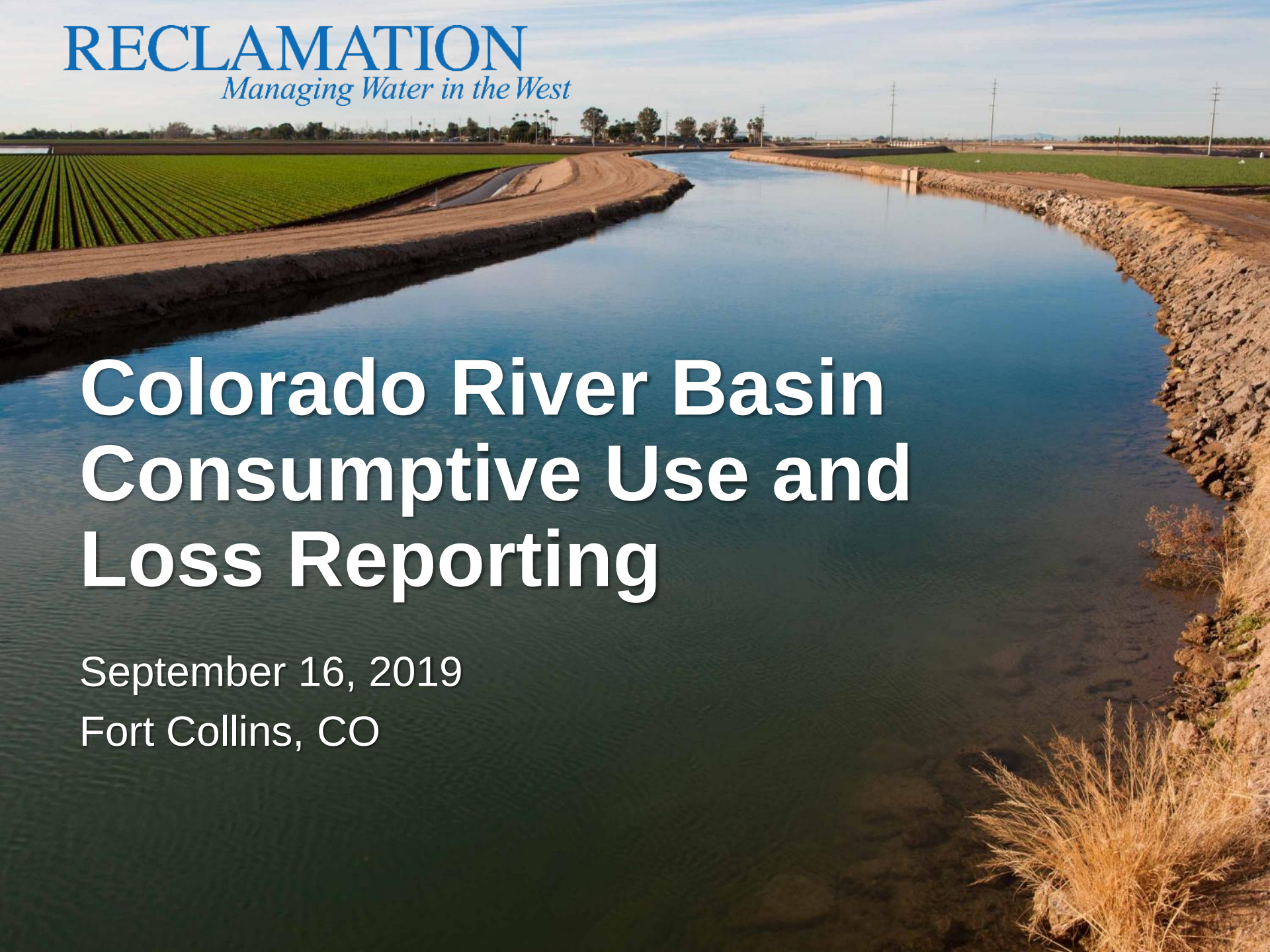


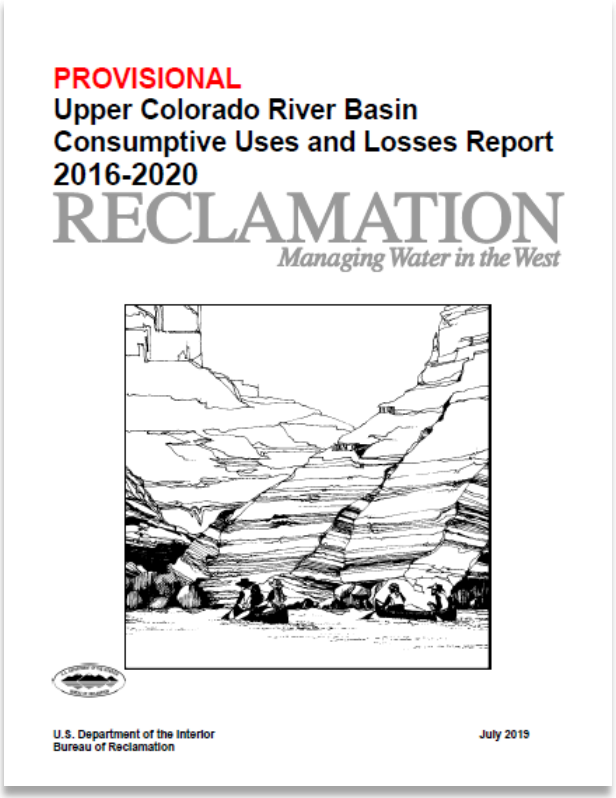
Colorado River Basin Consumptive Use and Loss Reporting

September 16, 2019

Fort Collins, CO

Upper Basin consumptive uses and losses

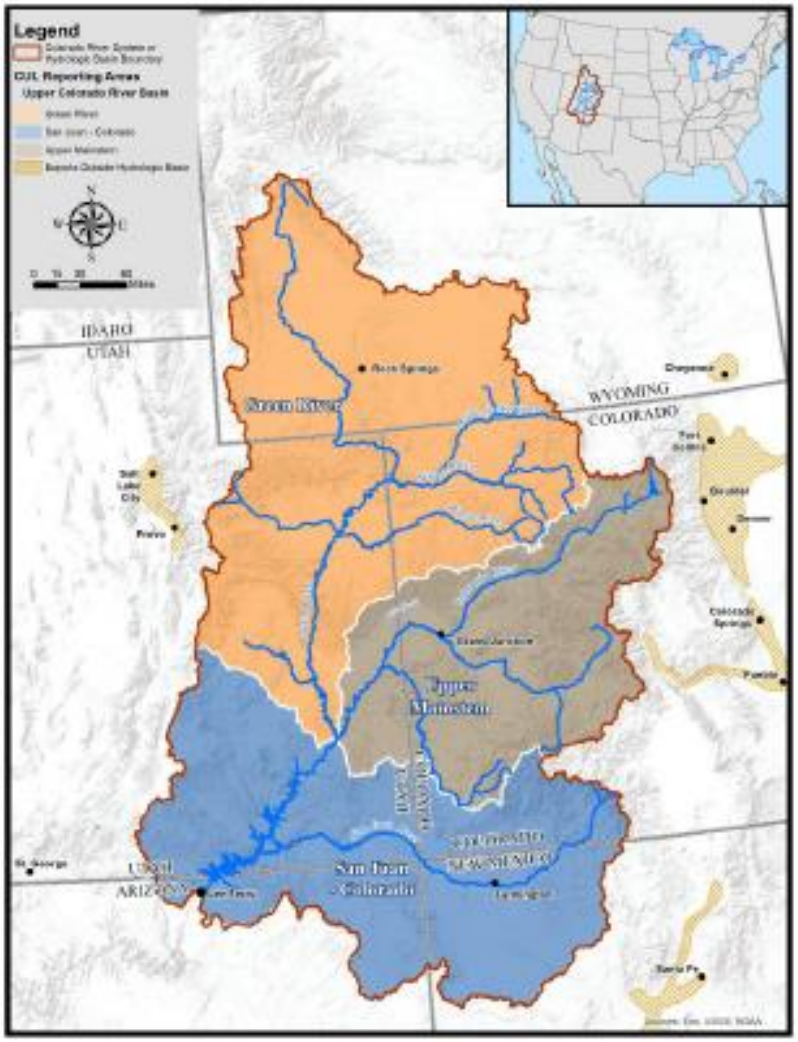
- Consumptive Uses and Losses
  - Reports are prepared pursuant to the Colorado River Basin Project Act of 1968, Public Law 90 537
  - Categories reported
    - Irrigated Agriculture
    - Reservoir Evaporation
    - Stock ponds
    - Livestock
    - Thermal Power
    - Minerals
    - Municipal and Industrial
    - Exports/Imports



http://www.usbr.gov/uc/library/envdocs/reports/crs/crsul.html

Upper Basin consumptive uses and losses overview

- Complete diversions and return flows are not available.
- Rely on theoretical and indirect methods of estimating consumptive use
- Major tributary reporting areas
  - Green River (Wyoming, Colorado, Utah)
  - Upper Main Stem (Colorado, Utah)
  - San Juan – Colorado (Colorado, New Mexico, Utah, Arizona)



Annual Reported Data

Table UC-4
Upper Colorado River Basin
Estimated Water Use within States, by Major Tributaries and Types of Use
2018 - Provisional data (subject to change)

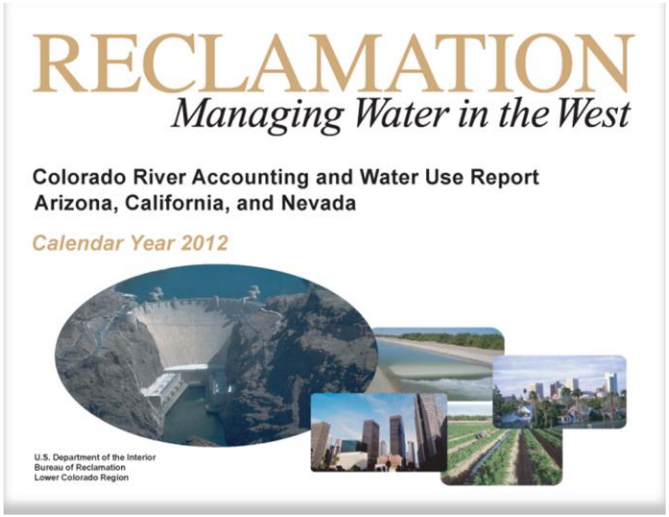
(1,000 acre-feet)

State	Tributary	Reservoir Evaporation[1]	Agriculture			Municipal and Industrial				Export		
			Irrigation	Stockpond Evaporation & Livestock	Subtotal	Mineral Resources	Thermal Electric Power	Other[2]	Subtotal	Outside System	Within System	TOTAL
Arizona	San Juan - Colorado Rivers	3.8	1.0	1.4	2.4	0.0	18.1	6.3	23.4	0.0	0.0	29.6
Colorado	Green River	8.4	201.2	3.2	204.4	0.2	17.9	3.9	22.0	0.0	0.4	235.2
	Upper Main Stem	67.1	1,148.9	6.9	1,155.8	3.1	1.8	40.1	44.9	484.1	208.8	1,870.7
	San Juan - Colorado Rivers	8.9	348.1	5.9	362.0	0.2	0.0	7.3	7.5	1.5	(209.2)	160.7
	TOTAL	84.4	1,698.2	16.1	1,712.3	3.5	19.5	51.4	74.3	486.8	0.0	2,388.8
New Mexico	San Juan - Colorado Rivers	24.4	235.1	4.4	238.5	1.1	35.0	16.0	51.1	166.1	0.0	480.0
Utah	Green River	71.9	688.4	4.4	690.8	0.8	34.4	16.1	50.2	127.2	0.0	840.0
	Upper Main Stem	1.5	11.4	0.2	11.6	0.4	0.0	1.8	2.2	0.0	0.0	15.3
	San Juan - Colorado Rivers	6.6	79.2	3.8	83.0	2.4	0.0	4.0	6.4	(3.1)	0.0	82.9
	TOTAL	80.0	778.9	8.4	785.3	3.4	34.4	21.0	58.8	124.1	0.0	1,048.2
Wyoming	Green River	35.7	345.1	4.8	350.0	0.7	37.7	7.1	45.6	9.4	0.0	440.7
Upper Basin	Green River	116.9	1,232.7	12.4	1,245.1	1.8	90.0	28.2	117.8	138.7	0.4	1,615.9
	Upper Main Stem	68.6	1,160.3	7.2	1,167.4	3.5	1.8	41.9	47.1	484.1	208.8	1,886.0
	San Juan - Colorado Rivers	43.8	661.4	15.4	676.8	3.8	53.1	31.8	88.4	163.4	(209.2)	763.2
	TOTAL	228.2	3,054.4	35.0	3,089.4	8.8	144.7	99.8	253.2	784.2	0.0	4,365.0

[1] Excludes reservoir evaporation from Colorado River main stem reservoirs listed in Table UC-1.
[2] Includes rural, urban, and other industrial uses.

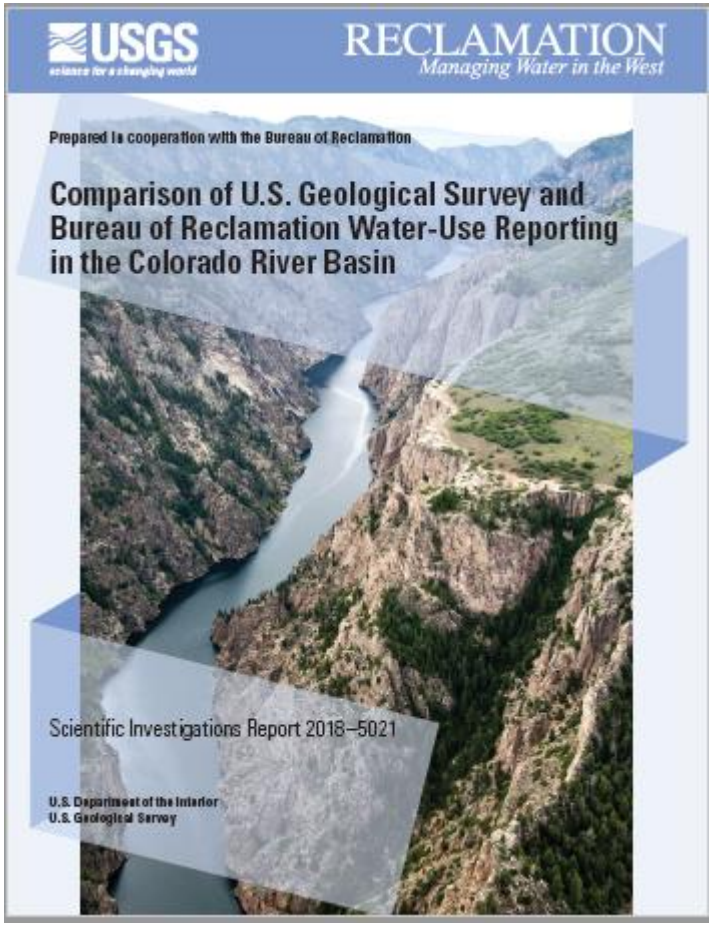
Lower Basin Water Accouting

- Decree Accounting Reports
  - Records complied in accordance with Article V of the Decree of the Supreme Court of the United States in Arizona v. California dated March 9, 1964
  - Reports gaged
    - total diversion
    - total return flow
      - Including unmeasured return flow
    - Estimated consumptive use
  - Over 98% of the lower basin diversion are gaged real-time

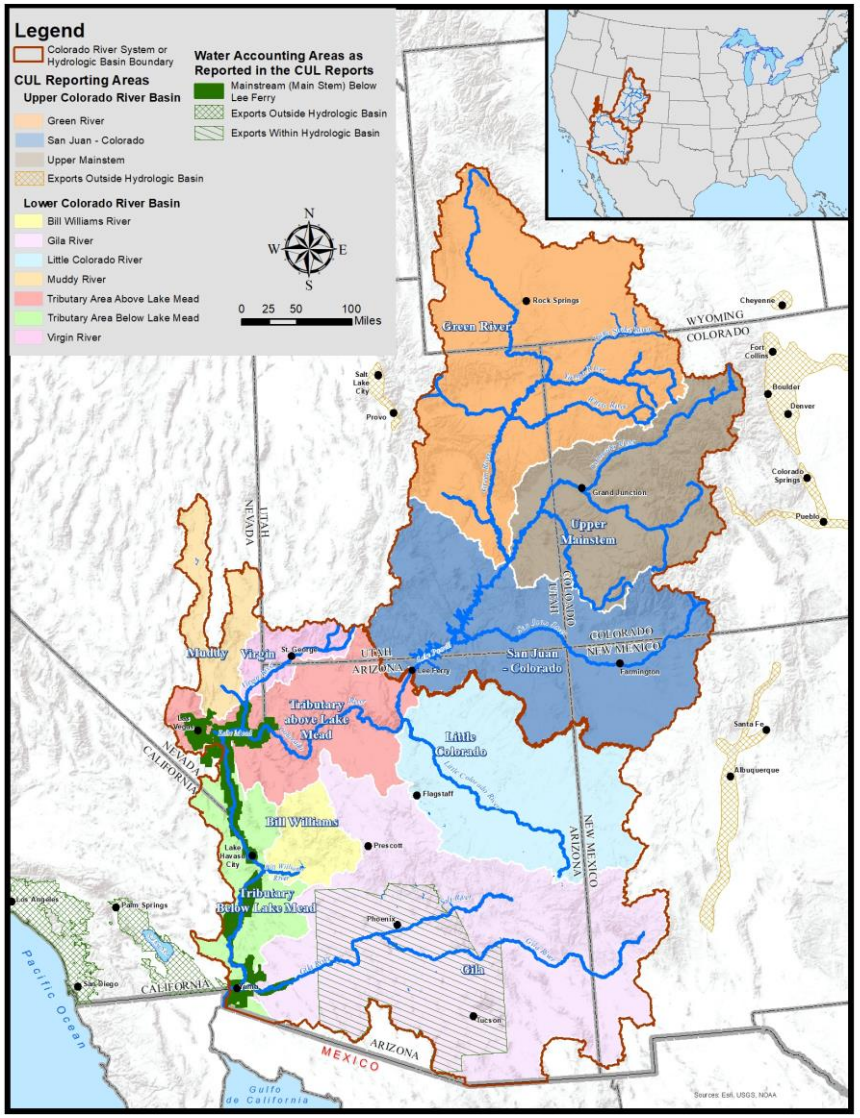


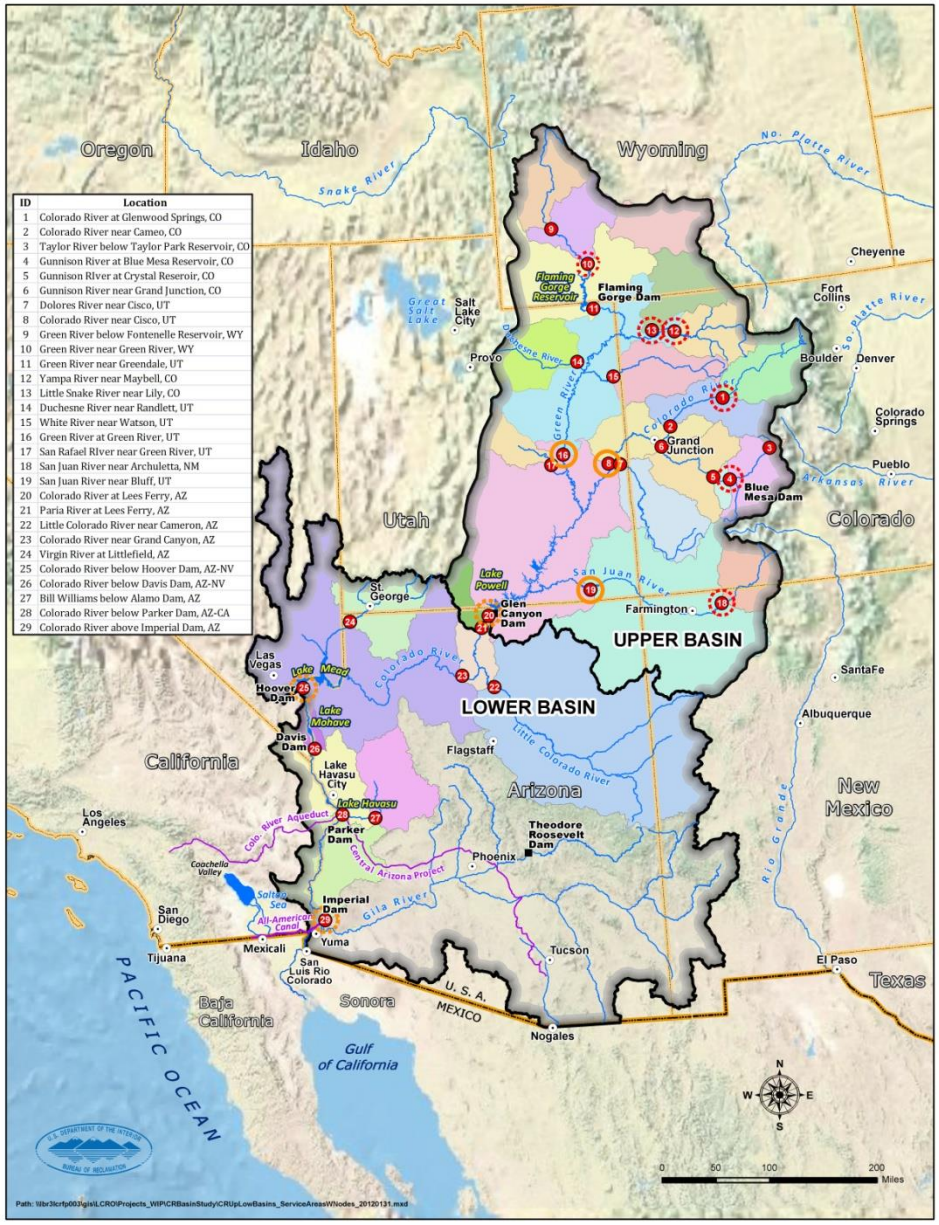
http://www.usbr.gov/lc/region/g4000/wtracct.html

Upper and Lower Basin



https://pubs.er.usgs.gov/publication/sir20185021





ID	Location
1	Colorado River at Glenwood Springs, CO
2	Colorado River near Cameo, CO
3	Taylor River below Taylor Park Reservoir, CO
4	Gunnison River at Blue Mesa Reservoir, CO
5	Gunnison River at Crystal Reseroir, CO
6	Gunnison River near Grand Junction, CO
7	Dolores River near Cisco, UT
8	Colorado River near Cisco, UT
9	Green River below Fontenelle Reservoir, WY
10	Green River near Green River, WY
11	Green River near Greendale, UT
12	Yampa River near Maybell, CO
13	Little Snake River near Lily, CO
14	Duchesne River near Randlett, UT
15	White River near Watson, UT
16	Green River at Green River, UT
17	San Rafael RIver near Green River, UT
18	San Juan River near Archuletta, NM
19	San Juan River near Bluff, UT
20	Colorado River at Lees Ferry, AZ
21	Paria River at Lees Ferry, AZ
22	Little Colorado River near Cameron, AZ
23	Colorado River near Grand Canyon, AZ
24	Virgin River at Littlefield, AZ
25	Colorado River below Hoover Dam, AZ-NV
26	Colorado River below Davis Dam, AZ-NV
27	Bill Williams below Alamo Dam, AZ
28	Colorado River below Parker Dam, AZ-CA
29	Colorado River above Imperial Dam, AZ

Supports Natural Flow Estimation

Natural Flow =

Historical Gage Flow
+ Consumptive Uses and Losses
+ Reservoir Regulation

Consumptive Use and Loss available monthly for an 8 digit HUC

Water Accounting available daily by contractor

Accessing Agricultural ET Estimation – Phase 3

September 16, 2019

Fort Collins, CO

Why are we doing this?

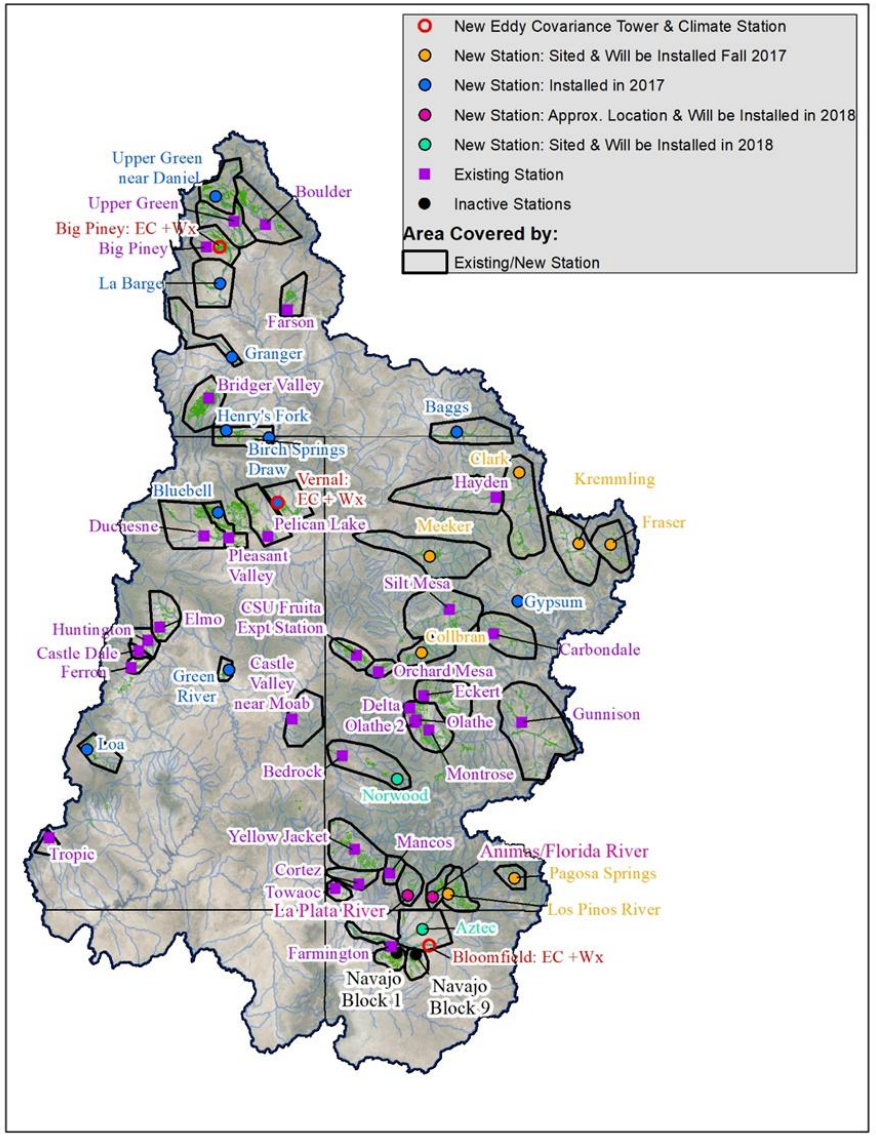
- States and Reclamation are not using the same methods and data, a setup for future conflict
- This is a cooperative effort seeking a unified method
- Current methods to determine potential crop ET and irrigation shortages were developed in the late 1960s and no longer considered “state of the science”
- Current methods do not allow results quickly enough (by April 1) to administer the compact

Taking a Phased Approach

- Phase 1 - completed November 2013
  - Document data and methods used in the UCRB by Reclamation and the upper basin states
- Phase 2 - completed May 2016
  - Evaluate need for additional data (climate, supply, acreage); began evaluating remote sensing methods.
  - Develop unbiased procedures to compare the methods in terms of accuracy, resources, time, and budget

Wx Station and EC Tower Network

- 57 Wx stations
  - 55 active, 2 inactive
  - Not all are well sited
- 4 EC towers, all installed and active
  - Provides a ‘groundtruth’ measurement



What are we doing in Phase 3?

- Two primary comparisons:
  - Two widely used methods to estimate actual ET with remote sensing **(SSEBop and METRIC)** were compared directly with the EC Towers.
    - Four Eddy-Covariance (EC) towers were installed, one in each state
    - Only one EC tower was able to be sited and installed for the 2017 irrigation season
    - All EC towers were available for the 2018 growing season
  - Current potential ET method used by Reclamation **(SCS Modified Blaney-Criddle)** compared to the ET expert-recommended standard **(Penman-Monteith)**.
    - The comparison was performed based on acreage in each of the Upper Basin states

Steps to determine ET

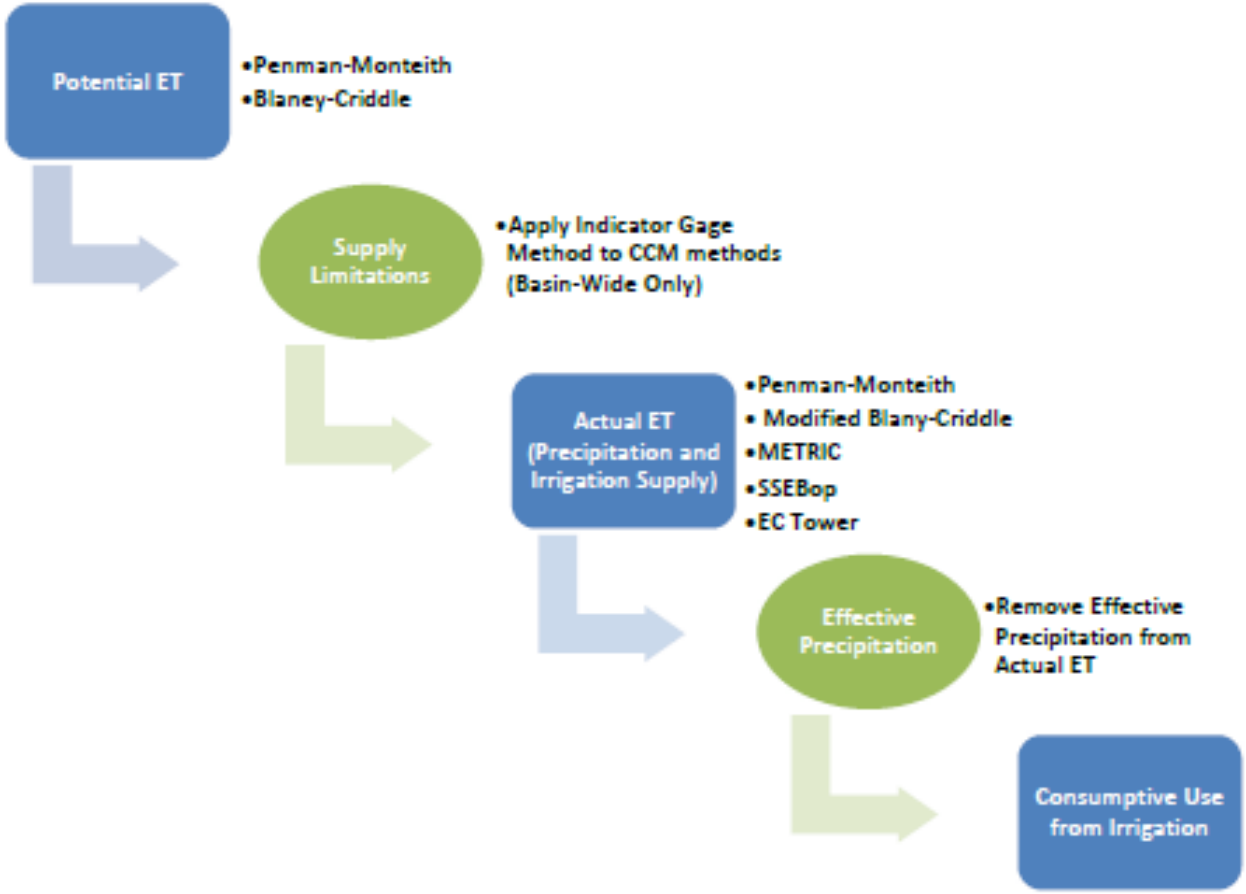
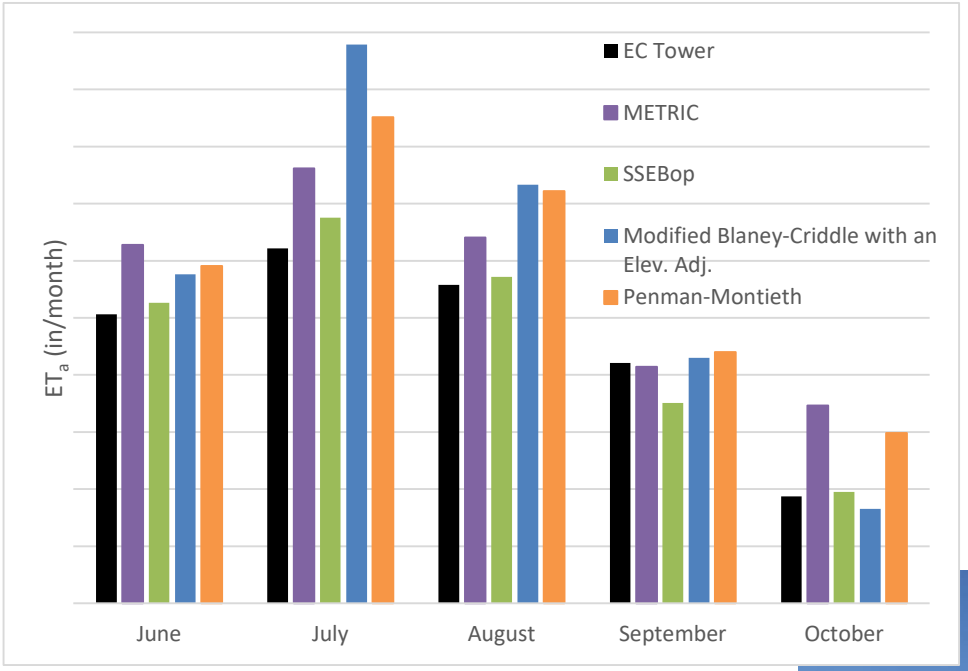
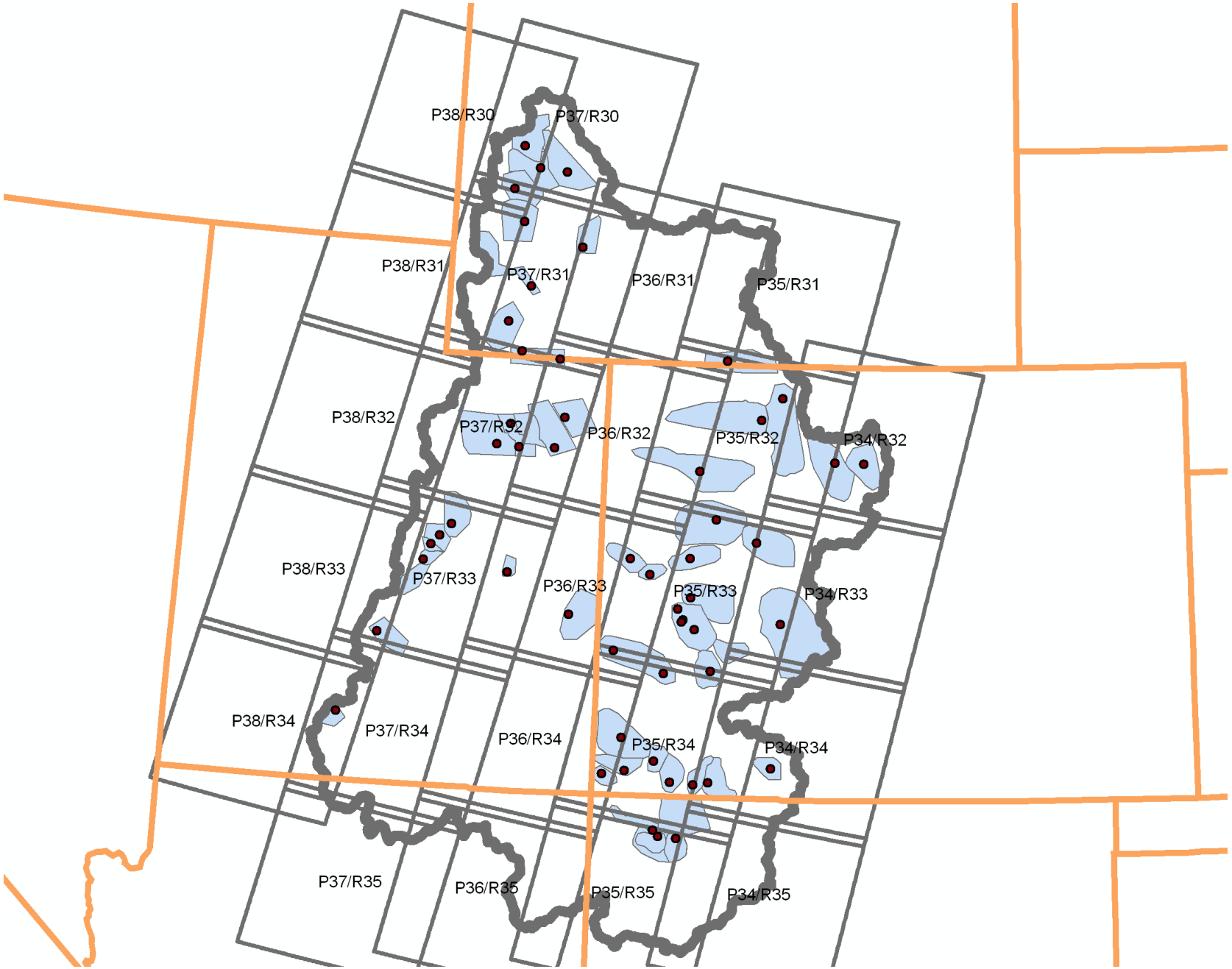


Figure 4. Approach used to determine Potential ET, Actual ET, and Irrigation Consumptive Use for each method

EC Towers


EC Tower
METRIC
SSEBop
Modified Blaney-Criddle with an Elev. Adj.
Penman-Montieth
ET_a (in/month)
June
July
August
September
October

Big Piney, WY
Rock Springs
Vernal, UT
Palisade, CO
Farmington
Bloomfield, NM
Ashley National Forest
Uintah and Ouray Reservation
Dinosaur National Monument
Colorado
White River National Forest
Gunnison National Forest
Uncompahgre National Forest
San Juan National Forest
Ute Mountain Reservation
Southern Ute Reservation
Navajo Nation Reservation
San Juan


P38/R30
P37/R30
P38/R31
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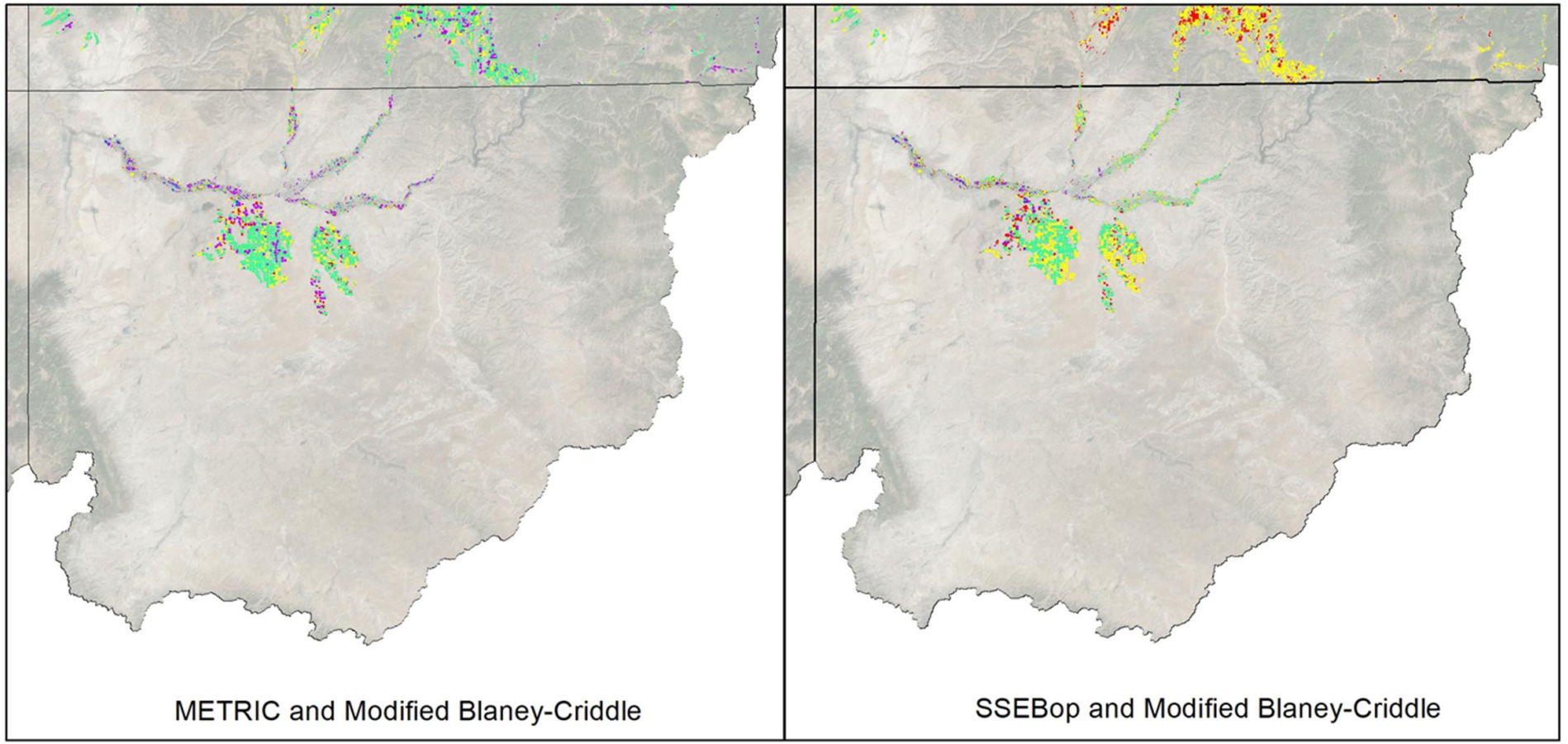
Basin wide comparison

Percent Difference of ETa
New Mexico



What is next?

- Compare 2018 remote sensing estimates to all four EC Towers.
  - Provides additional spatial coverage, and more supply variability, as 2017 was a higher runoff year, and 2018 was extremely dry
- Will move carefully towards another method
  - Assess the estimates and make a determination on whether we need more years of data to choose the remote sensing model or more hydrologically variable years to “calibrate” the model we chose.

Questions


DNR
CO

Office of the State Engineer
nm
Interstate Stream Commission

U.S. DEPARTMENT OF THE INTERIOR
BUREAU OF RECLAMATION

UPPER COLORADO RIVER COMMISSION
APRIL 6, 1949

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