Wyoming Cooperative Snow Survey Program
<table>
<thead>
<tr>
<th>Lee Hackleman</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Snow Course &amp; SNOTEL history</td>
</tr>
<tr>
<td>2. SWE</td>
</tr>
<tr>
<td>3. Basin Outlook Report</td>
</tr>
<tr>
<td>4. Daily Forecasts</td>
</tr>
<tr>
<td>5. Reservoir Graphs</td>
</tr>
<tr>
<td>6. Update Report</td>
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<tr>
<td>7. Projection or Trend Graphs</td>
</tr>
<tr>
<td>8. Monday Morning Report</td>
</tr>
<tr>
<td>9. WY Soil Moisture Sensors</td>
</tr>
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<td>10. Basin Reports</td>
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<table>
<thead>
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<th>Brian Domonkos</th>
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<tr>
<td>1. Data Collection (SNOTEL &amp; SC)</td>
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<tr>
<td>2. Report Generator</td>
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<tr>
<td>3. Interactive Map</td>
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<td>4. Data Editing</td>
</tr>
<tr>
<td>5. SWSI</td>
</tr>
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<td>6. Normals</td>
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</table>
Cooperative Snow Survey Program

- The first snow survey was conducted in 1906. Started by Dr. Church in the Lake Tahoe Area.
- Congressionally mandated in the 1930s.
- First snow courses in WY installed in 1930 in Teton and Yellowstone Parks about 7 of them.
- First SNOTELs in WY installed in 1978 about 11 of them.
Cooperative Snow Survey Program

- There are about 858 SNOTEL sites in the 12 western states plus Alaska.
- Wyoming has 89 SNOTEL sites and 61 manually read snow courses.
Cooperative Snow Survey Program

Standard site
- Shelter for electronics
- snow pillow
- storage precipitation gauge
- snow depth sensor
- temperature sensor.
Cooperative Snow Survey Program

- Other sensors
  - Solar Radiation
  - Relative Humidity
  - Wind speed
  - Wind direction
  - Soil Moisture
  - Tipping Bucket Rain Gage
Cooperative Snow Survey Program

Snow Pillow

- The hexagon shaped snow pillow is an envelope of synthetic rubber, fit into a 10 feet diameter area.
- Pillow contains an antifreeze solution.
- Attached to transducer to measure pressure
Cooperative Snow Survey Program

• Basin Outlook Report
  – Prepared January through June
  – 19 basins
  – 63 forecast points
Wyoming Outlook Report

Snake River Basin

Snow
Snake River Basin SWE above Palisades is 51% of median. SWE in the Snake River Basin above Jackson Lake is 22% of median. Pacific Creek Basin SWE is 37% of median. Buffalo Fork SWE is 76% of median. Gros Ventre River Basin SWE is 74% of median. SWE in the Hoback River drainage is 131% of median. SWE in the Grey's River drainage is 114% of median. In the Salt River area SWE is 0% of median. See Appendix C at the end of this report for a detailed listing of snow course information.

Precipitation
Last month’s precipitation for the Snake River Basin was 114% of average (56% last year). Percentages range from 89-255% of average for the 29 reporting stations. Water-year-to-date precipitation is 69% of average for the Snake River Basin (123% last year). Year-to-date percentages range from 71-114% of average.

Reservoirs
Current reservoir storage is 125% of average for the 3 storage reservoirs in the basin. Grassy Lake storage is about 108% of average (15,400 ac-ft compared to 14,300 last year). Jackson Lake storage is 140% of average (847,500 ac-ft compared to 636,900 ac-ft last year). Palisades Reservoir storage is about 116% of average (1,194,100 ac-ft compared to 847,600 ac-ft last year). Detailed reservoir data is shown on the following page and Appendix D.

Streamflow
The 50% exceedance forecasts for June through September are below average for this basin. The Snake near Moran is 210,000 ac-ft (42% of average). Snake River above reservoir near Alpine is 1,050,000 ac-ft (65% of average). The Snake near Irwin is 1,330,000 ac-ft (61% of average). The Snake near Heise is 1,450,000 ac-ft (62% of average). Pacific Creek near Moran is 46,000 ac-ft (48% of average). Buffalo Fork above Lava near Moran is 156,000 ac-ft (74% of average). Grey's River above Palisades Reservoir is 160,000 ac-ft (63% of average). Salt River near Etna is 119,000 ac-ft (57% of average). See the following page for further information.
### Snake River Basin Streamflow Forecasts - May 1, 2015

**Forecast Exceedance Probabilities for Risk Assessment**

*Change that actual volume will exceed forecast*

<table>
<thead>
<tr>
<th>Reservoir Storage</th>
<th>Current (KAF)</th>
<th>Last Year (KAF)</th>
<th>Average (KAF)</th>
<th>Capacity (KAF)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Grassy Lake</td>
<td>13.8</td>
<td>14.3</td>
<td>12.8</td>
<td>15.2</td>
</tr>
<tr>
<td>Jackson Lake</td>
<td>707.8</td>
<td>297.6</td>
<td>445.7</td>
<td>847.0</td>
</tr>
<tr>
<td>Palisades Reservoir</td>
<td>1194.4</td>
<td>509.6</td>
<td>911.7</td>
<td>1400.0</td>
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<tr>
<td>Basin-wide Total</td>
<td>1915.9</td>
<td>821.5</td>
<td>1370.2</td>
<td>2262.2</td>
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*Watershed Snowpack Analysis May 1, 2015*

<table>
<thead>
<tr>
<th>Reservoirs</th>
<th># of Sites</th>
<th>% Median</th>
<th>Last Year % Median</th>
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<tr>
<td>Snake River nr Moran</td>
<td>6</td>
<td>40%</td>
<td>141%</td>
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<tr>
<td>March Creek</td>
<td>2</td>
<td>65%</td>
<td>148%</td>
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<tr>
<td>Buffalo Fork</td>
<td>2</td>
<td>73%</td>
<td>149%</td>
</tr>
<tr>
<td>Gros Ventre River</td>
<td>4</td>
<td>75%</td>
<td>145%</td>
</tr>
<tr>
<td>Hoback River</td>
<td>5</td>
<td>61%</td>
<td>174%</td>
</tr>
<tr>
<td>Greys River</td>
<td>5</td>
<td>83%</td>
<td>172%</td>
</tr>
<tr>
<td>Salt River</td>
<td>5</td>
<td>44%</td>
<td>174%</td>
</tr>
<tr>
<td>Snake River Basin</td>
<td>27</td>
<td>57%</td>
<td>150%</td>
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Wyoming Forecast Points
## Aug. 1<sup>st</sup> Reservoir Storages used by WY Snow Survey Program

<table>
<thead>
<tr>
<th>WYOMING</th>
<th>Current (KAF)</th>
<th>Last Year (KAF)</th>
<th>Average (KAF)</th>
<th>Capacity (KAF)</th>
<th>Current % Capacity</th>
<th>Last Year % Capacity</th>
<th>Average % Capacity</th>
<th>Current % Average</th>
<th>Last Year % Average</th>
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<tr>
<td>Alcova</td>
<td>179.8</td>
<td>180.9</td>
<td>180.3</td>
<td>184.3</td>
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<td>98%</td>
<td>98%</td>
<td>100%</td>
<td>100%</td>
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<tr>
<td>Bighorn Lake</td>
<td>1001.2</td>
<td>997.2</td>
<td>966.2</td>
<td>1356.0</td>
<td>74%</td>
<td>74%</td>
<td>71%</td>
<td>104%</td>
<td>103%</td>
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<tr>
<td>Big Sandy</td>
<td>29.4</td>
<td>23.0</td>
<td>24.7</td>
<td>38.3</td>
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<td>60%</td>
<td>64%</td>
<td>119%</td>
<td>93%</td>
</tr>
<tr>
<td>Boysen</td>
<td>659.3</td>
<td>678.1</td>
<td>598.3</td>
<td>596.0</td>
<td>111%</td>
<td>114%</td>
<td>100%</td>
<td>110%</td>
<td>113%</td>
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<tr>
<td>Buffalo Bill</td>
<td>584.4</td>
<td>625.6</td>
<td>491.5</td>
<td>646.6</td>
<td>90%</td>
<td>97%</td>
<td>76%</td>
<td>119%</td>
<td>127%</td>
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<tr>
<td>Bull Lake</td>
<td>144.8</td>
<td>149.1</td>
<td>128.2</td>
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<td>98%</td>
<td>84%</td>
<td>113%</td>
<td>116%</td>
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<tr>
<td>Fontenelle</td>
<td>310.9</td>
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<td>260.3</td>
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<td>100%</td>
<td>75%</td>
<td>119%</td>
<td>133%</td>
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<tr>
<td>Glendo</td>
<td>381.5</td>
<td>314.5</td>
<td>300.8</td>
<td>506.4</td>
<td>75%</td>
<td>62%</td>
<td>59%</td>
<td>127%</td>
<td>105%</td>
</tr>
<tr>
<td>Grassy Lake</td>
<td>12.2</td>
<td>15.2</td>
<td>12.8</td>
<td>15.2</td>
<td>81%</td>
<td>100%</td>
<td>84%</td>
<td>96%</td>
<td>119%</td>
</tr>
<tr>
<td>Guernsey</td>
<td>1.6</td>
<td>27.5</td>
<td>24.1</td>
<td>45.6</td>
<td>4%</td>
<td>60%</td>
<td>53%</td>
<td>7%</td>
<td>114%</td>
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<tr>
<td>High Savery Reservoir</td>
<td>19.2</td>
<td>18.3</td>
<td>20.9</td>
<td>22.4</td>
<td>86%</td>
<td>82%</td>
<td>93%</td>
<td>92%</td>
<td>88%</td>
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<tr>
<td>Jackson Lake</td>
<td>729.2</td>
<td>785.2</td>
<td>640.8</td>
<td>847.0</td>
<td>86%</td>
<td>93%</td>
<td>76%</td>
<td>114%</td>
<td>123%</td>
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<tr>
<td>Kendrick Project</td>
<td>1152.7</td>
<td>744.6</td>
<td>1201.7</td>
<td>96%</td>
<td>62%</td>
<td></td>
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<tr>
<td>Keyhole</td>
<td>182.2</td>
<td>172.3</td>
<td>95.2</td>
<td>193.8</td>
<td>94%</td>
<td>89%</td>
<td>49%</td>
<td>191%</td>
<td>181%</td>
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<tr>
<td>Meeks Cabin Reservoir</td>
<td>21.4</td>
<td>16.1</td>
<td>16.7</td>
<td>32.5</td>
<td>66%</td>
<td>49%</td>
<td>51%</td>
<td>128%</td>
<td>96%</td>
</tr>
<tr>
<td>North Platte Project</td>
<td>976.3</td>
<td>869.4</td>
<td>1062.1</td>
<td>92%</td>
<td>82%</td>
<td></td>
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<td></td>
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<tr>
<td>Pathfinder</td>
<td>842.8</td>
<td>650.3</td>
<td>588.9</td>
<td>1016.5</td>
<td>83%</td>
<td>64%</td>
<td>58%</td>
<td>143%</td>
<td>110%</td>
</tr>
<tr>
<td>Pilot Butte</td>
<td>27.2</td>
<td>26.6</td>
<td>20.8</td>
<td>31.6</td>
<td>86%</td>
<td>84%</td>
<td>66%</td>
<td>131%</td>
<td>128%</td>
</tr>
<tr>
<td>Seminoe</td>
<td>895.5</td>
<td>757.5</td>
<td>708.0</td>
<td>1016.7</td>
<td>88%</td>
<td>75%</td>
<td>70%</td>
<td>126%</td>
<td>107%</td>
</tr>
<tr>
<td>Viva Naughton Res</td>
<td>41.9</td>
<td>42.1</td>
<td>40.4</td>
<td>42.4</td>
<td>99%</td>
<td>99%</td>
<td>95%</td>
<td>104%</td>
<td>104%</td>
</tr>
<tr>
<td>Wheatland #2</td>
<td>84.5</td>
<td>74.2</td>
<td>58.0</td>
<td>98.9</td>
<td>85%</td>
<td>75%</td>
<td>59%</td>
<td>146%</td>
<td>128%</td>
</tr>
<tr>
<td>Woodruff Narrows Reservoir</td>
<td>37.2</td>
<td>17.5</td>
<td>25.7</td>
<td>57.3</td>
<td>65%</td>
<td>30%</td>
<td>45%</td>
<td>145%</td>
<td>68%</td>
</tr>
<tr>
<td><strong>Basin-wide Total</strong></td>
<td><strong>6186.2</strong></td>
<td><strong>5917.4</strong></td>
<td><strong>5202.6</strong></td>
<td><strong>7244.1</strong></td>
<td><strong>85%</strong></td>
<td><strong>82%</strong></td>
<td><strong>72%</strong></td>
<td><strong>119%</strong></td>
<td><strong>114%</strong></td>
</tr>
<tr>
<td><strong># of reservoirs</strong></td>
<td><strong>20</strong></td>
<td><strong>20</strong></td>
<td><strong>20</strong></td>
<td><strong>20</strong></td>
<td><strong>20</strong></td>
<td><strong>20</strong></td>
<td><strong>20</strong></td>
<td><strong>20</strong></td>
<td><strong>20</strong></td>
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Reservoir Storage as of August 1, 2015

Capacity of Reservoirs Reported (1000 Acre-Feet)

<table>
<thead>
<tr>
<th>State</th>
<th>Number of Reservoirs Reported</th>
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<tbody>
<tr>
<td>AZ</td>
<td>4/4</td>
</tr>
<tr>
<td>CA</td>
<td>154/154</td>
</tr>
<tr>
<td>CO</td>
<td>79/84</td>
</tr>
<tr>
<td>ID</td>
<td>25/25</td>
</tr>
<tr>
<td>MT</td>
<td>45/46</td>
</tr>
<tr>
<td>NV</td>
<td>4/5</td>
</tr>
<tr>
<td>NM</td>
<td>15/17</td>
</tr>
<tr>
<td>OR</td>
<td>31/31</td>
</tr>
<tr>
<td>UT</td>
<td>42/42</td>
</tr>
<tr>
<td>WA</td>
<td>8/11</td>
</tr>
<tr>
<td>WY</td>
<td>20/22</td>
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# Update Report for Snotels

## Wyoming SNOTEL Snow/Precipitation Update Report

Based on Mountain Data from NRCS SNOTEL Sites

**Provisional data, subject to revision**

Data based on the first reading of the day (typically 00:00) for Monday, April 06, 2015

<table>
<thead>
<tr>
<th>Basin Site Name</th>
<th>Elev (ft)</th>
<th>Snow Water Equivalent</th>
<th>Water Year-to-Date Precipitation</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Current (in)</td>
<td>Median (in)</td>
</tr>
<tr>
<td><strong>SNAKE RIVER</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Base Camp</td>
<td>7030</td>
<td>12.8</td>
<td>15.2</td>
</tr>
<tr>
<td>Black Bear</td>
<td>8170</td>
<td>25.5</td>
<td>37.2</td>
</tr>
<tr>
<td>Blind Bull Sum</td>
<td>8650</td>
<td>22.9</td>
<td>23.1</td>
</tr>
<tr>
<td>Cottonwood Creek</td>
<td>7670</td>
<td>19.4</td>
<td>21.0</td>
</tr>
<tr>
<td>East Rim Divide</td>
<td>7930</td>
<td>8.3</td>
<td>10.2</td>
</tr>
<tr>
<td>Grand Targhee</td>
<td>9260</td>
<td>33.8</td>
<td>38.2</td>
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<tr>
<td>Granite Creek</td>
<td>6770</td>
<td>13.5</td>
<td>14.6</td>
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<tr>
<td>Grassy Lake</td>
<td>7265</td>
<td>23.4</td>
<td>31.5</td>
</tr>
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<td>Gros Ventre Summit</td>
<td>8750</td>
<td>8.9</td>
<td>12.9</td>
</tr>
<tr>
<td>Gunsight Pass</td>
<td>9820</td>
<td>11.2</td>
<td>13.7</td>
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<td>Lewis Lake Divide</td>
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<td>20.8</td>
<td>29.8</td>
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<td>Phillips Bench</td>
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<td>20.8</td>
<td>25.2</td>
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<tr>
<td>Salt River Summit</td>
<td>7760</td>
<td>8.8</td>
<td>12.9</td>
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<tr>
<td>Snake River Station</td>
<td>6920</td>
<td>10.7</td>
<td>14.9</td>
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<td>Spring Creek Divide</td>
<td>9000</td>
<td>23.6</td>
<td>22.5</td>
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<td>Thumb Divide</td>
<td>7980</td>
<td>7.2</td>
<td>14.7</td>
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<tr>
<td>Togwotee Pass</td>
<td>9580</td>
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<td>22.0</td>
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<tr>
<td>Willow Creek</td>
<td>8380</td>
<td>18.9</td>
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</tr>
<tr>
<td>Younts Peak</td>
<td>8350</td>
<td>–M</td>
<td>14.3</td>
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**Basin Index (%)**

<p>| | | | |</p>
<table>
<thead>
<tr>
<th></th>
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<tr>
<td><strong>Basin Index (%)</strong></td>
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<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>81</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>83</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Basin Site Name</td>
<td>Elev (ft)</td>
<td>Snow Water Equivalent</td>
<td>Water Year-to-Date Precipitation</td>
</tr>
<tr>
<td>--------------------------</td>
<td>-----------</td>
<td>------------------------</td>
<td>----------------------------------</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Current (in)</td>
<td>Median (in)</td>
</tr>
<tr>
<td>SNAKE RIVER</td>
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<tr>
<td>Basin Index (%)</td>
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<td>81</td>
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</tr>
<tr>
<td>MADISON-GALLATIN</td>
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</tr>
<tr>
<td>Basin Index (%)</td>
<td></td>
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</tr>
<tr>
<td>YELLOWSTONE</td>
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<td>Basin Index (%)</td>
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<td>WIND RIVER</td>
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<tr>
<td>Basin Index (%)</td>
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</tr>
<tr>
<td>BIGHORN BASIN</td>
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<tr>
<td>Basin Index (%)</td>
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</tr>
<tr>
<td>SHOSHONE RIVER</td>
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<td>Basin Index (%)</td>
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<tr>
<td>POWDER RIVER</td>
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<tr>
<td>Basin Index (%)</td>
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<tr>
<td>TONGUE RIVER</td>
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<td>Basin Index (%)</td>
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Cold Springs Site
Good morning everyone this is our 22nd Monday Snow Report for the 2014-2015 snow season. Last year at this time the state median was at 139% with a low of 116% and a high of 158%. This year the state median is falling at 62% with a low of 0% and a high of 88% of median. See the table & map below for more information.

For those of you with INTERNET capability, this report and map showing SWE percentages for the state can be found at http://www.wrds.uwyo.edu/wrds/nrcs/nrcs.html. Go to http://www.wcc.nrcs.usda.gov/normals/median_average.htm for median.

Figure 1 -- SNOW WATER EQUIVALENT AS PERCENT OF MEDIAN The following table shows the current, last year's ending weeks and 2012 equivalent(SWE) amounts for Wyoming basins. Median is based on all reporting SNOTEL sites in the basin not the snow courses. The reference period for average comparison is 1981-2010.

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* data is suspect
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SNOTELs used by WY Snow Survey Program
Snow courses used by WY Snow Survey Program
## WY Monthly Forecasts (Wind River)

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### WY Monthly Precipitation Report

**Report Created: 8/18/2015 11:47:12 AM**

**Basinwide Summary: August 1, 2015**
(Averages/Medians based on 1981-2010 reference period)

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<th>Average (in)</th>
<th>% Average</th>
<th>Last Year (in)</th>
<th>Last Year % Avg</th>
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<th>Average (in)</th>
<th>% Average</th>
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**Basin Index**

- **SNOWMELT**: 105%
- **PACIFIC CREEK**: 114%
- **BUFFALO FORK**: 117%
- **GROS VENTRE RIVER**: 117%
- **HOBACK RIVER**: 115%
- **GREYS RIVERS**: 117%
## WY Snowpack Summary for April

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<th>Elevation (ft)</th>
<th>Depth (in)</th>
<th>SWE (in)</th>
<th>Median (in)</th>
<th>% Median</th>
<th>Last Year SWE (in)</th>
<th>Last Year % Median</th>
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<td>141%</td>
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<td>147%</td>
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<th>Median (in)</th>
<th>% Median</th>
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<td>147%</td>
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# WY Reservoirs used by Basin

## Basinwide Summary: August 1, 2015 (averages based on 1981-2010 reference period)

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<th>Current (KAF)</th>
<th>Last Year (KAF)</th>
<th>Average (KAF)</th>
<th>Current % Capacity</th>
<th>Last Year % Capacity</th>
<th>Average % Capacity</th>
<th>Current % Average</th>
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<td>93%</td>
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<td>71%</td>
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<td>78%</td>
<td>79%</td>
<td>74%</td>
<td>106%</td>
</tr>
</tbody>
</table>

| **Madison-Gallatin River Basins** |               |                 |               |                    |                     |                    |                   |                    |
| Ennis Lake         | 37.3          | 37.7            | 37.5          | 41.0               | 91%                 | 92%                | 91%               | 100%               |
| Hebgen Lake        | 361.4         | 372.5           | 367.3         | 377.5              | 96%                 | 99%                | 97%               | 98%                |
| **Basin-wide Total** | 398.7         | 410.2           | 404.8         | 418.5              | 95%                 | 98%                | 97%               | 98%                |

| **Wind River Basin** |               |                 |               |                    |                     |                    |                   |                    |
| Bull Lake          | 144.8         | 149.1           | 128.2         | 151.8              | 95%                 | 98%                | 84%               | 113%               |
| Boysen             | 659.3         | 678.1           | 598.3         | 596.0              | 111%                | 114%               | 100%              | 110%               |
| Pilot Butte        | 27.2          | 26.6            | 20.8          | 31.6               | 86%                 | 84%                | 66%               | 131%               |
| **Basin-wide Total** | 831.3         | 853.8           | 747.3         | 779.4              | 107%                | 110%               | 96%               | 111%               |

| **BigHorn River Basin** |               |                 |               |                    |                     |                    |                   |                    |
| Boysen             | 659.3         | 678.1           | 598.3         | 596.0              | 111%                | 114%               | 100%              | 110%               |
| Bighorn Lake       | 1001.2        | 997.2           | 966.2         | 1356.0             | 74%                 | 74%                | 71%               | 104%               |
| **Basin-wide Total** | 1660.5        | 1675.3          | 1564.5        | 1952.0             | 85%                 | 86%                | 80%               | 106%               |

| **Shoshone River Basin** |               |                 |               |                    |                     |                    |                   |                    |
| Buffalo Bill       | 584.4         | 625.6           | 491.5         | 646.6              | 90%                 | 97%                | 76%               | 119%               |
| **Basin-wide Total** | 584.4         | 625.6           | 491.5         | 646.6              | 90%                 | 97%                | 76%               | 119%               |

| **Tongue River Basin** |               |                 |               |                    |                     |                    |                   |                    |
| Tongue River Res   | 71.4          | 71.5            | 48.3          | 79.1               | 90%                 | 90%                | 61%               | 148%               |
| **Basin-wide Total** | 71.4          | 71.5            | 48.3          | 79.1               | 90%                 | 90%                | 61%               | 148%               |
Snowpack Monitoring for Water Supply Forecasting and Drought Planning
USDA-NRCS Colorado Snow Survey

Brian Domonkos
Hydrologist, Data Collection Officer
Who is Colorado Snow Surveys?

- USDA NRCS Colorado – We are aligned under CO NRCS
- Brian Domonkos – Snow Survey Supervisor
- Vacant – Asst. Snow Survey Supervisor
- Lexi Landers – Hydrologist
- Karl Wetlaufer – Hydrologist
- Butch Horner – Electronics Technician
- Mike Ardison – Hydrologic Technician
- Zack Wilson – Hydrologic Technician
- 3 Seasonal hires to aid in summer SNOTEL and Snow Course maintenance
- Seven full time employees
By the Numbers - Snow Surveys

- Across west, seasonal snowpack in place Nov – May/Jun
- Snow Surveys is a Federally funded program
  - 858 Automated SNOTELs
  - 1113 Manual Snow Courses including Canada
  - 219 Soil Climate Analysis Network (SCAN)
  - Staffing
    - 62 Fulltime positions
    - 10 Vacant positions
  - Work in coordination with Canada as watersheds
  - Agreements with Mexico & Canada

- Colorado Snow Surveys
  - 7 fulltime employees
  - 3 Summer employees
A SNOTEL Site

– Cost between $25,000 and $35,000 depending on the sensor suite
– About $3,000 to maintain annually
– Ideally would have 30 years in the period of record
  • For the purposes of normals or averages
  • Have used a 10 year period of record to generate averages
– May often be back estimated/correlated from data gathered by a collocated snow course
– Most sites are facilitated by correlating with a streamflow gauge for snowmelt runoff forecasting purposes
  • Uses and purposes for sites do vary greatly

• Manual Snow Courses
  – Cost about $3,500 annually to measure when you consider
    • Staff time
    • Training – safety & procedural techniques
Nationally

- 855 Automated SNOTELs
- 1113 Manual Snow Courses including Canada
Colorado DCO Measurement Locations - 2015

SNOTEL Sites
183 Automated Sites
Of the CO DCO
How do I access SNOTEL data: Daily Data?

**Individual Site Data**

Site Selection Map


Then Click on “Open the Map” otherwise web address is too big, then you can save that to your favorites

The web based map will provide access:

- Daily and Hourly data for an individual SNOTEL site
- Current Water Year Data (Oct 1st – Sept 30th)
- Historical Data for a SNOTEL site
Visualization of daily data parameters

You can save ANY map or data table in your favorites in your browser so every time you click on the favorite the most recent data populates in the color filled map, or even data tables. (there is a quick trick to enable this so feel free to contact me and we can set it up for you)
Data Quality Control

**Hourly Data**

- Not quality controlled by Colorado Snow Survey Staff
- Automated profiles flag data as suspect if out of a defined range or daily change
  - Suspect data is not publicly available
- Should be used for guidance purposes only
- All values, including sensor errors are published

**Daily Data**

- Midnight readings (00:00) quality controlled and reviewed on business days by office staff
- Data edits are completed on a weekly basis on Friday and may spill over into Monday
- Should be used primarily
- Year-end edits for previous year’s data– are often started in November and are typically finalized in February
Quality Assurance/Control

- Majority of SNOTEL sites on hourly reporting
- Some on 3-hr reports b/c of batteries levels
- Automated Data Trapping - Data profiles suspect data in database and restrict data from being available
- On top of automated editing routines, personnel quality check data and edit regularly and when necessary
- Data Editing Frequency
  - Typically data is edited weekly every Friday
Hourly SWE vs Hourly Precip.

1.1" SWE
In 48 hours

-0.2" Prec
In 48 hours?

Why is the SWE decreasing???

Drops in Temperature impacts the fluid based SWE sensor

Precipitation Gauge is plugged!
SNOTEL site physical issues:
- Plugged precipitation gauges
- Bridging of snow pillow
- Wind drifted snow on/off pillow
- Wind induced precip under-catch

Solution:
- Utilize data from other sensors to help determine what the correct data is most likely to be
- Graphical tools can be very helpful in this process!!
SNOTEL Data Issues: SWE and Precipitation

- Temperature induced diurnal fluctuations
  - Commonly due to air in the line or transducer itself
- Can complicate obtaining accurate estimates of storm totals using hourly data
1981 – 2010 Normals

- Normals are simply a way to compare the current value to a baseline.
- Every decade, normals are recalculated to reflect the current climactic conditions because we are most familiar with the last 30 years.
- Daily averages and medians were smoothed with a 7-day running average except at the truncation to zero and at the beginning and end of the year.
1981 – 2010 Normals

• Default is the value that will be most frequently represented in reports and graphs unless otherwise stated.
• “Yes” specifies those values have been calculated and stored in our database.
• Elements not specified here have no calculated normals for this 30yr period.

<table>
<thead>
<tr>
<th>Element</th>
<th>Default</th>
<th>Average</th>
<th>Median</th>
</tr>
</thead>
<tbody>
<tr>
<td>Temperature</td>
<td>Average</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>Precipitation</td>
<td>Average</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Snow Water Eq.</td>
<td>Median</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Snow Depth</td>
<td>Median</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Streamflow</td>
<td>Average</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Reservoir Storage</td>
<td>Average</td>
<td>Yes</td>
<td>No</td>
</tr>
</tbody>
</table>
So why did we use medians?
Streamflow Forecasting

- Volumetric – the total amount of water predicted to pass through a gauge, example; April 1 – July 31
  - Use various forecast periods
  - Water Supply forecasts updated monthly Jan 1 – Jun 1
- Forecasts produced using multiple regression analysis
- Forecast inputs optimized with principal components analysis
Streamflow Forecasting

- Forecasts are provided in exceedances to provide probability of occurrence for each volumetric forecast.
- Coordinate our forecasts with other federal agencies.
- Also provide daily “guidance” forecasts for select locations.

<table>
<thead>
<tr>
<th>Period</th>
<th>Min (90%)</th>
<th>50</th>
<th>30</th>
<th>Max (10%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>APR-JUL</td>
<td>168</td>
<td>210</td>
<td>235</td>
<td>260</td>
</tr>
<tr>
<td>APR-SEP</td>
<td>275</td>
<td>325</td>
<td>360</td>
<td>395</td>
</tr>
<tr>
<td></td>
<td>300</td>
<td>330</td>
<td>360</td>
<td>395</td>
</tr>
</tbody>
</table>

Dillon Reservoir Inflow

Flow & Forecasts in 1000*Ac-ft

<table>
<thead>
<tr>
<th>Period</th>
<th>Avg</th>
<th>Last Year’s Observed Flow</th>
<th>% of Avg</th>
<th>% of Last Year</th>
</tr>
</thead>
<tbody>
<tr>
<td>APR-JUL</td>
<td>330</td>
<td>282.18207</td>
<td>71%</td>
<td>83%</td>
</tr>
<tr>
<td>APR-SEP</td>
<td>485</td>
<td>420.33338</td>
<td>74%</td>
<td>86%</td>
</tr>
</tbody>
</table>

This is an automated product based solely on SNOWTEL data; provisional data are subject to change. This product is a statistically based guidance forecast containing indices of streamflow and precipitation. Yellow squares are the official outlooks. Grey background is the historical period of record variability. This product does not contain climate information such as El Niño or short range weather forecasts, or a variety of other factors considered in the official forecasts. This product is not meant to replace or supersede the official forecasts produced in coordination with the National Weather Service. Science Contact: Cara J. McCarthy@usda.gov or www.nrcs.usda.gov/Whafs-held_forecasts.html
VIPER – NRCS Forecasting Model

- Multiple Regression Analysis w/ many input options
Analog Year Snowpack Projections

Arkansas River Basin Snowpack with Select Analog Year Projections
Based on Provisional SNOTEL Data as of May 20, 2015

Average
Current
Maximum
Minimum
WY1982 Proj
WY1997 Proj
WY2008 Proj
WY2011 Proj

Natural Resources Conservation Service

NRCS
Arkansas River Basin Snowpack with Non-Exceedence Projections

Based on Provisional SNOTEL Data as of May 20, 2015

Median
Non-Exceedance YTD Precip Projections

Laramie & North Platte River Basins Precipitation with Non-Exceedence Projections

Based on Provisional SNOTEL Data as of Aug 26, 2015

NRCS
National Resources Conservation Service
Products – Westwide

SNOTEL 1-Day Snow Depth Change (Inches)

Feb 14, 2012

Westwide SNOTEL Current Snow Water Equivalent (SWE) % of Normal

Feb 14, 2012

Prepared by the USDA-NRCS National Water and Climate Center
Portland, Oregon http://www.nwcc.usda.gov

The snow water equivalent percent of normal represents the current snow water equivalent divided by the long-term NWSPE (as defined in this guide) and then multiplied by 100. This data represents the average snow at this site on this day. Data based on the first reading of the day (typically 07:00). Data subject to revision.
Products – Aggregated Reservoir Data

Colorado Reservoir Storage Point Map

End of May 2015

Colorado Reservoir Storage Map

End of May 2015
Wyoming Surface Water Supply Index

Surface Water Supply Index - June 2015

SWSI Classification System

> 4.0 Extremely Wet
3.0 Very Wet
2.0 Moderately Wet
1.0 Slightly Wet
0.5 Incipient Wet Spell
0.0 Near Normal
-0.5 Incipient Dry Spell
-1.0 Mild Drought
-2.0 Moderate Drought
-3.0 Severe Drought
<-4.0 Extreme Drought

The Surface Water Supply Index (SWSI) is computed using only surface water supplies for the drainage. The
### Surface Water Supply Index

**June, 8 2015**

<table>
<thead>
<tr>
<th>Basin or Region</th>
<th>May EOM Storage</th>
<th>JUN-JUL Forecast</th>
<th>Storage + Forecast</th>
<th>Percentile</th>
<th>$SwSI^*$</th>
<th>Years with similar $SwSI^*$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Belle Fourche</td>
<td>413.1</td>
<td>0.0</td>
<td>413.1</td>
<td>81</td>
<td>2.55</td>
<td>98, 00, 14, 01</td>
</tr>
<tr>
<td>Big Horn</td>
<td>1631.3</td>
<td>909.0</td>
<td>2540.3</td>
<td>53.00</td>
<td>0.23</td>
<td>81, 05, 14, 08</td>
</tr>
<tr>
<td>Cheyenne</td>
<td>183.9</td>
<td>8.7</td>
<td>192.6</td>
<td>56.00</td>
<td>0.46</td>
<td>91, 83, 01, 94</td>
</tr>
<tr>
<td>Laramie</td>
<td>89.0</td>
<td>80.0</td>
<td>169.0</td>
<td>58.00</td>
<td>0.69</td>
<td>93, 88, 98, 85</td>
</tr>
<tr>
<td>Little Snake</td>
<td>21.0</td>
<td>85.0</td>
<td>106.0</td>
<td>50.00</td>
<td>0.00</td>
<td>81, 06, 90, 91</td>
</tr>
<tr>
<td>Lower Green</td>
<td>3534.6</td>
<td>527.0</td>
<td>4061.6</td>
<td>56.00</td>
<td>0.46</td>
<td>87, 10, 05, 91</td>
</tr>
<tr>
<td>Lower n Platte</td>
<td>1471.1</td>
<td>574.1</td>
<td>2045.2</td>
<td>56.00</td>
<td>0.46</td>
<td>93, 88, 85, 08</td>
</tr>
<tr>
<td>Madison-Gallatin</td>
<td>414.4</td>
<td>219.0</td>
<td>633.4</td>
<td>14.00</td>
<td>-3.01</td>
<td>87, 88, 94, 13</td>
</tr>
<tr>
<td>Powder</td>
<td>239.2</td>
<td>239.2</td>
<td>56.00</td>
<td>0.46</td>
<td>98, 05, 92, 91</td>
<td></td>
</tr>
<tr>
<td>Shoshone</td>
<td>666.9</td>
<td>864.0</td>
<td>1530.9</td>
<td>50.00</td>
<td>0.00</td>
<td>05, 12, 03, 81</td>
</tr>
<tr>
<td>Snake</td>
<td>2057.0</td>
<td>3348.0</td>
<td>5405.0</td>
<td>25.00</td>
<td>-2.08</td>
<td>88, 04, 03, 02</td>
</tr>
<tr>
<td>Sweetwater</td>
<td>724.4</td>
<td>19.1</td>
<td>743.5</td>
<td>53.00</td>
<td>0.23</td>
<td>82, 89, 81, 01</td>
</tr>
<tr>
<td>Tongue</td>
<td>83.4</td>
<td>183.0</td>
<td>271.4</td>
<td>47.00</td>
<td>-0.23</td>
<td>82, 91, 81, 93</td>
</tr>
<tr>
<td>Upper Bear</td>
<td>55.5</td>
<td>68.0</td>
<td>123.5</td>
<td>51.00</td>
<td>-1.62</td>
<td>04, 03, 88, 89</td>
</tr>
<tr>
<td>Upper Green</td>
<td>332.2</td>
<td>809.0</td>
<td>1141.2</td>
<td>58.00</td>
<td>0.69</td>
<td>93, 08, 91, 05</td>
</tr>
<tr>
<td>Upper N Platte</td>
<td>804.8</td>
<td>474.1</td>
<td>1278.9</td>
<td>53.00</td>
<td>0.23</td>
<td>05, 88, 08, 93</td>
</tr>
<tr>
<td>Wind River</td>
<td>843.0</td>
<td>1221.0</td>
<td>2064.0</td>
<td>47.00</td>
<td>-0.23</td>
<td>90, 81, 89, 08</td>
</tr>
<tr>
<td>Yellowstone</td>
<td>1710.0</td>
<td>1710.0</td>
<td>3420.0</td>
<td>19.00</td>
<td>-2.55</td>
<td>88, 85, 04, 13</td>
</tr>
</tbody>
</table>

*Kaf: thousand acre feet

What is a Surface Water Supply Index?

The Surface Water Supply Index ($SwSI$) is a predictive indicator of total surface water availability within a watershed for the spring and summer water use seasons. The index is calculated by combining pre-runoff reservoir storage (carryover) with forecasts of spring and summer streamflow which are based on current snowpack and other hydrologic variables. $SwSI$ values are scaled from +4.1 (abundant supply) to -4.1 (extremely dry) with a value of zero (0) indicating median water supply as compared to historical analysis. $SwSI$s are calculated in this fashion to be consistent with other hydroclimatic indicators such as the Palmer Drought Index and the Precipitation index.
Data Feeds – Web Services

• Written in:
  – Java
  – Visual Basic for Applications (VBA)

• Near Real-Time Data

• Provides direct feed to database

• Data profiles auto QC data and blank out if data is suspect

• Database updated as soon as live person QCs data

• Database provides latest 30-year normals for select data types
Questions? Comments?

Global Warming Protest
For more information, Contact: Lee Hackleman (307) 233-6744  
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