

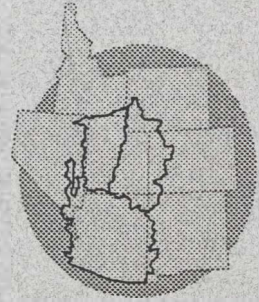
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1993

1993 Water Year in REVIEW



Colorado Basin
River Forecast Center

National Weather Service
Salt Lake City, UT

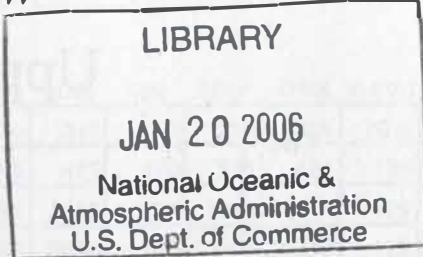


UPPER COLORADO REPORT

October, 1993

*UPPER COLORADO
1993 WATER YEAR IN REVIEW*

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A LOOK BACK AT LAST YEAR...

This is a summary of the 1993 Upper Colorado River Basin water supply forecasts and observed runoff volumes where available. Volume forecasts and observations are for the April-July period (except where indicated) and are expressed in 1000's of acre-feet. Averages used are for the 1961-1990 period.

This product is designed to assist individuals and agencies with water supply concerns in summarizing last year's (1993) spring runoff and in planning for the coming year.

Please note that all observed values are provisional. Final values may differ from those listed herein. Many adjustments for diversions have been estimated from historical averages.

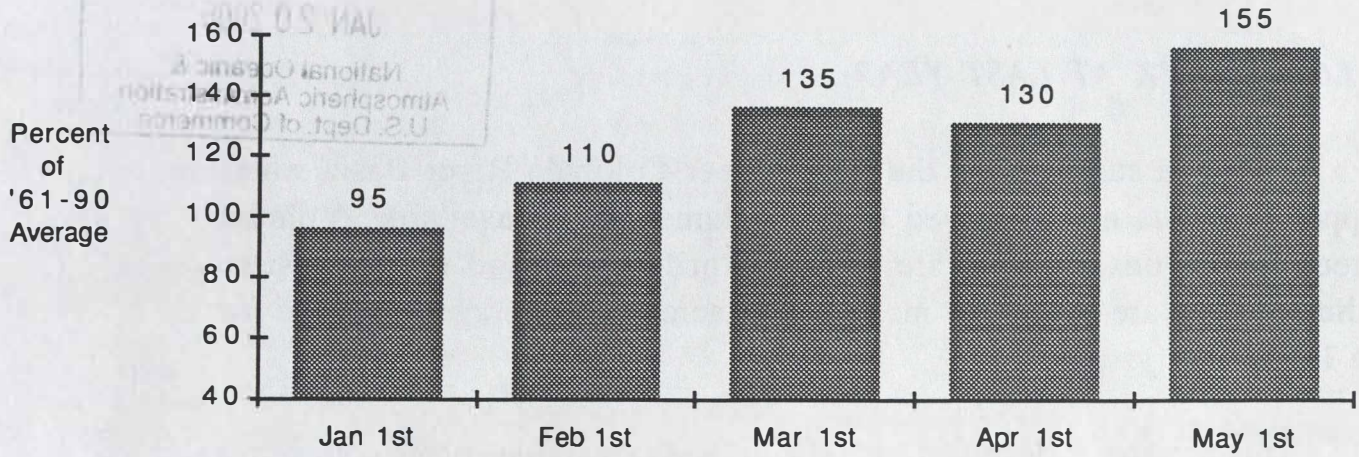
Coordinated forecasts for the upcoming, 1994, spring runoff season will be issued monthly January through May and released in various publications including the Water Supply Outlook reports produced by the Colorado Basin River Forecast Center.

A LOOK AHEAD TO NEXT YEAR... see page 8

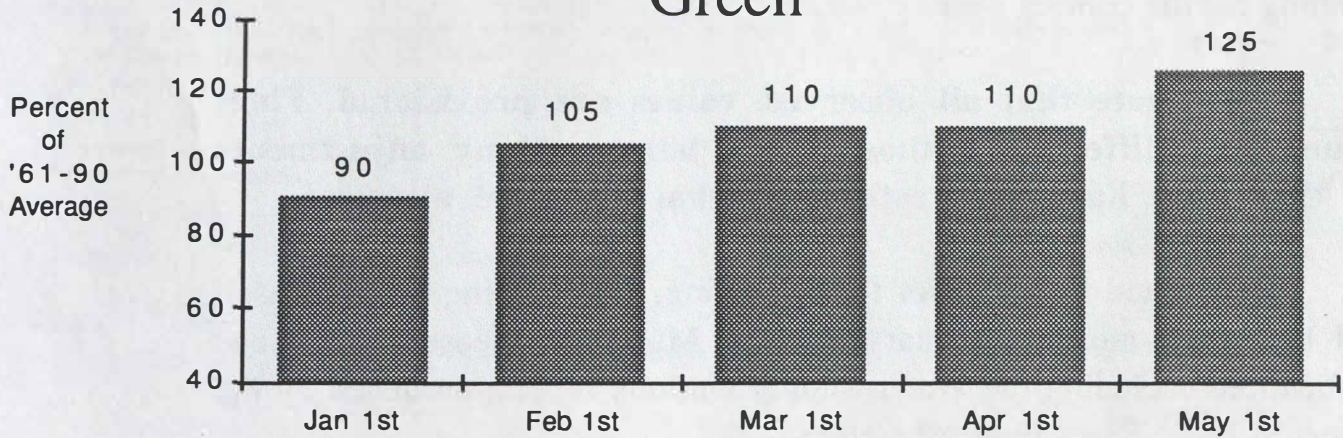
SPRING '93 SNOWPACK REVIEW

Snow Water Equivalent

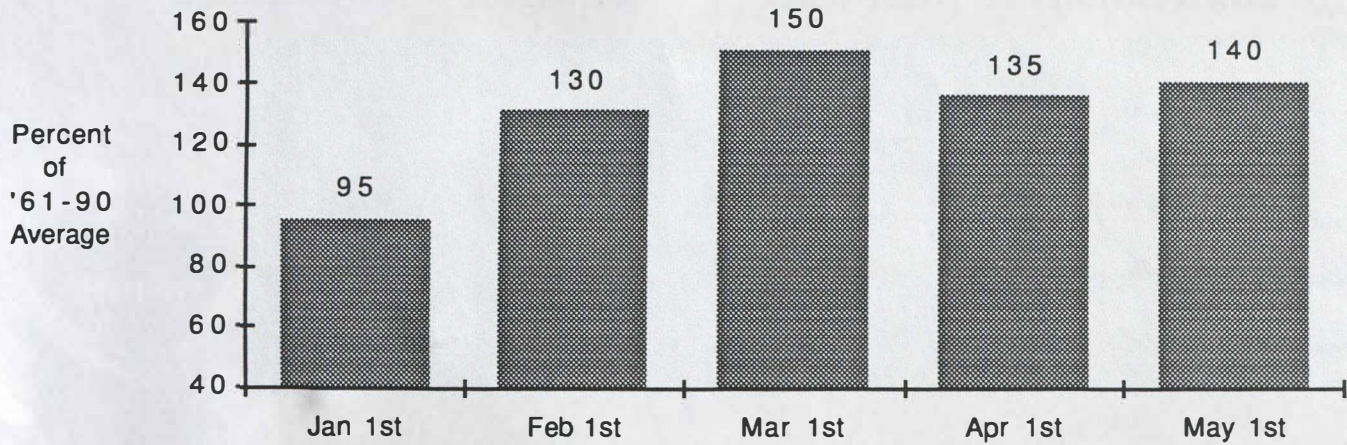
Upper Colorado Mainstem



Green



San Juan



1993 Forecast Summary for: UPPER COLORADO MAINSTEM

April-July volumes unless otherwise noted

| STREAM | STATION | JAN | FEB | MAR | APR | MAY | OBS | %AVG |
|-------------------|---------------------------------|------|------|------|------|------|------|------|
| COLORADO | LAKE GRANBY, GRANBY, NR | 200 | 200 | 245 | 250 | 280 | N/A | N/A |
| | HOT SULPHUR SPRINGS | 395 | 395 | 475 | 470 | 525 | 494 | 128 |
| | DOTSERO, NR | 1250 | 1250 | 1530 | 1570 | 1750 | 1760 | 129 |
| | GLENWOOD SPRINGS, BLO | 1960 | 2020 | 2490 | 2570 | 2890 | 2380 | 112 |
| | CAMEO, NR | 2110 | 2180 | 2750 | 2850 | 3180 | 3104 | 135 |
| | CISCO, NR | 3640 | 4150 | 5700 | 5740 | 6260 | 6258 | 150 |
| WILLOW CK | WILLOW CK RES, GRANBY, NR | 50 | 55 | 65 | 60 | 65 | N/A | N/A |
| FRASER | WINTER PARK, NR, UPR STATION, | 54 | 52 | 60 | 60 | 65 | 54 | 102 |
| WILLIAMS FORK | PARSHALL, NR | 54 | 54 | 70 | 75 | 85 | 79 | 134 |
| | WILLIAMS FORK RES, PARSHALL, NR | 62 | 62 | 79 | 84 | 93 | 103 | 152 |
| EF TROUBLESOME CK | TROUBLESOME, NR | 19 | 21 | 23 | 23 | 25 | N/A | N/A |
| BLUE | DILLONRES | 145 | 125 | 150 | 150 | 175 | 155 | 103 |
| | GREEN MTN RES | 235 | 220 | 270 | 275 | 320 | 310 | 118 |
| EAGLE | GYPSUM, BLO | 275 | 275 | 345 | 360 | 400 | 345 | 112 |
| FRYING PAN | RUEDI RES, BASALT, NR | 165 | 170 | 200 | 180 | 190 | 165 | 98 |
| ROARING FORK | GLENWOOD SPRINGS | 650 | 690 | 850 | 900 | 1010 | N/A | N/A |
| PLATEAU CK | CAMEO, NR | 140 | 175 | 235 | 190 | 215 | 177 | 98 |
| TAYLOR | TAYLOR PARK RES | 85 | 90 | 125 | 135 | 135 | N/A | N/A |
| | ALMONT | 130 | 140 | 200 | 220 | 220 | N/A | N/A |
| EAST | ALMONT | 164 | 185 | 260 | 255 | 265 | 277 | 151 |
| GUNNISON | GUNNISON, NR | 315 | 355 | 520 | 540 | 550 | 557 | 148 |
| | GRAND JUNCTION, NR | 1250 | 1490 | 2100 | 2050 | 2260 | 2396 | 165 |
| MUDDY CK | PAONIA RES, BARDINE, NR | 120 | 145 | 230 | 185 | 200 | 209 | 201 |
| NF GUNNISON | SOMERSET, NR | 320 | 355 | 475 | 425 | 500 | 502 | 181 |
| SURFACE CK | CEDAREGE | 20 | 25 | 32 | 30 | 30 | N/A | N/A |
| UNCOMPAHGRE | RIDGWAY RES | 81 | 95 | 120 | 120 | 120 | N/A | N/A |
| | COLONA | 99 | 125 | 165 | 165 | 170 | N/A | N/A |
| | DELTA | 84 | 105 | 140 | 140 | 150 | N/A | N/A |
| DOLORES | DOLORES | 225 | 275 | 360 | 360 | 340 | 410 | 166 |
| | MCPHEE RES | 260 | 320 | 420 | 420 | 400 | 519 | 183 |
| | CISCO, NR | 440 | 595 | 830 | 840 | 800 | 1065 | 198 |
| SAN MIGUEL | PLACERVILLE, NR | 106 | 130 | 156 | 155 | 160 | 161 | 131 |
| | NATURITA | 140 | 185 | 240 | 230 | 235 | N/A | N/A |
| MILL CK | MOAB, NR, SHELEY TUN, AT | 6.8 | 8.7 | 10.9 | 9.5 | 9.4 | N/A | N/A |
| INDIAN CK | ◆ MONTICELLO, NR, BOGUS POCKET, | 10.4 | 16.7 | 24 | 23 | 23 | N/A | N/A |

◆ March-July period

Provisional Flows in 1000 Acre-Feet

1993 Forecast Summary for: GREEN RIVER BASIN

April-July volumes unless otherwise noted

| STREAM | STATION | JAN | FEB | MAR | APR | MAY | OBS | %AVG |
|------------------|--------------------------------|------|------|------|------|------|------|------|
| GREEN | DANIEL, NR, WARREN BRIDGE, AT | 220 | 200 | 200 | 220 | 250 | N/A | N/A |
| | GREEN RIVER, WY, NR | 750 | 665 | 665 | 720 | 810 | 805 | 92 |
| | GREEN RIVER, UT | 2650 | 3000 | 3300 | 3350 | 3750 | 3329 | 106 |
| PINE CK | FREMONT LK, ABV | 97 | 88 | 88 | 96 | 104 | 103 | 99 |
| NEW FORK | BIG PINEY, NR | 355 | 300 | 300 | 335 | 375 | 426 | 110 |
| LA BARGE CK | ♣ LA BARGE MEADOWS RS, NR | 8.6 | 7.7 | 7.7 | 8.6 | 10 | N/A | N/A |
| BIG SANDY | FARSON, NR | 50 | 48 | 48 | 50 | 57 | 59 | 104 |
| BLACKS FK | MILLBURNE, NR | 89 | 92 | 105 | 105 | 93 | N/A | N/A |
| EF SMITHS FORK | ROBERTSON, NR | 29 | 30 | 33 | 33 | 31 | N/A | N/A |
| HAMS FORK | ♣ FRONTIER, NR, POLE CK, BLO | 64 | 60 | 60 | 64 | 73 | 66 | 99 |
| | VIVA NAUGHTON RES | 84 | 80 | 80 | 85 | 97 | 98 | N/A |
| HENRYS FORK | MANILA, NR | 43 | 50 | 56 | 47 | 48 | 33 | 78 |
| YAMPA | STAGECOACH RES, BLO | 29 | 35 | 41 | 38 | 48 | 32 | N/A |
| | STEAMBOAT SPRINGS | 220 | 240 | 280 | 265 | 310 | 296 | 108 |
| | MAYBELL, NR | 750 | 810 | 955 | 910 | 1100 | 1169 | 123 |
| ELK | CLARK | 160 | 170 | 195 | 185 | 215 | N/A | N/A |
| ELKHEAD CK | ELKHEAD, NR | 29 | 35 | 39 | 32 | 43 | N/A | N/A |
| FORTIFICATION CK | FORTIFICATION, NR | 5.3 | 6.5 | 7.3 | 5.9 | 8.2 | N/A | N/A |
| LITTLE SNAKE | SLATER, NR | 133 | 145 | 155 | 155 | 175 | 162 | N/A |
| | DIXON, NR | 275 | 305 | 320 | 320 | 375 | N/A | N/A |
| | LILY, NR | 300 | 335 | 350 | 350 | 405 | 406 | 113 |
| BIG BRUSH CK | VERNAL, NR, RED FLEET RES, ABV | 19 | 24 | 27 | 25 | 24 | N/A | N/A |
| ASHLEY CK | VERNAL, NR | 50 | 65 | 75 | 70 | 64 | N/A | N/A |
| WF DUCHESNE | HANNA, NR | 24 | 29 | 33 | 30 | 27 | 27 | 104 |
| ROCK CK | UPPER STILLWATER RES | 75 | 81 | 95 | 95 | 88 | 93 | 114 |
| | MTN HOME, NR | 85 | 92 | 109 | 109 | 100 | 109 | 116 |
| DUCHESNE | TABIONA, NR | 95 | 99 | 122 | 120 | 110 | 113 | 107 |
| | DUCHESNE, NR, KNIGHT DIV, ABV | 170 | 184 | 225 | 220 | 200 | 213 | 112 |
| | MYTON | 250 | 290 | 360 | 350 | 315 | 313 | 119 |
| | RANDLETT, NR | 300 | 375 | 480 | 460 | 420 | 353 | 107 |

♣ April-June Forecast Period

Provisional Flows in 1000 Acre-Feet

1993 Forecast Summary for: GREEN RIVER BASIN

April-July volumes unless otherwise noted

| STREAM | STATION | JAN | FEB | MAR | APR | MAY | OBS | %AVG |
|---------------|----------------------------------|------|------|------|------|------|------|------|
| STRAWBERRY | SOLDIER SPRINGS, NR | 59 | 70 | 80 | 76 | 65 | 78 | 131 |
| | DUCHESNE, NR | 120 | 140 | 155 | 150 | 130 | 150 | 128 |
| CURRANT CK | FRUITLAND, NR | 20 | 25 | 27 | 25 | 23 | 17.6 | 40 |
| LAKE FORK | MOON LK RES, MTN HOME, NR | 62 | 71 | 85 | 85 | 79 | N/A | N/A |
| YELLOWSTONE | ALTONAH, NR | 63 | 67 | 80 | 77 | 79 | N/A | N/A |
| UINTA | NEOLA, NR | 85 | 100 | 120 | 118 | 112 | N/A | N/A |
| WHITEROCKS | WHITEROCKS, NR | 52 | 70 | 85 | 83 | 78 | 51 | 88 |
| WHITE | MEEKER, NR | 245 | 285 | 300 | 300 | 380 | 359 | 128 |
| | WATSON, NR | 255 | 295 | 315 | 315 | 400 | N/A | N/A |
| GOOSEBERRY CK | SCOFIELD, NR | 11 | 12.5 | 15 | 14.8 | 14.8 | N/A | N/A |
| PRICE | SCOFIELD RES, SCOFIELD, NR | 46 | 48 | 55 | 55 | 55 | 54 | 122 |
| WHITE | BLO TABBYUNE CK, SOLDIER SUMMIT | 18.5 | 20 | 24 | 24 | 24 | N/A | N/A |
| HUNTINGTON CK | ELECTRIC LAKE | 13.8 | 17 | 19.1 | 18 | 17.5 | 16.4 | N/A |
| | HUNTINGTON, NR | 37 | 45 | 50 | 50 | 48 | 52 | 126 |
| SEELEY CK | JOES VALLEY RES, ORANGEVILLE, NR | 52 | 60 | 75 | 75 | 75 | 64 | 120 |
| FERRON CK | FERRON, NR | 38 | 50 | 60 | 60 | 60 | N/A | N/A |
| SEVEN MILE CK | FISH LAKE, NR | 5.3 | 7.2 | 9.5 | 9.5 | 8.6 | N/A | N/A |
| MUDDY CK | EMERY, NR | 16.6 | 23 | 30 | 28 | 28 | N/A | N/A |

Provisional Flows in 1000 Acre-Feet

1993 Forecast Summary for: SAN JUAN BASIN

April-July volumes unless otherwise noted

| STREAM | STATION | JAN | FEB | MAR | APR | MAY | OBS | %AVG |
|--------------|---------------------------------|------|------|------|------|------|------|------|
| SAN JUAN | PAGOSA SPRINGS | 217 | 260 | 310 | 305 | 295 | 315 | 148 |
| | CARRACAS, NR | 385 | 460 | 560 | 535 | 490 | N/A | N/A |
| | FARMINGTON | 1053 | 1360 | 1800 | 1650 | 1630 | 1674 | 150 |
| | BLUFF, NR | 1090 | 1440 | 1920 | 1750 | 1690 | 1730 | 150 |
| RIO BLANCO | PAGOSA SPRINGS, NR, BLANCO DAM | 52 | 62 | 85 | 85 | 83 | N/A | N/A |
| NAVAJO | CHROMO, NR, OSO DIV DAM, BLO | 65 | 80 | 100 | 100 | 100 | N/A | N/A |
| PIEDRA | ARBOLES, NR | 220 | 270 | 340 | 310 | 285 | N/A | N/A |
| LOS PINOS | VALLECTORES, BAYFIELD, NR | 185 | 230 | 290 | 265 | 250 | 255 | 130 |
| ANIMAS | DURANGO | 385 | 470 | 620 | 590 | 560 | 613 | 146 |
| FLORIDA | LEMON RES, DURANGO, NR | 54 | 66 | 83 | 77 | 73 | 75 | 131 |
| LA PLATA | HESPERUS | 25 | 33 | 43 | 37 | 33 | N/A | N/A |
| MANCOS | ◆ TOWAOC, NR | 28 | 43 | 60 | 57 | 57 | N/A | N/A |
| MONTEZUMA CK | ◆ MONTICELLO, GOLF COURSE, AT | N/A | 6.9 | 12 | 11.5 | 11.5 | N/A | N/A |
| RECAPTURE CK | ◆ BLANDING, NR, JOHNSON CK, BLO | N/A | 12.2 | 16.9 | 16.6 | 16.6 | N/A | N/A |

◆ March-July Forecast Period

Provisional Flows in 1000 Acre-Feet

1993 Forecast Summary for: FLOOD CONTROL RESERVOIRS

April-July volumes unless otherwise noted

| STREAM | STATION | JAN | FEB | MAR | APR | MAY | OBS | %AVG |
|----------|---------------|------|------|-------|-------|-------|-------|------|
| GREEN | FONTENELLE | 730 | 655 | 655 | 700 | 795 | 757 | 86 |
| | FLAMING GORGE | 1050 | 980 | 980 | 1020 | 1150 | 1039 | 82 |
| GUNNISON | BLUE MESA | 660 | 680 | 920 | 950 | 1020 | 987 | 142 |
| SAN JUAN | NAVAJO | 750 | 960 | 1230 | 1150 | 1080 | 1193 | 156 |
| COLORADO | LAKE POWELL | 6800 | 7900 | 10100 | 10100 | 11000 | 10100 | 125 |

Averages used are for the '61-85 period

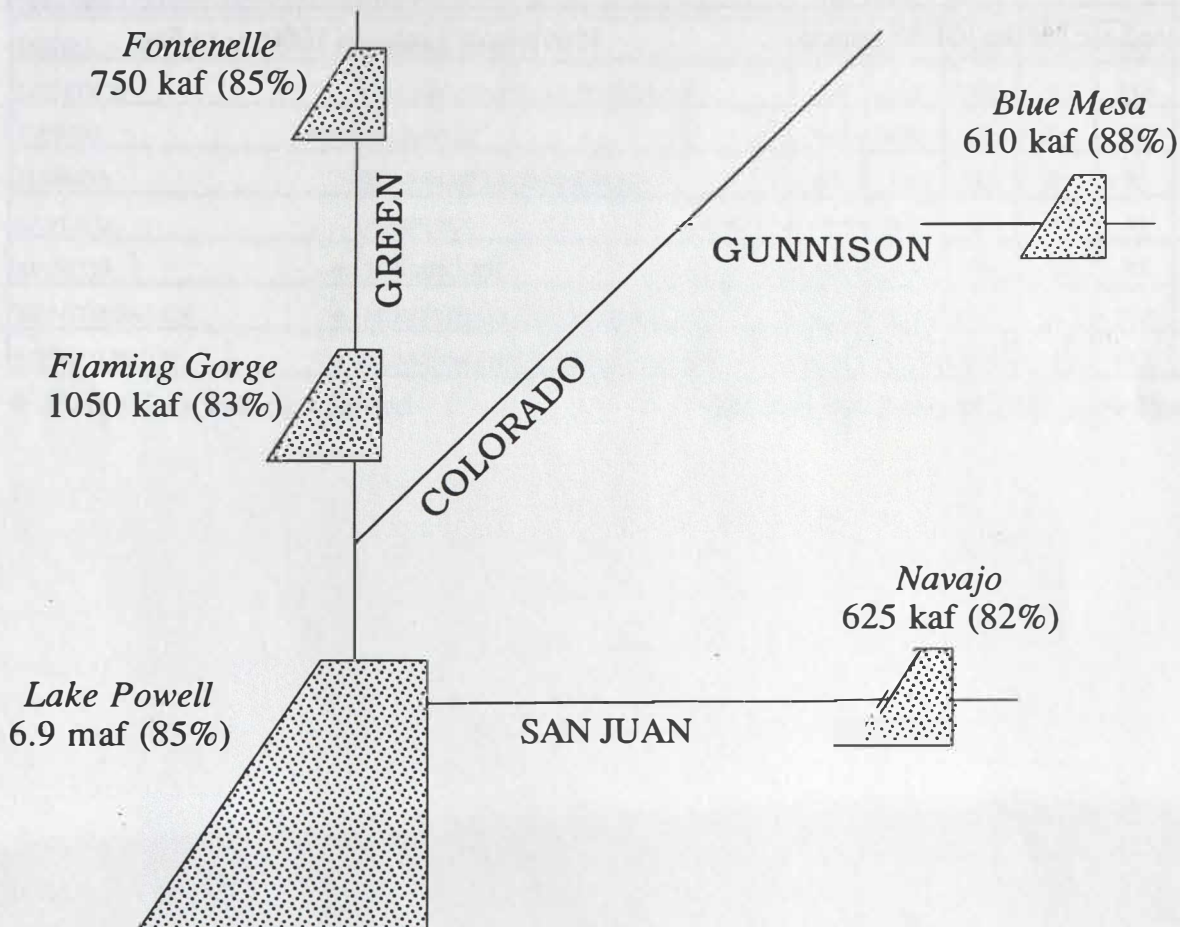
Provisional Flows in 1000 Acre-Feet

PREVIEW OF WATER YEAR '94

OUTLOOK FOR MAJOR FLOOD CONTROL RESERVOIRS USING THE EXTENDED STREAMFLOW PREDICTION (ESP) MODEL

MOST PROBABLE FORECASTS (AS OF 10/12/93)

1994 APRIL - JULY INFLOW VOLUMES
(% OF '61 - '85 AVERAGE)



At this early juncture in the forecast and snow accumulation season, there is a great deal of uncertainty in the April-July runoff forecast. In statistical terms, the confidence bounds around the most probable forecast are quite wide. Users are advised to make appropriate adjustments in their use of the numbers.

What makes a **GOOD** water supply forecast?... a **BAD** forecast?

Is it as simple as which forecast comes closest to the actual observation? Probably not, as a number of factors necessitate a more sophisticated evaluation of forecast quality be undertaken. Such an evaluation would not be trivial and is beyond the time and space constraints of this note. Nonetheless, with apologies for simplification and omission, some of the factors include:

subsequent meteorologic conditions - the implicit assumption behind any forecast is that the meteorologic conditions during the remainder of the snow accumulation and melt season will be "normal". While it may be difficult to adequately define what "normal" is, it is easier to discern conditions that are extreme or "not normal". As such, a given forecast at a given time may have been the best forecast possible in light of known conditions, although ultimately turning out to be 20% too low; it just so happened that the ensuing meteorologic conditions were unusually wet. Just as a good forecast may be made to look bad by abnormal conditions in the future, the reverse situation is also possible.

natural variability of site's streamflow - simply put, some rivers are much more difficult to forecast than others. Historically, such river flows may vary over a wide range and be quite sensitive to changing conditions, particularly in environs where the number of precipitation events are few. On the other hand, some river flows may be relatively constant with the effects of diverse conditions dampened. Oftentimes scale is a good indicator of the variability of flow at a given site. A 20% error on a small stream in Arizona may be more laudable than a 10% error on Lake Powell inflow.

character of the year - by definition, extreme events are rare and forecasting such events becomes more difficult. Because the number of past extreme events is small, less is known about the distribution and variability than in situations with "near-normal" populations. Even if it was possible to remove uncertainty about future meteorological conditions, there would still be more error associated with forecasting extreme events.

During extreme conditions there is a demand that the forecaster make a more powerful (and potentially more valuable) statement: in effect, that "even normal conditions from here on out will not be enough to compensate for current abnormal snowpack and soil states." It is during such events that consideration of information other than just the most probable forecast becomes especially important. Probability statements that convey the likelihood of exceeding a certain level (such as the reasonable maximum and minimum forecasts) help to underscore the uncertainty associated with the forecast.

So why do it? Although it may not be a simple matter to grade a forecast, it is still useful for users and forecasters alike to review the previous year's forecasts and adjusted observations (provisional as they may be with estimated diversions) so as to act on obvious problems and to gain perspective for the coming forecast season.

ADDITIONAL INFORMATION

Water supply forecasts take into consideration present hydrometeorological conditions and use average basin temperatures and precipitation for the forecast period. As the forecast season progresses, a greater portion of the future hydrologic and meteorologic uncertainty becomes known and monthly forecasts become more accurate.

Volume forecasts represent adjusted flows; that is, observed flows with upstream water use taken into account. At best, adjusted flows will closely approximate natural or unimpaired flows. However, not all upstream diversions or impoundments are measured, quantifiable or predictable.

The Water Supply Outlook is issued monthly January through May by the Colorado Basin River Forecast Center, National Weather Service. It represents a coordinated effort between the National Weather Service, Soil Conservation Service, Bureau of Reclamation, U.S. Geological Survey and local water district managers.

DEFINITIONS:

Acre-Foot:

The volume equal to one acre covered one foot deep (43,560 cubic feet).

Average:

The arithmetic mean. The sum of the values divided by the number of values.

Categories:

| | | | | |
|---|----------------------------|-------------------------|-------------------------|-------------------------------------|
| Much above Average Greater than 130% | Above Average 111 -130% | Near Average 90-110% | Below Average 70-89% | Much below Average Less than 70% |
|---|----------------------------|-------------------------|-------------------------|-------------------------------------|

Forecast Period:

The period from April 1 to July 31.

Most Probable Forecast:

Given the current hydrometeorological conditions to date, this is the best estimate of what the runoff volume will be this season.

Reasonable Maximum Forecast:

Given the current hydrometeorological conditions, the seasonal runoff that has a ten percent (10%) chance of being exceeded.

Reasonable Minimum Forecast:

Given the current hydrometeorological conditions, the seasonal runoff that has a ninety percent (90%) chance of being exceeded.

Water Year:

The period from October 1 through September 30.

NOTE: Data used in this report are provisional and are subject to revision.

For more information, or to be included on the mailing list, please contact:

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