

## Flaming Gorge Technical Working Group

### May 5, 2015 Hydrology Summary

Heather Patno

For the purposes of discussions related to implementing the ROD in 2015, an evaluation has been made of the current hydrologic conditions in the Upper Green River (*i.e.* above Flaming Gorge Dam) and Yampa River Basins. The evaluation centered on the historical unregulated inflow statistics for Flaming Gorge Dam during the period from 1963 through 2014. Based on these statistics and the May 5, 2015 final forecast of 570,000 acre-feet for Flaming Gorge, the hydrologic classification will be moderately dry (70% to 90% exceedance) for spring 2015.

The combined April through July forecast of the Yampa River at Maybell and Little Snake at Lily is 614,000 acre-feet. This forecast would fall into the dry hydrologic classification of the ROD. It is recommended that the official hydrologic classification for 2015 be designated at dry.

Snow water equivalent (SWE) as of May 5, 2015, for the Upper Green River and Yampa/White River Basins are 53 and 50 percent of median, respectively. Flaming Gorge SWE is similar to 2012 and 1992, while Deerlodge SWE is similar to 2002 and 2012.

## Basin Hydrology

### ***Green River Basin Hydrology***

The May 5, 2015, May final forecast of April through July unregulated inflow (current forecast) for Flaming Gorge Reservoir is 570,000 acre-feet (AF) (58% of 30-year average). This forecast falls at approximately 83% exceedance based on the historic unregulated inflow record (1963-2014).

Figure 1 illustrates the Upper Green River SWE as of April 27 and compares it against water years 2004 and 2012. Figure 2 shows the current forecast in relation to the historic unregulated inflow volumes. Figure 3 illustrates Flaming Gorge Reservoir May final forecast probability (percent exceedance).

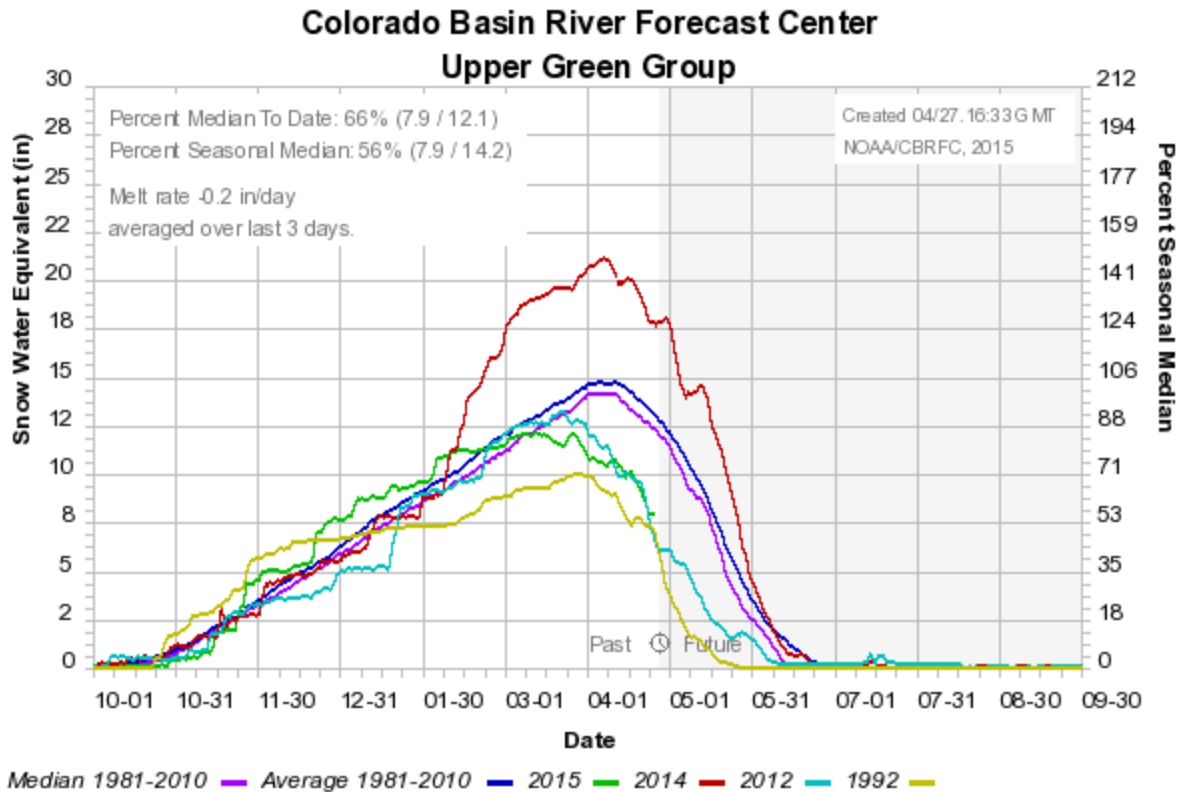


FIGURE 1. Upper Green River Basin Snotel Tracking. 1981-2010 percent of median compared against 2015 YTD Snow Water Equivalent (SWE) and 1992 and 2012 percent of average SWE

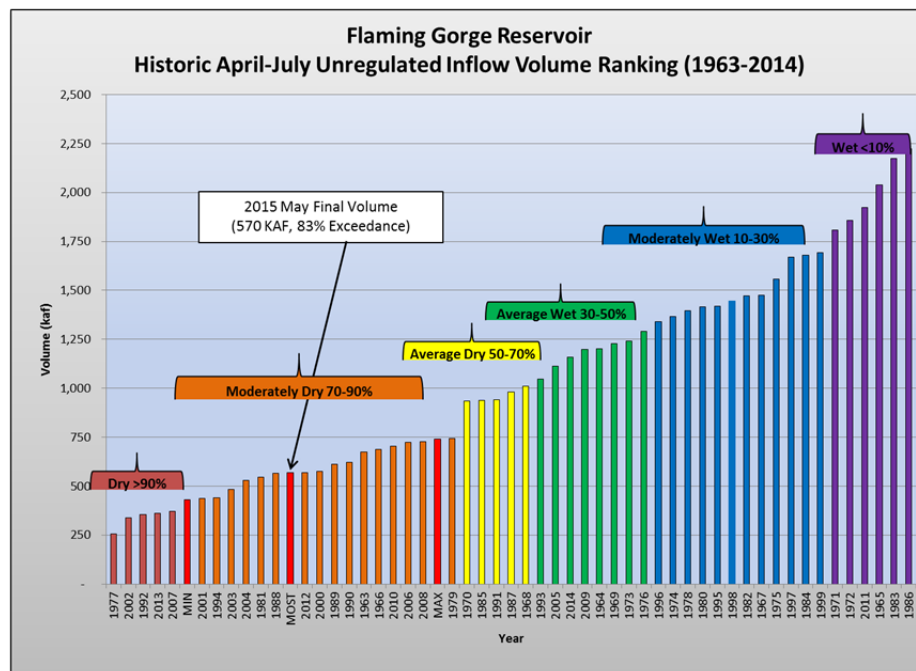


FIGURE 2. Flaming Gorge Reservoir May final forecast and ranked historic April-July unregulated inflow volume for years 1963-2014

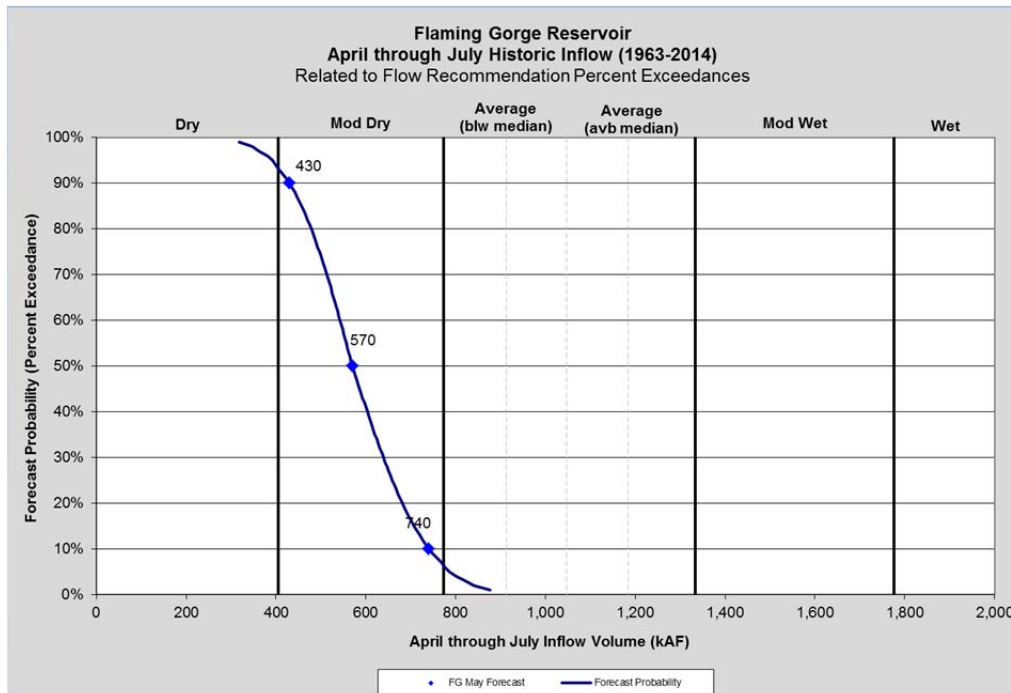


FIGURE 3. Flaming Gorge Reservoir May final forecast probability (percent exceedance) and historic April-July unregulated inflow volume for years 1963-2014

### ***Yampa River Basin Hydrology***

The combined current forecast for the Little Snake at Lily plus Yampa River at Maybell is 614,000 AF (50% of 30-year average). This forecast falls at approximately 92% exceedance based on a ranking of the historic record (1922-2014).

Figure 4 illustrates the Yampa River at Deerlodge Park SWE as of May 5, 2015 and compares it against water years 2002 and 2012. Figure 5 below shows the current forecast in relation to historic flow volumes. Figure 6 illustrates the Yampa River at Maybell plus Lily May final forecast probability (percent exceedance).

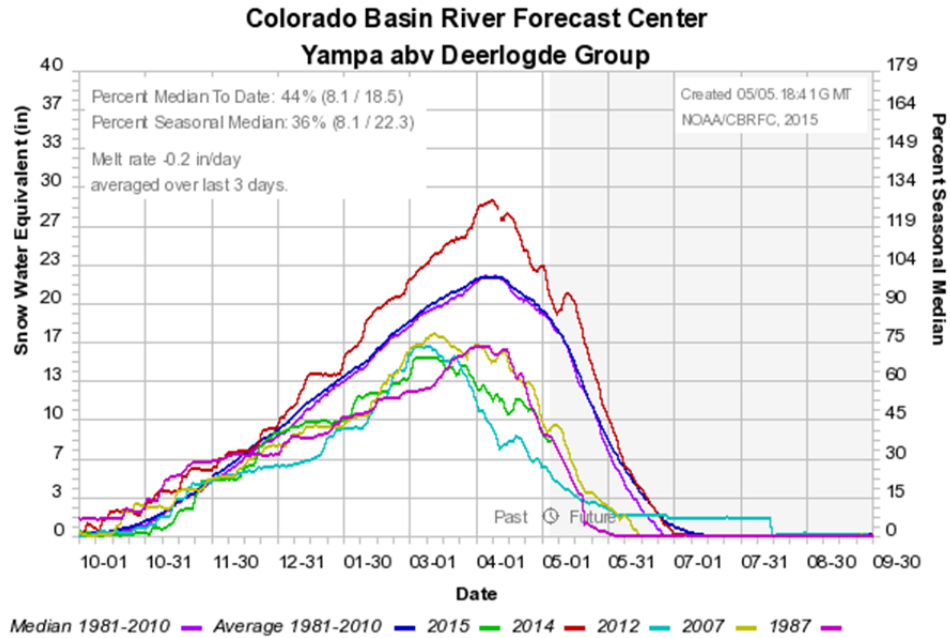


FIGURE 4. Yampa River above Deerlodge SNOTEL Group. 1981-2010 percent of average SWE compared against 2015 YTD, and analog years 1987, 2007 and 2012 percent of median SWE

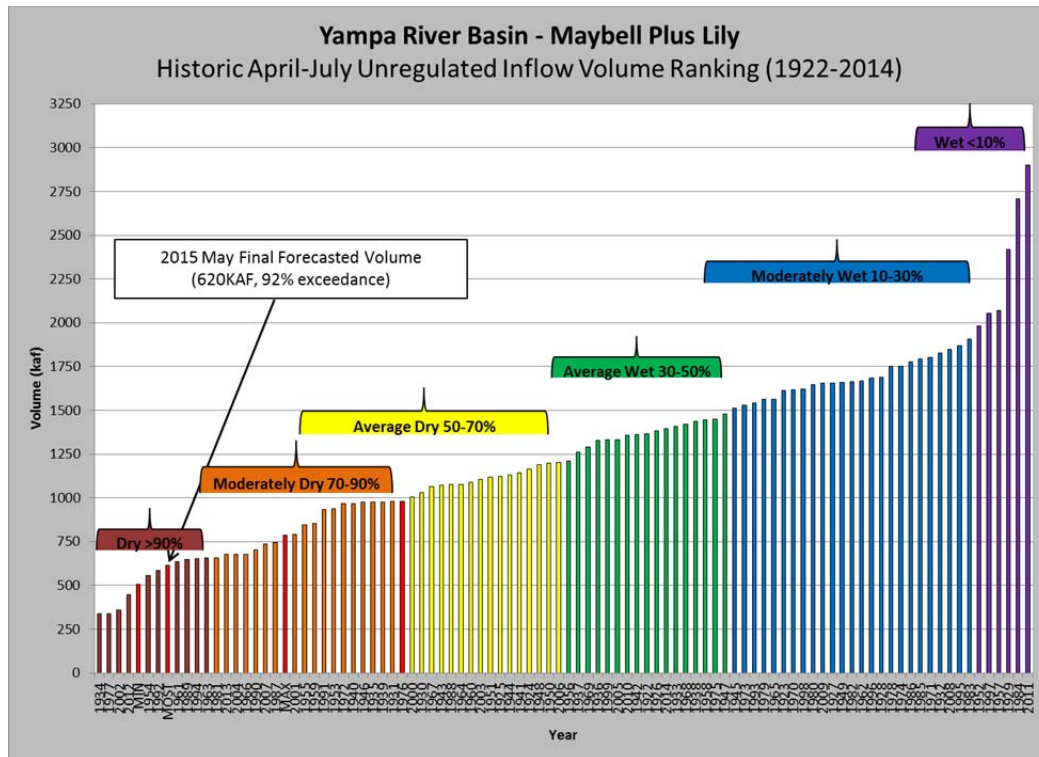


FIGURE 5. Yampa River Basin (Maybell plus Lily) May final forecast and ranked April-July unregulated inflow volume for years 1922-2014

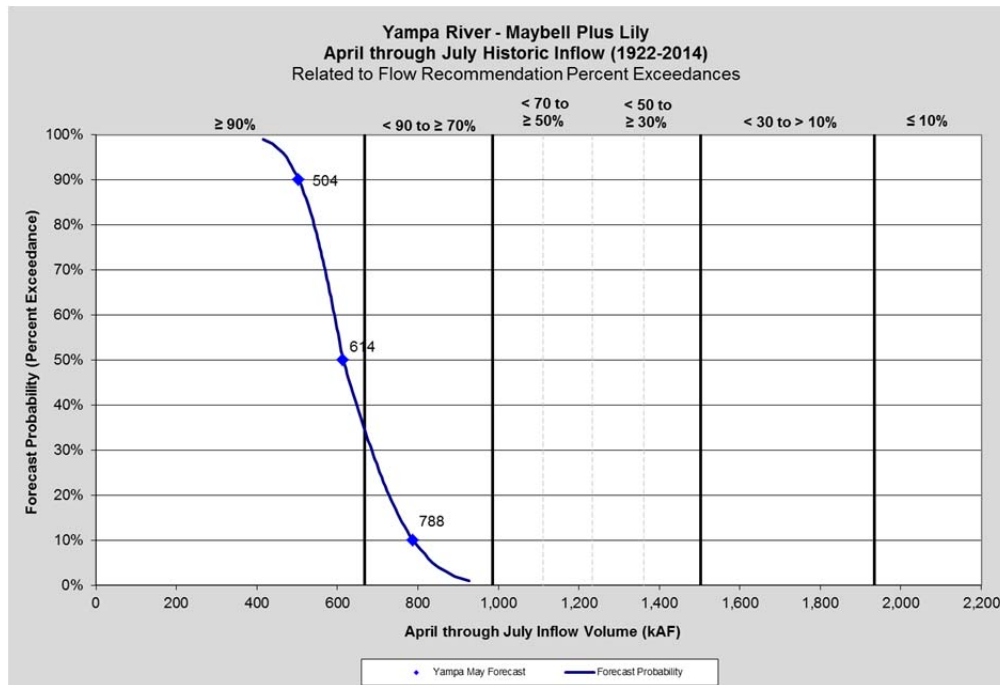


FIGURE 6. Flaming Gorge Reservoir May final forecast probability (percent exceedance) and historic April-July unregulated inflow volume for years 1963-2014

### ***Probabilities of Flow Events for Spring 2015***

The Flaming Gorge unregulated inflow and Yampa River forecasts are dry and trending drier. Conditions this year are similar to 2002, 2007 and 2012. An analysis was completed to assist in the determination of appropriate flow objectives for spring and summer 2015. The ten most similar historic years for the Yampa River Basin (Maybell plus Lily) compared to the current forecast (Table 1) were analyzed assuming a normal distribution.

Table 2 presents the percent exceedance of cumulative days greater than or equal to various flow levels at Yampa River (Maybell plus Lily). The current analysis indicates that it is 504 likely Yampa River flows above 10,000 cfs will not be achieved this year.

**Table 1**  
**Yampa River (Maybell plus Lily) – April through July Unregulated Volume**  
**Ten Similar Years to the May final Forecast**  
**Thousand Acre-Feet (KAF)**

<b>Year</b>	<b>April- July Unreg Inflow Volume (KAF)</b>
MIN	504
1977	339
2002	359
2012	449
1954	555
1992	587
MOST	614
1961	635
1989	650
1994	651
1963	658
1981	659
MAX	788

**Table 2**  
**Spring 2015 – Days above Specific Flow Thresholds in the Yampa River**  
**(Maybell plus Lily)**  
**Based on the May final Forecast**  
**Percent Exceedance (%)**

<b>May Final Forecast</b>	<b>% Exceed</b>	<b>Days above 3500 cfs</b>	<b>Days above 4500 cfs</b>	<b>Days above 5500 cfs</b>	<b>Days above 6500 cfs</b>	<b>Days above 7500 cfs</b>	<b>Days above 8500 cfs</b>	<b>Days above 10000 cfs</b>
<b>YAMPA</b>	25%	41	29	22	10	2	0	0
	50%	32	24	5	2	0	0	0
	75%	20	9	1	0	0	0	0
	90%	4	0	0	0	0	0	0

## Colorado Basin River Forecast Center Yampa River Analysis

Current observed streamflow on the Yampa River measured at Deerlodge is 6,140 cubic feet per second (cfs). The Green River measured at Jensen, Utah flow is currently 6,690 cfs. The forecast for Yampa River at Deerlodge indicates flows are expected to reach between 8,000 and 9,000 cfs on May 8-9, Friday and Saturday. Flows at Jensen, Utah, are expected to reach between 9,500 and 10,500 cfs on Saturday and Sunday, May 9 and 10. Current forecasts and the current fluctuating weather patterns indicate that Yampa River flows will not experience another peak. Forecast uncertainty increases beyond 5 days and the magnitude of flows is highly uncertain.

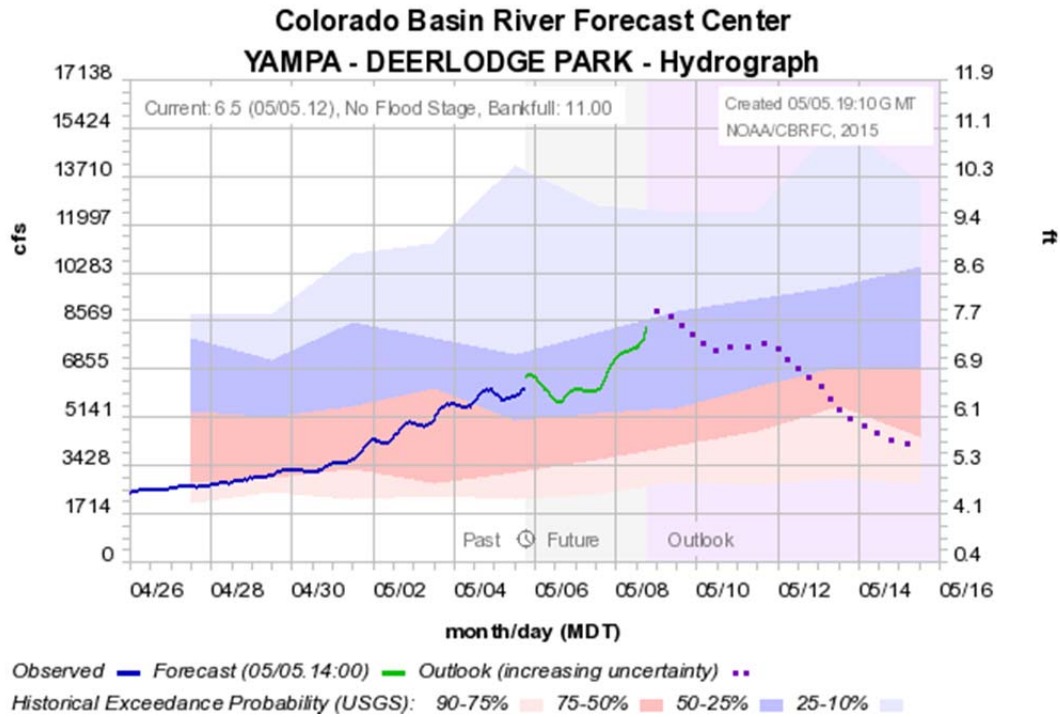


FIGURE 7. RFC Yampa at Deerlodge 10-day deterministic forecast.

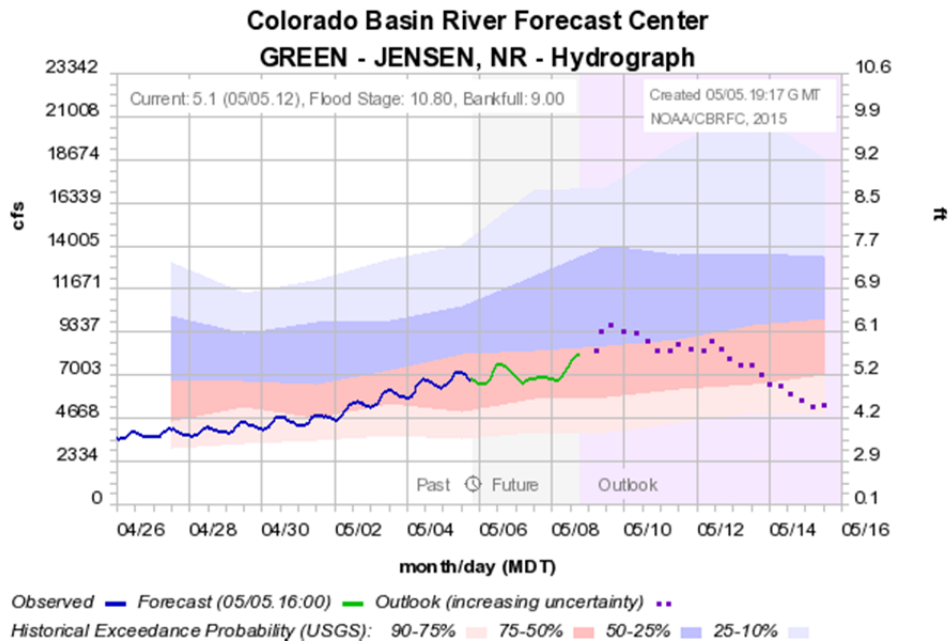


FIGURE 8. RFC Green River at Jensen, Utah 10-day deterministic forecast.

## ***Larval Trigger Study Plan Projected Operations***

Previous to the implementation of the ROD, the U.S. Fish and Wildlife Service issued a Biological Opinion in 1992 that timed releases from Flaming Gorge to occur during the spring peak of the Yampa River. Under the ROD, Flaming Gorge releases are timed during the Yampa River spring peak and immediate post peak.

The Larval Trigger Study Plan experimental protocol alters Flaming Gorge releases to occur after razorback sucker larvae have been observed in the Green River below Flaming Gorge Dam. This modification in timing of spring peak releases alters projected operations from Flaming Gorge as compared against historic releases.

Figures 9-11 below illustrate potential Flaming Gorge releases utilizing similar hydrologic years to the current one.

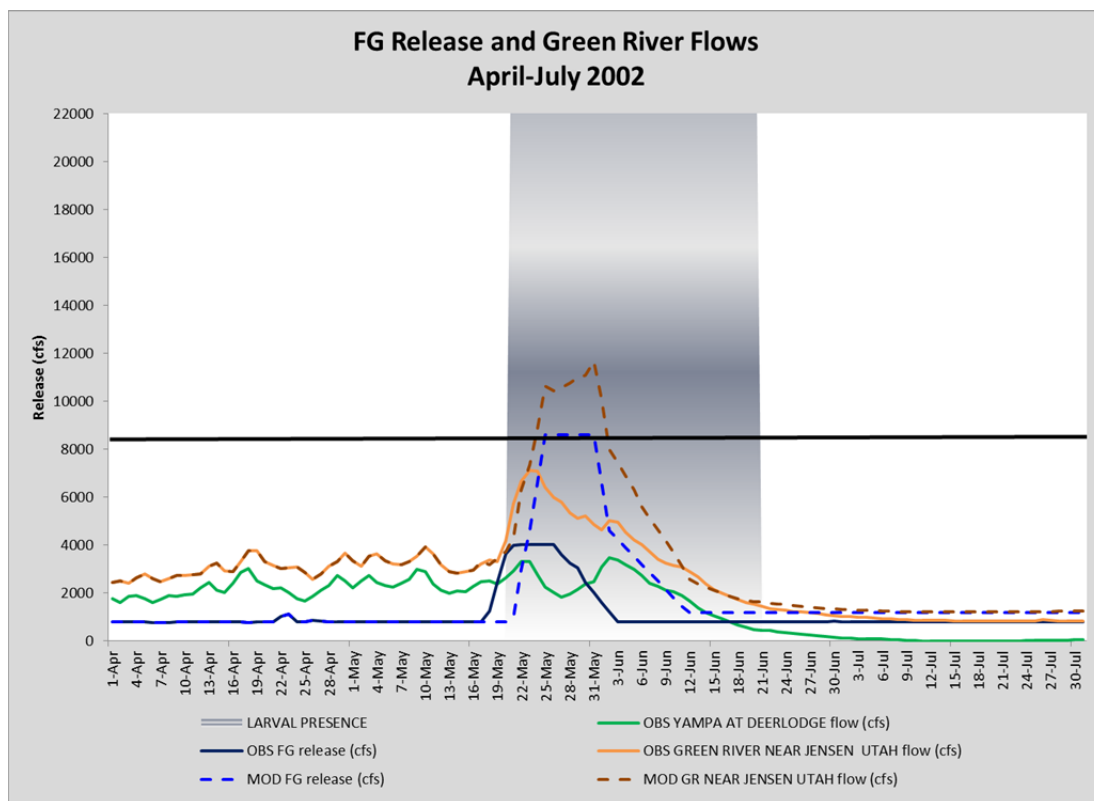


FIGURE 9. Flaming Gorge release, Yampa and Jensen flows for WY2002 and projected operations under LTSP using 2002 flows. Shaded grey area indicates larval presence.



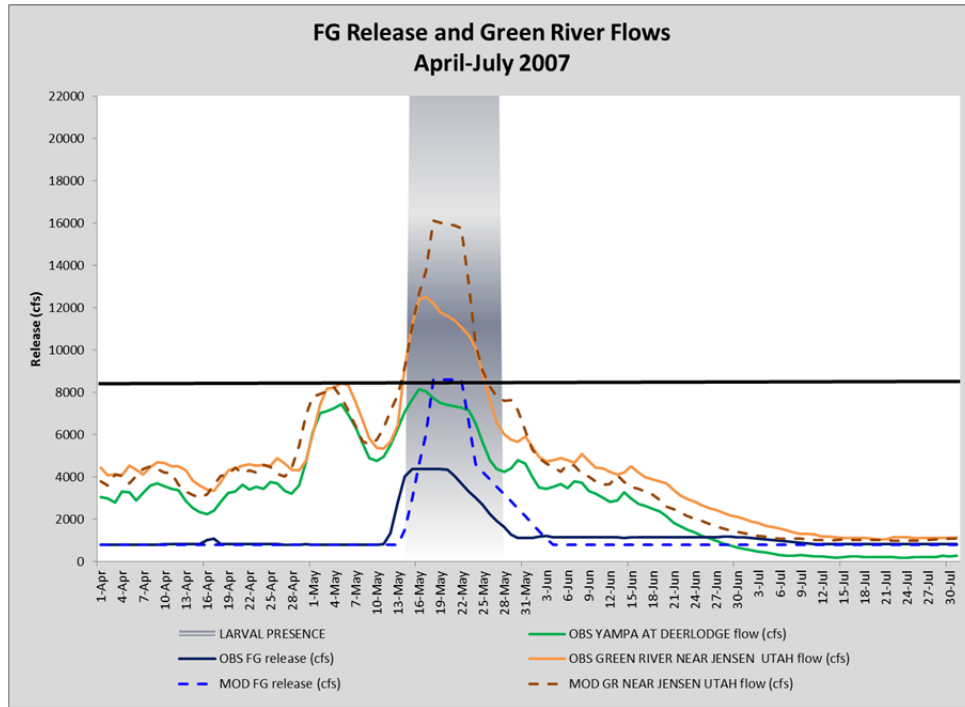


FIGURE 10. Flaming Gorge release, Yampa and Jensen flows for WY2007 and projected operations under LTSP using 2007 flows. Shaded grey area indicates larval presence.

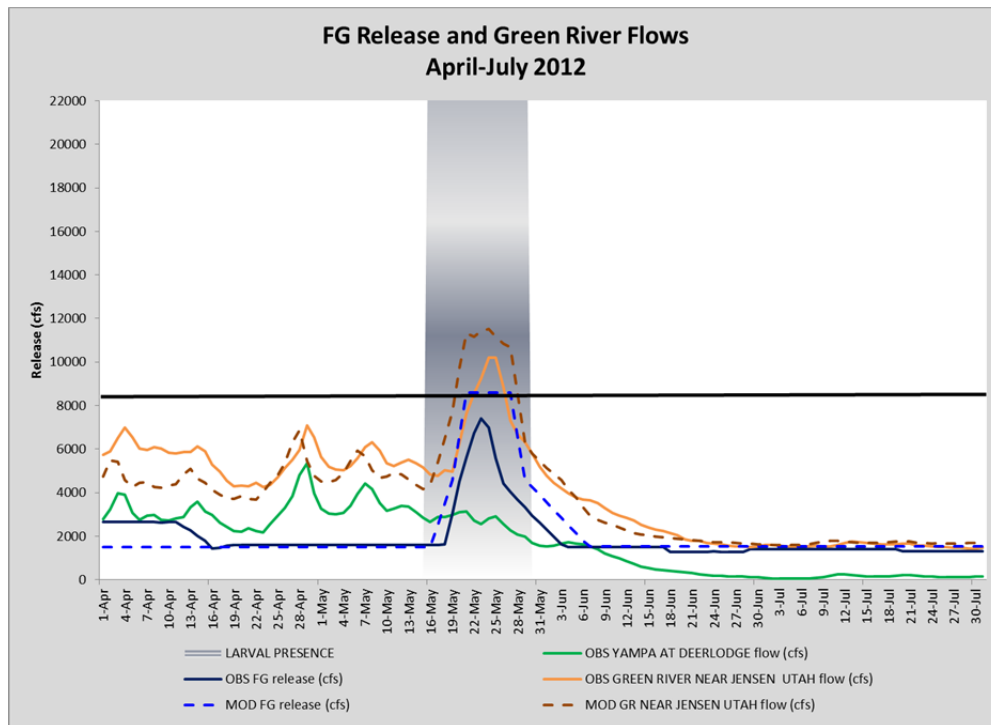


FIGURE 11. Flaming Gorge release, Yampa and Jensen flows for WY2012 and projected operations under LTSP using 2012 flows. Shaded grey area indicates larval presence.

## Record of Decision Spring Flow Objectives

This hydrologic update provides information regarding current conditions and how it relates to the Operating Plan detailed in the 2005 Flaming Gorge Final Environmental Impact Statement (FEIS) in Section 2.5.3.1. The operating plan is to describe the current hydrologic classification of the Green River and Yampa River Basins, including the most probable runoff patterns for the two basins. The operating plan is also to identify the most likely Reach 2 flow magnitudes and durations that are to be targeted for the upcoming spring release. It further specifies that “[b]ecause hydrologic conditions often change during the April through July runoff period; the operations plan 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.”

The potential classifications for 2015 are as follows:

### ***Moderately Dry Classification***

If the April through July unregulated inflow into Flaming Gorge Reservoir remains in the range from 405,000 AF to 774,000 AF the hydrological classification would be moderately dry.

The peak flow as measured at Jensen, Utah this year would correspond with the moderately dry hydrologic condition. The LTSP outlines moderately dry flows between 8,300 cfs and 14,000 cfs at Jensen for a period between 7 to 14 days, and minimum seven-day duration. These flows provide connection at Stewart Lake, Above Brennan and Old Charley Wash.

The ROD spring flow objectives for moderately dry years are:

**Table 3 – Moderately Dry Spring Flow Objectives**

Reach	Spring Peak Magnitude (cfs)	Spring Peak Duration
Reach 1	≥ 4,600 cfs	That necessary to achieve duration target in Reach 2
Reach 2	≥ 8,300 cfs	1 week (i.e. 7 days)

Flow Recommendations and FEIS

### ***Dry Classification***

If the April through July unregulated inflow into Flaming Gorge Reservoir remains in the range below 405,000 AF the hydrological classification would be dry.

The peak flow as measured at Jensen, Utah this year would correspond with the moderately dry hydrologic condition. The LTSP outlines dry flows between 8,300 cfs and 14,000 cfs at Jensen for a period between 1 to 7 days. These flows provide connection at Stewart Lake, Above Brennan and Old Charley Wash.

The ROD spring flow objectives for dry years are:

**Table 4 – Moderately Dry Spring Flow Objectives**

Reach	Spring Peak Magnitude (cfs)	Spring Peak Duration
Reach 1	≥ 4,600 cfs	That necessary to achieve duration target in Reach 2
Reach 2	≥ 8,300 cfs	2 days or more except in extremely dry years (≥98% exceedance).

Flow Recommendations and FEIS

### ***Average (Below Median) Classification***

It is likely that hydrologic conditions into Flaming Gorge Reservoir will change before implementation of the proposed 2015 flow objectives. In the event conditions become wetter and the Flaming Gorge Reservoir unregulated inflow forecast for April through July falls between 774,000 AF to 1,047,000 AF, and the Yampa River hydrologic classification increases to average (below median), the hydrological classification would be average (below median).

The peak flow as measured at Jensen, Utah, would correspond with the average (below median) hydrologic condition with targeted flows between 14,000 and 18,600 cfs for a period between 1 to 14 days in Reach 2. These flows provide connection at the Stewart Lake, Above Brennan, Old Charley Wash, Thunder Ranch, Bonanza Bridge, Johnson Bottom, Stirrup and Leota 7 floodplains.

ROD spring flow objectives for average (below median) years are:

**Table 5 – Average (Below Median) Spring Flow Objectives**

Reach	Spring Peak Magnitude (cfs)	Spring Peak Duration
Reach 1	≥ 4,600 cfs	That necessary to achieve duration target in Reach 2
Reach 2	≥ 8,300 cfs in 50% of average years	One week (i.e. 7 days) in 50% of average years

Flow Recommendations and FEIS

### ***Average (Above Median) Classification***

If conditions become wetter than the current forecast at Flaming Gorge Reservoir and the April through July forecast increases between 1,047,000 AF and 1,334,000 AF, the hydrological classification would be average (above median).

The peak flow as measured at Jensen, Utah, would correspond with the average (above median) hydrologic condition with targeted flows between 18,600 and 20,300 cfs for a period

between 1 to  $\geq 14$  days in Reach 2. These flows provide connection at the Stewart Lake, Above Brennan, Old Charley Wash, Thunder Ranch, Bonanza Bridge, Johnson Bottom, Stirrup and Leota 7 floodplains.

ROD spring flow objectives for average (above median) wet years are:

**Table 6 – Average (Above Median) Spring Flow Objectives**

Reach	Spring Peak Magnitude (cfs)	Spring Peak Duration
Reach 1	$\geq 4,600$ cfs	That necessary to achieve duration target in Reach 2
Reach 2	$\geq 18,600$ cfs in 50% of average years	Two weeks ( <i>i.e.</i> 14 days) in 25% of all average years

Flow Recommendations and FEIS