Methods of Analysis

Main Variables:

- Current Soil Moisture States
- Snowpack
- Future Precipitation Events
- Future Temperature
- Current Base Flow Condition

**Historical Observations:** Regression Analysis

Regression methods are static compared to physically based models. Regressions lend themselves to use where real time data is not available and as a check against the model based forecast where available.

Comparing:
- Historical Seasonal Volumes to Historical Peaks
- ESP MP Forecast Volumes by Mo. to Historical Peaks
- Historical Snowpack to Historical Peaks
Focus from April - June: Peak Flows – Threat of Snow Melt Flooding

Methods of Analysis

(1) Regression Method: Historical Observations i.e. Climatology

Example:
Comparing Historical Observed Seasonal Volumes or Historical Forecast Volumes to Historical Peaks

The accuracy of this method improves considerably as you approach the average period of peak flow.

<table>
<thead>
<tr>
<th>April-July Obs. volume (acre-ft)</th>
<th>Peak Flow Mean-Daily-CFS</th>
</tr>
</thead>
<tbody>
<tr>
<td>1983 94,000</td>
<td>1670 June 19</td>
</tr>
<tr>
<td>1995 99,000</td>
<td>2530 June 16</td>
</tr>
<tr>
<td>1998 74,000</td>
<td>1130 May 22</td>
</tr>
<tr>
<td>1999 52,000</td>
<td>1250 May 26</td>
</tr>
<tr>
<td>2000 41,000</td>
<td>950 May 6</td>
</tr>
</tbody>
</table>

Runoff volume

Runoff Peak
Focus Today: Peak Flows – Threat of Snow Melt Flooding This Spring

Methods of Analysis

(2) Model Analysis: NWSRFS, River forecast System, ESP

Initial Watershed Conditions
- Antecedent Flow
- Soil Moisture States
- Snow Pack Conditions
- Reservoir Regulation Plans

Model results should produce better results than static regression equations.

Model analysis using ESP can also be used to weight a forecast based on certain Climate Indices’ such as El Nino or CPC 3 month Climate Forecast Model output.
Initial Watershed Condition: Antecedent Flow for Whiterocks

![Hydrograph chart](chart.png)

Current: 3.3 (03/17/14), Flood Stage: 6.0, Bankfull: 5.0

Created 03/17/16 15 GMT
NOAA/CRREC 2005

Observations (USGS):
- Forecast (03/17/14:00)
- Bankfull: 5.0
- Flood: 6.0

Historical Exceedance Probability (USGS):
- 90-75%
- 75-50%
- 50-25%
- 25-10%
Initial Watershed Condition: Snowpack

Comparing Peaks of Similar Years against Model and Regression Output helps Reduce Uncertainty
Initial Watershed Condition: Soil Moisture

Currently No Basin Wide or Historical Soil Moisture Network
NWRFS Uses: Sacramento Soil Moisture Accounting Model

[Graph showing soil moisture levels across different years (1984, 2004, 2005, 1995)]
ESP Creates a frequency distribution using each forecast value in the specified window and determines a “most probable” Max Mean Daily forecast. Using this method we determine the Max, Min and Most Probable values.
Max Instantaneous vs. Max Mean Daily

Whiterocks River near Whiterocks

2005 April Forecast

Mean Daily Peak (CFS)


Instantaneous Peaks  NWS Flood Flow  Average Peak

Max  Min  MP
Peak Flow Exceedance Probability

Visualizing Exceedance Probability

Forecast Window Chances of Exceeding River Levels on the CITY CREEK - SLC
Latitude: 40.8  Longitude: 111.9
Forecast for the period 4/10/2006 - 7/31/2006
This is a conditional simulation based on the current conditions as of 4/10/2006

Exceedance Probability
- 10 - 25%
- 25 - 50%
- 50 - 75%
- 75 - 90%
- >= 90%

River Flow (CFSD)
120.0
139.0
158.0
177.0
196.0
215.0
234.0
253.0
272.0
291.0
310.0

4/10  24:00 MST  7/31
Timing Related Issues

Multiple Peaks are not Uncommon.
Hydrographs – CBRFC Webpage

Useful Tools for Historical Data Searches

Colorado Basin River Forecast Center

Colorado Basin River Forecast Center

WHITEROCKS - WHITEROCKS, NR - Hydrograph

Current: 1.8 (09/06/18), Flood Stage: 6.00, Bankfull: 5.00

Created 09/06/19 19:57 GMT
NOAA/CBRFC, 2006

Historical Exceedance Probability (USGS): 90-75% 75-50% 50-25% 25-10%
Peak Flow Display Options on the Web

Mean Daily Flow and Instantaneous Peaks

Colorado Basin River Forecast Center

![Hydrograph Image]

- Current: 1.8 (09/06.18)
- Flood Stage: 6.00
- Bankfull: 5.00

Created 09/06.20:44 GMT
NOAA/CERF, 2006

Colorado Basin River Forecast Center

- Observed
- Forecast (09/06.20:00)
- Outlook (increasing uncertainty)
- Peak (06/22/1983)
- Yearly Peaks
- Historical Exceedance Probability (USGS): 90-75%, 75-50%, 50-25%, 25-10%
Selected Historical Data for Cisco, Green River, UT, Cataract Canyon and San Juan at Bluff

Colorado near Cisco, UT

In general, the higher the flow, the higher the velocity. The velocity reaches a maximum, for the most extreme events, between 5 and 7 mph.
<table>
<thead>
<tr>
<th>STATION NAME</th>
<th>Historic Peak</th>
<th>Average Peak</th>
<th>Flood* Peak</th>
<th>2005 Date</th>
<th>2006 Forecast Exceedance Probability</th>
<th>Normal time of peak</th>
</tr>
</thead>
<tbody>
<tr>
<td>COLORADO - KREMMLING, NR</td>
<td>12,700</td>
<td>3,900</td>
<td>10,100</td>
<td>2,510</td>
<td>6/25</td>
<td>N/A</td>
</tr>
<tr>
<td>EAGLE - GYPSUM, BLO</td>
<td>6,580</td>
<td>3,600</td>
<td>6,600</td>
<td>3,400</td>
<td>5/23</td>
<td>3,500 5,000 N/A N/A 6/1 - 6/21</td>
</tr>
<tr>
<td>ROARING FORK - GLENWOOD SPRINGS</td>
<td>11,200</td>
<td>6,150</td>
<td>16,800</td>
<td>5,720</td>
<td>6/24</td>
<td>4,000 5,300 6,500 7,700 9,000 6/3 - 6/18</td>
</tr>
<tr>
<td>COLORADO - CAMEO, NR</td>
<td>38,000</td>
<td>17,500</td>
<td>23,500</td>
<td>16,800</td>
<td>5/25</td>
<td>13,000 17,000 21,000 25,000 30,000 5/29 - 6/18</td>
</tr>
<tr>
<td>PLATEAU CK - CAMEO, NR</td>
<td>4,100</td>
<td>1,460</td>
<td>3,260</td>
<td>2,310</td>
<td>5/24</td>
<td>300 700 1,000 1,400 2,000 5/9 - 6/11</td>
</tr>
<tr>
<td>EAST - ALMONT, NR</td>
<td>5,000</td>
<td>2,080</td>
<td>3,100</td>
<td>2,070</td>
<td>5/25</td>
<td>1,500 1,810 2,100 2,500 3,000 5/28 - 6/17</td>
</tr>
<tr>
<td>NF GUNNISON - SOMERSET, NR</td>
<td>7,080</td>
<td>3,310</td>
<td>12,400</td>
<td>4,730</td>
<td>5/21</td>
<td>1,500 1,800 2,500 3,300 4,200 5/11 - 6/2</td>
</tr>
<tr>
<td>SURFACE CK - CEDAREIDGE</td>
<td>640</td>
<td>210</td>
<td>1,400</td>
<td>685</td>
<td>5/24</td>
<td>40 80 120 200 250 5/3 - 6/8</td>
</tr>
<tr>
<td>UNCOMPAHGRE - COLONA</td>
<td>1,900</td>
<td>1,390</td>
<td>3,100</td>
<td>1,130</td>
<td>6/25</td>
<td>N/A N/A N/A N/A N/A N/A 5/20 - 6/27</td>
</tr>
<tr>
<td>COLORADO - CO-UT STATELINE, NR</td>
<td>68,300</td>
<td>26,150</td>
<td>47,800</td>
<td>30,300</td>
<td>5/25</td>
<td>20,000 25,000 29,000 33,000 38,000 5/22 - 6/16</td>
</tr>
<tr>
<td>DOLORES - DOLORES</td>
<td>6,950</td>
<td>2,980</td>
<td>8,700</td>
<td>4,890</td>
<td>5/23</td>
<td>1,000 1,300 1,750 2,200 2,800 5/9 - 6/4</td>
</tr>
<tr>
<td>SAN MIGUEL - PLACERVILLE, NR</td>
<td>2,740</td>
<td>1,310</td>
<td>2,650</td>
<td>1,380</td>
<td>5/23</td>
<td>500 700 950 1,200 1,400 5/26 - 6/23</td>
</tr>
<tr>
<td>DOLORES - CISCO, NR (see note1 below)</td>
<td>12,900</td>
<td>6,050</td>
<td>N/A</td>
<td>9,030</td>
<td>5/26</td>
<td>N/A N/A N/A N/A N/A 4/26 - 6/9</td>
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<tr>
<td>COLORADO - CISCO, NR</td>
<td>69,500</td>
<td>28,800</td>
<td>61,300</td>
<td>39,500</td>
<td>5/25</td>
<td>22,000 27,000 31,000 35,000 40,000 5/20 - 6/15</td>
</tr>
<tr>
<td>GREEN - DANIEL, NR, WARREN BRIDGE, AT</td>
<td>5,620</td>
<td>2,975</td>
<td>N/A</td>
<td>2,850</td>
<td>6/25</td>
<td>2,100 2,500 2,900 3,100 3,400 5/30 - 6/30</td>
</tr>
<tr>
<td>NEW FORK - BIG PINERY, NR</td>
<td>9,110</td>
<td>5,285</td>
<td>N/A</td>
<td>5,330</td>
<td>6/23</td>
<td>3,000 4,200 5,000 5,500 7,000 5/31 - 6/24</td>
</tr>
<tr>
<td>GREEN - LABARGE, NR</td>
<td>18,800</td>
<td>9,270</td>
<td>14,600</td>
<td>8,590</td>
<td>6/25</td>
<td>N/A N/A N/A N/A N/A 5/30 - 6/24</td>
</tr>
<tr>
<td>BIG SANDY - FARSON, NR</td>
<td>1,690</td>
<td>820</td>
<td>1,300</td>
<td>926</td>
<td>6/22</td>
<td>N/A N/A N/A N/A N/A 5/28 - 6/23</td>
</tr>
<tr>
<td>GREEN - GREEN RVR WY, NR</td>
<td>15,400</td>
<td>7,110</td>
<td>15,500</td>
<td>6,510</td>
<td>6/03</td>
<td>N/A N/A N/A N/A N/A 5/23 - 7/11</td>
</tr>
<tr>
<td>HAMS FORK - FRONTIER, NR, POLE CK, BLO</td>
<td>2,000</td>
<td>825</td>
<td>1,600</td>
<td>1,030</td>
<td>6/21</td>
<td>700 810 900 1,050 1,400 5/10 - 6/9</td>
</tr>
<tr>
<td>BLACKS FORK - LITTLE AMERICA, NR</td>
<td>6,970</td>
<td>2,440</td>
<td>5,500</td>
<td>5,500</td>
<td>5/19</td>
<td>1,500 2,000 2,400 3,900 5,000 5/2 - 6/27</td>
</tr>
</tbody>
</table>

N/A - NOT AVAILABLE (NOT A FLOOD FORECAST POINT OR NO FORECAST PROCEDURE EXISTS)

note1 - for releases below McPhee Reservoir call 970-565-7562

* Flood flow is for current year only and is an instantaneous value
Where peaks have occurred the magnitude and date are listed.

<table>
<thead>
<tr>
<th>STATION NAME</th>
<th>Historic Peak</th>
<th>Average Peak</th>
<th>Flood* Peak</th>
<th>2005 Peak</th>
<th>2005 Date</th>
<th>Provisional 2006 Peak through 6/06/06</th>
<th>Normal time of peak</th>
</tr>
</thead>
<tbody>
<tr>
<td>COLORADO - KREMMLING, NR</td>
<td>12,700</td>
<td>3,900</td>
<td>10,100</td>
<td>2,510</td>
<td>6/25</td>
<td>2690 cfsd on 5/22 (%)</td>
<td>5/15 - 6/27</td>
</tr>
<tr>
<td>EAGLE - Gypsum, BLO</td>
<td>6,580</td>
<td>3,600</td>
<td>6,600</td>
<td>3,400</td>
<td>5/23</td>
<td>3920 cfsd on 5/23 (%)</td>
<td>6/1 - 6/21</td>
</tr>
<tr>
<td>ROARING FORK - GLENWOOD SPRINGS</td>
<td>11,200</td>
<td>6,150</td>
<td>16,800</td>
<td>5,720</td>
<td>6/24</td>
<td>5640 cfsd on 5/23 (%)</td>
<td>6/3 - 6/18</td>
</tr>
<tr>
<td>COLORADO - CAMEO, NR</td>
<td>38,000</td>
<td>17,500</td>
<td>23,500</td>
<td>16,800</td>
<td>5/25</td>
<td>16400 cfsd on 5/23 (%)</td>
<td>5/29 - 6/18</td>
</tr>
<tr>
<td>PLATEAU CK - CAMEO, NR</td>
<td>4,100</td>
<td>1,460</td>
<td>3,260</td>
<td>2,310</td>
<td>5/24</td>
<td>1250 cfs on 5/23 (%)</td>
<td>5/9 - 6/11</td>
</tr>
<tr>
<td>EAST - ALMONT, NR</td>
<td>5,000</td>
<td>2,080</td>
<td>3,100</td>
<td>2,070</td>
<td>5/25</td>
<td>1830 cfsd on 5/27 (%)</td>
<td>5/28 - 6/17</td>
</tr>
<tr>
<td>NF GUNNISON - SOMERSET, NR</td>
<td>7,080</td>
<td>3,310</td>
<td>12,400</td>
<td>4,730</td>
<td>5/21</td>
<td>2350 cfsd on 5/23 (%)</td>
<td>5/11 - 6/2</td>
</tr>
<tr>
<td>SURFACE CK - CEDAREIDGE</td>
<td>640</td>
<td>210</td>
<td>1,400</td>
<td>685</td>
<td>5/24</td>
<td>150 cfsd on 5/23 (%)</td>
<td>5/3 - 6/8</td>
</tr>
<tr>
<td>UNCOMPAHGRE - COLONA</td>
<td>1,900</td>
<td>1,390</td>
<td>3,100</td>
<td>1,130</td>
<td>6/25</td>
<td>540 cfs on 5/22 (%)</td>
<td>5/20 - 6/27</td>
</tr>
<tr>
<td>COLORADO - CO-UT STATELINE, NR</td>
<td>68,300</td>
<td>26,150</td>
<td>47,800</td>
<td>30,300</td>
<td>5/25</td>
<td>21300 cfsd on 5/24 (%)</td>
<td>5/22 - 6/16</td>
</tr>
<tr>
<td>DOLORES - DOLORES</td>
<td>6,950</td>
<td>2,980</td>
<td>8,700</td>
<td>4,890</td>
<td>5/23</td>
<td>1490 cfsd on 5/22 (%)</td>
<td>5/9 - 6/4</td>
</tr>
<tr>
<td>SAN MIGUEL - PLACERVILLE, NR</td>
<td>2,740</td>
<td>1,310</td>
<td>2,650</td>
<td>1,380</td>
<td>5/23</td>
<td>815 cfsd on 5/25</td>
<td>5/26 - 6/23</td>
</tr>
<tr>
<td>DOLORES - CISCO, NR (see note1 below)</td>
<td>12,900</td>
<td>6,050</td>
<td>N/A</td>
<td>9,030</td>
<td>5/26</td>
<td>1080 cfsd on 4/16 (%)</td>
<td>4/26 - 6/5</td>
</tr>
<tr>
<td>COLORADO - CISCO, NR</td>
<td>69,500</td>
<td>28,800</td>
<td>61,300</td>
<td>39,500</td>
<td>5/25</td>
<td>21400 cfsd on 5/24 (%)</td>
<td>5/20 - 6/15</td>
</tr>
<tr>
<td>GREEN - DANIEL, NR, WARREN BRIDGE, AT</td>
<td>5,620</td>
<td>2,975</td>
<td>N/A</td>
<td>2,850</td>
<td>6/25</td>
<td>2330 cfsd on 5/24</td>
<td>5/30 - 6/30</td>
</tr>
<tr>
<td>NEW FORK - BIG PINEY, NR</td>
<td>9,110</td>
<td>5,285</td>
<td>N/A</td>
<td>5,330</td>
<td>6/23</td>
<td>4710 cfsd 5/24</td>
<td>5/31 - 6/24</td>
</tr>
<tr>
<td>GREEN - LABARGE, NR</td>
<td>18,800</td>
<td>9,270</td>
<td>14,600</td>
<td>8,590</td>
<td>6/25</td>
<td>7280 cfsd on 5/24</td>
<td>5/30 - 6/24</td>
</tr>
<tr>
<td>BIG SANDY - FARSON, NR</td>
<td>1,690</td>
<td>820</td>
<td>1,300</td>
<td>926</td>
<td>6/22</td>
<td>700 cfsd on 5/23</td>
<td>5/28 - 6/23</td>
</tr>
<tr>
<td>GREEN - GREEN RVR WY, NR</td>
<td>15,400</td>
<td>7,110</td>
<td>15,500</td>
<td>6,510</td>
<td>6/03</td>
<td>4150 cfsd on 6/5</td>
<td>5/23 - 7/11</td>
</tr>
<tr>
<td>HAMS FORK - FRONTIER, NR, POLE CK, BLO</td>
<td>2,000</td>
<td>825</td>
<td>1,600</td>
<td>1,030</td>
<td>6/21</td>
<td>850 cfsd on 5/21</td>
<td>5/10 - 6/9</td>
</tr>
<tr>
<td>BLACKS FORK - LITTLE AMERICA, NR</td>
<td>6,970</td>
<td>2,440</td>
<td>5,500</td>
<td>5,500</td>
<td>5/19</td>
<td>640 cfsd on 5/4</td>
<td>5/2 - 6/27</td>
</tr>
</tbody>
</table>

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** note1 - for releases below McPhee Reservoir call 970-365-7562

* Flood flow is for current year only and is an instantaneous value
If you have a point you’d like to add to our publication or have more specific needs in terms of Peak Flow Forecasts, please let us know so that we can provide you with forecasts where possible.

From our webpage select: “Snowmelt Peak Flow” and the current month.

http://www.cbrfc.noaa.gov/product/peak/peak.cgi

For more information or suggestions contact: Brent.Bernard@noaa.gov