



February 2, 2016

Filed via Electronic Submittal (E-File)

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

Subject: La Grange Hydroelectric Project, FERC Project No. 14581 Initial Study Report

Dear Secretary 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, herewith file their Initial Study Report (ISR) in accordance with Federal Energy Regulatory Commission (FERC or Commission) regulations at 18 CFR § 5.15(c).

Pursuant to 18 CFR § 5.13(a), on January 5, 2015, the Districts filed a Revised Study Plan containing three study plans: (1) Cultural Resources Study Plan; (2) Recreation Access and Safety Assessment Study Plan; and (3) Fish Passage Assessment Study Plan. The Fish Passage Assessment Study Plan contained a number of individual, but related, study elements. On February 2, 2015, FERC issued its Study Plan Determination for the La Grange Hydroelectric Project, approving or approving with modifications six studies addressing cultural resources, recreation resources, and water and aquatic resources.

The Districts' ISR includes four technical memorandums, four progress reports, and one study report which summarize results from the first year of the Fish Passage Assessment and the results of the Effects of the Project and Related Activities on the Losses of Marine-Derived Nutrients in the Tuolumne River, which has been completed. Given the significance of and the numerous complexities inherent in implementing the Fish Passage Assessment, the Districts focused their efforts in 2015 on this study. The meeting notes from the three workshops held as part of the Fish Passage Assessment, included as part of this ISR, provide insight into considerable efforts expended by all licensing participants on this multi-faceted study. The Districts will complete the Cultural Resources Study and the Recreation Access and Safety

Kimberly D. Bose Page 2 February 2, 2016

Assessment in 2016 and the results of both studies will be reported in the Updated Study Report. The Districts will make the ISR available to federal and state agencies, Indian tribes, local governments, non-governmental organizations, and members of the public likely to be interested in the proceeding.

It is noteworthy that the Districts and licensing participants held another workshop, Workshop No. 4, on the subject of fish reintroduction/fish passage on January 27, 2016, and in that workshop, the parties generally agreed to an overall approach, plan, and schedule for undertaking additional necessary studies to fill information gaps related to the feasibility of fish reintroduction and fish passage at the La Grange and Don Pedro projects. The Districts plan to present and discuss specific additional studies for 2016 in the ISR meeting.

FERC regulations at 18 CFR 5.15(c)(2) require license applicants to hold a meeting with licensing participants and FERC staff within 15 days following ISR filing. On December 2, 2015, the Districts filed a letter with FERC requesting a waiver from 18 CFR 5.15(c)(2) and proposing to hold the ISR meeting on February 25, 2016. On December 16, 2015, FERC approved the Districts' waiver request and proposed meeting date.

The Districts will hold an ISR meeting on February 25, 2016, with licensing participants and Commission staff to discuss study findings, variances, and any proposed study modifications. The meeting will be held from 9:00 am to 1:00 pm at the Hilton Double Tree Hotel, located at 1150 9<sup>th</sup> Street in Modesto, California.

If you have any questions about this filing, please contact the undersigned at the addresses or telephone numbers listed below.

Sincerely,

Steve Boyd Turlock Irrigation District P.O. Box 949 Turlock, CA 95381 (209) 883-8364 seboyd@tid.org

Grey Oias

Greg Dias Modesto Irrigation District P.O. Box 4060 Modesto, CA 95352 (209) 526-7566 gregd@mid.org

cc: Licensing Participants List

Enclosure: La Grange Hydroelectric Project Initial Study Report

## **INITIAL STUDY REPORT**

## LA GRANGE HYDROELECTRIC PROJECT FERC NO. 14581







Prepared for: Turlock Irrigation District – Turlock, California Modesto Irrigation District – Modesto, California

> Prepared by: HDR, Inc.

February 2016

This Page Intentionally Left Blank.

## **Initial Study Report**

#### **TABLE OF CONTENTS** Description

#### Page No.

Section No.			Page No.					
1.0	INTRODU		DUCTION					
1.1 B		Backg	ground		1-1			
	1.2	Licen	sing Studie	°S	1-4			
		1.2.1	Revised S	Study Plan	1-4			
		1.2.2	FERC St	udy Plan Determination	1-5			
		1.2.3	Resolutio	on of Disputed Studies	1-6			
	1.3	Conte	ent of this I	nitial Study Report	1-6			
	1.4	Distri	cts' Ongoin	ng Studies and Data Collection Activities	1-7			
2.0	SUM	SUMMARY OF LICENSING STUDIES						
	2.1	Fish F	Passage Ass	sessment	2-1			
		2.1.1	Fish Pass	age Facilities Alternatives Assessment	2-1			
			2.1.1.1	Study Goals and Objectives	2-1			
			2.1.1.2	Study Methods and Approach	2-2			
			2.1.1.3	Study Findings	2-3			
			2.1.1.4	Study Variances	2-4			
			2.1.1.5	Study Status	2-4			
		2.1.2	La Grang	e Project Fish Barrier Assessment				
			2.1.2.1	Study Goals and Objectives	2-4			
			2.1.2.2	Study Methods and Approach	2-4			
			2.1.2.3	Study Findings	2-5			
			2.1.2.4	Study Variances	2-6			
			2.1.2.5	Study Status	2-6			
		2.1.3	Upper Tu	olumne River Basin Fish Migration Barriers Study				
			2.1.3.1	Study Goals and Objectives	2-6			
			2.1.3.2	Study Methods and Approach	2-7			
			2.1.3.3	Study Findings	2-8			
			2.1.3.4	Study Variances	2-8			
			2.1.3.5	Study Status	2-9			

2.1.4	Upper Tuolumne River Basin Water Temperature Monitoring and Modeling Study2-10			
	2.1.4.1	Study Goals and Objectives		
	2.1.4.2	Study Methods and Approach2-10		
	2.1.4.3	Study Findings		
	2.1.4.4	Study Variances		
	2.1.4.5	Study Status		
2.1.5	Upstream	Habitat Characterization2-11		
2.1.6	Topograp	hic Survey2-11		
	2.1.6.1	Study Goals and Objectives		
	2.1.6.2	Study Methods and Approach2-12		
	2.1.6.3	Study Findings2-12		
	2.1.6.4	Study Variances		
	2.1.6.5	Study Status		
2.1.7	Salmonid	Habitat Mapping 2-13		
	2.1.7.1	Study Goals and Objectives		
	2.1.7.2	Study Methods and Approach2-13		
	2.1.7.3	Study Findings		
	2.1.7.4	Study Variances		
	2.1.7.5	Study Status		
2.1.8	Fish Prese	ence and Stranding Assessment		
	2.1.8.1	Study Goals and Objectives		
	2.1.8.2	Study Methods and Approach2-15		
	2.1.8.3	Study Findings		
	2.1.8.4	Study Variances		
	2.1.8.5	Study Status		
2.1.9	Flow Red Project	cords for Five Discharge Structures at the La Grange		
2.1.10	Investigat Tubes	tion of Fish Attraction to La Grange Powerhouse Draft		
	2.1.10.1	Study Goals and Objectives		
	2.1.10.2	Study Methods and Approach2-18		
	2.1.10.3	Study Findings		

			2.1.10.4	Study Variances	2-19
			2.1.10.5	Study Status	2-19
	2.2	Effects Derive	s of the Pr d Nutrients	coject and Related Activities on the Losses of Marines in the Tuolumne River	2-19
		2.2.1	Study Goa	als and Objectives	2-19
		2.2.2	Study Me	thods and Approach	2-19
		2.2.3	Study Fin	dings	2-20
		2.2.4	Study Var	iances	2-20
		2.2.5	Study Stat	tus	2-20
3.0	INITI	AL ST	UDY REP	ORT MEETING	3-1
4.0	REFE	RENC	ES CITED	)	4-1

List of Figures						
Figure No.	Description	Page No.				
Figure 1.1-1.	La Grange Hydroelectric Project location map.					
Figure 1.1-2.	La Grange Hydroelectric Project site plan	1-3				

List of Table	es	
---------------	----	--

Table No.	Description	Page No.
Table 1.2-1.	Studies approved or approved with modifications in FERC's Study Pla Determination.	an 1-5
Table 1.4-1.	Studies performed by the Districts during the current license term of the Don Pedro Hydroelectric Project.	he 1-8
Table 1.4-2.	Studies completed by the Districts as part of the Don Pedro Hydroelectr Project relicensing process	ric 1-12
Table 1.4-3.	Studies in the Don Pedro Hydroelectric Project relicensing process yet be completed.	to 1-13
Table 2.1-1.	Fish Passage Assessment elements and components	

### List of Appendices

Appendix A	Fish Passage Facilities Alternatives Assessment Progress Report
Appendix B	La Grange Project Fish Barrier Assessment Progress Report
Appendix C	Upper Tuolumne River Basin Fish Migration Barriers Study Progress Report

Appendix D	Upper Tuolumne River Basin Water Temperature Monitoring and Modeling Study Progress Report
Appendix E	Topographic Survey Technical Memorandum
Appendix F	Salmonid Habitat Mapping Technical Memorandum
Appendix G	Fish Presence and Stranding Assessment Technical Memorandum
Appendix H	Flow Records for Five Discharge Structures at the La Grange Project Technical Memorandum
Appendix I	Effects of the Project and Related Activities on the Losses of Marine-Derived Nutrients in the Tuolumne River Study Report

ac-ft	acre-foot
BLM	Bureau of Land Management
BOR	Bureau of Reclamation
CCSF	City and County of San Francisco
CDFG	California Department of Fish and Game, now CDFW
CDFW	California Department of Fish and Wildlife
cfs	cubic feet per second
CG	Conservation Group
Districts	Turlock Irrigation District and Modesto Irrigation District
FERC	Federal Energy Regulatory Commission
FLA	Final License Application
FPA	Federal Power Act
GIS	geographic information system
ILP	Integrated Licensing Process
ISR	Initial Study Report
LGDD	La Grange Diversion Dam
LP	Licensing Participant
M&I	municipal and industrial
MID	Modesto Irrigation District
NMFS	National Marine Fisheries Service
NPS	National Park Service
O&M	operation and maintenance
PAD	Pre-Application Document
PSP	Proposed Study Plan
QA/QC	quality assurance/quality control
RM	river mile
RSP	Revised Study Plan
SD2	Scoping Document 2
SPD	Study Plan Determination
TAF	thousand acre-feet
TID	Turlock Irrigation District
ТМ	technical memorandum
USFWS	United States Fish and Wildlife Service
USGS	United States Geological Survey
USR	Updated Study Report

### **1.0 INTRODUCTION**

#### 1.1 Background

The Turlock Irrigation District (TID) and Modesto Irrigation District (MID) (collectively, the Districts) own the La Grange Diversion Dam (LGDD) located on the Tuolumne River in Stanislaus County, California (Figures 1.1-1 and 1.1-2). LGDD is 131 feet high and is located at river mile (RM) 52.2 at the exit of a narrow canyon, the walls of which contain the pool formed by the diversion dam. Under normal river flows, the pool formed by the diversion dam extends for approximately one mile upstream. When not in spill mode, the water level upstream of the diversion dam is between elevation 294 feet and 296 feet approximately 90 percent of the time. Within this 2-foot range, the pool storage is estimated to be less than 100 acre-feet of water.

The drainage area of the Tuolumne River upstream of LGDD is approximately 1,550 square miles. Tuolumne River flows upstream of LGDD are regulated by four upstream reservoirs: Hetch Hetchy, Lake Eleanor, Cherry Lake, and Don Pedro. The Don Pedro Hydroelectric Project (Federal Energy Regulatory Commission [the Commission or FERC] No. 2299) 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 La Grange pool is the sum of releases from the Don Pedro Project, located 2.3 miles upstream, and very minor contributions from two small intermittent streams downstream of Don Pedro Dam.

LGDD was constructed from 1891 to 1893 displacing Wheaton Dam, which was built by other parties in the early 1870s. LGDD raised the level of the Tuolumne River to permit the diversion and delivery of water by gravity to irrigation systems owned by TID and MID. The Districts' irrigation systems currently provide water to over 200,000 acres of prime Central Valley farmland and drinking water to the City of Modesto. Built in 1924, the La Grange hydroelectric plant is located approximately 0.2 miles downstream of LGDD on the east (left) bank of the Tuolumne River and is owned and operated by TID. The powerhouse has a capacity of slightly less than five megawatts. The La Grange Hydroelectric Project (La Grange Project or Project; FERC No. 14581) operates in a run-of-river mode. The LGDD provides no flood control benefits, and there are no recreation facilities associated with the Project or the La Grange pool.





Figure 1.1-2. La Grange Hydroelectric Project site plan.

#### 1.2 **Licensing Studies**

#### 1.2.1 **Revised Study Plan**

Pursuant to 18 CFR § 5.11(a), on September 5, 2014, the Districts filed their Proposed Study Plan (PSP) to assess Project effects on fish and aquatic resources, recreation, and cultural resources in support of their intent to license the Project. On October 6, 2014, the Districts held a PSP meeting at MID's office in Modesto, California. Based on discussion at the PSP meeting, the Districts prepared an Updated Study Plan document that went to licensing participants (LP) for review and comment on November 21, 2014. On December 4, 2014, the National Marine Fisheries Service (NMFS), the Conservation Groups (CG), and the California Department of Fish and Wildlife (CDFW) filed comments on the PSP and/or Updated Study Plan.

On January 5, 2015, in response to comments from LPs, the Districts filed their Revised Study Plan (RSP) containing three study plans: (1) Cultural Resources Study Plan; (2) Recreation Access and Safety Assessment Study Plan; and (3) Fish Passage Assessment Study Plan<sup>1</sup>. The Fish Passage Assessment contains three related elements that together comprise the entire study plan: (1) Fish Passage Facilities Assessment; (2) Upper Tuolumne River Basin Habitat Assessment; and (3) Habitat Assessment and Fish Stranding Observations below La Grange Diversion Dam and Powerhouse. Each of these three elements contain several additional components (for a total of nine study components):

(1) Fish Passage Facilities Assessment

- Concept-level Fish Passage Alternatives
- La Grange Project Fish Barrier Assessment

(2) Upper Tuolumne River Basin Habitat Assessment

- Barriers to Upstream Anadromous Salmonid Migration
- Water Temperature Monitoring and Modeling
- Upstream Habitat Characterization<sup>2</sup>
- (3) Habitat Assessment and Fish Stranding Observations below La Grange Diversion Dam and Powerhouse
  - Topographic and Depth Survey
  - Salmon Habitat Mapping Data
  - Fish Presence and Potential for Stranding
  - Hydrologic Data for Flow Conduits

<sup>&</sup>lt;sup>1</sup> The Fish Passage Assessment Study Plan contained a number of individual, but related, study elements.

<sup>&</sup>lt;sup>2</sup> This component refers to ongoing upstream habitat characterization work being completed by NMFS.

It is important to note that the Districts proposed the Fish Passage Assessment as a single study given the relevance of all elements and associated components to, as the SPD states, "help define the nature and degree to which the dam and powerhouse are barriers or impediments to the upstream migration of anadromous salmonids" and to assess the need for fish passage facilities at the La Grange Project.

Comments on the RSP were received from CDFW on January 16, 2015, and from NMFS, the CGs and the City of Modesto on January 20, 2015.

#### **1.2.2 FERC Study Plan Determination**

On February 2, 2015, FERC issued the Study Plan Determination (SPD), approving or approving with modifications six studies (Table 1.2-1). Of those six studies, five had been proposed by the Districts in the RSP. The Districts note that although FERC's SPD identified the Fish Passage Barrier Assessment, Fish Passage Facilities Alternatives Assessment, and Fish Habitat and Stranding Assessment below La Grange Diversion Dam as three separate studies, all three assessments are elements of the larger Fish Passage Assessment as described in the RSP. The sixth study approved by FERC, Effects of the Project and Related Activities on the Losses of Marine-Derived Nutrients in the Tuolumne River, was requested by NMFS in its July 22, 2014 comment letter. Of the eight studies requested by LPs, FERC approved only the NMFS study noted above.

Although FERC's SPD did not require the Districts to undertake the Upper Tuolumne River Basin Habitat Assessment studies contained in the RSP, the Districts are voluntarily conducting the Upper River Barrier Study and the Water Temperature Monitoring and Modeling Study. Regarding the third component of the Upper Tuolumne River Basin Habitat Assessment, the ongoing upstream habitat characterization work being completed by NMFS, the Districts anticipate the results of this work becoming available for consideration in this licensing proceeding.

No.	Study	Approved by FERC in SPD without Modifications	Approved by FERC in SPD with Modifications
1	Recreation Access and Safety Assessment		Х
2	Cultural Resources Study		X
3	Fish Passage Barrier Assessment		X <sup>1</sup>
4	Fish Passage Facilities Alternatives Assessment		Х
5	Fish Habitat and Stranding Assessment below La Grange Dam		Х
6	Effects of the Project and Related Activities on the Losses of Marine-Derived Nutrients in the Tuolumne River	$X^2$	

Table 1.2-1.	Studies	approved	or	approved	with	modifications	in	FERC's	Study	Plan
	Determi	nation.								

<sup>1</sup> Page A-1 of Appendix A of FERC's SPD states that FERC approved with modifications the Fish Passage Barrier Assessment. However, the Districts found no modifications to this study plan in the SPD and page B-7 of the SPD states that "no modifications to the study plan are recommended."

<sup>2</sup> FERC directed the Districts to conduct the study plan as proposed by NMFS.

In addition to the six studies noted in Table 1.2-1, the SPD required the Districts to develop a plan to monitor anadromous fish movement in the Project's powerhouse draft tubes and to determine the potential for injury or mortality from contact with the turbine runners. Per the SPD, the Districts developed a study plan in consultation with NMFS and other LPs. The Districts filed the Investigation of Fish Attraction to La Grange Powerhouse Draft Tubes study plan with FERC on June 11, 2015, and on August 12, 2015, FERC approved the study plan as filed.

#### **1.2.3** Resolution of Disputed Studies

On February 23, 2015, NMFS filed a timely request with FERC for dispute resolution with regard to two of its study requests rejected by FERC staff in the SPD. The two disputed studies were:

- Request 3 Quantifying Existing Upper Tuolumne River Habitats for Anadromous Fish as They Pertain to Fish Passage Blockage at La Grange Dam.
- Request 4 Effects of the Project and Related Activities on the Genetic Makeup of Steelhead/Rainbow Trout Oncorhynchus mykiss in the Tuolumne River.

On February 27, 2015, FERC issued a letter to NMFS stating that FERC had determined that Request 3 would not be considered by the Study Dispute Panel because it had already been afforded the Commission's formal dispute resolution process in the Don Pedro Project dispute resolution proceeding. On May 1, 2015, FERC issued a Formal Study Dispute Determination, which stated that upon consideration of the findings and recommendations of the Study Dispute Panel, the Director was not requiring the La Grange Project study plan to be modified to incorporate a genetics study.

### **1.3** Content of this Initial Study Report

This Initial Study Report (ISR) summarizes results from the first year of the Fish Passage Assessment and includes the results of the Effects of the Project and Related Activities on the Losses of Marine-Derived Nutrients in the Tuolumne River, which has been completed. Given the significance of and the numerous complexities inherent in implementing the Fish Passage Assessment, the Districts focused their efforts in 2015 on this study. The Districts will complete the Cultural Resources Study and the Recreation Access and Safety Assessment in 2016 and the results of both studies will be reported in the Updated Study Report (USR).

Although not required by FERC, the Districts have elected to complete the Upper Tuolumne River Basin Habitat Assessment as described in the Fish Passage Assessment Study Plan in the RSP given its importance for assessing the need for fish passage at LGDD. Results from this portion of the Fish Passage Assessment are also included in this ISR.

Given the broad scope and complexity of implementing the Fish Passage Assessment, numerous entities participated in the study to complete the three related study elements and associated components as described in Section 1.2.1. To streamline the reporting process and subsequent review and comment by LPs, results from the Fish Passage Assessment are reported in this ISR

by component. Although results from the Fish Passage Assessment are reported in several documents for ease of presentation and information management, the results of each study component are critical to addressing the nature and degree of LGDD as a barrier to the upstream migration of anadromous salmonids and the need for fish passage. The progress of and schedule for each study component is discussed further in Section 2.

This ISR includes the following sections:

- Section 1. Introduction. This section describes the background and content of this ISR.
- Section 2. Summary of Licensing Studies. This section summarizes the Districts' progress in implementing the Fish Passage Assessment and summarizes the final results of the Effects of the Project and Related Activities on the Losses of Marine-Derived Nutrients in the Tuolumne River.
- Section 3. Initial Study Report Meeting. This section describes the Districts' intent to hold a meeting to discuss this ISR.
- Section 4. References Cited.
- Appendices. Four progress reports, four technical memorandums, and one study report are appended to this document.
  - Appendix A: Fish Passage Facilities Alternatives Assessment Progress Report
  - Appendix B: La Grange Project Fish Barrier Assessment Progress Report
  - Appendix C: Upper Tuolumne River Basin Fish Migration Barriers Study Progress Report
  - Appendix D: Upper Tuolumne River Basin Water Temperature Monitoring and Modeling Study Progress Report
  - Appendix E: Topographic Survey Technical Memorandum
  - Appendix F: Salmonid Habitat Mapping Technical Memorandum
  - Appendix G: Fish Presence and Stranding Assessment Technical Memorandum
  - Appendix H: Flow Records for Five Discharge Structures at the La Grange Project Technical Memorandum
  - Appendix I: Effects of the Project and Related Activities on the Losses of Marine-Derived Nutrients in the Tuolumne River Study Report

### 1.4 Districts' Ongoing Studies and Data Collection Activities

Extensive information on potential cumulative effects to environmental resources in the vicinity of LGDD and the lower Tuolumne River is available as part of the Don Pedro Hydroelectric Project relicensing docket (Tables 1.4-1 and 1.4-2). In addition to studies the Districts have previously completed in support of the Don Pedro Hydroelectric Project relicensing proceeding (Table 1.4-2), there are several ongoing water and aquatic resources studies, the results of which the Districts will file with FERC in the Don Pedro Hydroelectric Project docket (Table 1.4-3).

Study Number	Study Name				
Salmon Population Models					
1992 Appendix 1	Population Model Documentation				
1992 Appendix 26	Export Mortality Fraction Submodel				
	Stock Recruitment Analysis of the Population Dynamics of San Joaquin River				
1992 Appendix 2	System Chinook salmon				
Report 1996-5	Stock-Recruitment Analysis Report				
•	Salmon Spawning Surveys				
1992 Appendix 3	Tuolumne River Salmon Spawning Surveys 1971-88				
Report 1996-1	Spawning Survey Summary Report				
Report 1996-1.1	1986 Spawning Survey Report				
Report 1996-1.2	1987 Spawning Survey Report				
Report 1996-1.3	1988 Spawning Survey Report				
Report 1996-1.4	1989 Spawning Survey Report				
Report 1996-1.5	1990 Spawning Survey Report				
Report 1996-1.6	1991 Spawning Survey Report				
Report 1996-1.7	1992 Spawning Survey Report				
Report 1996-1.8	1993 Spawning Survey Report				
Report 1996-1.9	1994 Spawning Survey Report				
Report 1996-1.10	1995 Spawning Survey Report				
Report 1996-1.11	1996 Spawning Survey Report				
Report 1996-1.12	Population Estimation Methods				
Report 1997-1	1997 Spawning Survey Report and Summary Update				
Report 1998-1	Spawning Survey Summary Update				
Report 1999-1	1998 Spawning Survey Report				
Report 2000-1	1999 and 2000 Spawning Survey Reports				
Report 2000-2	Spawning Survey Summary Update				
Report 2001-1	2001 Spawning Survey Report				
Report 2001-2	Spawning Survey Summary Update				
Report 2002-1	2002 Spawning Survey Report				
Report 2002-2	Spawning Survey Summary Update				
Report 2003-1	Spawning Survey Summary Update				
Report 2004-1	2003 and 2004 Spawning Survey Reports				
Report 2004-2	Spawning Survey Summary Update				
Report 2006-1	2005 and 2006 Spawning Survey Reports				
Report 2006-2	Spawning Survey Summary Update				
Report 2007-1	2007 Spawning Survey Report				
Report 2007-2	Spawning Survey Summary Update				
Report 2008-2	Spawning Survey Summary Update				
Report 2009-1	2008 and 2009 Spawning Survey Reports				
Report 2009-2	Spawning Survey Summary Update				
Report 2009-8	2009 Counting Weir Report				
Report 2010-1	2010 Spawning Survey Reports				
Report 2010-2	Spawning Survey Summary Update				
Report 2010-8	2010 Counting Weir Report				
Report 2011-2	Spawning Survey Summary Update				
Report 2011-8	2011 Tuolumne River Weir Report				
Report 2012-2	Spawning Survey Summary Update				
Report 2012-6	2012 Tuolumne River Weir Report				
Seine, Sr	orkel, Fyke Reports and Various Juvenile Salmon Studies				
1992 Appendix 10	1987 Juvenile Chinook Salmon Mark-Recapture Study				

# Table 1.4-1.Studies performed by the Districts during the current license term of the Don<br/>Pedro Hydroelectric Project.

Study Number	Study Name
1992 Appendix 12	Data Reports: Seining of Juvenile Chinook salmon in the Tuolumne, San Joaquin, and Stanislaus Rivers, 1986-89
1992 Appendix 13	Report on Sampling of Chinook Salmon Fry and Smolts by Fyke Net and Seine in the Lower Tuolumne River, 1973-86
1992 Appendix 20	Juvenile Salmon Pilot Temperature Observation Experiments
Report 1996-2	Juvenile Salmon Summary Report
Report 1996-2.1	1986 Snorkel Survey Report
Report 1996-2.2	1988-89 Pulse Flow Reports
Report 1996-2.3	1990 Juvenile Salmon Report
Report 1996-2.4	1991 Juvenile Salmon Report
Report 1996-2.5	1992 Juvenile Salmon Report
Report 1996-2.6	1993 Juvenile Salmon Report
Report 1996-2.7	1994 Juvenile Salmon Report
Report 1996-2.8	1995 Juvenile Salmon Report
Report 1996-2.9	1996 Juvenile Salmon Report
Report 1996-9	Aquatic Invertebrate Report
Report 1997-2	1997 Juvenile Salmon Report and Summary Update
Report 1998-2	1998 Juvenile Salmon Report and Summary Update
Report 1999-4	1999 Juvenile Salmon Report and Summary Update
Report 2000-3	2000 Seine/Snorkel Report and Summary Update
Report 2001-3	2001 Seine/Snorkel Report and Summary Update
Report 2002-3	2002 Seine/Snorkel Report and Summary Update
Report 2003-2	2003 Seine/Snorkel Report and Summary Update
Report 2004-3	2004 Seine/Snorkel Report and Summary Update
Report 2005-3	2005 Seine/Snorkel Report and Summary Update
Report 2006-3	2006 Seine/Snorkel Report and Summary Update
Report 2007-3	2007 Seine/Snorkel Report and Summary Update
Report 2008-3	2008 Seine Report and Summary Update
Report 2008-5	2008 Sporkel Report and Summary Update
Report 2009-3	2009 Seine Report and Summary Update
Report 2009-5	2009 Snorkel Report and Summary Update
Report 2010-3	2010 Seine Report and Summary Update
Report 2010-5	2010 Snorkel Report and Summary Update
Report 2011-3	2011 Seine Report and Summary Update
Report 2011-5	2011 Sporkel Report and Summary Update
Report 2012-3	2012 Seine Report and Summary Update
Report 2012-5	2012 Snorkel Report and Summary Update
	Screw Trap Monitoring
Report 1996-12	Screw Trap Monitoring Report: 1995-96
Report 1997-3	1997 Screw Trap and Smolt Monitoring Report
Report 1998-3	1998 Tuolumne River Outmigrant Trapping Report
Report 1999-5	1999 Tuolumne River Upper Rotary Screw Trap Report
Report 2000-4	2000 Tuolumne River Smolt Survival and Upper Screw Traps Report
Report 2000-5	1999-2000 Grayson Screw Trap Report
Report 2001-4	2001 Grayson Screw Trap Report
Report 2004-4	1998, 2002, and 2003 Grayson Screw Trap Reports
Report 2004-5	2004 Grayson Screw Trap Report
Report 2005-4	2005 Grayson Screw Trap Report
Report 2005-5	Rotary Screw Trap Summary Update
Report 2006-4	2006 Rotary Screw Trap Report
Report 2006-5	Rotary Screw Trap Summary Update
Report 2007-4	2007 Rotary Screw Trap Report

Study Number	Study Name		
Report 2008-4	2008 Rotary Screw Trap Report		
Report 2009-4	2009 Rotary Screw Trap Report		
Report 2010-4	2010 Rotary Screw Trap Report		
Report 2011-4	2011 Rotary Screw Trap Report		
Report 2012-4	2012 Rotary Screw Trap Report		
	Fluctuation Assessments		
1992 Appendix 14	Fluctuation Flow Study Report		
1992 Appendix 15	Fluctuation Flow Study Plan: Draft		
Report 2000-6	Tuolumne River Chinook Salmon Fry and Juvenile Stranding Report		
2005 Ten-Year Summary			
Report Appendix E	Stranding Survey Data (1996-2002)		
	Predation Evaluations		
1992 Appendix 22	Lower Tuolumne River Predation Study Report		
1992 Appendix 23	Effects of Turbidity on Bass Predation Efficiency		
Report 2006-9	Lower Tuolumne River Predation Assessment Final Report		
	Smolt Monitoring and Survival Evaluations		
1002 Appendix 21	Possible Effects of High Water Temperature on Migrating Salmon Smolts in the		
1992 Appendix 21	San Joaquin River		
Report 1996-13	Coded-wire Tag Summary Report		
Report 1998-4	1998 Smolt Survival Peer Review Report		
Report 1998-5	CWT Summary Update		
Report 1999-7	Coded-wire Tag Summary Update		
Report 2000-4	2000 Tuolumne River Smolt Survival and Upper Screw Traps Report		
Report 2000-8	Coded-wire Tag Summary Update		
Report 2001-5	Large CWT Smolt Survival Analysis		
Report 2001-6	Coded-wire Tag Summary Update		
Report 2002-4	Large CWT Smolt Survival Analysis		
Report 2002-5	Coded-wire Tag Summary Update		
Report 2003-3	Coded-wire Tag Summary Update		
Report 2004-7	Large CWT Smolt Survival Analysis Update		
Report 2004-8	Coded-wire Tag Summary Update		
Report 2005-6	Coded-wire Tag Summary Update		
Report 2006-6	Coded-wire Tag Summary Update		
Report 2007-5	Coded-wire Tag Summary Update		
	Fish Community Assessments		
1992 Appendix 24	Effects of Introduced Species of Fish in the San Joaquin River System		
1992 Appendix 27	Summer Flow Study Report 1988-90		
Report 1996-3	Summer Flow Fish Study Annual Reports: 1991-94		
Report 1996-3.1	1991 Report		
Report 1996-3.2	1992 Report		
Report 1996-3.3	1993 Report		
Report 1996-3.4	1994 Report		
Report 2001-8	Distribution and Abundance of Fishes Publication		
Report 2002-9	Publication on the Effects of Flow on Fish Communities		
Report 2007-7	2007 Rainbow Trout Data Summary Report		
Report 2008-6	2008 July Oncorhynchus mykiss Population Estimate Report		
Report 2010	Tuolumne River Oncorhynchus mykiss         Monitoring Report (submitted January 15)		
Attachment 5	March and July 2009 Population Estimates of Oncorhynchus mykiss Report		
Report 2011	Tuolumne River Oncorhynchus mykiss Monitoring Summary Report (submitted January 15)		
Report 2010-6	2010 Oncorhynchus mykiss Population Estimate Report		
<b>i</b>			

Study Number	Study Name
Report 2010-7	2010 Oncorhynchus mykiss Acoustic Tracking Report
Report 2011-6	2011 Oncorhynchus mykiss Population Estimate Report
Report 2011-7	2011 Oncorhynchus mykiss Acoustic Tracking Report
	Invertebrate Reports
1992 Appendix 16	Aquatic Invertebrate Studies Report
1992 Appendix 28	Summer Flow Invertebrate Study
Report 1996-4	Summer Flow Aquatic Invertebrate Annual Reports: 1989-93
Report 1996-4.1	1989 Report
Report 1996-4.2	1990 Report
Report 1996-4.3	1991 Report
Report 1996-4.4	1992 Report
Report 1996-4.5	1993 Report
Report 1996-9	Aquatic Invertebrate Report
Report 2002-8	Aquatic Invertebrate Report
Report 2004-9	Aquatic Invertebrate Monitoring Report (2003-2004)
Report 2008-7	Aquatic Invertebrate Monitoring (2005, 2007, 2008) and Summary Update
Report 2009-7	2009 Aquatic Invertebrate Monitoring and Summary Update
	Delta Salmon Salvage
Report 1999-6	1993-99 Delta Salmon Salvage Report
	Gravel, Incubation, and Redd Distribution Studies
1992 Appendix 6	Spawning Gravel Availability and Superimposition Report (incl. map)
1992 Appendix 7	Salmon Redd Excavation Report
1992 Appendix 8	Spawning Gravel Studies Report
1992 Appendix 9	Spawning Gravel Cleaning Methodologies
1992 Appendix 11	An Evaluation of the Effect of Gravel Ripping on Redd Distribution
Report 1996-6	Redd Superimposition Report
Report 1996-7	Redd Excavation Report
Report 1996-8	Gravel Studies Report: 1987-89
Report 1996-10	Gravel Cleaning Report: 1991-93
Report 2000-7	Tuolumne River Substrate Permeability Assessment and Monitoring Program
P	Report
Report 2006-7	Survival to Emergence Study Report
Report 2008-9	Monitoring of Winter 2008 Runoff Impacts from Peasiee Creek
1002 Appendix 17	Proliminary Tuolumno Divor Water Temperature Deport
1992 Appendix 17	Instream Temperature Model Decumentation: Description and Calibration
1992 Appendix 18	Madalad Effacts of La Crange Delagase on Instream Temperatures in the Lawer
1992 Appendix 19	Tuolumne River
Report 1996-11	Intragravel Temperature Report: 1991
Report 1997-5	1987-97 Water Temperature Monitoring Data Report
Report 2002-7	1998-2002 Temperature and Conductivity Data Report
Report 2004-10	2004 Water Quality Report
Report 2007-6	Flow, Delta Export, Weather, and Water Quality Data Report: 2003-2007
•	IFIM Assessment
1992Appendix 4	Instream Flow Data Processing, Tuolumne River
1992 Appendix 5	Analysis of 1981 Lower Tuolumne River IFIM Data
<b>*</b> *	1995 USFWS Report on the Relationship between Instream Flow and Physical
	Habitat Availability (submitted by Districts to FERC in May 2004)

Study Number	Study Name		
	Flow and Delta Exports		
Report 1997-4	Streamflow and Delta Water Export Data Report		
Report 2002-6	1998-2002 Streamflow and Delta Water Export Data Report		
Report 2003-4	Review of 2003 Summer Flow Operation		
Report 2007-6	Flow, Delta Export, Weather, and Water Quality Data Report: 2003-2007		
Report 2008-8	Review of 2008 Summer Flow Operation		
Report 2009-6	Review of 2009 Summer Flow Operation		
	Restoration, Project Monitoring, and Mapping		
Report 1996-14	Tuolumne River GIS Database Report and Map		
Report 1000 8	A Summary of the Habitat Restoration Plan for the Lower Tuolumne River		
Report 1999-8	Corridor		
Report 1999-9	Habitat Restoration Plan for the Lower Tuolumne River Corridor		
Report 1999-10	1998 Restoration Project Monitoring Report		
Report 1999-11	1999 Restoration Project Monitoring Report		
Report 2001-7	Adaptive Management Forum Report		
Report 2004-12	Coarse Sediment Management Plan		
Report 2004-13	Tuolumne River Floodway Restoration (Design Manual)		
2005 Ten-Year Summary	Colorenid Hebitat Mana		
Report Appendix D	Samoniu Haoitat Maps		
2005 Ten-Year Summary	CIS Manning Droducts		
Report Appendix F	OIS Mapping Floducts		
Report 2005-7	Bobcat Flat/River Mile 43: Phase 1 Project Completion Report		
Report 2006-8	Special Run Pool 9 and 7/11 Reach: Post-Project Monitoring Synthesis Report		
Report 2006-10	Tuolumne River La Grange Gravel Addition, Phase II Annual Report		
Papart 2006 11	Tuolumne River La Grange Gravel Addition, Phase II Geomorphic Monitoring		
Report 2000-11	Report		
General Monitoring Information			
Report	1992 Fisheries Studies Report		
Report 2002-10	2001-2002 Annual CDFW Sportfish Restoration Report		
Report	2005 Ten-Year Summary Report		

# Table 1.4-2.Studies completed by the Districts as part of the Don Pedro Hydroelectric<br/>Project relicensing process.

Study			
Number	Study Title		
Cultural Resources (CR)			
CR-01	Historic Properties Study		
CR-02	Native American Traditional Cultural Properties Study		
Recreation Resources (RR)			
RR-01	Recreation Facility Condition and Public Accessibility Assessment, and Recreation use Assessment		
RR-02	Whitewater Boating Take Out Improvement Feasibility Study		
RR-03	Lower Tuolumne River Lowest Boatable Flow Study		
RR-04	Visual Quality Study		
	Terrestrial Resources (TR)		
TR-01	Special-Status Plants Study		
TR-02	ESA- and CESA-Listed Plants Study		
TR-03	Wetland Habitats Associated with Don Pedro Reservoir Study		
TR-04	Noxious Weed Survey		
TR-05	ESA-Listed Wildlife - Valley Elderberry Longhorn Beetle Study		
TR-06	Special-Status Amphibians and Aquatic Reptiles Study		
TR-07	ESA-Listed Amphibians - California Red-Legged Frog Study		

Study Number	Study Title	
TR-08	ESA-Listed Amphibians - California Tiger Salamander Study	
TR-09	Special-Status Wildlife - Bats Study	
TR-10	Bald Eagle Study	
	Water and Aquatic Resources (W&AR)	
W&AR-01	Water Quality Assessment	
W&AR-02	Project Operations/Water Balance Model	
W&AR-03	Don Pedro Reservoir Temperature Model	
W&AR-04	Spawning Gravel in the Lower Tuolumne River Study	
W&AR-05	Salmonid Population Information Integration and Synthesis Study	
W&AR-06	Tuolumne River Chinook Salmon Population Model	
W&AR-07	2012 Predation Study	
W&AR-08	Salmonid Redd Mapping Study	
W&AR-10	Oncorhynchus mykiss Population Model	
W&AR-13	Fish Assemblage and Population Between Don Pedro Dam and La Grange Dam Study	
W&AR-15	Socioeconomics Study	
W&AR-16	Lower Tuolumne River Temperature Model	
W&AR-17	Don Pedro Fish Population Survey	
W&AR-18	Sturgeon Study	
W&AR-19	Lower Tuolumne River Riparian Information and Synthesis Study	
W&AR-20	Oncorhynchus mykiss Scale Collection and Age Determination Study	
NMFS	Description of La Grange Eacilities and Potentially. Affected Environment of Anadromous Fish	
Information	in the Vicinity of the La Grange Facilities	
Request		
Lower		
Tuolumne	Lower Tuolumne River Instream Flow Study, including Habitat Suitability Curves for Splittail	
River Instream	and Lamprey	
Flow Study		
Additional Information Developed in Support of the Final License Application (FLA)		
FLA	Assessment of Don Pedro Project Operations to Meet EPA Region 10 Guidance for Pacific	
Attachment A	Northwest State and Tribal Temperature Water Quality Standards	
	Jayasundara, N. C., M. L. Deas, E. Sogutlugii, E. Miao, E. Limanto, A. Bale, Nd S. K. Tanaka.	
	2014. Luolumne Kiver flow and temperature model: without project assessment. Prepared by	
Attachment A	Northwest State and Tribal Temperature Water Quality Standards Jayasundara, N. C., M. L. Deas, E. Sogutlugil, E. Miao, E. Limanto, A. Bale, Nd S. K. Tanaka. 2014. Tuolumne River flow and temperature model: without project assessment. Prepared by Watercourse Engineering, Inc., Davis, CA.	

# Table 1.4-3.Studies in the Don Pedro Hydroelectric Project relicensing process yet to be<br/>completed.

Study Number	Study Title	
W&AR-11	Chinook Salmon Otolith Study	
W&AR-12	Oncorhynchus mykiss Habitat Survey	
W&AR-14	Temperature Criteria Assessment (Chinook Salmon and O. mykiss)	
W&AR-21	Lower Tuolumne River Floodplain Hydraulic Analysis	
Lower Tuolumne	Effective Weighted Usable Area Estimate for O. mykiss	
River Instream Flow Study	Evaluation of Non-Native Predatory Fish	

### 2.0 SUMMARY OF LICENSING STUDIES

#### 2.1 Fish Passage Assessment

The Fish Passage Assessment contains three related elements that together comprise the entire study plan: (1) Fish Passage Facilities Assessment; (2) Upper Tuolumne River Basin Habitat Assessment; and (3) Habitat Assessment and Fish Stranding Observations below La Grange Diversion Dam and Powerhouse. Each of these three elements contain several components (Table 2.1-1). There are ten study components in total.

No.	Element	No.	Component
1	Fish Passage Facilities Assessment	1	Fish Passage Facilities Alternatives Assessment
		2	La Grange Project Fish Barrier Assessment
2	Upper Tuolumne River Basin Habitat Assessment	3	Upper Tuolumne River Basin Fish Migration Barriers Study
		4	Upper Tuolumne River Basin Water Temperature Monitoring and Modeling Study
		5	Upper Tuolumne River Basin Habitat Characterization <sup>1</sup>
3	Habitat Assessment and Fish Stranding Observations below La Grange Diversion Dam and	6	Topographic Survey
		7	Salmon Habitat Mapping
		8	Fish Presence and Stranding Assessment
		9	Flow Records for Five Discharge Structures at the La Grange Project
	Powerhouse	10	Investigation of Fish Attraction to La Grange Powerhouse Draft Tubes

 Table 2.1-1.
 Fish Passage Assessment elements and components.

<sup>1</sup> This component is being completed by NMFS.

For ease of presentation and information management, the results from each component of the Fish Passage Assessment are reported on separately.

#### 2.1.1 Fish Passage Facilities Alternatives Assessment

### 2.1.1.1 Study Goals and Objectives

The goal of the Fish Passage Alternatives Assessment is to identify and develop concept-level alternatives for upstream and downstream passage of Chinook salmon and steelhead at the La Grange and Don Pedro dams. The functionality, configuration, and design of such fish passage facilities must be consistent with the resource agencies' goals and objectives established for the reintroduction of ESA-listed anadromous fish to the Tuolumne River between the Don Pedro Reservoir (RM 80) and the City and County of San Francisco's Early Intake (RM 105). Specific objectives of the Districts' study include:

- Obtain available information to establish existing baseline conditions relevant to impoundment operations and siting passage facilities,
- Obtain available hydrologic data and basic biological design criteria to identify potential types, configurations, and locations of fish passage facilities consistent with estimated run

size, fish periodicity, life stage requirements, and anticipated passage efficiencies for the selected species of interest,

- Formulate and develop preliminary facility sizing and functional design for select, alternative potential upstream and downstream fish passage facilities consistent with the agencies' anadromous fish reintroduction goals and objectives, and
- Develop reliable opinions of probable construction cost and annual operations and maintenance costs for select fish passage concept(s).

#### 2.1.1.2 Study Methods and Approach

The Fish Passage Facilities Alternatives Assessment is occurring in two phases as described below.

Phase 1, which began in 2015 and is continuing into 2016, consists of gathering information on facility siting, facility sizing, general biological and engineering design parameters, and operational considerations in a collaborative process with LPs. The collaborative process in 2015 called for the conduct of a number of public Workshops and production of technical memoranda (TM), the goals of which were to collaboratively identify key information needs and solicit input and feedback from LPs. Identification of data gaps and subsequently addressing these data gaps within a collaborative process is necessary to complete Phase 1 of the study, which is a prerequisite to the development of a suite of fish passage conceptual alternatives that are capable of meeting the anadromous fish reintroduction goals and objectives. Facility layout, sizing, and siting to support cost estimating would follow in Phase 2 of the assessment.

In 2016, based upon input developed in conjunction with LPs regarding both biological and engineering criteria, the Districts plan to develop and confirm functional site layouts, facility sizing, general design parameters, expected fish capture and survival efficiencies, and associated reliable opinions of probable construction and operation and maintenance costs for select fish passage alternatives developed in collaboration with LPs. Considerations addressed during the development of preliminary functional layouts for upstream passage alternatives will include, but not necessarily be limited to: (1) major facility siting and sizing components; (2) water supply infrastructure; (3) fish collection, acclimation, and holding facilities; (4) fish transport infrastructure and vehicles (if needed); (5) debris management; (6) fish attraction flows; (7) instrumentation and control equipment; (8) an explanation of how the proposed design complies with NMFS and CDFW fish passage criteria; and (9) identification of any additional information needs.

Similar to upstream passage conditions, considerations addressed during the development of preliminary functional layouts for downstream passage alternatives will include, but not necessarily be limited to: (1) major siting and sizing components; (2) fish sampling, acclimation, and holding facilities; (3) fish transport infrastructure and vehicles (if needed); (4) fish capture and debris management technologies; (5) provision of fish attraction flows; (6) guidance nets/curtains; (7) anchorage and flotation provisions (if needed); (8) dewatering facilities; (9) instrumentation and control equipment; (10) an explanation of how the proposed design complies

with NMFS and CDFW fish passage criteria; and (11) identification of any additional information needs.

2.1.1.3 Study Findings

Work performed in 2015 resulted in the identification of numerous data gaps relevant to informing the biological basis of the design for concept alternatives. The progress report appended to this ISR (Appendix A) provides a summary of consultation with LPs and site-specific considerations and potential design criteria that may be carried forward into Phase 2. However, given that anadromous salmonids are not currently present in the target reintroduction area, much of the biological information presented above is based upon assumptions. Therefore, this information may not be representative of current or future conditions in the Tuolumne River. In addition, there are numerous data gaps relevant to informing the biological basis of design for concept alternatives. Feedback from LPs on these factors is necessary to advance the study with confidence in the biological assumptions.<sup>3</sup>

Through a series of Workshops conducted in 2015 and 2016, the Districts, in collaboration with LPs, plan to broaden the scope of the Fish Passage Facilities Alternatives Assessment to implement an Upper Tuolumne River Reintroduction/Fish Passage Assessment Framework process. Elements of the framework are interconnected where fish passage engineering and design represent one of several key elements that require evaluation. Other reintroduction elements include ecological feasibility and biological constraints and economic, regulatory, and other key considerations. Fish passage in the Tuolumne River is fundamentally a decision to pursue fish reintroduction, and as such, fish passage should be evaluated in this broader context. Additionally, numerous data gaps and assumptions that are critical to advancing the fish passage design process were identified and the proposed framework process would provide an opportunity for collecting this information and confirming biological assumptions. The design, construction, and operation of fish passage facilities can be extremely complex and costly. As such, a thorough investigation of the engineering, biological, regulatory, and economic issues surrounding such a proposal is necessary to ensure that reintroduction is appropriate and that rigorously collected and scientifically defensible information is available to inform cost-effective and efficient fish passage facility design.

LPs identified January 27, 2016 for a meeting to begin discussing the Upper Tuolumne River Reintroduction/Fish Passage Assessment Framework process. For this meeting, a draft process and schedule, a summary of potential information gaps, and a preliminary studies list (to address information gaps) will be developed to help define 2016 activities. At the time the attached progress report was being developed, meeting information was unavailable for inclusion. Materials from this meeting will be available on the internet at <u>www.lagrange-licensing.com</u> and additional information will be provided at the ISR meeting.

<sup>&</sup>lt;sup>3</sup> The Districts provided TM No. 1 on September 4, 2015 and reviewed data gaps identified in the TM at a Workshop on September 17, 2015. An additional comment period was provided through October 30, 2015 and subsequent Workshops continued to highlight feedback necessary from LPs in order to proceed with the next steps in the Fish Passage Facilities Alternatives Assessment. No comments on the identified data gaps have been received to date.

#### 2.1.1.4 **Study Variances**

There has been one modification to, but no variances associated with, the study. The FERCapproved study plan states that Phase 1 will occur in 2015 and Phase 2 will occur in 2016. However, Phase 1 will continue into 2016 to allow for coordination with LPs on the Upper Tuolumne River Reintroduction/Fish Passage Assessment Framework process.

#### 2.1.1.5 **Study Status**

The study is currently in progress. Ongoing phases of work will be conducted in 2016 and 2017 to coordinate with LPs, support implementation of the Upper Tuolumne River Reintroduction/Fish Passage Assessment Framework process, and collect additional required information to be used as the basis of fish passage facility alternative development. Please refer to the Fish Passage Facilities Alternatives Assessment Progress Report (Appendix A) for more information about this study.

#### 2.1.2 La Grange Project Fish Barrier Assessment

#### 2.1.2.1 Study Goals and Objectives

The purpose of the La Grange Project Fish Barrier Assessment is to evaluate the potential impact of LGDD and the La Grange powerhouse as barriers to the upstream migration of adult fall-run Chinook salmon and, if they occur, steelhead. This includes documenting the proportion of the fall-run Chinook salmon population that may migrate upstream to these facilities and evaluating potential impacts to the spawning of these fish. Objectives of this study are listed below:

- Determine the number of fall-run Chinook salmon and steelhead migrating upstream to LGDD and the La Grange powerhouse during the 2015-2016 and 2016-2017 migration seasons.
- Compare the number of fall-run Chinook salmon and steelhead migrating upstream to the LGDD and the La Grange powerhouse to total escapement during the 2015-2016 and 2016-2017 migration seasons.
- Document carcass condition (egg retention) to evaluate pre-spawn mortality rates of fall-run Chinook salmon and steelhead migrating upstream to LGDD and the La Grange powerhouse, which do not move back downstream to spawn.
- Implement formal documentation of incidental fish observations in the vicinity of LGDD, La Grange powerhouse tailrace, and the TID sluice gate channel. Note that this objective is being addressed as part of the Fish Presence and Stranding Assessment (see Section 2.1.8 of this ISR).

#### 2.1.2.2 Study Methods and Approach

Two fish-counting weirs were installed in the Tuolumne River on September 11, 2015. After a brief testing period, weir operation and monitoring began on September 23, 2015. Flows permitting, weir operation and monitoring will continue through April 2016. Sampling is scheduled to occur during the same timeframe for the 2016/2017 field season.

One weir segment was placed downstream of the large pool below LGDD in the Tuolumne River main channel, and the second segment was placed just below the La Grange powerhouse in the tailrace channel. Each weir consisted of rigid panels that directed fish through a passing chute that was continuously monitored by a video system. Each weir panel was constructed of steel angle and horizontal pipe with 1<sup>1</sup>/<sub>8</sub>-inch spacing and secured in the channel diagonal to the river flow.

The passing chute of the main channel weir consisted of a three-foot-wide by 4-foot-long white high-density polyethylene floor secured to the substrate. An overhead camera and an underwater side-view camera were positioned to view the entire passing chute. The tailrace weir consisted of a six-foot by six-foot high-density polyethylene passing chute equipped with an overhead camera and two underwater side-view cameras. Each passing chute was equipped with an infrared lighting system for 24-hour monitoring.

The overhead cameras at each weir provided full coverage of the passing chute areas and were used to detect passing fish. Individual underwater cameras were used to assist with species identification. The camera systems for each weir were fed into a multi-camera video surveillance application (SecuritySpy) and stored on independent computers. Hourly video files from each camera were saved to external hard drives and downloaded daily for data backup. Motion detection settings were used to create five-second clips of all potential passage events.

Digital video footage was reviewed to identify passage events. Passage date, time, direction of passage, fish species, and estimated fish size were recorded for each passage event. The certainty of each fish observation was recorded as high, medium, or low. A high certainty rating signified complete confidence in determining species and the presence or absence of an adipose fin; medium certainty signified confidence in determining species, but sex and/or presence of an adipose fin were unknown; and low certainty signified uncertainty in determining species. Raw data were summarized to evaluate daily upstream and downstream weir counts and the total number of fish exhibiting persistent upstream migration behavior (upstream counts minus downstream counts). The total number of fish exhibiting persistent upstream migration behavior was divided by total escapement determined at the downstream weir (at RM 24.5) to estimate the extent to which the La Grange facilities are a barrier to upstream migration and spawning.

### 2.1.2.3 Study Findings

The appended progress report (Appendix B) is based on data gathered from September 23, 2015 (the start of monitoring) to October 31, 2015. Both weirs operated almost continuously during this period, with the exception of a high-debris flow event on October 17 that washed out a portion of the weir in the tailrace channel. Sections of the rigid weir were temporarily removed and reinstalled to make the weir fish-tight, and this resulted in the system being inoperable for 40 hours.

Based on data collected through October 31, 2015, 223 Chinook salmon passage events were detected at the tailrace channel weir. Passage events by salmon were generally characterized as "milling," which is when an upstream passage is followed by a downstream passage. Based on estimated fish length, sex, and general morphological characteristics, these passage events were comprised of eight Chinook salmon that approached La Grange powerhouse, with a net upstream passage of zero (i.e., no fish remained upstream of the weir).

To date, 13 *O. mykiss* passage events (4 upstream, 9 downstream) have been recorded at the tailrace weir. The estimated length of observed *O. mykiss* ranged from 10 cm to 50 cm. Unlike Chinook salmon, it was not possible to identify individual *O. mykiss* from passage events using fish length, sex, and general morphological characteristics. All *O. mykiss* observed were considered "resident", as no potentially anadromous *O. mykiss* (steelhead) were observed passing the Tuolumne River weir at RM 24.5 (FISHBIO unpublished).

Through October 31, 2015, no salmonids have been detected passing the main channel weir. The fish species observed to date at this weir include bluegill (*Lepomis macrochirus*), Sacramento pikeminnow (*Ptychocheilus grandis*), and unidentified juvenile species.

2.1.2.4 Study Variances

No study variances have occurred to date.

#### 2.1.2.5 Study Status

The study is currently in progress. The first year of weir monitoring will continue through April 2016. Fieldwork is anticipated for the 2016 fall-run Chinook salmon migration season and the 2017 steelhead migration season. Please refer to the La Grange Project Fish Barrier Assessment Progress Report (Appendix B) for more information about this assessment.

### 2.1.3 Upper Tuolumne River Basin Fish Migration Barriers Study

2.1.3.1 Study Goals and Objectives

The goal of the Upper Tuolumne River Basin Fish Migration Barriers Study is to assess barriers to the upstream migration of adult spring-run Chinook salmon and steelhead in the upper Tuolumne River basin from the upper end of the Don Pedro Reservoir to the CCSF Early Intake. Study objectives are listed below:

- Compile results from any relevant prior studies and conduct field surveys to identify barriers (both complete and partial) to upstream anadromous salmonid migration in the mainstem Tuolumne River upstream of the Don Pedro Project Boundary and tributaries, including the North, Middle, and South forks of the Tuolumne River, Cherry Creek, and the Clavey River.
- Characterize and document the physical structure of each barrier under base flow and high flow (i.e., spring runoff) conditions.

### 2.1.3.2 Study Methods and Approach

Activities performed in 2015 included both desktop exercises and measurements in the field. Desktop exercises utilized topographic mapping software, aerial photographs, available hydrologic data, and other existing information to identify initial accounts of physical features that may potentially be barriers to the upstream migration of spring-run Chinook salmon and steelhead. Field investigations included visual observation and the collection of physical data to confirm site characteristics and draw conclusions regarding the ability of migrating anadromous fish to pass physical features that may potentially be barriers.

Features identified within the study area through desktop or field exercises which may or may not be impediments to fish passage are classified in the report as follows:

- Potential Barrier A feature identified by the study team that may exhibit conditions which create an impediment to upstream fish passage of adult spring-run Chinook or steelhead on a partial, temporal, or intermittent basis but where conclusions have not yet been developed to establish the duration, range of flows, or conditions when or if the feature is passable.
- Partial Barrier A feature which has been evaluated by the study team and conclusions have been developed to establish the duration, range of flows, or conditions when the feature is passable.
- Total Barrier A feature which has been evaluated by the study team and found to be not passable by adult spring-run Chinook or steelhead throughout the range of flows when migration is anticipated.
- Passable Feature A feature which has been evaluated by the study team and found to be passable by adult spring-run Chinook or steelhead throughout the range of flows when migration is anticipated.

The presence and/or absence of barriers to upstream passage and findings regarding the ability of fish to pass identified features employed a phased approach as described below.

- A list of potential barriers to upstream passage was initially developed based upon the information gathered by desktop methods;
- Field surveys were performed to gather physical data at each feature and to characterize major elements which influence fish passage;
- A screening level barrier assessment was performed using data from desktop review and the field surveys;
- Each feature identified was classified as one of the following: (1) a "total barrier" to fish passage; (2) a "passable feature"; or (3) a "potential barrier" to fish passage. The initial classification was based upon screening criteria;
- Potential barriers requiring additional field surveys, further evaluation, and final classification were identified and recommendations for activities to be performed in the 2016 field season were made.

### 2.1.3.3 Study Findings

The work conducted in 2015 included a review of existing data, collection of field data, and analysis of all the resulting available data. Field surveys performed on foot were performed in very difficult terrain and required a high level of effort to collect an abbreviated dataset. For each of the studied tributaries (Clavey River and South Fork Tuolumne River), the 2015 work identified features generally consolidated together in the lower reaches of each tributary and a total barrier existing within two miles of the confluence of each tributary with the mainstem Tuolumne River. Two potential barriers and one total barrier were identified on the Clavey River and 17 potential barriers and one total barrier were identified on the South Fork Tuolumne River. On both the Clavey and South Fork Tuolumne rivers, these barriers occurred within the lower two miles. Potential barriers exhibited one of the following conditions:

- (1) the identified feature exhibited conditions which exceeded the maximum leaping or swimming capability of spring-run Chinook or steelhead but conditions which may facilitate passage at some range of migration flows were apparent; or
- (2) the identified feature exhibited conditions which were less than the maximum leaping or swimming capability of spring-run Chinook or steelhead but possessed elements which may inhibit passage at some range of migration flows.

Field observations and the resulting assessments have not been performed on the reach of the mainstem Tuolumne River from Lumsden Falls to the Cherry Creek confluence or the North Fork Tuolumne River. The Cherry/Eleanor Creek watershed and the mainstem Tuolumne River from Cherry Creek confluence upstream were surveyed in October 2015; however, results were unavailable at the time of reporting. Conclusions regarding access by anadromous fish for these areas will be made available no later than the USR.

Three field surveys are recommended for the 2016 phase of work. Surveys will be conducted on the mainstem Tuolumne River between RM 97.3 and 104.3, and on the North Fork Tuolumne River as these reaches were not surveyed in 2015. A more-detailed, second field survey will be conducted to collect additional data at Lumsden Falls. Upon collection of more detailed data at Lumsden Falls, a desktop analysis will be performed to determine whether passage is anticipated at various ranges of river flow conditions. Field data collected from the October 2015 surveys on the Cherry/Eleanor Creek watershed and the mainstem Tuolumne River from the Cherry Creek confluence upstream to Early Intake will be evaluated and assessed. Results, conclusions, and final barrier classifications for all barriers identified will be incorporated into the USR.

### 2.1.3.4 Study Variances

Given the difficult conditions experienced while conducting the field surveys on foot, only limited field gear was carried for the purpose of collecting data and in many cases abbreviated surveys were obtained given the constraint of available daylight and personnel safety. To maintain collection of a consistent set of data an abbreviated list of information was collected. This list deviates slightly from the original elements proposed as part of the RSP based upon sitespecific safety considerations, equipment requirements, time constraints, and ability to measure using alternative desktop methods. The three measurements not taken consistently were:

- Maximum and average depth of plunge pools at the base of barriers;
- Water velocity measurements at the apex of the barrier (if measurements could be made safely); and/or
- Measured (or estimated if measurement is unsafe) maximum and average depth of the landing zone on the upstream side of the barrier.

Depth of the plunge pool below each barrier was difficult to evaluate on a quantitative basis for all sites and therefore the summary of conditions presented herein are based on field notes, photographs, and aerial photos available for each site. Water velocities, depths, and landing conditions above the feature crest were sampled on an intermittent basis to provide general characterization of some features. These factors will vary to some degree as flow quantity changes at each feature. The flows present during field observations created relatively poor launching and landing conditions for many of the features.

The recommendation to perform additional surveys in 2016 and further hydraulic analysis of tributary barriers identified during 2015 is reserved for features that would have the potential limit of anadromy and access to suitable habitat. The decision to proceed with additional data collection and analysis is based upon the anticipated level of benefit which may be achieved by performing such activities. It is recommended that further field surveys occur in 2016 at Lumsden Falls and for reaches that were not able to be surveyed in 2015. The ability to pass Lumsden Falls on the mainstem Tuolumne River will have a quantifiable impact on the quantity of habitat accessible by spring-run Chinook and steelhead.

For the remaining potential barriers identified in the Clavey and South Fork Tuolumne rivers, the study team recommends that no further data collection take place and that those features be classified as partial barriers. By definition, partial barriers allow for the intermittent passage of both spring-run Chinook and steelhead during some range of flows.

#### 2.1.3.5 Study Status

This study is currently in progress. Results of remaining field surveys, assessment of barriers, and final conclusions will be available in the USR. Please refer to the Upper Tuolumne River Basin Fish Migration Barriers Study Progress Report (Appendix C) for more information about this study.

#### 2.1.4 Upper Tuolumne River Basin Water Temperature Monitoring and Modeling Study

#### 2.1.4.1 Study Goals and Objectives

The study goals and objectives are listed below:

- Use existing data to characterize the thermal regimes of the upper Tuolumne River from Early Intake to above Don Pedro Reservoir and portions of the North and South forks of the Tuolumne River, Cherry Creek, and the Clavey River. This will form the basis of future work that will identify potential locations where temperatures may be suitable for reintroduction of anadromous salmonids.
- Depending on the availability of information, logistical feasibility, and safety, install water temperature and/or stage data loggers to obtain additional information at locations for which existing data are inadequate.
- Develop and test a computer model to simulate existing thermal conditions in the Tuolumne River from below Early Intake to above Don Pedro Reservoir.

#### 2.1.4.2 Study Methods and Approach

Monitoring is being completed under a study plan and quality assurance process. Field deployment protocols have been developed, and a systematic quality assurance process has been implemented to ensure proper documentation and that valid data are used in thermal characterization and assessments.

Modeling will be conducted to simulate temperatures in the Tuolumne River mainstem from below Early Intake to the headwater of Don Pedro Reservoir (approximately Wards Ferry) and tributaries upstream to the first identified fish migration barrier. Models have been identified that effectively simulate water temperatures in steep river systems at short time steps (e.g., 1hour), providing the necessary information for biologists to assess appropriate temperature metrics (daily maximum, minimum, and average temperatures).

Datasets will be assembled for stream geometry, flow, stage, water temperature, and meteorological conditions. Simulation models will be adapted to the system reaches, calibrated with available data, and applied to identified hydrologic and meteorological conditions. Study reaches identified for temperature assessment will be evaluated based on the temperature requirements of the target fish species. Model results will be presented, along with the monitoring data, in a final report submitted with the USR.

### 2.1.4.3 Study Findings

Available flow, temperature, and meteorological data have been gathered, as well as any available channel geometry information. Geometry data in the tributaries are limited, but the Districts are working cooperatively with agencies to acquire other data (e.g., LiDAR) to support modeling. Water temperature data collected throughout the study area during 2015 are

consistent with historical data collected through 2014. The 2015 data at all sites exhibit seasonal trends similar to historical patterns, and maximum and minimum temperatures are comparable to those of previous years. Data collected at additional tributary locations have been useful for characterizing longitudinal thermal regimes in these systems. Data collection through winter and into the summer of 2016 will provide additional information to assist in characterizing and assessing thermal conditions in the study area.

#### 2.1.4.4 Study Variances

No study variances have occurred to date.

#### 2.1.4.5 Study Status

The study is currently in progress. Monitoring will continue through summer of 2016, and modeling is scheduled to begin in early 2016. Information from fish passage studies will be used to identify areas to be modeled. A final report will be issued by February 2017. Please refer to the Upper Tuolumne River Basin Water Temperature Monitoring and Modeling Study Progress Report (Appendix D) for more information about this study.

#### 2.1.5 Upstream Habitat Characterization

Several LPs requested information on habitat suitability for anadromous salmonids in the upper Tuolumne River watershed, including an account of upstream fish migration barriers and water temperatures. The Districts are conducting a two-year, phased assessment of certain physical barriers to upstream anadromous salmonid migration (see Section 2.1.3 of this ISR) and water temperature monitoring and modeling (see Section 2.1.4 of this ISR) in the upper Tuolumne River basin. In addition, NMFS is conducting an upper watershed habitat study and will be defining habitat units based on data collected via LiDAR and field information on substrates. Recent discussions with NMFS indicate that study data and results will be available in late summer 2016. Following review of data from the Districts' and NMFS upper Tuolumne River basin studies, the Districts will work with LPs to determine if additional information is still needed to complete a habitat assessment.

### 2.1.6 Topographic Survey

### 2.1.6.1 Study Goals and Objectives

The goal of the Topographic Survey is to collect information to evaluate the effects of Project operation on stream flow and anadromous fish habitat in the Tuolumne River between LGDD and the La Grange USGS gage. Specific objectives of the survey are listed below:

• Surveying a longitudinal profile and transects along the channel thalweg in the La Grange powerhouse tailrace, TID sluice gate channel, and the Tuolumne River mainstem channel upstream of where it joins the tailrace channel and take survey measurements that characterize the large cobble and bedrock island that separates the La Grange powerhouse tailrace and the mainstem Tuolumne River below LGDD.

- Take survey measurements at geomorphic hydraulic control features in the channels below the LGDD and La Grange powerhouse.
- Measure water depths at a flow of approximately 25 cubic feet per second (cfs) in the mainstem river channel upstream of where it joins the tailrace channel and at approximately 75 to 100 cfs in the La Grange powerhouse tailrace channel and the TID sluice gate channel.

### 2.1.6.2 Study Methods and Approach

The longitudinal and hydraulic control feature surveys were completed using a Real Time Kinematic (RTK) GPS system. The survey crew collected RTK positions along the thalweg of the channel at approximately every 10 feet. Additional positions were recorded at locations of hydraulic control. A Remote Control Vessel was used along with the RTK GPS and a single beam echo-sounder to record positions in regions of deeper water, such as the large pool at the upstream end of the mainstem channel.

Flows were measured on the same day as the RTK survey. Depths were recorded at each survey location along the longitudinal profiles. The large cobble and bedrock island that separates the La Grange powerhouse tailrace and the mainstem Tuolumne River below LGDD was characterized by existing LiDAR data. The TID sluice gate channel longitudinal profile was developed using the same LiDAR data.

#### 2.1.6.3 Study Findings

The topographic surveys were completed on two separate days. Charts and maps were developed and are included in the technical memo and appended to this ISR (Appendix E). Two points of hydraulic control were identified in each of the mainstem channel and the La Grange powerhouse tailrace channel. Both channels had a large pool at the upstream end with a smaller pool about halfway down the reach above the confluence of the channels.

Flows on the days of the surveys were approximately 25 cfs in the mainstem river channel and approximately 75 cfs in the La Grange powerhouse tailrace channel. Depths in the mainstem river channel ranged from 0.3 to 23.1 feet with an average of 6.2 feet and a median of 2.9 feet. Depths in the La Grange powerhouse channel ranged from 0.7 to 9.1 feet with an average of 3.4 feet and a median of 2.2 feet. No depths were recorded in the TID sluice gate channel because the sluice gate was closed during both survey days.

#### 2.1.6.4 Study Variances

There was one variance and no modifications to the study plan. At the time of the survey, there were no flows in the TID sluice gate and thus no depth measurements were taken. The Districts will collect this information in 2016.

#### 2.1.6.5 Study Status

The study is complete with the exception of TID sluice gate channel depths. These additional data will be available in the USR. Please refer to the Topographic Survey Technical Memorandum (Appendix E) for more information about this study.

#### 2.1.7 Salmonid Habitat Mapping

#### 2.1.7.1 Study Goals and Objectives

The Salmonid Habitat Mapping study provides information to examine potential effects of Project operations on anadromous fish habitat in the Tuolumne River in the vicinity of the LGDD and La Grange Project facilities. Specific objectives of the study are listed below:

- Map substrate and habitat in the main channel and tailrace, delineating the presence of pools, runs, high- and low-gradient riffles, step-pools, and chutes.
- Map patches of spawning-sized gravels in the tailrace and main channel that are greater than 2 m<sup>2</sup>.
- Conduct pebble counts in riffles, runs, and pool tailouts to document substrate particle size distribution in these habitats.

#### 2.1.7.2 Study Methods and Approach

Habitat mapping was conducted on foot by wading the main channel, tailrace, and sluice gate channel using high resolution aerial imagery as a base map to record mesohabitat unit boundaries. Mesohabitat typing followed USFWS recommendations for channel form and habitat type.

Gravel mapping was conducted by traversing the study area channels and gravel bars on foot using the same aerial imagery as a base map to record distinct units of surface sediment mixtures with a minimum recordable unit of approximately 100  $\text{ft}^2$ . The facies mapping method used was based on the methodology devised by Buffington and Montgomery (1999). The alluvial surface was classified according to the proportional occurrence of the five most prevalent substrate types: sand, gravel, cobble, boulder, and bedrock.

Four pebble counts were conducted in selected areas using methods developed by Bunte and Abt (2001) to calibrate visual estimates of sediment facies and to document the actual grain size distributions of individual facies.

#### 2.1.7.3 Study Findings

The main channel downstream of LGDD is dominated by pool habitat, including a plunge pool immediately downstream of LGDD, a large mid-channel pool adjacent to the MID hillside discharge, and two smaller pools in the lower portion of the channel. There are three small, low-gradient riffles in the lower portion of the main channel, along with one glide associated with the

tailout of the large pool, and a bedrock outcrop separating the large pool from the plunge pool. The total length of the main channel was calculated at 1,773 feet.

Upstream of the La Grange powerhouse, the TID sluice gate channel is a high-gradient step-pool that originates at the TID canal (a non-Project feature) and empties into the pool at the upstream portion of the tailrace channel. The tailrace channel includes two riffles along with one run, one pool, and one glide associated with the tailout of the pool. The length of the sluice gate and tailrace channels were calculated at 383 feet and 699 feet, respectively.

Gravel mapping showed the main channel to be predominately composed of cobble-sized sediments, with varying proportions of gravel and boulder substrates, along with some bedrock outcrops. The four pebble-count samples exhibited a well-graded (poorly sorted) texture, with measurable sizes varying between sand ( $\approx$ 2 mm) and bedrock (>4,096 mm), but with no patches meeting the size ranges suitable for spawning of Chinook salmon (16–78 mm) or *O. mykiss* (10–46 mm).

The tailrace and sluice gate channels were shown to be predominately cobble-bedded with varying proportions of gravel- and boulder-size substrates, along with some bedrock outcrops in the sluice gate channel. Of the two spawning gravel patches mapped in the tailrace channel, only one was suitable for Chinook salmon spawning based on a pebble count D50 of 70 mm. The D50 of 112 mm, based on a pebble count within the other spawning gravel patch, exceeded the suitable range for Chinook (16-78 mm).

There was no suitable spawning gravel for Chinook salmon in the Tuolumne River main channel or sluice gate channel, and no suitable spawning substrate found for *O. mykiss* at any location in the study area. For Chinook salmon, the area of suitable spawning gravel in the tailrace channel was estimated to be 13,610 ft<sup>2</sup>. Of that area, 9,014 ft<sup>2</sup> were estimated to meet the spawning depth and velocity criteria projected at approximately 175 cfs.

### 2.1.7.4 Study Variances

At the request of NMFS' representatives during a May 5, 2015 telephone discussion of study implementation, the study was expanded to provide (1) complete gravel facies mapping of channel and bar features found within the study area; and (2) an expanded assessment of spawning gravel areas with an estimate of maximum potential spawning population sizes of Chinook salmon and *O. mykiss*. Aside from these two additional objectives, there were no variances or modifications to the study.

### 2.1.7.5 Study Status

The study is complete. Please refer to the Salmonid Habitat Mapping Technical Memorandum (Appendix F) for more information about this study.

#### 2.1.8 Fish Presence and Stranding Assessment

#### 2.1.8.1 Study Goals and Objectives

The goal of the Fish Presence and Stranding Assessment is to formally document fish observations in the vicinity of the LGDD, La Grange powerhouse tailrace, and the TID sluice gate channel. Specific objectives of the assessment are listed below:

- Record daily observations of fish in the immediate vicinities of the LGDD, La Grange powerhouse, and within the sluice gate channel.
- If the La Grange powerhouse trips offline (i.e., unexpectedly stops operating), conduct sluice gate channel surveys to record fish presence and, if necessary, conduct relocation activities.
- Document redds that become dewatered, and the duration of any dewatering, due to changes in La Grange powerhouse operations.

#### 2.1.8.2 Study Methods and Approach

Daily fish observation surveys in the immediate vicinities of LGDD, La Grange powerhouse, and within the TID sluice gate channel began on September 23, 2015. Surveys were conducted twice daily: morning surveys were conducted by FISHBIO fisheries biologists/technicians during daily operations and maintenance of the weir associated with the Fish Barrier Assessment (see Section 2.1.2 of this ISR). Afternoon surveys were conducted by TID Project operators under the supervision of the TID fisheries biologist.

FISHBIO surveys included observation of the tailrace channel area above the weir, sluice gate channel, and the mainstem Tuolumne River channel from LGDD downstream to where it meets the tailrace channel. Surveys conducted by TID project operators included the tailrace channel area above the weir and the sluice gate channel.

Observations recorded on standardized datasheets included the following:

- Observer;
- Date and time of survey;
- Approximate discharge and sluice gate conduit status at time of survey (flow observations were also post-processed using data from the Project);
- Powerhouse output at time of survey;
- Number of fish observed and their approximate sizes;
- Identification of species, if possible; at a minimum each fish was identified as either a salmonid or non-salmonid;
- Locations of fish (indicated on a previously-generated base map);
- Description of general fish behaviors, such as moving upstream or downstream, spawning, holding in one specific location, or leaping/jumping;

- Notation of any observations of fish swimming into the La Grange powerhouse tailrace; and
- Notation of any observations of fish swimming into the TID sluice gate channel.

If La Grange powerhouse trips offline, the TID sluice gate opens immediately to bypass the powerhouse and maintain river flow. Direct observations in the TID sluice gate channel downstream to the end of the La Grange powerhouse tailrace channel (i.e., to the confluence of the tailrace channel and the mainstem Tuolumne River) for the presence and potential stranding of salmonids were conducted during any flow transition from the time of maximum flow in the sluice gate channel through the subsequent closing of the sluice gate and until complete cessation of the sluice gate flow release. Once powerhouse operations were restored and the sluice gate had been closed, an additional survey was conducted to ensure that fish were not stranded in the sluice gate channel.

Powerhouse operators conducted sluice gate channel stranding surveys. A qualified biologist was present during the first five surveys to ensure that surveys were conducted effectively.

Data collected during sluice gate channel stranding surveys included:

- Presence of fish;
- Species;
- Fish location;
- Estimated fish length;
- Presence of adipose fin clip;
- General condition of fish;
- Photo documentation, and, if appropriate;
- Relocation time.

### 2.1.8.3 Study Findings

Fish observation surveys conducted twice daily began on September 23, 2015. Observation data through November 15, 2015, are presented in the Fish Presence and Stranding Assessment Technical Memorandum (Appendix G). Fish species observed in the tailrace during this period included Chinook salmon, *O. mykiss*, Sacramento pikeminnow, Sacramento sucker, and striped bass. Fish observed in the main channel included bluegill, Chinook salmon, hardhead, sculpin, Sacramento pikeminnow, Sacramento sucker, and threespine stickleback. No incidences of fish attempting to enter La Grange powerhouse or the TID sluice gate channel were observed.

Beginning on September 30, a minimum channel maintenance flow of approximately 5 to 10 cfs was provided in the sluice gate channel at all times. It was determined that this flow level would significantly reduce the risk of stranding or dewatering any fish that entered the channel during a high-flow event and would allow fish to volitionally exit the channel at all times, thereby minimizing the need for handling and relocating any Chinook salmon or *O. mykiss*.

La Grange powerhouse tripped offline, and the TID sluice gate opened, four times during the current monitoring period (September 23, 2015 through November 15, 2015). The duration of flow events in the sluice gate channel (above the minimum flow maintained at all times) ranged from 8.25 hours to 484.4 hours, and average flow ranged from 73 to 143 cfs. TID operators and a qualified biologist were on site each time the sluice gate channel was closed and flow was reduced to the minimum flow of approximately 5 to 10 cfs. No fish were observed in the sluice gate channel during stranding surveys. If stranded fish had been observed in the sluice gate channel, a qualified biologist would have been contacted to conduct salvage activities and relocate any stranded Chinook salmon or O. mykiss to the tailrace channel. No fish were observed in the sluice gate channel during stranding surveys.

2.1.8.4 **Study Variances** 

No study variances have occurred to date.

2.1.8.5 **Study Status** 

The study is currently in progress. Fieldwork will continue through April 2016. Please refer to the Fish Presence and Stranding Assessment Technical Memorandum (Appendix G) for more information about this study.

#### 2.1.9 Flow Records for Five Discharge Structures at the La Grange Project

FERC's Study Plan Determination for the La Grange Project recommended that the Districts develop historical flow records for all five "release structures" at the La Grange Project "if existing information allows for some sort of back-calculation method to provide historical estimates." Flow records are provided herein in the Flow Records for Five Discharge Structures at the La Grange Project Technical Memorandum (Appendix H). The Districts note that as part of the Don Pedro Hydroelectric Project (FERC No. 2299) relicensing, a list of available flow information for the La Grange Project was provided in the ISR (TID/MID 2013) and an assessment of rates of change of flow as measured at the USGS La Grange gage located just below LGDD was provided in the USR (TID/MID 2014).

#### 2.1.10 **Investigation of Fish Attraction to La Grange Powerhouse Draft Tubes**

#### 2.1.10.1 Study Goals and Objectives

The goal of the Investigation of Fish Attraction to La Grange Powerhouse Draft Tubes is to evaluate the potential impact of certain La Grange powerhouse facilities on adult fall-run Chinook salmon and O. mykiss. Study objectives are listed below:

- Document adult resident O. mykiss and adult anadromous salmonid behavior in the vicinity of the La Grange powerhouse discharge during the fall 2015 (fall-run Chinook) to spring 2016 (O. mykiss) migration season.
- Identify anadromous fish reaching the La Grange powerhouse.

- Describe behavioral activities of fish in relation to La Grange powerhouse operations.
- Determine if fish are moving into the draft tube of operating units.

### 2.1.10.2 Study Methods and Approach

An imaging sonar unit (ARIS Explorer 1800, Sound Metrics) was installed at the outlet of the La Grange powerhouse on September 1, 2015 to determine if fish are attempting to access the La Grange powerhouse or enter the powerhouse draft tubes, and to assess fish behavior in relation to powerhouse operations. The Unit 1 draft tube is the focus of the evaluation because water availability and projected generation have indicated that only this unit is likely to operate during the 2015-2016 study period.

Continuous data collection began on September 4, 2015. Data are ported directly to external hard drives and backed up and archived daily to additional hard drives. Because analyzing imagery data is time-intensive; monitoring footage is being analyzed for five consecutive weeks during the fall-run Chinook salmon migration/spawning period (October-December) and five additional three-day sampling periods after the fall-run Chinook salmon season and *O. mykiss* migration season (January-April/May). This level of effort is appropriate given that the Districts have installed a counting weir downstream of the La Grange powerhouse (see Section 2.1.2 of this ISR). Weir count data from the Fish Barrier Assessment will be reviewed retrospectively to optimize the timing of the sonar imaging analysis (i.e., to determine when peak numbers of fish are in the vicinity of the powerhouse). In addition, sonar data will be recorded during any unit shutdown periods greater than 24 hours at times when salmonids are expected in the vicinity of the tailrace.

Raw data will be processed initially by using a Convolved-Samples-Over-Threshold (CSOT) algorithm to filter out data that do not contain moving targets. For all adult-sized (>300 mm) fish detected, the following data will be documented: date, time, estimated total length, direction of travel, and whether the fish entered into and/or exited the Unit 1 draft tube. Flow through the powerhouse will also be reported. Fish observations will be reported by hour, day, month, and total observations. Segmented data clips and images from the footage will be extracted to provide general examples of fish observations and behaviors.

### 2.1.10.3 Study Findings

Collection of continuous sonar data to assess fish presence and behavior in the vicinity of and directly below the La Grange Unit 1 draft tube is ongoing. At the time of this ISR filing, weir count data from the Fish Barrier Assessment was not yet complete and therefore the five consecutive week analysis period has not yet been identified. As such, processed sonar data are not yet available. Viewing and analysis of these data using weir counts to identify peak activity near the powerhouse will occur in two phases: after the fall-run Chinook salmon migration/spawning period is completed (October – December) and after the *O. mykiss* migration season is completed (spring 2016). Preliminary results from the fall-run Chinook salmon migration/spawning period will be presented at the ISR meeting.

#### 2.1.10.4 Study Variances

No study variances have occurred to date.

2.1.10.5 Study Status

The study is currently in progress. Monitoring will continue through April 2016.

#### 2.2 Effects of the Project and Related Activities on the Losses of Marine-Derived Nutrients in the Tuolumne River

#### 2.2.1 Study Goals and Objectives

The goal of the Losses of Marine-Derived Nutrients study, as cited by NMFS, is to evaluate the potential effects of the Project and Project-related activities on the degree of reduction in or loss of nutrient replenishment in the upper and lower Tuolumne River. Specific objectives of this study, as requested by NMFS, are described below:

- NMFS Request Element #1: Estimate a range of the historical mass of marine-derived nitrogen transported annually by Chinook salmon (all runs) to the Tuolumne River.
- NMFS Request Element #2: Estimate the historical mass of marine-derived nitrogen that was transported annually by spring-run Chinook salmon to the upper Tuolumne River.
- NMFS Request Element #3: Estimate the current annual mass of marine-derived nitrogen transported by fall-run Chinook salmon to the Tuolumne River.
- NMFS Request Element #4: Estimate annual losses, from historical to current levels, of marine-derived nitrogen transported by fall-run Chinook salmon to the Tuolumne River.
- Estimate the annual loss, from historical to current levels, of marine-derived nitrogen to the upper Tuolumne River.

#### 2.2.2 Study Methods and Approach

NMFS Request Element #1 of the study required derivation of three primary variables: (1) estimated historical total annual escapement of all runs of Chinook salmon (i.e., fall-run and spring-run) to the Tuolumne River; (2) estimated average mass of individual adult Chinook salmon; and (3) estimated average nitrogen content of individual fish. Three different approaches were used to develop rough approximations of historical spring-run and fall-run Chinook salmon escapement to the Tuolumne River.

NMFS Request Element #2 required estimation of the historical mass of marine-derived nitrogen transported annually by spring-run Chinook salmon to the upper Tuolumne River. A range in the maximum annual run sizes associated with the three different escapement estimation approaches was used in the calculations.

NMFS Request Element #3 required estimation of the current annual escapement of fall-run Chinook salmon to the Tuolumne River. Current annual escapement was characterized by the recent peak and 10-year average for two time periods (2001-2010 and 2005-2014) in the calculation of transport of marine-derived nitrogen.

NMFS Request Element #4 involved the subtraction of estimates of marine-derived nitrogen transported to the Tuolumne River by fall-run Chinook salmon under current conditions from estimates of historically transported marine-derived nitrogen.

In addition, although not presented as a request element, in its study request NMFS stated that the information to be obtained included an estimate of the annual loss, from historical to current levels, of marine-derived nitrogen to the upper Tuolumne River. This equates to the results of NMFS Request Element #2, that is, a comparison of historical conditions to existing conditions in the upper river (i.e., extirpated spring-run Chinook population).

### 2.2.3 Study Findings

In its study request, NMFS acknowledges that empirical data are not available to estimate historical annual Chinook salmon escapement in the Tuolumne River. Consequently, historical annual escapement estimates, and resultant estimates of marine-derived nitrogen, are highly speculative. The speculative nature of the estimates and necessary assumptions in the estimation methodology are reflected in the extremely broad range of results.

The estimated historical mass of marine-derived nitrogen transported annually by Chinook salmon (all runs) to the Tuolumne River ranged from 34,000 to 315,000 pounds (lbs).

The estimated historical mass of marine-derived nitrogen transported annually by spring-run Chinook salmon to the upper Tuolumne River ranged from 4,400 to 147,000 lbs. Because no Chinook salmon presently return to the upper Tuolumne River, the estimated loss of marine-derived nitrogen from historical to current conditions in the upper Tuolumne River ranges from 4,400 to 147,000 lbs.

The current estimated annual mass of marine-derived nitrogen transported by fall-run Chinook salmon to the Tuolumne River ranges from 200 to 11,400 lbs. The difference from historical to current escapement levels in the annual mass of marine-derived nitrogen transported by fall-run Chinook salmon to the Tuolumne River is estimated to range from 18,400 to 167,800 lbs. This represents the potential loss of marine-derived nitrogen from historical to current conditions in the lower Tuolumne River.

### 2.2.4 Study Variances

There were no variances or modifications in the implementation of this study.

#### 2.2.5 Study Status

The study is complete. Please refer to the Effects of the Project and Related Activities on the

Losses of Marine-Derived Nutrients in the Tuolumne River Study Report (Appendix I) for more information about this study.

### 3.0 INITIAL STUDY REPORT MEETING

FERC regulations at 18 CFR 5.15(c)(2) require the Districts to hold a meeting with participants and FERC staff within 15 days following ISR filing. On December 2, 2015, the Districts filed a letter with FERC requesting a waiver from 18 CFR 5.15(c)(2) and proposing to hold the ISR meeting on February 25, 2016. On December 16, 2015, FERC approved the Districts' waiver request and proposed meeting date.

The Districts' ISR meeting will be held from 9:00 am to 1:00 pm on February 25, 2016, at the Hilton DoubleTree Hotel, located at 1150 9<sup>th</sup> Street in Modesto, California. Following the meeting, the La Grange Project licensing schedule is as follows:

- March 3, 2016 Districts file ISR meeting summary
- April 2, 2016 LPs file disputes and requests to amend study plan
- May 2, 2016 Districts file response to April 2 comments
- June 1, 2016 FERC issues Determination on Requests for Study Modifications and New Studies

- Buffington, J. M., and D. R. Montgomery. 1999. A Procedure for classifying textural facies in gravel-bed rivers, Water Resour. Res., 35(6), 1903–1914.
- Bunte, K. and Abt, S.R. 2001. Sampling surface and subsurface particle-size distributions in wadable gravel-and cobble-bed streams for analyses in sediment transport, hydraulics, and streambed monitoring. Gen. Tech. Rep. RMRS-GTR-74. Fort Collins, CO: U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station. 428 p.