Agenda Item
Basin Hydrology, Operations, and 2015 Hydrograph

Action Requested
Information only

Presenter
Katrina Grantz, Hydraulic Engineer, Upper Colorado Region, Bureau of Reclamation

Previous Action Taken
By AMWG:
At the August 2013 AMWG meeting, the following motion was passed:
AMWG recommends to the Secretary of the Interior his approval of the DOI-DOE Proposed Hydrograph for Water Year 2014 as follows:

- **Annual Release Volumes** will be determined in compliance with the 2007 Interim Guidelines (in consultation with the Basin States as appropriate).
- **Monthly Release Volumes** are anticipated to shift depending upon: (1) the Annual Release Volume, and (2) the magnitude of a potential High Flow Experiment in the fall of 2013.
- Monthly Release Volumes may vary within the targets identified below. Any remaining monthly operational flexibility will be used for existing power production operations under the Modified Low Fluctuating Flow (MLFF) alternative selected by the 1996 ROD and contained in the 1995 FEIS and in compliance with all applicable NEPA compliance documents (HFE EA, NNFC EA, 2007 IG).
- **Release objective for June 2014** is 600 kaf to 650 kaf.
- **Release objective for August 2014** is 800 kaf.
- **Release objective for September and October 2014** is 600 kaf to 630 kaf (or less).
- **Monthly Release Volumes** will generally strive to maintain 600 kaf levels in the spring/fall timeframe and 800 kaf in December/January and July/August timeframe.
- Additionally, the Bureau of Reclamation will continue to apply best professional judgment in conducting actual operations and in response to changing conditions throughout the water year. Such efforts will continue to be undertaken in coordination with the DOI/DOE agencies, and after consultation with the Basin States as appropriate, to consider changing conditions and adjust projected operations at Glen Canyon Dam in a manner consistent with the objectives of these parameters as stated above and pursuant to the Law of the River.

Relevant Science
N/A

Background Information
The presentation is intended to provide pertinent information to AMWG members on current water supply and forecasted hydrologic conditions within the Upper Colorado River Basin. The presentation will focus on projected reservoir conditions and operations at Lake Powell/Glen Canyon Dam for the remainder of water year 2014 and provide a provisional outlook for water years 2015 and 2016.

The presentation will cover the implementation of the *Colorado River Interim Guidelines for Lower Basin Shortages and the Coordinated Operations of Lake Powell and Lake Mead* and the forecast for annual releases from Lake Powell in water year 2015. Such information is provided to assist the AMWG in developing recommendations to the Secretary on the operation of Glen Canyon Dam for water year 2015.

The presentation will include a brief review of the 2014 hydrograph development and an overview of the upcoming 2015 hydrograph development process. In cooperation with the other federal agencies, Reclamation is beginning its development of Interior’s recommendation for the 2015 Hydrograph. This recommendation will be based upon the scenarios analyzed for the 2014 Hydrograph and any new ideas that may become known through our discussions. Reclamation will review the analyses with the TWG and Interior will provide a recommendation for the AMWG’s consideration later this year.
### Lake Powell & Lake Mead
### Operational Diagrams for 2014 (projected in Aug 2013)

<table>
<thead>
<tr>
<th>Elevation (feet)</th>
<th>Operation According to the Interim Guidelines</th>
<th>Live Storage (maf)</th>
<th>Elevation (feet)</th>
<th>Operation According to the Interim Guidelines</th>
<th>Live Storage (maf)</th>
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<tbody>
<tr>
<td>3,700</td>
<td>Equalization Tier</td>
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<td>1,220</td>
<td>Flood Control Surplus or Quantified Surplus Condition</td>
<td>25.9</td>
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<td>3,636 - 3,686 (2008-2026)</td>
<td>Upper Elevation Balancing Tier Release 8.23 maf, if Lake Mead &lt; 1,075 feet, balance contents with a min/max release of 7.0 and 9.0 maf</td>
<td>15.5 - 19.3 (2008-2026)</td>
<td>1,200 (approx.)</td>
<td>Domestic Surplus or ICS Surplus Condition</td>
<td>22.9 (approx.)</td>
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<td>3,575</td>
<td><strong>Mid-Elevation Release Tier</strong> Release 7.48 maf, if Lake Mead &lt; 1,025 feet, release 6.23 maf</td>
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<td>1,145</td>
<td>Normal or ICS Surplus Condition</td>
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<td><strong>Projection of 1/1/14</strong></td>
<td><strong>11.9</strong></td>
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<td><strong>895</strong></td>
<td>Further measures may be undertaken</td>
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</table>

Diagram not to scale

1. Acronym for million acre-feet
2. This elevation is shown as approximate as it is determined each year by considering several factors including Lake Powell and Lake Mead storage, projected Upper Basin and Lower Basin demands, and an assumed inflow.
3. Subject to April adjustments which may result in a release according to the Equalization Tier.
4. Of which 2.48 maf is apportioned to Arizona, 4.4 maf to California, and 0.287 maf to Nevada.
5. Of which 2.40 maf is apportioned to Arizona, 4.4 maf to California, and 0.283 maf to Nevada.
6. Of which 2.32 maf is apportioned to Arizona, 4.4 maf to California, and 0.280 maf to Nevada.
7. Whenever Lake Mead is below elevation 1,025 feet, the Secretary shall consider whether hydrologic conditions together with anticipated deliveries to the Lower Division States and Mexico is likely to cause the elevation at Lake Mead to fall below 1,000 feet. Such consideration, in consultation with the Basin States, may result in the undertaking of further measures, consistent with applicable Federal law.

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1 Lake Powell’s projected elevation is based on an 8.23 maf annual release pattern from in water year 2014.
### WY2014 Operations under Interim Guidelines
determined in August 2013 24-Month Study

<table>
<thead>
<tr>
<th>Scenario</th>
<th>Operational Tier</th>
<th>Annual Release Volume</th>
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<tr>
<td>Minimum Probable</td>
<td>Mid-Elevation Release</td>
<td>7.48 maf</td>
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<tr>
<td>Most Probable</td>
<td>Mid-Elevation Release</td>
<td>7.48 maf</td>
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<tr>
<td>Maximum Probable</td>
<td>Mid-Elevation Release</td>
<td>7.48 maf</td>
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* Note that in the Mid-Elevation Release Tier, there is no provision for an April adjustment to the operating tier.
As of 02/18/2014 with 114 of 116 sites reporting, the basin wide SWE is 112 percent of median.

Currently 112% of median (1981-2010)

Upper Colorado River Basin Snotel Tracking
Aggregate of 116 Snotel Sites above Lake Powell

Data Provided by the Natural Resource Conservation Service
Lake Powell Unregulated Inflow
Apr - Jul 2014 Forecast (issued Feb 4)
Comparison with History

April - July Forecast:
- Feb Most Prob: 7,250 kaf (101%)
- Feb Min Prob: 4,750 kaf (66%)
- Feb Max Prob: 10,300 kaf (144%)

Feb mid-month: 7,700 kaf (108%)

Historic Average: 7.16 maf
Powell Unregulated Inflow
Apr-Jul 2014 Forecast (Feb 4)
Comparison with History

April - July Forecast
Feb Most Prob: 7,250 kaf (101%)
Feb Min Prob: 4,750 kaf (66%)
Feb Max Prob: 10,300 kaf (144%)

Feb mid-month: 7,700 kaf (108%)

Historic Average: 7,160 kaf
Projected Lake Powell Monthly Release Volume Distribution
February 2014 Release Projections
Water Year 2014

WY 2014 Release: 7.48 maf
For all inflow scenarios
Lake Powell End of Month Elevations
Historic and Projected based on February modeling

Water Year 2015 projections
Most = 9.0 maf release
Max = ~11 maf release
Min = 7.48 maf release
Glen Canyon Power Plant Provisional Unit Outage Schedule for Water Year 2014

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¹ Projected release, based on Feb 2014 Inflow Projections and 24-Month Study model runs
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1 Projected release, based on Jan 2014 Min and Max Probable Inflow Projections and 24-Month Study model runs
2 Projected release, based on Feb 2014 Most Probable Inflow Projections and 24-Month Study model runs

(updated 2-18-2014)
Glen Canyon Dam Hourly Release Pattern FEB 2014

February 1-28, 2014
81 MW reg/res at GCD

February Volume = 600 kaf

Date-Hour

- Scheduled Hourly Releases
- Actual Hourly Releases
- Lees Ferry Flow
DOI-DOE Hydrograph Development for 2015
2015 Hydrograph Concepts

• Objective—retain sand inputs high in the system in anticipation of a potential HFE

• Continue to target lower August through October releases

• Avoid shifting “extra” water to June (which cools temperatures at the mouth of the LCR)

• Move water from August to other equal value months for hydropower (Dec/Jan)
Sand Transport Model
(based on median inputs)

Note: Median to Mean July-Nov Inputs range from 630 to 946 ktons
Based on 2013 initial conditions; sand transport values may be slightly higher in 2014 (due to
2014 Hydrograph language

- **Annual Release Volumes** will be determined in compliance with the 2007 Interim Guidelines (in consultation with the Basin States as appropriate).
- **Monthly release Volumes** are anticipated to shift depending upon: (1) the Annual Release Volume, and (2) the magnitude of a potential High Flow Experiment.
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- **Release objective for June** is 600 kaf to 650 kaf.
- **Release objective for August** is 800 kaf.
- **Release objective for September and October** is 600 kaf to 630 kaf (or less).
- Monthly Release Volumes will generally strive to maintain 600 kaf levels in the spring/fall timeframe and 800 kaf in December/January and July/August timeframe.
- Additionally, the Bureau of Reclamation will continue to apply best professional judgment in conducting actual operations and in response to changing conditions throughout the water year. Such efforts will continue to be undertaken in coordination with the DOI/DOE agencies, and after consultation with the Basin States as appropriate, to consider changing conditions and adjust projected operations in a manner consistent with the objectives of these parameters as stated above and pursuant to the Law of the River.
2015 Projected Annual Release
(Based on January and February 2014 modeling)

- **Min probable**: 7.48 maf release
  (less likely with improved hydrology)
- **Most probable**: 9.0 maf release
  (Upper Elevation Balancing, between 8.23 and 9.0 maf)
- **Max probable**: ~11 maf release
  (with April adjustment to equalization)
2015 Possible Hydrograph
7.48 maf release

- Flows are already low – no difference from typical MLFF
2015 Possible Hydrograph
8.23 maf release
2015 Possible Hydrograph
9.0 maf release
2015 Possible Hydrograph
10.95 maf release

- Lots of water to move: limited flexibility, minimal difference
2015 Hydrograph Next Steps

• Continue to coordinate with DOI-DOE Agencies
• Analyze impacts of hydrograph release scenarios:
  – Hydropower Impacts: GTMax
  – Sediment retention: Sand Budget model
  – Temperature Impacts
• Present to TWG in June
Questions?

Katrina Grantz
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kgrantz@usbr.gov

Hydraulic Engineer, Glen Canyon
Reclamation, Upper Colorado Region
Resource Management Division
Water Resources Group
Lake Powell Release Temperature
2014 Projected Temperature based on February 2014 Forecast

- Observed - Lees Ferry
- Most Probable Hydrology
- Jan Min Probable Hydrology
- Jan Max Probable Hydrology

Projection start date is based on initial conditions (December 2013)
Colorado River, Grand Canyon Water Temperatures
Projections based on February 2014, Most Probable Hydrology

Temperature, °C

Month


RECLAMATION