

COLORADO

2010 Drought Mitigation & Response Plan



**COLORADO WATER
CONSERVATION BOARD**



Overview

Colorado's Drought Mitigation and Response Plan (Plan) was developed by the Colorado Water Conservation Board (CWCB) to provide an effective and systematic means for the State to reduce the impacts of water shortages due to drought over the short or long term. The Plan outlines a mechanism for coordinated drought monitoring, impact assessment, response to emergency drought problems, and mitigation of long term drought impacts.

The 2010 FEMA-required revision process resulted in a Plan that uses state of the art planning techniques to prepare Colorado for drought. The Plan now serves as a "how to" guide for dealing with drought, from prior to the onset of an event through conclusion of the event. The Plan improves the lines of communication among statewide drought related taskforces, Department of Natural Resources (DNR), Division of Local Affairs (DOLA), Department of Agriculture and the Governor's Office during times of drought. In addition, the Plan:

- Meets FEMA and Emergency Management Accreditation Program (EMAP) standards & requirements
- Meets drought requirements for the State of Colorado's Natural Hazard Mitigation Plan
- Incorporates improvements in drought monitoring since 2001
- Modernizes drought monitoring indices such as the Surface Water Supply Index (SWSI)
- Includes a vulnerability assessment of natural resource & economic sectors, including an examination of the influence of climate change
- Provides a comprehensive drought planning tool box for local entities, including a comprehensive drought planning guidance document and additional web based resources and materials
- Integrates local drought planning efforts into the State drought plan

"Colorado is once again leading the West and the nation with innovative approaches to drought preparedness. In a state where at least one region experiences drought nearly every year, this work will help protect the citizens, environment and economy of Colorado."

- DR. MICHAEL J. HAYES,
DIRECTOR OF THE NATIONAL
DROUGHT MITIGATION CENTER



Elements of the 2010 Colorado Drought Mitigation & Response Plan

The revised 2010 Plan contains key findings from the appendices and annexes described below.

Annex A | Drought Response Plan

All of the drought response elements have been consolidated into this annex, making it easier and more efficient to separate response actions for immediate implementation

Annex B | Drought Vulnerability Assessment

The enhanced drought vulnerability assessment highlights drought exposure and adaptive capacity for sectors and State assets, county-by-county within Colorado.

- State Assets
- Agriculture
- Energy
- Environmental
- Municipal & Industrial
- Recreation
- Socioeconomic

Annex C | Climate Change Implications

This annex is a reconnaissance level analysis of possible implications of climate change for drought in Colorado. It is based on previous studies and an enhanced analysis of the CWCB Colorado River Water Availability Study results.

Annex D | Drought Monitoring Indices

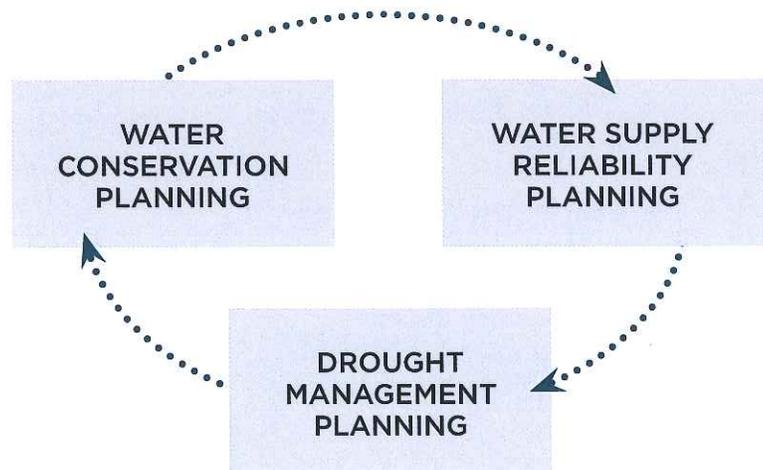
This annex is an evaluation, enhancement, and integration of drought monitoring indices, including their role and use within Colorado's Drought Mitigation and Response Plan.

Appendices (A-E)

- Planning Committee
- Actions Taken to Reduce Drought Impacts in Previous Droughts
- Drought Mitigation Capabilities Summary
- References
- Definitions and Acronyms

Benefits of the 2010 Colorado Drought Mitigation & Response Plan

- 1 | Efficient, Coordinated Government
- 2 | Reduced Losses (economic, social, physical)
- 3 | Reduced State and Local Expenditures
- 4 | Reduced Liability
- 5 | Includes Continued Eligibility for Federal Mitigation Funding
- 6 | Increased Stakeholder Collaboration



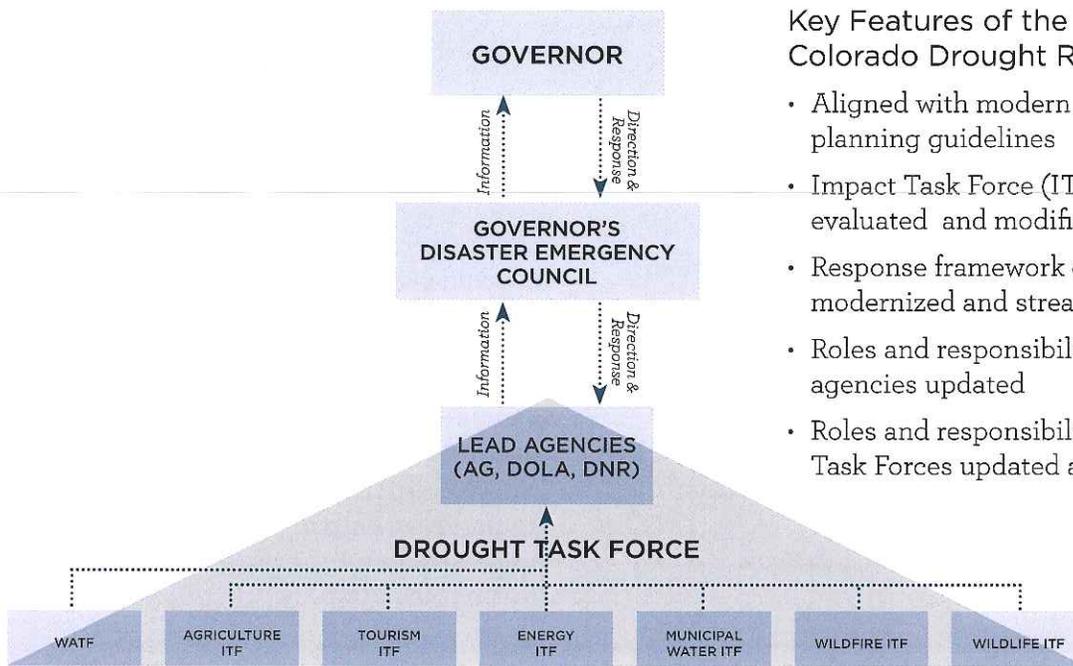
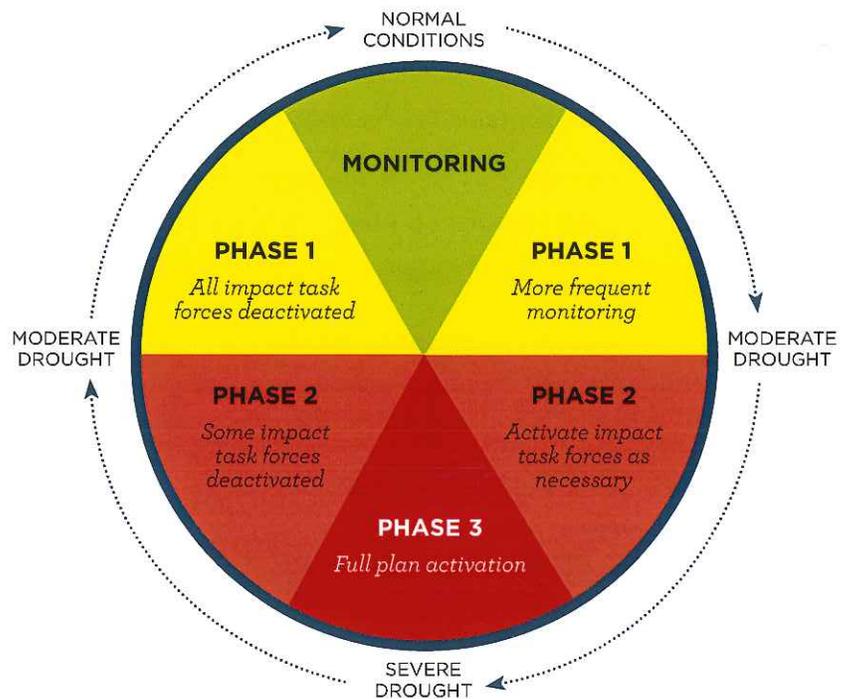
The main objective of water conservation planning is to achieve lasting, long-term improvement in water use efficiency while reducing overall water demands.

In contrast, **drought planning** focuses on mitigation and response strategies that can provide short-term relief from temporary drought-related water supply shortages. Drought response measures often achieve temporary savings during a drought. Both are essential elements of overall integrated water resource planning.

Drought Response

The figure to the right graphically depicts the general sequence of monitoring and response actions of the Drought Response Plan. Severity indices are used to provide a general framework for response based on pre-determined trigger points and by themselves do not initiate response actions. Further data analysis may be required to fully understand impacts of abnormally dry conditions. Recommendations for action may also be dependent on timing, location, extent, water supply, and subjective considerations. The evaluation of these additional variables is critical because in Colorado it is common for different parts of the State to be in different drought phases at different times.

The Drought Response Plan can be partially or fully implemented allowing maximum flexibility to meet the unique response requirements for any level of pre-drought or drought conditions.



Key Features of the 2010 Colorado Drought Response Plan

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

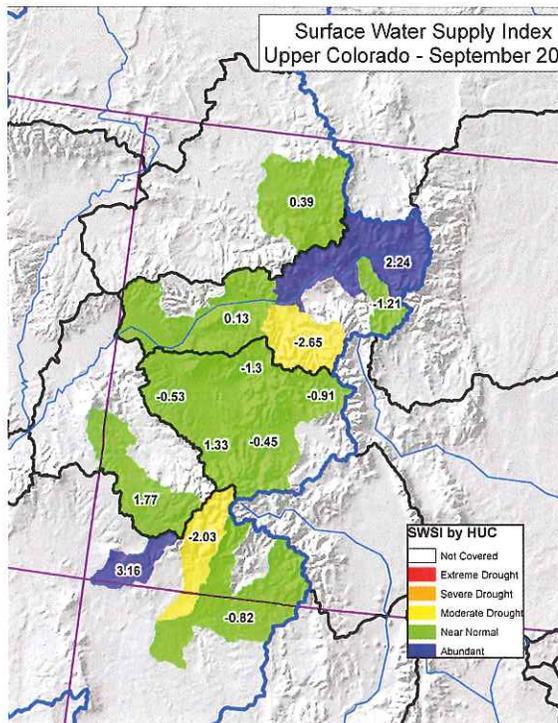
Monitoring

Surface Water Supply Index (SWSI)

An updated SWSI was adopted as part of the 2010 State drought plan revision. The revised technique for calculating the SWSI provides a more stable month to month transition, eliminating abrupt shifts in index values, sometimes produced as the variables change throughout the year. The revised SWSI will use the following variables as indicators of available water supplies:

TIME PERIOD	VARIABLES
January - June	Forecasted Runoff + Reservoir Storage
July - September	Previous Month's Streamflow + Reservoir Storage
October - December	Reservoir Storage

The revised SWSI also increases the spatial resolution to approximately 30 watersheds instead of the seven major basins previously covered. As of April 2010, the State utilizes the revised SWSI to monitor drought conditions in the west slope basins. Transition to the revised SWSI for the rest of the State will be completed by the end of 2011.



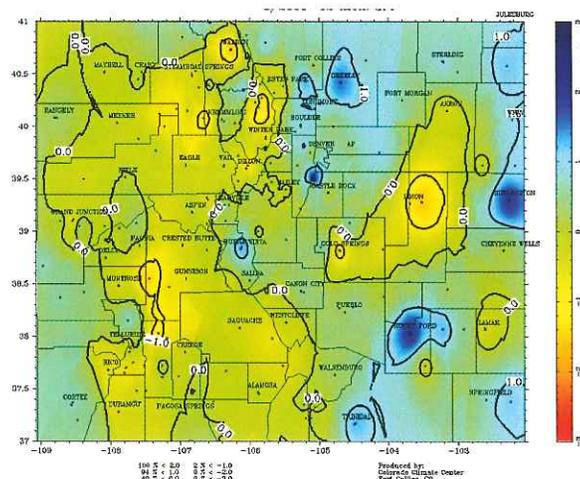
“Utilizing up-to-date techniques for drought indices, such as the Surface Water Supply Index, provide greater precision in assessing drought status. This is the first step in the development of a drought early warning system in Colorado; this system will help us identify potential impacts earlier, so we have more time to make smart decisions about how to respond.”

- NOLAN DOESKEN,
COLORADO STATE CLIMATOLOGIST

Colorado Modified Palmer Drought Index (CMPDI) & Standard Precipitation Index (SPI)

Previously the CMPDI was considered an antiquated index for monitoring drought. However, the work done on the 2010 revised Plan revealed that it does have usefulness and should continue to be used by the State. Additional findings include:

- The CMPDI correlates well with certain impacts such as wheat yield and water year streamflow. Sometimes it is the best leading indicator of these important impacts. However, The CMPDI does not perform equally well in all parts of the State. It has a very long memory, and thus does not respond well to fairly rapid changes in hydrologic conditions.
- The 3-9 month SPI values are more likely to provide predictive skills of some near future (next 1-9 month) drought impacts.
- The 9 and 12 month SPI often behave similarly to the CMPDI.
- The 24 and 48 month SPIs are excellent for providing diagnostic documentation — after an event on the frequency, severity and areal extent of droughts that have occurred.



Mitigation

Colorado has revised the framework of its drought mitigation strategy to improve its ability to track progress in meeting Plan goals and to improve alignment with local mitigation strategies (e.g., goals, objectives, and actions).

THE FRAMEWORK OF THE STATE'S DROUGHT MITIGATION STRATEGY HAS TWO PARTS: **GOALS, AND ACTIONS,** WHICH ARE DEFINED AS FOLLOWS: The goals are broad based and describe the overall direction that the State will take to reduce drought impacts. The actions describe the activities or projects used to support the accomplishment of the goals.

The following eight goals of the Colorado Drought Mitigation and Response Plan are listed below, in no particular order.

- | | |
|---|---|
| 1 Improve Water Availability Monitoring and Drought Impact Assessment | 5 Reduce Water Demand/Encourage Conservation |
| 2 Increase Public Awareness and Education | 6 Reduce Drought Impacts to Colorado's Economy, People, State Assets, and Environment |
| 3 Augment Water Supply Through Mechanisms to Transfer Water from Areas of Surplus to Areas of Shortage During a Drought | 7 Develop Intergovernmental and Interagency Stakeholder Coordination |
| 4 Coordinate and Provide Technical Assistance for State, Local, and Watershed Planning Efforts | 8 Evaluate Potential Impacts from Climate Change |

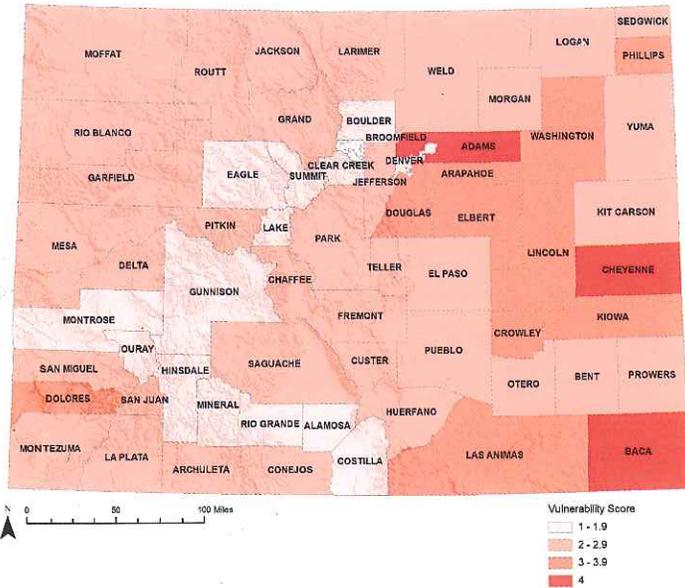
The Plan also consists of more than 80 different action items proposed to achieve the above goals. Some of these actions are ongoing while others are recommendations. Many of the actions can be implemented in the short term which is defined as the next three year update cycle; others must be viewed as long-term measures, and some will be implemented during drought cycles. The actions are prioritized by High, Medium and Low. Lead agencies responsible for the implementation of these goals are also listed. Below is a brief excerpt of some of the items listed in the Plan as mitigation actions. For the full list of mitigation actions see Table 20 of the Plan.

Priority	Recommended Action	Primary & Related Goal	Lead Agency/ Entity	Action Dev. Date	Status 2010		Status, Implementation and Funding Comments
					Completed	Ongoing	
Goal 1: Improve Water Availability Monitoring and Drought Impact Assessment							
H	Integrate state flood & drought monitoring	1	CWCB	2010			Improve efficiency through better integration
H	Collect climatologic data at mid & lower elevations to fill existing gaps in the data collection network	1	WATF NRCS CCC CoCo RAHS CAIC	2010			
H	Additional Drought DSS support & development	1	CWCB SEO	2002		X	Basin Needs DSS will be developed in 2010
M	Funding: stream gage improvements	1	USGS CWCB	2002	2001	X	Instream flow program coordinates with USGS. Funding set aside for program within CWCB
M	Colorado Drought Status strategy	1,2	WATF	2002	2002	X	Monthly drought status update developed for State leadership; some elements of this are being revised with 2010 Plan revision and will continue into the future
M	Improved Impact Assessment	1	CWCB and ITFs	2010			Impact analysis has always been a weak link; need multiple impact reporting and data mechanisms; adapt the tools developed for the 2010 drought vulnerability assessment

Vulnerability Assessment

For the first time ever, the Plan includes a quantitative and qualitative vulnerability assessment of state-owned assets and other natural resource and economic sectors in Colorado. This assessment is the first of its kind to be done in the West. The methodology enables a more targeted approach to drought planning. The revised Plan also quantitatively addresses how climate change may influence drought in the future.

STATEWIDE AGRICULTURE SECTOR VULNERABILITY ASSESSMENT RESULTS



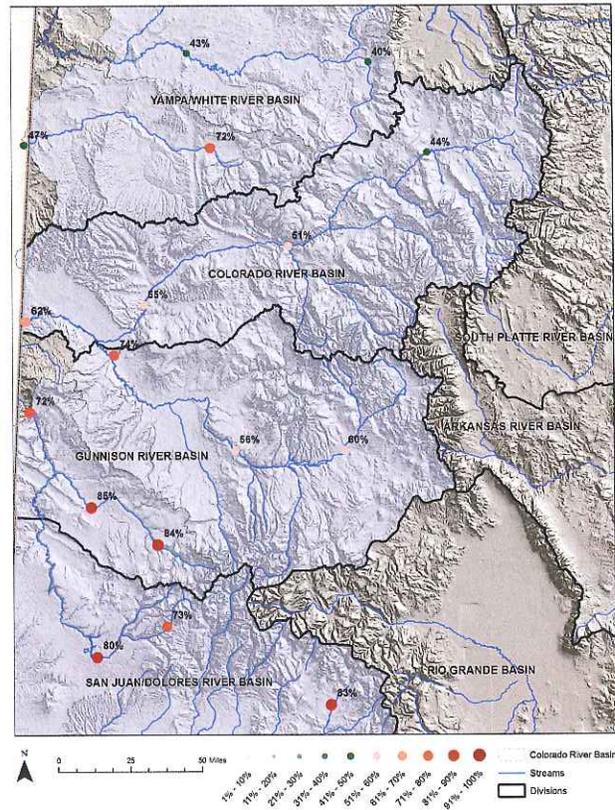
Among the findings, the vulnerability assessment determined that agriculture on the eastern plains is more vulnerable to drought impacts than west slope agriculture, based on the metrics used for evaluation. Findings also included the observation that tourism and recreation businesses in Colorado's northwest are more likely to feel drought impacts than in other parts of the State.

The Plan also looks at the State owned and managed assets, such as State Parks, wildlife and State Land Board lands, to assess their vulnerability to drought.

"This new drought plan will help us evaluate how a drought could impact the various sectors of our economy down to the county level, that's a powerful tool we haven't had before and it will aid in the development of drought planning to safeguard the assets most important to each region."

- JENNIFER GIMBEL,
CWCB DIRECTOR

AVERAGE MAXIMUM DROUGHT LENGTH EXCEEDANCE PROBABILITIES





Office of Water Conservation and Drought Planning

The CWCB's Office of Water Conservation and Drought Planning was created to promote water conservation and drought mitigation planning and implementation by: acting as a repository for related information; providing technical assistance; providing financial assistance; and providing evaluation of plans to address water needs and prepare for water related emergencies.

1313 Sherman Street
Room 721
Denver, CO 80203

P 303.866.3441
F 303.866.4474

www.cwcb.state.co.us

