

RECLAMATION

Managing Water in the West

Annual Report of Operations For Flaming Gorge Dam Water Year 2014



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Annual Report of Operations for Flaming Gorge Dam

Water Year 2014

Introduction

This report details the operations of Flaming Gorge Dam during water year 2014¹, and is produced pursuant to the February 2006 Record of Decision for the Operation of Flaming Gorge Dam (ROD)², the Operation of Flaming Gorge Dam Final Environmental Impact Statement (FEIS)³ and 2005 Final Biological Opinion on the Operation of Flaming Gorge Dam (2005 BO)⁴. This is the ninth year of operations of Flaming Gorge Dam under the ROD and this report is the ninth annual report produced as described in the ROD.

Flaming Gorge Dam, located on the upper main-stem of the Green River in northeastern Utah about 200 miles east of Salt Lake City, is an authorized storage unit of the Colorado River Storage Project. The Green River system is part of the upper Colorado River basin in Utah, Colorado, and Wyoming. Below Flaming Gorge, the Green River supports populations of four endangered native fishes. Operation of Flaming Gorge Dam influences downstream flow and temperature regimes and the ecology of the Green River, including native fishes. Downstream of Flaming Gorge Dam the Green River is joined by the Yampa, White and Duchesne Rivers, portions of which have all been designated as critical habitat under provisions of the Endangered Species Act of 1973 (Muth, *et al.*, 2000).

The Upper Colorado River Endangered Fish Recovery Program (Recovery Program) was initiated in 1988 by the signing of a cooperative agreement amongst the states of Colorado, Wyoming, and Utah, the Secretary of Interior and the Administrator of the Western Area Power Administration (WAPA). The goal of the Recovery Program is to recover the endangered fish species while allowing for the continued operation and development of water resources in the Upper Colorado River Basin. The Recovery Program is the forum for discussion of endangered fish response to Flaming Gorge Dam operations and for identification of endangered fish research needs.

In 2000, the Recovery Program issued Flow and Temperature Recommendations for Endangered Fishes in the Green River Downstream of Flaming Gorge Dam (Muth *et al.*, 2000; Flow Recommendations). The Flow Recommendations provide the basis for the proposed action described and analyzed in the FEIS. The ROD implements the proposed

¹ A water year begins October 1 and ends September 30.

² [Record of Decision Operation of Flaming Gorge Dam Final Environmental Impact Statement \(February 2006\)](#)

³ [Operation of Flaming Gorge Dam FINAL Environmental Impact Statement \(September 2005\)](#)

⁴ [2005 Final Biological Opinion on the Operation of Flaming Gorge Dam](#)

action by modifying the operations of Flaming Gorge Dam, to the extent possible, to assist in the recovery of endangered fishes, and their critical habitat, downstream from the dam and, at the same time, maintains and continues all authorized purposes of the Colorado River Storage Project (Reclamation 2006). Table 2.1 in the FEIS summarizes the Flow Recommendations and can be found in Appendix B.

The ROD directs Reclamation to operate to achieve, to the extent possible, the Flow Recommendations as described in the FEIS (Reclamation 2006). The Flow Recommendations divide the Green River below Flaming Gorge Dam into three river reaches. Reach 1 begins directly below the dam and extends to the confluence with the Yampa River. Reach 2 begins at the Yampa River confluence and continues to the White River confluence. Reach 3 is between the White River and Colorado River confluences. (Muth et. al 2000)

Operational Decision Process for Water Year 2014

The Flaming Gorge Technical Working Group (FGTWG) was established pursuant to the FEIS as recommended in the Flow Recommendations.⁵ The ROD clarified the purpose of the FGTWG as proposing specific flow and temperature targets for each year's operations based on current year hydrologic conditions and the conditions of the endangered fish. The FGTWG was also charged with integrating, to the extent possible, any flow requests received by Reclamation from the Recovery Program into the flow proposal so that Recovery Program research could also be facilitated. This process concurrently fulfills the informal consultation and coordination requirements of the ESA for the action agencies as committed to in the ROD.

Members of the FGTWG include biologists and hydrologists from Reclamation, the U.S. Fish and Wildlife Service (Service), and WAPA.

Each year, FGTWG's recommendation is presented to the Flaming Gorge Working Group, along with any flow requests or operational requests proposed by other federal or state agencies or stakeholders. The Flaming Gorge Working Group (Working Group) was formed in 1993 to provide interested parties with an open forum to express their views and interests in the operations of Flaming Gorge Dam. The Working Group meets biannually, at a minimum, and functions as a means of providing information to and gathering inputs from stakeholders and interested parties on dam operations, other resource concerns and research flows.

In 2014, the operational process developed in 2006 was used for making operational decisions at Flaming Gorge Dam. This process was developed based on descriptions provided in the FEIS (Section 1.5) and the ROD (Sections III, VI, and VII; Reclamation, 2005, Reclamation 2006). A detailed description of this process can be found in Appendix A. The implementation of the four steps of the process in 2014 is described below:

⁵ FGTWG meeting summaries and documents are also available at: <http://www.usbr.gov/uc/water/crsp/wg/fg/twg/twgSummaries.html>.

Step 1: Flow Requests for Research, and Other Federal, State and Stakeholder Input

Reclamation received a memorandum on March 21, 2014 (Appendix C) from the Director of the Recovery Program stating the Recovery Program's research request for 2014 Green River spring flows. It referenced the final *Study Plan to Examine the Effects of Using Larval Razorback Sucker Occurrence in the Green River as a Trigger for Flaming Gorge Dam Peak Releases* (*ad hoc* Committee, March 2012; LTSP).⁶ The Recovery Program's spring 2014 Flow Request was to establish a release regime that would facilitate further research under the LTSP. The LTSP primary research objective is the request that "Reclamation use the occurrence of razorback sucker larvae in channel margin habitats (as determined by real-time monitoring) as the 'trigger' to determine when peak releases should occur from Flaming Gorge Dam."

The Recovery Program requested that the FGTWG consider and propose matching research needs identified in the LTSP with the best available spring flow forecast information to develop a specific Reach 2 floodplain connection scenario. The LTSP describes a range of floodplain scenarios to study and how the results would be evaluated. Additionally, the 2014 Spring Flow Request's primary objective was to build on past research to benefit the razorback sucker population throughout the Green River by timing the river-floodplain connection with the presence of wild-produced razorback sucker larvae (2014 Spring Flow Request). The 2014 Spring Flow Request supported operations consistent with the 2005 BO and ROD.

The 2014 Spring Flow Request referenced research regarding the magnitude and period of inundation at Stewart Lake, which typically inundates at relatively low flow elevations (*i.e.*, normally about 5,000 to 8,000 cfs). During summer 2012, UDWR excavated sediment deposited during 2011 from the inlet channel to restore connection conditions more consistent with those described for this site in the LTSP. However, as was the case in 2012, potential existed to fill Stewart Lake via its outflow channel, which typically connects to the Green River at lower flow elevations than the inflow. Also, personnel from WAPA, Argonne National Laboratories (funded by WAPA), and the Recovery Program surveyed Reach 2 levee breach elevations in Autumn 2012 to better assess connection flows for future LTSP experimentation.

The experimental timetable is to achieve three years of flows at Jensen, Utah, below 18,600 cfs, and three years above 18,600 cfs, with connecting flows in each of these years of at least seven days duration. However, spring peak flow magnitudes will be driven by hydrologic conditions in the Upper Green and Yampa River Basins; therefore, it may not be possible to complete the experiment in six consecutive years.

On June 17, 2015, Reclamation received a spring and base flow request from the Service (Appendix D). The Service supported the Recovery Program research request from the previous year. The Service acknowledged the potential tradeoff between timing of releases for experiments and meeting the Reach 2 targets outlined in the ROD. The Service supported

⁶ [Study Plan to Examine the Effects of Using Larval Sucker Occurrence in the Green River as a Trigger for Flaming Gorge Dam \(Larval Trigger Study Plan *ad hoc* Committee 2012\).](#)

Reclamation approving the Recovery Program's 2014 Spring Flow Request, and affirmed that doing so would meet Reclamation's responsibility to meet the ROD objectives in 2014.

The Service further requested that Reclamation augment the calculated Reach 1 base flow targets by as much as 40% above the average daily base flow for that reach of the Green River during the summer period through September 30. The intent of the request was to improve backwater habitat conditions for young-of-year Colorado pikeminnow and negatively impact nonnative fish species. The Service acknowledged that higher summer flows in Reach 1 might require reduced Flaming Gorge Dam flows during winter releases.

Step 2: Development of Spring Proposal

The FGTWG met on March 10, 2014, to begin the development of a flow proposal for the spring of 2014. The intent of the flow proposal was to integrate the flow request from the Recovery Program into a flow regime consistent with the ROD. The flow proposal for 2014 described three possible flow regimes that were consistent with the ROD and FEIS.

Depending upon the outcome of hydrologic conditions during spring runoff, the intent was to achieve one of these proposed flow regimes. January through May, water year 2014 was characterized by average conditions in the Upper Green and moderately wet conditions in the Yampa River Basins, respectively.

On June 16, 2014, the FGTWG met to discuss the spring and current base flow hydrology. The formal recommendation for Reach 1 average daily base flow for the June 2014 through February 2015 base flow season of 1,725 cfs. The formal recommendation for targets at Jensen requested use of the +/- 40 percent flexibility of releases during the summer base flow period to advantage the Colorado Pikeminnow spawn. The Recovery Program and the Service requested increased releases to target 2,415 cfs at the USGS Jensen streamgauge through September 30, 2014.

Step 3: Solicitation of Comments

On April 24, 2014, Reclamation presented the 2014 FGTWG flow proposal to the Working Group and solicited comments. The presentation at the Working Group meeting clearly described the FGTWG proposed flow regime for the Green River, the intended operation of Flaming Gorge Dam for the spring and summer of 2014. Meeting minutes were recorded and written comments were solicited by Ed Vidmar, Chairperson of the Working Group.⁷ Reclamation received comments from the public during the 2014 decision-making process and these comments are available for review in Appendix E.

Step 4: Final Decision

The hydrologic classifications for the Upper Green Basin was average (above median) and Yampa River Basin was in the moderately wet hydrologic category. The ROD provides for flexibility to operate one classification lower or two classifications higher than indicated while allowing for adjustment if conditions warrant. Reclamation reviewed the FGTWG proposal and decided to implement the LTSP recommendations for average (above median)

⁷ Working Group Meeting notes are also available at http://www.usbr.gov/uc/water/crsp/wg/fg/pdfs/fg_20140424.pdf and http://www.usbr.gov/uc/water/crsp/wg/fg/pdfs/fg_20140821.pdf.

hydrologic conditions and operate Flaming Gorge Dam to increase releases once biologists determine razorback sucker larvae were in the system and ready to be entrained. The Recovery Program targeted Stewart Lake, Johnson Bottom, Above Brennan, Thunder Ranch, Bonanza Bridge, Stirrup, Leota 7, and Old Charlie Wash (assuming land access was available) as the research floodplains of interest. Reclamation decided to utilize full powerplant and bypass capacity to evacuate above average inflows in conjunction with Yampa River flows to meet floodplain connection at 18,600 cfs for as long as possible.

Unregulated inflow forecasts for Flaming Gorge Reservoir continued to decrease during May and June. Reclamation communicated with the FGTTWG regarding the July-September base flow releases and agreed to continue releasing 2,000 cfs through September 2014.

Basin Hydrology and Operations

Progression of Inflow Forecasts

Snowpack conditions in the Upper Green River and Yampa River Basins varied significantly throughout the snow accumulation season (November 2013 through April 2014). The Upper Green River Basin snowpack condition was near median on January 1, 2014, at 98 percent of median.⁸ On April 1, 2014, snowpack conditions in the Upper Green River Basin had increased to 141 percent of median, with continued storms through April retaining snowpack at 151 percent of median by May 1, 2014. The Yampa River Basin snowpack condition was around median on January 1, 2014, at 108 percent of median. On April 1, 2014, snowpack conditions in the Yampa River Basin had increased to 128 percent of median, and had remained at 128 percent of median by May 1, 2014. The Flaming Gorge Reservoir unregulated inflow volume was 135 percent of average.

The Colorado Basin River Forecast Center (CBRFC), beginning in January every year and continuing through June, issues a monthly forecast of the total volume of anticipated unregulated inflow for the April through July period in thousands of acre-feet (kaf). The progression of Flaming Gorge Reservoir unregulated inflow and the Yampa River forecasts over the 2014 water supply season are shown in Table 1.

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⁸ In water year 2013, the Natural Resources Conservation Service (NRCS) implemented percent of median as the standard measure of snow water equivalent (SWE) based on the 1981-2010 period of record.

Table 1 – Progression of CBRFC Unregulated Inflow⁹ Volume Forecasts for the April through July Water Supply Period

Forecast Issuance Month	Flaming Gorge Reservoir		Yampa River near Maybell, CO		Little Snake River near Lily, CO	
	Volume (1000 AF)	% of Average	Volume (1000 AF)	% of Average	Volume (1000 AF)	% of Average
January	825	84	1010	108	375	113
February	815	83	1120	120	375	113
March	1430	146	1200	128	415	125
April	1400	143	1200	128	415	125
May	1320	135	1200	128	385	116
June	1320	135	1200	117	375	113
July	1190	122	---	---	---	---
Actual	1159	118	1092	61	310	93

Summary of Flaming Gorge Operations

Releases from Flaming Gorge were approximately 800 cfs from October 1, 2013 through May 29, 2014, when releases increased after detection of larval razorback sucker and the beginning of spring operations.

The Utah Division of Wildlife Resources (UDWR) requested a modification from normal operations on April 21 and 22, 2014, in order to conduct their spring fishery assessment. Releases were maintained at 800 cfs before and after completion of the spring assessment in anticipation of spring runoff.

Prior to LTSP (2012), Flaming Gorge Dam releases under the Flow Recommendations were typically increased to coincide with the immediate peak and post-peak of the Yampa River spring peak flows to create a spring peak in the Green River at Jensen. Spring runoff in the Yampa River Basin generally produces two distinct peaks (flows above 10,000 cfs) as low elevation snow melts first followed by the mid-level and higher elevation snowmelt. In 2014, Reclamation responded to the Recovery Program's request and agreed to support research under the LTSP and time releases from Flaming Gorge Dam to coincide with the presence of wild razorback sucker larvae in the Green River system.

In response to the LTSP parameters, Flaming Gorge releases were increased to powerplant capacity of 4,600 cfs on May 30, 2014. Larvae were detected on May 28, 2014 and releases were further increased to combined powerplant and bypass capacity on June 6, 2014 (approximately 8,600 cfs) for a total of nine days at bypass capacity. Yampa River flows at the Deerlodge gage peaked at 16,500 cfs on June 1, 2014 and were on the descending limb of

⁹ Unregulated inflow adjusts for the effects of operations at upstream reservoirs. It is computed by adding the change in storage and the evaporation losses from upstream reservoirs to the observed inflow. Unregulated inflow is used because it provides an inflow time series that is not biased by upstream reservoir operations. In the case of Flaming Gorge Reservoir, unregulated inflow accounts for change in storage and evaporation at Fontenelle Reservoir only.

the hydrograph during the LTSP. Deerlodge flows were less than or equal to 12,000 cfs when Flaming Gorge releases were at bypass capacity in support of the LTSP.

The hydrologic conditions during spring 2014 consisted of above average snow accumulation with late season storms increasing snowpack and shifting runoff to later in the season. Yampa River spring peak flows were above average. The ROD hydrologic classification for the Upper Green was average. Yampa River conditions began in the moderately wet category and decreased to average. Releases from Flaming Gorge Dam remained at an average daily release of 830 cfs through May 29, 2014, when releases were increased to meet the LTSP request. After releases for the LTSP concluded, releases were decreased to base flow releases of 1,675 cfs. Jensen peak flow magnitude achieved was 19,600 cfs. Flows at Jensen met or exceeded targets in Reach 2 for the ROD Flow Recommendation of one-day peak duration at 18,600 cfs and the LTSP average (above median) target of 18,600 cfs for a total of 4 days, all of which occurred during larval drift.

Flaming Gorge Dam releases began decreasing to base flow levels on June 16, 2014, at a rate of 500 cfs/day in accordance with a single-peak hourly release pattern. Flaming Gorge reached the summer base flow level of an average daily release of 1,675 cfs on June 24, 2014 in accordance with a single-peak hourly pattern. The hourly release pattern includes hydropower fluctuations. The fluctuations are designed such that they maintain a 0.1 meter stage change at Jensen,.

Yampa River flows peaked at 9,540 cfs on May 19, 2014, as Flaming Gorge Dam was releasing at the steady rate of 820 cfs prior to detection of wild razorback sucker larvae in the Green River system. The Green River at Jensen, Utah peak was 10,700 cfs on June 6, 2014, with total releases 5,500 cfs from Flaming Gorge Dam augmenting Yampa River flows. Flows at Jensen, Utah were above 8,300 cfs for 25 days total and above 8,300 cfs during larval presence for 18 consecutive days.

Flaming Gorge Reservoir elevation decreased a total of 6.14 feet (ft) from the maximum elevation of 6028.67 ft on August 8, 2014, to the annual minimum elevation of 6015.79 ft on January 1, 2014.

Flaming Gorge Dam releases (blue line), and flows for the Yampa River (green line) and Jensen (orange line) are illustrated in Figure 1. The graph illustrates the differences between ROD peak releases had they been timed with the peak and immediate post peak of the Yampa River, and those actually conducted (observed) under the LTSP timed with the emergence of razorback sucker larvae in the Green River.

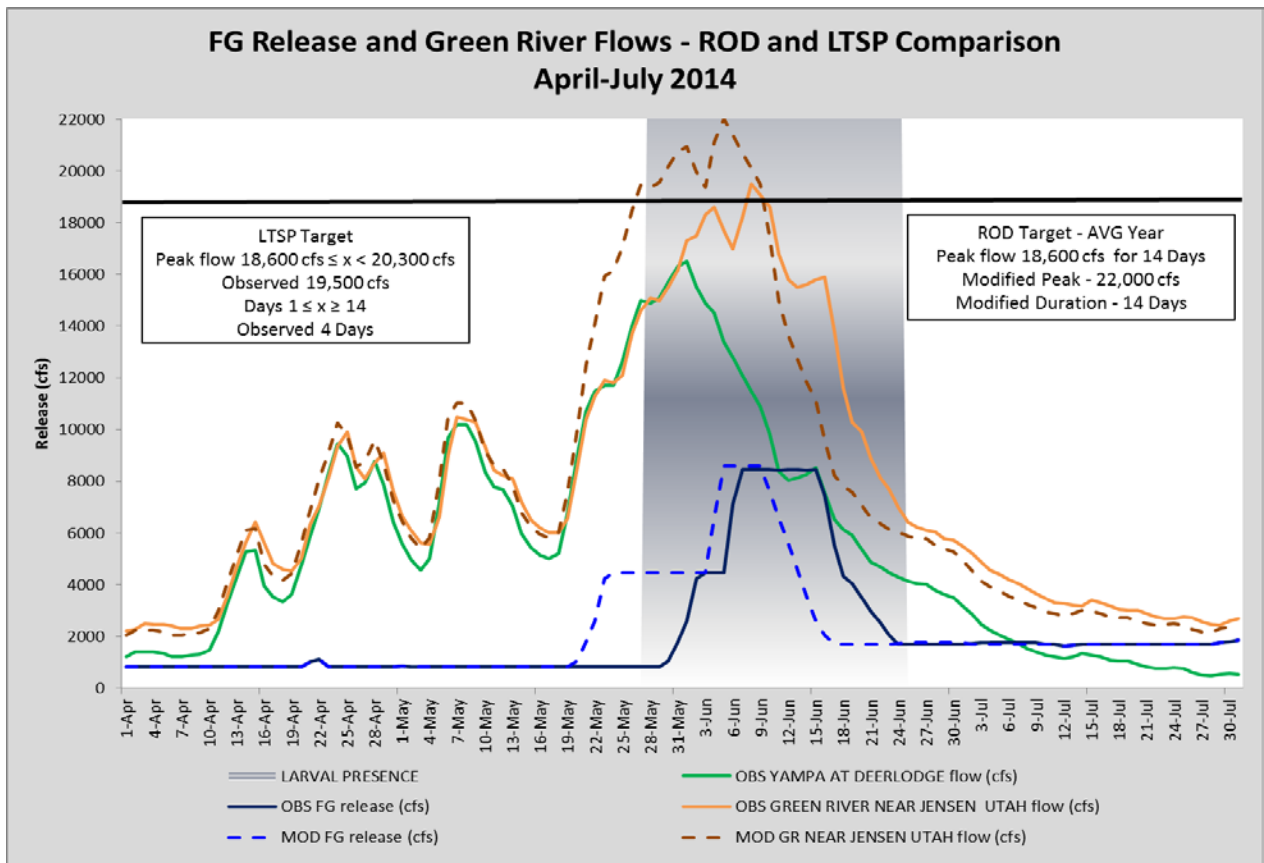


Figure 1 – Spring 2014 Flaming Gorge Spring Releases and Flows Measured at Yampa River at Deerlodge and Green River at Jensen.

Spillway Inspection

The 2005 BO directs Reclamation to provide the results of its annual spillway inspections. During these inspections, inspectors operate gates 1 and 2 through a one-foot open and close cycle during which time it notes any unusual or excessive noise or vibration. The spillway inspection occurred on October 28, 2014, at reservoir elevation 6015.25 ft. gates 1 and 2 are both opened one foot at an average rate of one foot per minute. The total volume released was approximately 1 acre-foot.

Flow Objectives Achieved in Water Year 2014

The ROD directs Reclamation to operate to achieve, to the extent possible, the Flow Recommendations as described in the FEIS (Reclamation 2006). The Flow Recommendations divide the Green River below Flaming Gorge Dam into three river reaches. Reach 1 begins directly below the dam and extends to the confluence with the Yampa River. Reach 2 begins at the Yampa River confluence and continues to the White River confluence. Reach 3 is between the White River and Colorado River confluences. (Muth et. al 2000)

The Flow Recommendations use five different categories to classify both spring and base flow water year conditions and the Reach 1, 2, and 3 targets associated with that classification (Appendix B). Reach 1 targets are, for the most part, release patterns from Flaming Gorge Dam needed to achieve target peak and base flows identified in Reaches 2 and 3. Reach 2 targets are measured at Jensen, Utah, and Reach 3 targets, measured at Green River, Utah, are largely dependent on flows targets for Reach 2 and runoff patterns of tributaries. The Flow Recommendations acknowledged that Reach 3 base flows will be subject to natural variation in tributary flows, and this variation should not be compensated for by Flaming Gorge Dam releases, (Muth *et al.*, 2000).

Further, the FEIS summarizes the Flow Recommendations further and indicates that the recommendations for each reach are not integrated with those of other reaches in such a way that a particular release from Flaming Gorge Dam could equally achieve the recommendations for multiple reaches simultaneously. The intent of the Action Alternative is first to meet the recommended objectives for Reach 2 and then, if necessary, make adjustments to releases so that the recommended objectives for Reach 1 could also be met. It is assumed that the flow objectives in Reach 3 are met whenever the flow objectives in Reach 2 are met (Reclamation, 2005). Information contained in this report related to Reach 3 is for information purposes only and in no way implies a requirement to meet Reach 3 targets under the ROD.

After achievement of the spring flow objectives in Reach 1 and Reach 2, flows are gradually reduced to achieve base flow levels by no later than the date specified in the Flow Recommendation. Base flows in Reaches 1 and 2 are generally managed to fall within the prescribed base flow ranges described in the Flow Recommendations based on the observed April through July unregulated inflow into Flaming Gorge Reservoir.

The Flow Recommendations state that, during the August through November base-flow period, the daily flows should be within ± 40 percent of mean base flow and that during the December through February base-flow period, the daily flows should be within ± 25 percent of the mean base flow.

Additionally, the Flow Recommendations state that the mean daily flows should not exceed 3 percent variation between consecutive days and daily fluctuations at Flaming Gorge Dam should produce no more than a 0.1-meter daily stage change at Jensen, Utah. On the basis of the stage-flow relationship near Jensen, the maximum stage change that could occur with this level of flow variability over the summer through autumn period would be about 0.4 meters. Flow variability during the winter (December through February) would produce a maximum stage change of about 0.2 meters. This recommendation is based on the fact that the average depth of backwaters occupied by Colorado pikeminnow larvae in Reach 2 is 0.3 m. By restricting within-day variation in flow, conditions critical for young of year fish in backwater habitats should be protected. (Muth *et al.*, 2000).

Table 2 –April – July Forecasts and Spring and Base Flow Hydrologic Classifications

Year	May 1st A-J Unreg Inflow Forecast (1000 AF)	Spring Hydrologic Classification	Observed A-J Unreg Inflow (1000 AF)	Base Flow Hydrologic Classification
2006	1,100	Average (Abv Median)	724	Moderately Dry
2007	500	Moderately Dry	370	Dry
2008	820	Average (Blw Median)	728	Moderately Dry
2009	890	Average (Blw Median)	1,197	Average (Abv Median)
2010	515	Moderately Dry	705	Moderately Dry
2011	1,660	Moderately Wet	1,925	Wet
2012	630	Moderately Dry	570	Moderately Dry
2013	480	Moderately Dry	361	Dry
2014	1,320	Average (Abv Median)	1,159	Average (Blw Median)

Spring Flow Objectives

The spring hydrologic classification is based on the CBRFC May final forecast of April-July unregulated inflow volume into Flaming Gorge Reservoir. The May final forecast for water year 2014 was 1,320,000 acre-feet (AF) and resulting spring hydrologic classification was average (above median).¹⁰ The recommended peak-flow magnitudes designated under the ROD for Reaches 1, 2, and 3 were 8,600 cfs, 18,600 cfs, and 22,000 cfs, respectively.

The Reaches 1, 2 and 3, Flow Recommendation spring objectives and the desired frequency of achievement are described in Tables 3, 4 and 5. Water year 2014 is the ninth year of

¹⁰ Hydrologic classifications are based on Pearson III percentile exceedance volumes for the period of record beginning in 1963 through the previous year hydrology. This calculation results in annual variations in exceedance ranges.

operations under the ROD and is the ninth year for establishing the long-term frequencies of these spring flow objectives.

Table 3 – Reach 1 ROD Flow Objectives Achievement in 2014

Spring Peak Flow Objective[†]	Hydrologic Classification	Desired Frequency Percent of Achievement	Achieved in 2014	Achievement Rate to Date (Cumulative Frequency %)*
Peak ≥ 8,600 cfs for at least 1 day	Wet	10 %	Yes	22 %
Peak ≥ power plant capacity for at least 1 day	Dry	100%	Yes	100 %

[†] Reach 1 release objectives are based on the flows needed to achieve recommended duration of bankfull and overbank flows in Reaches 2 and 3.

*Based on nine years of operation under the ROD and spring hydrologic classification (2006-2014)

Table 4 – Reach 2 ROD Flow Objectives Achievement in 2014

Spring Peak Flow Objective	Hydrologic Classification	Desired Frequency Percent of Achievement	Achieved in 2014	Achievement Rate to Date (Cumulative Frequency %)*
Peak ≥ 26,400 cfs for at least 1 day	Wet	10 %	No	11 %
Peak ≥ 22,700 cfs for at least 2 weeks	Wet	10 %	No	11 %
Peak ≥ 18,600 cfs for at least 4 weeks	Wet	10 %	No	11 %
Peak ≥ 20,300 cfs for at least 1 day	Moderately Wet	30 %	No	25 %
Peak ≥ 18,600 cfs for at least 2 weeks	Average (Wet)	40 %	No	25 %
Peak ≥ 18,600 cfs for at least 1 day	Average (Wet)	50 %	Yes	56 %
Peak ≥ 8,300 cfs for at least 1 day	Average (Dry)	100 %	Yes	100 %
Peak ≥ 8,300 cfs for at least 1 week	Moderately Dry	90 %	Yes	88 %
Peak ≥ 8,300 cfs for at least 2 days except in extreme dry years	Dry	98 %	Yes	100 %

*Based on nine years of operation under the ROD and spring hydrologic classification (2006-2014)

Table 5 – Reach 3 ROD Flow Objectives Achievement in 2014

Spring Peak Flow Objective	Hydrologic Classification	Desired Frequency Percent of Achievement	Achieved in 2014	Achievement Rate to Date (Cumulative Frequency %)*
Peak $\geq$ 39,000 cfs for at least 1 day	Wet	10 %	No	11 %
Peak $\geq$ 24,000 cfs for at least 2 weeks	Wet	10 %	No	11 %
Peak $\geq$ 22,000 cfs for at least 4 weeks	Wet	10 %	No	11 %
Peak $\geq$ 24,000 cfs for at least 1 day	Moderately Wet	20 %	No	33 %
Peak $\geq$ 22,000 cfs for at least 2 weeks	Average (Wet)	40 %	No	11 %
Peak $\geq$ 22,000 cfs for at least 1 day	Average (Wet)	50 %	No	33 %
Peak $\geq$ 8,300 cfs for at least 1 day	Moderately Dry	100 %	Yes	100 %
Peak $\geq$ 8,300 cfs for at least 1 week	Moderately Dry	90 %	Yes	88 %
Peak $\geq$ 8,300 cfs for at least 2 days except in extreme dry years	Dry	98 %	Yes	100 %

*Based on nine years of operation under the ROD and spring hydrologic classification (2006-2014)

Based upon a request of the Recovery Program, Reclamation decided to operate in support of the LTSP, which “includes a matrix to be used as a guide in testing hypothesis associated with the larval trigger.” (*ad hoc* Committee, March 2012) Implementation of the Recovery Program’s LTSP occurs over a range of peak flow magnitudes and durations. The experimental timetable is for three years of flows at Jensen, Utah, below 18,600 cfs, and three years above 18,600 cfs, with connecting flows in each of these years of at least seven days duration, as minimally necessary to complete the study.

Water years 2012 and 2013 are included in the three years of flows below 18,600 cfs, and water year 2014 is included in the three years of flows above 18,600 cfs. Table 6 is a copy of the matrix found in Table 2 of the LTSP. It describes the flow conditions and corresponding targeted wetlands. The peak flow as measured at Jensen, Utah, targeted this year corresponded with the average (above median) hydrologic condition with flows between 18,600 cfs and 20,300 cfs targeted between 1 to 7 days. Flows at Jensen, Utah, were above

18,600 cfs for four days during larval drift, which met the objective for average (above median) years outlined in the LTSP and the average classification in the ROD.

Table 6 – LTSP TABLE 2. Matrix to Be Used in Studying the Effectiveness of a Larval Trigger

Peak Flow (x) as Measured at Jensen, Utah	Potential Study Wetlands ^(a,b)	Number of Days (x) Flow Exceeded and Corresponding Hydrologic Conditions ^(c)		
		$1 \leq x < 7$	$7 \leq x < 14$	$x \geq 14$
$8,300 \leq x < 14,000$ cfs	Stewart Lake (f), Above Brennan (f), Old Charley Wash (s)	Dry	Moderately dry	Moderately dry and average (below median)
$14,000 \leq x < 18,600$ cfs	Same as previous plus Thunder Ranch (f), Bonanza Bridge (f), Johnson Bottom (s), Stirrup (s), Leota 7 (s)	Average (below median)	Average (below median)	Average (below median)
$18,600 \leq x < 20,300$ cfs	Same as previous	Average (above median)	Average (above median)	Average (above median)
$20,300 \leq x < 26,400$ cfs	Same as previous plus Baeser Bend (s), Wyasket (s), additional Leota units (7a and 4), Sheppard Bottom (s)	Moderately wet	Moderately wet	Moderately wet
$x \geq 26,400$ cfs	Same as previous	Wet	Wet	Wet

(a) f = flow-through wetland, s = single-breach wetland

(b) Up to eight wetlands would be sampled in a given year with the three in the lowest flow category being sampled in all years.

(c) Note that the hydrologic conditions presented are the driest that could support a particular combination of peak flow magnitude and duration. For any combination, wetter hydrology could also support an experiment.

Base Flow Objectives

Base flows are classified based on the observed April-July unregulated inflow volume into Flaming Gorge and monthly base flow forecast from the CBRFC. The observed April-July unregulated inflow volume was 1,159,000 AF and resulting base flow hydrologic classification was average (below median). Reach 1 flows were reduced to base flows of 1,675 cfs by June 24, 2014. The observed April-July unregulated inflow volume into Flaming Gorge Reservoir, August final forecast and average daily releases needed to achieve the May 1, 2015 elevation target of 6027 feet were used to calculate the Reach 1 daily average base flow of 1,800 cfs, which is within the base flow range for the average (below median) classification as shown in Figure 2.

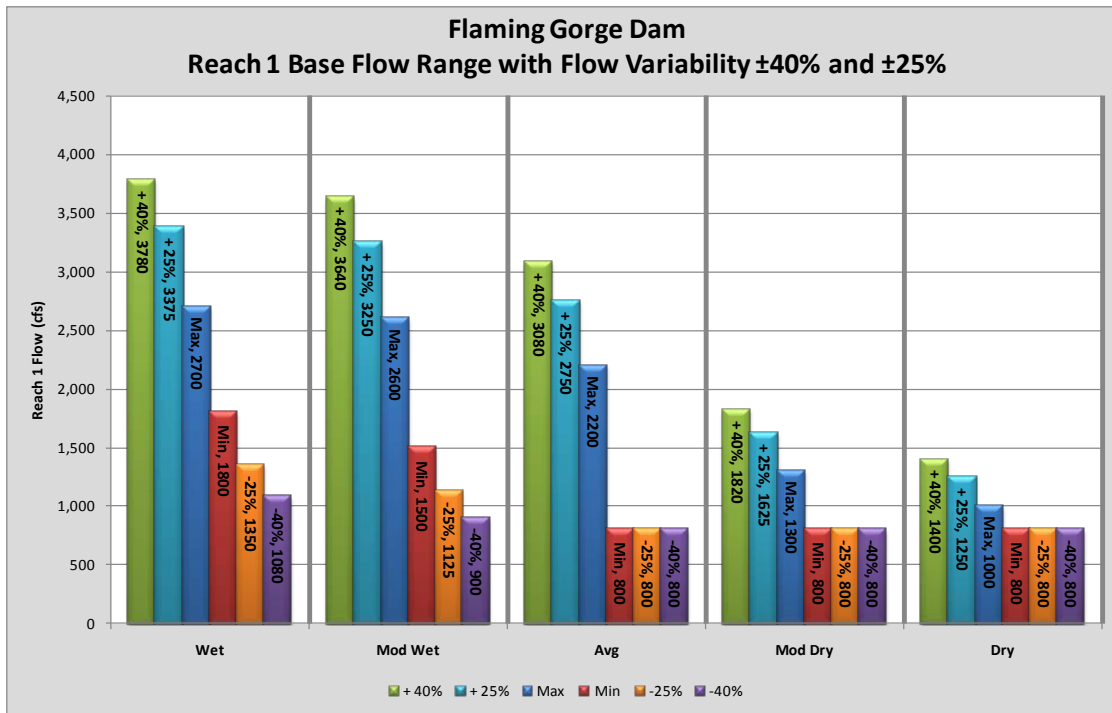


Figure 2 – Reach 1 Base Flow Ranges for each Hydrologic Classification as Outlined in the ROD.

The FGTWG and the Service requested and the FGTWG proposed flows in Reach 2 for July through September at the maximum variability of +40 percent of the dry base flow classification. Reclamation decided to implement +40 percent for Reach 1 in the average classification during July through September, and released 1,950 cfs in an effort to sustain flows in Reach 2 of 2,400 cfs. Significant precipitation occurred above Flaming Gorge during September and October with 220 and 145 percent of average per month, respectively.

Observed September and October base flows in Reach 2 were within 40 percent of the established average (below median) base flow (*i.e.* between 900 cfs to 2,400 cfs), except for occasional precipitation driven events on the Yampa River which fall within the variability outlined in the ROD. Observed December through February base flows for the average (below median) classification in Reach 2 were within 25 percent of the established average (below median) base flow classification (*i.e.* between 1,115 cfs to 2,150 cfs). The daily fluctuations at Flaming Gorge Dam remained within the 0.1 meter daily stage change at Jensen, Utah parameters. The maximum daily stage change at Jensen was within the limits outlined in the Flow Recommendations.

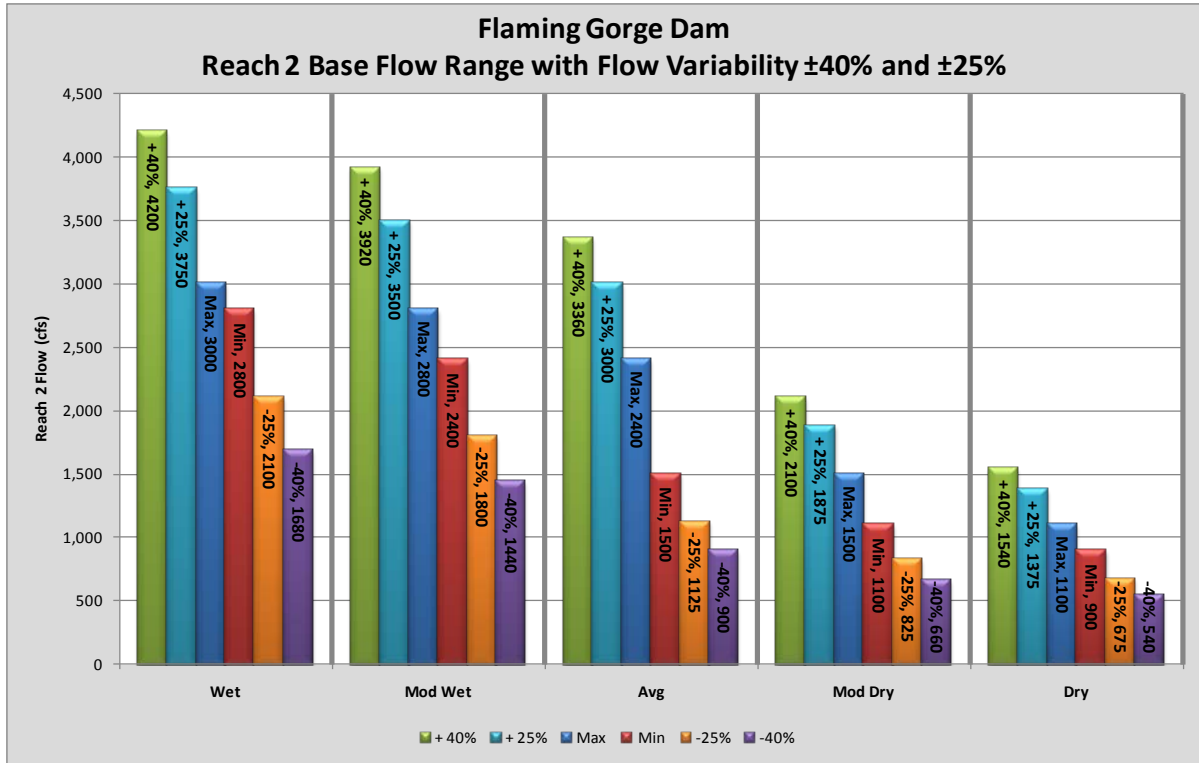


Figure 3 – Reach 2 Base Flow Ranges for each Hydrologic Classification as Outlined in the ROD.

Observed August through November base flows in Reach 3 as measured at the USGS Green River at Green River, Utah stream gage were within 40 percent of the established average base flow classification (*i.e.* between 1,060 cfs to 5,880 cfs as shown in Figure 4). Most of the observed December through February base flows in Reach 3 were within 25 percent of the established moderately dry base flow classification (*i.e.* between 1,350 cfs to 5,250 cfs).

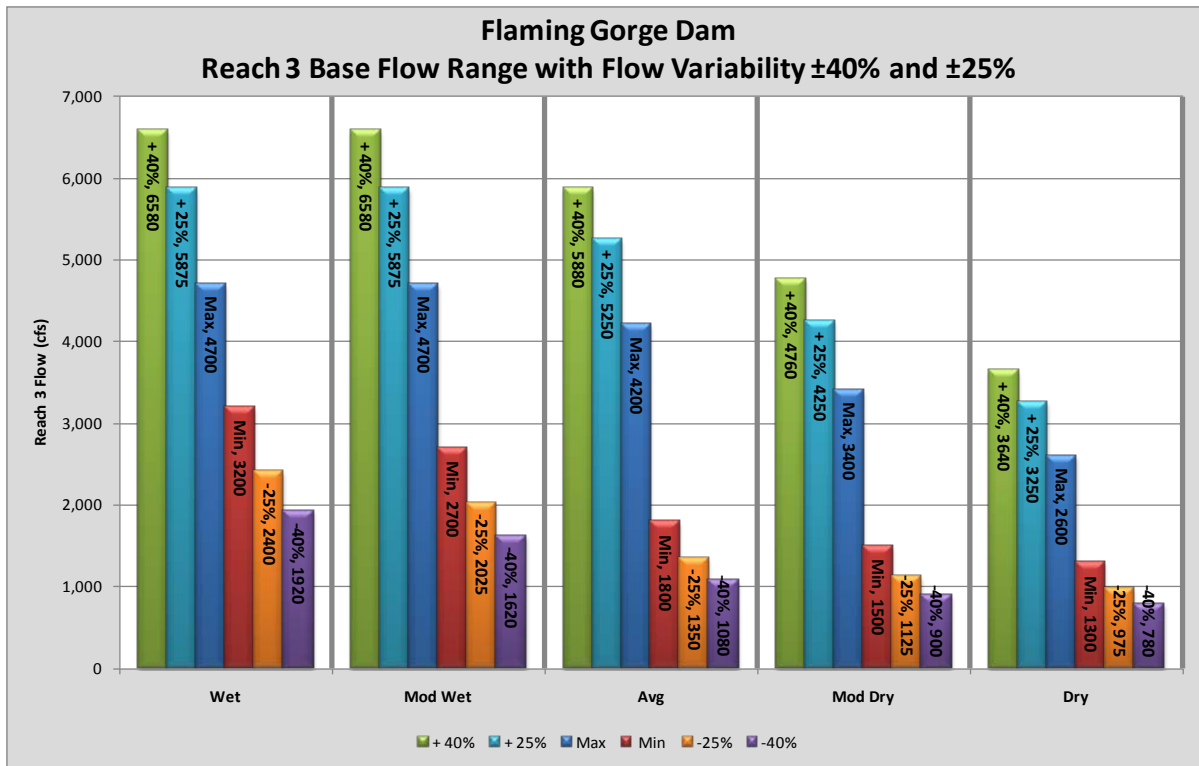


Figure 4 – Reach 3 Base Flow Ranges for each Hydrologic Classification as Outlined in the ROD.

Temperature Objectives Achieved in Water Year 2014

An operational plan for the selective withdrawal system (SWS) on Flaming Gorge Dam was completed by a subset of the Flaming Gorge Technical Work Group (FGTWG) in June 2007 and revised in June 2012. The operational plan provides guidelines for implementation of the 2006 ROD temperature objectives below Flaming Gorge Dam (Table 1). Operational guidelines direct operators to achieve maximum gate elevation (40 feet below reservoir surface) by June 15 of each year in order to deliver target outflow temperatures of 15.0-16.0 °C (59.0 - 60.8 °F) during the summer months.

In WY2014, the elevation target was achieved on June 16, although target release temperatures were not achieved until about a month later (Figure 1). On July 8, operating temperatures on the power generation units exceeded equipment thresholds and as a result SWS gates were lowered to 45 vertical feet below the surface of the reservoir. Temperature of water passing through the unit at the time of the alarm was 14.4 °C (58.0 °F). Continued concerns for equipment prompted further SWS adjustments on July 9 and August 4, at which points the gates were lowered to 50 and 55 feet below the surface, respectively.

On August 6, attempts were made to release warmer water by raising the SWS gates by 2.5 feet, and while water temperature did increase following this adjustment, it is unknown if the

increase is related to operations, weather, the thermal profile of the reservoir or some combination of these factors. After August 2014, the gates remained at 5,976 feet msl through December 2, at which point they were lowered to their winter operating elevation of 5,913 feet msl.

Average daily temperatures at Gates of Lodore (USGS 404417108524900) in 2014 intermittently equaled or exceeded Reach 1 objectives (18.0 °C or 64.4 °F; Figure 1) for 30 days between July 2 and August 15. Water temperatures in the Yampa and Green rivers differed by more than 5 °C on one day (August 16) and exceeded the objective for 4 days in June, although this was prior to onset of the base flow period (July 15) and Colorado Pikeminnow larval drift. Exceedance in June may have been due in part to peak releases from Flaming Gorge Dam which entrained cold water (ca. 10 °C) for much of the month.

Table 7. Temperature objectives for the Green River below Flaming Gorge Dam pursuant to the 2005 EIS and 2006 ROD. Reach 1 is from the dam to the Yampa River confluence; Reach 2 is from the Yampa River to Sand Wash, UT.

Temperature Objectives	Reach	Desired Frequency %	Achieved in 2014
Temperatures ≥ 18.0 °C (64.4 °F) for 3-5 weeks from June (average-dry years) or August (moderately wet-wet years) to March 1	1	100%	Yes
Green River should be no more than 5.0 °C (9.0 °F) colder than the Yampa River during the base flow period	2	100%	No (one day above objective)

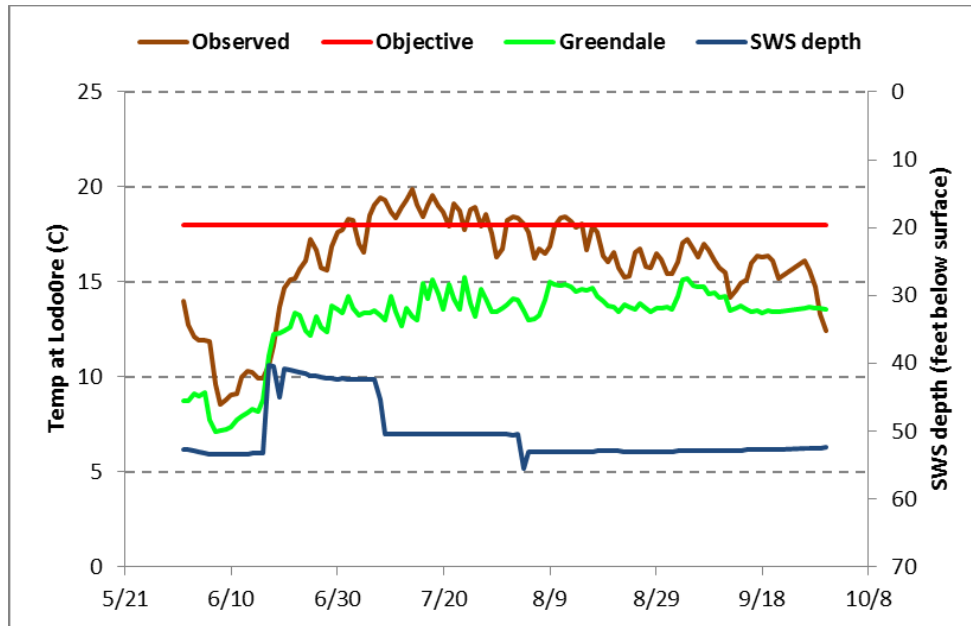


Figure 1. Average daily temperatures recorded at the Gates of Lodore gage (brown series), Greendale gage (green series; USGS 09234500), Reach 1 (Gates of Lodore) objective (red line), and SWS gate depth below reservoir surface (blue series, second axis), June-September 2014. SWS gate depths are the average of 3 units.

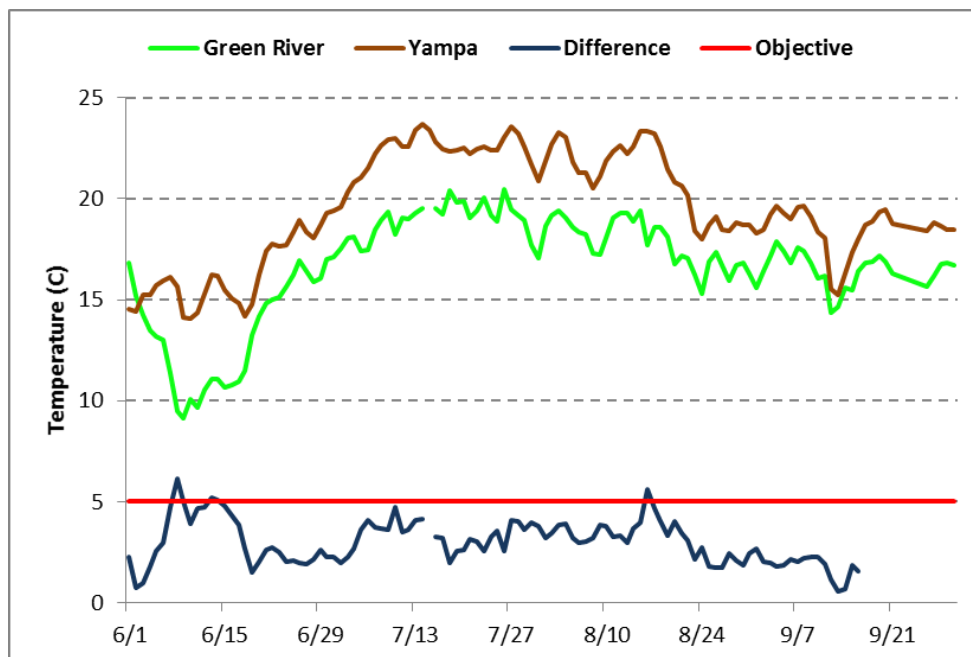


Figure 2. Water temperature in the Green River (green series) at the Yampa River confluence and of the Yampa River (brown series), the difference between the two rivers (blue line), and the maximum temperature difference specified in the 2006 ROD (red line), June-September 2014.

Recommendations

In 2014, Reclamation operated Flaming Gorge Dam and Reservoir in compliance with the 2006 ROD and, to the extent possible, meet the goals and objectives of the Flow Recommendations and the LTSP. This was the third year implementing the LTSP, and the first year under average conditions. While Reclamation has normally increased Flaming Gorge Dam releases in the spring to match the peak and immediate post-peak of the Yampa River, in 2014, at the request of the Recovery Program to meet LTSP objectives, it increased releases after the Yampa River had peaked and was on the descending limb of the hydrograph. Reclamation met the average Reach 2 peak magnitude flow target of 18,600 cfs at Jensen, Utah. Flows at Jensen, Utah in 2014 were above 18,600 cfs for a total of 4 days, all during larval drift; and 8,300 cfs for a total of 45 days, 24 days of which was during larval drift, which conformed to the duration requirements for average (above median) years outlined in Table 2 of the LTSP (Table 6 in this document; 1-14 days between 18,600 and 20,300 cfs as measured at Jensen, Utah).

Coordination among Reclamation, the Recovery Program, the Service and UDWR occurred regularly and was used to determine the timing of the peak release in 2014 in support of the LTSP.

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Appendix A

Flaming Gorge Decision Process Intended Implementation under the 2006 Flaming Gorge Record of Decision

Overview – This document describes the four-step process the Bureau of Reclamation (Reclamation) will use to adaptively manage Flaming Gorge Dam operations and implement the 2006 Record of Decision for the Operation of Flaming Gorge Dam Final Environmental Impact Statement (ROD). These four steps are described in detail below:

1. Recovery Program
2. Flaming Gorge Technical Working Group (FGTWG)
3. Flaming Gorge Working Group (Working Group)
4. Reclamation Operational Plan

In 2000, the Upper Colorado River Endangered Fish Recovery Program (Recovery Program) issued Flow and Temperature Recommendations for Endangered Fishes in the Green River Downstream of Flaming Gorge Dam (flow recommendations). The Flow Recommendations provide the basis for the proposed action outlined in the 2005 final environmental impact statement (FEIS). The ROD implements the proposed action by modifying the operations of Flaming Gorge Dam, to the extent possible, to assist in the recovery of endangered fishes, and their critical habitat, downstream from the dam and, at the same time, maintains and continues all authorized purposes of the Colorado River Storage Project.¹¹

Reclamation believes that the Recovery Program remains the appropriate forum for discussion of endangered fish response to Flaming Gorge Dam operations, endangered fish research needs, and refinements to the flow recommendations. The purpose of the FGTWG would be limited to proposing annual flow and temperature recommendations as outlined in the FEIS, including research requests by the Recovery Program. The Working Group remains the forum for public information/input.

1. Recovery Program – The ROD Environmental Commitment #2 defines the science role of the Recovery Program in the adaptive management process to include design and execution of studies that monitor implementation of the flow recommendations, and testing the outcomes of such studies. This includes conducting research to answer specific questions raised by previous studies, to fill information gaps identified in the Recovery Implementation Program Recovery Action Plan and related documents, and/or to address uncertainties associated with the flow recommendations. For example, effects of specific spring flow elevations on entrainment rates of larval endangered fish and their floodplain habitats is an uncertainty which prompted the Recovery Program to request periods of steady flows during the spring 2005 runoff season. A request for such flows or release temperatures is not

¹¹ Reclamation, 2006, Record of Decision on the Operation of Flaming Gorge Dam Final Environmental Impact Statement.

necessarily explicit in the flow recommendations, but is necessary to fulfill adaptive management research functions that should be made no later than February of each calendar year.

Beginning each summer, the Recovery Program should begin a process to develop any desired flow request for the Green River for the following year. Maintenance schedules for the dam and powerplant are a critical part of the proposal in order to assure release capability. Reclamation will clearly communicate equipment and maintenance issues to the Recovery Program during development of any Recovery Program request. This communication should include analysis of contingency plans for maintenance issues, system emergencies, equipment failures, or changes in hydrology. The Recovery Program should issue a finalized flow request by the end of February to Reclamation, the U.S. Fish and Wildlife Service (Service), and Western Area Power Administration (WAPA).

2. Flaming Gorge Technical Working Group (FGTWG) - The ROD clarified the purpose of the FGTWG as limited to proposing specific flow and temperature targets for each year's operations based on current year hydrologic conditions and the conditions of the endangered fish. The FGTWG was also charged with integrating, to the extent possible, any flow requests from the Recovery Program into the flow proposal so that Recovery Program research could also be facilitated. Members of the FGTWG include biologists and hydrologists from Reclamation, the Service, and WAPA. This group also serves as the informal consultation body for Endangered Species Act compliance as has occurred historically and as directed by the ROD.

An annual meeting of the FGTWG should be held in early March to develop a proposed flow and temperature regime for the upcoming spring and base flow season (Proposal). This Proposal should achieve the flow recommendations and/or the Recovery Program flow request for the current year within the current hydrologic conditions and Reclamation's operating parameters.

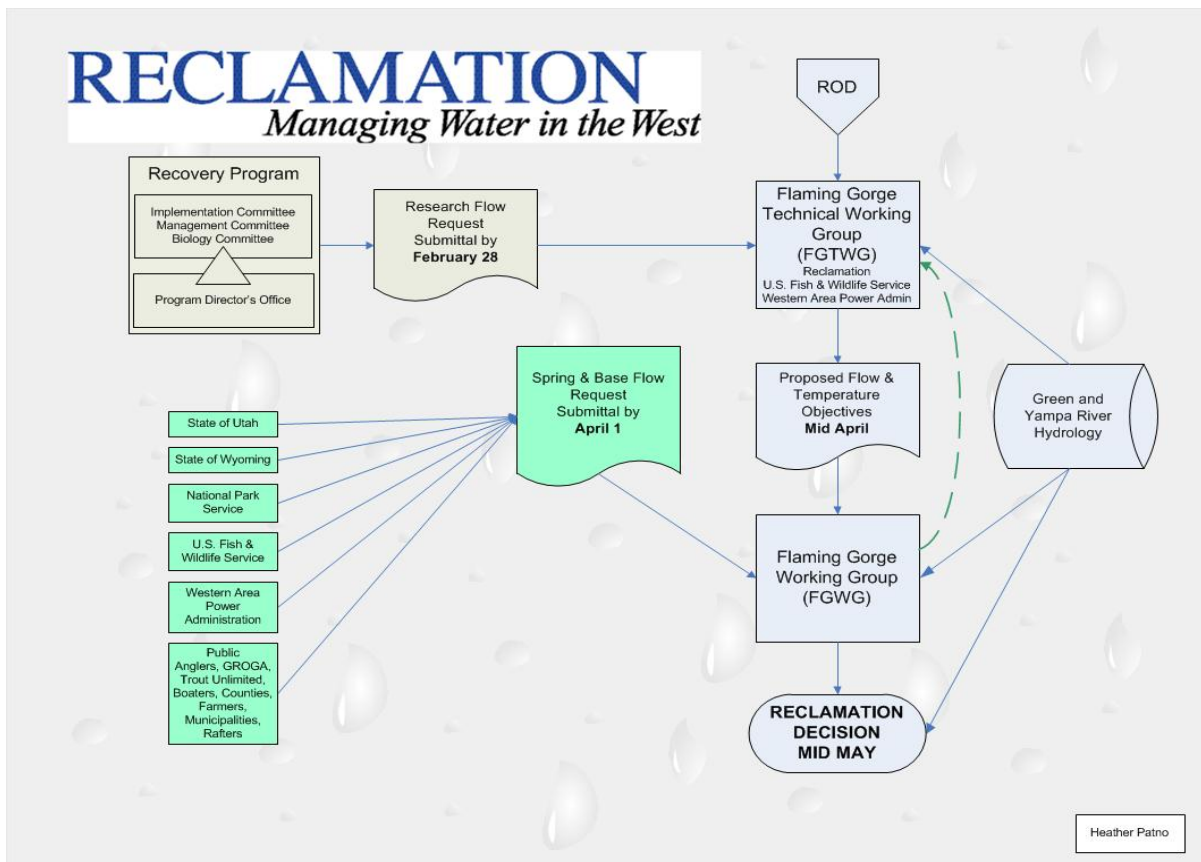
The FEIS specifically addresses and outlines the content of the Proposal. The Proposal describes the current hydrologic classification of the Green River and Yampa River Basins, including the most probable runoff patterns for the two basins. The Proposal also identifies the most likely Reach 2 flow magnitudes and durations that are to be targeted for the upcoming spring release. It further specifies that

Because hydrologic conditions often change during the April through July runoff period, the [Proposal] would contain a range of operating strategies that could be implemented under varying hydrologic conditions. Flow and duration targets for these alternate operating strategies would be limited to those described for one classification lower or two classifications higher than the classification for the current year (FEIS, Section 2.5.3.1).

The FGTWG proposal should be finalized by early April in time to present to the Working Group.

3. Flaming Gorge Working Group – The Working Group was formed in 1993 to provide interested parties with an open forum to express their views and interests in the operations of Flaming Gorge Dam. The Working Group meets biannually (April and August) and functions as a means of providing information to and gathering input from stakeholders and interested parties on dam operations, other resource concerns and research flows. Reclamation presents the FGTWG Proposal to the Working Group during the April meeting and constitutes the public involvement and public outreach component of the adaptive management process as described in the FEIS (Sections 4.20, 4.21).

4. Operational Plan - Reclamation makes the final decision on how to operate Flaming Gorge Dam based on hydrologic conditions, the FGTWG flow proposal, and input from the public received via the Flaming Gorge Working Group.



Appendix B

Flaming Gorge Final Environmental Impact Statement

Table 2.1: Recommended Magnitudes and Durations Based on Flows and Temperatures for Endangered Fishes in the Green River Downstream from Flaming Gorge Dam as Identified in the 2000 Flow and Temperature Recommendations

Table 2-1.—Recommended Magnitudes and Duration of Maximum Spring Peak and Summer-to-Winter Base Flows and Temperatures for Endangered Fishes in the Green River Downstream From Flaming Gorge Dam as Identified in the 2000 Flow and Temperature Recommendations

Location	Flow and Temperature Characteristics	Hydrologic Conditions and 2000 Flow and Temperature Recommendations ¹				
		Wet ² (0–10% Exceedance)	Moderately Wet ³ (10–30% Exceedance)	Average ⁴ (30–70% Exceedance)	Moderately Dry ⁵ (70–90% Exceedance)	Dry ⁶ (90–100% Exceedance)
Reach 1 Flaming Gorge Dam to Yampa River	Maximum Spring Peak Flow	• 8,600 cfs (244 cubic meters per second [m ³ /s])	• 4,600 cfs (130 m ³ /s)	• 4,600 cfs (130 m ³ /s)	• 4,600 cfs (130 m ³ /s)	• 4,600 cfs (130 m ³ /s)
	Peak flow duration is dependent upon the amount of unregulated inflows into the Green River and the flows needed to achieve the recommended flows in Reaches 2 and 3.					
	Summer-to-Winter Base Flow	1,800–2,700 cfs (50–60 m ³ /s)	1,500–2,600 cfs (42–72 m ³ /s)	800–2,200 cfs (23–62 m ³ /s)	800–1,300 cfs (23–37 m ³ /s)	800–1,000 cfs (23–28 m ³ /s)
Above Yampa River Confluence	Water Temperature Target	• 64 degrees Fahrenheit (°F) (18 degrees Celsius [°C]) for 3–5 weeks from mid-August to March 1	• 64 °F (18 °C) for 3–5 weeks from mid-August to March 1	• 64 °F (18 °C) for 3–5 weeks from mid-July to March 1	• 64 °F (18 °C) for 3–5 weeks from June to March 1	• 64 °F (18 °C) for 3–5 weeks from mid-June to March 1
Reach 2 Yampa River to White River	Maximum Spring Peak Flow	• 26,400 cfs (748 m ³ /s)	• 20,300 cfs (575 m ³ /s)	• 18,600 cfs ⁷ (527 m ³ /s) • 8,300 cfs ⁸ (235 m ³ /s)	• 8,300 cfs (235 m ³ /s)	• 8,300 cfs (235 m ³ /s)
	Peak Flow Duration	Flows greater than 22,700 cfs (643 m ³ /s) should be maintained for 2 weeks or more, and flows 18,600 cfs (527 m ³ /s) for 4 weeks or more.	Flows greater than 18,600 cfs (527 m ³ /s) should be maintained for 2 weeks or more.	Flows greater than 18,600 cfs (527 m ³ /s) should be maintained for 2 weeks in at least 1 of 4 average years.	Flows greater than 8,300 cfs (235 m ³ /s) should be maintained for at least 1 week.	Flows greater than 8,300 cfs (235 m ³ /s) should be maintained for 2 days or more except in extremely dry years (98% exceedance)
	Summer-to-Winter Base Flow	2,800–3,000 cfs (79–85 m ³ /s)	2,400–2,800 cfs (69–79 m ³ /s)	1,500–2,400 cfs (43–67 m ³ /s)	1,100–1,500 cfs (31–43 m ³ /s)	900–1,100 cfs (26–31 m ³ /s)
Below Yampa River Confluence	Water Temperature Target	Green River should be no more than 9 °F (5 °C) colder than Yampa River during summer base flow period.	Green River should be no more than 9 °F (5 °C) colder than Yampa River during summer base flow period.	Green River should be no more than 9 °F (5 °C) colder than Yampa River during summer base flow period.	Green River should be no more than 9 °F (5 °C) colder than Yampa River during summer base flow period.	Green River should be no more than 9 °F (5 °C) colder than Yampa River during summer base flow period.
Reach 3 White River to Colorado River	Maximum Spring Peak Flow	• 89,000 cfs (1,104 m ³ /s)	• 24,000 cfs (680 m ³ /s)	• 22,000 cfs ⁹ (623 m ³ /s)	• 8,300 cfs (235 m ³ /s)	• 8,300 cfs (235 m ³ /s)
	Peak Flow Duration	Flows greater than 24,000 cfs (680 m ³ /s) should be maintained for 2 weeks or more, and flows 22,000 cfs (623 m ³ /s) for 4 weeks or more.	Flows greater than 22,000 cfs (623 m ³ /s) should be maintained for 2 weeks or more.	Flows greater than 22,000 cfs (623 m ³ /s) should be maintained for 2 weeks in at least 1 of 4 average years.	Flows greater than 8,300 cfs (235 m ³ /s) should be maintained for at least 1 week.	Flows greater than 8,300 cfs (235 m ³ /s) should be maintained for 2 days or more except in extremely dry years (98% exceedance)
	Summer-to-Winter Base Flow	3,200–4,700 cfs (92–133 m ³ /s)	2,700–4,700 cfs (76–133 m ³ /s)	1,800–4,200 cfs (52–119 m ³ /s)	1,500–3,400 cfs (42–95 m ³ /s)	1,300–2,600 cfs (32–72 m ³ /s)

Appendix C

March 21, 2014 Memorandum from the Recovery Program Director containing the Research Request for 2014 Green River Spring Flows



Upper Colorado River Endangered Fish Recovery Program

Noreen Walsh, Chairman
Implementation Committee

Thomas E. Chart
Program Director

U.S. Fish and Wildlife Service - P.O. Box 25486 - Denver Federal Center - Denver, CO 80225 - (303) 969-7322 - Fax (303) 969-7327

FWS/CRRP
K3a1
Mail Stop 65115
Memorandum

March 21, 2014

To: Larry Walkoviak, Regional Director, Upper Colorado Region, Bureau of Reclamation
Heather Patno, Chair, Flaming Gorge Technical Working Group, Bureau of Reclamation
From: Thomas Chart, Director, Upper Colorado River Endangered Fish Recovery Program
Subject: Recovery Program's Research Request for 2014 Green River Spring Flows

The Upper Colorado River Endangered Fish Recovery Program (Recovery Program) supports the Bureau of Reclamation's (Reclamation) operations at Flaming Gorge Dam in 2014 consistent with the 2005 biological opinion (U.S. Fish and Wildlife Service 2005) and 2006 record of decision (ROD; U.S. Department of Interior 2006). As in the past three years, the objective of our request this year is to build on past research (Bestgen et al. 2011) to benefit the razorback sucker population throughout the Green River by timing the river-floodplain connection with the presence of wild-produced razorback sucker larvae.

The Recovery Program's 2014 spring flow request is based on objectives outlined in our *Study Plan to Examine the Effects of Using Larval Sucker Occurrence in the Green River as a Trigger for Flaming Gorge Dam* (LTSP; Larval Trigger Study Plan Ad Hoc Committee 2012). In the LTSP we describe a desired range of experimental floodplain connection scenarios and studies we would implement to evaluate those scenarios. More specifically, our study design matrix (Table 2 in the LTSP) details the range of experimental conditions we would like to assess with recognition that more than one cell of that matrix could be accomplished in a single year. Minimally, to complete the experiment, the Recovery Program requests three years with flows < 18,600 cfs and three years with flows $\geq$ 18,600 cfs and with connecting flows in each of these years of at least seven days duration. However, spring peak flow magnitude requests will be driven by hydrologic conditions in the upper Green River Basin and to some extent the Yampa River basin; therefore, it may not be possible to complete the experiment in six consecutive years. The LTSP experiment began

Colorado River Energy Distributors Association - Colorado Water Congress - National Park Service - State of Colorado
State of Utah - State of Wyoming - The Nature Conservancy - U.S. Bureau of Reclamation - U.S. Fish and Wildlife Service
Utah Water Users Association - Western Area Power Administration - Western Resource Advocates - Wyoming Water Association

officially in 2012, however, the Recovery Program was able to gather some LTSP related information during 2011. Results from 2012 and 2013 are summarized below.

LTSP-Related Operations and Findings: 2011

In 2011, the Recovery Program identified two spring flow objectives: a) to provide floodplain connection after larval razorback sucker were detected in the Green River and secondarily, b) to connect the Stirrup floodplain as outlined in Recovery Program Project No. C6 RZ-RECR. Therefore the Recovery Program requested: a) that Reclamation's spring 2011 operations be timed to coincide with the presence of larval razorback sucker in Reach 2 habitats, and b) that if the hydrology remains wet-average, moderately wet, or wet that Reclamation release flows that maintained 18,600 cfs or greater for two weeks or more in Reach 2 (post-larval detection). The Recovery Program's request also considered scenarios in the event that the hydrology trended drier; it did not.

The May final forecast of April-July unregulated inflow volume to Flaming Gorge Reservoir was classified moderately wet. The Yampa River forecast was wet. All of the wet hydrologic classification peak flow targets for Reach 2 under the ROD were met in 2011 (Reclamation 2013). Razorback sucker larvae were detected on June 24, 2011. The following spring flows conditions were recorded post-larval detection: ten days $\geq$ 22,700 cfs; 19 days $\geq$ 18,600 cfs; and 21 days $\geq$ 15,000 cfs.

USFWS field crews sampled 14 wetland habitats during September, October, and November 2011. Juvenile razorback sucker were collected in Wyasket Lake ($n=15$; size range 106-161mm total length) and in Leota Unit 4 ($n=3$; size range 85-110mm total length). This was the first evidence of over-summer survival of wild produced razorback sucker larvae since 1996 (Webber and Jones 2011). Breen (2011) reported 1,216 unique endangered fish detections at stationary PIT tag antennas set in the Stirrup floodplain levee breach during the extended period of riverine connection.

LTSP Operations and Findings: 2012

In 2012, hydrologic classifications for the Yampa River and Upper Green River basins were categorized as 'dry'. The Recovery Program and the Flaming Gorge Technical Work Group (FGTWG) ultimately agreed to focus the 2012 spring flow request on the driest category of experimental conditions outlined in the LTSP, i.e. a peak flow between 8,300 and 14,000 cfs for 1 to 7 days. The Recovery Program detected wild produced razorback sucker larvae on May 16, 2012 (Bestgen et al. 2012). Reclamation ramped up Flaming Gorge releases to a peak of 7,420 cfs, which resulted in a peak flow at Jensen, Utah of 10,200 cfs on May 24, 2012 (Reclamation 2013). Flows at Jensen, Utah were sustained above 8,300 cfs for 5 days after larvae were detected. Floodplain connection occurred at Stewart Lake and Old Charley Wash. Utah Division of Wildlife Resources (UDWR) crews documented larval entrainment into Stewart Lake and described physical conditions at that floodplain site (Breen and Skorupski 2012). Similarly, USFWS field crews documented larval entrainment into the Old Charley site. Unfortunately, all fish entrained at both locations likely perished, because water quality deteriorated quickly after flows declined. During the spring

and summer months of 2012, USFWS crews (Webber and Jones 2012) sampled fish and monitored water quality at a variety of other floodplains that still held water from the extensive period of connection in 2011, but did not connect in 2012.

Personnel from Western Area Power Administration (Western), Argonne National Laboratory (funded by Western), and the Recovery Program surveyed Reach 2 levee breach elevations in Autumn 2012 to better assess connection flows for future LTSP experiments. Those data, in preliminary form, were available for FGTWG discussions in Spring 2013.

LTSP Operations and Findings: 2013

In 2013, the spring hydrologic classification started off 'dry' but turned 'moderately dry'. Reclamation reviewed the FGTWG recommendation and decided to implement the LTSP recommendations for moderately dry hydrologic conditions and to increase releases when larvae were detected (Reclamation 2014; Draft Report). The Recovery Program and the Flaming Gorge Technical Work Group (FGTWG) ultimately agreed to focus the 2013 spring flow request on the moderately dry category of experimental conditions outlined in the LTSP, i.e. a peak flow between 8,300 and 14,000 cfs for 7 to 14 days. The Recovery Program detected wild produced razorback sucker larvae on May 26, 2013 (Bestgen et al. 2013). Flaming Gorge Dam releases were increased to full power plant capacity (~4,500 cfs) on May 29, 2013. Yampa River flows dropped below 4,000 cfs and Flaming Gorge Dam releases were increased 1,000 cfs on June 4th above power plant capacity for a total release of ~5,500 cfs to maintain flows in Reach 2 above 8,300 cfs. Releases returned to power plant capacity on June 5, 2013. The Green River measured at Jensen, Utah reached its peak of 10,700 cfs on June 6, 2013. Flows at Jensen, Utah were above 8,300 cfs for 25 days total and above 8,300 cfs during larval presence for 18 consecutive days. Prior to, during, and after floodplain connection, Stewart Lake proper and the Stewart Lake drain were sampled using an assortment of techniques to monitor the fish community. UDWR biologists documented that razorback sucker larvae were entrained into Stewart Lake and grew quickly (~1mm/day) during the ~2 month inundation period. On July 31, 2013, UDWR began draining Stewart Lake because of declining water quality. A total of 613 Age-0 razorback sucker were collected, of which 592 were released alive to the Green River (Skorupski et al. 2013). This is the largest number of juvenile razorback suckers ever documented in the Colorado River Basin, demonstrating the importance of appropriately timed connections between the river and floodplain wetlands. The Recovery Program hopes that Stewart Lake water levels can be maintained in 2014 at least as long as they were in 2013, recognizing that prolonged favorable conditions for razorback sucker growth in late summer months results in larger fish with a higher probability of surviving their first winter. Razorback sucker larvae were not detected in the Escalante Ranch wetland; the only other wetland identified in the LTSP that connected to the Green River in 2013 (Webber and Jones 2013).

THE RECOVERY PROGRAM'S SPRING 2014 GREEN RIVER FLOW REQUEST:

Implement the LTSP. The Recovery Program requests that the FGTWG match Recovery Program research needs identified in the LTSP with the best available spring flow forecast information to develop a specific middle Green River floodplain connection scenario. The Recovery Program

Director's office will distribute the pertinent FGTWG recommendation to the Biology and Management Committees and Principal Investigators as quickly as possible.

The Recovery Program will provide a real-time assessment of razorback sucker larval presence (i.e., the 'larval trigger') through ongoing Recovery Program Project No. 22f. Based on information provided in Bestgen et al. (2011), waiting for this larval trigger will likely cause Reclamation to make spring releases from Flaming Gorge Dam after the Yampa River has peaked, which may necessitate releases in excess of power plant capacity to meet the flow magnitude thresholds needed for river-floodplain connections. As addressed in the LTSP, the Recovery Program is prepared to direct sampling efforts each year to the appropriate floodplain habitats based on hydrologic forecasting and the FGTWG request. The Recovery Program is poised and properly funded to follow through on specific LTSP field investigations again in 2014 (e.g., Project Nos. 22F, 164 and 165; Scopes of Work available at: <http://www.coloradoriverrecovery.org/documents-publications/work-plan-documents/project-scopes-of-work.html>) ; sampling protocols and rationale are discussed further in Bestgen et al. (2012).

The Recovery Program remains concerned about possible release of nonnative burbot from Flaming Gorge Reservoir, particularly during the spring when release volumes increase. Accordingly, the Recovery Program, the National Park Service, UDWR, and Western committed to initiating a risk assessment of burbot entrainment associated with Flaming Gorge spring operations (Trammell et al. 2014; also referenced in the LTSP). The Recovery Program considers the risk of entraining burbot to be reasonably low at this time.

That conclusion is based on the following:

- The incidence of adult burbot in the portion of Flaming Gorge Reservoir nearest the dam is currently very low.
- The risk of entraining adults and juveniles through the spillway will always be fairly low based on the species' behavior.
- The risk of entraining larvae is of moderate concern. According to the literature and known water temperatures in the reservoir in late May-June, Age-0 burbot would likely range in size from 10 to 40 mm (total length). Young burbot of 30-40 mm should be entering a "settlement period", i.e. transitioning from using the full water column in near shore habitats to a primarily benthic behavior, remaining near the shoreline but on the substrate, and largely unavailable for entrainment. In June 2013, burbot larvae with lengths of 10-20mm were captured in the Sheep Creek inflow area, about 20 miles upstream of the dam (Carl Saunders, pers. comm.); thus, a portion of a larval cohort could still be found in open water during the spring runoff period. Therefore if Reclamation is considering using the spillway¹ the Recovery Program will sample for burbot larvae in the reservoir near the entrance to the spillway. This type of sampling could be accomplished quickly and on short notice.
 - If larvae are captured, the Recovery Program would determine if additional monitoring / management would be needed below the dam.

¹ As noted in Section 2.5.3.2 of the Flaming Gorge EIS, there were concerns regarding damage to the spillway and it was stated that excessive spillway damage would limit its use to cases of hydrologic necessity. Inspections since issuance of the ROD in 2006 have verified continued deterioration of the air slot in the spillway. As a result, Reclamation cannot support use of the spillway unless absolutely necessary for flood control or dam safety reasons.

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Cc: Malcolm Wilson, Chief, Water Resources Group, USBR, 125 So. State, Salt Lake City, Utah

Beverley Heffernan, Manager, Environmental Resources Division, USBR, 125 So. State, Salt Lake City, Utah

Bridget Fahey, Endangered Species Branch Chief, Ecological Services, USFWS, Lakewood, Colorado

Henry Maddux, Chairman, UCREFRP - Management Committee, Utah Department of Natural Resources, 1594 W. North Temple Salt Lake City, UT 84114-5610

David Speas, Chairman, UCREFRP - Biology Committee, USBR, 125 So. State, Salt Lake City, Utah

Larry Crist, Field Supervisor, Ecological Service, USFWS, Utah Field Office, 2369 West Orton Circle, Suite 50, West Valley City, Utah 84119-7603

Lynn Jeka, Manager, Western Area Power Administration, 12155 West Alameda Parkway Lakewood, CO 80228

Clayton Palmer, Environmental Specialist, Western Area Power Administration, 150 East Social Hall Avenue, Suite 300, Salt Lake City, UT 84111-1580

Appendix D

June 17, 2015 Memorandum from the U.S. Fish and Wildlife Service for the 2014 Green River Spring and Base Flows to Assist in Recovery of the Endangered Fishes – UPDATED June 2015



United States Department of the Interior
FISH AND WILDLIFE SERVICE

UTAH FIELD OFFICE
2369 WEST ORTON CIRCLE, SUITE 50
WEST VALLEY CITY, UTAH 84119

June 17, 2015

In Reply Refer To:
FWS/R6
ES/UT
06E23000-2008-FA-0180

Memorandum

To: Director, Upper Colorado Region, Bureau of Reclamation
Chair, Flaming Gorge Technical Working Group, Bureau of Reclamation

From: Field Supervisor, Utah Field Office, U.S. Fish and Wildlife Service

Subject: 2014 Green River Spring and Base Flows to Assist in Recovery of the
Endangered Fishes – **UPDATED June 2015**

This memorandum provides our recommended 2014 spring and base flows in Reach 2 of the Green River for Bureau of Reclamation's (Reclamation) annual Flaming Gorge Dam operations. Our intent is to coordinate with Flaming Gorge Technical Working Group FGTWG members to ensure consistency with the 2005 biological opinion (BO; U.S. Fish and Wildlife Service 2005) and 2006 record of decision (ROD; U.S. Department of Interior 2006), which recommend flows to protect and assist in recovery of endangered fishes.

The following recommendations are subject to forecasted and real-time May – July hydrologic conditions in the upper Green River drainage, with recognition that trade-offs of spring and base flows should be considered and used to adjust operations as deemed appropriate.

Update June 2015 – *The Service's 2014 flow request letter was not finalized. Here we offer a brief review of flows observed in Reach 2 last year and our post hoc Endangered Species Act Section 7 evaluation of Reclamation's 2014 Flaming Gorge operations to meet our draft flow requests.*

Spring-peak Research Flow

We support the Upper Colorado River Endangered Fish Recovery Program's (Recovery Program) 2014 Spring Flow Request, as explained in their March 21, 2014 letter. The primary objective as presented in their letter is to time Flaming Gorge releases and resultant floodplain connection with the presence of wild produced razorback sucker larvae. The Recovery Program's objective is consistent with the intent of the Flow and Temperature Recommendations for Endangered Fishes in the Green River Downstream of Flaming Gorge Dam (Flow Recommendations; Muth et al. 2000), the 2005 BO, and the 2006 ROD, and uses the best available science to guide Flaming Gorge operations and recovery actions in an adaptive management framework. Timing Flaming Gorge releases concurrently with wild produced larvae is a major step in re-establishing a stable population of razorback sucker in the Green River basin.

The Recovery Program, in an effort to scientifically evaluate the results of operating Flaming Gorge Dam concurrent with the presence of larval razorback sucker, developed the *Study Plan to Examine the Effects of Using Larval Sucker Occurrence in the Green River as a Trigger for Flaming Gorge Dam*¹ (Larval Trigger Study Plan or LTSP). The Study Design matrix (Table 2 in the LTSP) details the range of experimental conditions the Recovery Program would like to assess, with recognition that more than one set of flow conditions of that matrix could be accomplished in a single year. Because the LTSP describes a systematic analysis for evaluating the success of operating Flaming Gorge concurrently with wild produced razorback sucker larvae, we conclude it is very important to follow its recommendations whenever possible.

Initial findings of the LTSP operations and related operations (2011 through 2013) indicate that larval razorback sucker have been successfully entrained into connected floodplain areas and have been able to over-summer in these habitats. See the Recovery Program's 2014 Spring Flow Request for more information on these preliminary study results. Additionally, preliminary information collected by Recovery Program crews this spring, has confirmed that larval razorback sucker were entrained into all managed floodplain areas in 2014 (Kevin McAbee 2014, pers. comm.). The water management scenarios that have allowed for these successes provide a major step towards recovery of this species and demonstrates the importance of LTSP-related water operations. We commend the Reclamation for operating Flaming Gorge such that larval razorback sucker were entrained into wetlands and thus now have the potential to reach juvenile sizes this year. Thus far, we believe the Adaptive Management of Flaming Gorge has been very successful under the LTSP.

Justification for the LTSP under the Flaming Gorge BO and ROD

The LTSP is an important document that is assisting in the consistent evaluation of how Flaming Gorge operations are benefiting razorback sucker. The LTSP and updated flow release is supported by the most recent scientific research into endangered fish ecology

¹ Can be found online at: <http://www.coloradoriverrecovery.org/documents-publications/technical-reports/isf/larvaltriggerstudyplan.pdf>

and floodplain management (Bestgen et al. 2011). As the Recovery Program described in the LTSP, the Bestgen et al. (2011) report synthesized long term data, evaluated the ability to operate Flaming Gorge Dam for the purpose of entraining wild razorback larvae into floodplain habitats, and created a set of conclusions and recommendations to guide future management.

We believe that the Recovery Program's 2014 Spring Flow Request and implementation of the LTSP are supported by the 2005 BO and we support Reclamation's implementation of this request. The Recovery Program has determined that a minimum of six study years are needed to meet the objectives of the LTSP. Unless otherwise specifically stipulated, this letter conveys the Service's interpretation of ESA compliance under the 2005 BO as it relates to Reclamation's future LTSP-related spring operations. We recognize that Reclamation's targeting of a biological trigger (presence of larval razorback sucker) rather than a hydrological one (Yampa River flows) deviates from past operations and may require greater volumes of water in some years. However, we conclude that this experiment is consistent with the intent of the Flow Recommendations and will assist in the recovery of the endangered fish.

We further recognize that timing releases from Flaming Gorge Dam consistent with the Recovery Program's 2014 Spring Flow Request and the LTSP may require the hydrologic tradeoff of not meeting the 2000 Flow and Temperature Recommendations for Reach 2. Nevertheless, we support Reclamation following the Recovery Program's 2014 Spring Flow Request and LTSP, and consider that doing so will meet Reclamation's responsibility to the ROD objectives in 2014.

Update June 2015 – *In May 2014, the Colorado River Basin Forecast Center predicted inflow to Flaming Gorge Reservoir that was consistent with an average (above median) hydrologic category; inflow to the Yampa River was categorized moderately wet. Larval razorback sucker were detected on May 28, 2014. Reclamation began their LTSP ramp-up on May 30, 2014. Average daily releases exceeded 8,000 cfs from June 7 through June 15, 2014. Reclamation began their ramp-down on June 16, 2014 when declining Yampa River flows no longer supported appropriate LTSP targets in Reach 2. Post larval detection, flows in Reach 2 exceeded 8,300 cfs for 25 days and exceeded 18,600 cfs for 4 days. Larvae were entrained into most study floodplains and record high numbers of juvenile razorback sucker were released from the Stewart Lake floodplain in September 2014 (as summarized in the Recovery Program's 2015 Spring flow request letter).*

Reclamation's Spring 2014 operations met LTSP Average (above median) objectives and were therefore in full compliance with the 2005 BO.

Base Flow Request

Base flows are important for a variety of ecological reasons, such as increased resource and habitat availability. Reclamation has provided a provisional operational plan for base flows at Flaming Gorge Dam that specifies releases to target 2,400 cfs at the Jensen gage

through September 30, 2014. Releases are expected to be decreased to approximately 1,300 cfs beginning in October and through the remainder of the season.

It is our understanding that for the 2014 water year, inflow conditions into Flaming Gorge were considered 'average above median', and were very close to the 'moderately wet' classification (within just a few percentage points). As such, we believe it is appropriate to operate Flaming Gorge base flows to target 2,400 cfs at the Jensen gage, which is the high end of the average base flow recommendations for the average category and the low end of the moderately wet base flow recommendations. As described in previous base flow requests, this base flow would support YOY pikeminnow and disadvantage smallmouth bass. We appreciate your consideration and believe this request meets the provisions of Muth et al. (2000).

Update June 2015 – *Average monthly summer / fall 2014 flows in Reach 2 were as follows:*

<i>Month</i>	<i>Flow (cfs)</i>
<i>July</i>	<i>3,390</i>
<i>August</i>	<i>3,096</i>
<i>September</i>	<i>2,857</i>
<i>October</i>	<i>2,592</i>
<i>November</i>	<i>2,255</i>
<i>December</i>	<i>2,671</i>

Average daily flow did not drop below 2,400 cfs in Reach 2 until October 16, 2014. The Service considers Reclamation's 2014 base flow operations in full compliance with the 2005 BO.

Conclusion

In summary, we request that Reclamation:

- Continue to time spring flow releases from Flaming Gorge to correspond with the presence of wild produced razorback sucker larvae according to the LTSP in order to improve entrainment success; and
- Manage summer base flows in Reach 2 of the Green River to provide 2,400 cfs at the Jensen gage.

We believe that data gathered by the Recovery Program make a strong case for these proposed operations in 2014 and should benefit young life stages of endangered fish. We hope that hydrology conditions in the Upper Green and Yampa River drainages will supply sufficient water to meet these needs. Furthermore, we believe that these operations are consistent with the existing BO for Flaming Gorge and the Flaming Gorge ROD.

We thank Reclamation for the opportunity to provide this input and look forward to participating in the Flaming Gorge Technical Working Group process. If you have any questions or concerns, please contact Paul Abate at 801-975-3330 ext. 130.

bcc: Project file
Reading file

File: DOI\BOR\NEPA\2015
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Appendix E

Comment Letters Received through the Flaming Gorge Working Group Process

