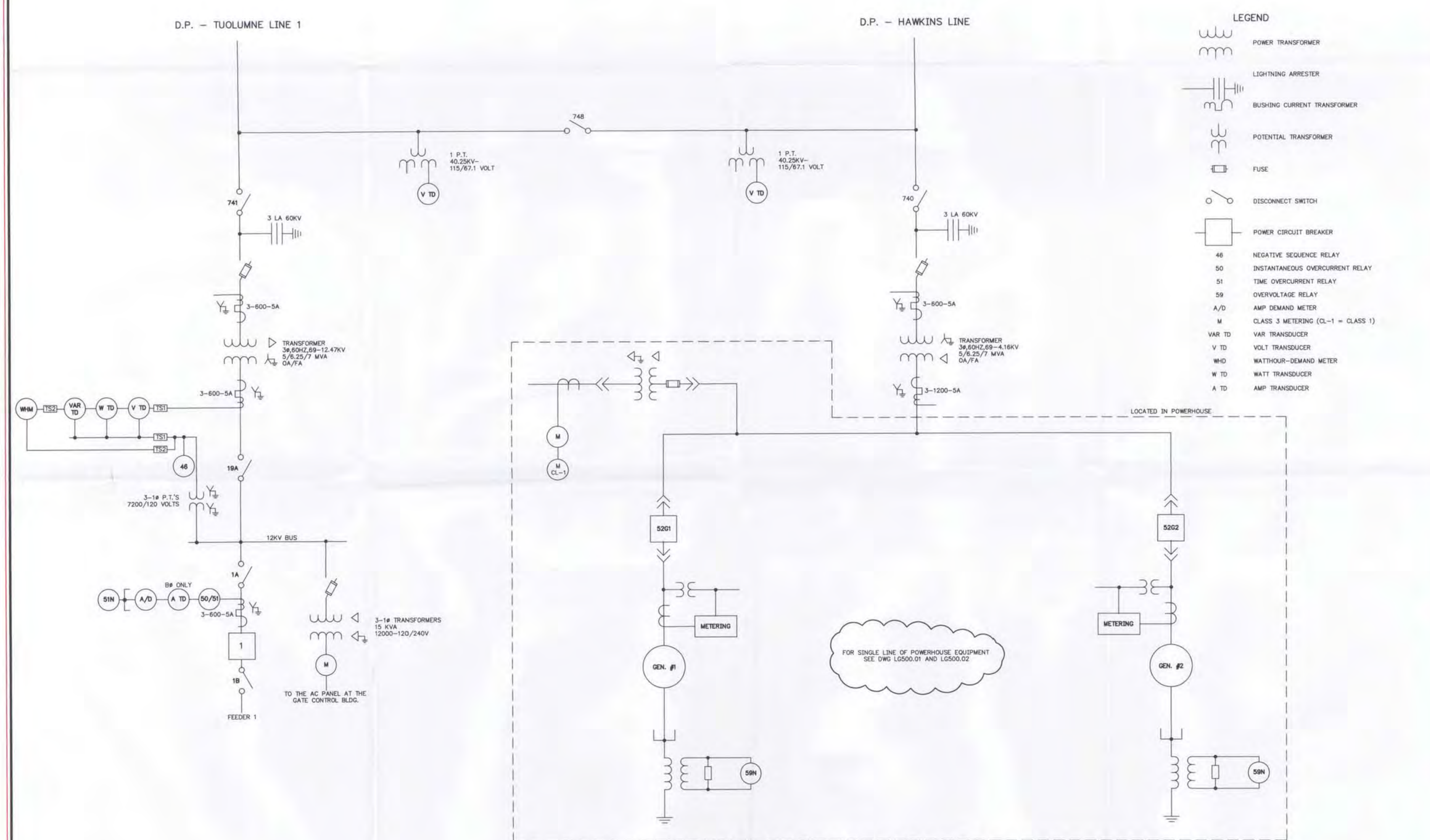
ATTACHMENT A

Single Line Diagram



20111012-0038

REV	DATE	DESCRIPTION	DR	CHK	APP
01	04/05/1993	AS BUILT	CH	CH	RA
02	03/02/1999	CHANGED DRAWING REFERENCES	ELJ	ELJ	CH

DRAWN: CH 03/23/1988
CHECKED:
REVIEWED:
REVIEWED: RCB 12/09/1989
APPROVED: RA 12/09/1989

TURLOCK IRRIGATION DISTRICT — TID

ENGINEERING ADMINISTRATION

LA GRANGE POWER PLANT

SINGLE LINE DIAGRAM 69KV AND 12KV

SCALE: NONE
SHEET: 1 OF: 1
REV DATE: 03/03/1999
DWG #LG500
REV 02

ATTACHMENT B

2012 Bathymetry Survey

GENERAL NOTES

(1) BATHYMETRIC DATA IS FROM A SURVEY CONDUCTED BY MERIDIAN SURVEYING ENGINEERING, INC. ON SEPTEMBER 12 AND 13, 2011 THIS REPRESENTS THE RIVER BOTTOM CONDITIONS ON THAT DATE.

(2) A TRIMBLE R8 REAL–TIME KINEMATIC GPS RECEIVER, AN INNERSPACE 455 ECHOSOUNDER WITH A SINGLE FREQUENCY TRANSDUCER AT 200 KHZ WERE USED FOR RIVER BOTTOM. A HYDROLITE ECHOSOUNDER WITH A SINGLE FREQUENCY TRANSDUCER WAS ASLO USED.

(3) THE CONTOURS SHOWN ARE INTERPOLATED FROM A 3 DIMENSIONAL MODEL CREATED FROM THE TRUE SOUNDINGS.

(4) SHORELINE CONTOURS PROVIDE BY TID.

BASIS OF COORIDATES AND ELEVATION

SURVEY WAS BASED ON TID POINT 102

ELEVATION OF THE RIVER SURFACE AT THE TIME OF SURVEY

DATE	TIME	ELEVATION
09/12/11	13:09	301.4'
09/13/11	11:05	298.4'
09/13/11	15:37	296.6'

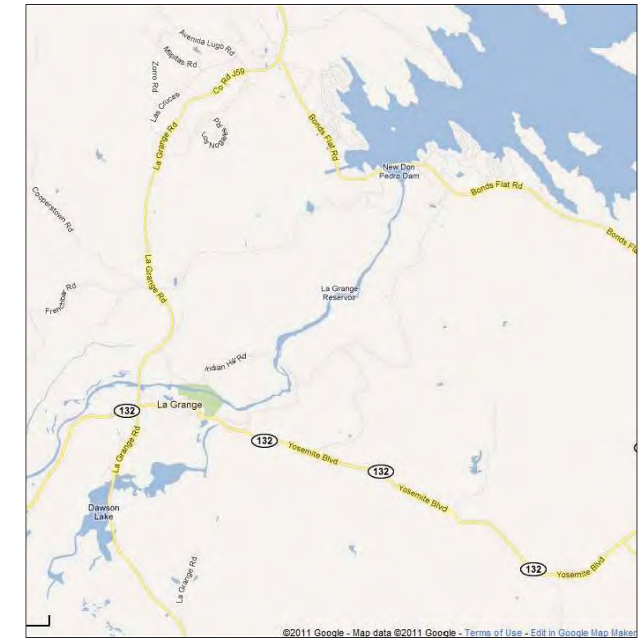
MATCHLINE – SEE BELOW MIDDLE

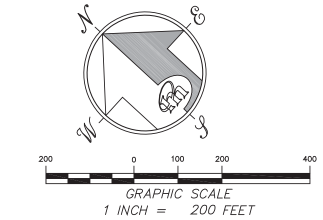
MATCHLINE – SEE BELOW RIGHT

MATCHLINE – SEE ABOVE LEFT

MATCHLINE – SEE ABOVE MIDDLE

VICINITY MAP





LEGEND

N.T.S. NOT TO SCALE
TID TURLOCK IRRIGATION DISTRICT

CONTOUR INTERVAL: 2 FEET

PRELIMINARY RESULTS

HYDROGRAPHIC SURVEY

TOULUMNE RIVER
SECTION 16, 9 AND 10
TOWNSHIP 4 SOUTH
RANGE 14 EAST

PREPARED AT THE REQUEST OF
TID

TOULUMNE/STANISLAUS CO. CALIFORNIA
SEPTEMBER 2011

MERIDIAN SURVEYING ENGINEERING, INC.
1812 UNION STREET, SAN FRANCISCO 94123, (415) 440-4131
777 GRAND AVENUE, #202, SAN RAFAEL, CA 94901, (415) 456-5450

SURVEY BY:	STG/GTI/NDF	REVISION DATE:	08/15/11
DRAWN:	NDF	PROJ. NO.:	11092
APPROVED:	STG	SHEET 1 OF 1	
FILE NAME:	11092		
SURVEY DATE:			

Districts' Response to NMFS-4, Element 1 through 6
Effects of Don Pedro Project and Related Facilities on Hydrology for Anadromous Fish:
Magnitude, Timing, Duration, and Rate of Change

1.0 Background

On June 10, 2011, the National Marine Fisheries Service ("NMFS") filed a number of requests for studies in connection with the relicensing of the Don Pedro Project (FERC No. 2299). NMFS Study Request 4 ("NMFS-4") contained six subsections, referred to as "elements." Specifically, these requests related to information on the effects of the project hydrology on anadromous fish. The six elements are listed below.

- Element #1: Data development and statistical analysis;
- Element #2: Additional analysis of Tuolumne River below La Grange Dam (USGS #11289650);
- Element #3: Peak flow analysis;
- Element #4: Rate of stage change analysis;
- Element #5: Quantify lower Tuolumne flow accretion and depletion; and
- Element #6: Evaluate potential to increase lower Tuolumne River flood capacity.

In the Study Plan Determination ("SPD") issued December 22, 2011, FERC staff noted that Turlock Irrigation District ("TID") and Modesto Irrigation District ("MID") (collectively, the "Districts") had agreed to provide substantially all of the information requested by NMFS in NMFS-4, Elements 2 through 6. With regard to Element 1, FERC staff stated that the NMFS request for the Districts to provide flow statistics for either a "partially unimpaired flow scenario" or a "full unimpaired flow simulation" was not necessary to evaluate Project effects and therefore was not required. NMFS and other agencies subsequently filed a Notice of Study Dispute on January 11, 2012, contesting parts of FERC's SPD. FERC convened a Dispute Resolution Panel which filed its findings on May 4, 2012, and on May 24, 2012, FERC issued the Director's Study Dispute Determination.

As part of the Dispute Determination, FERC directed the Districts to undertake the following work related to NMFS-4:

- Using the Workshop Consultation protocols, finalize the number and location of the accretion/depletion measurements in the lower Tuolumne River (NMFS-4, Element 5);

- Using the Workshop Consultation process, generate the statistics requested by Element 1; provide discharge information from the resulting W&AR-02: Operations Model report for the five flow paths available at the La Grange development; provide NMFS-4, Element 3 peak flow analysis for the "base case"; and perform the analysis needed to meet the NMFS-4, Element 4 rate of change analysis.

All of the requested information in NMFS-4 involved hydrology and hydrologic analysis. Project hydrology was a prominent part of the W&AR-02: Operations Modeling study plan that was carried out in accordance with the Consultation Workshop protocols. As directed by FERC, the details of developing a consensus on the exact information needed to address the NMFS-4 requests and the methods to be employed were left to be discussed, decided, and documented through the Consultation Workshop process. The Districts issued a draft Consultation Workshop protocol on March 5, 2012, and conducted a workshop with relicensing participants on March 20, 2012, to review and discuss the proposed Workshop protocols. NMFS did not participate in the March 20th workshop. At the March 20, 2012 workshop, relicensing participants recommended that action items resulting from each Workshop be included in the meeting notes and reviewed during subsequent meetings. The Districts modified the protocols to reflect these changes. Additional time was provided for relicensing participants to comment further on the protocols following the March 20th meeting. No further comments were received and the Districts filed the amended Consultation Workshop protocols with FERC as final on May 18, 2012.

The Districts proceeded to conduct a series of Workshops in accordance with Workshop protocols in conjunction with W&AR-02: Operations Modeling. The first Workshop was held on April 9, 2012, with the specific title of "Hydrology Workshop". Issues related to the development of the appropriate hydrology for the Operations Model were the topic of discussion. Also discussed was the schedule and approach to obtaining accretion/depletion flow measurements (see NMFS-4, Element 5). NMFS did not participate in the Workshop. The second Workshop was held on September 21, 2012, to discuss the results of the first set of accretion measurements and to discuss the details of the various hydrologic analyses required by NMFS-4, Elements 1 through 4 (see Workshop Agenda provided as Attachment 1). NMFS participated in the Workshop. Substantial agreement was reached on the scope and methods to be used for all of the NMFS-requested analyses, except for the rate of stage change assessment (NMFS-4, Element 4). NMFS agreed to provide to the Districts specific subdivisions of flow ranges to be evaluated. Workshop meeting notes were circulated that identified all Action Items from the Workshop. No further breakdown of flow ranges for the rate of stage change was provided by NMFS; therefore, the Districts have attempted to break down the flow ranges as appropriate to the purpose of the analysis. In total, the Districts conducted five Workshops dedicated to the Operations Modeling study, which included the topics of hydrology development and hydrologic analyses, accretion flow measurement and estimation, and overall Don Pedro project operations. NMFS did not participate in subsequent W&AR-02 Workshops.

The Districts filed their Initial Study Report (ISR) on January 16, 2013, and held an ISR Meeting on January 30 and 31, 2013. The ISR contained a report on Operations Modeling and a section that identified existing hydrology information applicable to the reach of the Tuolumne River from La Grange diversion dam to USGS Gage No. 11289650. In the same section of the ISR, the Districts also provided an analysis of the hydrologic effects of the La Grange project operations on flows in the Tuolumne River between La Grange diversion dam and USGS Gage No. 11289650.

On March 11, 2013, NMFS filed comments on the Districts' ISR. No comments were received from NMFS related to NMFS-4.

2.0 Response to NMFS-4, Element 1

In accordance with the request contained in NMFS-4, Element 1, FERC's December 21, 2011 SPD, and the results of discussions and presentations in the various Consultation Workshops, the Districts have completed various statistical analyses of project hydrology for the "base case" scenario developed in the W&AR-02: Operations Modeling. As requested in NMFS-4, Element 1, these analyses include:

- average, maximum and minimum monthly flows for the period of record used in the Operations Model and by water year type;
- average and monthly flow duration curves for the period of record and by water year type;
- average annual flow;
- 1-, 3-, and 7-day maximum-mean daily flow for all years;
- 1-, 3-, and 7-day minimum-mean daily flow for all years;
- Julian Date and magnitude of annual maximum daily flow; and
- Julian date and magnitude of annual minimum daily flow.

As further agreed during the Consultation Workshops, the Districts are providing this information for the following locations:

- Tuolumne River inflow to Don Pedro Reservoir;
- Tuolumne River above La Grange diversion dam;
- Turlock Canal near La Grange diversion dam;
- Modesto Canal near La Grange diversion dam;
- Tuolumne River below La Grange diversion dam; and
- Tuolumne River at Modesto.

Using the hydrology developed for the "base case" Operations Model, the Districts have developed a spreadsheet containing all of the requested information. Attachment 2 to this report contains plots and tables addressing NMFS-4, Element 1. A "live" spreadsheet is available upon request.

3.0 Response to NMFS-4, Element 2

By this request, NMFS was seeking additional information about how the flows recorded at the La Grange gage are passed at the La Grange development. As NMFS stated, flow arriving at the

USGS La Grange gage "has a multitude of potential conduits to be released from" the La Grange development. Therefore, NMFS study request "seeks to partition the flow recorded at the Tuolumne River below La Grange diversion dam near La Grange CA gage" into "four potential conduits for flow", consisting of (1) the La Grange powerhouse; (2) the MID canal "spillway"; (3) TID canal "spillway", and (4) La Grange diversion dam spillway. The Districts subsequently provided through the Consultation Workshop process information on the available records of flow at the various La Grange discharge points. FERC directed the Districts to provide such information to the extent it was available. The various locations that flow can be passed at the La Grange diversion dam and the records associated with each are discussed in the following sections.

3.1 General Operational Procedures for Passing Flows at La Grange Project

Generally speaking, it is the preference of TID, which acts as the managing operator of the La Grange development, to first pass downstream flows through the La Grange powerhouse up to its two-unit hydraulic capacity of roughly 550 cfs to 575 cfs (flow capacity will vary with available head). Records of flow through the La Grange powerhouse are generally available. However, normal operations at the La Grange development also include the passing of 25 cfs through the historical MID canal headworks (the upper section is no longer used for irrigation/M&I flows) to the plunge pool below La Grange spillway. There are no records collected or maintained for this flow, but personal communications with TID and MID operations staff confirm that this flow passage route is normally open year-round and is estimated to be about 25 cfs. The two sluice gates adjacent to the TID penstock intakes can pass approximately 550 cfs. These are normally closed, except when the TID powerhouse is off-line for maintenance or when flows passing downstream exceed the hydraulic capacity of the powerhouse. Records of sluice gate openings are intermittently available since 2004 on TID's computer database; however, flows are not available. The old MID canal headworks, no longer in use for irrigation and M&I deliveries, can still pass approximately 350 cfs to the river below the La Grange diversion dam, and may be used to do so when flows will exceed the powerhouse capacity. No records are available for these discharges. There is also a slide gate located in the face of the La Grange spillway. This gate can pass a maximum of about 200 cfs and is used when repairs are being made on the spillway or during high flow events. No records are kept of the flows from this gate.

3.2 Flows in the Lower Tuolumne River

Lacking actual flow records of discharges from each of the various gates, it is only possible to draw general inferences about the points of flow passage at the La Grange project. The "partitioning" of flows recorded at the La Grange gage can be considered as the following based upon general operational procedures at the La Grange project:

- Flows less than 75 cfs at the gage (this amount of flow is exceeded at the La Grange gage 99 percent of the time since 1997): 50 cfs from the TID powerhouse and 25 cfs from the MID canal headworks;

- Flows from 75 cfs to 600 cfs at the gage: 25 cfs from MID headworks, remainder from the TID powerhouse;
- Flows from 600 cfs to 1,150 cfs at the gage: 25 cfs from the MID canal headworks, 575 cfs from the TID powerhouse, and the remainder from the two TID sluice gates;
- Flows from 1,150 cfs to 1,400 cfs at the gage: 550 cfs from the TID powerhouse (tailwater levels are rising), 550 cfs from the two TID sluice gates, 300 cfs from the old MID canal headworks;
- Flows from 1,400 cfs to 1,600 cfs at the gage: 550 cfs from the TID powerhouse (tailwater levels are rising), 550 cfs from the two TID sluice gates, 300 cfs from the MID canal headworks, and 200 cfs from the slide gate in the spillway.

At flows above 1,600 cfs, water would start to be discharged over the La Grange spillway, assuming all the other facilities are in use. Actual decisions about which facilities are used are based on real-time information on facility condition and river conditions.

4.0 Response to NMFS-4, Element 3: Peak Flow Analysis

NMFS-4, Element 3, requested a peak flow analysis, also known as a flood flow-frequency analysis, using Bulletin 17B methods from the Interagency Advisory Committee on Water Data (1982) for three flow scenarios and eight locations. The NMFS request specified that records of daily average flow rates be converted to instantaneous peaks using the MOVE equations presented in the California regional skew document (Parrett et al. 2011).

Flood frequency analysis is a way of summarizing and extrapolating historical information on the probability and magnitude of flood flows at a given location. The analysis consists of annual peak instantaneous flow estimates from a streamflow gage, regional flood characteristics (regional skew), and a Log-Pearson Type III fitting and extrapolation of the peak flow data. When instantaneous peak flow data are limited, various statistical techniques such as MOVE can be employed to develop a relationship between the annual maximum daily average flow to instantaneous peak annual flow. However, Bulletin 17B flood frequency analysis is not applicable to streams with more than a small fraction of flow regulation, and is therefore not applicable to the USGS La Grange gage records.

Some methods have been developed for flood frequency analysis of regulated systems; however, there are no widely accepted or industry standard scientific methods for conducting such an analysis. The shape of a regulated frequency curve varies based on storm duration, spillway capacity, operational decisions, reservoir surface area-volume relationships, and the frequency of peak inflows (Ergish 2010). To develop estimates of flood frequency applicable to instantaneous flows, the only applicable flow scenario from the NMFS-4 request would be the "fully unimpaired" scenario, and the only applicable sites are Dry Creek at Modesto, and estimated unimpaired flow at La Grange.

4.1 Analysis of Peak Flow

Flood frequency analysis has already been completed by USGS for both of the applicable sites in the NMFS-4 request (Parrett et al. 2011). The flood frequency analysis for Dry Creek at Modesto was extended using instantaneous data from the California Water Data Library from water years 1989 through 2013. The impact of extending the period of record for this gage resulted in a slightly increased flood frequency curve compared to the results from Parrett et al.

The gage designation for Tuolumne River above La Grange (11288099) has been changed, from ending in 00 to ending in 99 to indicate that it is a simulated unimpaired relationship with the Mokelumne River (11323599) that was used to extend its period of record and convert annual maximum daily average flow to peak flow. Table 4-1 shows the flood frequency results, and Figures 4-1 and 4-2 show the flood frequency results in graphical form for the Tuolumne River and Dry Creek respectively.

Table 4-1. Flood frequency results for selected sites.

Station number	Station name	Period of historic record (water years)	Annual peak flow, in thousand cubic feet per second, for recurrence interval, in years, and annual exceedance probability, in percent							
			2	5	10	25	50	100	200	500
			50	20	10	4	2	1	0.5	0.2
11288099	TUOLUMNE R AB LA GRANGE DAM NR LA GRANGE CA	1862-2006	21.7	41.2	58.8	87.4	114	146	183	244
11289950 AND DCM	DRY C NR MODESTO CA (USGS & WDL)	1939-73, 1989-2013	1.85	3.72	5.12	6.53	8.38	9.78	11.2	13.0

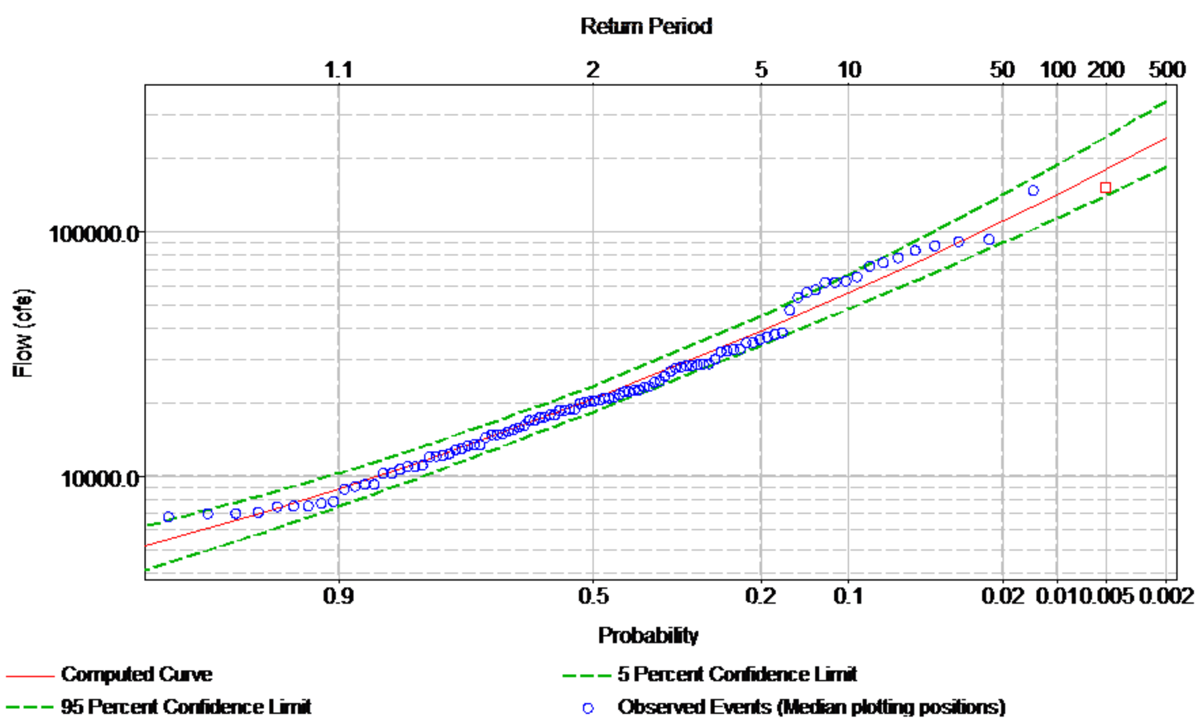


Figure 4-1. Flood frequency for Tuolumne River above La Grange, unimpaired.

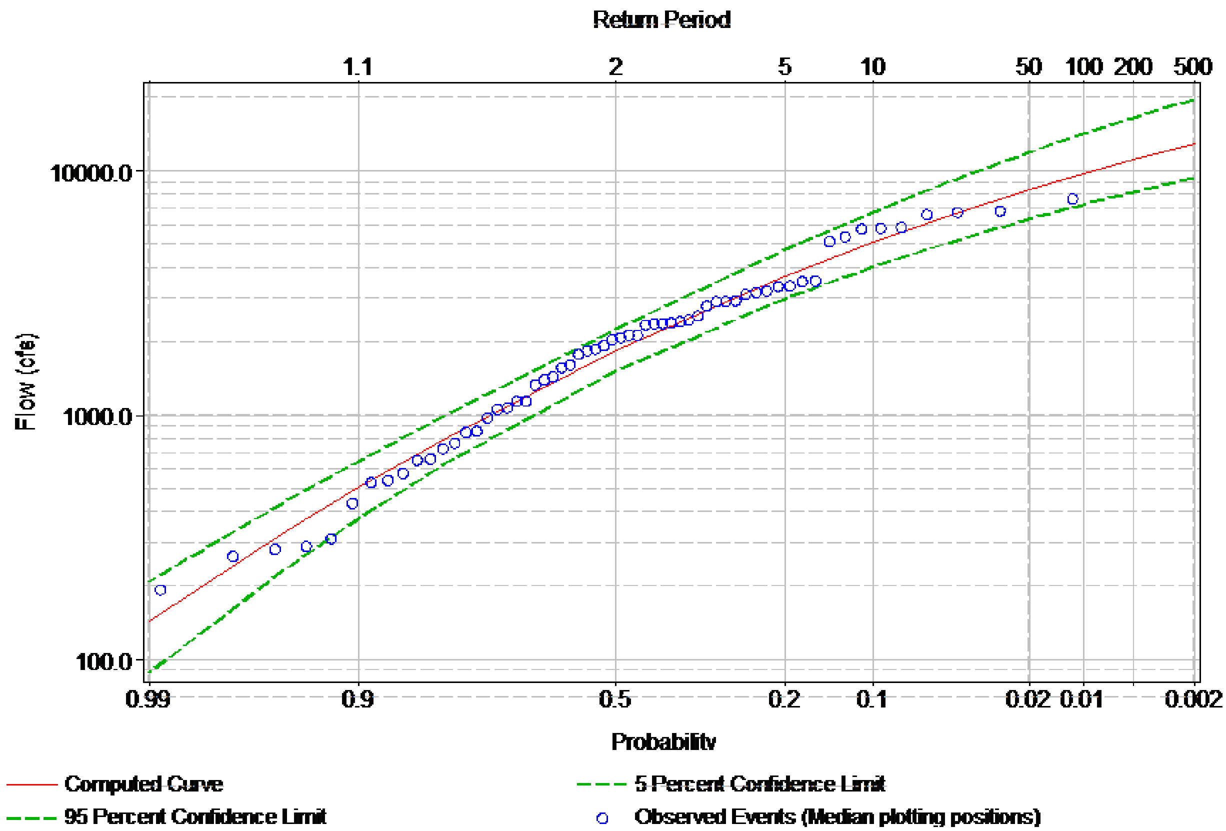


Figure 4-2. Flood frequency for Dry Creek near Modesto.

4.3 References

Ergish, Natalie J., 2010, Flood Frequency Analysis for Regulated Watersheds, Masters Thesis, University of California, Davis. 40p. Available at http://cee.engr.ucdavis.edu/faculty/lund/students/ErgishThesis.pdf

Interagency Advisory Committee on Water Data, 1982, Guidelines for determining flood-flow frequency, Bulletin #17B of the Hydrology Subcommittee: Office of Water Data Coordination, U.S. U.S. Geological Survey, 183 p. Available at http://water.usgs.gov/osw/bulletin17b/dl_flow.pdf.

Parrett, Charles, Veilleux, Andrea, Stedinger J.R., Barth, N.A., Knifong, D.L, Ferris, J.C., 2011, Regional Skew for California and Flood Frequency for Selected Sites in the Sacramento-San Joaquin River Basin Based on Data through Water Year 2006: U.S. Geological Survey Scientific Investigations Report 2010–5260, 94 p.

5.0 Response to NMFS-4, Element 4: Rate of Stage Change Analysis

In NMFS-4, Element 4, NMFS requested an analysis of the rate of stage change that has occurred historically at the Tuolumne River below La Grange gage (USGS 11289650) located about 0.2 miles below the La Grange tailrace. In the request, NMFS indicated it was seeking an analysis of stage changes at the gage based on both 15 minute and rolling one hour time intervals using the 15-minute data available from the USGS records. NMFS requested that the results be summarized in histogram and exceedance plot form, and the largest rate of stage changes be summarized in a table. NMFS had indicated during Consultation Workshop No. 2 that it would provide the flow/stage ranges to be selected (e.g., using starting stages between 1 ft and 1.25 ft; 1.25 and 1.5 ft; etc.) No further direction from NMFS was forthcoming; therefore, the Districts have used their judgment in this matter.

The request is herein fulfilled in its entirety with one exception. The 15-minute data for the full project period of record (WY 1971-2012) is not available from USGS. Therefore, this analysis focuses on the period of the current FERC license conditions, from 1997 to 2013.

5.1 Analysis of Stage Changes

The original stage recordings are not available from the USGS. However, the 15-minute flow data was converted back into stage by using the latest rating curve available from the USGS (Figure 5-1). While this may not result in the exact recorded stage, the magnitude of stage changes will be valid assuming the gage cross-section hasn't had significant changes in overall shape.

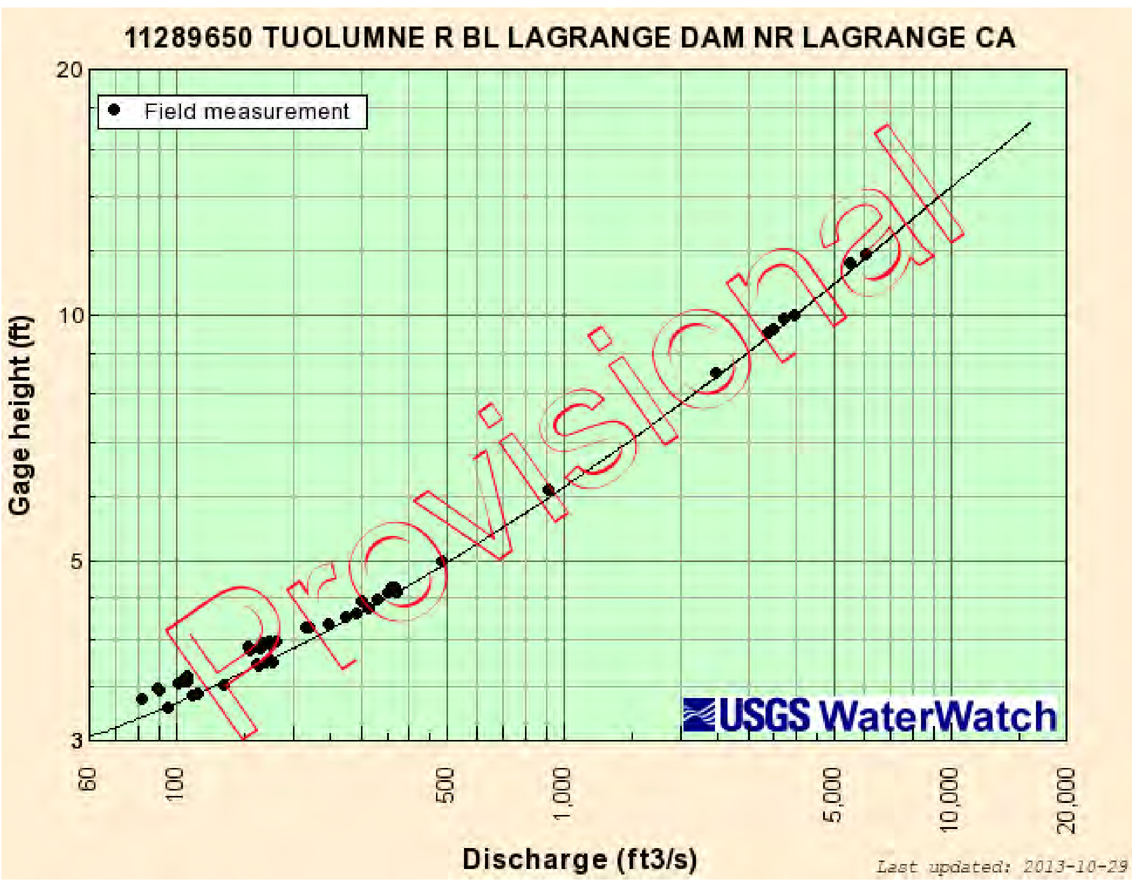


Figure 5-1. Rating curve for Tuolumne River below La Grange gage.

The gage rating only goes to 16,000 cfs without extrapolation, so the period of analysis did not start until the 1997 storm dropped below 16,000 cfs on Jan 9th, 1997, at 1300 hours, and the analysis is continuous from then until June 17, 2013 at 0800, which amounts to over 16 years, or about 6,000 days of analysis.

The largest stage change events were examined manually by TID to determine a cause for the change, when records were available to help determine such a cause. For single time step jumps in the flow data, the cause was suspected to be gage error.

5.2 Discussion of Results

The stage change in fifteen minutes is less than two inches (0.17 ft.) up or down 99.4% of the time, less than four inches (0.33 ft.) 99.9% of the time, and less than eight inches (0.67 ft.) 99.99% of the time. One hour stage change is less than two inches up or down 96.6% of the time, less than four inches 99.0% of the time, and less than eight inches 99.8% of the time. Tables 5-1 and 5-2 summarize the ten largest 15-minute and 1-hour stage change events respectively. Most of the largest stage changes were related to flood control operations at the Don Pedro Project, especially the 1997 flood event when river flows were very high.

Table 5-1. Ten largest fifteen minute stage changes (negative denotes a drop in stage).

Change (ft)	Julian Day	Date and Time	Cause of Stage Change
-1.92	98	09Apr1999 1145	Suspected Gage Error
1.91	98	09Apr1999 1200	Suspected Gage Error
-1.84	17	18Jan1997 0830	Flood Control Operations
1.75	17	18Jan1997 0900	Flood Control Operations
-1.73	16	17Jan1997 1530	Flood Control Operations
1.59	16	17Jan1997 1600	Flood Control Operations
-1.56	18	19Jan1997 0830	Flood Control Operations
-1.51	17	18Jan1997 1530	Flood Control Operations
1.41	38	09Feb1999 0000	Flood Control Operations – increased flow to keep Don Pedro below 801.9 ft
1.29	18	19Jan1997 0900	Flood Control Operations

Table 5-2. Ten largest one hour stage changes (negative denotes a drop in stage).

Change (ft)	Julian Day	Date and Time	Cause of Stage Change
2.82	17	18Jan1997 0900	Flood Control Operations
-2.89	17	18Jan1997 0800	Flood Control Operations
-2.57	16	17Jan1997 1500	Flood Control Operations
2.43	16	17Jan1997 1600	Flood Control Operations
2.42	104	15Apr1997 0645	Pre-Flood Releases
2.31	86	28Mar1999 2015	La Grange tripped offline
-2.23	16	17Jan1997 0800	Flood Control Operations
2.22	246	04Sep1998 1045	Pre-Flood Releases

Change (ft)	Julian Day	Date and Time	Cause of Stage Change
2.12	15	16Jan1998 0100	Pre-Flood Releases
2.11	16	17Jan1997 0900	Flood Control Operations

NMFS also requested that the largest stage change of each water year be identified. The summaries provided in Tables 5-3 and 5-4 are by calendar year for 15-minute and 1-hour stage changes, respectively. Because stage change direction was not specified in the NMFS request, the largest magnitude stage changes both up and down are shown for each year. In addition to flood control operations, stage changes can also occur due to La Grange generation unit outages, normal fish-related pulse flow requirements, or rapid flow adjustments to remain under 9,000 cfs at the 9th St. Modesto Gage (USGS 11290000) in response to rapid changes in natural Dry Creek flows.

Table 5-3. Largest fifteen minute stage changes up and down each year (negative denotes a drop in stage).

Change (ft)	Julian Day	Date and Time	Cause of Stage Change
1.75	17	18Jan1997 0900	Flood Control Operations
-1.84		18Jan1997 0830	
0.92	246	04Sep1998 1115	Flood Control Operations – Don Pedro releases increased to get reservoir down before commencing the 45 day minimum flow period
-0.65	53	23Feb1998 0715	Don Pedro flow decreased to keep 9,000 cfs @ Modesto requirement
1.91	98	09Apr1999 1200	Suspected Gage Error
-1.92		09Apr1999 1145	
1.08	44	14Feb2000 1030	Flood Control Operations - Releases increased to keep reservoir below 801.9
-0.71	302	29Oct2000 1200	Unknown
0.76	128	09May2001 1130	Unknown
-0.81		09May2001 1030	
0.88	342	09Dec2002 1100	La Grange Unit 1 tripped offline – sluice gate opens resulting in increased flow to compensate for unit loss
-0.53	121	02May2002 1845	Suspected Gage Error
0.91	272	30Sep2003 1330	Unknown
-0.82	106	17Apr2003 1615	La Grange Unit 2 Tripped offline
0.76	65	06Mar2004 0830	Pre-Flood Releases
-0.62	357	23Dec2004 2215	Suspected Gage Error
0.84	261	19Sep2005 0945	Suspected Gage Error
-0.85		19Sep2005 1000	
0.59	169	19Jun2006 0800	Flood Control Operations – old MID canal headworks gate brought online
-0.73	92	03Apr2006 1945	9,000 cfs requirement - Dry Creek went from 274 cfs to 5,068 cfs
0.64	251	09Sep2007 0230	Unknown
-0.36	339	06Dec2007 1730	Suspected Gage Error

Change (ft)	Julian Day	Date and Time	Cause of Stage Change
0.60	111	21Apr2008 1445	Unknown
-0.35		21Apr2008 1245	
0.54	106	17Apr2009 1415	Normal Increase for fish-related pulse flow requirement
-0.21	142	23May2009 0815	Unknown
0.51	181	01Jul2010 0930	Normal pre-flood release operations; sluice gate opened
-0.42		01Jul2010 0615	
0.70	261	19Sep2011 1100	Unit 2 tripped offline; sluice gate opens to compensate
-0.65	82	24Mar2011 2100	9,000 cfs requirement - Dry Creek went from 117 cfs to 3,510 cfs
0.65	120	30Apr2012 2115	Normal increase/decrease for fish-related pulse flow requirement
-0.40	145	25May2012 0645	

Table 5-4. Largest one hour stage changes up and down each year (negative denotes a drop in stage).

Change (ft)	Julian Day	Date and Time	Cause of Stage Change
2.82	17	18Jan1997 0900	Flood Control Operations
-2.89		18Jan1997 0800	
2.22	246	04Sep1998 1045	Flood Control Operations – Don Pedro releases increased to get reservoir down before commencing the 45 day minimum flow period
-1.32	36	06Feb1998 2115	Flood Control Operations
2.31	86	28Mar1999 2015	La Grange unit tripped offline; sluice gate opens to compensate
-1.94	98	09Apr1999 1100	Suspected Gage Error
2.10	102	12Apr2000 2000	Flood control space encroached upon - Pre-flood releases made to get out of flood control space in 15 days
-1.30	76	17Mar2000 2030	Flood control flow temporarily diverted to put water in Turlock Lake
1.76	52	22Feb2001 0830	Flood Control Operations - Releases from Don Pedro increased to keep Don Pedro reservoir below 801.9 ft
-0.93	128	09May2001 1015	Unknown
1.11	342	09Dec2002 1015	La Grange Unit 1 tripped offline – sluice gate opens resulting in increased flow to compensate for unit loss
-0.67	101	12Apr2002 1130	Flood Control Operations
1.64	106	17Apr2003 1645	La Grange Unit 2 tripped offline; then came back on-line
-0.90		17Apr2003 1545	
1.48	215	03Aug2004 1130	La Grange units tripped offline; then came back on-line
-1.17		03Aug2004 1315	
1.42	353	20Dec2005 1400	Pre-Flood Releases
-1.22	212	01Aug2005 1130	Unit 1 taken offline for repair of brushes
1.22	93	04Apr2006 0445	9,000 cfs Requirement - Dry Creek went from 274 cfs to 5,068 cfs and back down to 945 cfs
-1.77	92	03Apr2006 1915	
1.33	339	06Dec2007 1800	Gage Error - River Flow did not change, EMS had elevation 174.17 and flow of 179 cfs
-0.91		06Dec2007 1700	
0.90	111	21Apr2008 1515	La Grange Units 1 and 2 tripped offline; then came back on-line.
-0.75		21Apr2008 1245	

Change (ft)	Julian Day	Date and Time	Cause of Stage Change
0.65	107	18Apr2009 1330	Normal Increase for Pulse flow requirement
-0.45	265	23Sep2009 0330	Unknown
1.10	160	10Jun2010 1245	Unknown
-1.11	181	01Jul2010 0700	Flood Control Operations
1.33	282	10Oct2011 0815	Pre-Flood Releases
-1.90	82	24Mar2011 2015	9,000 cfs requirement, Dry Creek went from 117 cfs to 3,510 cfs
0.92	144	25May2012 0000	Normal Increase/Decrease for Pulse flow requirement
-0.46	134	14May2012 0930	

The NMFS request also asked that specific additional exceedance and histogram figures be provided summarizing stage change data by month. The requested figures are provided as Attachment 3 to this report.

6.0 Response to NMFS-4, Element 5: Lower Tuolumne River Flow Accretion and Depletion

NMFS-4, Element 5, NMFS requested additional information about accretion and depletion in the lower Tuolumne River. In the December 21, 2011 SPD, FERC directed that the specific methods, locations, and scope of this work be developed through the Consultation Workshop process. At the April 9, 2012 Hydrology Workshop, the Districts provided a proposal for initial accretion/depletion measurements in the lower Tuolumne River. All parties present agreed with the approach; NMFS was not present nor provided any comments. On June 6, 2012, the Districts issued a detailed map showing locations and further describing field measurement methods, asking for any final comments to be provided by June 20, 2012. No further comments were provided. The initial set of accretion measurements took place on June 25, 2012. The results of the measurements were provided to relicensing participants on July 26, 2012. At Consultation Workshop No. 2 held on September 21, 2012, relicensing participants reviewed the results of the first measurements and agreed that two additional field accretion measurements should be taken with several measurement locations added. The additional field accretion measurements were taken on October 3-4, 2012 and February 11-12, 2013. The results of the three sets of field measurements were provided to relicensing participants as part of W&AR-02 Consultation Workshop No. 2 Final Meeting Notes filed with FERC on March 19, 2013. The same results were provided to relicensing participants again in separate form via email on April 25, 2013.

In addition to the three episodes of field measurements, the Districts also proposed to develop a continuous daily flow record of the accretion flows occurring between the La Grange and Modesto USGS gages for use in the W&AR-02: Tuolumne River Operations Model. On November 6, 2012, the Districts issued an updated draft of the proposed approach for developing this hydrology. No comments were received from relicensing participants on the proposed methods. The analysis and resulting daily flow record were published with the Initial Study Report on January 17, 2013 as part of the W&AR-02 report. This data set is built into and available via the Tuolumne River Operations Model.

6.1 Analysis of Field Accretion/Depletion Measurements

The three episodes of field measurements can be used to further inform accretion/depletion estimates by specific river mile locations examined by the flow measurements taken at numerous locations along the lower Tuolumne River. Discharge at each site was measured using standard methods for collecting data in wadeable streams (Rantz 1982).

Table 6-1 summarizes the results of the accretion measurements and Figure 6-1 shows the results graphically by river mile.

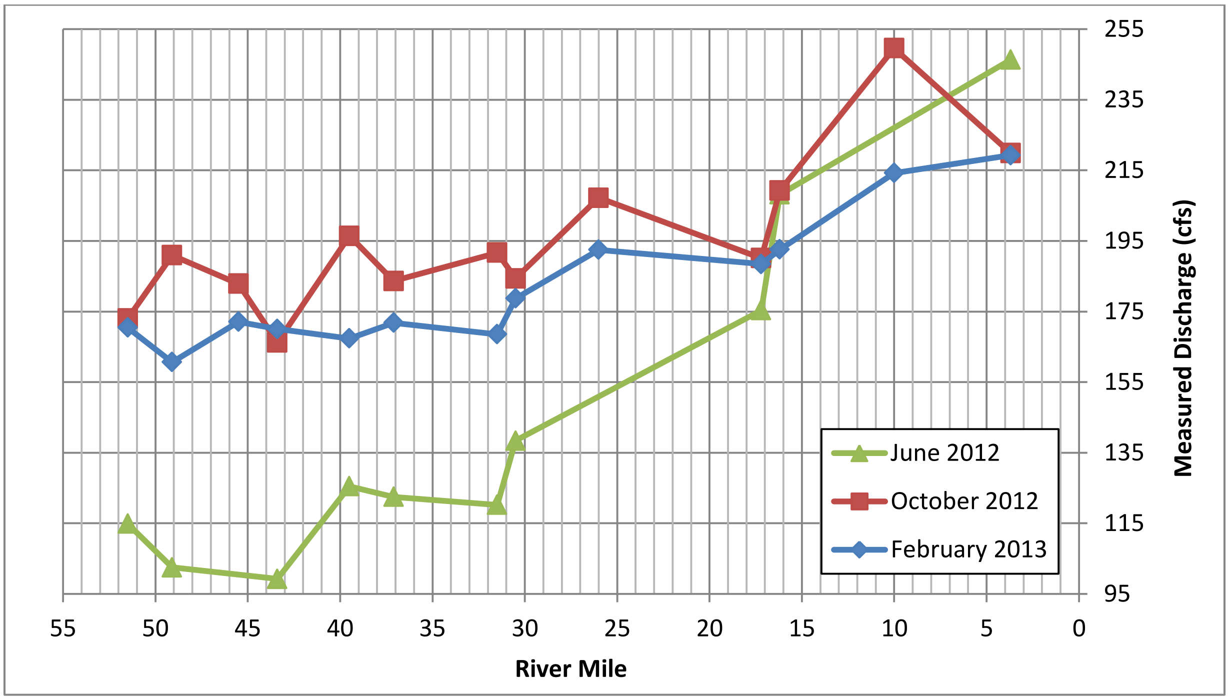


Figure 6-1. Discharge measurements by River Mile.

All measurements were taken during extended dry periods and specific efforts were made to eliminate irrigation system operational spills. The timing of the measurements were chosen to capture the three primary seasons of accretion flows – irrigation season (June), end-of-irrigation season (October), and winter season (February). Overall, the Tuolumne River can be considered a slightly accreting river between the USGS gage at La Grange and Dry Creek, and generally greater accretions between Dry Creek and the mouth.

Table 6-1. Discharge measurement locations and results.

Site	Dry Creek River Mile	Tuolumne River Mile	Irrigation Season[a]	Flow (cfs)	Irrigation Season-- Low Flow[a]	Flow (cfs)	Non-Irrigation Season[b]	Flow (cfs)	Reason behind location selection	Reach[c]	Notes
Tuolumne River at La Grange gage house	--	51.5	6/25/12	115	10/3/12	202[g]	2/11/13	170	For comparing measured values to gaged values	Dominant Salmon Spawning Reach	--
Tuolumne River at La Grange (USGS 11289650)	--	51.5	6/25/12	130	10/3/12	179[g]	2/11/13	182	Gage	Dominant Salmon Spawning Reach	--
Tuolumne River at La Grange (CDEC LGN)	--	51.5	6/25/12	94	10/3/12	170	2/11/13	164	Gage	Dominant Salmon Spawning Reach	--
Tuolumne River at Basso Pool	--	49.1	6/25/12	103	10/3/12	191	2/11/13	161	From Instream Flow Study	Dominant Salmon Spawning Reach	--
Tuolumne River at Zanker property	--	45.5	--	--	10/4/12	183	2/12/13	172	Targets potential depletion/ recharge area	Dredger Tailings Reach	--
Tuolumne River at Bobcat Flat	--	43.4	6/25/12	99	10/4/12	166	2/12/13	170	From Instream Flow Study	Dredger Tailings Reach	--
Tuolumne River at Roberts Ferry Bridge	--	39.5	6/25/12	125	10/4/12	196	2/11/13	167	Downstream of Turlock Lake but above Modesto Reservoir	Gravel Mining Reach	--
Tuolumne River at Santa Fe Aggregates	--	37.1	6/25/12	123	10/4/12	184	2/12/13	182	From Instream Flow Study	Gravel Mining Reach	--
Waterford Main (MID)	--	33.0	6/25/12	8	10/3/12	1	2/12/13	0	Operational outflow	--	--
Hickman Spill (TID)	--	33.0	6/25/12	0	10/3/12	0	2/12/13	0	Operational outflow	--	--
Tuolumne River at Waterford	--	31.5	6/25/12	120	10/3/12	192	2/11/13	169	From Instream Flow Study	In-channel Gravel Mining Reach	--
Tuolumne River at Delaware Road	--	30.5	6/29/12	138	10/3/12	184	2/11/13	179	From Instream Flow Study	In-channel Gravel Mining Reach	--
Tuolumne River at Fox Grove Park	--	26.0	--	--	10/4/12	207	2/12/13	192	Information between RM 30.5 and RM 17.2	In-channel Gravel Mining Reach	--
Faith Home Spill (TID)	--	20.0	6/25/12	0	10/3/12	0	2/12/13	0	Operational outflow	--	--
Lateral No. 1 (MID)	--	18.0	6/25/12	1	10/3/12	1.6	2/12/13	0	Operational outflow	--	--
Tuolumne River at Legion Park	--	17.2	6/25/12	175	10/3/12	190	2/11/13	188	Added at 9/21/12 Workshop	Urban Sand-Bedded Reach	--
Dry Creek (CDEC DCM)	5.3	16.4	6/25/12	32	10/4/12	33	2/12/13	0.6	Gage	--	MID's Lateral 2 outlet is the only true operational outlet with consistent flow into Dry Creek at latitude/longitude 37.652142; -120.930206 (Loschke, pers. comm. 2013). [d,e,f]
Dry Creek at gage	5.3	16.4	--	--	10/4/12	37	2/12/13	0.5	For comparing measured values to gaged values	--	
Dry Creek 2.0	2.0	16.4	--	--	10/4/12	31	2/12/13	0.8	Information between RM 5.3 and RM 0.0	--	
Mouth of Dry Creek	0.0	16.4	6/25/12	56	10/3/12	37	2/12/13	0.6	Inflow to Tuolumne River	--	
Tuolumne River at Modesto 9th St. Bridge	--	16.2	6/25/12	208	10/3/12	209	2/11/13	193	For comparing measured values to gaged values	Urban Sand-Bedded Reach	--
Tuolumne River at Modesto (USGS 11290000)	--	16.2	6/25/12	219	10/3/12	227	2/11/13	197	Gage	Urban Sand-Bedded Reach	--
Tuolumne River at Modesto (CDEC MOD)	--	16.2	6/25/12	216	10/3/12	238	2/11/13	197	Gage	Urban Sand-Bedded Reach	--
Lateral 1 (TID)	--	11.0	6/25/12	0	10/3/212	0	2/11/13	0	Operational outflow	--	--
Tuolumne River near Riverdale Park	--	10.0	--	--	10/3/12	250	2/12/13	214	Information between RM 16 and RM 3.7	Lower Sand-Bedded Reach	--
Tuolumne River at Shiloh Bridge	--	3.7	6/25/12	246	10/3/12	220	2/11/13	219	Added at 9/21/12 Workshop	Lower Sand-Bedded Reach	
Lateral No. 5 (MID)	--	2.0	6/25/12	29	10/3/12	14.3	2/11/13	0	Operational outflow	--	--

[a] Irrigation deliveries for 2012 started mid-March and ended October 10.
[b] Irrigation deliveries for 2013 started March 5.
[c] See W&AR-04 Spawning Gravel (TID/MID 2013).
[d] Lateral 2 has 15 minute flow records back to 2007 and chart recorders and staff gage records back to 1972 (Loschke, pers. comm. 2013).
[e] As of 10/30/2012, the small amount of flow in MID's WTFD L-3 is captured by a private land owner (Loschke, pers. comm. 2013).
[f] All spills from the Waterford system into dry creek are inconsistent and minimal (Loschke, pers. comm. 2013).
[g] Gage discharge was not steady on this day, and the measurement occurred during a small peak in flow reading 196 cfs at the Gage.

6.2 References

Rantz, S.E. 1982. Measurement and computation of streamflow: volume 1. Measurements of stage and discharge. USGS Water Supply Paper 2175. U.S. Geological Survey.

7.0 Response to NMFS-4, Element 6: Potential to Increase Lower Tuolumne River Flood Capacity

NMFS-4, Element 6 requested that the Districts evaluate the possibility of increasing the current target allowable flood flow from 9,000 cfs at the Modesto gage to 15,000 cfs above the gage and 20,000 cfs from the gage to the confluence with the San Joaquin River. The maximum flood flow targets on the lower Tuolumne River are contained within the 1971 Army Corps of Engineers (ACOE) Flood Control Manual. The Districts operations are consistent with the flood control manual.

To evaluate the possibility of modifying the maximum target flood flows, the Districts submitted a letter to Colonel William Leady, District Commander of the ACOE on July 12, 2012, inquiring as to the feasibility of amending the flood control manual to allow for higher flows to the lower Tuolumne River. On March 4, 2013, the ACOE responded (see Attachment 4) that there has been no "changes to the authorized flood control criteria since 1996 that would allow the Corps to increase the maximum flood release to the Tuolumne River." Without support from the ACOE to increase flood flows, the Districts intend to continue compliance with the Flood Control Manual.

ATTACHMENT 1

September 21, 2012
Hydrologic Investigations Workshop Agenda

Don Pedro Relicensing Participants
Hydrologic Investigations Workshop
AGENDA

September 21, 2012 - 9:00 a.m. – 12:30 p.m.
Modesto Irrigation District Offices
Conference Call-In Number 866-994-6437; Code 5424697994

9:00 a.m.- 9:15 a.m.	**Introductions & Purpose of Meeting** (1) Review of Accretion Flow Measurements Conducted on June 25, 2012 (2) Discussion of Hydrologic Analyses the Districts are Planning to Undertake
9:15 a.m.-10:30 a.m.	**Discussion of Results and Path Forward Related to Accretion Flow Measurements Conducted on June 25, 2012 and Provided to Relicensing Participants on July 26, 2012**
10:30 a.m.-11:30 a.m.	**Discussion of Hydrologic Analyses to be Conducted by the Districts in Accordance with FERC's Study Plan Determination and Dispute Resolution** (1) Available Streamflow Data Records/Sources Confirmed by Districts (2) Overview of FERC's Study Plan Determination and Dispute Decision as Relates to Hydrologic Analyses (3) Statistical Analyses to be Conducted for Existing Project Conditions a. Average, maximum and minimum monthly flows for 1971-2009, 1996-2009, and by water year type b. Annual and monthly flows duration curves for 1971-2009, 1996-2009, and by water year type c. Average annual flows for 1971-2009 and 1996-2009 d. 1-, 3-, and 7-day maximum mean daily flow for each year of 1971-2009 e. 1-, 3-, and 7-day minimum mean daily flows for each year of 1971-2009 f. Julian date and magnitude of annual maximum and minimum (4) Watershed Locations for Statistical Analyses a. Tuolumne River, inflow to Don Pedro Reservoir b. Tuolumne River just above La Grange Dam c. Turlock Canal near La Grange CA (USGS gage) d. Modesto Canal near La Grange CA (USGS gage) e. Tuolumne River below La Grange Dam near La Grange CA (USGS gage) f. Dry Creek at Modesto (CDWR gage) g. Tuolumne River at Modesto CA (USGS gage)
11:30 a.m.-12:30 p.m.	**Other Hydrologic Analyses to be Conducted (these analyses need further clarification and discussion)** (1) Peak Flow Analysis using log-Pearson type III flood flow frequency for existing conditions and return intervals of 1 to 100 years for Tuolumne River locations above using USGS Regional skew for California (2) Rate of Stage Change Analysis Tuolumne River below La Grange Dam near La Grange CA (USGS gage) for 1971-2009 using 15-minute gage records

ATTACHMENT 2

Districts' Response to NMFS-4, Element 1

Base Case Hydrologic Statistics

Inflow to Don Pedro Reservoir:

Operations Model Base Case

Table 1. Average inflow to Don Pedro Reservoir by water year type, by water year, and for the period of record for the Base Case (cfs).

cfs	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Annual
C	339	423	309	337	904	1,056	1,285	1,850	653	500	387	276	692
D	435	431	319	501	1,323	1,684	1,898	3,129	990	411	385	315	983
BN	234	494	541	629	1,842	2,326	2,236	4,746	1,252	539	423	319	1,297
N	283	638	781	1,442	3,340	3,332	3,224	6,424	4,238	849	473	413	2,110
AN	372	1,426	1,782	2,240	4,240	4,168	3,887	7,214	6,186	1,450	568	529	2,826
W	527	1,155	2,296	4,844	6,096	6,515	5,949	8,883	8,907	5,209	1,138	763	4,345
1971	299	888	1,402	1,255	2,240	2,601	2,655	5,337	3,116	1,387	472	489	1,843
1972	217	615	1,019	831	1,880	2,077	1,906	4,512	1,520	529	427	288	1,318
1973	200	597	1,018	1,938	4,606	3,719	3,565	6,612	6,666	645	483	309	2,510
1974	370	2,066	1,662	2,402	2,756	4,149	4,265	6,987	6,135	1,122	569	512	2,744
1975	381	416	479	668	3,878	4,293	3,412	6,474	7,686	1,484	630	577	2,515
1976	727	979	455	217	569	804	740	1,171	426	403	450	377	610
1977	195	301	128	192	318	338	338	626	533	305	312	208	316
1978	122	283	1,028	2,693	4,501	5,120	5,540	6,717	8,266	4,512	887	1,198	3,392
1979	294	611	452	2,023	3,887	4,230	3,608	7,453	4,903	666	477	435	2,408
1980	434	654	631	7,385	7,232	4,636	4,091	8,356	5,793	5,121	854	705	3,817
1981	317	331	400	711	1,405	2,127	1,953	4,410	1,205	468	492	333	1,180
1982	401	2,214	2,737	3,638	7,175	6,832	9,334	10,166	8,663	4,724	996	1,293	4,823
1983	2,162	3,632	3,914	4,092	7,539	9,789	5,952	8,521	14,743	9,854	3,035	956	6,170
1984	826	4,905	6,324	3,326	3,669	3,525	3,105	6,362	5,293	909	452	385	3,253
1985	422	1,179	685	486	1,781	2,206	2,488	4,978	975	450	468	402	1,375
1986	397	790	1,123	1,549	10,977	7,695	4,478	8,113	7,851	1,435	514	633	3,741
1987	334	308	210	135	778	1,169	1,044	1,685	551	369	365	234	598
1988	185	427	610	881	988	1,015	1,029	1,705	757	440	339	228	717
1989	134	494	420	438	1,916	3,267	2,806	5,484	1,377	395	314	283	1,442
1990	662	549	278	407	1,159	1,451	1,563	2,248	1,353	379	310	226	880
1991	117	187	105	129	951	2,246	1,982	4,052	1,905	1,091	517	341	1,137
1992	296	215	181	271	1,533	1,829	3,215	2,965	782	913	419	301	1,074
1993	187	140	491	3,526	3,737	4,202	4,189	7,366	6,886	2,951	673	572	2,903
1994	301	311	271	324	1,222	1,182	1,345	2,951	866	570	439	308	839
1995	136	706	724	4,658	4,242	9,148	6,362	10,968	9,872	9,884	2,157	580	4,965
1996	183	228	821	1,630	5,927	5,279	4,523	8,927	5,553	1,112	482	549	2,920
1997	258	1,255	5,816	16,121	4,164	3,666	3,218	7,159	5,068	645	583	504	4,054
1998	244	440	510	2,936	7,879	5,899	5,724	8,686	8,988	8,262	1,017	688	4,247
1999	283	804	918	1,886	5,437	3,558	3,826	7,170	5,565	1,123	600	580	2,622
2000	240	426	259	1,691	5,573	4,431	3,694	7,049	3,815	640	533	415	2,383
2001	352	426	339	428	1,628	2,145	2,266	4,698	712	481	390	357	1,184
2002	238	560	1,313	1,330	1,999	2,421	2,667	5,829	1,662	531	406	262	1,602
2003	136	855	940	990	2,248	2,479	3,145	5,678	5,108	541	528	472	1,919
2004	182	333	956	1,049	2,532	2,523	2,372	5,168	949	380	402	278	1,426
2005	588	913	954	3,508	4,955	5,645	4,806	9,841	9,706	3,356	691	608	3,786
2006	274	394	2,737	3,959	4,113	5,958	9,669	10,556	9,950	2,723	551	537	4,277
2007	286	417	423	360	1,610	1,549	1,516	2,346	727	366	337	385	855
2008	214	226	262	1,043	2,169	1,817	1,827	4,334	1,326	446	440	287	1,197
2009	170	813	339	1,162	2,892	3,621	2,958	6,897	3,163	655	469	424	1,957
2010	690	349	522	1,144	3,196	3,154	3,504	6,537	5,468	1,728	414	501	2,257
2011	784	1,419	5,081	2,744	4,244	7,276	6,264	8,635	9,079	6,783	1,237	686	4,523
2012	477	425	175	527	1,125	1,609	2,558	3,515	675	431	401	317	1,019
1971-2012	374	811	1,169	2,064	3,392	3,635	3,464	5,934	4,420	1,934	632	477	2,352

Table 2. Minimum daily inflow to Don Pedro Reservoir by water year type, by water year, and for the period of record for the Base Case (cfs).

cfs	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Annual	Julian Day of Annual Min	3-day Min	7-day Min
C	114	144	87	111	249	307	270	497	359	301	307	126	87	--	--	--
D	178	167	118	161	906	1,204	1,105	1,896	453	321	307	132	118	--	--	--
BN	81	105	99	116	679	1,259	1,600	3,394	457	312	307	135	81	--	--	--
N	96	121	197	198	1,705	1,855	2,177	4,902	1,183	424	377	180	96	--	--	--
AN	106	100	156	310	2,608	2,425	2,771	4,824	4,355	458	413	190	100	--	--	--
W	86	93	202	436	2,647	2,971	2,867	5,635	4,333	544	428	249	86	--	--	--
1971	226	233	783	655	2,022	1,855	2,177	4,925	2,556	522	446	242	226	17	227	229
1972	134	183	381	682	1,511	1,686	1,675	4,140	1,108	447	408	197	134	13	136	138
1973	160	191	366	465	2,726	2,948	2,562	5,778	4,986	495	452	212	160	13	161	166
1974	251	277	949	1,207	2,645	3,215	3,470	6,123	4,851	604	482	310	251	18	253	257
1975	260	261	294	310	2,754	3,186	3,032	4,824	5,726	624	548	345	260	19	261	262
1976	335	643	310	195	413	712	621	676	359	373	368	187	187	341	190	195
1977	138	149	87	118	249	307	270	497	370	301	307	126	87	80	88	89
1978	86	93	202	1,165	2,647	2,971	4,286	5,635	6,113	2,084	515	337	86	16	86	86
1979	184	271	312	399	2,523	3,220	3,054	6,654	3,671	525	458	272	184	24	188	189
1980	237	454	336	1,179	3,282	3,784	3,332	7,365	5,150	2,171	602	451	237	11	239	241
1981	221	190	330	316	1,248	1,425	1,614	3,912	719	419	418	196	190	36	192	199
1982	247	478	695	2,074	3,650	5,483	4,481	8,772	7,690	2,464	538	493	247	9	259	298
1983	745	1,715	1,554	1,871	5,093	6,383	4,814	6,511	10,018	5,454	979	824	745	21	775	799
1984	686	948	2,621	1,771	3,063	3,006	2,771	5,712	4,547	458	413	190	190	339	191	204
1985	334	468	504	449	1,332	1,642	2,001	4,293	628	410	410	222	222	337	232	263
1986	330	388	669	1,045	3,567	5,352	4,054	7,646	6,699	604	436	251	251	337	252	354
1987	227	183	166	111	532	643	810	1,209	376	352	337	133	111	108	113	116
1988	114	165	470	537	792	808	860	1,544	565	368	318	126	114	7	116	120
1989	88	105	303	382	1,724	1,923	2,013	5,041	1,029	367	307	135	88	13	88	88
1990	315	428	182	206	979	1,204	1,324	1,896	631	321	307	132	132	347	133	133
1991	81	125	99	116	679	1,259	1,742	3,620	1,161	504	427	222	81	11	81	81
1992	147	144	133	225	642	1,489	2,416	1,741	449	410	368	185	133	77	140	145
1993	118	116	156	447	2,608	2,425	3,686	6,534	6,060	982	535	333	116	50	116	119

cfs	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Annual	Julian Day of Annual Min	3-day Min	7-day Min
1994	198	178	222	263	866	1,031	1,125	2,626	535	484	401	208	178	34	190	211
1995	87	108	510	547	3,784	3,792	4,889	9,544	7,048	5,174	664	423	87	16	87	87
1996	106	100	255	572	3,455	4,126	3,848	7,857	4,355	665	447	277	100	31	104	110
1997	159	309	1,923	3,127	3,521	3,505	2,867	6,716	4,333	544	472	250	159	17	162	170
1998	174	193	357	436	4,125	3,714	4,727	7,601	6,837	2,383	570	365	174	24	176	178
1999	176	292	629	533	2,999	3,329	2,890	6,746	4,629	616	536	349	176	22	178	182
2000	155	186	199	198	2,703	3,769	3,433	6,559	3,071	528	482	284	155	20	155	156
2001	267	260	279	289	1,281	1,552	1,600	3,394	457	409	371	201	201	339	202	232
2002	153	168	735	780	1,705	1,997	2,184	5,517	1,183	424	377	180	153	17	155	158
2003	96	121	333	816	2,091	2,154	2,404	4,902	3,822	471	422	223	96	10	96	96
2004	110	134	318	786	1,774	2,040	1,853	4,610	722	312	354	161	110	20	110	111
2005	165	710	570	1,475	3,886	3,989	4,299	7,689	7,864	964	517	346	165	7	169	170
2006	186	216	783	1,846	3,614	4,575	6,511	7,502	7,415	1,009	428	249	186	20	193	197
2007	178	167	248	252	906	1,285	1,105	1,933	453	351	325	152	152	340	158	188
2008	147	127	183	267	1,594	1,636	1,604	3,809	1,024	372	357	167	127	36	127	131
2009	106	252	197	500	2,318	2,882	2,556	6,241	2,816	473	418	224	106	23	108	109
2010	172	319	309	459	2,607	2,825	2,439	5,951	4,273	507	388	240	172	12	173	246
2011	396	908	1,480	1,976	3,735	4,005	5,210	7,655	6,417	2,907	675	441	396	17	399	404
2012	312	305	118	161	1,095	1,247	1,412	2,878	560	384	374	212	118	82	121	123
1971-2012	81	93	87	111	249	307	270	497	359	301	307	126	81	--	--	--

Table 3. Maximum daily inflow to Don Pedro Reservoir by water year type, by water year, and for the period of record for the Base Case (cfs).

cfs	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Annual	Julian Day of Annual Max	3-day Max	7-day Max
C	1,793	1,567	1,018	1,871	3,186	2,508	4,066	4,066	1,810	2,416	928	545	4,066	--	--	--
D	2,096	1,173	1,223	3,610	3,883	4,617	6,330	5,461	2,811	686	540	509	6,330	--	--	--
BN	744	2,958	4,377	4,030	6,073	6,485	3,558	6,728	2,696	2,322	644	541	6,728	--	--	--
N	1,879	3,491	3,797	15,001	18,878	7,913	5,896	8,935	10,841	4,252	839	613	18,878	--	--	--
AN	1,283	18,209	21,615	12,099	16,468	11,553	9,790	20,177	10,892	6,254	963	734	21,615	--	--	--
W	7,249	13,697	26,023	116,502	45,341	36,225	37,729	22,350	18,146	19,407	5,703	8,557	116,502	--	--	--
1971	439	3,491	3,797	2,163	2,591	6,903	3,095	5,845	4,987	3,332	527	610	6,903	177	5,812	5,715
1972	537	1,605	4,377	1,070	3,211	2,347	2,152	4,865	2,523	687	442	433	4,865	215	4,839	4,802
1973	345	1,329	2,410	7,343	13,391	4,714	5,012	8,935	10,841	892	532	486	13,391	134	10,469	8,872
1974	913	6,102	4,696	5,099	3,028	9,480	9,790	7,793	8,374	3,285	894	636	9,790	183	8,231	7,907
1975	853	696	2,354	1,933	8,573	11,553	4,864	7,809	10,892	3,065	800	722	11,553	176	10,383	10,106
1976	1,793	1,567	700	268	938	1,198	999	1,678	545	439	928	545	1,793	26	1,573	1,541
1977	390	435	301	318	525	407	441	789	1,326	323	317	327	1,326	253	1,050	762
1978	280	716	3,846	7,718	15,769	12,427	12,779	7,623	11,257	7,186	2,051	2,483	15,769	132	10,823	9,813
1979	780	1,285	900	15,001	9,119	7,913	5,141	8,111	8,708	827	514	613	15,001	103	8,827	7,971
1980	748	993	1,997	36,867	24,804	7,025	5,054	9,279	10,151	11,265	2,072	796	36,867	104	30,276	19,740
1981	643	396	1,223	3,610	1,543	4,617	2,534	5,461	2,179	526	540	459	5,461	213	5,196	4,702
1982	1,037	7,941	11,309	17,110	36,655	10,569	37,729	11,969	11,105	6,251	2,186	8,557	37,729	193	26,110	16,838
1983	7,249	13,697	19,981	14,721	13,996	23,730	8,770	11,610	18,146	17,440	5,703	1,939	23,730	152	18,709	16,480
1984	1,283	18,209	21,615	8,237	6,148	4,624	3,431	9,512	8,575	2,014	478	529	21,615	85	19,179	13,598
1985	591	2,958	1,377	612	5,904	4,419	3,019	5,609	1,382	506	511	541	5,904	131	5,418	5,382
1986	464	2,167	3,108	3,469	45,341	24,257	5,396	8,556	12,159	2,397	670	999	45,341	140	40,102	27,330
1987	692	354	341	217	2,955	2,508	1,730	2,384	936	394	380	329	2,955	136	2,319	2,158
1988	324	565	1,018	1,871	1,511	1,647	1,431	2,034	1,470	511	365	348	2,034	229	1,941	1,857
1989	316	1,394	619	543	2,282	6,485	3,558	6,115	1,984	499	323	518	6,485	159	5,980	5,834
1990	2,096	1,173	582	773	1,598	1,778	1,994	2,898	2,811	686	317	328	2,898	240	2,652	2,532
1991	270	250	126	147	1,062	6,016	2,379	4,753	2,696	2,322	644	419	6,016	155	4,588	4,250
1992	1,740	293	370	355	3,186	2,416	4,066	4,066	1,698	2,416	557	359	4,066	201	4,066	4,066
1993	481	214	2,076	12,099	6,076	8,164	5,865	8,131	7,615	6,254	963	681	12,099	114	8,507	7,505

cfs	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Annual	Julian Day of Annual Max	3-day Max	7-day Max
1994	538	412	410	544	2,100	1,318	1,593	3,316	1,810	676	495	470	3,316	224	3,229	3,079
1995	366	1,206	1,264	14,977	5,045	36,225	13,856	22,350	16,564	19,407	4,518	675	36,225	161	26,183	17,614
1996	495	263	2,272	6,020	13,235	11,296	5,525	20,177	8,176	2,596	567	658	20,177	228	13,477	10,850
1997	535	4,116	14,051	116,502	6,256	3,972	3,757	7,551	7,986	1,009	677	653	116,502	94	77,439	45,929
1998	521	957	990	14,349	24,658	20,669	6,861	10,708	13,025	12,917	2,007	1,076	24,658	126	15,442	12,506
1999	580	1,569	1,889	8,510	16,468	4,283	4,729	7,629	7,540	2,156	691	734	16,468	132	12,016	8,666
2000	553	608	531	11,304	18,878	5,650	4,518	8,617	5,362	1,029	611	586	18,878	136	12,431	8,423
2001	744	532	494	1,078	2,566	5,534	3,461	5,976	2,186	611	422	494	5,976	223	5,685	5,408
2002	443	1,316	3,087	3,759	2,524	3,482	3,249	7,024	3,509	851	448	376	7,024	243	6,455	6,062
2003	318	1,898	2,712	1,264	2,544	3,474	5,896	6,604	7,470	717	839	611	7,470	253	7,309	6,662
2004	500	432	2,378	2,963	6,073	2,914	3,036	6,728	1,386	423	448	370	6,728	217	6,492	5,974
2005	1,441	1,146	4,880	10,413	8,104	14,769	5,365	14,514	15,103	6,289	1,108	819	15,103	244	14,493	13,638
2006	552	596	26,023	14,287	9,591	8,151	25,622	15,431	13,223	5,573	1,038	635	26,023	92	19,296	13,767
2007	543	555	668	498	3,883	1,777	2,129	2,944	1,770	382	380	509	3,883	134	3,157	2,815
2008	467	272	510	4,030	5,451	2,160	2,225	5,515	1,786	796	506	374	5,515	231	5,342	5,022
2009	342	1,064	640	3,996	5,528	7,703	3,801	8,653	4,227	1,333	507	563	8,653	214	7,956	7,412
2010	1,879	463	1,420	3,554	8,924	3,842	4,900	7,179	7,498	4,252	513	612	8,924	150	7,289	6,931
2011	2,535	2,095	18,955	6,462	6,818	15,709	8,087	9,778	16,554	13,448	3,311	846	18,955	80	15,529	13,210
2012	739	484	351	2,443	1,236	3,596	6,330	4,390	873	490	462	402	6,330	208	5,123	4,524
1971-2012	7,249	18,209	26,023	116,502	45,341	36,225	37,729	22,350	18,146	19,407	5,703	8,557	116,502	--	--	--

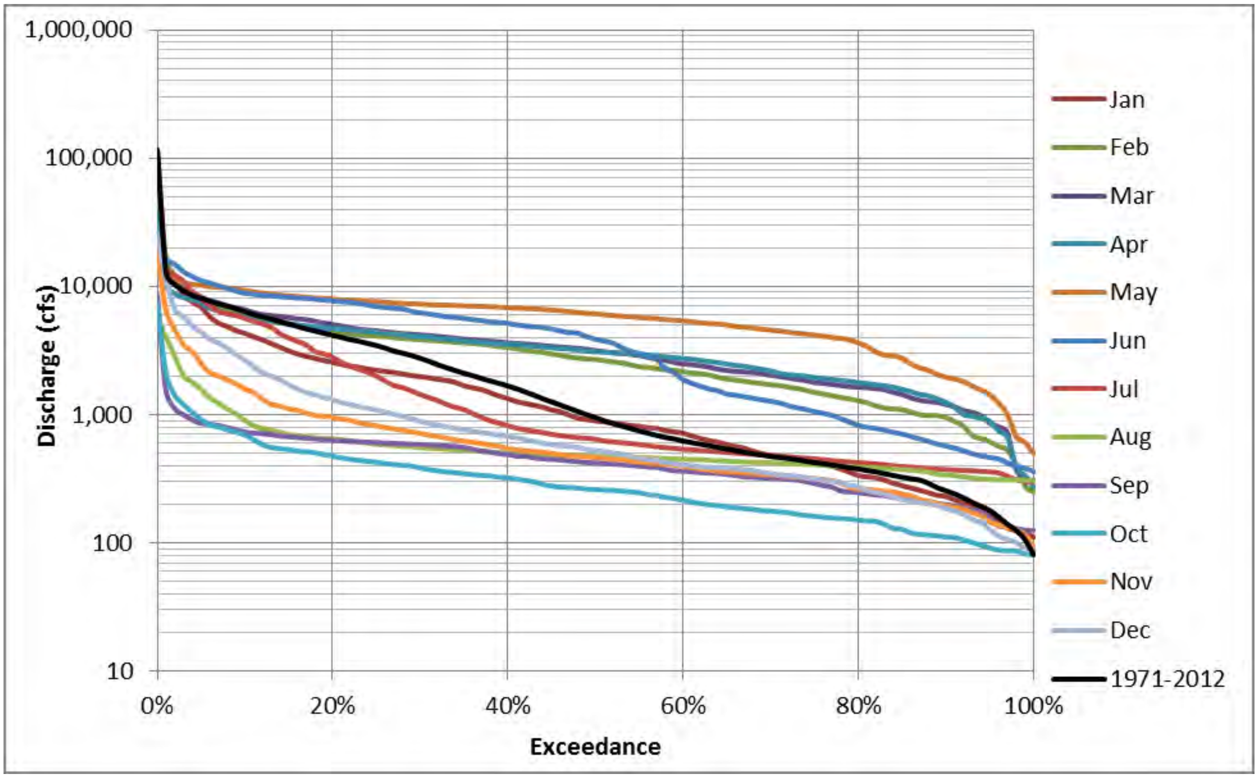


Figure 1. **Base Case inflow to Don Pedro: flow duration curves by month and for the period of record**

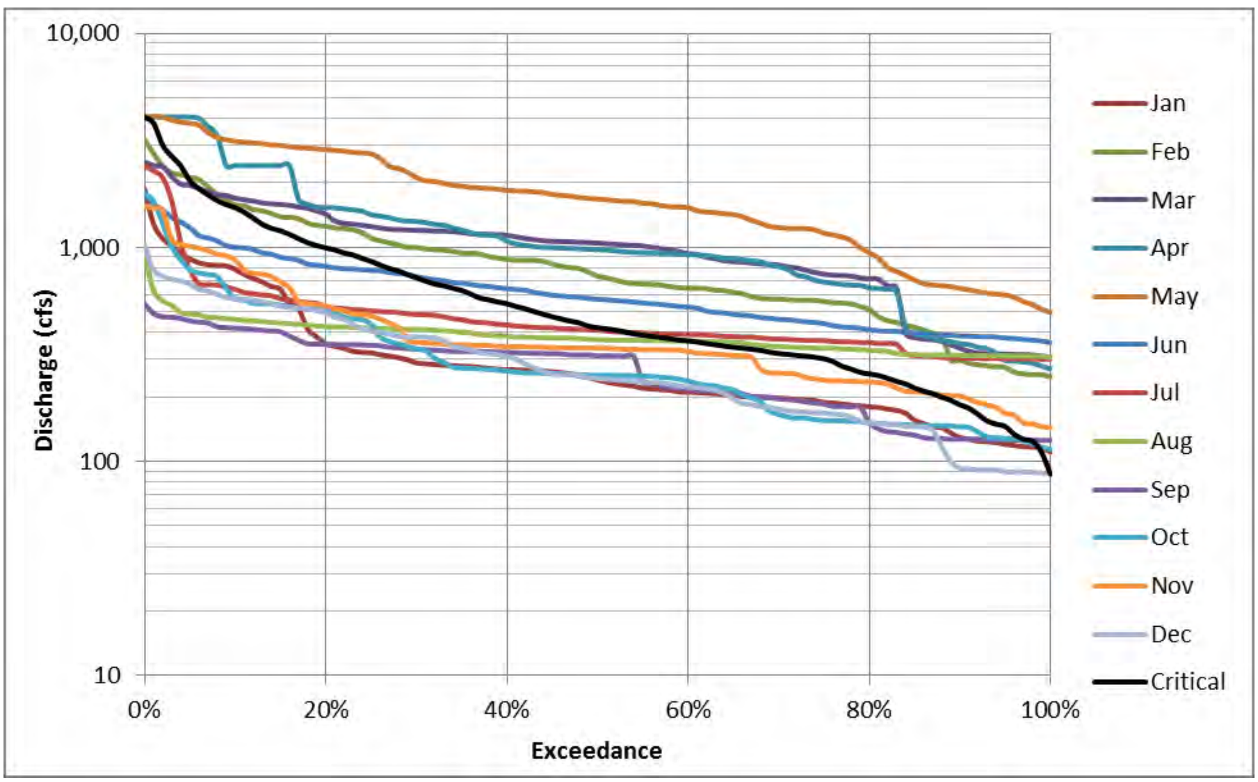


Figure 2. **Base Case inflow to Don Pedro: flow duration curves for Critical years by month and for all Critical years**

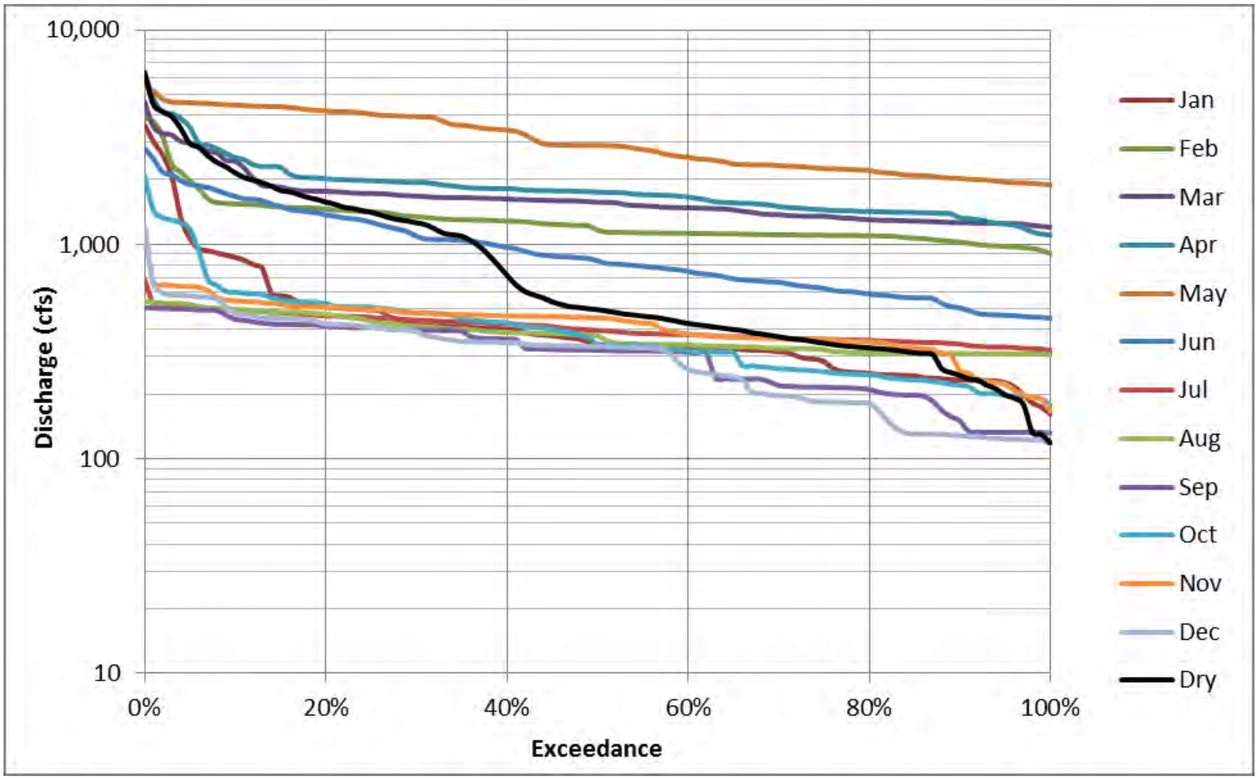


Figure 3. **Base Case inflow to Don Pedro flow: duration curves for Dry years by month and for all Dry years**

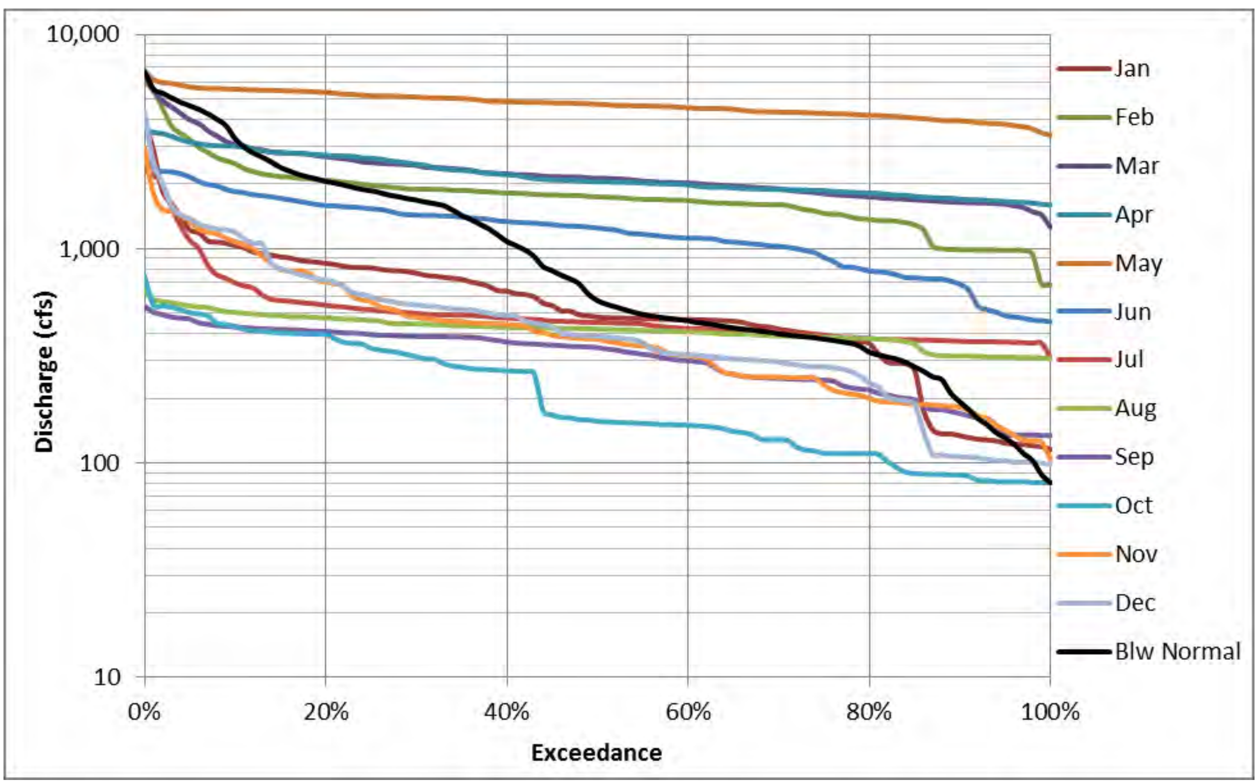


Figure 4. **Base Case inflow to Don Pedro: flow duration curves for Below Normal years by month and for all Below Normal years**

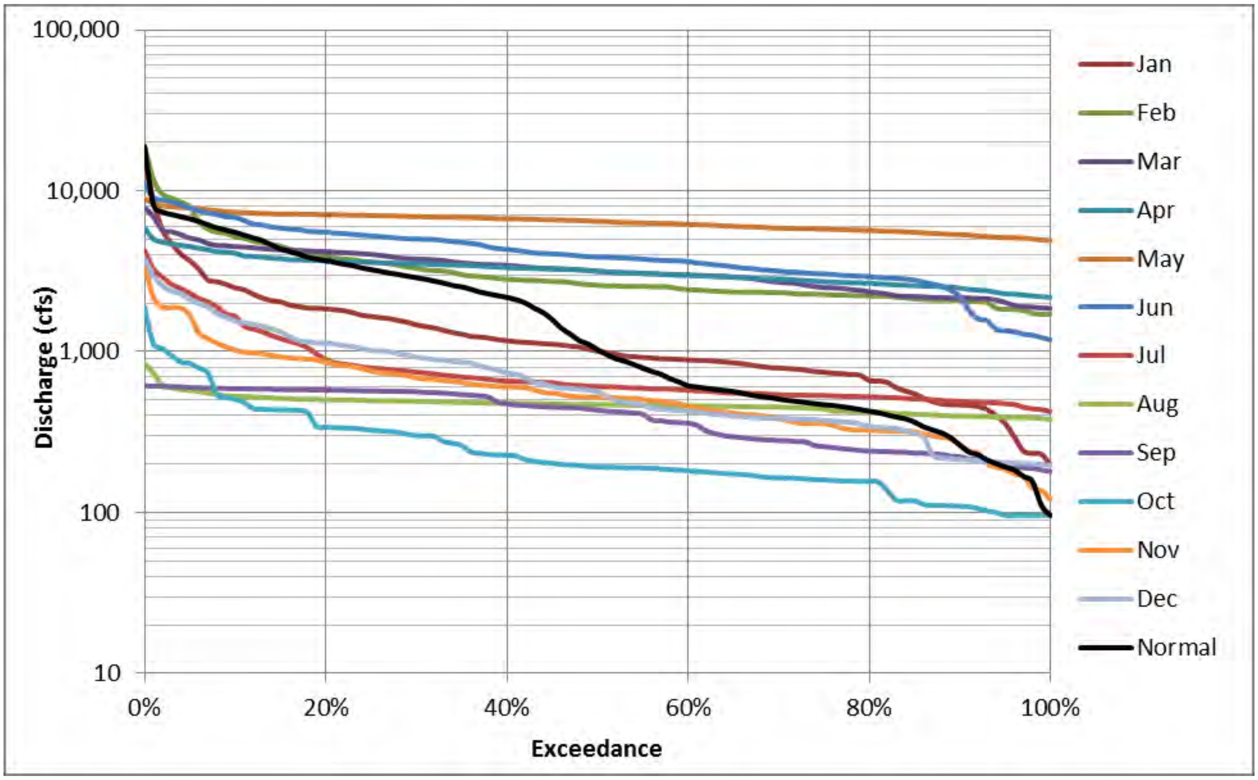


Figure 5. **Base Case inflow to Don Pedro: flow duration curves for Normal years by month and for all Normal years**

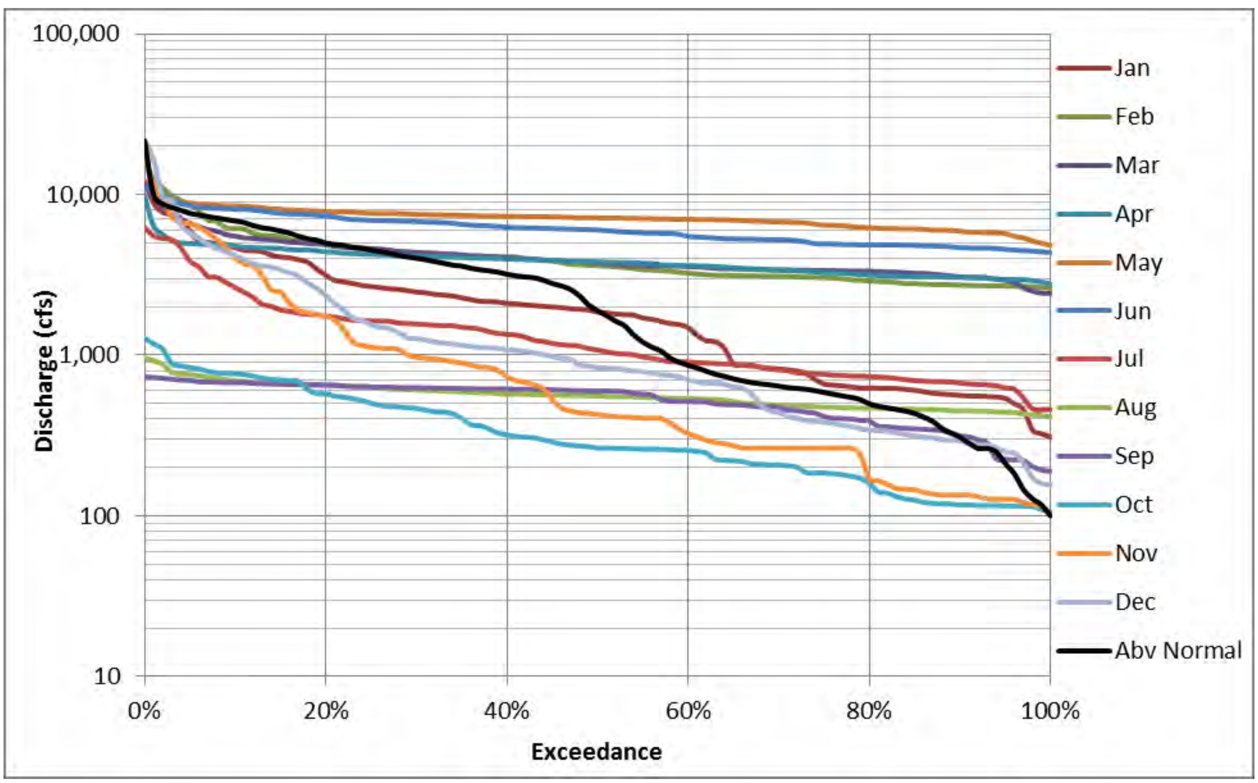


Figure 6. **Base Case inflow to Don Pedro: flow duration curves for Above Normal years by month and for all Above Normal years**

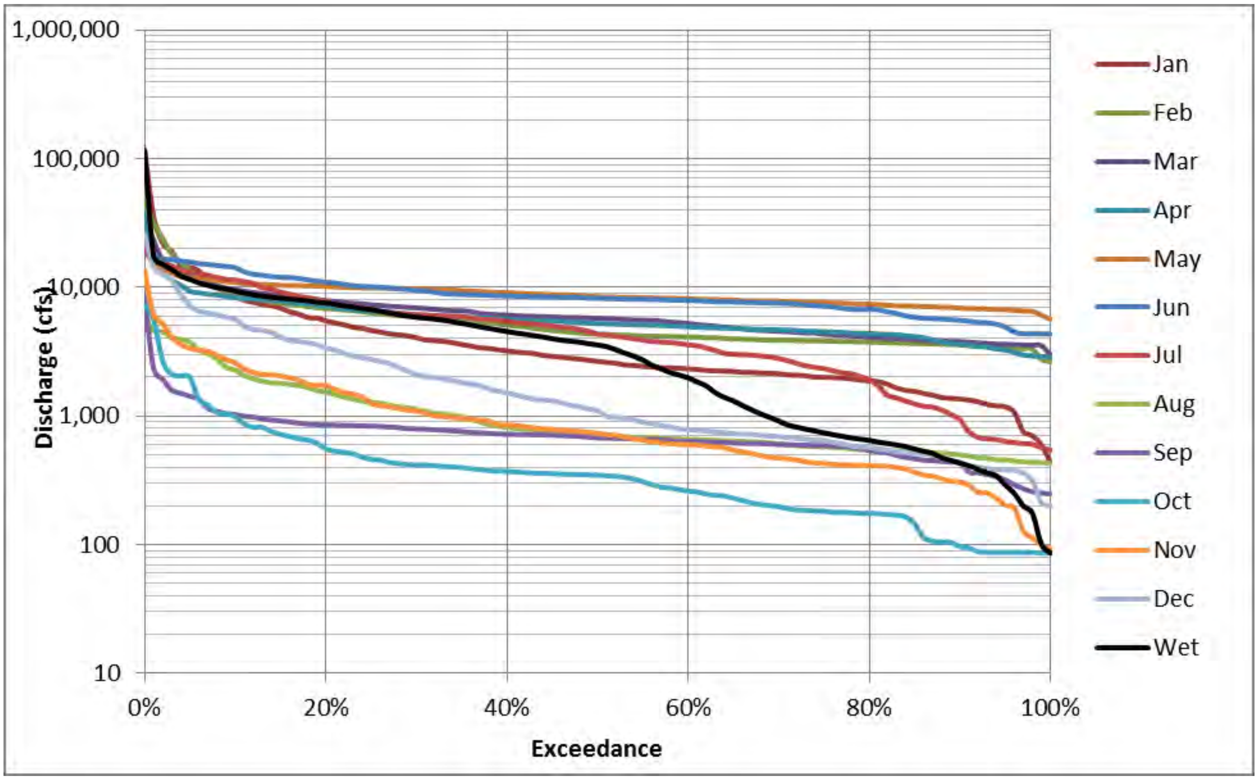


Figure 7. Base Case inflow to Don Pedro: flow duration curves for Wet years by month and for all Wet years

Tuolumne River above La Grange Dam:

Operations Model Base Case

Table 1. Average Tuolumne River above La Grange Dam flow by water year type, by water year, and for the period of record for the Base Case (cfs).

cfs	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Annual
C	1,893	804	597	777	951	2,558	3,728	4,106	4,140	4,771	4,035	2,326	2,566
D	2,197	825	631	851	1,055	3,092	4,515	4,712	4,599	5,242	4,538	2,660	2,921
BN	1,833	707	507	727	1,424	3,246	4,852	5,064	4,540	5,242	4,512	2,538	2,941
N	2,100	647	558	1,116	2,602	4,921	6,340	5,712	5,995	5,949	4,986	3,110	3,674
AN	2,310	1,452	2,629	3,501	5,941	7,753	7,885	6,417	8,064	6,218	5,098	3,344	5,043
W	2,211	1,150	2,235	6,132	8,350	11,816	12,001	12,009	14,482	11,357	7,006	3,704	7,698
1971	2,304	718	942	2,236	4,070	4,819	7,453	5,958	4,897	5,565	4,827	2,900	3,888
1972	1,944	655	460	679	963	3,627	4,953	5,384	4,797	5,515	4,778	2,759	3,052
1973	1,814	421	410	630	701	6,267	7,527	6,414	9,100	6,372	5,174	3,307	4,027
1974	2,304	718	1,797	4,716	5,432	8,050	9,269	6,169	8,910	5,879	5,174	3,307	5,137
1975	2,304	936	708	927	4,762	8,262	8,257	6,631	10,200	6,717	4,718	3,572	4,823
1976	2,517	1,048	943	928	1,268	3,901	4,245	4,940	4,633	5,325	4,045	2,269	3,014
1977	1,479	502	410	630	1,014	2,893	3,697	3,109	3,446	4,004	3,462	1,940	2,224
1978	1,065	524	390	611	701	2,119	2,770	6,662	5,244	5,912	5,463	4,337	2,999
1979	2,923	718	708	2,568	5,816	8,930	8,212	6,290	7,225	5,844	5,174	3,307	4,801
1980	2,304	718	708	8,761	12,588	13,725	8,611	9,276	8,984	11,607	6,655	3,751	7,298
1981	2,681	1,109	708	927	1,110	3,503	4,888	5,262	4,897	5,565	4,827	2,960	3,217
1982	1,928	480	470	2,243	10,674	14,978	15,173	16,108	16,448	11,198	6,811	3,703	8,326
1983	4,444	6,248	7,714	6,931	14,217	17,237	16,057	19,936	19,817	17,235	11,848	4,472	12,169
1984	2,983	4,692	11,362	11,143	6,266	7,717	7,763	6,450	5,202	5,899	5,174	3,272	6,509
1985	2,304	718	708	927	2,040	4,424	5,845	5,493	4,734	5,565	4,827	2,909	3,384
1986	1,814	421	410	630	5,996	18,453	12,622	10,222	10,886	6,728	5,174	3,208	6,379
1987	2,304	1,098	708	927	1,110	2,352	4,375	5,067	4,664	5,338	4,603	2,707	2,950
1988	1,479	617	410	630	667	2,004	3,285	3,928	3,994	4,672	4,033	2,373	2,348
1989	1,416	410	400	621	895	1,869	4,202	4,566	4,090	4,672	3,956	1,237	2,372
1990	1,272	630	400	621	905	2,555	4,062	3,257	4,090	4,672	4,033	2,342	2,411
1991	1,272	734	400	621	955	1,869	4,095	4,559	3,895	4,672	3,910	2,373	2,455
1992	1,272	724	400	621	657	1,683	2,671	3,817	3,437	3,952	3,462	2,039	2,067
1993	1,065	540	390	611	701	2,119	4,322	5,421	4,897	5,912	5,174	3,307	2,885
1994	2,304	833	708	927	999	2,512	4,095	3,775	4,664	5,338	4,603	2,628	2,794
1995	1,527	421	410	630	701	8,359	12,931	16,057	19,934	17,175	10,485	3,970	7,757
1996	2,619	1,109	708	927	8,986	11,874	9,610	7,608	11,169	6,712	5,174	3,307	5,794
1997	2,304	718	5,717	27,259	15,885	8,172	7,933	6,378	6,026	5,928	5,174	3,287	7,870
1998	2,352	718	708	2,257	12,944	11,730	12,789	9,767	18,284	15,744	7,564	3,754	8,172
1999	2,587	718	807	2,682	9,382	8,496	8,089	6,226	8,009	6,189	5,174	3,297	5,104
2000	2,465	1,012	708	927	7,213	10,827	8,201	4,938	5,695	5,912	5,174	3,292	4,685
2001	2,304	947	708	927	999	2,808	4,297	5,045	4,874	5,565	4,827	2,835	3,025
2002	1,839	421	410	630	701	2,119	4,624	5,089	4,897	5,565	4,827	2,960	2,854
2003	1,983	421	410	630	701	2,119	6,146	5,757	4,897	5,565	4,712	2,960	3,038
2004	2,113	785	460	686	3,410	6,068	6,006	5,260	4,723	5,367	4,683	2,944	3,542
2005	1,814	421	410	630	4,186	11,088	11,614	9,229	20,252	9,581	5,154	3,127	6,451
2006	2,462	1,011	927	9,245	6,819	11,345	16,877	14,650	20,427	9,750	5,174	3,302	8,492
2007	2,304	718	708	927	1,242	3,561	4,510	5,078	4,664	5,338	4,603	2,492	3,026
2008	1,479	703	410	630	677	2,055	4,567	5,139	4,664	5,338	4,603	2,707	2,755
2009	1,527	638	410	630	701	2,119	5,341	5,459	4,847	5,565	4,827	2,844	2,922
2010	1,944	828	460	679	751	2,169	3,215	5,789	6,405	7,204	5,174	3,307	3,177
2011	2,304	964	6,724	8,261	6,989	12,769	14,631	13,818	13,003	14,072	7,568	3,829	8,766
2012	2,533	844	708	927	964	2,748	4,602	5,251	4,743	5,395	4,688	2,846	3,029
1971-2012	2,094	943	1,297	2,632	3,994	6,340	7,248	7,029	7,873	7,051	5,274	3,049	4,571

Table 2. Minimum daily Tuolumne River above La Grange Dam flow by water year type, by water year, and for the period of record for the Base Case (cfs).

cfs	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Annual	Julian Day of Annual Min	3-day Min	7-day Min
C	480	491	400	621	657	883	1,578	2,526	2,265	3,221	2,740	888	400	--	--	--
D	480	584	400	621	873	1,093	2,318	2,532	2,691	3,809	3,190	1,069	400	--	--	--
BN	480	410	400	621	677	935	2,234	3,439	2,564	3,809	3,094	596	400	--	--	--
N	568	421	410	630	701	1,052	1,299	2,935	3,170	4,579	3,774	1,435	410	--	--	--
AN	440	492	390	611	701	1,052	2,027	3,496	3,423	4,821	3,856	1,820	390	--	--	--
W	440	421	390	611	701	1,052	1,035	4,288	3,602	4,926	4,195	1,744	390	--	--	--
1971	1,136	718	708	1,698	3,106	3,442	5,275	3,637	3,298	4,579	3,864	1,462	708	62	708	708
1972	914	640	460	679	903	1,389	2,680	4,037	3,215	4,529	3,815	1,369	460	61	460	460
1973	838	421	410	630	701	2,363	5,333	4,214	5,752	5,285	4,211	1,833	410	62	410	410
1974	1,136	718	708	2,989	5,252	5,800	6,549	4,124	5,803	4,821	4,211	1,833	708	62	708	711
1975	1,136	895	708	927	999	6,819	5,999	5,006	6,784	5,491	3,856	2,680	708	62	708	708
1976	1,136	914	817	927	1,163	1,634	2,374	3,897	3,046	4,341	3,204	1,058	817	85	817	817
1977	520	491	410	630	889	1,165	2,212	2,526	2,274	3,265	2,740	888	410	62	410	410
1978	440	492	390	611	701	1,052	1,035	5,709	3,645	4,926	4,211	2,716	390	62	390	390
1979	1,204	718	708	927	2,777	7,549	6,540	4,161	3,954	5,101	4,211	1,833	708	62	708	708
1980	1,136	718	708	927	7,675	8,751	6,513	8,234	7,385	9,793	4,306	2,920	708	61	708	708
1981	1,183	933	708	927	1,099	1,422	2,892	4,015	3,298	4,579	3,864	1,486	708	62	708	708
1982	898	480	470	689	4,851	13,026	4,758	12,102	14,905	5,980	4,528	2,590	470	62	470	470
1983	1,449	2,757	4,457	4,355	3,839	5,724	13,348	19,006	18,218	13,244	7,978	3,823	1,449	24	1,485	1,678
1984	1,223	718	7,370	4,835	4,506	6,315	5,597	4,343	3,619	4,915	4,211	1,820	718	31	718	718
1985	1,136	718	708	927	999	3,514	4,407	4,019	3,193	4,579	3,864	1,463	708	62	708	708
1986	838	421	410	630	701	13,749	9,264	9,200	7,394	5,285	4,211	1,795	410	62	410	410
1987	1,136	933	708	927	1,099	1,285	2,382	3,893	3,065	4,352	3,640	1,233	708	62	708	708
1988	520	591	410	630	667	968	2,013	3,178	2,628	3,809	3,190	1,083	410	61	410	410
1989	512	410	400	621	872	935	2,286	3,440	2,691	3,809	3,130	596	400	62	400	400
1990	480	584	400	621	873	1,093	2,318	2,532	2,691	3,809	3,190	1,069	400	62	400	400
1991	480	612	400	621	881	935	2,234	3,439	2,564	3,809	3,094	1,083	400	62	400	400
1992	480	612	400	621	657	883	1,578	2,971	2,265	3,221	2,740	933	400	61	400	400
1993	440	492	390	611	701	1,052	2,027	3,496	3,423	4,926	4,211	1,833	390	62	390	390

cfs	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Annual	Julian Day of Annual Min	3-day Min	7-day Min
1994	1,136	812	708	927	999	1,315	2,235	2,803	3,065	4,352	3,640	1,203	708	62	708	708
1995	568	421	410	630	701	1,052	11,075	15,255	18,488	14,074	5,658	2,482	410	62	410	410
1996	1,204	933	708	927	3,438	9,701	7,803	6,293	8,954	5,285	4,211	1,833	708	61	708	708
1997	1,136	718	708	9,810	8,701	6,673	5,144	4,288	3,602	4,926	4,211	1,826	708	62	708	708
1998	1,156	718	708	927	4,360	8,006	9,620	9,170	16,909	10,169	4,474	2,863	708	62	708	708
1999	1,136	718	708	1,173	5,468	7,357	5,313	4,167	4,781	5,285	4,211	1,827	708	62	708	708
2000	1,201	919	708	927	964	8,432	6,655	2,935	3,170	4,926	4,211	1,825	708	61	708	708
2001	1,136	900	708	927	999	1,350	3,100	3,731	3,283	4,579	3,864	1,433	708	62	708	708
2002	849	421	410	630	701	1,052	2,477	3,709	3,298	4,579	3,864	1,486	410	62	410	410
2003	907	421	410	630	701	1,052	3,407	3,747	3,298	4,579	3,774	1,486	410	62	410	410
2004	982	672	460	679	875	4,329	3,754	3,966	3,190	4,409	3,750	1,477	460	61	460	460
2005	838	421	410	630	701	8,459	8,626	7,694	17,629	5,285	4,195	1,744	410	62	410	410
2006	1,168	908	708	3,187	5,290	8,246	1,592	11,237	17,522	5,285	4,211	1,830	708	62	708	708
2007	1,136	718	708	927	1,183	1,569	2,451	3,863	3,065	4,352	3,640	1,144	708	62	708	708
2008	520	610	410	630	677	988	2,474	3,876	3,065	4,352	3,640	1,233	410	61	410	410
2009	568	597	410	630	701	1,052	2,705	3,825	3,265	4,579	3,864	1,435	410	62	410	410
2010	914	679	460	679	751	1,102	1,299	3,787	3,812	5,474	4,211	1,833	460	62	460	460
2011	1,136	718	1,934	4,823	4,894	9,193	11,180	12,784	11,799	11,337	4,661	2,629	718	32	718	718
2012	1,136	812	708	927	964	1,350	2,446	3,861	3,183	4,426	3,743	1,414	708	61	708	708
1971-2012	440	410	390	611	657	883	1,035	2,526	2,265	3,221	2,740	596	390	--	--	--

Table 3. Maximum daily Tuolumne River above La Grange Dam flow by water year type, by water year, and for the period of record for the Base Case (cfs).

cfs	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Annual	Julian Day of Annual Max	3-day Max	7-day Max
C	5,763	1,504	1,079	931	1,410	6,991	5,677	6,410	6,346	6,289	5,613	4,117	6,991	--	--	--
D	5,914	1,541	708	927	1,332	6,472	6,526	6,831	6,579	6,516	5,837	4,370	6,831	--	--	--
BN	5,763	1,063	708	927	5,784	7,205	7,844	7,157	6,545	6,516	5,837	4,341	7,844	--	--	--
N	7,125	1,236	1,893	5,287	12,899	13,741	10,601	9,861	14,757	8,839	6,184	4,717	14,757	--	--	--
AN	6,920	13,453	17,406	17,805	14,036	13,453	12,024	10,293	18,295	10,217	6,184	4,717	18,295	--	--	--
W	9,798	8,290	14,407	132,971	17,997	20,726	19,524	27,370	29,752	24,075	15,400	7,380	132,971	--	--	--
1971	5,763	718	1,893	3,034	4,670	5,868	9,694	8,504	6,579	6,516	5,837	4,279	9,694	199	9,416	9,340
1972	3,818	693	460	679	1,053	6,388	6,478	6,912	6,456	6,466	5,787	4,078	6,912	226	6,799	6,178
1973	3,743	421	410	630	701	8,204	9,943	9,861	14,757	8,709	6,184	4,717	14,757	255	13,333	11,632
1974	5,763	718	2,770	5,961	5,578	10,006	12,024	10,293	14,061	8,255	6,184	4,717	14,061	258	13,320	11,742
1975	5,763	1,037	708	927	7,661	11,223	11,179	8,445	18,295	9,657	5,613	4,717	18,295	259	15,386	13,287
1976	5,763	1,326	1,079	931	1,410	6,991	5,432	6,144	6,305	6,274	4,919	3,460	6,991	181	6,366	6,240
1977	3,402	520	410	630	1,189	5,133	4,614	3,788	4,688	4,715	4,219	2,935	5,133	181	4,773	4,685
1978	2,493	604	390	611	701	3,468	4,199	7,744	6,926	6,863	6,852	5,457	7,744	226	7,649	7,159
1979	7,125	718	708	5,287	9,157	9,934	10,601	8,825	13,301	6,807	6,184	4,717	13,301	256	12,405	10,546
1980	5,763	718	708	17,871	17,818	18,978	10,362	10,093	10,666	16,477	10,514	4,812	18,978	153	18,861	18,413
1981	5,914	1,541	708	927	1,128	6,472	6,307	6,681	6,579	6,516	5,837	4,370	6,681	226	6,571	6,190
1982	3,803	480	470	4,803	17,963	19,053	18,790	21,709	18,065	17,655	10,364	7,380	21,709	213	21,010	20,822
1983	9,798	8,290	10,504	12,635	16,805	20,480	18,369	20,670	21,498	23,283	15,400	5,013	23,283	287	22,718	21,046
1984	6,920	13,453	17,406	17,805	7,950	9,081	10,200	8,788	6,871	6,848	6,184	4,666	17,805	95	17,768	17,648
1985	5,763	718	708	927	3,196	5,779	7,844	7,157	6,355	6,516	5,837	4,287	7,844	199	7,401	7,030
1986	3,743	421	410	630	17,937	20,726	19,524	11,023	14,730	10,286	6,184	4,571	20,726	181	20,471	20,449
1987	5,763	1,504	708	927	1,128	3,701	5,677	6,410	6,346	6,289	5,613	4,117	6,410	226	6,296	5,930
1988	3,402	681	410	630	667	3,312	4,081	4,779	5,423	5,504	4,916	3,606	5,504	288	5,356	5,120
1989	3,257	410	400	621	926	3,049	5,480	5,845	5,561	5,504	4,823	1,837	5,845	226	5,746	5,207
1990	2,947	742	400	621	953	4,467	5,172	4,086	5,561	5,504	4,916	3,557	5,561	272	5,396	5,195
1991	2,947	1,033	400	621	1,065	3,049	5,340	5,833	5,287	5,504	4,765	3,606	5,833	226	5,735	5,197
1992	2,947	1,000	400	621	657	2,695	3,419	4,785	4,666	4,659	4,219	3,096	4,785	226	4,702	4,374
1993	2,493	660	390	611	701	3,468	6,112	7,543	6,452	6,863	6,184	4,717	7,543	226	7,458	6,996

cfs	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Annual	Julian Day of Annual Max	3-day Max	7-day Max
1994	5,763	886	708	927	999	4,132	5,339	4,879	6,346	6,289	5,613	4,001	6,346	272	6,159	5,930
1995	3,450	421	410	630	701	17,570	15,852	16,552	21,461	22,307	15,391	6,118	22,307	284	21,304	21,093
1996	5,996	1,541	708	927	14,036	13,453	11,895	10,152	15,935	10,217	6,184	4,717	15,935	252	15,236	13,870
1997	5,763	718	10,950	132,971	17,997	9,779	9,667	8,699	9,997	6,925	6,184	4,689	132,971	95	99,271	65,273
1998	5,828	718	708	5,063	17,169	16,818	15,336	10,601	19,752	19,872	13,090	4,707	19,872	274	19,706	19,534
1999	5,763	718	1,250	5,809	12,902	11,274	10,443	8,514	14,606	7,759	6,184	4,698	14,606	262	13,365	12,902
2000	5,986	1,236	708	927	12,899	13,741	10,531	8,506	10,354	6,863	6,184	4,688	13,741	153	13,471	13,134
2001	5,763	1,059	708	927	999	4,981	5,474	6,936	6,545	6,516	5,837	4,175	6,936	213	6,368	6,142
2002	3,786	421	410	630	701	3,468	6,104	6,627	6,579	6,516	5,837	4,370	6,627	226	6,511	6,161
2003	4,097	421	410	630	701	3,468	9,394	7,975	6,579	6,516	5,693	4,370	9,394	204	9,222	9,044
2004	4,172	1,063	460	747	5,784	7,205	7,499	6,723	6,355	6,305	5,670	4,341	7,499	199	7,112	6,990
2005	3,743	421	410	630	11,019	14,756	13,908	27,370	29,752	19,349	6,161	4,387	29,752	244	28,516	25,293
2006	5,857	1,267	2,967	15,801	7,508	13,019	19,232	21,383	25,945	19,924	6,184	4,707	25,945	250	24,901	23,689
2007	5,763	718	708	927	1,332	6,113	5,870	6,464	6,346	6,289	5,613	3,787	6,464	226	6,352	5,930
2008	3,402	932	410	630	677	3,403	5,962	6,575	6,346	6,289	5,613	4,117	6,575	226	6,460	5,930
2009	3,450	740	410	630	701	3,468	7,186	7,283	6,507	6,516	5,837	4,186	7,283	226	7,176	6,706
2010	3,818	1,197	460	679	751	3,517	4,728	7,992	14,591	8,839	6,184	4,717	14,591	271	14,175	11,138
2011	5,763	1,944	14,407	14,522	8,967	18,632	17,470	14,726	14,309	24,075	11,178	4,983	24,075	280	22,397	18,715
2012	5,763	924	708	927	964	4,946	6,526	6,831	6,393	6,338	5,683	4,230	6,831	213	6,600	6,145
1971-2012	9,798	13,453	17,406	132,971	17,997	20,726	19,524	27,370	29,752	24,075	15,400	7,380	132,971	--	--	--

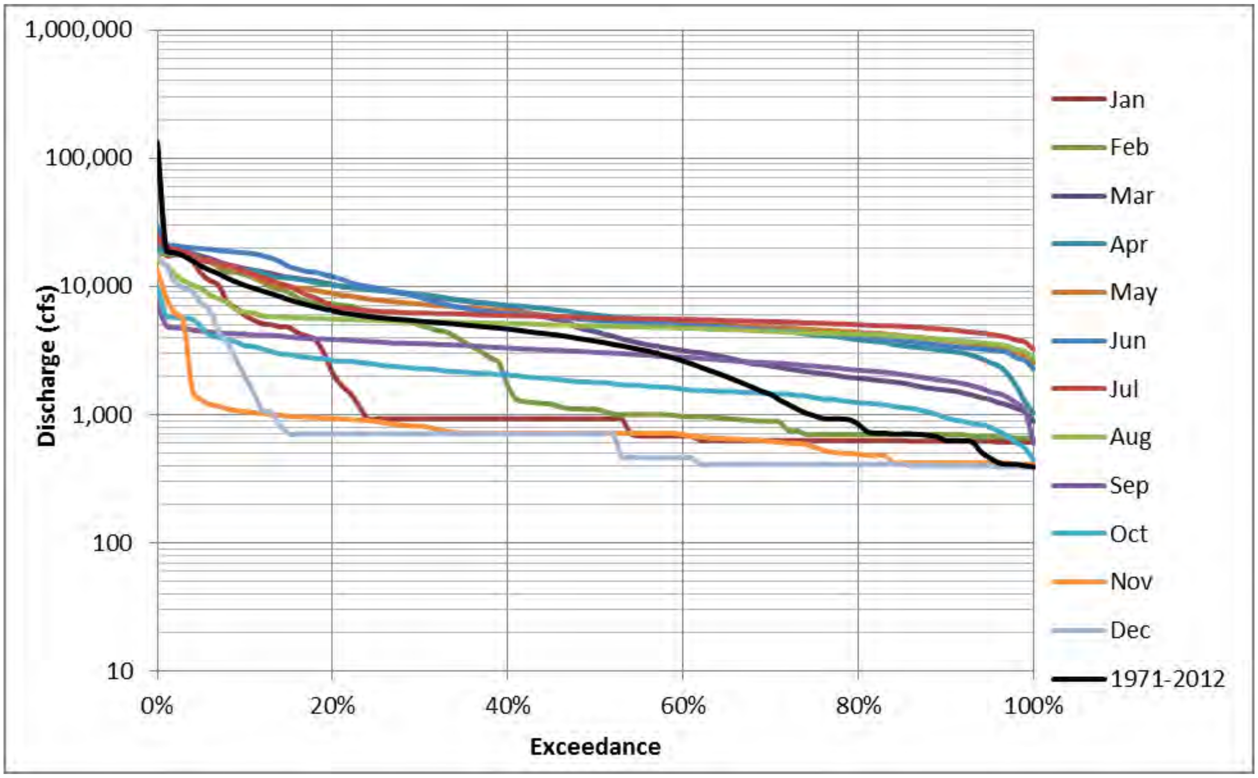


Figure 1. **Tuolumne River above La Grange Dam flow duration curves by month and for the period of record for the Base Case (cfs).**

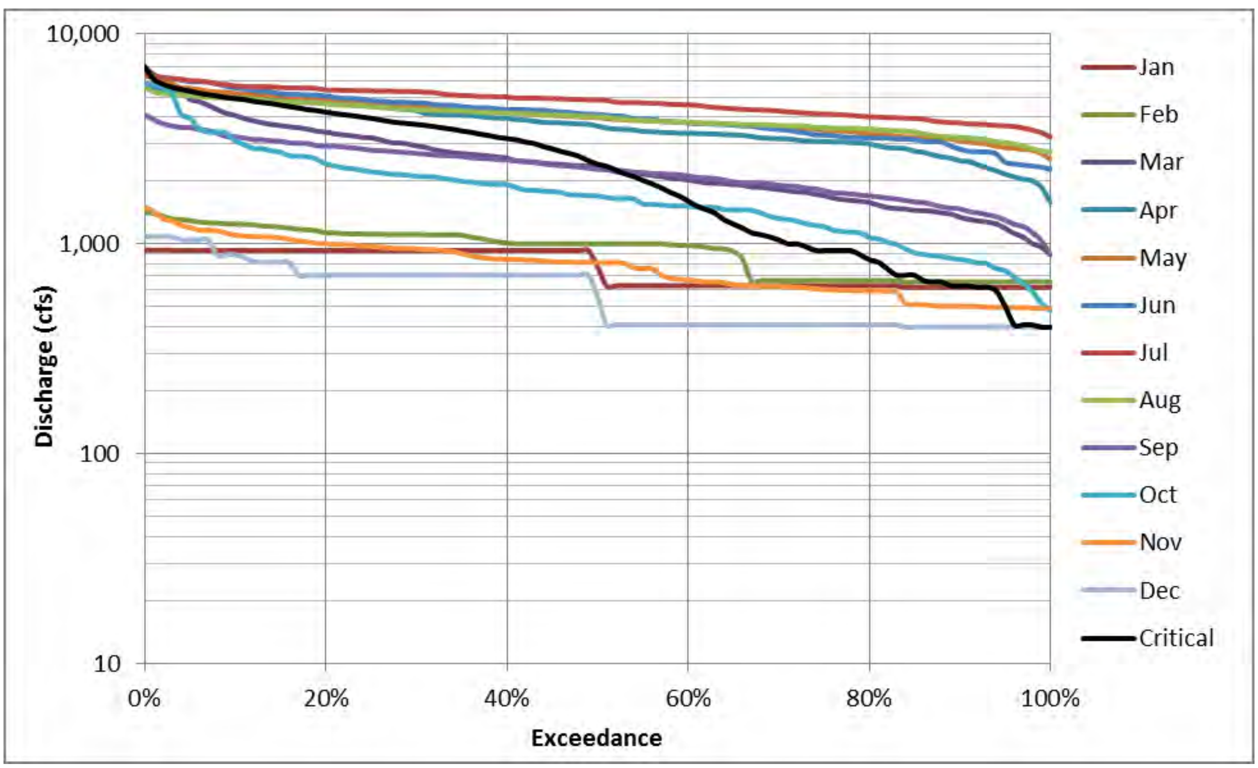


Figure 2. **Tuolumne River above La Grange Dam flow duration curves for Critical years by month and for all Critical years for the Base Case (cfs).**

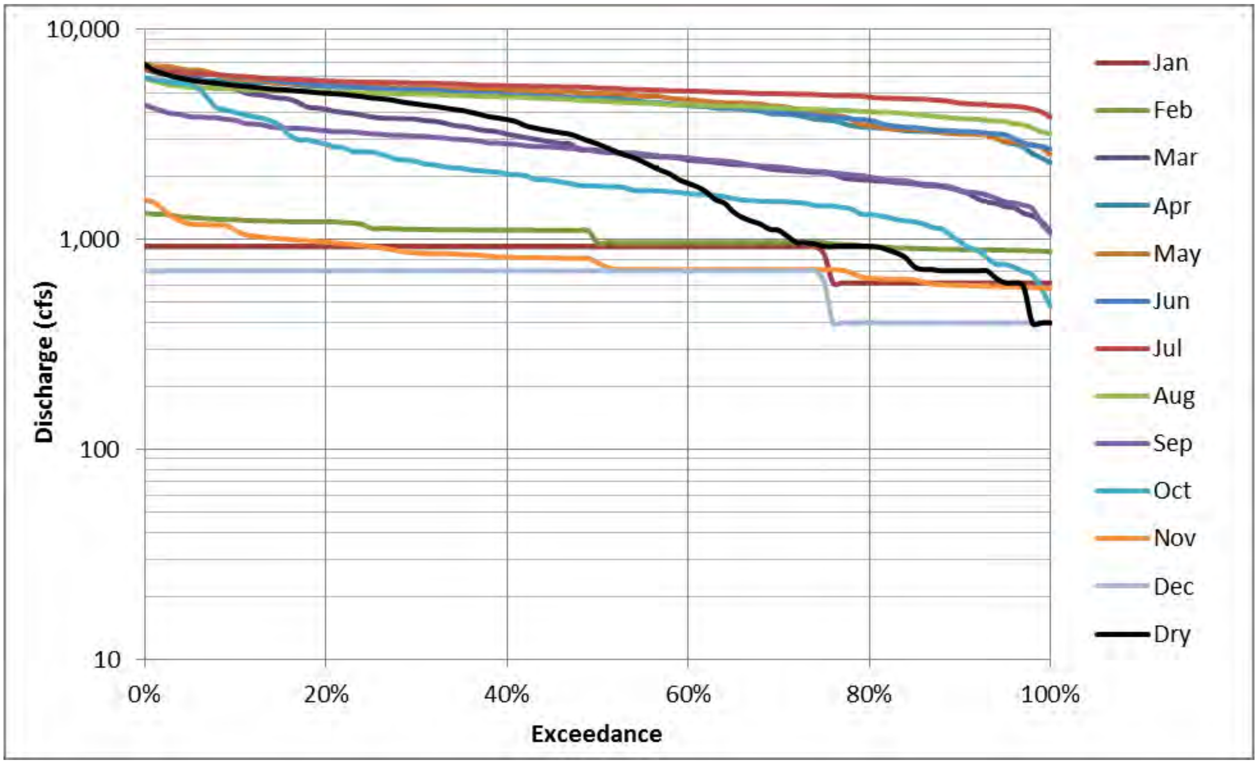


Figure 3. **Tuolumne River above La Grange Dam flow duration curves for Dry years by month and for all Dry years for the Base Case (cfs).**

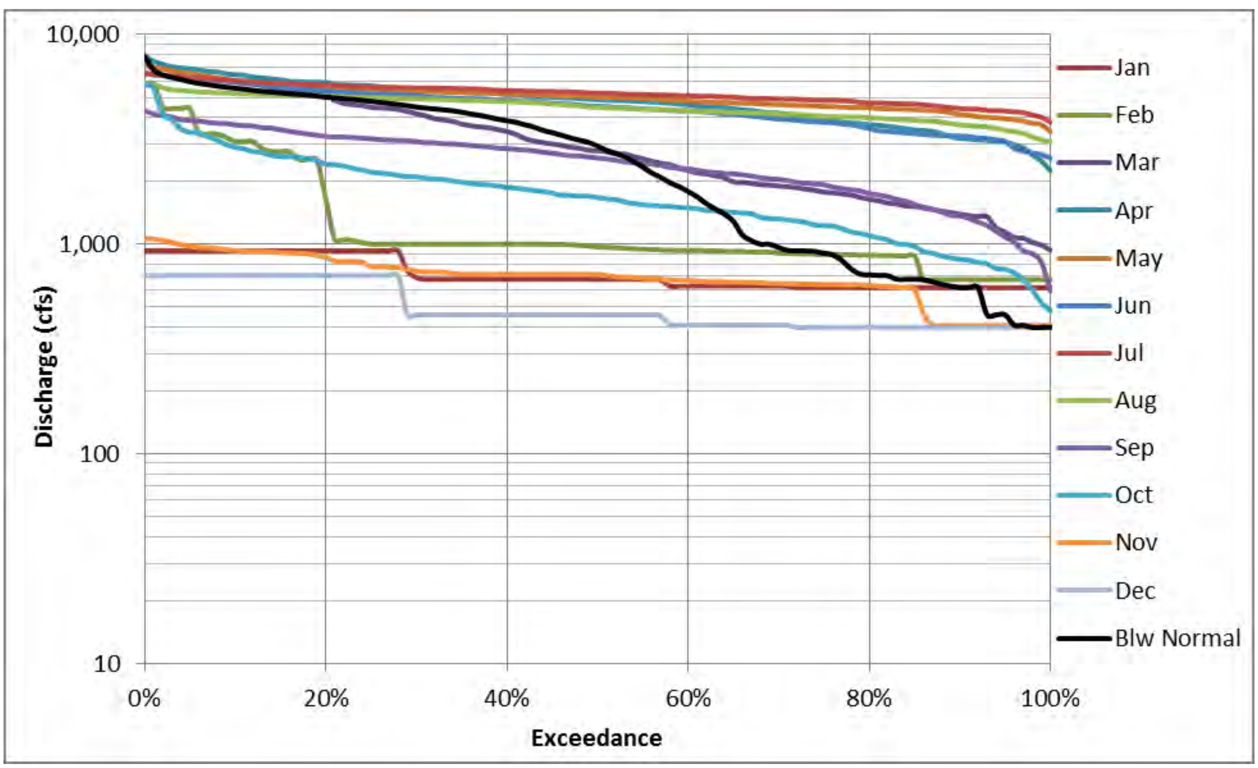


Figure 4. **Tuolumne River above La Grange Dam flow duration curves for Below Normal years by month and for all Below Normal years for the Base Case (cfs).**

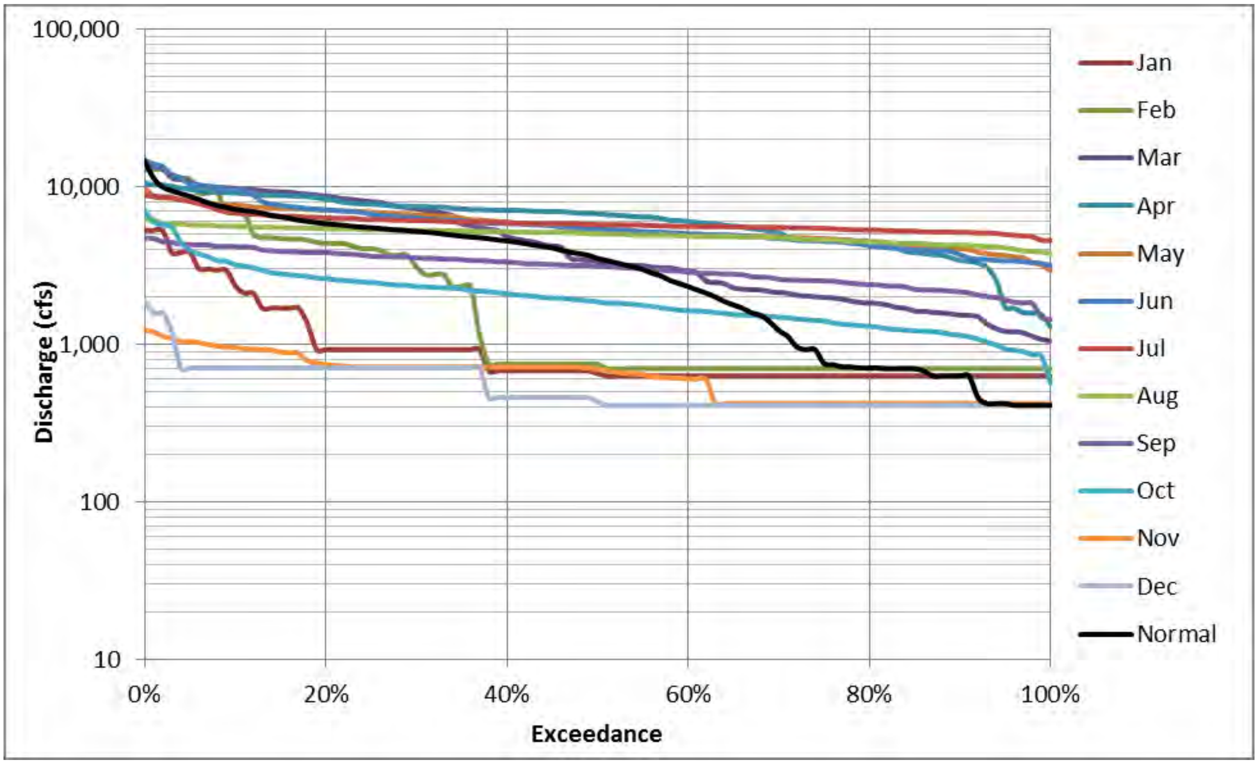


Figure 5. **Tuolumne River above La Grange Dam flow duration curves for Normal years by month and for all Normal years for the Base Case (cfs).**

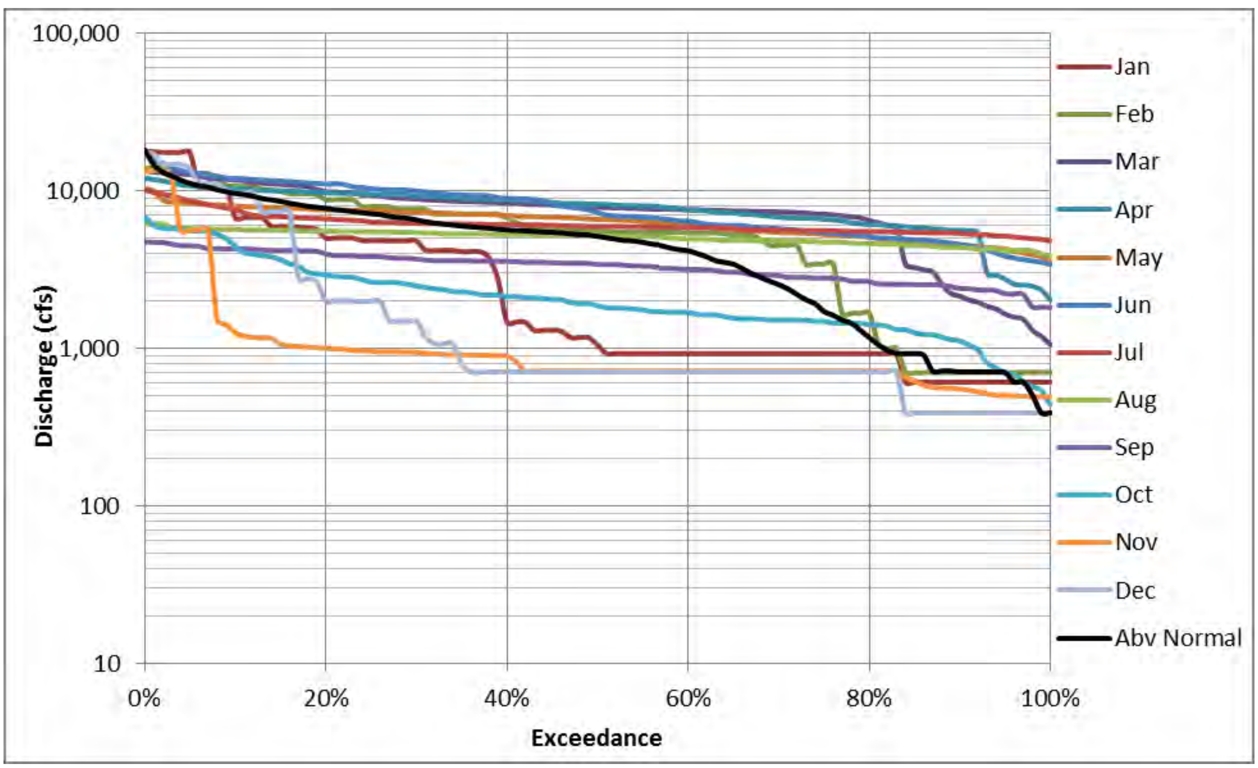


Figure 6. **Tuolumne River above La Grange Dam flow duration curves for Above Normal years by month and for all Above Normal years for the Base Case (cfs).**

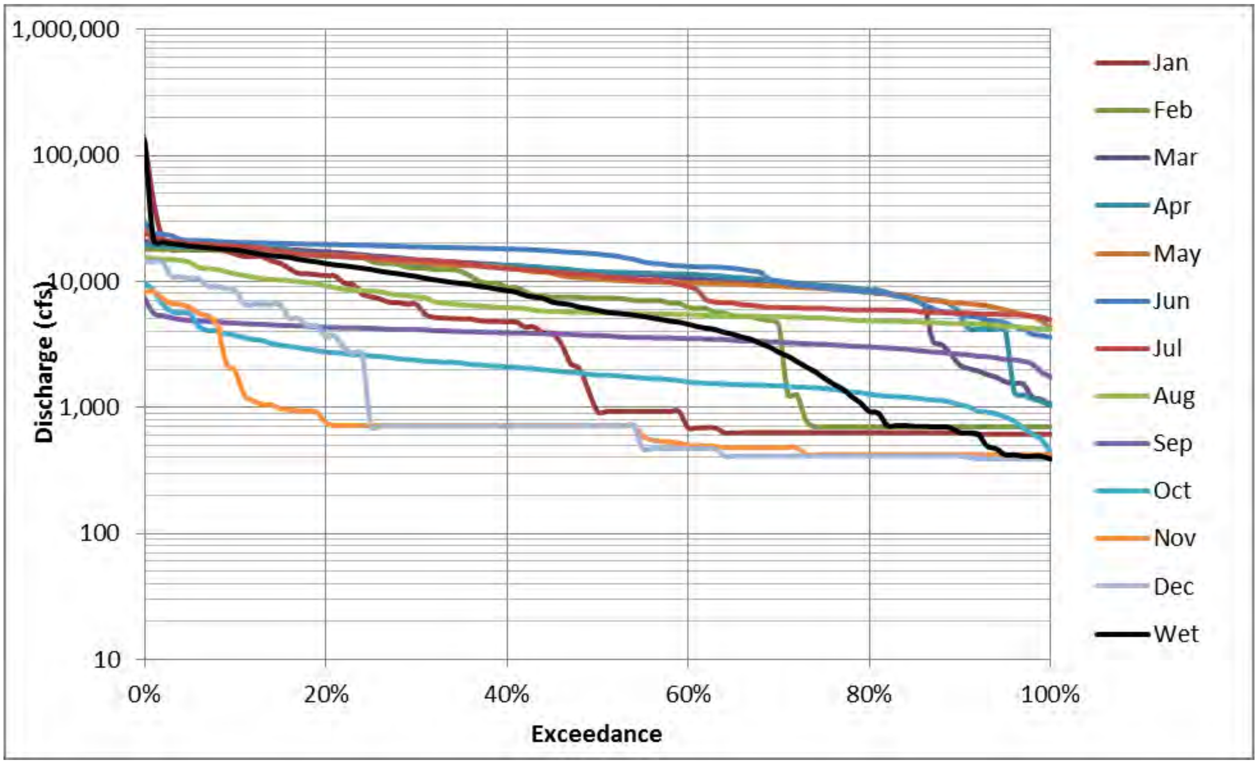


Figure 7. Tuolumne River above La Grange Dam flow duration curves for Wet years by month and for all Wet years for the Base Case (cfs).

Turlock Canal

Table 1. Average Turlock Canal flow by water year type, by water year, and for the period of record for the Base Case (cfs).

cfs	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Annual
C	374	86	16	98	185	784	1,020	1,168	1,376	1,595	1,310	670	726
D	393	78	16	98	193	834	1,129	1,288	1,517	1,742	1,472	777	798
BN	383	72	16	98	174	724	1,147	1,385	1,493	1,738	1,460	740	789
N	431	48	16	98	143	679	882	1,278	1,569	1,830	1,556	861	787
AN	396	59	16	98	142	679	898	1,279	1,565	1,803	1,537	866	782
W	399	31	16	98	144	679	584	1,175	1,526	1,829	1,554	751	737
1971	424	17	16	98	144	679	990	1,273	1,600	1,836	1,560	846	795
1972	424	69	16	98	218	1,134	1,283	1,482	1,586	1,836	1,560	826	881
1973	424	17	16	98	144	679	737	1,428	1,594	1,836	1,560	869	788
1974	424	17	16	98	144	679	649	1,324	1,539	1,656	1,560	869	753
1975	424	80	16	98	144	679	982	1,374	1,600	1,821	1,423	869	797
1976	424	112	16	98	236	1,156	1,131	1,449	1,544	1,791	1,326	626	829
1977	346	17	16	98	252	985	1,081	888	1,125	1,326	1,108	557	653
1978	212	80	16	98	144	679	146	1,163	1,600	1,836	1,560	605	683
1979	468	17	16	98	144	679	885	1,401	1,600	1,786	1,560	869	798
1980	424	17	16	98	139	679	812	1,311	1,600	1,741	1,560	869	775
1981	444	134	16	98	200	679	1,083	1,447	1,600	1,836	1,560	869	835
1982	424	17	16	98	144	679	299	1,273	1,549	1,836	1,560	421	699
1983	424	17	16	98	144	679	223	1,173	1,600	1,836	1,493	416	682
1984	424	17	16	98	139	679	1,236	1,484	1,578	1,832	1,560	854	829
1985	424	17	16	98	144	679	1,121	1,476	1,539	1,836	1,560	856	819
1986	424	17	16	98	144	679	591	1,290	1,600	1,836	1,560	826	762
1987	424	128	16	98	200	679	1,148	1,448	1,558	1,796	1,507	800	821
1988	346	75	16	98	139	664	969	1,157	1,335	1,561	1,307	691	699
1989	315	17	16	98	205	609	1,119	1,259	1,359	1,561	1,279	315	683
1990	279	83	16	98	210	843	1,130	885	1,359	1,561	1,307	682	707
1991	279	111	16	98	231	609	1,091	1,262	1,301	1,561	1,263	691	712
1992	279	106	16	98	139	540	711	1,069	1,135	1,302	1,108	582	592
1993	212	88	16	98	144	679	710	1,125	1,471	1,836	1,560	869	738
1994	424	75	16	98	144	679	1,082	1,001	1,558	1,796	1,507	765	766
1995	346	17	16	98	144	679	404	937	1,441	1,832	1,560	869	700
1996	468	134	16	98	139	679	757	943	1,600	1,836	1,560	869	761
1997	424	17	16	98	144	679	1,310	1,468	1,578	1,836	1,560	859	837
1998	432	17	16	98	144	679	512	613	1,353	1,836	1,560	869	682
1999	424	17	16	98	144	679	1,052	1,422	1,600	1,836	1,560	869	814
2000	468	96	16	98	139	679	597	901	1,375	1,836	1,560	869	722
2001	424	80	16	98	144	679	815	1,338	1,594	1,836	1,560	826	789
2002	424	17	16	98	144	679	1,174	1,305	1,600	1,836	1,560	869	814
2003	468	17	16	98	144	679	1,095	1,321	1,600	1,836	1,525	869	810
2004	468	107	16	98	139	679	1,363	1,440	1,512	1,736	1,488	869	828
2005	424	17	16	98	144	679	903	1,301	1,600	1,836	1,550	792	785
2006	428	107	16	98	144	679	477	1,144	1,600	1,836	1,560	869	751
2007	424	17	16	98	224	1,136	1,208	1,436	1,558	1,796	1,507	723	850
2008	346	102	16	98	139	679	1,235	1,438	1,558	1,796	1,507	800	812
2009	346	80	16	98	144	679	1,262	1,363	1,584	1,836	1,560	834	821
2010	424	123	16	98	144	679	314	1,231	1,600	1,836	1,560	869	746
2011	424	17	16	98	144	681	750	1,253	1,258	1,860	1,568	869	750
2012	424	80	16	98	139	679	1,093	1,386	1,549	1,776	1,515	836	802
1971-2012	398	57	16	98	159	716	894	1,254	1,512	1,769	1,494	778	766

Table 2. Minimum daily Turlock Canal flow by water year type, by water year, and for the period of record for the Base Case (cfs).

cfs	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Annual	Julian Day of Annual Min	3-day Min	7-day Min
C	1	17	16	98	139	230	465	606	682	1,100	829	152	1	--	--	--
D	1	17	16	98	139	264	700	604	826	1,321	982	196	1	--	--	--
BN	1	17	16	98	139	247	537	851	790	1,321	948	66	1	--	--	--
N	1	17	16	98	139	264	231	626	852	1,520	1,162	295	1	--	--	--
AN	1	17	16	98	139	264	435	654	911	1,408	1,083	302	1	--	--	--
W	1	17	16	98	139	264	111	436	790	1,481	1,137	146	1	--	--	--
1971	1	17	16	98	144	264	643	872	991	1,562	1,189	299	1	14	16	16
1972	1	64	16	98	190	379	822	1,010	982	1,562	1,189	292	1	13	16	16
1973	1	17	16	98	144	264	489	974	987	1,562	1,189	307	1	14	16	16
1974	1	17	16	98	144	264	435	906	953	1,408	1,189	307	1	14	16	16
1975	1	64	16	98	144	264	638	939	991	1,549	1,083	307	1	14	16	16
1976	1	64	16	98	191	385	722	977	940	1,518	997	176	1	13	16	16
1977	1	17	16	98	198	342	691	606	682	1,121	829	152	1	12	1	16
1978	1	64	16	98	144	264	111	800	991	1,562	1,189	213	1	12	1	16
1979	7	17	16	98	144	264	580	957	991	1,520	1,189	307	7	14	16	16
1980	1	17	16	98	139	264	535	897	991	1,481	1,189	307	1	13	16	16
1981	2	64	16	98	195	264	700	987	991	1,562	1,189	307	2	14	16	16
1982	1	17	16	98	144	264	222	872	959	1,562	1,189	148	1	14	16	16
1983	1	17	16	98	144	264	176	806	991	1,562	1,137	146	1	14	16	16
1984	1	17	16	98	139	264	794	1,011	977	1,559	1,189	302	1	13	16	16
1985	1	17	16	98	144	264	724	1,006	953	1,562	1,189	303	1	14	16	16
1986	1	17	16	98	144	264	400	883	991	1,562	1,189	292	1	14	16	16
1987	1	64	16	98	195	264	732	976	949	1,522	1,135	238	1	14	16	16
1988	1	64	16	98	139	261	623	784	811	1,321	982	199	1	11	1	16
1989	1	17	16	98	195	247	714	851	826	1,321	960	66	1	12	1	16
1990	1	64	16	98	196	306	721	604	826	1,321	982	196	1	12	1	16
1991	1	64	16	98	197	247	697	853	790	1,321	948	199	1	12	1	16
1992	1	64	16	98	139	230	465	726	688	1,100	829	161	1	11	1	16
1993	1	64	16	98	144	264	473	774	911	1,562	1,189	307	1	12	1	16
1994	1	64	16	98	144	264	692	681	949	1,522	1,135	226	1	14	16	16

cfs	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Annual	Julian Day of Annual Min	3-day Min	7-day Min
1995	1	17	16	98	144	264	286	650	893	1,559	1,189	307	1	12	1	16
1996	7	64	16	98	139	264	501	654	991	1,562	1,189	307	7	13	16	16
1997	1	17	16	98	144	264	839	1,001	977	1,562	1,189	304	1	14	16	16
1998	1	17	16	98	144	264	352	436	839	1,562	1,189	307	1	14	16	16
1999	1	17	16	98	144	264	681	970	991	1,562	1,189	307	1	14	16	16
2000	7	64	16	98	139	264	403	626	852	1,562	1,189	307	7	13	16	16
2001	1	64	16	98	144	264	537	915	987	1,562	1,189	292	1	14	16	16
2002	1	17	16	98	144	264	756	893	991	1,562	1,189	307	1	14	16	16
2003	7	17	16	98	144	264	708	903	991	1,562	1,162	307	7	14	16	16
2004	7	64	16	98	139	264	871	982	936	1,477	1,133	307	7	13	16	16
2005	1	17	16	98	144	264	590	891	991	1,562	1,181	280	1	14	16	16
2006	1	64	16	98	144	264	330	787	991	1,562	1,189	307	1	14	16	16
2007	1	17	16	98	196	380	769	968	949	1,522	1,135	211	1	14	16	16
2008	1	64	16	98	139	264	785	969	949	1,522	1,135	238	1	11	1	16
2009	1	64	16	98	144	264	810	931	981	1,562	1,189	295	1	12	1	16
2010	1	64	16	98	144	264	231	844	991	1,562	1,189	307	1	14	16	16
2011	1	17	16	98	144	264	492	850	790	1,562	1,189	307	1	14	16	16
2012	1	64	16	98	139	264	706	946	959	1,510	1,154	296	1	13	16	16
1971-2012	1	17	16	98	139	230	111	436	682	1,100	829	66	1	--	--	--

Table 3. Maximum daily Turlock Canal flow by water year type, by water year, and for the period of record for the Base Case (cfs).

cfs	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Annual	Julian Day of Annual Max	3-day Max	7-day Max
C	1,206	290	16	98	341	2,072	1,470	1,841	2,211	2,057	1,768	1,236	2,211	--	--	--
D	1,254	308	16	98	270	2,034	1,549	1,828	2,253	2,097	1,822	1,305	2,253	--	--	--
BN	1,312	228	16	98	287	2,030	1,744	1,873	2,244	2,097	1,822	1,305	2,244	--	--	--
N	1,312	271	16	98	144	1,170	1,613	1,804	2,253	2,097	1,822	1,305	2,253	--	--	--
AN	1,312	308	16	98	144	1,170	1,580	1,875	2,253	2,097	1,822	1,305	2,253	--	--	--
W	1,225	214	16	98	144	1,170	1,676	1,855	2,253	2,478	1,822	1,305	2,478	--	--	--
1971	1,206	17	16	98	144	1,170	1,258	1,605	2,253	2,097	1,822	1,272	2,253	268	2,069	1,945
1972	1,206	83	16	98	263	2,030	1,640	1,873	2,233	2,097	1,822	1,242	2,233	268	2,051	1,940
1973	1,206	17	16	98	144	1,170	929	1,804	2,244	2,097	1,822	1,305	2,244	268	2,061	1,943
1974	1,206	17	16	98	144	1,170	815	1,671	2,167	1,892	1,822	1,305	2,167	268	1,990	1,861
1975	1,206	120	16	98	144	1,170	1,248	1,735	2,253	2,080	1,661	1,305	2,253	268	2,069	1,934
1976	1,206	233	16	98	308	2,072	1,448	1,841	2,191	2,052	1,558	975	2,191	268	2,009	1,974
1977	1,125	17	16	98	341	1,749	1,383	1,121	1,600	1,522	1,304	873	1,749	176	1,688	1,667
1978	789	120	16	98	144	1,170	165	1,465	2,253	2,097	1,822	910	2,253	268	2,069	1,945
1979	1,312	17	16	98	144	1,170	1,122	1,769	2,253	2,040	1,822	1,305	2,253	268	2,069	1,934
1980	1,206	17	16	98	139	1,170	1,028	1,654	2,253	1,988	1,822	1,305	2,253	268	2,069	1,934
1981	1,254	308	16	98	210	1,170	1,380	1,828	2,253	2,097	1,822	1,305	2,253	268	2,069	1,945
1982	1,206	17	16	98	144	1,170	359	1,605	2,181	2,097	1,822	634	2,181	268	2,003	1,927
1983	1,206	17	16	98	144	1,170	260	1,477	2,253	2,097	1,743	627	2,253	268	2,069	1,945
1984	1,206	17	16	98	139	1,170	1,580	1,875	2,222	2,092	1,822	1,283	2,222	268	2,041	1,934
1985	1,206	17	16	98	144	1,170	1,430	1,865	2,167	2,097	1,822	1,287	2,167	268	1,990	1,926
1986	1,206	17	16	98	144	1,170	739	1,627	2,253	2,097	1,822	1,242	2,253	268	2,069	1,945
1987	1,206	290	16	98	210	1,170	1,470	1,838	2,211	2,057	1,768	1,236	2,211	268	2,027	1,904
1988	1,125	101	16	98	139	1,143	1,237	1,465	1,896	1,789	1,536	1,073	1,896	268	1,738	1,649
1989	1,049	17	16	98	221	1,039	1,433	1,597	1,930	1,789	1,503	508	1,930	268	1,769	1,658
1990	957	130	16	98	234	1,480	1,447	1,117	1,930	1,789	1,536	1,060	1,930	268	1,769	1,658
1991	957	228	16	98	287	1,039	1,396	1,601	1,848	1,789	1,485	1,073	1,848	268	1,694	1,639
1992	957	212	16	98	139	909	901	1,353	1,615	1,494	1,304	909	1,615	268	1,480	1,384
1993	789	149	16	98	144	1,170	895	1,415	2,071	2,097	1,822	1,305	2,097	284	1,987	1,926

cfs	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Annual	Julian Day of Annual Max	3-day Max	7-day Max
1994	1,206	101	16	98	144	1,170	1,385	1,266	2,211	2,057	1,768	1,184	2,211	268	2,027	1,904
1995	1,125	17	16	98	144	1,170	496	1,175	2,029	2,092	1,822	1,305	2,092	284	1,982	1,921
1996	1,312	308	16	98	139	1,170	955	1,182	2,253	2,097	1,822	1,305	2,253	268	2,069	1,945
1997	1,206	17	16	98	144	1,170	1,676	1,855	2,222	2,097	1,822	1,290	2,222	268	2,041	1,938
1998	1,225	17	16	98	144	1,170	636	759	1,905	2,097	1,822	1,305	2,097	284	1,987	1,926
1999	1,206	17	16	98	144	1,170	1,339	1,796	2,253	2,097	1,822	1,305	2,253	268	2,069	1,945
2000	1,312	177	16	98	139	1,170	746	1,128	1,935	2,097	1,822	1,305	2,097	284	1,987	1,926
2001	1,206	120	16	98	144	1,170	1,031	1,688	2,244	2,097	1,822	1,242	2,244	268	2,061	1,943
2002	1,206	17	16	98	144	1,170	1,498	1,646	2,253	2,097	1,822	1,305	2,253	268	2,069	1,945
2003	1,312	17	16	98	144	1,170	1,396	1,666	2,253	2,097	1,781	1,305	2,253	268	2,069	1,945
2004	1,312	214	16	98	139	1,170	1,744	1,818	2,128	1,983	1,737	1,305	2,128	268	1,955	1,839
2005	1,206	17	16	98	144	1,170	1,145	1,642	2,253	2,097	1,810	1,190	2,253	268	2,069	1,945
2006	1,216	214	16	98	144	1,170	591	1,440	2,253	2,097	1,822	1,305	2,253	268	2,069	1,945
2007	1,206	17	16	98	270	2,034	1,549	1,824	2,211	2,057	1,768	1,121	2,211	268	2,027	1,938
2008	1,125	196	16	98	139	1,170	1,584	1,826	2,211	2,057	1,768	1,236	2,211	268	2,027	1,904
2009	1,125	120	16	98	144	1,170	1,613	1,720	2,231	2,097	1,822	1,253	2,231	268	2,049	1,940
2010	1,206	271	16	98	144	1,170	378	1,551	2,253	2,097	1,822	1,305	2,253	268	2,069	1,945
2011	1,206	17	16	98	144	1,170	1,098	1,563	1,795	2,478	1,822	1,305	2,478	274	2,143	1,964
2012	1,206	120	16	98	139	1,170	1,392	1,750	2,181	2,028	1,769	1,257	2,181	268	2,003	1,882
1971-2012	1,312	308	16	98	341	2,072	1,744	1,875	2,253	2,478	1,822	1,305	2,478	--	--	--

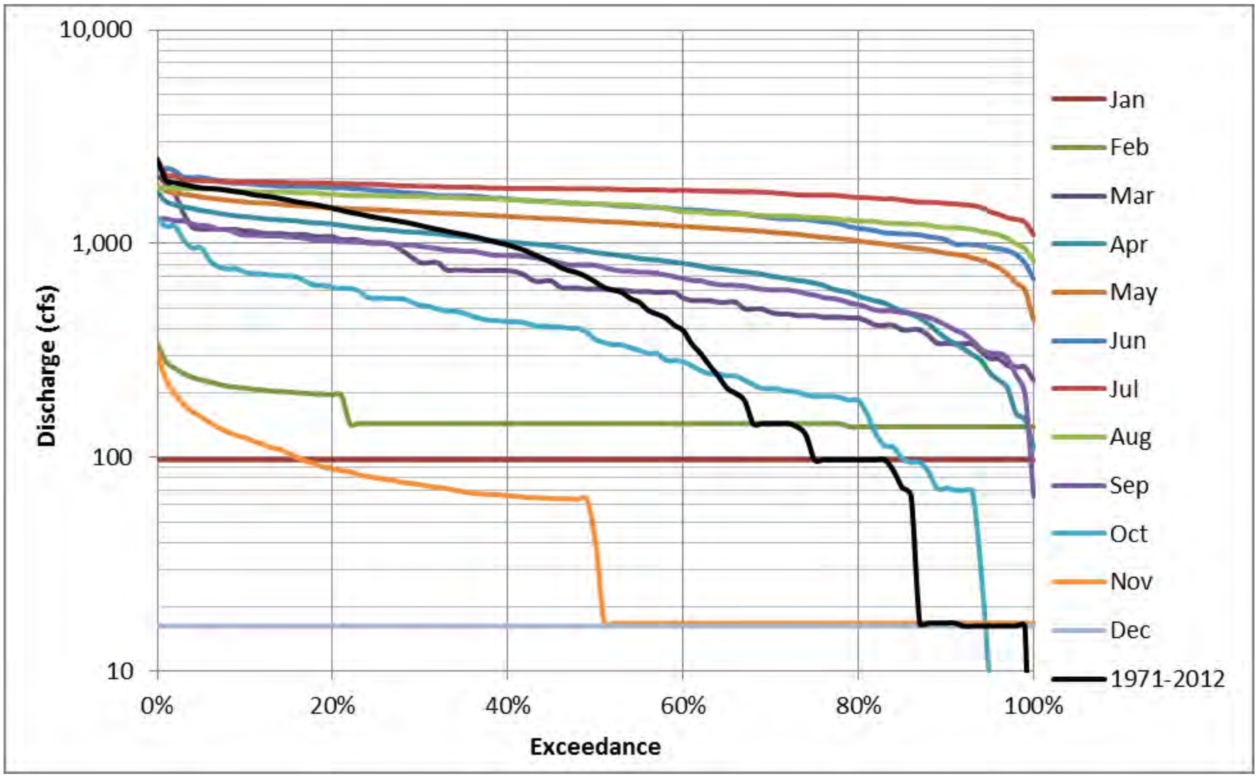


Figure 1. **Turlock Canal flow duration curves by month and for the period of record for the Base Case (cfs).**

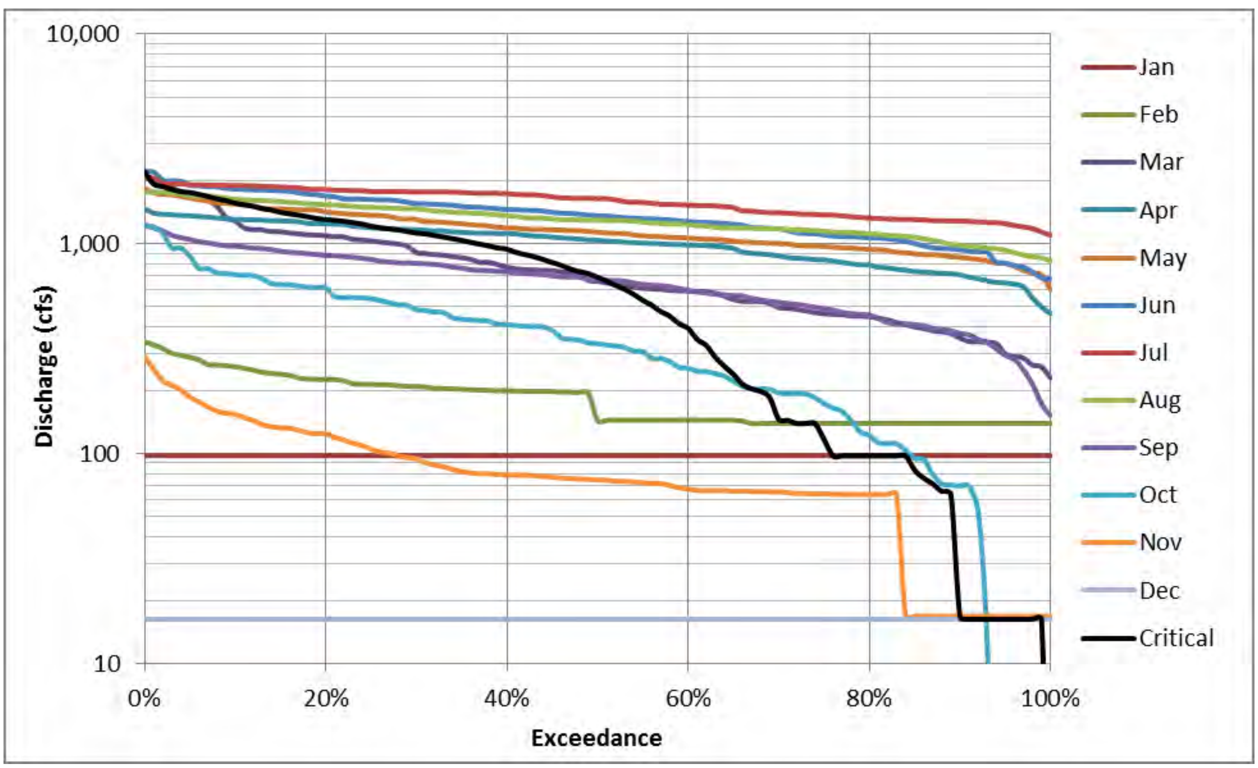


Figure 2. **Turlock Canal flow duration curves for Critical years by month and for all Critical years for the Base Case (cfs).**

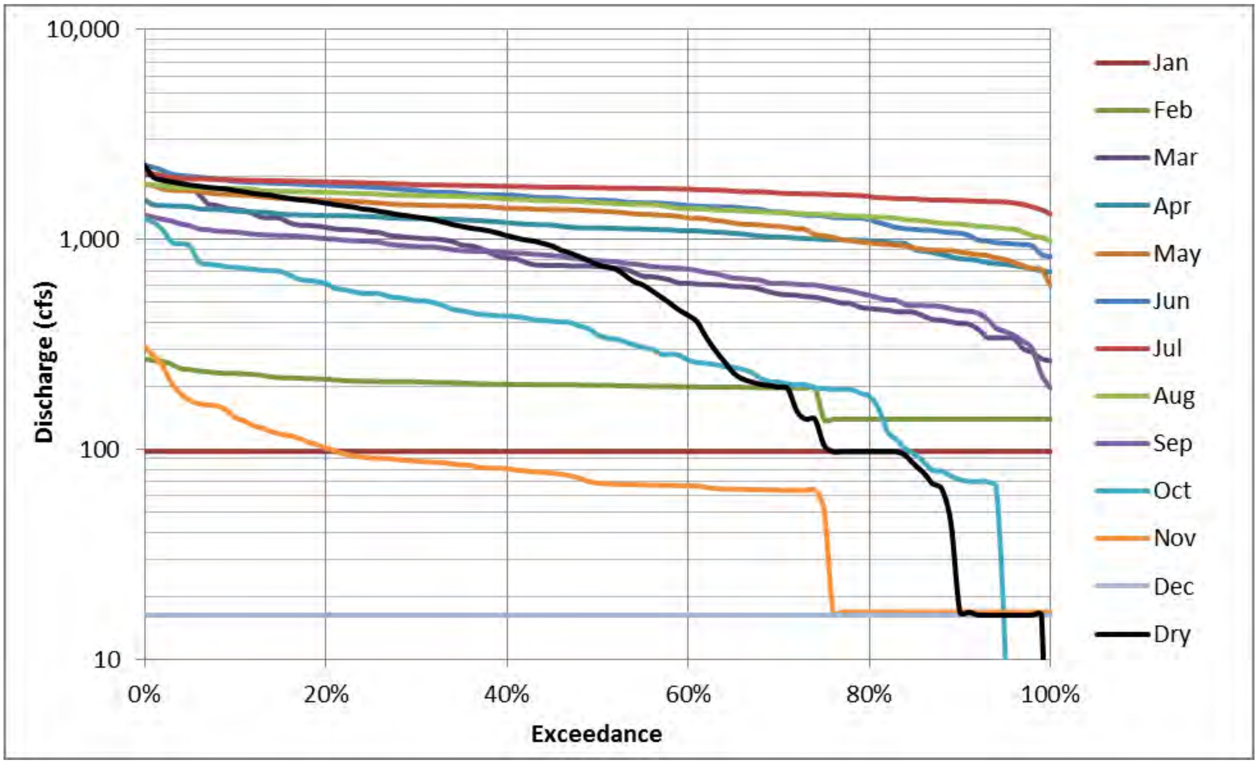


Figure 3. **Turlock Canal flow duration curves for Dry years by month and for all Dry years for the Base Case (cfs).**

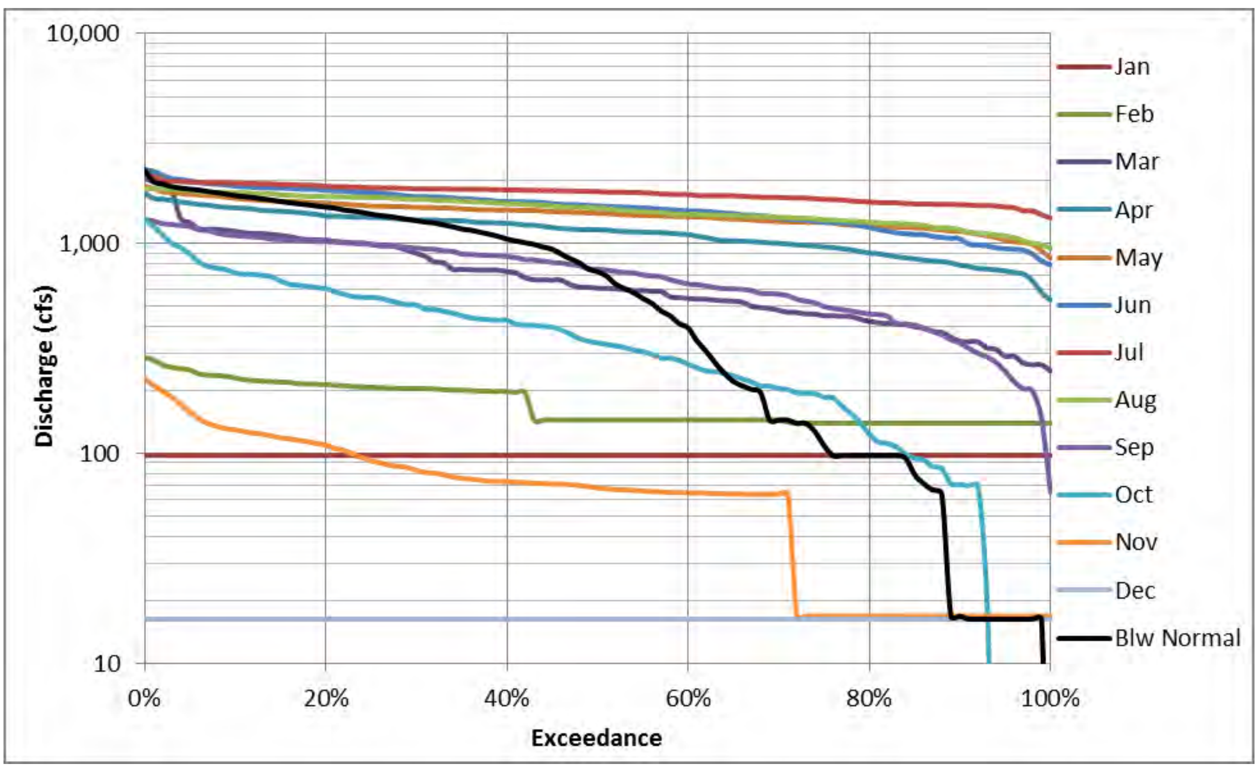


Figure 4. **Turlock Canal flow duration curves for Below Normal years by month and for all Below Normal years for the Base Case (cfs).**

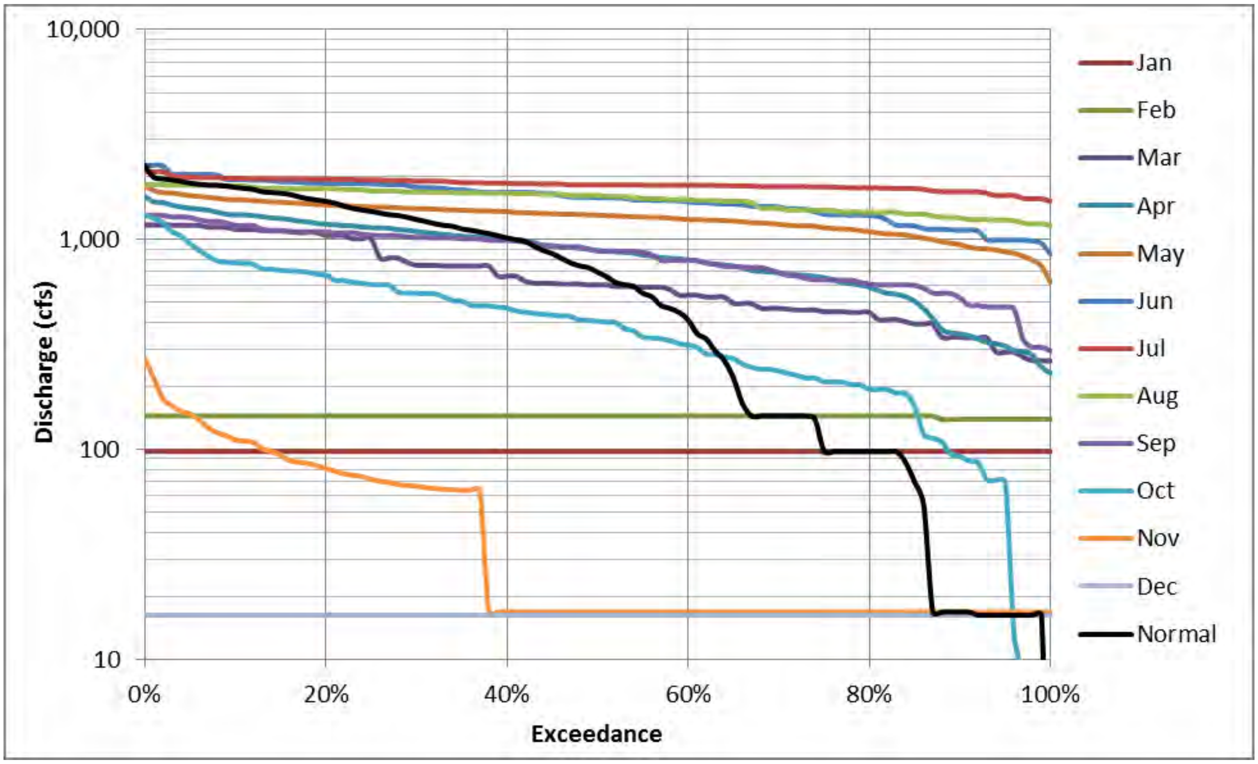


Figure 5. **Turlock Canal flow duration curves for Normal years by month and for all Normal years for the Base Case (cfs).**

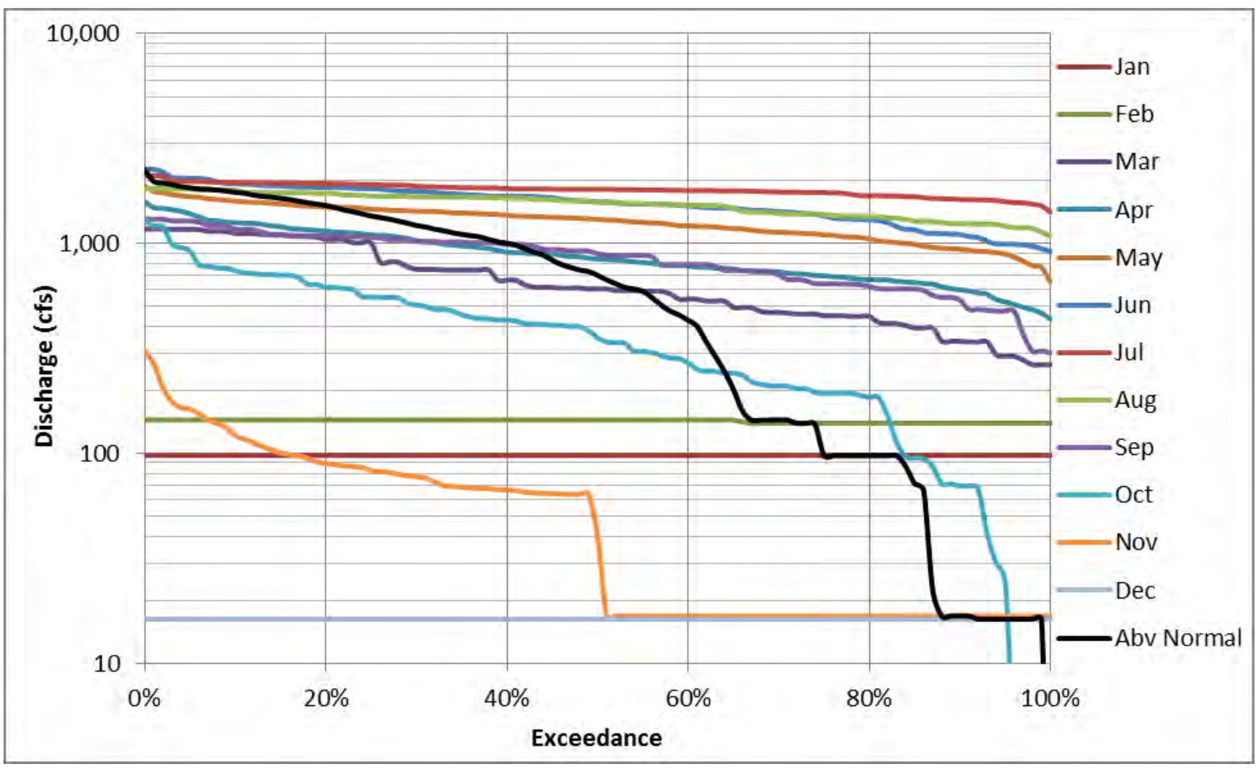


Figure 6. **Turlock Canal flow duration curves for Above Normal years by month and for all Above Normal years**

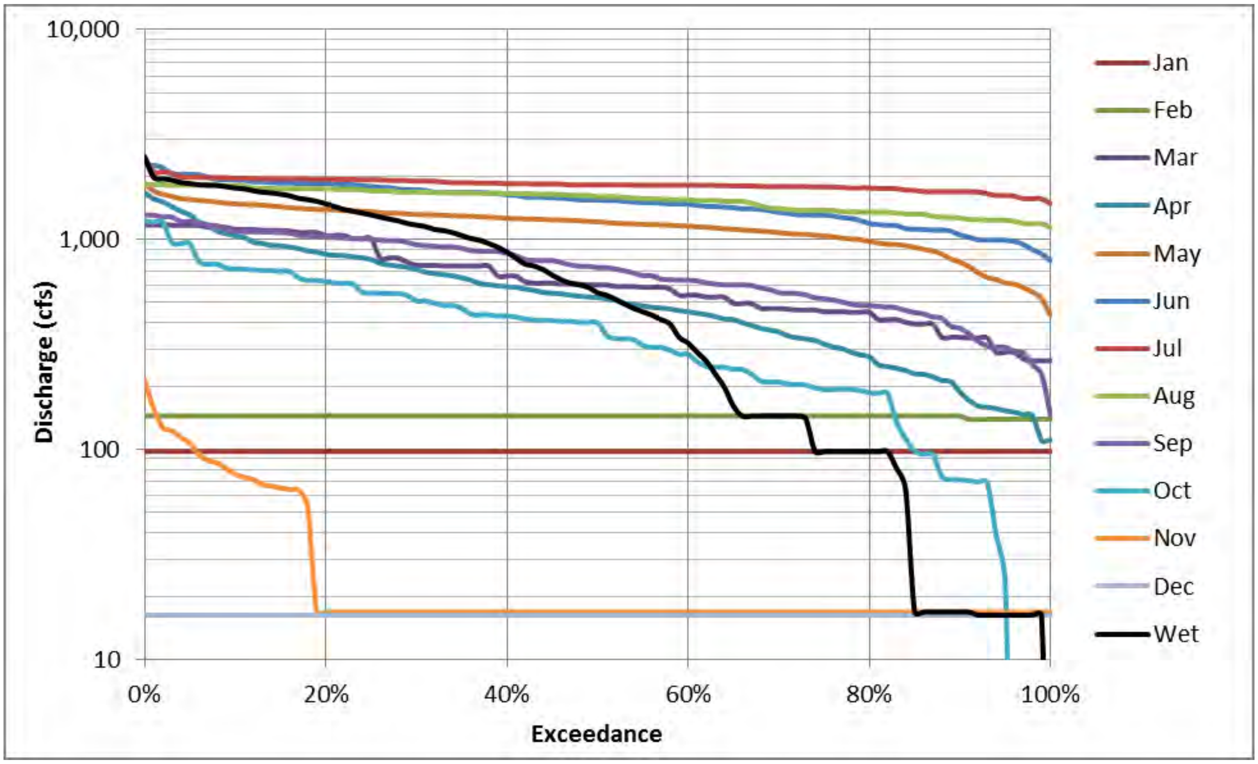


Figure 7. **Turlock Canal flow duration curves for Wet years by month and for all Wet years for the Base Case (cfs).**

Modesto Canal

Table 1. Average Modesto Canal flow by water year type, by water year, and for the period of record for the Base Case (cfs).

cfs	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Annual
C	301	93	40	69	73	281	524	583	661	760	674	453	378
D	324	75	39	69	79	284	598	664	746	845	759	508	417
BN	313	85	39	69	82	268	587	710	735	845	754	479	415
N	349	69	41	70	59	240	464	689	774	892	795	544	418
AN	324	64	39	68	59	240	459	666	780	879	783	548	411
W	326	50	40	69	59	240	352	643	763	888	796	485	395
1971	341	45	41	70	59	240	515	698	794	894	798	541	422
1972	341	86	41	70	99	404	705	757	782	894	798	515	459
1973	341	45	41	70	59	240	399	738	790	894	798	549	416
1974	341	45	41	70	59	240	304	698	760	809	798	549	395
1975	341	92	41	70	59	240	484	727	794	892	706	549	418
1976	341	108	41	70	113	510	671	720	742	843	663	468	442
1977	274	86	41	70	109	323	537	443	562	642	588	371	339
1978	199	34	30	61	59	240	170	645	794	894	798	429	365
1979	382	45	41	70	59	240	459	734	794	878	798	549	423
1980	341	45	41	70	57	240	413	700	794	826	798	549	408
1981	378	125	41	70	59	240	561	742	794	894	798	549	440
1982	341	45	41	70	59	240	213	698	764	894	798	290	374
1983	341	45	41	70	59	240	186	652	794	894	773	267	366
1984	341	45	41	70	57	240	634	761	794	892	798	546	436
1985	341	45	41	70	59	240	556	751	772	894	798	536	428
1986	341	45	41	70	59	240	331	687	794	894	798	541	406
1987	341	125	41	70	59	207	646	720	744	845	764	515	425
1988	274	86	41	70	52	196	441	586	629	745	676	456	355
1989	273	40	36	65	96	183	563	633	653	745	666	259	353
1990	237	85	36	65	96	296	593	448	653	745	676	449	366
1991	237	109	36	65	101	183	539	628	613	745	658	456	365
1992	237	109	36	65	47	158	300	537	548	641	588	396	306
1993	199	34	30	61	59	240	389	601	748	894	798	549	386
1994	341	45	41	70	59	288	547	494	744	845	764	510	398
1995	274	45	41	70	59	240	268	536	738	894	798	549	378
1996	382	125	41	70	57	240	416	502	792	894	798	549	407
1997	341	45	41	70	59	240	692	740	782	894	798	549	440
1998	357	45	41	70	59	240	343	316	730	894	798	546	372
1999	341	45	41	70	59	240	525	709	792	894	798	544	424
2000	378	114	41	70	57	240	336	477	651	894	798	541	385
2001	341	97	41	70	59	240	367	719	788	894	798	528	414
2002	353	45	41	70	59	240	607	747	794	894	798	549	436
2003	382	45	41	70	59	240	457	717	794	894	775	549	421
2004	382	114	41	70	104	419	771	761	794	894	798	541	475
2005	341	45	41	70	59	240	612	751	792	894	798	517	432
2006	374	103	41	70	59	240	220	679	794	894	798	546	404
2007	341	45	41	70	102	359	627	712	744	845	764	484	430
2008	274	103	41	70	57	207	605	720	744	845	764	515	413
2009	274	92	41	70	59	240	709	719	784	894	798	525	436
2010	341	120	41	70	59	240	228	681	794	894	798	549	404
2011	341	45	41	70	59	240	418	675	613	894	798	549	398
2012	341	45	41	70	57	240	610	753	792	894	798	549	434
1971-2012	324	70	40	69	67	255	476	660	747	858	766	502	405

Table 2. Minimum daily Modesto Canal flow by water year type, by water year, and for the period of record for the Base Case (cfs).

cfs	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Annual	Julian Day of Annual Min	3-day Min	7-day Min
C	102	45	36	65	47	65	141	315	338	472	433	235	36	--	--	--
D	102	45	36	65	57	92	233	321	401	547	496	280	36	--	--	--
BN	102	40	36	65	57	73	204	437	378	547	483	179	36	--	--	--
N	120	45	41	70	57	114	111	357	424	656	577	340	41	--	--	--
AN	84	34	30	61	57	114	186	373	479	608	529	349	30	--	--	--
W	84	34	30	61	57	114	111	253	402	620	575	202	30	--	--	--
1971	187	45	41	70	59	114	249	499	506	668	592	348	41	62	41	41
1972	187	81	41	70	97	142	306	537	499	668	592	334	41	61	41	41
1973	187	45	41	70	59	114	214	525	503	668	592	352	41	62	41	41
1974	187	45	41	70	59	114	186	499	486	608	592	352	41	62	41	41
1975	187	81	41	70	59	114	239	517	506	667	529	352	41	62	41	41
1976	187	81	41	70	105	134	260	499	454	618	489	294	41	61	41	41
1977	120	81	41	70	99	92	212	315	346	473	433	235	41	62	41	41
1978	84	34	30	61	59	114	111	465	506	668	592	288	30	62	30	30
1979	203	45	41	70	59	114	232	522	506	656	592	352	41	62	41	41
1980	187	45	41	70	57	114	218	500	506	620	592	352	41	61	41	41
1981	201	81	41	70	59	114	263	527	506	668	592	352	41	62	41	41
1982	187	45	41	70	59	114	111	499	489	668	592	214	41	62	41	41
1983	187	45	41	70	59	114	111	469	506	668	575	202	41	62	41	41
1984	187	45	41	70	57	114	284	539	506	667	592	351	41	61	41	41
1985	187	45	41	70	59	114	261	533	493	668	592	345	41	62	41	41
1986	187	45	41	70	59	114	194	491	506	668	592	348	41	62	41	41
1987	187	81	41	70	59	82	253	499	455	619	558	319	41	62	41	41
1988	120	81	41	70	52	75	187	410	387	547	496	284	41	61	41	41
1989	116	40	36	65	94	73	224	440	401	547	489	179	36	62	36	36
1990	102	75	36	65	94	92	233	321	401	547	496	280	36	62	36	36
1991	102	75	36	65	97	73	216	437	378	547	483	284	36	62	36	36
1992	102	75	36	65	47	65	141	376	338	472	433	249	36	61	36	36
1993	84	34	30	61	59	114	211	436	479	668	592	352	30	62	30	30

cfs	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Annual	Julian Day of Annual Min	3-day Min	7-day Min
1994	187	45	41	70	59	95	223	353	455	619	558	316	41	62	41	41
1995	120	45	41	70	59	114	175	395	474	668	592	352	41	62	41	41
1996	203	81	41	70	57	114	219	373	504	668	592	352	41	61	41	41
1997	187	45	41	70	59	114	302	526	499	668	592	352	41	62	41	41
1998	193	45	41	70	59	114	197	253	469	668	592	351	41	62	41	41
1999	187	45	41	70	59	114	252	506	504	668	592	349	41	62	41	41
2000	201	81	41	70	57	114	195	357	424	668	592	348	41	61	41	41
2001	187	81	41	70	59	114	204	512	502	668	592	341	41	62	41	41
2002	192	45	41	70	59	114	276	531	506	668	592	352	41	62	41	41
2003	203	45	41	70	59	114	231	511	506	668	577	352	41	62	41	41
2004	203	81	41	70	99	145	325	539	506	668	592	348	41	61	41	41
2005	187	45	41	70	59	114	278	533	504	668	592	336	41	62	41	41
2006	200	81	41	70	59	114	111	487	506	668	592	351	41	62	41	41
2007	187	45	41	70	100	108	247	494	455	619	558	302	41	62	41	41
2008	120	81	41	70	57	82	240	499	455	619	558	319	41	61	41	41
2009	120	81	41	70	59	114	307	512	500	668	592	340	41	62	41	41
2010	187	81	41	70	59	114	111	488	506	668	592	352	41	62	41	41
2011	187	45	41	70	59	114	220	484	402	668	592	352	41	62	41	41
2012	187	45	41	70	57	114	277	534	504	668	592	352	41	61	41	41
1971-2012	84	34	30	61	47	65	111	253	338	472	433	179	30	--	--	--

Table 3. Maximum daily Modesto Canal flow by water year type, by water year, and for the period of record for the Base Case (cfs).

cfs	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Annual	Julian Day of Annual Max	3-day Max	7-day Max
C	531	199	41	70	135	1,278	895	977	1,153	1,208	1,018	877	1,278	--	--	--
D	597	199	41	70	108	870	834	1,007	1,204	1,257	1,052	910	1,257	--	--	--
BN	604	170	41	70	115	978	1,014	1,017	1,204	1,257	1,052	896	1,257	--	--	--
N	604	184	41	70	59	496	929	999	1,204	1,257	1,052	910	1,257	--	--	--
AN	604	199	41	70	59	496	825	1,017	1,204	1,257	1,052	910	1,257	--	--	--
W	589	140	41	70	59	496	905	1,004	1,204	1,257	1,052	910	1,257	--	--	--
1971	531	45	41	70	59	496	660	929	1,204	1,257	1,052	896	1,257	288	1,224	1,126
1972	531	95	41	70	104	937	923	1,012	1,184	1,257	1,052	847	1,257	288	1,224	1,113
1973	531	45	41	70	59	496	500	985	1,197	1,257	1,052	910	1,257	288	1,224	1,122
1974	531	45	41	70	59	496	369	929	1,149	1,130	1,052	910	1,149	271	1,130	1,058
1975	531	110	41	70	59	496	617	969	1,204	1,253	924	910	1,253	288	1,221	1,125
1976	531	155	41	70	135	1,278	895	977	1,150	1,205	877	789	1,278	181	1,173	1,073
1977	464	95	41	70	133	793	715	590	870	913	778	620	913	288	889	813
1978	342	34	30	61	59	496	195	853	1,204	1,257	1,052	687	1,257	288	1,224	1,126
1979	604	45	41	70	59	496	583	980	1,204	1,232	1,052	910	1,232	288	1,200	1,120
1980	531	45	41	70	57	496	520	931	1,204	1,155	1,052	910	1,204	271	1,184	1,101
1981	597	199	41	70	59	496	724	991	1,204	1,257	1,052	910	1,257	288	1,224	1,126
1982	531	45	41	70	59	496	245	929	1,156	1,257	1,052	429	1,257	288	1,224	1,094
1983	531	45	41	70	59	496	212	864	1,204	1,257	1,017	386	1,257	288	1,224	1,126
1984	531	45	41	70	57	496	825	1,017	1,204	1,253	1,052	906	1,253	288	1,221	1,125
1985	531	45	41	70	59	496	717	1,004	1,168	1,257	1,052	886	1,257	288	1,224	1,103
1986	531	45	41	70	59	496	406	913	1,204	1,257	1,052	896	1,257	288	1,224	1,126
1987	531	199	41	70	59	463	861	977	1,153	1,208	1,018	877	1,208	288	1,176	1,076
1988	464	95	41	70	52	442	580	790	972	1,062	898	772	1,062	288	1,034	919
1989	467	40	36	65	101	407	748	856	1,011	1,062	884	406	1,062	288	1,034	945
1990	403	101	36	65	101	710	789	595	1,011	1,062	898	759	1,062	288	1,034	945
1991	403	166	36	65	110	407	714	849	947	1,062	873	772	1,062	288	1,034	916
1992	403	166	36	65	47	350	387	723	846	911	778	667	911	288	887	796
1993	342	34	30	61	59	496	486	792	1,130	1,257	1,052	910	1,257	288	1,224	1,090

cfs	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Annual	Julian Day of Annual Max	3-day Max	7-day Max
1994	531	45	41	70	59	680	724	657	1,153	1,208	1,018	867	1,208	288	1,176	1,076
1995	464	45	41	70	59	496	319	700	1,114	1,257	1,052	910	1,257	288	1,224	1,090
1996	604	199	41	70	57	496	523	652	1,200	1,257	1,052	910	1,257	288	1,224	1,124
1997	531	45	41	70	59	496	905	988	1,184	1,257	1,052	910	1,257	288	1,224	1,113
1998	560	45	41	70	59	496	423	389	1,101	1,257	1,052	906	1,257	288	1,224	1,090
1999	531	45	41	70	59	496	674	945	1,200	1,257	1,052	901	1,257	288	1,224	1,124
2000	597	170	41	70	57	496	413	617	973	1,257	1,052	896	1,257	288	1,224	1,090
2001	531	125	41	70	59	496	456	958	1,194	1,257	1,052	872	1,257	288	1,224	1,120
2002	553	45	41	70	59	496	788	999	1,204	1,257	1,052	910	1,257	288	1,224	1,126
2003	604	45	41	70	59	496	580	956	1,204	1,257	1,020	910	1,257	288	1,224	1,126
2004	604	170	41	70	115	978	1,014	1,017	1,204	1,257	1,052	896	1,257	288	1,224	1,126
2005	531	45	41	70	59	496	794	1,004	1,200	1,257	1,052	852	1,257	288	1,224	1,124
2006	589	140	41	70	59	496	255	902	1,204	1,257	1,052	906	1,257	288	1,224	1,126
2007	531	45	41	70	108	870	834	966	1,153	1,208	1,018	818	1,208	288	1,176	1,076
2008	464	140	41	70	57	463	804	977	1,153	1,208	1,018	877	1,208	288	1,176	1,076
2009	464	110	41	70	59	496	929	958	1,188	1,257	1,052	867	1,257	288	1,224	1,116
2010	531	184	41	70	59	496	265	905	1,204	1,257	1,052	910	1,257	288	1,224	1,126
2011	531	45	41	70	59	496	527	896	912	1,257	1,052	910	1,257	288	1,224	1,090
2012	531	45	41	70	57	496	791	1,007	1,200	1,257	1,052	910	1,257	288	1,224	1,124
1971-2012	604	199	41	70	135	1,278	1,014	1,017	1,204	1,257	1,052	910	1,278	--	--	--

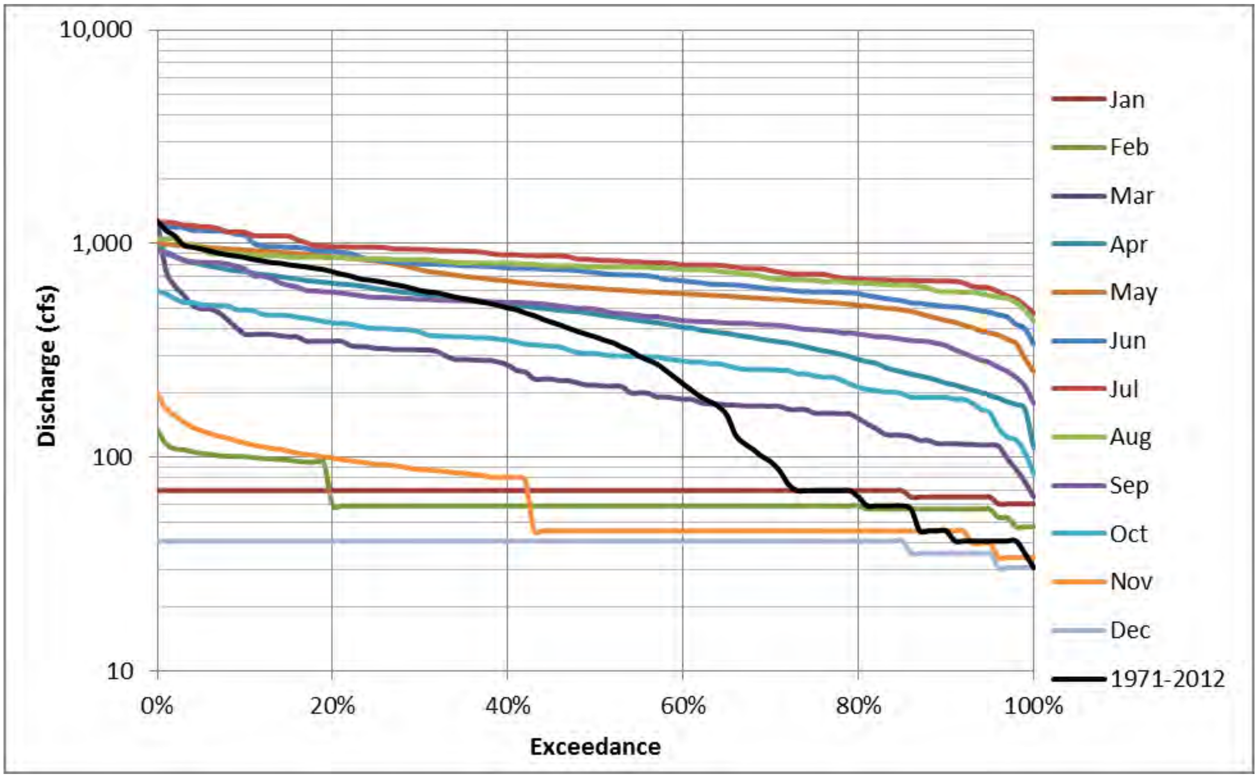


Figure 1. **Modesto Canal flow duration curves by month and for the period of record for the Base Case (cfs).**

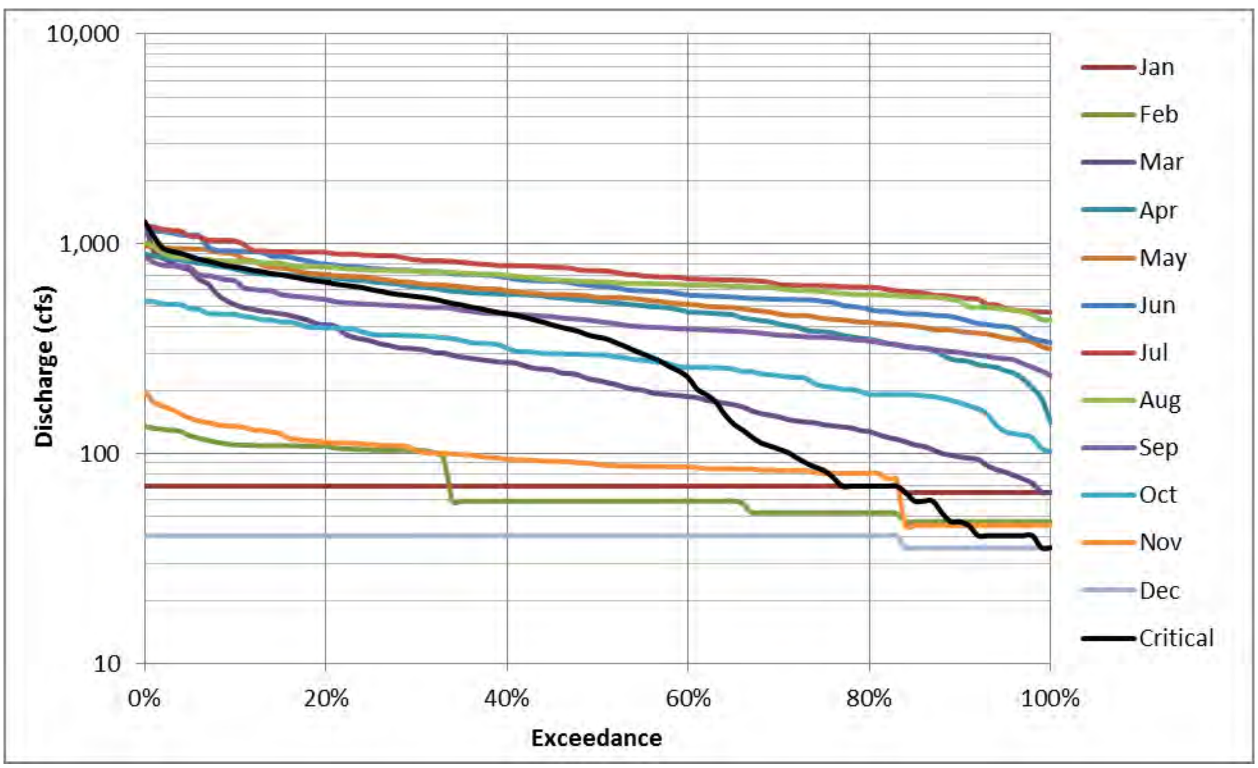


Figure 2. **Modesto Canal flow duration curves for Critical years by month and for all Critical years for the Base Case (cfs).**

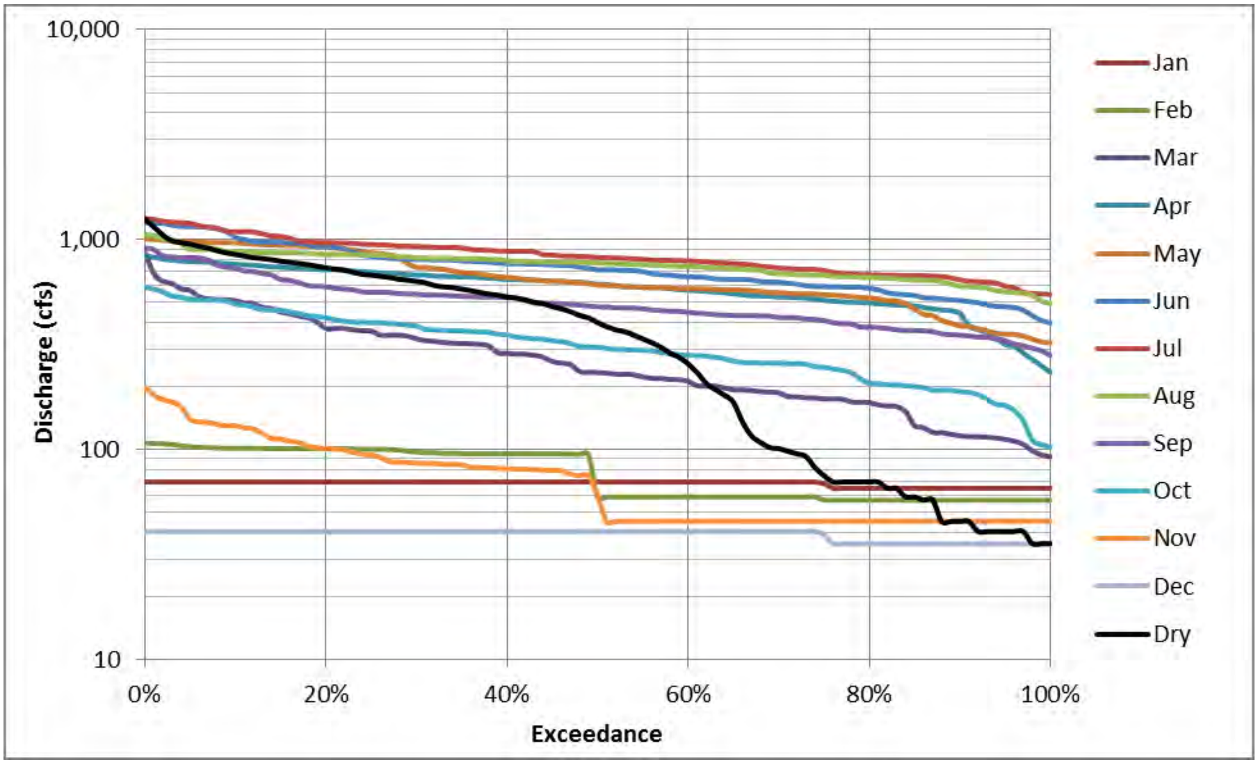


Figure 3. **Modesto Canal flow duration curves for Dry years by month and for all Dry years for the Base Case (cfs).**

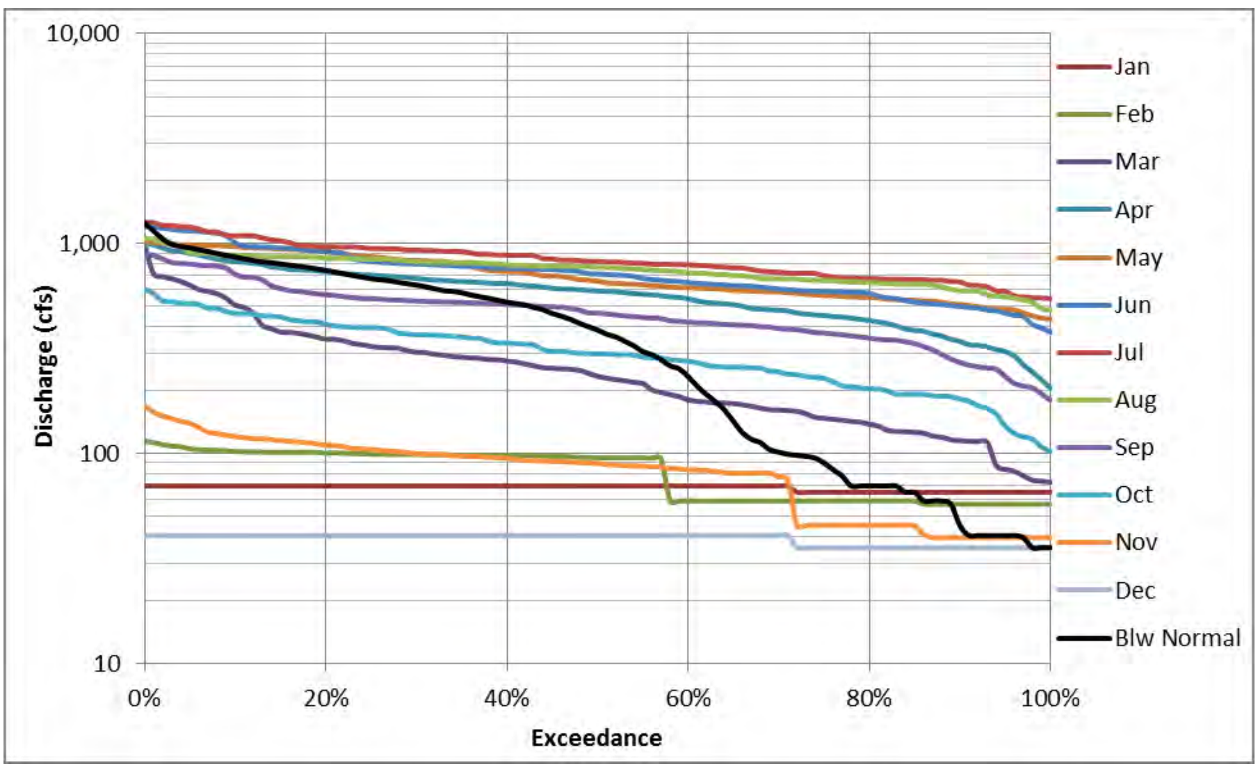


Figure 4. **Modesto Canal flow duration curves for Below Normal years by month and for all Below Normal years for the Base Case (cfs).**

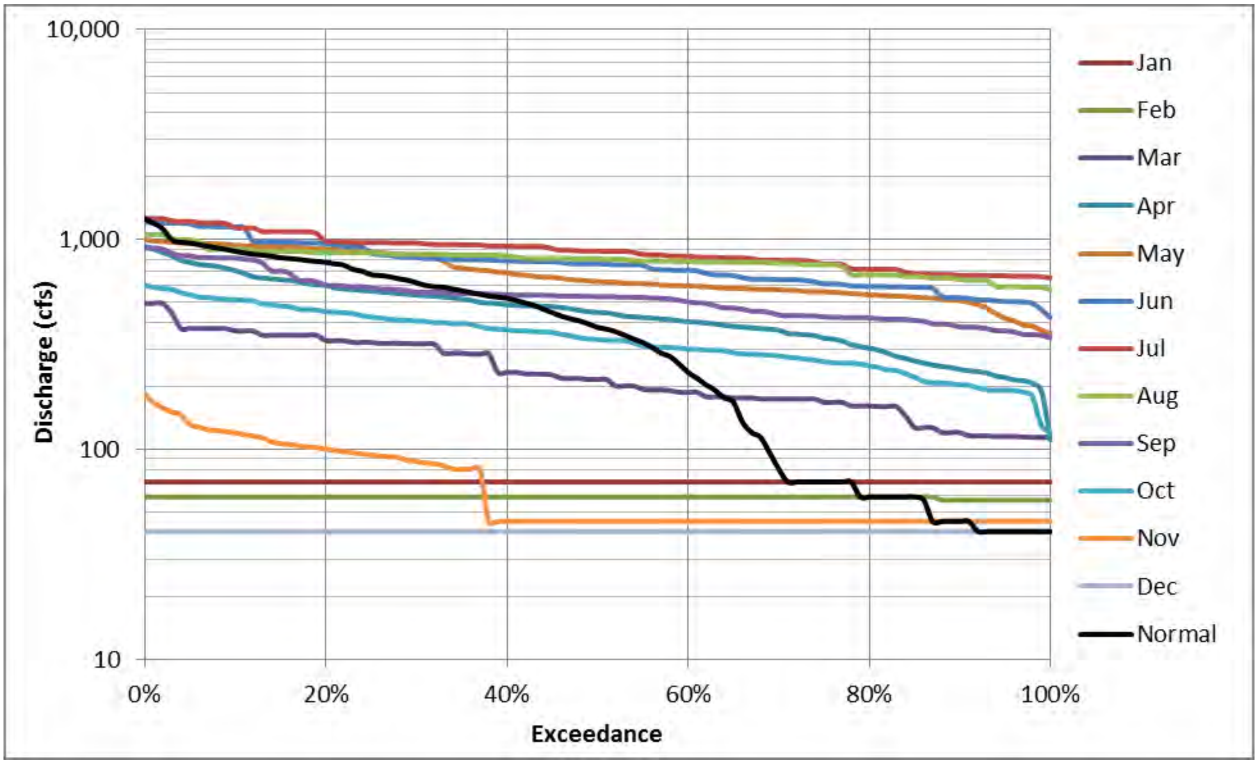


Figure 5. **Modesto Canal flow duration curves for Normal years by month and for all Normal years for the Base Case (cfs).**

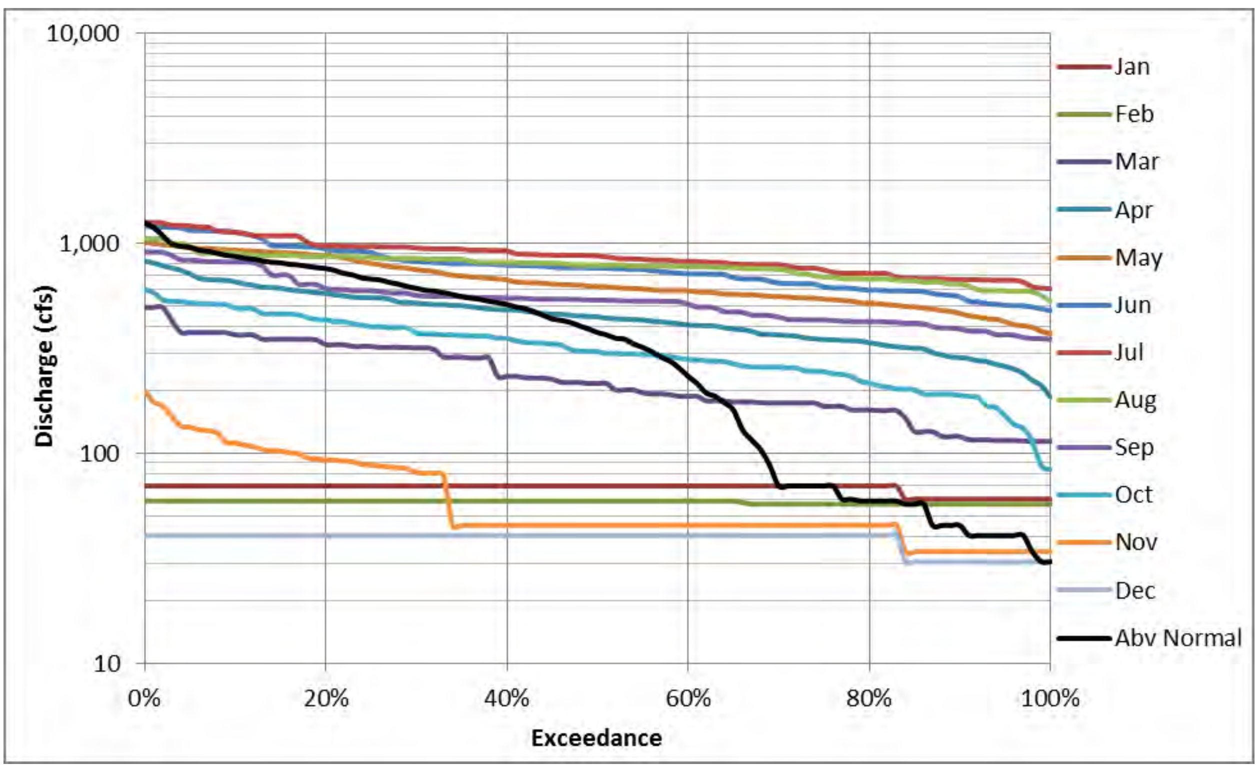


Figure 6. **Modesto Canal flow duration curves for Above Normal years by month and for all Above Normal years for the Base Case (cfs).**

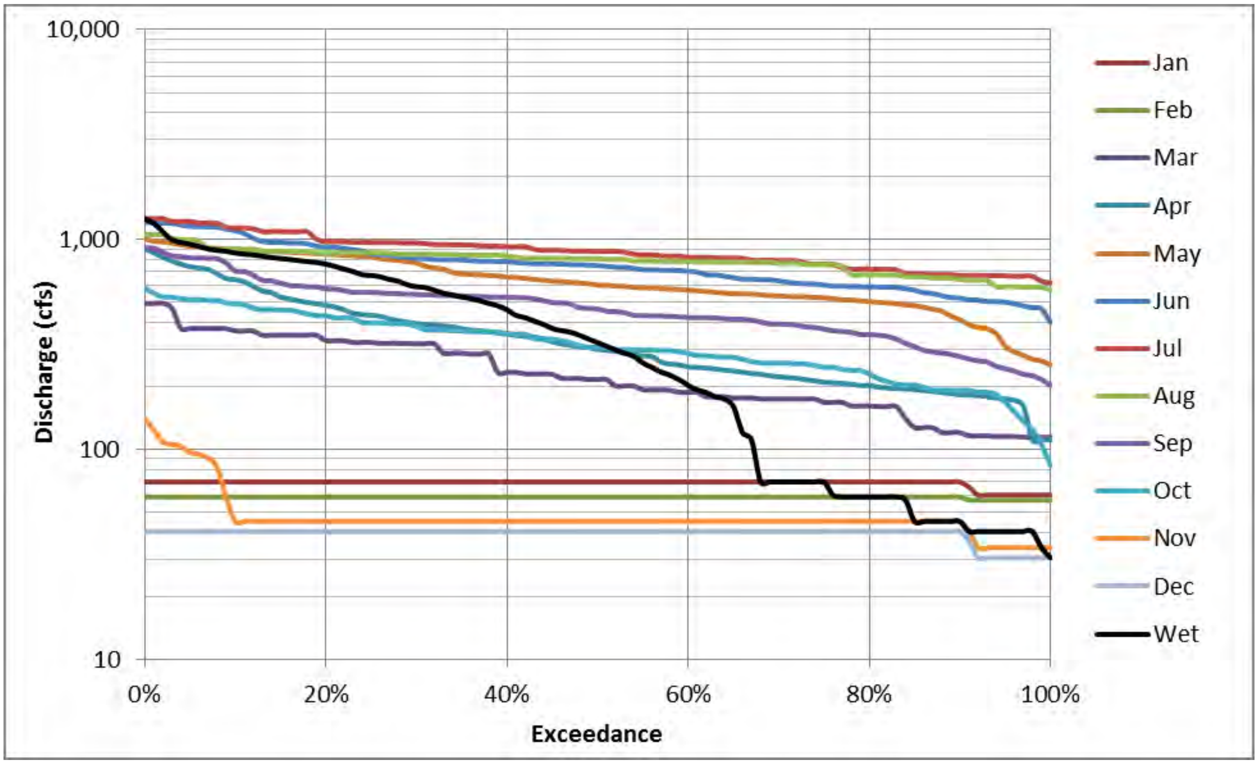


Figure 7. **Modesto Canal flow duration curves for Wet years by month and for all Wet years for the Base Case (cfs).**

Tuolumne River below La Grange Dam

Table 1. Average Tuolumne River below La Grange Dam flow by water year type, by water year, and for the period of record for the Base Case (cfs).

cfs	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Annual
C	279	226	245	225	221	225	336	318	50	50	50	50	190
D	391	263	263	263	260	441	550	423	56	56	56	56	257
BN	229	200	200	200	461	645	713	458	61	61	61	61	278
N	279	209	224	395	1,109	1,563	1,851	913	679	277	163	163	648
AN	445	609	1,270	1,599	2,794	2,990	2,619	1,290	1,721	453	250	272	1,350
W	390	499	1,071	2,925	4,007	5,039	5,114	4,236	5,013	3,009	1,182	631	2,749
1971	397	300	418	960	1,848	1,511	2,253	1,033	75	75	75	75	743
1972	215	175	175	175	169	291	509	476	50	50	50	50	199
1973	150	150	150	150	150	2,241	2,659	1,068	2,204	482	250	250	825
1974	397	300	849	2,210	2,535	3,140	3,720	1,088	2,192	499	250	250	1,442
1975	397	300	300	300	2,198	3,247	2,697	1,242	2,748	673	250	384	1,217
1976	504	308	419	300	290	300	339	321	50	50	50	50	249
1977	126	150	150	150	150	150	246	237	50	50	50	50	130
1978	126	150	150	150	150	150	1,080	1,551	250	250	395	1,153	463
1979	624	300	300	1,127	2,729	3,584	2,795	1,036	1,248	282	250	250	1,199
1980	397	300	300	4,249	6,150	6,001	3,116	2,666	2,136	3,286	996	474	2,497
1981	530	300	300	300	300	848	820	464	75	75	75	75	347
1982	207	180	180	963	5,178	6,633	7,137	6,151	5,979	2,915	1,075	1,155	3,124
1983	1,476	3,088	3,832	3,327	6,964	7,772	7,686	8,226	7,597	5,959	3,708	1,572	5,086
1984	739	2,303	5,672	5,450	2,962	2,972	2,044	1,007	250	250	250	250	2,016
1985	397	300	300	300	825	1,312	1,269	542	75	75	75	75	460
1986	150	150	150	150	2,819	8,385	5,442	3,177	3,095	661	250	250	2,048
1987	397	300	300	300	300	300	411	387	50	50	50	50	241
1988	126	150	150	150	145	150	246	237	50	50	50	50	129
1989	126	150	150	150	150	150	437	410	50	50	50	50	160
1990	126	150	150	150	150	150	325	309	50	50	50	50	142
1991	126	150	150	150	150	150	435	408	50	50	50	50	160
1992	126	150	150	150	145	150	336	319	50	50	50	50	144
1993	126	150	150	150	150	150	1,080	1,007	250	250	250	250	331
1994	397	300	300	300	300	300	435	409	50	50	50	50	245
1995	150	150	150	150	150	3,296	5,847	6,622	7,870	5,933	2,927	584	2,832
1996	470	300	300	300	4,334	5,068	3,672	2,391	3,239	653	250	250	1,754
1997	397	300	2,826	13,576	7,805	3,202	1,997	1,007	677	258	250	250	2,691
1998	397	300	300	970	6,323	4,995	5,593	3,996	7,134	5,207	1,455	478	3,066
1999	540	300	350	1,184	4,527	3,365	2,501	1,007	1,646	390	250	250	1,335
2000	397	300	300	300	3,440	4,540	3,202	1,111	845	250	250	250	1,255
2001	397	300	300	300	300	497	984	487	75	75	75	75	322
2002	150	150	150	150	150	150	550	513	75	75	75	75	189
2003	150	150	150	150	150	150	1,546	865	75	75	75	75	300
2004	215	175	175	178	1,477	1,962	894	451	75	75	75	75	482
2005	150	150	150	150	1,907	4,672	4,340	2,600	7,818	2,100	250	268	2,035
2006	440	300	410	4,494	3,235	4,801	7,812	5,563	7,905	2,185	250	250	3,126
2007	397	300	300	300	300	300	438	412	50	50	50	50	246
2008	126	150	150	150	145	150	462	433	50	50	50	50	164
2009	150	150	150	150	150	150	721	671	75	75	75	75	216
2010	215	175	175	175	175	175	1,080	1,007	835	901	250	250	452
2011	397	424	3,333	3,997	3,320	5,517	6,208	5,039	4,685	4,341	1,449	513	3,271
2012	512	300	300	300	290	467	618	508	50	50	50	50	292
1971-2012	334	348	598	1,160	1,788	2,226	2,285	1,630	1,711	928	399	258	1,134

Table 2. Minimum daily Tuolumne River below La Grange Dam flow by water year type, by water year, and for the period of record for the Base Case (cfs).

cfs	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Annual	Julian Day of Annual Min	3-day Min	7-day Min
C	126	150	150	150	145	150	150	150	50	50	50	50	50	--	--	--
D	126	150	150	150	150	150	150	150	50	50	50	50	50	--	--	--
BN	126	150	150	150	145	150	150	150	50	50	50	50	50	--	--	--
N	150	150	150	150	150	150	150	150	75	75	75	75	75	--	--	--
AN	126	150	150	150	150	150	300	300	250	250	250	250	126	--	--	--
W	126	150	150	150	150	150	232	300	250	250	250	250	126	--	--	--
1971	300	300	300	688	1,362	1,355	1,712	175	75	75	75	75	75	244	75	75
1972	188	175	175	175	169	175	150	150	50	50	50	50	50	244	50	50
1973	150	150	150	150	150	774	1,946	300	1,319	250	250	250	150	32	117	107
1974	300	300	300	1,340	2,444	2,354	2,354	374	1,399	250	250	250	250	281	250	250
1975	300	300	300	300	300	2,859	2,092	755	1,832	250	250	250	250	281	250	250
1976	300	300	355	300	290	300	150	150	50	50	50	50	50	244	50	50
1977	126	150	150	150	150	150	150	150	50	50	50	50	50	244	50	50
1978	126	150	150	150	150	150	300	1,353	250	250	250	260	126	1	101	93
1979	300	300	300	300	1,196	3,177	2,208	300	406	250	250	250	250	281	250	250
1980	300	300	300	300	3,673	3,086	2,486	2,666	2,136	2,067	250	250	250	325	250	250
1981	300	300	300	300	300	300	434	180	75	75	75	75	75	244	75	75
1982	180	180	180	180	2,242	5,569	1,887	4,443	5,979	250	325	467	180	1	145	135
1983	300	1,328	2,190	2,028	1,732	2,505	6,321	8,226	7,597	3,936	2,222	1,556	300	21	300	300
1984	300	300	3,659	2,270	2,075	2,394	1,481	300	250	250	250	250	250	244	250	250
1985	300	300	300	300	300	1,191	961	150	75	75	75	75	75	244	75	75
1986	150	150	150	150	150	6,216	3,775	3,177	2,140	250	250	250	150	32	125	118
1987	300	300	300	300	300	300	150	150	50	50	50	50	50	244	50	50
1988	126	150	150	150	145	150	150	150	50	50	50	50	50	244	50	50
1989	126	150	150	150	150	150	150	150	50	50	50	50	50	244	50	50
1990	126	150	150	150	150	150	150	150	50	50	50	50	50	244	50	50
1991	126	150	150	150	150	150	150	150	50	50	50	50	50	244	50	50
1992	126	150	150	150	145	150	150	150	50	50	50	50	50	244	50	50
1993	126	150	150	150	150	150	300	300	250	250	250	250	126	1	101	93

cfs	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Annual	Julian Day of Annual Min	3-day Min	7-day Min
1994	300	300	300	300	300	300	150	150	50	50	50	50	50	244	50	50
1995	150	150	150	150	150	150	4,922	6,583	7,870	4,284	957	341	150	32	117	107
1996	300	300	300	300	1,537	3,565	3,173	2,046	2,104	250	250	250	250	281	250	250
1997	300	300	300	4,778	4,183	2,646	1,378	300	250	250	250	250	250	244	250	250
1998	300	300	300	300	1,995	3,604	3,833	3,906	7,134	2,185	382	250	250	338	250	250
1999	300	300	300	424	2,553	2,460	1,687	300	824	250	250	250	250	281	250	250
2000	300	300	300	300	290	2,925	2,726	300	250	250	250	250	250	244	250	250
2001	300	300	300	300	300	300	697	150	75	75	75	75	75	244	75	75
2002	150	150	150	150	150	150	150	150	75	75	75	75	75	244	75	75
2003	150	150	150	150	150	150	175	175	75	75	75	75	75	244	75	75
2004	188	175	175	175	203	1,552	618	150	75	75	75	75	75	244	75	75
2005	150	150	150	150	150	3,884	2,684	2,162	6,862	250	250	250	150	32	125	118
2006	300	300	300	1,439	2,463	3,501	232	3,897	7,162	250	250	250	232	187	250	250
2007	300	300	300	300	300	300	150	150	50	50	50	50	50	244	50	50
2008	126	150	150	150	145	150	150	150	50	50	50	50	50	244	50	50
2009	150	150	150	150	150	150	175	175	75	75	75	75	75	244	75	75
2010	188	175	175	175	175	175	300	300	334	250	250	250	175	62	150	140
2011	300	300	918	2,264	2,264	4,225	4,452	5,039	4,685	3,137	464	250	250	343	250	250
2012	300	300	300	300	290	300	150	150	50	50	50	50	50	244	50	50
1971-2012	126	150	150	150	145	150	150	150	50	50	50	50	50	--	--	--

Table 3. Maximum daily Tuolumne River below La Grange Dam flow by water year type, by water year, and for the period of record for the Base Case (cfs).

cfs	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Annual	Julian Day of Annual Max	3-day Max	7-day Max
C	1,800	357	487	302	300	300	685	685	50	50	50	50	1,800	--	--	--
D	1,800	300	300	300	300	1,665	1,545	1,208	75	75	75	75	1,800	--	--	--
BN	1,800	300	300	300	2,674	2,680	1,985	1,343	75	75	75	75	2,680	--	--	--
N	1,800	300	898	2,498	6,307	6,180	4,236	2,837	4,806	1,514	250	250	6,307	--	--	--
AN	1,844	6,720	8,719	8,809	6,880	5,859	4,961	3,884	7,551	2,037	250	720	8,809	--	--	--
W	3,202	4,117	7,207	66,872	8,870	8,865	8,889	12,080	13,354	9,902	5,251	3,152	66,872	--	--	--
1971	1,800	300	898	1,362	2,151	2,037	3,126	1,948	75	75	75	75	3,126	197	3,126	3,126
1972	612	175	175	175	169	501	823	823	50	50	50	50	823	197	823	823
1973	150	150	150	150	150	2,825	3,695	2,696	4,806	1,276	250	250	4,806	255	4,260	3,666
1974	1,800	300	1,340	2,838	2,609	4,121	4,961	3,067	5,248	1,354	250	250	5,248	258	4,961	4,356
1975	1,800	300	300	300	3,659	4,060	4,060	1,762	7,551	1,773	250	720	7,551	259	5,838	4,486
1976	1,800	357	487	302	290	300	504	504	50	50	50	50	1,800	15	1,300	729
1977	126	150	150	150	150	150	330	330	50	50	50	50	330	197	330	330
1978	126	150	150	150	150	150	1,762	1,762	250	250	587	1,707	1,762	197	1,762	1,762
1979	1,800	300	300	2,498	4,413	4,261	3,775	2,208	4,172	393	250	250	4,413	145	4,413	4,413
1980	1,800	300	300	8,842	8,787	8,829	3,948	2,666	2,136	5,636	2,629	865	8,842	121	8,840	8,830
1981	1,800	300	300	300	300	1,665	1,545	767	75	75	75	75	1,800	16	1,665	1,648
1982	602	180	180	2,254	8,853	8,859	8,889	8,885	5,979	5,786	2,674	3,152	8,889	212	8,888	8,886
1983	3,202	4,117	5,239	6,202	8,269	8,746	8,872	8,226	7,597	8,875	5,251	1,702	8,875	287	8,871	8,823
1984	1,844	6,720	8,719	8,809	3,812	3,469	2,942	1,762	250	250	250	250	8,809	95	8,791	8,730
1985	1,800	300	300	300	1,408	1,408	1,985	961	75	75	75	75	1,985	197	1,985	1,778
1986	150	150	150	150	8,840	8,865	8,860	3,177	5,398	2,071	250	250	8,865	158	8,863	8,858
1987	1,800	300	300	300	300	300	640	640	50	50	50	50	1,800	16	1,300	729
1988	126	150	150	150	145	150	330	330	50	50	50	50	330	197	330	330
1989	126	150	150	150	150	150	688	688	50	50	50	50	688	197	688	688
1990	126	150	150	150	150	150	479	479	50	50	50	50	479	197	479	479
1991	126	150	150	150	150	150	684	684	50	50	50	50	684	197	684	684
1992	126	150	150	150	145	150	499	499	50	50	50	50	499	197	499	499
1993	126	150	150	150	150	150	1,762	1,762	250	250	250	250	1,762	197	1,762	1,762

cfs	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Annual	Julian Day of Annual Max	3-day Max	7-day Max
1994	1,800	300	300	300	300	300	685	685	50	50	50	50	1,800	16	1,300	729
1995	150	150	150	150	150	7,311	7,232	6,755	7,870	8,309	5,183	957	8,309	284	7,870	7,870
1996	1,800	300	300	300	6,880	5,859	4,635	3,884	5,421	2,037	250	250	6,880	145	6,880	6,725
1997	1,800	300	5,464	66,872	8,870	4,183	2,839	1,762	2,711	376	250	250	66,872	95	49,882	32,741
1998	1,800	300	300	2,385	8,453	7,080	6,881	4,301	7,134	6,904	3,951	770	8,453	140	8,225	7,829
1999	1,800	300	573	2,761	6,301	4,937	3,417	1,762	4,710	797	250	250	6,301	134	6,301	6,301
2000	1,800	300	300	300	6,307	6,180	4,236	2,837	3,175	251	250	250	6,307	139	6,307	6,307
2001	1,800	300	300	300	300	913	1,343	1,343	75	75	75	75	1,800	16	1,343	1,343
2002	150	150	150	150	150	150	900	900	75	75	75	75	900	197	900	900
2003	150	150	150	150	150	150	2,854	1,600	75	75	75	75	2,854	199	2,854	2,854
2004	612	175	175	209	2,674	2,680	1,267	773	75	75	75	75	2,680	152	2,680	2,676
2005	150	150	150	150	5,352	5,841	5,412	12,080	13,354	6,640	250	516	13,354	244	12,726	10,989
2006	1,800	300	1,439	7,799	3,582	5,441	8,887	8,889	10,892	6,931	250	250	10,892	250	10,585	9,870
2007	1,800	300	300	300	300	300	691	691	50	50	50	50	1,800	16	1,300	729
2008	126	150	150	150	145	150	734	734	50	50	50	50	734	213	734	734
2009	150	150	150	150	150	150	1,199	1,199	75	75	75	75	1,199	197	1,199	1,199
2010	612	175	175	175	175	175	1,762	1,762	4,330	1,514	250	250	4,330	271	4,116	2,604
2011	1,800	918	7,207	7,154	4,317	7,854	7,291	5,039	4,685	9,902	3,137	967	9,902	280	8,907	7,532
2012	1,800	300	300	300	290	947	1,208	1,208	50	50	50	50	1,800	15	1,300	1,208
1971-2012	3,202	6,720	8,719	66,872	8,870	8,865	8,889	12,080	13,354	9,902	5,251	3,152	66,872	--	--	--

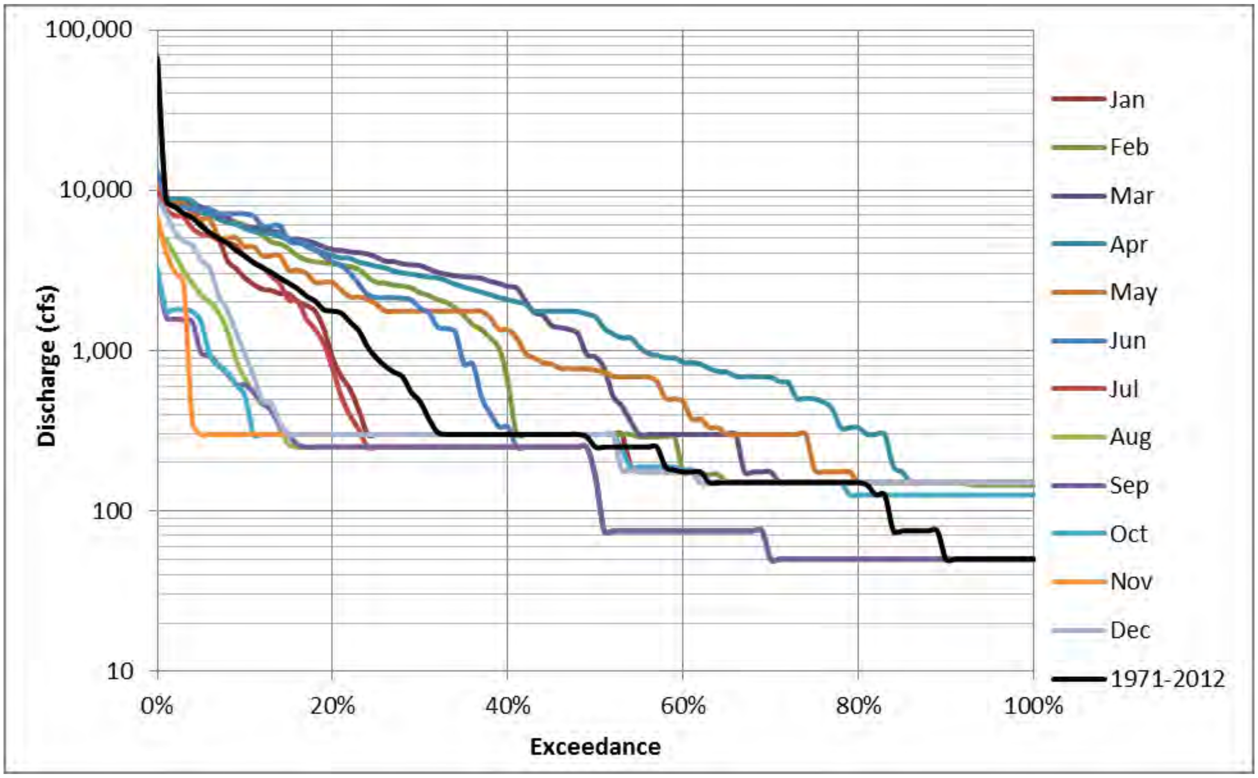


Figure 1. **Tuolumne River below La Grange Dam flow duration curves by month and for the period of record for the Base Case (cfs).**

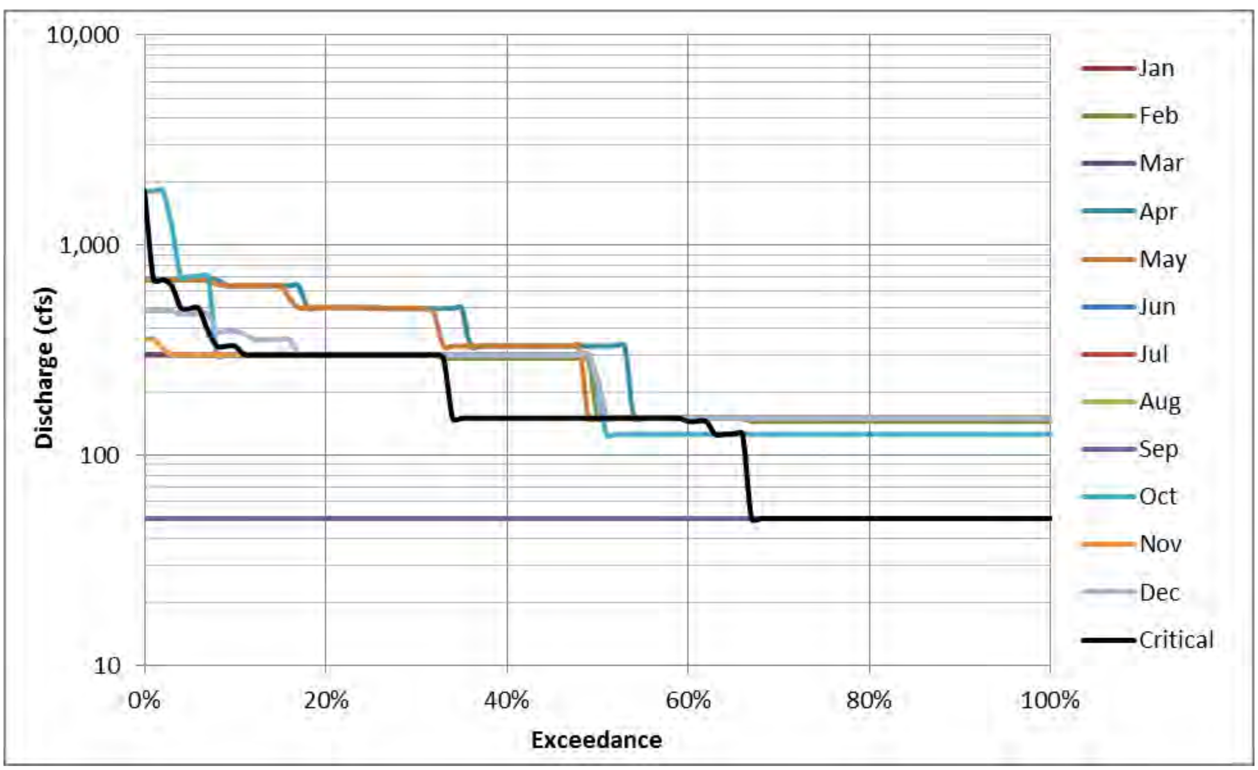


Figure 2. **Tuolumne River below La Grange Dam flow duration curves for Critical years by month and for all Critical years for the Base Case (cfs).**

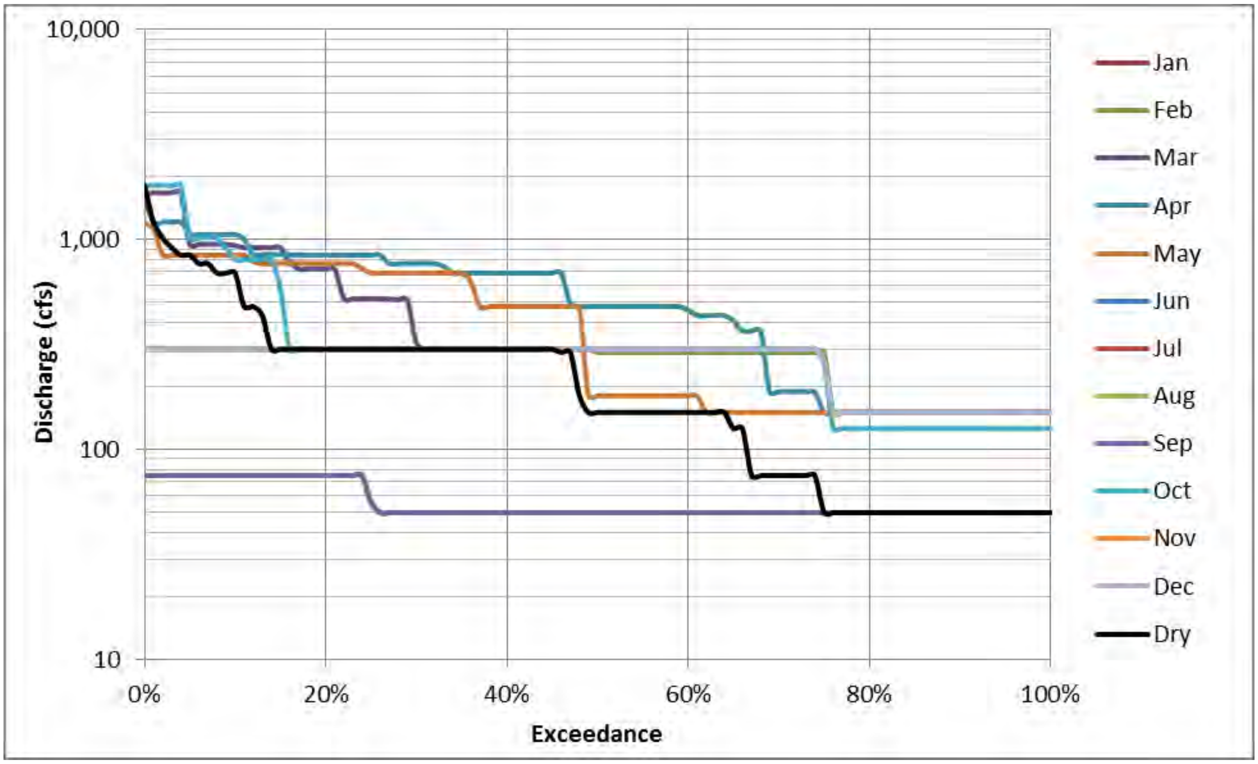


Figure 3. **Tuolumne River below La Grange Dam flow duration curves for Dry years by month and for all Dry years for the Base Case (cfs).**

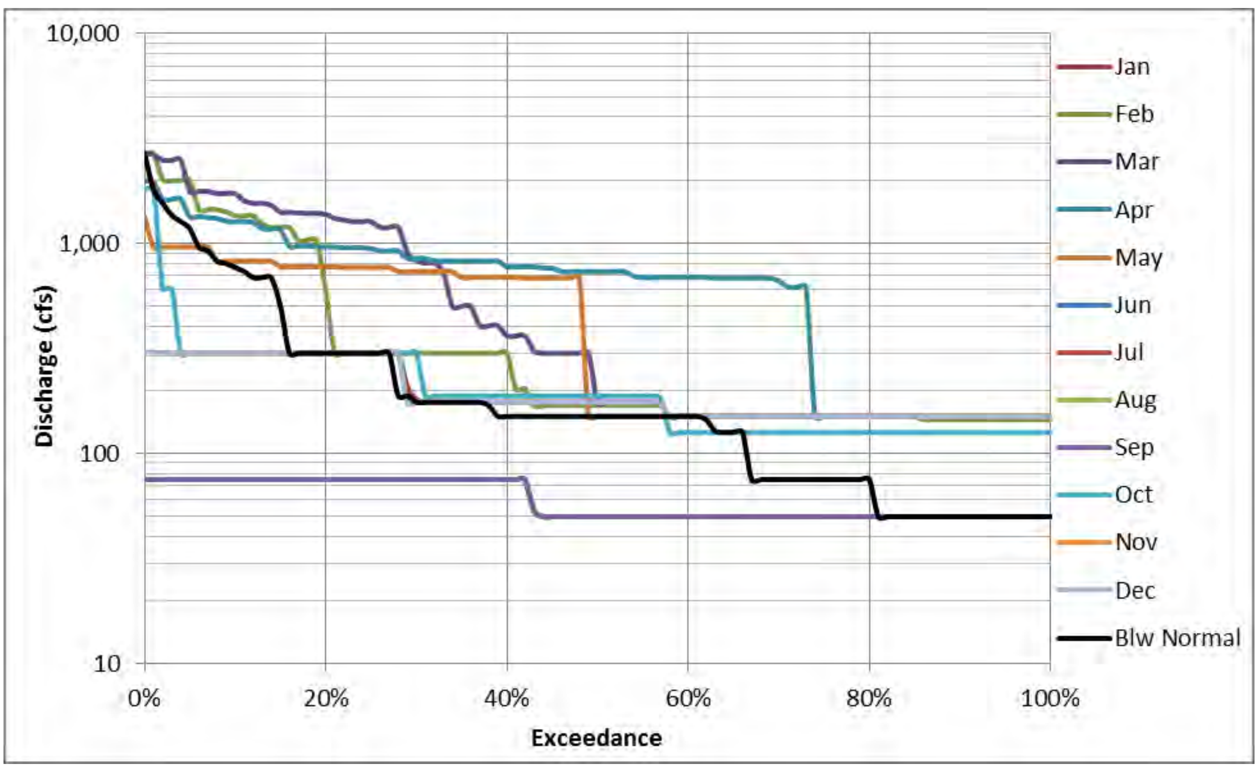


Figure 4. **Tuolumne River below La Grange Dam flow duration curves for Below Normal years by month and for all Below Normal years**

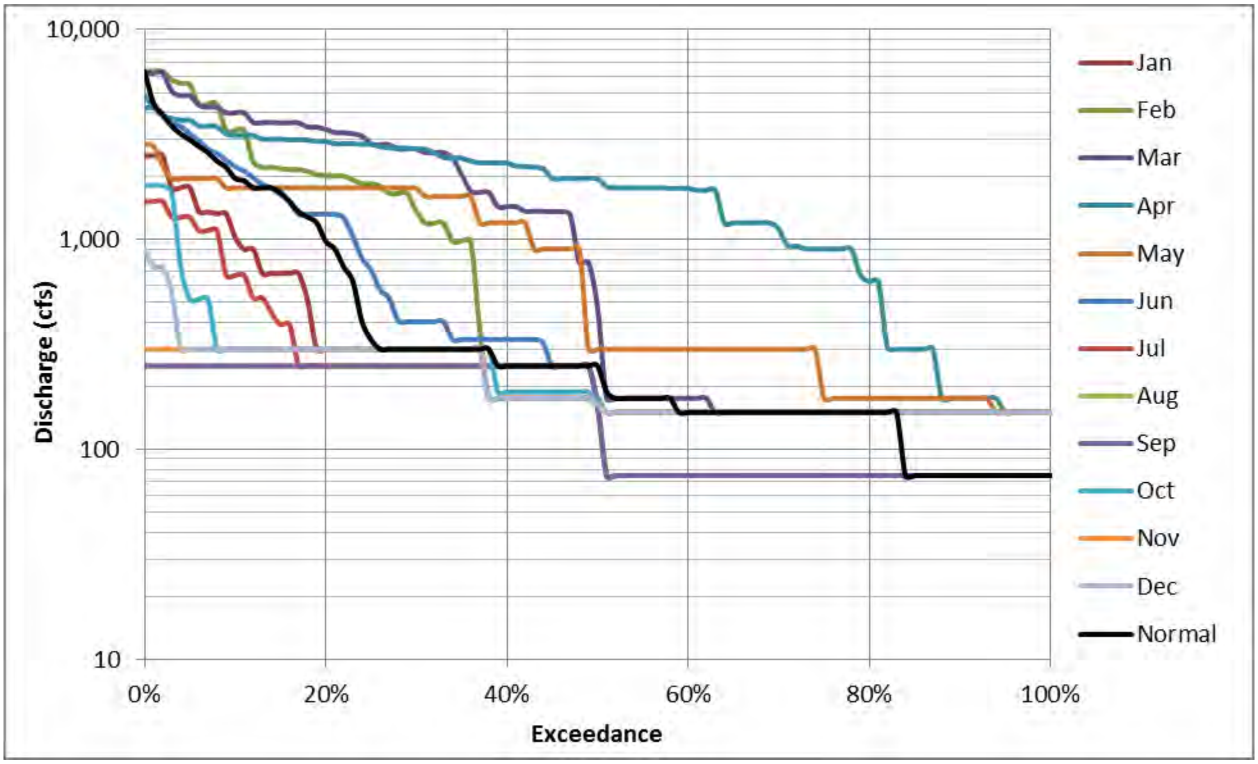


Figure 5. **Tuolumne River below La Grange Dam flow duration curves for Normal years by month and for all Normal years for the Base Case (cfs).**

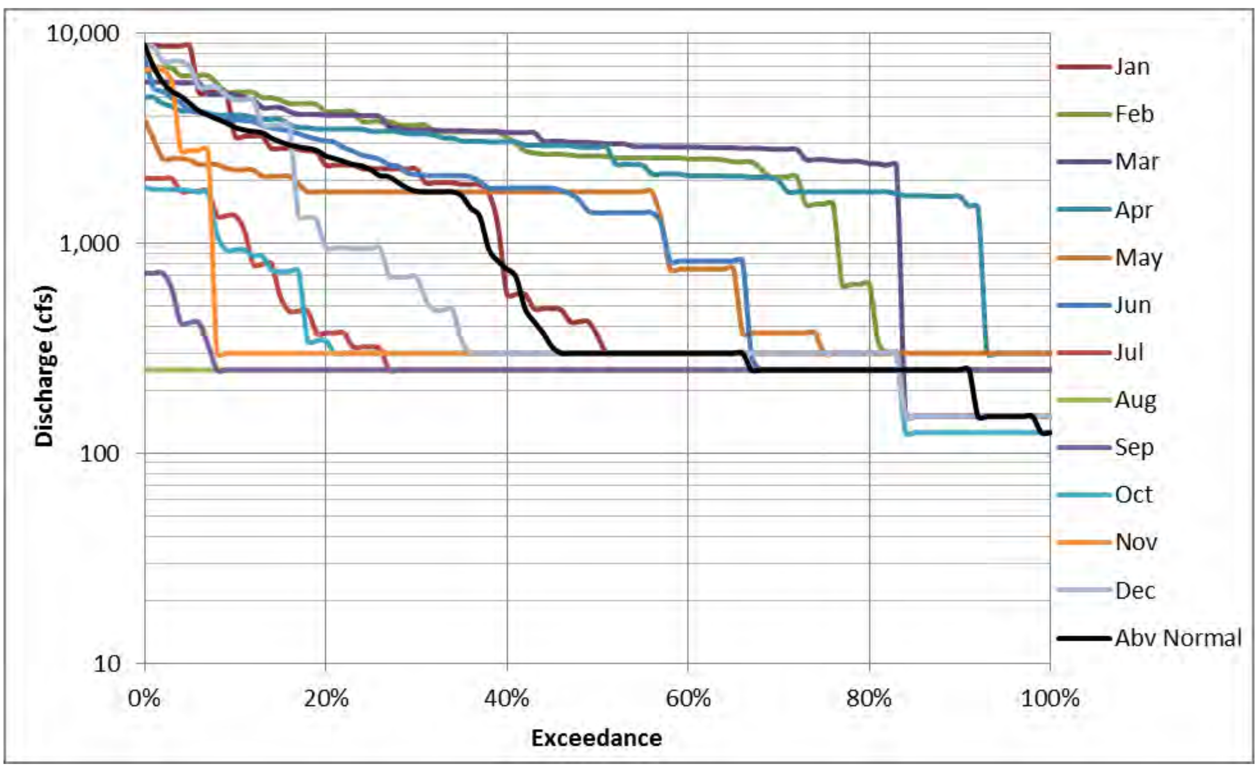


Figure 6. **Tuolumne River below La Grange Dam flow duration curves for Above Normal years by month and for all Above Normal years for the Base Case (cfs).**

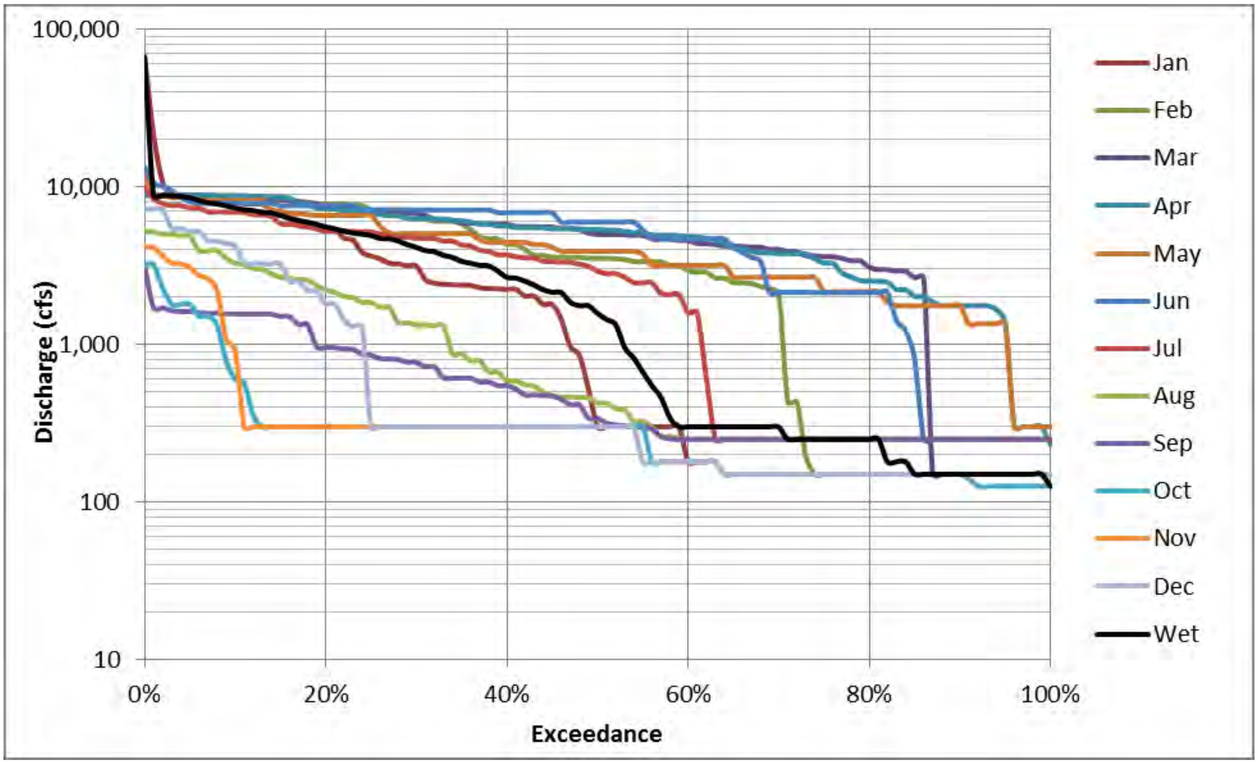


Figure 7. Tuolumne River below La Grange Dam flow duration curves for Wet years by month and for all Wet years for the Base Case (cfs).

Tuolumne River at Modesto 9th St Bridge

Table 1. Average Tuolumne River at Modesto flow by water year type, by water year, and for the period of record for the Base Case (cfs).

cfs	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Annual
C	389	309	326	333	437	398	461	433	170	175	190	190	317
D	501	345	343	406	401	649	679	538	176	181	196	195	384
BN	339	283	296	352	663	847	838	573	181	186	201	201	412
N	389	297	352	643	1,457	1,810	1,978	1,028	799	402	303	302	808
AN	574	783	1,502	1,954	3,180	3,219	2,771	1,405	1,841	578	390	412	1,540
W	500	582	1,262	3,598	4,610	5,603	5,414	4,352	5,133	3,134	1,322	771	3,011
1971	507	422	649	1,118	1,978	1,641	2,378	1,148	195	200	215	215	881
1972	325	258	331	304	317	421	635	591	170	175	190	190	326
1973	260	233	231	680	964	2,673	2,788	1,183	2,324	607	390	390	1,057
1974	533	383	1,100	2,461	2,665	3,459	3,941	1,203	2,312	624	390	390	1,612
1975	598	402	381	400	2,497	3,614	2,874	1,357	2,868	798	390	523	1,380
1976	614	391	500	400	420	430	464	436	170	175	190	190	365
1977	236	233	231	250	280	280	372	352	170	175	190	190	246
1978	236	233	231	533	698	599	1,615	1,673	370	375	535	1,292	697
1979	734	383	381	1,535	3,025	3,892	2,921	1,151	1,368	407	390	390	1,369
1980	507	383	381	5,038	6,849	6,203	3,241	2,781	2,256	3,411	1,136	614	2,723
1981	640	383	381	575	444	1,263	947	579	195	200	215	215	504
1982	317	263	353	1,412	5,736	7,110	7,767	6,266	6,099	3,040	1,215	1,295	3,382
1983	1,586	3,171	3,913	4,387	7,988	9,000	7,845	8,341	7,717	6,084	3,848	1,711	5,449
1984	849	2,915	6,482	5,583	3,189	3,105	2,169	1,122	370	375	390	390	2,248
1985	507	383	411	400	1,071	1,475	1,396	657	195	200	215	215	590
1986	260	233	231	251	3,694	9,000	5,567	3,292	3,215	786	390	390	2,263
1987	507	383	381	400	496	622	537	502	170	175	190	190	379
1988	236	233	231	294	275	280	372	352	170	175	190	190	250
1989	236	233	231	250	280	351	562	525	170	175	190	190	283
1990	236	233	231	250	280	280	451	424	170	175	190	190	259
1991	236	233	231	250	280	548	560	523	170	175	190	190	299
1992	236	233	231	250	662	345	462	434	170	175	190	190	296
1993	236	233	231	1,125	571	366	1,219	1,122	370	375	390	390	552
1994	507	383	381	408	488	430	561	524	170	175	190	190	367
1995	260	233	231	1,157	305	4,372	6,001	6,737	7,990	6,058	3,067	724	3,110
1996	580	383	386	748	5,187	5,270	3,798	2,506	3,359	778	390	390	1,964
1997	507	383	3,569	14,629	7,958	3,332	2,122	1,122	797	383	390	390	2,947
1998	507	383	381	1,836	8,119	5,318	5,833	4,111	7,254	5,332	1,595	618	3,401
1999	650	383	431	1,409	4,900	3,500	2,627	1,122	1,766	515	390	390	1,481
2000	507	383	381	463	4,266	4,920	3,339	1,226	965	375	390	390	1,454
2001	509	385	381	419	477	739	1,109	602	195	200	215	215	453
2002	260	233	407	457	280	280	676	628	195	200	215	215	338
2003	260	233	284	269	280	280	1,671	980	195	200	215	215	423
2004	325	258	256	310	1,751	2,099	1,020	566	195	200	215	215	614
2005	260	233	239	1,021	2,281	5,205	4,468	2,715	7,938	2,225	390	408	2,271
2006	550	383	515	4,959	3,365	5,321	8,756	5,678	8,025	2,310	390	390	3,376
2007	507	383	381	400	459	444	564	527	170	175	190	190	365
2008	236	233	231	532	446	292	587	548	170	175	190	190	319
2009	260	233	231	250	280	357	847	786	195	200	215	215	339
2010	325	258	256	374	482	441	1,205	1,122	955	1,026	390	390	602
2011	507	507	3,838	4,354	3,637	6,175	6,341	5,154	4,805	4,466	1,589	648	3,505
2012	622	380	380	400	420	608	753	623	170	175	190	185	409
1971-2012	447	445	741	1,489	2,144	2,532	2,461	1,745	1,831	1,053	539	397	1,313

Table 2. **Minimum daily Tuolumne River at Modesto flow by water year type, by water year, and for the period of record for the Base Case (cfs).**

cfs	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Annual	Julian Day of Annual Min	3-day Min	7-day Min
C	236	233	231	240	275	280	277	265	170	175	190	185	170	--	--	--
D	236	233	231	240	280	280	277	265	170	175	190	180	170	--	--	--
BN	236	233	231	240	275	280	277	265	170	175	190	185	170	--	--	--
N	260	233	231	240	280	280	277	265	195	200	215	210	195	--	--	--
AN	236	233	231	240	278	280	427	415	370	375	390	385	231	--	--	--
W	236	233	231	240	263	280	483	415	370	375	390	382	231	--	--	--
1971	410	383	410	803	1,492	1,485	1,839	290	195	200	215	210	195	244	195	195
1972	298	258	256	274	294	305	277	265	170	175	190	185	170	244	170	170
1973	260	233	231	240	340	1,038	2,076	415	1,439	375	390	385	231	62	231	231
1974	410	383	381	1,559	2,574	2,518	2,555	489	1,519	375	390	385	375	281	375	375
1975	410	383	381	390	430	3,061	2,208	870	1,952	375	390	385	375	281	375	375
1976	410	383	436	392	420	430	277	265	170	175	190	185	170	244	170	170
1977	236	233	231	240	280	280	277	265	170	175	190	185	170	244	170	170
1978	236	233	231	240	263	280	483	1,468	370	375	390	395	231	62	222	218
1979	410	383	381	390	1,330	3,307	2,319	415	526	375	390	385	375	281	375	375
1980	410	383	381	390	3,833	3,216	2,613	2,781	2,256	2,192	390	386	381	61	381	381
1981	410	383	381	390	430	430	561	295	195	200	215	210	195	244	195	195
1982	290	263	261	338	2,398	5,704	5,750	4,558	6,099	375	465	602	261	62	261	260
1983	410	1,411	2,271	2,306	6,506	9,000	6,432	8,341	7,717	4,061	2,362	1,692	410	21	410	410
1984	410	383	3,815	2,376	2,205	2,524	1,608	415	370	375	390	385	370	244	370	370
1985	410	383	381	390	430	1,350	1,072	265	195	200	215	210	195	244	195	195
1986	260	233	231	240	316	9,000	3,886	3,292	2,260	375	390	385	231	62	231	231
1987	410	383	381	390	430	425	277	265	170	175	190	185	170	244	170	170
1988	236	233	231	240	275	280	277	265	170	175	190	185	170	244	170	170
1989	236	233	231	240	280	280	277	265	170	175	190	185	170	244	170	170
1990	236	233	231	240	280	280	277	265	170	175	190	185	170	244	170	170
1991	236	233	231	240	280	280	277	265	170	175	190	185	170	244	170	170
1992	236	233	231	240	275	280	277	265	170	175	190	185	170	244	170	170
1993	236	233	231	240	278	280	427	415	370	375	390	385	231	62	222	218

cfs	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Annual	Julian Day of Annual Min	3-day Min	7-day Min
1994	410	383	381	390	430	430	277	265	170	175	190	185	170	244	170	170
1995	260	233	231	240	280	280	5,033	6,698	7,990	4,409	1,097	478	231	62	231	231
1996	410	383	381	393	2,132	3,695	3,300	2,161	2,224	375	390	385	375	281	375	375
1997	410	383	381	6,260	4,313	2,776	1,505	415	370	375	390	385	370	244	370	370
1998	410	383	381	390	2,596	3,738	3,944	4,021	7,254	2,310	522	386	381	62	381	381
1999	410	383	381	522	2,706	2,590	1,814	415	944	375	390	385	375	281	375	375
2000	410	383	381	390	462	3,055	2,855	415	370	375	390	385	370	244	370	370
2001	410	383	381	390	430	430	824	265	195	200	215	210	195	244	195	195
2002	260	233	231	258	280	280	277	265	195	200	215	210	195	244	195	195
2003	260	233	231	245	280	280	314	290	195	200	215	210	195	244	195	195
2004	298	258	256	271	333	1,682	745	265	195	200	215	210	195	244	195	195
2005	260	233	231	274	280	4,014	2,795	2,277	6,982	375	390	385	231	62	231	231
2006	410	383	381	1,683	2,593	3,665	5,722	4,012	7,282	375	390	385	375	285	375	375
2007	410	383	381	390	430	430	277	265	170	175	190	185	170	244	170	170
2008	236	233	231	240	275	280	277	265	170	175	190	185	170	244	170	170
2009	260	233	231	240	280	280	302	290	195	200	215	210	195	244	195	195
2010	298	258	256	265	305	305	427	415	454	375	390	385	256	62	256	256
2011	410	383	999	2,379	2,394	4,355	4,563	5,154	4,805	3,262	604	382	382	343	383	383
2012	410	380	380	390	420	430	278	265	170	175	190	180	170	244	170	170
1971-2012	236	233	231	240	263	280	277	265	170	175	190	180	170	--	--	--

Table 3. Maximum daily Tuolumne River at Modesto flow by water year type, by water year, and for the period of record for the Base Case (cfs).

cfs	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Annual	Julian Day of Annual Max	3-day Max	7-day Max
C	1,910	440	568	1,189	3,934	3,919	811	800	170	175	190	195	3,934	--	--	--
D	1,910	383	381	2,511	984	3,665	1,705	1,323	195	200	215	220	3,665	--	--	--
BN	1,910	410	906	2,794	4,235	2,873	2,111	1,458	195	200	215	220	4,235	--	--	--
N	1,910	962	3,691	3,196	9,000	9,000	4,502	2,952	4,926	1,639	390	395	9,000	--	--	--
AN	1,954	9,000	9,000	9,000	9,000	6,611	5,098	3,999	7,671	2,162	390	865	9,000	--	--	--
W	3,312	4,200	9,000	72,099	9,000	9,000	9,000	12,195	13,474	10,027	5,391	3,297	72,099	--	--	--
1971	1,910	962	1,031	1,490	2,281	2,167	3,252	2,063	195	200	215	220	3,252	197	3,251	3,249
1972	722	258	906	662	546	631	949	938	170	175	190	195	949	197	948	946
1973	260	233	231	3,119	7,403	4,859	3,821	2,811	4,926	1,401	390	395	7,403	135	4,380	3,786
1974	1,910	383	4,200	3,510	2,739	4,839	5,098	3,182	5,368	1,479	390	395	5,368	258	5,090	4,481
1975	1,910	514	381	409	4,938	4,454	4,229	1,877	7,671	1,898	390	865	7,671	259	5,958	4,606
1976	1,910	440	568	409	420	430	630	619	170	175	190	195	1,910	15	1,410	847
1977	236	233	231	259	280	280	456	445	170	175	190	195	456	197	455	453
1978	236	233	231	2,408	3,645	4,001	4,963	1,935	370	375	727	1,851	4,963	208	3,398	2,603
1979	1,910	383	381	3,176	4,804	6,720	3,901	2,323	4,292	518	390	395	6,720	153	5,914	5,228
1980	1,910	383	381	9,000	9,000	9,000	4,074	2,781	2,256	5,761	2,769	1,010	9,000	108	9,000	9,000
1981	1,910	383	381	2,511	595	3,665	1,705	882	195	200	215	220	3,665	171	2,495	2,110
1982	712	263	1,290	3,845	9,000	9,000	9,000	9,000	6,099	5,911	2,814	3,297	9,000	139	9,000	9,000
1983	3,312	4,200	5,320	9,000	9,000	9,000	9,000	8,341	7,717	9,000	5,391	1,846	9,000	119	9,000	9,000
1984	1,954	9,000	9,000	9,000	4,696	3,622	3,068	1,877	370	375	390	395	9,000	55	9,000	9,000
1985	1,910	383	708	409	2,975	1,676	2,111	1,076	195	200	215	220	2,975	132	2,110	1,901
1986	260	233	231	296	9,000	9,000	9,000	3,292	5,518	2,196	390	395	9,000	143	9,000	9,000
1987	1,910	383	381	409	1,502	3,919	766	755	170	175	190	195	3,919	157	2,013	1,189
1988	236	233	231	1,189	275	280	456	445	170	175	190	195	1,189	109	669	453
1989	236	233	231	259	280	1,214	814	803	170	175	190	195	1,214	154	813	811
1990	236	233	231	259	280	280	605	594	170	175	190	195	605	197	604	602
1991	236	233	231	259	280	2,207	810	799	170	175	190	195	2,207	178	1,578	1,141
1992	236	233	231	259	3,934	1,421	625	614	170	175	190	195	3,934	135	2,437	1,782
1993	236	233	231	6,521	3,351	1,318	1,888	1,877	370	375	390	395	6,521	110	3,254	2,602

cfs	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Annual	Julian Day of Annual Max	3-day Max	7-day Max
1994	1,910	383	381	535	1,536	430	811	800	170	175	190	195	1,910	16	1,410	839
1995	260	233	231	5,068	415	9,000	7,358	6,870	7,990	8,434	5,323	1,093	9,000	174	8,912	8,418
1996	1,910	383	477	2,465	9,000	6,611	4,761	3,999	5,541	2,162	390	395	9,000	144	8,050	7,562
1997	1,910	383	9,000	72,099	9,000	4,313	2,965	1,877	2,831	501	390	395	72,099	95	53,225	34,318
1998	1,910	383	381	7,460	9,000	8,674	7,388	4,416	7,254	7,029	4,091	915	9,000	127	9,000	9,000
1999	1,910	383	654	3,507	6,787	5,082	3,543	1,877	4,830	922	390	395	6,787	134	6,610	6,523
2000	1,910	383	381	1,715	9,000	9,000	4,502	2,952	3,295	376	390	395	9,000	150	7,520	6,970
2001	1,910	410	381	619	826	2,496	1,458	1,458	195	200	215	220	2,496	157	1,476	1,457
2002	260	233	3,691	3,196	280	280	1,026	1,015	195	200	215	220	3,691	91	2,132	1,765
2003	260	233	609	427	280	280	2,978	1,715	195	200	215	220	2,978	199	2,977	2,975
2004	722	258	256	667	4,235	2,873	1,393	888	195	200	215	220	4,235	149	3,731	3,244
2005	260	233	481	3,660	5,881	8,903	5,626	12,195	13,474	6,765	390	661	13,474	244	12,844	11,108
2006	1,910	383	1,778	8,382	3,712	7,675	9,000	9,000	11,012	7,056	390	395	11,012	250	10,705	9,990
2007	1,910	383	381	409	984	718	817	806	170	175	190	195	1,910	16	1,410	839
2008	236	233	231	2,794	1,691	406	860	849	170	175	190	195	2,794	115	1,816	1,296
2009	260	233	231	259	280	1,975	1,325	1,314	195	200	215	220	1,975	156	1,324	1,322
2010	722	258	256	1,333	2,031	1,969	1,888	1,877	4,450	1,639	390	395	4,450	271	4,236	2,726
2011	1,910	1,001	9,000	9,000	5,845	9,000	7,489	5,154	4,805	10,027	3,277	1,107	10,027	280	9,032	8,647
2012	1,910	380	380	409	420	1,077	1,323	1,323	170	175	190	190	1,910	15	1,410	1,321
1971-2012	3,312	9,000	9,000	72,099	9,000	9,000	9,000	12,195	13,474	10,027	5,391	3,297	72,099	--	--	--

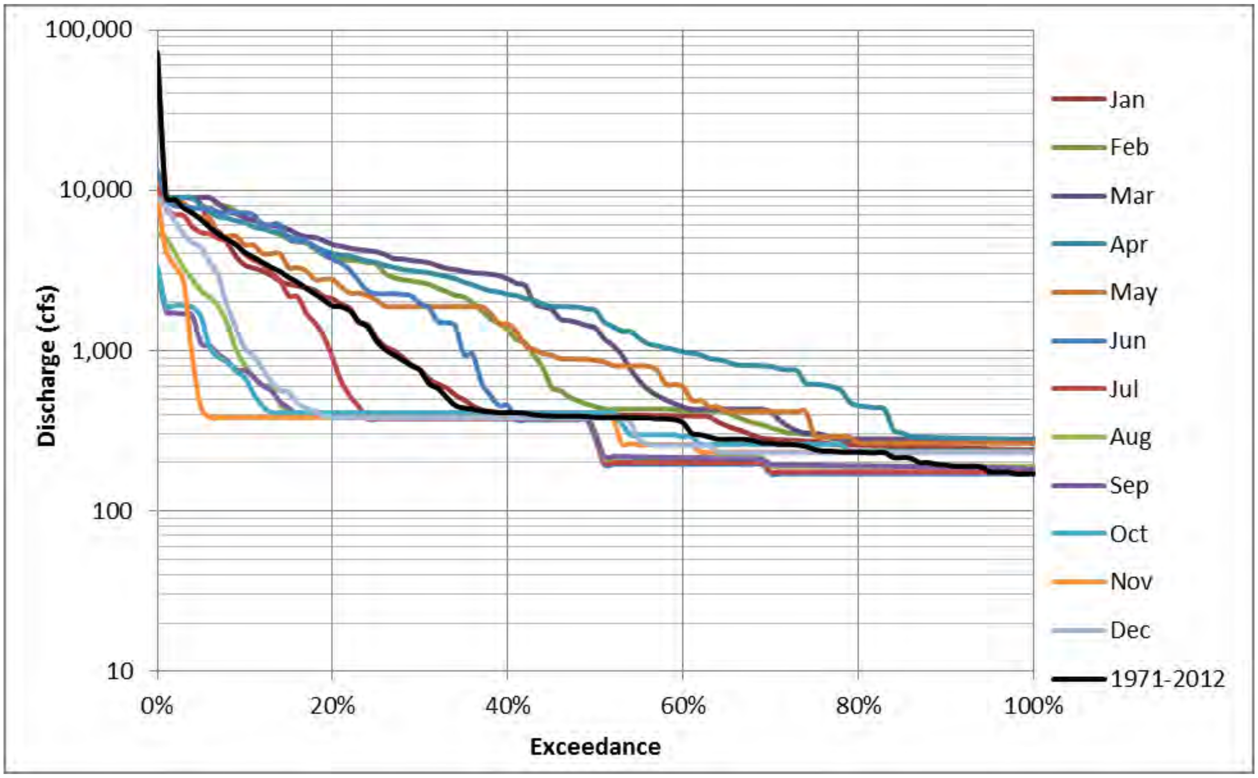


Figure 1. **Tuolumne River at Modesto flow duration curves by month and for the period of record for the Base Case (cfs).**

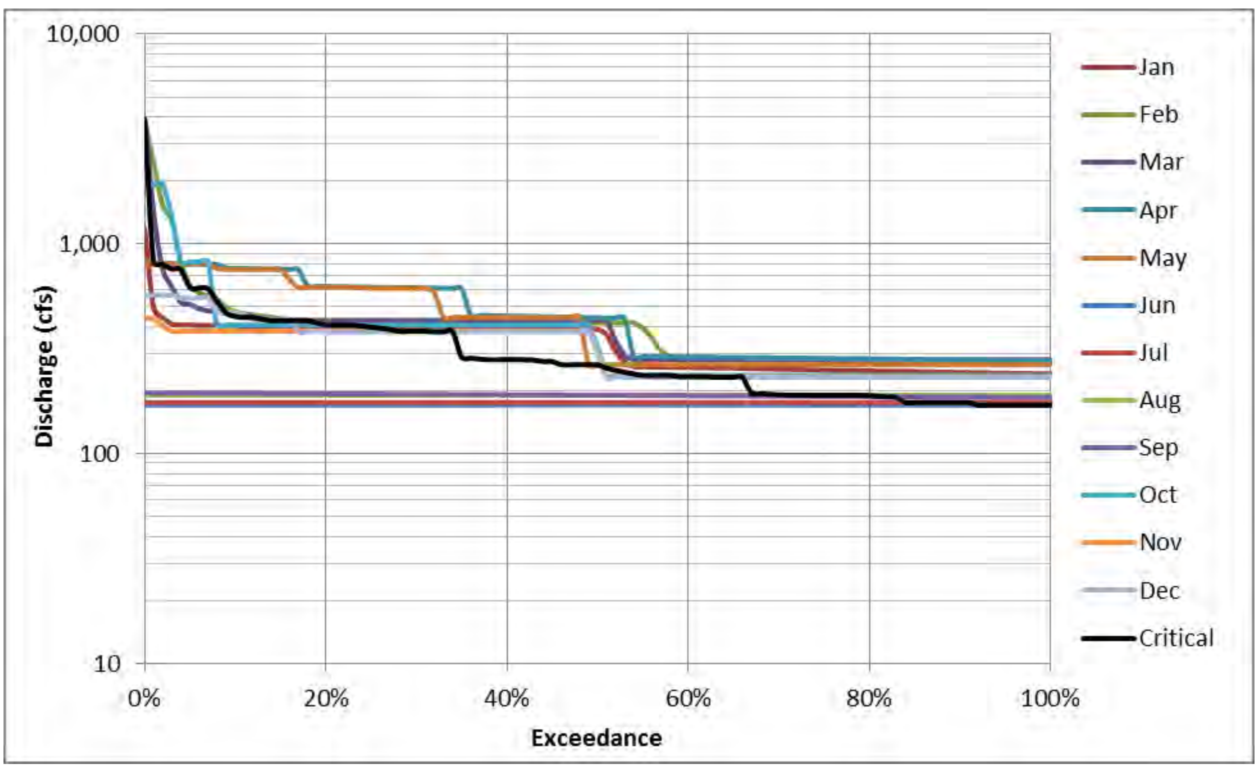


Figure 2. **Tuolumne River at Modesto flow duration curves for Critical years by month and for all Critical years for the Base Case (cfs).**

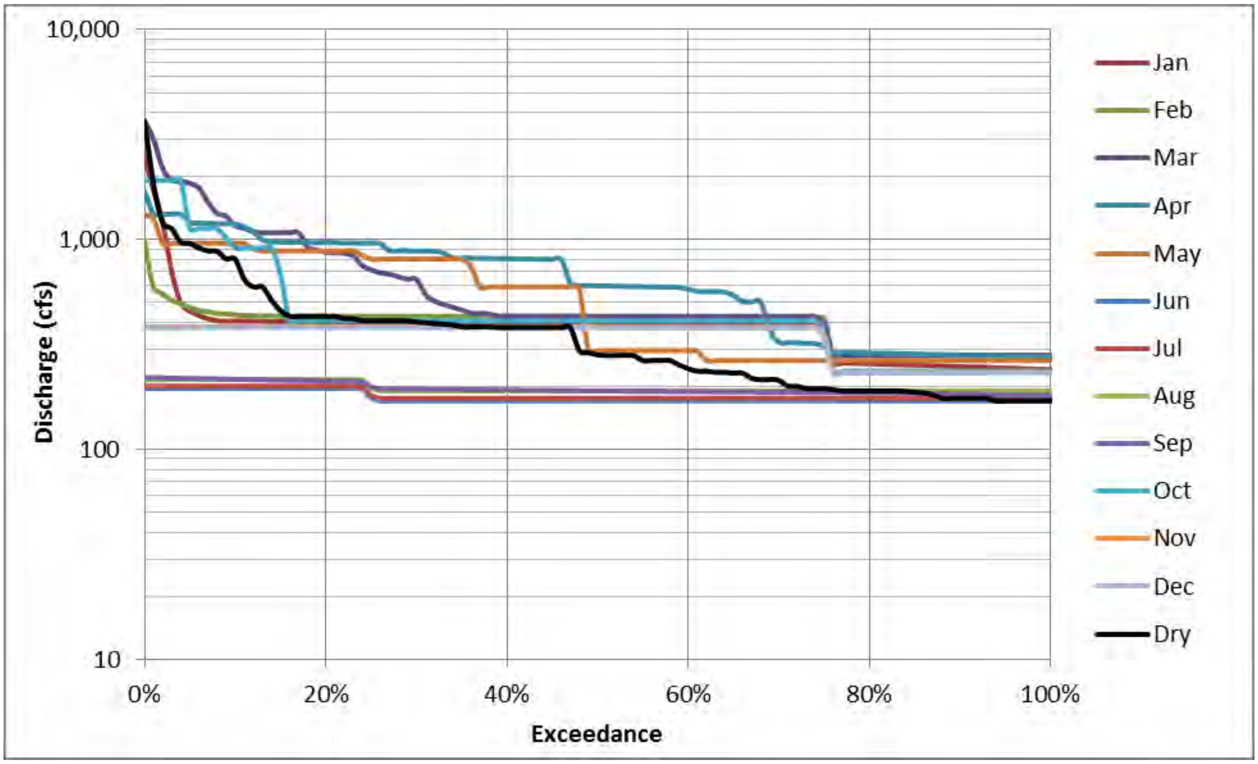


Figure 3. **Tuolumne River at Modesto flow duration curves for Dry years by month and for all Dry years for the Base Case (cfs).**

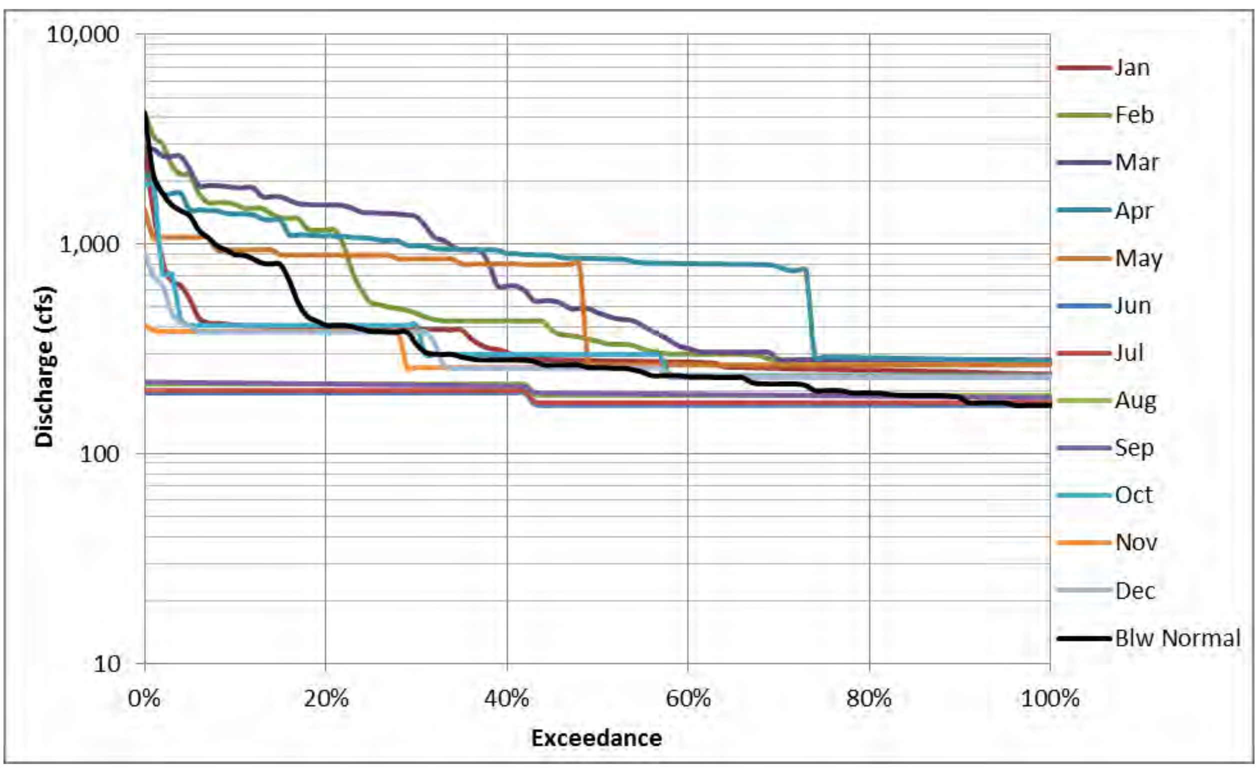


Figure 4. **Tuolumne River at Modesto flow duration curves for Below Normal years by month and for all Below Normal years for the Base Case (cfs).**

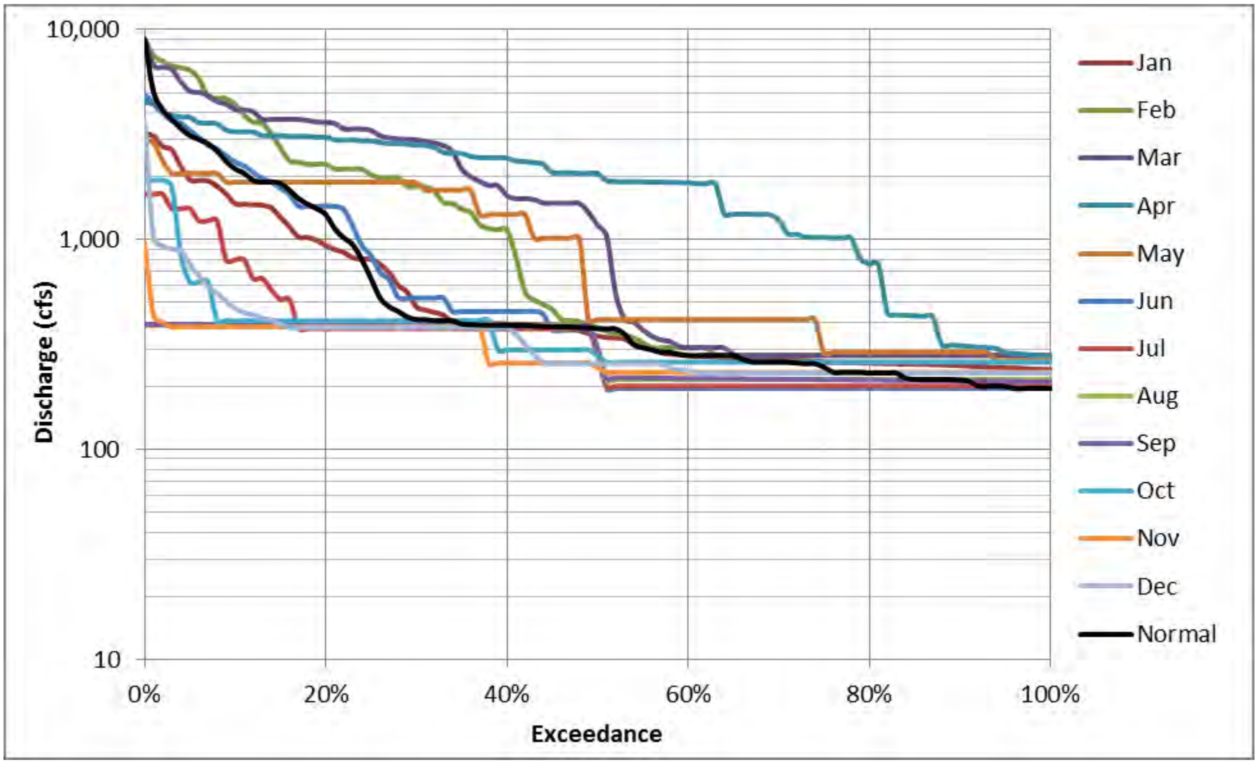


Figure 5. **Tuolumne River at Modesto flow duration curves for Normal years by month and for all Normal years for the Base Case (cfs).**

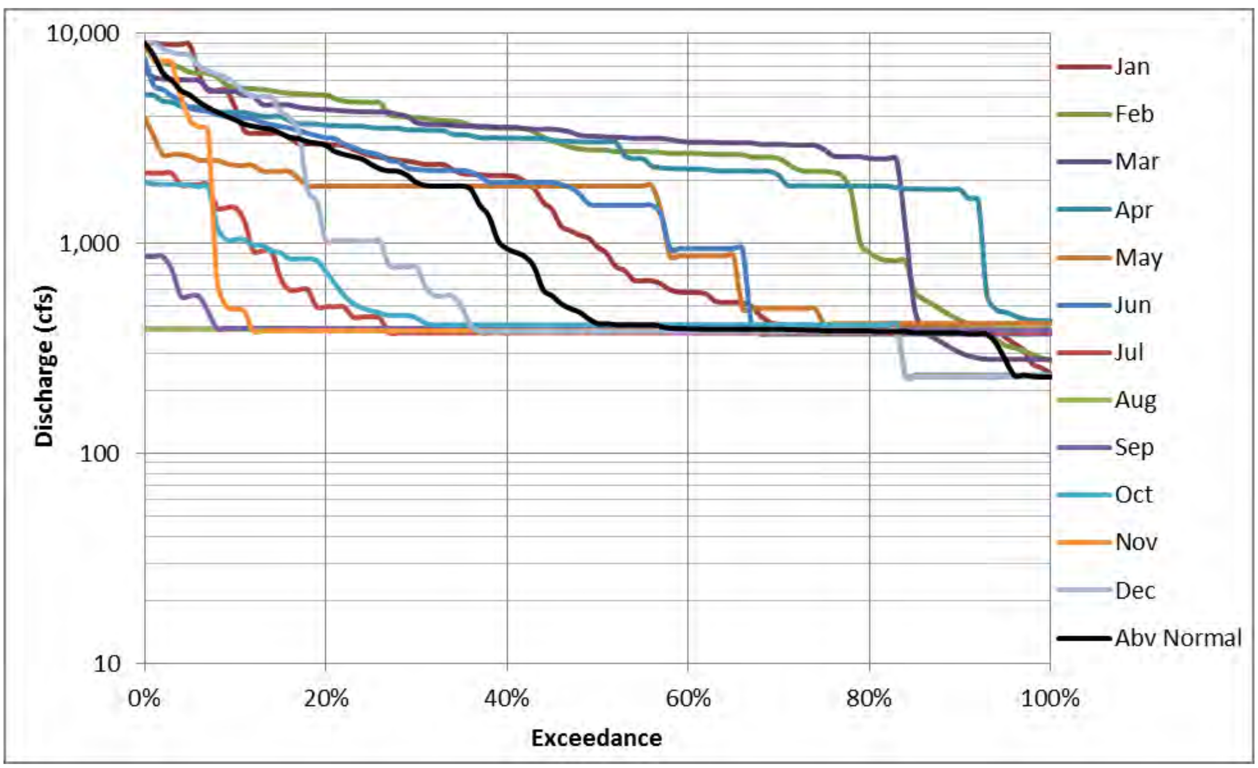


Figure 6. **Tuolumne River at Modesto flow duration curves for Above Normal years by month and for all Above Normal years for the Base Case (cfs).**

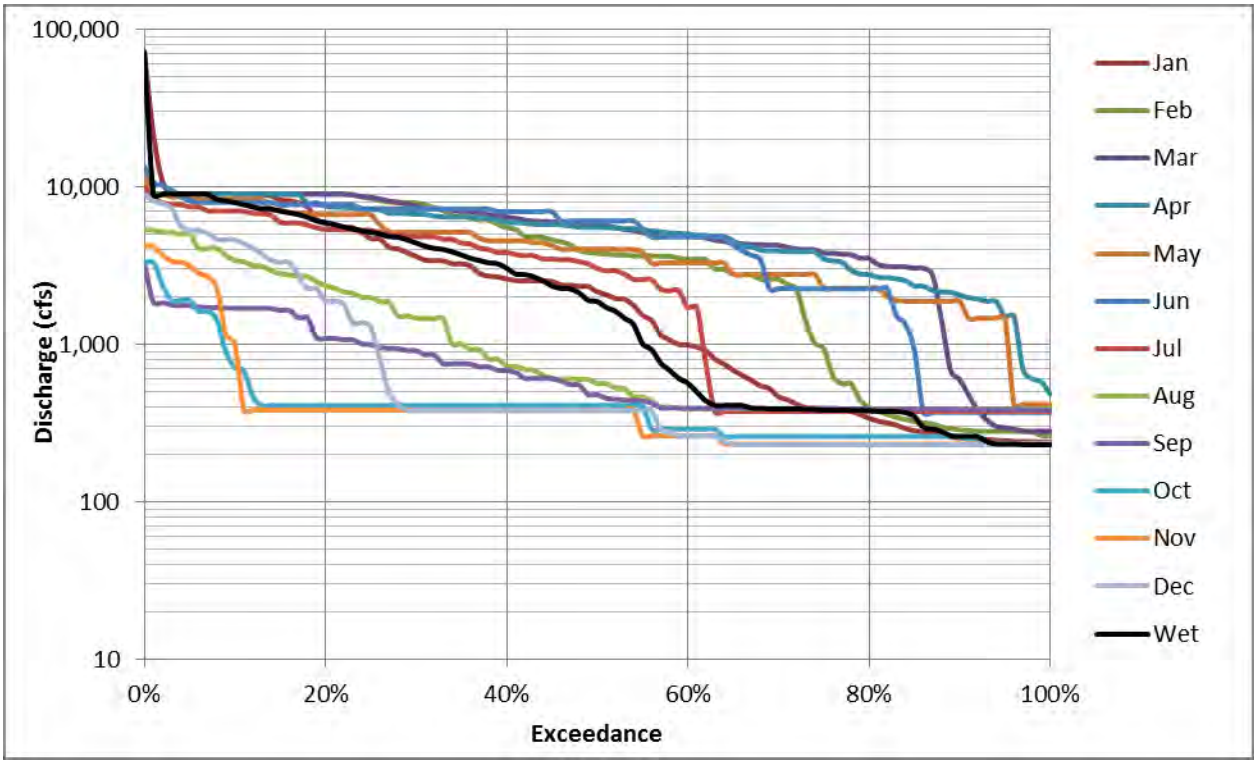
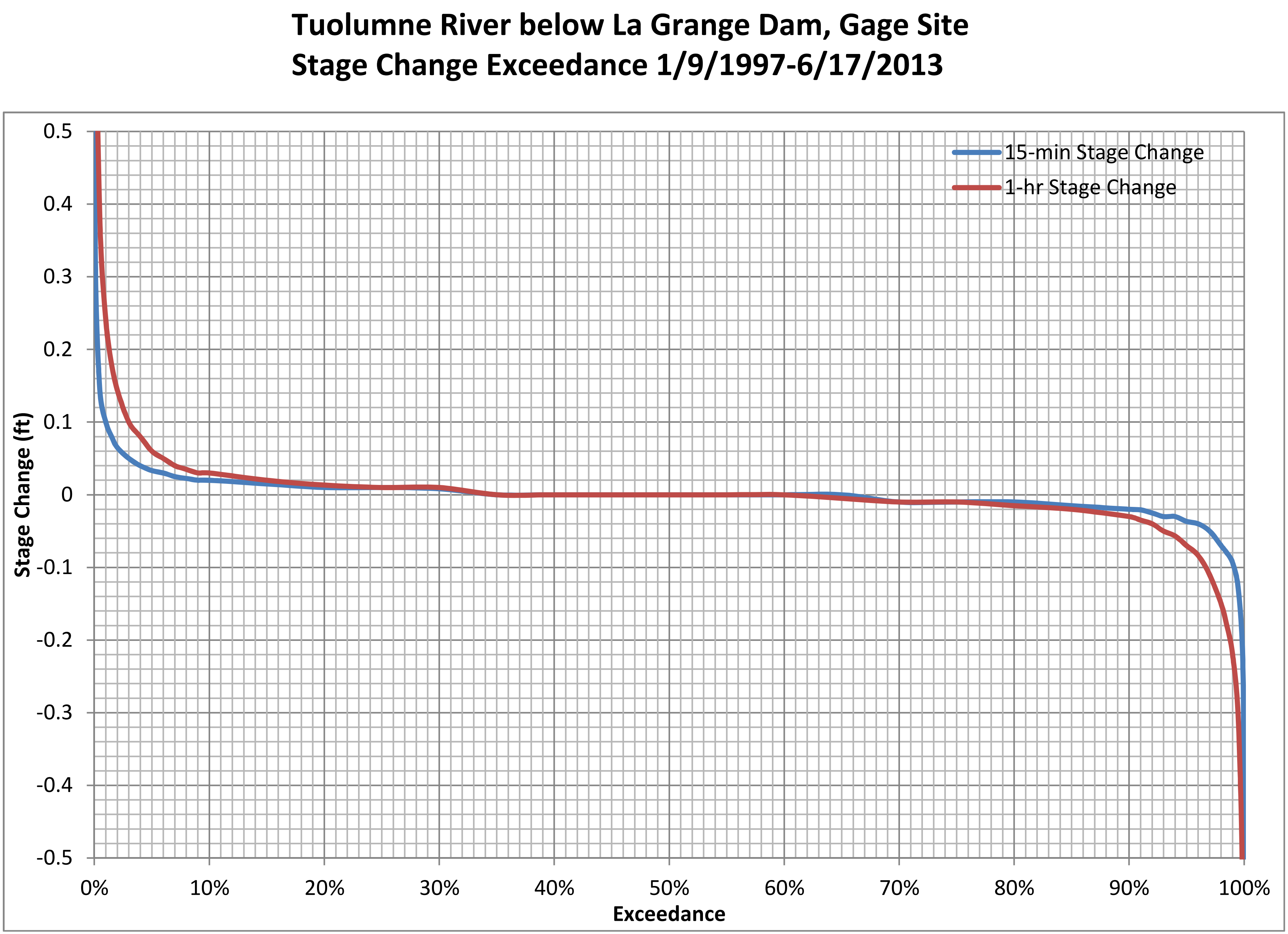


Figure 7. **Tuolumne River at Modesto flow duration curves for Wet years by month and for all Wet years for the Base Case (cfs).**

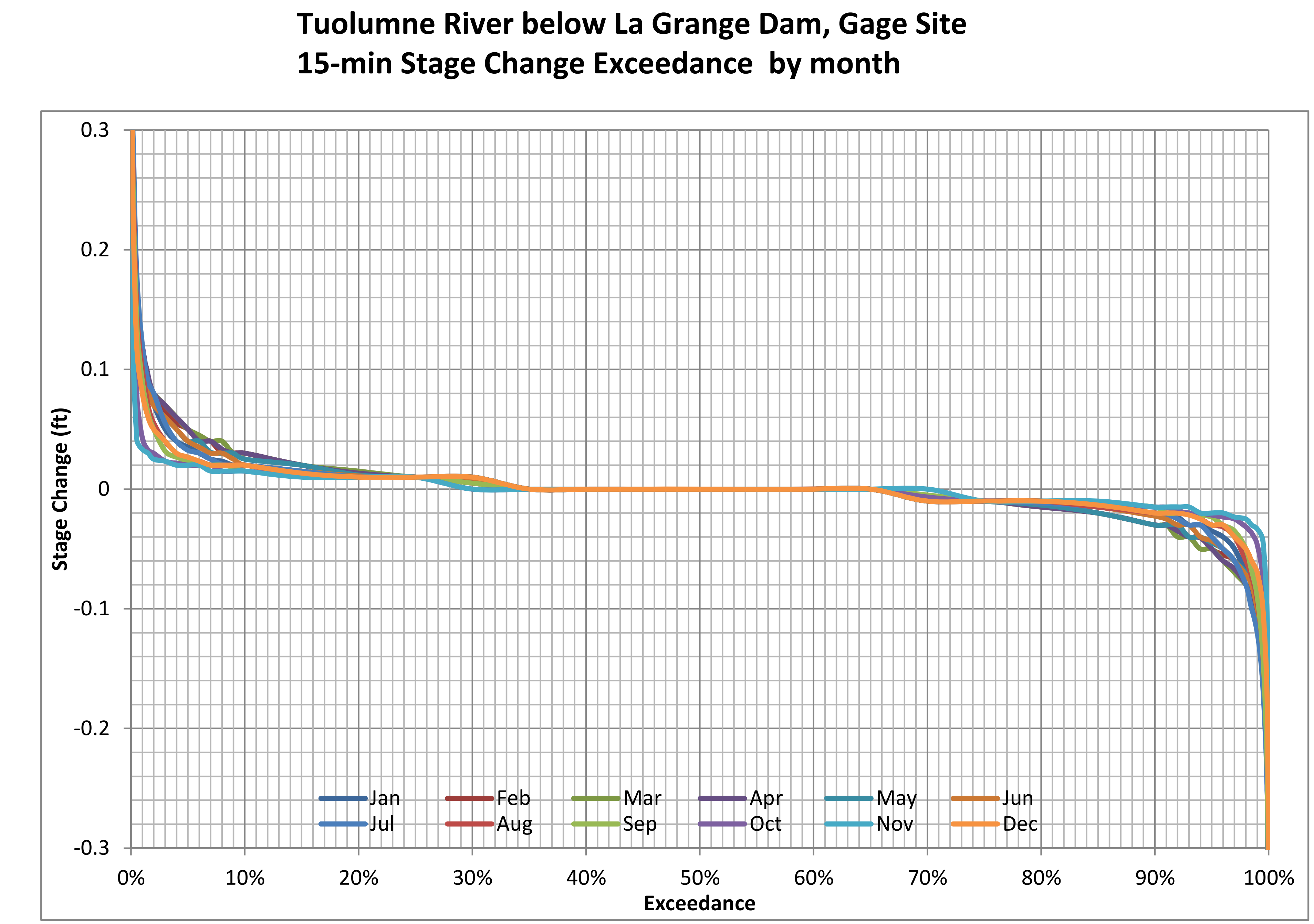
ATTACHMENT 3

Districts' Response to NMFS-4, Element 4

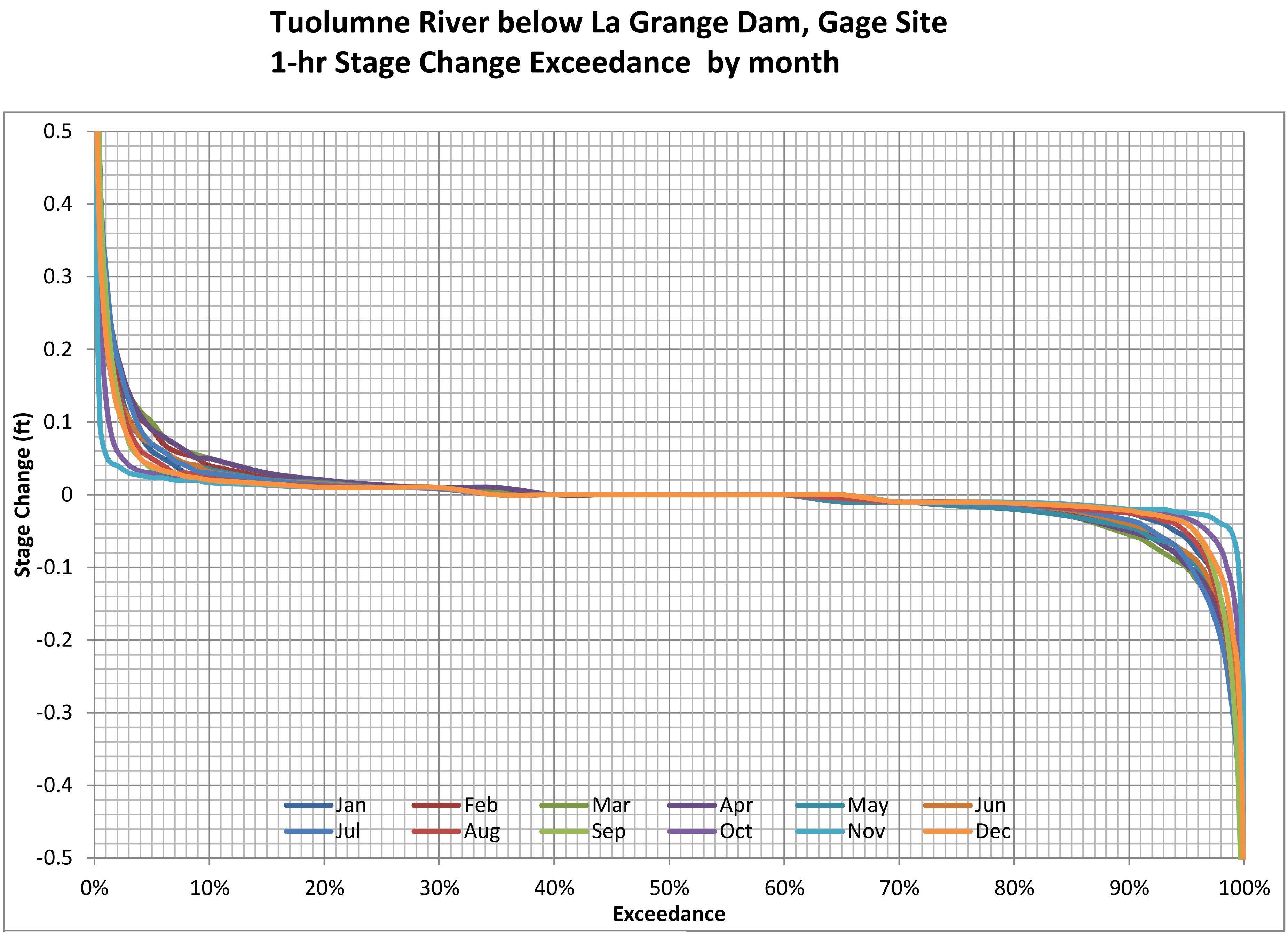
Rate of Stage Change Assessment



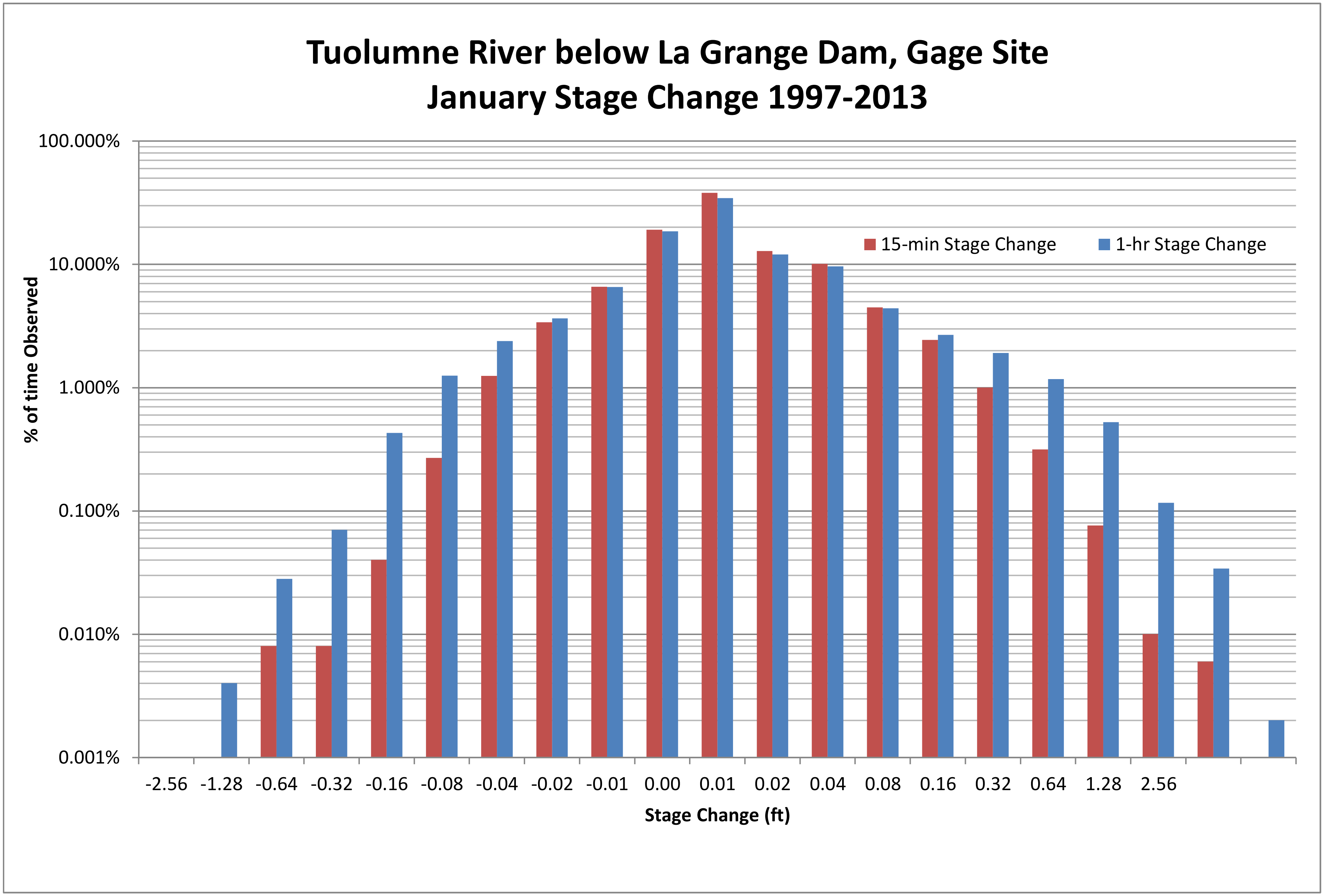
Note: Positive stage change is an increase in water elevation and negative stage change is a decrease



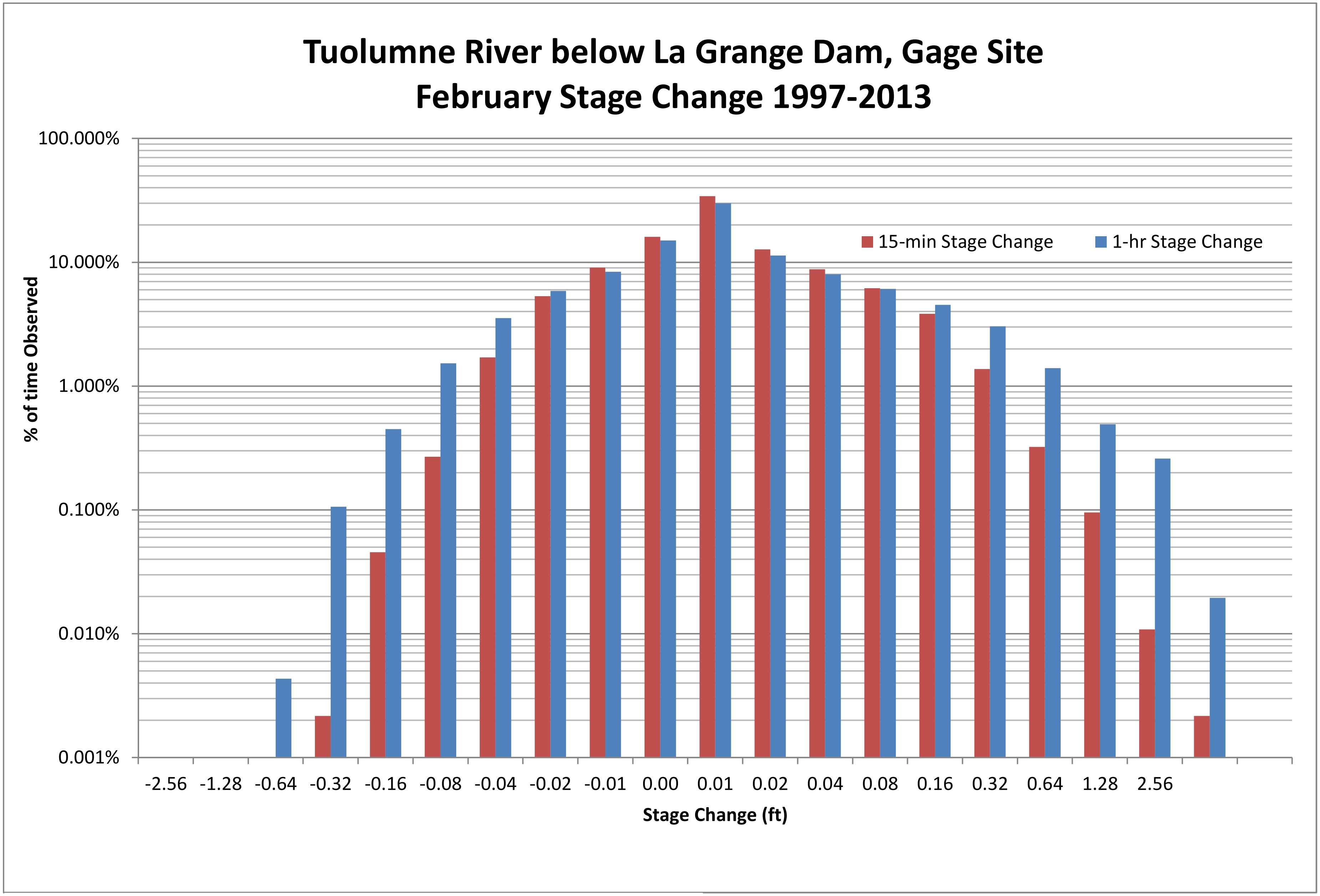
Note: Positive stage change is an increase in water elevation and negative stage change is a decrease



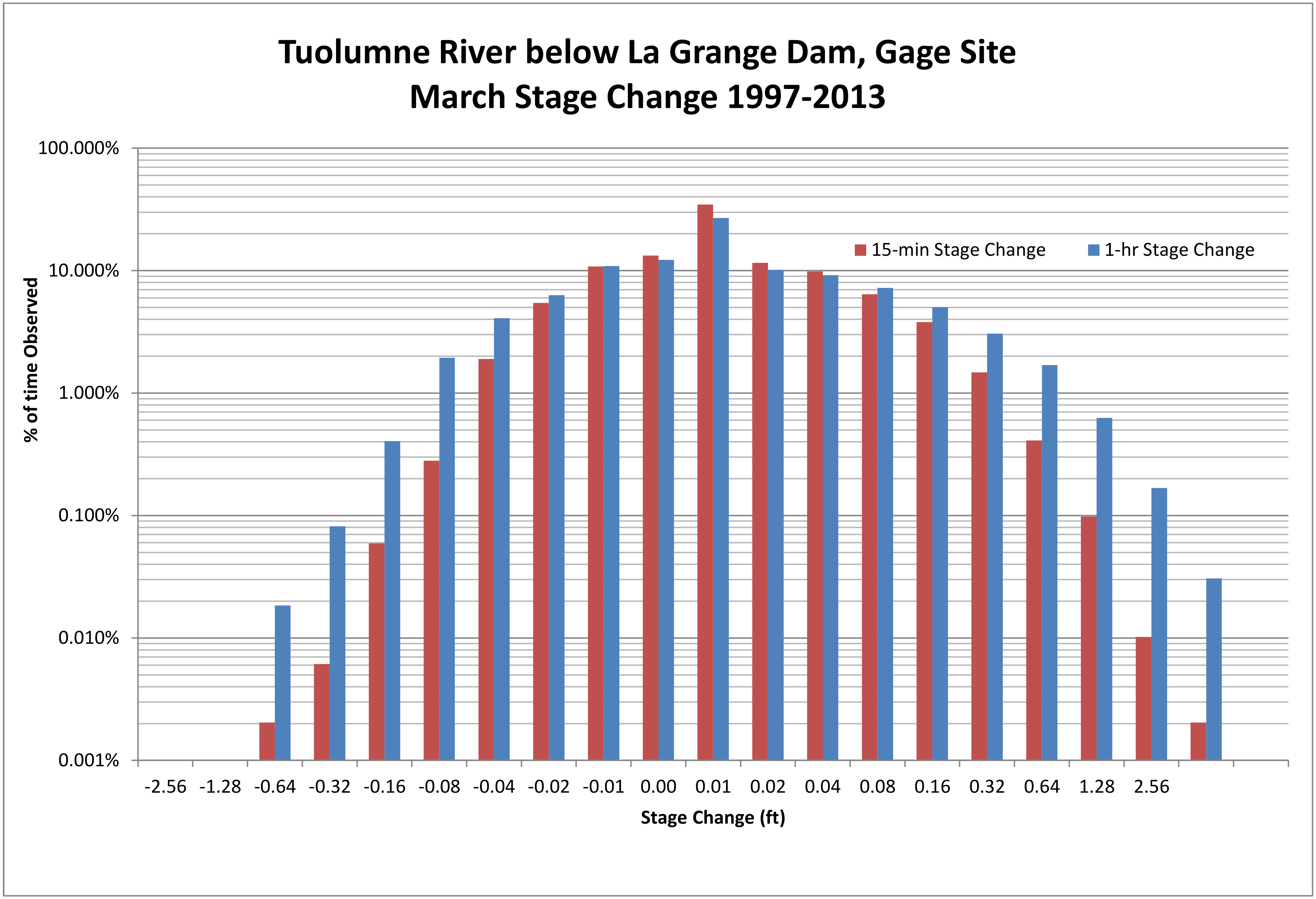
Note: Positive stage change is an increase in water elevation and negative stage change is a decrease



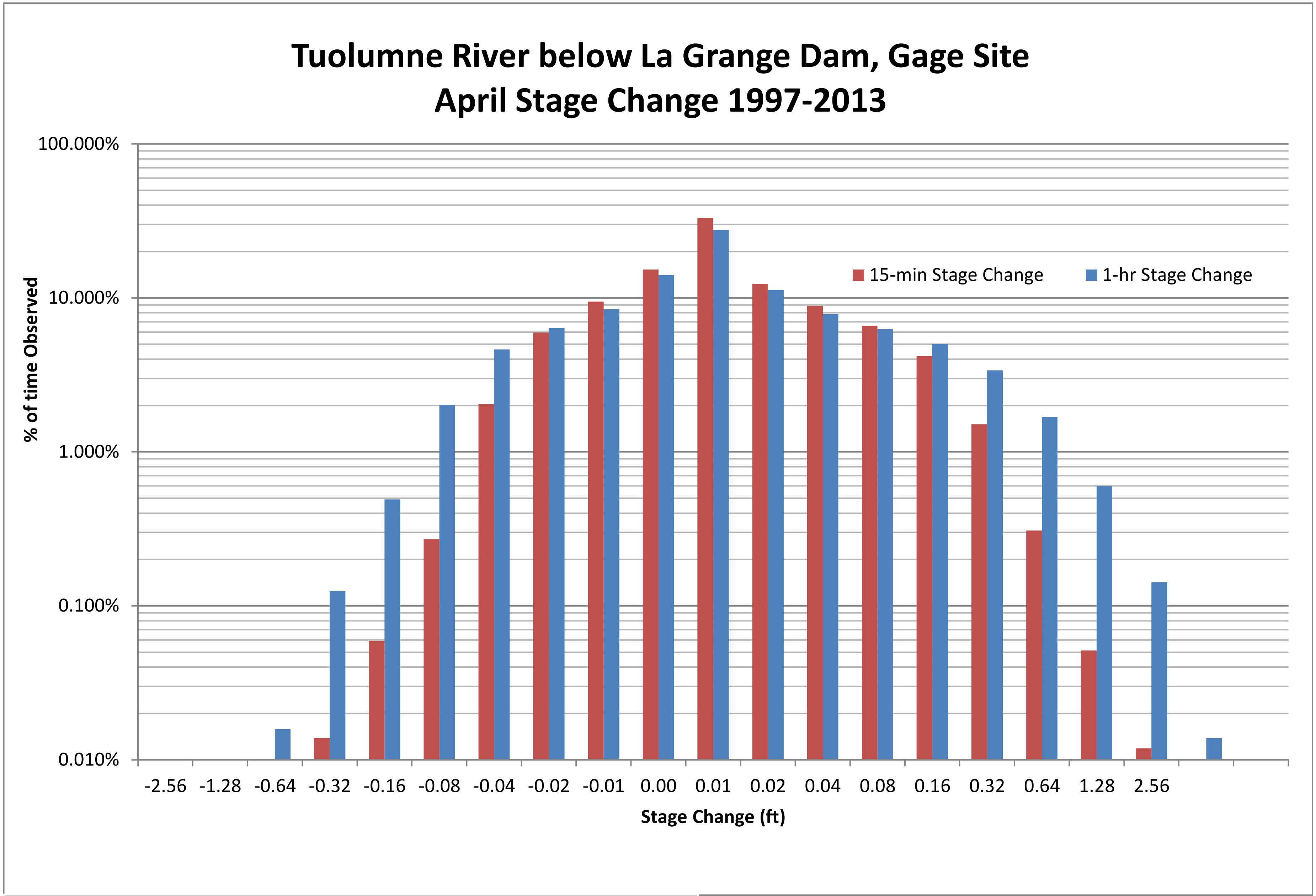
Note: Positive stage change is an increase in water elevation and negative stage change is a decrease



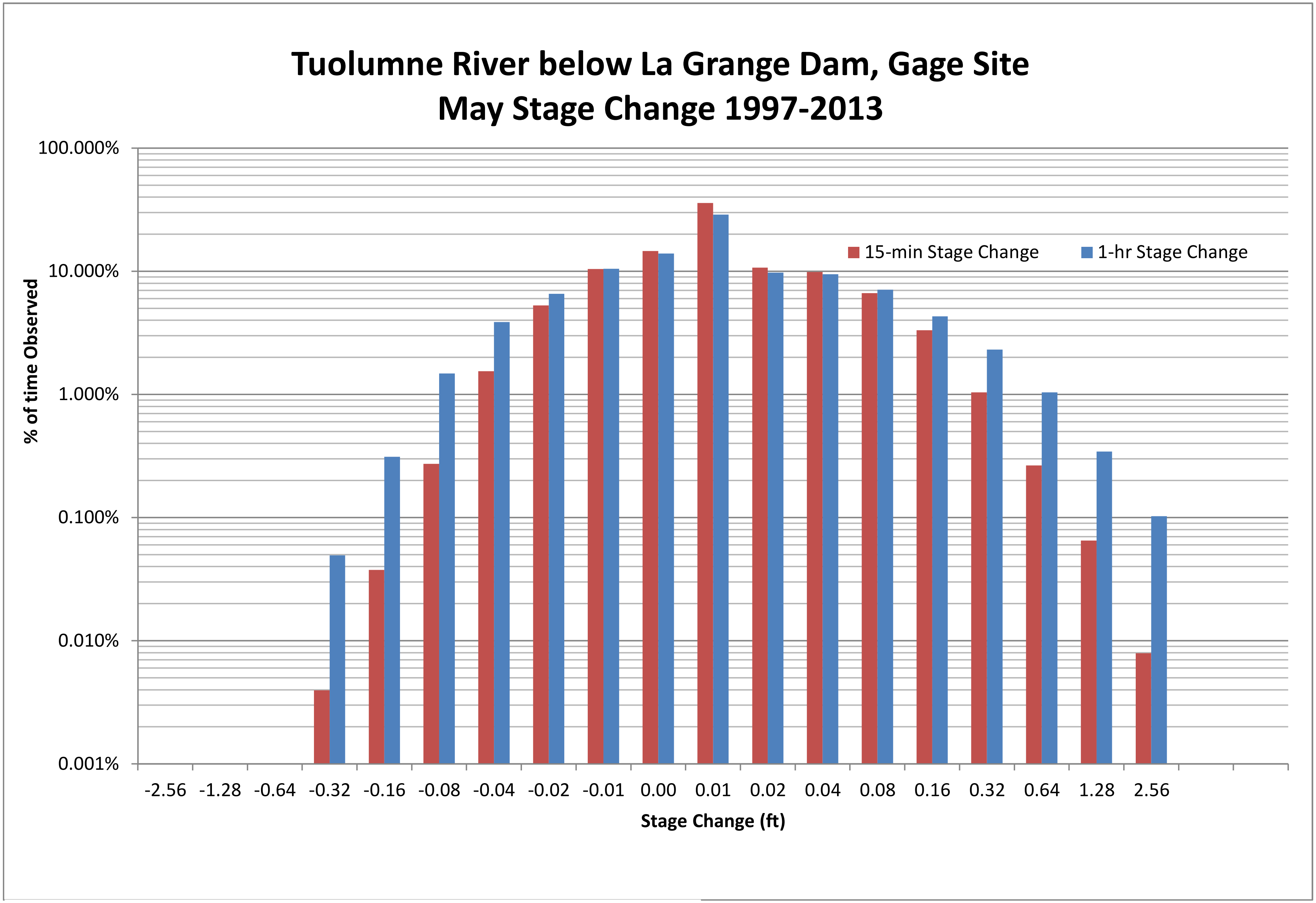
Note: Positive stage change is an increase in water elevation and negative stage change is a decrease



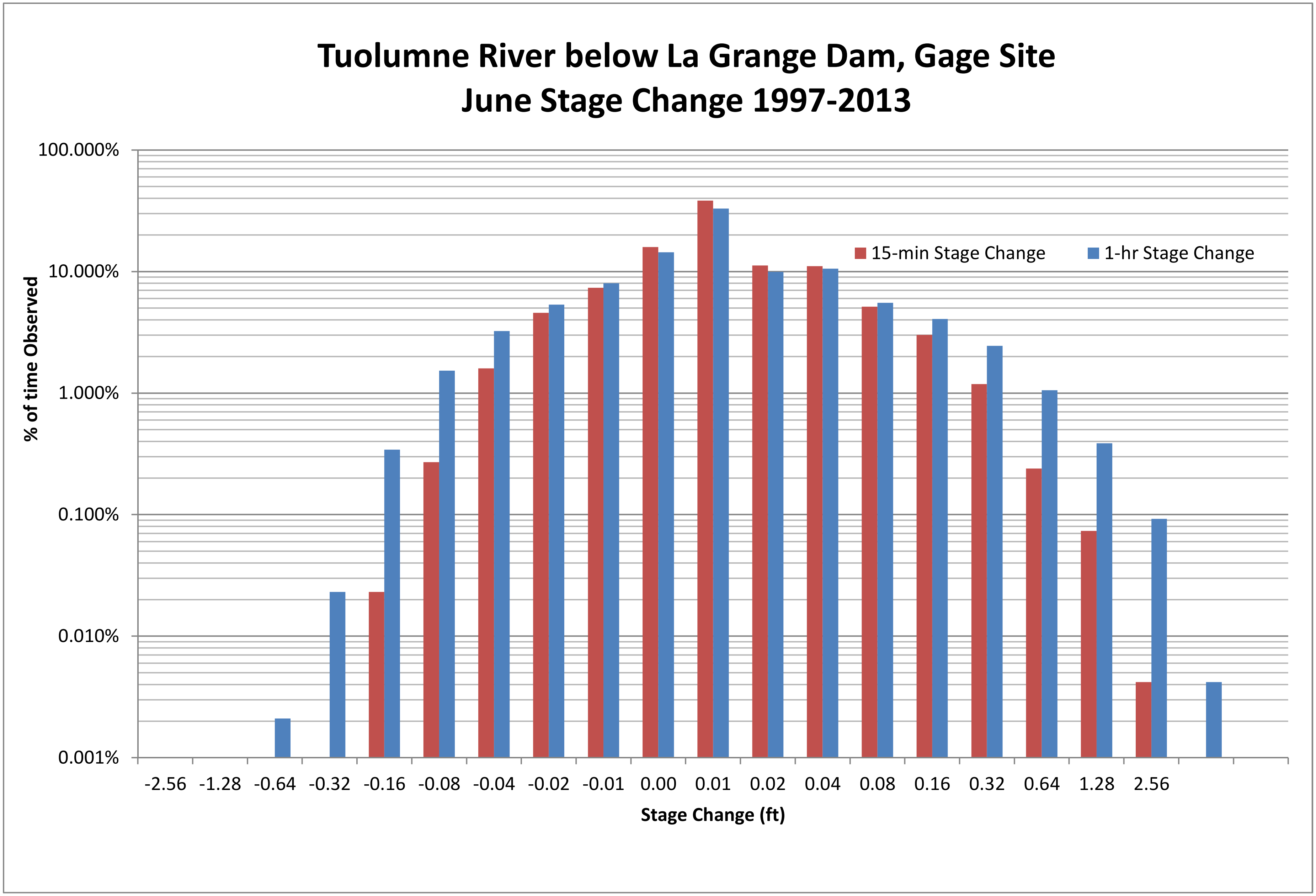
Note: Positive stage change is an increase in water elevation and negative stage change is a decrease



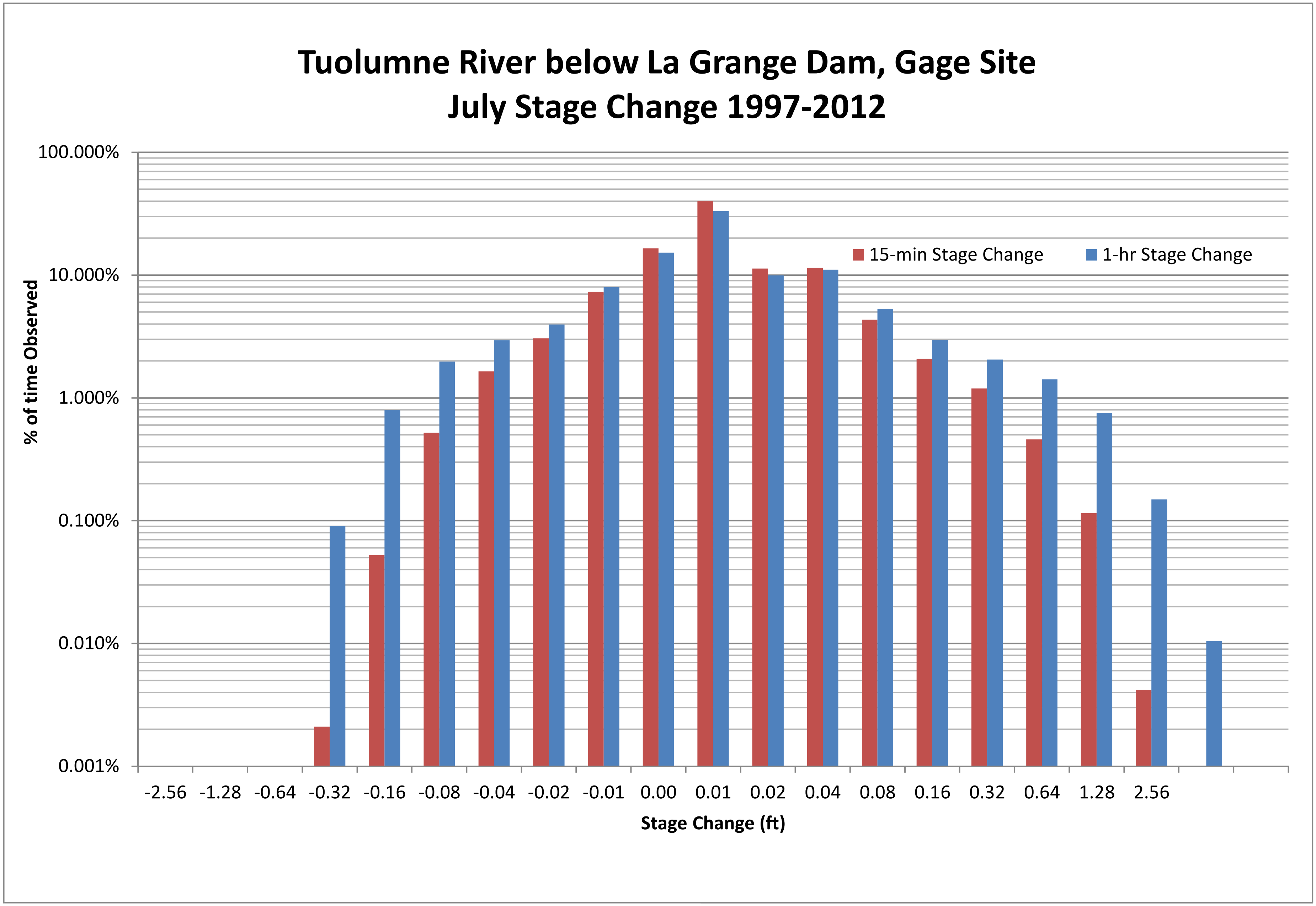
Note: Positive stage change is an increase in water elevation and negative stage change is a decrease



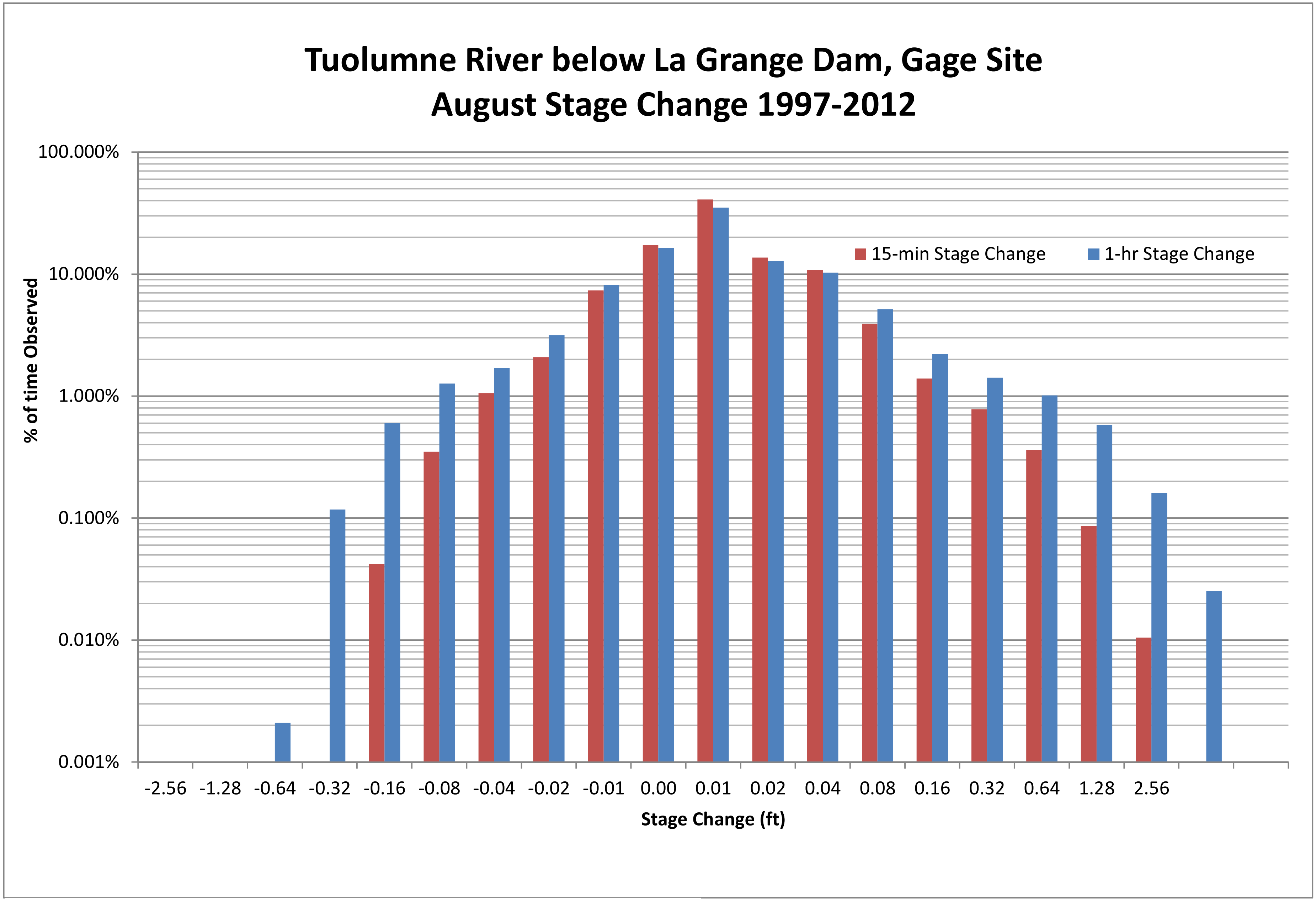
Note: Positive stage change is an increase in water elevation and negative stage change is a decrease



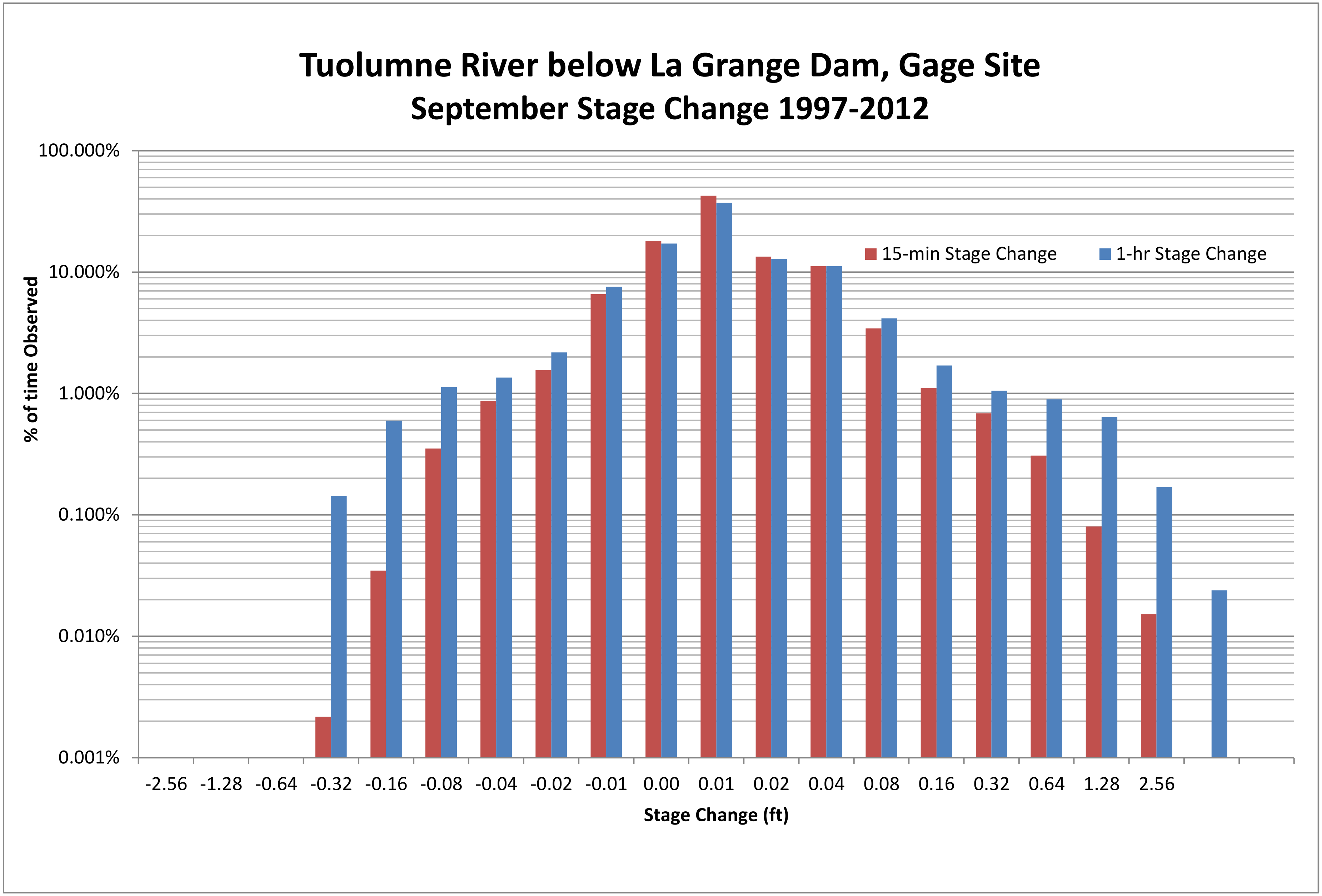
Note: Positive stage change is an increase in water elevation and negative stage change is a decrease



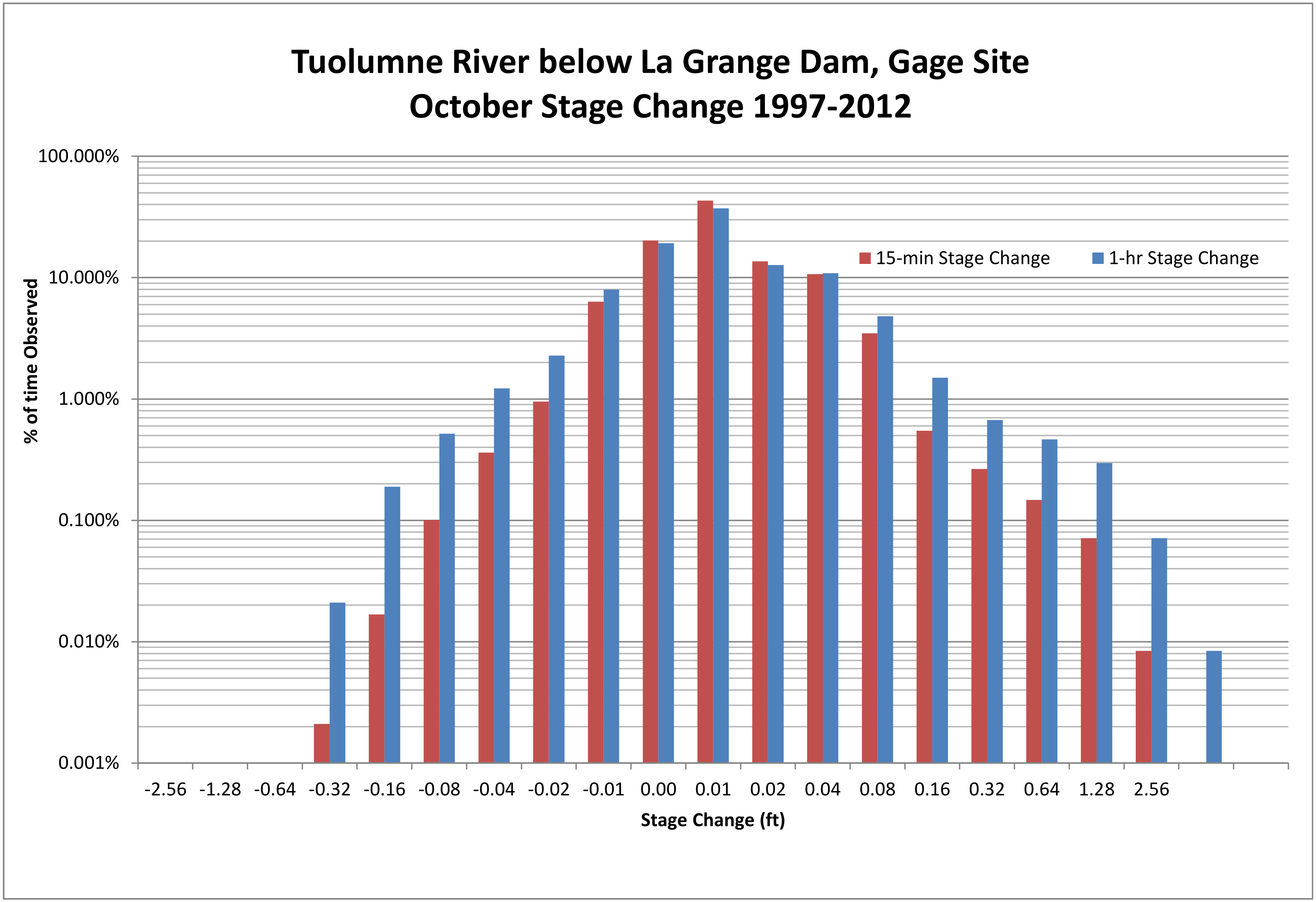
Note: Positive stage change is an increase in water elevation and negative stage change is a decrease



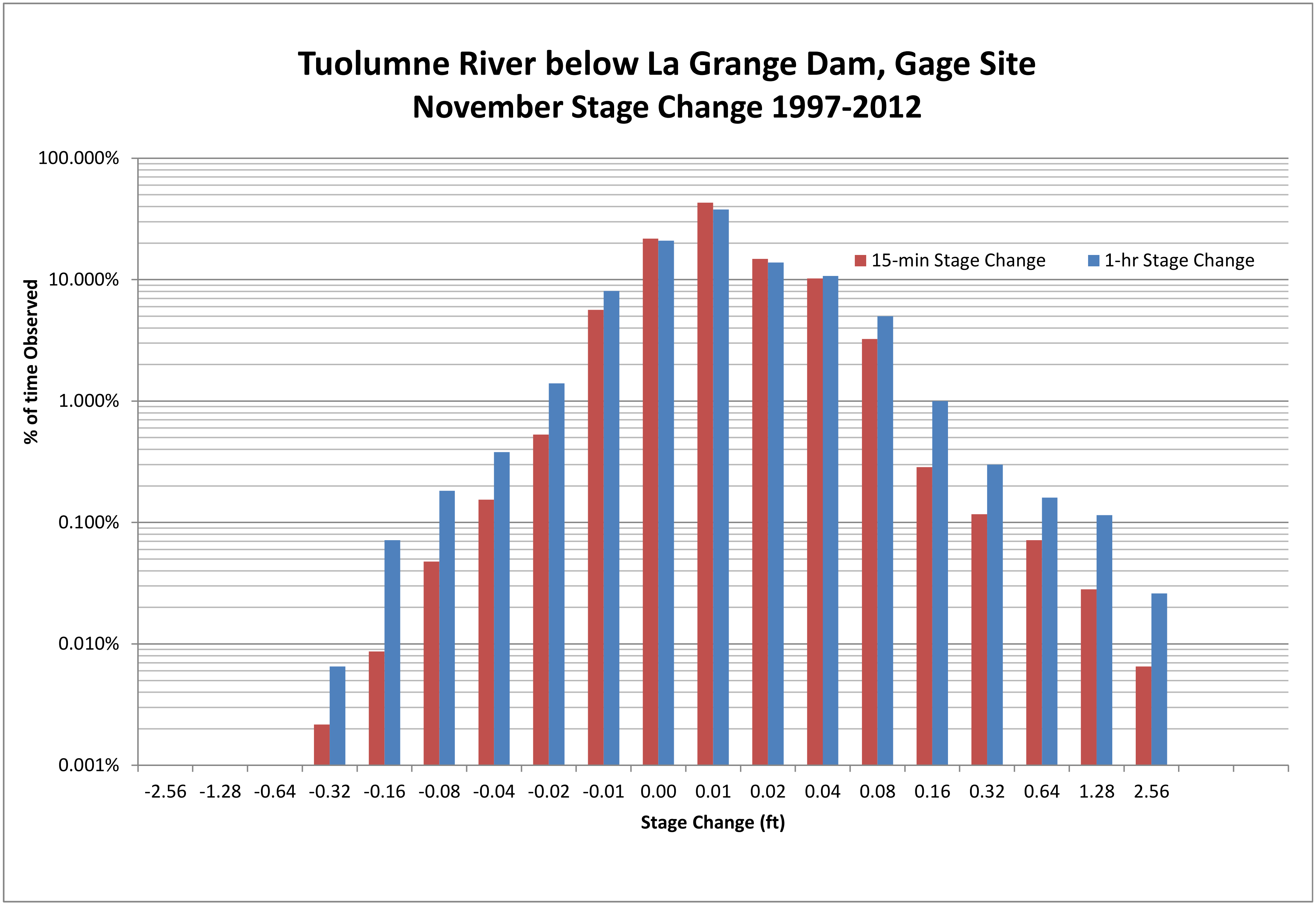
Note: Positive stage change is an increase in water elevation and negative stage change is a decrease



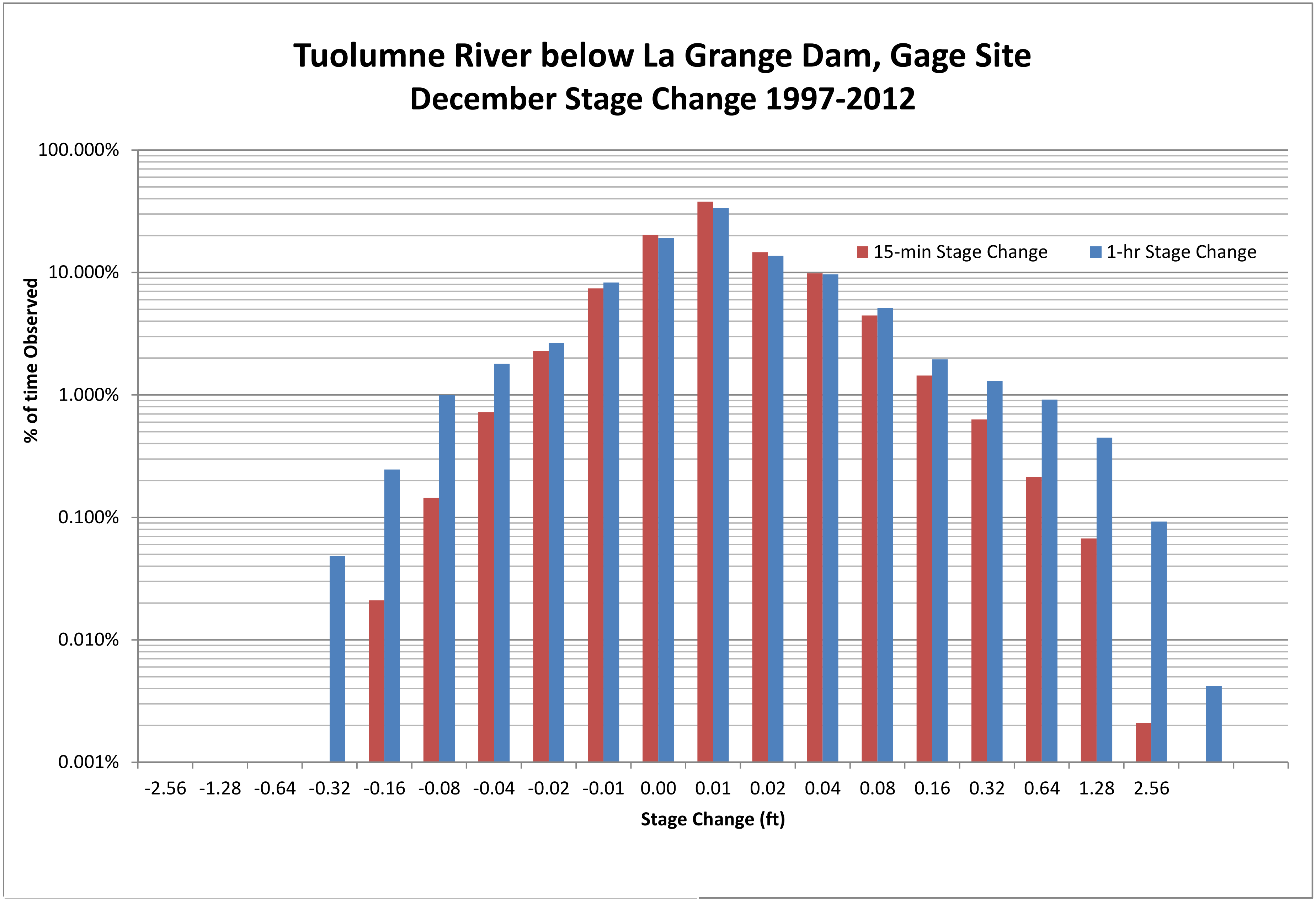
Note: Positive stage change is an increase in water elevation and negative stage change is a decrease



Note: Positive stage change is an increase in water elevation and negative stage change is a decrease



Note: Positive stage change is an increase in water elevation and negative stage change is a decrease



Note: Positive stage change is an increase in water elevation and negative stage change is a decrease

ATTACHMENT 4

March 4, 2013 ACOE Response Regarding Request to Investigate Increasing Don Pedro Project Releases

ORIGINAL

DEPARTMENT OF THE ARMY
U.S. ARMY ENGINEER DISTRICT, SACRAMENTO
CORPS OF ENGINEERS
1325 J STREET
SACRAMENTO CA 95814-2922

REPLY TO
ATTENTION OF

March 04, 2013

Engineering Division – CESPK-ED

Mr. John J Devine
Project Manager
HDR Engineering, Inc.
970 Baxter Boulevard, Suite 301
Portland, ME 04103-5346

RE: Don Pedro Project – FERC Project #2299-075 - Request to increase releases (per your letter of July 12, 2012)

Dear Mr. Devine:

Your letter of July 12 requested the U.S. Army Corps of Engineers (Corps) to investigate increasing the maximum objective releases from Don Pedro Dam into the Tuolumne River. The increases you describe would be from 9,000 cfs to 15,000 cfs above Dry Creek and to 20,000 cfs below Dry Creek during flood events. Your letter also mentioned that this same request was made in 1996, and at that time the Corps rejected that request as it would not meet the flood protection goals along the lower Tuolumne River.

There have been no improvements in the downstream capacity or any changes to the authorized flood control criteria since 1996 that would allow the Corps to increase the maximum flood release to the Tuolumne River. Some agricultural damage to low-lying unprotected areas below Waterford would occur when flows exceed 9,000 cfs, and significant damage would begin at 12,000 cfs.

If you have any other questions or concerns, please contact Wayne Johnson, Chief of the Water Management Section (email Wayne.L.Johnson@usace.army.mil, phone (916) 557-7139) or Christy Jones, Lead Senior Water Manager (email Christy.A.Jones@usace.army.mil, phone (916) 557-7107).

Sincerely,

Rick L. Poeppelman

RICK L. POEPPELMAN, P.E.
Chief, Engineering Division

Cc: Robert Nees, Turlock Irrigation District
Greg Dias, Modesto Irrigation District
Jim Hastreiter, FERC