2005 Colorado River Symposium
Sharing the Risks: Shortage, Surplus, and Beyond

Present Day Drought Conditions in the Colorado River Basin

Greg Smith, Hydrologist
Colorado Basin River Forecast Center / NWS / NOAA

September 28-30, 2005
Bishops Lodge, Santa Fe, New Mexico
Location: Salt Lake City, Utah
Mission: Protection lives/property-Enhance national economy

Event Driven (rain, snowmelt) River Forecasts => Warnings
Flash Flood Guidance => Warnings
Recreational Forecasts (River trends – Peak Flows)

Water Supply => Reservoir Management

Colorado River
Drought: How Severe?

- Drought is in the eye of the beholder -

- Common occurrence & normal part of climate variability -

Drought is a function of:

Spatial Extent & Duration

Magnitude of:
- Precipitation Deficits
- Water Supply Deficits
- Impacts (environmental, social, economic)
Drought: How Severe?

Hydrologic Stats

Five consecutive years of below average inflow to Lake Powell (Colorado River Basin) 2000-2004.

Average inflow 2000-2004 lower than “dustbowl years” of 1930-1937.

Lowest Inflow on record (observed data) occurred in 2002.

Lake Powell / Lake Mead System storage decreased 45% from 1999 to 2004.

USGS: Dendrochronology suggests recent drought largest in 500 years.
Inflow Volume To Lake Powell For April-July Period
Ranked From Smallest to Largest Volumes

The Good Old Days
Snow Water Equivalent From 116 Stations Above Lake Powell

To Date: 2778% (0.0 / 0.0)
Seasonal: 0% (0.0 / 18.1)
Melt rate: -0.1 in/day averaged over last 3 days.
2005 Apr-Jul Streamflow Volumes

- Upper Green: 94%
- Yampa / White: 104%
- Upper Colorado Mainstem: 97%
- Gunnison / Dolores: 105%
- San Juan: 148%
- Salt / Verde / Gila: 200-450%
- Lake Powell Inflow: 111%
U.S. Drought Monitor

September 21, 2004
Valid 8 a.m. EDT

The Drought Monitor focuses on broad-scale conditions. Local conditions may vary. See accompanying text summary for forecast statements.

http://drought.unl.edu/dm

Released Thursday, September 23, 2004
Author: Brad Rippey, U.S. Department of Agriculture

Intensity:
Yellow: D0 Abnormally Dry
Light Orange: D1 Drought - Moderate
Dark Orange: D2 Drought - Severe
Red: D3 Drought - Extreme
Brown: D4 Drought - Exceptional

Drought Impact Types:

\(\sim\) Delineates dominant impacts
A = Agricultural (crops, pastures, grasslands)
H = Hydrological (water)
(No type = Both impacts)
Does this mean the drought is over
Have we turned the corner

What about 2006
Above average years occur during longer ‘drought’ periods.
U.S. Seasonal Drought Outlook
Through December 2005
Released September 15, 2005

KEY:
- Drought to persist or intensify
- Drought ongoing, some improvement
- Drought likely to improve, impacts ease
- Drought development likely

Depicts general, large-scale trends based on subjectively derived probabilities guided by numerous indicators, including short- and long-range statistical and dynamical forecasts. Short-term events -- such as individual storms -- cannot be accurately forecast more than a few days in advance, so use caution if using this outlook for applications -- such as crops -- that can be affected by such events. "Ongoing" drought areas are schematically approximated from the Drought Monitor (D1 to D4). For weekly drought updates, see the latest Drought Monitor map and text. NOTE: the green improvement areas imply at least a 1-category improvement in the Drought Monitor intensity levels, but do not necessarily imply drought elimination.
**Time Line For Early Season Outlooks**

- **Planning Outlook August**
- **Outlooks Begin Oct/Nov**
- **Forecasts Begin Jan 1**
- **Forecast Target (April – Jul Volume)**

**Month:**
- Jan
- Feb
- Mar
- Apr
- May
- Jun
- Jul

**Outlook Drivers**
- Historical Observations
- Streamflow
- Soil Moisture Conditions
- Climate Forecasts/Indices
- Autumn flow / recession

**Forecast Drivers**
- Observed snow water equivalent
- Observed Precipitation
- Observed Streamflow
- Updated Soil Moisture Conditions
- Updated Climate/Weather Forecasts
Developing A Forecast

Start with Today’s Conditions - Create several possible future streamflow patterns - Based on historical climate.

Colorado Basin River Forecast Center
Developing A Forecast

Near Term – Blend Temperature / Precipitation (1-15 days)

Flow Traces

Past <-> Future Time

Today's Conditions
River / Res. Levels
Soil Moisture
Snowpack

1971
1972
1973
1974
1975

Longer Term (months-year): Weigh analysis on Climate Prediction Center forecasts.

Colorado Basin River Forecast Center
Developing a forecast

Past <-> Future Time - >

Flow

April-July

Determine a most likely forecast (most probable 50/50)
Determine an upper boundary forecast (10% chance of exceeding)
Determine a lower boundary forecast (90% chance of exceeding)
Skill: Improvement over climatology

∼ 5-15% improvement over simply using climatology
2006 Outlook for April-July Lake Powell Inflow

10% Chance To Exceed: 13.0 MAF

25% Chance To Exceed: 10.5 MAF

Average: 7.9 MAF

50% Chance To Exceed: 7.0 MAF

75% Chance To Exceed: 3.5 MAF

90% Chance To Exceed: 1.5 MAF
Other indicators we can use for the near term?

**Autumn 2004**

Statistics: 5 years below average flow
Active Monsoon extending into Autumn
Higher autumn streamflow / soil moisture
Signs of a weak El Nino
Ocean/Atmospheric Adjustments?

- 16th coolest summer on record
- 7th coolest August on record
- Wettest summer in TX, LA, MS, AK, OK, KS
- 8 Named tropical cyclones in August
- 3 Major Hurricanes hit Florida

**Today**

Statistics: Even in droughts normal years occur
Less Active / Less extensive Monsoon
Greater variation streamflow / soil moisture
Neutral ENSO Conditions
Ocean/Atmospheric Adjustments?

- June – August 10th warmest on record (lower 48)
- Warmest summer in NJ, 2nd warmest in NY, VT, MA
- All time summer high temperature records in Hawaii
- 3rd warmest summer on record in Alaska.
- 12 named Atlantic tropical cyclones through August
- Hurricanes Katrina and Rita

Indications favoring a change
- Less Clear: Near to below normal
Any long term climate trend information?

PDO: Pacific Decadal Oscillation
AMO: Atlantic Multidecadal Oscillation

AMO positive since mid 1990’s
PDO Negative since late 1990s.

Complex relationships between climate indices (AMO, PDO, SOI, etc.), precipitation, and runoff volumes. Climate indices offer only a partial explanation.

Short time-scale atmospheric phenomena can have a significant effect on seasonal climate and streamflow


River flow records in the Colorado River Basin exhibit significant variability during multi-year periods of above/below average flows that are not explained by the present climate indices available.
River Forecasts & Data

Forecasts on this web page are not official and should be used only as guidance. Official warnings and forecasts can be found here.

Legend. Map data updated 09/21 18:34 GMT, 09/21 10:34 MDT. Click map to zoom.

Data Type: River Forecasts | Reservoirs | Recreational | Snow Conditions

Click to: Select Zoom  Zoom to: 1x 4x 8x  Help

Legend
Basin Conditions (0-3 days)
☐ 1 = Normal, 0 = No Data
☐ 2 = Significant Rise
☐ 3 = Near Bankfull
☐ 4 = Above Bankfull
☐ 5 = Above Flood Stage
☐ Observed (Solid)
☐ Simulated (Striped)
☐ Outlook (beyond 3 days)

Station Types
☐ AHPS Point
☐ Forecast Point
☐ Data Point

Quick Plot
NWS ID

Open

Display Options
☐ Topography
☐ States
☐ RFC
☐ Rivers
☐ HSAs
☐ Basins
☐ Basins Above Normal
☐ Data Points
☐ Forecast Points
☐ AHPS Points
☐ Stations Above Normal
☐ Station Labels

Apply

Additional Information:

www.cbrfc.noaa.gov

greg.smith@noaa.gov

Thank You !