Analyzing SPARROW Data to Quantify Changes in Salt Load from Irrigation

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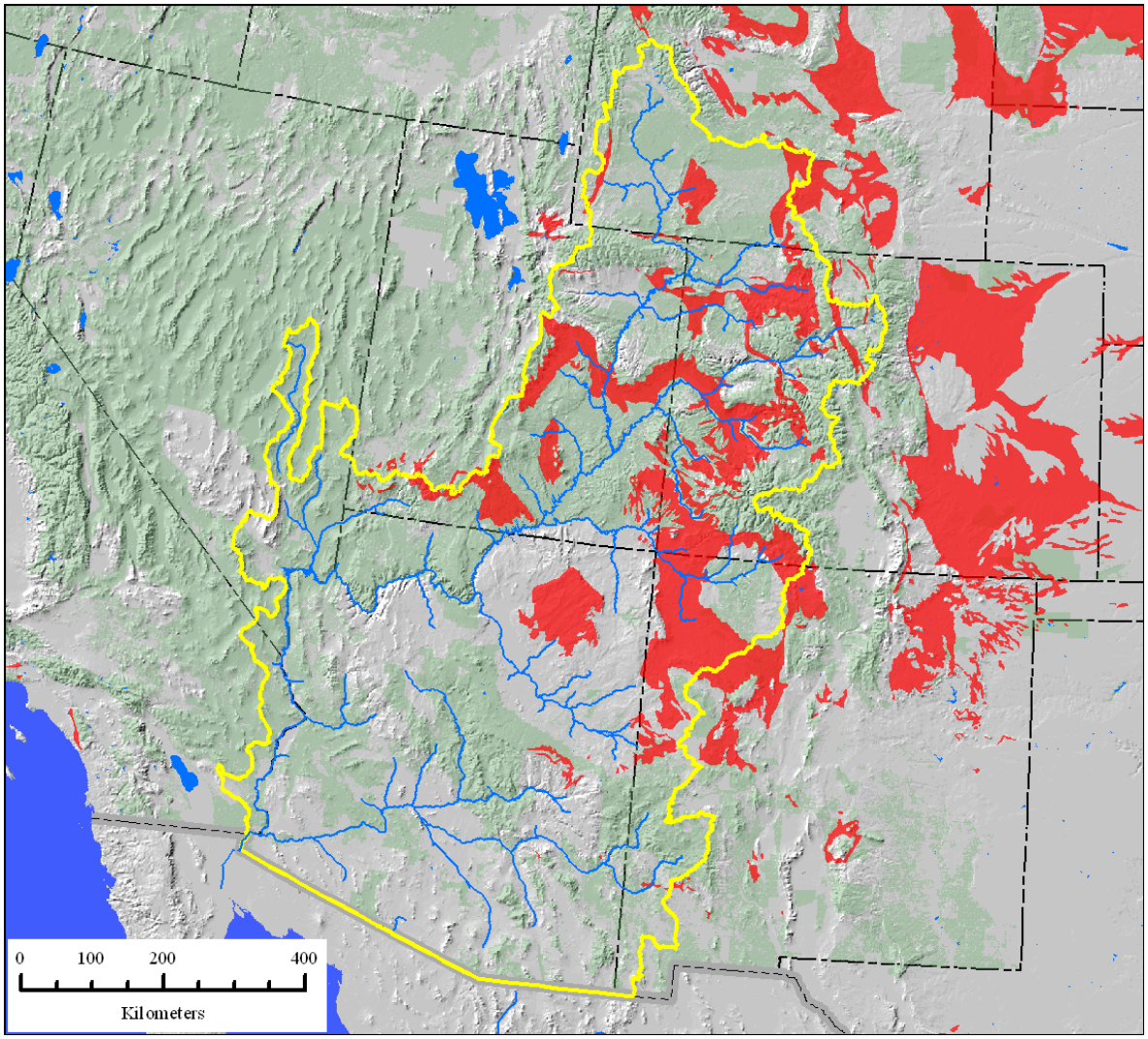
SPARROW data from Terry Kenney, USGS, Salt Lake City, Utah

USDA NRCS
United States Department of Agriculture
Natural Resources Conservation Service

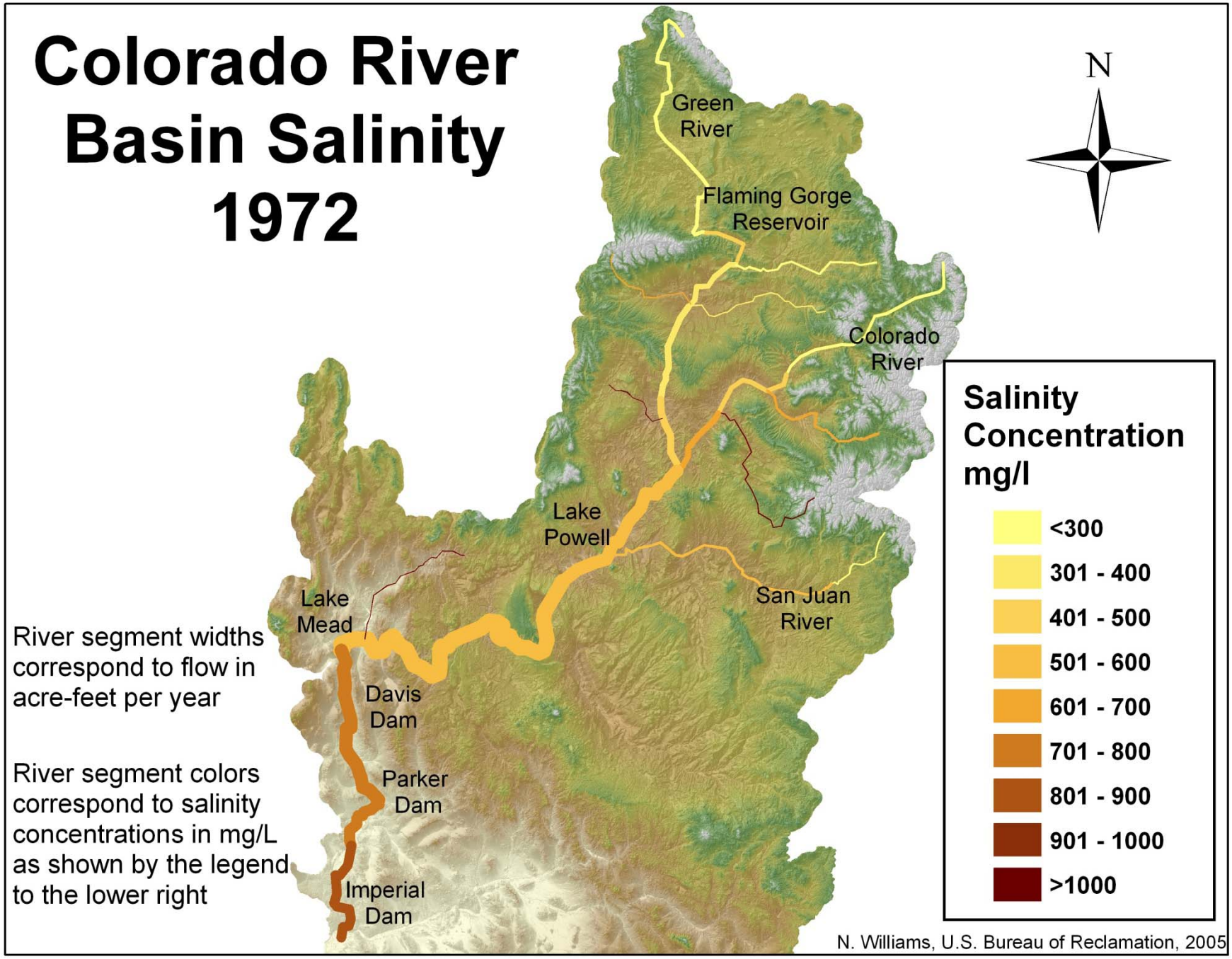
The Colorado River

- Drains 246,000 square miles (155 M acres).
- Serves 7.5 M persons in the U.S portion of the Basin and, through export, another 25.4 M persons outside the Basin.
- Irrigates 2.3 M acres within the Basin and an equal amount through exports
- Generates 12 billion kilowatt-hours of electricity
- Serves 2.6 M persons in Mexico and irrigates .5 M acres.

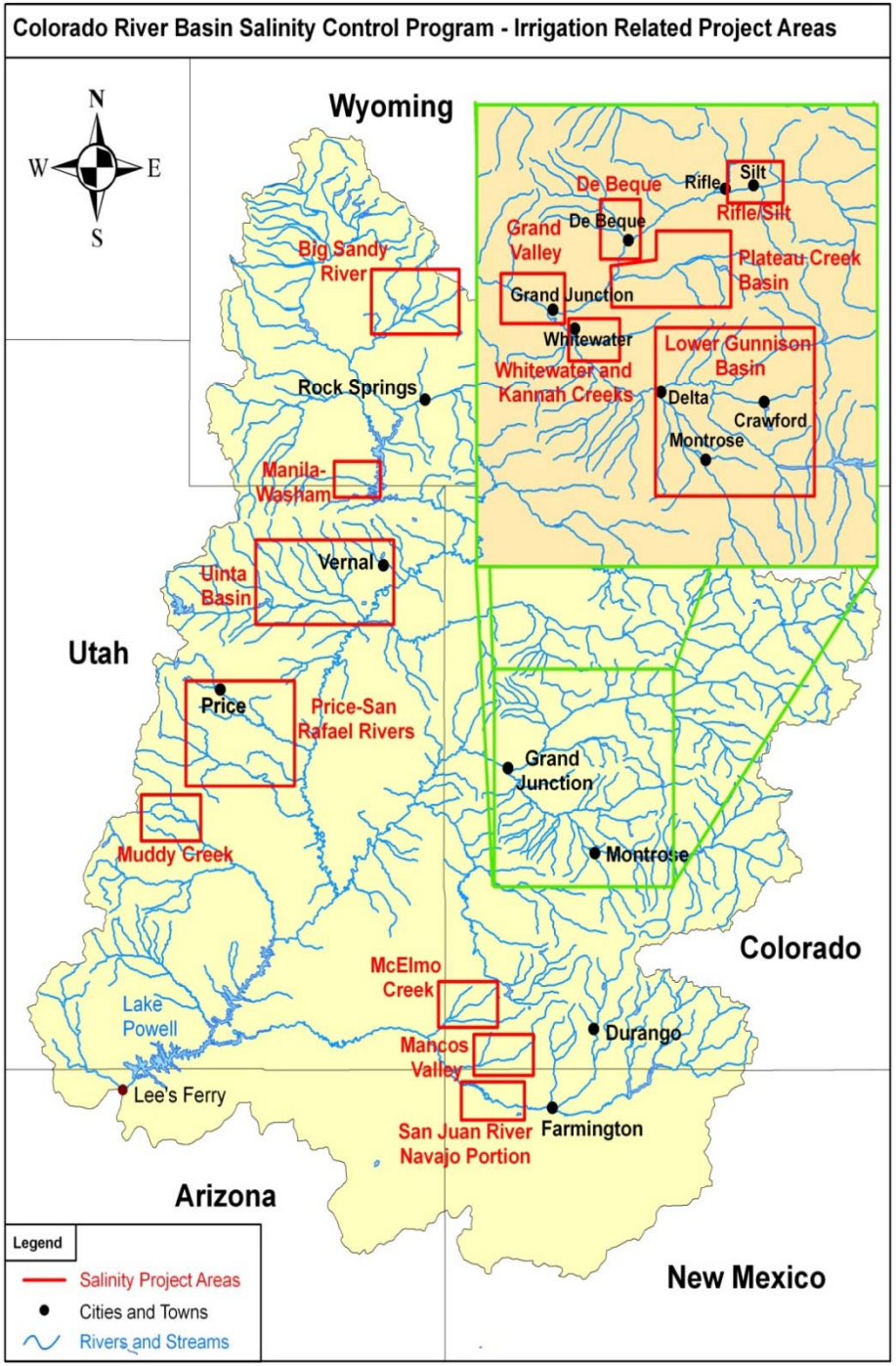
Upper Cretaceous Deposits



From R. Grauch, USGS, 2004


Colorado River Basin Salinity 1972
N
Green River
Flaming Gorge Reservoir
Colorado River
Lake Powell
San Juan River
Lake Mead
Davis Dam
Parker Dam
Imperial Dam
River segment widths correspond to flow in acre-feet per year
River segment colors correspond to salinity concentrations in mg/L as shown by the legend to the lower right
Salinity Concentration mg/l
<300
301 - 400
401 - 500
501 - 600
601 - 700
701 - 800
801 - 900
901 - 1000
>1000
N. Williams, U.S. Bureau of Reclamation, 2005

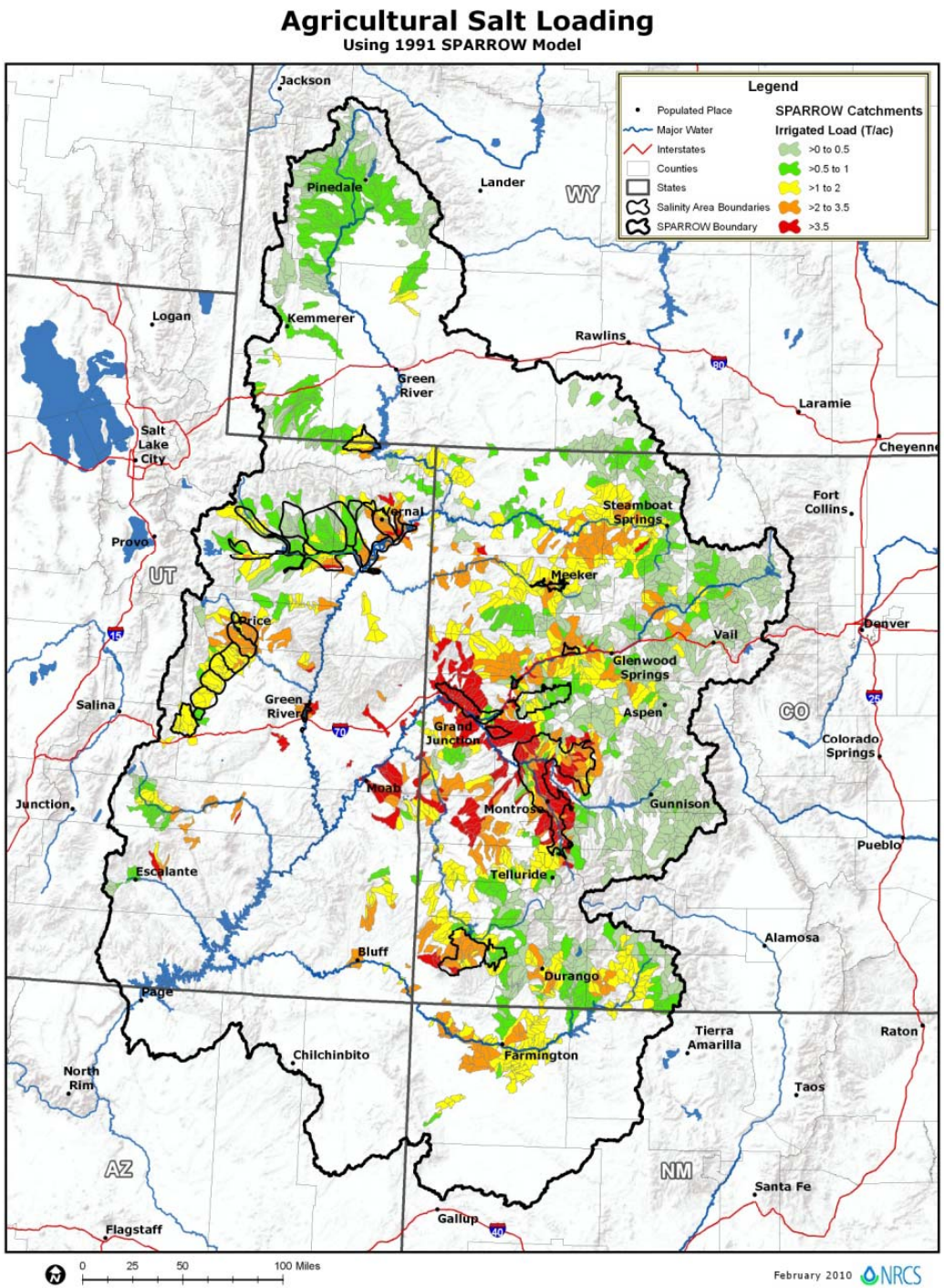
Map of Project Areas



Analysis Methodology

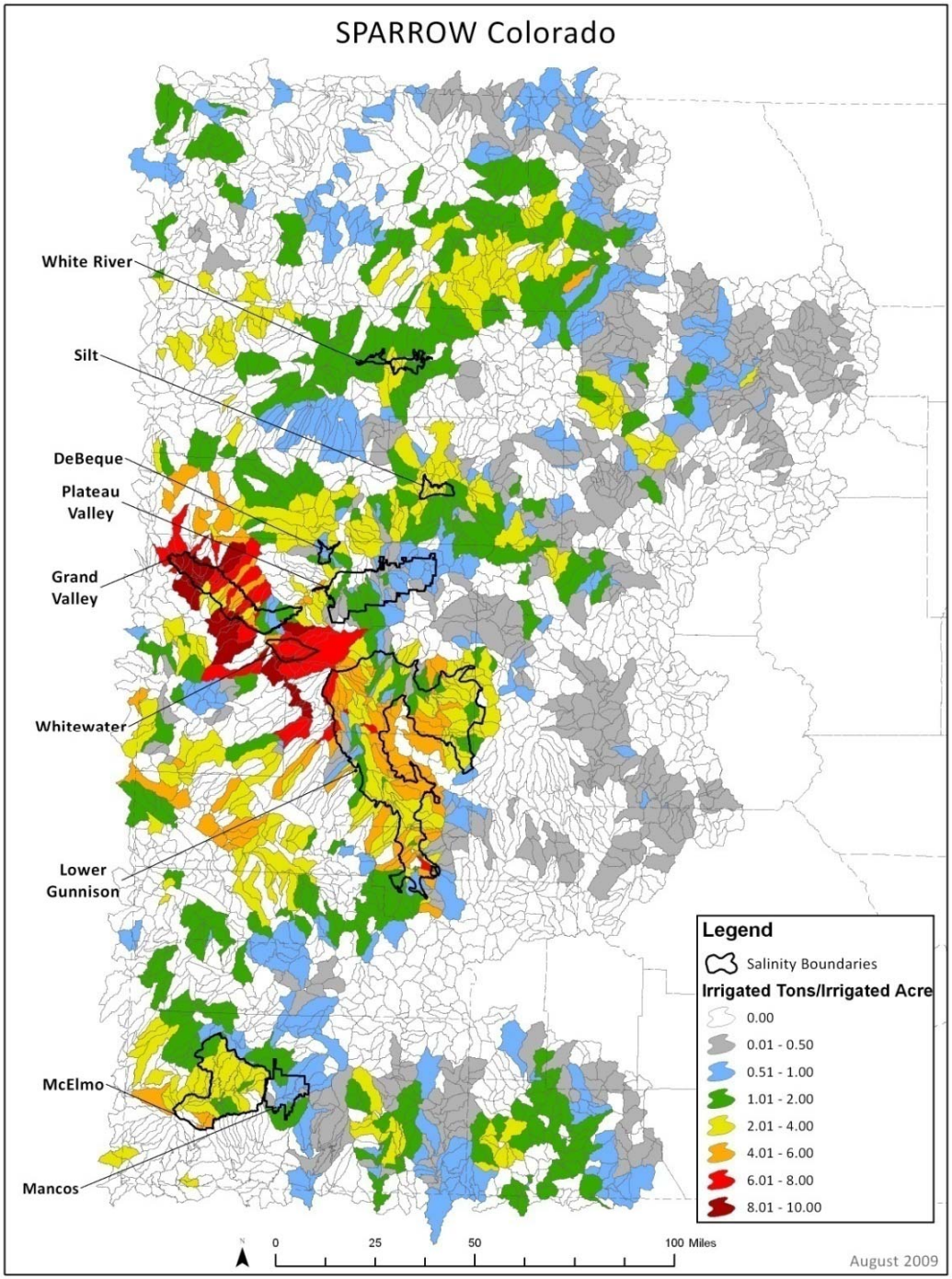
- SPARROW[1/] data was obtained from the USGS in Excel format.
- Salt loading attributable to irrigated agriculture was calculated on a ton per acre basis for each catchment

[1/] SPARROW Data from: "Spatially Referenced Statistical Assessment of Dissolved-Solids, Load Sources, and Transport in Streams of the Upper Colorado River Basin", by Terry A. Kenney, Steven J. Gerner, Susan G. Buto, and Lawrence E. Spangler, USDI/USGS-Scientific Investigations Report 2009-5007



Colorado River Basin

Upper Basin States



Map showing SPARROW data and catchments projected onto Western Colorado

Outlined areas show detailed salinity study boundaries

Microsoft Excel - SPARROW_GIScoFINAL.xls

File Edit View Insert Format Tools Data Window Help Adobe PDF

Q2

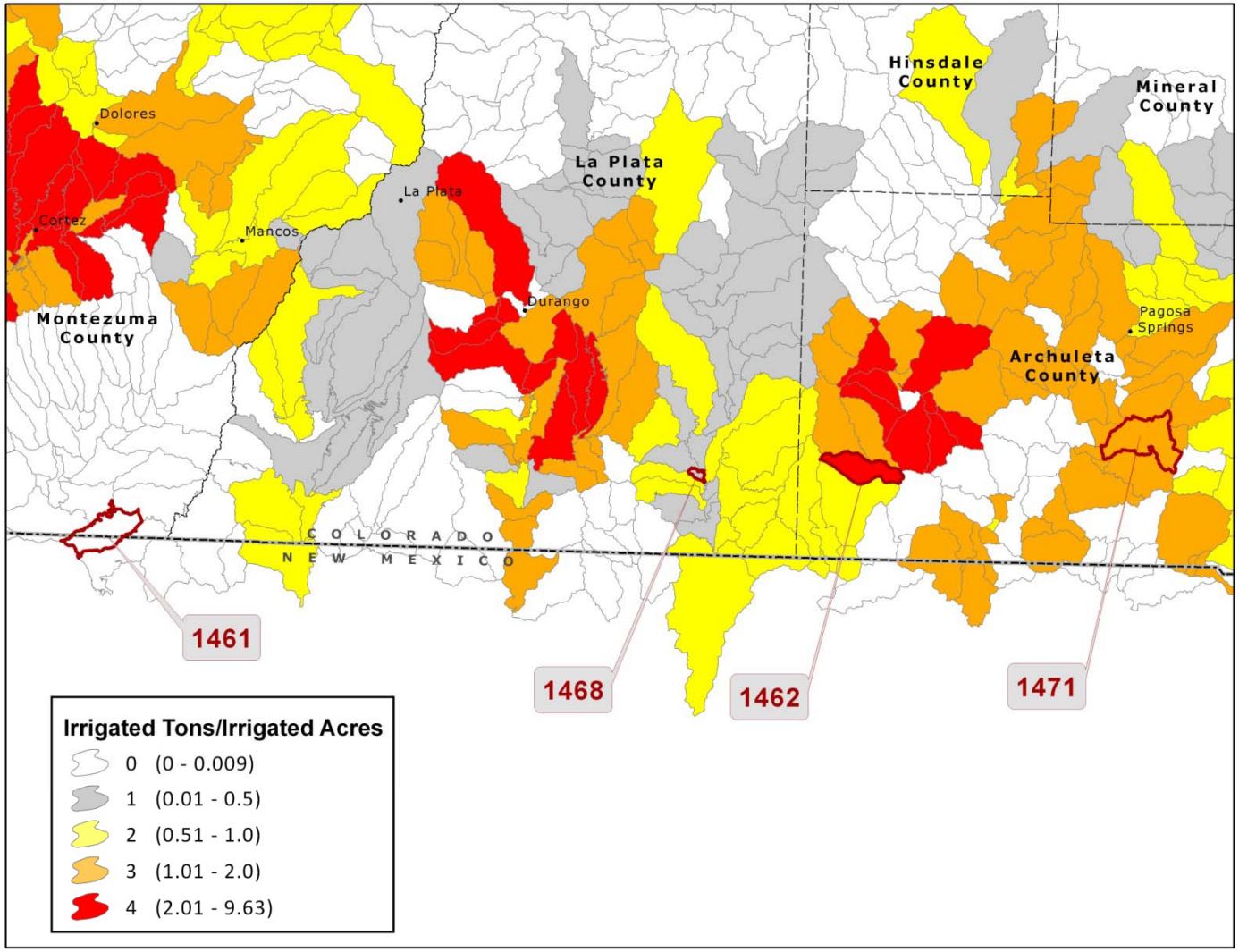
	A	B	C	D	E	F	G	H	I	J	K	L	M	N
1	IRRIGATED ACRES							Incremental Adjusted						
2	SPARROW Reach Identifier (WATERID)	Catchment Acres	Incremental drainage area, in square miles	Incremental irrigated lands, in acres	USGS monitoring site ID	Next downstream USGS monitoring site ID	Adjusted predicted total incremental load, in tons	from irrigated lands of other lithologies	from irrigated sedimentary-clastic Mesozoic lands	from irrigated sedimentary-clastic Tertiary lands	Total Irrigated Load (%)	Irrigated Load (Tons)	Irrigated Tons/ Irr Acre	Formula Number
61	1383	8708.98	13.61	0.00		9346400	32	0	0	0	0	0.0	0.00	0
62	1387	11858.77	18.53	185.82		9346400	738	0	39	0	39	289.8	1.56	3
63	1391	4046.11	6.32	0.00		9365000	43	0	0	0	0	0.0	0.00	0
64	1392	4659.08	7.28	771.95		9354500	362	0	10	83	94	338.6	0.44	1
65	1394	2345.73	3.66	0.00		9367500	7	0	0	0	0	0.0	0.00	0
66	1395	3806.17	5.94	0.00		9367500	43	0	0	0	0	0.0	0.00	0
67	1398	12730.42	19.87	731.18		9367500	514	0	33	50	84	429.9	0.59	2
68	1403	592.90	0.93	295.54		9354500	87	0	0	106	106	92.2	0.31	1
69	1404	243.58	0.38	19.77		9367500	17	0	89	0	89	14.9	0.76	2
70	1410	3701.36	5.78	118.36		9364500	276	0	0	70	70	194.5	1.64	3
71	1413	8265.62	12.92	7.17		9346400	356	0	3	0	3	10.3	1.44	3
72	1421	14670.94	22.92	523.12		9355500	761	0	0	37	37	284.8	0.54	2
73	1423	529.94	0.83	27.43		9346400	60	0	66	0	66	39.6	1.44	3
74	1424	1237.97	1.93	0.00		9367500	2	0	0	0	0	0.0	0.00	0
75	1425	231.80	0.36	0.00		9367500	0	0	0	0	0	0.0	0.00	0
76	1426	9362.78	14.61	0.00		9371010	140	0	0	0	0	0.0	0.00	0
77	1428	6506.39	10.16	2857.27		9355000	2240	0	98	2	100	2244.7	0.79	2
78	1429	923.47	1.44	56.83		9354500	26	0	0	87	87	23.0	0.40	1
79	1430	7397.64	11.55	0.00		9367500	64	0	0	0	0	0.0	0.00	0
80	1431	12126.89	18.94	2786.60		9355500	1810	0	15	76	91	1645.5	0.59	2
81	1433	4602.56	7.19	286.39	09363500	9363500	535	0	0	84	84	447.6	1.56	3
82	1434	4471.95	6.98	676.57		9355000	522	0	88	6	94	492.9	0.73	2
83	1436	4456.33	6.96	326.92		9354500	188	0	45	46	90	169.7	0.52	2
84	1439	3819.48	5.96	420.57		9354500	254	0	66	28	94	239.8	0.57	2
85	1440	4028.10	6.29	0.00		9346400	236	0	0	0	0	0.0	0.00	0
86	1445	14057.26	21.95	0.00		9364500	217	0	0	0	0	0.0	0.00	0
87	1448	7624.66	11.91	0.00		9346400	176	0	0	0	0	0.0	0.00	0
88	1449	4515.37	7.05	0.00		9346400	168	0	0	0	0	0.0	0.00	0
89	1451	1110.84	1.74	1.48		9346400	34	0	6	0	6	2.1	1.41	3
90	1453	84.97	0.13	0.49		9354500	1	0	0	31	31	0.2	0.40	1
91	[illegible]	[illegible]	[illegible]	[illegible]		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
92	1461	7382.09	11.52	0.00		9371010	104	0	0	0	0	0.0	0.00	0
93	1462	5757.84	8.99	66.22	09349800	9349800	292	0	17	29	46	132.9	2.01	4
94	1468	498.97	0.78	13.10		9354500	6	0	0	84	84	5.1	0.39	1
95	1471	10095.18	15.77	248.34		9346400	688	0	51	0	51	349.9	1.41	3
96	[illegible]	[illegible]	[illegible]	[illegible]		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
97	1479	18495.34	28.86	0.00		9367500	108	0	0	0	0	0.0	0.00	0
98	1485	5902.54	9.22	0.00		9346400	239	0	0	0	0	0.0	0.00	0

DeBeque / Silt / Lower Gunnison / Non "Salinity Project" Areas / Colorado SPARROW catchments

Analysis Methodology

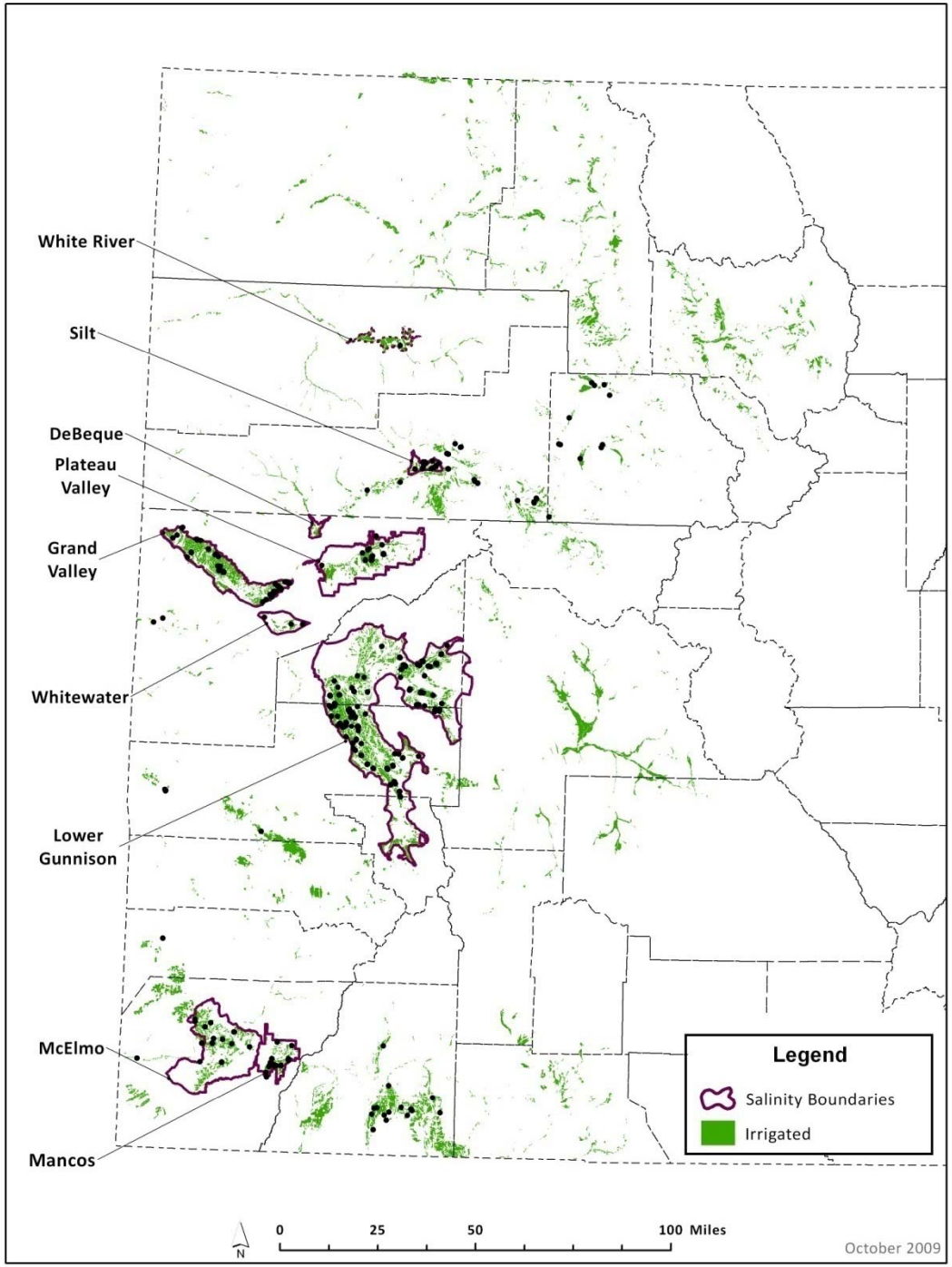
- Records were sorted by the Irrigated Tons/Acre column
- Grouped based on salt load (tons/acre) using the following ranges:
  - 0 to 0.009 0
  - 0.01 to 0.5 1
  - 0.51 to 1.0 2
  - 1.01 to 2.0 3
  - 2.01 to 9.63 (maximum) 4

Catchment Groups



Catchment Groupings

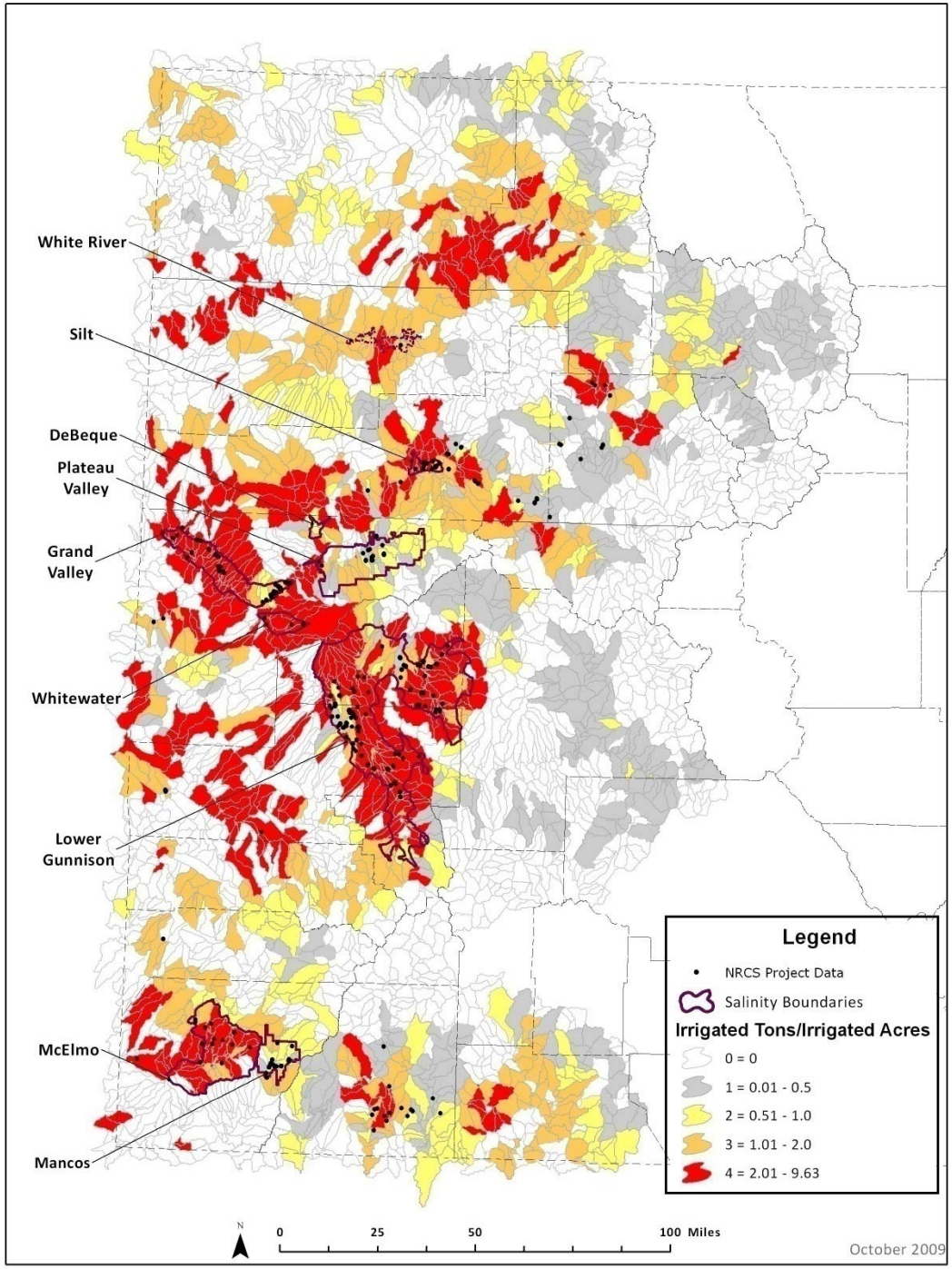
- Catchments were assigned an average salt loading rate based on loading group
- Values were assigned as follows:
  - Group 0 — 0 Tons/Acre
  - Group 1 — 0.25 Tons/Acre
  - Group 2 — 0.75 Tons/Acre
  - Group 3 — 1.5 Tons/Acre
  - Group 4 — 3.0 Tons/Acre



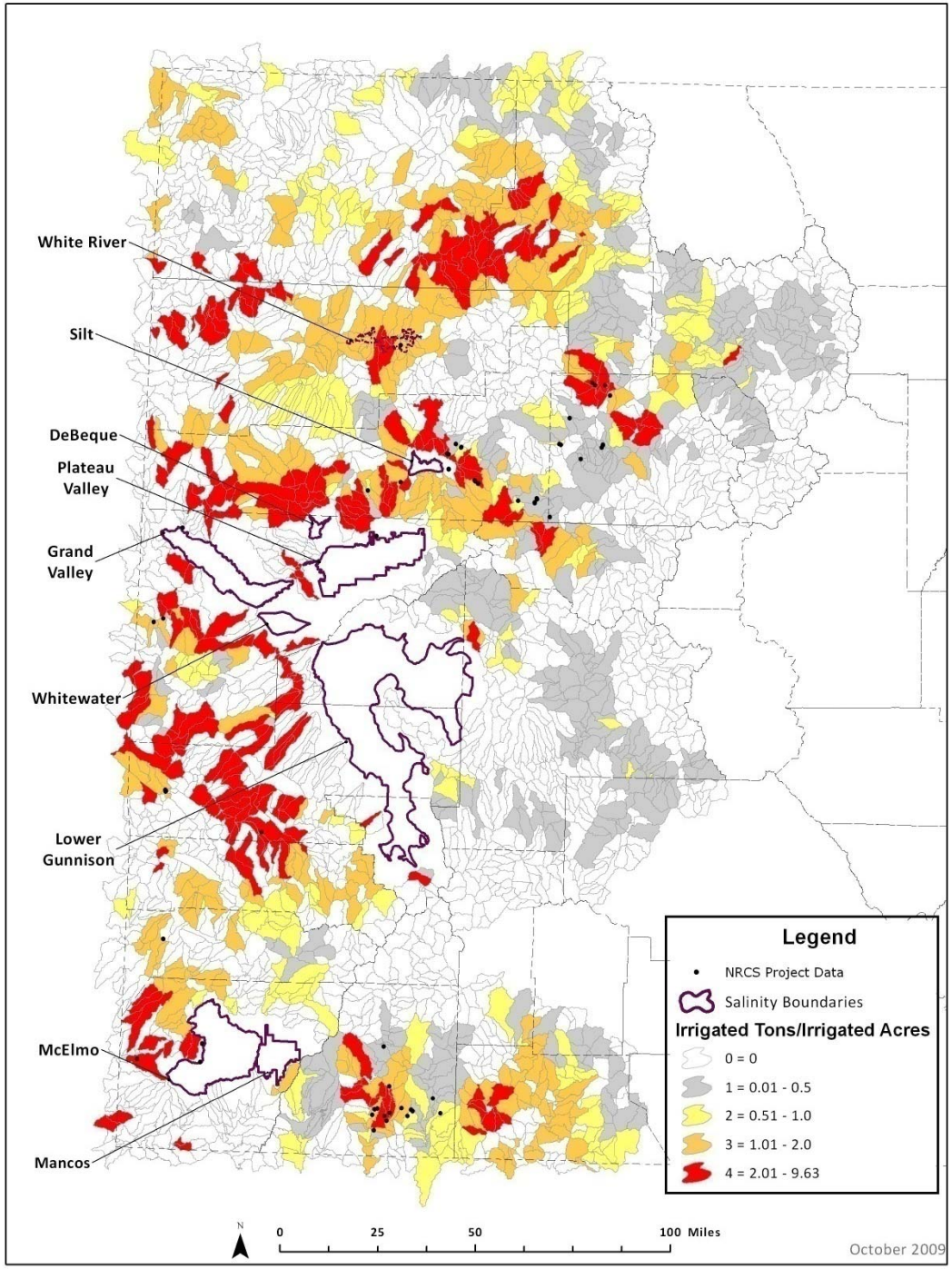
Fiscal Year 2008

Map showing irrigated acres in Colorado and irrigation system improvements.

Data points represent individual irrigation practices or multiple practices installed in FY2008.



Map showing Colorado Catchments and Salinity Project or Study Area Boundaries



Map showing Colorado Catchments and irrigation improvement locations with the current Salinity Project Areas removed

FY 2008 Irrigation Improvements

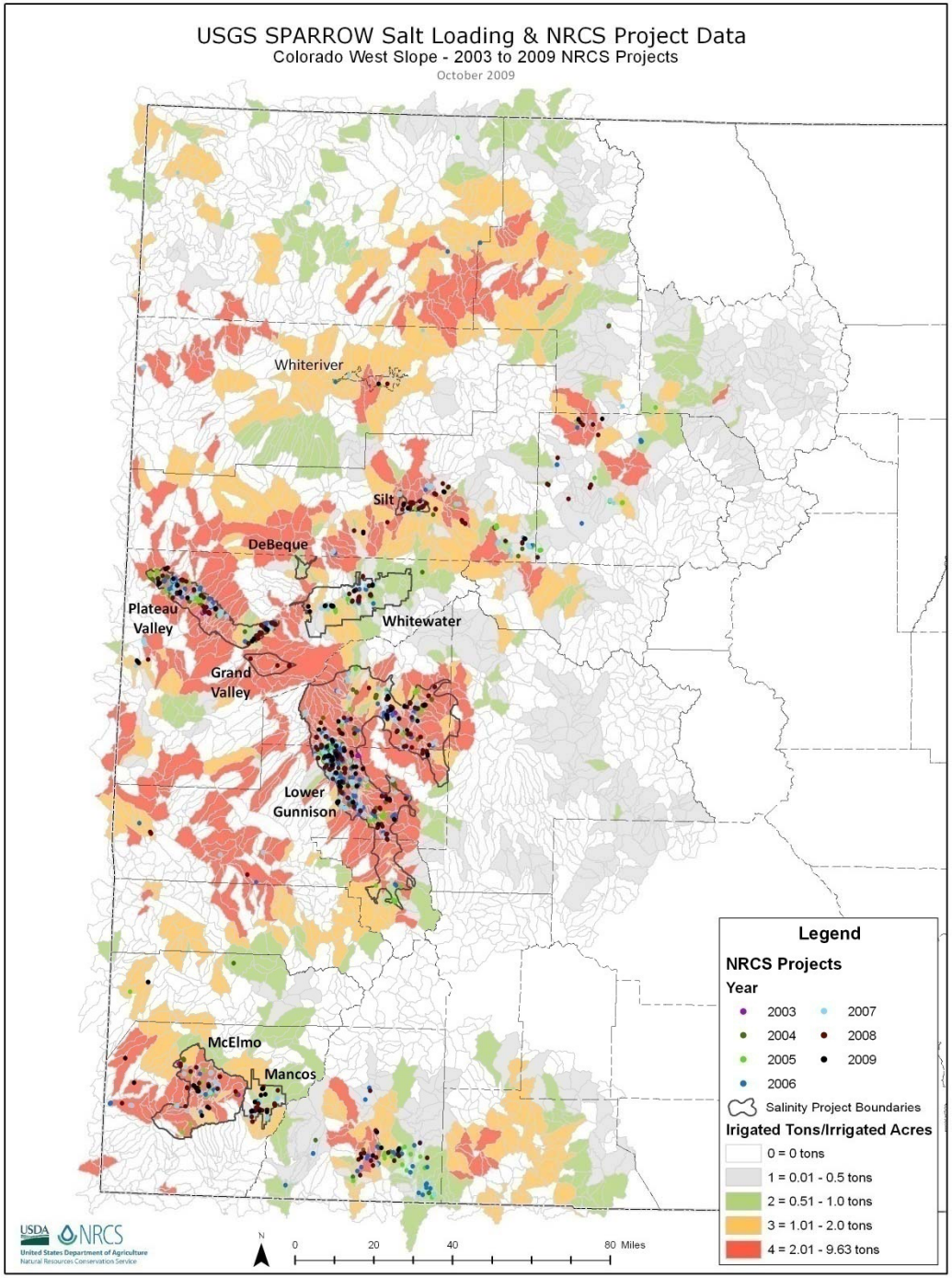
Used load reductions of:

- Improved flood 52%
- Sprinkler 86%
- Microspray 91%

FY 2008 Irrigation Improvements

2008 EQIP work outside of existing project areas:

- 63 irrigation system improvements
- 1,816 tons per year reduction



Map showing Colorado Catchments and NRCS project point locations for:

FY2003-2009

Identified Salinity Benefits Outside Salinity Areas FY2003-2009*

- Identified Improvements: 303
- Total Acres Treated: 12,185
- Total Tons Controlled: 11,629*

*A significant number of other irrigation improvements have been made that are not included in this analysis. The actual cumulative salinity reduction benefits will be higher.

General Observations From the Analysis

- There are opportunities for cost-effective salinity control work outside of existing salinity control project areas.
- For these small areas additional hydro-salinity studies and detailed project plans are cost prohibitive.
- SPARROW data allows for cost-effective analysis to determine salt loading changes across the whole basin.

Questions?

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