

# RECLAMATION

*Managing Water in the West*

## **Annual Report of Operations For Flaming Gorge Dam Water Year 2015**



## Table of Contents

Annual Report of Operations for Flaming Gorge Dam .....	1
Operational Decision Process for Water Year 2015 .....	2
Step 1: Flow Requests for Research, and Other Federal, State and Stakeholder Input .....	2
Step 2: Development of Spring Proposal.....	4
Step 3: Solicitation of Comments .....	4
Step 4: Final Decision.....	5
Basin Hydrology and Operations.....	5
Progression of Inflow Forecasts.....	5
Summary of Flaming Gorge Operations.....	6
Spillway Inspection.....	8
Flow Objectives Achieved in Water Year 2015 .....	8
Spring Flow Objectives.....	10
Number of Days (x) Flow Exceeded and Corresponding Hydrologic Conditions <sup>(c)</sup> .....	13
Base Flow Objectives .....	13
Temperature Objectives Achieved in Water Year 2015 .....	16
Recommendations.....	18

## **Appendices**

Appendix A – Flaming Gorge Decision Process – Intended Implementation under the 2006 Flaming Gorge Record of Decision

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

Appendix C – March 27, 2015, Memorandum from the Recovery Program Director  
containing the Research Request for 2015 Green River Spring Flows

Appendix D – May 15, 2015, Memorandum from the U.S. Fish and Wildlife Service  
regarding the 2015 Green River Spring and Base Flows to Assist in Recovery  
of the Endangered Fishes

Appendix E – June 9, 2015, USFWS Clarification of May 15, 2015 Green River  
Spring and Base Flow Recommendation

Appendix F – Comment Letters Received through the Flaming Gorge Working  
Group Process

# Annual Report of Operations for Flaming Gorge Dam

## Water Year 2015

### Introduction

This report details the operations of Flaming Gorge Dam during water year 2015<sup>1</sup>, and is produced pursuant to the February 2006 Record of Decision for the Operation of Flaming Gorge Dam (ROD)<sup>2</sup>, the Operation of Flaming Gorge Dam Final Environmental Impact Statement (FEIS)<sup>3</sup> and 2005 Final Biological Opinion on the Operation of Flaming Gorge Dam (2005 BO)<sup>4</sup>. This is the tenth year of operations of Flaming Gorge Dam under the ROD and this report is the tenth 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

---

<sup>1</sup> A water year begins October 1 and ends September 30.

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

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

<sup>4</sup> [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.

## Operational Decision Process for Water Year 2015

The Flaming Gorge Technical Working Group (FGTWG) was established pursuant to the FEIS as recommended in the Flow Recommendations.<sup>5</sup> 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 2015, 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 2015 is described below:

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

Reclamation received a memorandum on March 27, 2015 (2015 Spring Flow Request, Appendix C) from the Director of the Recovery Program stating the Recovery Program's research request for 2015 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).<sup>6</sup>

---

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

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

The Recovery Program's 2015 Spring Flow Request was to establish a release regime that would facilitate further research under the LTSP. The LTSP's 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 2015 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. The 2015 Spring Flow Request supported operations consistent with the 2005 BO and ROD.

The 2015 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 and 2014 to better assess connection flows for future LTSP experimentation.

The Recovery Program indicated that implementation of the LTSP over the last three years has yielded an increasingly positive response from razorback sucker. Most significantly, "in September 2014, researchers collected wild produced razorback sucker in the Green River Reach 2 main channel backwater habitats for the first time since 2000." (2015 Spring Flow Request)

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 May 15, 2015, Reclamation received a spring and base flow request from the Service (USFWS 2015 Flow Request, Appendix D). The Service supported the Recovery Program 2015 Spring Flow Request. 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 Reclamation approving the Recovery Program's 2015 Spring Flow Request, and affirmed that doing so would meet Reclamation's responsibility to meet the ROD objectives in 2015. Their specific spring peak request was to "[t]ime spring bypass flow releases (up to 8,600 cfs) for up to five days (subject to modification based on actual

hydrology) from Flaming Gorge to correspond with the presence of wild produced razorback sucker larvae according to the LTSP in order to improve entrainment success.” (USFWS 2015 Flow Request)

The Service further requested that Reclamation “enhance summer base flows in Reach 2 of the Green River by maintaining  $\geq 1,900$  cfs through September 30, 2015” (USFWS 2015 Flow Request). The intent of the request was to improve backwater habitat conditions for young-of-year Colorado pikeminnow and negatively impact nonnative fish species. Additionally, the Service requested base flows in Reach 2 to support Reach 3 to “provide preferred flows in this important reach of the Green River, because in recent years, we have learned the critical role lower Green River nursery habitats play in Colorado pikeminnow population viability (Bestgen et al. 2010).” (USFWS 2015 Flow Request)

On June 9, 2015, Reclamation received an email from the Service regarding the USFWS Clarification of May 15, 2015 Green River Spring and Base Flow Recommendation (USFWS 2015 Clarification Email, Appendix E). The Reach 2 base flow request was clarified as an experiment based on current research and requested the ROD base flow flexibility to operate at +40% summer seasonal variability to the appropriate moderately dry base flow range through September 30, 2015. The Service further recognized that the summer base flow request may mean that Reclamation is unable to balance annual operations and requested further discussion within the FGTWG to ascertain water available to meet the request within the parameters of current hydrologic uncertainty. Finally, the Service clarified that Reclamation’s primary concern is to operate Flaming Gorge Dam consistent with the ROD to achieve base flow targets in Reach 2, which the Service assumes will meet the flow recommendations in Reach 3. (USFWS 2015 Clarification Email)

## **Step 2: Development of Spring Proposal**

The FGTWG met on March 11, 2015, to begin the development of a flow proposal for the spring of 2015. 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 2015 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 2015 was characterized by moderately dry conditions in the Upper Green and dry conditions in the Yampa River Basins, respectively.

On June 8, 2015, the FGTWG met to review the spring releases and discuss current base flow hydrology. The formal recommendation to target at Jensen for the summer base flow season was 1,625 cfs. The Recovery Program and U.S. Fish and Wildlife Service requested increased releases to target up to 2,175 cfs at the USGS Jensen streamgauge to extend the releases through October 2015, if possible.

## **Step 3: Solicitation of Comments**

On April 30, 2015, Reclamation presented the 2015 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 2015. Meeting minutes were recorded and written comments were solicited by Heather Patno, Co-Chair of the Working Group.<sup>7</sup> Reclamation received comments from the public during the 2015 decision-making process and these comments are available for review in Appendix F.

#### **Step 4: Final Decision**

The hydrologic classifications for the Upper Green Basin was moderately dry and Yampa River Basin was in the dry hydrologic category. The ROD allows for flexibility to operate one classification lower or two classifications higher than indicated while allowing adjustment if conditions warrant. Reclamation reviewed the FGTWG proposal and decided to implement the LTSP recommendations for moderately dry 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, and Old Charley Wash (as available), as the research floodplains of interest. Reclamation decided to utilize full powerplant and bypass capacity in conjunction with the Yampa River flows to reach the LTSP moderately dry target of 14,000 cfs. for as long as possible.

## **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 2014 through April 2015). The Upper Green River Basin snowpack condition was above median on January 1, 2015, at 124 percent of median.<sup>8</sup> On April 1, 2015, snowpack conditions in the Upper Green River Basin had decreased to 74 percent of median, with dry conditions through April eroding snowpack at 58 percent of median by May 1, 2015. The Yampa River Basin snowpack condition was around median on January 1, 2015, at 105 percent of median. On April 1, 2015, snowpack conditions in the Yampa River Basin had decreased to 63 percent of median, and had further decreased to 52 percent of median by May 1, 2015. The Flaming Gorge Reservoir unregulated inflow volume forecast on May 1, 2015, was 58 percent of average. Significant late season storm activity and rainfall precipitation increased the observed unregulated inflow volume to 106 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 2015 water supply season are shown in Table 1.

---

<sup>7</sup> Working Group Meeting notes are also available at [http://www.usbr.gov/uc/water/crsp/wg/fg/fg\\_20130424.html](http://www.usbr.gov/uc/water/crsp/wg/fg/fg_20130424.html) and [http://www.usbr.gov/uc/water/crsp/wg/fg/fg\\_20130821.html](http://www.usbr.gov/uc/water/crsp/wg/fg/fg_20130821.html).

<sup>8</sup> 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 Inflow<sup>9</sup> Volume Forecasts for the April through July Water Supply Period**

Forecast Issuance Month	Flaming Gorge Reservoir		Yampa River at Deerlodge Park, CO	
	Volume (1000 AF)	% of Average	Volume (1000 AF)	% of Average
January	1000	102	1200	97
February	875	89	945	76
March	825	84	925	75
April	650	66	730	59
May	570	58	620	50
June	910	93	945	76
July	990	101	---	---
<b>Actual</b>	<b>1,035</b>	<b>106</b>	<b>1042</b>	<b>84</b>

### Summary of Flaming Gorge Operations

Releases from Flaming Gorge varied during the base flow season from October 1, 2014 through May 11, 2015, when releases increased after detection of larval razorback sucker and the beginning of spring operations. Releases were 1,300 cfs during October and November increasing to 2,000 cfs during the winter period from December through March. Releases then decreased to 1,000 cfs through the beginning of runoff on May 11, 2015.

The Utah Division of Wildlife Resources (UDWR) requested a modification from normal operations on April 21 and 22, 2015, in order to conduct their spring fishery assessment. Releases were maintained at 1,000 cfs before and after completion of the spring assessment in anticipation of spring runoff.

The Flow Recommendations call for Flaming Gorge Dam releases to be 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. Reclamation responded to the Recovery Program's request and agreed to support research under the LTSP and time increased releases from Flaming Gorge Dam to coincide with the presence of wild razorback sucker larvae in the Green River system.

Larvae were detected on May 7, 2015, and, in response to the LTSP parameters, Flaming Gorge releases were increased to powerplant capacity of 4,600 cfs with an additional bypass release of 2,900 cfs on May 11, 2015, for a total of six days at 7,500 cfs. The LTSP

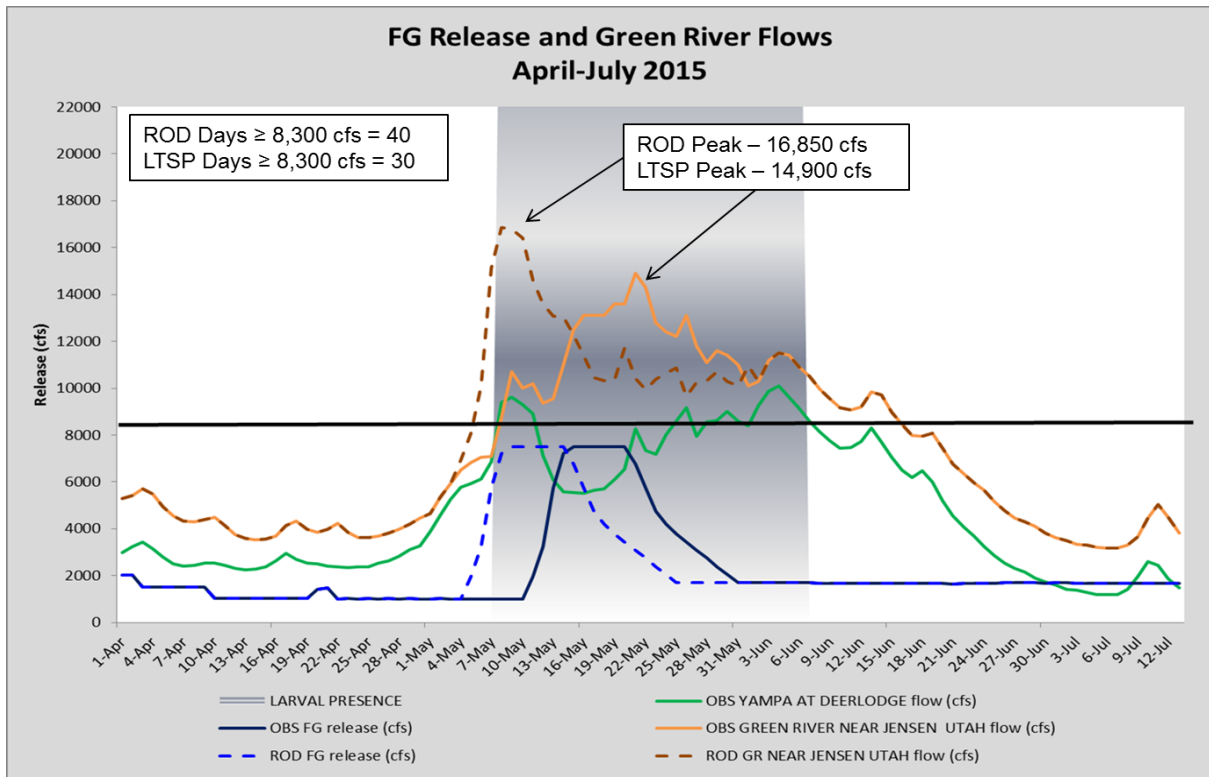
<sup>9</sup> Unregulated inflow adjusts for the effects of operations at upstream reservoirs. It is computed by adding the change in storage and the evaporation losses from upstream reservoirs to the observed inflow. Unregulated inflow is used because it provides an inflow time series that is not biased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

moderately dry flow range targets 8,300 cfs to 14,000 cfs at Jensen. Releases from Flaming Gorge Dam were kept at 7,500 cfs to meet the upper range of the moderately dry flow target during larval presence with the Yampa River flows around 5,500 cfs. Yampa River flows at the Deerlodge gage peaked at 9,630 cfs on May 9, 2015, and were on the descending limb of the hydrograph during the LTSP spring release. The rainfall events in late May and June extended the spring peak release with the second peak of Deerlodge flows reaching 9,020 cfs on May 30, 2015. The USGS streamgage at the Green River at Jensen, Utah, measured a peak flow of 14,900 cfs on May 21, 2015, during larval drift when Flaming Gorge was releasing the peak of 7,500 cfs on May 20, 2015.

The hydrologic conditions during spring 2015 consisted of above average snow accumulation through February with lack of late season precipitation resulting in below average snowpack and early melt. Similar year snowpack runoff ranged from 34 to 62 percent of average (Upper Green 1987, 2004, 2013; Yampa 1987, 1992, 2002, 2012). Spring rainfall significantly increased total runoff to 106 percent of average volume into Flaming Gorge and 84 percent of average on the Yampa River. The ROD hydrologic classification for the Upper Green was moderately dry with Yampa River conditions in the dry classification. After releases for the LTSP concluded, releases were decreased to base flow releases of 1,675 cfs through July increasing to 1,700 cfs at the request of the Recovery Program and Service from August through September. Flows at Jensen met or exceeded targets in Reach 2 for the ROD Flow Recommendation of one-day peak duration at 8,300 cfs and the LTSP moderately dry target between 8,300 to 14,000 cfs for a total of 7 to 14 days, all of which occurred during larval drift.

Flaming Gorge Reservoir elevation decreased a total of 9.68 feet (ft) from the maximum elevation of 6034.79 ft on July 24, 2015, to the annual minimum elevation of 6025.11 ft on May 23, 2015.

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 peak releases timed with the peak and immediate post peak of the Yampa River and resulting Green River flows as called for in the ROD and those actually conducted under the Larval Trigger Study Plan and timed with the emergence of razorback sucker larvae in the Green River.



**Figure 1 – Spring 2015 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 July 27, 2015, at reservoir elevation 6034.68 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 2015

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 Flaming Gorge Dam releases cannot equally achieve targets for all three reaches simultaneously because of the reliance on tributary flows. 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 for Reclamation 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  $\pm 40$  percent of mean base flow and that during the December through February base-flow period, the daily flows should be within  $\pm 25$  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**

<b>Year</b>	<b>May 1<sup>st</sup> A-J Unreg Inflow Forecast (1000 AF)</b>	<b>Spring Hydrologic Classification</b>	<b>Observed A-J Unreg Inflow (1000 AF)</b>	<b>Base Flow Hydrologic Classification</b>
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)
2015	570	Moderately Dry	1,035	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 2015 was 570,000 acre-feet (AF) and resulting spring hydrologic classification was moderately dry.<sup>10</sup> The recommended peak-flow magnitudes designated under the ROD for Reaches 1, 2, and 3 were 4,600 cfs, 8,300 cfs, and 8,300 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 2015 is the tenth year of

<sup>10</sup> 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 tenth year for establishing the long-term frequencies of these spring flow objectives.

**Table 3 – Reach 1 ROD Flow Objectives Achieved in 2015**

<b>Spring Peak Flow Objective<sup>†</sup></b>	<b>Hydrologic Classification</b>	<b>Desired Frequency Percent of Achievement</b>	<b>Achieved in 2015</b>	<b>Achievement Rate to Date (Cumulative Frequency %)*</b>
Peak $\geq$ 8,600 cfs for at least 1 day	Wet	10 %	No	20 %
Peak $\geq$ power plant capacity for at least 1 day	Dry	100%	Yes	100 %

<sup>†</sup> 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 ten years of operation under the ROD and spring hydrologic classification (2006-2015)

**Table 4 – Reach 2 ROD Flow Objectives Achieved in 2015**

<b>Spring Peak Flow Objective</b>	<b>Hydrologic Classification</b>	<b>Desired Frequency Percent of Achievement</b>	<b>Achieved in 2015</b>	<b>Achievement Rate to Date (Cumulative Frequency %)*</b>
Peak $\geq$ 26,400 cfs for at least 1 day	Wet	10 %	No	10 %
Peak $\geq$ 22,700 cfs for at least 2 weeks	Wet	10 %	No	10 %
Peak $\geq$ 18,600 cfs for at least 4 weeks	Wet	10 %	No	10 %
Peak $\geq$ 20,300 cfs for at least 1 day	Moderately Wet	30 %	No	20 %
Peak $\geq$ 18,600 cfs for at least 2 weeks	Average (Wet)	40 %	No	20 %
Peak $\geq$ 18,600 cfs for at least 1 day	Average (Wet)	50 %	No	50 %
Peak $\geq$ 8,300 cfs for at least 1 day	Average (Dry)	100 %	Yes	100 %
Peak $\geq$ 8,300 cfs for at least 1 week	Moderately Dry	90 %	Yes	90 %
Peak $\geq$ 8,300 cfs for at least 2 days except in extreme dry years	Dry	98 %	Yes	100 %

\*Based on ten years of operation under the ROD and spring hydrologic classification (2006-2015)

**Table 5 – Reach 3 ROD Flow Objectives Achieved in 2015**

<b>Spring Peak Flow Objective</b>	<b>Hydrologic Classification</b>	<b>Desired Frequency Percent of Achievement</b>	<b>Achieved in 2015</b>	<b>Achievement Rate to Date (Cumulative Frequency %)*</b>
Peak $\geq$ 39,000 cfs for at least 1 day	Wet	10 %	No	10 %
Peak $\geq$ 24,000 cfs for at least 2 weeks	Wet	10 %	No	10 %
Peak $\geq$ 22,000 cfs for at least 4 weeks	Wet	10 %	No	10 %
Peak $\geq$ 24,000 cfs for at least 1 day	Moderately Wet	20 %	No	30 %
Peak $\geq$ 22,000 cfs for at least 2 weeks	Average (Wet)	40 %	No	10 %
Peak $\geq$ 22,000 cfs for at least 1 day	Average (Wet)	50 %	No	30 %
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	90 %
Peak $\geq$ 8,300 cfs for at least 2 days except in extreme dry years	Dry	98 %	Yes	100 %

\*Based on ten years of operation under the ROD and spring hydrologic classification (2006-2015)

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 moderately dry hydrologic condition with flows between 8,300 cfs and 14,000 cfs targeted between 7 to 14 days with a peak flow of 14,900 cfs. Flows at

Jensen, Utah, were above 8,300 cfs for 34 days during larval drift, which met the objective for moderately dry years outlined in the LTSP under 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 <sup>(a,b)</sup>	Number of Days (x) Flow Exceeded and Corresponding Hydrologic Conditions <sup>(c)</sup>		
		$1 \leq x < 7$	$7 \leq x < 14$	$x \geq 14$
$8,300 \leq x < 14,000$ 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

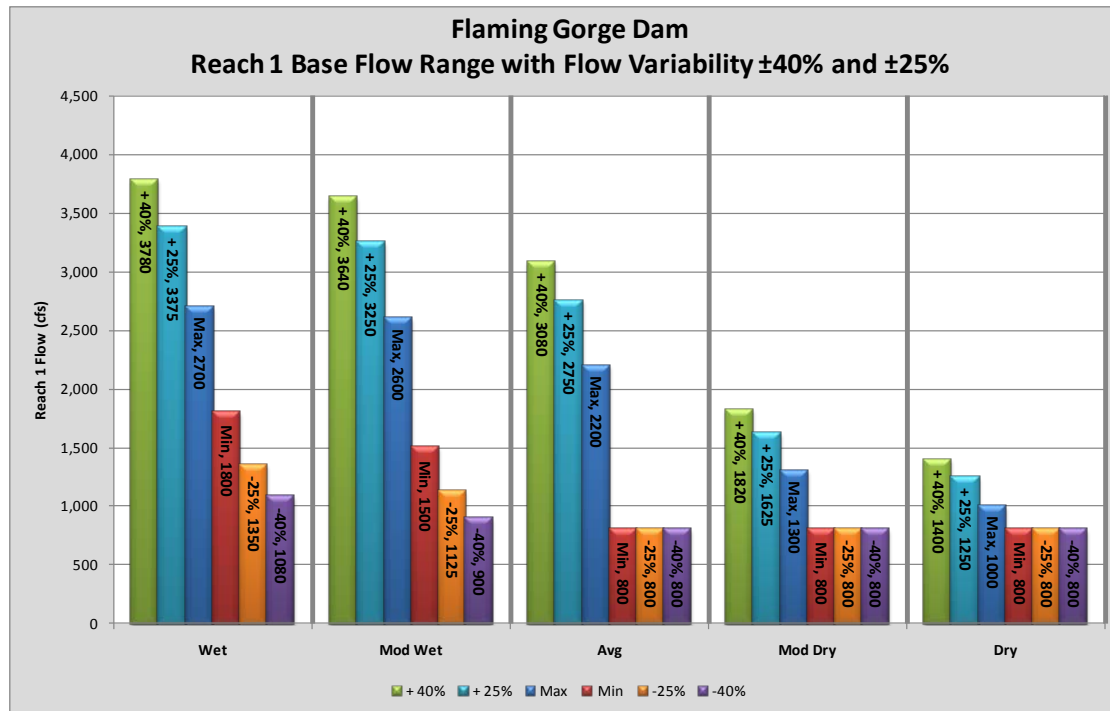
(b) Up to eight wetlands would be sampled in a given year with the three in the lowest flow category being sampled in all years.

(c) Refer to [Appendix C] for exceedance percentages and peak flow recommendations for each hydrologic condition. 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 1,035,000 AF and resulting base flow hydrologic classification was average (below median). Reach 1 flows were reduced to base flows of 1,675 cfs by May 31, 2015. The observed April-July unregulated inflow volume into Flaming Gorge Reservoir, August final forecast and average daily releases needed to achieve the May 1, 2016 elevation target of 6027 feet were used to calculate the Reach 1 daily average base flow of 1,625 cfs, which is within the base flow range for the average classification as shown in Figure 2.

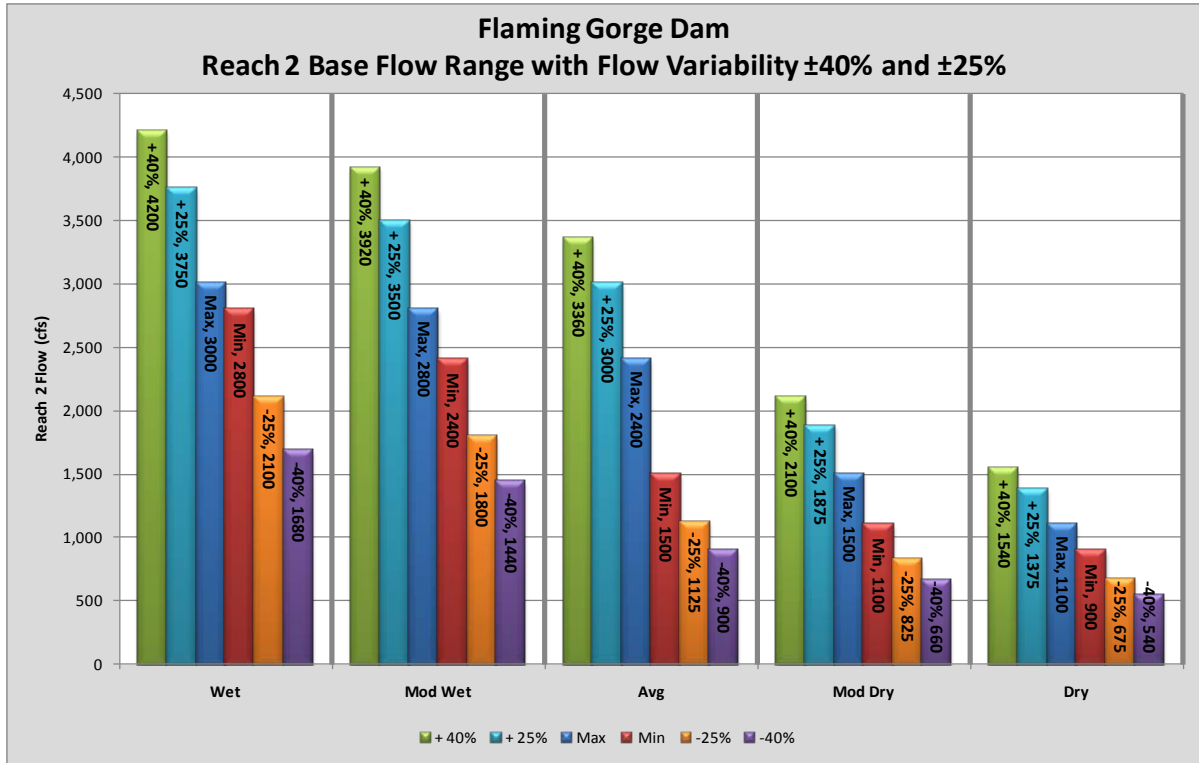




**Figure 2 – Reach 1 Base Flow Ranges for each Hydrologic Classification as Outlined in the ROD.**

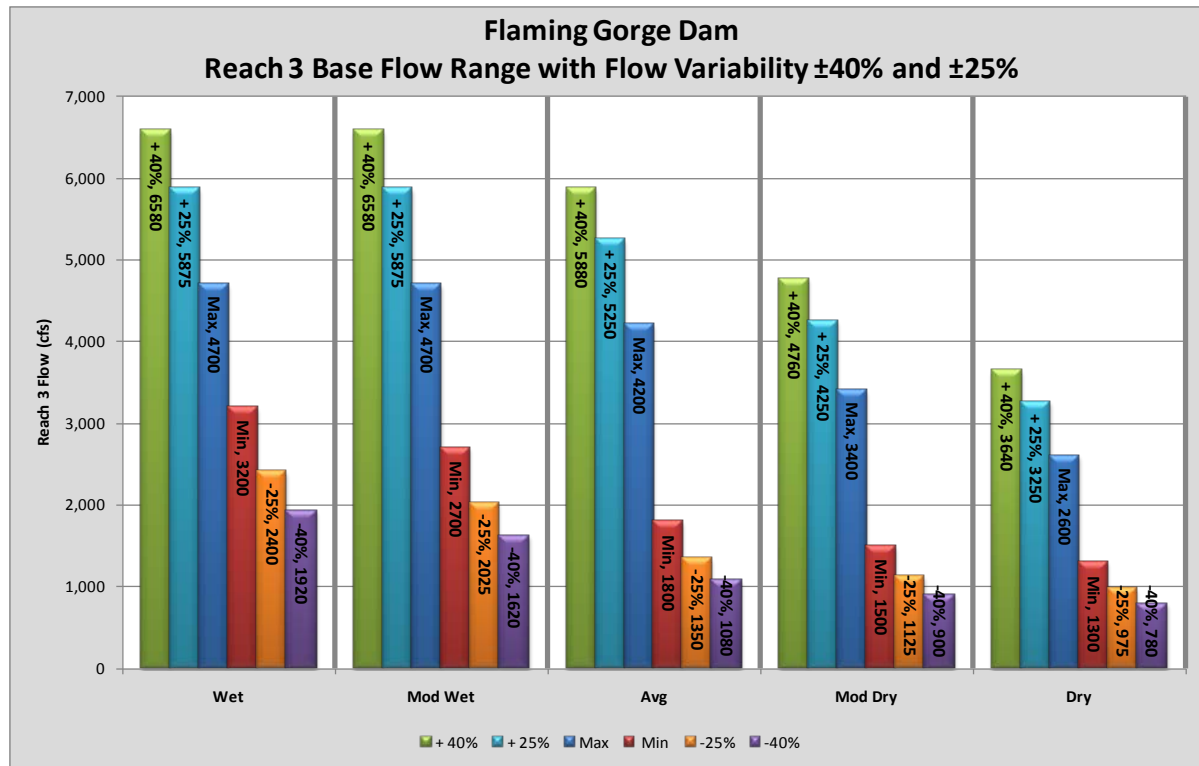
The FGTWG and the Service requested and the FGTWG proposed flows in Reach 2 for July through September at the maximum variability of +40 percent of the dry base flow classification. Reclamation decided to implement a portion of the +40 percent for Reach 1 in the average classification during July through September, and released 1,700 cfs in an effort to sustain flows in Reach 2 of 1,900 cfs. Significant precipitation occurred above Flaming Gorge during August and September with 255 and 210 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 3,080 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 900 cfs to 3,000 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 2015

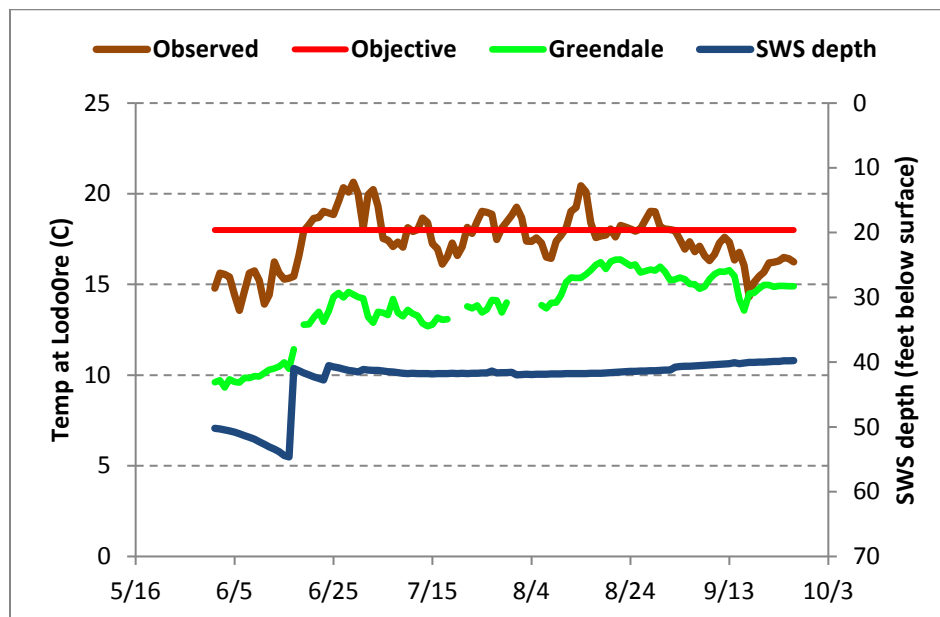
An operational plan for the selective withdrawal system (SWS) on Flaming Gorge Dam was completed by a subset of the Flaming Gorge Technical Work Group (FGTWG) in June 2007 and revised in June 2012. The operational plan provides guidelines for implementation of the 2006 ROD temperature objectives below 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 WY2015, the elevation target was achieved on June 17, although target release temperatures were not fully achieved until almost two months later (Figure 1). Summer operating temperatures of the three power generation units never exceeded equipment thresholds, and no high temperature alarms were reported. Thus, there was no need to adjust SWS gate elevations from the level achieved on June 17 (5,993 feet msl). Reclamation was also able to achieve temperatures at or above 16 °C (60.8 °F) for eight days in August, which is a threshold Reclamation was directed to periodically “experiment” with as a term and condition of the 2005 Biological Opinion.

Average daily temperatures at Gates of Lodore (USGS 404417108524900) in 2015 intermittently equaled or exceeded Reach 1 objectives (18.0 °C or 64.4 °F; Figure 1) for 35

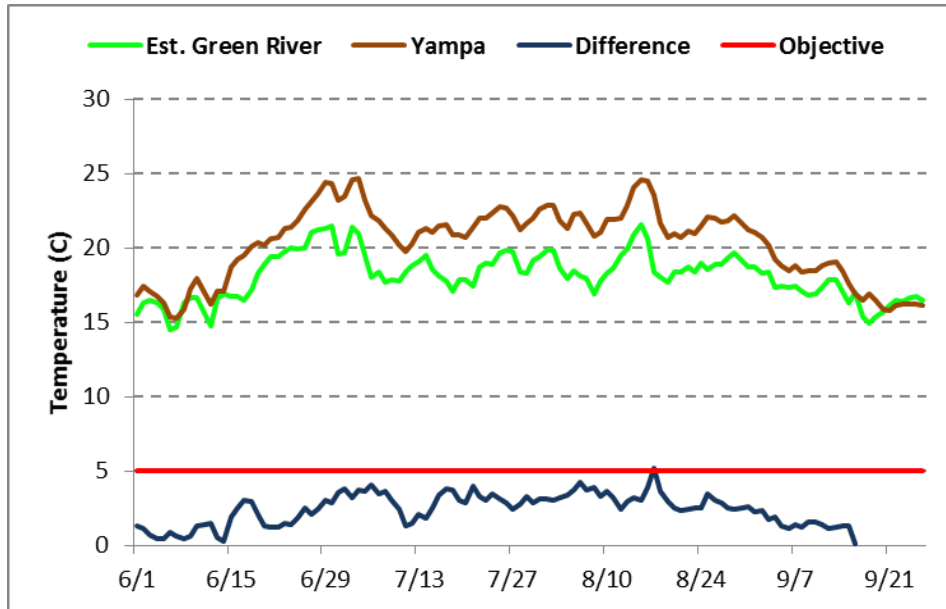
days between June 20 and September 1. Temperatures in the Yampa and Green rivers differed by more than 5 °C on one day (August 17; Figure 2).

**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 2015
Temperatures $\geq 18.0$ °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 5. 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 2015. SWS gate depths are the average of three units.**



**Figure 2. Temperature of 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 2015.**

## Recommendations

In 2015, 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 fifth year implementing the LTSP. 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 2015, 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 8,300 cfs at Jensen, Utah. Flows at Jensen, Utah in 2015 were above 8,300 cfs for a total of 42 days, 34 days during larval drift, which conformed to the duration requirements for moderately dry years outlined in Table 2 of the LTSP (Table 6 in this document; 7-14 days between 8,300 and 14,000 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 2015 in support of the LTSP. The base flows were set prior to significant precipitation events during the fall months, which increased the reservoir further than originally anticipated. It is recommended that the FGTWG meet during the base flow season to adjust releases as needed in the future.

## Literature Cited

- Bureau of Reclamation. 2005. Operation of Flaming Gorge Dam Final Environmental Impact Statement. U.S. Department of the Interior, Bureau of Reclamation, Upper Colorado Region, Salt Lake City, Utah.
- Bureau of Reclamation. 2006. Record of Decision on the operation of Flaming Gorge Dam Final Environmental Impact Statement. U.S. Department of the Interior, Bureau of Reclamation, Upper Colorado Region, Salt Lake City, Utah.
- Bureau of Reclamation. 2015. Flaming Gorge Technical Working Group Proposed Flow and Temperature Objective for 2015. U.S. Department of the Interior, Bureau of Reclamation, Upper Colorado Region, Salt Lake City, Utah.
- Larval Trigger Study Plan *ad hoc* Committee. 2012. 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. U.S. Fish and Wildlife Service, Upper Colorado River Endangered Fish Recovery Program, Denver, Colorado.
- Muth, R.T., L.W. Crist, K.E. LaGory, J.W. Hayse, K.R. Bestgen, T.P. Ryan, J.K. Lyons, and R.A. Valdez. 2000. Flow and temperature recommendations for endangered fishes in the Green River downstream of Flaming Gorge Dam. Final Report to Upper Colorado River Endangered Fish Recovery Program, Denver, Colorado.
- Upper Colorado River Endangered Fish Recovery Program. March February 27, 2015. Memorandum to Larry Walkoviak and Heather Hermansen. Recovery Program Research Request for 2015 Green River Spring Flows. U.S. Fish and Wildlife Service, Upper Colorado River Endangered Fish Recovery Program, Denver, Colorado.
- U.S. Fish and Wildlife Service. 2005. Final Biological Opinion on the operation of Flaming Gorge Dam (Consultation # 6-UT-05-F-006). U.S. Department of the Interior, Fish and Wildlife Service, Utah Field Office, West Valley City, Utah.

## 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.<sup>11</sup>

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

---

<sup>11</sup> 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

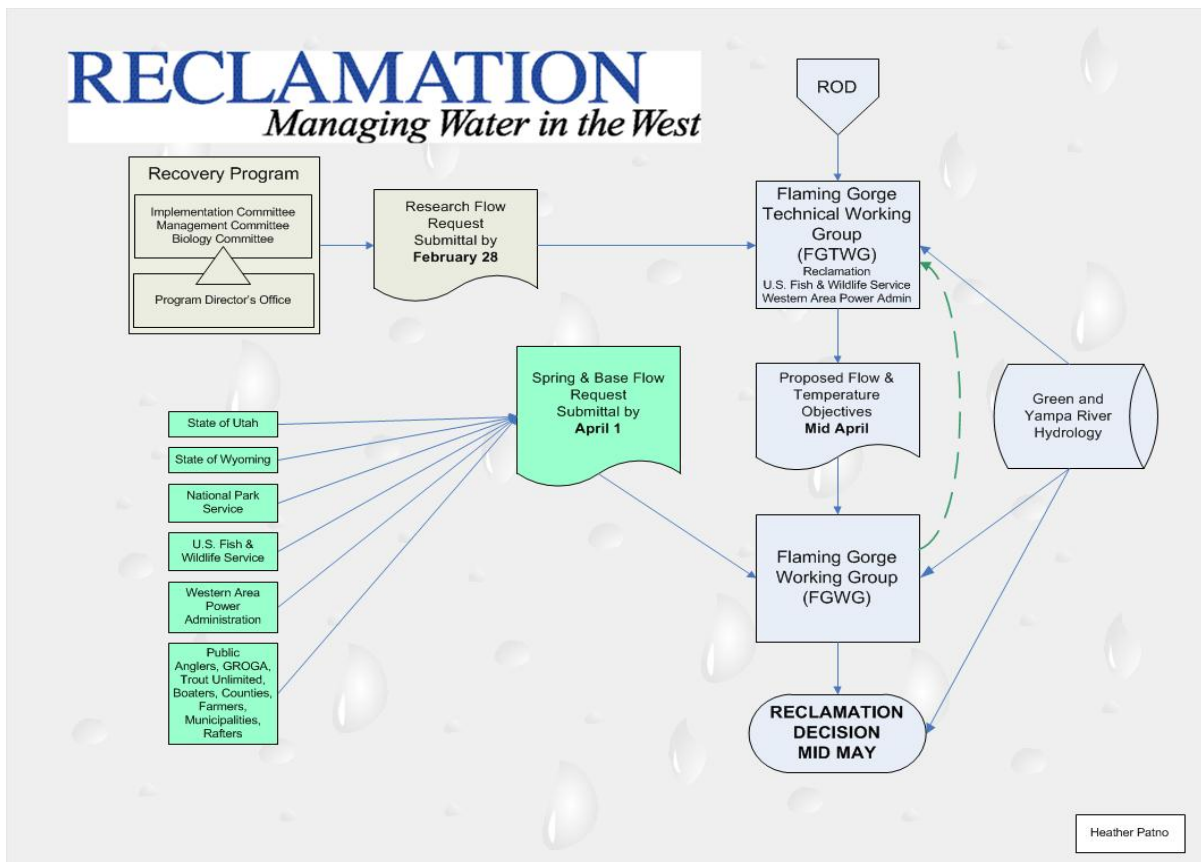
*Because hydrologic conditions often change during the April through July runoff period, the [Proposal] would contain a range of operating strategies that could be implemented under varying hydrologic conditions. Flow and duration targets for these alternate operating strategies would be limited to those 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 <sup>1</sup>				
		Wet <sup>2</sup> (0–10% Exceedance)	Moderately Wet <sup>3</sup> (10–30% Exceedance)	Average <sup>4</sup> (30–70% Exceedance)	Moderately Dry <sup>5</sup> (70–90% Exceedance)	Dry <sup>6</sup> (90–100% Exceedance)
Reach 1 Flaming Gorge Dam to Yampa River	Maximum Spring Peak Flow	• 8,600 cfs (244 cubic meters per second [m <sup>3</sup> /s])	• 4,600 cfs (130 m <sup>3</sup> /s)	• 4,600 cfs (130 m <sup>3</sup> /s)	• 4,600 cfs (130 m <sup>3</sup> /s)	• 4,600 cfs (130 m <sup>3</sup> /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 <sup>3</sup> /s)	1,500–2,600 cfs (42–72 m <sup>3</sup> /s)	800–2,200 cfs (23–62 m <sup>3</sup> /s)	800–1,300 cfs (23–37 m <sup>3</sup> /s)	800–1,000 cfs (23–28 m <sup>3</sup> /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 <sup>3</sup> /s)	• 20,300 cfs (575 m <sup>3</sup> /s)	• 18,600 cfs <sup>7</sup> (527 m <sup>3</sup> /s)  • 8,300 cfs <sup>8</sup> (235 m <sup>3</sup> /s)	• 8,300 cfs (235 m <sup>3</sup> /s)	• 8,300 cfs (235 m <sup>3</sup> /s)
	Peak Flow Duration	Flows greater than 22,700 cfs (643 m <sup>3</sup> /s) should be maintained for 2 weeks or more, and flows 18,600 cfs (527 m <sup>3</sup> /s) for 4 weeks or more.	Flows greater than 18,600 cfs (527 m <sup>3</sup> /s) should be maintained for 2 weeks or more.	Flows greater than 18,600 cfs (527 m <sup>3</sup> /s) should be maintained for 2 weeks in at least 1 of 4 average years.	Flows greater than 8,300 cfs (235 m <sup>3</sup> /s) should be maintained for at least 1 week.	Flows greater than 8,300 cfs (235 m <sup>3</sup> /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 <sup>3</sup> /s)	2,400–2,800 cfs (69–79 m <sup>3</sup> /s)	1,500–2,400 cfs (43–67 m <sup>3</sup> /s)	1,100–1,500 cfs (31–43 m <sup>3</sup> /s)	900–1,100 cfs (26–31 m <sup>3</sup> /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 <sup>3</sup> /s)	• 24,000 cfs (680 m <sup>3</sup> /s)	• 22,000 cfs <sup>9</sup> (623 m <sup>3</sup> /s)	• 8,300 cfs (235 m <sup>3</sup> /s)	• 8,300 cfs (235 m <sup>3</sup> /s)
	Peak Flow Duration	Flows greater than 24,000 cfs (680 m <sup>3</sup> /s) should be maintained for 2 weeks or more, and flows 22,000 cfs (623 m <sup>3</sup> /s) for 4 weeks or more.	Flows greater than 22,000 cfs (623 m <sup>3</sup> /s) should be maintained for 2 weeks or more.	Flows greater than 22,000 cfs (623 m <sup>3</sup> /s) should be maintained for 2 weeks in at least 1 of 4 average years.	Flows greater than 8,300 cfs (235 m <sup>3</sup> /s) should be maintained for at least 1 week.	Flows greater than 8,300 cfs (235 m <sup>3</sup> /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 <sup>3</sup> /s)	2,700–4,700 cfs (76–133 m <sup>3</sup> /s)	1,800–4,200 cfs (52–119 m <sup>3</sup> /s)	1,500–3,400 cfs (42–95 m <sup>3</sup> /s)	1,300–2,600 cfs (32–72 m <sup>3</sup> /s)

## Appendix C

### March 27, 2015 Memorandum from the Recovery Program Director containing the Research Request for 2015 Green River Spring Flows



United States Department of the Interior  
FISH AND WILDLIFE SERVICE

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

May 15, 2015

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

Memorandum

To: Mr. Brent Rhees, Director, Upper Colorado Region, U. S. Bureau of Reclamation  
Ms. Heather Patno, Chair, Flaming Gorge Technical Working Group, Bureau of Reclamation

From: *ACTING* Field Supervisor, Utah Field Office, U.S. Fish and Wildlife Service  
*Betsy Hume*

Subject: 2015 Green River Spring and Base Flows to Assist in Recovery of the Endangered Fishes

This letter describes our recommendations for 2015 spring and base flows in Reach 2 (with consideration of effects in Reach 3) of the Green River for discussion by the Flaming Gorge Technical Working Group (FGTWG) in development of recommendations for Flaming Gorge Dam operations. Our intent is to work with other 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 call for flows and water temperatures to protect and assist in recovery of endangered fishes (Muth et al. 2000).

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. We apologize for the late date of our letter this year.

Spring Research Flows

We support the Upper Colorado River Endangered Fish Recovery Program's (Recovery Program) 2015 Spring Flow Request, as explained in their March 27, 2015 letter. We believe the primary objective, to time Flaming Gorge releases and resultant floodplain

connection with the Green River during presence of razorback sucker larvae, 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. Specifically, the objectives and criteria presented in their letter are consistent with the common goal of the Flow Recommendations, BO and ROD: to use the best available science to guide Flaming Gorge operations and recovery actions in an adaptive management framework. Timing Flaming Gorge releases concurrently with larvae presence is proving to be a major step forward in re-establishing a stable population of razorback sucker in the Green River basin.

*The Study Plan to Examine the Effects of Using Larval Sucker Occurrence in the Green River as a Trigger for Flaming Gorge Dam (LTSP)* details the range of experimental conditions the Recovery Program would like to assess with recognition that more than one set of flow conditions identified in their LTSP study 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 razorback sucker, we feel it is very important to follow those recommendations whenever possible.

Based on recent information provided by Ms. Heather Patno to the FGTDWG, we understand that inflow into Flaming Gorge is in the moderately dry hydrologic category and the Yampa River drainage has been categorized as dry. At the time this letter is being drafted we are aware of the following current events: 1) larval razorback have been detected in the Green River (first detection: May 7, 2015); 2) flows at Jensen, Utah increased above 8,300cfs on May 8, 2015; 3) the Stewart Lake outlet gate was opened on May 9, 2015; 4) the Johnson Bottom inlet gate was opened May 11, 2015; 5) larval sampling has been expanded from standardized riverine monitoring locations into those connected floodplain habitats; and 6) Reclamation initiated their LTSP releases on May 11, 2015. We also understand that Reclamation intends to increase releases up to bypass levels (up to a total dam release of 8,600 cfs) for up to five days, which is subject to modification due to actual hydrology. It appears that 'moderately dry' LTSP study objectives will be achieved in 2015. We applaud the coordination between Reclamation and the Recovery Program for what appears to be another successful year of spring studies.

#### Justification for the LTSP under the Flaming Gorge BO and ROD

The LTSP is an important document that will assist in consistent evaluation into 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 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. The Flow Recommendations recommended utilizing up-to-date research and monitoring, such as the Bestgen et al. (2011) report:

"the collection of additional data on endangered fishes and their habitats should focus on the evaluation and possible modification of our recommendations by following an adaptive-management process" (Muth et al. 2000, p. 5-39);

as well as biological information to guide the onset of spring peak flow:

"Examples of real-time and other year-specific information to be considered in determining annual patterns of releases . . .

- Initial appearance of larval suckers in established reference sites in Reach 2 (e.g., Cliff Creek)" (Muth et al. 2000, p. 5-9, Table 5.3).

Similarly, the 2005 BO calls for adaptive management in implementing the proposed action (operations of Flaming Gorge Dam) (U.S. Fish and Wildlife Service 2005, p. 16) and set forth this process as a conservation measure:

"The adaptive management process will rely on the Recovery Program for monitoring and research studies to test the outcomes of implementing the proposed action and proposing refinements to dam operations" (U.S. Fish and Wildlife Service 2005, p. 17);

and

"[Bureau of] Reclamation, Western [Area Power Administration], and the [U.S. Fish and Wildlife] Service will use any new information collected in these studies to determine the need for management actions or modification of operations as determined appropriate" (U.S. Fish and Wildlife Service 2005, p. 17).

Therefore, we believe that the Recovery Program's 2015 Spring Flow Request and implementation of the LTSP are supported by the 2005 BO and we support the Bureau of Reclamation's (Reclamation) 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 2015 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 2015 Spring Flow Request and LTSP, and consider that doing so will meet Reclamation's responsibility to the ROD objectives in 2015.

#### Base flow operations

Because of projected drier than average year conditions, we believe that Green River base flow augmentation is a very important consideration for 2015. We propose the following approach to base flow operations in 2015, which is heavily influenced by a recent report presented to the Recovery Program that summarizes 33 years of Age-0 Colorado pikeminnow collection information in Green River Reaches 2 and 3 (Bestgen and Hill 2014; *in draft*). Here we excerpt from the author's (21) draft conclusions and (10) draft recommendations, which will serve as the primary basis for our 2015 baseflow request:

- *Conclusion - Age-0 Colorado pikeminnow abundance declined in both the middle and lower Green River reaches over time, especially since about 1994.*
- *Conclusion - Middle Green River base flows in the range of 51-85 m<sup>3</sup>/sec (1,800-3,000 ft<sup>3</sup>/sec) were consistent with higher densities of age-0 Colorado pikeminnow in autumn and with more backwater habitat.*
- *Conclusion - Lower Green River base flows in the range of 62-108 m<sup>3</sup>/sec (2,200-3,800 ft<sup>3</sup>/sec) were consistent with higher densities of age-0 Colorado pikeminnow in autumn and with higher backwater habitat availability; the existing upper end of flow ranges in wetter classifications may need to be reduced. Flow recommendations for the lower Green River naturally follow from flows in the upstream middle Green River.*
- *Conclusion - Timing of the onset of base flow conditions should be linked with first presence of Colorado pikeminnow larval drift in the lower Yampa River to ensure adequate backwater conditions throughout the reproductive period and longer growing seasons for age-0 Colorado pikeminnow.*
- *Recommendation - Initiate immediately, an experimental program of base flows in the middle and lower Green River that are higher than presently recommended for average and drier hydrologic conditions and begin those flows earlier in summer, with a goal to bolster populations of age-0, juvenile, and eventually adult, Colorado pikeminnow abundance in the Green River.*

#### Base Flow Request:

As per Reclamation's *Proposed Flow and Temperature Objectives for 2015* document, base flows in Reaches 1 and 2 should be managed to fall within the base flow ranges described in the Flow Recommendations based on the observed April through July unregulated inflow into Flaming Gorge Reservoir. April through July unregulated inflow into Flaming Gorge Reservoir has been categorized as 'moderately dry' in 2015. Pursuant to the Flow Recommendations, during the August through November base-flow period, the daily flows should be within  $\pm 40\%$  of mean base flow. The recommended 'moderately dry' Reach 2 baseflow range from the Flow Recommendations is 1,100 – 1,500 cfs. When we apply the summer seasonal variability of + 40% the 'moderately dry' category shifts to 1,540 - 2,100 cfs. Consistent with the new information presented in Bestgen and Hill (2014; *in draft*), we request that Reclamation maintain a baseflow of

≥1,900 cfs in Reach 2 through September 30, 2015. The 30 September end date is consistent with the duration of time needed to maintain conditions for improved growth and survival of age-0 Colorado pikeminnow. We understand that Reclamation may not be able to maintain that target base flow in Reach 2 beyond September 30, 2015 and still balance annual operations.

We believe that the Flow Recommendations intended that seasonal variability be incorporated into dam operations to assist in the recovery of endangered fishes and accommodate natural variability, but not allow for manipulation that targets a specific operational pattern. Our 2015 base flow request, which complies with the ROD and the BO, is consistent with the intent of the flow recommendations, is based on information gathered by the Recovery Program, and responds to current biological conditions in the Green River system including reduced survival of age-0 Colorado pikeminnow.

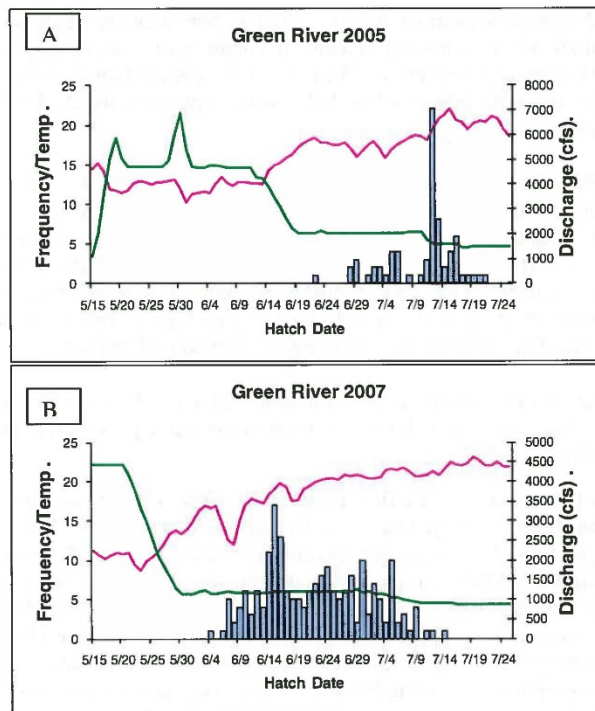
Our rationale for requesting elevated base flows through September 30 is consistent with our requests in 2008 - 2013, and is now bolstered by the information presented in Bestgen and Hill (2014; *in draft*).

A secondary benefit of elevating the base flow target in Reach 2 and the associated increased releases from Flaming Gorge Dam (at least through September 30, 2015) is the deleterious effect higher flows have on spawning time and growth of nonnative and predaceous smallmouth bass in Reach 1 and to a lesser extent in the upper portions of Reach 2. To illustrate this point we provide a graphical comparison of two Reach 1 base flow hydrologies and thermal regimes (years 2005 and 2007) and the resultant effect on smallmouth bass spawning chronology (Figure 1). During a relatively wet and cool year (2005), smallmouth bass spawning occurred nearly 3 weeks later than during a drier, warmer year (2007). The same relationship was observed in related investigations on the Yampa River.

Also, preliminary information from population dynamics modeling of smallmouth bass in the upper Colorado River basin indicate that any disruption of early season spawning nests have the largest reductions to future sub-adult and adult density (Breton et al. 2015, *in draft*). Furthermore, Breton et al. recommend undertaking any means of early season nest disturbance, including flow releases, to reduce abundance of invasive smallmouth bass. Elevated releases from Flaming Gorge to primarily benefit Colorado pikeminnow will therefore also delay spawning and reduce growth of smallmouth bass.

The Flow Recommendations call for a base flow range of 1,500 – 3,400 cfs in Reach 3 during 'moderately dry' hydrologic years. Bestgen and Hill (2014; *in draft*) recommend a preferred base flow range of 2,200 – 3,800 cfs for this lower Green River reach in all years. In drier than average years, the Green River between the Jensen, Utah and Green River, Utah gauges can become a 'losing' reach, where substantial volumes of flow are subsumed into the alluvium and are unavailable as surface water. Our Reach 2 base flow request of ≥1,900 cfs may support the lower end of the Flow Recommendation base flow range in Reach 3. It is important to provide preferred flows in this important reach of the Green River, because in recent years, we have learned the critical role lower Green River nursery habitats play in Colorado pikeminnow population viability (Bestgen et al. 2010).





**Figure 1. A comparison of flow (green), temperature (purple), and smallmouth bass hatching dates (bars) in Lodore and Whirlpool canyons (Green River - Reach 1 and upper Reach 2). A) 2005 conditions included higher base flows and cooler temps; B) 2007 conditions included lower base flows and warmer temps. Figures excerpted from Recovery Program Project #115 2009 Annual Report (preliminary information)<sup>1</sup>**

### Conclusions

In summary, we request that Reclamation:

- Time spring bypass flow releases (up to 8,600 cfs) for up to five days (subject to modification based on actual hydrology) 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

<sup>1</sup> Available online at: <http://coloradoriverrecovery.org/documents-publications/work-plan-documents/arpts/2009/naa/115.pdf>



- Enhance summer base flows in Reach 2 of the Green River by maintaining  $\geq 1,900$  cfs through September 30, 2015.

We believe that data gathered by the Recovery Program make a strong case for these proposed operations in 2015 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 BOs 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 FGTWG process. If you have any questions or concerns, please contact Paul Abate at 801-975-3330 x130.

### Literature Cited

- Bestgen, K.R., G.B. Haines, and A.A. Hill. 2011. Synthesis of floodplain wetland information: timing of razorback sucker reproduction in the Green River, Utah, related to streamflow, water temperature, and floodplain wetland availability. Final Report to the Upper Colorado River Endangered Fish Recovery Program. Larval Fish Laboratory Contribution 163.
- Bestgen, K.R., J. A. Hawkins, G. C. White, C. D. Walford, P. Badame, and L. Monroe. 2010. Population Status of Colorado Pikeminnow in the Green River Basin, Utah and Colorado 2006-2008. Final Report. Colorado River Recovery Implementation Program Project Number 128 Larval Fish Laboratory Contribution 161
- Bestgen, K.R. and A. Hill. 2014. Reproduction, abundance, and recruitment dynamics of young Colorado pikeminnow in the Green River Basin, 1979-2012. Larval Fish Laboratory Contribution 183, *Draft*
- Breton, A.R., D.L. Winkelman, K.R. Bestgen, and J.A. Hawkins. Population Dynamics Modeling of Introduced Smallmouth Bass in the Upper Colorado River Basin. Final report to the Upper Colorado River Endangered Fish Recovery Program, Denver, Colorado. Larval Fish Laboratory Contribution 186.
- Muth, R.T., L.W. Crist, K.E. LaGory, J.W. Hayse, K.R. Bestgen, T.P. Ryan, J.K. Lyons, R.A. Valdez. 2000. Flow and temperature recommendations for endangered fishes in the Green River downstream of Flaming Gorge Dam. Upper Colorado River Endangered Fish Recovery Program, Denver, CO.
- Shuter, B.J., J.A. MacLean, F.E.J. Fry, and H.A. Regier. 1980. Stochastic simulation of temperature effects of first-year survival of smallmouth bass. Transactions of the American Fisheries Society 109:1-34.
- U.S. Department of the Interior. 2006. Record of Decision on the operation of Flaming Gorge Dam Final Environmental Impact Statement. U.S. Department of the Interior, Bureau of Reclamation, Salt Lake City, Utah.
- U.S. Fish and Wildlife Service. 2005. Final Biological Opinion on the operation of Flaming Gorge Dam. U.S. Fish and Wildlife Service, Denver, Colorado.



## Appendix D

### May 15, 2015 Memorandum from the U.S. Fish and Wildlife Service for the 2015 Green River Spring and Base Flows to Assist in Recovery of the Endangered Species



United States Department of the Interior  
FISH AND WILDLIFE SERVICE

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

May 15, 2015

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

Memorandum

To: Mr. Brent Rhees, Director, Upper Colorado Region, U. S. Bureau of Reclamation  
Ms. Heather Patno, Chair, Flaming Gorge Technical Working Group, Bureau of Reclamation

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

Subject: 2015 Green River Spring and Base Flows to Assist in Recovery of the Endangered Fishes

This letter describes our recommendations for 2015 spring and base flows in Reach 2 (with consideration of effects in Reach 3) of the Green River for discussion by the Flaming Gorge Technical Working Group (FGTWG) in development of recommendations for Flaming Gorge Dam operations. Our intent is to work with other 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 call for flows and water temperatures to protect and assist in recovery of endangered fishes (Muth et al. 2000).

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. We apologize for the late date of our letter this year.

Spring Research Flows

We support the Upper Colorado River Endangered Fish Recovery Program's (Recovery Program) 2015 Spring Flow Request, as explained in their March 27, 2015 letter. We believe the primary objective, to time Flaming Gorge releases and resultant floodplain

connection with the Green River during presence of razorback sucker larvae, 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. Specifically, the objectives and criteria presented in their letter are consistent with the common goal of the Flow Recommendations, BO and ROD: to use the best available science to guide Flaming Gorge operations and recovery actions in an adaptive management framework. Timing Flaming Gorge releases concurrently with larvae presence is proving to be a major step forward in re-establishing a stable population of razorback sucker in the Green River basin.

*The Study Plan to Examine the Effects of Using Larval Sucker Occurrence in the Green River as a Trigger for Flaming Gorge Dam (LTSP)* details the range of experimental conditions the Recovery Program would like to assess with recognition that more than one set of flow conditions identified in their LTSP study 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 razorback sucker, we feel it is very important to follow those recommendations whenever possible.

Based on recent information provided by Ms. Heather Patno to the FGTWG, we understand that inflow into Flaming Gorge is in the moderately dry hydrologic category and the Yampa River drainage has been categorized as dry. At the time this letter is being drafted we are aware of the following current events: 1) larval razorback have been detected in the Green River (first detection: May 7, 2015); 2) flows at Jensen, Utah increased above 8,300cfs on May 8, 2015; 3) the Stewart Lake outlet gate was opened on May 9, 2015; 4) the Johnson Bottom inlet gate was opened May 11, 2015; 5) larval sampling has been expanded from standardized riverine monitoring locations into those connected floodplain habitats; and 6) Reclamation initiated their LTSP releases on May 11, 2015. We also understand that Reclamation intends to increase releases up to bypass levels (up to a total dam release of 8,600 cfs) for up to five days, which is subject to modification due to actual hydrology. It appears that 'moderately dry' LTSP study objectives will be achieved in 2015. We applaud the coordination between Reclamation and the Recovery Program for what appears to be another successful year of spring studies.

#### Justification for the LTSP under the Flaming Gorge BO and ROD

The LTSP is an important document that will assist in consistent evaluation into 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 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. The Flow Recommendations recommended utilizing up-to-date research and monitoring, such as the Bestgen et al. (2011) report:

"the collection of additional data on endangered fishes and their habitats should focus on the evaluation and possible modification of our recommendations by following an adaptive-management process" (Muth et al. 2000, p. 5-39);

as well as biological information to guide the onset of spring peak flow:

"Examples of real-time and other year-specific information to be considered in determining annual patterns of releases . . .

- Initial appearance of larval suckers in established reference sites in Reach 2 (e.g., Cliff Creek)" (Muth et al. 2000, p. 5-9, Table 5.3).

Similarly, the 2005 BO calls for adaptive management in implementing the proposed action (operations of Flaming Gorge Dam) (U.S. Fish and Wildlife Service 2005, p. 16) and set forth this process as a conservation measure:

"The adaptive management process will rely on the Recovery Program for monitoring and research studies to test the outcomes of implementing the proposed action and proposing refinements to dam operations" (U.S. Fish and Wildlife Service 2005, p. 17);

and

"[Bureau of] Reclamation, Western [Area Power Administration], and the [U.S. Fish and Wildlife] Service will use any new information collected in these studies to determine the need for management actions or modification of operations as determined appropriate" (U.S. Fish and Wildlife Service 2005, p. 17).

Therefore, we believe that the Recovery Program's 2015 Spring Flow Request and implementation of the LTSP are supported by the 2005 BO and we support the Bureau of Reclamation's (Reclamation) 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 2015 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 2015 Spring Flow Request and LTSP, and consider that doing so will meet Reclamation's responsibility to the ROD objectives in 2015.

#### Base flow operations

Because of projected drier than average year conditions, we believe that Green River base flow augmentation is a very important consideration for 2015. We propose the following approach to base flow operations in 2015, which is heavily influenced by a recent report presented to the Recovery Program that summarizes 33 years of Age-0 Colorado pikeminnow collection information in Green River Reaches 2 and 3 (Bestgen and Hill 2014; *in draft*). Here we excerpt from the author's (21) draft conclusions and (10) draft recommendations, which will serve as the primary basis for our 2015 baseflow request:

- *Conclusion - Age-0 Colorado pikeminnow abundance declined in both the middle and lower Green River reaches over time, especially since about 1994.*
- *Conclusion - Middle Green River base flows in the range of 51-85 m<sup>3</sup>/sec (1,800-3,000 ft<sup>3</sup>/sec) were consistent with higher densities of age-0 Colorado pikeminnow in autumn and with more backwater habitat.*
- *Conclusion - Lower Green River base flows in the range of 62-108 m<sup>3</sup>/sec (2,200-3,800 ft<sup>3</sup>/sec) were consistent with higher densities of age-0 Colorado pikeminnow in autumn and with higher backwater habitat availability; the existing upper end of flow ranges in wetter classifications may need to be reduced. Flow recommendations for the lower Green River naturally follow from flows in the upstream middle Green River.*
- *Conclusion - Timing of the onset of base flow conditions should be linked with first presence of Colorado pikeminnow larval drift in the lower Yampa River to ensure adequate backwater conditions throughout the reproductive period and longer growing seasons for age-0 Colorado pikeminnow.*
- *Recommendation - Initiate immediately, an experimental program of base flows in the middle and lower Green River that are higher than presently recommended for average and drier hydrologic conditions and begin those flows earlier in summer, with a goal to bolster populations of age-0, juvenile, and eventually adult, Colorado pikeminnow abundance in the Green River.*

#### Base Flow Request:

As per Reclamation's *Proposed Flow and Temperature Objectives for 2015* document, base flows in Reaches 1 and 2 should be managed to fall within the base flow ranges described in the Flow Recommendations based on the observed April through July unregulated inflow into Flaming Gorge Reservoir. April through July unregulated inflow into Flaming Gorge Reservoir has been categorized as 'moderately dry' in 2015. Pursuant to the Flow Recommendations, during the August through November base-flow period, the daily flows should be within  $\pm 40\%$  of mean base flow. The recommended 'moderately dry' Reach 2 baseflow range from the Flow Recommendations is 1,100 – 1,500 cfs. When we apply the summer seasonal variability of + 40% the 'moderately dry' category shifts to 1,540 - 2,100 cfs. Consistent with the new information presented in Bestgen and Hill (2014; *in draft*), we request that Reclamation maintain a baseflow of

≥1,900 cfs in Reach 2 through September 30, 2015. The 30 September end date is consistent with the duration of time needed to maintain conditions for improved growth and survival of age-0 Colorado pikeminnow. We understand that Reclamation may not be able to maintain that target base flow in Reach 2 beyond September 30, 2015 and still balance annual operations.

We believe that the Flow Recommendations intended that seasonal variability be incorporated into dam operations to assist in the recovery of endangered fishes and accommodate natural variability, but not allow for manipulation that targets a specific operational pattern. Our 2015 base flow request, which complies with the ROD and the BO, is consistent with the intent of the flow recommendations, is based on information gathered by the Recovery Program, and responds to current biological conditions in the Green River system including reduced survival of age-0 Colorado pikeminnow.

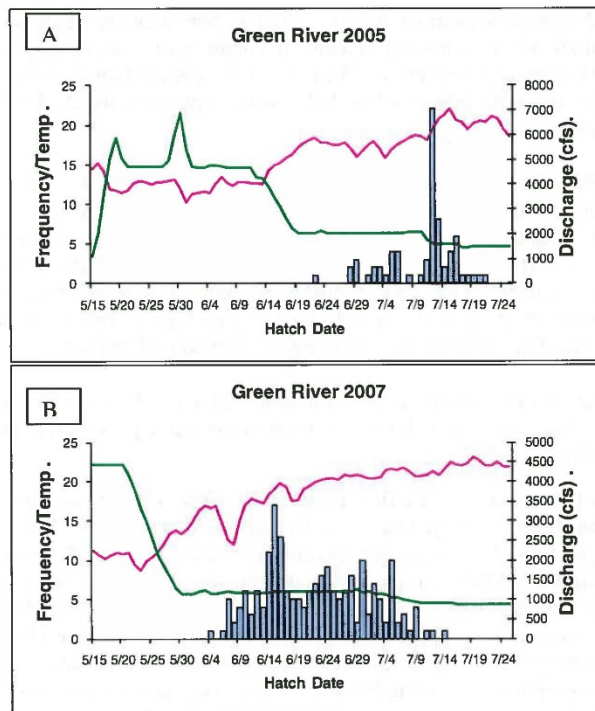
Our rationale for requesting elevated base flows through September 30 is consistent with our requests in 2008 - 2013, and is now bolstered by the information presented in Bestgen and Hill (2014; *in draft*).

A secondary benefit of elevating the base flow target in Reach 2 and the associated increased releases from Flaming Gorge Dam (at least through September 30, 2015) is the deleterious effect higher flows have on spawning time and growth of nonnative and predaceous smallmouth bass in Reach 1 and to a lesser extent in the upper portions of Reach 2. To illustrate this point we provide a graphical comparison of two Reach 1 base flow hydrologies and thermal regimes (years 2005 and 2007) and the resultant effect on smallmouth bass spawning chronology (Figure 1). During a relatively wet and cool year (2005), smallmouth bass spawning occurred nearly 3 weeks later than during a drier, warmer year (2007). The same relationship was observed in related investigations on the Yampa River.

Also, preliminary information from population dynamics modeling of smallmouth bass in the upper Colorado River basin indicate that any disruption of early season spawning nests have the largest reductions to future sub-adult and adult density (Breton et al. 2015, *in draft*). Furthermore, Breton et al. recommend undertaking any means of early season nest disturbance, including flow releases, to reduce abundance of invasive smallmouth bass. Elevated releases from Flaming Gorge to primarily benefit Colorado pikeminnow will therefore also delay spawning and reduce growth of smallmouth bass.

The Flow Recommendations call for a base flow range of 1,500 – 3,400 cfs in Reach 3 during 'moderately dry' hydrologic years. Bestgen and Hill (2014; *in draft*) recommend a preferred base flow range of 2,200 – 3,800 cfs for this lower Green River reach in all years. In drier than average years, the Green River between the Jensen, Utah and Green River, Utah gauges can become a 'losing' reach, where substantial volumes of flow are subsumed into the alluvium and are unavailable as surface water. Our Reach 2 base flow request of ≥1,900 cfs may support the lower end of the Flow Recommendation base flow range in Reach 3. It is important to provide preferred flows in this important reach of the Green River, because in recent years, we have learned the critical role lower Green River nursery habitats play in Colorado pikeminnow population viability (Bestgen et al. 2010).





**Figure 1. A comparison of flow (green), temperature (purple), and smallmouth bass hatching dates (bars) in Lodore and Whirlpool canyons (Green River - Reach 1 and upper Reach 2). A) 2005 conditions included higher base flows and cooler temps; B) 2007 conditions included lower base flows and warmer temps. Figures excerpted from Recovery Program Project #115 2009 Annual Report (preliminary information)<sup>1</sup>**

### Conclusions

In summary, we request that Reclamation:

- Time spring bypass flow releases (up to 8,600 cfs) for up to five days (subject to modification based on actual hydrology) 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

<sup>1</sup> Available online at: <http://coloradoriverrecovery.org/documents-publications/work-plan-documents/arpts/2009/anna/115.pdf>

- Enhance summer base flows in Reach 2 of the Green River by maintaining  $\geq 1,900$  cfs through September 30, 2015.

We believe that data gathered by the Recovery Program make a strong case for these proposed operations in 2015 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 BOs 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 FGTWG process. If you have any questions or concerns, please contact Paul Abate at 801-975-3330 x130.

### Literature Cited

- Bestgen, K.R., G.B. Haines, and A.A. Hill. 2011. Synthesis of floodplain wetland information: timing of razorback sucker reproduction in the Green River, Utah, related to streamflow, water temperature, and floodplain wetland availability. Final Report to the Upper Colorado River Endangered Fish Recovery Program. Larval Fish Laboratory Contribution 163.
- Bestgen, K.R., J. A. Hawkins, G. C. White, C. D. Walford, P. Badame, and L. Monroe. 2010. Population Status of Colorado Pikeminnow in the Green River Basin, Utah and Colorado 2006-2008. Final Report. Colorado River Recovery Implementation Program Project Number 128 Larval Fish Laboratory Contribution 161
- Bestgen, K.R. and A. Hill. 2014. Reproduction, abundance, and recruitment dynamics of young Colorado pikeminnow in the Green River Basin, 1979-2012. Larval Fish Laboratory Contribution 183, *Draft*
- Breton, A.R., D.L. Winkelman, K.R. Bestgen, and J.A. Hawkins. Population Dynamics Modeling of Introduced Smallmouth Bass in the Upper Colorado River Basin. Final report to the Upper Colorado River Endangered Fish Recovery Program, Denver, Colorado. Larval Fish Laboratory Contribution 186.
- Muth, R.T., L.W. Crist, K.E. LaGory, J.W. Hayse, K.R. Bestgen, T.P. Ryan, J.K. Lyons, R.A. Valdez. 2000. Flow and temperature recommendations for endangered fishes in the Green River downstream of Flaming Gorge Dam. Upper Colorado River Endangered Fish Recovery Program, Denver, CO.
- Shuter, B.J., J.A. MacLean, F.E.J. Fry, and H.A. Regier. 1980. Stochastic simulation of temperature effects of first-year survival of smallmouth bass. Transactions of the American Fisheries Society 109:1-34.
- U.S. Department of the Interior. 2006. Record of Decision on the operation of Flaming Gorge Dam Final Environmental Impact Statement. U.S. Department of the Interior, Bureau of Reclamation, Salt Lake City, Utah.
- U.S. Fish and Wildlife Service. 2005. Final Biological Opinion on the operation of Flaming Gorge Dam. U.S. Fish and Wildlife Service, Denver, Colorado.

## Appendix E

# USFWS Clarification of May 15, 2015 Green River Spring and Base Flow Recommendation

11/29/2016

DEPARTMENT OF THE INTERIOR Mail - USFWS Clarification of May 15, 2015 Green River Spring and Base Flow Recommendation



Patno, Heather <hpatno@usbr.gov>

### USFWS Clarification of May 15, 2015 Green River Spring and Base Flow Recommendation

6 messages

Larry Crist <Larry\_Crist@fws.gov>

Tue, Jun 9, 2015 at 10:09 AM

To: Brent Rhees <brhees@usbr.gov>

Cc: Heather Patno <hpatno@usbr.gov>, Paul Abate <paul\_abate@fws.gov>, Tom Chart <tom\_chart@fws.gov>

Brent,

There was some confusion following the Service's initial flow recommendations this year and I wanted to provide the following information to supplement the U.S. Fish and Wildlife Service's (Service) 2015 Green River spring and base flow recommendation letter sent to you and Ms. Heather Patno, dated May 15, 2015. Based on a conversation with Ms. Patno on May 19 and a subsequent discussion with the Flaming Gorge Technical Work Group (FGTWG) on May 21, 2015, I agreed to provide clarification (via electronic mail) on three topics: 1) the experimental nature of our base flow request; 2) better recognition of the role of Reach 1 flows, i.e. Flaming Gorge Dam releases, in achieving our requested Reach 2 base flow target; 3) the expectation that dam operations to achieve requested base flow targets in Reach 2 should meet Reach 3 based flow targets.

To preface this discussion, it is important to note that the Service's 2015 base flow request was different than requests we made in earlier years. In our most recent letter we requested a 'moderately dry year' base flow target for Reach 2; in previous years we specifically requested a Reach 1 flow regime intended to create conditions that would favor endangered Colorado pikeminnow early life stage survival in Reach 2. The shift in our request was based on a draft synthesis of Colorado pikeminnow larval drift / Age-0 survival as a function of environmental correlates in Reach 2 (Bestgen and Hill 2014; *draft* - as cited in our letter). Hopefully, what follows captures the hydrologic uncertainty in meeting any flow request and that it is not our intention to request dam operations that do not comply with your 2006 Flaming Gorge Record of Decision.

#### 1. 'Experimental Flows'

Our Reach 2 base flow request was based on conclusions and recommendations from a draft backwater synthesis report, which has not been fully vetted through the Recovery Program's report approval process. However, the Service considers information presented in that draft report as the best available information on Reach 2 base flow management to assist in the recovery of the endangered fish. Therefore we ask that Reclamation consider our Reach 2 base flow request as an experiment which, applies the ROD-recognized (+) 40% summer seasonal variability to the appropriate 'moderately dry' base flow range through September 30, 2015.

#### 2. The significant contribution Flaming Gorge Dam releases have on Reach 2 base flows

When the Service wrote our base flow request we were aware that it might be difficult for Reclamation to meet 1,900 cfs in Reach 2, because summertime contributions from the Yampa River could be very low. With the following language we tried to recognize that flows in Reach 2 might need to drop below 1,900 cfs after September 30, 2015 due to limited water availability: *We understand that Reclamation may not be able to maintain that target base flow in Reach 2 beyond September 30, 2015 and still balance annual operations.*

[https://mail.google.com/mail/u/0/?ui=2&ik=57639fb547&view=pt&q=from%3Alarry\\_crist%40fws.gov&q=true&search=query&th=14dd91539a618624&siml=14...](https://mail.google.com/mail/u/0/?ui=2&ik=57639fb547&view=pt&q=from%3Alarry_crist%40fws.gov&q=true&search=query&th=14dd91539a618624&siml=14...) 1/3

11/29/2016

DEPARTMENT OF THE INTERIOR Mail - USFWS Clarification of May 15, 2015 Green River Spring and Base Flow Recommendation

Furthermore, and as stated in our letter, we expected that the FGTWG would take our request and temper it with current hydrologic conditions through the summer and they might need to modify their base flow recommendation accordingly. At the end of our letter we stated, *We believe that data gathered by the Recovery Program make a strong case for these proposed operations in 2015 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.*

We will strive to better recognize the hydrologic uncertainty associated with our flow requests in future years.

3. Reach 3

Also consistent with information provided in the draft report was the importance of beneficial nursery habitat conditions in Reach 3 to the health of the entire Green River pikeminnow population. However, the Service would like to clarify language in our May 15, 2015 letter by stating that we agree that Reclamation's primary concern is to operate the dam consistent with the ROD to achieve base flow targets in Reach 2, which we assume will meet the flow recommendations in Reach 3.

I hope this clarifies our May 15 letter but if you have any questions please feel free to contact myself or Paul Abate in our office.

Larry Crist

Utah Field Supervisor

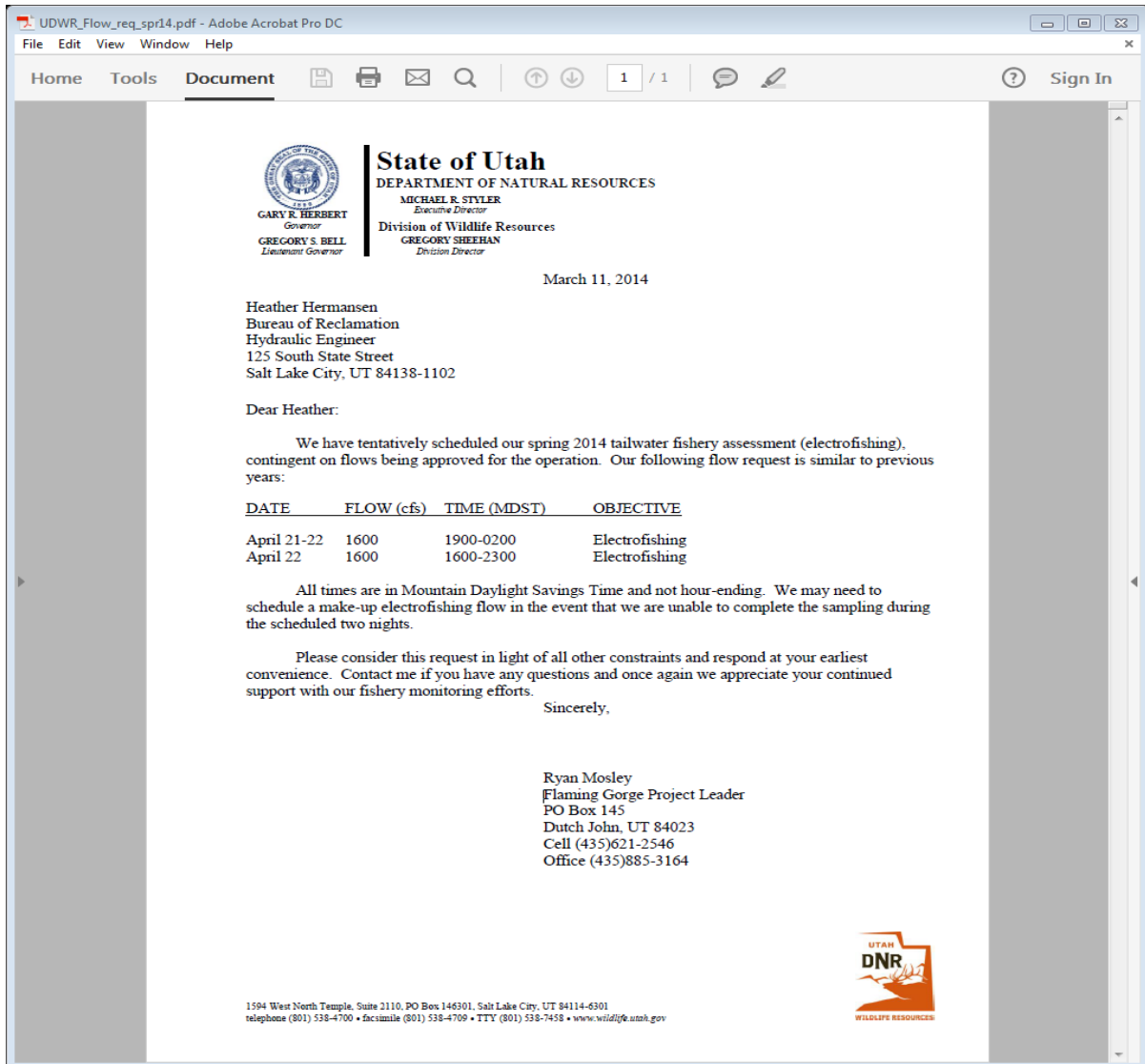
USFWS, Ecological Services

Office: 801-975-3330 X126

Fax: 801-975-3331

## Appendix F

### Comment Letters Received through the Flaming Gorge Working Group Process





GROGA FGWG Comments.pdf - Adobe Acrobat Pro DC

File Edit View Window Help

Home Tools Document 1 / 1 Sign In

---

**Re: FGWG**  
1 message

---

**Heather Patno** <hpatno@usbr.gov> Fri, Mar 7, 2014 at 3:59 PM  
To: Doug Burton <dougburton@ymail.com>  
Cc: Malcolm Wilson <mmwilson@usbr.gov>

Doug,

Thank you for your email. Reclamation understands the Green River is an important resource for multiple interests and the need for a balanced approach. Your concerns will be addressed at the spring Flaming Gorge Working Group meeting, although your participation in person at the meeting will be missed. I will definitely get the webinar info to you before the FGWG.

I hope you are doing well and that you will enjoy the water releases planned this year. I will be sending out hydrologic updates as we move closer to the peak flow season.

Best.  
Heather

Sent from my iPhone.

On Mar 6, 2014, at 12:52 PM, Doug Burton <dougburton@ymail.com> wrote:

Good Morning, Heather. We are still a ways out from the FGWG meeting in late April. Unfortunately, I will be out of state that week so I cannot attend in person. I will endeavor to be on the webcast. Please email directions prior to the meeting.

I'm writing to remind you of the position of the angling community regarding flows. I would hope that our concerns can be addressed at the FGWG meeting. It seems that most of the decisions are practically set prior to the FGWG meetings which we can attend. I know that it is not news that we prefer flows above the 800 cfs. minimum whenever possible, along with the smallest daily fluctuation possible (particularly during the fishing day — approx. 6 am to 6 pm).

The bypass flows during the past few spring releases have proven to be excellent for the fishery, confirmed by the anecdotal evidence of guides and anglers as well as scientifically by the "bug lab". Happy bugs make for happy fish, which make for happy fishermen! As anglers we would hope for another bypass flow during this year's spring release. I understand that most of the parameters are mostly fixed by the ROD... However, where there is "wiggle room" we would love to trade some amount of durational volume for an equal amount of increase in flow volume.

With storage down across all the Upper Colorado Region, I know that this is going to be a challenging year, even if we continue to receive decent precipitation. I am anxious to hear how "our" Flaming Gorge water may be used to assist in filling downstream units. I hope we have enough to share!

thanks for 'listening'

Doug Burton GROGA



