DRAFT BWS Water Shortage Response and Recovery Plan

Abstract

Procedures to control water demand and optimize supply during water shortage from low groundwater levels, contamination and infrastructure disruptions

Water Resources October 12, 2022

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Introduction

The purpose of this Water Shortage Response and Recovery Plan is to provide the Honolulu Board of Water Supply (BWS) with strategic and tactical steps to assess the need to declare a water shortage and manage water demands related to a water shortage condition

> *A water shortage condition exists when water supply is not available to meet existing and/or future max day water demands due to degradation of water quality or extended drought or disruptions to water system delivery infrastructure.*

The different phases of water shortage provides possible actions BWS can take to mitigate the emergency. Figure 1 shows the different phases of water shortage covered in this plan.

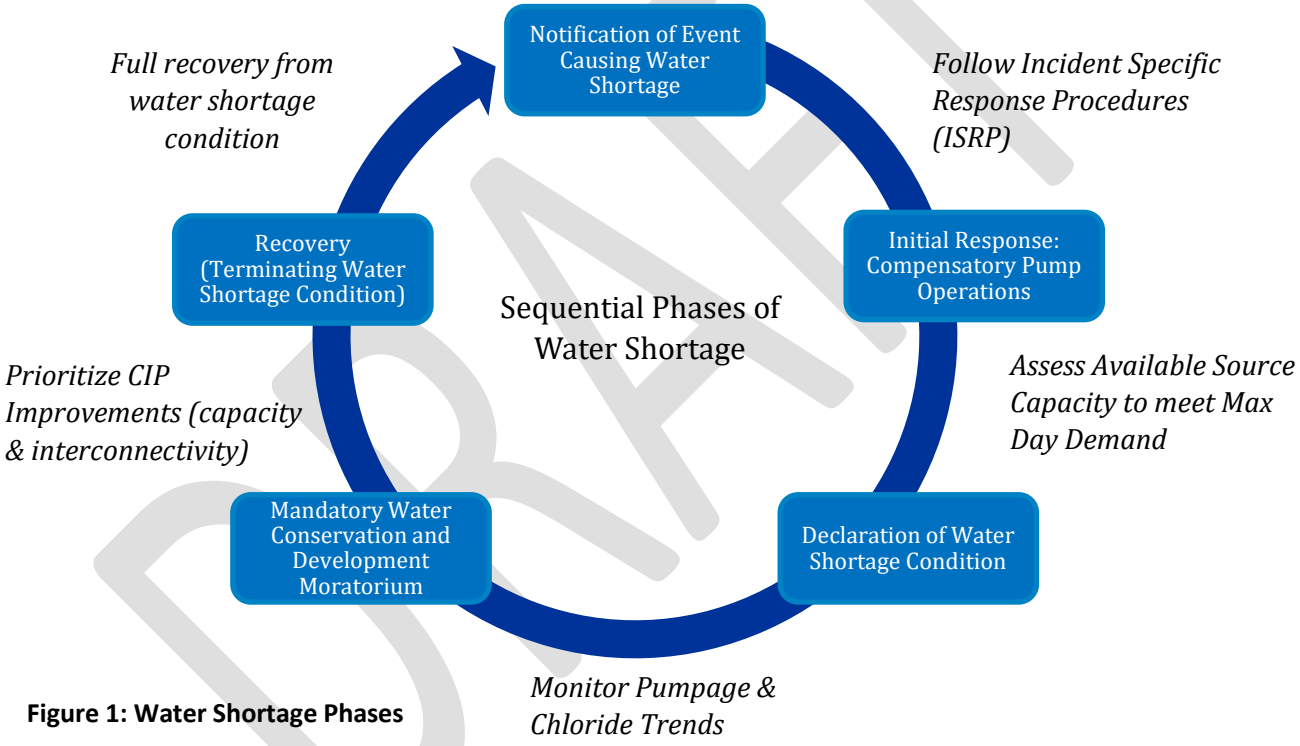

Figure 1: Water Shortage Phases

This Water Shortage Response and Recovery Plan provides recommended triggers, procedures and implementation actions to respond to a water shortage condition. The actual order in which response procedures are implemented during any specific water shortage will be at BWS's discretion to most effectively respond to the situation.

The objectives of the water shortage procedures are to reduce potable water use, prevent water service disruptions, low water pressures and groundwater quality degradation from overdraft.

Authorization

Definitions:

BWS means the Department of Water, known as the "Board of Water Supply," consisting of a Board of Water Supply, Manager and Chief Engineer and the necessary staff.

Board means the policy-making body, consisting of seven members of the Board of Water Supply

Water Shortage Condition: A water shortage condition exists when water supply is not available to meet existing and/or future max day water demands due to degradation of water quality, extended drought or disruptions to water system delivery infrastructure.

Authorization:

The **Honolulu City Charter**, under **Article VII, Section 7-105 (j), Powers, Duties and Functions of the Board of Water Supply,** directs the Board to:

Prescribe and enforce Rules and Regulations having the force and effect of law to carry out the provisions of this article of the charter, including

1. The regulation of water systems and necessary appurtenances for subdivisions and other properties and requirements for adequate water supply and storage facilities for domestic use and fire protection,
2. **The prevention of waste and pollution of water,**
3. The manner in which new wells or shafts may be bored, drilled or excavated, cased and capped or re-cased,
4. The manner in which wells or shafts shall be maintained, controlled and operated to prevent waste of water or the impairment of potability,
5. **The limitation to beneficial uses of all water,**
6. **In times of shortage or threatened shortage of water or of danger to potability of the water of any ground water basin or area by overdraft on such basin, the restriction of the drawing of water in all wells supplied from such basin on a basis proportionate to the proper and beneficial uses served by them respectively,** and
7. Other matters having for their object the proper conservation and beneficial use of the water resources available for the city.

BWS Rules and Regulations provide the authorization to restrict water use to prevent water shortages:

Sec. 2-209: Conservation Measures and Interruption of Water Supply

1. The Department will exercise reasonable diligence to deliver water to the consumer and avoid shortages or interruptions in service, but will not be liable for any interruption, shortage, insufficiency of supply, or any loss or damage occasioned thereby.

2. **Whenever, in the Department's opinion, special conservation measures are advisable in order to forestall water shortages, the Department may restrict the use of water by any means or method of control.**

A summary of the low groundwater condition rules Sections 3-318 to 3-322 provide progressively restrictive response requirements and procedures.

Sec. 3-318: Low Groundwater Level Conditions

- Establishes Caution, Alert & Critical Low Groundwater Conditions and response actions to reduce water demand to protect water resources
- 3 or more index wells must be in low groundwater condition

Sec. 3-319: Mandatory Restrictions Related to Alert Low Groundwater Condition

- The Board may set lawn and ground cover water irrigation restrictions on any of the Department's consumers.
- The Board may establish water allotments for commercial, residential, industrial, military, governmental, and agricultural consumers.

Sec. 3-320: Mandatory Restrictions Related to Critical Low Groundwater Condition

- The Board may restrict irrigation, car washing, filling pools, washing sidewalks and operating fountains.
- Require rate surcharges for excess water use and allotments

Sec. 3-321: Penalties

- Any violation by any person of the restrictions declared by the Board under Sections 3-319 and 3-320 of this Chapter shall be punishable according to Chapter II, Section 2-205 and Chapter V, Section 5-501 of these Rules and Regulations.
- Require flow restrictors for excess water use
- Charge $50 for installation and removal of the flow restrictor.
- Discontinue water service for violations after the flow restrictor is installed in accordance with Ch. II, Sec. 2-205

Sec. 3-322: Procedures for Control of Water Use During Low Groundwater Level Condition

- Declaration of Low Groundwater Level Condition
- Notice of Restrictions
- Notice of Water Allotment to Consumers
- Notice of Maximum Monthly Water Allotment to Private Well Operators
- Exceptions
- Termination of Low Groundwater Level Condition.

Sec. 5-501: Penalty (misdemeanor, pursuant to Chapter 1, Article 3, Section 1-3.1, ROH)

Water Shortage Declaration

A water shortage condition exists when water supply is not available to meet existing and/or future max day water demands due to degradation of water quality, extended drought or disruptions to water system delivery infrastructure.

During a water shortage condition, BWS will inform and coordinate response actions with the State Department of Health, Safe Drinking Water Branch and the State Commission on Water Resource Management (CWRM), and other agencies as needed. Note that a water shortage condition caused by extended drought has specific head levels and/or chloride triggers and CWRM coordination requirements listed within the Low Groundwater Response, Recovery Plan, a separate document.

In accordance with Sec. 3-318, *BWS may at any time during the period in which a low groundwater condition exists* or is anticipated:

a. *Declare that a water shortage condition exists. A water shortage condition shall continue to exist, once it is declared, until such time as BWS declares that the condition is terminated.*

b. *Implement mandatory restrictions within the scope of BWS Rules and Regulations.*

c. *Punish offenders within the scope of these Rules and Regulations.*

The Manager shall, at each regular Board meeting while a declared water shortage condition as provided herein is in effect, report to the Board the status of the head and chloride levels and water system capacity; the weekly average of daily pumpage and demands; the effectiveness of the restrictions and allotments in force; recommendations to increase or reduce restrictions and allotments; and such other information.

BWS may terminate the declared water shortage condition when the event causing degradation of water quality or disruptions to water system delivery infrastructure has been resolved.

In a Critical Water Shortage Condition where Mandatory Conservation is required because of insufficient response to voluntary conservation, the Board may declare a Building Moratorium.

BWS Water Shortage Condition Triggers

A BWS Water Shortage Condition can be declared by an actual or imminent contamination of a water source(s) that requires curtailing or shutting off wells and diverting flow from another part of the water system to meet the water demands or an extended (multi-year potential) infrastructure disruption event. A water shortage condition may also result in declining groundwater head levels or rising chloride levels in BWS water sources used to compensate for the temporary loss of available water pumping capacity. An extended drought may also cause a water shortage condition. To the extent practicable, BWS will manage pumping within the integrated water system such that the combined 12-month moving averages of the BWS sources

within each aquifer system will be within the total State permitted use, as to not detrimentally impact water resources.

BWS Water System Standards provide requirements for total pump capacity for water systems.

Section 111.08 Total Pump Capacity

- The total pump capacity for each site shall be based on the criteria that yields the maximum pumpage.
- Meet maximum day demand with an operating time of 16 hours. The largest pumping unit shall be considered out of service (standby).

Triggers for Alert and Critical Water Shortage Conditions

A trigger framework can be based on the ability for available (in-service) pump capacity in the target water system to meet max day demand (summer dry season) in progressive run times between 16 hours to 24 hours a day. Increasing pumping must be monitored for head and chloride levels to ensure a low groundwater condition does not develop.

- **Adequate pump capacity** is defined in BWS Water System Standards as meeting max day demand in 16 hours of pump run time, with the largest pumping unit considered standby. Standby pumps will be identified using pump operations experience and engineering judgement specific to the target water system.

- In a water shortage condition, **max day demand is defined as the 95th percentile (Q_{95}) of actual production**. During a water shortage condition, water conservation is assumed to flatten the highest 5% of the max day demand profile.

- **Alert Water Shortage Condition** is defined as available pumping units to meet Q_{95} max day demand in 20 hours, standby pumps are not included in pump run time calculation.

- **Critical Water Shortage Condition** is defined as available pumping units cannot meet Q_{95} max day demand in 22 hours of pump run time, standby pumps are not included in pump run time calculation.

- **Requirement for Monitoring** chloride trends, well production (peak hour and total) by pump station, index monitoring well head levels will be sampled more frequently (weekly, instead of monthly). Available remaining pumping stations may have to be pumped harder to meet Q_{95} max day summer demand and may increase chloride levels and decrease head levels into Alert or Critical low groundwater levels.

    - In accordance with Sec. 3-318 Low Groundwater Conditions, *whenever chloride content rises 16 ppm or more over three consecutive months at sufficient sources to hamper operations.*

- Index well head levels decrease into Alert or Critical low groundwater levels in 3 or more index wells within the target water system.

Table 1 presents the triggers for each Water Shortage Condition. Note that an exceedance of either source capacity/demand or chloride trigger could result in a water shortage condition. A reduction in sufficient sources to hamper operations due to rising chlorides are dependent on pump operations experience and engineering judgement specific to the target water system.

Table 1: BWS Water Shortage Condition Triggers

Water Shortage Condition	Source Capacity/Demand Trigger	Chloride Content Trigger*
No Water Shortage	Available pumping units meet max day demand in 16 hours, standby not included.	Stable Chloride and Head Level Trends
Alert	Available pumping units meet Q_{95} max day demand in 20 hours, standby pumps not included.	Chloride content rises between 12 ppm and 16 ppm over three consecutive months at sufficient sources to hamper operations.
Critical	Available pumping units cannot meet Q_{95} max day demand in 22 hours, standby pumps not included	Chloride content rises over 16 ppm over three consecutive months at sufficient sources to hamper operations.

*Chloride content must rise at sufficient wells to hamper operations to activate a Low Groundwater Condition

The Low Groundwater Condition water level triggers for each index well are presented in Table 2.

Table 2: BWS Index Wells and Low Groundwater Condition Water Level Triggers

CWRM Aquifer System	BWS Index Area	BWS Index Well Name	Avg. Median GW Elevation (ft MSL)	Caution Level (ft MSL)	Alert Level (ft MSL)	Critical Level (ft MSL)
Palolo	Kaimuki	Kaimuki H.S. 25-1A Deep MW	25.0	23.5	22.5	20.5
Nuuanu	Beretania	Thomas Square 83 MW	23.0	21.0	20.0	17.5
Kalihi	Kalihi	Kalihi "Kapalama" MW	23.0	20.5	19.5	17.0
Moanalua	Moanalua	Manaiki T-24 MW	20.0	18.5	17.5	15
Waimalu	Halawa	Halawa T-45 MW	17.0	15.5	14.5	12.0
	Kalauao	Upper Waimalu T-52 MW		15.5	14.5	12.0
Waipahu-Waiawa	Pearl City	Waiawa T-27 MW	17.0	14.0	13.0	12.0
	Waipahu	Waipahu 241 Deep MW		17.0	16.0	15.0
	Hoaeae-Kunia	Kunia T-41 Deep MW		13.0	12.0	11.0
Makaha	Makaha	Makaha V Well	18	7.0	6.0	4.0
Waialua	Helemano	Helemano MW	11	11.0	10.5	10.0
Koolauloa	Punaluu	Punaluu Deep MW	18	17.0	16.0	14.0
	Kaluanui	Kaluanui Deep MW		16.0	15.0	14.0
Waialae-West	Waialae-West	Kapakahi Well (State Well Number 3-1746-003)	8	7	6.5	6

Median groundwater elevation based on available historical data, typically available since the 1990s
Ft. MSL – Feet above mean sea level

BWS Response Objectives, Strategies, and Tactics

Water Shortage response objectives aims to ensure safe, dependable and affordable water supply for public health and safety.

- Prevent source water and water system contamination and extended delivery infrastructure disruptions
- Meet max day water demand
- Reduce potable water use through progressively restrictive water conservation measures
- Minimize low water pressure incidents
- Minimize overdraft conditions and excessive salt-water intrusion
- Pursue new water source development and water system connectivity improvements

Fire flow is expected to be available as long as storage tanks are operated within normal operating levels.

These BWS water shortage response objectives shape the compensatory water system operations, water conservation, conditions for development approvals, monitoring and tactics in this plan. Figure 2 presents the Objectives, Strategies and Tactics for the Water Shortage Response and Recovery plan.

For the purposes of this plan:

- Objectives are the goals, what needs to be achieved.
- Strategies are the approach and measurable steps on how to achieve the objective.
- Tactics are the concrete actions, tools and measures pursued associated with each strategy.

Table 3 presents progressively restrictive water conservation responses by Water Shortage Condition if water use reduction targets are not achieved and if infrastructure improvements that resolve the water shortage condition extends more than 2 years.

Table 3: Progressive Conservation Responses by Water Shortage Condition

Water Shortage Condition	Source Capacity/Demand Trigger	Conservation Response
No Water Shortage	Available pumping units meet max day demand in 16 hours, standby pumps not included	Voluntary – General Seasonal Messaging
Alert	Available pumping units meet Q_{95} max day demand in 20 hours, standby pumps not included.	Voluntary – Targeted Seasonal Messaging Requesting 10% Water Use Reductions
Critical	Available pumping units cannot meet Q_{95} max day demand in 22 hours, standby pumps not included	Mandatory in Progressively Restrictive Order 1) Require Targeted Water Use Reductions 2) Water Allotments, Flow Restrictors, Rate Surcharges 3) Moratorium if improvements extend more than 2 years

Figure 2: BWS Water Shortage Response and Recovery Objectives Strategies and Tactics

Water Shortage Response Procedures

In the assessment of meeting the water shortage objectives, relative risk can provide additional guidance in decision making. In the BWS water master plan, Risk is defined as the Consequence of Failure x the Likelihood of Failure and can be applied to water shortages from contamination, overdraft, low pressures, service disruptions, drought, etc.

Risk = Consequence of Failure x Likelihood of Failure

For example, the consequence of contaminating a water source and water system is extremely high, but the likelihood may be difficult to assess without a viable monitoring and reporting network. The consequence of losing a major source from overdraft is high, but the likelihood of over pumping a source can be managed with frequent chloride reporting and changes in pump

operation such as "Last On–First Off", limited to meeting max day demand peaks and backed off during the wet season.

A contamination event or long-duration infrastructure outage event that triggers an Alert Water Shortage Condition begins with the Initial Response. During the Initial Response, the BWS Water Shortage Response Team can recommend voluntary or progressive mandatory conservation measures from customers to prevent a Water Shortage Condition, per Section 2-209 of the BWS Rules & Regulations.

The BWS Water Shortage Response Team, will implement compensatory water system operations, monitoring, voluntary and/or mandatory conservation measures, water use allotments, flow restrictors and fines, building controls and water system improvements as presented in this plan.

Mandatory Water Conservation

In Critical Water Shortage Conditions, the BWS will declare mandatory conservation measures and progressive water use restrictions including the Restricted Irrigation and Other Outdoor Uses procedures because of insufficient response to voluntary conservation. If Mandatory Conservation is required and if infrastructure improvements are necessary, the Board may declare a Building Moratorium extending until the improvements are completed.

Building Moratorium Rules

BWS Rules and Regulations Section 1-101 Availability of Water states:

Availability of Water for Proposed Developments. The Department may issue water commitments to proposed developments as follows:

> *Category 1: Areas with Adequate Water Supply. The Department may issue advance water commitments to proposed developments in areas where the water system has adequate supplies to assume new or additional services.*
>
> *Category 2: Areas with Limited Additional Water Supply. The Department may restrict the issuance of advance water commitments to proposed developments in areas where the water system has limited additional supplies to assume new or additional services.*
>
> *Category 3: Areas with No Additional Water Supply. The Department shall not issue water commitments to proposed developments in areas where the water system has no additional supplies to assume new or additional services. The only exception shall be the issuance of a single 3/4-inch meter to proposed developments on existing single vacant lots.*

BWS typically operates under Category 2 water availability, where water commitments are confirmed when residential subdivision construction plans are approved or when building permits are approved for all other developments. In a Critical Water Shortage Condition with Mandatory Conservation, BWS will operate under Category 3, for water systems with no additional water supply until the water system improvements to increase capacity are completed.

Building Moratorium Controls

In a Critical Water Shortage Condition, if voluntary and mandatory conservation measures and available pumping units are insufficient to accommodate existing and/or future growth, BWS may implement building development conditions to control the rate of water demand growth and the risk of water shortage. The moratorium should extend until the infrastructure improvements that restore or expand water system capacity are completed. Limitations may include:

- Limit approvals to a single minimum size water meter for existing vacant lots.
- For redeveloped residential and non-residential parcels, limit water demands to:
    - Existing use or previous water allocations (previously paid WSFC), or
    - Existing water meter sizes, (meters may have more capacity than existing use)
- Require alternative onsite water supplies such as grey water reuse, stormwater catchments, A/C condensate recovery and high efficiency plumbing fixtures. Refer to the National Blue Ribbon Committee Distributed Nonpotable Water Manual.
- Fee In-Lieu: Retrofit another building to high efficiency plumbing fixtures and obtain fixture credits for the redevelopment, (No Net Gain in Water Use)

Additional Options, as long as No Detrimental Impacts to Existing Customers:

- Allow affordable and homeless housing providing critical social services.
- Allow an additional dwelling unit (ADU) on existing lots, per DPP rules, no increase in meter size.
- Allow Department of Hawaiian Homeland projects because of priority water rights.

Declarations and Notifications for Conditional Building Moratoriums:

- Board Action for the Declaration of a Building Moratorium is required.
- Before declaring moratoriums, verify that growth forecasts and development approvals (building permit and construction status) are accurate, and existing source production trends are not decreasing with conservation efficiencies offsetting incremental growth. Account for the timing of new sources and pipeline inter-connections improvements. Typical timeframes for P&E, Design and Construction of new sources are approximately 5 to 7 years. Ensure developer proposed water demands are calculated consistently and are accurate.
- The Manager shall inform and obtain approval of the Board to declare a water shortage condition building moratorium and report to the Board the status of head and chloride levels and water system capacity; the weekly average of daily pumpage and demands; the effectiveness of the restrictions and allotments in force; recommendations to increase or reduce restrictions and allotments; and such other information.

- Notify affected elected officials, agencies, landowners and developers.
- The Board may terminate the declared water shortage condition building moratoriums when the event causing degradation of water quality or disruptions to water system delivery infrastructure has been resolved.

Water Shortage Response Team

The Water Shortage Response Team is comprised of BWS Divisions and Water Resources branches that will assess the extent of the water shortage condition, support compensatory pump operations, control water demand and recommend any system improvements in support of the Incident Specific Response Plan. Figure 3 presents the Water Shortage Response Team.

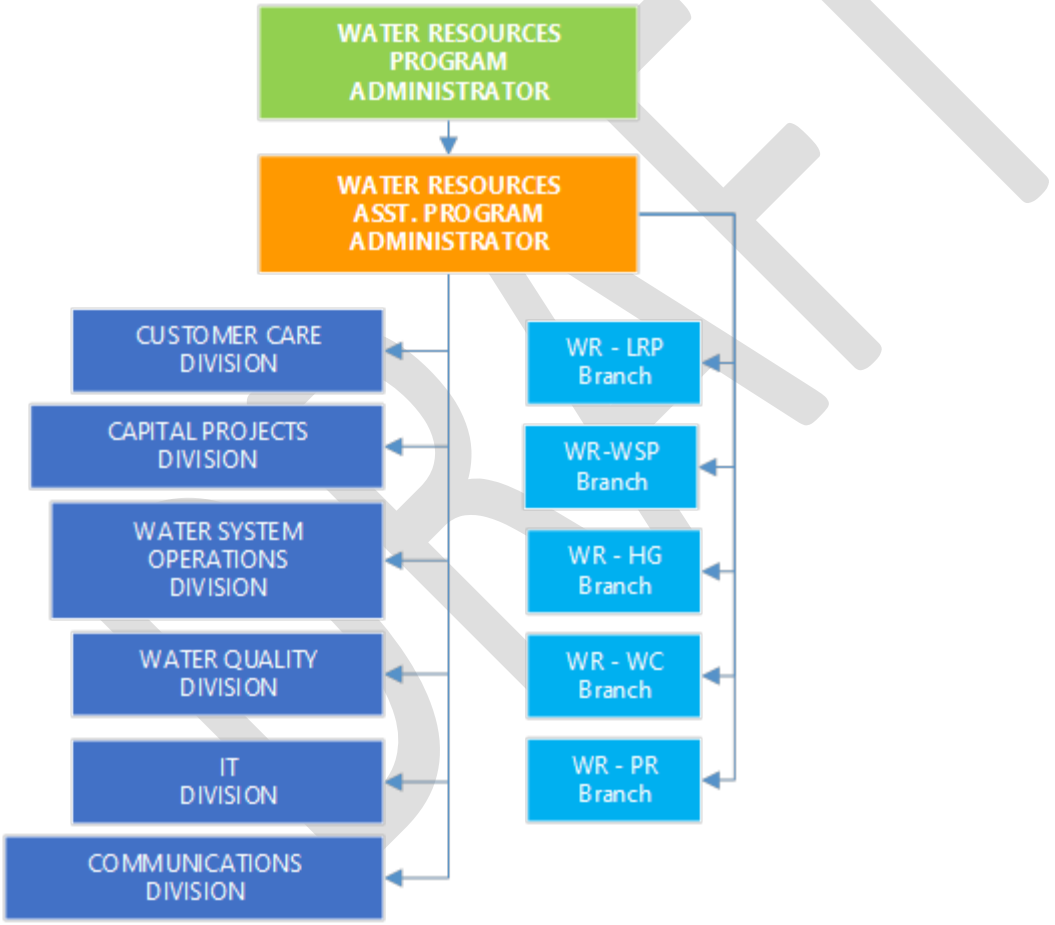

Figure 3: Water Shortage Response Team

Consistent with the Drought Response and Recovery Plan, the Water Resources Division Program Administrator will lead of the Water Shortage Team and act as liaison to the BWS Manager and Deputy Manager, and Incident Command. The Water Resources Assistant Division Head is the co-coordinator. Initial Response procedures are presented in the next section.

Initial Response

The BWS declares a water shortage condition after a contamination event or long-duration infrastructure outage event. Table 4 presents the Initial Response procedures available to BWS during a water shortage.

Table 4: Initial Response Procedures

Tactic		Responsible BWS Division
Data Collection and Analysis	▪ Increase frequency of water supply and well production monitoring to detect changes in supply availability. ▪ Monitor available pumping units and run times relative to max day demand ▪ Track rainfall across the aquifers sectors to determine potential for an eventual Low Groundwater Condition	Water Resources
	▪ Initiate annual or more frequent water loss audits, determining possible pressure zones in need of improvements to reduce water loss ▪ Identify and prioritize non-essential uses such as outdoor landscaping, decorative pools, swimming pool refilling, irrigation or recreational facilities; determine which uses can be reduced or eliminated during the Water Shortage Conditions	Water Resources
Inter-Agency Coordination	▪ Establish direct communication with City Dept. of Emergency Management to keep them informed of water shortage conditions for critical facilities where public health and safety is threatened, such as hospitals, government facilities, etc ▪ Meet with CWRM, developers, landowners, and other stakeholders (as needed) to discuss anticipated water shortages o Exchange ideas, advocate for joint solutions, and share media and public information messaging and costs fairly ▪ Partner with other agencies, utilities, and private sector and volunteer organizations that share common interests or special expertise, such as water-efficient landscaping o Share ideas and potential ways to save water o Coordinate shortage response activities, apply for funding, share resources, and work through regulatory issues ▪ Require HFD to notify BWS when they connect their portable wildland fire fighting dip tanks to the BWS system o Portable dip tank pad locations and BWS reservoirs near them are shown in Appendix H	OMCE
Stable Condition Operation Guidance	▪ Update water shortage operational guidance: o Update the stable condition pumping recommendations (see Appendix A) for previously analyzed sources: Beretania PS, Kalihi PS, Kaimuki PS, Halawa Shaft, Punanani Wells, Kalauao Wells ▪ Analyze and determine stable pumping recommendations for additional wells/aquifers. o Recommended sites in Appendix A	Water Resources, Water Systems Operations, Water Quality
Public Outreach and Education	▪ Expand the rainwater barrel and catchment program ▪ Implement end user leak detection programs and expand current leak detection outreach: o Conduct outreach activities	Water Resources, Communications

	○ Implement a leak and minor plumbing repair program for low-income households ○ Offer free inspections to identify leaking toilets and plumbing fixtures ○ Implement irrigation inspections for automatic sprinkler and irrigation systems	
	▪ Hire a water conservation education specialist to give classes to local K-12 students ○ Funding may be provided, fully or in part, by the County and BWS	OMCE, HRO, ESO
Public Communication	▪ Use social media and traditional media and newsletters to disseminate water shortage information and conservation goals and tips ▪ Keep messages clear, simple, and consistent; collaborate with other utilities and agencies to share the same message ○ Include easily accessible and useful info on BWS website related to the water shortage condition, conservation tips, and how customers can access their own water use data from meters ▪ Prepare a presentation and talking points for BWS staff to provide clear, accurate, and consistent information to customers and the community on conservation measures	Communications

Water Shortage Condition

The BWS may declare a Water Shortage Condition based on an analysis of available pumping units and run times to determine when water supply is not available to meet existing and/or future water demands due to degradation of water quality or extended disruptions to water system delivery infrastructure.

BWS will activate the Water Shortage Response Team (WSRT) to lead and coordinate the Water Shortage response and planning activities.

The WSRT shall meet regularly, with increasing frequency as the water shortage conditions worsens, as recommended in Table 5.

Table 5: Recommended Meeting Schedule per Water Shortage Condition

Water Shortage Condition	Recommended Meeting/Update Schedule
Alert	Convene and provide updates bi-weekly to the Manager and monthly to the Board and as needed to City Council and other agencies
Critical	Convene and provide updates weekly to the Manager and monthly to the Board and as needed to City Council and other agencies

Water Shortage Procedures

Table 6 presents the tactics and procedures that the Water Shortage Response Team may recommend during Water Shortage Conditions, along with the responsible BWS Divisions. The procedures are increasingly restrictive as the situation moves to an Alert Condition and to a Critical Condition.

Table 6: Procedures in Response to Water Shortage Conditions

Tactic	Pre-Declaration Procedures (prior to summer)	Alert Condition Procedures	Critical Condition Procedures	Responsible Party
Data Collection	Customer Care collect reports from the public of observed wasteful water usage and forward to Water Resources Division	▪ Customer Care forwards data on non-compliance with voluntary conservation program to Water Resources Division ▪ Customer Care Division prepares and mails letters requesting voluntary reductions of water use to identified customers	▪ Customer Care initiates patrolling program to identify violators of the mandatory water use irrigation restrictions and allotments. ▪ Water Resources assists as needed	▪ Customer Care ▪ Water Resources ▪ Finance
	Increase chloride content data collection to monthly for wells near affected index wells		Increase chloride content data collection to weekly for wells near affected index wells	Water Resources
	Request and/or assist CWRM with increasing deep monitor well monitoring frequency			Water Resources
	Implement the following if CWRM mandates pumpage reductions if water resources are being impacted: ▪ Finance conducts a financial impact analysis of lost revenue due to CWRM's mandated pumpage reduction at varying durations. ○ Evaluate financial reserve, projected spending, and identify if mitigation measures are needed. ▪ Water Resources increases sampling of source water to continuously monitor water quality ▪ WSRT coordinates with CWRM on their planned spot checks of BWS deep monitor wells and pumpage.			▪ Water Shortage Response Team ▪ Water Resources ▪ Finance
Improve System Efficiency	▪ Identify and prioritize non-essential uses such as outdoor landscaping, decorative pools, swimming pool refilling, and irrigation or recreational facilities. Determine which uses can be reduced or eliminated during certain water shortage stages ▪ Install centralized weather-based irrigation controls in large landscaped areas to adjust irrigation rates depending on rainfall.			Water Shortage Response Team
	Increase frequency of water loss audits – determine areas of improvement to minimize potential water loss. Adjust AMR meters to hourly reads for large users and install meter masters on high off-hour (usually early morning) water use.			Water Resources, Field Operations
Triage Water Supply Sources	Kalihi, Beretania and Kaimuki wells ("in-town" wells) are utilized extensively during high demand periods. To manage average annual production from these wells, prioritize production from Pearl City and Ewa areas wells as much as feasible during the fall, winter and spring season in anticipation of exceeding the average annual production rates from "in-town" wells.			Water Resources Operations

Tactic	Pre-Declaration Procedures (prior to summer)	Alert Condition Procedures	Critical Condition Procedures	Responsible Party
Inter-Agency Coordination	▪ Ensure City properties comply with all BWS demand reduction measures ▪ Meet with CWRM, private well users, and other stakeholders (as needed) to discuss anticipated water shortages ○ Exchange ideas, advocate for joint solutions, and share media and public information messaging and costs ○ Coordinate water shortage response activities, apply for funding, share resources, and work through regulatory issues ▪ Discuss communication plans with CWRM, DOE, DOT, DPR, DES, etc. ▪ Water Resources to stay apprised of water levels and water quality and provide information to Water Shortage Response Team ▪ Communications to lead communications with public and private agencies			▪ Water Shortage Response Team ▪ Water Resources ▪ Communications
Voluntary Conservation Measures for Alert Water Shortage Conditions	▪ Request military, commercial, industrial, and agricultural users and government agencies reduce their usage by 10% ▪ Include some water conservation strategies and current usage in communication	Request the following of all customers: ▪ Use automatic shut-off nozzles on all hoses. ▪ Only wash cars, boats, trailers, or other vehicles with automatic shut-off nozzle hoses and buckets ▪ Do not hose or wash sidewalks, walkways, driveways, parking lots, or other hard surfaces ▪ Require customers to make a reasonable effort to repair water leaks in toilets, plumbing fixtures, and customer-side water lines within 24 hours		Water Shortage Response Team
Mandatory Conservation Measures for Critical Water Shortage Conditions		Require the following of applicable customers: ▪ Do not fill swimming pools and other types of pools and ponds. Close public pools, outdoor fountains and other water features ▪ Serve water in restaurants only when requested by the customer, provide a notice of water shortage on each table ▪ Post a notice of water shortage and tips for water conservation in each hotel and motel room ▪ Use re-circulating water only in ornamental fountains and post signage nearby that states that re-circulated water is being used ▪ Limit use of potable water for recreational purposes ▪ Coordinate with commercial water recreational facilities (such as water parks) on restrictions to minimize impact to businesses ▪ Eliminate use of decorative water features and outdoor misting systems		▪ Water Shortage Response Team ▪ Communications

Tactic	Pre-Declaration Procedures (prior to summer)	Alert Condition Procedures	Critical Condition Procedures	Responsible Party
Mandatory Conservation Measures for Critical Water Shortage Conditions			Implement mandatory BWS construction restrictions: ▪ Halt all approvals of temporary water meters ▪ Halt all approvals of new permanent water meters ▪ Halt all approvals of pipeline chlorination or disinfection using potable water	▪ Capital Projects
	Implement mandatory restrictions for City agencies: ▪ Restrict turf watering/landscaping irrigation at City facilities other than parks and right-of-way ▪ Inspect automatic sprinkler and irrigation systems		▪ Partner with HFD to reduce non-essential training ▪ Increase use of reclaimed water for irrigation, construction activities, fire-fighting storage, agriculture, or other non-potable uses	Water Shortage Response Team
Water Allotments & Flow Restrictors (Only applies to Critical Condition)		Establish water allotments and flow restrictors: For commercial, residential, industrial, military, governmental, and agricultural consumers ▪ At no less than 90% of user's previous 12-month average billed consumption ▪ At no less than 350 gals/day for SFD and duplex residences ▪ At no less than 270 gals/day/unit for Multi Family low rise and 180 gals/day/unit for High Rise Apts.	Establish water allotments and flow restrictors: For commercial, residential, industrial, military, governmental, and agricultural consumers: ▪ At no less than 70% of user's previous 12-month average billed consumption ▪ At no less than 300 gallons/day for SFD and duplex residences ▪ At no less than 210 gals/day/unit for Multi Family low rise and 140 gals/day/unit for High Rise Apts. ▪ At different times and different levels for the various classes of consumers	▪ Water Shortage Response Team
		▪ Customer Care Division notifies each customer of billing period water use allotment by printing such amount on their bill or by direct mail to them ▪ Customer Care Division requests flow restrictors installed by Field Operations Division.		▪ Customer Care ▪ Field Operations
		Process all written applications for exceptions to the customer allotment and appeals to any adverse action and notify all Divisions of any exceptions that are granted appeals to any adverse action.		Customer Care

Tactic	Pre-Declaration Procedures (prior to summer)	Alert Condition Procedures	Critical Condition Procedures	Responsible Party
Non-Residential Conservation Targets	Government agencies; military and commercial, industrial, and agricultural users reduce their usage by 10% during Alert Water Shortage Conditions and 30% during Critical Water Shortage Conditions. Include applicable strategies and/or tactics and current usage in communication			Water Shortage Response Team
Irrigation Schedule	Implement the voluntary irrigation schedule ▪ Goal: Overall reduction of 25% in irrigation ▪ No watering during rain or within 48 hours following rain. ▪ Parks, highways, cemeteries, schools ○ Between the hours of 7 AM and 9 AM ○ Irrigation days for odd digit address: Tuesday, Thursday and Saturday ○ Irrigation days for even digit address: Wednesday, Friday, Sunday ▪ Domestic: Between the hours of 5 PM and 7 PM ▪ Military and golf courses: Between the hours of 12 AM and 5 AM			Water Shortage Response Team
		Implement the mandatory irrigation schedule ▪ Goal: Overall reduction of 50% in irrigation ▪ No watering during rain or within 48 hours following rain. ▪ Parks, highways, cemeteries, schools ○ Between the hours of 7 AM and 11 AM ○ Irrigation days for odd digit address: Tuesday, Thursday and Saturday ○ Irrigation days for even digit address: Wednesday, Friday, Sunday ▪ Domestic: Between the hours of 5 PM and 7 PM ▪ Military and golf courses: Between the hours of 12 AM and 5 AM ▪ Turf replacement rebate / xeriscape incentives $3.65/sf cost to remove turf only (CA)	Water Shortage Response Team
Stable Condition Operation Guidance	Update and follow the Low Groundwater operational guidance (see Appendix A): ▪ Update chloride level, transition zone mid-point, and pumpage data ▪ Identify the stable condition operation limits for previously analyzed sources: Beretania PS, Kalihi PS, Kaimuki PS, Halawa Shaft, Punanani Wells, Kalauao Wells ▪ Analyze and determine stable pumping recommendations for additional wells in the Water Management Areas of concern ○ Recommended sites in Appendix A			Water Resources
Engage Critical Customers		▪ Collaborate with major water users to identify water-saving measures that would not harm their business		▪ Water Resources ▪ Communications

Tactic	Pre-Declaration Procedures (prior to summer)	Alert Condition Procedures	Critical Condition Procedures	Responsible Party
	▪ Engage with stakeholders (especially industrial users) of any expected changes in water quality and/or water supply reliability due to the water shortage.			Water Shortage Response Team
Public Outreach and Education	▪ Partner with private sector and volunteer organizations that share common interests or special expertise, such as water-efficient landscaping o Reach out to local community partners, other utilities, and agencies to share ideas and potential ways to save water ▪ Implement or enhance the following end user leak detection programs: o A leak and minor plumbing repair program for low income households o Free inspections to identify leaking toilets and plumbing fixtures o Incentive programs or tax credits for installing water saving fixtures o Irrigation inspections for automatic sprinkler and irrigation systems			Water Shortage Response Team
	▪ Implement incentive programs such as: o Incentives to follow through with voluntary measures o Incentives or tax credits to install water saving fixtures ▪ Hire a water conservation education specialist who gives classes to local elementary and high school students o Seek funding assistance through the ODC and SDC			▪ Water Shortage Response Team Finance
	Consider meeting with business who may be affected by mandatory water restrictions, including but not limited to: car washes, golf courses, water parks or other commercial water recreational facilities, resorts, hotels			Water Shortage Response Team
Public Communication	▪ Use social media, traditional media, and bill inserts ▪ Keep messages clear, simple, and consistent. Collaborate with other utilities and agencies to share the same message o Include easily accessible and useful info on BWS website related to the current water shortage condition, conservation tips, and how customers can access their own water use data from meters ▪ Conservation messaging templates should: o Use simple messages, short sentences, and provide one to three recommendations o Have specific conservation measures or restrictions per customer type in bill inserts ▪ Provide a telephone hotline or website for customers to report leaks, with resources tied to field crew work orders to prioritize leak repairs			▪ Communications
	▪ Establish a schedule for frequent, frank communication using all available methods for customers to understand the severity of the water shortage and encourage reduced water use ▪ Engage major employers, local businesses, and county officials to help spread water shortage-related messages and act as water conservation "models" within the community ▪ Ask school and religious leaders, youth groups, and service organizations to promote conservation to their students, congregations, and members			▪ Communications ▪ Water Shortage Response Team

Tactic	Pre-Declaration Procedures (prior to summer)	Alert Condition Procedures	Critical Condition Procedures	Responsible Party
Public Communication	▪ Prepare information on the status of the water supply sources, the need for conservation, and suggestions on how to conserve water, and disseminate the information to the public through the mass media ▪ Prepare focused letters to government leaders requesting support of these conservation efforts ▪ Prepare a presentation and talking points for BWS staff to provide clear, accurate, and consistent information to customers and the community on conservation measures ▪ Develop a FAQ template with answers that change as different low groundwater conditions occur, thus forming a consistent message for communications, Neighborhood Board reps, and other staff who engage customers		▪ Provide weekly updates to media and public on: ○ Water supply conditions ○ Status of community demand reduction response ○ Recommended conservation measures enforcement information, including fines and reporting procedures ▪ Require all commercial customers to prominently display “save water” signage and develop conservation plans	▪ Communications ▪ Water Resources

Surcharges, Exceptions, Appeals and Penalties

Special rates and charges during mandatory water shortage conditions

During a mandatory water shortage condition, a surcharge schedule for excess water use shall be established for customers whose monthly consumption is in excess of their water allotment, in accordance with the following:

- Maximum allowable exceedance of water allotments:
- Residential (single family and duplex): 5,000 gallons per monthly billing period
- Resort, commercial, multi-family, industrial, agricultural, military, and government: Difference between allotment and previous 12-month monthly average

Table 7: Surcharges for Exceedance of Water Allotment by Percentage and Meter Size

Gallons in Excess of Allotment for Meter Sizes 2" and Larger*	Gallons in excess of Allotment for Meter Sizes 5/8" to 1-1/2" (Monthly Billing)	Gallons in excess of Allotment for Meter Sizes 5/8" to 1-1/2" (Bi-Monthly Billing)	Surcharge
25% or less	3,000 or less	6,000 or less	2 Times Existing Water Rate
26% - 50%	3,001 – 6,000	6,001 - 12,000	3 Times Existing Water Rate
51% - 75%	6,001 – 9,000	12,001 - 18,000	4 Times Existing Water Rate
76% - 100%	9,001 – 12,000	18,001 - 24,000	12 Times Existing Water Rate
Over 100%	Over 12,000	Over 24,000	20 Times Existing Water Rate

*Surcharge for 2” and larger meters are the same for either monthly or bi-monthly billing

- For residential consumers, the surcharge will be charged at the block rate that the allotment falls in. Surcharges will be assessed for each consumer after receipt of the first water bill following the establishment of allotments by the BWS Board. Upon termination of allotments by the Board, surcharges shall cease.

Exceptions and Appeals

Sec. 3-322(5) Procedures for Control of Water Use During Low Groundwater Level Condition provides a process to consider exceptions:

Consideration of written applications for exceptions regarding the allotment system or regulations and restrictions on water use set forth in this Chapter shall be as follows:

a. Written applications for exceptions shall be accepted, and may be granted, by the Manager.

b. Grounds for granting such exceptions are:

(1) Failure to do so would cause an unnecessary and undue hardship to the Applicant, including but not limited to adverse economic impacts such as loss of production or jobs;

(2) Failure to do so would cause an emergency condition affecting the health, sanitation, fire protection, or safety of the Applicant or the public;

(3) For single family residences with more than four persons permanently residing in the home, if a written application for an exception is granted as provided herein, the applicable allotment shall be increased by 40 gallons per person per day for each person permanently residing in the home in excess of four persons;

(4) For multiple residential units with more than two dwelling units where the allotment is less than 280 gallons per day per dwelling unit, if a written application for an exception is granted as provided herein, the applicable allotment shall be 280 gallons for each unit;

(5) Denial of an application for exception may be appealed in writing to the Board.

Penalties:

Sec. 3-321 Penalties, provides the following:

1. Any violation by any person of the restrictions declared by the Board under Sections 3-319 and 3-320 of this Chapter shall be punishable according to Chapter II, Section 2-205 and Chapter V, Section 5-501 of these Rules and Regulations.

2. Any consumer who violates the restrictions declared by the Board under Sections 3-319 and 3-320 of this Chapter or who consumes water in excess of the amount designated below for their class shall be subject to the installation of a flow restriction device by the Department and punishable according to Chapter V, Section 5-501, (charged with a misdemeanor, pursuant to Chapter 1, Article 3, Section 1-3.1, ROH). An offender shall pay $50.00 for the installation and removal of a flow restriction device by the Department. Water service may be discontinued for an offense committed after the installation of a flow restrictor in accordance to Chapter II, Section 2-205.

BWS can implement penalties for customers whose monthly consumption is in excess of their water allotment, in accordance with the following:

Maximum allowable exceedance of water allotments:

Residential (single family and duplex): 5,000 gallons per monthly billing period, 10,000 gallons per bi-monthly billing period

Resort, commercial, multi-family, industrial, agricultural, military, and government: Difference between allotment and previous 12-month monthly average

First two offenses if the excessive use does not exceed the maximum allowable as specified above and in Section 3-321 of the BWS Rules and Regulations.

A warning letter will be issued after the first offense

A flow restrictor may be installed after the second offense

Declaration and Termination of Water Shortage Condition

The Manager shall inform the public and the Department's consumers of the declaration and termination of an alert or critical water shortage condition by publishing such declaration and termination in a newspaper of general circulation on the island of Oahu at least once a day for three consecutive days. The alert or critical water shortage condition and all restrictions and allotments associated therewith shall terminate at midnight on the first day of a publication terminating such condition. Flow restrictors will be removed.

Recovery Phase

If the Water Shortage included the trigger and declaration of a Water Shortage Condition, a recovery phase will be needed for over-pumped sources. The recovery phase of the Water Shortage Response & Recovery Plan is crucial, as rolling back voluntary and/or mandatory conservation measures and operational restrictions may slow or even reverse the recovery.

The Water Shortage Response Team will determine when it is appropriate to reduce the severity of the Water Shortage Condition, based on the restoration of available pumping units, water level and chloride data from ongoing monitoring of supply wells and customer conservation implementation. This water shortage recovery process will be undertaken conservatively and may take a minimum of three months. Figure 4 presents an example of a water shortage recovery process from the Critical Water Shortage Condition and the potential triggers for stepping down to each lower condition.

The water shortage conditions should be characterized to understand the applicable length of time of the declaration and whether it extends annually or only through the summer seasons.

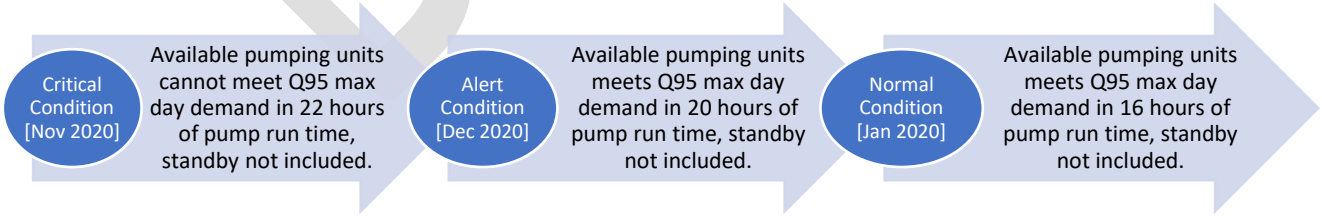

Figure 4: Example of Recovery from a BWS Water Shortage Critical Condition

During the Recovery Phase, procedures are split between WSRT procedures which mainly deal with decision-making on when to rollback voluntary/mandatory conservation measures and agency

coordination. BWS Divisions and Sections will also have operational procedures. These procedures are shown in the next sections.

Recovery Procedures

The WSRT will still be needed to monitor the effectiveness of the water shortage response and as long as a Water Shortage Condition is active, even while improving, the WSRT remains the group in charge of water shortage actions and other BWS Divisions will continue certain Water Shortage Condition procedures through recovery. The BWS should implement the organizational procedures listed in Table 8 to ensure recovery from a Water Shortage Condition, depending upon the severity.

Table 8: Recovery Procedures

Procedures	Responsible Division
▪ Write an after-action report that describes effective water shortage response actions and areas that could be improved o The after-action report will be submitted to the Water Shortage Response Team and the Manager for inclusion in the County after-action report	Water Shortage Response Team
Identify new standard operating procedures for future Water Shortage Conditions and for routine operations	Water Shortage Response Team
▪ Revise the BWS Water Shortage Response and Recovery Plan based on lessons learned o Did the Initial Response procedures, Low Groundwater Condition triggers and procedures achieve the anticipated results? o Were the demand reduction measures too prescriptive, or did they not provide enough direction to customers?	Water Shortage Response Team
▪ Conduct a debrief with BWS staff and stakeholders shortly after the water shortage event to discuss the effectiveness of or improvements to response activities. o Continue to engage the public by providing tips to use water efficiently throughout public and private facilities, such as installing low-flow fixtures, retrofitting landscapes, and replacing inefficient irrigation systems o Engage with large water users and local businesses to help them prepare for the next water shortage	Water Shortage Response Team
▪ Document how water demand in the system changed during water shortage response o Use production and consumption data to estimate the lag time between different public announcements and voluntary and/or mandatory measures o This information can help revise trigger levels for when procedures are implemented o Pre-Water shortage information can be found in Appendix G	Water Shortage Response Team
▪ Document how the aquifers and wells reacted to the water shortage condition, (chlorides and heads) o How did the Sources of concern react to the water shortage condition? o What emergency operations were put in place due to restricted pumping in certain wells or aquifers? o Where there any damages to the system incurred as a result of the water shortage condition? o Did a CWRM Water Shortage Warning Stage occur and if so, how did the BWS respond? Was the 15% mandated cutback in pumpage met? o Did the trigger index wells recover to pre-Water shortage conditions?	Water Shortage Response Team
▪ Keep the Water Shortage Response Team active by conducting water shortage preparedness activities o Once BWS and the aquifers have recovered from the water shortage, the WSRT should meet annually and conduct water shortage planning and exercises	Water Shortage Response Team

Work with County, State, and Federal officials to secure funding and technical assistance to implement large projects to build longer-term water shortage resilience, such as new groundwater wells, resilient water sources, and interconnections	OMCE
Develop a plan to implement projects that address long-term needs to make BWS more resilient to future water shortage	Water Resources
Continue the water loss program to conduct annual water loss audits and provide recommended improvements	Water Resources
Continue or increase monitoring activities to maintain a full awareness of water supply conditions	Water Resources
Continue to implement leak detection and repair programs that ensure a prompt response mechanism for staff to make repairs	Water Resources
Keep communicating frequently and frankly with all customers about the water shortage recovery progress	Communications Water Resources
Reframe messages to a focus on long-term water supply reliability; continue to stress the importance of conserving water, actions BWS is taking, and actions the public can take	Communications