Municipal Drought Planning Toolbox Workshop

Glenwood Springs, CO
June 14, 2011

Workshop Objectives

- Overview of the State's perspective on Drought Planning
- Walk through of the CWCB's Drought Planning Toolbox
- Ideas on incorporating uncertainty into drought planning
- Overview of CWCB Drought Planning Guidance Document and Sample Plan

After this day, attendees should

- Feel comfortable using the tools that the CWCB provides for local drought planning
- Understand what CWCB views as essential elements of drought planning

Schedule for the Day

9-9:15	Welcome, Introductions & Workshop Objectives
9:15 -9:45	Drought: Colorado's Silent Natural Hazard
9:45- 10:10	Highlights of the State Drought Plan Revision
10:10-10:35	What the Statewide Vulnerability Assessment Tells us About Your Community
10:35- 11:00	*Break*
11:00-11:45	Planning Tools for Local Water Providers -I
11:45- 12:30pm	Climate Change
12:30-1:15	*LUNCH (Provided)*
1:15 -1:45	Planning Tools for Local Water Providers - II
1:45-3	CWCB Municipal Drought Planning Guidance Document
3-3:20	*Break*
3:20-4:30	Mock Drought Scenario Exercise
4:30-4:45	Resources Available to Help You & Next Steps
4:45-5pm	Questions & Wrap Up

Drought Colorado's Silent Natural Hazard

Nolan Doesken, Colorado Climate Center

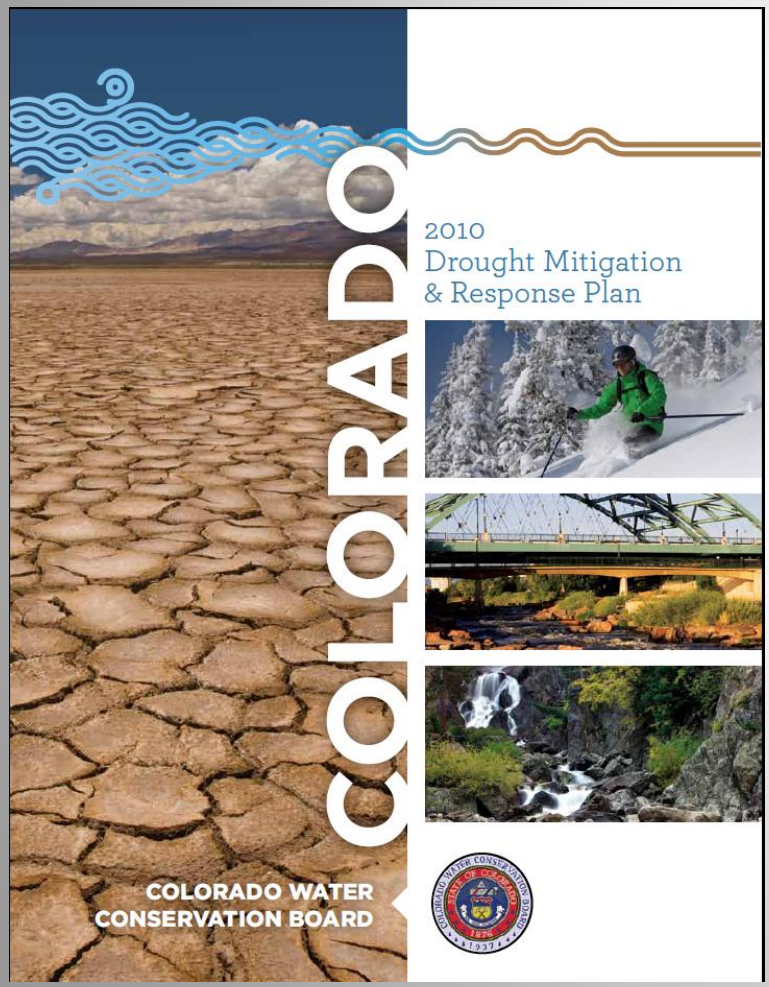
COLORADO CLIMATE CENTER

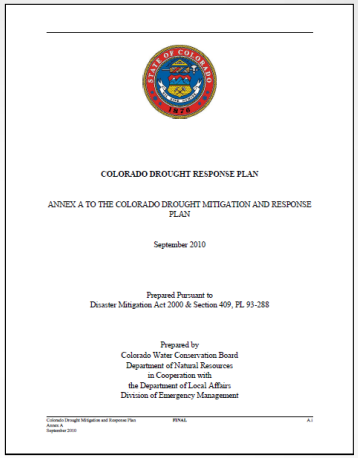
Questions?

Highlights of the State Drought Plan Revision & Key Improvements

Veva Deheza, CWCB

Drought Mitigation and Response Plan

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September 2010

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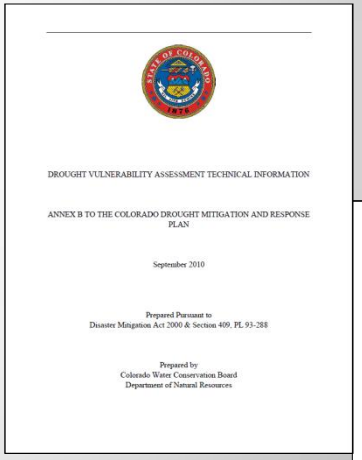
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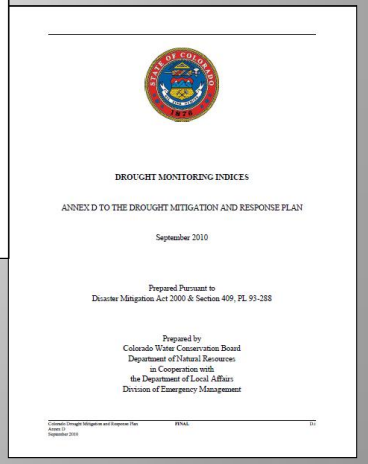
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Drought Monitoring Indices

Benefits of the Newly Revised Drought Plan

- Reduced Losses (economic, social, physical, etc..)
- Efficient, Coordinated Government
- Reduced Liability
- Reduced State and Local Expenditures
- Includes Continued Eligibility for Mitigation Funding
- Increased Collaboration

Drought Mitigation and Response Plan Goals

1. Improve Water Availability Monitoring and Drought Impact Assessment
2. Increase Public Awareness and Education
3. Support Substitute Water Supply Plans and Leasing Options to Augment Water Supply
4. Coordinate and Provide Technical Assistance for State, Local, and Watershed Planning Efforts
5. Reduce Water Demand/Encourage Conservation
6. Reduce Drought Impacts to Colorado's Economy, People, State Assets, and Environment.
7. Develop Intergovernmental and Interagency Stakeholder Coordination
8. Evaluate Potential Impacts from Climate Change

Key Changes in the 2010 Plan Revision

Planning Process

- Extensive planning effort documented
- Multi-agency outreach and coordination
- More clearly defined and revised plan maintenance process

Vulnerability Assessment

- Revised with latest climate science
- Developed drought vulnerability methodology
- Includes EMAP consequence analysis
- Updated drought indices

Key Changes in the 2010 Plan Revision

Coordination of Local Mitigation Planning

- Information revised with changes and assistance provided in past 3 years

Mitigation Strategy

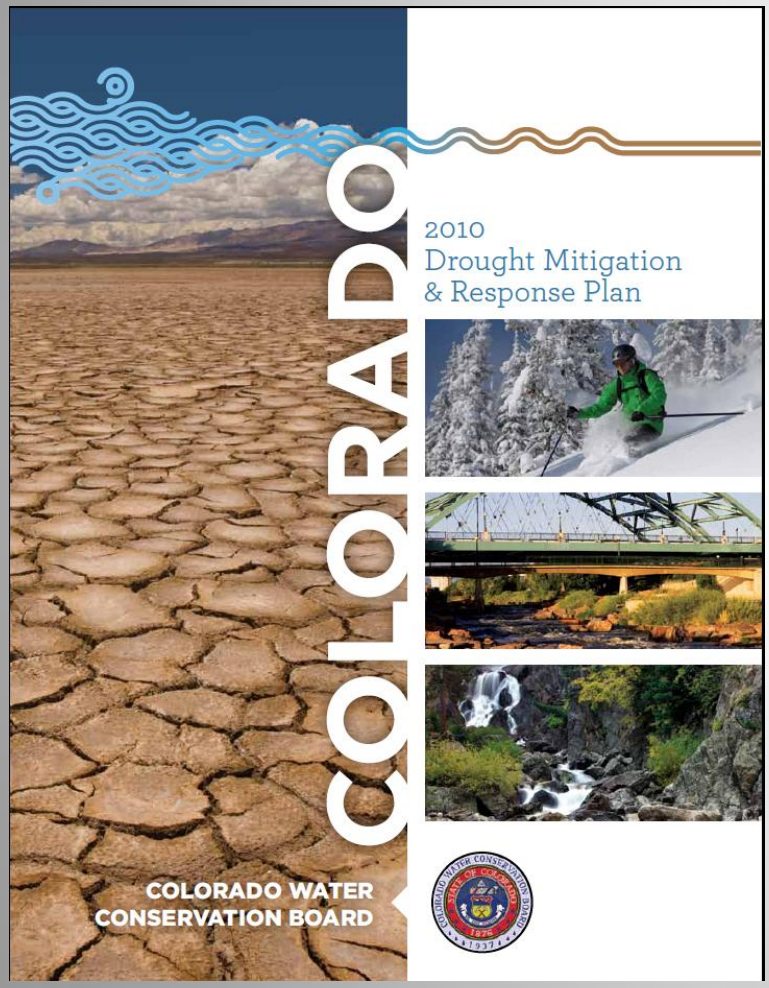
- Goals re-assessed and revised to reflect current priorities
- Mitigation Action table expanded and organized by goal
- Actions revised and prioritized
- New actions developed
- Comprehensive capability assessment review
- Funding sources revised

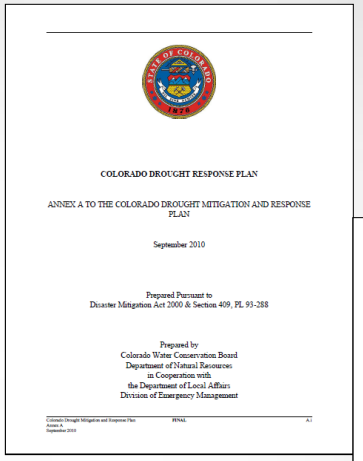
Key Changes in the 2010 Plan Revision

Drought Response Plan Annex

- Response elements from 2002 plan consolidated in Annex.
- NIMS compliant response and recovery plan format
- Streamlined response framework
- Consolidated Impact Task Force framework

Drought Mitigation and Response Plan

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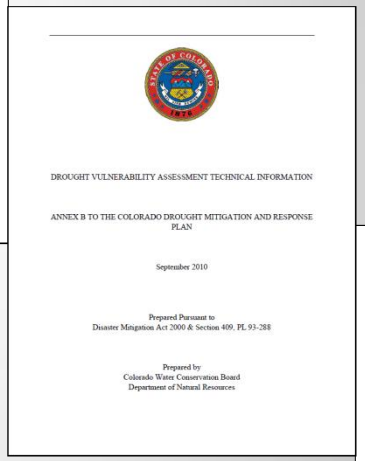
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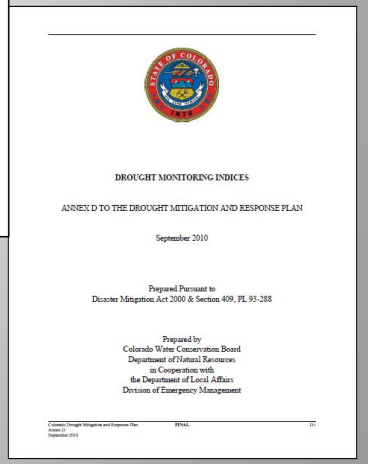
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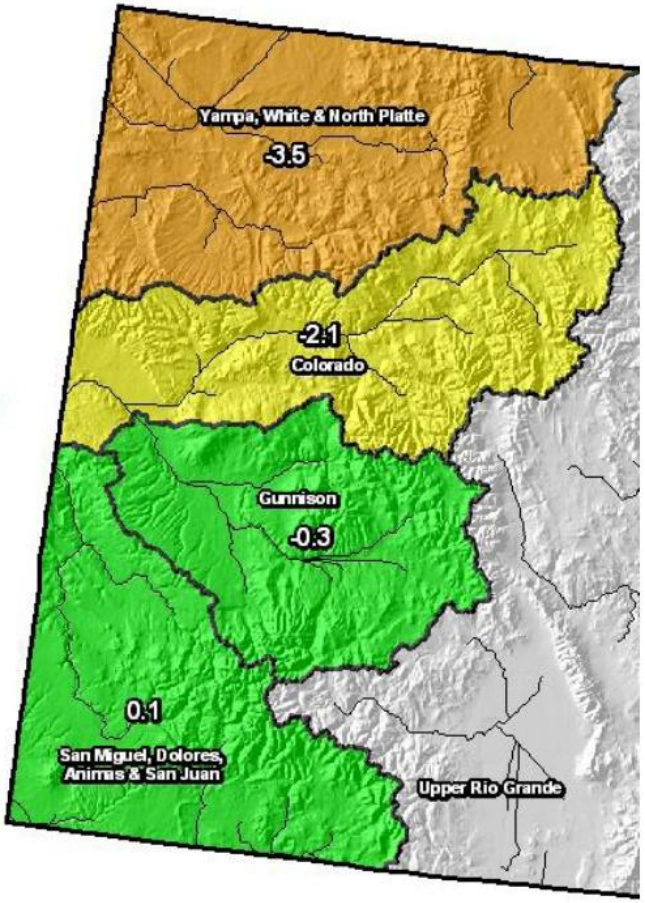
Drought Monitoring Indices

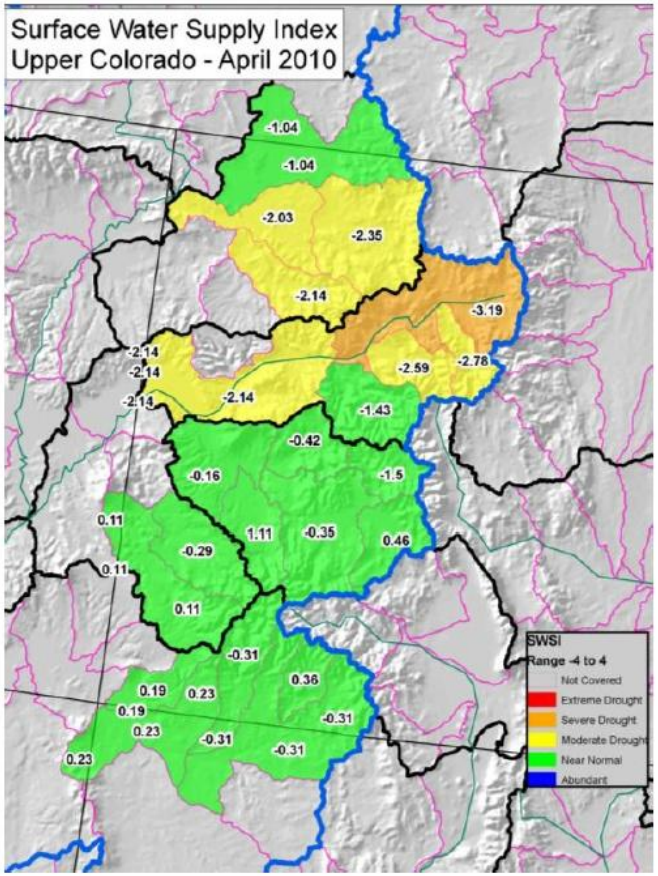
Drought Monitoring Indices

- Drought Indicators historically used for activation and deactivation of the Colorado Drought Response Plan:
  - Surface Water Supply Index (SWSI)
  - Palmer Drought Severity Index (PDSI)
  - Standardized Precipitation Index (SPI)
- Goals of this work
  - Modernize the SWSI index for Colorado
  - Analyze the effectiveness of the Colorado Modified Palmer Drought Index (CMPDI)

Comparison of Old and New Surface Water Supply Index – April 2010

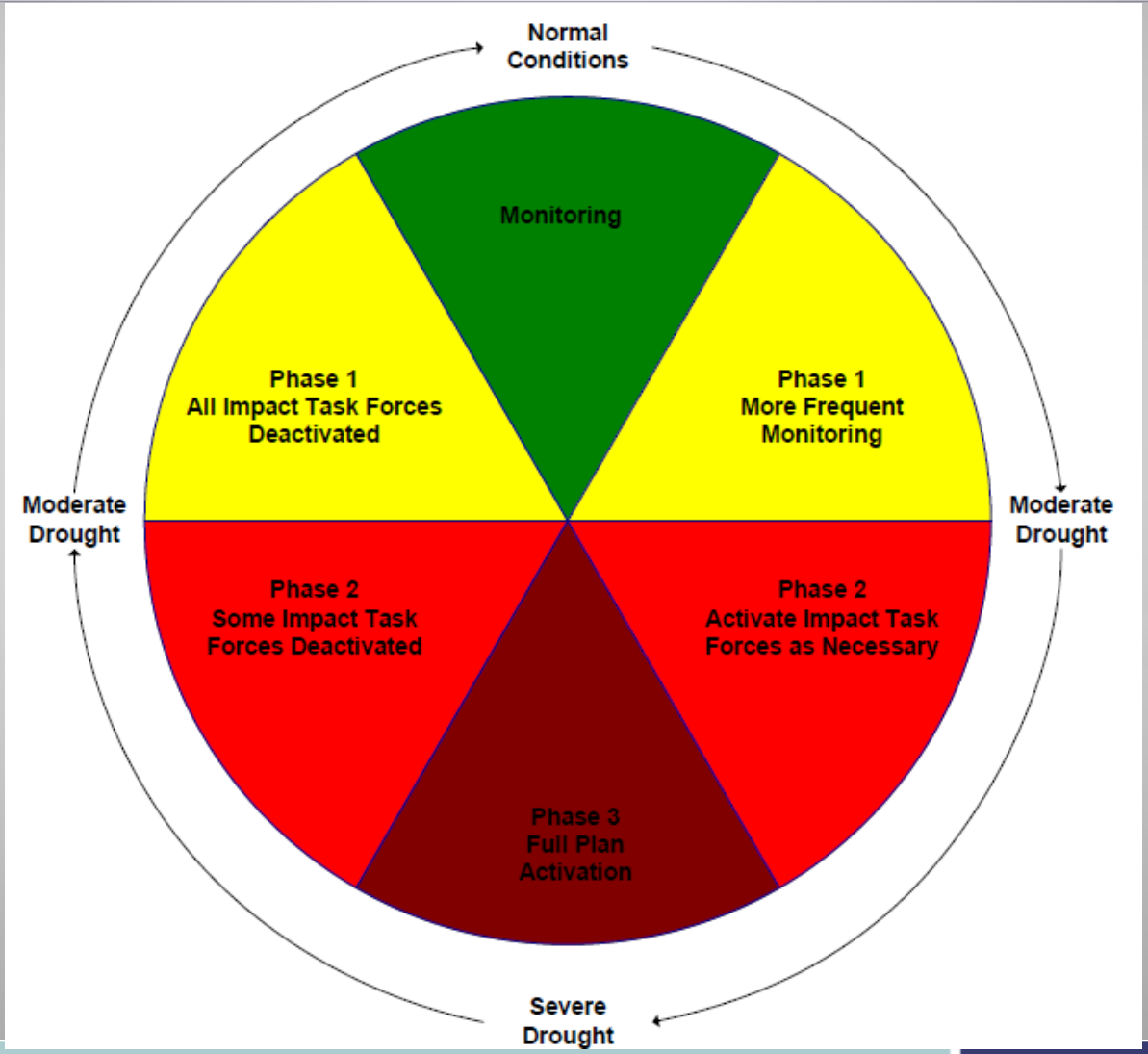
Old Method	New Method





Source: USDA – Natural Resources Conservation Service

Revised Plan Implementation Cycle



Revised Drought Response Summary Action Table

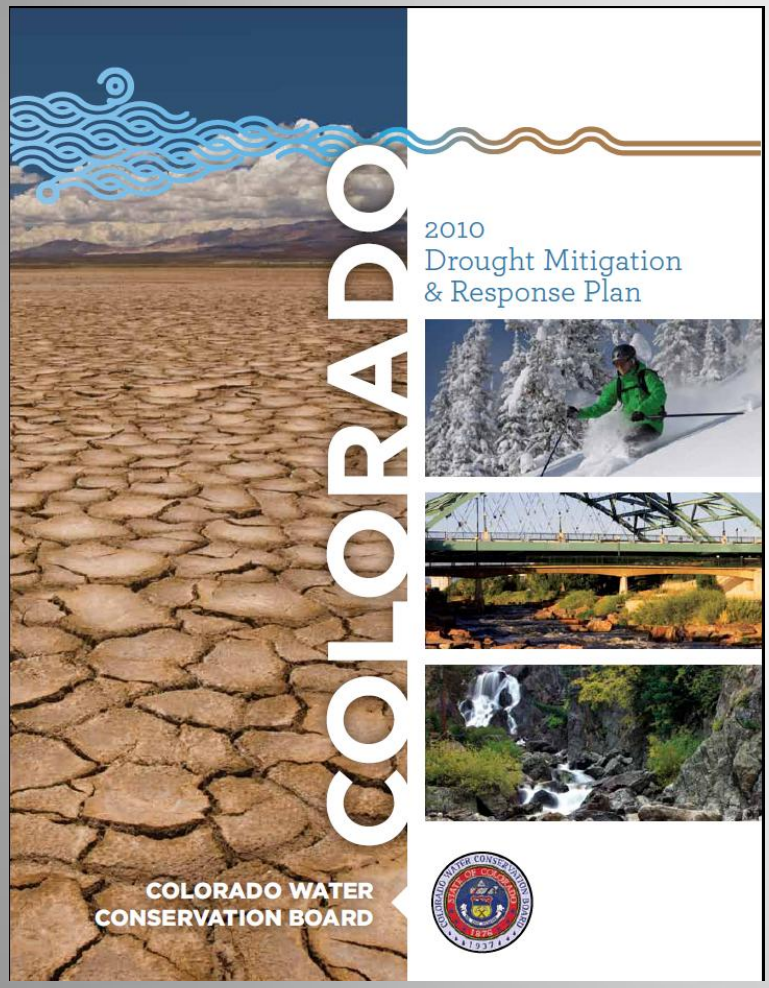
Severity Indicators and Impacts	Drought Phase and Response Summary	Actions to be Considered
• -0.5 to positive SPI (six month) • D0 Abnormally Dry • CMPDI or SWSI: -1.0 to -1.9 • SPI: -0.5 to -0.7	Normal Conditions Regular Monitoring	• CWCB/WATF monitors situation on monthly basis. • Data reviewed for drought emergence and summarized in Governor's Drought Situation Report. • Implement long term mitigation actions • ITF chairs meet twice yearly
• -0.6 to -1.0 SPI (six month) • D1 Moderate Drought • CMPDI or SWSI: -2.0 to -2.9 • SPI: -0.8 to -1.2	**Phase 1** More close monitoring of conditions for persisting or rapidly worsening drought; Official drought not yet declared	• ITF chairs alerted of potential for activation, monitoring of potential impacts • Assess need for formal ITF and DTF activation • DTF Lead Agencies (CDA/DoLA/DNR) notified of need for potential activation
• Less than -1.0 SPI (six month) • D2 Severe Drought • CMPDI or SWSI: -3.0 to -3.9 • SPI: -1.3 to -1.5	**Phase 2** Drought Task Force and Impact Task Forces are activated; Potential Drought Emergency declared	• Governor's Memorandum activates the Drought Task Force and necessary Impact Task Forces. • Department of Agriculture initiates Secretarial Disaster Designation process if appropriate • ITF's make an initial damage or impact assessment. • ITF's recommend opportunities for mitigation to minimize or limit potential impacts • Relevant state agencies undertake response and incident mitigation actions with their normal programs with available resources

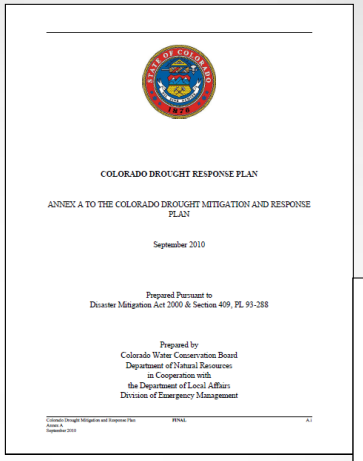
Current Status for SE Colorado

Mitigation Action Strategy

- Sample actions include:
  - Collect climatologic data at mid & lower elevations to fill existing gaps in the data collection network
  - Integrate and correlate the State Drought Mitigation Plan with other statewide planning efforts
  - Develop a state-wide drought messaging campaign
  - Construction of water storage facilities on State Trust Land
  - Integrate results, tools and methods from the 2010 vulnerability assessment to improve local hazard mitigation plans
  - Evaluate the relationship/interaction between both drought and water conservation on water quality of streams as well as health related consequences
  - Continue to pursue improved climate data to inform the planning process

Drought Mitigation and Response Plan





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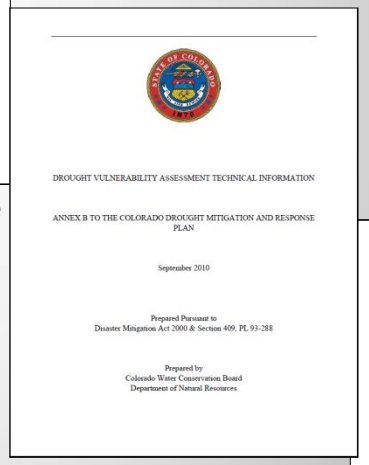

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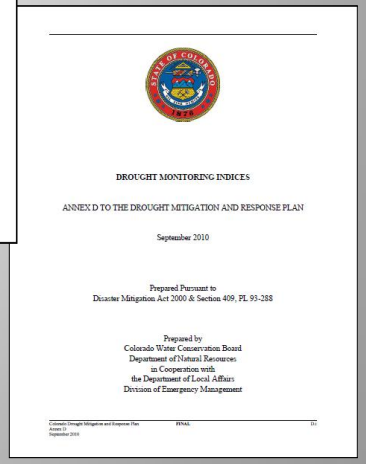

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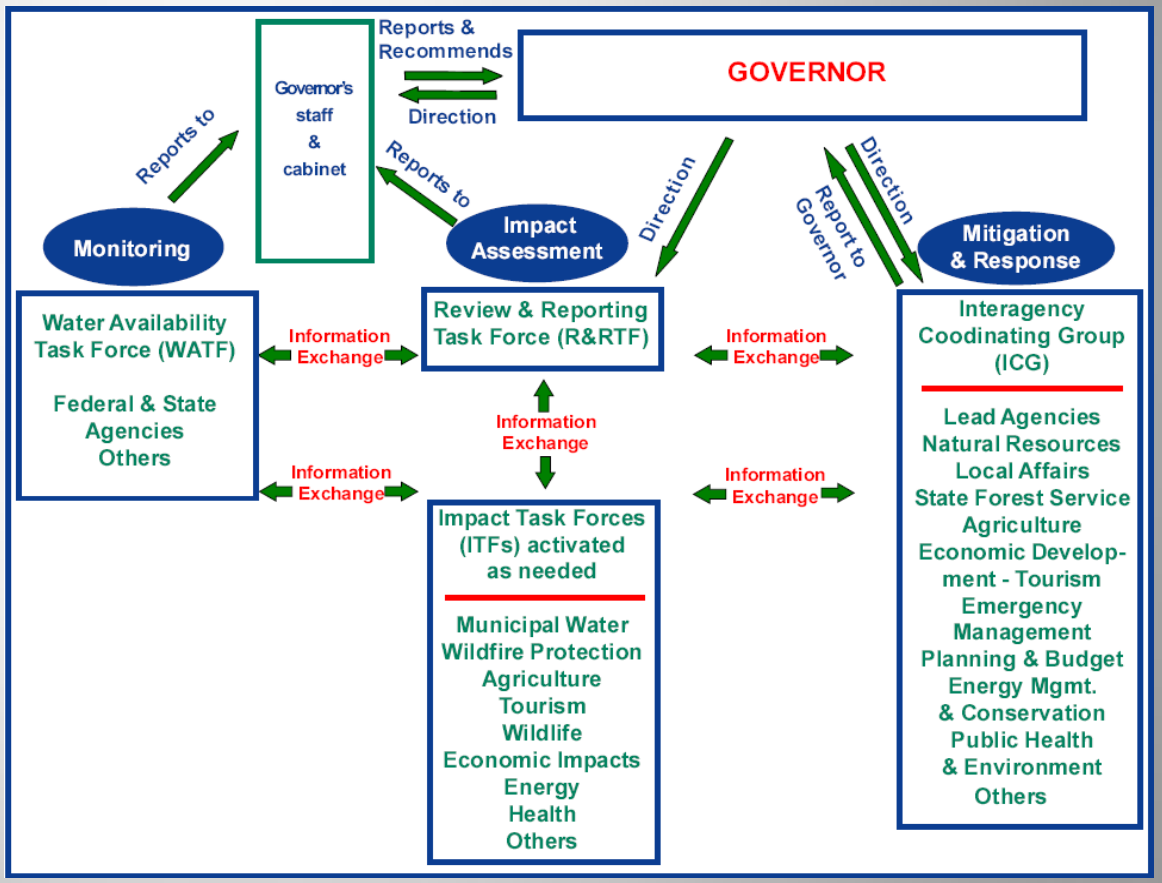
Drought Monitoring Indices

Response Element Key Updates

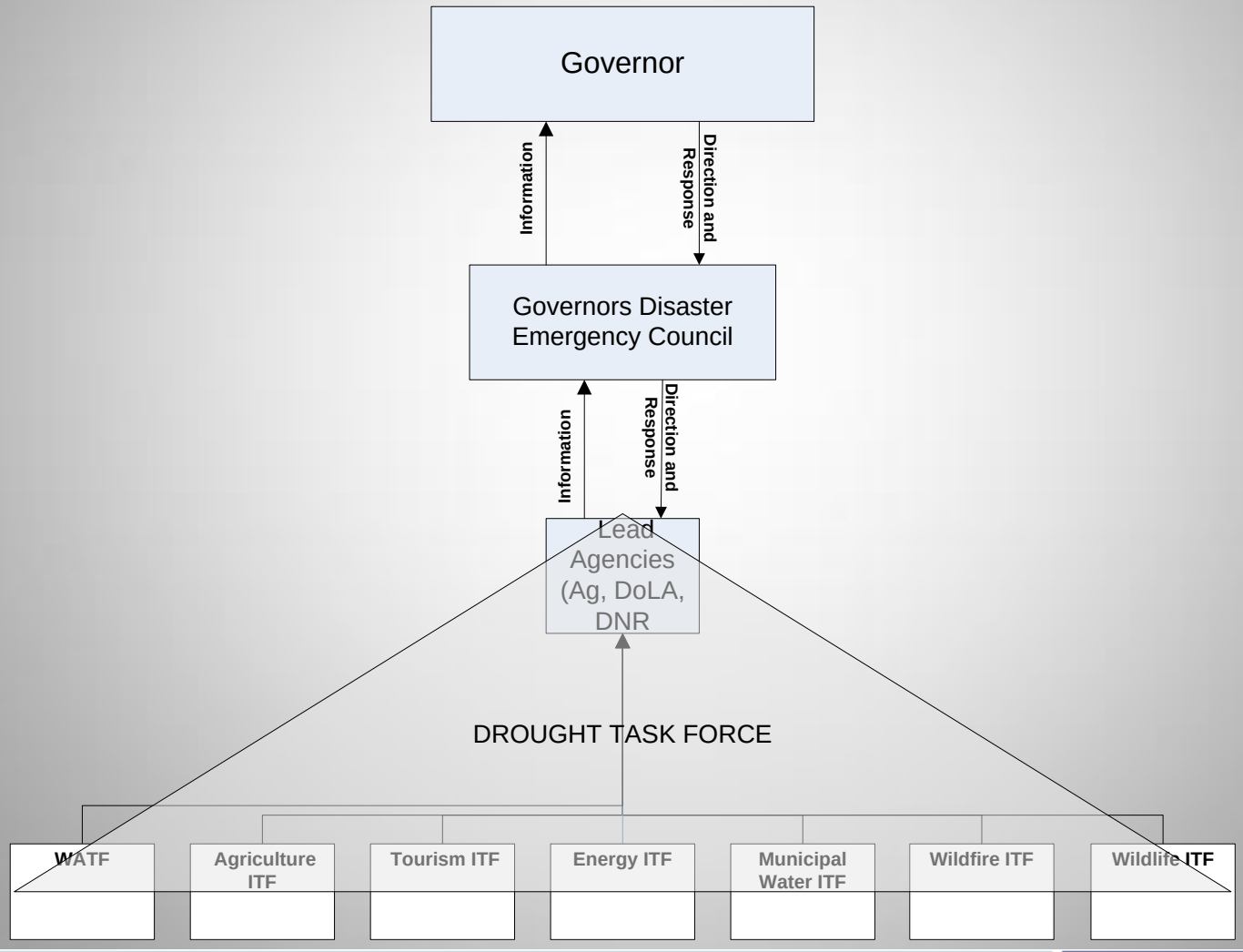
- Aligned with modern emergency planning guidelines
- Impact Task Force structure evaluated modified
- Response framework evaluated, modernized and streamlined
- Roles and responsibilities of state agencies updated
- Roles and responsibilities of Impact Task Forces updated and clarified

Previous Response Framework

- WATF
- Agriculture ITF
- Tourism ITF
- Economic ITF
- Energy ITF
- Health ITF
- Municipal Water ITF
- Wildfire ITF
- Wildlife ITF



Revised Response Framework



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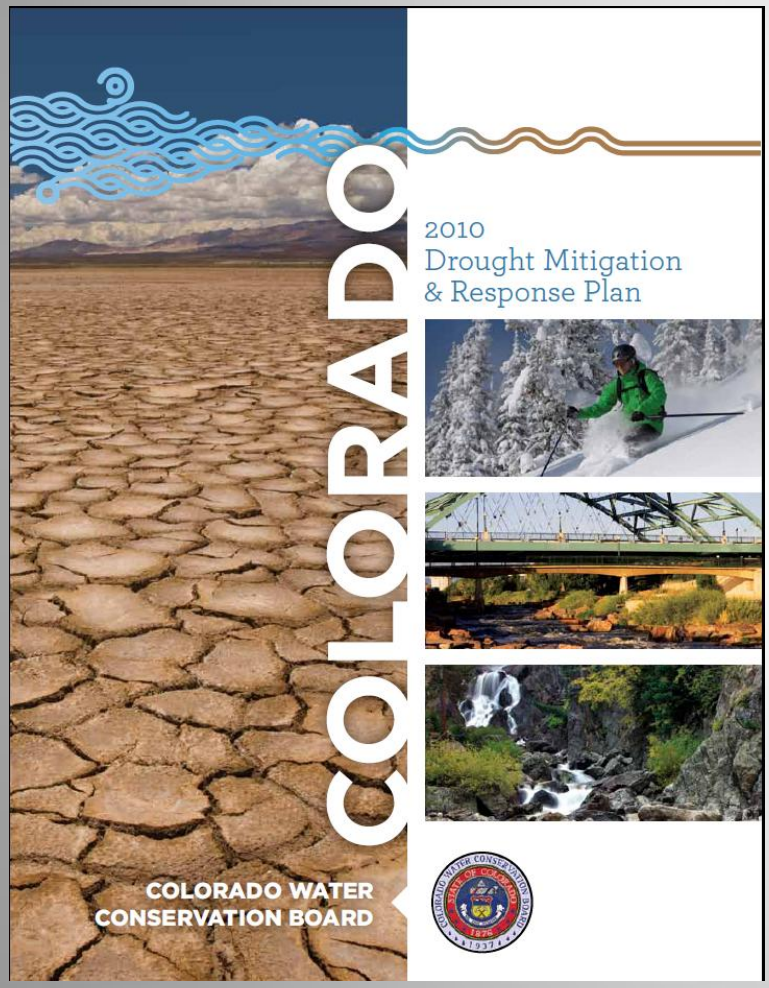

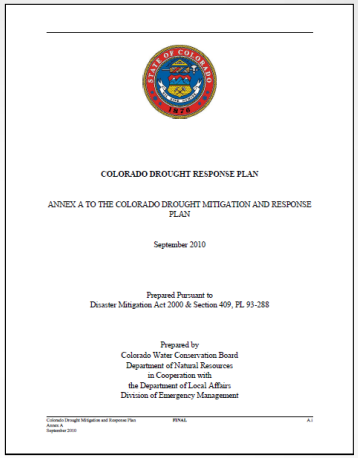

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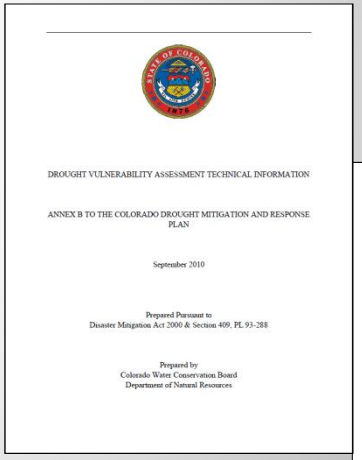

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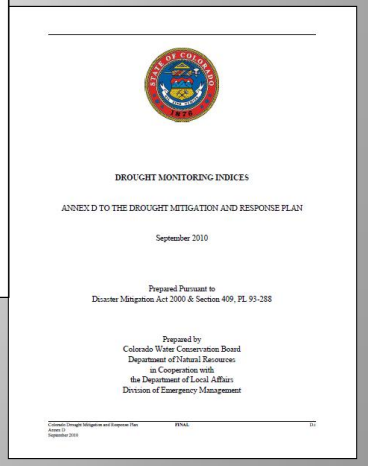

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Drought Monitoring Indices

Definitions

Risk Assessment: The process of identifying the likelihood and consequences of an event to provide the basis for informed planning decisions on a course of action (FEMA 1992)

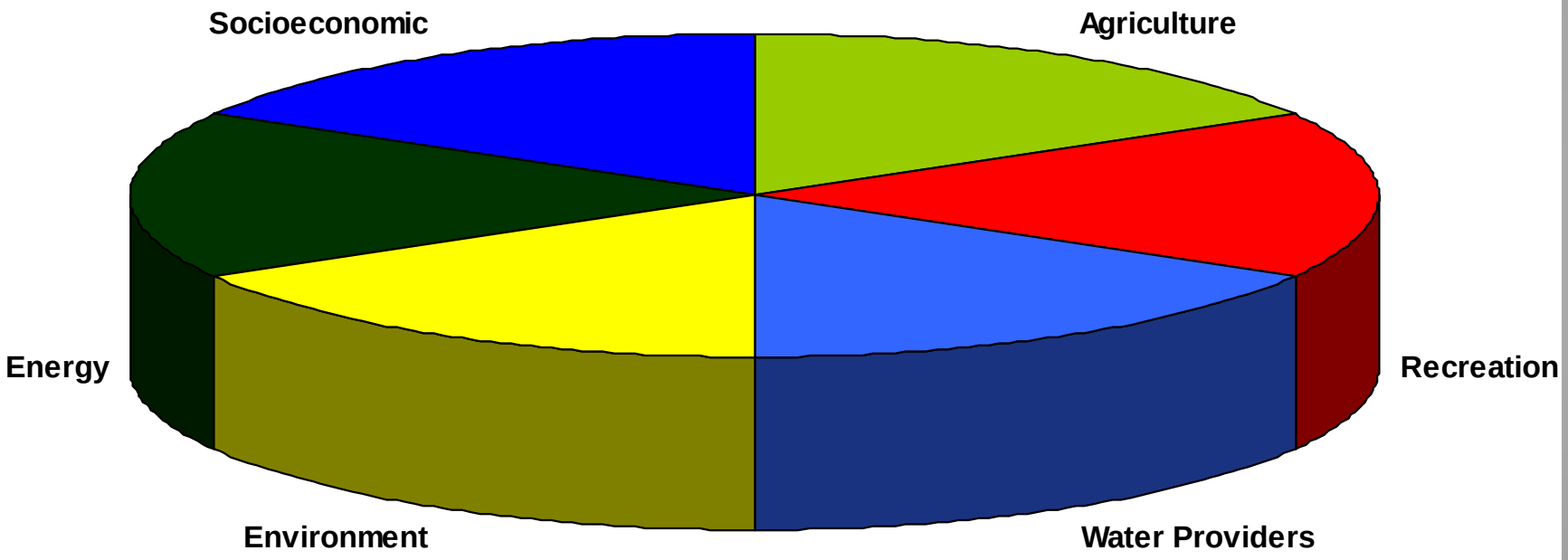
Drought Risk =

Hazard x **VULNERABILITY**

Drought Hazard: a period of abnormally dry weather sufficiently prolonged for the lack of water to cause serious hydrologic imbalance in the affected area."

Vulnerability: The susceptibility to injury or damage from hazards." (Godschalk 1991, 132)

Integrated System



Questions?

What the statewide vulnerability assessment tells us

Colorado Front Range / Denver Metro Area

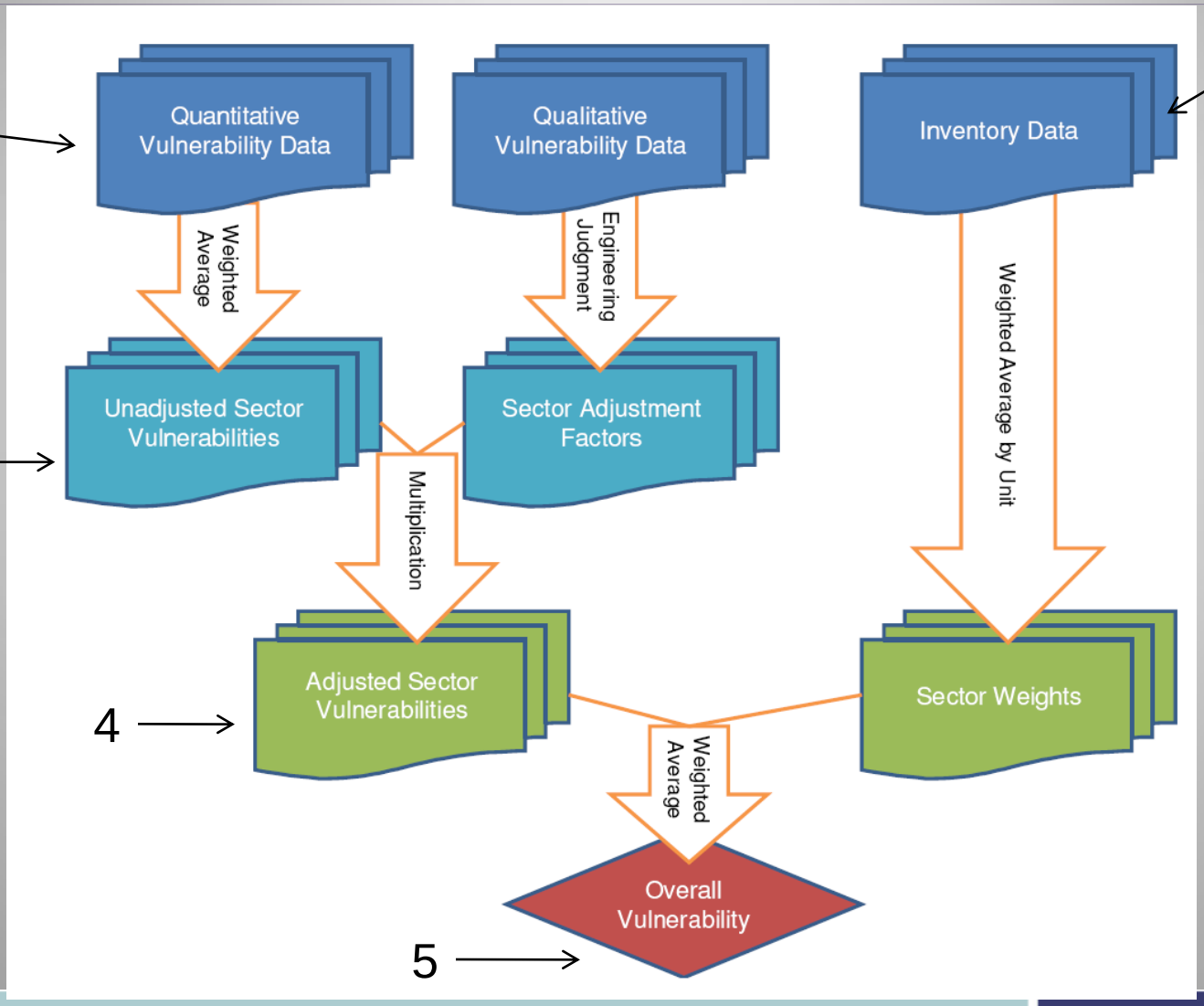
Why is a Vulnerability Assessment Useful?

Vulnerability is any susceptibility to injury or damage from hazards.

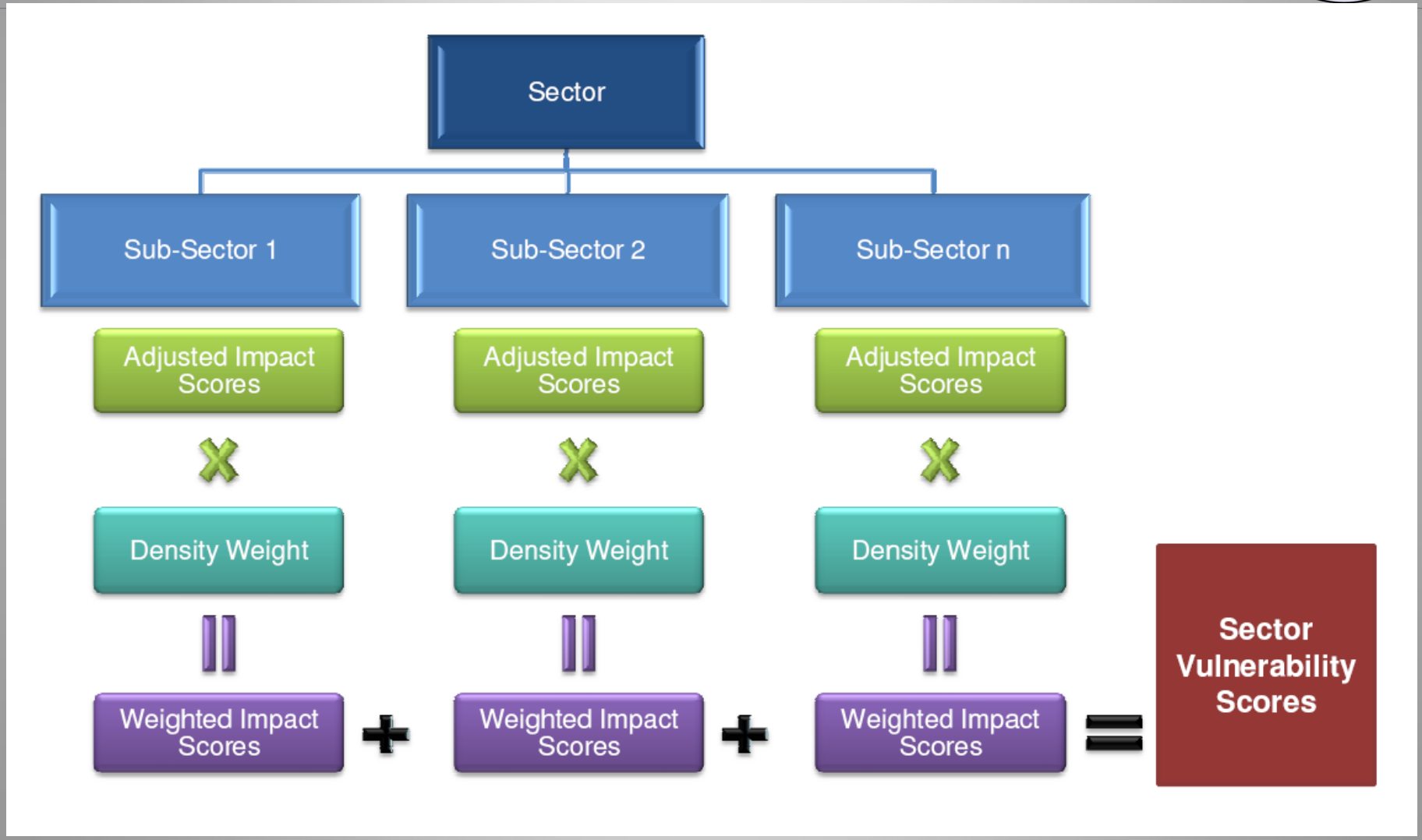
Vulnerability Assessment is an in-depth analysis of the characteristics to identify weaknesses and lack of redundancy.

The findings can then be used to determine priorities for mitigations or corrective actions that can be designed or implemented to reduce the vulnerabilities.

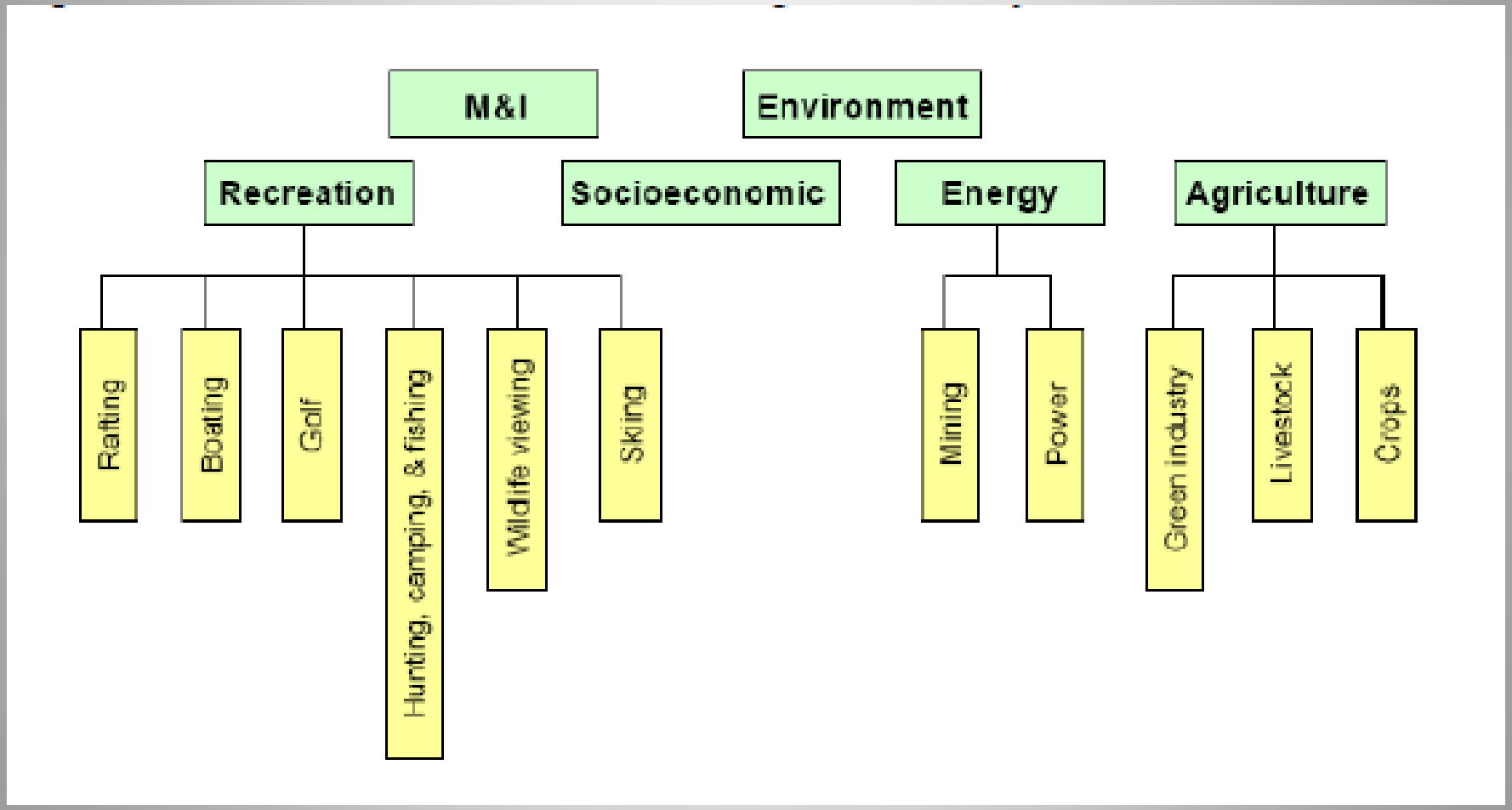
Methodological Framework



Sector Vulnerability Calculations



Sectors and Sub-sectors for Drought Vulnerability Assessment



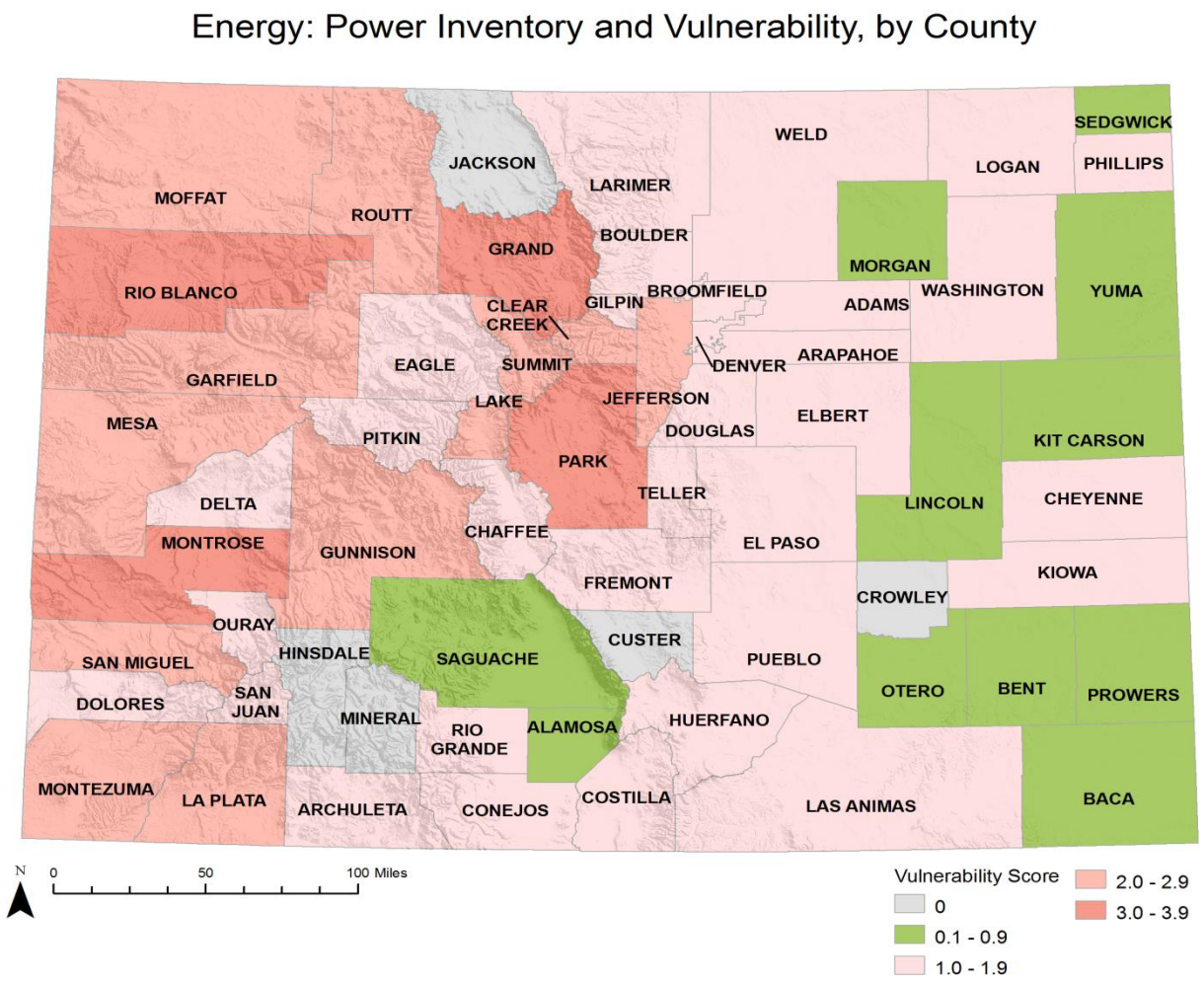
Denver Metropolitan Area

IMPACT METRIC RESULTS

Energy Impact Metrics

	Power Producers	Mining	Mining	
	Total Withdrawals (MGD)	Total Withdrawals (MGD)	% of Withdrawals from Groundwater	OVERALL Energy Vulnerability Ranking
Garfield	H	L	L	2.29
Mesa	H	L	L	2.50
Pitkin			L	1.67
Eagle	L	L	L	1.0
Summit		L	L	2.33
Grand		L	L	3.00

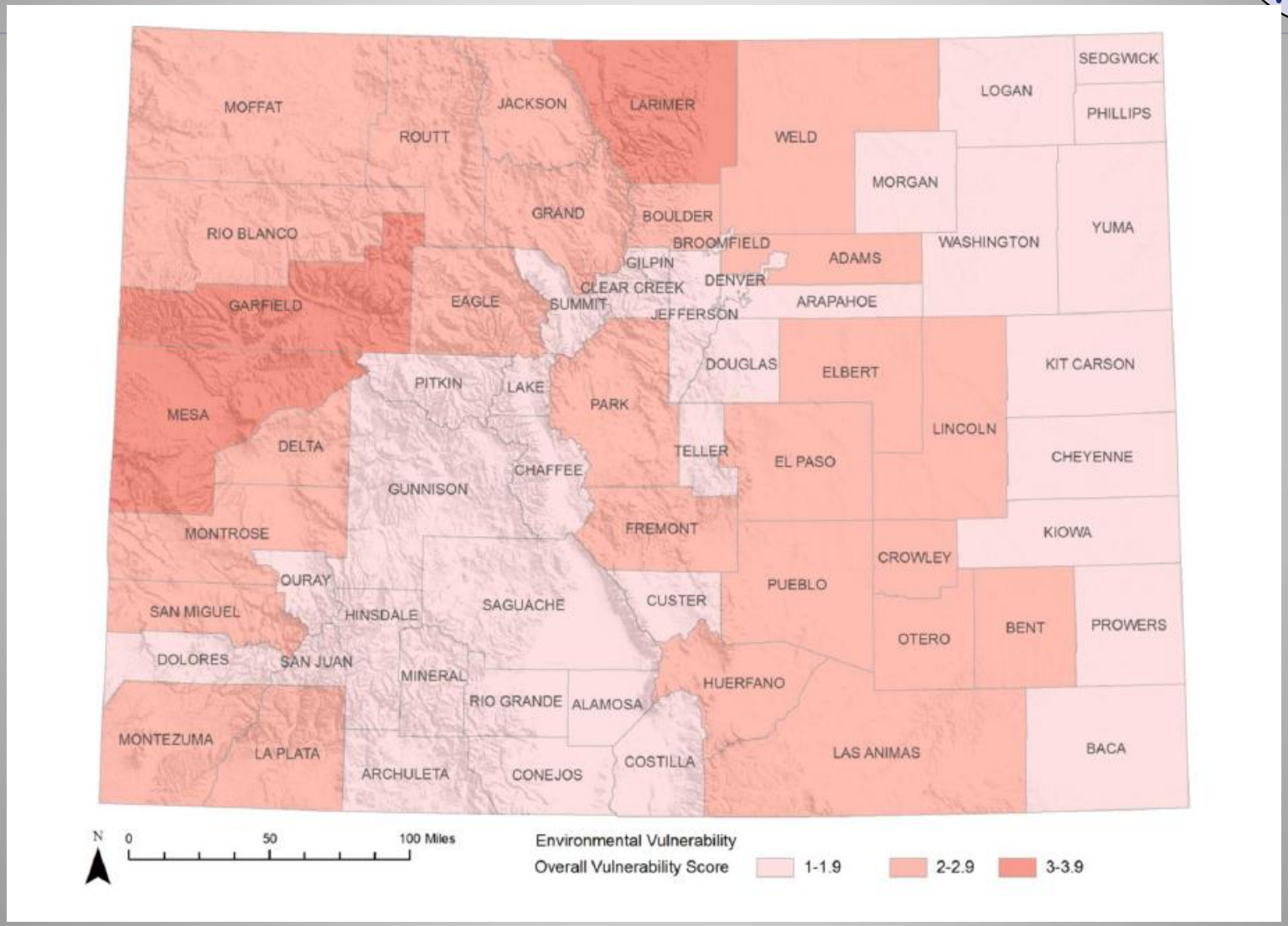
Overall Energy Vulnerability Scores



Environment Impact Metrics

	GAP Stewardship Status	Impaired Reach Length (meters)	Impaired Lake Area (sq km)	Bark beetle aerial extent (acres per county)	Wildfire susceptibility index (ranking)	Sum length (km) of higher order streams	Instream flow rights (adaptive)	OVERALL Vulnerability Ranking
Garfield	H	H	L	H	H	H		3
Mesa			L	H	H	H	H	3
Pitkin	L	L	L				L	1
Eagle	H	L	L	H	H			2
Summit	H	L	L			L		2
Grand		L		H				2

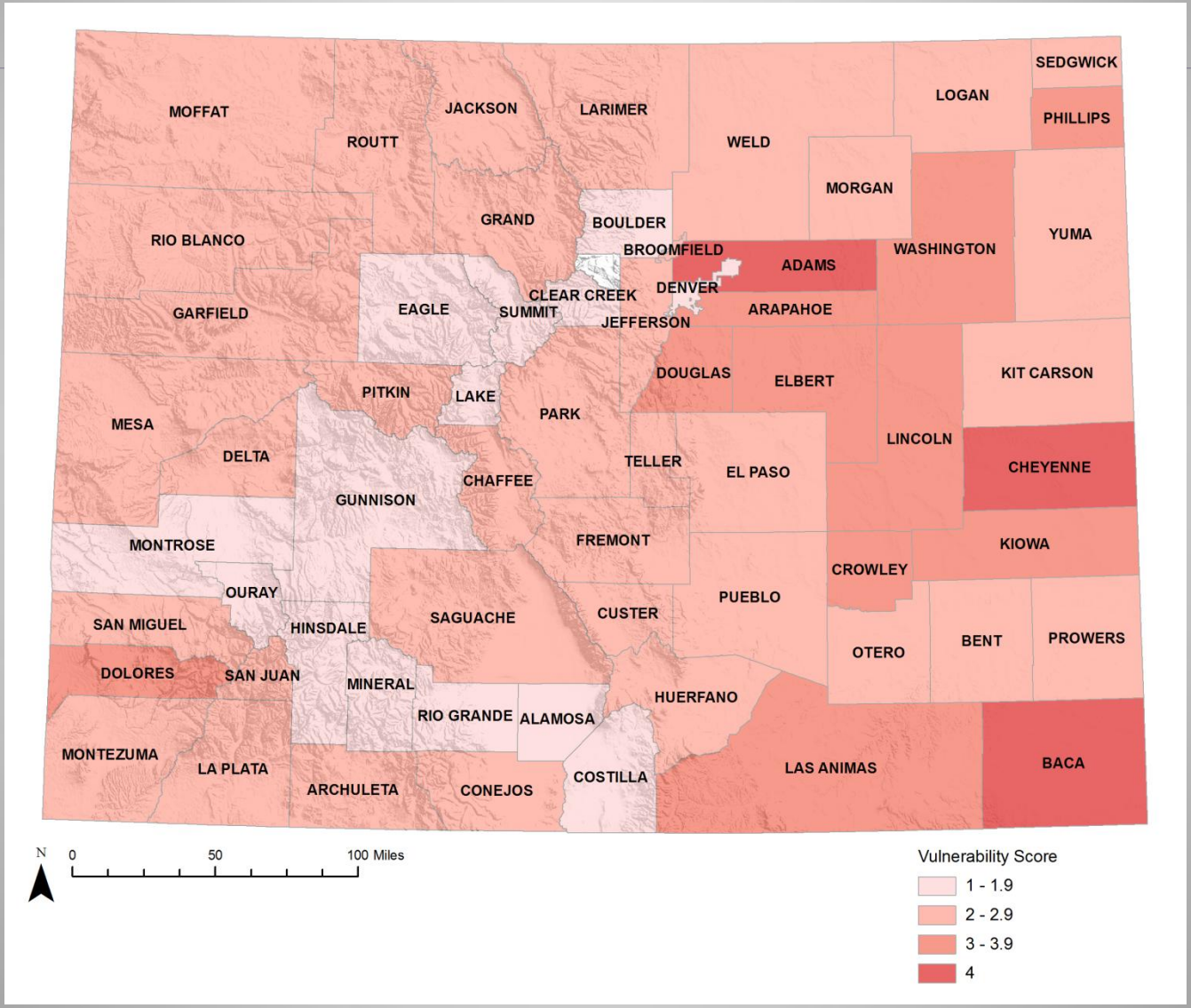
Overall Environmental Vulnerability Scores



Agricultural Impact Metrics

	Livestock			Crops			
	2010 Livestock Indemnity	Reduction in Herd Size	'01-'09 Avg. # of Dairy Cattle	% Dry land Acreage	2002 Crop Indemnities	Non-insured Assurance Prog. Allotments	OVERALL Vulnerability Ranking
Garfield	L		L		L	L	2.1
Mesa	L		L	L	L		2.1
Pitkin	L	H	L	L	L	L	2.1
Eagle	L	H	L	L	L	L	1.8
Summit	L		L	L	L	L	1.4
Grand	L	H	L		L	L	2.4

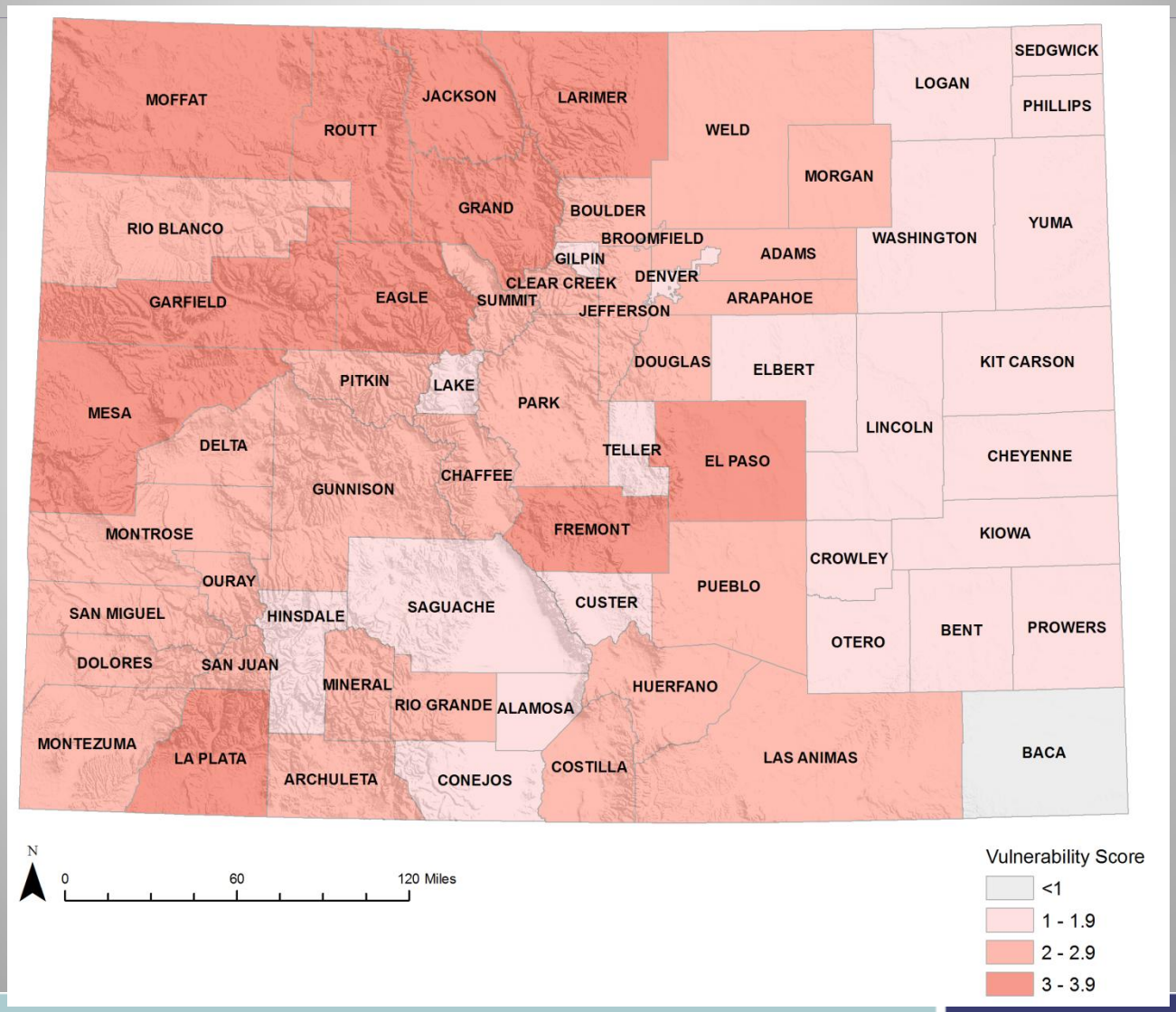
Overall Agriculture Vulnerability Scores



Recreation Impact Metrics

	Skiing		Wildlife & Hunting, Fishing, Camping	Hunting, Fishing, Camping	Golf	Boating		Rafting		
	Acres	Snow Making	Wildfire Hazard Zone	Bark Beetle Infestation	Irrigated Golf Course Acres	Water Based State Parks	Relative Visitation 2002	User Days	Relative Visitation 2002	OVERALL Vulnerability Ranking
Garfield	L	L	L	H	H			H	L	3
Mesa		L	H	H	H	H			L	3
Pitkin	H					L	L		H	2
Eagle	H		H	H	H			H		3
Summit	H	L				L	L	L	H	2
Grand		L		H		L	L	H	L	3

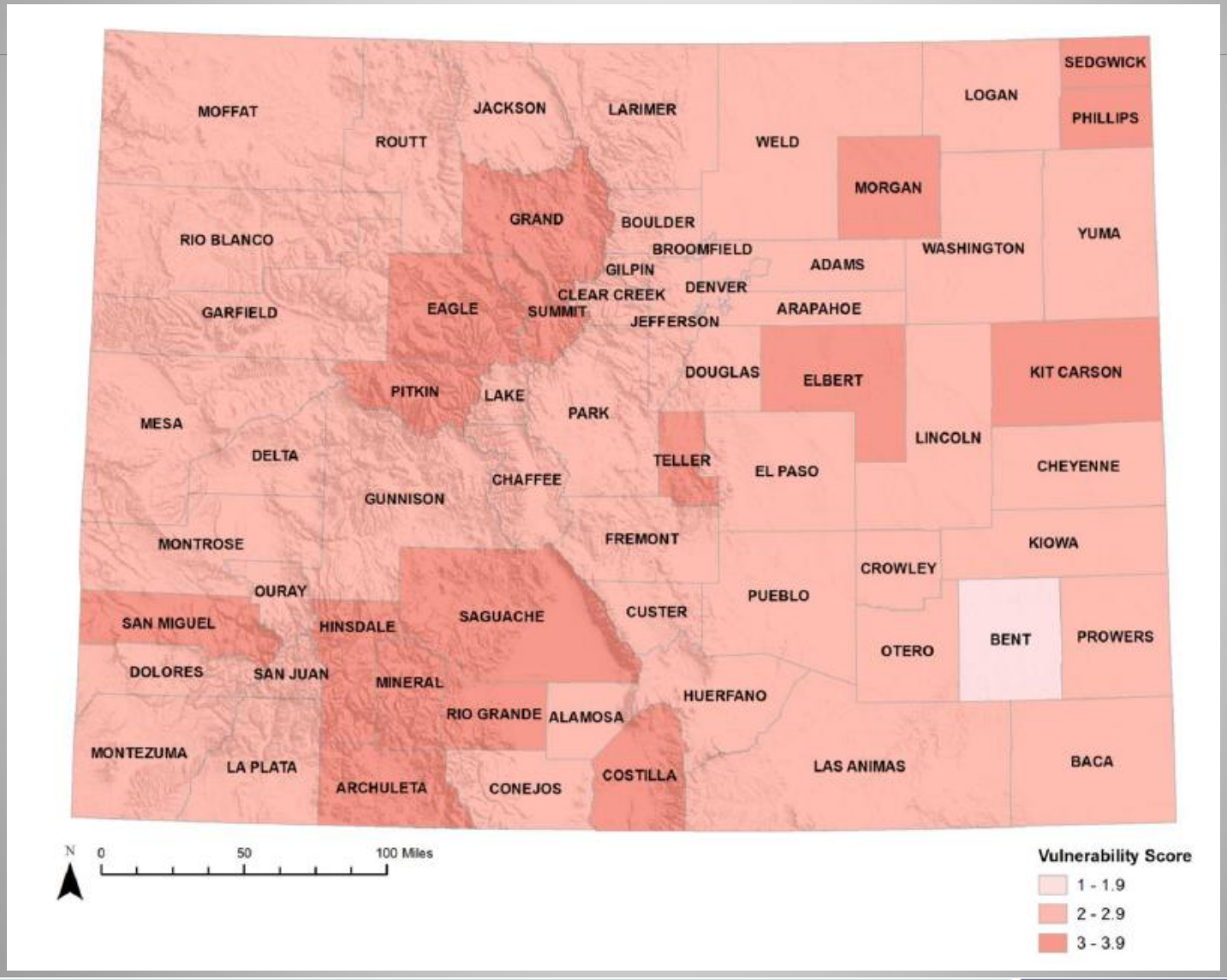
Overall Recreation and Tourism Vulnerability Scores



Socioeconomic Impact Metrics

	Projected Population Growth	Economic Diversity	Mental Health Shortages	OVERALL Vulnerability Ranking
Garfield	H			2.8
Mesa				2.4
Pitkin		H		3.2
Eagle		H		3.2
Summit		H		3.2
Grand		H		3.2

Overall Socioeconomic Vulnerability Scores



Questions?


COFFEE
BREAK

Colorado Water Conservation Board

PLANNING TOOLBOX & WEBSITE TOUR


scavenger
hunt

Climate Change

Ideas on How to Incorporate into Your Planning Process

Climate Change Analysis

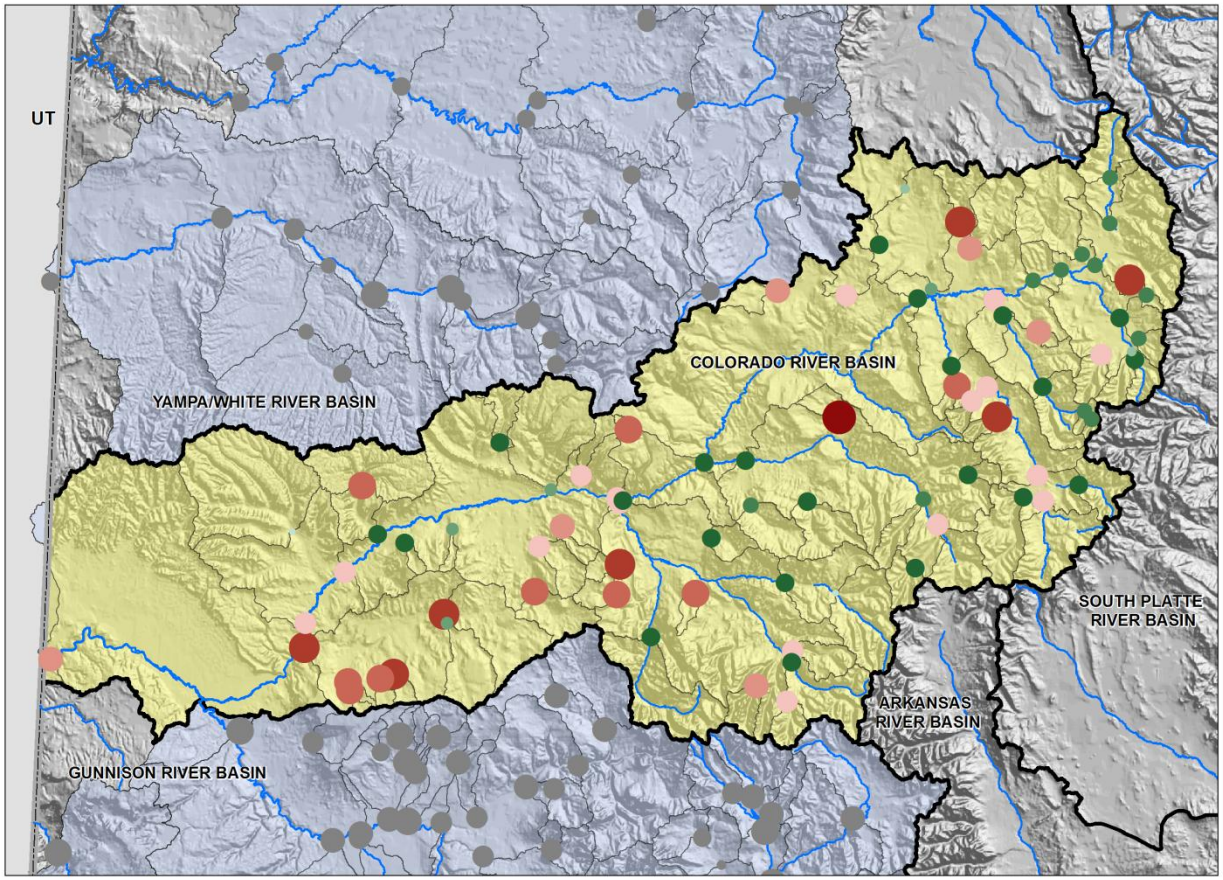
- What could drought look like in the future?
- Drought profile analysis using Colorado River Water Availability Study results for 2040
- Six scenarios from Colorado River Water Availability Study considered
- 100 paleo re-sequenced traces for each scenario
- Calculated maximum drought duration and intensity for each trace
- Drought calculations done relative to the mean of each scenario
- Exceedance probability is the chance that the maximum drought length will be greater than the observed median drought length given 100 traces

Colorado River near Cameo

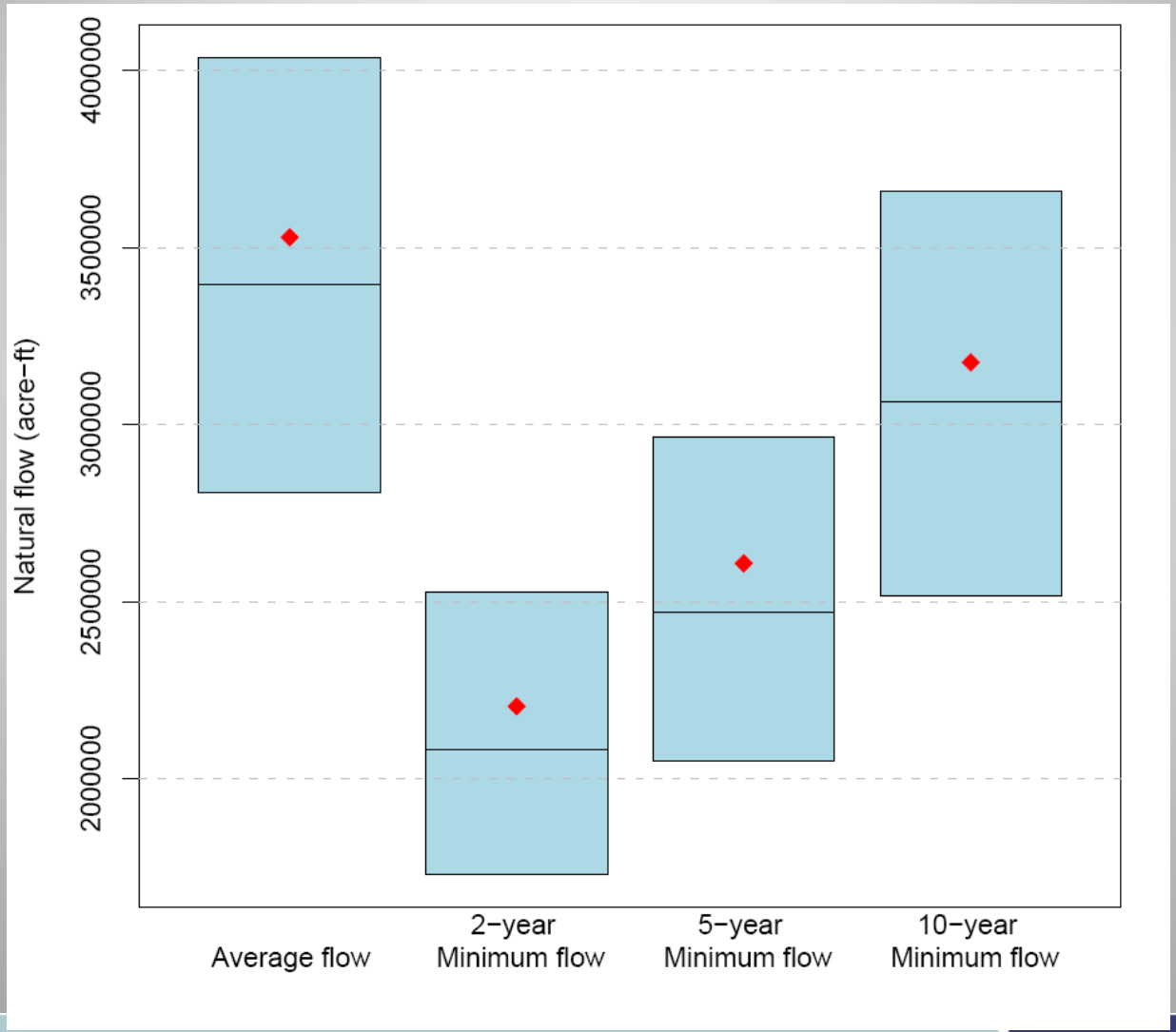
Longest observed drought : 6 Years

	Average length of maximum drought (years)	Maximum drought length (years)	Chance of drought longer than observed
Alternate Historical Hydrology	5.8	15	58.3%
Climate Scenario 1	6.5	13	56.7%
Climate Scenario 2	6.1	15	54.0%
Climate Scenario 3	6.2	12	50.5%
Climate Scenario 4	6.5	12	55.4%
Climate Scenario 5	6.4	12	54.3%

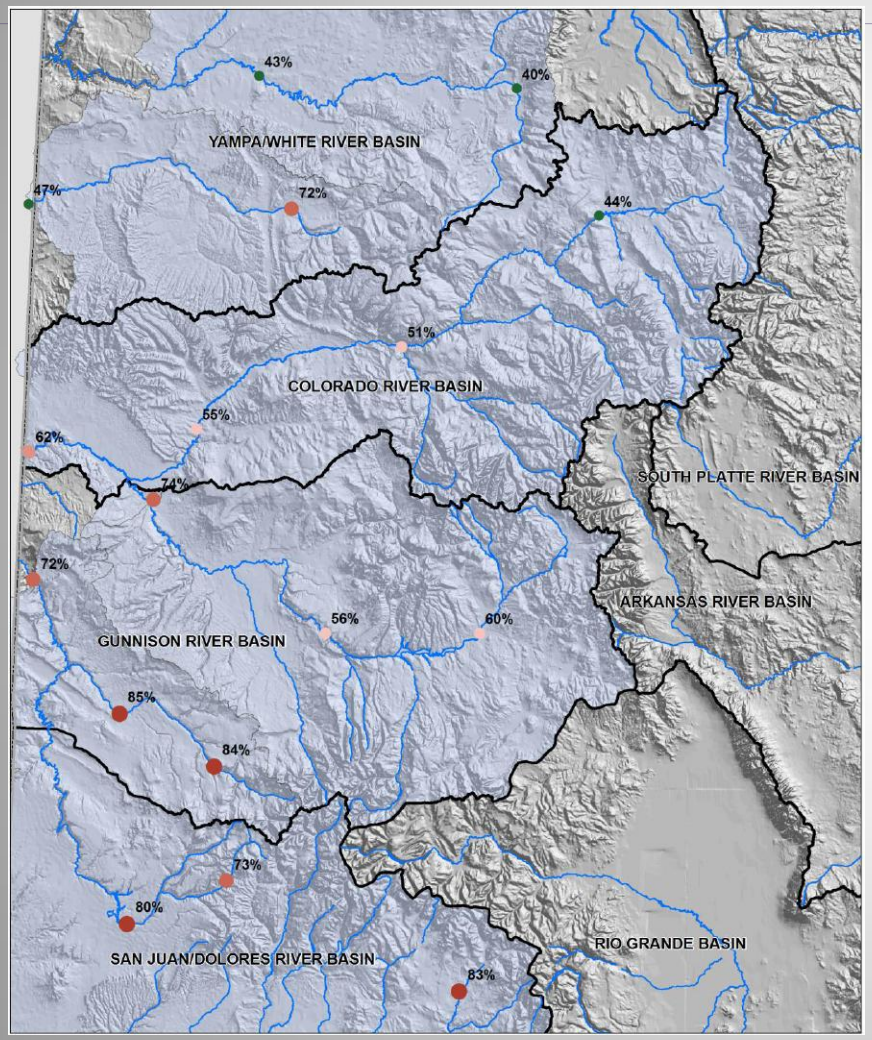
Maximum Drought Length Exceedance Probabilities – Colorado River Basin

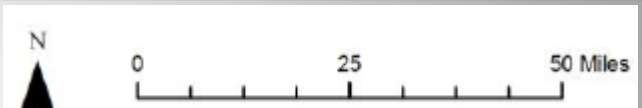


Colorado River near Cameo



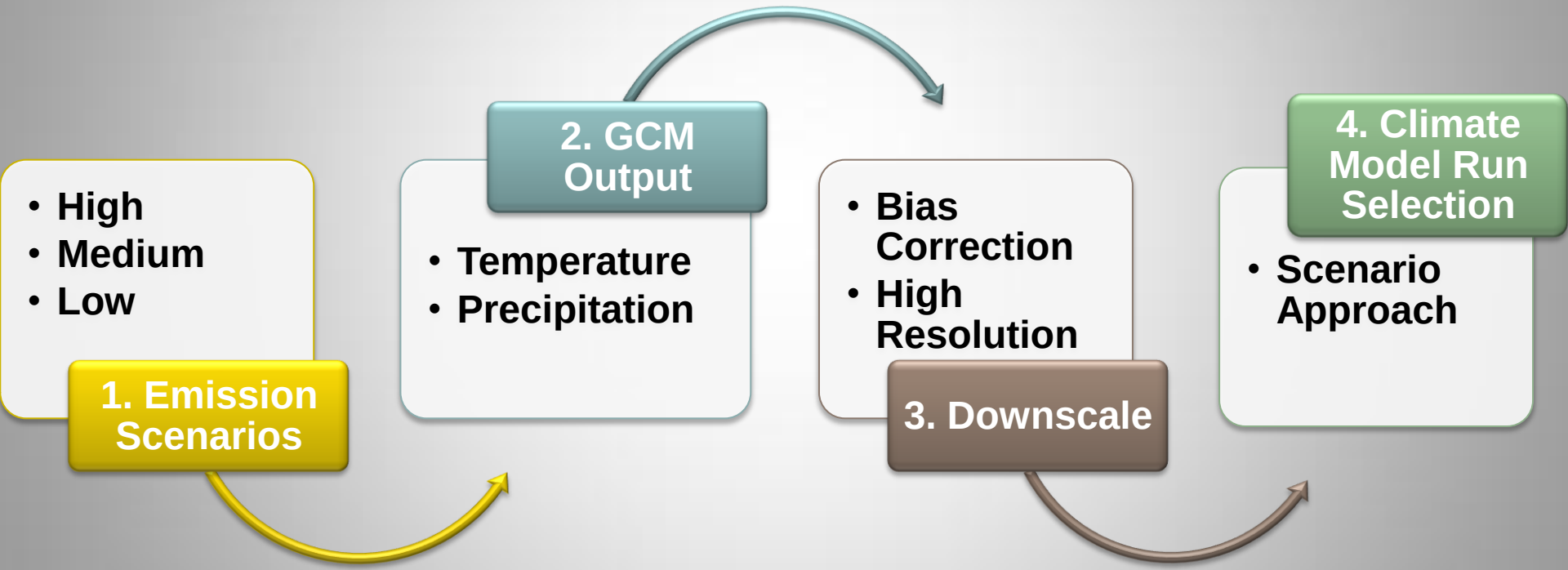
Average Maximum Drought Length Exceedance Probabilities



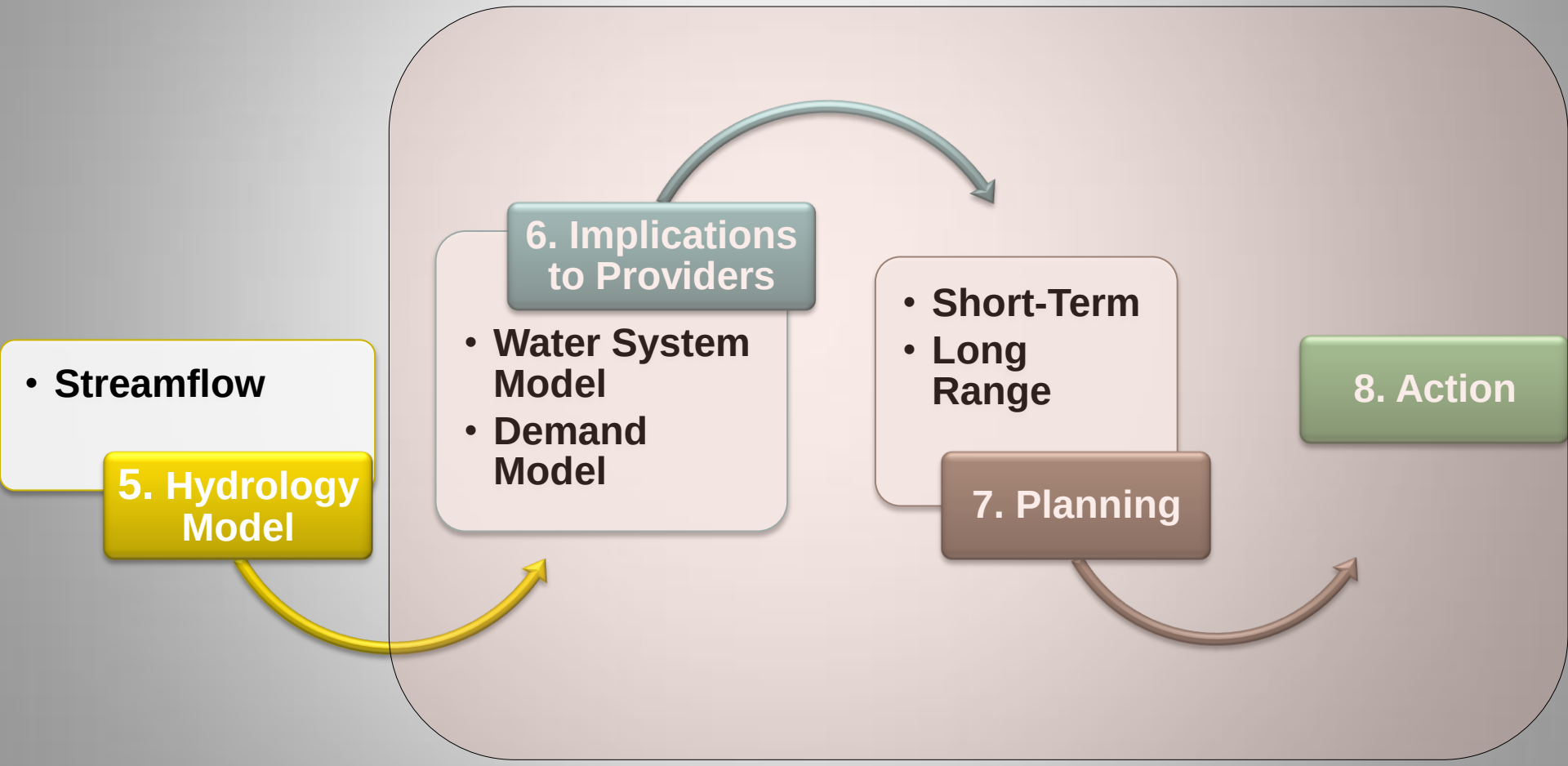


The Joint Front Range Climate Change Vulnerability Study

Determine streamflow sensitivity to projected changes in temperature and precipitation



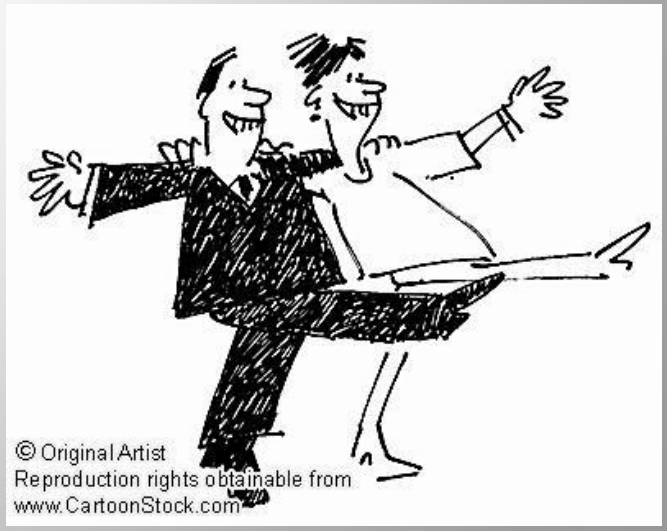
Methodology Continued



A Regional Planning Effort

Benefits of a Regional Approach

- ***Communication:*** Cohesively communicate with customers and the media.
- ***Coordination:*** Coordinate with other investigations and participants.
- ***Collaboration:*** Initiate or continue collaboration on different investigations.
- ***Resources:*** Pool finances, staff, and expert resources
- ***Scale:*** Projections are coarse and cover watersheds



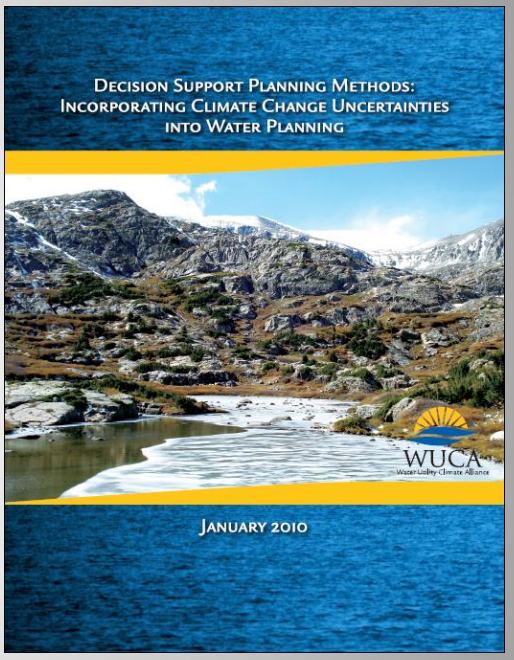
Climate Offset Scenarios

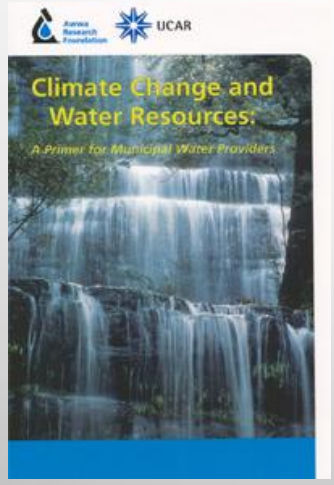
- ***Simple Assessment***
  - Constant T or P offsets
    - Increase of 1º C
    - Increase of 4º C
    - Increase of 7.5%
    - Decrease of 3%
- ***Sophisticated Approach***
  - T and P Scenarios (2040, 2070)
    - warm and wet
    - warm and dry
    - middle
    - very warm and wet
    - very warm and dry

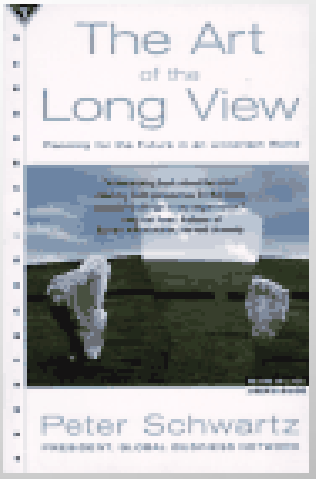
16 Sets of NEW Streamflow

Resources for Planning

- The Water Utility Climate Alliance (WUCA) http://www.wucaonline.org/html/
- The Art of the Long View: Planning for the Future in an Uncertain World (Peter Schwartz, 1991)
- Climate Change and Water: A Primer for Municipal Water Providers (Miller, K. and D. Yates, 2006)





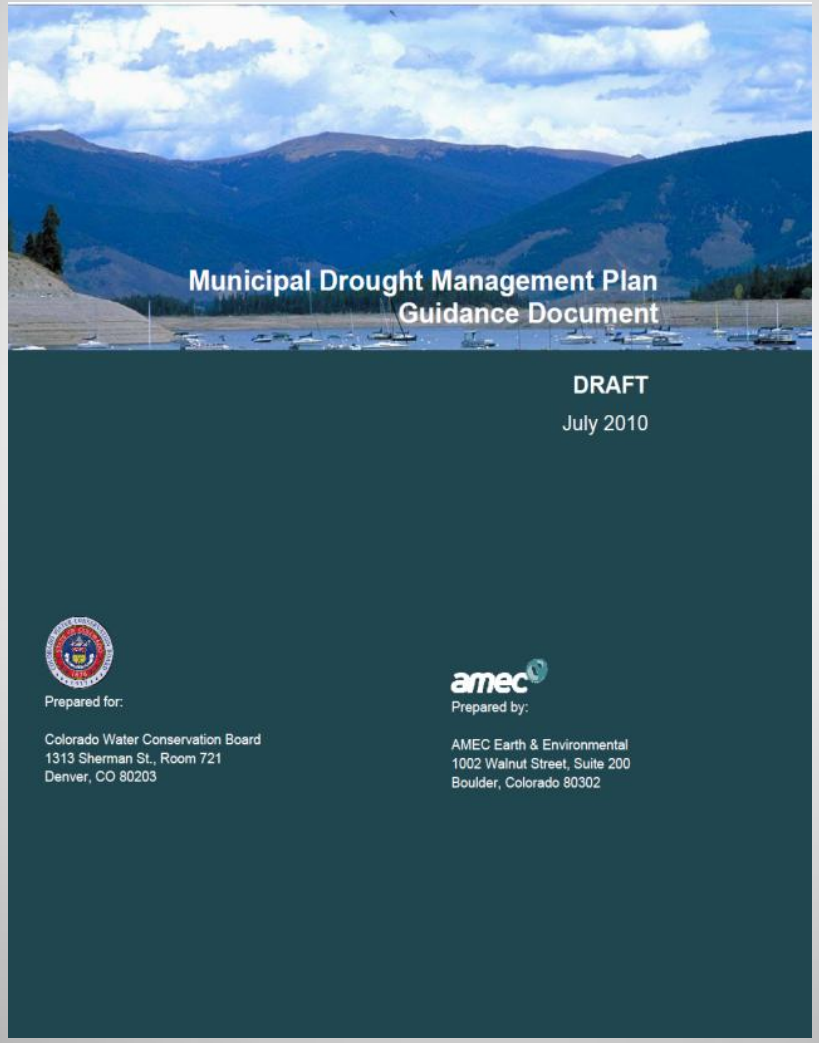


Questions?

Monitoring of Drought

Nolan Doesken, Colorado Climate Center

Municipal Drought Planning Guidance Document



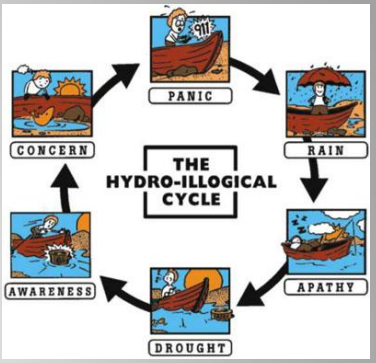
Goals of the guidance document

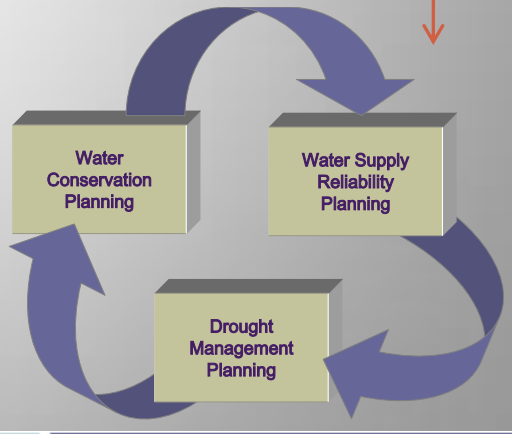
- Provide a comprehensive background on municipal drought management planning

- Recommend drought mitigation and response planning steps and components useful in developing local plans

- Disclose the essential and recommended elements of an effective local drought management plan

- Ensure the Document is applicable and useful to statewide stakeholders that vary by geographic location, size, water supply sources, financial resources, etc.

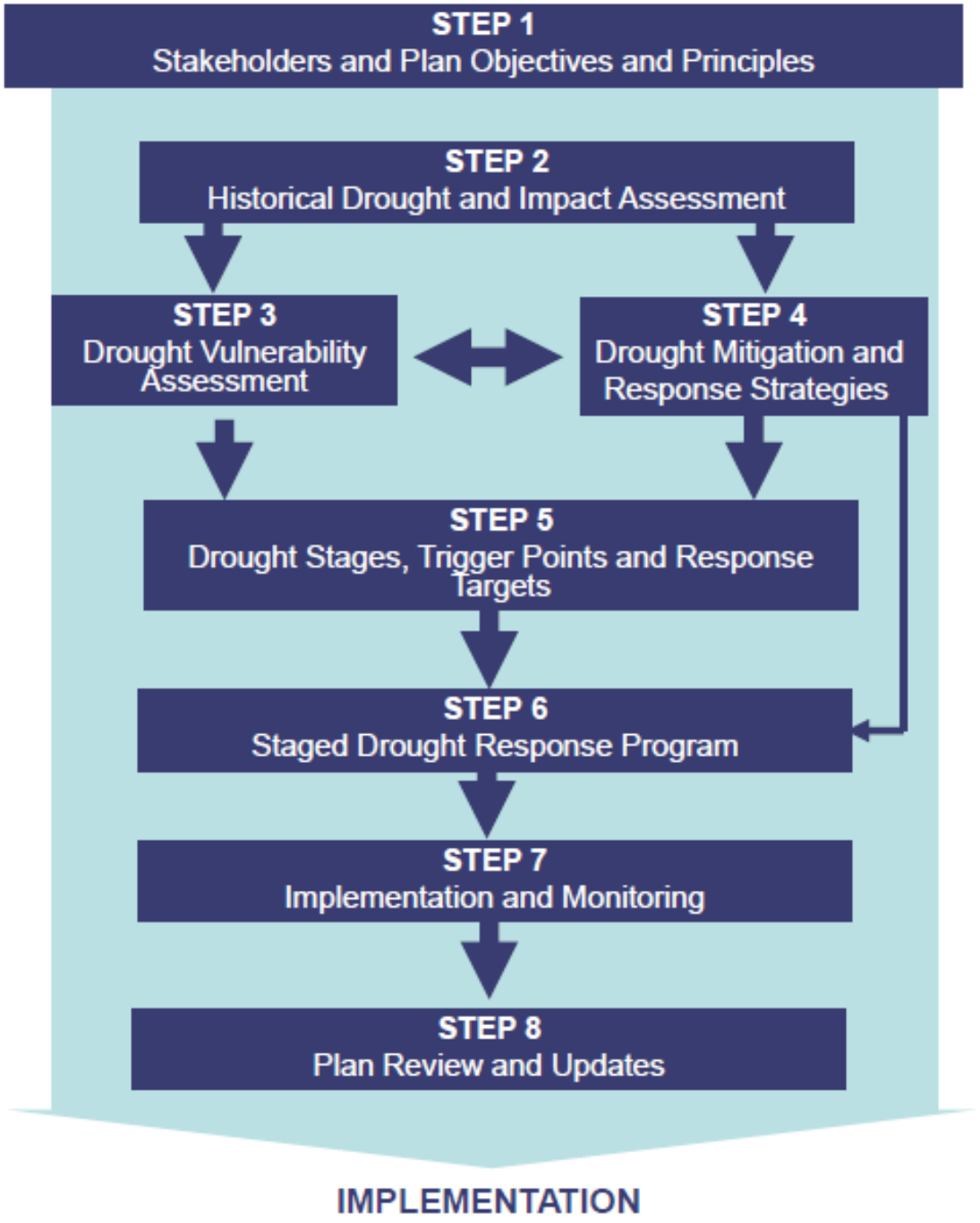




Sections of the Guidance Document

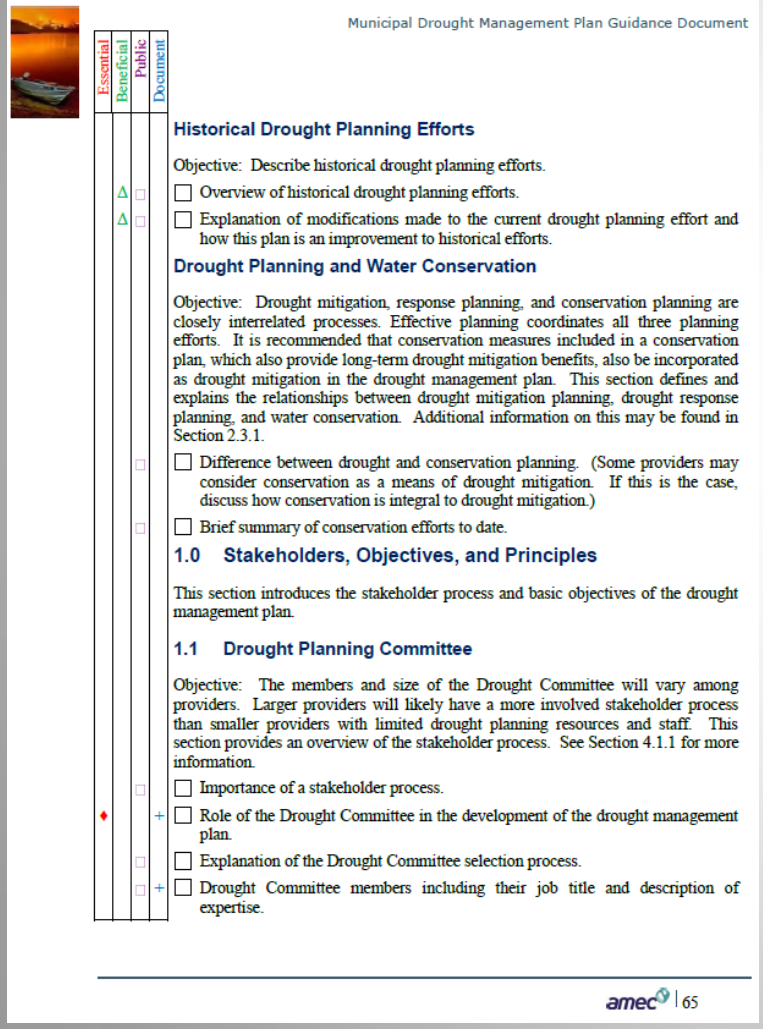
1. Introduction to Drought Management Planning
2. State and Local Drought Planning
3. How to Use this Guidance Document
4. Steps to Drought Management Planning
5. Model Template of a Drought Management Plan

Appendix A - Worksheets



8 Steps to Municipal Drought Management Planning

Check list & Prioritization



Municipal Drought Management Plan Guidance Document

Essential	Beneficial	Public	Document	
				Historical Drought Planning Efforts
				Objective: Describe historical drought planning efforts.
	Δ	□		☐ Overview of historical drought planning efforts.
	Δ	□		☐ Explanation of modifications made to the current drought planning effort and how this plan is an improvement to historical efforts.
				Drought Planning and Water Conservation
				Objective: Drought mitigation, response planning, and conservation planning are closely interrelated processes. Effective planning coordinates all three planning efforts. It is recommended that conservation measures included in a conservation plan, which also provide long-term drought mitigation benefits, also be incorporated as drought mitigation in the drought management plan. This section defines and explains the relationships between drought mitigation planning, drought response planning, and water conservation. Additional information on this may be found in Section 2.3.1.
		□		☐ Difference between drought and conservation planning. (Some providers may consider conservation as a means of drought mitigation. If this is the case, discuss how conservation is integral to drought mitigation.)
		□		☐ Brief summary of conservation efforts to date.
				1.0 Stakeholders, Objectives, and Principles
				This section introduces the stakeholder process and basic objectives of the drought management plan.
				1.1 Drought Planning Committee
				Objective: The members and size of the Drought Committee will vary among providers. Larger providers will likely have a more involved stakeholder process than smaller providers with limited drought planning resources and staff. This section provides an overview of the stakeholder process. See Section 4.1.1 for more information.
		□		☐ Importance of a stakeholder process.
♦			+	☐ Role of the Drought Committee in the development of the drought management plan.
		□		☐ Explanation of the Drought Committee selection process.
		□	+	☐ Drought Committee members including their job title and description of expertise.

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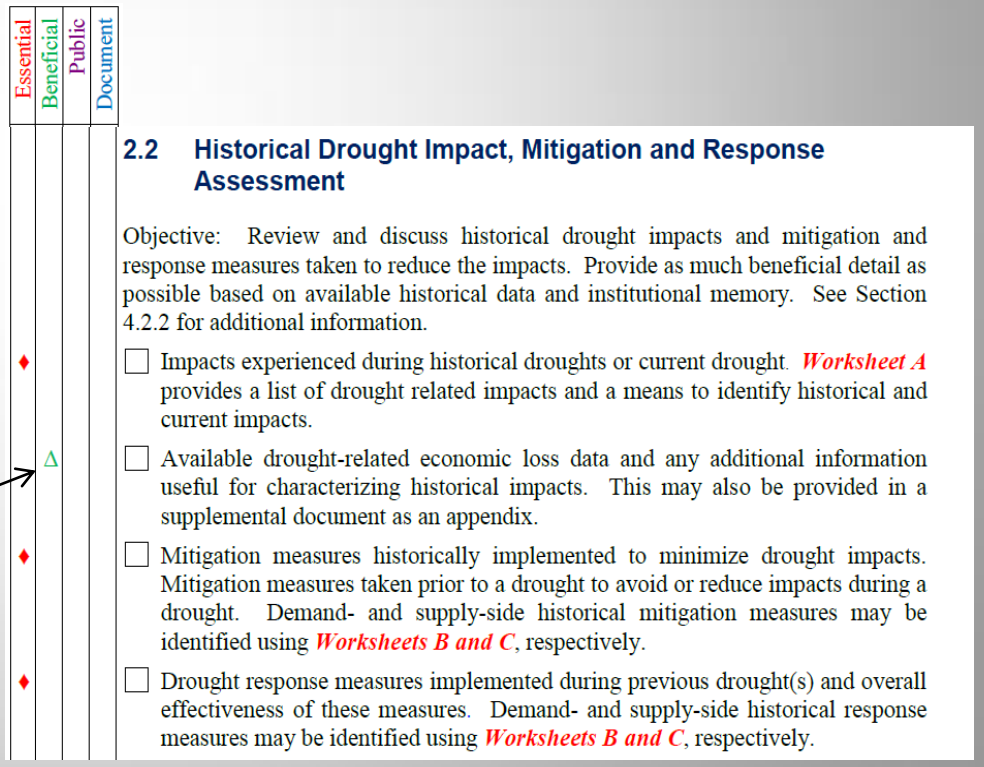
- Outlines plan elements that are…
  - Essential to Planning
  - Beneficial Planning
  - To Benefit the Public
  - For Documentation

How could I use this?

Your general manager is debating whether or not to include available drought related economic loss data and other information useful for characterizing historical impacts in your drought plan, but is questioning if it is essential or not according to the CWCB Municipal Drought Management Plan Guidance Document?

Beneficial, but not essential



1.2 Objectives of the Drought Management Plan

E	B	P	D	
				Objective: Introduce the basic objectives and operating principles of the plan and describe how these objectives are integrated into the broader water management planning efforts. See Section 4.1.2 for more information.
♦			+	☐ List of the objectives and operating principles.
	Δ	☐		☐ Discussion of how the objectives and operating principles reflect water use priorities during periods of a drought.
	Δ	☐		☐ List of water use priorities (i.e., a) essential water needs, b) social or economic impacts, and c) nonessential uses such as outdoor irrigation).
		☐		☐ Discussion of how the operating principles were incorporated into the plan development and how these principles will be considered during implementation (i.e., "The operating principles are reflective of the community's values and will be reviewed prior to implementing mandatory water use reductions.")

2.2 Historical Drought Impact, Mitigation and Response Assessment

E	B	P	D	
				Objective: Review and discuss historical drought impacts and mitigation and response measures taken to reduce the impacts. Provide as much beneficial detail as possible based on available historical data and institutional memory. See Section 4.2.2 for additional information.
♦				☐ Impacts experienced during historical droughts or current drought. ***Worksheet A*** provides a list of drought related impacts and a means to identify historical and current impacts.
	Δ			☐ Available drought-related economic loss data and any additional information useful for characterizing historical impacts. This may also be provided in a supplemental document as an appendix.
♦				☐ Mitigation measures historically implemented to minimize drought impacts. Mitigation measures taken prior to a drought to avoid or reduce impacts during a drought. Demand- and supply-side historical mitigation measures may be identified using ***Worksheets B and C***, respectively.
♦				☐ Drought response measures implemented during previous drought(s) and overall effectiveness of these measures. Demand- and supply-side historical response measures may be identified using ***Worksheets B and C***, respectively.

3.2 Drought Impact Assessment

E	B	P	D	
				Objective: Identify potential future drought impacts. See Section 4.3.2 for additional information.
♦				☐ Potential impacts that could occur during future droughts. ***Worksheet A*** may be used to identify potential impacts.
	Δ			☐ Discussion of the relative priorities assigned to the potential impacts. This information may be best represented as a table listing the potential impacts and corresponding priority with follow-up discussion. ***Worksheet A*** provides a means to record these priorities.

4.3 Demand-Side Response Strategies

E	B	P	D	
				Objective: Provide an overview of the demand-side response strategies taken when drought is imminent or occurring. See Section 4.4 for additional information.
♦				☐ List of the selected demand-side response strategies. Demand-side strategies listed in ***Worksheet C*** may be used as an initial reference source for identifying strategies. This worksheet is also useful for identifying whether the strategy is to be implemented on a voluntary, incentive, or mandatory basis. For example, strategies may be voluntary for a Stage 1 drought and elevated to mandatory under more drought severe conditions. Coordination with other entities may also be beneficial and can be noted in ***Worksheet C***. Similar to the supply-side strategies, details related to the future implementation of each strategy should be included.
	Δ			☐ Discussion of the criteria used to select the demand-side strategies. Section 4.4.2 provides a list of suggested criteria.
		□		☐ Discussion of how the selection process is reflective of the Step 1 objectives and operating principles.

5.2 Drought Declaration and Predictability

E	B	P	D	
				Objective: Provide a brief discussion of the challenges involved in early detection of a drought, how drought indicator data help characterize a drought, and other factors that influence drought declaration. See Section 4.5.2 for additional information.
		□		☐ Discussion of how weather patterns in Colorado can be unpredictable and the overall challenges in early detection of drought. Example(s) of past unpredicted weather events may be beneficial.
♦				☐ List of selected drought indicators and description of how these indicators are reflective of water supply conditions.
	Δ		+	☐ If applicable, significance of the selected drought trigger(s). In other words, why were these trigger(s) selected as opposed to other drought indicators.
♦				☐ Discussion of how the drought indicators, triggers, and other pertinent data are incorporated into the decision making process of declaring a drought.
♦				☐ Summary of how drought indicators will be monitored and general frequency of monitoring. Address critical times of year when monitoring is particularly important for identifying drought conditions (i.e., reservoir storage near the end of runoff).
	Δ	□		☐ Advantages and disadvantages of declaring a drought early versus delaying declaration of a drought stage until later in the season. Address the balance between prematurely declaring a drought and waiting too long to respond.
	Δ	□		☐ Discussion of how droughts can behave differently and the necessity for flexibility in declaring a drought stage (i.e., a multi-year drought could result in water shortages greater than anticipated requiring drought stages, trigger points, and response targets to be adjusted accordingly).

6.0 Staged Drought Response Program

E	B	P	D	
				This section outlines the drought response measures corresponding to each of the drought stages developed in Step 5. See Section 4.6 for additional information.
♦				☐ Supply- and demand-side response measures by drought stage. ***Worksheet F*** may be used to divide the strategies into individual measures according to drought stage. ***Worksheet G*** provides a template for presenting the supply- and demand-side measures.
♦	□			☐ Provide a summary table that highlights the drought stages, trigger points, response targets and a summary of drought response measures. ***Worksheet H*** provides a template that may be used to summarize the staged drought response program (for insert into an executive summary, fact sheet for public distribution, etc.)
	Δ			☐ Provide detailed staged public drought campaign plan if the provider chooses to include a detailed public drought campaign plan as a component of the staged drought response program. If appropriate, this may be an appendix or supplemental document. See Section 4.6.2 for additional information.

7.3 Drought Declarations

E	B	P	D	
				Objective: Describe the decision-making process necessary to publicly declare a drought and the corresponding drought stage and how this information is conveyed to the public. See Section 4.7.3 for additional information.
♦				☐ Summary of guidelines (e.g., trigger points and/or drought indicator data) used by staff to evaluate drought conditions.
	Δ			☐ If applicable, approach and/or resources used to forecast drought.
♦				☐ Decision maker(s) responsible for declaring a drought and corresponding drought stages.
	Δ			☐ If applicable, protocol for conveying drought information and recommendations from staff to decision makers.
♦				☐ Discussion of importance in identifying and declaring drought in a timely manner. Address timing of when decision-makers are informed and, subsequently, when the public is informed of a drought declaration.
♦				☐ Staff or entity responsible for announcing drought declaration to the public.

8.3 Drought Management Plan Approval

E	B	P	D	
				Objective: Briefly summarize the formal process for Plan adoption. Note: For some water suppliers, formal approval of its Plan may not be desirable. See Section 4.8.3 for additional information.
♦				☐ Government body that either approved or officially adopted the Plan.
♦				☐ Date of approval/adoption.
	Δ			☐ Potential conflicts/issues with the approval/adoption.
			+	☐ Copy of the official approval/adoption document in appendix.

WORKSHEET B - Supply-side mitigation and response strategies

Instructions:

[1] This column provides a list of supply-side response strategies. List additional strategies identified using Worksheet A or alternative sources

[2] This column identifies long-term mitigation actions.

[3] This column identifies short-term response strategies.

[4] Preliminary Selection: Identify the mitigation and response strategies that meet the following

Enter "existing" for all mitigation and response strategies included in existing drought management plans that will continue to be used in the future

Enter "new" for all mitigation and response strategies are to be considered for this drought management planning effort

Enter "eliminated" for all existing mitigation and response strategies that will no longer be used in the future

[5] Specify whether the selected "existing" and "new" mitigation and response strategies are to be implemented as mitigation or short-term response strategies by entering an "X" in the appropriate column.

[6] Screening: Specify how well the selected mitigation and response measures meet the criteria to the right of these instructions by entering the following ranking value

Enter "1" for mitigation and response strategies that meet one of the five screening criteria.

Enter "2" for mitigation and response strategies that meet two of the five screening criteria.

Enter "3" for mitigation and response strategies that meet three of the five screening criteria.

Enter "4" for mitigation and response strategies that meet four of the five screening criteria.

Enter "5" for mitigation and response strategies that meet five of the five screening criteria.

[6] Screening Criteria:

a) Technical feasibility

b) Perceived benefits

c) Cost effectiveness

d) Public acceptance

e) Environmental sensitivity and other extraneous impacts

[7] Enter an X for selected mitigation and response strategies following the screening process.

[8] If necessary provide additional explanation of why a mitigation or response strategy was retained or eliminated.

Supply-Side Mitigation and Response Strategies

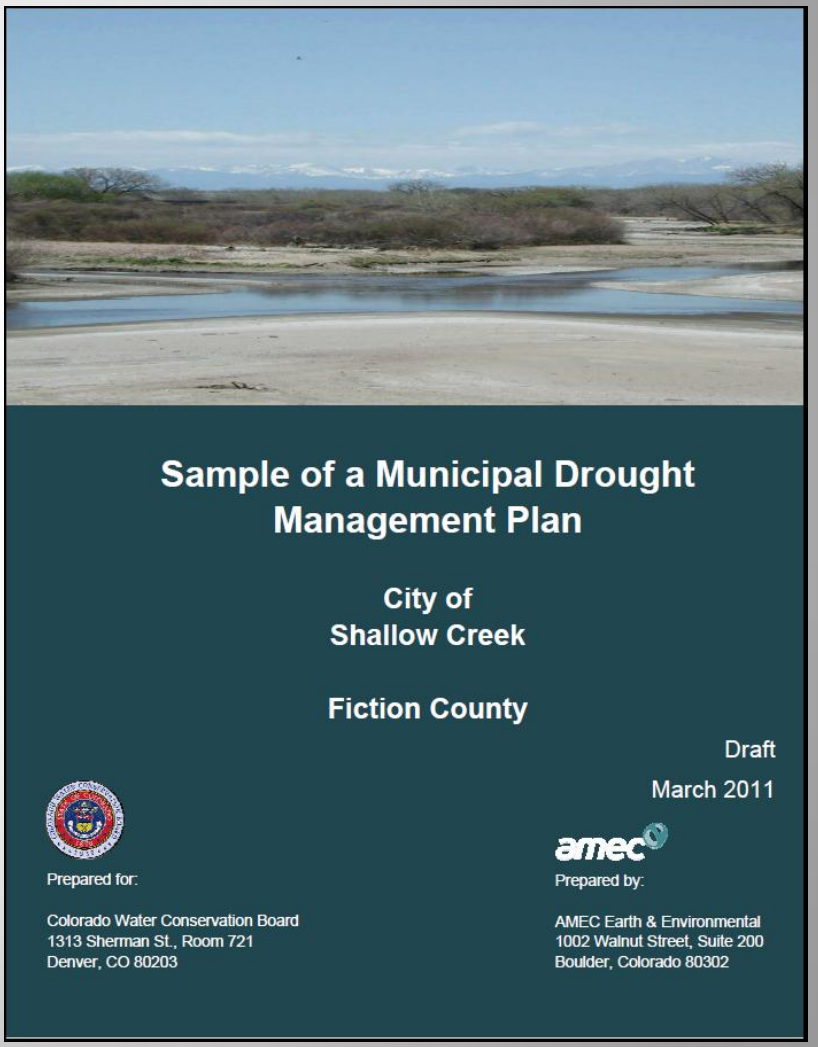
Supply-Side Mitigation and Response Strategies [1]	Long-term Mitigation Actions [2]	Short-term Response Strategy [3]	Preliminary Selection of Mitigation and Response Strategies	Selection of Planning Horizon [5]		Screening Ranking Value [6]	Post-Screening Selection of Mitigation and Response Strategies	Comments [8]
				Long-term Mitigation Actions	Short-term Response Strategy			
Elements of a Drought Management Plan								
Establish drought response principles, objectives, and priorities	X							
Establish authority and process for declaring a drought emergency	X							
Develop drought stages, trigger points, and response targets	X							
Prepare ordinances on drought measures	X							
Evaluate historical drought impacts	X							
Monitor drought indicators (snowpack, streamflow, etc.)	X	X						
Monitor water quality	X	X						
Track public perception and effectiveness of drought measures	X	X						
Improve accuracy of runoff and water supply forecasts	X							
List additional strategies identified using Worksheet A or alternative sources								
Emergency Response								
Declare a drought emergency		X						
Establish water hauling programs	X	X						
Restrict/prohibit new taps		X						
Identify state and federal assistance	X	X						
Provide emergency water to domestic well users		X						
Import water by truck/train		X						
List additional strategies identified using Worksheet A or alternative sources								
Public Education and Relations								
Establish a public advisory committee	X	X						
Develop Drought Public Education Campaign with long- and short-term strategies. (See Worksheet D)	X	X						
Extend boat ramps and docks for recreational use when reservoirs are low	X	X						
List additional strategies identified using Worksheet A or alternative sources								

WORKSHEET D- Drought public information campaign

Public Information Campaign Components	Screening [1]		Targeted Audience [2]																Coordinate with Other Entities [4]
	Long-term Mitigation Actions	Short-term Reponse Strategy	Decision makers/policy makers	Governmental bodies/city departments (i.e. parks, fire department)	Community recreational facilities	Media	Single-family residential	Multi-family residential	HOAs	Commercial business owners	Commercial business employees	School facility managers	School children	Industrial businesses	Specific targeted businesses (local nurseries, landscape architects, health facilities)	Large water users (golf courses)	*Insert other audience members [3]*	
Drought Information to Convey to the Public																			
Status of current drought conditions and drought stage																			
Long-term sustainability of water supply system																			
Where customers may access drought mitigation plan																			
Measures and/or impacts that customers can expect if drought continues or intensifies																			
Factors that could influence water supply services and cost of services																			
Water provider's actions to save water and/or acquire new water																			
Policy recommendations, requirements, and penalties																			
Enforcement of drought policies																			
Explanation of rate increases/drought surcharge																			
Increase advertisement of conservation incentives in conservation and drought plans																			
Water conservation savings tips																			
Landscaping tips during a drought (i.e., which plants to convert to drip, which to save, which to let die)																			
Post-drought landscape revival information																			
Use of gray water where legal and appropriate																			
Promote existing xeriscape gardens																			

Shallow Creek Drought Management Plan

- Shallow Creek is of “medium size,” serving water to a residential service area population of approximately 30,000 people in addition to commercial and municipal end users.
- Challenges faced by Shallow Creek are similar to the typical challenges many municipalities are confronted with (i.e. anticipated growth, limited funds, uncertainties related to drought cycles and climate change, etc).
- Shallow Creek uses planning tools of moderate sophistication for forecasting the availability of its water supplies on an annual basis as well as for estimating the firm yield of its water supply system.



Drought Committee Members

Name	Position	Department	Role on Committee
Bob Fisher	City Manager	n/a	Provided general direction on Plan development
Nancy Harper	Water Utilities Director	Utilities	Facilitated the Drought Committee meetings, led the coordination and gathering and dissemination of information, and delegated assignments to staff.
Jim Bell	Water Resources Engineer	Utilities	Provided input on water source availability, water rights yields, reservoir storage levels, and opportunities for use of non-potable water, operations, etc.
Henry Smith	Water Treatment and Operations Manager	Utilities	Provided information on water treatment operations and potential implications of a drought.
Melanie Thatcher	Conservation Specialist	Utilities	Served as a liaison between the Conservation Plan and development of the Drought Plan. Was primarily responsible for evaluating the drought response measures during the screening process.
Charles Goode	Accountant	Finance	Provided input on revenue implications associated with drought and costs necessary to implement the Plan.
Sandra Herring	Communications Director	Public Affairs	Provided input on public outreach, media relations, etc. Administered the public review period process discussed in Section 8.1.
Henry Boyd	Parks Manager	Parks Department	Provided feedback related to management of parks and open space
Bob Kandid	City Lawyer	Law	Provided legal advice
Susan Richards	Elected Council Member	City Council	Served as a liaison between the City Council and staff
Emily Woods	Business Woman	Public Resident	Provide input from public business and residential perspective
Samantha Good	Shop Owner	Public Resident	Provided input from public business, commercial, and residential perspective
George Wall	Teacher	Public Resident	Provided input from education and school facility perspective
Trudy Scooter	President of the Tourist Board	Public Resident	Provide input from the tourist sector perspective

Drought Planning Committee Tasks

- Meeting No. 1 – Introductions and development of water use priorities, objectives and operating principles.
- Meeting No. 2 – Historical drought information, lessons learned from past droughts, identification of historical and potential future drought impacts, and development of preliminary mitigation and response strategies.
- Meeting No. 3 – Screening of mitigation and response measures as well as development of drought stages, trigger points, and response targets.
- Meeting No. 4 – Development of staged drought response plan.
- Meeting No. 5 – Development of implementation plan.

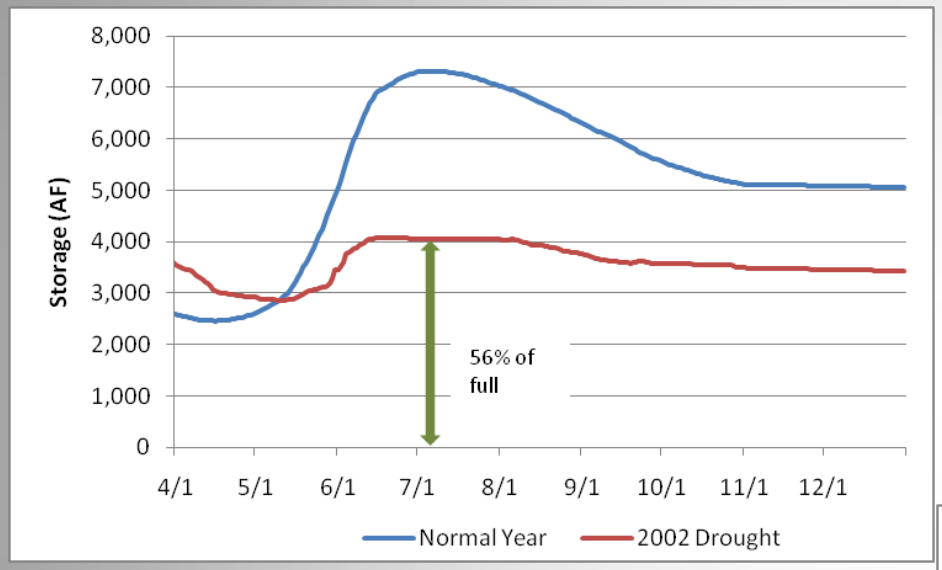
Plan Objectives

- Preserve essential public services during any level of drought severity from mild to critical emergency conditions.
- Minimize the adverse drought-related impacts on public health and safety, economic activity, environmental resources, and individual lifestyles during a drought event.
- Provide a comprehensive yet flexible framework to guide City staff on the drought mitigation and monitoring efforts, as well as on procedures to follow for declaring a drought and implementing the drought response.
- Effective communication of drought awareness and response information to the water customers.
- Provide an efficient means to monitor and improve the effectiveness of the Plan over time.
- Closely coordinate the drought mitigation and response with Shallow Creek's water supply reliability planning efforts described in Section 3.1 as well as with other City and regional level policies and planning efforts. This includes City, County and State policy as well as Shallow Creek's Conservation Plan and Fiction County's multi-hazard and emergency operations plans.
- Provide sufficient contextual information in the Plan to convey the importance of drought preparedness and management to the public and how the actions set forth in this Plan are relevant to reducing future drought-related impacts.

Water Use Priorities

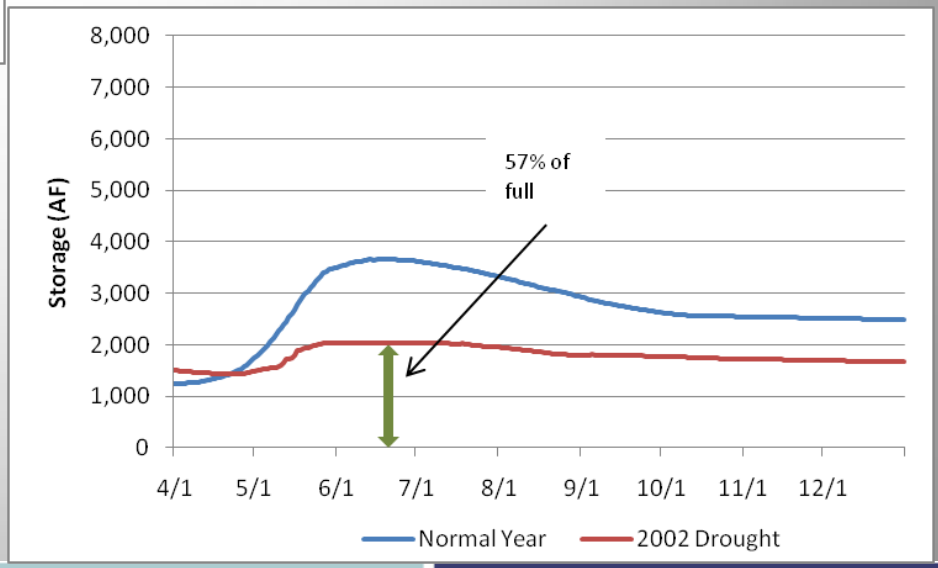
Priority	End Use	Description
1	Heath and Safety	Single-family residential, multi housing, water treatment plant, hydrants (for emergency use), wastewater treatment plant, and hospital
2	Business	Indoor use by the commercial and public sector including schools, stores, offices, hotels, restaurants, etc. and outdoor use on golf courses
3	Public outdoor irrigation	Parks, sports fields, and open spaces
4	Construction water	Water used for construction purposes
5	Outdoor irrigation	Outdoor irrigation in the single- and multi-family residences, and public and commercial sectors

2002 Storage



Storage in Crown Reservoir

Storage in Castle Reservoir



Historical Impacts of the Utility

Potential Future Drought Impacts	Potential Severity
Loss of revenue from reduction in water sales	Moderate
Reduction in storage reserves	Significant
Disruption of water supplies	Significant
Degraded water quality	Significant
Higher water treatment costs	Moderate
Sediment and fire debris loading to reservoirs following a wildfire	Significant
Increased costs and staff time to implement drought plan	Minor
Increased data/information needs to monitor and implement drought mitigation plan	Minor
Increased costs of acquiring additional supplies during times of drought	Significant
Favorable/unfavorable public perception of provider regarding drought response	Moderate
Scarcity of equipment and other water related services (i.e., contractors to repair wells)	Moderate

Drought Stages, Trigger Point Guidelines and Response Targets

Drought Stage	Drought Trigger Point Guidelines			Response Targets[1]
	Measured Snowpack near the end of April	Projected Reservoir Storage on July 1		
		Storage Level	Approximate Supply[2]	
Watch	90% of normal	Storage less than 90% of full	2 years of unrestricted total demand	10% water savings
Warning	75% of normal	Storage less than 80% of full	1 year of unrestricted total demand	25% water savings
Critical	50% of normal	Storage less than 65% of full	1 year of total demand with mandatory outdoor restrictions	40% water savings
Emergency	30% of normal	Storage less than 50% of full	1 year of unrestricted indoor demand	50% water savings

Public Drought Campaign Audiences and Communication Tools

Targeted Audience	Communication Tools	
	Long-term Mitigation	Short-term Response Strategy
Decision/policy makers, City departments (i.e. parks, finance, etc)	Email	Email Meetings
Media	Website Social networking media Interviews	Website Newspaper articles Social networking media Interviews Television ads
Water Customers (Single and multi-family, HOAs, commercial)	Website Broadly distributed emails Social networking media	Website Broadly distributed emails Social networking media Public meetings Bill inserts Newspaper articles Billboards Booths at special events
Targeted business owner customers (recreation facilities, nurseries, health facilities, schools)	Website Social networking media	Website Emails targeted for business owners Social networking media
Large water users (golf courses, water-intensive industrial customers)	Website Social networking media	Website Emails targeted for large water users Social networking media Meetings
Commercial business employees	Website Broadly distributed emails Social networking media	Website Broadly distributed emails Social networking media
School children	Water educational curricula for teachers Water educational programs for students Water festivals	School programs Booths at special events for children

Summary of the Staged Drought Response Program

	Watch	Warning	Critical	Emergency
	Reservoirs less than 90% full	**Reservoirs less than 80% full**	**Reservoirs less than 65% full**	**Reservoirs less than 50% full**
	10% savings	**25% savings**	**40% savings**	**50% savings**
Supply-Side Measures				
Technical and financial assistance	Seek technical and financial assistance opportunities	Seek technical and financial assistance opportunities	Seek technical and financial assistance opportunities	Seek technical and financial assistance opportunities
Water rights and cooperative agreements	Assess new water rights management and cooperative agreement opportunities	Assess new water rights management and cooperative agreement opportunities	Assess new water rights management and cooperative agreement opportunities	Assess new water rights management and cooperative agreement opportunities
Modify reservoir releases	n/a	Modify reservoir releases to enhance streamflows during critical recreational times of the day (12:00 pm to 3:00 pm for tubing July – August)	Modify reservoir releases to enhance streamflows during critical recreational times of the day (1:00 pm to 3:00 pm for tubing July – August)	n/a (too dry to implement)
	n/a	Adjust reservoir releases to maintain Castle Reservoir storage at 50% of capacity to avoid degradation of drinking water quality	Adjust reservoir releases to maintain Castle Reservoir storage at 50% of capacity to avoid degradation of drinking water quality	n/a (too dry to implement)
Demand-Side Measures Shallow Creek Utilities Department				
Drought surcharge	n/a	n/a	Design a drought surcharge to support water use restrictions and the targeted water savings. Surcharges will be applied to all customers.	Design a drought surcharge to support water use restrictions and the targeted water savings. Surcharges will be applied to all customers.
Outdoor irrigation	Standard irrigation practices on City-owned property that promote conservation	Standard irrigation practices on City-owned property that promote conservation	Eliminate turf irrigation on City parks and open spaces. Sports fields, trees, and shrubs & preferred “green areas” specified via community outreach efforts may be irrigated on a predetermined limited basis.	Eliminate all turf irrigation on City parks and open spaces until drought has ceased. Limited irrigation of trees with a hand held hose or non-spray device is allowed to help ensure survival.

Shallow Creek Template in Action

4.4 Drought Public Information Campaign

Objective: Provide the drought public campaign framework. See Section **Error! Reference source not found.** for additional information.

- ☒ List of the public drought campaign goals.
- ☒ Discussion of how the public drought campaign will be differentiated from the public conservation education program and how synergistic benefits can be developed between the two programs.
- ☒ General components of the public drought campaign. This includes the types of audiences to be targeted, communication tools to be used to convey drought related information, specific key information to convey, and opportunities for future synergies. *Worksheet D* may be used as a means to develop this framework.
- ☐ Prescripted messages targeted towards the public to be released through public information outlets during various drought stages. These could be detailed in an appendix.

8.2 Adoption of Ordinances and Official Agreements

Objective: Summarize the ordinances and official agreements adopted to implement the Plan. See Section **Error! Reference source not found.** for additional information.

- ☒ Summary of the ordinance(s) and policy necessary to implement the Plan. This may include policy changes to: facilitate the formal declaration of a drought; implement and enforce the staged drought response program and drought public campaign; and adopt revenue changes, etc.
- ☒ Official agreement(s) needed with other entities for drought-related coordination purposes.
- ☐ Official copies of the ordinance(s) and/or official agreement(s) may be included in an appendix.
- ☐ Challenges encountered to develop and approve the ordinance(s) and/or official agreement(s).

WORKSHEET A - Historical drought impacts, future potential impacts, and mitigation (Shallow Creek)

Historical, Existing and Potential Drought Impacts [1]	Step 2 - Historical Drought Assessment						Step 3 - Vulnerability Assessment		Step 4 - Drought Mitigation and Response Strategies	
	Historical Impact [2]	Existing Impact [3]	Ranking of Drought Impact Severity [4]	Historical/Existing Mitigation & Response Strategies [5]	Effectiveness of Historical/Existing Mitigation & Response Strategies [6]	Comments [7]	Potential Future Impact [8]	Potential Impact Priority [9]	Mitigation [10]	Response Strategies [11]
Water Provider										
Loss of revenue from reduction in water sales	X		2	Raised rates in 2003	2	Effective but not popular	X	2		Drought surcharge that is spread over period
Reduction in municipal well production										
Reduction in storage reserves	X		2				X	1	Acquire addiitional storage/supplies	
Disruption of water supplies							X	1	Acquire addiitional storage/supplies	
Degraded water quality	X		2				X	1		Blend sources, change reservoir operations
Higher water treatment costs	X		2	Raised rates in 2003	2	Minor when compared to revenue loss	X	2		Drought surcharge that is spread over period
Sediment and fire debris loading to reservoirs following a wildfire							X	1	Develop Emergency Wildfire Plan	
Increased costs and staff time to implement drought plan	X		2				X	3		
Increased data/information needs to monitor and implement drought mitigation plan	X		3				X	3		
Costs to acquire/develop new water supplies/water rights transfers							X	2		
Costs to increase water use efficiency										
Public favorable/unfavorable perception of provider regarding drought response	X		3	Public Education	2	Mixed reviews from public	X	2		
Scarcity of equipment and other water related services (i.e., contractors to repair wells)							X	2		
List other provider related impacts										
Community and Societal										
Domestic landscaping stressed or killed							X	2		
Public landscaping stressed or killed							X	2		
Lower quality drinking water (i.e., poor taste and odor)	X		2	Increased treatment but still issue	3		X	2		Manage reservoir releases
Reduced firefighting capability										
Cross-connection contamination as a result of lower pressures										
Increased pollutant concentrations	X		3				X	3		
Reduced quality of life							X	3		
Loss of human life (i.e., heat stress)							X	3		

Shallow Creek Drought Management Plan - Summary

- Provides an example of how the guidance document can be applied
- It is ONLY meant to be an example not “what should be done”
- An additional reference tool in the “toolbox” for drought planning

Questions?

Cookie Break

Table Top Drought Exercise

I always tried to turn every disaster into an opportunity.
John D. Rockefeller

To help frame the discussion…

- ASSUME THAT YOU HAVE A CWCB APPROVED DROUGHT PLAN

- What actions do you take to monitor, mitigate or respond given the conditions laid out in your scenario

Response
- What phase are you in?
- What is the communication Plan?
- How are you messaging to the public and policy makers?
- What response actions are you taking to reduce demand/lessen impacts/increase supply?

Mitigation
- Are there actions that you can take now that will lessen or eliminate impacts in the future should conditions deteriorate or in a future drought event?

Monitoring
- What phase are you in?
- What is the monitoring plan?

For all of the above - who are the folks that you are engaging?

Drought Mitigation Planning Grant Program

Water Efficiency Grant Program

Who is Eligible?

Covered Entities

CWCB-Approved Conservation Plan

State or Local Governmental Entities

To Do What?

CWCB-Approved Drought Mitigation Plans

Implementation

Going Forward

Resources Available to Help You & Next Steps

Key Elements

Water Efficiency Grant Program

Detailed Scope of Work & Budget & Timeline

25% Match (In-kind/cash)

Amounts requested commensurate with project

OWCDP staff review (4 – 8 weeks)

- Progress Report at 50% completion
- Progress Report at 75% completion
- Final Plan or Report

Approval & Timing

Water Efficiency Grant Program

CWCB Director Approval – at anytime

Board Approval

July	June 1
September	August 1
November	October 1
January	December 1

NOTE: All grant awards are based on fund availability & applicant demand.

Specific Guidelines

Website: www.cwcb.state.co.us

↳ *Loans & Grants*

↳ *Water Efficiency Grant Program*

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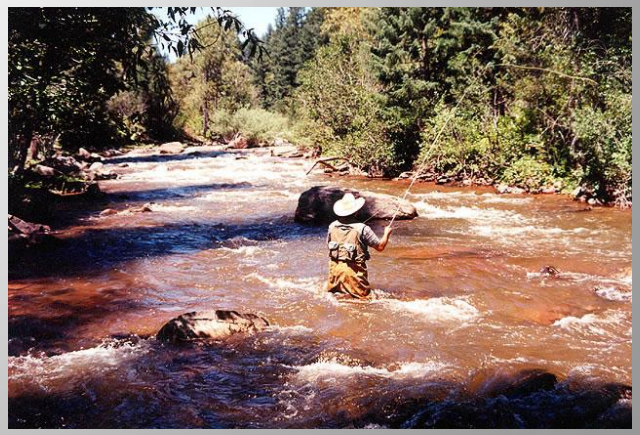
Next Steps—
Implementation Projects

- DART
- Colorado Climate Preparedness Project
- Drought Portal Website Efforts
- SWSI

What is DART?
(Drought Assessment for Tourism & Recreation)

- Two-phase pilot project
- Phase I - Scoping
  - Evaluate the metrics used in the State Drought Plan Vulnerability Assessment
  - Identify additional data and information to fill gap areas
  - Stakeholder driven
- Phase II - Implementation of the findings

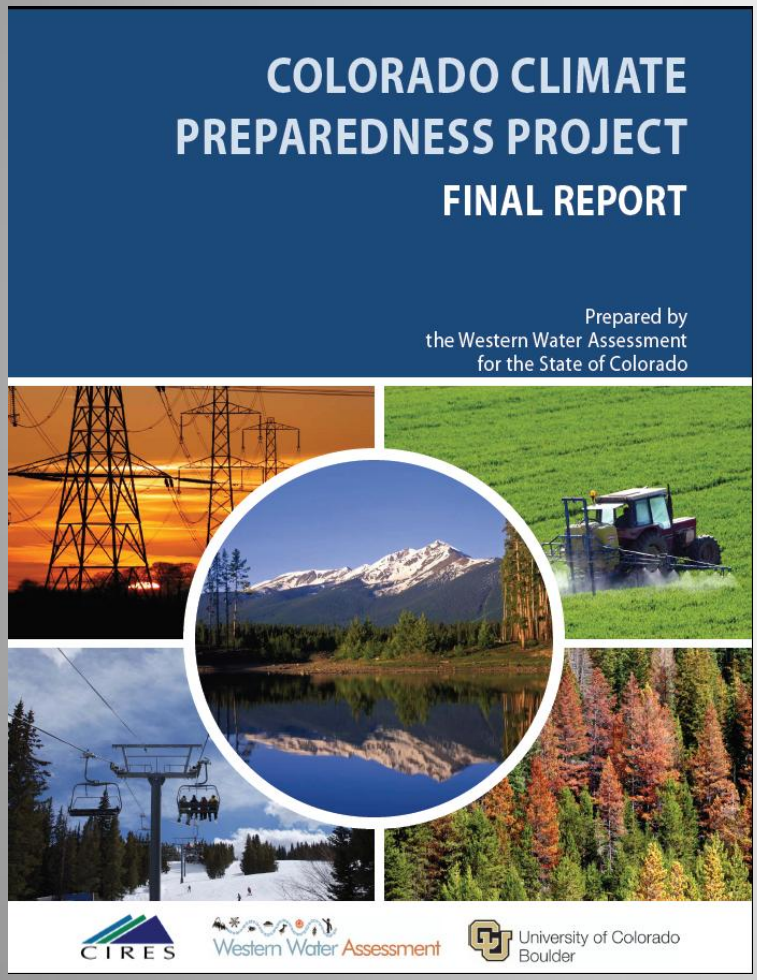


Colorado Climate Preparedness Project

http://www.coloadaptationprofile.org/

- To assist Colorado in continuing to prepare itself for climate variability and change by providing a catalog of climate vulnerabilities and current activities.
- Database- a searchable collection of information about groups and individuals actively engaged in climate adaptation work in Colorado and relevant to state adaptation efforts. It contains four linked sections:
  - Organizations
  - People
  - Projects
  - Products

Colorado Climate Preparedness Report

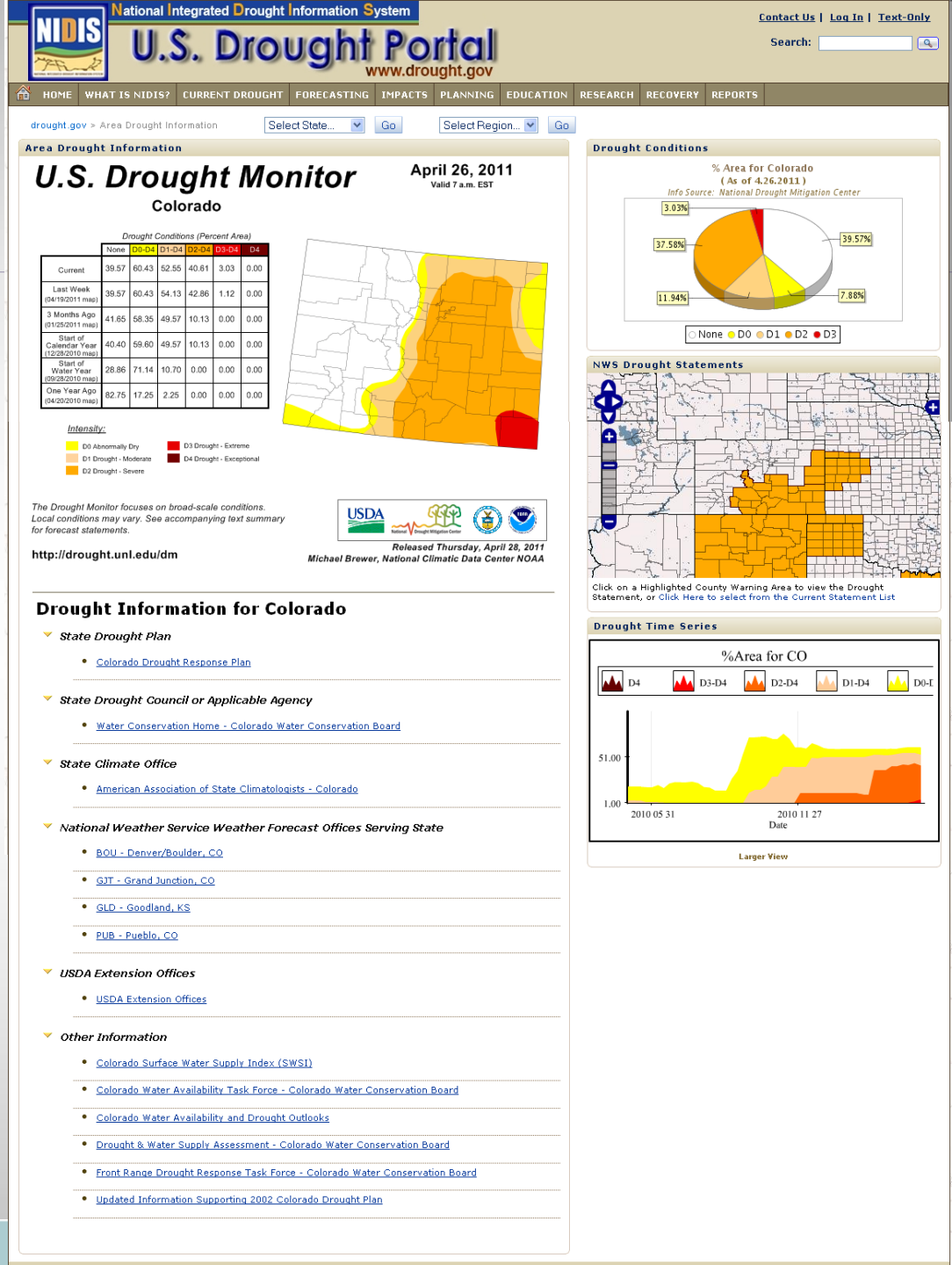


- Adaptation will require coordination
- Monitoring is a critical element of climate adaptation
- Additional research
- More complete impacts and vulnerability assessment is needed to prioritize Colorado's key climate threats and vulnerabilities
- Climate impacts on water resources—e.g., changes in runoff patterns, snowpack, and storage—are a significant source of impacts
- The state is already engaged in many activities
- Inherent uncertainty of long-term climate projections and the incompatibility of the timescales of climate change with existing planning regimes.

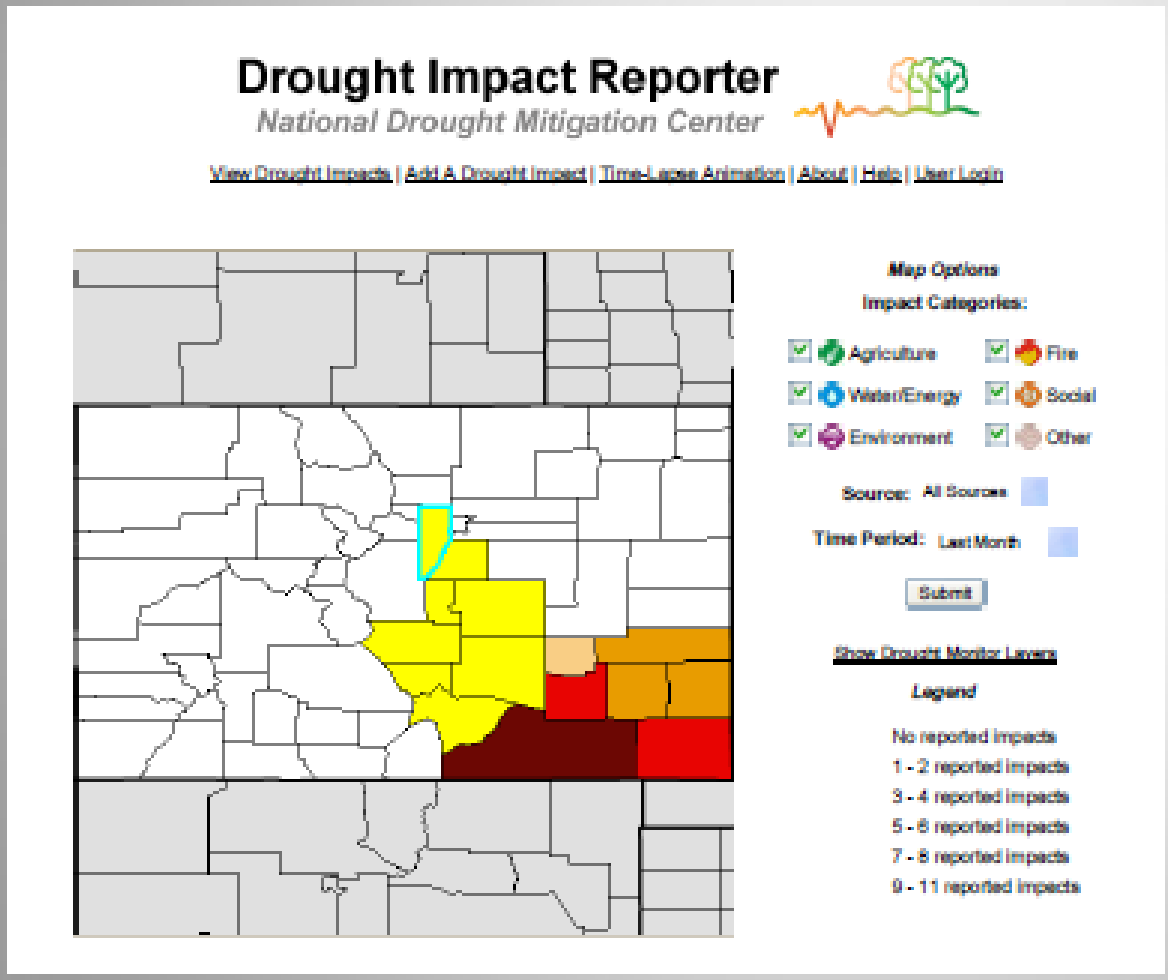
Current US Drought Portal Colorado Page

USDP uses the same model for each state. Categories include:

- Drought Monitor with statistics
- NWS Drought Information Statements
- State Drought Plan
- State Drought Council
- State Climatologist
- NWS Offices
- USDA Extension
- Other (State-directed, often AASC-based)



Drought Impact Reporter



National drought impact database for the US

Information for the impact report database comes from a variety of sources:

1.on-line drought-related news stories and scientific publications, reviewed by NDMC staff

2.members of the public who visit the website and submit a drought-related impact for their region (YOU)

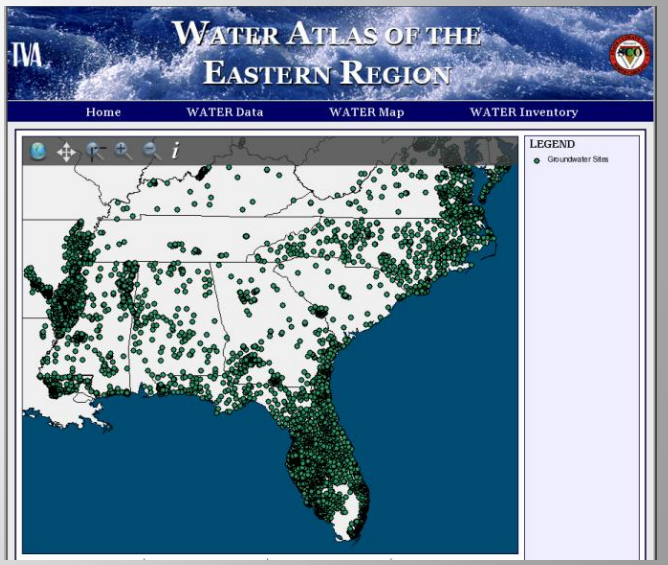
3.members of the media

4. members of government agencies such as National Oceanic and Atmospheric Administration (NOAA) and U.S. Department of Agriculture (USDA).

Opportunities Being Pursued in the East

NIDIS is working with the Tennessee Valley Authority's *Water Atlas for the Eastern Region* activity to identify locations where NIDIS services could replace TVA data handling and service provision. Benefits include:

- Reduce duplication of effort
- Reduce cost to TVA for data provision
- Reduce NIDIS effort to generate information
- Enhance suite of products available to TVA and other regional decision makers through the Drought Portal



State and private groundwater measurement sites not previously available through NIDIS, now available because of collaboration with TVA.

Opportunities For Improved Services In Colorado?

Possible Ties Between NIDIS and CWCB to:

- Tabbed Colorado State Page on USDP with
  - Data views for Colorado
  - Links to applicable information
  - Ties directly to CWCB for Drought PLanning
- Reduce cost for data provision
- Reduce NIDIS effort to generate information
- Enhance suite of products available to decision makers through the Drought Portal

Questions?

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Thank you for your attendance

PLEASE FILL OUT SURVEY BEFORE LEAVING