DROUGHT

Laurna Kaatz
Climate Adaptation Program Director
Colorful Colorado
Aspen
Arkansas River
South Platte River.
Yampa River
Gunnison River
Colorado River
Continental Divide
South Platte Watershed
Colorado River Watersheds
Denver
Transbasin Diversions

- 25% of state population
- 1.0 million jobs
- 30% of state GDP
- 2% of Colorado’s water
Comparison of Water Supply and Demand Patterns

- DW Service Area Average Demand Pattern
- Average Supply Pattern (S.F. Williams Fork)
Factors Affecting Water Supply

Objective: Fill Reservoirs and Balance System

- Available Flow (natural flows)
  - Variations in annual, seasonal and daily weather patterns and runoff
  - System losses (evaporation, carriage losses)

- System Constraints
  - Tunnels, canals, reservoirs
  - Stream channels
  - Treatment plants and distribution
  - Water quality

- Water Rights and Agreements
  - Colorado water law
  - Contracts & agreements
  - Minimum, maximum flows
  - Environmental factors

- Demand
  - Existing vs. Future
  - Variations in annual, seasonal and daily demand
  - Indoor versus outdoor demand
  - Future conservation savings
  - Demands of other entities
  - Social values
2018

**Snowpack: South Platte River Watershed**

- Historical Range (1979-2016)
- Median (1981-2010)
- 2017-2018

Today's % of Normal: 0%
2017-2018 Peak % of Normal Peak: 85%
Date of 2017-2018 Peak: 4/16/2018

**Snowpack: Colorado Riv**

Data are from the 7 SNOTEL stations above Denver Water's Upper South Platte diversion facilities.

- Historical Range (1978-2016)
- Median (1981-2010)
- 2017-2018

Today's % of Normal: 0%
2017-2018 Peak % of Normal Peak: 107%
Date of 2017-2018 Peak: 4/22/2018

Data are from the 7 SNOTEL stations above Denver Water's Upper Colorado diversion facilities.
Acre-Feet

SUPPLY RESERVOIR CONTENTS

Full

2018

Historic Median

Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
Denver Metro Area Weather Variation: May 15 to July 15

The weather average (where the axes cross) is 1981-2010.
Flash Drought in a semiarid region

- **Context matters:**
  - Current conditions: drought year?
  - Timing: spring vs late fall vs winter
  - Location: service area vs watersheds, headwaters vs downstream

- **Another acute challenge?**
  - Extreme heat, forest fire, compact call, flash drought?

- **WWWM?**
  - Vulnerable to warming
  - Year types?
    - Dry → drier
    - Ave → dry
    - Wet → ave, wet, wetter?
Denver Water Reservoir Contents
(1634-2005)
Water Supply: 345,000 af
Includes 30,000 af Strategic Water Reserve and Drought Restrictions
Summary of Lessons: For scientists (and their science) to be relevant for decision-makers:

1. TRUST
2. UNDERSTANDING
3. PROOF
4. CAPACITY
Summary of Lessons with coproduction

1. TRUST and Respect
2. Mutual UNDERSTANDING
3. PROOF imbedded in the process
4. CAPACITY – non factor
Conclusions

• Proven skillful forecasts
• Snow, etc.
• Streamflow
• Spring storms
• Wet years
• Social science
2018 Water Use and Weather Conditions

- Precipitation Event - Metro Avg.
- Water Use*
- Daily High Temperature*
- Long-Term Avg. Daily High Temperature*
Embracing Uncertainty

- Robust and Low Regrets Actions
- Preserving Options

Planning Futures
Learn with Others

Water Utility Climate Alliance

Vision: Climate-resilient water utilities, thriving communities

Mission: Collaboratively advance water utility climate change adaptation

http://www.wucaonline.org/
Available at: WUCAonline.org
<table>
<thead>
<tr>
<th></th>
<th>2° F Warming</th>
<th>5° F Warming</th>
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</thead>
<tbody>
<tr>
<td>Reduced Supply</td>
<td>7%</td>
<td>14%</td>
</tr>
<tr>
<td>Additional precipitation needed to offset 5° F warming</td>
<td>10%</td>
<td></td>
</tr>
<tr>
<td>2017 Reduced Supply</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3°F with wet winters</td>
<td>5%</td>
<td></td>
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<tr>
<td>6°F + more daily variability</td>
<td>22%</td>
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What Will Warming Mean?

dry

average

wet

? 

dry

average

wet
Thank you.

Laurna Kaatz
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Planning for Drought - 2002

Deterministic thinking

Integrated Resources Planning

Observed hydrology and extrapolation of past trends

Unprecedented Simultaneous Natural Disasters

Cylinder of Certainty

Present 1950s Future
Water Demand and Supply

Acre Feet

Total Demand = Adjusted Treated Water Demand + Fixed Contracts

Current Supply

Year

2005 2010 2015 2020 2025 2030 2035 2040 2045 2050

200,000 250,000 300,000 350,000 400,000 450,000
Projected Changes for North Central Colorado

Precipitation Change (%) vs. Temperature Change (Fahrenheit)

Projected Changes for North Central Colorado