City of Boulder

Drought Plan

2022 Update

CITY OF BOULDER
DROUGHT PLAN

This Drought Plan was developed by the City of Boulder's Utilities Department staff, on behalf of the city manager, with support from ELEMENT Water Consulting, Inc. and Lynker Technologies. Recognizing that a variety of perspectives is valuable in preparing a comprehensive drought plan and informing the development of an effective drought response program, the city formed a Drought Committee comprising stakeholders from multiple city departments. The Drought Committee was pivotal in the development of this plan and will be directly involved in the implementation of a drought declaration. Committee members include city staff from the following divisions and departments: City Attorney's Office, City Manager's Office, Communications and Engagement, Planning and Development Services, Open Space and Mountain Parks, Parks and Recreation, Public Works Business Services, Transportation and Mobility and Utilities. The city's Water Resources Advisory Board, which advises the Boulder City Council, Planning Board and city staff on community utilities issues, provided critical input on key plan components throughout the plan development.

This Drought Plan was approved by the City Manager on November 2, 2022.

*By:*_____
Nuria Rivera-Vandermyde, City Manager

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PREFACE

The purpose of the City of Boulder Drought Plan is to provide a guidance document for recognizing and responding to droughts and other conditions that affect water supply availability for Boulder. This document is an update to Boulder's 2010 drought plan[1] which was originally prepared in 2003, revised in 2004 and appended in 2010. The original plan included an assessment of the adequacy of the city's water supply system and a plan for recognizing and responding to droughts in a manner that is consistent with the city's adopted water supply reliability criteria. The original plan also provided research information about the use of water budget rate structures for encouraging long-term water conservation and enhancing drought management. In 2010, the city updated the plan content and incorporated the application of water budgets as a drought response tool.

In the process of preparing this plan update, the city re-evaluated how it monitors for and assesses drought conditions, mitigates potential impacts from drought and responds to drought. The city considered analyses of recent supply and demand data along with lessons learned from prior drought periods. While the 2010 plan was structured around using water budgets as the primary tool to influence water use reductions during drought, experience with water budgets since that time has informed the use of additional response measures and tools in this updated plan. An update to how the city classifies droughts and the staged drought response program reflect that work. New features of this plan include:

- A process for engaging stakeholders in multiple city departments in monitoring conditions and responding to droughts.
- An updated set of Guiding Principles that applies to the selection of response measures for each unique drought.
- A change from using four Drought Alert Stages, in which the first stage was voluntary, to using a pre-declaration Watch category and three Drought Alert Stages, in which each stage is mandatory, to better align with the city's water supply reliability criteria.
- Clarification of the process by which the city formally declares a drought under one of the three Drought Alert Stages.
- A modified staged drought response program, with guidance for selecting and adapting best-practice Drought Response Measures.
- A monitoring and implementation strategy for responding to droughts.

Demand-side strategies are the foundation of Boulder's drought response program. During drought conditions, water supply shortages often occur during summer months when water use, commensurate with landscape irrigation, is highest. For that reason and because outdoor water use tends to be more discretionary than indoor use, many of the response measures outlined in this plan target outdoor water uses. Supply-side measures often take longer to implement and are primarily used as a long-term drought mitigation strategy, although certain short-term supply-side strategies are described in Section 4, below.

[1] The 2010 drought plan comprises Volume 1, titled "Drought Planning and Response Plan," dated March 15, 2010, and Volume 2, titled "Drought Plan Technical Information and Analysis," dated February 20, 2003, and revised November 2004.

APPLICABILITY

This plan specifically focuses on the municipal water supply system, which is managed by the Utilities Department. Customers who have private water rights for non-municipal uses, e.g., use of a well or irrigation ditch rights for lawn or landscape watering, are encouraged to follow the city's drought declarations but are not restricted under this plan for such non-municipal uses because that water is not provided by the city. Other unique situations are described below.

OPEN SPACE AND MOUNTAIN PARKS

Open Space and Mountain Parks (OSMP) has a separate portfolio of water rights, conveyed primarily via irrigation ditches, which it uses for irrigation of agricultural properties. OSMP's 2017 Agricultural Resources Management Plan calls out specific management strategies for preparing for climate change–related impacts to water supplies, such as increased drought frequency. OSMP staff participated in this Drought Plan update process for information-sharing and collaboration purposes.

OTHER CITY DEPARTMENTS

Certain city departments that use significant amounts of water from the municipal water supply system for outdoor irrigation have separate plans which address specific measures that, during a drought declaration, will be implemented to meet water savings goals described in this plan. Boulder Parks and Recreation (BPR) developed a drought response plan in 2003 in conjunction with the city's first drought plan. BPR expects to update its drought response plan in 2022–2023. That update may inform specific water use limitations that, together with any required Drought Response Measures, BPR can use to meet the demand reduction goals set during a drought declaration. BPR manages many commonly used community spaces and public trees. Maintaining those resources as feasible through irrigation is one of the Guiding Principles for water use in a drought, as described in Section 2 below. In 2020, the Transportation and Mobility Department developed a Plan for Transportation Landscapes which specifically outlines ways to more efficiently irrigate medians and other vegetated areas it maintains. Staff from both departments participated in this Drought Plan update process.

RELATED PLANNING EFFORTS

Other city planning efforts influence drought planning, including but not limited to the following:

- The city's water conservation program was established in 1992 to address the need to use water efficiently. Conservation and efficient water use programs help mitigate the impacts of drought, delaying the need for a drought declaration in some instances. The conservation program includes ongoing efforts related to customer education and outreach and technical assistance. Boulder continues to evaluate opportunities to implement technology to help manage water loss and to support the city and its customers in monitoring water use and using data to make educated decisions about water use. Water use reduction measures that take longer than a drought period to implement or have a delayed response to implementation are presented in the City of Boulder 2016 Water Efficiency Plan, which is anticipated to be updated in 2023.
- The city is actively engaged in efforts to mitigate climate change and build a more resilient community. While led by the Climate Initiatives Department, much of this work overlaps with the Drought Plan. For example, the city prioritizes preserving large landscape trees, in part because research indicates that, in addition to mitigating climate change and urban heat island effects, such trees have been associated with reduced water use on properties

along the Front Range. The city models the performance of its water supply system under future climate scenarios in long-term water supply planning efforts. That work informed several aspects of this plan.

- The city conducts long-term planning to improve the reliability of its water supplies, as informed by its Source Water Master Plan. Actions implemented from the long-term planning may mitigate impacts of droughts in the future. Boulder evaluates and, as appropriate, pursues opportunities to apply for new water rights, acquire existing water rights and change them for municipal use through the water court process; expand storage capacity; and work with other water rights owners and neighbouring water suppliers to develop emergency or interruptible water supply agreements. The city will continue to explore opportunities for additional use of raw water from ditches on city facilities, to reuse its rights as feasible and legally allowed and to pursue other avenues identified in the long-term planning process.

1. INTRODUCTION

Boulder's municipal water supply originates in watersheds on both sides of the Continental Divide. Approximately two-thirds of Boulder's supply comes from the Boulder Creek basin and the balance comes from water diverted and stored by the Northern Colorado Water Conservancy District in the Colorado–Big Thompson (C-BT) and Windy Gap projects at the headwaters of the Colorado River basin. The Colorado River supplies water to much of the southwestern U.S. and is subject to a complex set of agreements, compacts and operating constraints. Colorado River management is an ongoing process which Boulder continues to monitor and consider in its water supply planning efforts.

Boulder's raw water system includes the diversion structures, reservoirs, pipelines and canals that convey and store water prior to its treatment, as well as a diversified water rights portfolio. Boulder uses that raw water system to supply the city's two water treatment plants in a manner that meets seasonal and daily demand patterns and treatment needs. The treated water system delivers high-quality water at appropriate flow rates and pressures to the city's customers for residential; commercial, industrial and institutional; firefighting and other purposes. The system must operate in a manner consistent with Colorado's prior appropriation doctrine water laws and the city's water rights decrees, with policies and rules that govern the operation of the C-BT and Windy Gap projects and with the city's internal system operating policies, including the water supply reliability criteria.

Based on modeling and infrequency of historical drought declaration, the city's municipal water system is not currently expected to experience conditions requiring drought declaration very often. However, Boulder is located in a semi-arid climate, and droughts are an expected part of the natural hydrologic cycle in this region, particularly under climate change. Although meteorological and hydrological droughts[2] will occur regularly, the city may not experience significant shortfall in water availability because Boulder's water rights and municipal water system are highly reliable. Sections 2 and 3 describe how the city assesses drought conditions to determine when they warrant a drought declaration and response in order to protect the municipal water supply and appropriately meet demand.

[2] **Meteorological drought** occurs when dry weather patterns dominate, including below-normal precipitation, and **hydrological drought** occurs when streams, reservoirs, lakes and aquifers have below-normal levels of water supply.

A comparison of relatively recent droughts in 2002, when the city last implemented drought restrictions, and in 2012 demonstrates differences between droughts. Both years had a combination of below-average snow accumulation, below-average summer precipitation and above-average temperatures, all of which collectively led to low streamflow. The 2002 drought was exceptional in that severe to extreme drought conditions were present for 11 consecutive months. That drought is the worst on record in terms of single-year streamflow deficit and average streamflow deficit over the multiyear drought period. Comparatively, in 2012, drought conditions spanned a shorter period and were less extreme, and July 2012 turned out to be Boulder's third wettest July on record. Those differences help illustrate why Boulder imposed drought restrictions in 2002 but only increased water efficiency messaging in 2012 without imposing restrictions.

The city's long-term water supply and demand modeling shows that, with planned investments in water conservation and water system infrastructure, Boulder's water supply system can meet projected build-out demands in a manner that is consistent with the city's water supply reliability criteria (listed in Section 2) under current climate conditions. Climate change is projected to increase the severity of drought. Under certain future climate scenarios modeled for the years 2050 and 2070, results suggest that drought declarations may become more frequent. This plan is intended to support the city's response to drought conditions that may occur in the relatively near term. It does not address potential impacts to the city's supplies or demands in response to future climate conditions; however, the city is actively planning for potential longer-term impacts and will update this plan in the future as new information becomes available.

While this plan specifically references drought conditions as the cause for water shortage response, other conditions such as wildfires, infrastructure outages, operational issues, supply shortages, floods and water quality impacts may also create water shortages.[3] The city may use this plan to guide mitigation and response to drought conditions and, as appropriate, to other conditions that may create a water shortage.

2. Reliability Criteria and Guiding Principles

During the development of Boulder's 1988 Raw Water Master Plan, the city established water supply reliability criteria intended to strike a balance between the costs and environmental impacts of increased reliability and the consequences of temporary supply restrictions. These reliability criteria provide standards for the number of occurrences of water demand reductions in response to drought within a given number of years and were described in that plan as follows:

1. For that increment of water needed to fully satisfy all municipal water needs, Boulder shall make every effort to ensure reliability of supply against droughts with recurrence intervals of up to 20 years.
2. For that increment of water use needed to provide continued viability of outdoor lawns and gardens, Boulder shall make every effort to ensure reliability of supply against droughts with recurrence intervals of up to 100 years.
3. For those uses of water deemed essential to the maintenance of basic public health, safety, and welfare such as indoor domestic, commercial and industrial uses, and firefighting uses, Boulder shall make every effort to ensure reliability of supply against droughts with recurrence intervals of up to 1,000 years.

[3] A projected or actual water shortage occurs when the projected or actual water supply is less than the projected or actual water demand, due to drought and/or other conditions.

Expected impacts to vegetation, including dormancy of certain plant types, are considered in the reliability criteria, though not explicitly specified. For example, the phrase “continued viability of outdoor lawns and gardens” has been interpreted as a provision, at a minimum, of the amount of water necessary to meet the basic survival needs of outdoor landscaping in general, including trees and shrubs. As a result, during droughts with recurrence intervals between 1-in-20 years and 1-in-100 years, landscape watering may be restricted to the extent that irrigated turfgrass (e.g., bluegrass) goes dormant and other vegetation becomes stressed. In more severe droughts, watering may be restricted to the point of threatening the continued viability of portions of the landscape.

This Drought Plan is structured to support the city in meeting the water supply reliability criteria through a staged response program based on drought severity, which is segmented into Drought Alert Stages[4] as described in Section 3. Because each drought event is unique, it is more effective to have approaches that apply to specific drought declarations. The staged drought response program involves a menu of potential response options for each Drought Alert Stage, as described in Section 4. A set of Guiding Principles, listed in Figure 1, provides the framework to inform highest-priority water uses in a drought. The Guiding Principles are intended to inform selection and implementation of Drought Response Measures[5], to empower the community to actively participate in reducing water use when needed due to drought and to provide flexibility and reasonableness in responding to drought.

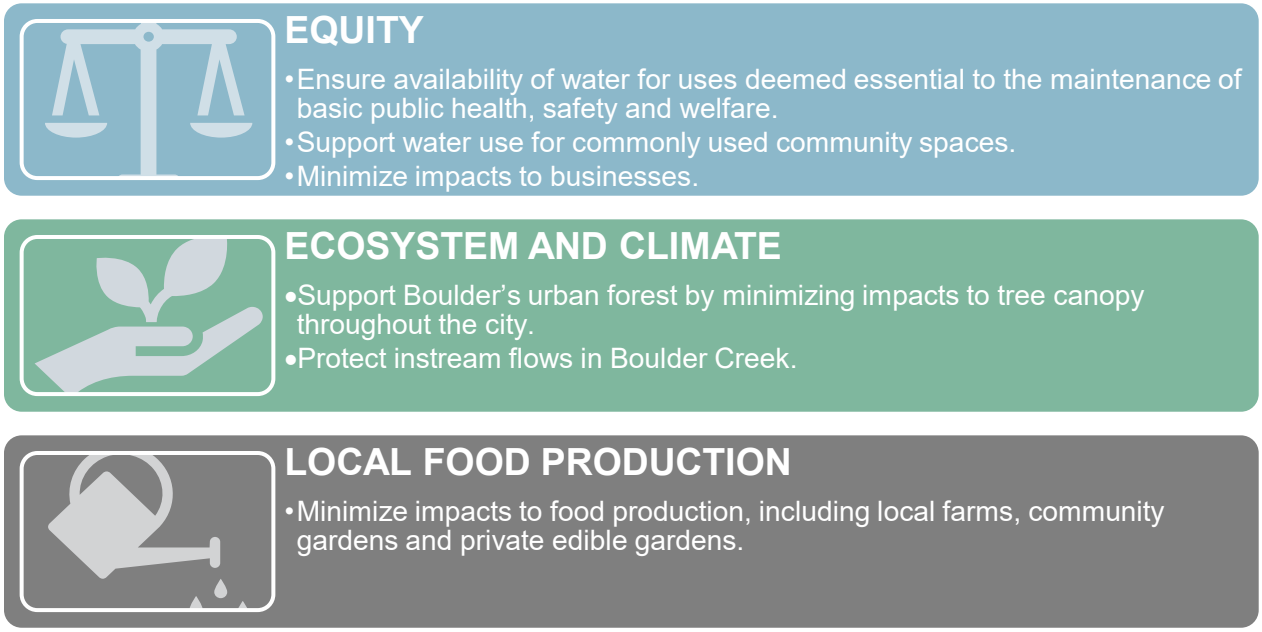

Figure 1: Guiding Principles for Water Use in a Drought.

Utilities staff worked with the Drought Committee and the Water Resources Advisory Board (WRAB) to develop these Guiding Principles, using the Racial Equity Instrument to inform the process. All agreed that the highest priority in a drought is the provision of water for essential uses

[4] **Drought Alert Stages** are water supply alert levels that represent the severity of drought and potential water supply shortages. The city manager is authorized to declare a Drought Alert Stage and impose Drought Response Measures.
[5] **Drought Response Measures** are requirements, limitations, tools and programs that may be implemented in response to projected or actual drought-related water shortages. Drought Response Measures include but are not limited to price-related actions through adjustments to water budgets and water rates; water use limitations and temporarily limiting new water-related activities.

such as those necessary to maintain basic public health, safety and welfare. The city solicited feedback from the community through a questionnaire on the remaining five Guiding Principles. The respondents ranked the Guiding Principles almost equally, resulting in a staff recommendation that all principles be included to support the Drought Plan. Typically, water uses that are named in the Guiding Principles will be prioritized and subject to restrictions only after other lower-priority uses have been restricted.

3. PROJECTED STORAGE INDEX AND DEMAND REDUCTION GOALS

The drought response program is designed to progress through Drought Alert Stages as the severity of a unique drought event increases, described below in Table 1. Water supply availability is the primary driver that influences the city to declare a drought. Boulder's water supply is a function of available streamflow and reservoir storage levels. Reservoir inflows in the alpine and sub-alpine environment are driven by processes including snow accumulation, evapotranspiration, runoff generation and soil moisture. Drivers such as customer water demands, water rights administration, operations and maintenance, regional circumstances affecting the C-BT system and emergencies can also affect water supply availability.

To help predict storage contents and supply availability under varying hydrologic conditions, Boulder uses detailed modeling of the operation of the water supply system, C-BT allocations and recent water use data. Each year, as spring approaches, the city evaluates hydrologic and climatic data along with information from its modeling to project storage levels following mountain snowmelt and corresponding runoff.

The city uses a Projected Storage Index (PSI) calculation to help indicate the potential need for a drought declaration. The PSI is the ratio of the city's projected useable storage[6] to unrestrained system demand, as represented below:

$$PSI = \frac{S_{max}}{d}$$

$$S_{max} = S_{mountain} + 0.4S_{C-BT}$$

Where:

- $S_{mountain}$ is the city's projected useable mountain storage in the Boulder Creek system.
- $S_{C\text{-}BT}$ is the city's portion of projected C-BT Project storage.
- d is the city's typical unrestrained (no drought restrictions) municipal water demand.

Based on historical conditions and the state's water rights administration, the city's mountain reservoirs typically fill by early July. However, Boulder makes drought declarations by the beginning of May, when sufficient key water supply data are available and there is considerable potential to influence water use behavior before the upcoming irrigation season. Staff forecast expected reservoir contents by the end of the runoff period using observed May 1 reservoir contents and projected reservoir inflow during the ensuing runoff period of May and June. While that forecast currently relies primarily on the use of snow-water equivalent data in the reservoir watersheds, Utilities staff will continue to investigate ways to improve the accuracy of the forecast,

[6] **Useable storage** is storage that is available to the city for consumptive use. That does not include dead-pool or storage contents earmarked for delivery obligations.

including adjusting the timing of the forecast, as relevant technology and environmental information become available.

Table 1 summarizes the city's drought classification approach, with water reduction goals and a brief overview of demand response measures at each stage. Based on the calculated PSI, staff may identify drought conditions, classify drought severity and inform the designation of a Drought Alert Stage. As discussed further in Section 5, staff also use other relevant drought indicators and operating experience when recommending a Drought Alert Stage declaration and in determining an appropriate drought response. Drought Alert Stages 1 through 3 roughly align with the city's reliability criteria, and as such, a Stage 1 declaration is expected to be most common and a Stage 3 declaration expected to be rare. Section 4 of this plan provides details about the drought response program in alignment with the response overview in Table 1.

Table 1: Projected Storage Index, Drought Alert Stages and Demand Reduction Goals

Projected Storage Index (PSI)	Drought Alert Stage[7]	Annual Citywide Water Demand Reduction Goals	Response Overview
As Conditions Warrant	Watch	-	Water conservation is encouraged. This is a pre-declaration communication tool to raise public awareness of conditions.
0.85 to 0.56	1	Up to 20%	Limitations are placed on lower-priority outdoor uses.
0.55 to 0.41	2	Up to 30%	Additional limitations are placed on lower-priority outdoor uses to allow higher-priority uses.
0.4 or Less	3	Up to 50%	Additional limitations are placed on outdoor water uses; some indoor use limits may be required to prioritize health and safety.

4. STAGED DROUGHT RESPONSE

Every drought is unique, and the necessary drought response will depend upon the severity of the conditions. The staged drought response program outlined below is designed to provide flexibility in responding to droughts in alignment with the city's water supply reliability criteria and this plan's Guiding Principles. Drought response programs in Colorado and throughout the western United States typically target outdoor water use to achieve demand reduction goals. In Boulder, as in other communities, outdoor uses tend to be considered of lower priority than indoor uses. Accordingly, the staged response program focuses most heavily on outdoor uses.

4.1. DROUGHT ALERT STAGES AND RESPONSE OVERVIEW

During less severe drought conditions, the city may initially focus on expanded water conservation–related public education and outreach and the implementation of Drought Response Measures such as the use of water budgets as a drought messaging and management tool. That approach allows flexibility for customers to choose how they use water while contributing to the necessary drought response. Under prolonged and more severe drought

[7] The paired PSI thresholds and Drought Alert Stages were developed through water supply system modeling and operational experience.

conditions, water budget reductions and water use limitations[8] may be implemented, together with other Drought Response Measures, as part of a specific drought declaration. The most extreme conditions may require some indoor water use limitations as part of the drought declaration. Annual water demand reduction goals are specified for each Drought Alert Stage and are anticipated to be met primarily by outdoor water use reductions. To support achievement of annual reduction goals, outdoor water use reduction goals are specified (Table 2). The progression is described below. Further details of measures that can be used in each stage are found in Sections 4.2 and 4.3. As detailed further in Appendix A, the city's Racial Equity Instrument will be used to evaluate drought response measures in each stage in an effort to reduce disproportionate impacts to communities of color and other underserved communities.

4.1.1. Pre-Declaration Drought Watch

The Drought Watch is a pre-declaration communication tool to raise public awareness about conditions that do not trigger the first PSI threshold (e.g., lower than normal water supplies, drought conditions in the region or the Colorado River basin), and to help prepare the community if a formal drought declaration is anticipated. The city will increase the communication and customer education it typically conducts, promoting water conservation activities as informed by the water conservation program and in coordination with neighboring water providers. Customer water budgets will continue to be used to communicate about efficient water use. The determination of a Drought Watch stage may be made by Utilities staff at any time of the year and does not require a formal city manager declaration, because it does not trigger mandatory actions or changes to water budgets.

4.1.2. Stage 1 – Serious

Under a Stage 1 declaration, the city will target an annual total (indoor and outdoor) water use reduction of up to 20% and an annual outdoor water use reduction of up to 50%. The city will advance its drought education materials and increase its water conservation communication to customers and stakeholders. Adjustments to customer water budgets will target a reduction in outdoor use and be supported through selected Drought Response Measures. Mandatory water use limitations may be placed on lower-priority outdoor water uses, requiring specific customer action. As such, this and subsequent stages require a city manager declaration, described further in Section 5.

4.1.3. Stage 2 – Severe

Under a Stage 2 declaration, the city will target an annual total water use reduction of up to 30% and an annual outdoor water use reduction of up to 70%. Additional mandatory limitations will be placed on outdoor water uses, with the intent of maintaining higher-priority outdoor uses and supporting community vitality. Education and outreach will continue to play an important role in achieving the necessary demand reductions. Additional adjustments to customer water budgets may be implemented to further reduce outdoor water use.

4.1.4. Stage 3 – Extreme

Under a Stage 3 declaration, the city will target an annual total water use reduction of up to 50% and an annual outdoor water use reduction of up to 100%. Additional mandatory limitations will

[8] **Water use limitations** are specific Drought Response Measures identified in the Drought Plan and the rules and regulations that the city manager may impose to address the occurrence of water supply shortages. Potential water use limitations are described in Table 2.

be placed on outdoor water uses, with the potential of maintaining only the most mature and established trees and shrubs. Restrictions may be placed on new water connections, i.e., new water taps. The city will be in continuous communication with customers and stakeholders to implement water use limitations that produce significant reductions in water use. Customer water budgets will be adjusted to reflect significant reductions in outdoor allocations, may remove outdoor allocations entirely and may require some indoor water use reductions in the most extreme droughts. Those messaging and pricing signal actions will increase customer awareness of the drought severity. Under extreme conditions, rationing may be required to prioritize health and safety.

4.2. SUPPLY-SIDE RESPONSE

During a drought, Boulder has the opportunity to increase water supply through provisions in several of its agreements. Those include reducing deliveries to Silver Lake Ditch and using water rights that are often used to support instream flows in Boulder Creek for municipal purposes instead. Boulder may evaluate municipal needs and projected supply and determine that its ability to lease surplus water to farmers is limited compared to normal years. It may thus reduce or curtail its leasing program to make the most of its supplies during a drought period.

4.3. DEMAND-SIDE RESPONSE

This section provides further detail about public education and outreach and the demand-side Drought Response Measures summarized for each stage in Section 4.1, including water budgets and water use limitations. Table 2 provides a concise summary of potential water use limitations for each Drought Alert Stage.

4.3.1. PUBLIC EDUCATION AND OUTREACH

Boulder's water customers generally tend to be engaged and informed in local water resource conditions and how to efficiently use water. The city and its customers will need to respond to droughts in a variety of ways. To effectively implement a successful drought response program and achieve the necessary water savings, it is important that customers understand how the city's water supplies are affected during a drought, how water budgets work and why customers are being asked to use less water under a drought declaration. Consistent messaging before, during and after a drought helps provide the city's customers with a better perspective under all conditions.

Beginning with the pre-declaration Drought Watch stage, and to the extent possible with all drought stages, drought response will be achieved by educating and influencing customers to change their water use behavior without being penalized. If a drought declaration is anticipated, customers will be informed as timing allows of current conditions and what to expect with the declaration of a Drought Alert Stage. Customer communication and outreach will increase with each drought declaration, and information will be clear, credible and concise. Drought Response Measures, demand reduction goals and enforcement protocol will be communicated and reinforced through various mediums, in accordance with municipal code and rule requirements and as guided by the city's Drought Committee. The city will develop a drought information campaign in close coordination with its existing water conservation education and outreach program to maintain consistency and reinforce the importance of efficient water use under all conditions. In an effort to effectively target all municipal water users, the city will build on partnerships with local organizations which specialize in bringing conservation messages to specific audiences, including Resource Central and Partners for a Clean Environment (PACE), and will continue to work with Community Connectors and Neighborhood Liaisons to collaborate

on approaches to education and outreach with communities of color and other underserved communities.

4.3.2. Water Budgets, Water Rates and Surcharges

Municipal water customers are billed according to a water budget structure intended to promote efficient water use through price signals. The water budgets include an indoor allocation and an individualized outdoor water budget that is based on each customer's estimated irrigable area and generalized landscaping water needs.

Beginning with the Drought Watch stage, the city will increase communications with customers about how water budgets work and how they may be modified under a drought declaration. During a drought declaration, water budget blocks can be lowered to encourage customers to reduce water usage while still allowing flexibility in how they use water. Staff will consider racial equity implications of using pricing to influence water use behavior, as described in Appendix A, and integrate it with other approaches, including mandatory water use limitations and public outreach and communication, to achieve demand reduction goals. Water rates may also need to be adjusted to maintain revenue stability, as further described in Section 5.4. Overall, the effectiveness of the water budgets as a Drought Response Measure may be improved by additional outreach about water budgets under non-drought conditions and by refinement of the water budget structure.

Drought surcharges, in the form of a penalty rate or additional fee applied to the volume of water used in a given water budget rate block, may be implemented as a penalty to customers who do not conserve water in the amounts specified under the drought declaration. Drought surcharges are intended to provide an emergency response to a temporary and severe limitation and are removed after the recovery. The city will carefully consider potential financial impacts and racial equity implications when preparing drought surcharges under a specific drought declaration.

4.3.3. Water Use Limitations

Specified water use limitations, initially targeting lower-priority water uses as informed by the Guiding Principles, may be needed at times to achieve the necessary drought response and to support customers in managing use within their water budgets. Mandatory indoor water use reductions are anticipated under only the most extreme drought conditions. Some water use limitations, including day-of-the-week watering schedules, will require ongoing water use monitoring to determine the most appropriate frequency to achieve water savings.

Table 2 provides a summary of potential water use limitations that may be required for each Drought Alert Stage. The city will use this table as a guide when imposing specific limitations as necessary, based on drought severity and water use reduction needs, to address the unique drought conditions of each drought declaration. City staff will identify appropriate limitations based on specific drought characteristics. This is not an exhaustive list of water use limitations and may be revised as needed as water supply or water use conditions change.

The city may, at its discretion, grant exemptions from the drought response for individual customers. For example, the city manager may approve exemptions in instances of extreme economic impacts, health and safety issues and religious objections.

Table 2: Potential Water Use Limitations.

CATEGORY	STAGE 1 – SERIOUS	STAGE 2 – SEVERE	STAGE 3 – EXTREME
Potential Water Use Impacts	Limitations are placed on lower-priority outdoor uses.	Additional limitations are placed on lower-priority outdoor uses to keep higher-priority uses (as listed in Guiding Principles).	Additional limitations are placed on outdoor water uses; some indoor use limits may also be required to prioritize health and safety.
Citywide Water Demand Reduction Goals (Specific systemwide target percentages will depend upon drought severity.)			
Annual Total	Up to 20% reduction	Up to 30% reduction	Up to 50% reduction
Annual Outdoor	Up to 50% reduction	Up to 70% reduction	Up to 100% reduction
Outdoor* (Unless otherwise noted, restrictions will allow watering on designated days and times)			
Existing Irrigated Turfgrass and Annual Flowers	Allowed 2-3 days/week, depending on severity	Allowed 1-2 days/week, depending on severity	Not allowed
New and Existing Vegetable Gardens	Hand, drip or subsurface irrigation any day; overhead irrigation allowed 2-3 days/week, depending on severity	Hand, drip or subsurface irrigation any day; overhead irrigation allowed 1-2 days/week, depending on severity	Not allowed
Existing Shrubs and Perennials	Hand, drip or subsurface irrigation any day; overhead irrigation allowed 2-3 days/week, depending on severity	Hand, drip or subsurface irrigation any day; overhead irrigation allowed 1-2 days/week, depending on severity	Established shrubs only, watered by hand, drip system or deep root fork or needle 1 day/week
Existing Trees	Recommended 3 or fewer days/week (customers choose days)	When water use limitations in other categories impact the watering of trees, follow Save Our Shade or more recent guidance for watering established trees	
Existing Community Parks, Athletic/Playing Fields	Irrigation reduced to achieve annual outdoor demand reduction goal of up to 50%	Irrigation reduced to achieve annual outdoor demand reduction goal of up to 70%	Not allowed
New Landscape Installation (Other Than Vegetable Gardens)	Allowed from September to April	No new installation allowed; stormwater control measures must be maintained	
Sprinkler System Maintenance	Minimize test run times per zone		Not allowed
Swimming Pools, Splash Parks, Misting Devices, Water Features*	Follow best practices to limit spillage, reduce evaporation (e.g., use pool covers), use backwash systems and maximize water reuse while maintaining water quality; pool filling/refilling and use of splash parks and/or water features may be prohibited under certain conditions		
Vehicle Washing	Limitations may be placed on car washing, particularly where water recycling technologies or other water efficient technologies and practices are not in place; at a minimum, best practices will be encouraged		
Additional Outdoor Uses for Public/Commercial/Industrial			
Public Street/Sidewalk Cleaning	Essential cleaning for the protection of public health, safety and the environment only; dry methods must be deployed first whenever possible		Extreme health and safety issues only; high-efficiency equipment only
Irrigated Stormwater Control Measures	Overhead irrigation allowed 2-3 days/week, depending on severity hand, drip or subsurface irrigation any day	No overhead irrigation; hand, drip or subsurface irrigation allowed 1-2 days/week, depending on severity	Established shrubs only, watered by hand, drip system or deep root fork or needle 1 day/week
Construction Dust Control and Construction Water	Encourage alternative (non-water) dust control measures; implement current industry best management practices	Whenever possible, industry best management practices must be deployed first	Allowed only when no alternative (non-water) dust control measures exist that meet environmental standards
Hydrant Flushing and Testing	Limit to an as-needed basis to meet operational requirements or to address water quality concerns		
Indoor			
Indoor Uses	Encourage efficient water use	Measures will be implemented to reduce non-sanitary indoor uses with exceptions for certain business functions	Indoor measures will be recommended and/or may be required
* BPR will follow internal guidance per the BPR Drought Plan, which may differ from the limitations listed above, to conserve and restrict water use on city-owned facilities to meet the required demand reduction goals specified in a drought declaration.			

4.4. Enforcement of Drought Response Measures

The city's municipal code authorizes enforcement of Drought Response Measures through administrative charges or fees, suspension of water service and criminal prosecution. The city will customize enforcement strategies to identify violations and the enforcement process based on the Drought Alert Stage and customer engagement levels. Racial equity considerations will be included in the enforcement strategy, as described in Appendix A. The enforcement protocol also will be influenced by the availability of staff, additional staff needs and additional resources or equipment needed for enforcement. Based on those conditions, the city will provide customers with consistent communication and the information necessary to comply with restrictions. Certain water use limitations, such as day-of-the-week landscape irrigation schedules, will facilitate identification of compliance and thus help with enforcement.

The city may also provide guidance and resources to help customers meet water use limitations in the future and avoid repeated violations. The city may work with third-party consultants to support enforcement of Drought Response Measures. For example, the city currently partners with Resource Central for several water conservation support programs. It is possible that, through that partnership, Resource Central could act as an extension of city staff through a program like Slow the Flow.

5. Monitoring and Implementation

Implementation of this plan includes monitoring of drought indicators, progressing through drought declaration protocols, implementing and enforcing the staged Drought Response Measures described in Section 4, evaluating revenue impact and intermittently reviewing the effectiveness of the drought response efforts to support modifications as needed. The following sections provide an overview of implementation details.

5.1. Drought Committee

Table 3 provides a list of the departments and workgroups with Drought Plan implementation responsibilities. To effectively implement and manage the drought response program, additional roles and responsibilities will be developed for and by Drought Committee members during a drought declaration.

Table 3: City of Boulder Drought Committee.

Division/Department/ Work Group	Responsibilities
City Manager	Take ultimate responsibility for drought declarations and rulemaking in consultation with the Utilities director.
Utilities Director	Provide overall direction, coordinate with staff and liaise with city manager.
Utilities – Water Resources	Lead implementation of Drought Plan with internal and external partners; monitor drought indicators; provide guidance on water supply conditions, water rights yields and Instream Flow Program; and evaluate demand response measures, including costs and effectiveness.
Utilities – Billing	Provide water bill format changes as needed, conduct customer database queries and assist with customer education and outreach.
Utilities – Community Engagement Manager	Coordinate and lead public education and outreach efforts.
Utilities – Engineering	Manage infrastructure improvements and coordinate capital projects regarding water supply limitations.
Utilities – Finance	Provide lost revenue estimates and input on water budget and rate adjustments and, as necessary, use of reserves or other funds.
Utilities – Maintenance	Coordinate on distribution issues and assist with customer interactions via the meter program.
Utilities – Water Treatment	Track daily demand and coordinate on needed treatment adjustments to meet supply constraints.
Utilities – Water Quality	Monitor water quality in source watersheds and urban creeks. Assess impacts of drought restrictions on ability to meet stormwater permit requirements.
Public Works Business Services	Assist with public education and outreach.
Parks and Recreation	Implement water use reductions while maintaining assets to the extent feasible, including trees, community parks and recreation facilities.
City Attorney's Office	Advise on legal issues involved in a drought declaration, including implementation of Drought Response Measures, code interpretation and rule or code changes needed during a drought.
Communications and Engagement	Provide input on public education and outreach; lead media relations and press releases.
Planning and Development Services	Coordinate on restrictions related to development, such as landscaping restrictions or stormwater treatment modifications.
Facilities and Fleet	Implement water use reductions at city facilities.
Open Space and Mountain Parks	Coordinate on agricultural demands.
Transportation and Mobility	Implement water use reductions while maintaining assets to the extent feasible, including medians, trees and other irrigated transportation facilities.
Climate Initiatives	Coordinate on messaging related to climate change and water supply impacts.

5.2. MONITORING OF DROUGHT INDICATORS

Utilities staff regularly monitor water supply conditions and the potential for drought. By early May each year, staff calculate the PSI discussed in Section 3, which entails evaluation of current reservoir levels, snow-water equivalent
, C-BT quota, runoff generation and customer demands. Staff also evaluate other supporting indicators, including:

- *Local water supply conditions and projections*, including anticipated streamflow conditions.
- *Rate of snowpack dissipation and streamflow response,* based on watershed operator observations and historical trends.
- *Customer demands,* including changes in demand in specific sectors or uses, both internal (e.g., the BPR and Transportation and Mobility departments) and external (e.g., new businesses).
- *Weather data and long-range forecasts,* which may identify temperature or precipitation trends.

- *Regional soil moisture levels and discussions with other water users,* which inform projections of downstream water use and expected water rights administrative call patterns.
- *The U.S. Drought Monitor,* which is used to understand general regional conditions and provides a reference for the city to support its review of other more localized indicators.

This list represents the primary indicators relied upon for preparing the city's drought response recommendations but is not a comprehensive list of all the indicators that the city monitors. Other factors considered as needed include state water rights administration issues, city water system operational constraints, the degree to which current demands approach projected build-out water demand levels and any other factor that may be affecting either water supply or water demand during the drought period. Staff will also monitor information provided by the State of Colorado through its Water Availability Task Force, which notifies the Governor when drought conditions reach significant levels and recommends activation of the Colorado Drought Mitigation and Response Plan. In addition, staff will monitor a sub-set of these indicators on a year-to-year basis to watch for signs of climate change impacts that specifically affect Boulder's water supply and may indicate the need to adjust the timing of drought determination, re-evaluate the PSI methodology, and/or update the Drought Plan.

The calculated PSI in conjunction with the drought indicators described above inform determination by May 1 of whether a drought should be declared. However, later-season droughts may occur. As conditions warrant, staff may recommend a drought declaration after May 1.

5.3. DROUGHT DECLARATIONS

Based on the monitoring described above, each spring Utilities staff complete a water supply analysis. If it indicates need for a drought declaration, staff will prepare that recommendation, in coordination with the Drought Committee, and present it to the Utilities director and city manager, keeping WRAB and City Council informed. The recommendation will include the designated Drought Alert Stage and Drought Response Measures, including specific water use limitations, to address the unique drought conditions.

The city manager is ultimately responsible for making drought declarations. The Boulder Revised Code authorizes the city manager to declare a Drought Alert Stage and implement necessary Drought Response Measures. Utilities and City Attorney's Office staff will support the city manager in formally declaring a drought and imposing response measures specific to the drought, as guided by this plan. This declaration will provide additional details and considerations as needed to guide the implementation of specific Drought Response Measures. Staff from the Drought Committee will use the best available means to inform the public about the declaration and Drought Response Measures, as discussed in Section 4, including providing advance notice before implementation of Drought Response Measures, if possible.

Throughout the drought, staff will continue to monitor water supply, water quality and water reduction achievements. Certain members of the Drought Committee will assist in key areas of monitoring. For example, Utility Billing, Finance and Water Treatment staff will assist with comparing actual water use to demand reduction targets to evaluate the effectiveness of the drought response. The Drought Committee will meet monthly or as needed to review water supply conditions and customer water use data. Utilities staff will summarize Drought Committee observations and provide frequent status updates about conditions, as well as any recommendations to adjust stages or response measures, to the Utilities director and the city

manager. The city manager and staff will inform City Council as the drought response program is implemented and drought conditions progress.

5.4. Revenue Implications

Water utilities often experience two competing goals during drought: to reduce the amount of water use and to maintain adequate revenues to meet system requirements. In the event of a drought declaration, staff will take the following five steps to understand and respond to potential financial impacts to the water enterprise fund:

1. Estimate decreased revenue based on anticipated/declared water use reduction goals associated with the Drought Alert Stage.
2. Consider use of resiliency reserve funds to offset revenue lost due to water use limitations.
3. Evaluate immediate cost savings potential in delaying capital improvement plan (CIP) and/or operating expenses, such as forgoing annual programs or specific CIP projects.
4. Evaluate temporary rate increases and surcharges that may help encourage water use reduction goals while also reducing the revenue impact to the utility (rate increases and surcharges may be implemented as Drought Response Measures as part of a drought declaration). As described in Appendix A, staff will use the racial equity instrument to assess such adjustments and will seek to reduce or eliminate any disparate impacts of rate increases or surcharges on communities of color and other underserved communities.
5. Assess fund balances to determine if the potential revenue shortfall should also be addressed in the next budget cycle through rate adjustments.

As drought progresses, particularly if it extends into multiple years, staff will monitor water use and billing revenue data to determine if any additional approaches are necessary to offset revenue depletions, accommodate fund deficiencies and meet water reduction goals.

5.5. Removal of Drought Declaration

Both during and after a drought declaration, and as long-term water supply and demand conditions change, members of the Drought Committee will evaluate the effectiveness of the drought response program to fine-tune and advance the response plan for future droughts. Drought Committee members will record observations and experiences during the declaration. Once the declaration is removed, the committee will convene and review committee member experiences, observations and recommendations. Water use data, storage level and supply condition data, financial impacts and customer violation data collected during the drought declaration will help the committee evaluate the effectiveness of the drought response and inform the development of future responses and policies.

Utilities staff will monitor changing water supply conditions and the results of Drought Response Measures throughout the year to evaluate the degree to which water use reduction goals have been achieved, with a focus on reductions achieved during the typical landscape irrigation season. Because the city's annual water supply is directly dependent on spring snowmelt, the decision to officially remove a drought declaration will typically not be made until the following spring. However, larger than expected water use reductions or significant improvements in water supply may be cause for an easing of the severity of Drought Response Measures prior to the next spring snowmelt period. Once drought conditions have ended, as determined based on assessment of the indicators discussed in Section 5.2, the city manager will remove the drought declaration. As applicable, the city will fully restore monthly water budgets, remove surcharges and remove administrative charges for certain types of water use.

6. Plan Approval

This section describes the processes used to adopt this Drought Plan and future updates.

6.1. Plan Approval and Adoption

This plan was prepared by Utilities staff and consultants, with input and support from the Drought Committee. Staff presented a draft of this plan to WRAB on April 25, 2022. Following WRAB's review, WRAB made a formal recommendation on May 23, 2022 for the city manager to adopt the Plan. The city manager adopted this Drought Plan on Nov. 2, 2022 and an updated Rule that reflects the plan and covers making and removing drought declarations and addressing responses to a drought or potential drought (Drought Declaration Rule) became effective on Nov. 21, 2022. City Council approved changes to relevant municipal code sections on October 20, 2022. The city manager will use this plan as a resource when preparing rules and regulations to address necessary responses to drought conditions, when declaring a specific drought declaration and when implementing Drought Response Measures.

6.2. Periodic Review and Update

This plan is intended to be a living document that will be reviewed and periodically updated. A variety of factors may inform those updates, such as experience implementing the plan; changes in water use trends, water supply or climate conditions; and major changes in policy. Boulder will continue to evaluate its drought response program and the associated impacts of climate change through ongoing monitoring of key indicators and related planning efforts. Interim updates to the response program and measures may occur before the next plan update, based on Drought Committee observations and recommendations.

7. Key References

Water Budget Rules. Rule 11-1-3.A(21). Establishing the Methodology to Determine the Monthly Water Budget for the Component of the Monthly Water User Charges Known as the Treated Water Quantity Charge, and to Determine the Monthly Wastewater User Charges. January 5, 2021.

2016 Water Efficiency Plan. Prepared for the City of Boulder by Rozaklis & Associates, LLC., October 2016.

Drought Declaration Rules. Rule Related to Declaring and Removing a Drought Alert and Addressing Responses to a Drought or Potential Drought, the City Manager May Declare. Final Copy as Approved June 29, 2011, with Changes.

Drought Plan Vol. 1. City of Boulder, Colorado Drought Plan Volume 1 Drought Planning and Response Plan. Prepared for the City of Boulder. Prepared by Hydrosphere Resource Consultants and Aquacraft Inc., March 15, 2010.

Drought Plan Vol. 2. City of Boulder, Colorado Drought Plan Volume 2 Drought Plan Technical Information and Analysis. Prepared for the City of Boulder. Prepared by Hydrosphere Resource Consultants and Aquacraft Inc., February 20, 2003, revised November 2004.

Raw Water Master Plan. Prepared for the City of Boulder by WBLA, Inc., September 15, 1988.

Municipal Code. City of Boulder Charter and Revised Code. Title 11 – Utilities and Airport.

Save Our Shade, A Guide to Tree Care in Dry Climates. https://sam.extension.colostate.edu/wp-content/uploads/sites/19/2017/02/save_our_shade_Spring.pdf