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Annual Report of Operations for Flaming Gorge Dam Water Year 2019

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Introduction

This report details the operations of Flaming Gorge Dam during water year (WY) 2019 and is produced pursuant to the February 2006 Record of Decision for the Operation of Flaming Gorge Dam (ROD) (USBR, 2006), the Operation of Flaming Gorge Dam Final Environmental Impact Statement (FEIS) (USBR, 2005) and the 2005 Final Biological Opinion (BO) on the Operation of Flaming Gorge Dam (USFWS, 2005). This is the fourteenth year of operations of Flaming Gorge Dam under the ROD. This report will entail that information as well as hydrologic conditions to support flow regimes.

The ROD directs Reclamation to operate to achieve, to the extent possible, the Flow Recommendations as described in the FEIS (USBR, 2005). 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).

As described in ROD (USBR, 2006): *“The administrative record referenced in Section 2.5.3 of the EIS and on page 4 above will include*

- *an annual report to document the technical working group’s recommendations and discussions;*
- *Reclamation’s target flow regimes on a season by season basis;*
- *analysis of previous operations as related to recommendations and targets;*
- *a long term analysis of the frequency of achieving the flow thresholds described in the 2000 Flow and Temperature Recommendations (Muth et al., 2000).”*

and stated in the FEIS (USBR, 2005)

- *“An administrative record of the operational decisionmaking would be maintained and available to the public. This record would include analysis of previous operations and the effectiveness of achieving desired targets on a year-by-year basis.*
- *Technical Working Group meetings would also provide an opportunity to discuss historic operations in terms of the accomplishments and shortcomings of meeting the 2000 Flow and Temperature Recommendations. Reclamation would maintain an administrative record of these meetings to document the planning process.”*

Finally, the USFWS 2005 BO (USFWS, 2005) has requirements for an annual report. It is as follows: *“Reclamation will provide to the Service and Recovery Program a concise annual operations report. A primary purpose of the annual report is to provide an assessment of how well operations at Flaming Gorge Dam contributed to meeting flow targets. In addition, the annual report will provide a record of operations as identified under the incidental take statement. Basic information that should be summarized includes the following:*

- *A review of the April-July unregulated inflow forecasts provided by the National Weather Service via the River Forecast Center that were used to classify Green River hydrology.*
- *Additional factors that were used to determine which flow recommendation hydrologic category was targeted (e.g. Flaming Gorge Reservoir elevation, Yampa hydrology, past operations, power needs, Technical Working Group conversations, etc.),*

- *An accounting of actual flows and operations: spring flows and baseflows (reference USGS gages at Yampa River at Deerlodge, Green River at Greendale, Utah Jensen, Ut, and near Green River, Ut),*
- *Results from Reclamation's spillway inspections,*
- *A summary of daily and seasonal fluctuations at Jensen, Utah,*
- *An overview of Reclamation's operations to meet thermal targets,*
- *An accounting of the actual thermal regime in upper and lower Lodore Canyon and the lower Yampa River based on available information.*
- *Recommendations to refine operations.*

Operational Plan Development and Process for Water Year 2019

In 2019, the operational process developed in 2006 was used to operate Flaming Gorge Dam. The operational plan development is based on the FEIS (Section 2.5.3) (USBR, 2005) and the commitments in the ROD (Sections VI, and VII) (USBR, 2006). The four-step process is described below.

Four-Step Process of developing and finalizing the Annual Operation Plan

The four-step process is a term used to discuss the ROD requested, proposed, development, comment/input and finalization of the Flaming Gorge Operation Plan. This process will concurrently fulfill informal consultation and Endangered Species Act coordination requirements for the action agencies. Below is a brief description of the four-step process,

1. Recovery Program may provide a request
2. A technical working group, known as the Flaming Gorge Technical Working Group (FGTWG), consisting of biologists and hydrologists from Reclamation, Western Area Power Administration (WAPA) and the Fish and Wildlife Service (FWS), will annually propose an initial flow regime to the existing Flaming Gorge Working Group.
3. The Flaming Gorge Working Group will then provide comments and input on the proposed flows relative to all resource concerns.
4. Reclamation will then make a determination on how to incorporate the additional information into the annual operational plan.

Pertinent dates of Four Step Process 2019

The Upper Colorado River Endangered Fish Recovery Program (Recovery Program) request was received on March 22, 2019. The key portion of the request is presented below. The Larval Trigger Study Plan (LTSP) refers to 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) (2012)).

THE RECOVERY PROGRAM'S 2019 GREEN RIVER FLOW REQUEST:

The Recovery Program's Green River Flow Request for 2019 has two components: a Larval Trigger Study Plan (LTSP)[LTSP, 2012] spring peak, and experimentation with alternative Reach 2 base flow target ranges as can be accomplished with the ROD seasonal base flow variability. The Recovery Program is committed to evaluating the biological effects of these experiments as well as the potential effects to river dynamics and other resources.

The Recovery Program believes all aspects of this request are supported by sound science, and we understand that achieving all components may not be possible based on water availability and operational considerations. The Recovery Program assumes that our 2019 flow requests will be refined in concert with the FGTWG using the best available flow forecast information, status and biological needs of the species, the readiness of necessary data collection activities, and other information.

To assist Reclamation and the FGTWG, should such deliberations be necessary, the Recovery Program prioritizes these flow experiments as follows:

- *Priority 1 - Experimental LTSP spring peak (as per LTSP ad hoc committee 2012)*
- *Priority 2 - Experimental revised Reach 2 base flow ranges (as, per Bestgen and Hill 2016a) [Bestgen and Hill, 2016], as feasible within existing authority under the 2006 ROD, subject to the limitations (i.e., pending study plans) described above in 2019.*

The FGTWG met on the week of March 18, 2019 and finalized the proposal on March 22, 2019.

Flaming Gorge Work Group Meetings were held on March 7, 2019 in Price, Utah; on April 18, 2019 in Vernal, Utah, and on August 15, 2020 in Price, Utah.

The Flaming Gorge Operation Plan - May 2019 through April 2020 (FG-Ops2019) was concurred by Kathleen Callister, Resources Management Division Chief, Wayne Pullan, Provo Area Office Manager, and Talmadge Oxford, Upper Colorado Power Manager and approved by the Upper Colorado Regional Director Brent Rhees on May 3, 2019.

On May 29, 2019, Kathleen E Callister sent notice per the FG-Ops2019 to initiate the LTSP (2012) spring operation flows via email to the Power Office.

On July 11, 2019 Tom Chart from the Recovery Program sent notice per the FG-Ops2019 to initiate the *Reproduction, abundance, and recruitment dynamics of young Colorado pikeminnow in the Green River Basin, Utah and Colorado, 1979-2012* (Bestgen and Hill, 2016 – aka Colorado Pikeminnow) study summer base flow via email to the Power Office.

Operation Decision

The Recovery Program request, FGTWG proposal and FG-Ops2019 all had the same two elements concerning the flow regimes for the LTSP (2012) spring peak and alternative Reach 2 base flow target ranges for use with the ROD seasonal base flow variability.

The Recovery Program's 2019 Spring Flow Request established a release regime that facilitated further research under the LTSP. The LTSP's primary research objective was 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 second flow regime request was to use the seasonal base flow flexibility identified in the 2006 ROD to achieve revised range of summer base flows (Bestgen and Hill, 2016) intended to improve survival of age-0 Colorado pikeminnow (*Ptychocheilus lucius*). This request from the Recovery Program did not have a valid study plan at the time of implementation. It was determined that the requested summer base flows could be achieved for all hydrologic conditions within the +/-40% flexibility allowed in the 2000 Flow and Temperature Recommendations (Muth et al., 2000). Therefore, to the maximum extent possible the objective flows in Reach 2 were attempted between the Request and 2000 Flow and Temperature Recommendations (Muth

et al., 2000).

The FG-Ops2019 was developed and approved by Reclamation. The FG-Ops2019 detailed operational hydrograph descriptions for average (below and above median) and moderately wet scenarios for the spring peak and the summer-autumn and winter base flow periods. The summer-autumn and winter base flows periods followed the 2000 Flow and Temperature Recommendations (Muth et al., 2000).

Hydrology

Reservoir storage in Flaming Gorge increased slightly during WY 2019. At the beginning of WY 2019, Flaming Gorge storage was 90 percent of live capacity at elevation 6,030.75 feet, with 3,380,000-acre feet in storage. The unregulated inflow to Flaming Gorge during WY 2019 was 1,550,000-acre feet which was 107 percent of average. At the end of the WY, Flaming Gorge storage was at 91 percent of live capacity at elevation 6,031.57 feet, with 3,410,000-acre feet resulting in a net increase during WY 2019 of 32,000-acre feet.

Table 1 –April – July Forecasts and Spring and Base Flow Hydrologic Classifications

Year	May 1st A-J Unregulated Inflow Forecast (1000 AF)	Spring Hydrologic Classification	Observed A-J Unregulated Inflow (1000 AF)	Base Flow Hydrologic Classification
2006	1,100	Average (Abv Median)	724	Moderately Dry
2007	500	Moderately Dry	370	Dry
2008	820	Average (Blw Median)	728	Moderately Dry
2009	890	Average (Blw Median)	1,197	Average (Abv Median)
2010	515	Moderately Dry	705	Moderately Dry
2011	1,660	Moderately Wet	1,925	Wet
2012	630	Moderately Dry	570	Moderately Dry
2013	480	Moderately Dry	361	Dry
2014	1,320	Average (Abv Median)	1,159	Average (Blw Median)
2015	570	Moderately Dry	1,035	Average (Blw Median)
2016	770	Moderately Dry	1,047	Average (Blw Median)
2017	2,260	Wet	2,214	Wet
2018	1,000	Average (Blw Median)	1,118	Average (Abv Median)
2019	1,050	Average (Blw Median)	1,179	Average (Abv Median)

Autumn and Winter Base Flow for Water Year 2019

Base Flow Calculation Autumn and Winter Water Year 2019 -- The autumn and winter base flow target were established using October 2018 Most 24-Month Study. To achieve a 6,027 feet elevation by March 1, starting at a pool elevation of 6,030.70 feet, approximately 1,620 cfs of dam releases achieved this condition. This was established as the base flow target for the October-November period. Releases in December 2018, January 2019, and February 2019 were 2,000 cfs which was approximately 24% above this base flow target which is allowed under the Flaming Gorge ROD. As a result of this elevated base flow the pool elevation on March 1, 2019 was 6,025.45 feet.

Two base flow objectives were targeted during WY 2019.

3% Daily Flow Changes -- As described in the FEIS, flow changes no greater than 3% of the total river flow are to occur during the base flow period. During WY 2019, release changes during the base flow periods were limited to no more than 50 cfs per day and this largely achieved the daily flow change restriction throughout the base flow periods during WY 2019

Jensen 0.1- stage change -- As described in the 2000 Flow and Temperature Recommendations (Muth et al., 2000) “*Flow variation resulting from hydropower generation at Flaming Gorge Dam should be limited to produce no more than a 0.1-m stage change within a day at the USGS gage near Jensen, Utah.*”

In WY 2019, during the base flow periods Reclamation coordinated with WAPA to establish Flaming Gorge release patterns for power production. This is to meet the requirement that hydropower generation at Flaming Gorge dam should produce no more than 0.1-m stage change at the USGS Jensen Gage. To estimate the impact of proposed release patterns, a routing model called the SSARR model was used to predict stage changes under various steady flow conditions for the Yampa River. Based on results from the SSARR model, a release pattern was developed which optimized power production that also met the stage change requirement of the FEIS. As conditions changed, the release pattern was modified to attempt to maintain this daily stage change restriction.

The observed 24-hour stages during the months of October and November 2018 at the USGS Jensen gage were all below 0.15 meters. During the months of December (2018) and January (2019), observed 24-hour stage changes remained below 0.12 meters while in February (2019) observed stage changes remained at or below 0.15 meters.

USGS Gage – Greendale, UT – The autumn and winter base flow at Reach 1 targets per the 2000 Flow and Temperature Recommendations for the average condition is 800 – 2,200 cfs. The maximum and minimum at a +/- 25% is 600 – 2,750 cfs. Flows ranged from October through February to approximately 1,600 cfs to 2,100 cfs which was measured at the USGS gage Greendale, UT.

USGS Gage – Yampa at Deerlodge Park, CO – The Yampa at Deerlodge Park (aka Yampa) gage supplements Reach 2 Targets. For the autumn and winter base flow the Yampa provided approximately 50 cfs to 590 cfs with an average near 300 cfs.

USGS Gage – Jensen, UT -- The autumn and winter base flow at Reach 2 targets per the 2000 Flow and Temperature Recommendations for the average condition is 1,500 – 2,400 cfs. The maximum and minimum at a +/- 25% is 1,125 – 3,000 cfs. Flows ranged from October through February to approximately 1,900 cfs to 2,700 cfs which was measured at the USGS gage Green River near Jensen, UT. Two distinct averages were observed first the autumn near 2,000 cfs and for the winter near 2,500 cfs.

USGS Gage – Green River, UT -- The autumn and winter base flow at Reach 3 targets per the 2000 Flow and Temperature Recommendations for the average condition is 1,800 – 4,200 cfs. The maximum and minimum at a +/- 25% is 1,350 – 5,250 cfs. Flows ranged from October

through February to approximately 1,330 cfs to 3,420 cfs which was measured at the USGS gage Green River near Jensen, UT. The bulk of the flows range from 2,200 to 3,200 cfs.

Spring Operations

Flaming Gorge Dam operations in 2019 were conducted in compliance with the 2006 Flaming Gorge ROD (USBR, 2006). The Razorback sucker larvae were initially detected on May 21, 2019. After public notification, releases from Flaming Gorge Dam were increased to full powerplant capacity starting after June 3, 2019. Bypass releases were utilized to bring the total release from Flaming Gorge Dam to 8,600 cfs for 7 days. Full power plant capacity and bypass releases were sustained to enhance floodplain inundation in the middle Green River for the benefit of endangered species.

In total, Flaming Gorge Dam released at or above powerplant capacity releases of 4,600 cfs for 17 days during the April through July runoff period. This bypass release volume totaled 99,620-acre feet. Yampa River flows at the USGS Yampa Deerlodge gage peaked at 15,600 cfs on June 23, 2019. The peak release from Flaming Gorge Dam occurred before the Yampa River peak to support larval entrainment and reservoir management during the high spring flows. Flows measured on the Green River at the USGS Jensen gage reached levels at or above 18,600 cfs for 9 days between June 9 and June 18, 2019 with a peak of 20,800 cfs on June 11, 2019. Flows measured on the Green River at Green River USGS gage reached levels at or above 22,000 cfs for 18 days between June 9 and June 26, 2019 with a daily average peak of 28,600 cfs on June 19, 2019.

Hydrologic conditions in the Upper Green River Basin upstream of Flaming Gorge Dam were above average in WY 2019. Snowpack development tracked near the median snow water equivalent level throughout the season. Near average fall precipitation conditions maintaining soil moisture resulting in near average runoff forecasts. Peak snow water equivalent reached 115 percent of seasonal median on April 17, 2019. The July forecast for the April through July inflow into Flaming Gorge Reservoir was 1,220,000-acre feet, or 124 percent of average. The observed inflow during the April to July season was 1,180,000-acre feet, or 120 percent of average.

Observed flow volumes from the Yampa River Basin were significantly different than projected flow volumes from the Upper Green River Basin and fell into the 30%-10% exceedance value. The 2006 Flaming Gorge ROD (USBR, 2006) hydrologic classification for the Upper Green was characterized as Average (above median). It was determined that, with the similar conditions in the Yampa River Basin, the hydrologic classification was average and the LTSP (2012) hydrologic classification was Average (above median) based on the June forecast. Flows at the USGS Jensen gage were at least 18,600 cfs for 9 days, which met Recovery Program LTSP request for this hydrologic condition.

Ramp down rates were consistent with 2000 Flow and Temperature Recommendations (Muth et al., 2000) at 500 cfs/day while below power plant capacity. A ramp down rate of 1,000 cfs/day was used the release rate from 8,600 to 4,600 cfs, which has historically been used to ramp down above power plant capacity to reduce the duration of colder water releases from bypass.

Base Flow Summer 2019

Base Flow Summer 2019 -- Hydrologic summer base flows for WY 2019 started in the first part of August 2019. From the 2000 Flow and Temperature Recommendations (Muth et al., 2000) for an average condition the beginning of the base flow season is typically about mid-July and

for a moderately wet condition the base flow season typically starts about August 1. The WY 2019 base flow was determined using both unregulated flow on the Green River and flow at Yampa River at Deerlodge. The Colorado Basin River Forecast Center (CBRFC) forecasted August 2019 unregulated inflow volume into the Flaming Gorge dam was about 85,000-acre feet which was approximately 120% of average. The average inflow for August month was 1,382 cfs calculated from the monthly CBRFC forecast. This inflow was not achieved until after August 11, 2019. The August 11, 2019 unregulated inflow into the Flaming Gorge Dam was the earliest the base flow season could be determined to have started based on this data. The August 2019 flow volume at the USGS Yampa Deerlodge gage was about 34,000-acre feet which was approximately 132% of average. The average flow for this August was 552 cfs. This flow was not achieved until after August 14, 2019. The start of the base flow season was determined to start based on flows measured at the USGS Yampa Deerlodge gage when flows measured between 400 and 600 cfs. This occurred on August 11th and ended on August 19th. This correlate very well with the average August base flow calculation below.

Summer base flow target in Reach 2 began on August 8 and the proposed flow targets from the Colorado Pikeminnow proposed study for an average condition is 2,000 - 2,600 cfs and for the 2000 Flow and Temperature Recommendations (Muth et al., 2000) is 1,500 - 2,400 cfs. The upper range of Colorado Pikeminnow study proposed flow started on August 3, at least 8 days before the hydrologic base flow period. The start and end of ramping occurred on August 7th and ended August 15th with a dam release of 1,900 cfs. Of the 59 days during the summer Base flow period 3 days were above 2,600 cfs at the USGS Jensen gage (Reach 2). The Reach 1 targets for 2000 Flow and Temperature Recommendations (Muth et al., 2000) is 800 cfs to 2,200 cfs. Targeted average daily releases ranged from 1,500 cfs to 1,900 cfs during the summer base flow period in Reach 1. Observed releases ranged from 1,440 cfs to 1,925 cfs, and two distinct releases can be observed that ranged near 1,500 cfs and 1,900 cfs. The Reach 3 targets for 2000 Flow and Temperature Recommendations (Muth et al., 2000) is 1,800 cfs to 4,200 cfs. Flows measured at the USGS gage Green River, Utah varied from about 2,400 cfs to 3,700 cfs.

Summer 2019 base flow calculation -- The April through July 2019 unregulated inflow was 1,180,000-acre feet (120 percent of average) which fell into an average hydrologic condition. Using the August 2019 Most Probable 24 Month Study the average releases rate from Flaming Gorge Dam to achieve the March 1 upper level drawdown target pool elevation of 6,027 was 1,937 cfs. This release rate also achieved a base flow in Reach 2 that was within the desired base flow range for the average hydrological classification. The August and September 2019 average daily release rate was established at 1,900 cfs and this was slightly lower than calculated release rate but still resulted in achieving a base flow rate in Reach 2 that was within the desired range.

3% changes – During the period from August 8, 2019 through August 15, 2019 daily average release changes were made to increase releases from 1,500 cfs to 1,900 cfs. Daily changes were limited to no more than 50 cfs per day which was within the 3% daily change limit described in the FEIS. No other base flow changes occurred in WY 2019.

Jensen 0.1-stage change – In WY 2019, during the base flow periods Reclamation coordinated with WAPA to establish Flaming Gorge release patterns for power production. This is to meet the requirement that hydropower generation at Flaming Gorge dam should produce no more than

0.1-m stage change at the USGS Jensen Gage. Observed stage changes during this summer base flow season were at or below 0.12-meters from August 11th through September 30th, 2019.

Spillway Inspection

Per the 2005 BO it is expected that spillway use would be limited to those times it was hydrologically necessary. The use of the spillway will only be used for extreme dam safety situation. Inspections of the structure would be made after each spill event. The Service expects Reclamation to report the results of their post-spill spillway inspections in their annual operations report. The spillway was not used in WY 2019. The spillway was inspected on June 10, 2019. The spillway, inlet, chute, walls, pier, floor, flip bucket walls and basin were inspected. These components of the spillway were either noted as Satisfactory (will fulfill the intended purpose, like new condition) and No (an issue was not observed). Also concerning the spillway a note was made that incomplete Operation and Maintenance was made and this is described as “Repair the two deteriorated areas along the left portion of the aeration slot as well as the spalls located 254-feet and 315-feet downstream of the spillway gates in the spillway tunnel”. For the 2019 inspection there are no operation and maintenance recommendation, per the Flaming Gorge Dam - Annual Site Inspection (ASI) FY 2019 Colorado River Storage Project report, concerning the spillway structure was made.

Long Term Analysis of the Frequency of Achieving the Flow Thresholds

Spring Peak Targets -- Per the ROD (USBR, 2006) long term thresholds described in the 2000 Flow and Temperature Recommendations (Muth et al., 2000) are described below. The 2019 April through July May 1st forecasted and August observed hydrologic condition during spring runoff stayed as an average hydrologic condition. Due to the implementation of the LTSP (2012), two additional hydrologic conditions were evaluated, Average below median and Average above median. The May 2019 CBRFC forecasted April through July had a volume of 1,050,000-acre feet which was an Average below median condition as described by the 2012 LTSP. The August 2019 observed April through July volume was 1,179,000-acre feet which was an Average above median hydrologic condition as described by the 2012 LTSP. According to the 2012 LTSP, for Average above median hydrological condition, flows in Reach 2 are recommended to be between 18,600 and 20,300 cfs for different durations, that is 1 to 7 days, 7 to 14 days, and greater than 14 days. According to the 2000 Flow and Temperature Recommendations, for this average condition with flows greater than 18,600 cfs for 9 days, this met the peak flow magnitude. For the peak-flow duration recommendations, 9 days were met in 2019.

Concerning base flow during the summer period (WY 2019) for an average condition this year's observed base flow for August and September averaged 2,360 cfs at the USGS Jensen gage in Reach 2. This is consistent with both the 2000 Flow and Temperature Recommendations (Muth et al., 2000) base flow as well as the Colorado Pikeminnow study proposed base flows for an average condition. Since the signing of the ROD 2006 and including this year and years where inflows were increased due to weather events 11 of 14 years were within the +/-40% of the 2000 Flow and Temperature Recommendations (Muth et al., 2000) summer base flow ranges. This is based on the April-July observed classification condition for August and September. The years 2008, 2010, 2011, 2013, and 2014 had flows outside the Reach 2 +/-40% targets. In years 2008

and 2014 this is due to short-term increases in tributary inflow resulting from weather events. In the 2010 and 2011 base flow seen on the Yampa River did not occur until later in August. Also, in 2010, Reach 2 targets were larger than +40% of maximum range but only varied near average at +46% of the base flow. In 2013 seasonal lag at the Yampa river occurred that resulted in elevated flow in late September at Reach 2.

Concerning base flow during the autumn period (WY 2019) for an average condition (based on 2018 April-July observed unregulated inflow) this year's observed base flow for August and September averaged 2,090 cfs at the USGS Jensen gage in Reach 2. This is consistent with the 2000 Flow and Temperature Recommendations (Muth et al., 2000) base flow for an average condition (1,500 to 2,400 cfs). Since the signing of the ROD 2006 and including this year and years where inflows were increased due to weather events 12 of 14 years were within the +/-40% of the 2000 Flow and Temperature Recommendations (Muth et al., 2000) autumn base flow ranges. The years 2007, 2008, 2011, 2014, and 2015 had flows outside the Reach 2 +/-40% targets. This is based on the previous WY April-July observed classification condition. In years 2007, 2011, and 2015 this is due to short-term increases in tributary inflow resulting from weather events. In years 2008 and 2014, both Dry Hydrologic classifications, flows in Reach 2 were above the +40% base flow ranges and this is due to dam minimum release constraints and the Yampa providing larger flows.

Concerning base flow during the winter period (WY 2019) for an average condition (based on 2018 April-July observed unregulated inflow) this year's observed base flow for December, January, and February predominately averaged 2,525 cfs at the USGS Jensen gage in Reach 2. The flows ranged between 2,340 to 2,670. The observed flows in Reach 2 is consistent with the 2000 Flow and Temperature Recommendations (Muth et al., 2000) base flow for an average condition (1,500 to 2,400 cfs). Since the signing of the ROD 2006 and including this year and years where inflows were increased due to weather events 11 of 13 years were within the +/-25% of the 2000 Flow and Temperature Recommendations (Muth et al., 2000) winter base flow ranges. The years 2007, 2008, 2009, 2011, 2012, 2013, 2014, 2015, 2016, 2017 and 2018 had flows outside the Reach 2 +/-25% targets. For the years 2007, 2008, 2009, 2011, 2013, 2015, 2016, and 2017, this is due to short-term increases in tributary inflow resulting from weather events. The 2011 and 2017 both April through-July observed unregulated inflow was either a moderately wet or wet and resulted in wet observed hydrologic conditions. Operations were such that releases were increased for the anticipated wet years, thus were operated above the flow recommendation. In 2012, flows in Reach decreased below -25% of base flow target and this occurred during transitioning the early period of the winter base flow periods and only lasted for three days. In 2014, a Dry Hydrologic classification, flows in Reach 2 were above the +25% base flow ranges and this is due to dam releases not being able to be below minimum releases and the Yampa providing larger flows. In 2018 a small drift from directive release from 2,800 to around 2,900 cfs resulted in Reach 2 flows being +26% and +28% of the targeted base flows in Reach 2.

The Reaches 1, 2 and 3, ROD Flow Recommendation spring objectives and the desired frequency of achievement are described in Tables 2, 3 and 4. WY 2019 is the 14th year of operations under the ROD.

Table 2 – Reach 1 ROD Flow Objectives Achievements in 2019

Spring Peak Flow Objective	Hydrologic Classification	Desired Frequency Percent of Achievement	Achieved in 2019	Achievement Rate to Date (Cumulative Frequency %)*
Peak \geq 8,600 cfs, \geq 1 day	Wet	10 %	Yes	36 %
Peak \geq power plant capacity \geq 1 day	Moderately Wet - Dry	100%	Yes	100 %

*Based on 14 years of operation under the ROD and spring hydrologic classification (2006-2019)

Table 3 – Reach 2 ROD Flow Objectives Achievements in 2019

Spring Peak Flow Objective	Hydrologic Classification	Desired Frequency Percent of Achievement	Achieved in 2019	Achievement Rate to Date (Cumulative Frequency %)*
Peak \geq 26,400, cfs \geq 1 day	Wet	10 %	No	7 %
Peak \geq 22,700, cfs \geq 2 weeks	Wet	10 %	No	7 %
Peak \geq 18,600, cfs \geq 4 weeks	Wet	10 %	No	7 %
Peak \geq 20,300, cfs \geq 1 day	Moderately Wet	30 %	Yes	29 %
Peak \geq 18,600, cfs \geq 2 weeks	Average	40 %	No	14 %
Peak \geq 18,600, cfs \geq 1 day	Average	50 %	Yes	43 %
Peak \geq 8,300, cfs \geq 1 day	Average	100 %	Yes	100 %
Peak \geq 8,300, cfs \geq 1 week	Moderately Dry	90 %	Yes	93 %
Peak \geq 8,300, cfs \geq 2 days except in extreme dry years	Dry	98 %	Yes	100 %

*Based on 14 years of operation under the ROD and spring hydrologic classification (2006-2019)

Table 4 – Reach 3 ROD Flow Objectives Achievements in 2019

Spring Peak Flow Objective	Hydrologic Classification	Desired Frequency Percent of Achievement	Achieved in 2019	Achievement Rate to Date (Cumulative Frequency %)*
Peak \geq 39,000, cfs \geq 1 day	Wet	10 %	No	7 %
Peak \geq 24,000, cfs \geq 2 weeks	Wet	10 %	Yes	14 %
Peak \geq 22,000, cfs \geq 4 weeks	Wet	10 %	No	7 %
Peak \geq 24,000, cfs \geq 1 day	Moderately Wet	20 %	Yes	36 %
Peak \geq 22,000, cfs \geq 2 weeks	Average	40 %	Yes	14 %
Peak \geq 22,000, cfs \geq 1 day	Average	50 %	Yes	36 %
Peak \geq 8,300, cfs \geq 1 day	Moderately Dry	100 %	Yes	100 %
Peak \geq 8,300, cfs \geq 1 week	Moderately Dry	90 %	Yes	93 %
Peak \geq 8,300, cfs \geq 2 days except in extreme dry years	Dry	98 %	Yes	100 %

*Based on 14 years of operation under the ROD and spring hydrologic classification (2006-2019)

Temperature Objectives Achieved in WY 2019

An operational plan for the selective withdrawal system (SWS) on Flaming Gorge Dam was completed by a subset of the 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 for the benefit of endangered fish.

Temperature objectives consist of:

- 1) Reach 1 (dam to Yampa River confluence): Water temperatures should be equal to or greater than 18.0 °C (64.4 °F) at Gates of Lodore for 3-5 weeks¹ starting in June - July (dry-average years) or July - August (moderately wet-wet years) coincident with drift of larval Colorado pikeminnow.
- 2) Reach 2 (Yampa River confluence to White River confluence): Green River should be no more than 5.0 °C (9°F) colder than the Yampa River during the base flow period in order to minimize thermal shock to drifting Colorado pikeminnow larvae.

Operational guidelines to achieve these objectives direct operators to achieve maximum gate elevation (40' 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.

On June 25, 2019, SWS gates were elevated to 44' below the reservoir surface and adjusted again on July 10 to 41' below the surface. Target daily average dam release temperatures (15.0 °C or 59.0 °F at the Greendale gauge immediately below Flaming Gorge Dam) were not achieved until July 21 (Figure 1; U.S. Geological Survey [USGS] 2019a). No high temperature stator alarms were sounded during SWS operations in summer 2019, and SWS gates remained at 40 – 47' below the reservoir's surface from June 25 through Sept 30.

Temperature objectives for reaches 1 and 2 were fully achieved in 2019. April-July unregulated inflow to Flaming Gorge Reservoir in 2019 was 1,179 KAF, which corresponds to an average (above median) hydrologic classification for the base flow period. In this hydrologic classification, temperature objectives went into effect on July 15 but Colorado pikeminnow larval drift had already begun on July 12. Average daily temperature values reported at Gates of Lodore (USGS 2020) in 2019 reached 18.0 °C (64.4 °F) on July 10 (2 days prior to emergence of Colorado pikeminnow, 5 days prior to onset of the base flow period) and remained at or exceeded that level for 39 days (5.6 weeks) between July 10 and September 7 (Figure 1). This duration encompassed the Colorado pikeminnow larval drift period which concluded on August 12. While temperature differences between the Yampa and Green rivers in 2019 differed by more than 5.0°C (9°F) for a few days in June (Figure 2), differences were less than 5.0°C following the onset of larval Colorado pikeminnow drift on July 12 (Figure 2; U.S. Fish and Wildlife Service [USFWS] 2019). While data from the Yampa River at its confluence with the Green River are currently only available through August 21, the Reach 2 temperature objective was achieved for the entirety of the Colorado pikeminnow drift period.

¹ The U.S. Fish and Wildlife Service (K. McAbee, personal communication, 2012) has advised Reclamation to observe the target duration of the Lodore temperature objective specified in the 2005 Biological Opinion, which is 3-5 weeks at or above 18°C.

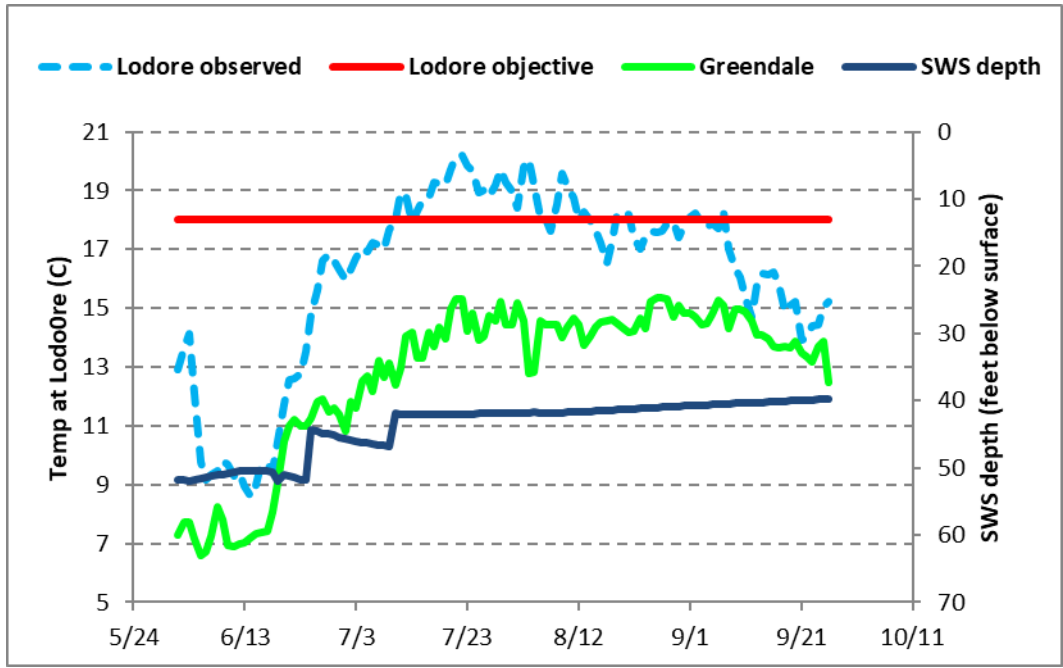


Figure 1. Average daily temperatures reported from the Gates of Lodore gage (blue dashed series), Greendale gage (green series), Reach 1 objective (red line; objective duration is 3-5 weeks above this line), and SWS gate depth below reservoir surface (blue series, second axis), June-September 2019.

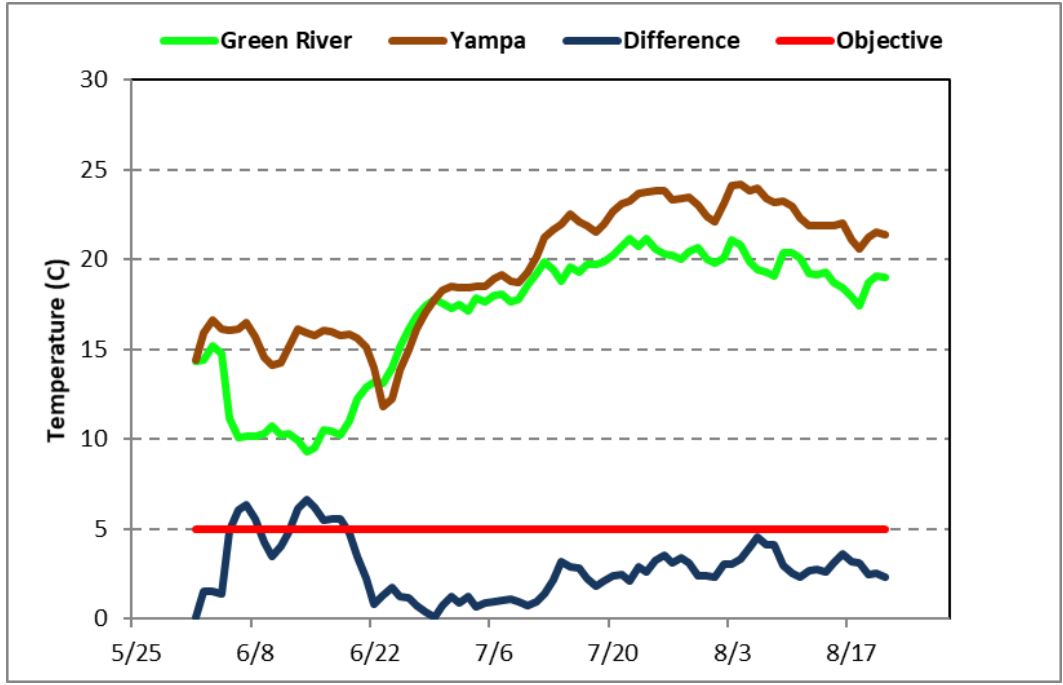


Figure 2. Temperature of the Green River (green series) at the Yampa River confluence and of the Yampa River (brown series), the difference between the two rivers (blue line), and the maximum temperature difference (5.0 °C in favor of the Yampa River) specified in the 2006 ROD (red line), June 1 – August 21, 2019.

Recommendations to Refine Operations

Recommendations are limited as the operation plan guided well. The transition from summer to autumn and autumn to winter, need to be represented correctly in FG-Ops2019 Figures of proposed regime. Working with WAPA it was decided to achieve winter base flows at the start of December. The State of Utah Division of Wildlife and Resources tailwater fishery assessment, does not need to be represented in operation plan figure, and will continue to be documented in operation plan.

Flaming Gorge Technical Working Group recommendations and discussions to document planning process

A FGTWG proposal was signed by FGTWG representatives from USBR, FWS, and WAPA on March 22, 2019. Included in the Appendix is a summary of events and meeting minutes from the March 18, 2019 FGTWG meeting. The FGTWG proposal was used to refine the draft operation plan.

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Appendix -- Summary of events and meeting minutes from the March 18, 2019 FGTWG meeting.

Summary of events:

March 18, 2019 FGTWG was convened, and Subject Matter Experts were included at a meeting at the Fish and Wildlife Service. At this point no Recovery Program request was received, FGTWG is moving forward as if no Recovery Program request will be received. Below are meeting minutes on 3/18/2019 meeting.

Drafts were initiated soon after March 18th. Iterations were used to capture use the LTSP as much to the extent possible within the ROD without a Recovery Program Request. Initiation of the LSTSP flows and duration were of concern. Consistency issues between EIS and 2000 Flow and Temperature were brought up and it was decided that 2000 Flow and Temperature being the original source would be used. The Small Bass study which was not part of the Recovery Program request was not include in proposal but was identified as not being considered in proposal.

A final FGTWG proposal was signed on March 22, 2019 and submitted to the FG-WG chair to share with FG-WG.

Flaming Gorge Technical Working Group (FGTWG)

Annual Operation Plan Proposal – Meeting Summary, meeting held on (March 18, 2019)

Attendance: (*In Person*) Larry Crist-USFWS, Paul Davidson-USBR, Ashley Nielson-NOAA, Nathaniel Todea-USBR, Beau Uriona-USBR, George Weekley-USFWS, (*On the Phone*) Don Anderson-USFWS, Paul Badame-Utah, Kevin Bestgen-Colorado State University, Matt Breen-Utah, Shane Capron-WAPA, Tom Chart-USFWS, David Speas-USBR, Melissa Trammell-NPS, and Mark Wondezell-NPS

Agenda for 3/18/2019 meeting

Flaming Gorge Technical Working Group (FGTWG)– Annual Operation Plan Proposal

Date/Time: March 18, 2019 / 1-4 p.m.

Location: US FWS -- 2369 West Orton Circle, Suite 50, SLC, Utah

Agenda:

- Welcome / Introductions
- FGTWG role and objective / Q & A
- 4-step process (how FGTWG fits in)
- FGTWG procedure
- FGTWG membership
- Forecast NOAA – Ashley Nielson
- Recovery Request -- Reviewed
- FGTWG and SME Discussion
- Reclamation initial developed Operation Plan to be presented to FGTWG
- AOP Implementation Team Coordination
- Members
- Frequency of meeting / expectations
- Next Steps

Summary of the meeting:

As of the meeting, the Recovery Program has not submitted a flow request therefore, the ROD/EIS/B0/2000 Flow and Temperature will be followed. If hydrologic conditions remain in the 30-70% exceedance range, Reclamation will set a flow target of 18,600 cfs for ~2 weeks in Reach 2.

The Flaming Gorge Operations 4-Step Process and Timelines was discussed. The FGTWG will meet once annual in mid-March to develop a proposal as part of the 4-Step Process. Reclamation will consider this proposal when drafting the Annual Operation Plan. The FGTWG will not convene again until the following year. Members of the FGTWG, SME's, and other experts may coordinate at various times of the year to provide insight on when biologic/hydrologic triggers occur for experiments, as well as, to inform the decision maker concerning other goals of the AOP. Reclamation will arrange these consultations as determined to be necessary. The 4-step process is as follows

- 1) The Recovery request submittal deadline is February 28th.
 - a. This will allow Reclamation the ability to develop a draft Annual Operation Plan to present to FGTWG.
- 2) By mid-March, the FGTWG will finalize their proposal and
- 3) The FGTWG Proposal will be sent to the WG (Mid-March) for review/comment at the WG meeting in mid-April.
- 4) Reclamation will provide the final/signed Annual Operation Plan by the beginning of May.

The CBRFC provided a Forecast.

Concerning the FGTWG proposal and Subject Matter Experts. We will work with the SMES. We are not leaving anyone out of the work group. It is transparent and meeting the timelines. Once we past the deadline we expect a certain product, coming out with an operation plan, and under the operation plan, we are still going to need SME input. FGTWG is to look at flow regime and the operation plan is how Reclamation handles the dam.

As is the FGTWG without a Recovery Request would follow the ROD and fulfill our mission regarding the dam releases and the fish recovery. The FGTWG will move forward with Proposal and will still accept the Recovery Request by March 22. The timeline is to work with Craig (WAPA) and George (FWS), and work with Beau tomorrow and send out Draft FGTWG Proposal to Craig and George for review / comments, and late wed or Thursday we will have a signed document.

Concerning this meeting and FGTWG proposal, we are talking about flow regimes. Spring peak was the first discussion. This is expected to occur in the first week of June. This could be the start of the biological triggers for high releases.

During discussion the Final Environmental Impact Statement Table 2.5 was reiterated.

Spring Releases→

It was noted that the ROD/2000 Flow and Temperature Recommendations (2000 F/T) allow for a longer duration than the LTSP. Therefore, the Razorback Sucker spring high lease flows are still being met, without the Recovery Request. According to the ROD - 2000 F/T every other year we need to be hitting 18,600 cfs. A goal for the FGTWG is to hit that 18,600 every other year. And this will be contingent upon biological triggers.

Summer base flow→

Base flow for summer/autumn was discussed with the hydrologic condition. The base flows will be realized at the USGS Jensen gage. Elevated base flows – it provides better access to larvae can use to grow up – small channels = back waters

With both the spring release and summer base flows it was decided there is good recommendation for drawing up a proposal for FGTWG.

The timeline will be followed as discussed above -- The timeline is to work with Craig (WAPA) and George (FWS), and work with Beau tomorrow and send out Draft FGTWG Proposal to Craig and George for review / comments, and late wed or Thursday we will have a signed document.