

RECLAMATION

Managing Water in the West

Annual Report of Operations for Flaming Gorge Dam Water Year 2006



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Annual Report of Operations for Flaming Gorge Dam Water Year 2006

Introduction

Pursuant to the February 2006 Record of Decision for the Operation of Flaming Gorge Dam (ROD) and as described in the Operation of Flaming Gorge Dam Final Environmental Impact Statement (FEIS), this report details the operations of Flaming Gorge Dam during water year 2006. This is the first year of operations of Flaming Gorge Dam under the ROD and this report is the first annual report produced under authority of the ROD.

Operational Decision Process for Water Year 2006

In 2006, a new process was developed 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). A detailed description of this process can be found in Appendix A and a timeline of how this process was implemented in 2006 can be found in Appendix B. In 2006, the decision process timeline was compressed due to the timing of the signing of the ROD which occurred on February 16, 2006. The process can largely be described by the four steps described below:

Step 1: Request for Research Flows

A flow request from the Upper Colorado River Endangered Fish Recovery Program (Recovery Program) was received by the Bureau of Reclamation (Reclamation) and the Flaming Gorge Technical Working Group on March 24, 2006. A copy of the letter received by the Chair, Flaming Gorge Technical Working Group, from the Recovery Program Director detailing the flow request can be found in Appendix C. The flow request outlined the flow regimes that the Recovery Program was interested in studying during the spring of 2006 dependent upon the hydrology in the Green River Basin during the spring runoff period.

Step 2: Development of Spring Proposal

The Flaming Gorge Technical Working Group met between March 20, 2006, and April 10, 2006, and developed a Green River flow proposal for the spring and summer of 2006. The flow proposal was intended to integrate, to the extent possible, the flow request from the Recovery Program with a flow regime consistent with the ROD. The flow proposal for 2006 described three possible flow regimes that were consistent with the ROD and FEIS (see Appendix D for details). Depending upon the outcome of hydrologic conditions during spring runoff, the intent was to achieve one of these proposed flow regimes.

Step 3: Solicitation of Comments

On April 13, 2006, Reclamation presented the flow proposal to the Flaming Gorge Working Group (Working Group). Reclamation requested comments on the flow proposal from the Working Group and provided a comment period that was open until April 28, 2006.

Step 4: Final Decision

Reclamation evaluated the changing hydrology and reviewed the comments received from the Working Group. On May 2, 2006, Reclamation made the decision to operate during the spring of 2006 with the objective of achieving a flow regime in Reach 2 with an instantaneous peak flow in the Green River at Jensen, Utah, of at least 18,600 cubic feet per second (cfs). To increase the potential of achieving this objective and also to moderate impacts to the resources of Flaming Gorge, Reclamation decided to provide bypass releases if necessary to achieve this flow objective up to a limit of 2,000 cfs for 24 hours.

Reclamation's decision also described conditions necessary to maintain powerplant capacity releases during the spring peak. Powerplant capacity releases were to continue as long as necessary to maintain flows in Reach 2 at or above 14,000 cfs as long as larval fish were present in Reach 2, and as long as there was sufficient water in Flaming Gorge to operate through the base flow season to achieve Reach 2 base flow levels specified by the ROD.

Flaming Gorge Technical Working Group

In 2006, a technical working group was established to provide a proposal to Reclamation on what flow and temperature regimes would best achieve ROD objectives based on current year hydrologic conditions and the conditions of the endangered fish. The Flaming Gorge Technical Working Group 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.

The Flaming Gorge Technical Working Group was represented by technical staff from the U.S. Fish and Wildlife Service, Western Area Power Administration, and Reclamation. This group also served as the informal consultation body for Endangered Species Act compliance as has occurred historically and as directed by the ROD.

During 2006, the Flaming Gorge Technical Working Group met several times to discuss Flaming Gorge operations and made a number of proposals regarding how flows in the Green River could be managed to achieve ROD objectives for water year 2006. The dates and times for these meetings can be found in Appendix B in the decision process timeline. The Green River flow proposal made by the Flaming Gorge Technical Working Group is included as Appendix D. Meeting minutes were taken at these meetings and are on file in the Provo Area office. For copies of the minutes, contact Peter Crookston at 801-379-1152.

Hydrology

Snowpack conditions in the Upper Green River and Yampa River Basins were above average throughout the snow accumulation season (October 2005 through April 2006). The Upper Green River Basin snowpack condition was above normal on January 1, 2006, at 108 percent of average. On April 1, 2006, the snowpack condition in the Upper Green River Basin was 102 percent of average. The Yampa River Basin snowpack condition was well above normal

on January 1, 2006, at 135 percent of average. On April 1, 2006, the snowpack condition in the Yampa River Basin was 123 percent of average. River flow forecasts issued by the Colorado Basin River Forecast Center for Flaming Gorge Reservoir and the Yampa River are shown in Table 1. Early seasonal forecasts indicated that hydrologic conditions would likely fall into the average to moderately wet hydrologic condition during the spring of 2006. These forecasts indicated that Flaming Gorge would have sufficient inflows to achieve a peak elevation of 6,030 feet above sea level by August 2006. Inflows did not materialize as forecasted, however, and the peak elevation at the end of the April through July period was approximately 6,024.5 feet above sea level. The end of water year elevation for Flaming Gorge Reservoir was approximately 6,024.17 feet above sea level.

Table 1 – 2006 Forecast Progression – April Through July Unregulated Volume in Thousand Acre-Feet (KAF)

Issuance Month	Flaming Gorge Reservoir		Yampa River near Maybell, CO		Little Snake River near Lily, CO	
	Volume (KAF)	% of Normal	Volume (KAF)	% of Normal	Volume (KAF)	% of Normal
January	1280	108	1340	135	455	125
February	1250	105	1350	136	470	129
March	1330	112	1220	123	420	115
April	1210	102	1220	123	420	115
May	1100	92	1100	111	355	97
June	950	80	955	96	280	77
July	765	65	955	96	280	77
Actual	725	61	969	97	207	57

Drought conditions have been persistent in the Green River over the past several years. To give some perspective to this year's spring peak flow regime, spring peak river flows for the past five years for Reaches 1, 2, and 3 of the Green River are shown in Table 2. Releases from Flaming Gorge Dam during the spring of 2006 were made with the objective of achieving an instantaneous peak flow of at least 18,600 cfs under the ROD. This flow objective should occur in approximately 50 percent of all years. Bypass releases were made for approximately 24 hours on May 22 and May 23, 2006, to achieve this flow objective. The bypass releases resulted in achieving an instantaneous peak flow on the Green River near Jensen, Utah, of 18,700 cfs on May 25, 2006. The total peak release was 6,500 cfs which was a combination of approximately 4,500 cfs from the powerplant and approximately 2,000 cfs from the bypass tubes. The total bypass volume for 2006 was approximately 4,000 acre-feet. Green River flows peaked a second time on May 26, 2006, at approximately 18,900 cfs due to heavy rain which fell on May 22 and May 23, 2006, in the Yampa River Basin.

Table 2 – 2006 Spring Peak Flows Achieved in Reaches 1, 2, and 3 of the Green River

Peak Flow Description	Reach 1	Reach 2	Reach 3
2006			
Instantaneous peak flow (cfs)	6,550	18,750	21,725
Days with flow at or above powerplant capacity*	12	N/A	N/A
Days with flow above 18,600 cfs	N/A	2	N/A
Days with flow above 22,000 cfs	N/A	N/A	0
2005			
Instantaneous peak flow (cfs)	6,800	20,000	34,300
Days with flow at or above powerplant capacity*	24	N/A	N/A
Days with flow above 18,600 cfs	N/A	4	N/A
Days with flow above 22,000 cfs	N/A	N/A	19
2004			
Instantaneous peak flow (cfs)	4,400	10,900	11,800
Days with flow at or above powerplant capacity*	4	N/A	N/A
Days with flow above 18,600 cfs	N/A	0	N/A
Days with flow above 22,000 cfs	N/A	N/A	0
2003			
Instantaneous peak flow (cfs)	4,600	19,200	22,300
Days with flow at or above powerplant capacity*	7	N/A	N/A
Days with flow above 18,600 cfs	N/A	5	N/A
Days with flow above 22,000 cfs	N/A	N/A	2
2002			
Instantaneous peak flow (cfs)	4,000	7,200	7,300
Days with flow at or above powerplant capacity*	0	N/A	N/A
Days with flow above 18,600 cfs	N/A	0	N/A
Days with flow above 22,000 cfs	N/A	N/A	0

*Powerplant capacity after Unit #3 turbine runner replacement is approximately 4,500 cfs.

Powerplant capacity releases (~4,500 cfs) were made from May 18, 2006, to May 30, 2006. These releases were made in order to maintain flows in Reach 2 above 14,000 cfs for the purpose of entraining larval fish into the floodplain. Figure 1 shows the spring release hydrograph and corresponding Yampa River and Green River hydrographs that occurred below Flaming Gorge Dam. The unregulated flow hydrograph of the Green River near Jensen is also shown in relation to the actual flow hydrograph. At no time during the peak flows of the Green River did the actual flow exceed the unregulated flow.

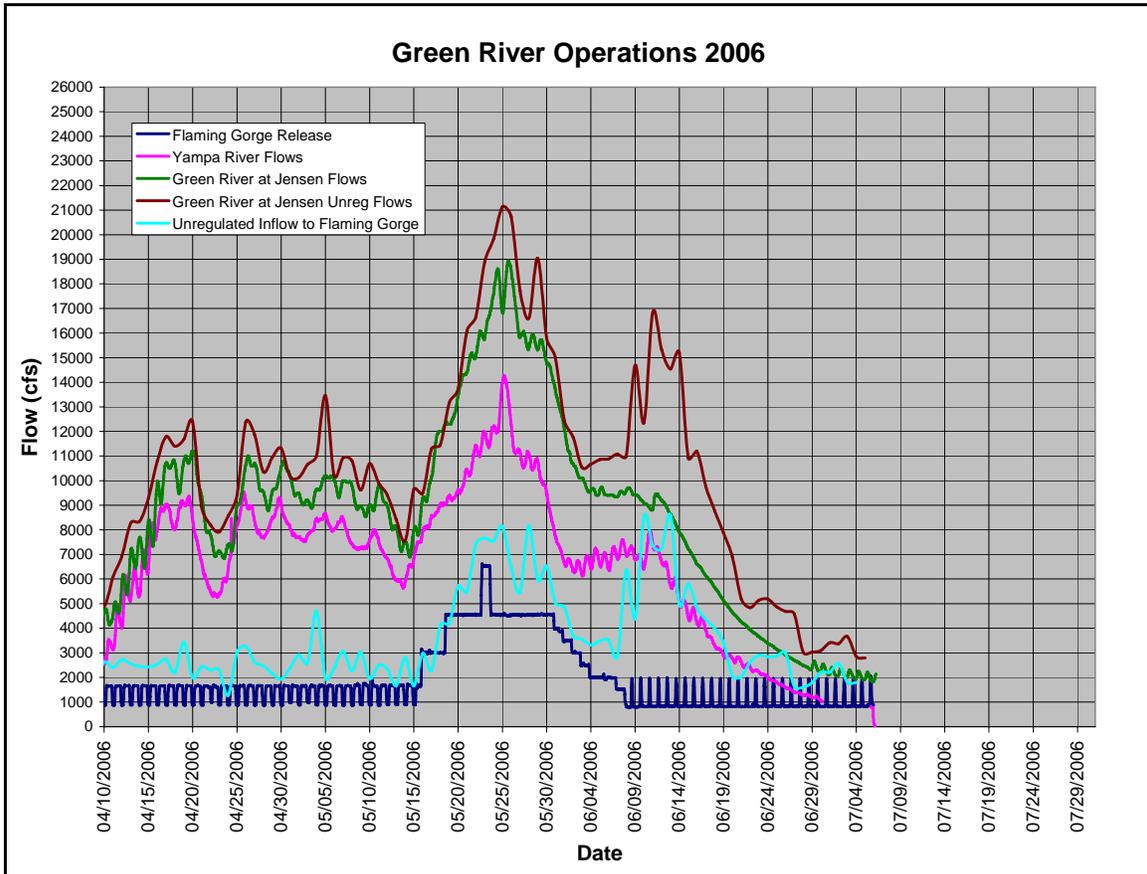


Figure 1 – 2006 Spring Release and Flow Hydrographs of the Green River

On June 9, 2006, releases from Flaming Gorge Dam resumed fluctuations for power generation with average releases of 1,000 cfs/day. On July 11, 2006, releases were reduced to 800 cfs based on revised forecast information. The July forecasted inflow volume for the April-July period shifted the hydrologic classification from average to moderately dry. The Flaming Gorge Technical Working Group concurred with Reclamation’s proposed Reach 2 base flow target of 1,230 cfs for 2006. This was near the mid point of the base flow range for the moderately dry hydrologic classification which is from 900 cfs to 1,500 cfs measured at Jensen, Utah.

Flow Objectives Achieved in Water Year 2006

The ROD directs Reclamation to operate to achieve, to the extent possible, specific flow objectives as described in the Action Alternative of the FEIS. These flow objectives and the desired minimum threshold frequencies are described in Table 3. This year (2006) is the first year of operations under the ROD and thus begins the long-term starting point for determining the frequencies of these spring flow objectives.

Table 3 – Reach 1 and 2 ROD Flow Objectives Achieved in 2006

Spring Peak Flow Objective	Reach	Desired Frequency %	Achieved in 2006	Long-Term Frequency %
Peak \geq 26,400 cfs for at least 1 day	2	10 %	No	0 %
Peak \geq 22,700 cfs for at least 2 weeks	2	10 %	No	0 %
Peak \geq 18,600 cfs for at least 4 weeks	2	10 %	No	0 %
Peak \geq 20,300 cfs for at least 1 day	2	30 %	No	0 %
Peak \geq 18,600 cfs for at least 2 weeks	2	40 %	No	0 %
Peak \geq 18,600 cfs for at least 1 day	2	50 %	Yes	100 %
Peak \geq 8,300 cfs for at least 1 day	2	100 %	Yes	100 %
Peak \geq 8,300 cfs for at least 1 week	2	90 %	Yes	100 %
Peak \geq 8,300 cfs for at least 2 days except in extreme dry years	2	98 %	Yes	100 %
Peak \geq 8,600 cfs for at least 1 day	1	10 %	No	0 %
Peak \geq powerplant capacity for at least 1 day	1	100 %	Yes	100 %

Temperature Objectives Achieved in Water Year 2006

The Flaming Gorge Technical Working Group was charged with making proposals to Reclamation on how best to achieve the temperature objectives for the Green River called for by the ROD (see Table 4). This group proposed that release temperatures should achieve the objective of 15° C (59° F) by June 15. Reclamation set the selective withdrawal gates at 40 feet from the reservoir surface on June 16, 2006, and data recorded at Flaming Gorge Dam indicated that outflow temperature objectives were not achieved until July 17 (see Figure 2).

Table 4 – Reach 1 and 2 ROD Temperature Objectives Achieved in 2006

Spring Peak Flow Objective	Reach	Desired Frequency %	Achieved in 2006	Long-Term Frequency %
Temperatures $\geq 64^{\circ}$ F (18° C) for 3-5 weeks from June (average-dry years) or August (moderately wet-wet years) to March 1	1	100 %	Yes	100 %
Green River should be no more than 9° F (5° C) colder than the Yampa River during the base flow period	2	100 %	To be determined	To be determined

Average daily temperatures at the Gates of Lodore, however, equaled or exceeded Reach 1 objectives (18° C, 64° F) beginning on June 18 and were maintained throughout the summer months. Evaluation of Reach 2 temperature objectives are pending data retrieval from the confluence of the Green and Yampa Rivers and should be available early in water year 2007.

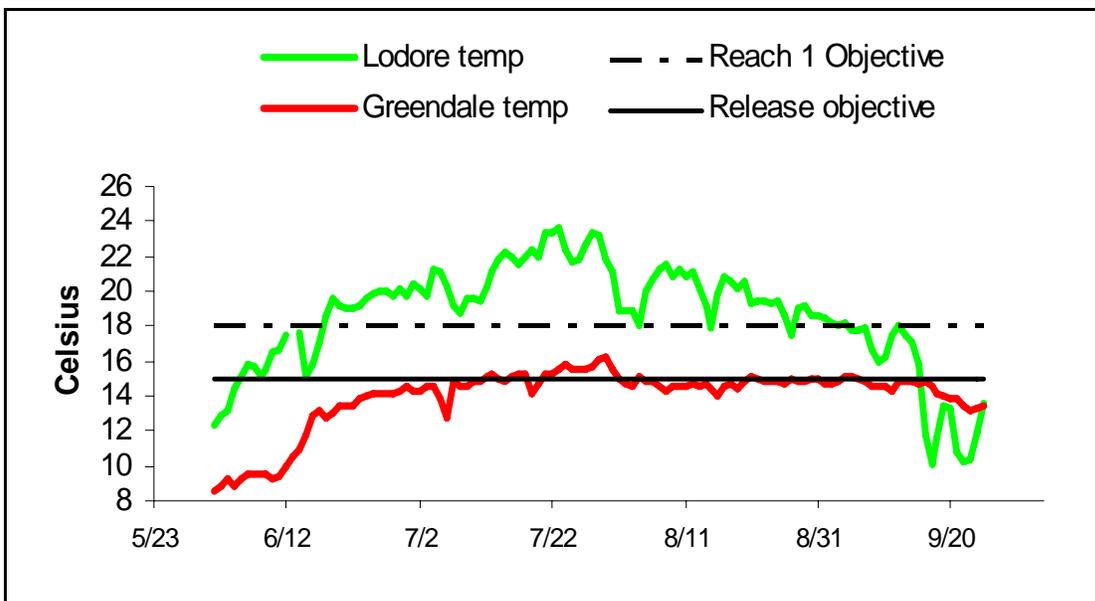


Figure 2 – Average Daily Temperatures Recorded at the Gates of Lodore Gage (Green Line), Flaming Gorge Dam (Red Line), Dam Outflow Objective (Solid Black Line), and Reach 1 Objective (Dashed Line), June-September 2006

Irreversible and Irretrievable Loss of Resources

Implementation of the ROD in 2006 impacted the generation of electricity due to bypass releases that occurred on May 22 and 23, 2006. The total volume of water which bypassed Flaming Gorge Powerplant in 2006 was approximately 4,000 acre-feet. Flaming Gorge Dam

could have produced approximately 1,365,000 kilowatt-hours of electricity with that volume of water. Depending on the market price of power at the time of generation, the impact to power generation of implementing the ROD in water year 2006 was estimated to be between \$60,000 and \$190,000.

Appendix A

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

Overview - To better clarify the process by which operational decisions at Flaming Gorge Dam will be made under the 2006 Record of Decision on the Operation of Flaming Gorge Dam Final Environmental Impact Statement (2006 Flaming Gorge Record of Decision), as well as the role of the Flaming Gorge Technical Working Group (FGTWG), the following document describes the four-step process Reclamation will be implementing. This process incorporates the Upper Colorado River Endangered Fish Recovery Program (Recovery Program), the FGTWG, and the Flaming Gorge Working Group.

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 2000 Flow and Temperature Recommendations. The purpose of the FGTWG would be limited to proposing specific flow and temperature targets (and contingencies) to meet the goals of the 2006 Flaming Gorge Record of Decision or as modified by the Recovery Program. The Flaming Gorge Working Group remains our public information/input forum.

1. Recovery Program - As stated in Environmental Commitment #2 in the 2006 Flaming Gorge Record of Decision, the role of the Recovery Program in the adaptive management process includes design and execution of studies to monitor the implementation of the 2000 Flow and Temperature Recommendations and test outcomes of modified flows and water temperatures from Flaming Gorge Dam. 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 2000 Flow and Temperature Recommendations (sec. 5.5, Muth et al. 2000; sec. 4.19 and 4.20, FGEIS; ROD environmental commitment #9). 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. Requests for such flows or release temperatures is not necessarily explicit in the 2000 Flow and Temperature Recommendations, but is necessary to fulfill adaptive management research functions that should be made no later than January 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 must be part of these initial discussions to assure release capability. Because of the critical need for dam and powerplant maintenance issues to be part of any proposal, Reclamation must 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. By the end of January each year, any desired flow request should be finalized and issued to Reclamation, the U.S. Fish and Wildlife Service, and the Western Area Power Administration.

2. FGTWG - The primary purpose of the FGTWG is to formulate a proposal of what flows and temperatures should be achieved each year. The proposal should consider current and foreseeable hydrologic conditions in the Green River Basin (including the Yampa River Basin), the 2006 Flaming Gorge Record of Decision, and any Recovery Program flow request for the current year.

The FGTWG should meet in early March of each year to develop a proposed flow and temperature regime for the upcoming year. This proposed flow and temperature regime should achieve the 2000 Flow and Temperature Recommendations as studied in the Action Alternative of the Flaming Gorge Environmental Impact Statement as directed in the 2006 Flaming Gorge Record of Decision and/or the Recovery Program flow request for the current year. The proposal should provide clear guidance for how to adjust flow and temperature objectives under alternate hydrologic scenarios in the event that conditions become wetter or dryer. The FGTWG proposal should be finalized by early April in time to present to the Flaming Gorge Working Group.

Because the FGTWG has representation from the U.S. Fish and Wildlife Service, Western Area Power Administration, and Reclamation, FGTWG meetings also serve the purpose of informal consultation for Endangered Species Act compliance.

3. Flaming Gorge Working Group - The FGTWG proposal is presented to the Flaming Gorge Working Group by Reclamation. Meetings of the Flaming Gorge Working Group are conducted as a public process with regularly scheduled meetings usually held in Vernal, Utah, in mid-April and mid-August of each year. This forum is where Recovery Program requests and FGTWG proposals are presented for public comment.

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

Appendix B

Flaming Gorge Decision Process for 2006 Chronology of Events

February 16, 2006 – Rick Gold signs the Record of Decision (ROD).

Week of March 20th

March 20, 2006 – Technical Working Group kickoff meeting.

This meeting was held to describe the process that Reclamation was intending to implement under the ROD to the U.S. Fish and Wildlife Service (Service) and Western Area Power Administration (Western). It turned out that several in attendance represented the Upper Colorado River Endangered Fish Recovery Program (Recovery Program) and did not represent the Service or Western. Reclamation stated that members of the Flaming Gorge Technical Working Group should fit two criteria: (1) members should represent the Service or Western only and (2) members should be hydrologists or biologists.

March 24, 2006 – Recovery Program flow request received by the Technical Working Group.

Week of March 27th

March 29, 2006 – Technical Working Group meeting.

This meeting was held to develop a flow proposal for how best to implement the 2000 Flow and Temperature Recommendations as directed by the ROD given hydrologic and habitat conditions. The flow request from the Recovery Program was consistent with the 2000 Flow and Temperature Recommendations asking for 18,600 cfs for 2 weeks if conditions remained near 30 percent exceedance.

Week of April 3rd

April 4, 2006 – Technical Working Group conference call.

Directed the issue of research needs back to the Biology Committee of the Recovery Program for discussion on April 7th.

April 4, 2006 – April Final Forecast issued (1,210 KAF).

April 7, 2006 – Biology Committee meeting.

April 7, 2006 – First press release announcing planning process for Flaming Gorge spring flows.

Week of April 10th

April 10, 2006 – Technical Working Group conference call.

The Technical Working Group proposal is finalized and distributed to the Management Committee of the Recovery Program.

April 11, 2006 – Management Committee of the Recovery Program meeting.

April 13, 2006 – Flaming Gorge Working Group meeting.

Flow proposal from the Technical Working Group presented to the Flaming Gorge Working Group. Comments accepted through April 28th.

April 15, 2006 – April Mid-Month Forecast issued (1,190 KAF).

Week of April 17th

Week of April 24th

April 26, 2006 – Temperature sub-group conference call.

Dave Speas (Reclamation) convened this call with Western, the Service, and Flaming Gorge Dam management personnel to discuss how to meet temperature objectives specified in the Flaming Gorge Record of Decision and related documents during 2006. Tom Chart (the Service) proposed that, as an interim target, Reclamation should raise the selective withdrawal structure gates to within 40 feet of the surface of the reservoir by June 15th, and that the target outflow temperatures for that time should be 15° C (59° F).

Week of May 1st

May 1, 2006 – Decision meeting.

The meeting was with Darryl Beckmann and Dave Sabo to make a final decision on how to operate Flaming Gorge Dam during the spring period. On May 4th, a second press release was issued giving general details of Reclamation's decision on how Flaming Gorge Dam would be operated.

May 2, 2006 – May Final Forecast issued (1,100 KAF).

Week of May 8th

Week of May 15th

May 15, 2006 – May Mid-Month Forecast issued (1,000 KAF).

May 18, 2006 – Flaming Gorge Powerplant ramped to powerplant capacity.

Unit 3 was fully commissioned and control was returned to the Glen Canyon Control Room. This occurred just in time for the spring peak of the Yampa River.

Implementation of final decision began on May 18, 2006, with the initial ramp of Flaming Gorge to powerplant capacity. At this time, daily forecasts were made of the Yampa River flows. These forecasts gave precise timing and magnitude information of future flows on the Yampa River. When the peak flow of the Yampa River appeared eminent, Flaming Gorge was ramped up to powerplant capacity to be ready to take advantage of potential opportunities to achieve the flow objective. During this time, daily e-mails were sent to the Flaming Gorge Working Group to keep the public informed of operational changes and flow conditions downstream.

May 19, 2006 – New flow request to Reclamation received from the Recovery Program.

No action was taken on this request because of the shortness of time and the fact that hydrologic conditions changed between May 19th and May 22nd.

Week of May 22nd

May 22, 2006 – Bypass release scheduled.

Based on improving forecasted flows of the Yampa River, it was determined that a reasonable opportunity to achieve 18,600 cfs would occur on March 24th if a bypass of 2,000 cfs was made beginning on May 22, 2006. Bypass release scheduled by 1:00 p.m. to begin at 4:00 p.m. MDT. Press release (third press release regarding spring flows) issued by 2:00 p.m.

May 23, 2006 – Bypass release terminated (4:00 p.m.).

Total volume bypassed = 4,000 acre-feet

Maximum release rate = 6,550 cfs

May 24, 2006 – Green River flows achieve 18,600 cfs.

An instantaneous peak of 18,700 cfs was achieved by mid afternoon. Flows remained at above 18,600 cfs for 3 hours before receding.

Week of May 29th

May 29, 2006 – Powerplant releases scheduled to be ramped down beginning on May 30, 2006.

Powerplant capacity releases maintained to provide maximum duration of 14,000 cfs measured at Jensen as indicated in the Reclamation decision and Technical Working Group proposal. Preliminary base flow target established at ~1875 cfs.

June 2, 2006 – Flaming Gorge Technical Working Group conference call.

Call to discuss base flow target in Reach 2. The Technical Working Group concurred that Reclamation's proposed base flow target in Reach 2 of 1,640 cfs for base flow period was appropriate in the context of the ROD and the 2000 Flow and Temperature Recommendations.

Week of June 5th

June 5, 2006 – June Final Forecast issued (950 KAF).

Week of June 12th

June 15, 2006 – Temperature sub-group conference call.

Dave Speas (Reclamation) convened this call with Western, the Service, and Flaming Gorge Dam management personnel to discuss how to meet temperature objectives specified in the Flaming Gorge Record of Decision and related documents during 2006. Steve Hulet informed the group that the gates were at elevation 5,968 feet and would be raised an additional 10 feet by June 16th, which brought them to within approximately 42 feet of the surface. Steve said that gate elevation could be adjusted whenever the group deemed it necessary.

Week of June 19th

Week of June 26th

June 30, 2006 – July Final Forecast issued (765 KAF).

Week of July 3rd

July 7, 2006 – Flaming Gorge Technical Working Group meeting.

Meeting to discuss base flow target in Reach 2. Reduced forecast levels had moved the hydrology into the moderately dry hydrologic classification (threshold between moderately dry and average is 821 KAF). The Technical Working Group concurred that Reclamation's proposed base flow target in Reach 2 of 1,230 cfs for the base flow period

was appropriate in the context of the ROD and the 2000 Flow and Temperature Recommendations.

Week of July 10th

July 11, 2006 – Releases reduced to 800 cfs from 1,000 cfs (average daily release).

Reclamation reduced releases to 800 cfs in response to a request from Western. This reduction is allowed under the ROD which allows base flows to deviate from the base flow target by 40 percent in the summer months and 25 percent in the winter months. Western is interested in saving water for winter months for double peaking study.

Week of July 17th

July 17, 2006 – Temperature sub-group conference call.

No decision to change selective withdrawal structure gate elevations was made at this time.

Appendix C

To: Chair, Flaming Gorge Technical Working Group

From: Robert Muth, Director, Upper Colorado River Endangered Fish Recovery Program (Recovery Program)

Subject: Implementation of spring-peak flow recommendations in 2006

This transmits the Recovery Program Biology Committee's recommendations for 2006 spring-peak flows in the Green River. These recommendations are intended for consideration by the Flaming Gorge Technical Working Group in developing their proposal to the Recovery Program and Flaming Gorge Working Group.

The Biology Committee convened during a conference call on March 9, 2006, to discuss requests for Green River flows in spring 2006 relative to meeting the objectives of Recovery Program research and monitoring projects (see conference call summary posted to the listserv on March 17). Participants considered snow conditions as of March 6 above Flaming Gorge (109% of normal) and in the Yampa River basin (113% of normal), the March water supply forecast for April–July unregulated Flaming Gorge inflow volume (105% of normal or 36% exceedance), and proposed changes to the larval razorback sucker floodplain entrainment research study (Project C-6 rz entrainment). Based on this information, the Biology Committee concluded that research and monitoring objectives in 2006 can be met by implementing the flow recommendations of Muth et al. (2000) without having to request any specific research flows at this time.

The Biology Committee recommended implementation of the spring-peak flow recommendations of Muth et al. (2000) for either a moderately wet (10–30% exceedance) or average (30–70% exceedance) year, depending on hydrologic conditions. The Biology Committee also recommended that if spring 2006 proves to be an wet-average year near 30% exceedance, the proposal should be to implement the recommendations for peak flow magnitude (18,600 cfs) and duration (2 weeks) in 1 of 4 average years (Muth et al. 2000). Further, the Biology Committee encouraged the use of real-time information (e.g., see Table 5-3 in Muth et al. 2000) to adaptively manage the implemented flow regime.

Recovery Program projects to be conducted in spring 2006 to evaluate and guide implementation of the Green River flow recommendations include:

- Project C-6 rz entrainment “Evaluation of larval razorback sucker drift and entrainment into depression floodplain wetlands of the middle Green River”,
- Project #22f “Annual assessment of endangered fish reproduction in relation to Flaming Gorge operations in the middle Green and lower Yampa rivers”,
- Project 85F “Gunnison and Green River basin sediment monitoring and evaluation program”,

- Project 85D “Monitoring of sediment deposition and erosion”, and
- Project 115 “Monitoring effects of Flaming Gorge Dam releases on the Lodore and Whirlpool Canyon fish communities”.

Based on 2005 study results, research on entrainment rates of larval razorback suckers at high priority floodplain sites in 2006 (Project C-6 rz entrainment) will focus more on entrainment performance measures at specific multi-inlet floodplains over a range of flows (with emphasis on replicating the 2005 study design with data collection at perhaps 14,000, 16,000, and 18,000 cfs). If hydrologic conditions turn drier such that flow recommendations for a wet-average year cannot be implemented and/or pending changes or additions to the floodplain research (which will be discussed at the April 6-7 Biology Committee meeting), the Biology Committee may request consideration of flows ranging from 14,000 to 18,000 cfs to meet the research objectives.

The Recovery Program looks forward to working with the Flaming Gorge Technical Working Group in implementing and evaluating the Green River flow and temperature recommendations.

Appendix D

Flaming Gorge Technical Working Group Proposed Flow and Temperature Targets for 2006

The April through July unregulated inflow forecast into Flaming Gorge Reservoir for water year 2006 as of April 1, 2006 is 1,210 thousand acre-feet (102% of normal). This forecast falls at approximately the 42% exceedance level within the wet to dry continuum based on the historic record for Flaming Gorge Dam (1963 to 2005). From this forecast, the Green River Basin for 2006 is currently classified as “Average” as defined by the 2006 Flaming Gorge Record of Decision. For this classification, we interpret the 2006 Flaming Gorge Record of Decision to call for the following flow and temperature targets during the spring and summer period:

In Reach 1 for average years the spring peak flow should be at least 4,600 cfs. The duration of this spring peak should be based on that needed to achieve the recommended duration for Reach 2. After spring operations have been completed, flows in Reach 1 should be managed to target a base flow level in the range from 800 cfs to 2,200 cfs until March of the following year. The descending ramping rate from peak to base flow should be limited to 500 cfs/day.

In Reach 2 for average years the spring peak flow should be equal to or greater than 18,600 cfs in 1 of every 2 years and equal to or greater than 8,300 cfs in all other average years. For average years with peak flows equal to or greater than 18,600 cfs, 1 of every 2 years should have durations of 2 weeks or greater. After spring operations have been completed, flows in Reach 2 should be managed to target a base flow level in the range from 1,500 cfs to 2,400 cfs until March of the following year.

In Reach 3, the magnitude and duration of spring peak flows are assumed to be achieved when the targets for Reach 2 are achieved. Base flows targets in Reach 3 are assumed to be achieved when Reach 2 base flow targets are achieved.

Recovery Program Biology Committee Request

A Recovery Program Biology Committee flow request has been submitted to us. It is requesting that our proposal implement the 2006 Flaming Gorge Record of Decision for 2006. No deviation from the 2006 Flaming Gorge Record of Decision has been requested for 2006. More specifically, the Biology Committee has requested that if conditions in the Green River basin become wetter to the point where the basin would be classified as moderately wet (10-30% exceedance), flow and temperature targets for the moderately wet classification should be followed. If hydrologic conditions remain in the 30-70% exceedance range near 30% exceedance, the Biology Committee requests a flow target of 18,600 cfs for 2 weeks in Reach 2 be considered.

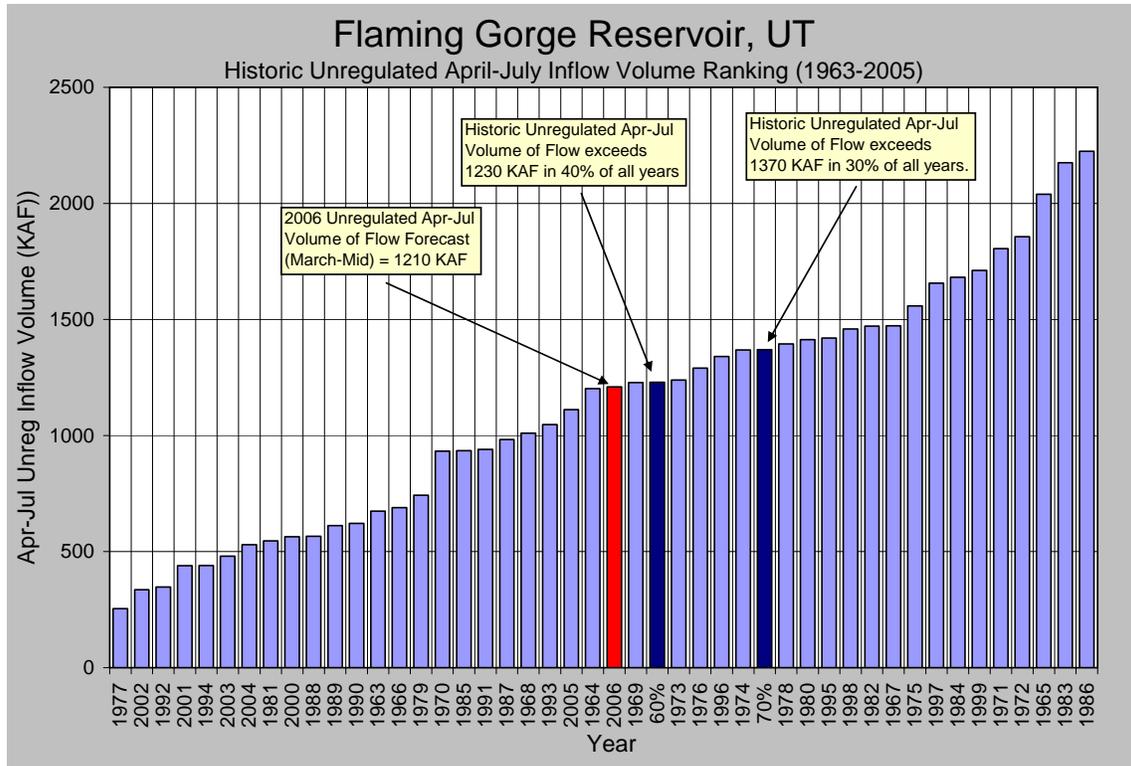
Factors Considered in Our Proposal

Table 5.3 of the Flow and Temperature Recommendations (Muth et al. 2000) summarizes examples of real-time and other year-specific information that should be considered in determining annual patterns of releases from Flaming Gorge Dam. Certainly, forecasted hydrologic conditions in the Green and Yampa Rivers drainages, water surface elevation of the Flaming Gorge Reservoir, and river temperatures (modeled and real-time) are critical pieces of information in that decision making process. However, status of the endangered fish populations and existing habitat conditions will be important factors to consider as well. The Recovery Program has conducted standardized larval sampling to assess annual reproduction of Colorado pikeminnow and razorback sucker in Reach 2 of the Green River since 1990 and 1993, respectively. These and other long term data sets will be used to predict important biological events and physical parameters (e.g. presence of early life stages of endangered fish and condition of habitat) to assist Reclamation as they prepare to meet annual targets, and communication of real-time data to Reclamation should inform them during actual operations.

Overall, surveys suggest recent upward trends in larval drift density of both razorback sucker and Colorado pikeminnow. Increases in razorback sucker larvae may be due to apparent increased reproductive activity by stocked razorback sucker. Thus, real-time biological information such as presence of larval razorback sucker or Colorado pikeminnow and congregations of razorback sucker on spawning bars have been and will continue to be used to refine operations during the spring and summer period.

Green River Basin Hydrology

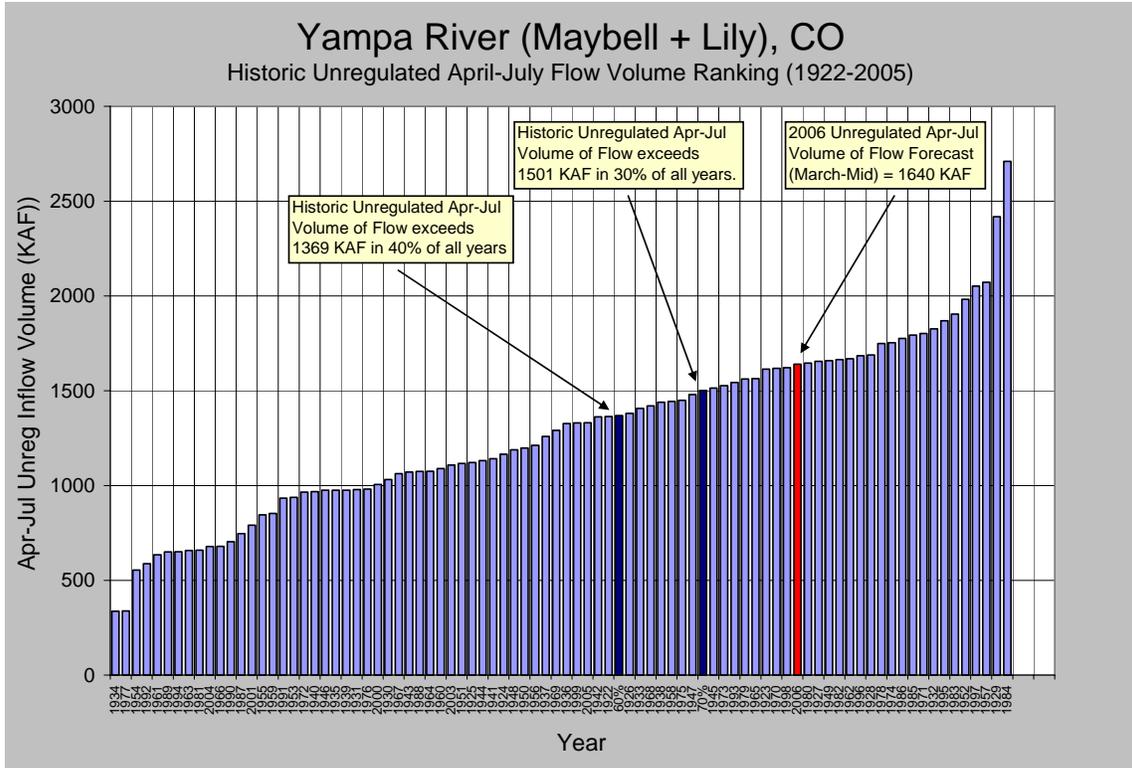
The current (April final) unregulated inflow forecast for Flaming Gorge Reservoir is 1,210 KAF (102% of normal). This forecast falls at approximately 42% exceedance based on the historic unregulated inflow record (1963-2005). The graph below shows the current forecast in relation to the historic unregulated inflow volumes. For reference, the 40% and 30% exceedance volumes are shown in dark blue.



Flaming Gorge Reservoir currently has a water surface elevation of approximately 6021 feet above sea level. There is approximately 3.02 million acre-feet of live storage in Flaming Gorge and approximately 0.76 million acre-feet of space.

Yampa River Basin Hydrology

The current (April final) forecasted April through July flow for the Little Snake River and Yampa River combined (Lily plus Maybell) is 1640 KAF (121% of normal). This forecast falls at approximately 23% exceedance based on a ranking of the historic record (1922-2005). The graph below shows the current forecast in relation to the historic volumes of flow. For reference, the 40% and 30% exceedance volumes are shown in dark blue.



Hydrologic conditions in the Yampa River basin look promising for high flows this year. Based on the current forecast, the following table describes the probabilities for specific flow events on the Yampa River this year.

Probabilities of Flow Events on the Yampa River for Spring 2006 (Number of Days)

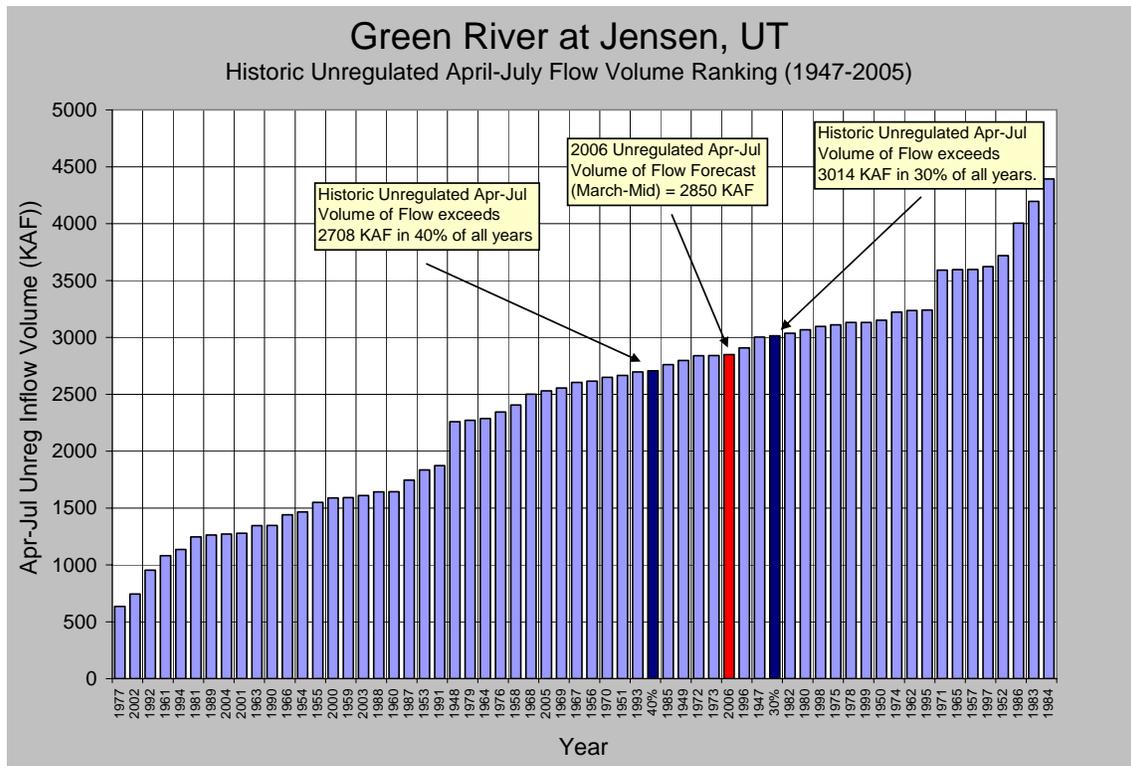
Event	90%	75%	50%	25%
Flow above 16,000 cfs	--	--	3	4
Flow above 15,000 cfs	--	2	5	8
Flow above 14,000 cfs	--	3	7	10
Flow above 13,000 cfs	2	6	10	13
Flow above 12,000 cfs	9	11	15	18
Flow above 11,000 cfs	16	19	22	25
Flow above 10,000 cfs	25	28	32	36

These statistics are based on comparison of the current forecast for the Yampa River Basin (Lily plus Maybell) to the 10 most similar historic years. These years are 1923, 1927, 1949, 1962, 1965, 1970, 1979, 1980, 1982 and 1998. The minimum Apr-Jul volume for these years was 1,562 KAF and the maximum Apr-Jul volume was 1,669 KAF. The average for these years was 1,627 KAF. The probabilities were computed assuming a normal distribution for the events.

Green and Yampa River Basin Hydrology (combined)

The combined Apr-Jul forecasts for Flaming Gorge, Little Snake near Lily, CO and Yampa River near Maybell, CO is currently (April final) 2,850 KAF. The combined Apr-Jul forecast for these points is the best indicator of what volume of unregulated flow will likely occur on the Green River at Jensen, Utah during 2006. This volume falls at approximately 34% exceedance when compared to the historic record (1947-2005).

The 2006 Flaming Gorge Record of Decision calls for a flow target of 18,600 cfs in 40% of all years. 30% of all years fall into either the ‘wet’ or ‘moderately wet’ hydrologic classification. The remaining 10% of all years are those that are classified as ‘average’ yet have above normal forecast levels. Our analysis indicates 2006 will likely be one of these average years. The graph shown below indicates where within the wet to dry continuum the current Apr-Jul forecast falls in comparison to history. For reference, the 40% and 30% exceedance volumes are identified in dark blue.



Proposed Flow and Temperature Targets for the Spring-2006

The Flaming Gorge technical working group proposes that during the spring of 2006, if the combined forecast of the Green and Yampa Rivers remains in the range from 2,710 KAF to 3,015 KAF, flows located on the Green River near Jensen, Utah should be managed to the extent possible in order to achieve at least 18,600 cfs for at least 14 days. A flow and duration of this magnitude has not occurred in this reach of the Green River since 1999. We believe that the current hydrologic conditions as well as conditions of the endangered fish support this target for 2006. We propose that flows in Reach 2 of at least 18,600 cfs be targeted during the peak and post peak flows of the Yampa River.

If the combined forecast of the Green and Yampa Rivers decreases below 2,710 KAF prior to or during spring operations for 2006, we propose that the flows in the Green River near Jensen, Utah be managed to achieve at least 18,600 cfs for at least 1 day.

If the Green and Yampa River combined forecast increases above 3,015 KAF prior or during spring operations for 2006, we propose that the flows located on the Green River near Jensen, Utah be managed to achieve at least 20,300 cfs for at least 1 day and at least 18,600 cfs for at least 14 days.

During this operational period, if forecasted Yampa River flows do not provide a reasonable opportunity to achieve the level specified in our proposal for Reach 2, we propose that flows in Reach 1 be managed to the extent possible in order to achieve at least 4,600 cfs for as long as necessary to safely manage Flaming Gorge Reservoir in order to obtain our proposed base flow target by no later than July 15, 2006. However, if this situation arises, decisions will incorporate historical and real-time data on the occurrence of razorback sucker larvae in the system and perhaps other parameters identified in table 5.3 of Muth et al. (2000). Maintaining connectivity with floodplain nursery habitats at flows of 14,000 or greater in reach two is desired for as long as possible in order to entrain drifting razorback sucker larvae. We propose no specific temperature targets during spring operations.

Proposed Flow and Temperature Targets for Summer-2006

The technical working group proposes that after the spring operation is completed, if the hydrology remains in the average category, a base flow target should be selected in the range from 1500 to 2400 cfs in Reach 2. If the hydrology moves to the moderately wet classification, we propose a base flow target be selected in the range from 2400 to 2800 cfs in Reach 2. This base flow target should be achieved on or before July 15, 2006.

The 2006 Flaming Gorge Record of Decision does allow for daily fluctuations to occur for power production. The technical working group proposes that fluctuations for power generation be allowed during the base flow period but should be limited to produce no more than a 0.1 meter stage change each day measured at the Green River near Jensen, Utah stream gauge.

The 2006 Flaming Gorge Record of Decision does allow for base flows in Reach 2 to vary about the mean base flow target.

Variation in flow around the established mean base flow should be consistent with the variability that occurred in pre-dam flows. Mean daily flows should be kept within +/-40% of the annual mean base flow in the summer-autumn (August through November) and within +/-25% of the annual mean base flow in winter (December through February); however, dam operations should not be adjusted to compensate for short-term increases in tributary inflows resulting from weather events that would exceed these thresholds. Differences due to reservoir operations in mean daily flows between consecutive days should not exceed 3%.

The technical working group proposes that variations about the mean base flow target be limited such that the following temperature targets can also be achieved.

1. Water temperatures of 18 degrees Celsius or greater for 3 to 5 weeks in the beginning of the base flow period should be targeted in upper Lodore Canyon.
2. Green River should be no more than about 5 degrees Celsius colder than the Yampa River at their confluence in Echo Park during the summer base flow period.

The Flaming Gorge technical working group will reconvene on July 7, 2006 to discuss the results of spring operations and to update the base flow proposal.