



# United States Department of the Interior

BUREAU OF RECLAMATION  
Central Valley Operations Office  
3310 El Camino Avenue, Suite 300  
Sacramento, California 95821

IN REPLY  
REFER TO:

CVO-100  
WTR-4.00

JUN 03 2013

Ms. Barbara Evoy  
Deputy Director, Division of Water Rights  
State Water Resources Control Board  
PO Box 2000  
Sacramento, CA 95812

Subject: Report on Proposed Operation of Shasta/Trinity Divisions for 2013

Dear Ms. Evoy:

Enclosed is a copy of the Report on Proposed Operations of Shasta/Trinity Divisions for 2013, including Sacramento and Trinity River Temperatures for Salmon Resources projected for the period April through November 2013. This report identifies the selected temperature operation plan and supporting operational studies.

The selected plan does not meet a daily average water temperature of 56 degrees Fahrenheit (°F) in the Sacramento River at Red Bluff Diversion Dam for all the periods in 2013, when higher temperatures could be detrimental to the fishery. The selected plan was developed by the Sacramento River Temperature Task Group (SRTTG), which consists of representatives of the State Water Resources Control Board (SWRCB), the California Department of Fish and Wildlife, the U.S. Fish and Wildlife Service, the National Marine Fisheries Service, Western Area Power Administration, Department of Water Resources, the Hoopa Valley Tribe, and the Bureau of Reclamation. It provides for the use of available cold water in Shasta Reservoir to provide the best practicable protection for races of Chinook salmon in the Sacramento River. The plan's objective is to meet 56.0 °F at Airport Road Bridge on the Sacramento River by operating to a surrogate temperature target of 56.75 °F at Balls Ferry. The surrogate temperature objective at Balls Ferry may change during the summer as needed to ensure meeting 56 °F at Airport Road Bridge. The plan will be updated as necessary through the summer to account for observed conditions and updated hydrology. Reclamation will notify the SWRCB if there is a need to revise the compliance point due to changes including operations to the critical year objectives in the Delta.

Reclamation prepared this report after consulting with other members of the SRTTG. If you have any questions regarding this report, please call Ms. Elizabeth Kiteck, Chief, Water Operations Division, Central Valley Operations Office, at 916-979-2684.

Sincerely,



*for* Ron Milligan  
Operations Manager

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## INTRODUCTION

This report is submitted to the State Water Resources Control Board (SWRCB) in compliance with Water Rights Orders WR-90-5, WR-91-01, and WR-92-02.

Shasta Reservoir storage on April 1, 2013 was 3,771,100 acre-feet (ac), and Trinity Reservoir storage was 2,077,400 ac. Based on the April 1 National Weather Service and California Department of Water Resources monthly 90% runoff forecasts, the water year inflow for Shasta Reservoir is forecast to be 3.750 million acre-feet (maf), approximately 63% of average. The 90% runoff to Trinity Reservoir is forecast to be 0.695 maf for water year 2013, or approximately 51% of average.

In order to discuss and evaluate proposed 2013 Sacramento River temperature control operations, several Sacramento River Temperature Task Group (SRTTG) meetings were held (March 19, 2013, May 2, 2013 and May 23, 2013). The SRTTG representatives consists of representatives of the State Water Resources Control Board (SWRCB), the California Department of Fish and Wildlife (DFW), the U. S. Fish and Wildlife Service, the National Marine Fisheries Service (NMFS), Western Area Power Administration, DWR, the Hoopa Valley Tribe, and the Bureau of Reclamation. Some of the SRTTG agency representatives participated in the preparation and review of this report.

## FINDINGS

Order 90-5, as amended, requires meeting 56.0 degrees Fahrenheit (°F) at Red Bluff Diversion Dam during times that higher temperatures would be detrimental to the fishery resources. After consultations with NMFS and review of temperature model results from March, April and May and supported by operational experience, it was determined that temperatures of 56.0 °F or less cannot be met at Red Bluff Diversion Dam regardless of the water supply allocation to Central Valley Project contractors. The SRTTG met early this year due to low storage conditions and subsequently selected control points at which current modeling of system resources indicates that 56 °F can be maintained.

Water year 2013 is classified as a dry year for the Sacramento River basin and follows a below normal year (2012). Initial temperature model runs completed in April 2013 showed that Reclamation should be able to meet the Balls Ferry objective point required in the NMFS 2004 Biological Opinion. Based on the April 2013 model runs, the SRTTG agreed to locate the compliance point at Balls Ferry for the months of April and May and to revisit the compliance location at the next meeting. The May modeling runs were done to determine the feasibility of meeting 56 °F at Balls Ferry. These runs suggest that it is likely that temperatures can be maintained at 56 °F at Balls Ferry through August, after which the control point may have to be moved up stream to Clear Creek. In order to be able to provide a consistent temperature regime in the Sacramento River through October, it would be advisable to establish the temperature control point at Airport Road.

A copy of this temperature analysis was given to NMFS on May 15, 2013 and Reclamation received an email from NMFS requesting to operate to a temperature target of 56 °F at Airport Road on May 17, 2013.

On May 23, 2013 at the SRTTG meeting, the group reviewed the May temperature analysis and agrees that an initial temperature target of 56 °F at Airport Road is an appropriate compliance point. The group agrees that starting the control point at Airport Road will help to insure that cold water is available to meet 56 °F at Airport Road for the entire temperature control season.

There is no temperature monitoring station at Airport Road Bridge. Similar to 2008, USBR would then operate to a surrogate target temperature of 56.75 °F at Balls Ferry, with the intention of achieving 56.0 °F at Airport Road Bridge. The surrogate temperature objective at Balls Ferry may change during the summer as needed to ensure meeting 56 °F at Airport Road Bridge. The group will continue to assess the cold water pool condition throughout the summer operations.

The basic objective of WR Order 90-5 is to control temperatures in the upper Sacramento River to 56.0 °F during times when higher temperatures would be harmful to fish. The ability to control daily temperatures to the desired range depends on numerous factors which unfold as the year progresses. Temperature operations may be affected by deviation from average meteorological conditions, actual inflow volumes and temperatures, wind driven mixing, rainfall, cloud cover, spring reservoir storage and initial temperatures, and system or equipment outages. The temperature model studies initially assume average meteorological conditions, although each month is updated with new initial conditions as the season progresses. Experience has shown that April through October represents the primary period when air temperatures and reservoir release temperatures can potentially adversely influence the Sacramento River temperatures. Outside of these months, atmospheric conditions generally keep the river cooler than the required temperature objective.

The SRTTG meets on a regular basis during the temperature control season, typically monthly, but more frequently as conditions warrant. Typical discussions in the regular meetings include an assessment of the temperature control operations, forecast of operations for the remainder of the season, and fishery updates. The temperature control evaluations include a continuing assessment of the capability to meet the temperature objective at the compliance point. The target temperature at Airport Road Bridge will be reevaluated as the season progresses and more measured data regarding the cold water resources becomes available, and the SWRCB will be notified of any proposed changes in either temperature compliance location or temperature operations at Airport Road Bridge. The SRTTG also evaluates survey data to help determine salmon spawning locations and quantity of fish and attempts to balance use of cold water for different runs and life stages.

TABLE 1

TEMPERATURE OPERATING OBJECTIVES FOR 2013

Initial Point of Compliance: 56.0 °F. at Airport Road effective May 17, 2013, until further notice.

Modification to Point of Compliance: As the year progresses, numerous unforeseen factors may indicate that changing the compliance point temperature will be necessary to continue maintaining 56 °F at the desired location. In the event that a compliance point change is required (based upon a combination of experience and modeling), Reclamation will present this information to the SRTTG. If the SRTTG concurs, Reclamation will modify this plan and re-submit it to the SWRCB. In the event that the SRTTG does not concur, Reclamation will forward the SRTTG position to the SWRCB along with Reclamation's recommendations, and the SWRCB may then select the preferred option.

Modeled Forecasted Temperatures for the Sacramento and Trinity Rivers.  
Initial Compliance at 56.0 °F at Airport Road Bridge

	Jun	Jul	Aug	Sep	Oct	Nov
Keswick	52.8	54.6	54.6	54.6	55.9	54.0
Airport Rd	53.5	55.7	55.7	55.4	55.7	52.9
Balls Ferry	54.2	56.7	56.6	56.3	56.0	52.7
Jellys Ferry	55.1	57.9	57.8	57.3	56.3	52.4
Bend Br	55.6	58.7	58.6	57.9	56.4	52.2
Red Bluff	56.6	60.2	60.0	59.0	56.8	51.9
		Jul	Aug	Sep	Oct	Nov
Lewiston		48.9	49.5	49.5	48.9	49.0
Douglas City		56.6	56.8	55.6		
Conf. N. Fork					54.2	50.6

## Appendix A

### BIOLOGICAL ANALYSIS OF 2013 TEMPERATURE CONTROL OPERATIONS

#### Winter-run Chinook Salmon

The initial plan developed by the Sacramento River Temperature Task Group (SRTTG) for the 2013 season was to set the temperature control point (TCP) at 56 °F at Balls Ferry from April 15 through May 15 consistent with the NMFS 2009 Biological Opinion (RPA Action 1.2.3, for the March to May 14 period) to protect the early segment of the pre-spawning and spawning periods for adult winter-run Chinook salmon. Temperature modeling results using the 90% exceedence forecast in March showed that a Balls Ferry TCP could be maintained all year (May through October). However, January, February, and March were the driest on record (critical water year) which meant Balls Ferry could only be maintained until the end of August. The SRTTG met in May and recommended to set the TCP further upstream at Airport Road (furthest point upstream) in order to conserve cold water for September and October. The peak of winter-run spawning is typically in June with 56 °F water temperatures needed for 90 days (until the end of September) to protect eggs and pre-emergent fry.

Aerial redd surveys showed that 100% of winter-run spawning occurred above Airport Road Bridge in 2012. In the last seven years since 2005, less than 1% of winter run have spawned below Airport Road Bridge. Thus, setting the TCP at Airport Road is expected to protect the vast majority of winter-run eggs until they emerge from the gravel. Given the critically dry year conditions the SRTTG recommended keeping the TCP as far upstream as possible (Airport Rd) for the remainder of the summer. Based on historical winter-run spawning distributions, it is expected that a TCP at Airport Rd is likely to provide the highest level of protection to the early life-stages of winter-run.

#### Spring-run and Fall-run Chinook Salmon

Reclamation's water temperature model based on the May 90% exceedence forecast predicts that mean daily water temperatures of 56 °F can be maintained at Airport Road until the end of October consistent with the NMFS 2009 Biological Opinion (RPA Action 1.2.4, for the May 15 through October 31 period). Spring-run Chinook typically spawn in the upper Sacramento River mainstem in September and Fall-run Chinook begin spawning in October. The SRTTG considered both in moving the TCP to Airport Rd. Generally, at this early stage, temperature modeling of the fall period is fairly uncertain. Spring-run and fall-run spawning typically occurs further downstream than the TCP in the fall. Therefore, some adverse effects can be expected if temperatures exceed 56 °F between Airport Rd and Balls Ferry. However, by moving the TCP to Airport Rd early in the year (May) it is anticipated that this action will provide the highest level of protection possible for all three runs of Chinook salmon under critically dry conditions.



## Upper Sacramento River – May 2013 Preliminary Temperature Analysis

May 23, 2013

Summary of Temperature Compliance Results by Month

Control Point	90%-Exceedance Outlook				
	JUN	JUL	AUG	SEP	OCT
Balls Ferry (BSF)	BSF	BSF	BSF	BSF/ClearCr	ClearCr
Airport Road (ArpTRd)	ArpTRd	ArpTRd	ArpTRd	ArpTRd	ArpTRd

### Temperature Model Inputs, Assumptions, Limitations and Uncertainty:

1. Operation is based on the May 2013 Operation Outlooks (monthly flows, reservoir release, and end-of-month reservoir storage).
2. **The initial profiles used for Shasta, Trinity and Whiskeytown were taken on May 20, May 1, and May 14, respectively.**
3. Guidance on forecasted flows from the creeks (e.g., Cow, Cottonwood, Battle, etc.) between Keswick Dam and Bend Bridge is not available beyond 5 days. Model input side flows (Cottonwood Cr & Bend Bridge local flow w/o Cottonwood Cr) were selected from the historical record, and are consistent with the forecast exceedance frequency. During spring, the relatively warm creek flows can be a significant percentage of the flows at Bend Bridge.
4. Although mean daily flows and releases are temperature model inputs, they are based on the mean monthly values from the operation outlooks. Mean daily flow patterns are user defined.
5. Cottonwood Creek flows, Keswick to Bend Bridge local flows, and diversions are mean daily synthesized flows based on the available historical record for a 1922-2002 study period.
6. Meteorological inputs were derived from a database of 86 years of meteorological data (1920-2005). The NOAA-NWS Local Three-Month Temperature Outlook (L3MTO), as a means of estimating air temperature expectation, was used to select each month's meteorology from the database.
7. Meteorology, as well as flow volume and pattern, significantly influences reservoir inflow temperatures and downstream tributary temperatures; and consequently, the development of the cold-water pool during winter and early spring.

## Temperature Analysis Results:

90%-Exceedance:

It would be difficult to maintain a Balls Ferry target through fall (Figure 1). Recent increases in Keswick Dam release due to extremely high system depletions since mid-April, and the subsequent need to open 2 middle shutters on the TCD for temperature control, are depleting the cold-water pool earlier than expected. By September, the target would likely need to be moved to Clear Creek.

Airport Road is a target location that can possibly be maintained through fall (Figure 2). Mean daily water temperature at Airport Road are expected to be approximately 0.75-1.0°F cooler than at Balls Ferry.

The relationship between end-of-September lake volume below 56°F and a Balls Ferry compliance through fall is based on the figure at the end of this document. Typically, mean daily water temperature at Jellys Ferry tends to be approximately 0.5-1.0°F warmer than at Balls Ferry after September and into late fall.

Figure 3 shows temperature results for Clear Creek at Igo for the 90%-exceedance.

Figure 4 includes results for the Trinity River at Lewiston Dam for the 90%-exceedance. The dashed lines are the 2011 mean daily temperatures at selected locations.

Sacramento River Modeled Temperature  
 2013 May 90%-Exceedance Outlook

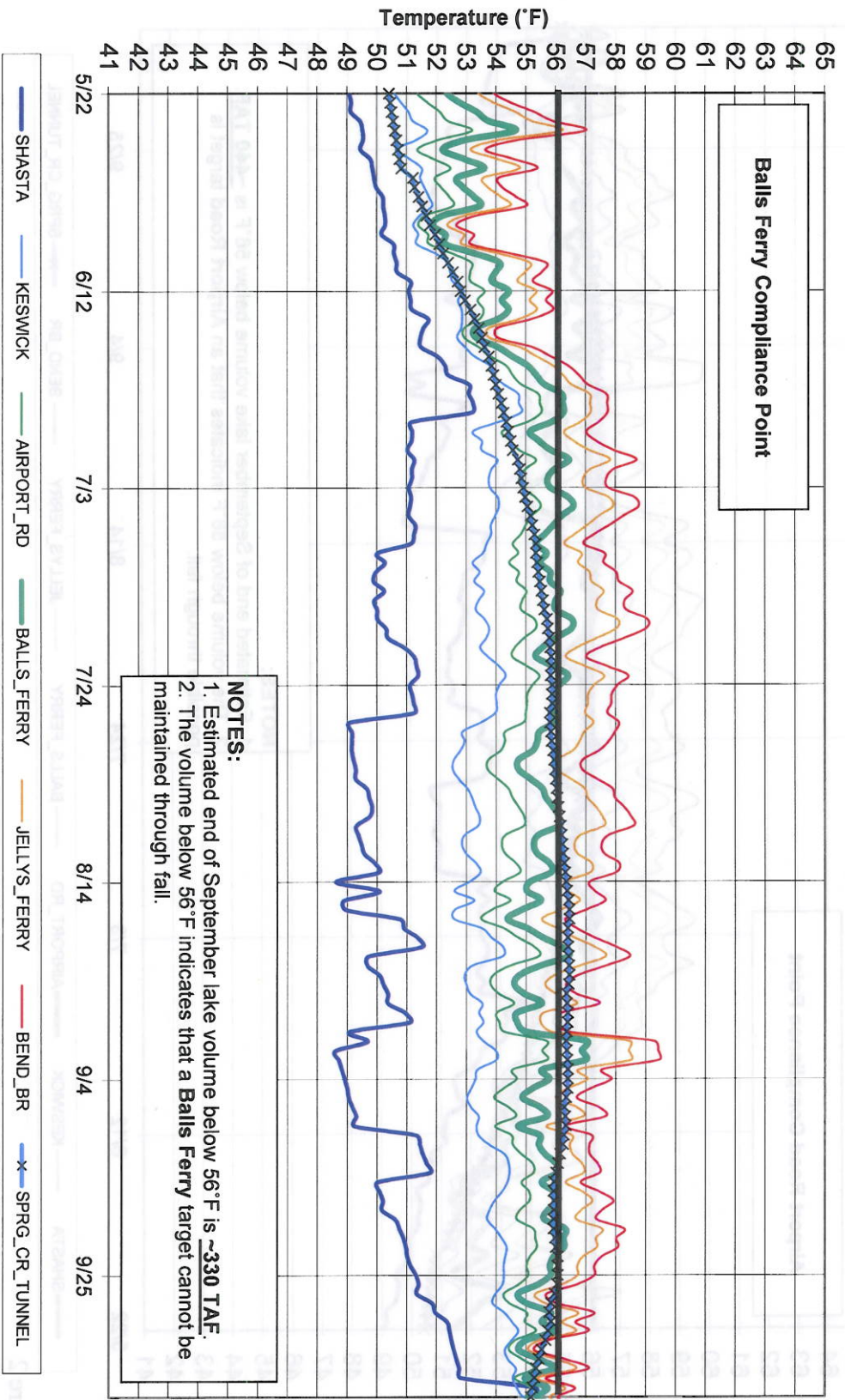


Figure 1

Sacramento River Modeled Temperature  
 2013 May 90%-Exceedance Outlook

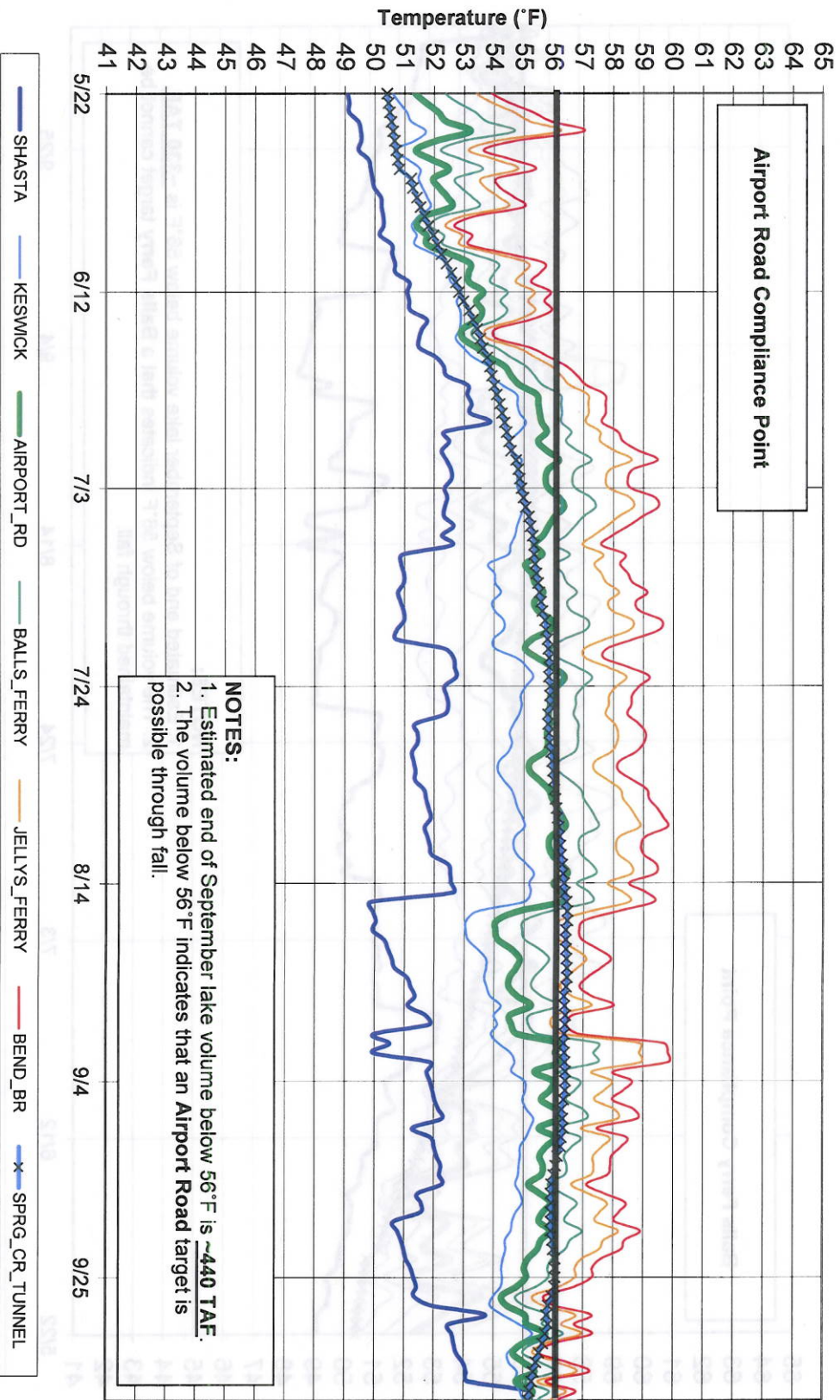


Figure 2

# Clear Creek - Igo Modeled Temperature 2013 May 90%-Exceedance Outlook

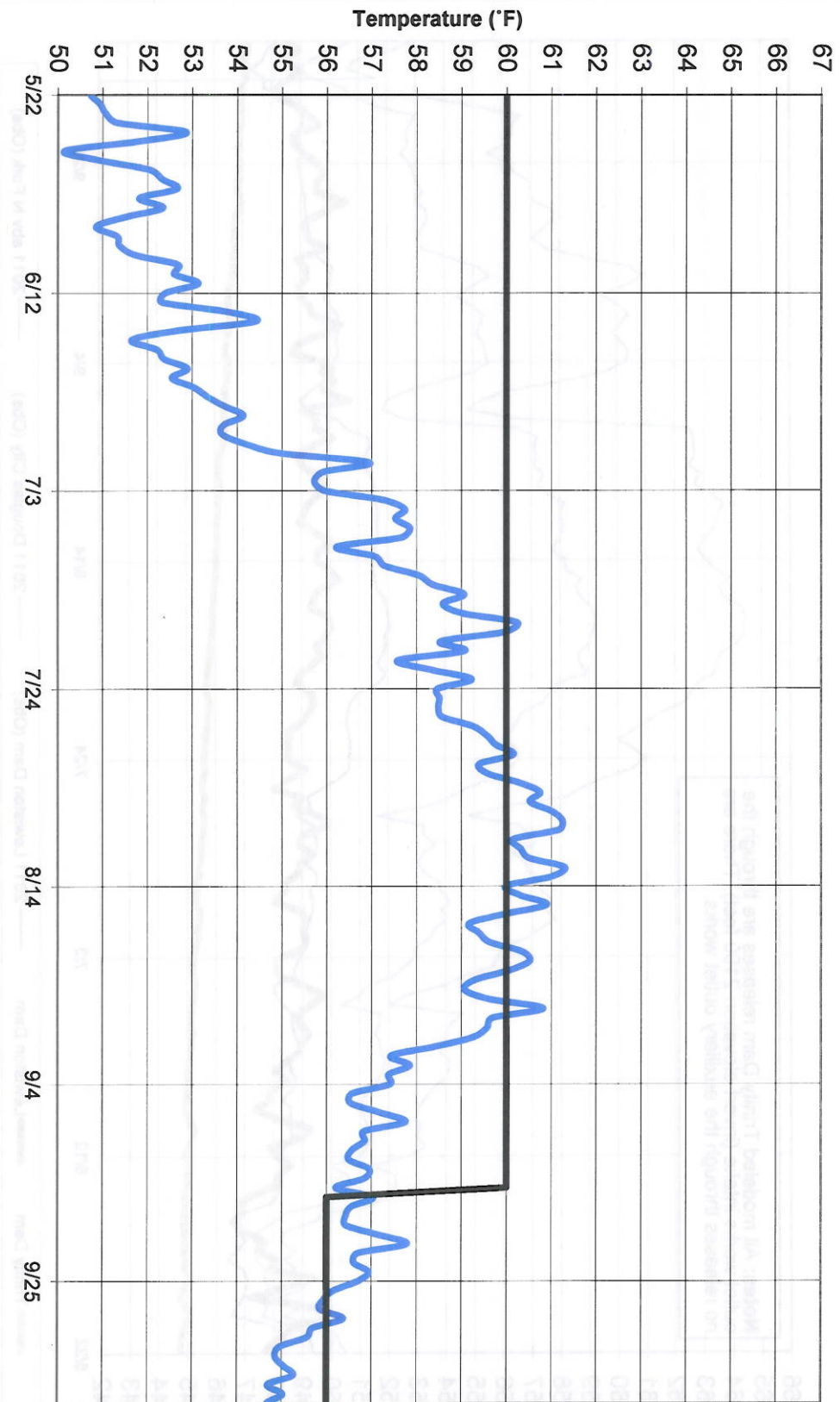


Figure 3

**Trinity River - 2013 May 90%-Exceedance Outlook  
"Dry Year" Release Schedule  
Mean Daily Water Temperature**

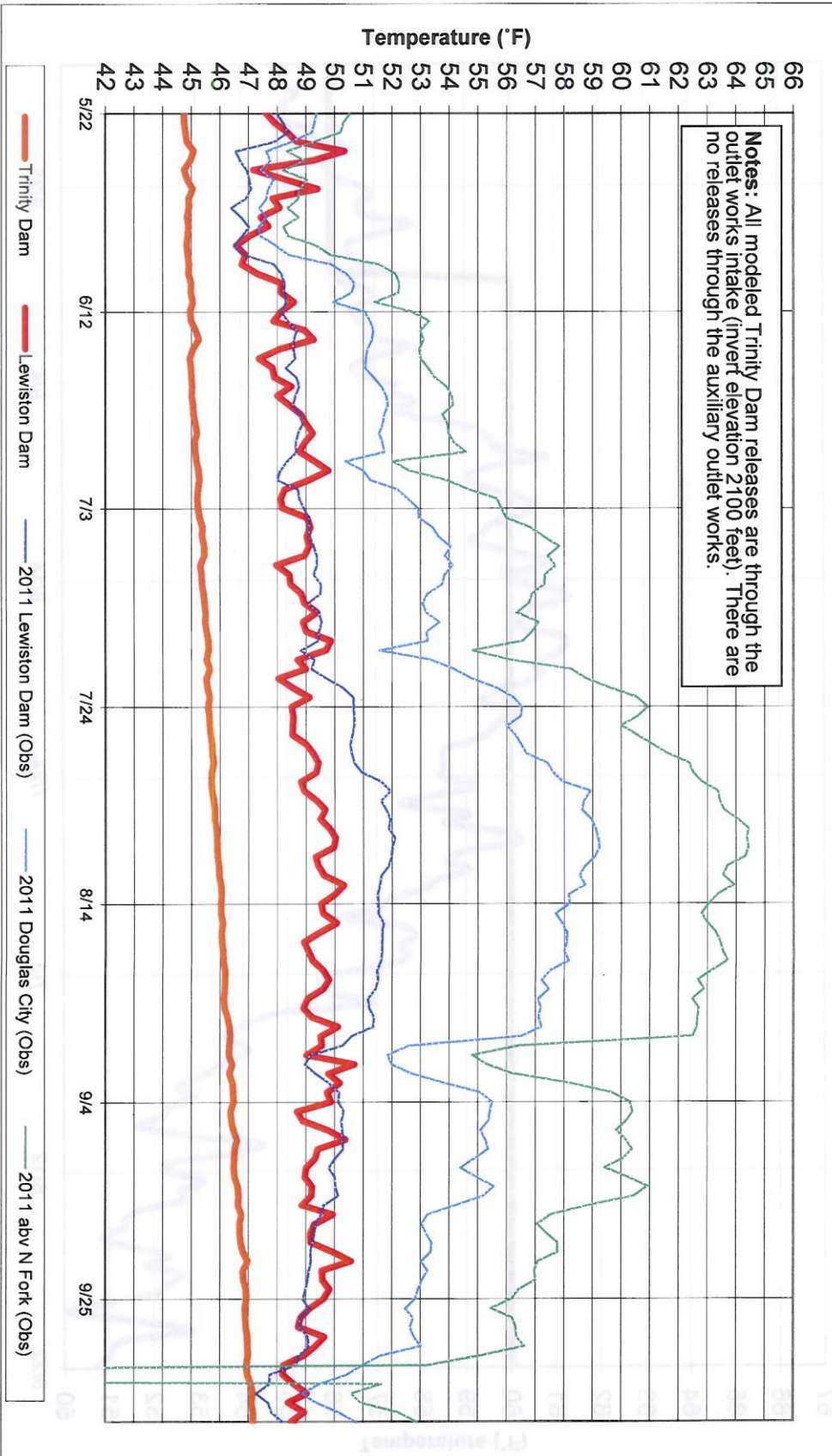


Figure 4

Model Performance and Fall Temperature Index:

1. Based on past analyses, the temperature model does not perform well from late September through fall. One factor is that the modeled release temperatures are cooler than has historically been achieved when all release is through the side gates (lowest gates), especially when there's a large temperature gradient between the pressure relief gates (PRG) and the side gates.
2. Based on historical records, the end-of-September Lake Shasta volume below 56°F is a reasonable indicator of fall water temperature in the river reach to Balls Ferry.
3. For river temperatures not to exceed 56 °F downstream to Balls Ferry, the end-of-September lake volume less than 56°F should be greater than about 650 TAF, see figure below:

**Sacramento River - Lake Shasta  
Early Fall Water Temperature at Balls Ferry**

