Green and Yampa Rivers: Current Conditions and Forecasts

April 20, 2017
Flaming Gorge Working Group Meeting

Ashley Nielson-Senior Hydrologist
Colorado Basin River Forecast Center
National Weather Service/NOAA
Seasonal Weather Review: Impacts to water supply conditions

April 2017 Water Supply Forecasts Overview

- April-July Water Supply Volumes
  - Flaming Gorge Reservoir
  - Yampa River
- Peak Flow Forecasts
  - Green River
  - Yampa River

How good are the forecasts?

- Forecast error and uncertainty
Mid December through February: “Atmospheric Rivers”

Narrow corridor of significant moisture transport in the atmosphere

Sunday Jan 8th 2017
Weather Review: Winter Precipitation (Dec-Feb)

- **Flaming Gorge**: 225%
- **Yampa River**: 140%

- **Flaming Gorge**: 210%
- **Yampa River**: 185%

- **Flaming Gorge**: 225%
- **Yampa River**: 95%
Upper Green had record precipitation for the 3 month period of December-February.
Weather Review: March Precipitation and Temperature

Monthly Precipitation - March 2017
(Averaged by Basin)

Max Temp - Monthly Deviation - March 2017
(Averaged by Basin)

Flaming Gorge: 145%
Yampa River: 40%

Daily temperatures reached 10-20 degrees above average

Degrees (F)
- Above 9
- 7-9 Above
- 5-7 Above
- 3-5 Above
- 1-3 Above
- Normal
- 1-3 Below
- 3-5 Below
- 5-7 Below
- 7-9 Below
- Below 9

Prepared by NOAA, Colorado Basin River Forecast Center
Salt Lake City, Utah, www.cbrfc.noaa.gov
March Weather: Temperature Impacts to Snowpack

Colorado Basin River Forecast Center
Upper Green Group

Percent Median To Date: 162% (21.1 / 13.0)
Percent Seasonal Median: 149% (21.1 / 14.2)
Melt rate 0.2 in/day averaged over last 3 days.

March Weather: Temperature Impacts to Snowpack

Colorado Basin River Forecast Center
Yampa abv Deerlodge Group

Percent Median To Date: 68% (14.1 / 20.7)
Percent Seasonal Median: 63% (14.1 / 22.3)

Melt rate -0.6 in/day averaged over last 3 days.

Median 1981-2010  
2017  
2011  

Created 04/19.20:49 G MT
NOAA/CBRFC, 2017
March Weather: Temperature Impacts to Snowpack

Upper Green: reduced low elevation (<8000 ft) snow; significant snow remains at high elevations

Yampa River: reduced significant low and mid elevation snow (~8500-10,000ft)
March Weather: Temperature Impacts to Streamflow

River Basin % Average Streamflow for March (approximate)

Record March Runoff

<table>
<thead>
<tr>
<th>Site (Rank/POR)</th>
<th>Mar Vol KAF / % Avg</th>
<th>old record</th>
<th>year</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pine Creek (1/60)</td>
<td>2.5 / 240%</td>
<td>2.2</td>
<td>1986</td>
</tr>
<tr>
<td>Fontenelle (1/52)</td>
<td>180 / 343%</td>
<td>99</td>
<td>1986</td>
</tr>
<tr>
<td>Green River-WY (1/66)</td>
<td>237 / 413%</td>
<td>115</td>
<td>1997</td>
</tr>
<tr>
<td>Hams Fork (1/41)</td>
<td>3.2 / 240%</td>
<td>2.5</td>
<td>2015</td>
</tr>
<tr>
<td>Flaming Gorge (1/55)</td>
<td>400 / 392%</td>
<td>237</td>
<td>1997</td>
</tr>
</tbody>
</table>

Many other sites in the top 2 or 3 in the Upper Green.

Data is provisional - not all basin stream flow sites are included.
April 1st Water Supply Forecasts

Water Supply Forecasts: April – July Volumes
Most Probable Scenario (% of 1981-2010 average)

- CBRFC model makes assumptions about long range future weather
- Official forecasts provide a range of possible outcomes based on “dry”, “average”, and “wet” weather scenarios
- “Average” scenario is most commonly used forecast

April 1st Flaming Gorge Forecasts:
- Dry: 1840 KAF (187% average)
- Average: 2260 KAF (231% average)
- Wet: 2670 KAF (272% average)

April 1st Yampa River Forecasts:
- Dry: 765 KAF (62% average)
- Average: 1050 KAF (85% average)
- Wet: 1370 KAF (110% average)

*Record volume forecasted
Forecast Evolution Plot: Flaming Gorge Inflow

Green - Flaming Gorge Res- Flaming Gorge Dam- At (GRNU1)
2017-04-15 Apr-Jul Official 50% Forecast: 2260 kaf (231% of average)
ESP is Unregulated and No Precipitation Forecast Included

The most recent (2017-04-18) full period 50% ESP forecast is 2273 kaf.
Plot Created: 2017-04-18 15:15:34, NOAA / NWS / CERFC
Forecasts in the forecast target period include observed values.
Forecast Evolution Plot: Yampa River-Deerlodge

Yampa - Deerlodge Park (YDLC2)
2017-04-01 Apr-Jul Official 50% Forecast: 1050 kaf (85% of average)
ESP is Unregulated and No Precipitation Forecast Included

Max/Min
ESP 50%
ESP 30-70%
ESP 10-90%
ESP w/o Obs**
Official
Observed Accumulation
Normal Accumulation

The most recent (2017-04-16) full period 50% ESP forecast is 934 kaf.
Plot Created 2017-04-15 11:48:27, NOAA / NWS / CERFC
Forecasts in the forecast target period include observed values.

- Max 2011
- Min 2002
- Average
- Median

- 1180 KAF /95%
- 1400 KAF /113%
- 1500 KAF /121%
- 1050 KAF /85%
- 1440 KAF /113%
- 1500 KAF /121%
- 1520 KAF /127%

Record volume forecasted
1180 KAF /95%
1440 KAF /113%
1500 KAF /121%
1520 KAF /127%
1400 KAF /113%
1050 KAF /85%
934 KAF /75%
1156 KAF /100%

- Forecast Target Period

Plot created with 

- ESP 50%
- ESP 30-70%
- ESP 10-90%
- ESP w/o Obs**
- Official
- Observed Accumulation
- Normal Accumulation
Peak Flow Outlook: Yampa River-Deerlodge

2017 Mean Daily Peak Flow Forecast
Yampa - Deerlodge Park (YDLC2)

Max peak of record
Forecast Probabilities
- 10%
- 50%
- 90%

Flood Flow
Bankfull Flow

10% Forecast: 13,000 CFS
50% Forecast: 9,400 CFS
90% Forecast: 7,400 CFS
Average Peak: 13,000 CFS
Last Year: 15,600 CFS
2011 Peak: 26,700 CFS

These graphics are updated approximately every two weeks between 3/1 and 5/1
Plot Created 2017-04-19 08:58:32
CBRFC / NWS / NOAA
Peak Flow Outlook: Green River- Jensen

<table>
<thead>
<tr>
<th>Forecast Percentage</th>
<th>Flow (cfs)</th>
</tr>
</thead>
<tbody>
<tr>
<td>10% Forecast</td>
<td>23,000 CFS</td>
</tr>
<tr>
<td>50% Forecast</td>
<td>19,000 CFS</td>
</tr>
<tr>
<td>90% Forecast</td>
<td>16,000 CFS</td>
</tr>
<tr>
<td>Average Peak</td>
<td>17,000 CFS</td>
</tr>
<tr>
<td>Last Year Peak</td>
<td>20,500 CFS</td>
</tr>
</tbody>
</table>

*Assuming 8,600 CFS Release
Peak Flow Outlook: Green River, Utah

10% Forecast: 33,000 CFS
50% Forecast: 24,000 CFS
90% Forecast: 19,000 CFS
Average Peak: 21,700 CFS
Last Year Peak: 24,200 CFS

*Assuming 8,600 CFS Release and 4000-9000cfs on Duchesne

These graphics are updated approximately every two weeks between 3/1 and 5/1
Plot Created 2017-04-19 08:57:42
CBRFC / NWS / NOAA
How good are the April-July volume forecasts?

Flaming Gorge Average Historical Model Error
50% Exceedance Forecast (1981-2010)

- Higher forecast error early in the season
- Error decreases through out the season
- Error may be higher in wet years

January 1st Forecast:
What we know:
- ~40% of snowpack accumulation
- Fall soil moisture conditions
What we DON'T know:
- Feb-May weather (4 months)
- ~60% of snowpack accumulation

April 1st Forecast:
What we KNOW:
- ~98% of snowpack accumulation
- Dec-March weather
What we don’t know:
- April-May weather (2 months)
- Snowmelt pattern

Colorado Basin River Forecast Center
Upper Green Group

- Created 04/17/17, 455 UT
- NOAA/CBRFC, 2017
What are the sources of uncertainty in the forecasts?

**Future Weather**
- Uncertainty in temperature and precipitation forecasts
- Extreme events (record wet/record dry) are rarely forecast
- Snowmelt pattern

**Model Snow States**
- Is the model’s representation (amount and extent) of the snowpack correct?
- SNOTELs and satellite images used to verify model snow states
- SNOTELs become less representative during melt

**Model Soil Moisture States**
- Current conditions are near the model max
- Near the upper end of the model calibration; more uncertainty than an average year
Contact Us!

- Operational Hydrologist
  - 801-524-5130 x340
  - cbrfc.operations@noaa.gov
- Michelle Stokes - Hydrologist In Charge
  - michelle.stokes@noaa.gov
- Ashley Nielson-Green River Forecaster
  - ashley.nielson@noaa.gov
  - 801-524-5130 x333

www.cbrfc.noaa.gov
Questions?