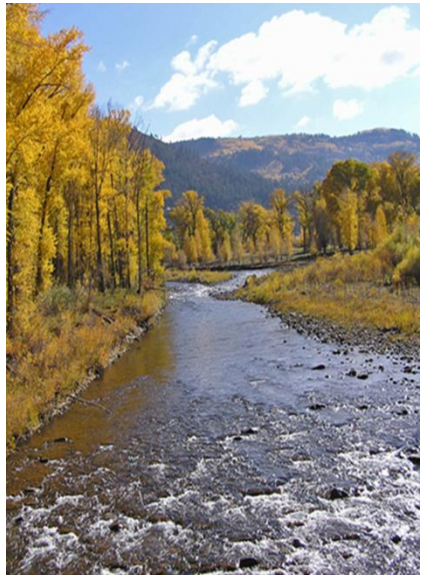

Upper Dolores River Stream Protection Working Group

Task Team Work Session 2 20 Nov 2019

Task Team Members

- Mary Hammer, SJNFS
- Garrett Hanks, NTU
- Clay Kampf, SJNFS
- Anthony Madrid, SJNFS
- Kelly A Palmer, SJNFS
- Mike Preston/Ken Curtis, DWCD
- Duncan Rose, DRA (TU chapter)
- Jim White, CPW
- Raymond Rose, DRA
- Keith Hutcheson, DRA

Today's Discussion Guide

- **Session 1**
  - **Review Discussion Guide, introductions, quick review of charge to Task Team**
  - **Setting the Stage: "Structure, Process, Substance"**
    - *Structure – envisioning a product - what is our "Deliverable"?*
    - *Process – how will we achieve the Deliverable?*
    - *Substance – what is in the Deliverable?*
  - **Testing/Applying the Process**
    - Procedural final-resolution: a "vulnerability/resilience" and "priority order" based "working draft" proposal presented for consideration (Jim/Clay/Garrett/Duncan)
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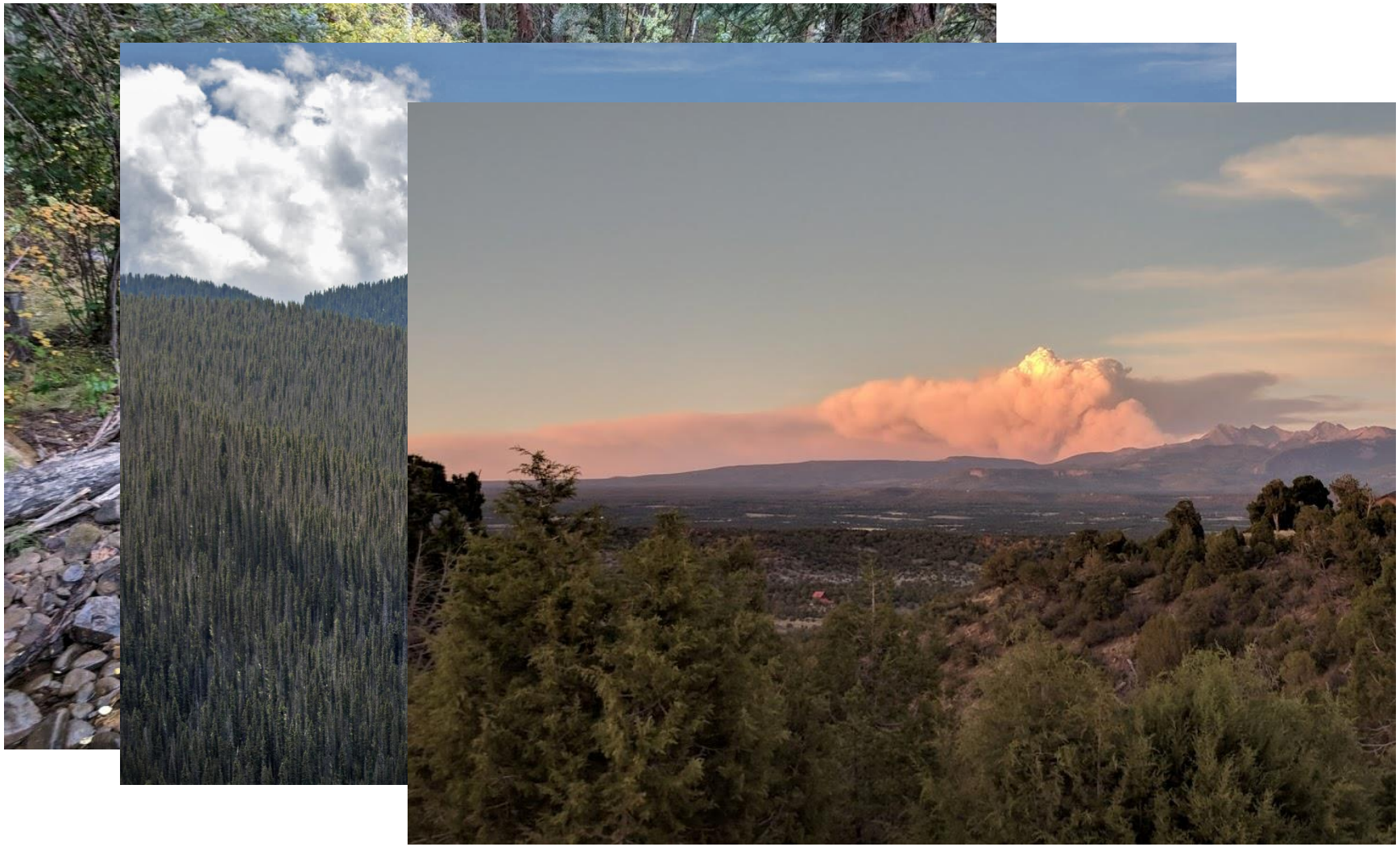
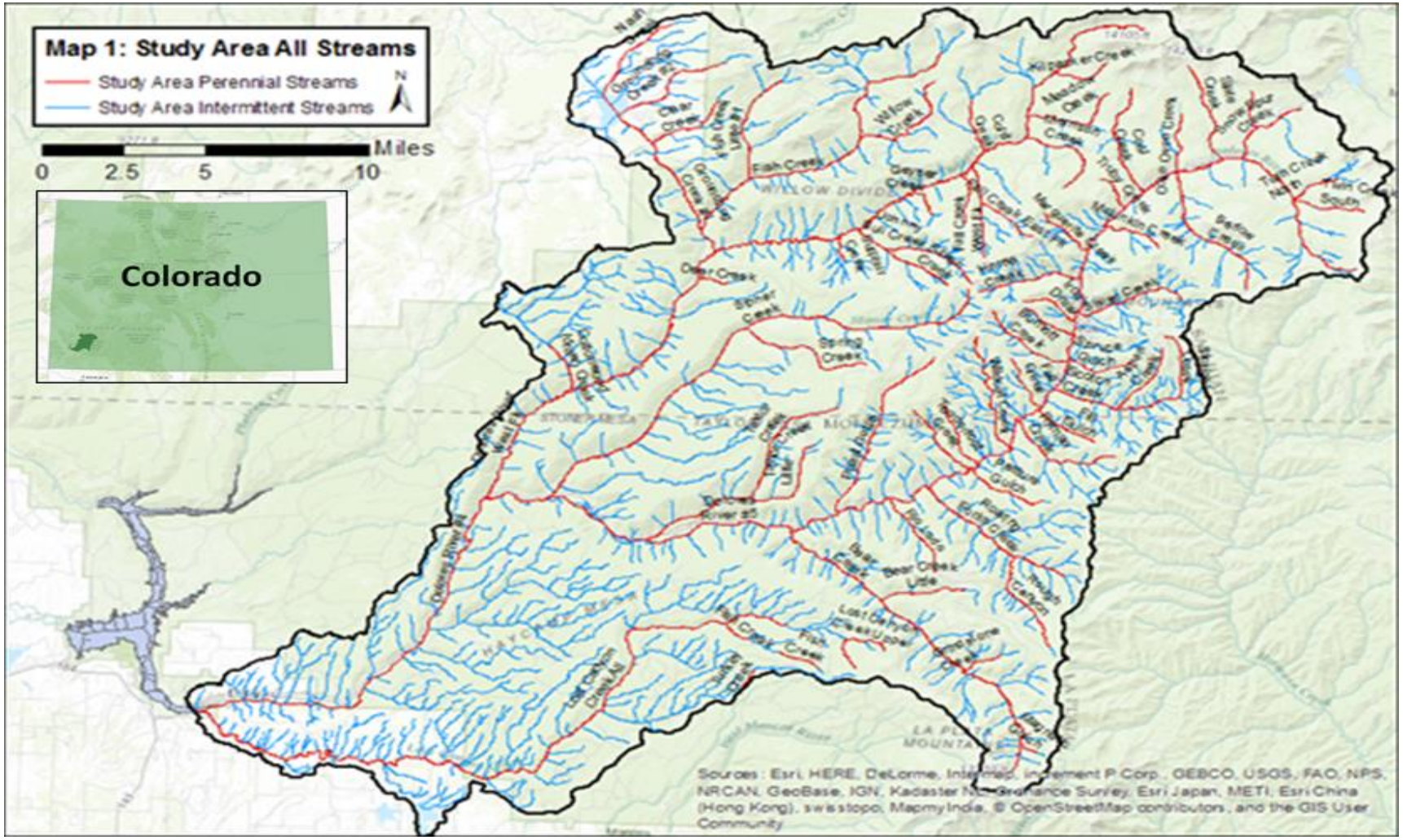
Context: Historic Drought, Extensive Beetle Kill, More Wildfire – Our Forest Is Changing



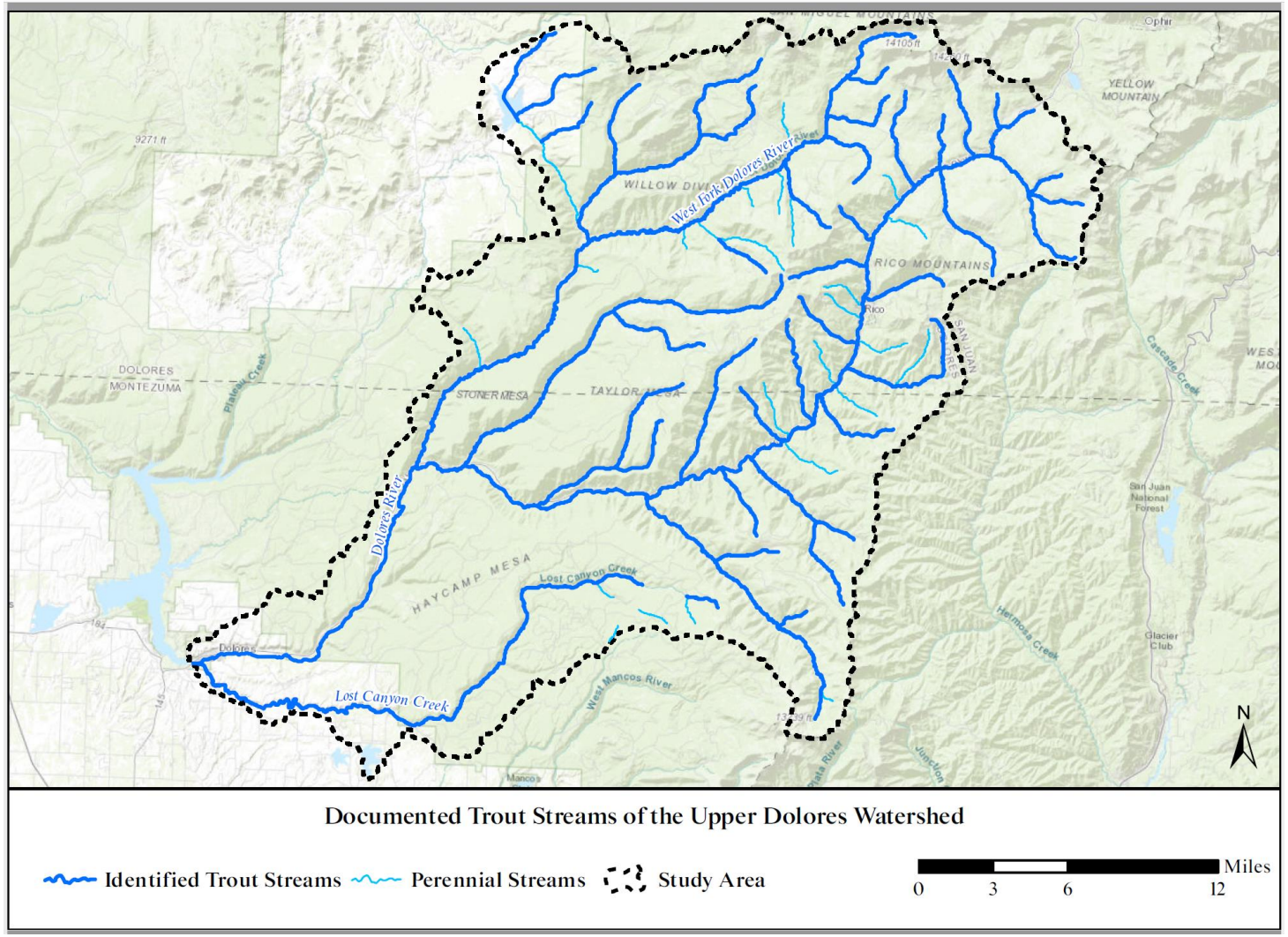
Do Our Trout Streams Need Additional Protection?

- **Core Questions**
  - What trout streams in the Upper Dolores watershed (Study Area or SA) are most threatened by (which?) forces/disturbances (present and foreseeable future)?
  - What additional protections, if any, for each stream, selected from a range of options, are best suited to mitigate those forces?
- **Anticipated Product**
  - Primary deliverable: a table, with concise documentary text, that reflects for each of the estimated 44 targeted streams in the SA the following:
    - 1) an identification of the most feasible adaptive-management – based protection strategy (and general tactics) associated with each stream for which additional protection is desireable; and
    - 3) a determination of who has lead for each tool for a given stream, timeframe.

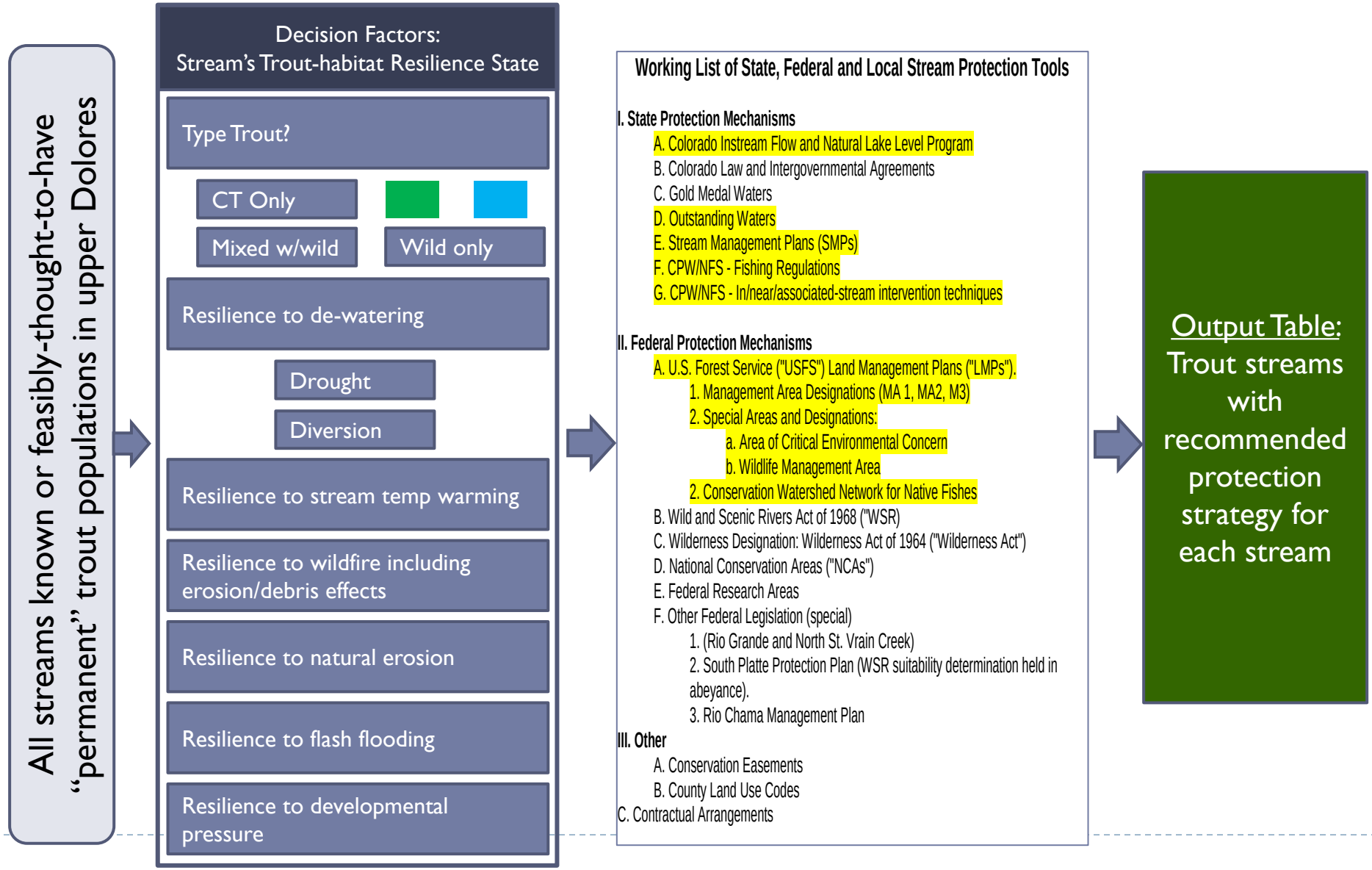
Our Study Area ("SA")



Our 44 Trout Streams



Upper Dolores Stream Protection Framework



Key Aspects of all Candidate Tools

1. Getting the protection in place
   - Who can initiate? How?
   - What is the initiation process? How long?
   - What/where is the authority to approve?
2. Managing the protection once it is in place
   - Who/how is it managed if approved?
3. Enforcing the protection
   - Who enforces and how?

- For each tool we are asking:

  "In what circumstances is this tool most relevant?"

Emergent "Take-aways" From Session 1

I. The current state of fisheries in the upper Dolores is excellent. Headwater meadows, bogs, fens and forests feed 44 streams which host about 300 miles of high quality trout waters. Proactive, professional management has considerably enhanced the quality of these fisheries.

II. The same precipitation that feeds our fisheries provides critical soil moisture and flow to the agriculture and forestry industries, both of which are core components of our local economy, and to a substantial and economically expanding recreational industry.

III. Western water law, Montezuma Valley Irrigation Company, existing diversions and decrees, and the Dolores Project/McPhee Reservoir are the link-pins to the use of these waters.

IV. The challenges that are emerging in our fisheries are due to a substantially changing environmental context, largely attributable to climate change induced disturbances.

V. None of these disturbances are new; what is changing is the *degree* of impact. These disturbances are projected to be increasingly persistent, more wide ranging, and more and more intense for many years to come.

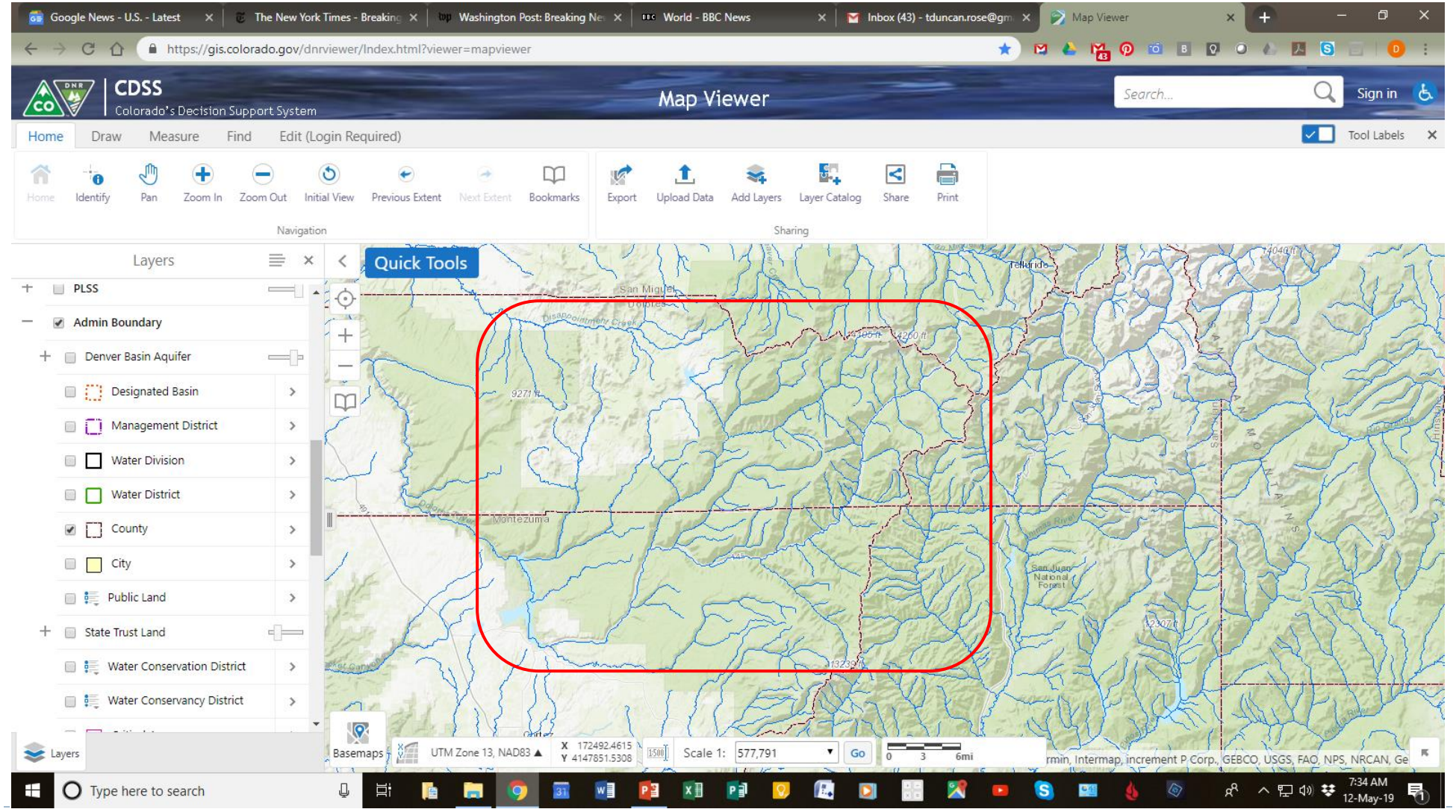
Emergent "Take-aways" From Session 1 (Page 2)

VI. The major disturbances our fisheries face include:
   1. Stream de-watering (natural, human) due to drought and increasing temperatures;
   2. Stream temperature increase due to same;
   3. Increased wildfire, including triggered sedimentation/debris flow due to drought, beetle kill;
   4. Increased non-wildfire induced erosion and sedimentation due to increasingly extreme precipitation events;
   5. Flash flooding wash-out due to increasingly extreme precipitation events; and
   6. Increased human activity (development, over-fishing) due to growth, expanding wealth.

VII. While all trout streams are of concern to our effort, our core focus is on *cutthroat* populations. 24 streams in the upper Dolores are currently identified as hosting cutthroat populations.

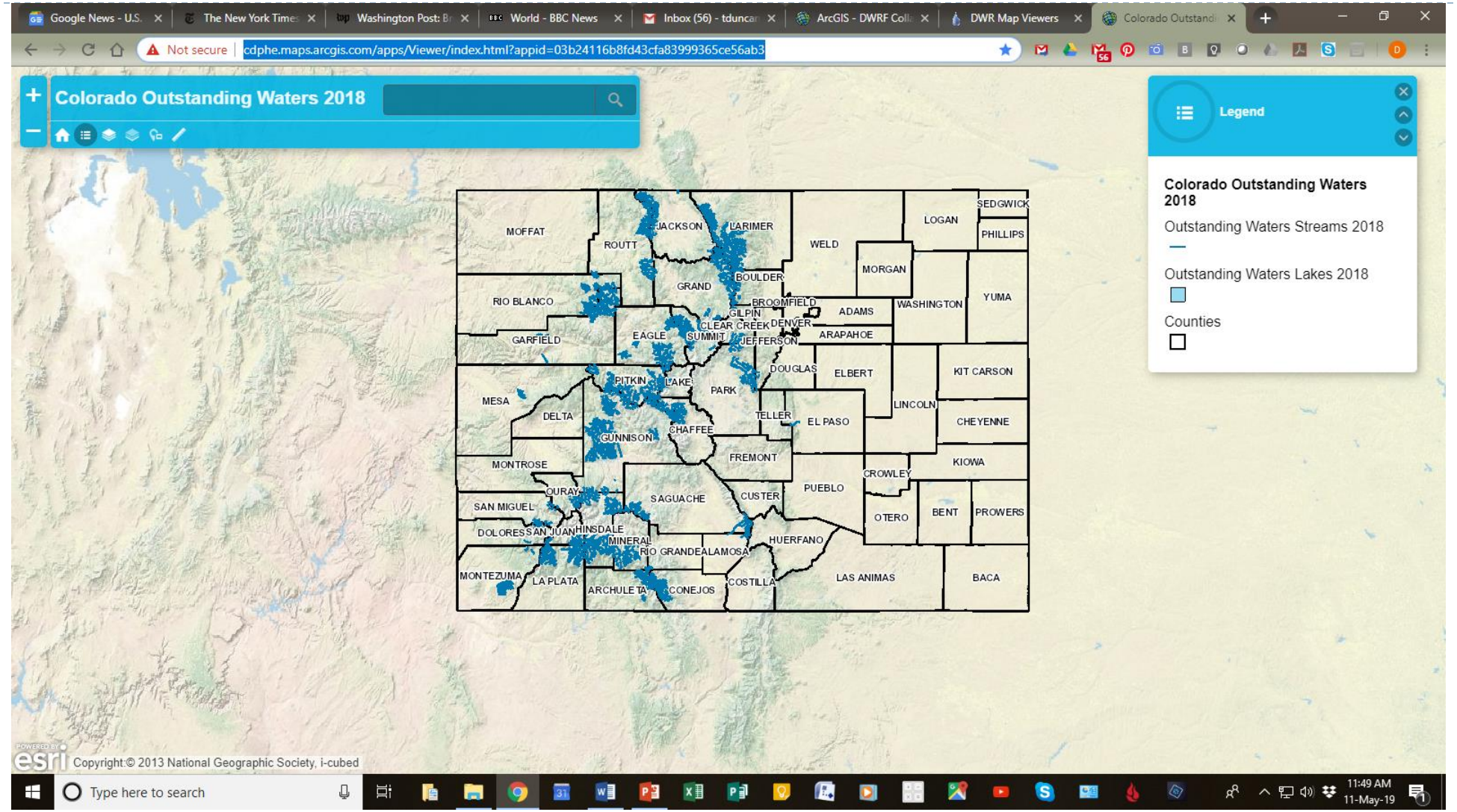
VIII. Managing to accommodate the emerging changes will require an integration of top-down strategies and bottom-up tactics--strategies which encompass overall emergent patterns of change and which integrate with existing management plans and frameworks, but are implemented tactically at a stream by stream, and even reach by reach, level. A common overall framework encourages efficiencies.

Colorado Decision Support System



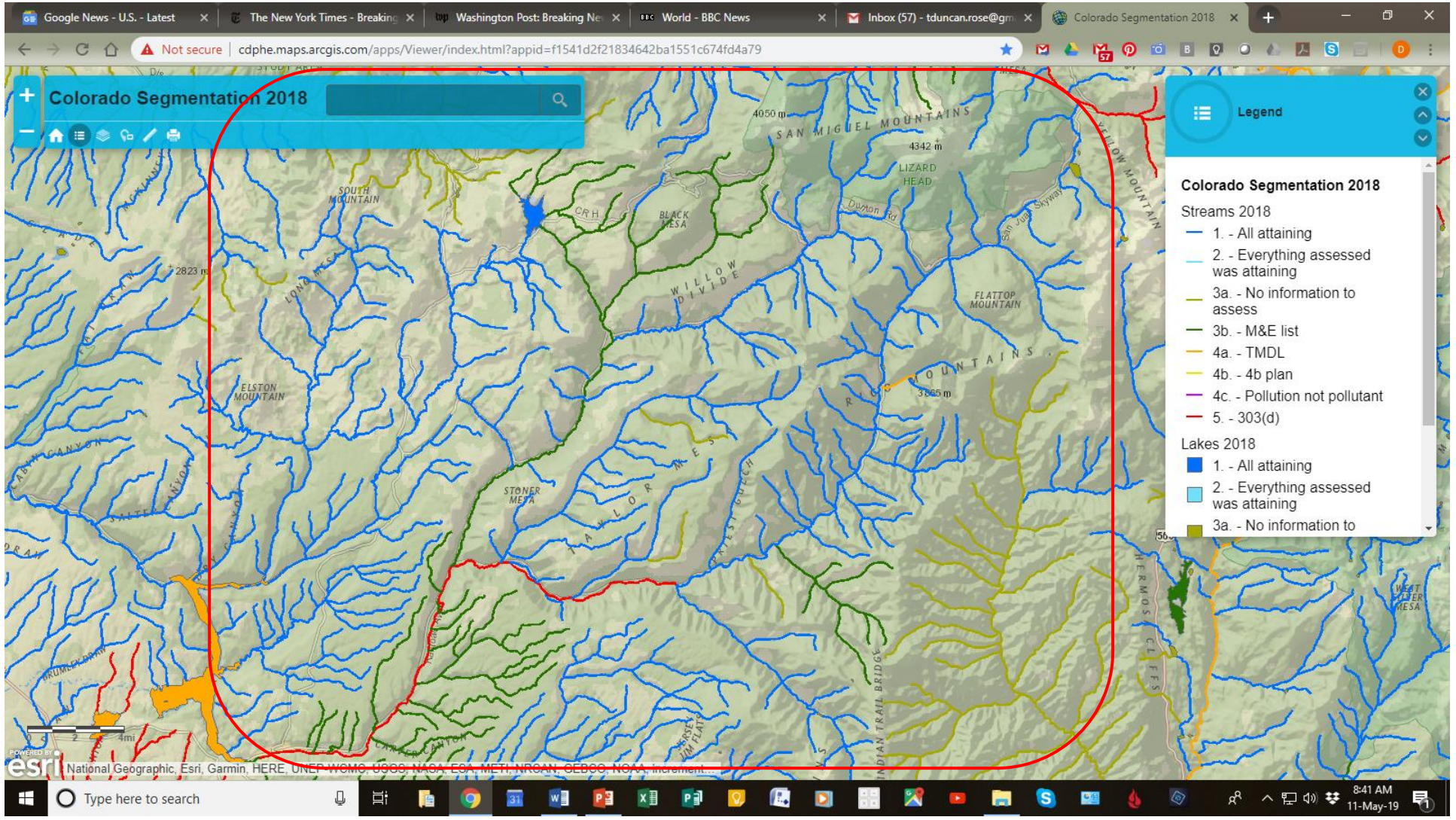
https://gis.colorado.gov/dnrviewer/Index.html?viewer=mapviewer

Colorado Outstanding Waters 2018



http://cdphe.maps.arcgis.com/apps/Viewer/index.html?appid=03b24116b8fd43cfa83999365ce56ab3

CDPHE Stream Segmentation Map



http://cdphe.maps.arcgis.com/apps/Viewer/index.html?appid=f1541d2f21834642ba1551c674fd4a79

Contextual Docs/Data

- Land and Resource Management Plan
- Climate Change Vulnerability Study
- Stream Temperature Analysis

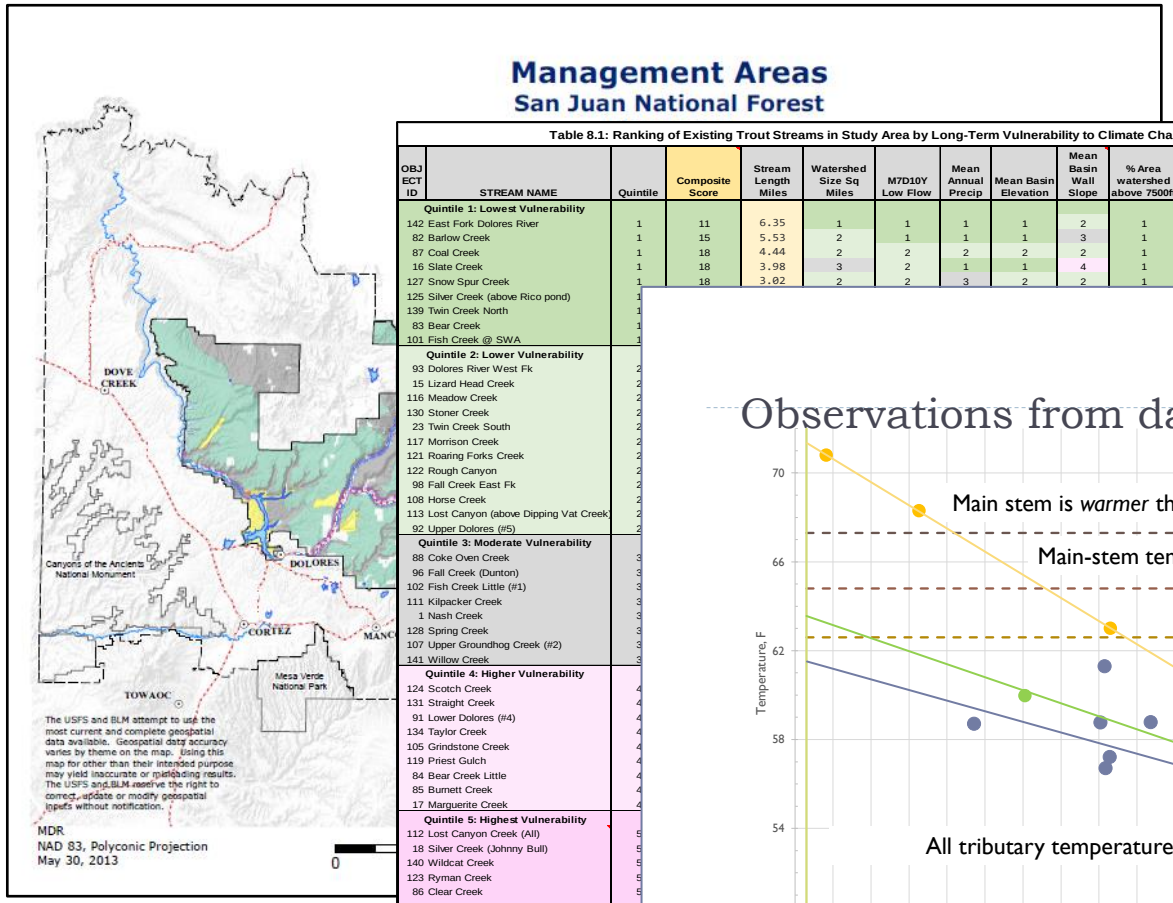
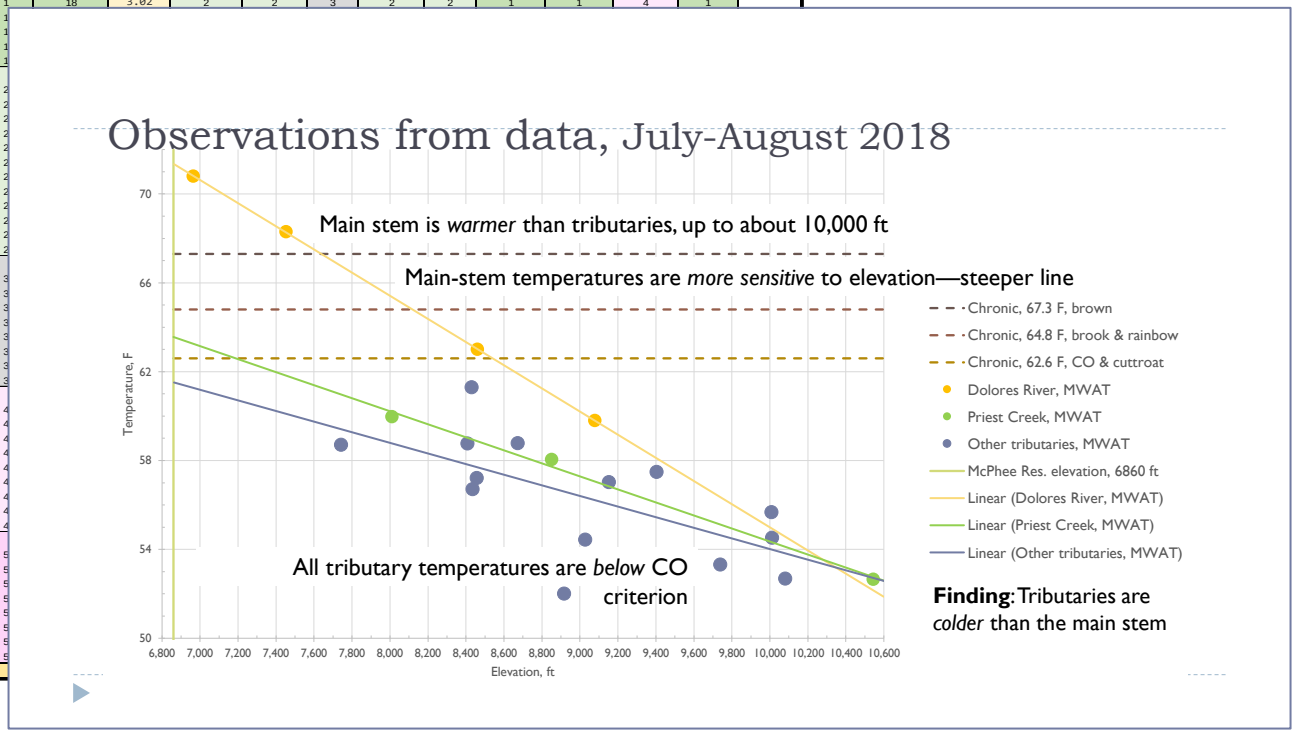
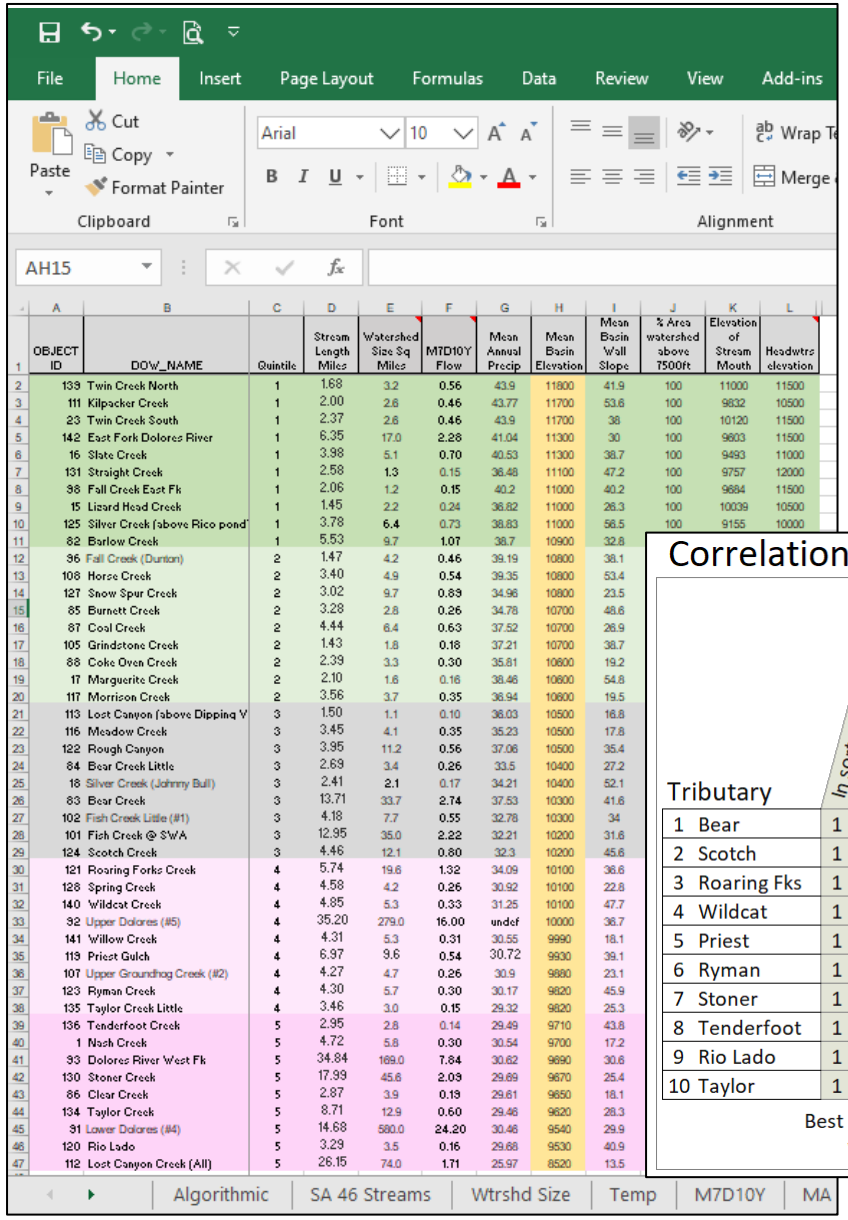


Table 8.1: Ranking of Existing Trout Streams in Study Area by Long-Term Vulnerability to Climate Change (Low to High)

OBJECTID	STREAM NAME	Quintile	Composite Score	Stream Length Miles	Watershed Size Sq Miles	M7D10Y Low Flow	Mean Annual Precip	Mean Basin Elevation	Mean Basin Wall Slope	% Area watershed above 7500ft	Elevation of Stream Mouth	Headwtrs elevation	Average Gradient	Miles by Category
Quintile 1: Lowest Vulnerability														
142	East Fork Dolores River	1	11	6.35	1	1	1	1	2	1	1	1	2	
82	Barlow Creek	1	15	5.53	2	1	1	1	3	1	2	2	2	
87	Coal Creek	1	18	4.44	2	2	2	2	2	1	2	2	3	
16	Slate Creek	1	18	3.98	3	2	1	1	4	1	1	2	3	
127	Snow Spur Creek	1	18	3.02	2	2	3	2	2	1	1	4	1	
125	Silver Creek (above Rico pond)	1												
139	Twin Creek North	1												
83	Bear Creek	1												
101	Fish Creek @ SWA	1												
Quintile 2: Lower Vulnerability														
93	Dolores River West Fk	2												
15	Lizard Head Creek	2												
116	Meadow Creek	2												
130	Stoner Creek	2												
23	Twin Creek South	2												
117	Morrison Creek	2												
121	Roaring Forks Creek	2												
122	Rough Canyon	2												
98	Fall Creek East Fk	2												
108	Horse Creek	2												
113	Lost Canyon (above Dipping Vat Creek)	2												
92	Upper Dolores (#5)	2												
Quintile 3: Moderate Vulnerability														
88	Coke Oven Creek	3												
96	Fall Creek (Dunton)	3												
102	Fish Creek Little (#1)	3												
111	Kilpacker Creek	3												
1	Nash Creek	3												
128	Spring Creek	3												
107	Upper Groundhog Creek (#2)	3												
141	Willow Creek	3												
Quintile 4: Higher Vulnerability														
124	Scotch Creek	4												
131	Straight Creek	4												
91	Lower Dolores (#4)	4												
134	Taylor Creek	4												
105	Grindstone Creek	4												
119	Priest Gulch	4												
84	Bear Creek Little	4												
85	Burnett Creek	4												
17	Marguerite Creek	4												
Quintile 5: Highest Vulnerability														
112	Lost Canyon Creek (All)	5												
18	Silver Creek (Johnny Bull)	5												
140	Wildcat Creek	5												
123	Ryman Creek	5												
86	Clear Creek	5												
135	Taylor Creek Little	5												
120	Rio Lado	5												
136	Tenderfoot Creek	5												
Total Miles														



Stream Attributes Data Files



OBJECT ID	DOW_NAME	Quintile	Stream Length Miles	Watershed Size Sq Miles	M7D10Y Flow	Mean Annual Precip	Mean Basin Elevation	Mean Basin Wall Slope	% Area watershed above 7500ft	Elevation of Stream Mouth	Headwtrs elevation
139	Twin Creek North	1	1.68	3.2	0.56	43.9	11800	41.9	100	11000	11500
111	Kilpacker Creek	1	2.00	2.6	0.46	43.77	11700	53.6	100	9832	10500
23	Twin Creek South	1	2.37	2.6	0.46	43.9	11700	38	100	10120	11500
142	East Fork Dolores River	1	6.35	17.0	2.28	41.04	11300	30	100	9603	11500
16	Slate Creek	1	3.98	5.1	0.70	40.53	11300	38.7	100	9493	11000
131	Straight Creek	1	2.58	1.3	0.15	36.48	11100	47.2	100	9757	12000
38	Fall Creek East Fk	1	2.06	1.2	0.15	40.2	11000	40.2	100	9684	11500
15	Lizard Head Creek	1	1.45	2.2	0.24	36.82	11000	26.3	100	10039	10500
125	Silver Creek (above Rico pond	1	3.78	6.4	0.73	38.83	11000	56.5	100	9155	10000
82	Barlow Creek	1	5.53	9.7	1.07	38.7	10900	32.6			
36	Fall Creek (Dunton)	2	1.47	4.2	0.46	39.19	10800	38.1			
108	Horse Creek	2	3.40	4.9	0.54	39.35	10800	53.4			
127	Snow Spur Creek	2	3.02	9.7	0.89	34.96	10800	23.5			
85	Burnett Creek	2	3.28	2.8	0.26	34.78	10700	48.6			
87	Coal Creek	2	4.44	6.4	0.63	37.52	10700	26.9			
105	Grindstone Creek	2	1.43	1.8	0.18	37.21	10700	38.7			
88	Coke Oven Creek	2	2.39	3.3	0.30	35.81	10800	19.2			
17	Marguerite Creek	2	2.10	1.6	0.16	38.46	10800	54.8			
117	Morrison Creek	2	3.56	3.7	0.35	36.94	10800	19.5			
113	Lost Canyon (above Dipping V	3	1.50	1.1	0.10	36.03	10500	16.8			
116	Meadow Creek	3	3.45	4.1	0.35	35.23	10500	17.8			
122	Rough Canyon	3	3.95	11.2	0.56	37.06	10500	35.4			
84	Bear Creek Little	3	2.69	3.4	0.26	33.5	10400	27.2			
18	Silver Creek (Johnny Bull)	3	2.41	2.1	0.17	34.21	10400	52.1			
83	Bear Creek	3	13.71	33.7	2.74	37.53	10300	41.6			
102	Fish Creek Little (#1)	3	4.18	7.7	0.55	32.78	10300	34			
101	Fish Creek @ SWA	3	12.95	35.0	2.22	32.21	10200	31.6			
124	Scotch Creek	3	4.46	12.1	0.80	32.3	10200	45.6			
121	Roaring Forks Creek	4	5.74	19.6	1.32	34.09	10100	36.6			
128	Spring Creek	4	4.58	4.2	0.26	30.92	10100	22.8			
140	Wildcat Creek	4	4.85	5.3	0.33	31.25	10100	47.7			
32	Upper Dolores (#5)	4	35.20	279.0	16.00	undef	10000	36.7			
141	Willow Creek	4	4.31	5.3	0.31	30.55	9990	18.1			
119	Priest Gulch	4	6.97	9.6	0.54	30.72	9930	39.1			
107	Upper Groundhog Creek (#2)	4	4.27	4.7	0.26	30.9	9880	23.1			
123	Ryman Creek	4	4.30	5.7	0.30	30.17	9820	45.9			
135	Taylor Creek Little	4	3.46	3.0	0.15	29.32	9820	25.3			
136	Tenderfoot Creek	5	2.95	2.8	0.14	29.49	9710	43.8			
1	Nash Creek	5	4.72	5.8	0.30	30.54	9700	17.2			
33	Dolores River West Fk	5	34.84	169.0	7.84	30.62	9690	30.6			
130	Stoner Creek	5	17.99	45.6	2.09	29.69	9670	25.4			
86	Clear Creek	5	2.87	3.9	0.19	29.61	9650	18.1			
134	Taylor Creek	5	8.71	12.9	0.60	29.46	9620	28.3			
31	Lower Dolores (#4)	5	14.68	580.0	24.20	30.46	9540	29.9			
120	Rio Lado	5	3.29	3.5	0.16	29.68	9530	40.9			
112	Lost Canyon Creek (All)	5	26.15	74.0	1.71	25.97	8520	13.5			

STREAM NAME	DRA Quintile**	Trout			Current Protection	
		Cutties?	Green?	CRT?	Out Wtr?	ISF?
Barlow Creek	1	y				Y
Bear Creek	1	y		Y		Y
Bear Creek Little	4					
Burnett Creek	4					
Clear Creek	5					
Coal Creek	1	y			y*	y
Coke Oven Creek	3	y			y*	y
Dolores River West Fk	2	y			y*	y
East Fork Dolores River	1	y				Y
Fall Creek (Dunton)	3	y				Y
Fall Creek East Fk	2	y				
Fish Creek @ SWA	1					y
Fish Creek Little (#1)	3					
Grindstone Creek	4	y				
Horse Creek	2					
Kilpacker Creek	3	y			y*	
Lizard Head Creek	2	y			?	
Lost Canyon (above Dipping Vat Creek)	2					
Lost Canyon Creek (All)	5					

only that portion in Lizard Head WA

** DRA's low flow vulnerability analysis

Correlation with elevation--highest and outlet--and slope and precipitation, all highest to lowest

Tributary	In sort or out, 1 or 0	Drainage area, sq mi	Score	Flow path length, mi	Score	Highest elev, ft, x 1000	Score	Mean slope, %	Score (highest is best)	Vegetation cover, %	Score	Precip, in, mean annual	Score	Flow, cfs, mean July	Score	Flow, cfs, mean August	Score	Flow, cfs, mean annual	Score	Flow, cfs, mean Jul-Aug	Score	Outlet elevation, ft	Score	Elevation chge, 10-85%	Score (lowest is best)	Total
1 Bear	1	33.70	0.00	15.60	0.00	**13.2**	1.00	41.6	0.87	90.9	0.00	**37.5**	1.00	**68.80**	0.00	**30.30**	0.00	**51.50**	0.00	**49.55**	0.00	7895	0.93	181	0.00	3.80
2 Scotch	1	12.10	0.00	7.65	0.00	12.6	0.95	45.6	0.96	93.7	0.00	32.3	0.86	15.80	0.00	7.41	0.00	13.00	0.00	11.61	0.00	**8530**	1.00	386	0.00	2.82
3 Roaring Fks	1	19.60	0.00	9.30	0.00	11.8	0.89	36.6	0.77	96.2	0.00	34.1	0.91	29.70	0.00	13.70	0.00	23.60	0.00	21.70	0.00	8167	0.96	372	0.00	2.76
4 Wildcat	1	5.27	0.00	5.34	0.00	11.9	0.90	**47.7**	1.00	**97.3**	0.00	31.3	0.83	6.58	0.00	3.08	0.00	5.51	0.00	4.83	0.00	8341	0.98	525	0.00	2.71
5 Priest	1	9.61	0.00	7.81	0.00	11.5	0.87	39.1	0.82	94.8	0.00	30.7	0.82	10.70	0.00	5.15	0.00	9.05	0.00	7.93	0.00	7974	0.93	388	0.00	2.62
6 Ryman	1	5.73	0.00	5.12	0.00	11.0	0.83	45.9	0.96	96.2	0.00	30.2	0.80	6.26	0.00	3.00	0.00	5.36	0.00	4.63	0.00	8396	0.98	412	0.00	2.62
7 Stoner	1	**45.60**	0.00	**19.00**	0.00	12.3	0.93	25.4	0.53	92.9	0.00	29.7	0.79	39.00	0.00	20.10	0.00	33.70	0.00	29.55	0.00	7467	0.88	**159**	0.00	2.60
8 Tenderfoot	1	2.75	0.00	3.90	0.00	11.2	0.85	43.8	0.92	92.1	0.00	29.5	0.79	2.96	0.00	1.41	0.00	2.57	0.00	2.19	0.00	8222	0.96	770	0.00	2.60
9 Rio Lado	1	3.45	0.00	3.75	0.00	10.9	0.83	40.9	0.86	96.5	0.00	29.7	0.79	3.72	0.00	1.78	0.00	3.22	0.00	2.75	0.00	8068	0.95	613	0.00	2.56
10 Taylor	1	12.90	0.00	10.50	0.00	10.8	0.82	28.3	0.59	91.9	0.00	29.5	0.79	12.00	0.00	6.00	0.00	10.40	0.00	9.00	0.00	7647	0.90	328	0.00	2.50
Best		**45.60**	0.00	**19.00**	0.00	**13.2**	1.00	**47.7**	1.00	**97.3**	0.00	**37.5**	1.00	**68.80**	0.00	**30.30**	0.00	**51.50**	0.00	**49.55**	0.00	**8530**	1.00	**159**	0.00	
Weight		0		0		1		1		0		1		0		0		0		0		1		0		

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- **Summarize, submit to full Working Group for consideration**

Linking Disturbance Type to Most Appropriate Tools

- Stream de-watering (natural, human)
  - LRMP, In-Stream Flow decree, in-stream/near-stream modifications
- Stream temperature increase
  - In-stream/near-stream modifications
- Wildfire, including triggered sedimentation/debris flow
  - Wildfire mitigation plan, in-stream/near stream modifications
- Non-wildfire induced erosion, sedimentation
  - In-stream/near-stream modifications
- Flash flooding wash-out
  - In-stream/near-stream modifications
- Human activity (development, over-fishing)
  - LRMP, Outstanding Waters designation, stream regulations

Getting Started: Suggested Approach

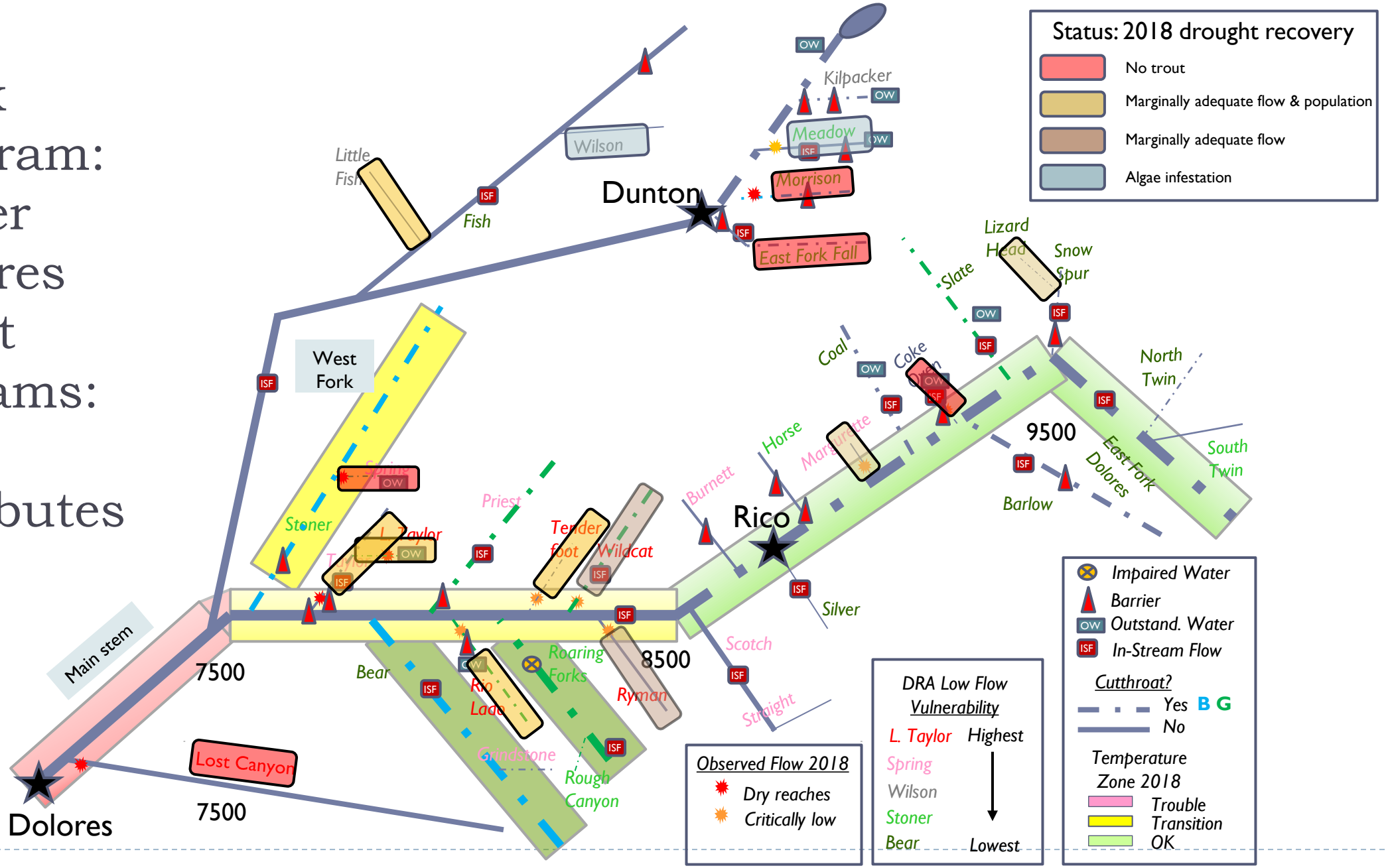
Top down – disturbance patterns (across Study Area)

- What are current and projected **patterns of disturbance** in the upper Dolores?
  - Stream de-watering (natural, human);
  - Stream temperature increase
  - Wildfire, including triggered sedimentation/debris flow;
  - Non-wildfire induced erosion, sedimentation;
  - Flash flooding wash-out;
  - Human activity (development, over-fishing).
  - Other?

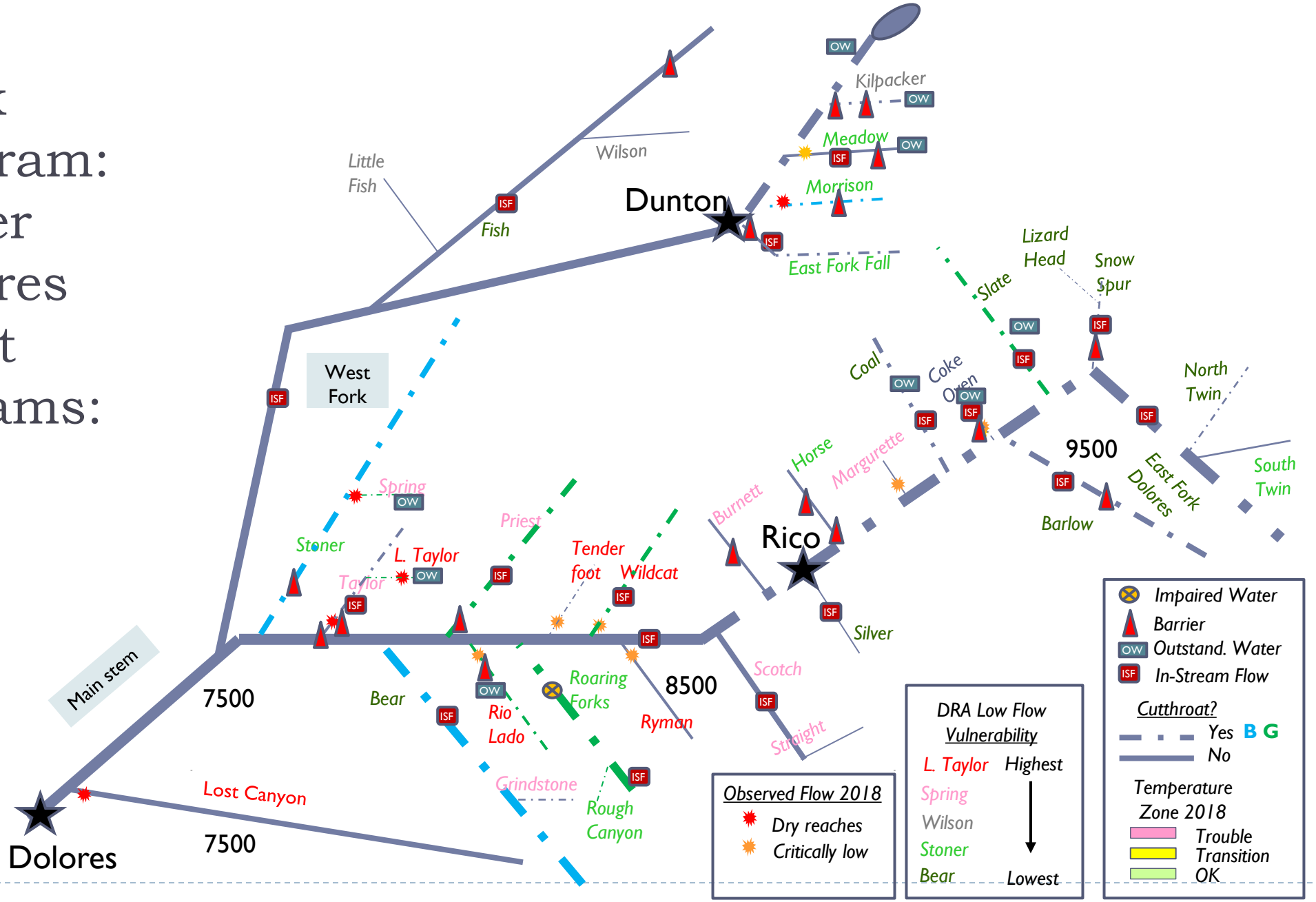
Bottom-up, stream-by-stream assessment

- Start with Stoner Creek
  - Summarize current state, key attributes.
  - Assess relevant disturbances likely to affect to mid, late century.
  - How does this fit with overall watershed level pattern of each disturbance?
- Rinse, repeat, move up main stem to next stream

Stick Diagram: Upper Dolores Trout Streams: All Attributes



Stick Diagram: Upper Dolores Trout Streams: Base

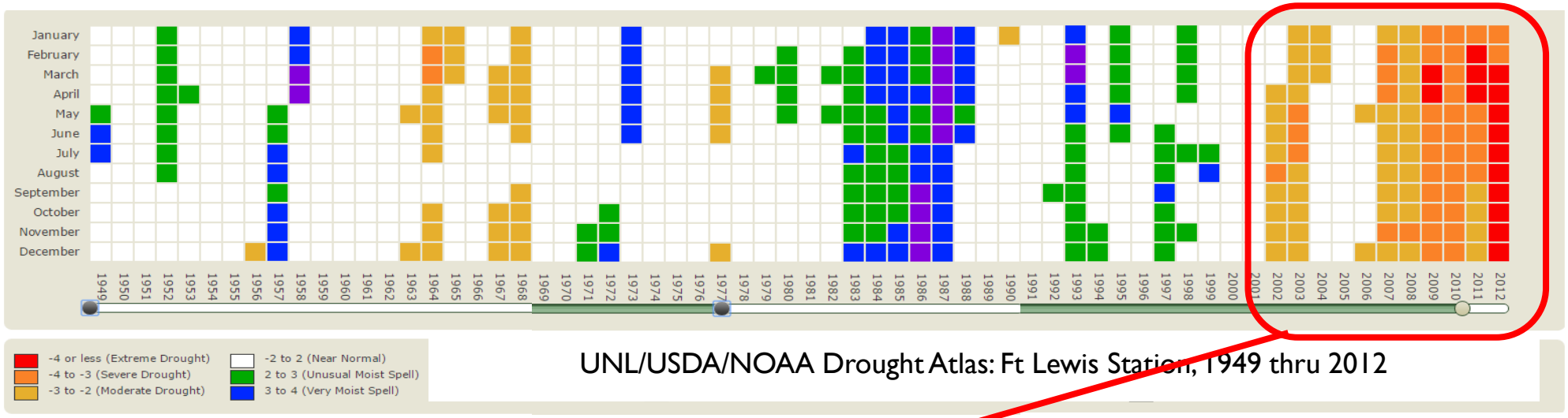


Drought, climate change, natural de-watering in the Upper Dolores

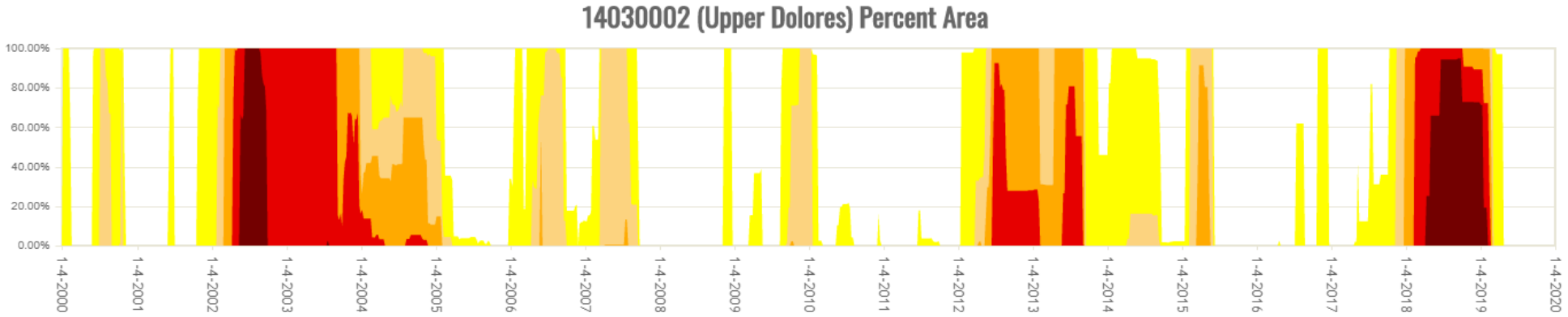
Key Messages From The San Juan Climate Models

- In all 72 climate change scenarios modeled for the San Juan Mountains by the Mountain Studies Institute in 2014, temperatures are likely to increase steadily over the analysis period (2017 – 2100).
- Precipitation may stay close to current levels (models are inconclusive), *but*:
  - "Phase proportions" will change (less snow, more rain) as will timing (snow starting later and ending earlier). Runoff will likely speed up. This will likely reduce available trout habitat "beneficial" precipitation.
  - Increasing air temperature increases the rate of transpiration which will reduce stream flow given the same precipitation level. *Roughly, sustained stream flow requires 10% more precipitation for each degree in average temperature rise.*
- Most models indicate *drought* will likely increase in both intensity and duration, with potentially very substantial drought becoming increasingly prevalent between 2050 and 2100.

Drought, An Increasingly Persistent Pattern…

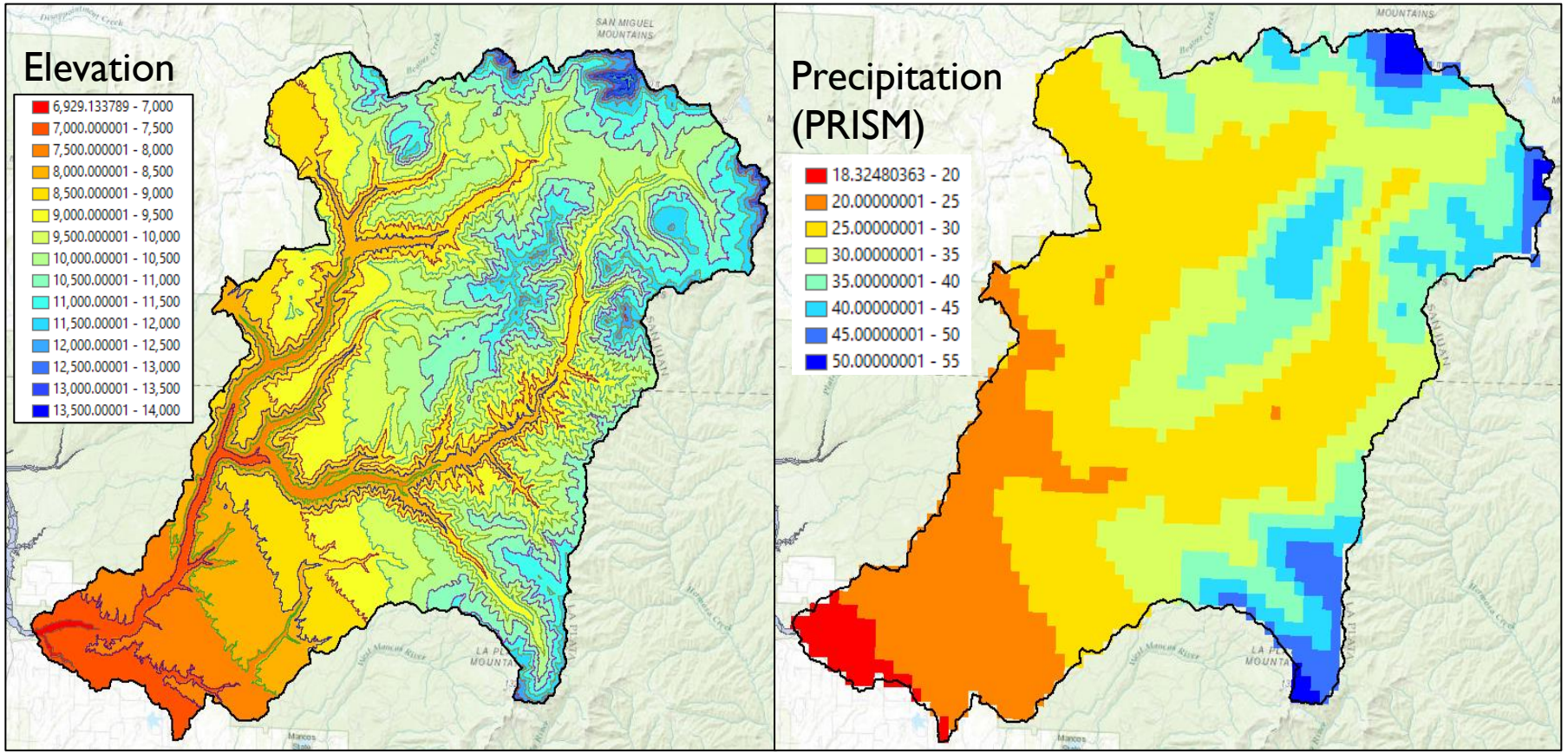


UNL/USDA/NOAA Drought Atlas: Ft Lewis Station, 1949 thru 2012

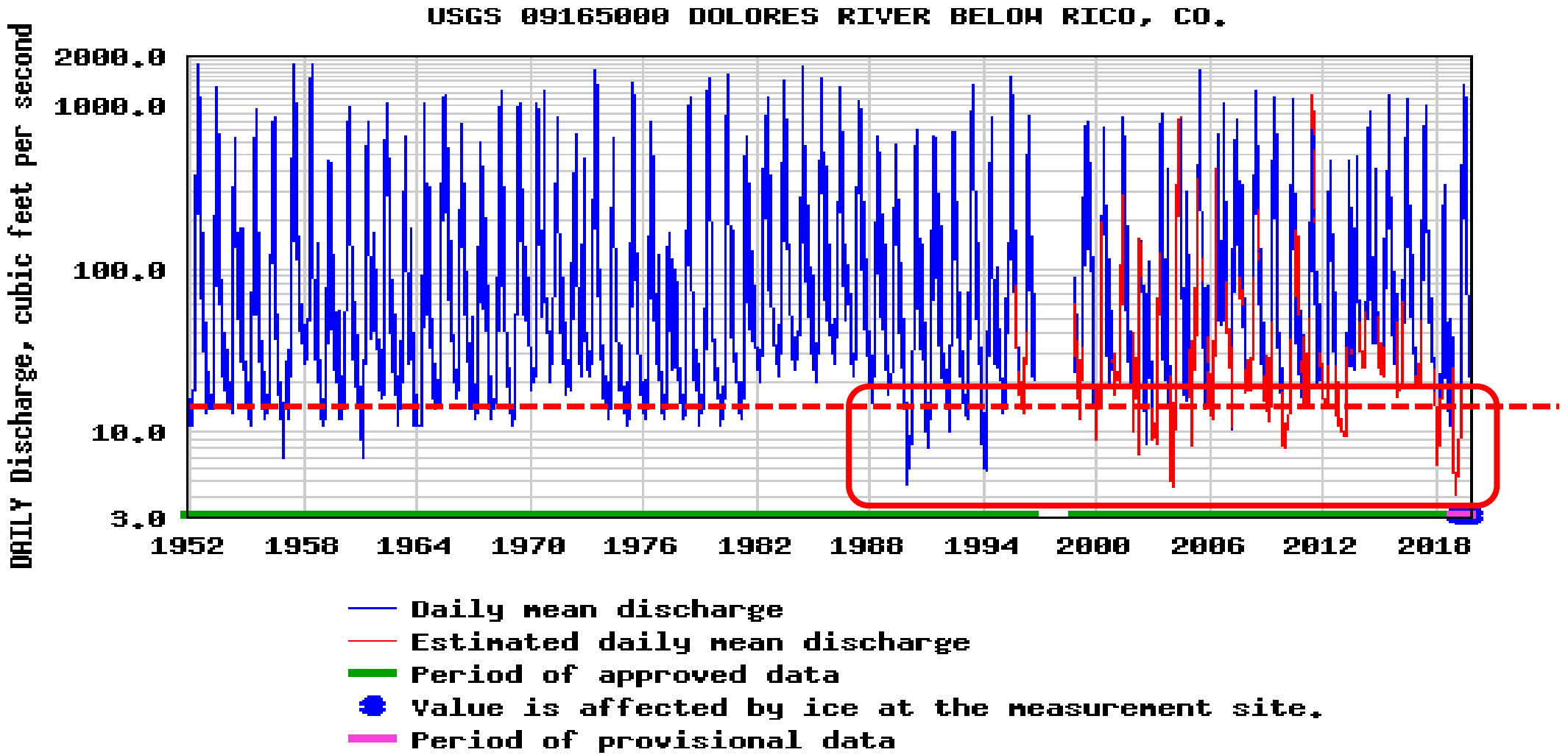


https://droughtmonitor.unl.edu/Data/Timeseries.aspx

Key: Elevation Is Precipitation

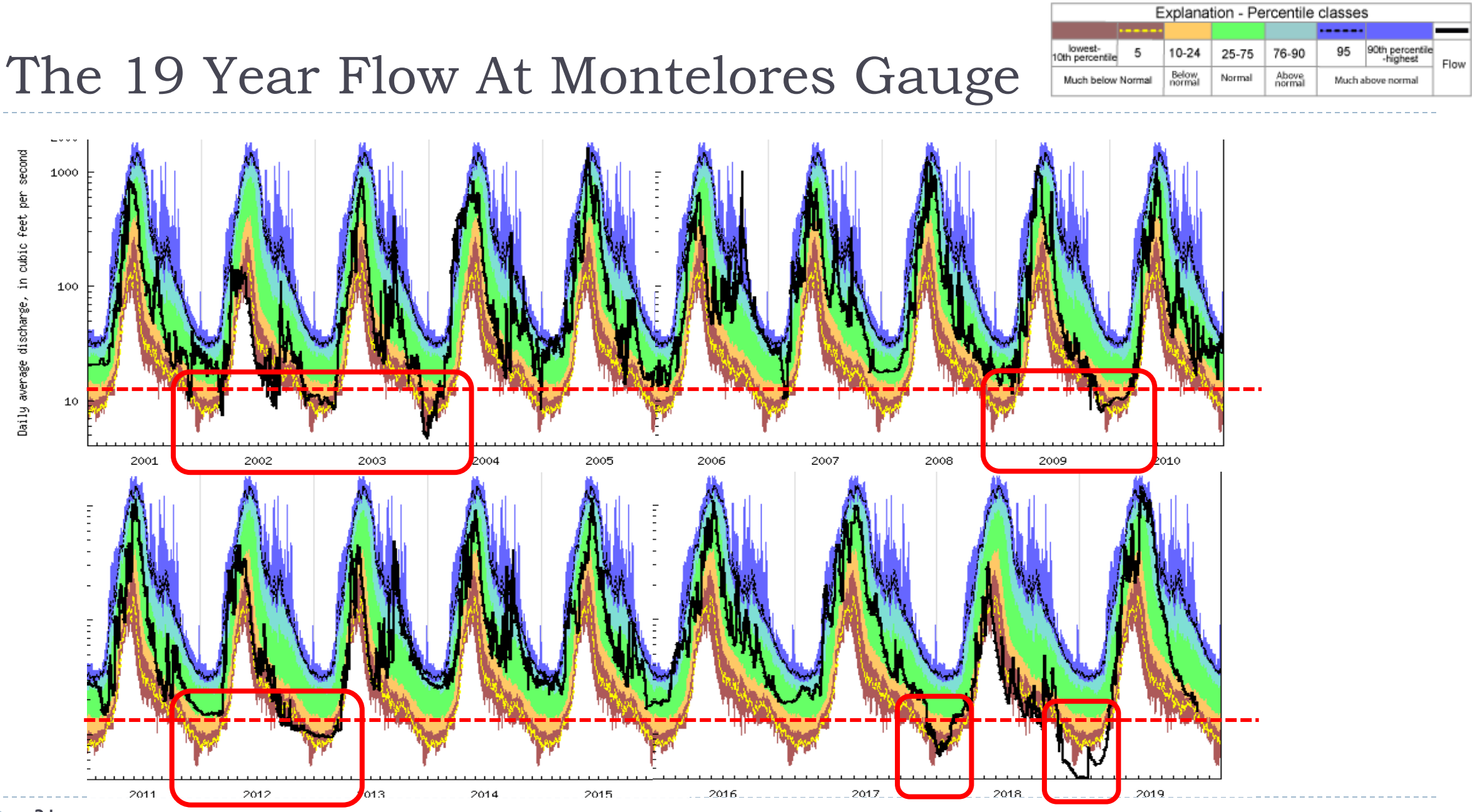


Flow @ Montelores Bridge 1952 – 2018



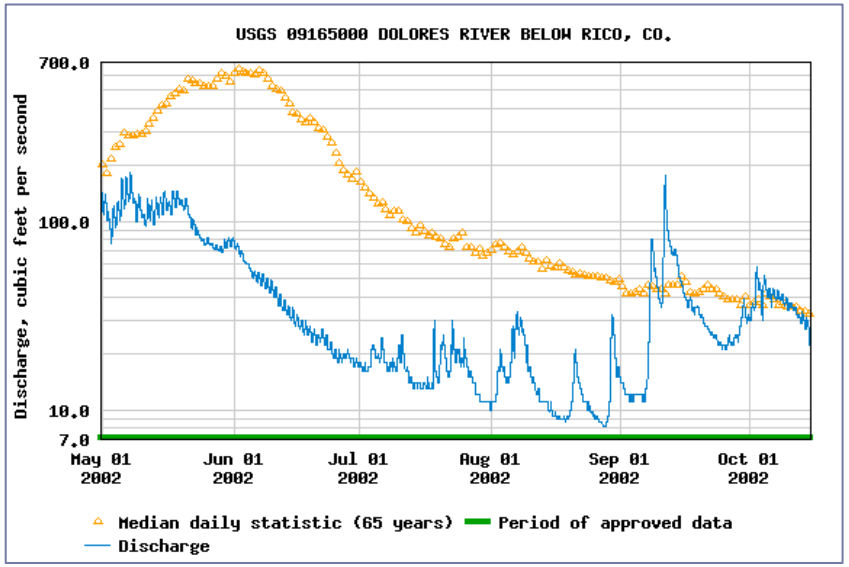
https://waterdata.usgs.gov/co/nwis/uv/?site_no=09165000&PARAmeter_cd=00065,00060

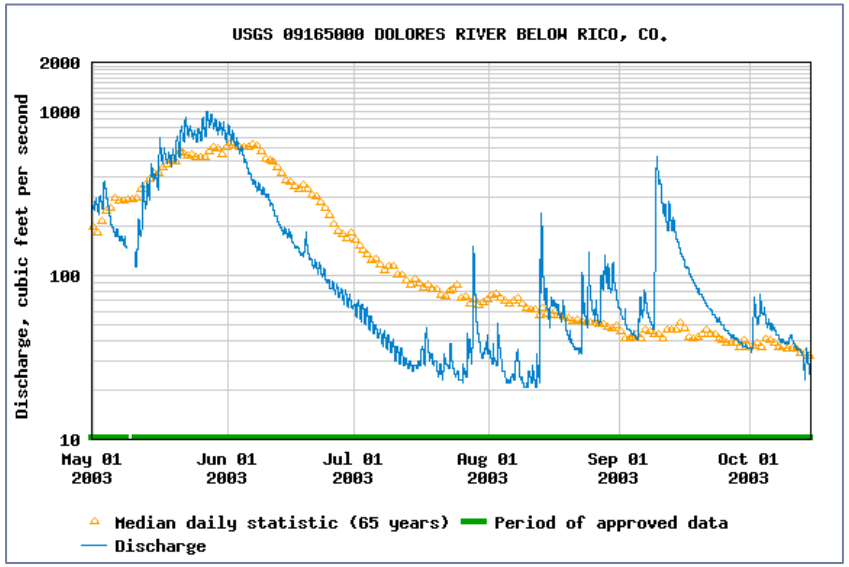
The 19 Year Flow At Montelores Gauge

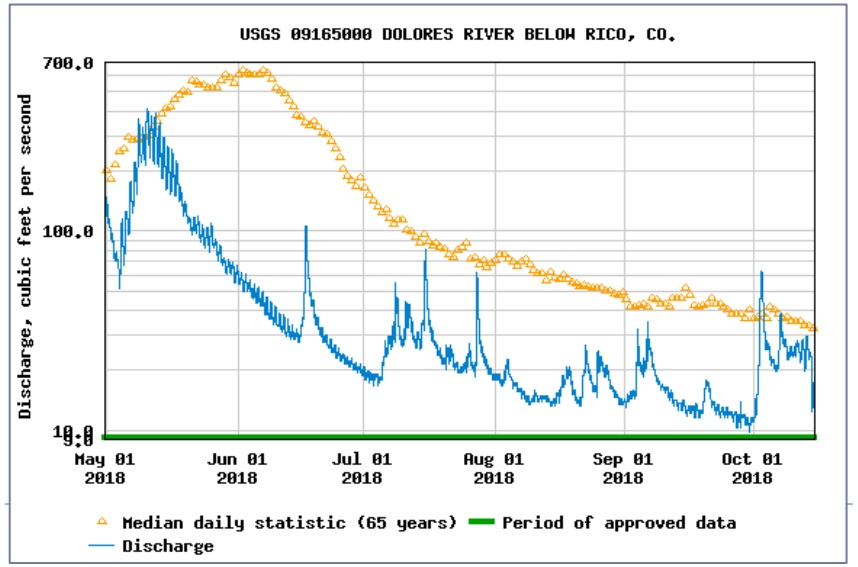


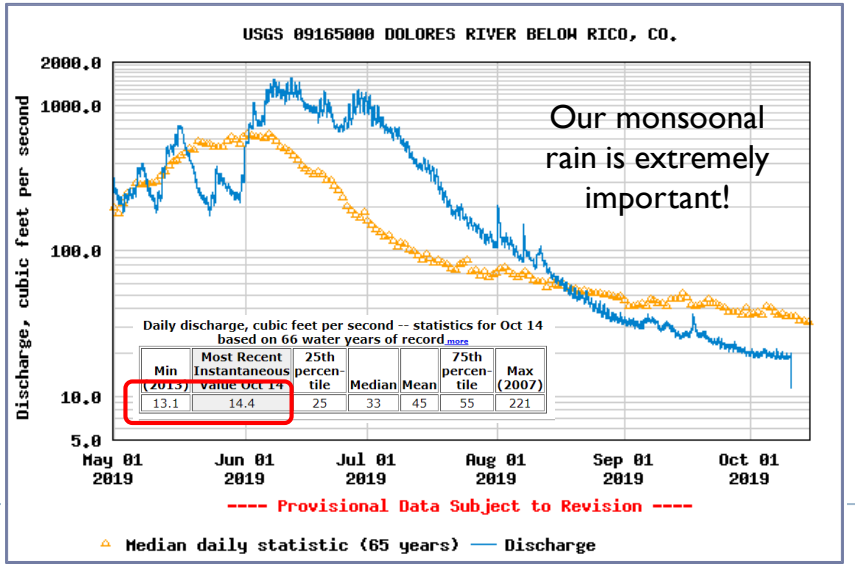
https://waterdata.usgs.gov/co/nwis/uv/?site_no=09165000&PARAmeter_cd=00065,00060

Flow @ Montelores Bridge: Major Drought Years









https://waterdata.usgs.gov/co/nwis/uv/?site_no=09165000&PARAmeter_cd=00065,00060

Table 8.1: Ranking of Existing Trout Streams in Study Area by Long-Term Vulnerability to Climate Change (Low to High)

OBJECT ID	STREAM NAME	Quintile	Composite Score	Stream Length Miles	Watershed Size Sq Miles	M7D10Y Low Flow	Mean Annual Precip	Mean Basin Elevation	Mean Basin Wall Slope	% Area watershed above 7500ft	Elevation of Stream Mouth	Headwtrs elevation	Average Gradient	Miles by Category
Quintile 1: Lowest Vulnerability														
142	East Fork Dolores River	1	11	6.35	1	1	1	1	2	1	1	1	2	
82	Barlow C		15	5.53	2	1	1	1	3	1	2	2		
87	Coal Cre		18	4.44	2	2						2		
16	Slate Cre		18	3.98	3	2						2		
127	Snow Sp		18	3.02	2	2						4		
125	Silver Cre		19	3.78	2	2						4		
139	Twin Cre		20	1.68	4	5						1		
83	Bear Creek	1	21	13.71	1	1						3		
101	Fish Creek @ SWA	1	21	12.95	1	1						3		
Quintile 2: Lower Vulnerability														
93	Dolores River West Fk	2	22	34.84	1	1						1		
15	Lizard Head Creek	2	22	1.45	5	5	2	1	2	1	1	3		
116	Meadow Creek	2	22	3.45	3	3	3	3	1	1	2	3		
130	Stoner Creek	2	22	17.99	1	1	5	5	2	1	5	1		
23	T		22	2.37	5	5	1	1	3	1	1	1		
117	M		23	3.56	4	5	2	2	1	1	2	3		
121	R		23	5.74	1	1	3	4	3	1	4	4		
122	Rough Canyon	2	23	3.95	2	2	2	3	3	1	3	3		
98	Fall Creek East Fk	2	24	2.06	5	5	1	1	4	1	1	1		
108	Horse Creek	2	24	3.40	3	2	1	2	5	1	3	2		
113	Lost Canyon (above Dipping Vat Cree	2	24	1.50	5	5	2	3	1	1	1	3		
92	Upper Dolores (#5)	2	24	35.20	1	1	3	4	3	1	5	5		
Quintile 3: Moderate Vulnerability														
88	Coke Oven Creek	3							1	1	2	3		
96	Fall Creek (Dunton)								3	1	3	5		
102	Fish Creek								3	1		4		
111	Kilpacker C		25	2.00	5	5	1	1	5			3		
1	Nash Creel		25	4.72	2	3	4	5	1			5		
128	Spring Creek	3	25	4.58	3	3	4	4	1			3		
107	Upper Groundhog Creek (#2)	3	25	4.27	3	3	4	4				4		
141	Willow Creek	3	25	4.31	3	3	4	4			3	4	2	27.93
Quintile 4: Higher Vulnerability														
124	Scotch Creek	4	26	4.46	2	2	4				4	1		
131	Straight Creek	4	26	2.58	5	5				1	1	1		
91			27	14.68	1	1				2	5	5		
134			27	8.71	1	2			2	1	5	4		
105			28	1.43	5				4	1	2	5		
119	Priest Gulch	4	28	6.97	2			4	4	1	5	2		
84	Bear Creek Little	4	29	2.69	4			3	2	1	3	4		
85	Burnett Creek	4	29	3.28				2	5	1	3	1		
17	Marguerite Creek	4	29	2.10			2	2	5	1	2	2		
Quintile 5: Highest Vulnerability														
112	Lost Canyon Creek (All)	5	30	26.15		4	5	5	1	5	5	3		
18	Silver Creek (Johnny Bull)	5	30	2.41		5	3	3	5	1	2	1		
140	Wildcat Creek	5	30	4.85		3	4	4	5	1	4	1		
123	Ryman Creek	5	32	4.30	3	3	5	4	5	1	4	3		
86	Clear Creek	5	33	2.87	4	5	5	5	1	1	4	5		
135	Taylor Creek Little	5	33	3.46	4	5	5	4	2	1	4	4		
120	Rio Lado	5	37	3.29	4	5	5	5	4	1	5	4	4	
136	Tenderfoot Creek	5	37	2.95	4	5	5	5	4	1	4	4	5	50.28
Total Miles				296.1										296.1

1: Lowest Vulnerability

2: Moderately Low

3: Moderate

4: Moderately High

5: Highest

9 Hydrologic attributes for each stream from StreamStats/GIS

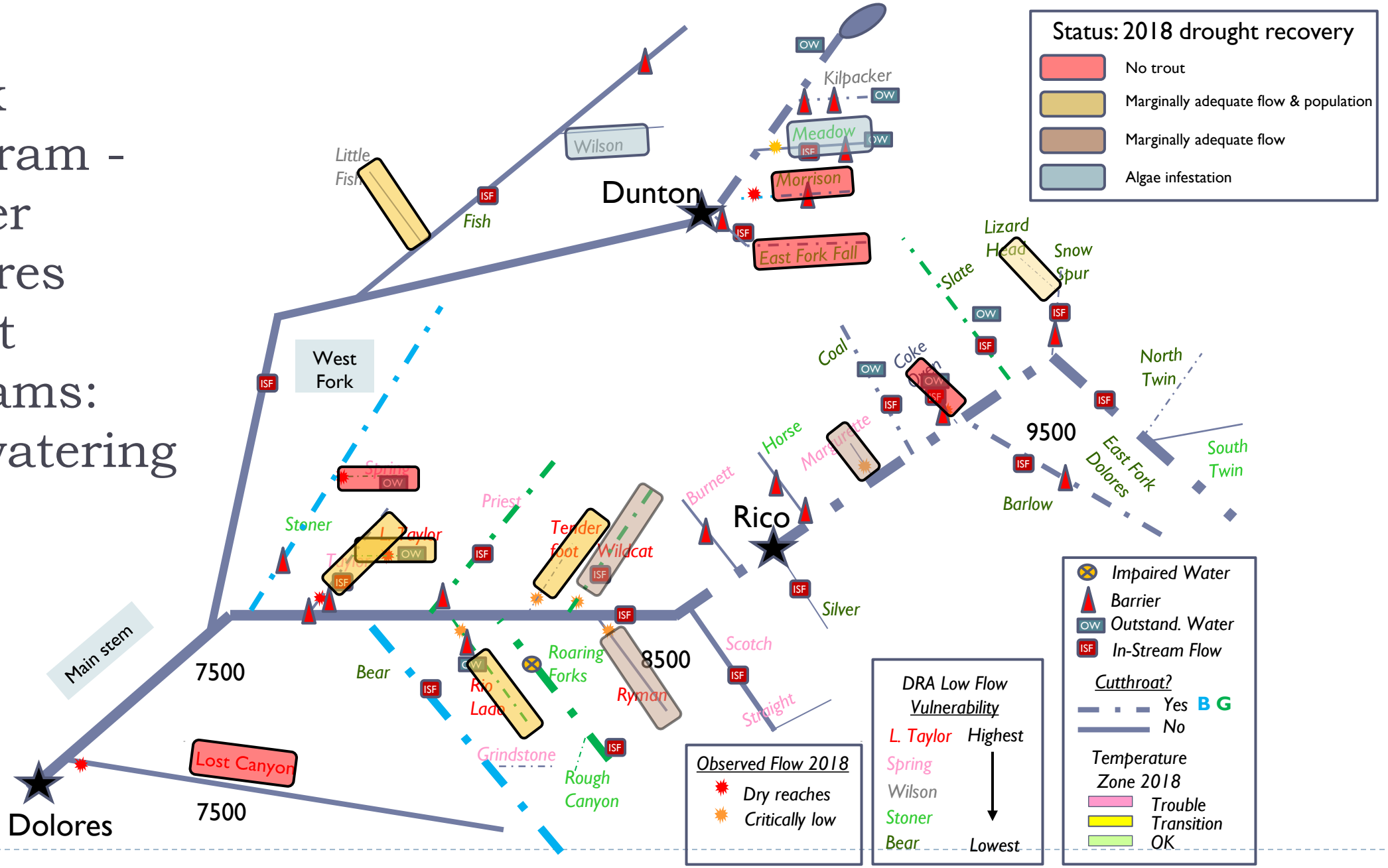
Our 46 streams with Trout

Relative Vulnerability!

Composite Worksheet: Ranking 46 Trout Streams by Geophysical/ Hydrological Vulnerability (Streamflow) [Low (Green) to High (Red)]

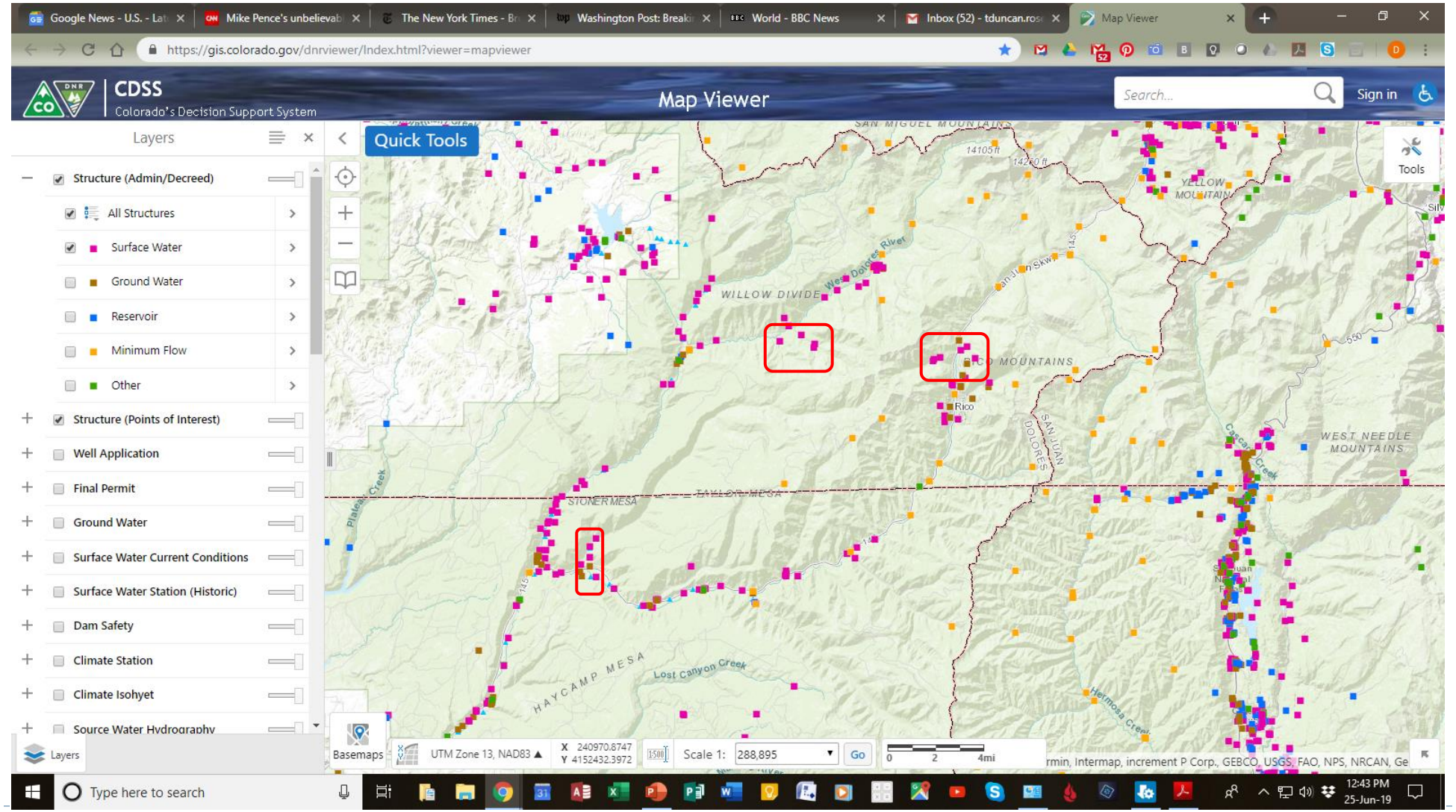
"Does it make sense?" Map!

Stick Diagram - Upper Dolores Trout Streams: De-watering



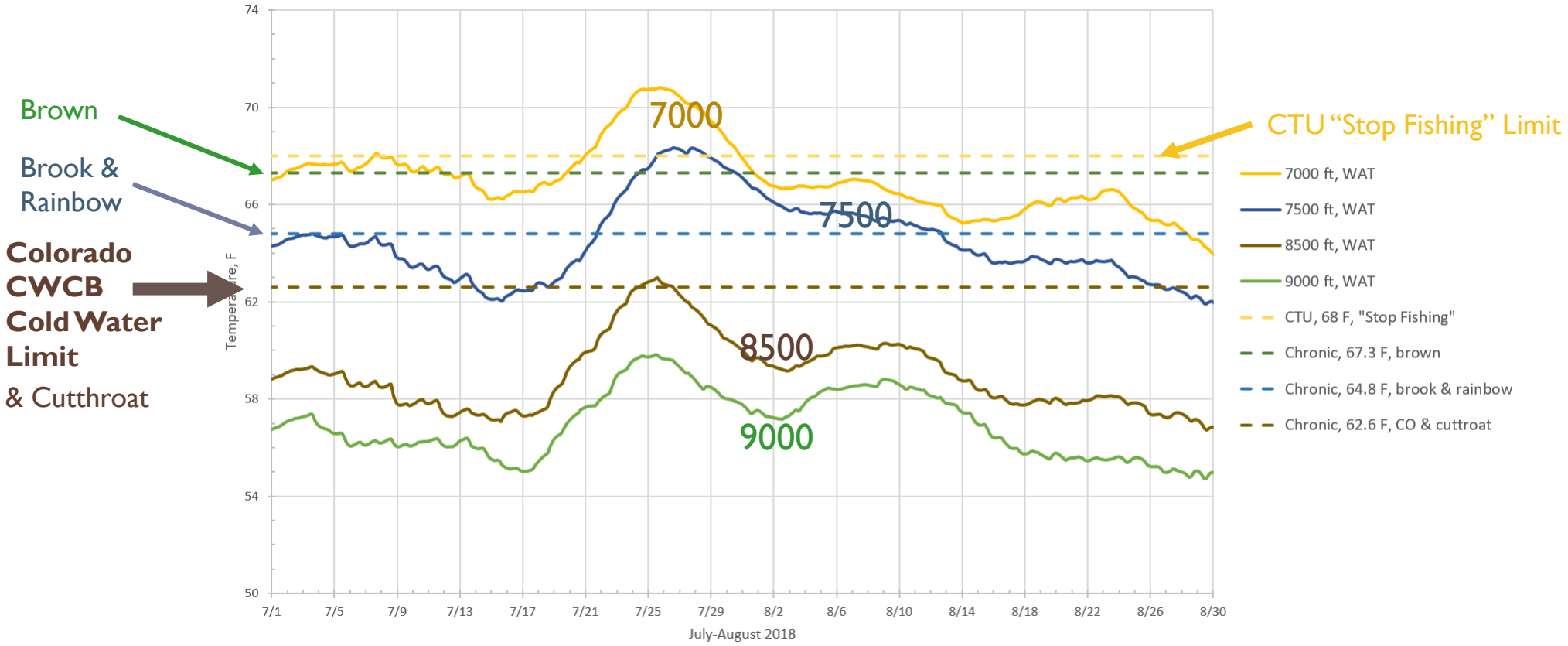
Diversions – Irrigation Impact

All Decreed Structures



Stream Temperature Patterns

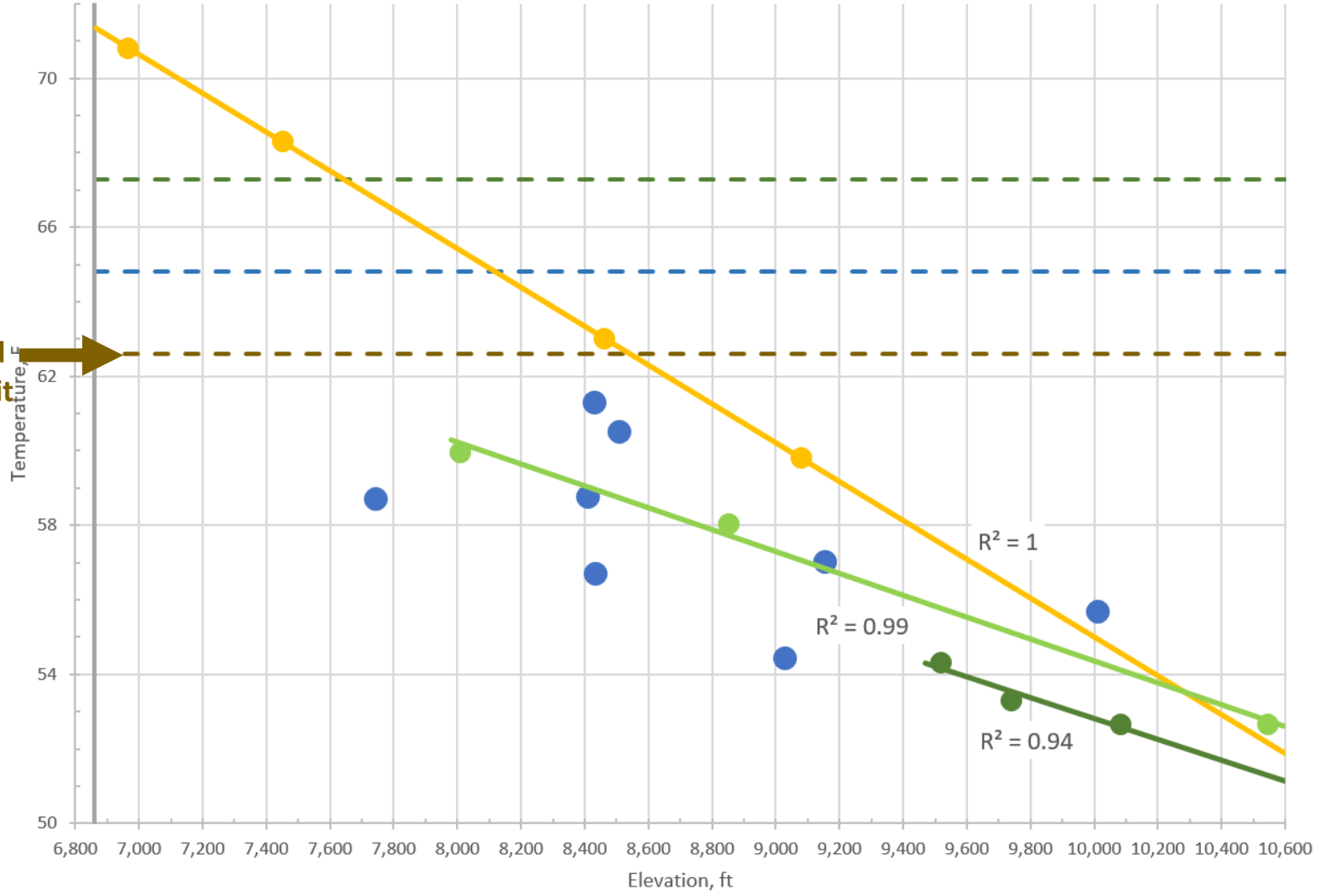
Weekly Average Temperature (WAT), July-August 2018



*Weekly Average Temperature

Main Stem Vs. Tributaries, MWAT, Jul-Aug 2018

Colorado CWCB Cold Water Limit



- Chronic, 67.3 F, brown
- Chronic, 64.8 F, brook & rainbow
- Chronic, 62.6 F, CO & cuttroat
- Dolores River, MWAT
- Priest Creek, MWAT
- Slate Creek, MWAT
- Other tributaries, MWAT
- McPhee Res. elevation, 6860 ft
- Linear (Dolores River, MWAT)
- Linear (Priest Creek, MWAT)
- Linear (Slate Creek, MWAT)

MWAT is *maximum* weekly average temperature

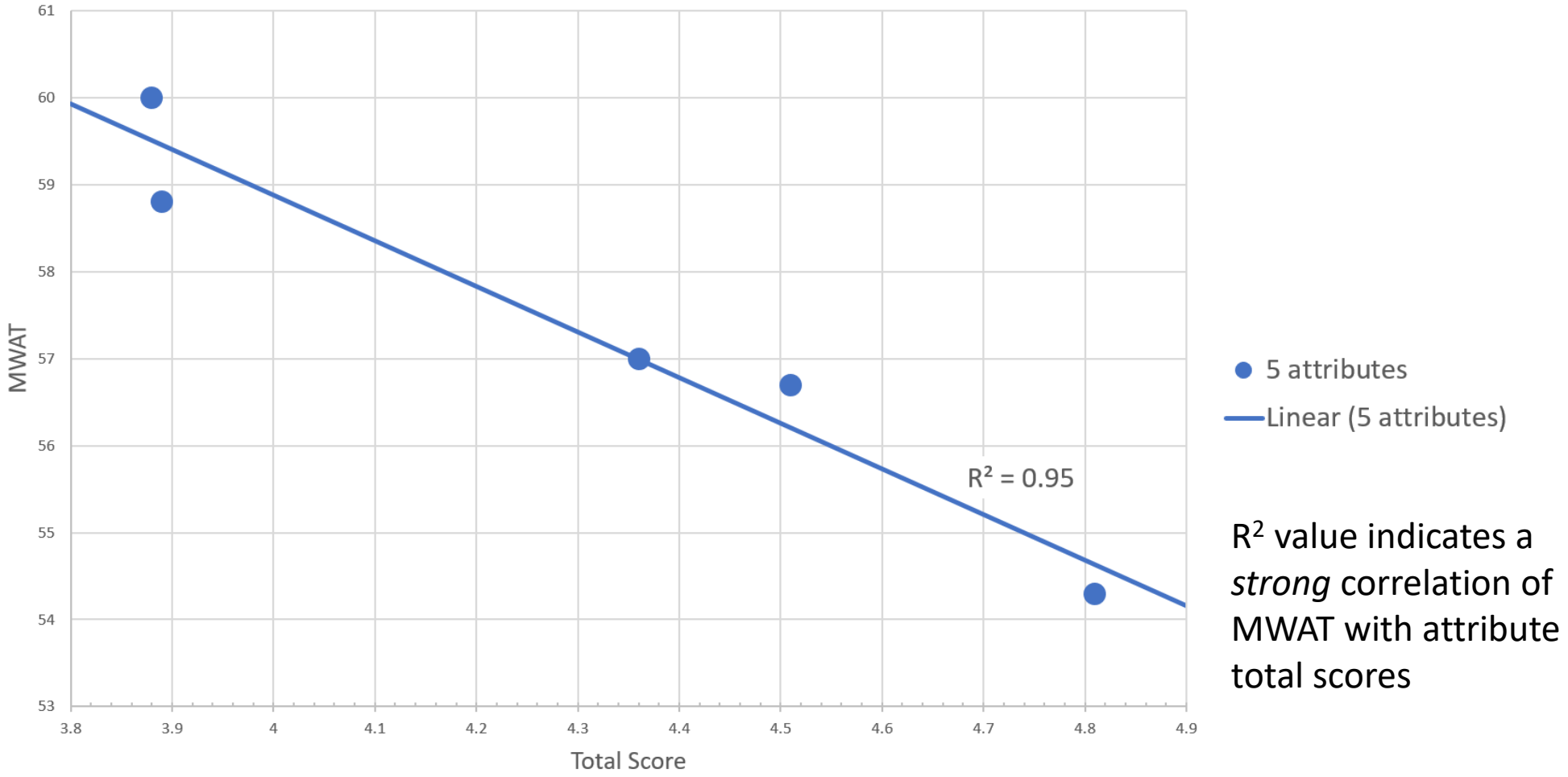
Finding: Tributaries are *colder* than chronic criteria and the main stem (<10,000 ft)

Correlation With Temperature Related Stream Attributes, MWAT, Jul-Aug 2018

Tributary	ID & Google Maps	MWAT, near outfall	Cutthroat trout	Sort, in/out: 1/0	Outfall elevation, ft	Proportional score	Max. elev, ft, x 1000	Proportional score	Slope, mean, %	Proportional score	Precip., in, annual	Proportional score	Flow, cfs, July	Proportional score	Total
1 Slate (OW)(GB)	32	54.3	CT	1	**9502**	1.00	**14.2**	1.00	38.7	0.81	**40.5**	1.00	**16.30**	1.00	4.81
2 Scotch	29	56.7	·	1	8530	0.90	12.6	0.89	45.6	0.96	32.3	0.80	15.80	0.97	4.51
3 Coal (OW)	6	57.0	CT	1	9190	0.97	13.8	0.97	26.9	0.56	37.5	0.93	15.10	0.93	4.36
4 Wildcat (GB)	43	58.8	CT	1	8341	0.88	11.9	0.84	**47.7**	1.00	31.3	0.77	6.58	0.40	3.89
5 Priest (GB)	24	60.0	CT	1	7974	0.84	11.5	0.81	39.1	0.82	30.7	0.76	10.70	0.66	3.88
Best					**9502**	1.00	**14.2**	1.00	**47.7**	1.00	**40.5**	1.00	**16.30**	1.00	
Weight					1		1		1		1		1		

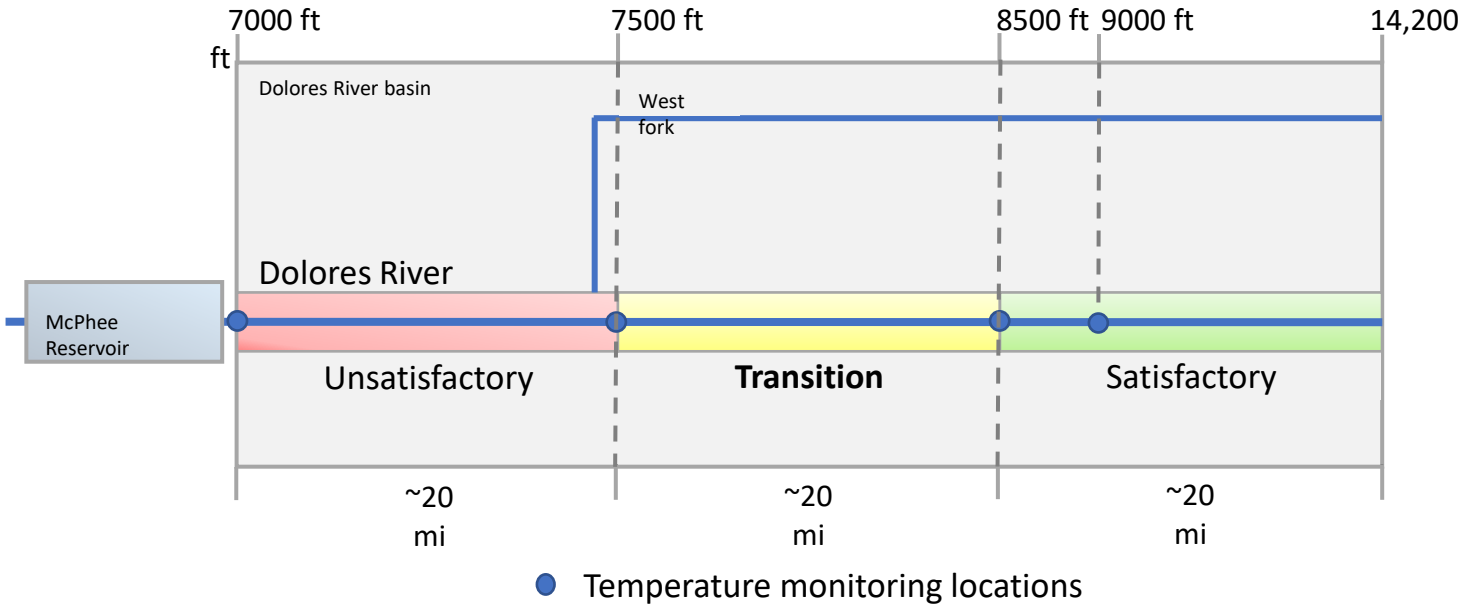
1. *Proportional scores* for the five attributes were summed to generate a *total* score for each tributary.
2. Attribute data are from application of the U.S. Geological program *StreamStats.*
3. MWAT is the *maximum* weekly average temperature, calculated with data obtained from in-stream sensors.
4. (OW) identifies streams designated by Colorado as Outstanding Waters, reaches above 10,000 ft for those tributaries.
5. (GB) marks the tributaries determined by U.S. Fish & Wildlife Service to host GB-lineage cutthroat trout.
6. CT identifies the tributaries having confirmed cutthroat populations.

Strength Of Correlation, MWAT, Jul-Aug 2018



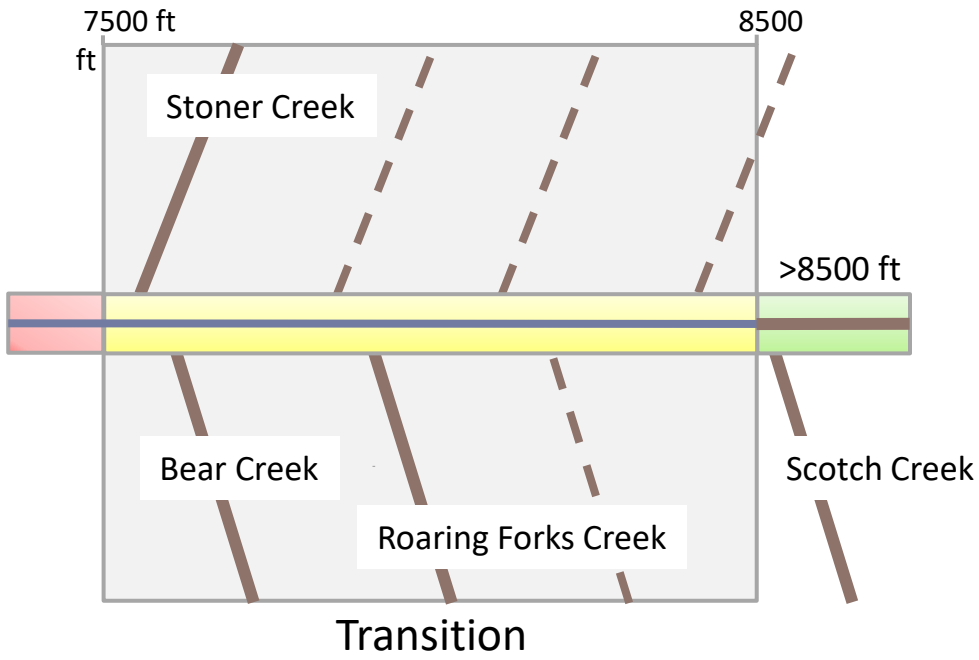
R^2 value indicates a *strong* correlation of MWAT with attribute total scores

Emergent Temperature Zones



From Data, Dolores River Habitat Temperature Conditions, Jul-Aug 2018

Largest Upstream Tributaries On The Main Stem Between 7500 and 8500 ft

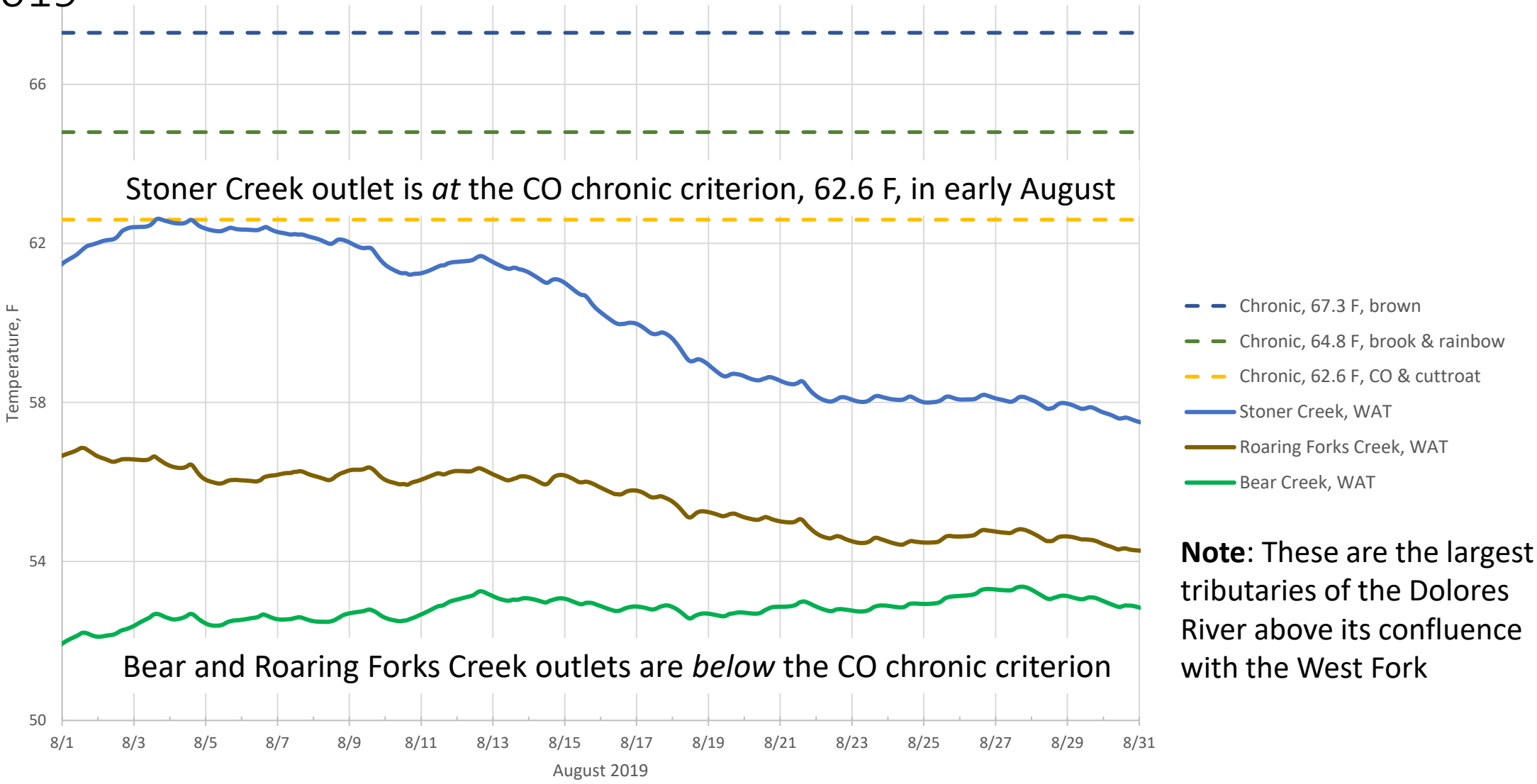


Temperature Findings, So Far, from the 2018 Data

1. The lower one-third of the upper Dolores River was *unsatisfactory* habitat all summer—too warm—for three-fourths of the river's resident trout species.
2. The middle third of the main stem was a *transition* section, with habitat becoming increasingly temperature safe as elevation increased.
3. 2018 data showed that all tributaries were *colder* than the main stem, given elevation, and were temperature safe, based on Colorado chronic criteria.
4. They were cold enough to be thermal relief *off ramps* for main-stem trout.
5. *Sufficient* water is upstream for trout seeking refuge, from a preliminary assessment of flow *capacity* at tributaries and the main stem above 8500 ft.
6. It may be wise to *identify* and *protect* tributaries having sufficient *flow* and *length* to provide thermal relief, including during *drought* conditions.

Source: doloresstudy.com

Tributary Temperatures At Confluence, August 2019



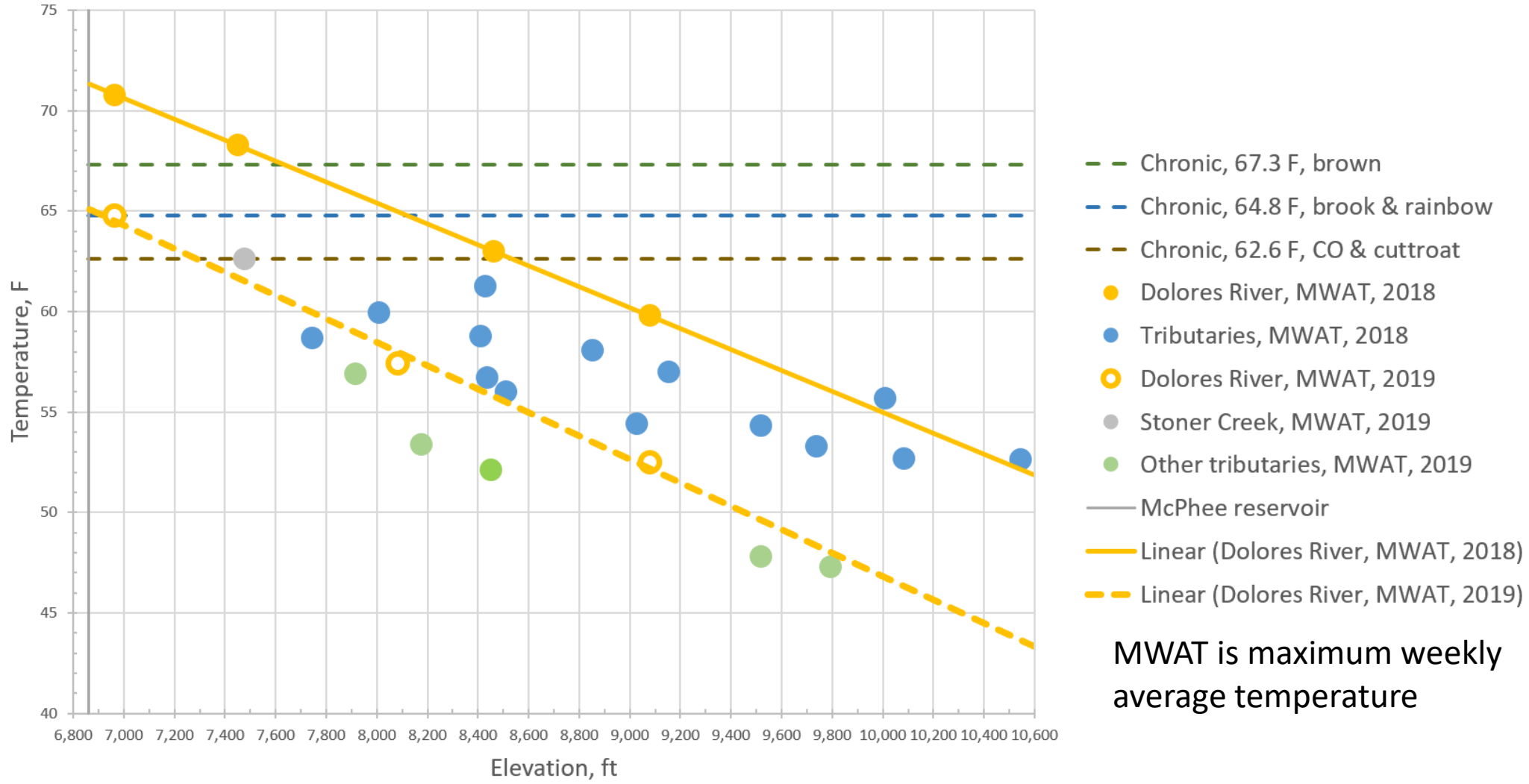
Note: These are the largest tributaries of the Dolores River above its confluence with the West Fork

Searching for Temperature Patterns In Streams w/Data, tributary attributes, July-August 2018 *and* August 2019 data

Tributary	MWAT, at or near outlet	In sort or out, 1 or 0	Drainage area, sq mi	Score	Flow path length, mi	Score	Highest elev, ft, x 1000	Score	Mean slope, %	Score (highest is best)	Vegetation cover, %	Score	Precip, in, mean annual	Score	Flow, cfs, mean July	Score	Flow, cfs, mean August	Score	Flow, cfs, mean annual	Score	Flow, cfs, mean Jul-Aug	Score	Outlet elevation, ft	Score	Total
1 Bear	53.4	1	33.70	0.00	15.60	0.00	13.2	0.93	41.6	0.87	90.9	0.00	37.5	0.93	**68.80**	0.00	**30.30**	0.00	**51.50**	0.00	**49.55**	1.00	7895	0.83	4.56
2 Slate	53.3	1	5.14	0.00	5.74	0.00	**14.2**	1.00	38.7	0.81	77.2	0.00	**40.5**	1.00	16.30	0.00	6.48	0.00	11.70	0.00	11.39	0.23	**9502**	1.00	4.04
3 Scotch	56.7	1	12.10	0.00	7.65	0.00	12.6	0.89	45.6	0.96	93.7	0.00	32.3	0.80	15.80	0.00	7.41	0.00	13.00	0.00	11.61	0.23	8530	0.90	3.77
4 Roaring Fks	56.9	1	19.60	0.00	9.30	0.00	11.8	0.83	36.6	0.77	96.2	0.00	34.1	0.84	29.70	0.00	13.70	0.00	23.60	0.00	21.70	0.44	8167	0.86	3.74
5 Coal	57.0	1	6.41	0.00	6.42	0.00	13.8	0.97	26.9	0.56	88.9	0.00	37.5	0.93	15.10	0.00	6.35	0.00	11.40	0.00	10.73	0.22	9190	0.97	3.65
6 Wildcat	58.8	1	5.27	0.00	5.34	0.00	11.9	0.84	**47.7**	1.00	**97.3**	0.00	31.3	0.77	6.58	0.00	3.08	0.00	5.51	0.00	4.83	0.10	8341	0.88	3.59
7 Stoner	62.6	1	**45.60**	0.00	**19.00**	0.00	12.3	0.87	25.4	0.53	92.9	0.00	29.7	0.73	39.00	0.00	20.10	0.00	33.70	0.00	29.55	0.60	7467	0.79	3.51
8 Priest	60.0	1	9.61	0.00	7.81	0.00	11.5	0.81	39.1	0.82	94.8	0.00	30.7	0.76	10.70	0.00	5.15	0.00	9.05	0.00	7.93	0.16	7974	0.84	3.39
Best			**45.60**	0.00	**19.00**	0.00	**14.2**	1.00	**47.7**	1.00	**97.3**	0.00	**40.5**	1.00	**68.80**	0.00	**30.30**	0.00	**51.50**	0.00	**49.55**	1.00	**9502**	1.00	
Weight				0		0		1		1		0		1		0		0		0		1		1	

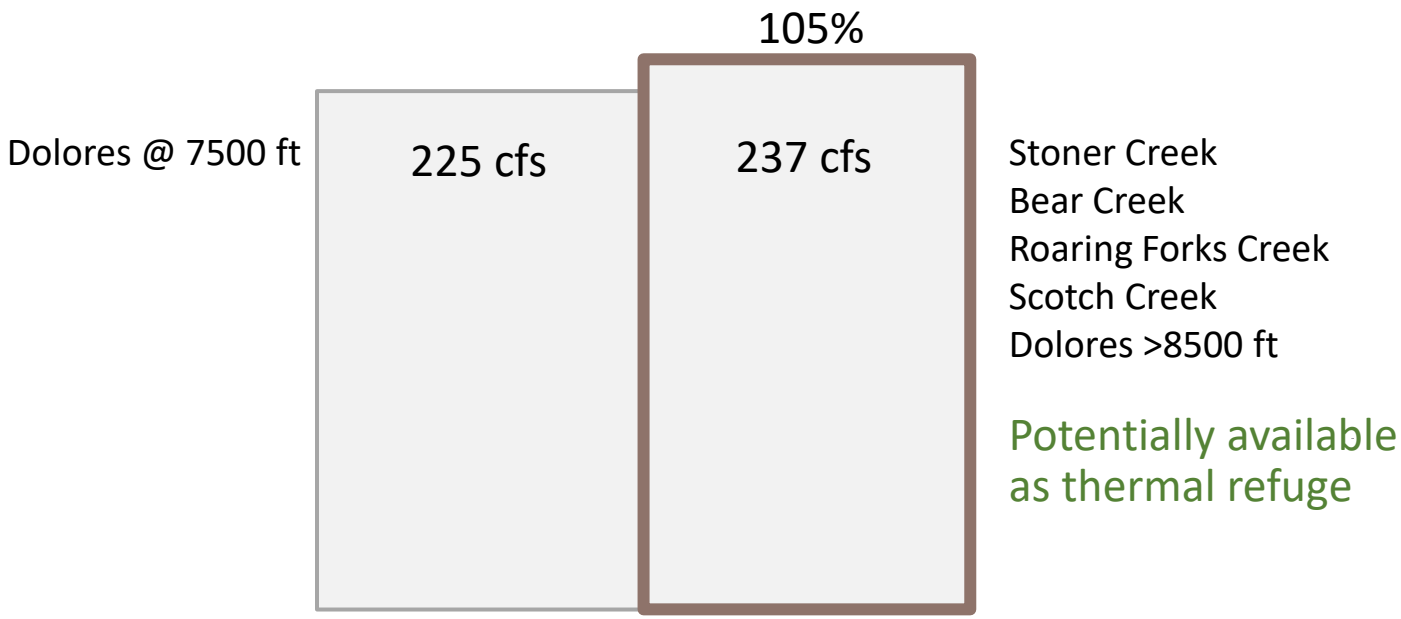
1. The correlation table uses water temperatures collected in July-August 2018 *and* August 2019 (in red).
2. Attribute values are scored highest to lowest and summed for a *total* score.
3. Relative MWAT values show *some correlation* with the combination of tributary attributes highlighted.
4. MWAT is the *maximum* weekly average temperature, F.
5. Temperature data are from measurement locations at or near a tributary's outlet with the Dolores River.
6. Attribute data are from application of the U.S. Geological Survey program *StreamStats*.

Comparison of 2018 and 2019 MWAT Values



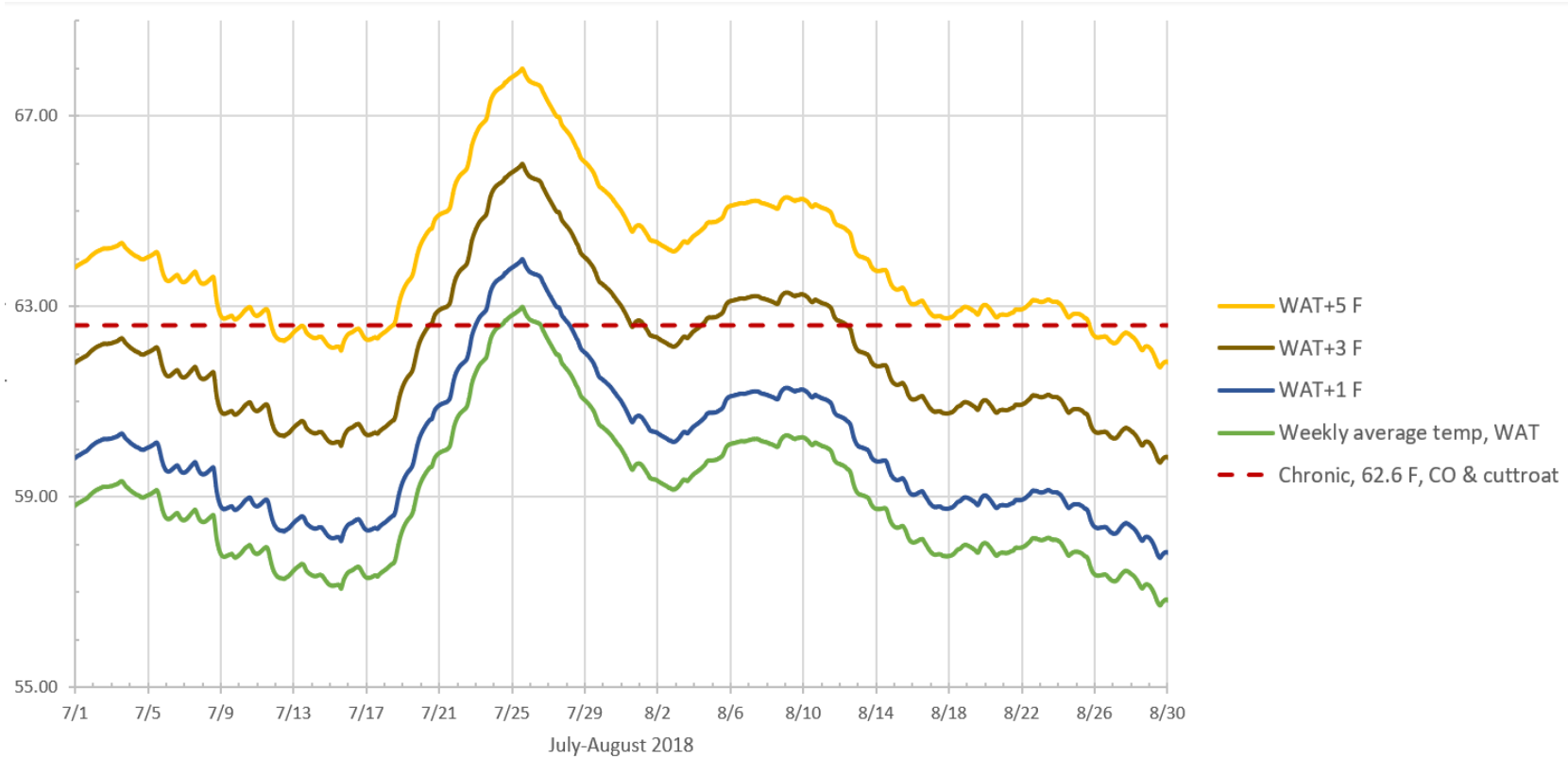
MWAT is maximum weekly average temperature

Flow Capacity for Potential Thermal Refuge, Jul-Aug



Flows from application of U.S. Geological Survey program *StreamStats*

Main Stem, 8500 ft, WAT and +1, +2, +3, and Chronic Criterion



Sorting 40 Tributaries as Potential Long-Term Habitat

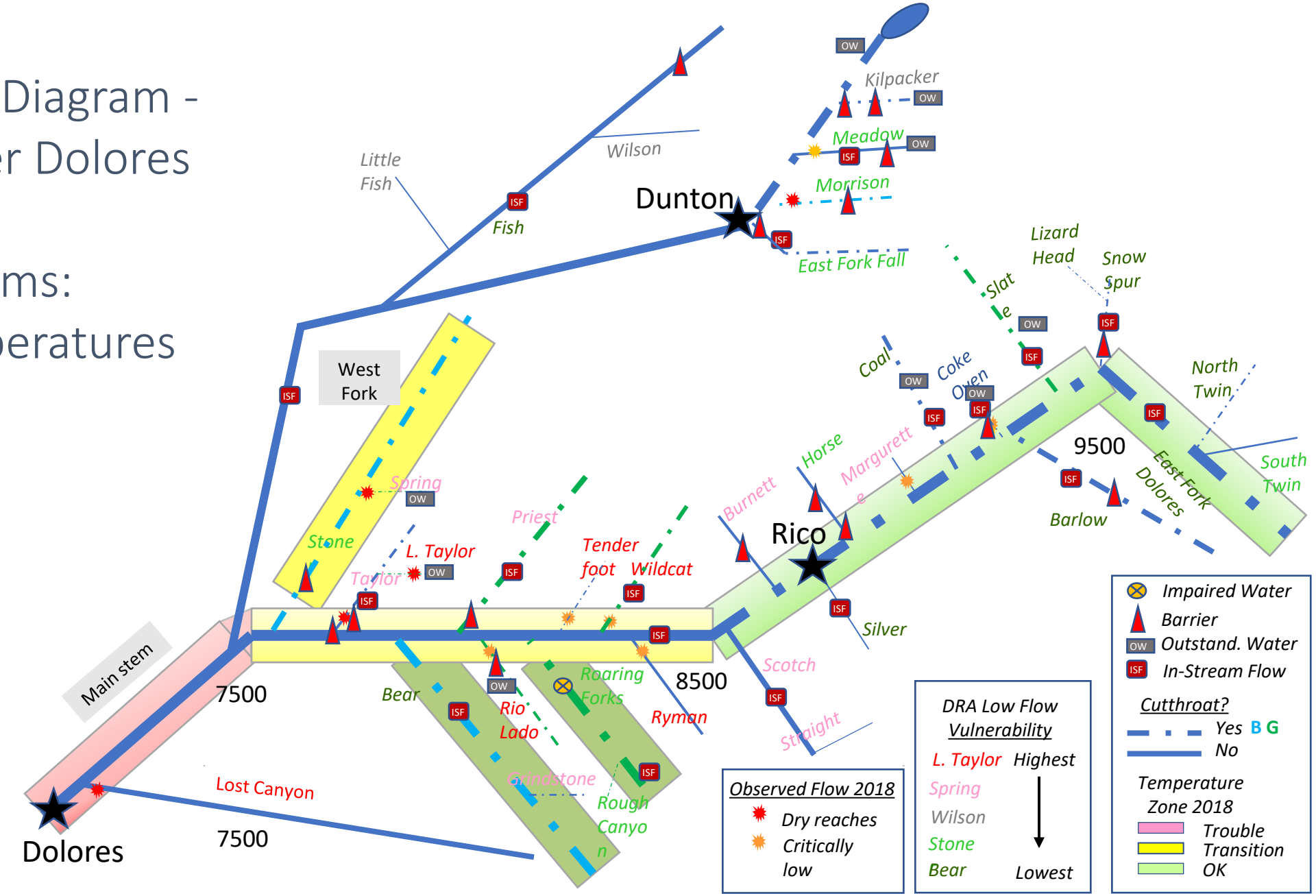
10 highest-scoring tributaries

Using 5 Attributes	Included
1 Bear	Both
2 East Fork	Both
3 Kilpacker (OW)	Both
4 Twin, South	Only
5 Horse	Both
6 Slate (T)(OW*)(GB)	Both
7 Fish	Both
8 Scotch (T)	Both
9 Roaring Forks	Both
10 Rough Canyon (GB)	Both

Using 12 Attributes	Included
1 Bear	Both
2 Fish	Both
3 East Fork	Both
4 Roaring Forks	Both
5 Scotch (T)	Both
6 Barlow	Only
7 Horse	Both
8 Kilpacker (OW)	Both
9 Slate (T)(OW*)(GB)	Both
10 Rough Canyon (GB)	Both

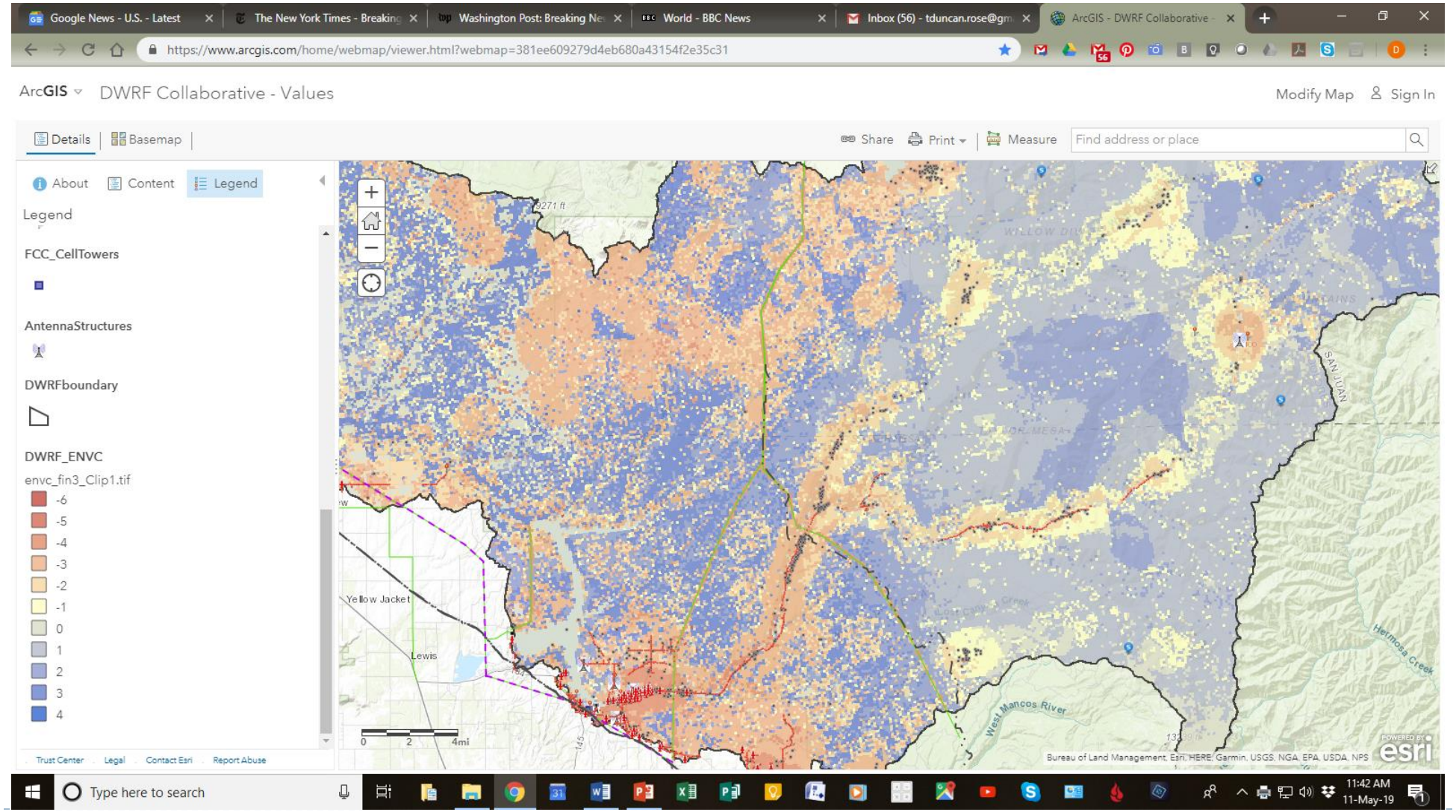
1. (T) temperatures were measured and showed close correlation with 5 attributes.
2. (OW) designated as Colorado Outstanding Waters.
3. (OW*) means the classification applies to upper reaches, in general, >10,000 ft.
4. (GB) determined by U.S. Fish & Wildlife Service to host GB-lineage cutthroat trout.

Stick Diagram - Upper Dolores Trout Streams: Temperatures



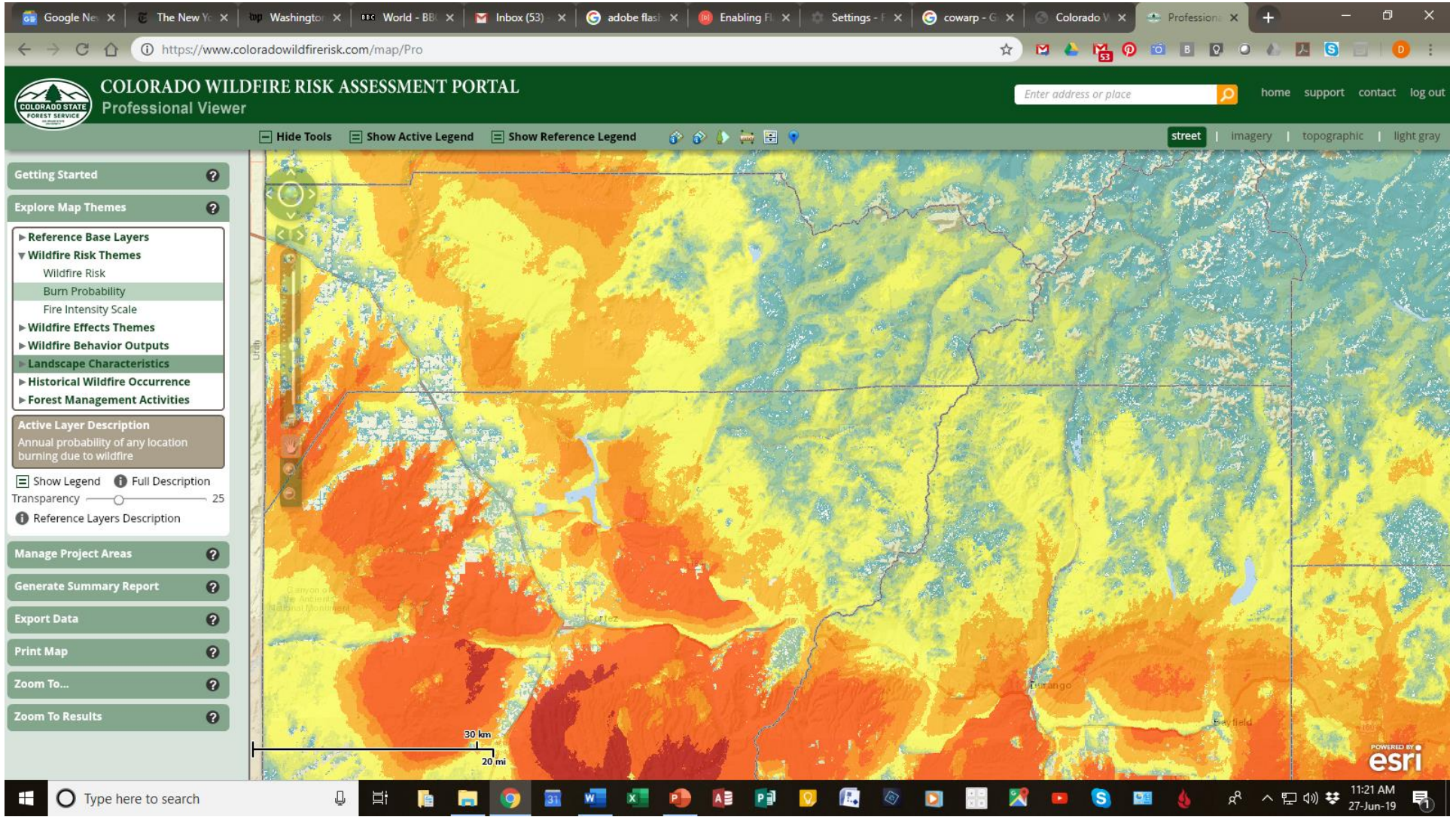
Wildfire, Erosion Patterns

SJNF/BLM/DWRF Wildfire Risk Maps



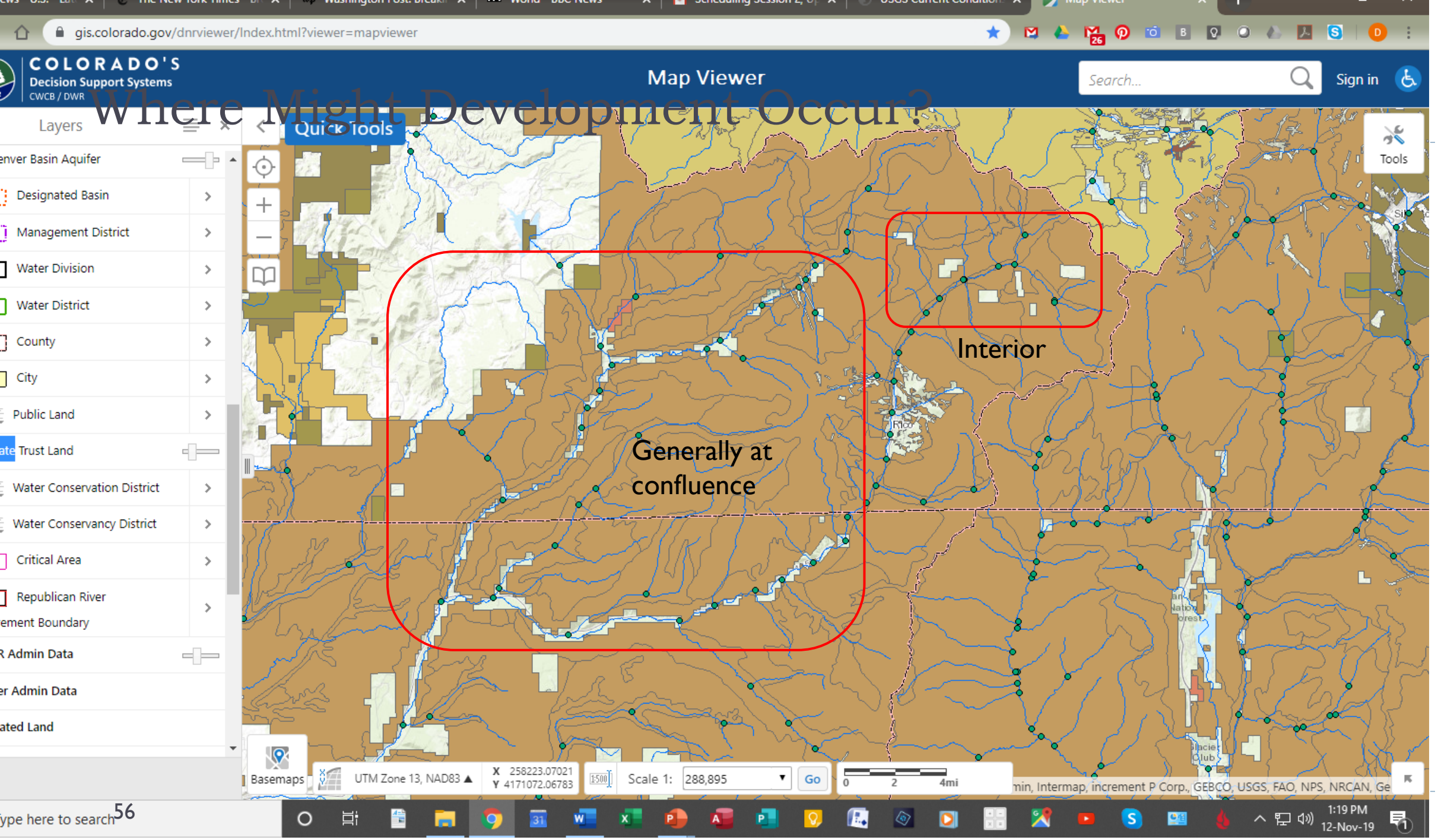
https://www.arcgis.com/home/webmap/viewer.html?webmap=381ee609279d4eb680a43154f2e35c31

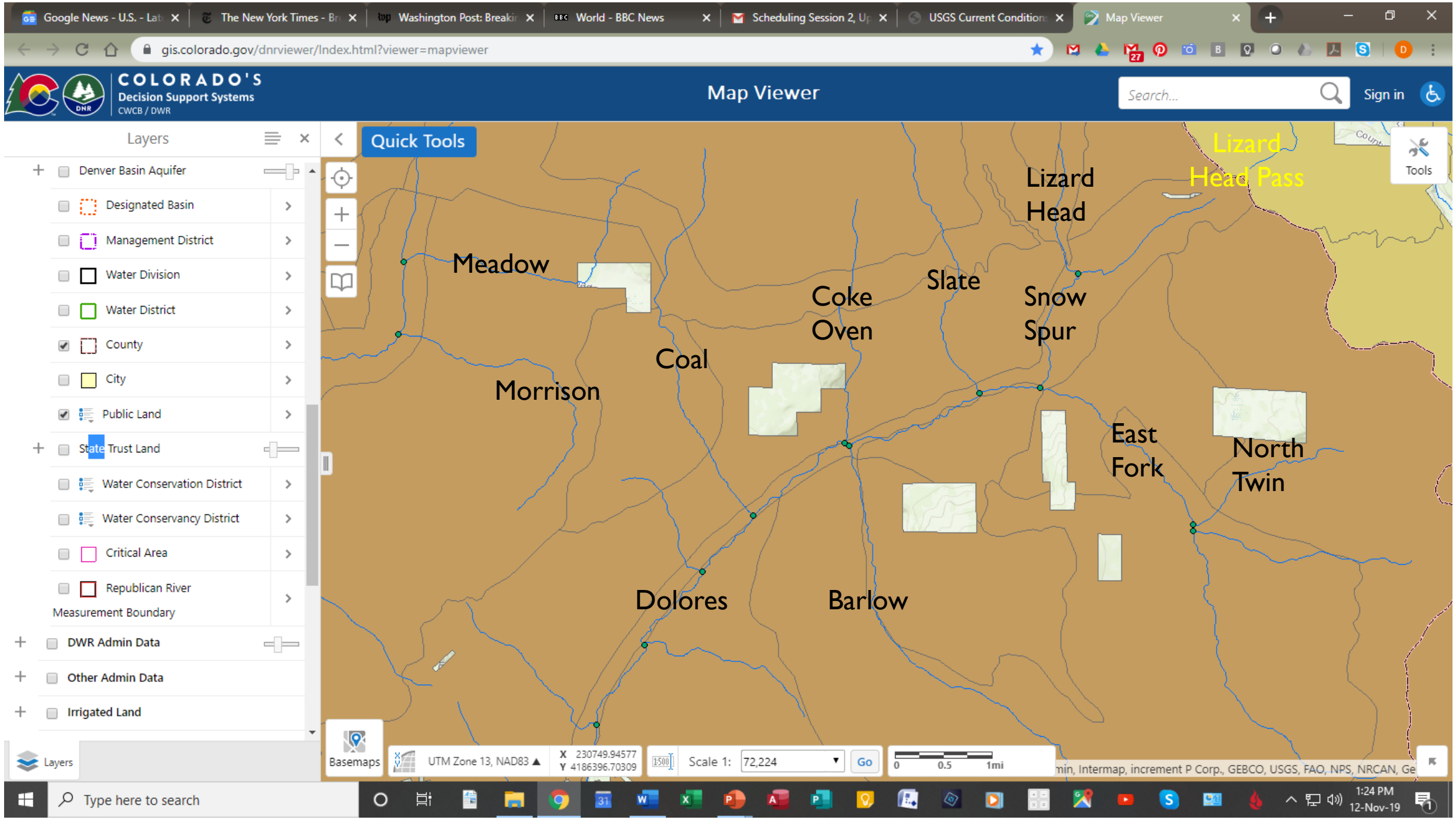
CO-WRAP Wildfire Risk Maps



Potential Development

Where Might Development Occur?




Google News - U.S. - Lat
The New York Times - Br
Washington Post: Breaki
World - BBC News
Scheduling Session 2, Up
USGS Current Conditions
Map Viewer
gis.colorado.gov/dnrviewer/Index.html?viewer=mapviewer
COLORADO'S
Decision Support Systems
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Tools
Denver Basin Aquifer
Designated Basin
Management District
Water Division
Water District
County
City
Public Land
State Trust Land
Water Conservation District
Water Conservancy District
Critical Area
Republican River
Measurement Boundary
DWR Admin Data
Other Admin Data
Irrigated Land
Meadow
Coal
Morrison
Coke
Oven
Slate
Lizard
Head
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Head Pass
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Spur
East
Fork
North
Twin
Dolores
Barlow
Basemaps
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Scale 1: 72,224
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Layers
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12-Nov-19

LRMP Vol II, Sec 2: Resources Direction

Table of Contents

2.4.25 Livestock browsing should not remove more than 25% of the annual leader growth of hydrophytic shrubs and trees.

2.4.26 Agency actions should avoid or otherwise mitigate adverse impacts to the abundance and distribution of willows to maintain or improve the ecological integrity of riparian area and wetland ecosystems.

2.4.27 Certified, weed-free native seed mixes of local ecotypes should be used to revegetate riparian area and wetland ecosystems where commercially available. Non-native, non-invasive plant material may be used in limited situations where considered necessary in order to protect resources and/or stabilize soils in a timely fashion. Persistent non-natives or invasive exotic plant species should be avoided.

2.4.28 Woody riparian vegetation along low-gradient ephemeral and permanent stream channels should be maintained or restored to ensure terrestrial food sources for invertebrates, fish, birds, and mammals, and to minimize water temperature changes.

Additional Guidance

The principal guidelines used to protect all riparian areas and wetlands on SJNF lands are found in the Region 2 Watershed Conservation Practices Handbook (Region 2 FSH 2509.25-2006-1). This handbook contains guidelines that prevent adverse impacts, maintain or improve stream health, preserve ecosystem function, prevent stream sedimentation, and reclaim disturbed sites. Additional guidance includes:

- Colorado River Basin Salinity Control Act of 1974
- Clean Water Act of 1977
- EOs 11288, 1966; 11752, 1973; 11988, 1977;11990, 1977
- FSM 2500
- FSH 2500
- MOU between the Colorado Department of Natural Resources and the USFS, 2004
- MOU between the Colorado Department of Natural Resources, the Colorado Water Conservation Board, and the BLM, 2005
- FSM 2070
- FSH 2509.13 Burned Area Emergency Rehabilitation.
- Additional standards and guidelines associated with riparian area and wetland ecosystems are found in Sections 2.2 and 2.7.

2.5 Aquatic Ecosystems and Fisheries

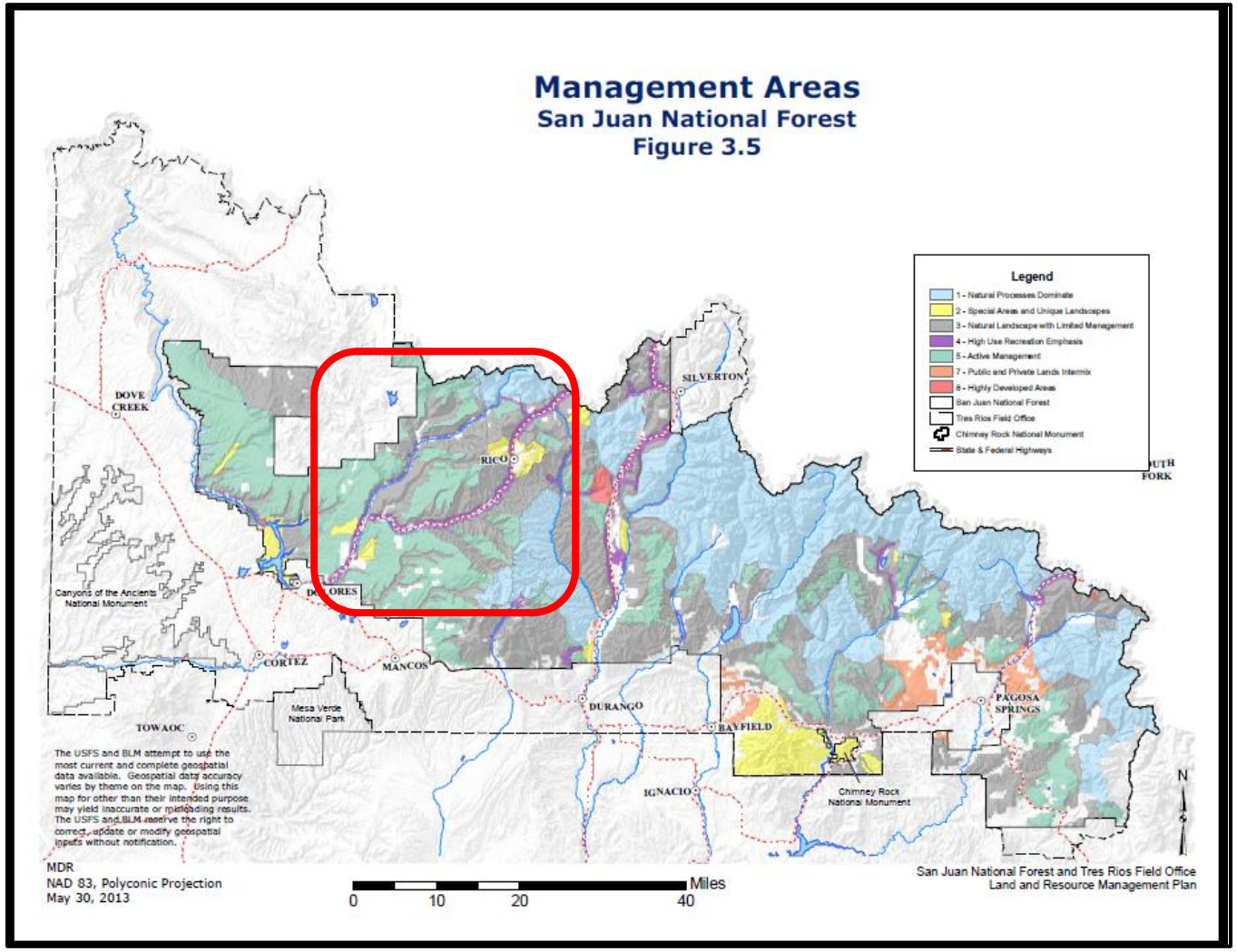
Introduction

Aquatic ecosystems of the SJNF and TRFO support a variety of water-dependent species, populations, and communities of plants and animals. These ecosystems include various types of flowing and standing waters that provide aquatic habitats sufficient to support the many biotic communities that depend on abundant, clean waters. The major biological components of these ecosystems include fish, amphibians, macroinvertebrates, zooplankton, macrophytes, and periphyton communities. The physical components are composed of features such as stream gradient, sinuosity, substrate material, stream bank material, large woody debris, and most importantly, water (refer also to Section 2.6, Water Resources).

These aquatic ecosystems play a critical role in the social, economic, and ecological well-being of the region. In addition to supporting some of the richest and most productive habitats for a variety of wildlife and plant species, they provide municipal and industrial water to communities, and serve as one of the primary recreational resources of the area. According to the USFWS National Survey of Fishing, Hunting, and Wildlife-Associated Recreation, fishing related expenditures contributed over $41.8 billion to the U.S. economy in 2011 (USFWS 2013b). Over 33 million anglers, 27 million of which were freshwater anglers, contributed an average of $1,261 each to local economies, and the demand for fishing-related recreation

https://www.fs.usda.gov/Internet/FSE_DOCUMENTS/stelprdb5435200.pdf

LRMP: Sec 3.5: Area Direction - Management Areas



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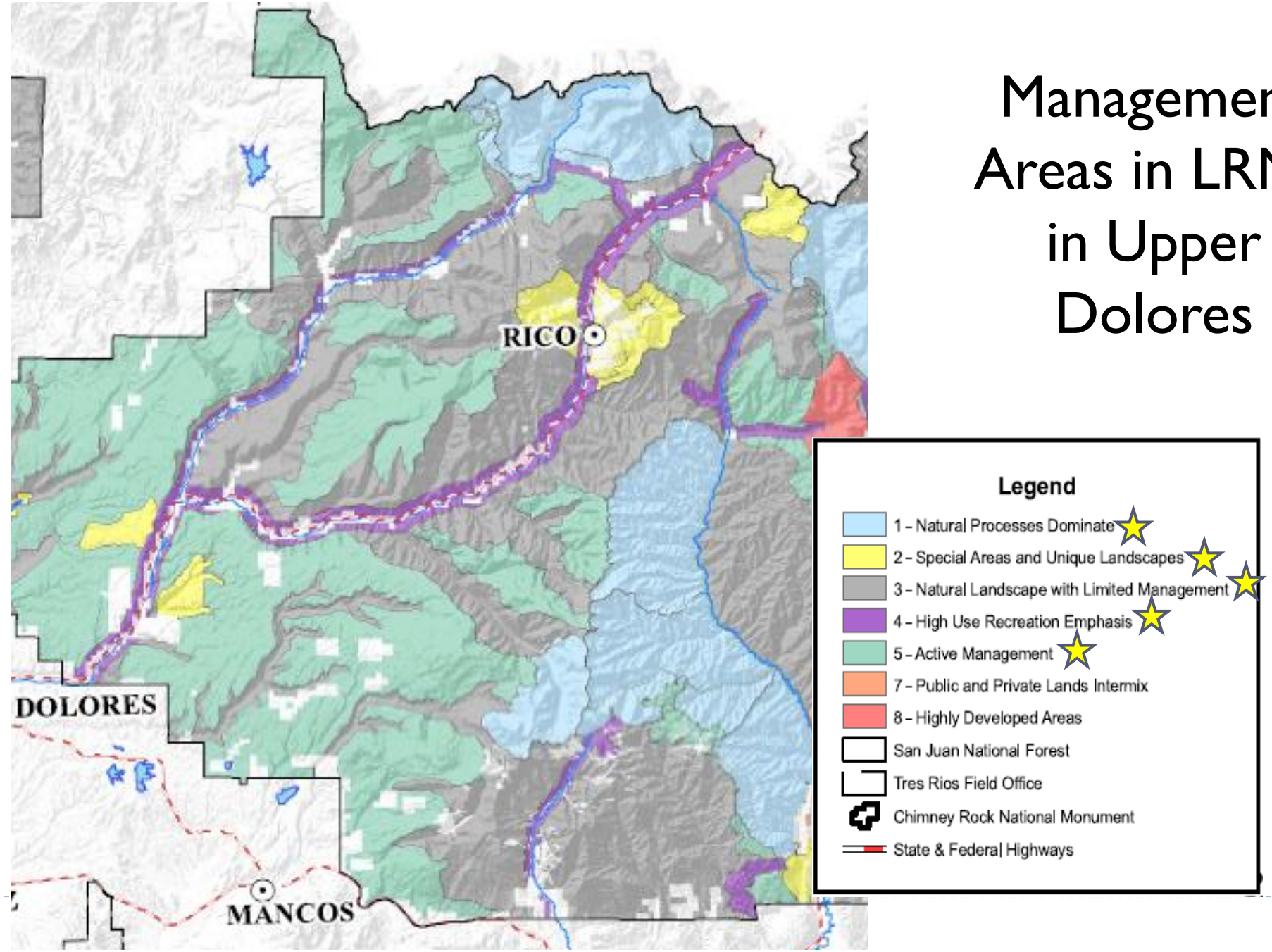
Management Areas in LRMP in Upper Dolores

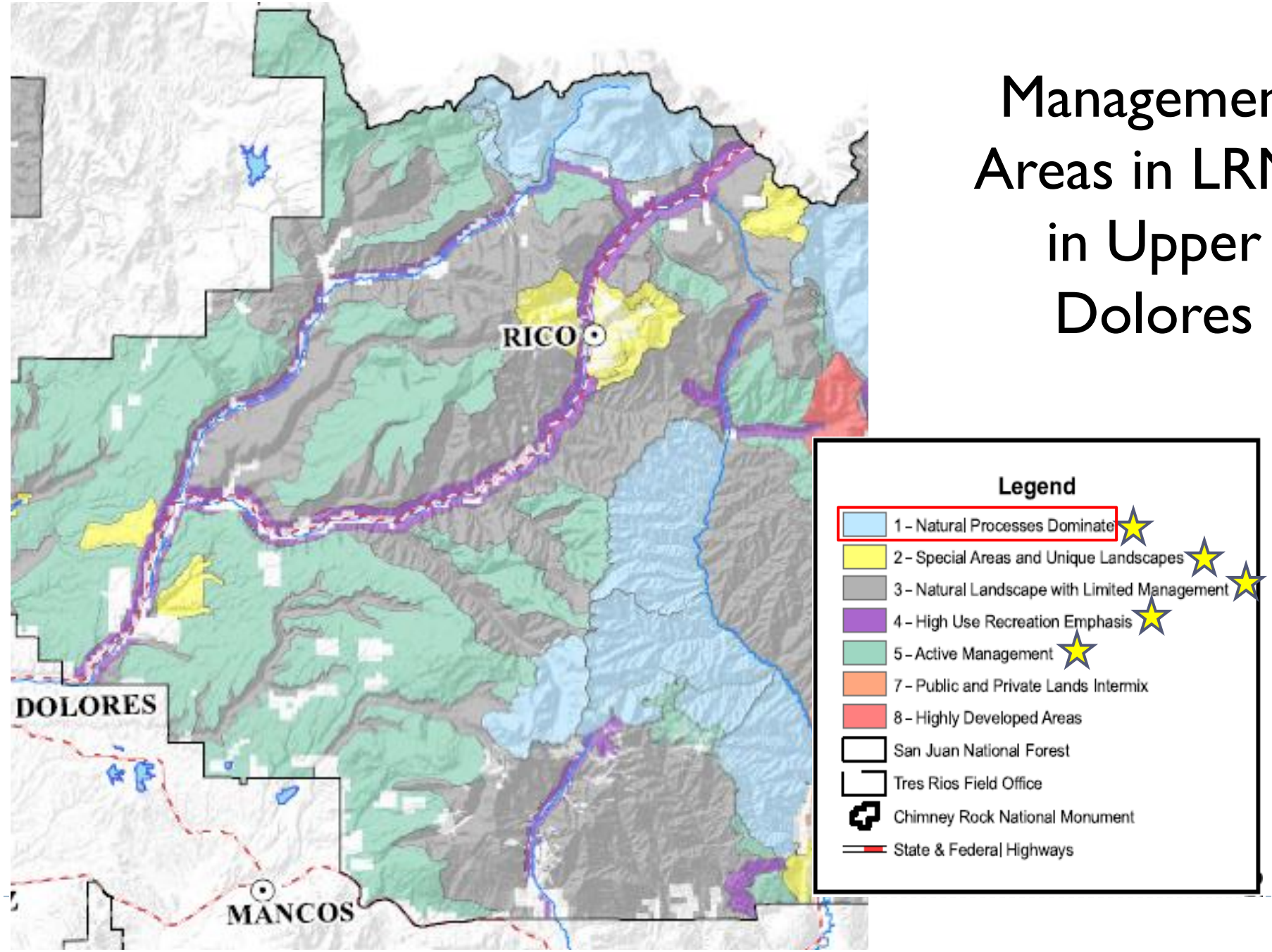


MA1: Natural Processes Dominate

Table 3.5.2: Management Area 1 Allowable Uses

Activities and Uses	Allowable - Restricted - Prohibited
Fire managed for resource benefit	Allowable
Prescribed burning	Allowable
Mechanical fuels treatment	Restricted (allowable when meeting desired conditions of the area)
Timber production (scheduled on a rotation basis)	Prohibited
Timber harvesting as a tool	Prohibited
Commercial use of special forest products and firewood	Prohibited
Land use ROWs, special use permits, and utility corridors	Prohibited
Livestock grazing	Allowable
Facilities	Prohibited
Motorized (summer)	Prohibited
Motorized (winter)	Prohibited
Non-motorized (summer and winter)	Allowable
Mechanical transport	Restricted (mountain bikes are allowable in MA 1 landscapes outside designated wilderness)
Road construction (permanent or temporary)	Prohibited
Minerals - leasable (oil and gas, and other)	Restricted (designated wilderness, WSAs, and the Piedra Area are withdrawn from mineral leasing; a NSO stipulation would be applied to CRAs outside designated wilderness)
Minerals - locatable	Prohibited (wilderness areas are withdrawn from locatable mineral entry, subject to valid and existing rights; other MA 1 areas are open to mineral entry, but impacts to natural resource must be minimized; the agency can petition for the area to be withdrawn from mineral entry)
Minerals - saleable (materials)	Prohibited

Management Areas in LRMP in Upper Dolores

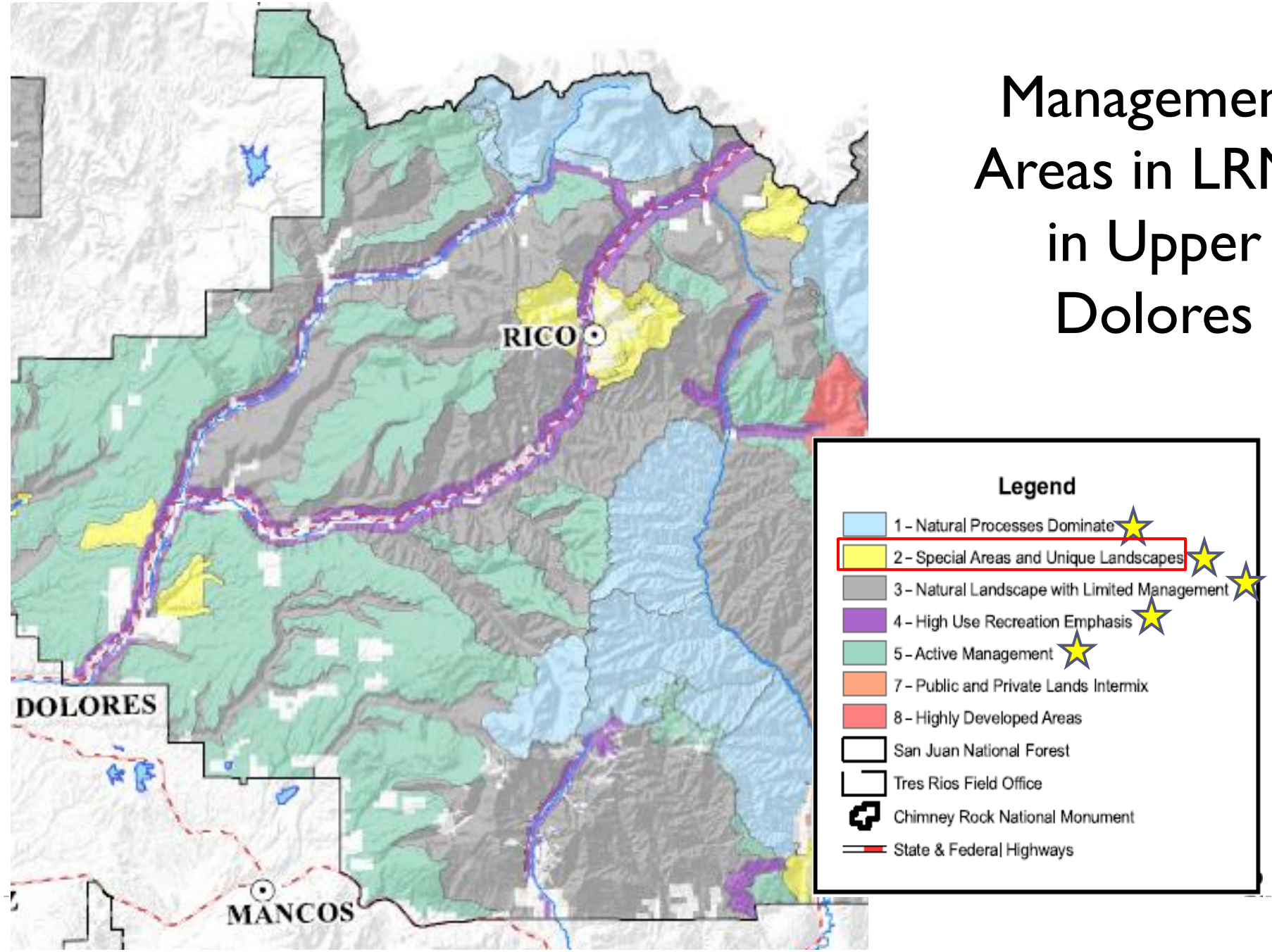


MA2: Special Areas and Designations

Management Area 2 (MA 2): Special Areas and Designations

These areas possess one or more special feature or characteristic that makes them, and their management, unique from other areas within the planning area. MA 2 areas include RNAs, archeological areas, habitat areas, botanical areas, and other unique areas that have a mix of special features and uses. In general, MA 2 areas are managed in order to protect or enhance their unique characteristics; therefore, management intensity and suitability varies by each area. See subsequent sections in Chapter 3 of this LRMP for specific management direction for these MA 2 areas.

Management Areas in LRMP in Upper Dolores

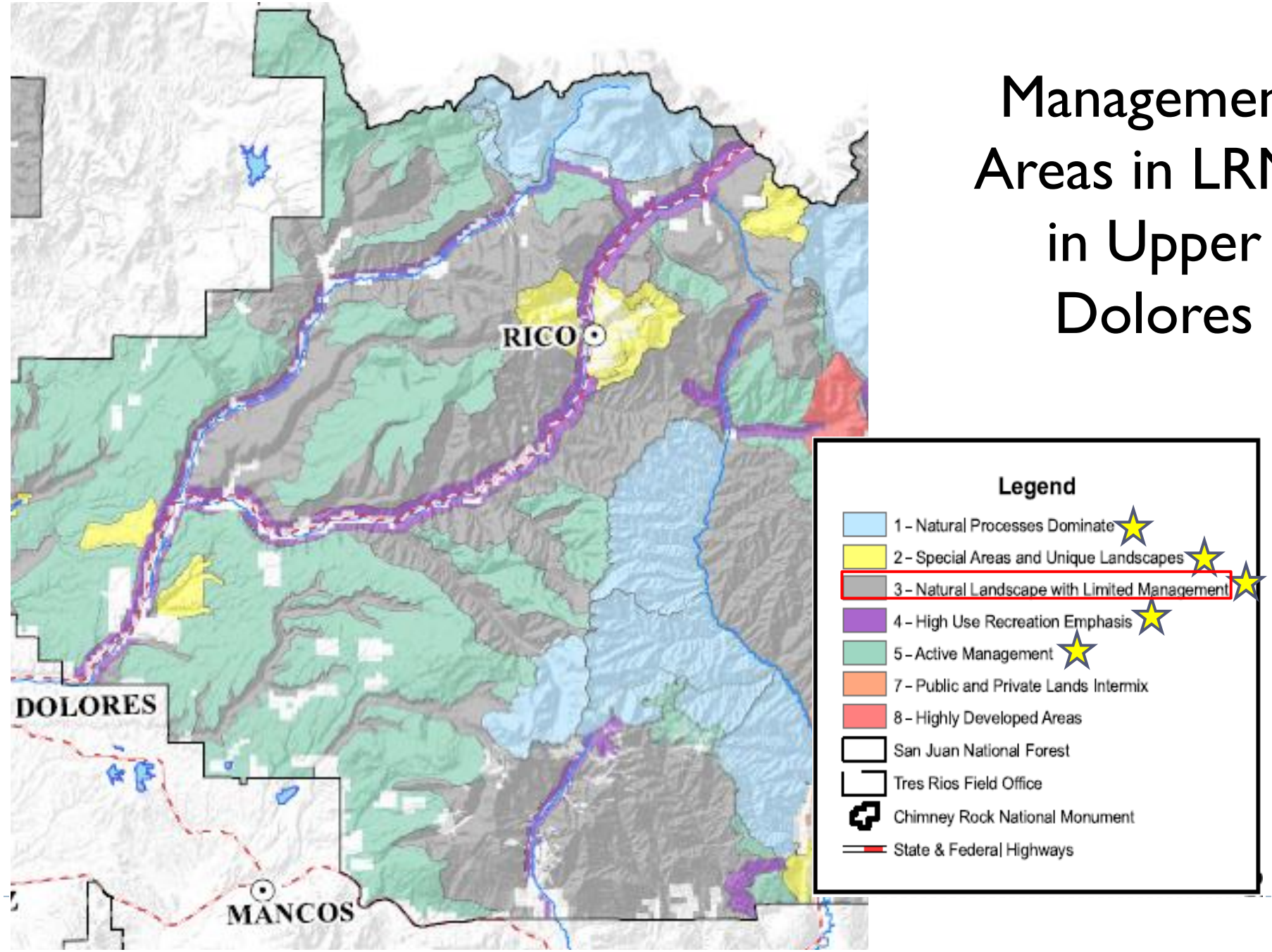


MA3: Natural Landscapes w/ Limited Management

Table 3.5.3: Management Area 3 Allowable Uses

Activities and Uses	Allowable - Restricted - Prohibited
Fire managed for resource benefit	Allowable
Prescribed burning	Allowable
Mechanical fuels treatment	Allowable
Timber production (scheduled on a rotation basis)	Prohibited
Timber harvesting as a tool	Allowable
Commercial use of special forest products and firewood	Allowable
Land use ROWs, special use permits, and utility corridors	Restricted (development may be conditioned or prohibited in CRAs and lands managed for wilderness characteristics)
Livestock grazing	Allowable
Facilities	Restricted (development may be prohibited in CRAs and lands managed for wilderness characteristics)
Motorized (summer)	Restricted (motorized travel may occur in some MA 3 locations on designated routes)
Motorized (winter)	Restricted (oversnow motorized travel may occur in some MA 3 locations)
Non-motorized (summer and winter)	Allowable
Mechanical transport	Allowable
Road construction (permanent or temporary)	Restricted (temporary road construction may occur in some MA 3 locations in order to achieve resource desired conditions; exceptions may apply for valid existing rights; additional road construction would also be allowed subject to valid existing rights and terms of development authorization)
Minerals - leasable (oil and gas, and other)	Restricted (special lease stipulations [i.e., NSO, CSU, TL] may apply to specific resources within MA 3 areas)
Minerals - locatable	Allowable (open to mineral entry per the 1872 Mining Law; however, the exploration and development of mining claims may be subject to restrictions to protect resources)
Minerals - saleable (materials)	Restricted (limited road access and other constraints in MA 3 landscapes may limit or preclude mineral collection.)

Management Areas in LRMP in Upper Dolores

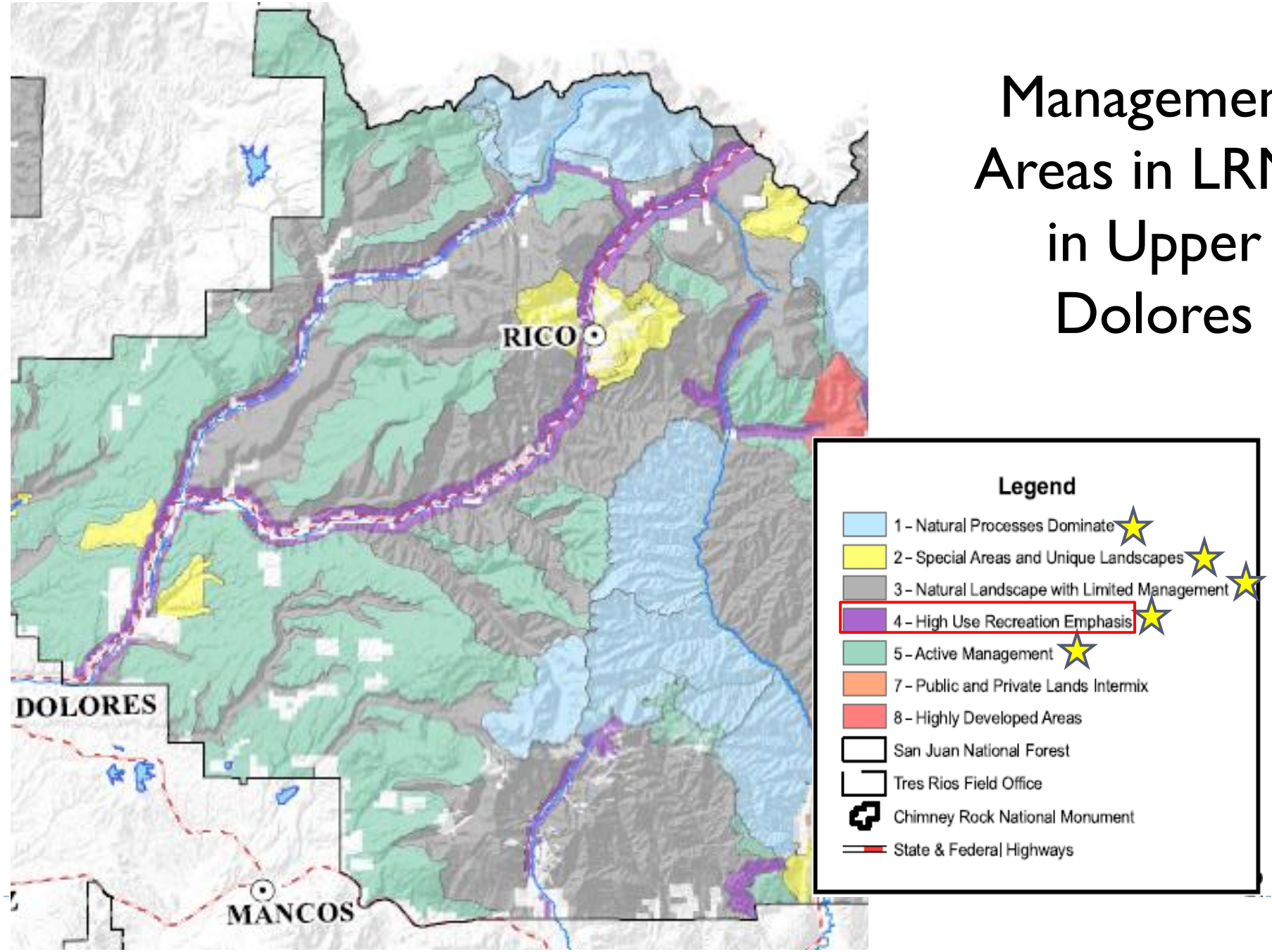


MA4: High-Use Recreation Emphasis

Table 3.5.4: Management Area 4 Allowable Uses

Activities and Uses	Allowable - Restricted - Prohibited
Fire managed for resource benefit	Restricted (may be used in order to meet desired conditions on adjacent lands)
Prescribed burning	Allowable
Mechanical fuels treatment	Allowable
Timber production (scheduled on a rotation basis)	Prohibited
Timber harvesting as a tool	Allowable
Commercial use of special forest products and firewood	Restricted (restrictions may apply within developed recreation areas)
Land use ROWs, special use permits, and utility corridors	Allowable
Livestock grazing	Restricted (restrictions may apply within developed recreation areas)
Facilities	Allowable
Motorized (summer)	Allowable
Motorized (winter)	Allowable
Non-motorized (summer and winter)	Allowable
Mechanical transport	Allowable
Road construction (permanent or temporary)	Allowable
Minerals - leasable (oil and gas, and other)	Restricted (special lease stipulations [i.e., NSO, CSU, TL] may apply to specific resources within MA 4 areas)
Minerals - locatable	Allowable (open to mineral entry per the 1872 Mining Law; however, the exploration and development of mining claims may be subject to restrictions to protect resources)
Minerals - saleable (materials)	Restricted (generally not compatible within developed recreation areas or scenic corridors)

Management Areas in LRMP in Upper Dolores

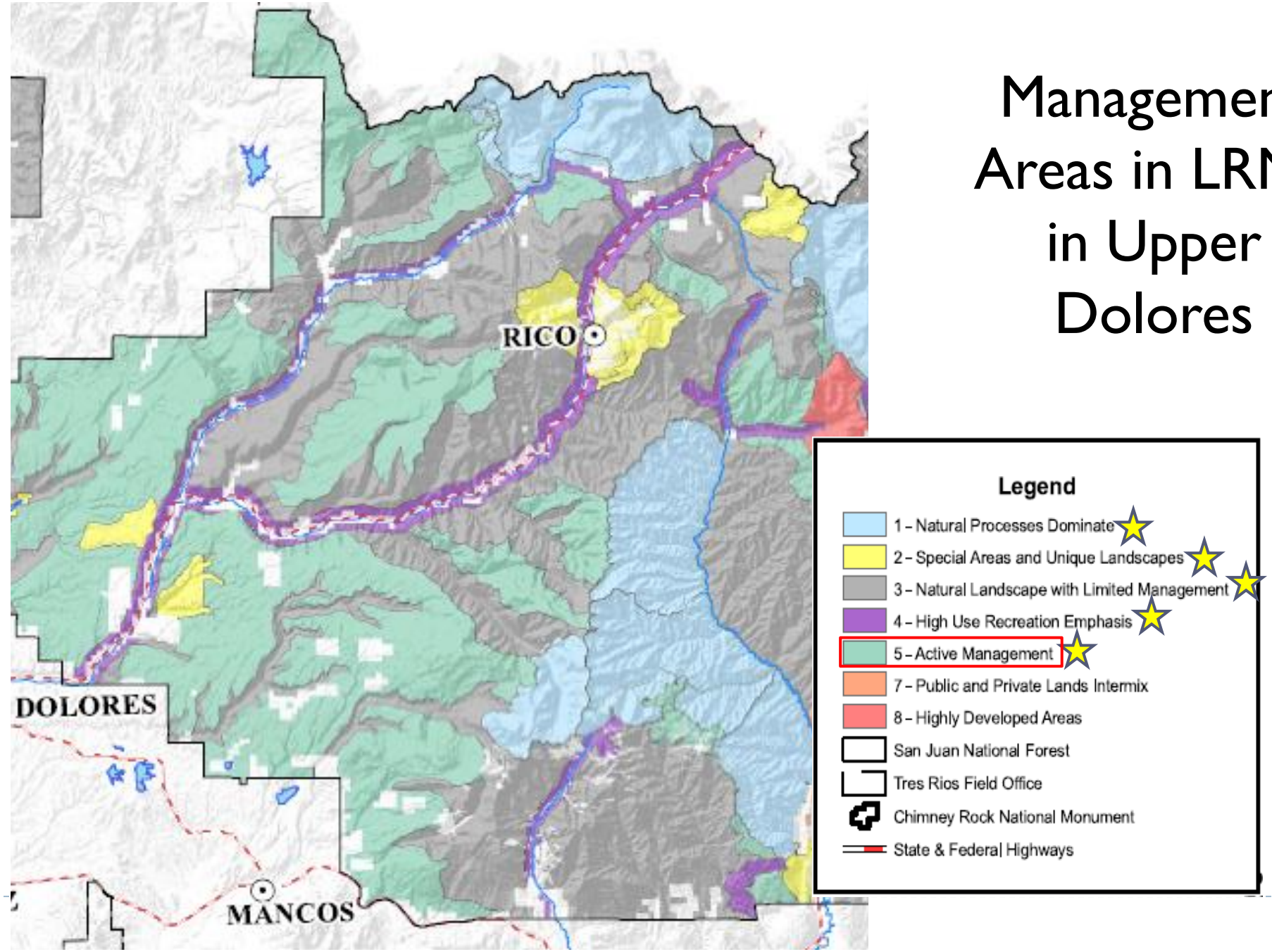


MA5: Active Management

Table 3.5.5: Management Area 5 Allowable Uses

Activities and Uses	Allowable – Restricted - Prohibited
Fire managed for resource benefit	Allowable
Prescribed burning	Allowable
Mechanical fuels treatment	Allowable
Timber production (scheduled on a rotation basis)	Allowable
Timber harvesting as a tool	Allowable
Commercial use of special forest products and firewood	Allowable
Land use ROWs, special use permits, and utility corridors	Allowable
Livestock grazing	Allowable
Facilities	Allowable
Motorized (summer)	Allowable
Motorized (winter)	Allowable
Non-motorized (summer and winter)	Allowable
Mechanical transport	Allowable
Road construction (permanent or temporary)	Allowable
Minerals - leasable (oil and gas, and other)	Allowable (special lease stipulations [i.e., NSO, CSU, TL)] may apply to specific resources within MA 5 areas)
Minerals - locatable	Allowable (open to mineral entry per the 1872 Mining Law; however, the exploration and development of mining claims may be subject to restrictions to protect resources)
Minerals - saleable (materials)	Allowable

Management Areas in LRMP in Upper Dolores

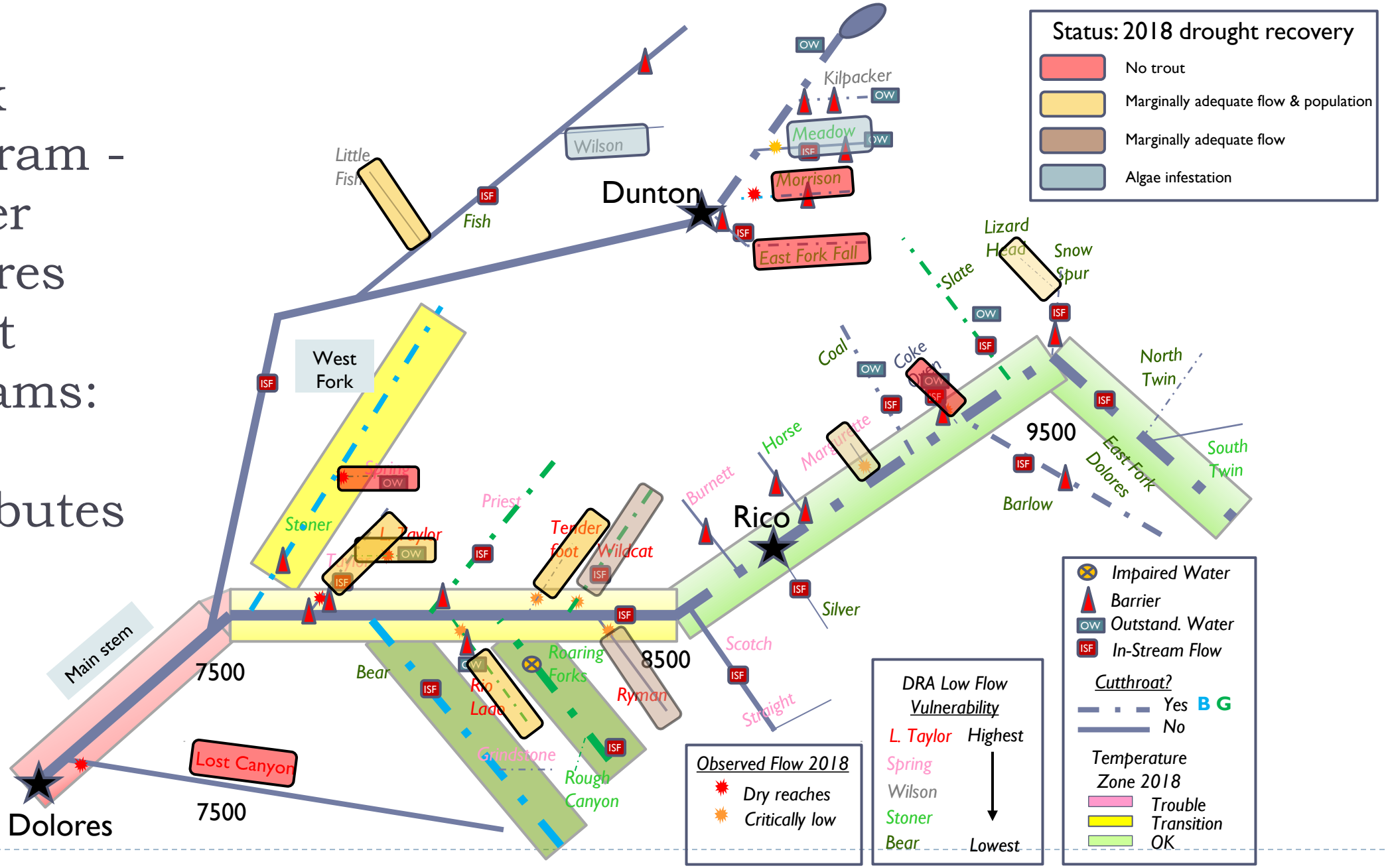


Poll:

1. What general patterns do we see?
2. What big picture strategies emerge?
3. Which streams face the biggest challenges?
4. Which can we feasibly assist given our tool box?
5. What solution set (if any) moving forward?

Take Aways? Action? Moving Forward…

Stick Diagram - Upper Dolores Trout Streams: All Attributes

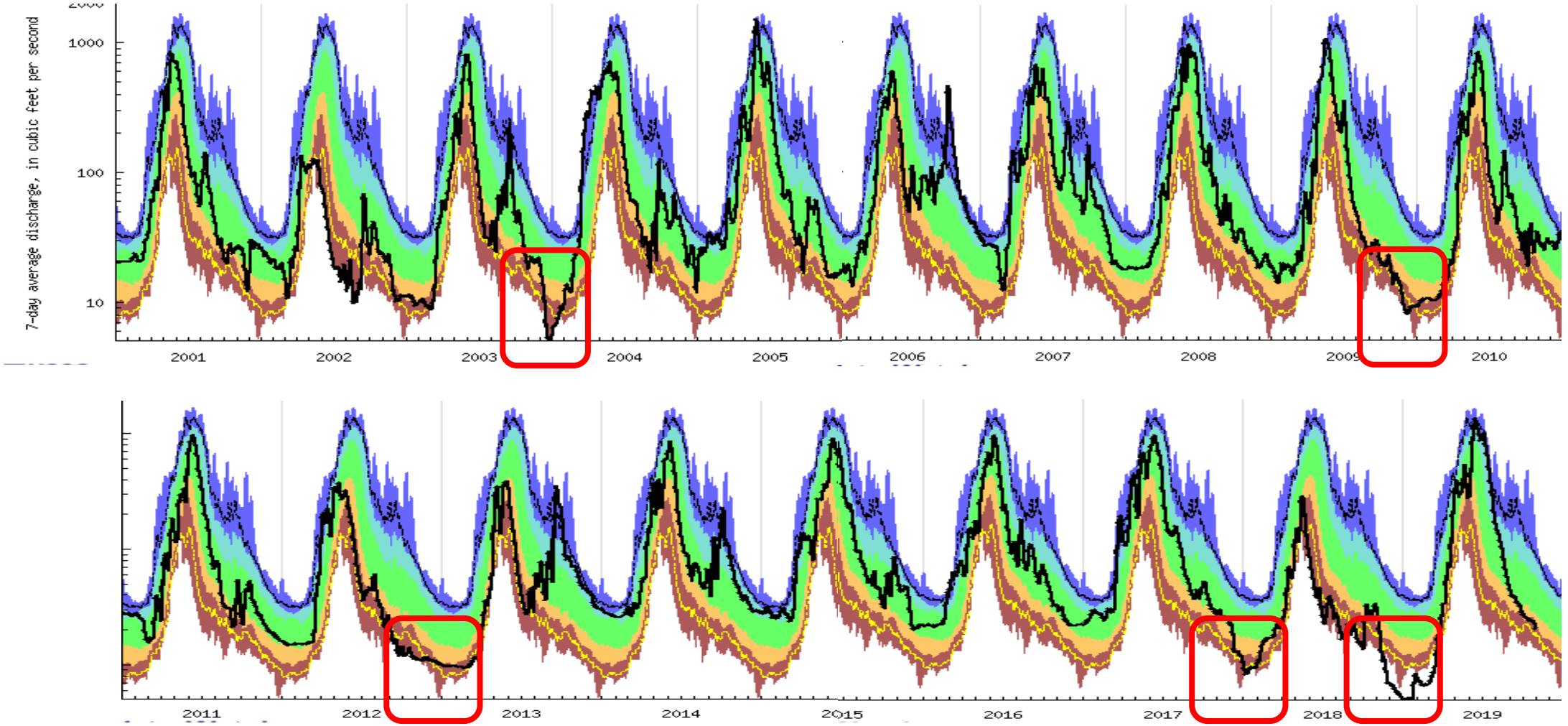



Thanks!

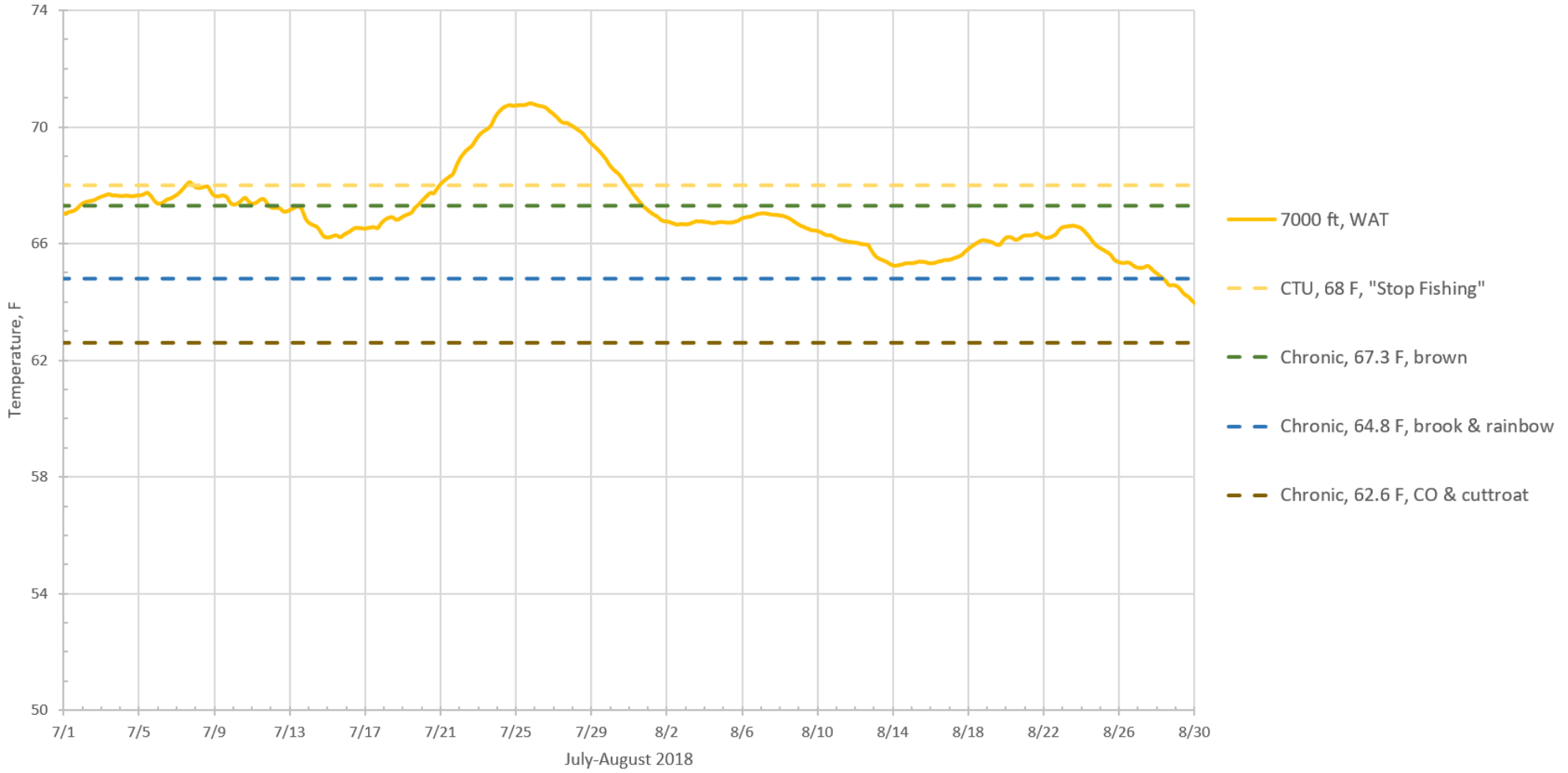
Working List of State, Federal and Local Stream Protection Tools

- **I. State Protection Mechanisms**
  - A. Colorado Instream Flow Program
  - B. Colorado Law and Intergovernmental Agreements
  - C. Gold Medal Waters
  - D. Outstanding Waters
  - E. Stream Management Plans (SMPs)
  - F. CPW/NFS - Fishing Regulations
  - G. CPW/NFS - In/near/associated-stream intervention techniques
- **II. Federal Protection Mechanisms**
- A. U.S. Forest Service ("USFS") Land Management Plans ("LMPs").
  - 1. Management Area Designations (MA 1, MA2, M3)
  - 2. Special Areas and Designations:
    - a. Area of Critical Environmental Concern
    - b. Wildlife Management Area
  - 2. Conservation Watershed Network for Native Fishes
- B. Wild and Scenic Rivers Act of 1968 ("WSR)
- C. Wilderness Designation: Wilderness Act of 1964 ("Wilderness Act")
- D. National Conservation Areas ("NCAs")
- E. Federal Research Areas
- F. Other Federal Legislation (special)
  - 1. (Rio Grande and North St. Vrain Creek)
  - 2. South Platte Protection Plan (WSR suitability determination held in abeyance).
  - 3. Rio Chama Management Plan
- **III. Local/Other**
- A. Conservation Easements
- B. County Land Use Codes
- C. Contractual Arrangements

The 20 Year Flow Picture At Montelores Gauge (7 day Avg)

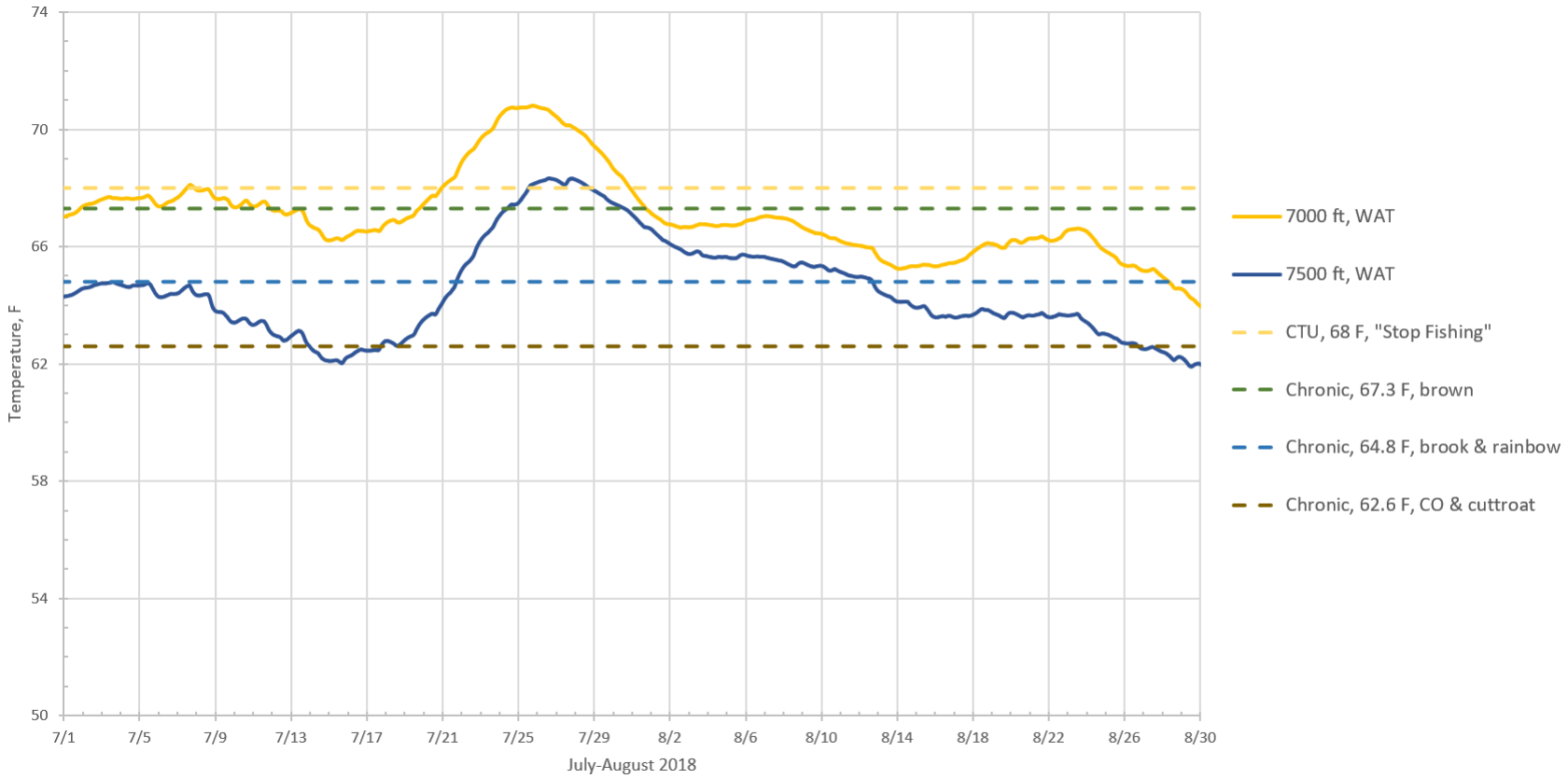


WAT* at 7000 ft, July-August 2018



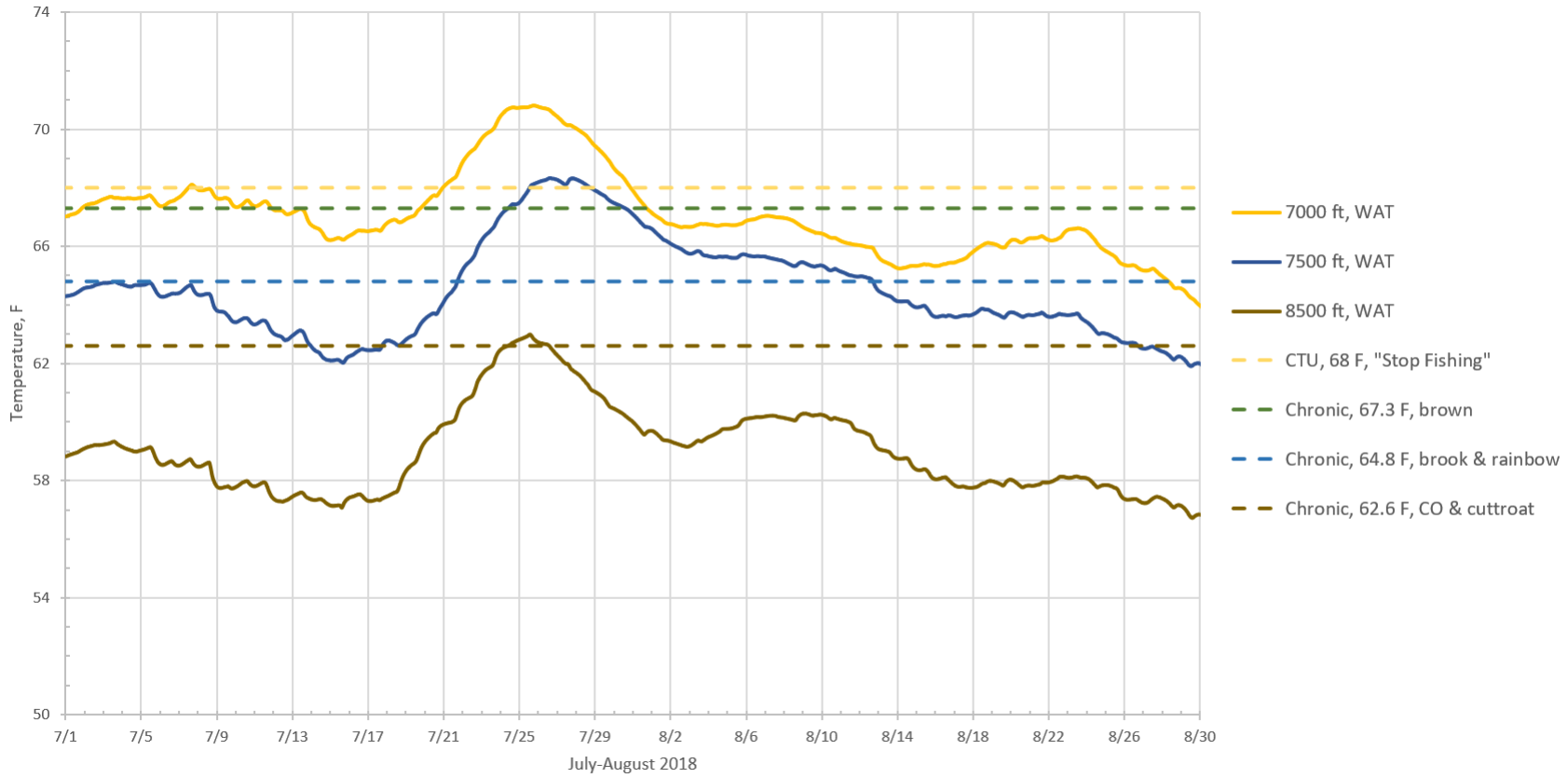
*Weekly Average Temperature

WAT* at 8500 ft, July-August 2018



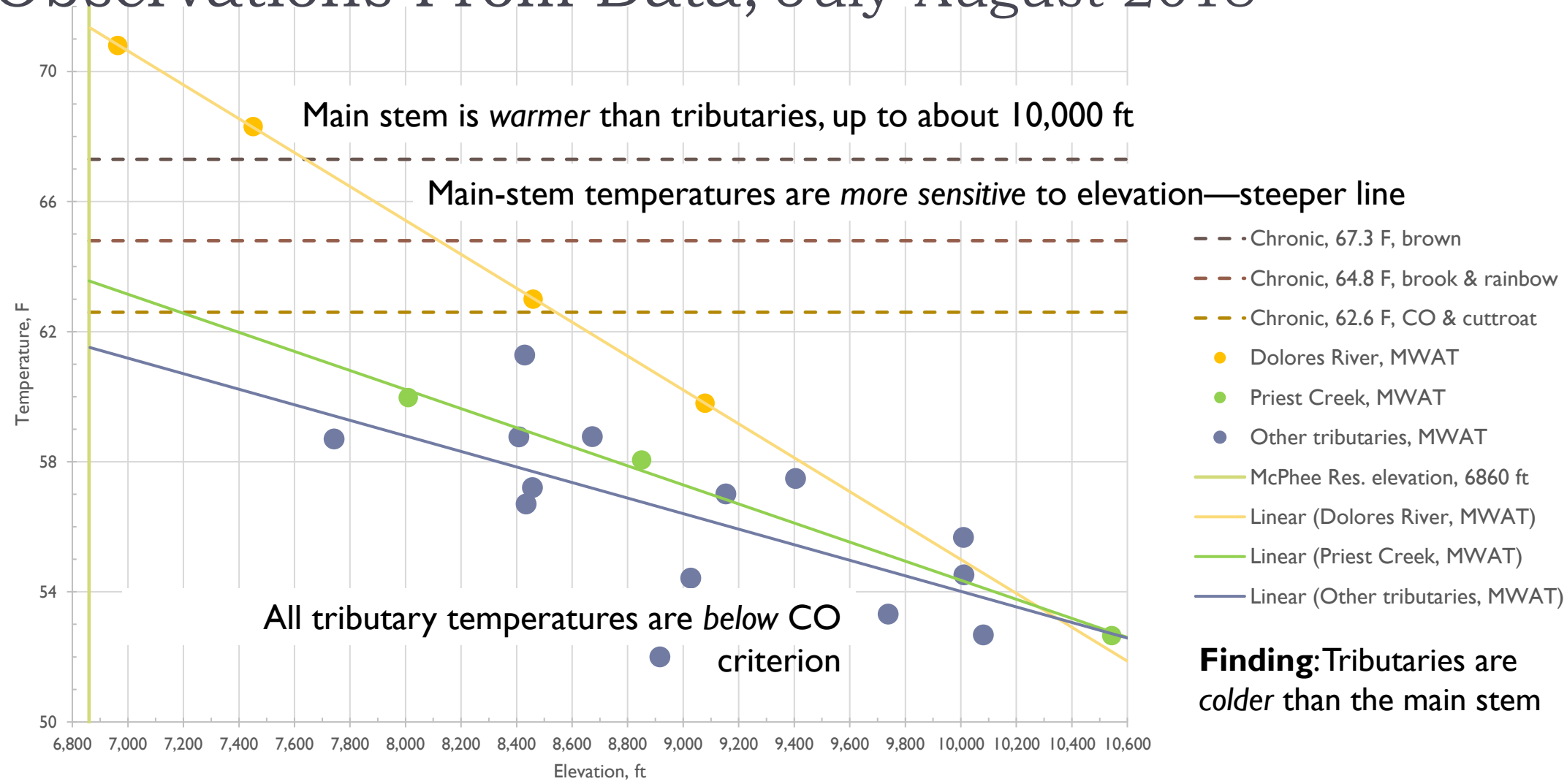
*Weekly Average Temperature

WAT* at 8500 ft, July-August 2018



*Weekly Average Temperature

Observations From Data, July-August 2018



Finding: Tributaries are *colder* than the main stem