TRINITY RIVER RESTORATION PROGRAM
P.O. BOX 1300
WEAVERVILLE, CA
PHONE: 530-623-1800
www.trrp.net

# Trinity River water allocation, temperatures, and model results for implemented flows and approved hydrographs for water year 2021

Todd H. Buxton
Bureau of Reclamation, Trinity River Restoration Program
Weaverville, California

February 3, 2022[1]

Suggested Citation:
Buxton, T.H. 2022. Trinity River water allocation, temperatures, and model results for implemented flows and proposed hydrographs for water year 2021. Technical Report TRRP-2022-1. Bureau of Reclamation, Trinity River Restoration Program, Weaverville, CA.

**ABSTRACT**

Water year (WY) 2021 was a critically dry WY based on the April 1st B120 report that projected full natural flow (FNF) at Lewiston would be 530,000 acre feet (AF). This projection was 54.4% higher than the observed FNF (343,344 AF). The critically dry WY projection in WY 2021 enabled 369,000 AF of water to be released from Lewiston Dam to the Trinity River for restoration purposes. The actual volume released for restoration (372,208 AF) was 0.9% higher than the allocated volume and within the assumed error range of the flow gage at Lewiston (±10%), indicating the allocated and released water volumes were functionally equivalent. Water exported from the Trinity River basin to the Central Valley via the Clear Creek tunnel was 604,290 AF, which is 155% more than the total volume of water released to the Trinity River (389,683 AF) in WY 2021, which includes the restoration water mentioned above and water released for the Hoopa Boat Dance (16,110 AF) and an emergency release to lower water temperatures in the river at Hoopa (1,365 AF). Trinity River water temperature targets were met at Douglas City, above the North Fork Trinity River, and Weitchpec for 82%, 100%, and 34% of the respective compliance periods. The volume of water stored in Trinity reservoir decreased from 1,351,400 AF at the start of the water year (10/1/2020) to 710,400 AF at the end of the water year (9/30/2021). This decrease lowered the water surface in the reservoir 71.7 ft to 2,218.7 ft above sea level, which dewatered the Cedar Stock, Trinity Center, Fairview, Clark Spring, and Stuart Fork boat ramps.

[1] With updates to Appendix A on March 3, 2022.

## 1. INTRODUCTION

Trinity River water is allocated to a variety of purposes in the Trinity basin and elsewhere. Trinity River water that is captured in Trinity Reservoir is used for recreation and power generation by two turbines in Trinity Dam, each with a flow capacity of 1,800 cfs. Flow released from Trinity Reservoir is briefly impounded in Lewiston Reservoir, which is an afterbay to Trinity powerplant and enables diversion of Trinity water through the Clear Creek Tunnel to Whiskeytown Lake. Flows are released from Lewiston Reservoir to the Trinity River via Trinity Power plant's power turbine that has a capacity of 110 cfs, through the turbine bypass and water supply to Trinity River hatchery, and by spilling to the river under two radial arm gates.

The largest volume of water released to the Trinity River is intended to promote the fishery resources and restore a healthy river ecosystem, as outlined in the Trinity River flow study (USFWS and HVT, 1999) and authorized by the ROD (USDOI ROD, 2000). The water volume allocated for restoration varies with the forecasted full natural flow (FNF) volume at Lewiston (Table 1). Water is also released to the Trinity River for reservoir storage management to protect the safety of Trinity and Lewiston Dams, Hoopa tribal ceremonial purposes (boat dance), and to augment flows in the lower Klamath River to benefit the adult salmon return. Emergency flow releases may also be used to meet Trinity River water temperature objectives set forth by the North Coast Regional Water Quality Control Board (NCWQCB, 1991) and adopted in the EIS (2000) and to adjust for unforeseen operational issues associated with the dams and other infrastructure.

On average, around half of the Trinity River's flow is released for the above purposes and the remainder is exported from the basin for irrigation by Central Valley farmers and to meet multiple objectives in transport along the way, as authorized by the U.S. Congress (1955). Trinity water is exported from the basin via the Clear Creek Tunnel to the Carr power plant for generation of electricity. From there, Trinity water passes through Whiskeytown reservoir before it is released from Whiskeytown Dam to lower Clear Creek. Trinity flow is also conveyed by the Spring Creek tunnel to Spring Creek debris Dam where electricity is generated before the water is released to Keswick reservoir to again generate electricity, assist temperature management on the Sacramento River, and dilute toxins from Iron Mountain mine.

Procedures are in place for implementation of safety of dams (SOD), reservoir storage management, and supplemental releases for the Klamath River. SOD releases are typically implemented with short notice and in winter or early spring and are designed to draw down a full or nearly full reservoir for public safety and to safeguard infrastructures from damage from an overtopping reservoir. SOD releases since year 2000 have followed EIS (2000) requirements for increasing and decreasing flow rates and have exceeded the flow capacity of turbines (3,600 cfs) at Trinity Dam once (2006) in the four years they have been implemented (2003, 2005, 2006, 2017). Reservoir storage management releases can also occur outside the period for SOD releases to meet reservoir operational needs or other requirements of the Trinity River Division of the Central Valley Project. Klamath River supplemental flows occur on an as-needed basis in August or September as recommended by a technical team of stakeholders for approval by the mid-Pacific Regional director of the Bureau of Reclamation. The supplemental release discharges and volumes vary with the severity of water quality conditions and can be up to that required to increase lower Klamath River flows to 5,000 cfs (see BOR (2016) for additional details).

Finally, in odd-numbered years, the Hoopa Tribe requests USBR increase flow in the Trinity River to facilitate a ceremonial boat dance in Hoopa Valley in late August or early September. The request is accommodated to increase discharge in the Hoopa Valley enough to enable ceremonial boats passage over riffle crests. Flow releases for the Hoopa boat dance have involved 3,600 to 16,110 acre-feet (AF) of water between WY 2001 the current water year. The ceremonial release volumes are variable because the amount of additional water at Hoopa that is needed to provide safe passage varies with the contribution of flow to the mainstem by tributary streams.

## 2. REPORT OBJECTIVES

Objectives of this report are to provide an accounting of Trinity River water volumes and temperatures at compliance points in WY 2021. Specifically, this report details scheduled and implemented flows on the Trinity River, modeled performance of scheduled flows and proposed alternatives to the recommended flow schedule, diversion volumes of Trinity water outside the basin, and effectiveness of implemented flows in meeting temperature objectives at compliance points on the Trinity River.

## 3. WATER YEAR DESIGNATION AND TRINITY RIVER FLOW RELEASE

### 3.1 Determination of water year type

For restoration flow scheduling, the WY type and associated restoration flow volume (Table 1) are set by the projected FNF for the WY at Lewiston. This projection is published annually by the California Department of Water Resources in its April 1st B120 report (CDWR, 2019), which is typically released the first week of April. Full natural flow is the volume of water that would have passed Lewiston in a WY had Trinity and Lewiston Dams and the Clear Creek tunnel and other flow diversions not been in place. Projections of FNF are used instead of observed FNF because the latter is not available when restoration flow release schedules are developed in winter and the spring flow release is implemented in spring. A water year is the 12-month period from October 1 through September 30, which begins earlier than the calendar year so that precipitation that falls as snow and runs off in spring is included in a single period. Nomenclature for water years is to associate them with the calendar year in which they end. For example, November 4, 2020 and March 1, 2021 are in WY 2021.

Full natural flow at Lewiston projected in the April 1st 2021 B120 report was 530,000 AF, which corresponds to a critically dry WY and 369,000 AF of water available for release from Lewiston Dam for restoration (Figure 1). The actual FNF was 343,344 AF, which also corresponds to a critically dry WY. The difference between the projected and actual FNF was 54.4%, which is the largest difference between projected and observed volumes for WY 2004-2020 (range 21% to -18%; Appendix A).

### 3.2 Timeline for flow scheduling in water year 2021

The Flow workgroup met on January 8 and February 1 and 23, 2021 to develop hydrographs for release from Lewiston Dam. Two hydrographs were developed for both a critically dry and dry WY type for consideration in a joint flow and Interdisciplinary Team (IDT) meeting on March 1. The IDT recommended one hydrograph for each water year type to the TMC (Table 2 and Appendix B), and the TMC approved both hydrographs in their March 11, 2021 meeting. The April 1st B120 report was released on April 8th projecting a critically dry WY (Figure 1). Therefore, the TMC approved hydrograph for a critically dry WY was presented to the Regional Directors of the U.S. Bureau of Reclamation and U.S. Fish and Wildlife Service, who approved the flow release.

**TABLE 1.** Water year designations and associated FNF volumes at Lewiston for allocating water for restoration of Trinity River. Probabilities of occurrence are based on FNF at Lewiston for water years 1912-1994 (USFWS and HVT, 1999).

| Water year type | Annual probability of occurrence | Forecasted full natural flow at Lewiston (acre feet) | Restoration water allocation (acre feet) |
|---|---|---|---|
| Extremely wet | 0.12 | ≥2,000,000 | 815,000 |
| Wet | 0.28 | 1,350,000 to 1,999,999 | 701,000 |
| Normal | 0.20 | 1,025,000 to 1,349,999 | 647,000 |
| Dry | 0.28 | 650,000 to 1,024,999 | 453,000 |
| Critically dry | 0.12 | <650,000 | 369,000 |

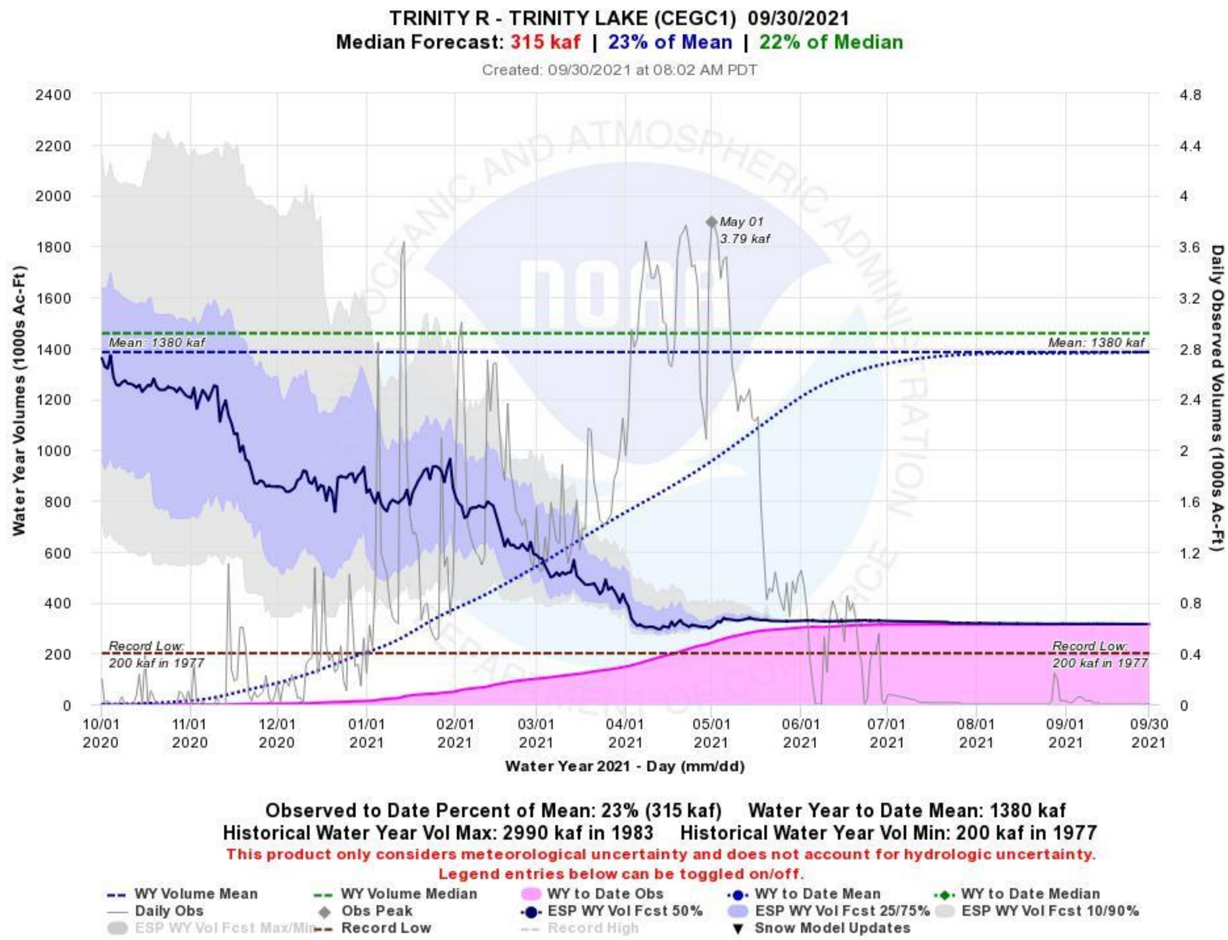



**FIGURE 1**. Projected and observed full natural flow into Trinity Lake for WY 2021.

### 3.3 Daily average flows prescribed for the Trinity River

The approved daily average flow schedule for the critically dry WY was a modification of the hydrograph for this WY type that is prescribed in the ROD (USDOI, 2000; Figure 2, Table 2). Changes from the ROD hydrograph included 1) fluctuating discharges at the beginning of the release to disperse steelhead smolt released from Trinity Hatchery; 2) dislodging macroinvertebrates from the streambed for drift feeding by salmonids; 3) providing a fluctuating water table in off-channel wetlands; 4) elevating discharge to ~3,600 cfs on April 28 to recruit leaf litter from floodplains, 5) mobilize sediment, and 6) inundate side channels for juvenile salmon rearing. These modifications were hypothesized to add to programmatic objectives for flow releases in a critically dry WY, which include, but are not limited to discouraging germination of riparian plants on lower bar surfaces and minimally recharge groundwater.

Models used to evaluate the daily average flow schedule for the approved hygrograph and the ROD hydrograph for a critically dry WY indicated that fry and parr abundance and temperature objectives were nearly equally met by both flow schedules (Table 2; see Appendix C for methods used in modeling). However, The approved hydrograph outperformed the ROD hydrograph in black cottonwood initiation, but the ROD hydrograph was the top performer in foothill yellow-legged froglet (FYLF) production. All other models gave functionally equal or quantifiably the same results for both flow schedules (Table 2).

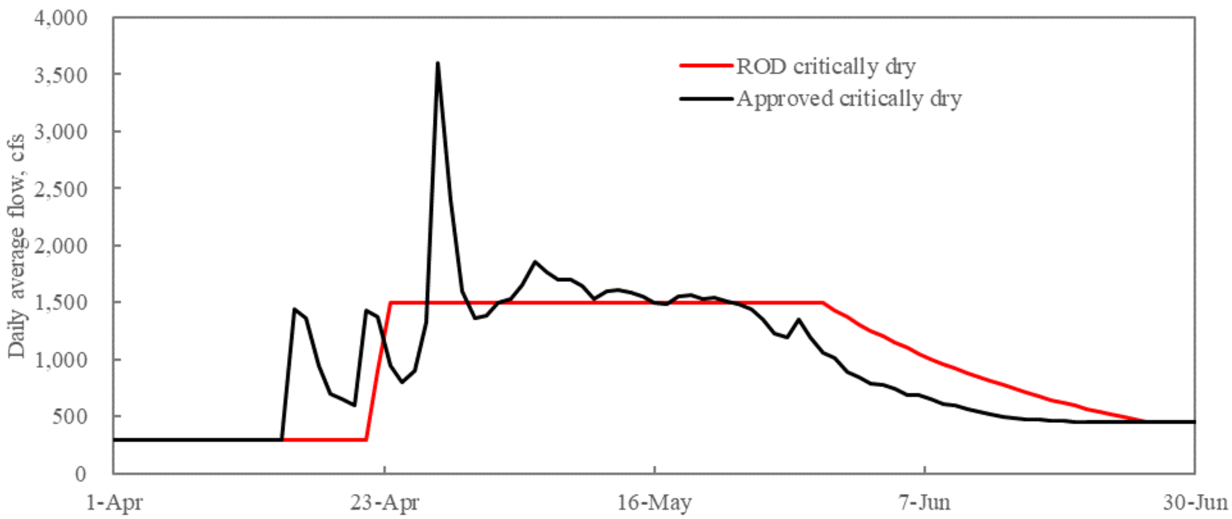



**FIGURE 2.** ROD and scheduled daily average flows for the WY 2021 spring flow release period (April 16 – June 20). Scheduled flows outside this period are 300 cfs from October 15 – April 15 and 450 cfs from June 21 – October 14.

**TABLE 2**. Modeling results for the ROD and approved critically dry water year hydrograph.

| **Parameter** | **ROD** critically dry | **Approved** critically dry |
|---|---|---|
| **Fisheries** | | |
| Total Natural Chinook Abundance at Pear Tree (spring and fall run) | 1,447,163 | 1,447,533 |
| Fry abundance (<55 mm) | 1,117,458 | 1,117,659 |
| Parr abundance (55 - 90 mm) | 329,704 | 329,874 |
| Total Natural Chinook Biomass at Pear Tree (metric tons)[1] | 1.55 | 1.55 |
| **Water temperature** | | |
| EIS Temperature objectives for adult salmon holding/spawning at Douglas City (exceedance degree Fahrenheit (ºF) days)[2] | | |
| Exceedance, average climate conditions (50% exceedance) | 0 | 0 |
| Exceedance, adverse climate conditions (10% exceedance) | 1.2 | 1.2 |
| EIS Temperature objectives for adult salmon holding/spawning above NF Trinity River (exceedance ºF days)[2] | | |
| Exceedance, average climate conditions (50% exceedance) | 0 | 0 |
| Exceedance, adverse climate conditions (10% exceedance) | 7.6 | 7.6 |
| Temperature Objectives for juvenile salmon at Weitchpec (exceedance ºF days)[2] | | |
| Exceedance, average climate conditions (50% exceedance) | 72.9 | 86.0 |
| Exceedance, adverse climate conditions (10% exceedance) | 245.9 | 279.1 |
| Temperature objective for juvenile salmonid rearing above NF Trinity River April 1-July 31 (7 DADA <55.4 ºF <61.7 ºF)[2,3] | | |
| Exceedance, average climate conditions (50% exceedance) | -59.2/+82.6 | -59.8/+89.3 |
| Exceedance, adverse climate conditions (90% exceedance) | -4.8/+161.0 | -4.8/+182.8 |
| **Riparian plants (woody)** | | |
| Black Cottonwood Initiation Potential (nodes)[4] | 918 | 1,386 |
| Risk of encroachment by narrow leaf willow | Yes | Yes |
| **Biology (foothill yellow-legged frogs)** | | |
| Number of froglets produced in the modeled reach (% survival)[5] | 29,925 (30%) | 21,451 (21%) |
| Median date for FYLF metamorphosis[5] | 8/31/2021 | 8/31/2021 |
| **Physical processes** | | |
| Total bedload transport at Douglas City (tons)[6] | 501 | 508 |
| **Administrative** | | |
| Construction Impacts (Days ≥1000 cfs; July 15 to Sept 15) | 0 | 0 |

[1]Estimated with data relating cumulative outmigration population to accumulated temperature units at rotary screw traps near Willow Creek, CA. [2]Estimated with the RBM10 stream temperature model (Jones et al., 2016). [3]7 DADA is the 7-day moving average of the daily average temperatures. [4]Modeled with TARGETS v2.2. [5]Modeled with a Foothill yellow legged frog model (Railsback et al., 2016). [6]Estimated with empirical bedload rating curve for this station.

### 3.4 Implementation of the approved hydrograph and water volumes to the Trinity River

Daily average flows on the river closely followed the flows scheduled for release except during the Hoopa Boat Dance and an emergency flow release made to lower river water temperatures at Hoopa (Figure 3). The total volume of water released from Lewiston Dam to the Trinity River in WY 2021 was 389,683 AF according to the USGS. According to USBR, water was released to the river via the power turbine (23,387 AF), fish hatchery and other outlets (120,034 AF), and radial gates at the dam (245,524 AF), for a total of 388,945 AF. The 0.2% discrepancy between the USGS volume (389,683 AF) and USBR volume (388,945 AF) reflects error in these respective measurements. Of the total volume reported by USGS, 372,208 AF was released for restoration purposes. The difference between the implemented restoration volume and the scheduled volume for restoration (369,000 AF) was +3,208 AF, or +0.9% (Figure 4). This difference is less than the assumed accuracy (±10%) of discharges reported for the USGS at Lewiston, indicating the allocated flow volume was functionally released as required by the Record of Decision (USDOI ROD, 2000) for a critically dry water year. A total of 1,365 AF of water was also released from Lewiston Dam in August to lower water temperatures at Hoopa. This water is separate from water released for restoration of the Trinity River as is water released for the Hoopa Boat dance. This flow release involved 16,110 AF of water and commenced at 1000 on September 2, 2021, reached a peak of 2,710 cfs at 0515 on September 6, and returned to summer baseflow (450 cfs) at 2315 on September 10.

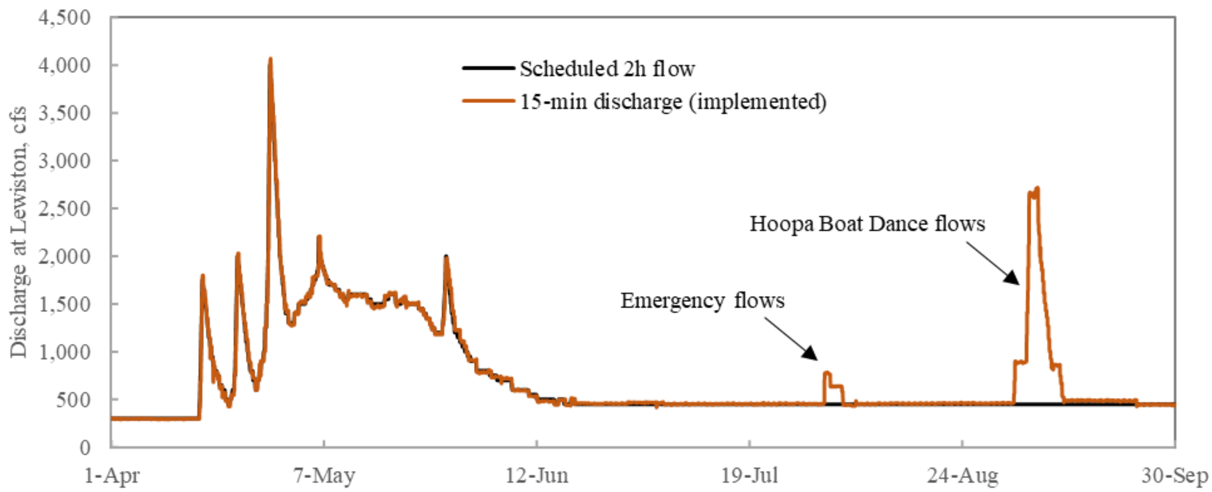



**FIGURE 3.** Scheduled and implemented daily average flow at Lewiston.

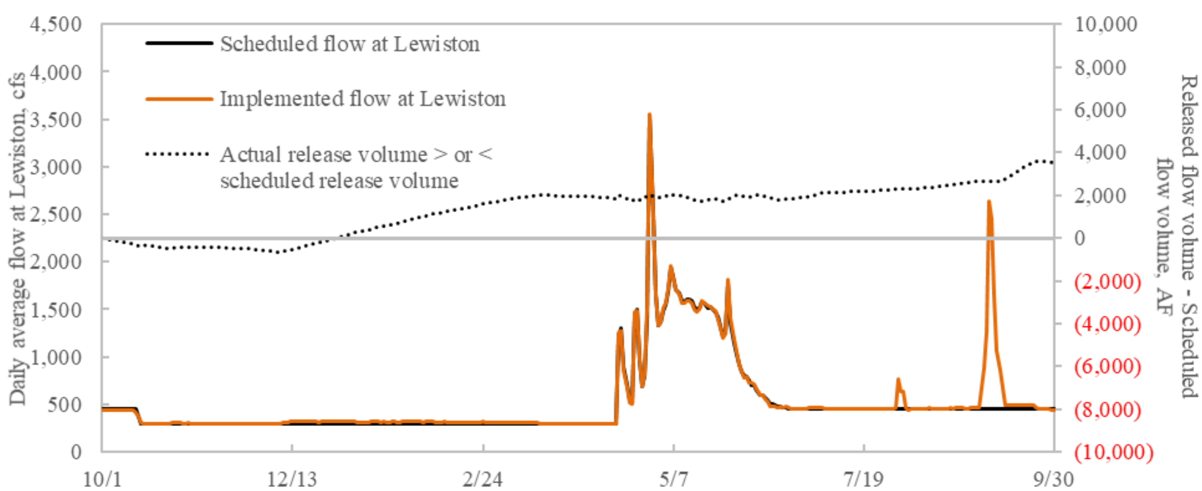



**FIGURE 4.** Daily average flows scheduled and implemented at Lewiston and the volume that implemented flows were above or below the ROD water volume allocated for a critically dry water year. The grey horizontal line indicates agreement between the scheduled and released water volume.

### 3.5 Water exported from the Trinity River

Water exported from the Trinity River basin to the Central Valley via the Clear Creek tunnel totaled 604,290 AF in WY 2021, which is 155% more than the total volume of water released to the Trinity River (389,683 AF). An additional 32,632 AF and 2,432 AF of water evaporation was respectively estimated for Trinity and Lewiston reservoirs, making the volumetric expense of impounding Trinity River water 35,064 AF, or 11% of the full natural flow at Trinity Lake (330,139 AF) and 11% of the flow volume allocated for Trinity River restoration in WY 2021 (369,000 AF).

## 4. TRINITY RESERVOIR OPERATIONS

The volume of water in Trinity reservoir decreased from 1,351,400 AF at the start of the water year (10/1/2020) to 710,400 AF at the end of the water year (9/30/2021). These volumes are respectively 55% and 29% of reservoir capacity (2,448,000 AF). The decrease in storage volume lowered the reservoir water surface 71.7 ft to 2218.7 ft above sea level and dewatered the Cedar Stock, Trinity Center, Fairview, Clark Spring, and Stuart Fork boat ramps. Lewiston reservoir operations are not presented here because the reservoir is an after bay to Trinity dam that enables flow diversions via Clear Creek tunnel and not a water storage body.

## 5. WATER TEMPERATURE COMPLIANCE

Water temperature targets are specified for two locations on the Trinity River to help provide adult salmon suitable conditions for upstream migration and holding in the mainstem channel. The compliance target locations are located at Douglas City and above the confluence with the North Fork (NF) Trinity River (SWRCB, 1990; NCWQCB, 1991). The temperature compliance targets are daily average values and vary with time of year and location on the river (Table 3). Daily average temperature criteria are also specified for the Trinity River at Weitchpec to aide juvenile salmonids in their downstream migration to the Klamath River (USFWS and HVT, 1999). The juvenile temperature criteria likewise vary with time of year and WY type (Table 3). Success meeting the temperature targets and criteria in WY 2021 varied between stations as described below.

Water temperatures targets at Douglas City were met for 75 of the 92-day compliance period in WY 2021. The peak daily exceedance and total exceedance at this station was respectively 3.0 $^{o}$F and 34.4 $^{o}$F (Figure 5). Peak daily exceedance is defined as the number of degrees the daily average temperature is above the compliance temperature and total exceedance describes the summed daily temperatures exceeding the compliance temperatures. For comparison, water temperatures modeled with RBM10 estimated the total exceedance at only 1.2 $^{o}$F at Douglas City under adverse climate conditions (Table 2). Monitoring compliance with temperature objectives for the Trinity River at Weitchpec is undertaken in real time by the USGS at Hoopa (USGS #11530000) and the USFWS measures water temperatures at Weitchpec and publishes these values a year after they are collected. Therefore, to evaluate compliance in this report, Hoopa water temperatures are adjusted by the average historic observed warming that occurred while flow traveled the 12 river miles downstream to Weitchpec, which is about 1 $^{o}$F in summer. Estimated water temperatures at Weitchpec exceeded the targets in 52 of the 79-day compliance period by a maximum of 16.3 $^{o}$F and a total exceedance of 420 $^{o}$F (Figures 6 and 7), which compares to 279.1 $^{o}$F estimated by RBM10 under adverse climate conditions (Table 2). In contrast, water temperatures above the NF Trinity River (TRNF) were substantially below the targeted values and no exceedances occurred in WY 2021 (Figure 8). This result was predicted by RBM10 under average climate conditions (Table 2). Finally, the temperature objective for juvenile salmonid rearing above TRNF is for temperatures to be between 55.4 $^{o}$F and 61.7 $^{o}$F in April 1-July 31. Optimal water temperatures for juvenile fish growth occurred at TRNF in May 15-20 and May 28 through June 17. Temperatures were lower than the target range (Table 2) April 7 through May 14 and May 21-27 by a total of 65.5 $^{o}$F. Temperatures were higher than the target range June 18 through July 31 by a total of 238.9 $^{o}$F (Figure 9)

**TABLE 3**. Temperature targets for adult salmonids and temperature criteria for juvenile salmonids at compliance points on the Trinity River. River miles (RM) are distance upstream of the Trinity River confluence with the Klamath River.

| | Celsius | | Fahrenheit | |
|---|---|---|---|---|
| **Temperature targets for adult salmonids** | Start date | End date | Start date | End date |
| at Douglas City (RM 93.8) | 1-Jul | 14-Sep | 1-Jul | 14-Sep |
| | 15.6 | 15.6 | 60.0 | 60.0 |
| | 15-Sep | 30-Sep | 15-Sep | 30-Sep |
| | 13.3 | 13.3 | 56.0 | 56.0 |
| above NF Trinity River (RM 72.4) | 1-Oct | 31-Dec | 1-Oct | 31-Dec |
| | 13.3 | 13.3 | 56.0 | 56.0 |
| **Temperature criteria for juvenile salmonids at Weitchpec (RM 0.1)** | Start date | End date | Start date | End date |
| | **22-Apr** | **22-May** | **22-Apr** | **22-May** |
| Normal and wetter water years | 13.0 | 13.0 | 55.4 | 55.4 |
| Dry and drier water years | 15.0 | 15.0 | 59.0 | 59.0 |
| | **23-May** | **4-Jun** | **23-May** | **4-Jun** |
| Normal and wetter water years | 15.0 | 15.0 | 59.0 | 59.0 |
| Dry and drier water years | 17.0 | 17.0 | 62.6 | 62.6 |
| | **5-Jun** | **9-Jul** | **5-Jun** | **9-Jul** |
| Normal and wetter water years | 17.0 | 17.0 | 62.6 | 62.6 |
| Dry and drier water years | 20.0 | 20.0 | 68.0 | 68.0 |

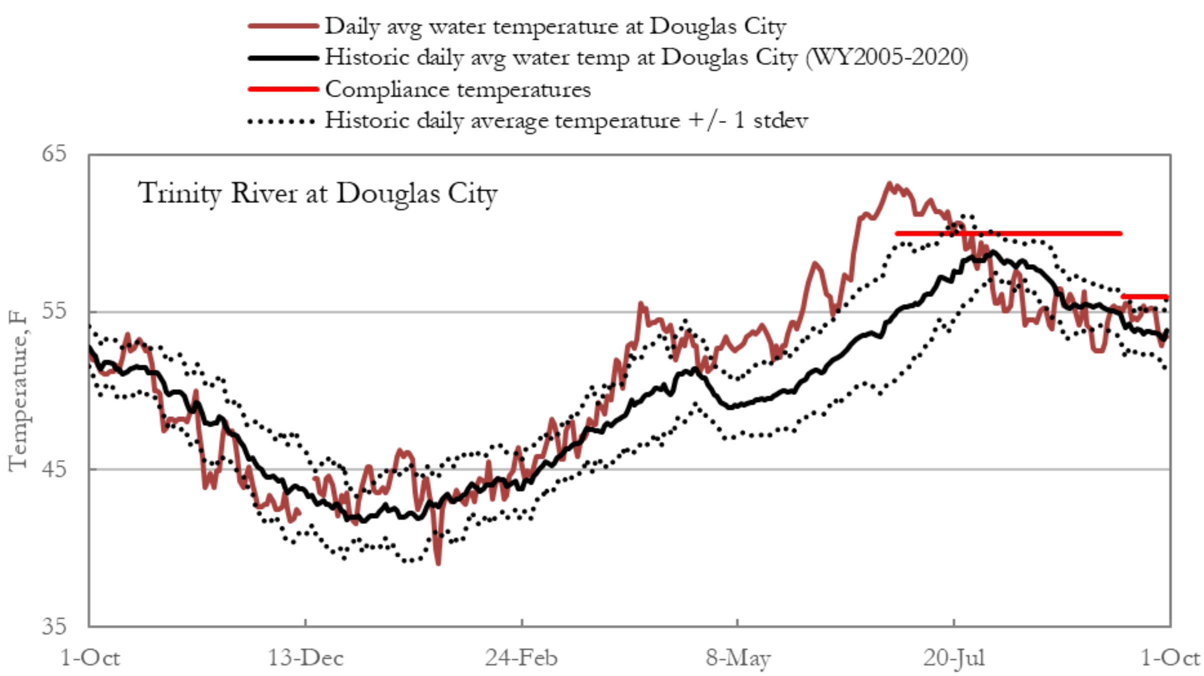



**FIGURE 5.** Daily average water temperatures at the Douglas City compliance point in WY 2021. Observed water temperatures are plotted with compliance targets and the average and range (+/- 1 standard deviation) of daily temperatures for the period of record (WY 2005-2020).

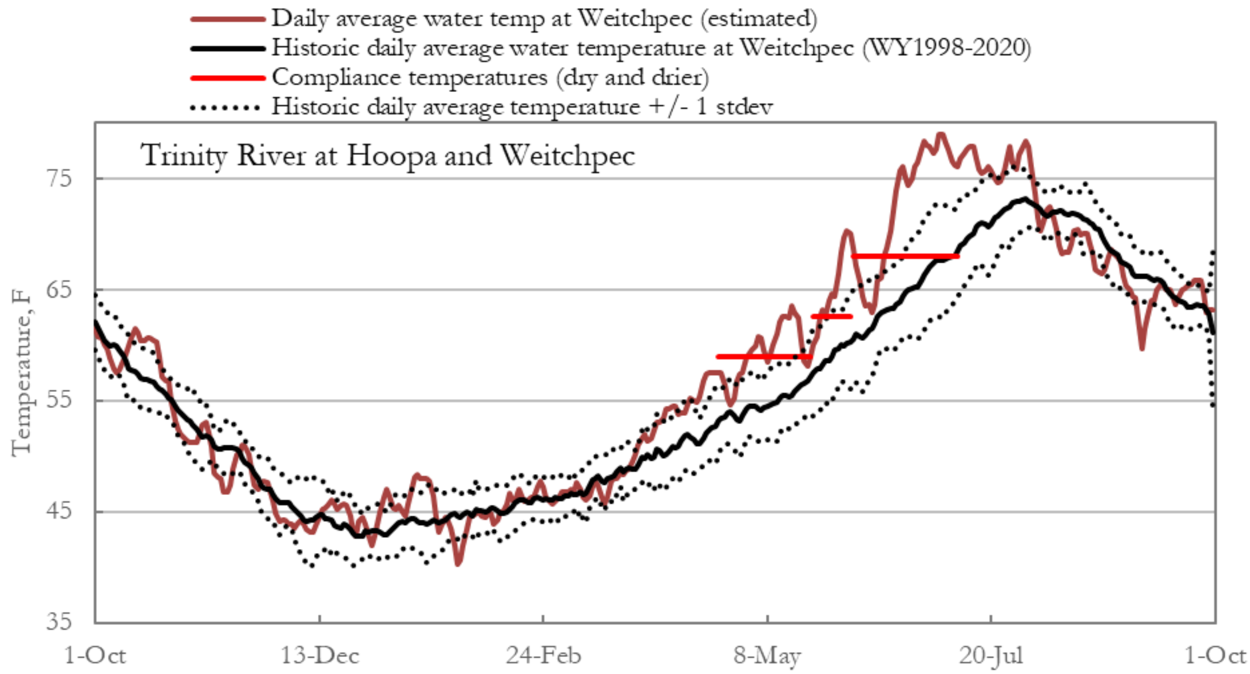



**FIGURE 6.** Daily average water temperatures on the Trinity River at Hoopa adjusted for warming that occurs while flow is in transit 12 river miles downstream to Weitchpec. Also shown are historic daily average and range (+/- 1 standard deviation) of daily temperatures estimated at Weitchpec for the period of record (WY 1998-2020) at Hoopa.

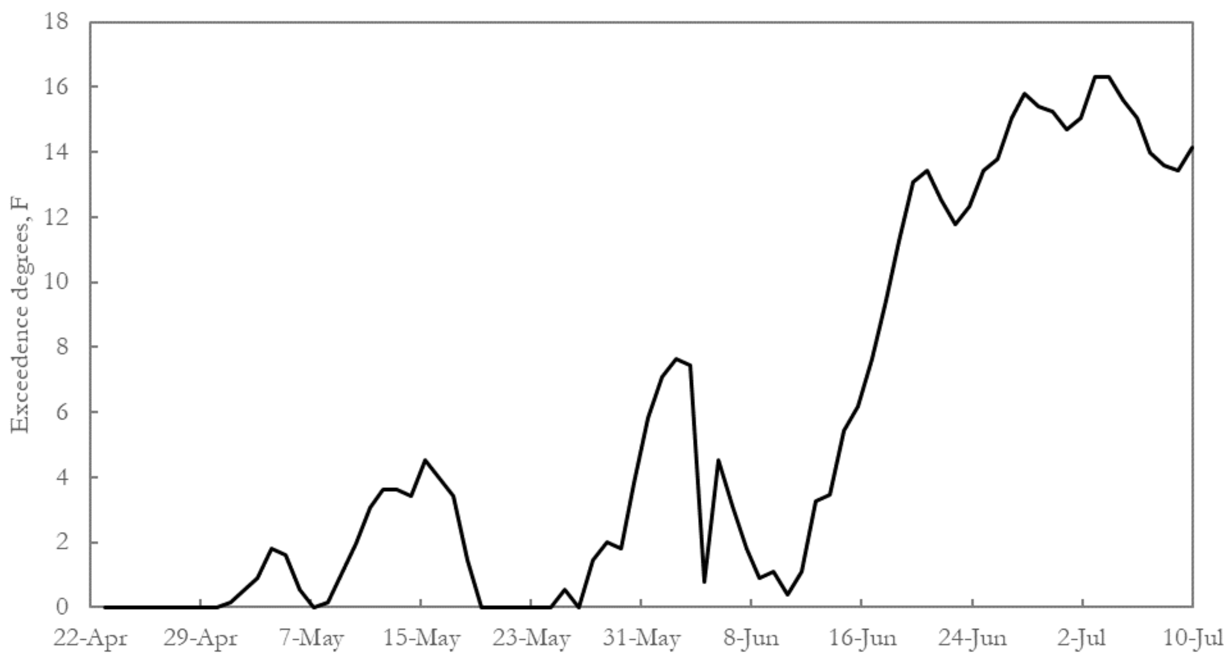



**FIGURE 7.** Water temperature exceedance for the compliance period at Weitchpec.

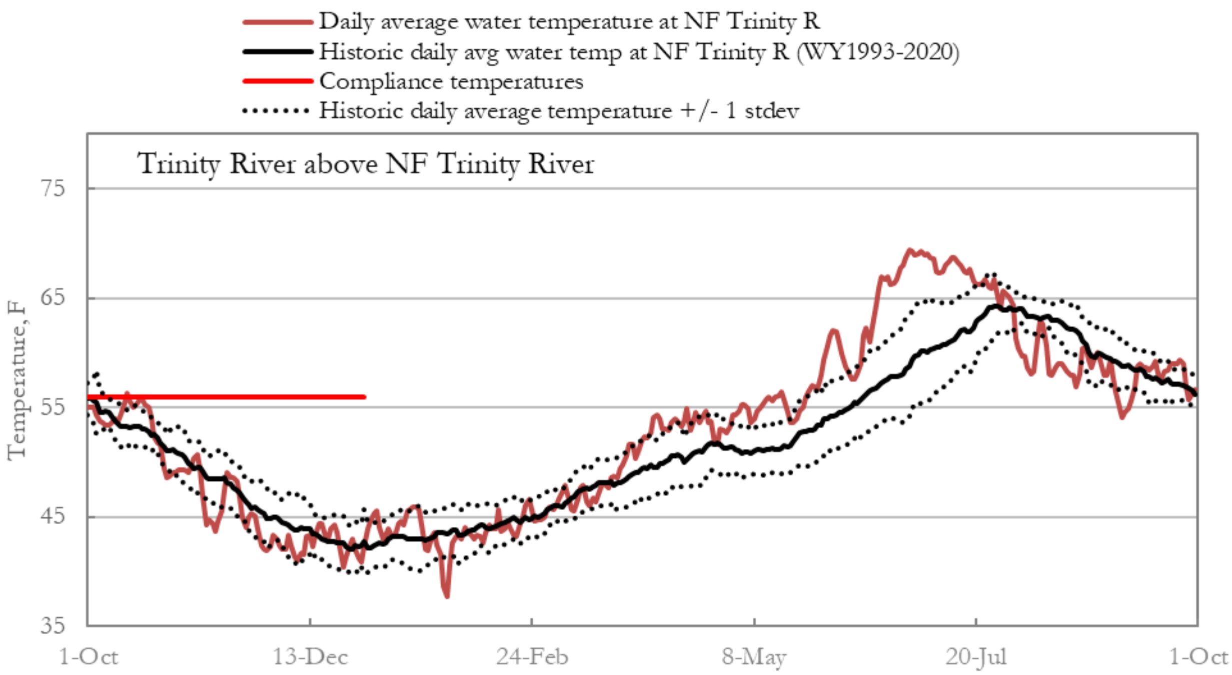



**FIGURE 8.** Daily average water temperatures for the Trinity River above NF Trinity River in WY 2021. Also shown are the historic daily average and range (+/- 1 standard deviation) of daily temperatures for the period of record (WY 1993-2020) at this station.

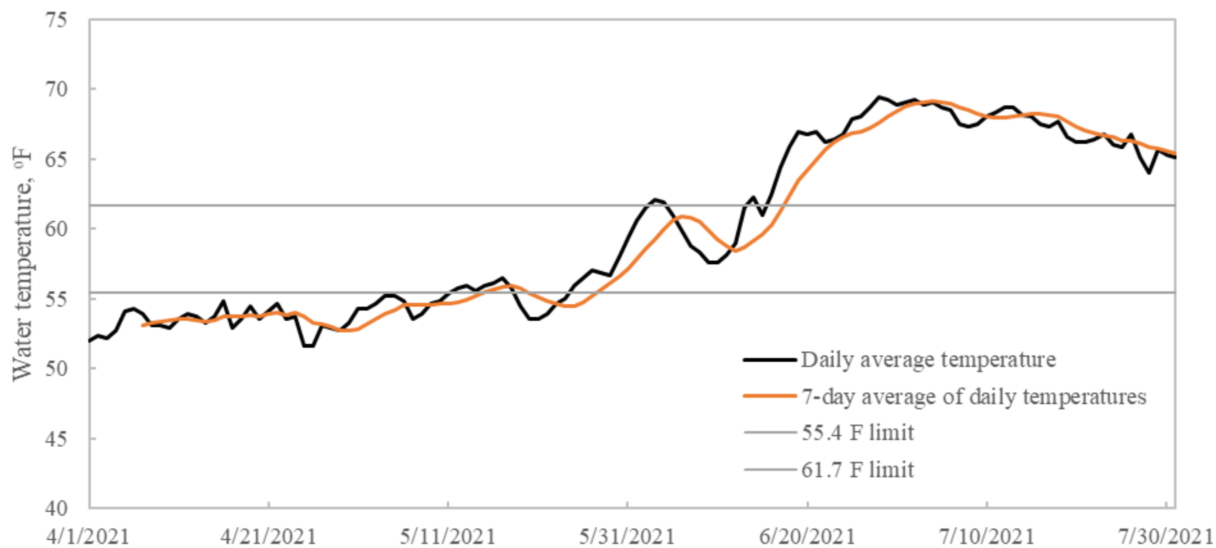



**FIGURE 9.** Daily average water temperatures and the 7-day running average of daily temperatures at the NF Trinity River in WY 2021. The upper (55.4 ºF) and lower (61.7 ºF) temperature limits for optimizing juvenile fish growth are indicated by the grey horizontal lines.

## REFERENCES


Bradley, D.N. (2016), Trinity River 40 Mile Hydraulic Model: Development and Analysis. Report SRH-2016-27 for the Trinity River Restoration Program (TRRP). U.S. Bureau of Reclamation, Technical Service Center, Denver, Colorado. Available at HTTP://WWW.TRRP.NET/LIBRARY/DOCUMENT?ID=2297.

CDWR (California Department of Water Resources) (2019), Bulletin 120, Summary of Water Conditions, April 1, 2015. *Bulletin of the California Department of Water Resources*. Available at http://cdec.water.ca.gov/snow/bulletin120/.

EIS (2000), Trinity River Mainstem Fishery Restoration Environmental Impact Statement / Environmental Impact Report. Available at http://www.trrp.net/library/document?id=1238.

Jones, E.C., R.W. Perry, J.C. Risley, N.A. Som, N.J. Hetrick (2016), Construction, calibration, and validation of the RBM10 water temperature model for the Trinity River, northern California. U.S. Geological Survey Open-File Report 2016–1056.

Perry, R.W., Jones, E.C., Plumb, J.M., Som, N.A., Hetrick, N.J., Hardy, T.B., Polos, J.C., Martin, A.C., Alvarez, J.S., and De Juilio, K.P. (2018), Application of the Stream Salmonid Simulator (S3) to the restoration reach of the Trinity River, California—Parameterization and calibration: U.S. Geological Survey Open-File Report 2018-1174, 64 p. Available at https://doi.org/10.3133/ofr20181174.

Pittman, S. (2018), 2017 Trinity River sediment transport monitoring report. for the Trinity River Restoration Program (TRRP) under U.S. Bureau of Reclamation contract R14PC00122. GMA Hydrology, Placerville, California. Available at HTTP://WWW.TRRP.NET/LIBRARY/DOCUMENT?ID=2361.

Railsback, S.F., Harvey, B.C., Kupferberg, S.J., Lang, M.M., McBain, S., and Welsh, H.H.J. (2016), Modeling potential river management conflicts between frogs and salmonids**.** Canadian Journal of Fisheries and Aquatic Sciences 73: 773-84

SWRCB (State Water Resources Control Board) (1990), Order WR-90-5 setting terms and conditions for fishery protection and setting a schedule for completion of tasks. http://www.waterboards.ca.gov/waterrights/board_decisions/adopted_orders/orders/1990/wro90-05.pdf.

TRRP (Trinity River Restoration Program) and ESSA technologies (2009), Integrated assessment plan (IAP) Version 1.0 – September 2009. Draft report prepared for the Trinity River Restoration Program, Weaverville, CA. 285 pp. Available at HTTP://WWW.TRRP.NET/LIBRARY/DOCUMENT/?ID=400.

U.S. Congress (1955), House of Representatives Rep. No. 602, 84th Congress, 1st Sess. 4-5 (1955); Senate Report 1154, 84th Congress., 1st Session 5.

USDOI (U.S. Department of the Interior) ROD (Record of Decision) (2000), Trinity River mainstem fishery restoration final environmental impact statement/environmental impact report. Available at http://www.trrp.net/library/document/?id=227.

USFWS (U.S. Fish and Wildlife Service) and HVT (Hoopa Valley Tribe) (1999), Trinity River flow evaluation final report. U.S. Fish and Wildlife Service, Arcata, California. Available at http://www.trrp.net/library/document/?id=226.

## APPENDIX A. Water volume summary for Trinity River releases and diversions[2]

| Water Year (WY) | Forecasted full natural flow volume (AF) [A] | Forecast WY Type [A] | Actual WY type [B] | Observed full natural flow (AF) [B] | Allocated restoration flow volume (AF) [C] | Actual Restoration Volume (AF) [D] | Ceremonial release volumes (AF) [E] | Augmentation flows for the Klamath River (AF) [F] | Reservoir Storage Management Releases (AF) [G] | Other releases (AF) [H] | Total Release to Trinity River (AF) [I] | Peak discharge to river (cfs) [J] | Diversion to Central Valley (AF) [K] |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 2001 | | Dry | Dry | 820,377 | 369,000 | 380,313 | 4,118 | 0 | 0 | 0 | 384,431 | 2,140 | 670,514 |
| 2002 | | Normal | Normal | 1,459,176 | 470,000 | 483,519 | 0 | 0 | 0 | 0 | 483,519 | 6,570 | 630,141 |
| 2003 | | Wet | Wet | 1,870,762 | 453,000 | 518,346 | 0 | 38,715 | 0 | 0 | 557,061 | 2,780 | 859,059 |
| 2004 | 1,580,000 | Wet | Wet | 1,503,284 | 647,000 | 648,359 | 0 | 37,135 | 84,180 | 0 | 769,674 | 6,350 | 989,320 |
| 2005 | 1,244,000 | Normal | Wet | 1,471,475 | 647,000 | 648,726 | 3,642 | 0 | 0 | 0 | 652,368 | 7,640 | 468,109 |
| 2006 | 2,105,000 | Ext Wet | Ext Wet | 2,496,685 | 815,000 | 810,315 | 0 | 0 | 408,022 | 0 | 1,218,337 | 10,400 | 1,232,967 |
| 2007 | 835,000 | Dry | Dry | 745,190 | 453,000 | 454,512 | 4,132 | 0 | 0 | 0 | 458,644 | 4,810 | 615,509 |
| 2008 | 1,066,000 | Normal | Dry | 870,747 | 647,000 | 649,803 | 0 | 0 | 0 | 0 | 649,803 | 6,890 | 555,967 |
| 2009 | 852,000 | Dry | Dry | 830,555 | 453,000 | 443,391 | 11,125 | 0 | 0 | 0 | 454,516 | 4,630 | 540,085 |
| 2010 | 1,310,000 | Normal | Wet | 1,602,211 | 647,000 | 657,814 | 0 | 0 | 0 | 0 | 657,814 | 7,840 | 275,203 |
| 2011 | 1,801,000 | Wet | Wet | 1,855,167 | 701,000 | 723,594 | 10,816 | 0 | 0 | 0 | 734,410 | 12,300 | 473,256 |
| 2012 | 1,025,000 | Normal | Normal | 1,050,868 | 647,000 | 648,258 | 0 | 39,033 | 0 | 0 | 687,291 | 6,180 | 709,797 |
| 2013 | 828,000 | Dry | Dry | 827,327 | 453,000 | 452,015 | 10,873 | 17,431 | 0 | 0 | 480,319 | 4,590 | 816,883 |
| 2014 | 395,000 | Crit Dry | Crit Dry | 381,100 | 369,000 | 370,415 | 0 | 64,883 | 0 | 0 | 435,298 | 3,460 | 618,595 |
| 2015 | 934,000 | Dry | Dry | 922,400 | 453,000 | 450,704 | 8,858 | 48,395 | 0 | 0 | 507,957 | 8,830 | 450,468 |
| 2016 | 1,600,000 | Wet | Wet | 1,478,678 | 701,000 | 708,883 | 0 | 39,176 | 0 | 0 | 748,059 | 9,600 | 277,940 |
| 2017 | 2,265,000 | Ext Wet | Ext Wet | 2,304,177 | 815,000 | 821,266 | 8,832 | 0 | 35,855 | 0 | 865,953 | 12,000 | 628,427 |
| 2018 | 530,000 | Crit Dry | Crit Dry | 570,812 | 369,000 | 377,155 | 0 | 16,413 | 0 | 17,554 | 411,122 | 2,040 | 389,893 |
| 2019 | 1,580,000 | Wet | Wet | 1,687,166 | 701,000 | 702,198 | 8,390 | 0 | 0 | 0 | 710,588 | 10,800 | 426,865 |
| 2020 | 515,000 | Crit Dry | Crit Dry | 472,416 | 369,000 | 369,146 | 0 | 6,891 | 0 | 0 | 376,037 | 3,970 | 811,333 |
| 2021 | 530,000 | Crit Dry | Crit Dry | 343,344 | 369,000 | 372,208 | 16,110 | 0 | 0 | 1,365 | 389,683 | 4,070 | 604,290 |

A. The forecasted full natural flow volume is published in the April 1st B-120 Forecast of annual Unimpaired Runoff (50% exceedance) at Lewiston by the California Department of Water Resources at https://cdec.water.ca.gov/snow/bulletin120/. This forecast volume determines the volume of water allotted to the Trinity River for restoration as prescribed in the TRINITY RIVER MAINSTEM FISHERY RESTORATION 2000 RECORD OF DECISION. B-120 forecasts were not issued for 2001-03.
B. Full Natural Flow is the inflow to Trinity Reservoir multiplied by 1.04 to account for the watershed area between the reservoir and Lewiston. Inflows to the reservoir are computed by the U.S. Bureau of Reclamation (USBR) from changes in reservoir storage, evaporation, and dam releases. Uncertainty in water storage and evaporation can result in negative inflows that are included in the calculations as reported.
C. Restoration water volume prescribed in the TRINITY RIVER MAINSTEM FISHERY RESTORATION 2000 RECORD OF DECISION.
D. Restoration release volumes are computed from the final daily average flow record published by USGS for the Trinity River at Lewiston after subtracting flows that are released for non-restoration purposes (see E, F, and G).
E. Ceremonial releases occur in most odd-numbered years for the Hoopa Boat Dance Festival.
F. Flows are released from Lewiston Dam to augment discharges in the lower Klamath River to aide juvenile salmon rearing and adult migration to spawning grounds.
G. Reservoir management releases occur when necessary to protect against over-filling Trinity Reservoir.

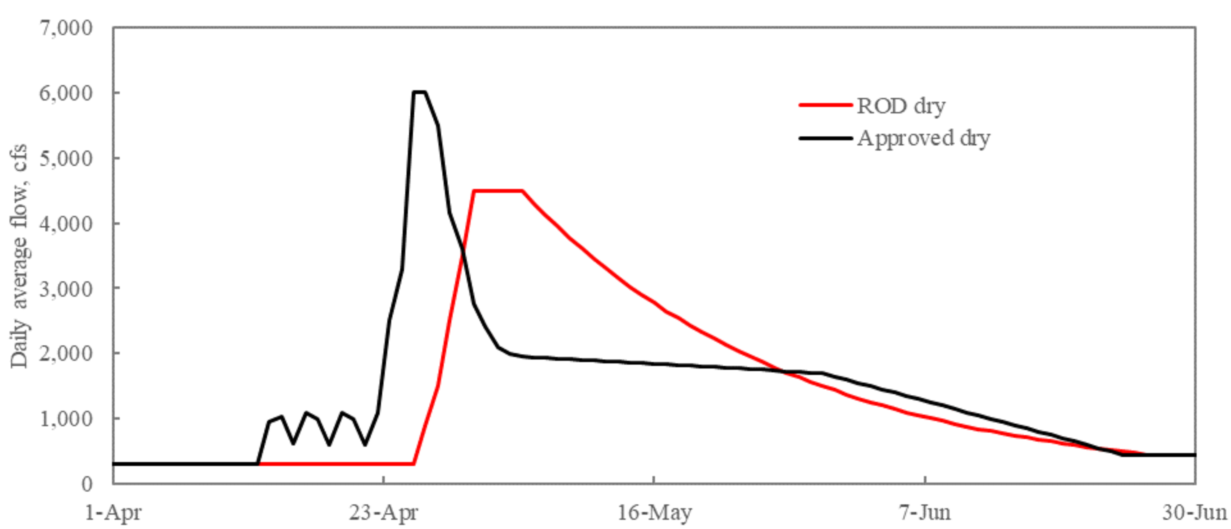
[2] Please note that Appendix A may differ from past versions of this information published in other reports. The differences result from changes in how some values were calculated, as mentioned in subnotes in Appendix A, and in using the latest published flows from USGS.

H. “Other releases” include flow events that occur for other than river restoration and can include emergency flows related to dam and flow diversion infrastructures and water temperature management in the Trinity River.
I. The total release to the Trinity River is the sum of columns with notes D through H.
J. The peak flow release is the highest discharge recorded from measurements at 15-minute intervals throughout the water year at the USGS GAGE AT LEWISTON.
K. Reported in USBR MONTHLY REPORTS FOR LEWISTON RESERVOIR.

APPENDIX B. Modeling results for dry water year flows prescribed by the ROD or approved for implementation by the TMC for a dry water year allocation of 453,000 AF.

| **Parameter** | **ROD** dry | **Approved** dry |
|---|---|---|
| **Fisheries** | | |
| Total Natural Chinook Abundance at Pear Tree (spring and fall run) | 3,058,642 | 3,057,150 |
| Fry abundance (<55 mm) | 1,776,527 | 1,779,089 |
| Parr abundance (55 - 90 mm) | 1,282,115 | 1,278,061 |
| Total Natural Chinook Biomass at Pear Tree (metric tons)[2] | 4.48 | 4.37 |
| **Water temperature** | | |
| EIS Temperature objectives for adult salmon holding/spawning at Douglas City (exceedance degree Fahrenheit (ºF) days)[3] | | |
| Exceedance, average climate conditions (50% exceedance) | 0 | 0 |
| Exceedance, adverse climate conditions (10% exceedance) | 1.2 | 1.2 |
| EIS Temperature objectives for adult salmon holding/spawning above NF Trinity River (exceedance ºF days)[3] | | |
| Exceedance, average climate conditions (50% exceedance) | 0 | 0 |
| Exceedance, adverse climate conditions (10% exceedance) | 7.6 | 7.6 |
| Temperature Objectives for juvenile salmon at Weitchpec (exceedance ºF days)[3] | | |
| Exceedance, average climate conditions (50% exceedance) | 62.7 | 64.8 |
| Exceedance, adverse climate conditions (10% exceedance) | 210.3 | 207.3 |
| Temperature objective for juvenile salmonid rearing above NF Trinity River April 1-July 31 (7 DADA <55.4 ºF/>61.7 ºF)[3,4] | | |
| Exceedance, average climate conditions (50% exceedance) | -69.5/+82.6 | -65.8/+82.6 |
| Exceedance, adverse climate conditions (90% exceedance) | -4.8/+161.0 | -4.8/+155.1 |
| **Riparian plants (woody)** | | |
| Black Cottonwood Initiation Potential (nodes)[5] | 1,992 | 1,069 |
| Risk of encroachment by narrow leaf willow (peak discharge >6000 cfs?) | Yes | No |
| **Biology (foothill yellow-legged frogs)** | | |
| Number of froglets produced in the modeled reach (% survival)[6] | 29,448 (29%) | 19,428 (19%) |
| Median date for FYLF metamorphosis[5] | 8/31/2021 | 8/31/2021 |
| **Physical processes** | | |
| Total bedload transport at Douglas City (tons)[7] | 1,996 | 1,551 |
| **Administrative** | | |
| Construction Impacts (Days ≥1000 cfs; July 15 to Sept 15) | 0 | 0 |

[1]Presented for comparison to model results for ROD and approved flows only. [2]Estimated with data relating cumulative outmigration population to accumulated temperature units at rotary screw traps near Willow Creek, CA. [3]Estimated with the RBM10 stream temperature model (Jones et al., 2016). [4]7 DADA is the 7-day moving average of the daily average temperatures. [5]Modeled with TARGETS v2.2. [6]Modeled with a Foothill yellow legged frog model (Railsback et al., 2016). [7]Estimated with empirical bedload rating curve for this station.



APPENDIX C. Methods in hydrograph modeling.

**RBM10 (Klamath-Trinity River basin model 10) v.1.7.5**
**Modeler:** Todd Buxton (U.S. Bureau of Reclamation)
**Methods:** Temperatures were modeled for temperature compliance with RBM10 set to provide output at river mile (RM) 92.5 (Douglas City), RM 72.3 (above the confluence with the NF Trinity River), and RM 0.1 (Weitchpec). The upstream boundary condition in the model runs was the daily average flow release schedule at Lewiston Dam for each assessed hydrograph. Associated temperatures at the upstream boundary of the model were not adjusted from those provided in the input file with the model. Temperature outputs for each channel location were averaged in daily timesteps for all dry and critically dry water years that occurred between January 1, 1980 and December 31, 2018 to provide daily average values for comparison to temperature targets for each station.

**Targets (Tool for Achieving Riparian Germination and Establishment of Target Species) v2.0.3**
**Modeler:** John Bair (McBain Associates)
**Methods:** TARGETS is a 1-dimensional cross-section based model. Thirty-four cross sections in the Trinity River restoration reach were assessed with the model to estimate black cottonwood establishment. The risk of narrow leaf willow encroachment was considered low if the peak flow exceeded 6,000 cfs, it was considered high if it did not. ROAD and proposed streamflow releases for dry and critically dry water years were used in the model; tributary accretion was not considered. Soil capillarity was set to 0.1 m (representative of coarse sand). Cottonwood root growth was set at 2.5 cm/day. Seed dispersal period for black cottonwood was set at May 15 to May 31 based on 2015-2019 Trinity River data (Bair et al. 2020 TARGETS predicts the potential locations (i.e., initiation nodes) on a cross section in one-foot increments where cottonwood germination and first year establishment through September 30 may occur. Initiation nodes for each hydrograph were summed for each cross section within flow categories ( <450; 450-2,000; 2,000-4,500; 4,500-6,000; 6;000- 8,000, 8,000-11,000). For each hydrograph, the total number of black cottonwood initiation nodes in each flow category and the overall total were summarized.

**FYFAM (Foothill Yellow-legged Frog Assessment Model) v2.0**
**Modeler:** Don Ashton (McBain Associates); Shaun Green (Hoopa Valley Tribal Fisheries)
**Methods:** Topography for the Chapman Ranch (A) rehabilitation site (post construction) was used for FYFAM modeling in 2021. This topographic model was based on a 2016 LiDAR flight and design changes to the reach. RBM10 was used to model for flow and temperature inputs to FYFAM within the Soldier Creek to Canyon Creek reach of the Trinity River. Dry water year hydrographs were assessed using the median daily flow and temperature predicted with RBM10 in 13 dry water years that occurred from 1980 to 2018. The same was done for three critically dry water years that occurred from 1980 to 2018. One-hundred breeding female frogs were modeled in FYFAM within the designated reach each depositing one egg mass containing 1,000 embryos. The water temperature threshold for start of breeding was set at 10°C. FYFAM is a probabilistic model so ten model runs were used per proposed hydrograph each with a start date of March 1, 2021. Mean number of froglets produced and the median metamorphosis date was determined from the replicate model runs (Table 1).

**Bedload transport at Douglas City**
**Modeler:** Todd Buxton (U.S. Bureau of Reclamation)
**Methods:** Bed loads were computed in daily time steps separately for grains 0.5 to ≤8 mm and >8 mm in the rising and falling limbs of the hydrograph and then summed to provide the total bedload transport estimate for each hydrograph. Rating curves used in the calculations were measured by Pittman (2018) in WY 2015 (dry water year) on the Trinity River at Douglas City. Threshold discharges in the transport equations were 2,029 cfs and 1,100 cfs for grains 0.5 to <8 mm and 1,050 cfs and 500 cfs for grains >8 mm in the rising and falling limbs of the hydrograph, respectively. Discharges in the computations were daily average values computed from the average estimated flow for all dry and critically dry water years that occurred between January 1, 1980 and December 31, 2018 by RBM10. The boundary condition for RBM10 model runs was the daily average flow release schedule at Lewiston for each assessed hydrograph.

APPENDIX D. Scheduled and implemented flow on the Trinity River at Lewiston for WY 2021

| Date | Scheduled discharge (cfs) | Implemented discharge (cfs) | Notes on implemented discharges |
|---|---|---|---|
| 10/1/2020 | 450 | 439 | Summer baseflow |
| 10/2/2020 | 450 | 441 | Summer baseflow |
| 10/3/2020 | 450 | 441 | Summer baseflow |
| 10/4/2020 | 450 | 442 | Summer baseflow |
| 10/5/2020 | 450 | 441 | Summer baseflow |
| 10/6/2020 | 450 | 439 | Summer baseflow |
| 10/7/2020 | 450 | 439 | Summer baseflow |
| 10/8/2020 | 450 | 439 | Summer baseflow |
| 10/9/2020 | 450 | 442 | Summer baseflow |
| 10/10/2020 | 450 | 443 | Summer baseflow |
| 10/11/2020 | 450 | 439 | Summer baseflow |
| 10/12/2020 | 450 | 438 | Summer baseflow |
| 10/13/2020 | 450 | 437 | Summer baseflow |
| 10/14/2020 | 450 | 413 | Summer baseflow |
| 10/15/2020 | 450 | 368 | Winter baseflow |
| 10/16/2020 | 375 | 312 | Winter baseflow |
| 10/17/2020 | 300 | 294 | Winter baseflow |
| 10/18/2020 | 300 | 292 | Winter baseflow |
| 10/19/2020 | 300 | 291 | Winter baseflow |
| 10/20/2020 | 300 | 293 | Winter baseflow |
| 10/21/2020 | 300 | 294 | Winter baseflow |
| 10/22/2020 | 300 | 294 | Winter baseflow |
| 10/23/2020 | 300 | 293 | Winter baseflow |
| 10/24/2020 | 300 | 293 | Winter baseflow |
| 10/25/2020 | 300 | 292 | Winter baseflow |
| 10/26/2020 | 300 | 291 | Winter baseflow |
| 10/27/2020 | 300 | 296 | Winter baseflow |
| 10/28/2020 | 300 | 306 | Winter baseflow |
| 10/29/2020 | 300 | 306 | Winter baseflow |
| 10/30/2020 | 300 | 305 | Winter baseflow |
| 10/31/2020 | 300 | 303 | Winter baseflow |
| 11/1/2020 | 300 | 300 | Winter baseflow |
| 11/2/2020 | 300 | 301 | Winter baseflow |
| 11/3/2020 | 300 | 303 | Winter baseflow |
| 11/4/2020 | 300 | 301 | Winter baseflow |
| 11/5/2020 | 300 | 300 | Winter baseflow |
| 11/6/2020 | 300 | 299 | Winter baseflow |
| 11/7/2020 | 300 | 298 | Winter baseflow |
| 11/8/2020 | 300 | 299 | Winter baseflow |

APPENDIX D. (continued)

| Date | Scheduled discharge (cfs) | Implemented discharge (cfs) | Notes on implemented discharges |
|---|---|---|---|
| 11/9/2020 | 300 | 299 | Winter baseflow |
| 11/10/2020 | 300 | 298 | Winter baseflow |
| 11/11/2020 | 300 | 301 | Winter baseflow |
| 11/12/2020 | 300 | 299 | Winter baseflow |
| 11/13/2020 | 300 | 299 | Winter baseflow |
| 11/14/2020 | 300 | 298 | Winter baseflow |
| 11/15/2020 | 300 | 298 | Winter baseflow |
| 11/16/2020 | 300 | 298 | Winter baseflow |
| 11/17/2020 | 300 | 298 | Winter baseflow |
| 11/18/2020 | 300 | 298 | Winter baseflow |
| 11/19/2020 | 300 | 298 | Winter baseflow |
| 11/20/2020 | 300 | 296 | Winter baseflow |
| 11/21/2020 | 300 | 295 | Winter baseflow |
| 11/22/2020 | 300 | 298 | Winter baseflow |
| 11/23/2020 | 300 | 297 | Winter baseflow |
| 11/24/2020 | 300 | 296 | Winter baseflow |
| 11/25/2020 | 300 | 296 | Winter baseflow |
| 11/26/2020 | 300 | 299 | Winter baseflow |
| 11/27/2020 | 300 | 297 | Winter baseflow |
| 11/28/2020 | 300 | 294 | Winter baseflow |
| 11/29/2020 | 300 | 294 | Winter baseflow |
| 11/30/2020 | 300 | 292 | Winter baseflow |
| 12/1/2020 | 300 | 294 | Winter baseflow |
| 12/2/2020 | 300 | 293 | Winter baseflow |
| 12/3/2020 | 300 | 292 | Winter baseflow |
| 12/4/2020 | 300 | 293 | Winter baseflow |
| 12/5/2020 | 300 | 293 | Winter baseflow |
| 12/6/2020 | 300 | 293 | Winter baseflow |
| 12/7/2020 | 300 | 292 | Winter baseflow |
| 12/8/2020 | 300 | 298 | Winter baseflow |
| 12/9/2020 | 300 | 313 | Winter baseflow |
| 12/10/2020 | 300 | 314 | Winter baseflow |
| 12/11/2020 | 300 | 313 | Winter baseflow |
| 12/12/2020 | 300 | 315 | Winter baseflow |
| 12/13/2020 | 300 | 315 | Winter baseflow |
| 12/14/2020 | 300 | 315 | Winter baseflow |
| 12/15/2020 | 300 | 315 | Winter baseflow |
| 12/16/2020 | 300 | 315 | Winter baseflow |
| 12/17/2020 | 300 | 316 | Winter baseflow |

APPENDIX D. (continued)

| Date | Scheduled discharge (cfs) | Implemented discharge (cfs) | Notes on implemented discharges |
|---|---|---|---|
| 12/18/2020 | 300 | 316 | Winter baseflow |
| 12/19/2020 | 300 | 316 | Winter baseflow |
| 12/20/2020 | 300 | 316 | Winter baseflow |
| 12/21/2020 | 300 | 316 | Winter baseflow |
| 12/22/2020 | 300 | 315 | Winter baseflow |
| 12/23/2020 | 300 | 314 | Winter baseflow |
| 12/24/2020 | 300 | 315 | Winter baseflow |
| 12/25/2020 | 300 | 315 | Winter baseflow |
| 12/26/2020 | 300 | 316 | Winter baseflow |
| 12/27/2020 | 300 | 316 | Winter baseflow |
| 12/28/2020 | 300 | 315 | Winter baseflow |
| 12/29/2020 | 300 | 316 | Winter baseflow |
| 12/30/2020 | 300 | 316 | Winter baseflow |
| 12/31/2020 | 300 | 317 | Winter baseflow |
| 1/1/2021 | 300 | 319 | Winter baseflow |
| 1/2/2021 | 300 | 317 | Winter baseflow |
| 1/3/2021 | 300 | 317 | Winter baseflow |
| 1/4/2021 | 300 | 318 | Winter baseflow |
| 1/5/2021 | 300 | 318 | Winter baseflow |
| 1/6/2021 | 300 | 316 | Winter baseflow |
| 1/7/2021 | 300 | 314 | Winter baseflow |
| 1/8/2021 | 300 | 314 | Winter baseflow |
| 1/9/2021 | 300 | 314 | Winter baseflow |
| 1/10/2021 | 300 | 312 | Winter baseflow |
| 1/11/2021 | 300 | 314 | Winter baseflow |
| 1/12/2021 | 300 | 315 | Winter baseflow |
| 1/13/2021 | 300 | 316 | Winter baseflow |
| 1/14/2021 | 300 | 316 | Winter baseflow |
| 1/15/2021 | 300 | 315 | Winter baseflow |
| 1/16/2021 | 300 | 314 | Winter baseflow |
| 1/17/2021 | 300 | 315 | Winter baseflow |
| 1/18/2021 | 300 | 314 | Winter baseflow |
| 1/19/2021 | 300 | 313 | Winter baseflow |
| 1/20/2021 | 300 | 315 | Winter baseflow |
| 1/21/2021 | 300 | 315 | Winter baseflow |
| 1/22/2021 | 300 | 314 | Winter baseflow |
| 1/23/2021 | 300 | 314 | Winter baseflow |
| 1/24/2021 | 300 | 315 | Winter baseflow |
| 1/25/2021 | 300 | 315 | Winter baseflow |

APPENDIX D. (continued)

| Date | Scheduled discharge (cfs) | Implemented discharge (cfs) | Notes on implemented discharges |
|---|---|---|---|
| 1/26/2021 | 300 | 315 | Winter baseflow |
| 1/27/2021 | 300 | 316 | Winter baseflow |
| 1/28/2021 | 300 | 315 | Winter baseflow |
| 1/29/2021 | 300 | 315 | Winter baseflow |
| 1/30/2021 | 300 | 315 | Winter baseflow |
| 1/31/2021 | 300 | 315 | Winter baseflow |
| 2/1/2021 | 300 | 314 | Winter baseflow |
| 2/2/2021 | 300 | 315 | Winter baseflow |
| 2/3/2021 | 300 | 317 | Winter baseflow |
| 2/4/2021 | 300 | 316 | Winter baseflow |
| 2/5/2021 | 300 | 315 | Winter baseflow |
| 2/6/2021 | 300 | 311 | Winter baseflow |
| 2/7/2021 | 300 | 311 | Winter baseflow |
| 2/8/2021 | 300 | 314 | Winter baseflow |
| 2/9/2021 | 300 | 315 | Winter baseflow |
| 2/10/2021 | 300 | 312 | Winter baseflow |
| 2/11/2021 | 300 | 311 | Winter baseflow |
| 2/12/2021 | 300 | 309 | Winter baseflow |
| 2/13/2021 | 300 | 311 | Winter baseflow |
| 2/14/2021 | 300 | 313 | Winter baseflow |
| 2/15/2021 | 300 | 313 | Winter baseflow |
| 2/16/2021 | 300 | 311 | Winter baseflow |
| 2/17/2021 | 300 | 311 | Winter baseflow |
| 2/18/2021 | 300 | 314 | Winter baseflow |
| 2/19/2021 | 300 | 314 | Winter baseflow |
| 2/20/2021 | 300 | 314 | Winter baseflow |
| 2/21/2021 | 300 | 314 | Winter baseflow |
| 2/22/2021 | 300 | 313 | Winter baseflow |
| 2/23/2021 | 300 | 313 | Winter baseflow |
| 2/24/2021 | 300 | 316 | Winter baseflow |
| 2/25/2021 | 300 | 310 | Winter baseflow |
| 2/26/2021 | 300 | 309 | Winter baseflow |
| 2/27/2021 | 300 | 312 | Winter baseflow |
| 2/28/2021 | 300 | 313 | Winter baseflow |
| 3/1/2021 | 300 | 313 | Winter baseflow |
| 3/2/2021 | 300 | 314 | Winter baseflow |
| 3/3/2021 | 300 | 312 | Winter baseflow |
| 3/4/2021 | 300 | 309 | Winter baseflow |
| 3/5/2021 | 300 | 310 | Winter baseflow |

APPENDIX D. (continued)

| Date | Scheduled discharge (cfs) | Implemented discharge (cfs) | Notes on implemented discharges |
|---|---|---|---|
| 3/6/2021 | 300 | 314 | Winter baseflow |
| 3/7/2021 | 300 | 312 | Winter baseflow |
| 3/8/2021 | 300 | 310 | Winter baseflow |
| 3/9/2021 | 300 | 310 | Winter baseflow |
| 3/10/2021 | 300 | 308 | Winter baseflow |
| 3/11/2021 | 300 | 307 | Winter baseflow |
| 3/12/2021 | 300 | 309 | Winter baseflow |
| 3/13/2021 | 300 | 309 | Winter baseflow |
| 3/14/2021 | 300 | 310 | Winter baseflow |
| 3/15/2021 | 300 | 310 | Winter baseflow |
| 3/16/2021 | 300 | 303 | Winter baseflow |
| 3/17/2021 | 300 | 300 | Winter baseflow |
| 3/18/2021 | 300 | 301 | Winter baseflow |
| 3/19/2021 | 300 | 300 | Winter baseflow |
| 3/20/2021 | 300 | 299 | Winter baseflow |
| 3/21/2021 | 300 | 297 | Winter baseflow |
| 3/22/2021 | 300 | 296 | Winter baseflow |
| 3/23/2021 | 300 | 297 | Winter baseflow |
| 3/24/2021 | 300 | 300 | Winter baseflow |
| 3/25/2021 | 300 | 299 | Winter baseflow |
| 3/26/2021 | 300 | 299 | Winter baseflow |
| 3/27/2021 | 300 | 299 | Winter baseflow |
| 3/28/2021 | 300 | 299 | Winter baseflow |
| 3/29/2021 | 300 | 300 | Winter baseflow |
| 3/30/2021 | 300 | 298 | Winter baseflow |
| 3/31/2021 | 300 | 296 | Winter baseflow |
| 4/1/2021 | 300 | 298 | Winter baseflow |
| 4/2/2021 | 300 | 296 | Winter baseflow |
| 4/3/2021 | 300 | 297 | Winter baseflow |
| 4/4/2021 | 300 | 297 | Winter baseflow |
| 4/5/2021 | 300 | 297 | Winter baseflow |
| 4/6/2021 | 300 | 298 | Winter baseflow |
| 4/7/2021 | 300 | 296 | Winter baseflow |
| 4/8/2021 | 300 | 295 | Winter baseflow |
| 4/9/2021 | 300 | 294 | Winter baseflow |
| 4/10/2021 | 300 | 294 | Winter baseflow |
| 4/11/2021 | 300 | 296 | Winter baseflow |
| 4/12/2021 | 300 | 296 | Winter baseflow |
| 4/13/2021 | 300 | 295 | Winter baseflow |

APPENDIX D. (continued)

| Date | Scheduled discharge (cfs) | Implemented discharge (cfs) | Notes on implemented discharges |
|---|---|---|---|
| 4/14/2021 | 300 | 298 | Winter baseflow |
| 4/15/2021 | 300 | 296 | Spring flow release |
| 4/16/2021 | 1179 | 1250 | Spring flow release |
| 4/17/2021 | 1308 | 1280 | Spring flow release |
| 4/18/2021 | 892 | 860 | Spring flow release |
| 4/19/2021 | 704 | 680 | Spring flow release |
| 4/20/2021 | 550 | 522 | Spring flow release |
| 4/21/2021 | 517 | 505 | Spring flow release |
| 4/22/2021 | 1433 | 1470 | Spring flow release |
| 4/23/2021 | 1500 | 1480 | Spring flow release |
| 4/24/2021 | 967 | 971 | Spring flow release |
| 4/25/2021 | 692 | 692 | Spring flow release |
| 4/26/2021 | 800 | 814 | Spring flow release |
| 4/27/2021 | 1408 | 1510 | Spring flow release |
| 4/28/2021 | 3542 | 3550 | Spring flow release |
| 4/29/2021 | 2500 | 2450 | Spring flow release |
| 4/30/2021 | 1650 | 1640 | Spring flow release |
| 5/1/2021 | 1333 | 1330 | Spring flow release |
| 5/2/2021 | 1367 | 1370 | Spring flow release |
| 5/3/2021 | 1492 | 1510 | Spring flow release |
| 5/4/2021 | 1554 | 1570 | Spring flow release |
| 5/5/2021 | 1692 | 1720 | Spring flow release |
| 5/6/2021 | 1946 | 1960 | Spring flow release |
| 5/7/2021 | 1842 | 1820 | Spring flow release |
| 5/8/2021 | 1713 | 1710 | Spring flow release |
| 5/9/2021 | 1667 | 1660 | Spring flow release |
| 5/10/2021 | 1588 | 1560 | Spring flow release |
| 5/11/2021 | 1575 | 1560 | Spring flow release |
| 5/12/2021 | 1600 | 1590 | Spring flow release |
| 5/13/2021 | 1600 | 1590 | Spring flow release |
| 5/14/2021 | 1588 | 1570 | Spring flow release |
| 5/15/2021 | 1525 | 1500 | Spring flow release |
| 5/16/2021 | 1500 | 1470 | Spring flow release |
| 5/17/2021 | 1513 | 1500 | Spring flow release |
| 5/18/2021 | 1575 | 1590 | Spring flow release |
| 5/19/2021 | 1567 | 1570 | Spring flow release |
| 5/20/2021 | 1517 | 1540 | Spring flow release |
| 5/21/2021 | 1521 | 1530 | Spring flow release |
| 5/22/2021 | 1500 | 1500 | Spring flow release |

APPENDIX D. (continued)

| Date | Scheduled discharge (cfs) | Implemented discharge (cfs) | Notes on implemented discharges |
|---|---|---|---|
| 5/23/2021 | 1479 | 1480 | Spring flow release |
| 5/24/2021 | 1417 | 1400 | Spring flow release |
| 5/25/2021 | 1317 | 1300 | Spring flow release |
| 5/26/2021 | 1217 | 1200 | Spring flow release |
| 5/27/2021 | 1246 | 1250 | Spring flow release |
| 5/28/2021 | 1779 | 1810 | Spring flow release |
| 5/29/2021 | 1358 | 1410 | Spring flow release |
| 5/30/2021 | 1146 | 1180 | Spring flow release |
| 5/31/2021 | 1029 | 1050 | Spring flow release |
| 6/1/2021 | 925 | 917 | Spring flow release |
| 6/2/2021 | 850 | 840 | Spring flow release |
| 6/3/2021 | 800 | 784 | Spring flow release |
| 6/4/2021 | 788 | 789 | Spring flow release |
| 6/5/2021 | 750 | 733 | Spring flow release |
| 6/6/2021 | 700 | 727 | Spring flow release |
| 6/7/2021 | 700 | 720 | Spring flow release |
| 6/8/2021 | 654 | 657 | Spring flow release |
| 6/9/2021 | 600 | 595 | Spring flow release |
| 6/10/2021 | 600 | 594 | Spring flow release |
| 6/11/2021 | 571 | 558 | Spring flow release |
| 6/12/2021 | 542 | 526 | Spring flow release |
| 6/13/2021 | 500 | 479 | Spring flow release |
| 6/14/2021 | 500 | 483 | Spring flow release |
| 6/15/2021 | 492 | 472 | Spring flow release |
| 6/16/2021 | 475 | 471 | Spring flow release |
| 6/17/2021 | 475 | 476 | Spring flow release |
| 6/18/2021 | 467 | 465 | Spring flow release |
| 6/19/2021 | 463 | 472 | Spring flow release |
| 6/20/2021 | 450 | 460 | Spring flow release |
| 6/21/2021 | 450 | 458 | Spring flow release |
| 6/22/2021 | 450 | 456 | Spring flow release |
| 6/23/2021 | 450 | 455 | Spring flow release |
| 6/24/2021 | 450 | 458 | Spring flow release |
| 6/25/2021 | 450 | 456 | Spring flow release |
| 6/26/2021 | 450 | 456 | Spring flow release |
| 6/27/2021 | 450 | 456 | Spring flow release |
| 6/28/2021 | 450 | 464 | Spring flow release |
| 6/29/2021 | 450 | 467 | Spring flow release |
| 6/30/2021 | 450 | 466 | Spring flow release |

APPENDIX D. (continued)

| Date | Scheduled discharge (cfs) | Implemented discharge (cfs) | Notes on implemented discharges |
|---|---|---|---|
| 7/1/2021 | 450 | 467 | Spring flow release |
| 7/2/2021 | 450 | 467 | Spring flow release |
| 7/3/2021 | 450 | 462 | Spring flow release |
| 7/4/2021 | 450 | 457 | Summer baseflow |
| 7/5/2021 | 450 | 449 | Summer baseflow |
| 7/6/2021 | 450 | 451 | Summer baseflow |
| 7/7/2021 | 450 | 452 | Summer baseflow |
| 7/8/2021 | 450 | 454 | Summer baseflow |
| 7/9/2021 | 450 | 452 | Summer baseflow |
| 7/10/2021 | 450 | 454 | Summer baseflow |
| 7/11/2021 | 450 | 452 | Summer baseflow |
| 7/12/2021 | 450 | 451 | Summer baseflow |
| 7/13/2021 | 450 | 452 | Summer baseflow |
| 7/14/2021 | 450 | 454 | Summer baseflow |
| 7/15/2021 | 450 | 454 | Summer baseflow |
| 7/16/2021 | 450 | 454 | Summer baseflow |
| 7/17/2021 | 450 | 452 | Summer baseflow |
| 7/18/2021 | 450 | 453 | Summer baseflow |
| 7/19/2021 | 450 | 451 | Summer baseflow |
| 7/20/2021 | 450 | 452 | Summer baseflow |
| 7/21/2021 | 450 | 452 | Summer baseflow |
| 7/22/2021 | 450 | 453 | Summer baseflow |
| 7/23/2021 | 450 | 452 | Summer baseflow |
| 7/24/2021 | 450 | 456 | Summer baseflow |
| 7/25/2021 | 450 | 456 | Summer baseflow |
| 7/26/2021 | 450 | 455 | Summer baseflow |
| 7/27/2021 | 450 | 457 | Summer baseflow |
| 7/28/2021 | 450 | 453 | Summer baseflow |
| 7/29/2021 | 450 | 453 | Summer baseflow |
| 7/30/2021 | 450 | 453 | Summer baseflow |
| 7/31/2021 | 450 | 464 | Summer baseflow |
| 8/1/2021 | 450 | 767 | Summer baseflow + Emergency release |
| 8/2/2021 | 450 | 635 | Summer baseflow + Emergency release |
| 8/3/2021 | 450 | 636 | Summer baseflow + Emergency release |
| 8/4/2021 | 450 | 461 | Summer baseflow |
| 8/5/2021 | 450 | 439 | Summer baseflow |
| 8/6/2021 | 450 | 448 | Summer baseflow |
| 8/7/2021 | 450 | 452 | Summer baseflow |
| 8/8/2021 | 450 | 453 | Summer baseflow |

APPENDIX D. (continued)

| Date | Scheduled discharge (cfs) | Implemented discharge (cfs) | Notes on implemented discharges |
|---|---|---|---|
| 8/9/2021 | 450 | 453 | Summer baseflow |
| 8/10/2021 | 450 | 456 | Summer baseflow |
| 8/11/2021 | 450 | 455 | Summer baseflow |
| 8/12/2021 | 450 | 457 | Summer baseflow |
| 8/13/2021 | 450 | 459 | Summer baseflow |
| 8/14/2021 | 450 | 456 | Summer baseflow |
| 8/15/2021 | 450 | 456 | Summer baseflow |
| 8/16/2021 | 450 | 455 | Summer baseflow |
| 8/17/2021 | 450 | 456 | Summer baseflow |
| 8/18/2021 | 450 | 456 | Summer baseflow |
| 8/19/2021 | 450 | 457 | Summer baseflow |
| 8/20/2021 | 450 | 458 | Summer baseflow |
| 8/21/2021 | 450 | 460 | Summer baseflow |
| 8/22/2021 | 450 | 458 | Summer baseflow |
| 8/23/2021 | 450 | 459 | Summer baseflow |
| 8/24/2021 | 450 | 461 | Summer baseflow |
| 8/25/2021 | 450 | 460 | Summer baseflow |
| 8/26/2021 | 450 | 460 | Summer baseflow |
| 8/27/2021 | 450 | 458 | Summer baseflow |
| 8/28/2021 | 450 | 456 | Summer baseflow |
| 8/29/2021 | 450 | 459 | Summer baseflow |
| 8/30/2021 | 450 | 459 | Summer baseflow |
| 8/31/2021 | 450 | 462 | Summer baseflow |
| 9/1/2021 | 450 | 461 | Summer baseflow |
| 9/2/2021 | 450 | 679 | Summer baseflow + Boat Dance |
| 9/3/2021 | 450 | 888 | Summer baseflow + Boat Dance |
| 9/4/2021 | 450 | 1260 | Summer baseflow + Boat Dance |
| 9/5/2021 | 450 | 2640 | Summer baseflow + Boat Dance |
| 9/6/2021 | 450 | 2450 | Summer baseflow + Boat Dance |
| 9/7/2021 | 450 | 1660 | Summer baseflow + Boat Dance |
| 9/8/2021 | 450 | 1070 | Summer baseflow + Boat Dance |
| 9/9/2021 | 450 | 854 | Summer baseflow + Boat Dance |
| 9/10/2021 | 450 | 671 | Summer baseflow + Boat Dance |
| 9/11/2021 | 450 | 486 | Summer baseflow |
| 9/12/2021 | 450 | 489 | Summer baseflow |
| 9/13/2021 | 450 | 492 | Summer baseflow |
| 9/14/2021 | 450 | 489 | Summer baseflow |
| 9/15/2021 | 450 | 489 | Summer baseflow |
| 9/16/2021 | 450 | 487 | Summer baseflow |

APPENDIX D. (continued)

| Date | Scheduled discharge (cfs) | Implemented discharge (cfs) | Notes on implemented discharges |
|---|---|---|---|
| 9/17/2021 | 450 | 487 | Summer baseflow |
| 9/18/2021 | 450 | 490 | Summer baseflow |
| 9/19/2021 | 450 | 488 | Summer baseflow |
| 9/20/2021 | 450 | 485 | Summer baseflow |
| 9/21/2021 | 450 | 485 | Summer baseflow |
| 9/22/2021 | 450 | 485 | Summer baseflow |
| 9/23/2021 | 450 | 461 | Summer baseflow |
| 9/24/2021 | 450 | 446 | Summer baseflow |
| 9/25/2021 | 450 | 447 | Summer baseflow |
| 9/26/2021 | 450 | 446 | Summer baseflow |
| 9/27/2021 | 450 | 446 | Summer baseflow |
| 9/28/2021 | 450 | 446 | Summer baseflow |
| 9/29/2021 | 450 | 443 | Summer baseflow |
| 9/30/2021 | 450 | 443 | Summer baseflow |