Climate Change Vulnerability Assessment

White River National Forest, Colorado

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White River National Forest

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White River National Forest

Introduction:

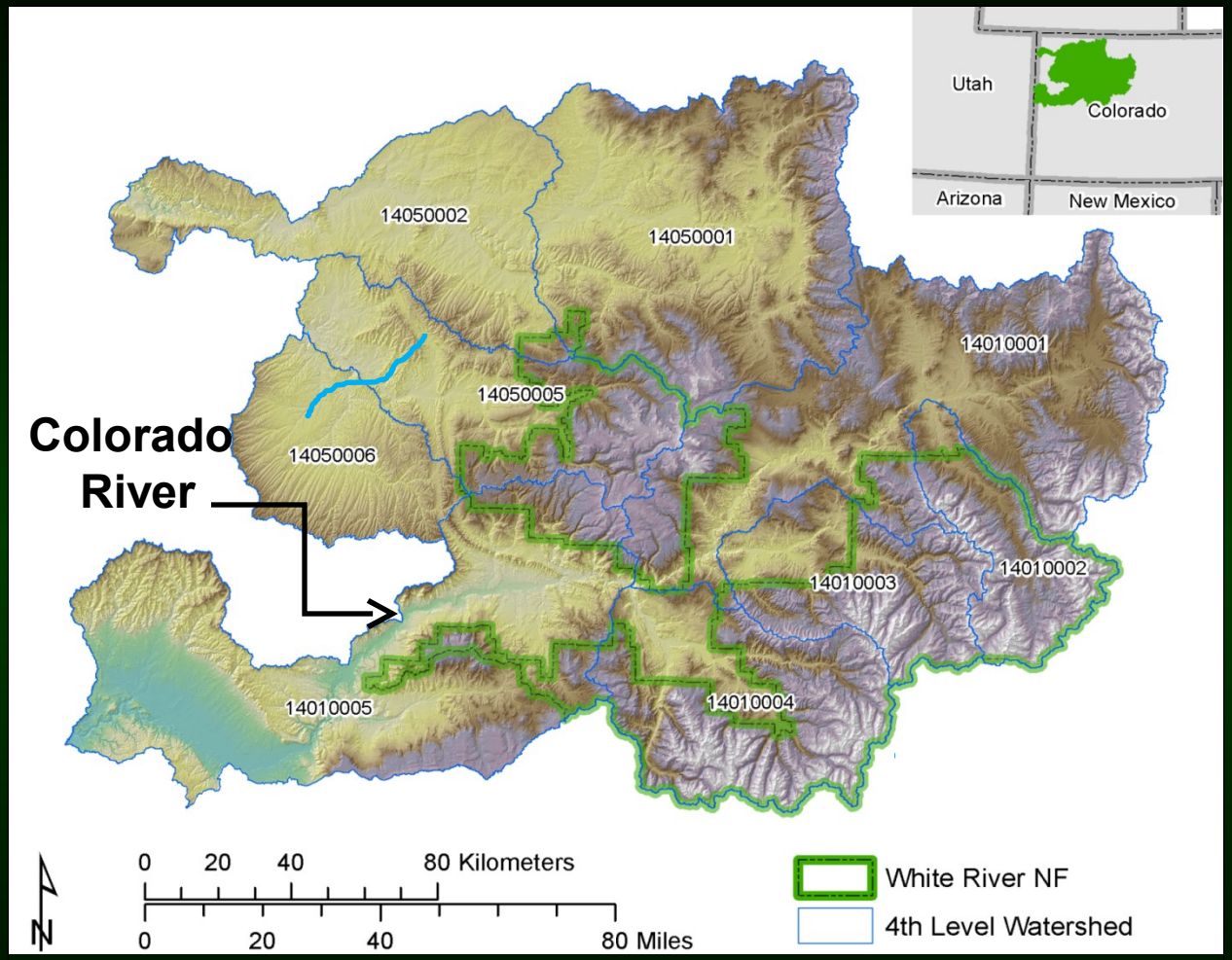
2.3 Million Acres

9,000 ft Elevation Gain

Snow – 11 Ski Areas

Pine Beetle Mortality

166 HUC 6's



Principles:

Focus on Resource Values

Scale: HUC-6

Local Climate Data Provides Context

Analyze Exposure Before Sensitivity

Don't Get Lost in Exposure Data

Keep the End Product in Mind

Values x Exposure x Sensitivity

= Vulnerability

Resource Values Considered:

- Aquatic Habitat
- Water Uses
- Infrastructure

Aquatic Habitat

Resource Values Considered:

Aquatic Habitat: CRCT and Boreal Toads

Water Uses

Infrastructure

Water Uses (Diversions)

Resource Values Considered:

Aquatic Habitat: CRCT and Boreal Toads

Water Uses

Infrastructure

Road – Stream Crossings

Resource Values Considered:

Aquatic Habitat: CRCT and Boreal Toads

Water Uses

Infrastructure

Road – Stream Crossings

Exposure:

- Temperature
- Precipitation
- Runoff

Climate Change in Colorado

A Synthesis to Support Water Resources Management and Adaptation

A REPORT FOR THE COLORADO WATER CONSERVATION BOARD

Colorado
University of Colorado at Boulder

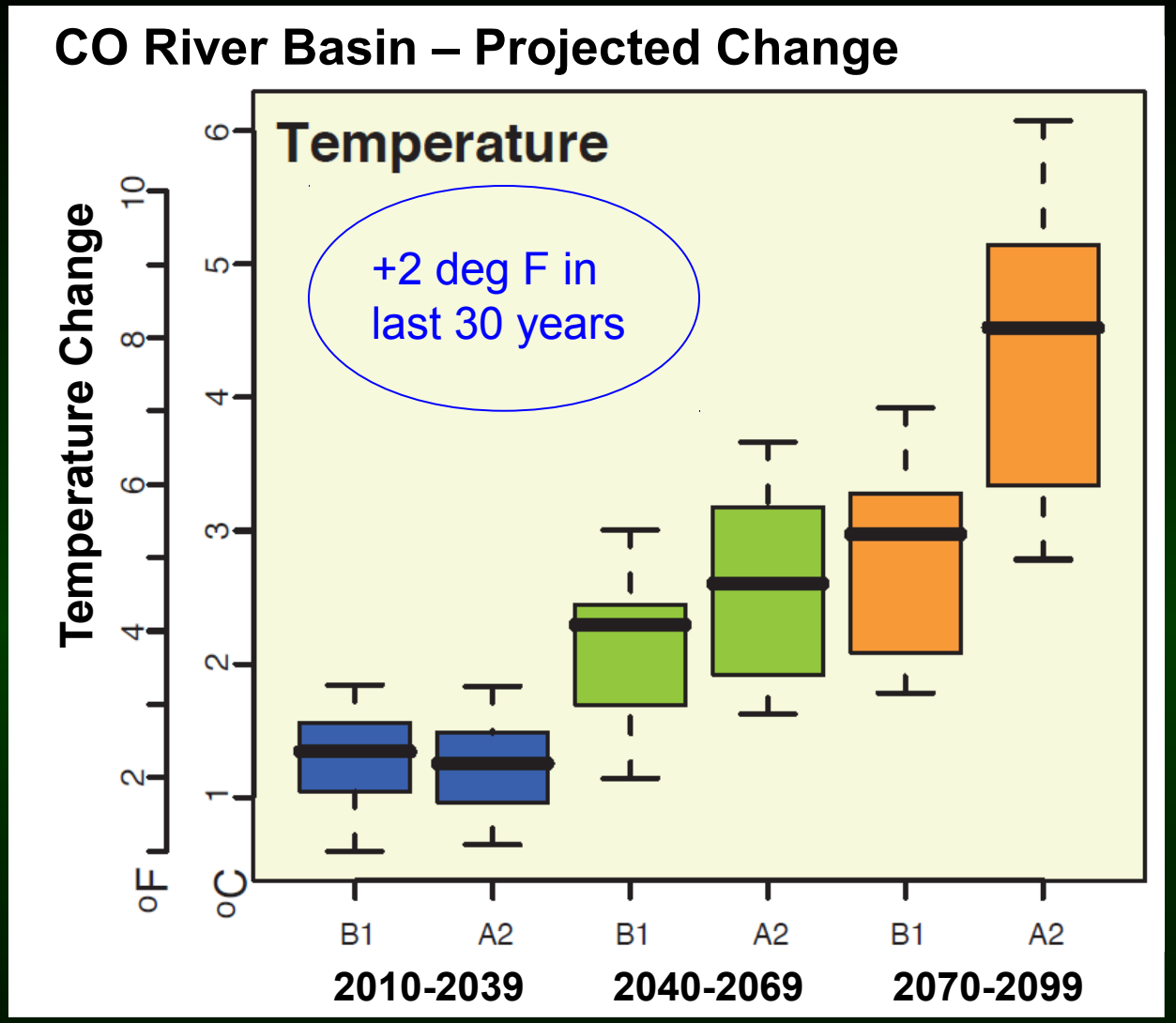
2008

Exposure:

Temperature

Precipitation

Runoff

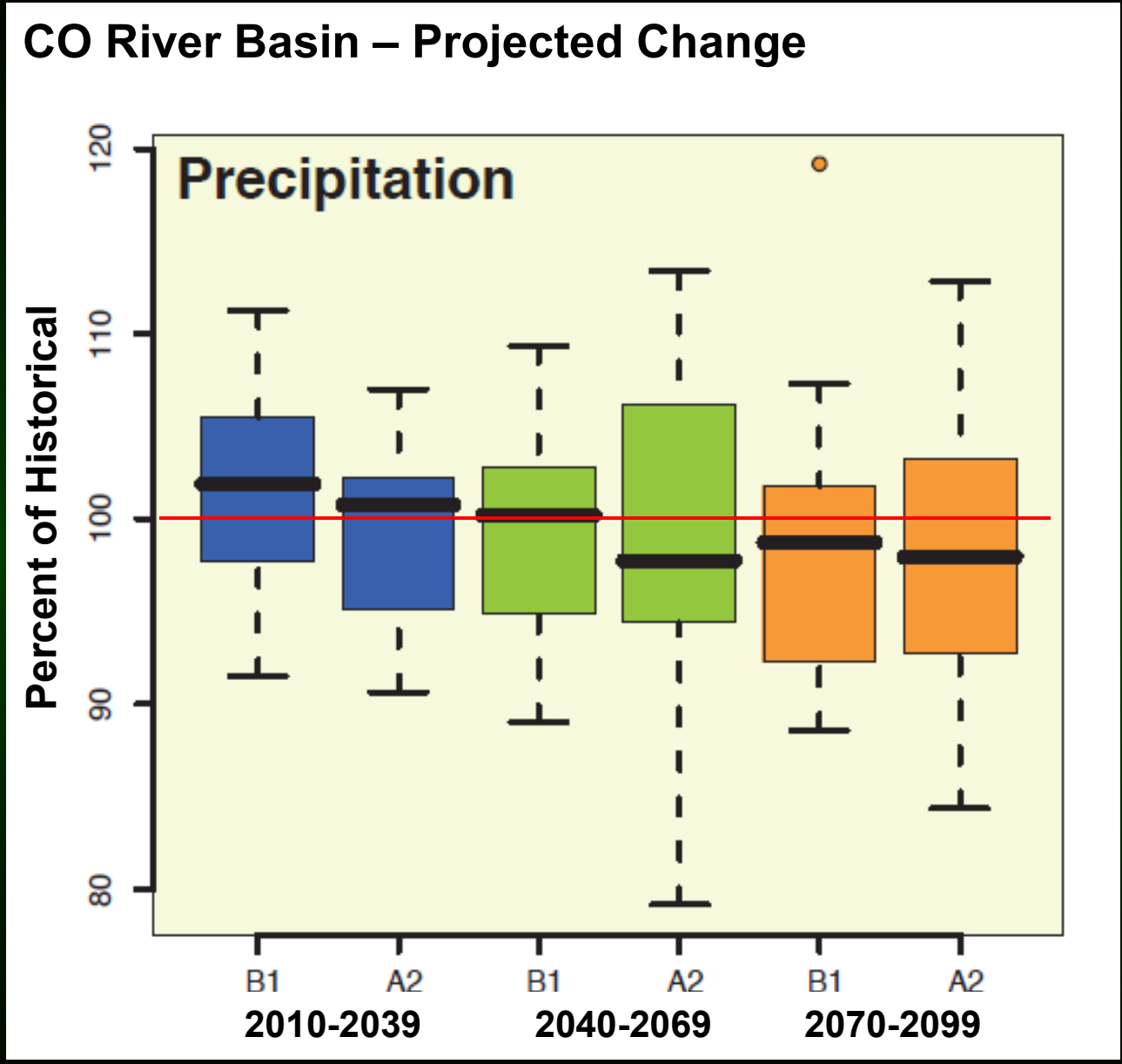


Summers - warm more than winters

Winters - fewer extreme colds months, more extreme warm months

Exposure:

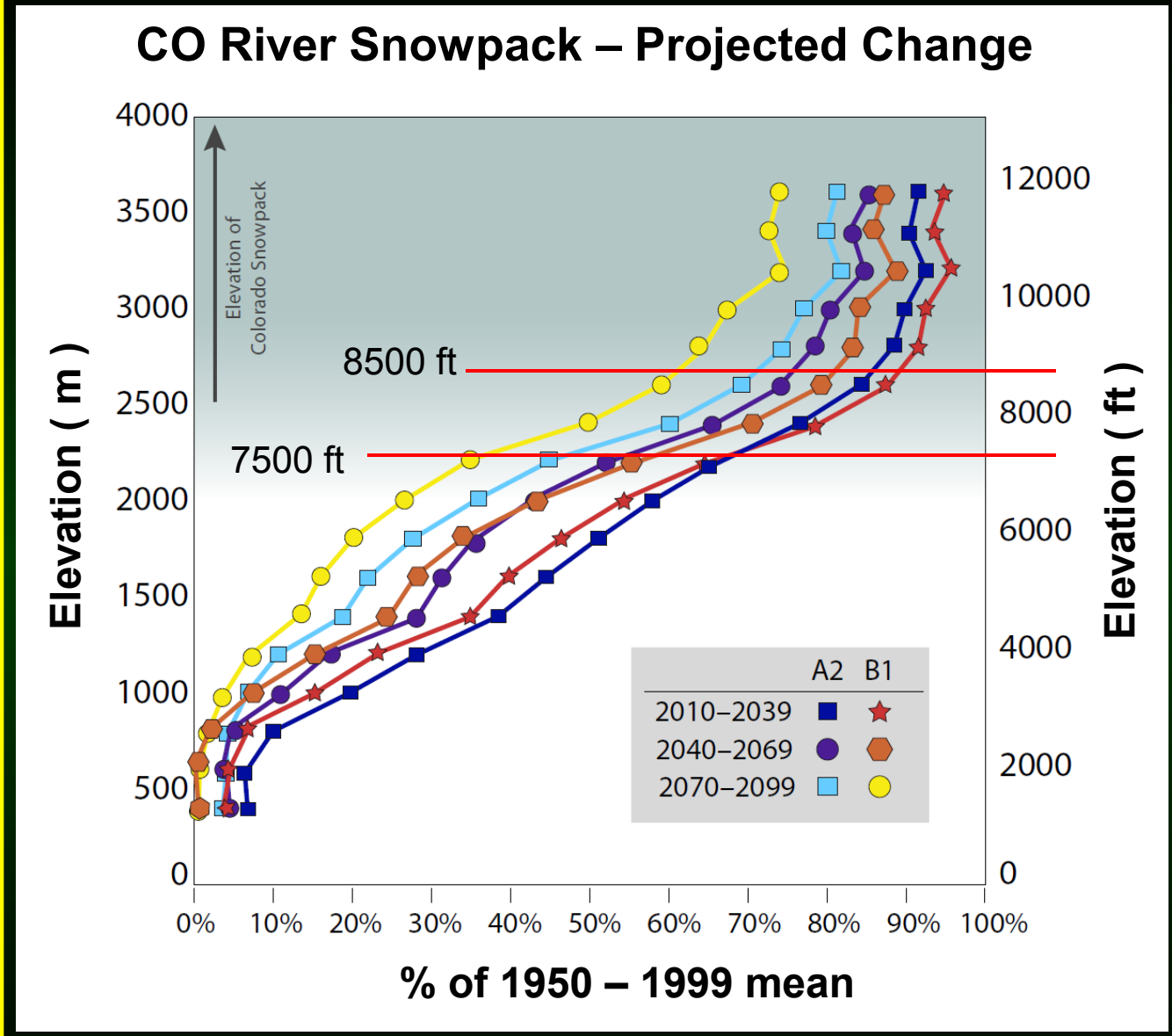
- Temperature
- Precipitation
  - Amount
  - Type
- Runoff



Christensen and Lettenmaier 2007

Exposure:

- Temperature
- Precipitation
  - Amount
  - Type
- Runoff



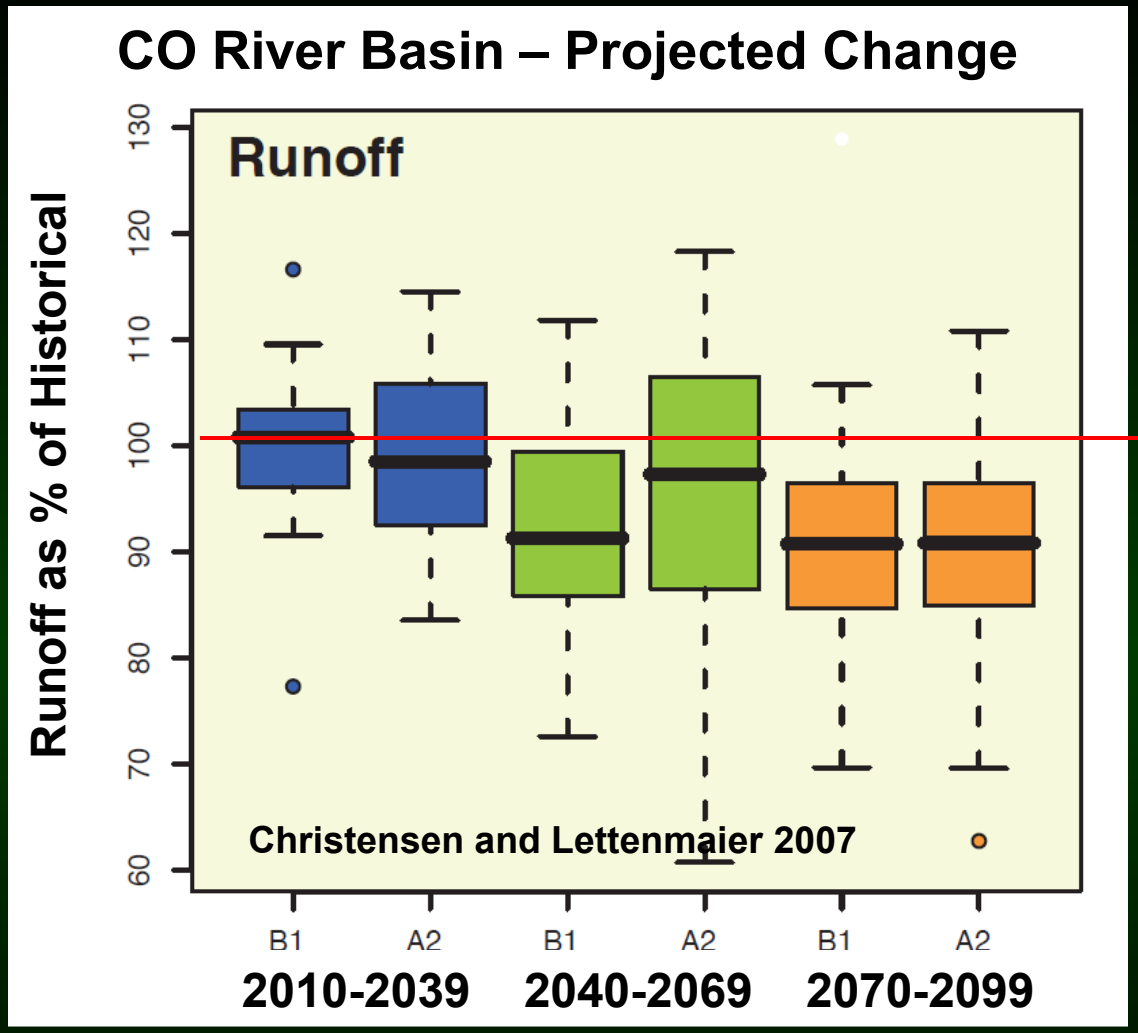
Christensen and Lettenmaier 2007

Exposure:

Temperature

Precipitation

Runoff



Total runoff decrease of 6-20% by 2050

Reduced late summer flows

Spring pulse earlier by 2+ weeks since 1978

Exposure:

Temperature

Precipitation

Runoff

Dirty Snow

Early runoff timing exacerbated by albedo changes from dust

Landscape Drivers:

Increase or Decrease Adaptive Capacity ?

High, Mod or Low Effect ?

Relative Influence ?

What Drivers Buffer/Add to Anticipated Climate Effects?

NATURAL

Geochemistry
Water Production
Hydroclimatic Regime
Aspect
Surface Water/Springs
Glaciation
Pine Beetle Mortality

ANTHROPOGENIC

Water Uses
Development/Roads
Beetle Salvage

Rank HUC 6 Adaptive Capacity

Landscape Drivers:

Increase or Decrease Adaptive Capacity ?

High, Mod or Low Effect ?

Relative Influence ?

VALUE 1: Aquatic Habitat (Cutthroat and Boreal Toads)

NATURAL	
Weighted Precipitation	Buffer
Glaciation	Buffer
Surface Water/Springs	Buffer
South Aspect	Additive
Transient Snow Zone	Additive
Calcareous Geology	Buffer
Pine Beetle Mortality	Buffer (short term)
ANTHROPOGENIC	
Road Density	Additive
Water Uses	Additive

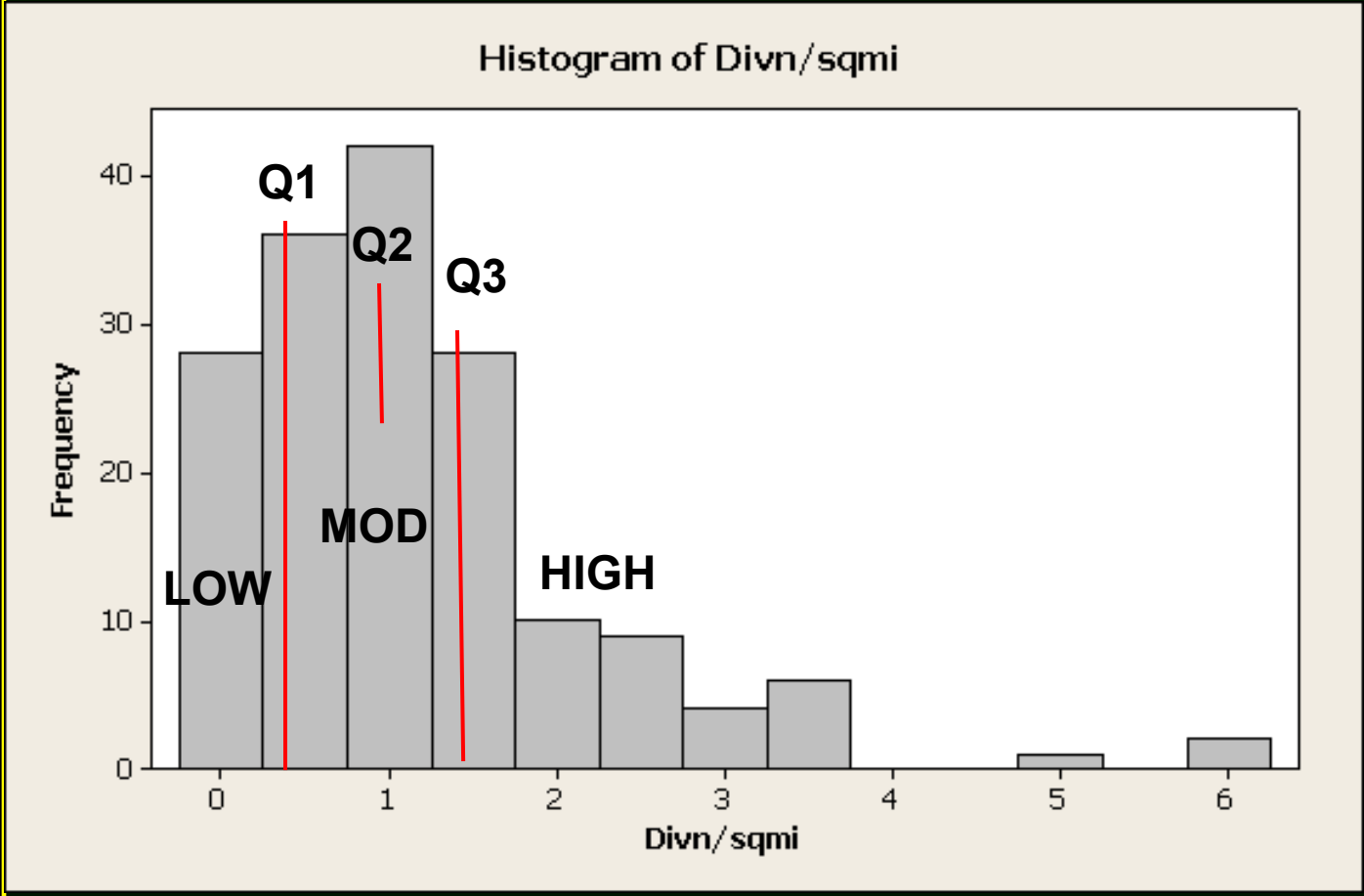
Landscape Drivers:

Increase or Decrease Adaptive Capacity ?

High, Mod or Low Effect ?

Relative Influence ?

Driver Ranking – High, Medium or Low ?



Example : water uses

Landscape Drivers:

Increase or Decrease Adaptive Capacity ?

High, Mod or Low Effect ?

Relative Influence ?

Relative Influence

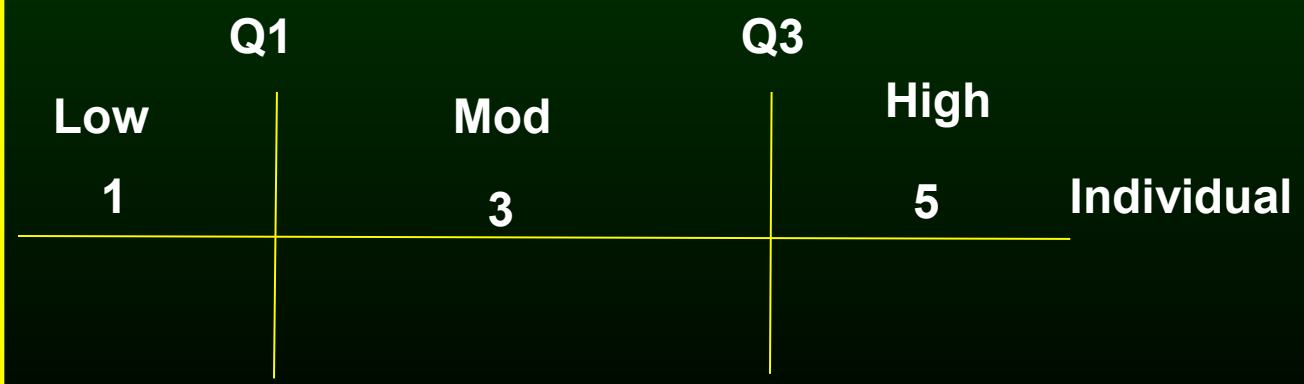
NATURAL	
Weighted Precipitation	1.00
Glaciation	0.75
Surface Water/Springs	1.00
South Aspect	0.50
Transient Snow Zone	1.00
Calcareous Geology	0.25
Pine Beetle Mortality	0.50
ANTHROPOGENIC	
Road Density	0.50
Water Uses	1.00
Beetle Salvage	0.50

Results – Aquatic Habitat:

Amalgamation of Rankings

6th HUC	Wtd Precip		Waterbodies		South Aspect		7500-8500 elev		Road Density		Water Uses		Overall Sensitivity	
	inches	Rank	#/sq.mi	Rank	percent	Rank	percent	Rank	mi/sq.mi	Rank	No./sq.mi	Rank	Average	Rank
140100010801	27.88	3	0.87	3	26.1	1	3.0	3	0.24	1	0.14	1	2.00	L
140100010802	22.55	3	1.20	3	26.0	1	26.1	3	0.42	3	0.93	3	2.67	M
140100010803	19.98	5	1.46	3	28.0	3	32.5	3	0.51	3	1.68	5	3.67	M
140100010903	24.86	3	2.41	1	26.3	1	10.7	3	0.80	5	1.50	3	2.67	M
140100010904	17.77	5	0.82	3	29.9	5	41.2	5	0.72	5	1.21	3	4.33	H
140100010906	16.15	5	0.26	5	31.0	5	37.1	5	0.21	1	0.94	3	4.00	H
140100011101	28.74	3	1.81	3	27.8	3	25.6	3	0.24	1	0.74	3	2.67	M
140100011102	25.53	3	0.67	3	27.6	3	27.0	3	0.51	3	0.94	3	3.00	M
140100011201	44.38	1	5.48	1	28.0	3	0.0	1	0.04	1	0.36	3	1.67	L
140100011202	41.61	1	4.16	1	26.3	1	0.4	1	0.39	3	0.33	1	1.33	L
140100011203	23.73	3	0.43	5	24.8	1	35.7	5	0.88	5	0.90	3	3.67	M

Overall HUC Ranking

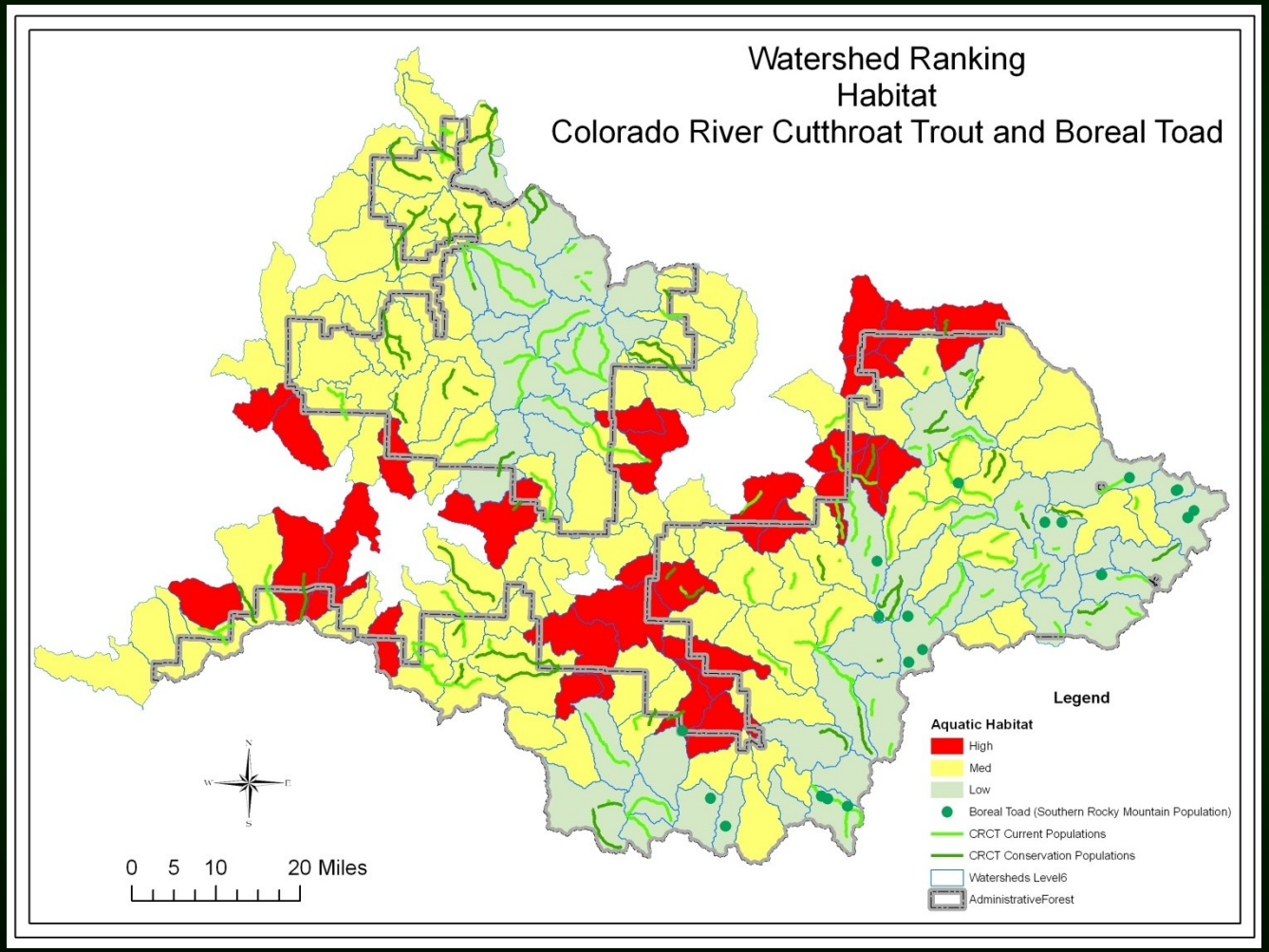


Results – Aquatic Habitat:

Overall HUC Ranking

Map Results

One Possible Outcome



Landscape Drivers:

Increase or Decrease Adaptive Capacity ?

High, Mod or Low Effect ?

Relative Influence ?

VALUE 2: Water Uses

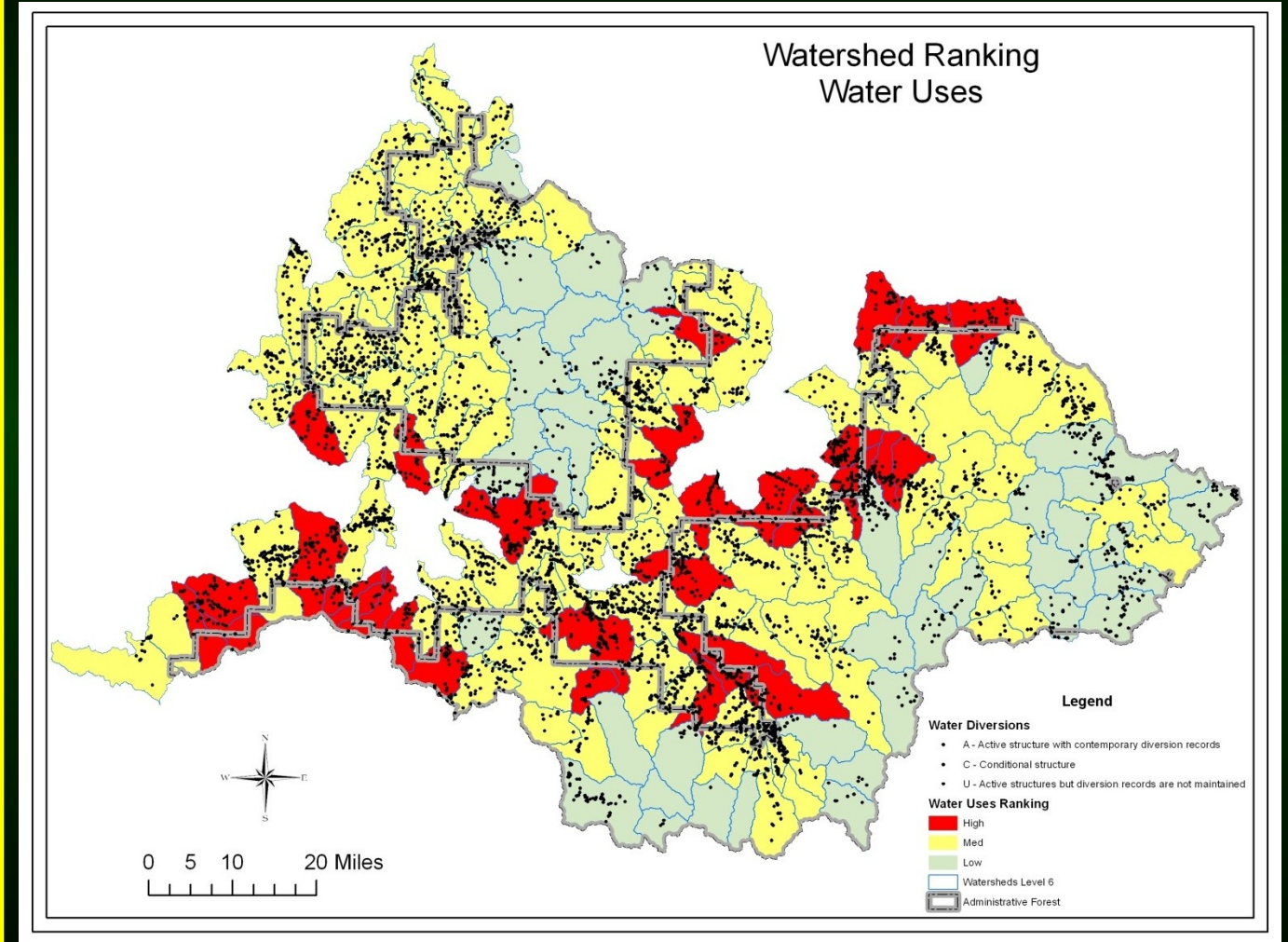
NATURAL	
Weighted Precipitation	Buffer
Glaciation	Buffer
Surface Water/Springs	Buffer
South Aspect	Additive
Transient Snow Zone	Additive
Pine Beetle Mortality	Buffer (short term)
ANTHROPOGENIC	
Road Density	Additive

Results – Water Uses:

Overall HUC Ranking

Map Results

Another Possible Outcome



Landscape Drivers:

Increase or Decrease Adaptive Capacity ?

High, Mod or Low Effect ?

Relative Influence ?

VALUE 3: Infrastructure (Road-Stream Crossings)

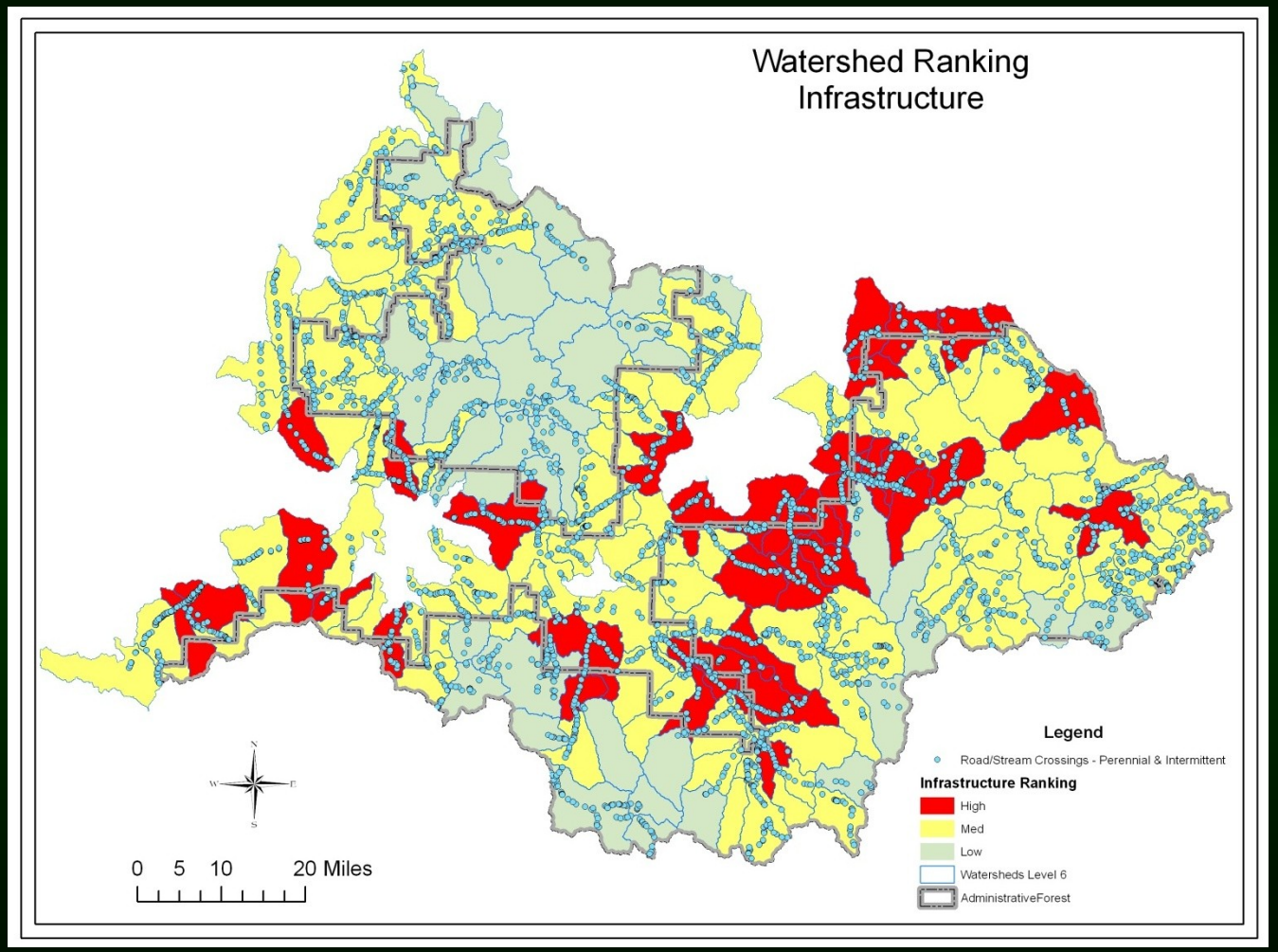
NATURAL	
Weighted Precipitation	Buffer
Surface Water/Springs	Buffer
South Aspect	Additive
Transient Snow Zone	Additive
Pine Beetle Mortality	Additive (short term)
ANTHROPOGENIC	
Road Density	Additive
Water Uses	Buffer (Reservoirs?)

Results – Infrastructure (road-stream crossings):

Overall HUC Ranking

Map Results

Yet Another Possible Outcome



So What?:

Limited Sphere of Influence

Focus on Anthropogenic Influences

Back to Ecological and Anthropogenic Drivers…

NATURAL

Geochemistry
Water Production
Hydroclimatic Regime
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Roads
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So What?:

Limited Sphere of Influence

Focus on Anthropogenic Influences

e.g. Aquatic Habitat: What Can We Affect?

Water Uses

- Contest Water Rights
- Anticipate Storage Proposals
- Augment Flows (CWT)

Roads

Beetle Salvage

So What?:

Limited Sphere of Influence

Focus on Anthropogenic Influences

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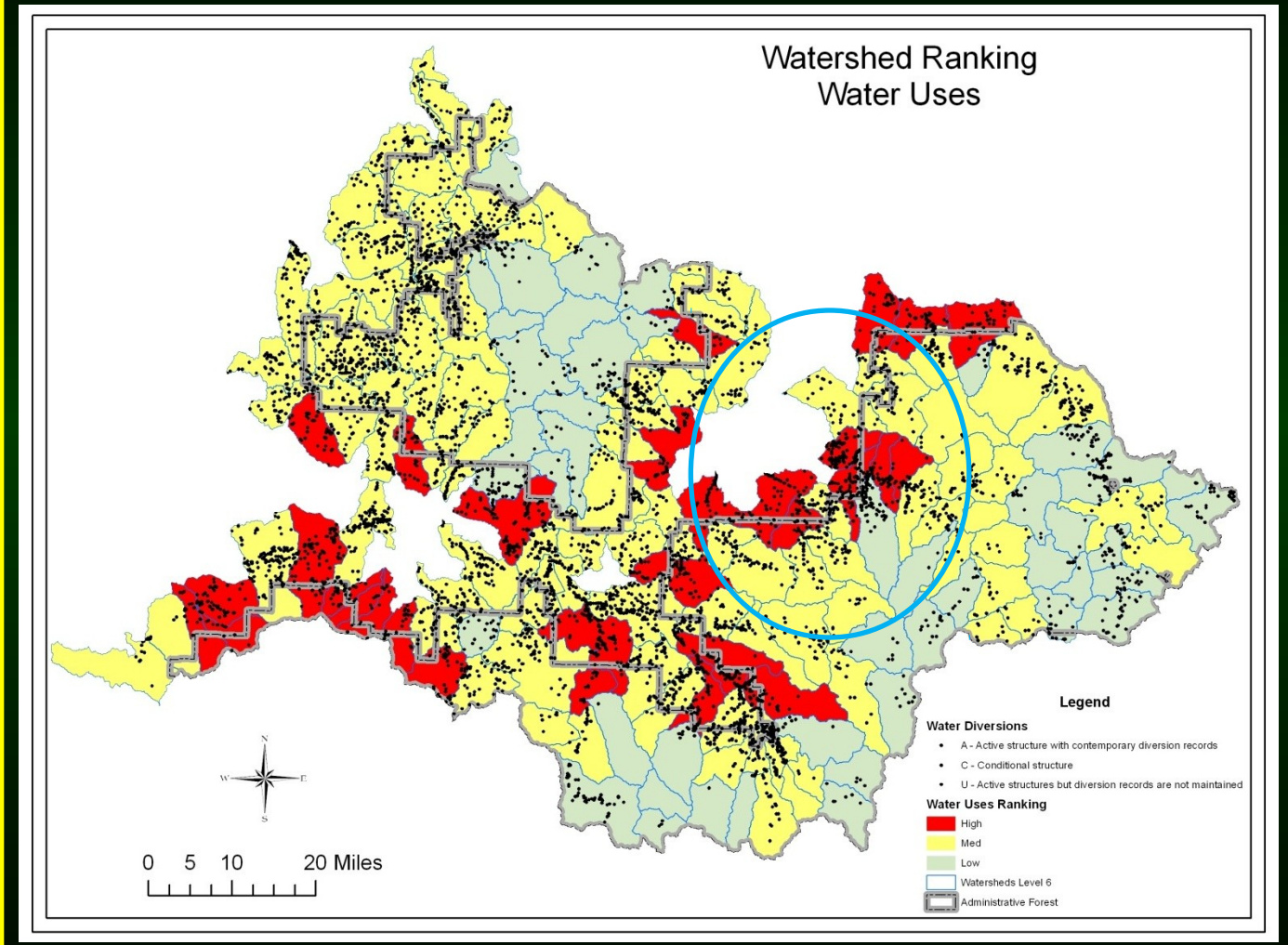
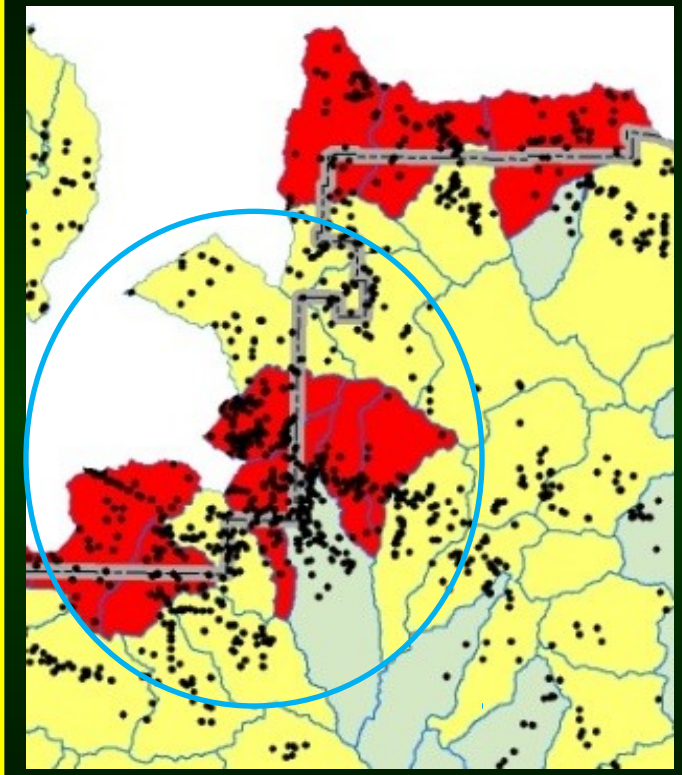


So What?:

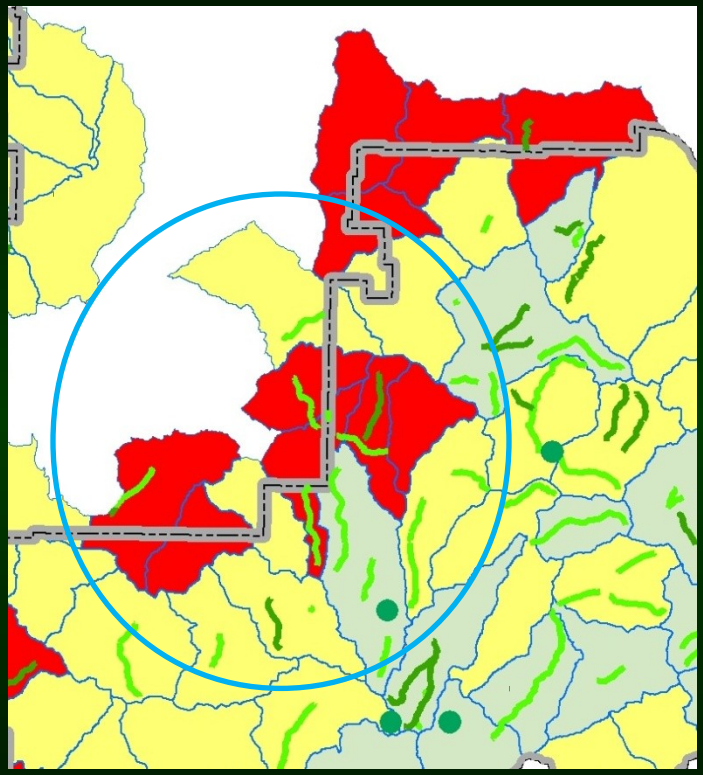
Limited Sphere of Influence

Focus on Anthropogenic Influences

Colorado Water Trust ?



Water Uses



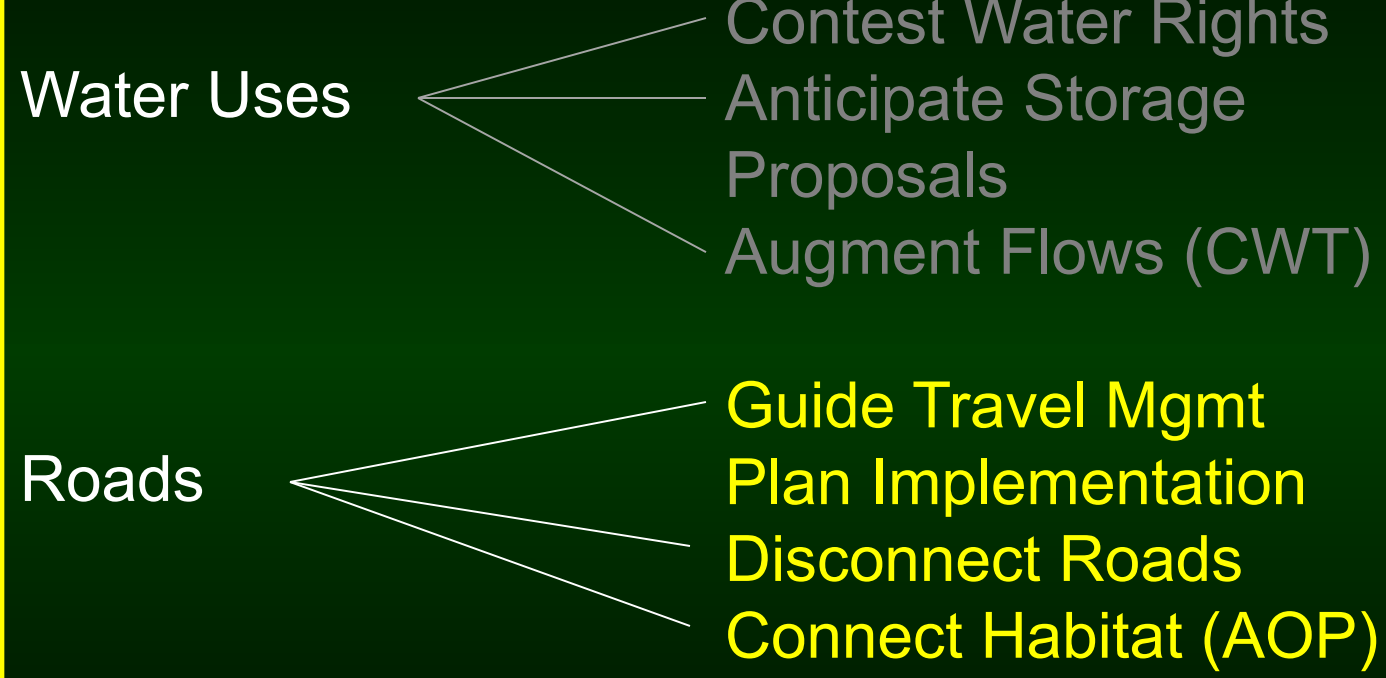
Cutthroat Populations

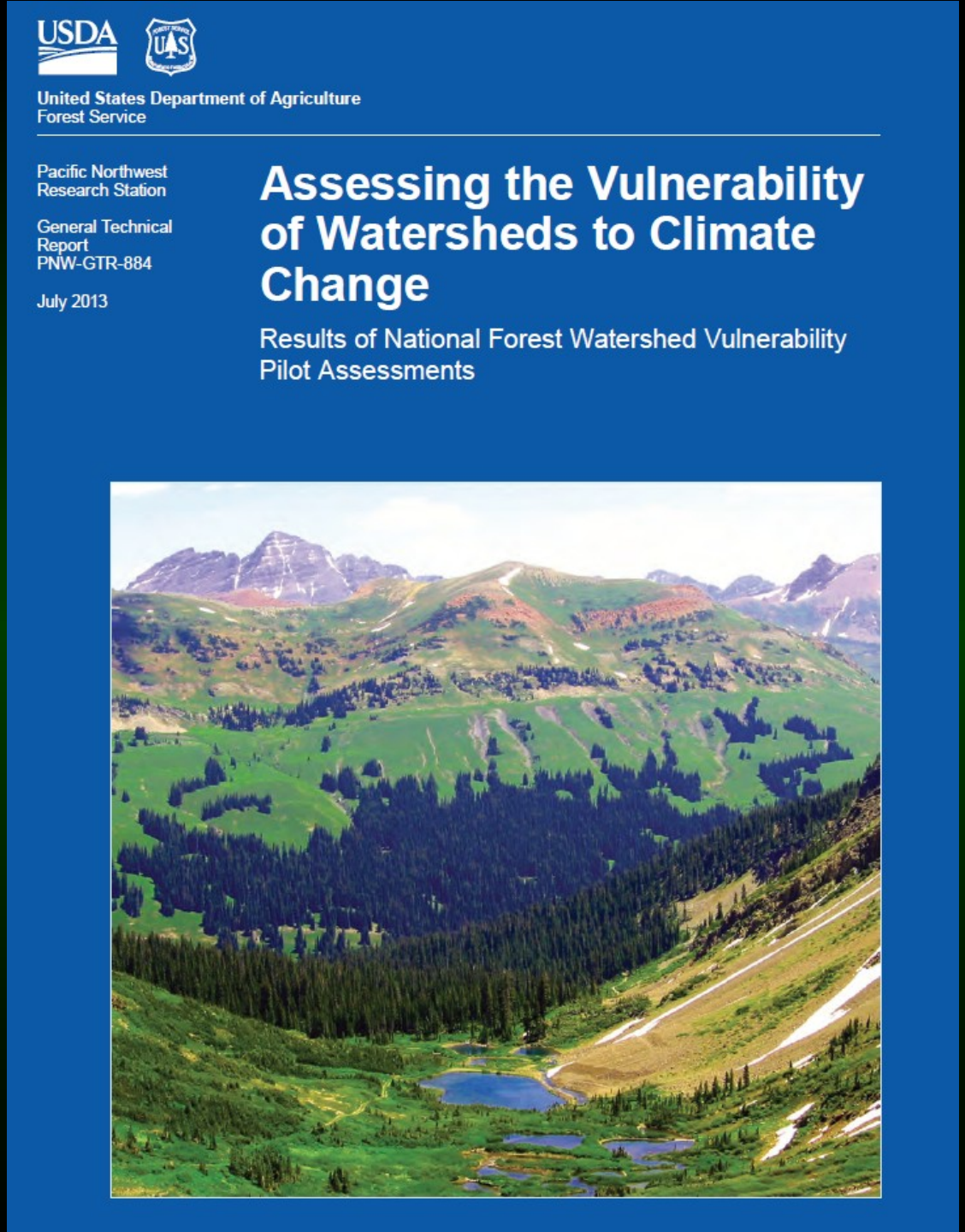
So What?:

Limited Sphere of Influence

Focus on Anthropogenic Influences

e.g. Aquatic Habitat: What Can We Affect?





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