TRUCKEE MEADOWS WATER AUTHORITY
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Drought Contingency Plan

Prepared by
Truckee Meadows Water Authority
February, 2020

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List of Abbreviations

AF	Acre-Feet
AFA	Acre-Feet Annually
ASR	Aquifer Storage & Recovery
BOR/USBR	United States Department of Interior, Bureau of Reclamation
CFS	Cubic Feet per Second
CIP	Capital Improvement Plan
DCP	Drought Contingency Plan
DSS	Decision Support System model
EPA	Environmental Protection Agency
GPM	Gallons per Minute
HOA	Home Owners Association
IPR	Indirect Potable Reuse
LP	Linear Program
MGD	Million Gallons per Day
M&I	Municipal & Industrial
NAC	Nevada Administrative Code
NRCS	Natural Resource Conservation Service
NRS	Nevada Revised Statute
PLPT	Pyramid Lake Paiute Tribe
POSW	Privately Owned Stored Water
SAC	Standing Advisory Committee
SCADA	Supervisory Control & Data Acquisition
SDF	State of Nevada Demographer's Projection
SNOTEL	Snow Telemetry
SWE	Snow Water Equivalent
TMRPA	Truckee Meadows Regional Planning Agency
TMSA	Truckee Meadows Service Area
TMWA	Truckee Meadows Water Authority
TROA	Truckee River Operating Agreement
UCLA	University of California, Los Angeles
UNR	University of Nevada, Reno
USGS	US Geologic Survey
UV	Ultraviolet Light
WCF	Consensus Forecast of Washoe County population
WDWR	Washoe County Department of Water Resources
WFP	Water Facility Plan
WRP	Water Resource Plan
WTP	Water Treatment Plant
WUR	Water Usage Review

Executive Summary

The Truckee Meadows Water Authority (TMWA) was formed in 2001 via an interlocal agreement among Washoe County, the City of Reno, and City of Sparks. TMWA serves municipal water to over 400,000 residents via 130,000 service connections within the Truckee Meadows Service Area (TMSA). The TMSA, which is situated at the eastern base of the Sierra Nevada Mountains, is primarily classified as a high desert environment.

Plan Development

Overview

TMWA developed this Drought Contingency Plan (DCP) for the Truckee River Basin as part of a project funded by the United States Department of Interior, Bureau of Reclamation (BOR). This DCP was also created to comply with Nevada Revised Statute (NRS) 540.141 that requires a plan for water conservation that includes a contingency plan for drought conditions to ensure a reliable supply of potable water. TMWA's previous plan which can be found in Chapter 5 of the 2016-2035 Water Resource Plan (WRP) was developed based on the worst drought of record over the 125 years of recorded flows of the Truckee River. The DCP considers a worse-than-recorded multi-year drought resulting from changes to the climate. TMWA worked with local stakeholders and municipalities to develop the plan, specifically to define relevant risks and vulnerabilities.

Drought Planning Task Force

TMWA formed a Drought Planning Task Force (Task Force). The Task Force is a broad representation of municipal agencies, customer classes, and subject matter experts. The goal of the Task Force was to identify the risks and vulnerabilities likely to occur in the area over the next few decades. The Task Force also discussed how such risks and vulnerabilities to TMWA's water resources might impact the region over the long-term.

Drought Monitoring

TMWA monitors meteorological and hydrological droughts as these have direct effects on availability of surface water along the Truckee River and availability of groundwater in hydrogeographic basins during low-precipitation years. TMWA's water resource operations and management vary based on the region's hydrologic conditions. TMWA monitors precipitation and snowpack conditions, Truckee River flows, and groundwater levels.

In the Truckee River system, a Drought Situation is defined by the Truckee River Operating Agreement (TROA) and declared by the US Water Master. TROA defines a Drought Situation based on Lake Tahoe's elevation and on the loss of Floriston Rates. When a Drought Situation exists under TROA, TMWA has four categories for the severity of the drought, which are based on when TMWA's upstream drought storage is projected to be needed to meet customer demands later in the year. If the release of upstream storage is projected to be needed in June, July, and August, those correspond to drought severity levels 4, 3, and 2, respectively, with 4 being the most-severe. If upstream storage is not projected to be needed until after Labor Day, then, despite being a Drought Situation under TROA, TMWA's drought severity is a level 1 (TROA, 2008).

Potential Vulnerabilities

Historically, TMWA has considered the hydrology of 1987-1994 (the worst drought on record) in planning for drought mitigation and response. For this DCP, TMWA assessed climate change studies and considered how plausible, future climate change scenarios may affect water resources used for municipal water demand within the TMSA. TMWA used a scenario-based planning approach with a drought more severe than the worst drought on record, to stress test its system to expose potential risks and vulnerabilities.

Exposure to extended periods of drought has associated risks and vulnerabilities to the local community. Changes in the climate globally are expected to increase temperatures within the Truckee Meadows region (BOR, 2015). These changes could potentially alter the severity and duration of drought within the watershed. The potential effects of climate change on the regional drought cycle are related to increased regional temperatures and annual precipitation cycle changes. Increases in temperature and changes in the form, quantity, and timing of precipitation create challenges to the management of water resources, specifically in capturing, storing and delivering water when it is needed. Regionally, the largest risk from climate change to water resource management is uncertainty regarding future water supplies.

Drought Response Actions

Drought response actions are actions TMWA can take to either bring awareness to drought conditions within its service area, and in extreme cases or severity, promote short-term reduction in demands to limit drought supplies necessary to meet those demands.

Drought Response Triggers

When a Drought Situation is determined, additional conservation measures may be needed. If drought reserves are not needed prior to Labor Day, the severity of the drought is so minimal that no additional response actions are needed. If drought reserves are needed before Labor Day, response actions are taken in the form of enhancing existing programs, and in extreme cases temporary water curtailment can be requested.

Enhanced Conservation Implementation

When a Drought Situation is identified, depending on the severity TMWA can enhance its existing conservation programs to help bring awareness to the drought. In some cases of extreme severity, TMWA can request temporary cutbacks in water usage by its customers.

Drought Mitigation Measures

Ongoing Conservation Programs

- Water Conservation Education and Outreach Program
    - TMWA has numerous educational initiatives designed to help customers learn the benefits of water conservation while providing tools, tips, and techniques to foster smart water use.
- Water-Efficiency Codes
    - As a condition of service, customers must not engage in any act which results in excessive use of water (i.e. no waste). The rule requires that customers follow an

assigned, three-day-a-week irrigation schedule for lawns. Assigned-day watering helps prevent overwatering and reduces peak-day demand.

- Water Pricing Structure
  - TMWA has an inverted, tiered-rate billing structure in which customers are charged increasing rates based on the amount of water they use. This billing structure provides a "price signal" to customers whose usage crosses into a higher tier, thereby encouraging efficient use of water.
- Water Usage Review Program
  - The Water Usage Review (WUR) Program assists TMWA customers with issues with their water meter or their water delivery system related to high consumption. When a WUR is requested, TMWA staff review the usage history of the service to determine water usage behavior. Then staff go onsite to check meter accuracy as well as detect potential leaks in the customer's system. If a leak is detected, staff provide the customer direction in identifying and fixing the leak.
- Water Watcher Program
  - During the outdoor watering season TMWA hires seasonal staff and trains them regarding TMWA's water use rules and techniques for using water efficiently. Staff is tasked with monitoring the TMWA service territory to ensure that customers are following watering restrictions.
- Landscape Retrofit Fund
  - The Landscape Retrofit Fund provides financial support for approved projects that improve water efficiency by local government entities. The fund supports landscape-augmentation projects which reduce water requirements and educational programs designed to inform about drought-tolerant landscaping (e.g. xeriscape) and conservation practices.

Future Drought Mitigation Projects

Capital improvement projects are a central component of TMWA's drought mitigation strategy. These projects can be made to improve surface and groundwater supplies, improve the water distribution and storage systems as well as administrative outlays. Projects identified either create new supply, increase capacity, increase reliability during a drought, or reduce risk of water loss.

Summary

This DCP is one element of TMWA's water resource planning process to ensure that the region has a reliable and resilient potable water supply. TMWA is regularly assessing hydrologic and drought conditions to ensure that the region's water supply can meet demand. The modeling effort in this DCP shows that TMWA has adequate water supplies under a drought more severe than any on record within the region. TMWA will continually update this DCP every five years to investigate new potential vulnerabilities to the system.

1 Introduction

1.1 Drought Contingency Plan

TMWA developed this Drought Contingency Plan (DCP) for the Truckee River Basin as part of a project funded by the United States Department of Interior, Bureau of Reclamation (BOR). This DCP was also created to comply with Nevada Revised Statute (NRS) 540.141 that requires a plan for water conservation that includes a contingency plan for drought conditions that ensures a supply of potable water. TMWA's previous plan which can be found in Chapter 5 of the 2016-2035 Water Resource Plan (WRP) was developed based on the worst drought of record over the 125 years of recorded flows of the Truckee River. This DCP considers a worse-than-recorded multi-year drought resulting from changes to the climate. The plan utilizes the most up-to-date scientific modeling on potential increases to temperatures and evaporation rates within the Truckee River Basin. TMWA worked with local stakeholders and municipalities to develop the plan, specifically to define relevant risks and vulnerabilities.

1.2 DCP Project

1.2.1 Plan Development

The DCP was developed using a work plan approved by the BOR as part of a funding assistance agreement. The DCP includes an overview of TMWA's water system including sources of supply, current and future demands and water use efficiency. It contains a vulnerability assessment that identifies risks and factors of climate change, and drought that result from climate change, that could impact water resources critical to municipal demand within the Truckee River Basin.

The DCP utilizes scientific information regarding future hydrologic conditions within the Truckee River Basin. While predictions on potential climate change impacts within the region vary greatly, the likelihood for unprecedented drought is of real concern. Based on those predictions, this DCP outlines mitigation actions TMWA could take in the coming years to dampen impacts from future drought, as well as potential response actions, that would avoid shortages in supply, should drought occur.

1.2.2 Drought Planning Task Force

TMWA formed a Drought Planning Task Force (Task Force), which is a broad representation of municipal agencies, customer classes, and subject matter experts. Table 1-1 provides a list of the Task Force members and their affiliation.

The goal of the Task Force was to identify the risks and vulnerabilities likely to occur in the area over the next few decades. The Task Force also discussed how such risks and vulnerabilities to TMWA's water resources might impact the region over the long-term. Risks identified and discussed include inadequate water supplies, inability to meet future demands, response actions by municipal agencies within the region, and related economic impacts. The Task Force also evaluated and provided feedback on modeling efforts that analyzed impacts to water supplies from plausible future hydrologic conditions.

Table 1-1 Task Force Members

Participant Name	Affiliation	Position
Beth Christman	Truckee River Watershed Council	Director of Restoration Programs
Bruce Gescheider	TMWA's Standing Action Committee	Chamber Representative
Colin Hayes	TMWA's Standing Action Committee	Commercial Stakeholders Representative
Jeremy Smith	Truckee Meadows Regional Planning Authority	GIS Coordinator
Jerry Wager	TMWA's Standing Action Committee	Residential Stakeholder Representative
Jim Smitherman	Northern Nevada Water Planning Commission	Program Manager
Karl Katt	TMWA's Standing Action Committee	Senior Citizen Stakeholder Representative
Laine Christman	Truckee Meadows Water Authority	Resource Economist / USBR Project Manager
Lynne Barker	City of Reno	Sustainability Manager
Maureen McCarthy	University of Nevada, Reno	Water for the Seasons Project Director
Mike Shulewitch	TMWA's Standing Action Committee	Multi-family Stakeholders Representative
Neil Krutz	City of Sparks	Deputy City Manager
Neil McGuire	TMWA's Standing Action Committee	Irrigation Stakeholder Representative
Robert Charpentier	Truckee Meadows Water Authority	Communications Specialist
Seth Williams	Reno Fire Dept.	Fire Protection Services Representative
Shawn Stoddard	Truckee Meadows Water Authority	Senior Resource Economist
Sonia Folsom	Truckee Meadows Water Authority	Meeting Facilitator
Vahid Behmaram	Washoe County	Water Management Planner Coordinator
William Boyer	University of Nevada, Reno	Graduate Research Assistant

1.2.3 Outreach Plan

In addition to the formation of the Task Force, TMWA sought feedback by other stakeholders and the public regarding the content of the DCP. TMWA held a public open house at TMWA's Corporate Office. In accordance with Open Meeting Law, the time and location of the open house meetings was posted using a variety of media outlets including local newspapers, tmwa.com, social media (Facebook, Twitter, etc.), postings at local public agencies and email correspondence. Stakeholders and the public were provided access to a copy of the draft DCP via TMWA's website, as well as in-person at the public open house. Members of the public were able to submit comments regarding the DCP through email, direct mail, or in-person at the public open house or TMWA’s main office via a public comment card. All comments were reviewed and considered.

2 Water System Overview

2.1 Truckee Meadows Service Area

TMWA was formed in 2001 via an interlocal agreement among Washoe County, the City of Reno, and City of Sparks. TMWA serves municipal water to over 400,000 residents via 130,000 service connections within the Truckee Meadows Service Area (TMSA). The TMSA, which is situated at the eastern base of the Sierra Nevada Mountains, is primarily classified as a high desert environment. Its primary water supply comes from the snow-fed Truckee River. The Truckee River originates in California at Lake Tahoe and flows out of the Sierra Nevada through the Truckee Meadows to its terminus, Pyramid Lake. Figure 2-1 provides an overview of the Truckee River watershed as well as the TMSA. The Truckee River provides water for the northern Nevada municipalities of Reno, Sparks, and Washoe County. Lake Tahoe is the largest storage reservoir on the Truckee River system. TMWA uses its Truckee River diversions conjunctively with groundwater resources located throughout the TMSA to supply water for municipal demand. Water from Lake Tahoe is also used by commercial interests in the largest industrial park in the United States located in nearby Storey County, feeds agricultural production and livestock grazing in the Truckee Meadows and Lahontan Valley region, as well as irrigation and fisheries for the Pyramid Lake Paiute Tribe (PLPT). It is important to note, these other stakeholders do not fall under this DCP.

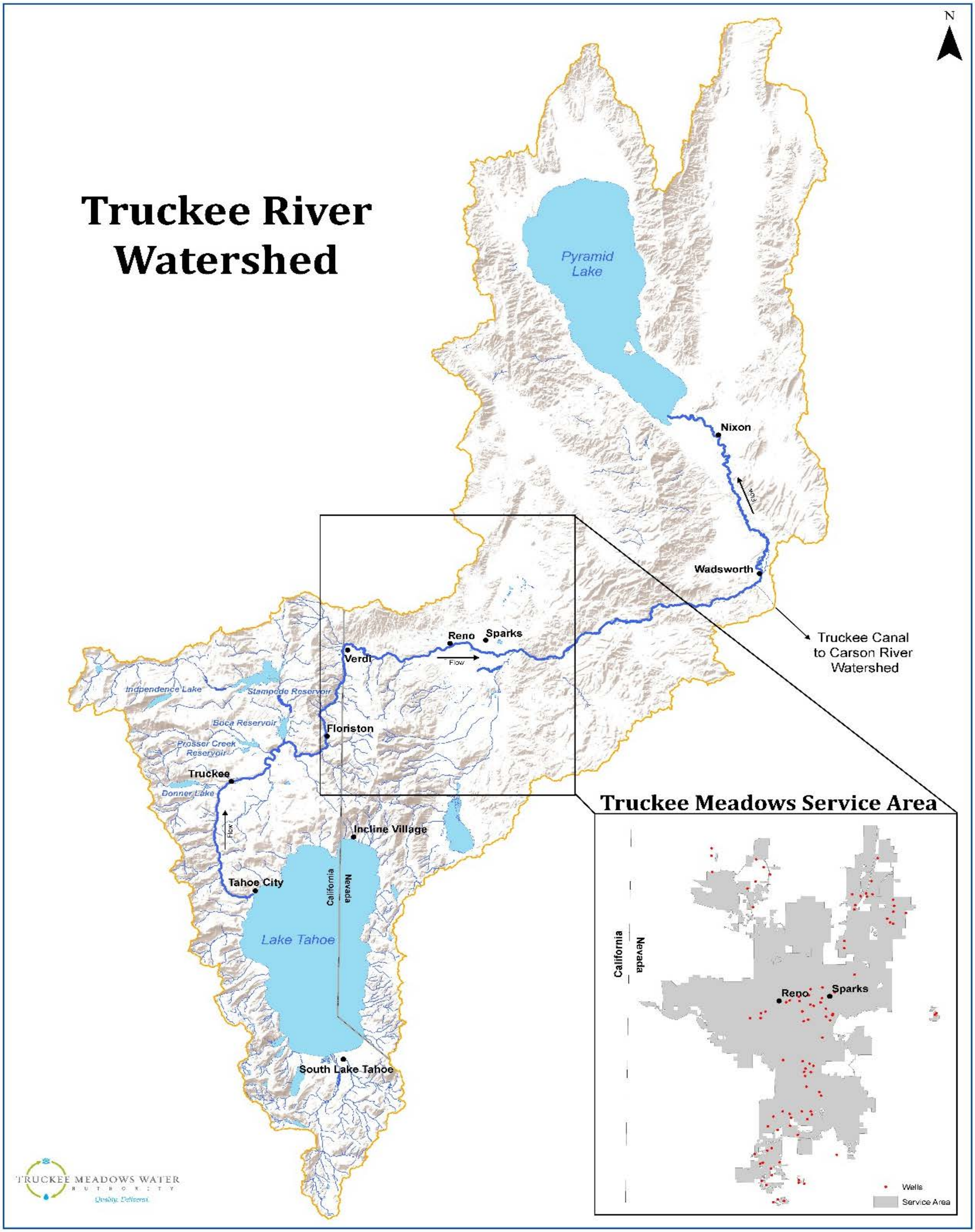

Figure 2-1 Overview of the Truckee River Watershed

2.2 Water Supply Sources

2.2.1 Surface Water

The Truckee River is the primary source of water within the TMSA, providing approximately 80-85% of the region's potable water. TMWA's surface water rights come predominantly from the Truckee River, plus water from several major tributaries, including Hunter, Steamboat, and Whites Creeks.

TMWA has two surface water treatment plants (WTP) on the Truckee River: Chalk Bluff and Glendale. The Chalk Bluff WTP is TMWA's largest, capable of producing approximately 90 million gallons per day (MGD) of treated water. Raw water at the Chalk Bluff WTP is treated via a conventional water treatment process through settling of heavy solids, screening, flocculation and sedimentation, filtration, and chlorination. The plant is designed for modular expansions to have an ultimate treatment capacity of 120 MGD.

The Glendale WTP is TMWA's supplemental treatment facility. Glendale WTP comes online to help meet increased demands during the irrigation season (typically May through October), and can produce approximately 33 MGD of surface water on this seasonal basis. Additionally, groundwater from six wells can be pumped to Glendale to be treated for arsenic and blended with surface water for distribution into the system. With groundwater included, the combined capacity of the Glendale WTP is 45 MGD and employs the same treatment process as the Chalk Bluff WTP.

2.2.2 Truckee River Operating Agreement

The Truckee River watershed is predominantly snow-fed. Mountain snowpack acts as a natural reservoir, accumulating in the winter and melting in the spring and summer months when more water is needed for outdoor irrigation by its municipal customers. The Truckee River is the only outlet from Lake Tahoe and is controlled by a dam at Tahoe City that holds back the top 6.1 feet of the lake. Truckee River flows are highly dependent on Lake Tahoe's surface elevation at any point in time throughout the year.

In addition to Lake Tahoe, other reservoirs within the Truckee River watershed include Donner Lake, Independence Lake, Stampede Reservoir, Boca Reservoir, and Prosser Reservoir. TMWA owns all water rights from Donner and Independence Lakes, which is referred to as TMWA's Privately Owned Stored Water (POSW). Together, this amounts to 27,000 acre-feet annually (AFA) of surface water storage. In dry years, when river flows are low and additional water resources are required in the Truckee Meadows, POSW is typically released to help meet those demands.

The Truckee River Operating Agreement (TROA) governs operations on the Truckee River system. The US Water Master manages reservoir releases and the flow of water in the Truckee River system to ensure the operating requirements under TROA are satisfied for all water rights holders, including TMWA. TROA clarified the interstate allocation of water between California and Nevada, ensuring that Nevada will receive 90% of the water in the Truckee River. The required flow rates at the state line are known as Floriston Rates. Floriston Rates require an average flow at the US Geological Survey (USGS) Farad Gage, near the California-Nevada border, of 500 cubic feet per second (cfs) each day from March 1st through September 30th and 400 cfs each day from October 1st through the last day of February. Floriston Rates can be reduced under certain conditions under TROA. Reduced Floriston Rates require either 300 cfs or 350 cfs at the Farad Gage and go into effect from November 1 through March 31, whenever the water surface elevation of Lake Tahoe is lower than 6,226 feet.

2.2.3 Groundwater

TMWA has groundwater production wells throughout the TMSA to supplement surface water supplies and to provide water to the satellite systems where surface water supplies are not available. The utility operates and maintains 89 active production wells in nine distinct hydrographic basins, with 74 available to meet customer demands in TMWA's main service area and 15 available for service in the satellite systems. Yield ratings for TMWA's groundwater production wells range from approximately 100 gallons per minute (gpm) to 3,000 gpm.

TMWA's primary operating objective is to maximize the use of available surface water and rely on groundwater production wells for summer peaking and when needed during dry years. Some production wells, generally located at the far reaches of the distribution system, may also pump during the winter months to provide greater service reliability and reduced pumping costs. All satellite systems are solely dependent on groundwater, and therefore, the wells operate year-round.

The wellfield TMWA operates in Honey Lake Valley, Nevada is a product of the Fish Springs Ranch Water Supply Project completed by Vidler Water Company. The basin is located approximately 38 miles north of the Reno-Sparks metropolitan area. The project is currently permitted to provide up to 8,000 AFA of groundwater supply to the Truckee Meadows region. With additional aquifer testing and basin monitoring, the Nevada State Engineer may allow an additional 5,000 AFA of groundwater pumping from the wells for a total supply of 13,000 AFA.

TMWA also has an Aquifer Storage and Recovery (ASR) program. Under TMWA's ASR program, treated surface water is injected, or recharged, into groundwater aquifers for water quality mitigation and additional drought storage. Since its inception, TMWA's ASR program has helped improve or stabilize groundwater levels in and around recharge sites, thereby improving the ability to utilize groundwater resources to meet summer peak demand and Drought Situation pumping requirements. ASR is one element of TMWA's integrated management strategy to augment drought reserve supplies for later use. Through ASR, TMWA has injected approximately 38,000 acre-feet (AF) of water since the program began in 1993.

2.3 Current and Future Demand Conditions

TMWA's 20-year water demand projection estimates that water demand will increase approximately 14% from 84,486 AF in 2020 to 98,968 AF in 2040. To estimate future annual water demand in the TMSA, TMWA created a water demand model using the following data sources: Washoe County population, historical water services in TMWA's service area, and historical water use data. Population growth is the basis for projecting the number of future active water services. Though several population projections for the region exist, including the State of Nevada Demographer's projection (SDF) and TMRPA's Consensus Forecast of Washoe

County population (WCF), TMWA’s population projection is based on a logistic growth curve and provides an estimate of population equilibrium assuming that current trends and conditions continue to 2099.

Using the population projection, TMWA’s projection of total active water services is estimated via a vector autoregression model. The model predicts water services as a function of the relationship between population, active services in prior months, and correlation between the different service classes. Water services classes include: single family residential, multi-family residential, commercial businesses, and landscape irrigation. The next step of the water demand model is to estimate water use coefficients for each of the four customer classes using historical water use information. Water use coefficients are derived from a 3-year average, per service water usage. These coefficients are multiplied by the total number of active services for each respective class and aggregated at the annual level, over the 20-year period, resulting in the final water demand projection.

Since the model is based on historical information, it assumes current socio-economic trends will continue. Therefore, future changes in economic growth, building and landscaping trends, climate conditions, and water-saving technology are not captured. Since these factors can ultimately influence true demand up or down, the model is re-estimated on a semi-annual bias. Analysis of prior water demand models have shown estimations to be slightly higher than actual demand. Figure 2-2 illustrates the projection for TMWA’s total water demand.

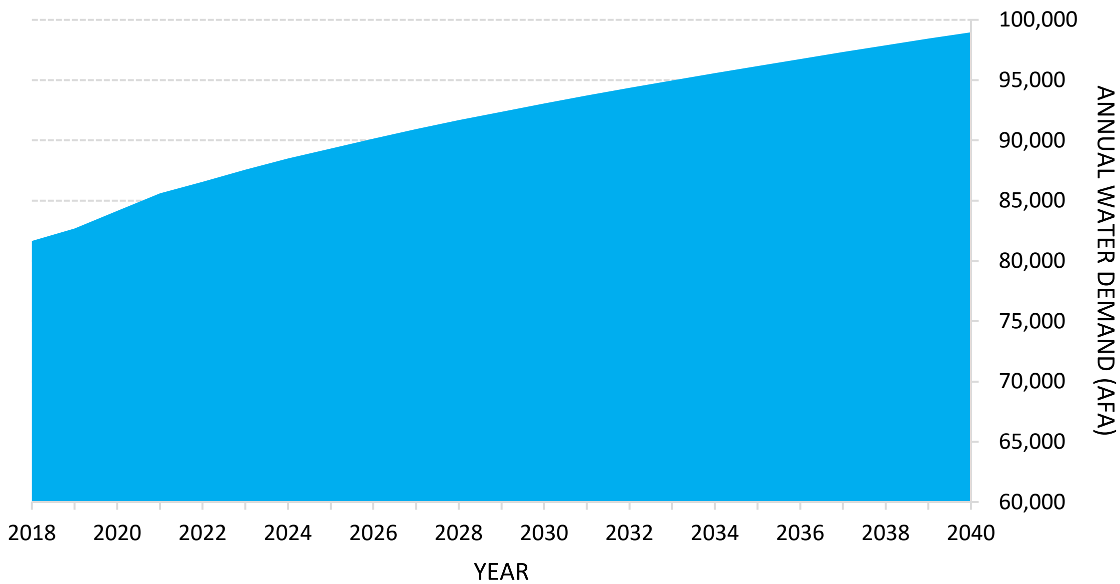

Figure 2-2 TMWA's 20-Year Water Demand Projection

2.4 Water Use Efficiency

2.4.1 Statewide Water Use and Drought Policies

Under NRS 540.131, every water purveyor in Nevada must submit a water conservation plan to the State. This DCP must include provisions related to: 1) increasing public education awareness; 2) encouraging use of drought-tolerant plants and reductions in the size of lawns; 3) managing for leaks in the supply system; and 4) increasing the reuse of effluent water. The statute also mandates a contingency plan be in place to ensure potable water is available during drought conditions and a schedule for how such a plan will be implemented. NRS 540.141 also requires each conservation measure specified in a purveyor's conservation plan to have an estimate of the gallons of water saved annually, that will be conserved each year, stated in gallons per-person, per-day (see NRS 540.141 1.(g)).

Moreover, pursuant of TROA, TMWA must have in place a conservation plan "designed to produce water savings each year which is equal to or better than a plan requiring water savings of 10 percent or more during a drought" (TROA 12.A.2(e)).

More recently, in order to address mounting concerns over the 2015 drought, Nevada's Governor, Brian Sandoval created the Nevada Drought Forum. Six meetings were held between June and November of that year. In September 2015, the Governor held a Drought Summit at the State's capital, Carson City. As a culmination of those efforts, the Governor released the *Nevada Drought Forum: Recommendations Report in December of 2015*. To address the state's water resource challenges, the report outlined, among other things, recommendations on the best water conservation practices. Those conservation recommendations include all water purveyors' conservation plans include: (1) metering of all water connections; (2) the development of water efficiency standards for new development; (3) tiered rate structures to promote conservation; (4) time-of-day and day-of-week water restrictions; and (5) a request that local political subdivisions explore the implementation of water conservation measures where Covenants, Conditions, and Restrictions are in place.

2.4.2 Agency Commitment to Water Use Efficiency

As the water purveyor for approximately 90% of Washoe County residents, TMWA has a responsibility to be a good steward of the region's water resources. Therefore, in order to comply with specific provisions under NRS and TROA and promote good stewardship, TMWA's commitment to conservation extends beyond drought years by promoting water efficiency every year.

3 Drought Monitoring

3.1 Statewide Water Supply Monitoring

The State of Nevada defines drought as follows: "Drought is a complex physical and social phenomenon of widespread significance." The State of Nevada Drought Plan sets forth the State's definition for each of the five types of droughts. The role of a water purveyor is to secure reliable water resources to meet its customers' requirements, including mitigating the risks that droughts can impose on water resources. Nevada uses the US Drought Monitor to track droughts and assess drought severity (https://droughtmonitor.unl.edu/).

3.2 Local Water Supply Monitoring

TMWA's water resource operations and management strategies vary based on the region's hydrologic conditions. Therefore, TMWA monitors meteorological and hydrological droughts as these have direct effects on availability of surface water along the Truckee River and availability of groundwater in hydrogeographic basins during low-precipitation years.

Precipitation and Snowpack

A good indicator of an impending dry-year water supply is snowpack accumulation. Measured on April 1 of each year, the water content of the snowpack is used to forecast the amount of water that will run off each spring to help fill upstream reservoirs and provide river flows through the year. The risk of continued drought conditions increases in lower-than-average-snowpack years. TMWA monitors the network of Natural Resource Conservation Service (NRCS) Snow Telemetry (SNOTEL) sites throughout the Sierra Nevada mountains in the Truckee River watershed to assess snowpack. TMWA also monitors precipitation gages in the region, particularly at the Reno-Tahoe International Airport, which is located in the central Truckee Meadows.

TMWA collects this data to help estimate flows within the Truckee River during the course of the water year. Such modeling is critical in determining the likelihood of a drought and the duration of impacts to the main water supply for the Truckee Meadows region.

Truckee River Flows

TMWA monitors surface water flows of the Truckee River and adjacent creeks using stream gages maintained by the USGS. Since the Truckee River is operated under TROA, TMWA works closely with the US Water Master who manages releases from the federally operated reservoirs in the Truckee River system. TMWA provides reservoir storage levels and release schedules to the US Water Master, which are inputs into a RiverWare model. This model allows TMWA to determine possible hydrologic and storage conditions throughout the year.

Droughts

The US Water Master also is responsible for declaring whether the region is in a Drought Situation. According to TROA, Drought Situation means:

> A situation under which it is determined by April 15, based on the April 1 Natural Resources Conservation Service median forecast in combination with runoff forecasts as set forth in TROA Section 3.D, either that there will not be sufficient

> **Floriston Rate Water** to maintain **Floriston Rates** through October 31, or the projected amount of **Lake Tahoe Floriston Rate Water** in Lake Tahoe, and including **Lake Tahoe Floriston Rate Water** in other **Truckee River Reservoirs** as if it were in Lake Tahoe, on or before the following November 15 will be equivalent to an elevation less than 6,223.5 feet Lake Tahoe Datum". (p. 24)

Since 1980, there have been four periods of varying degrees of hydrologic drought within the Truckee River system: 1987-1994 (8 years); 2001 to 2004 (4 years); 2007 to 2010 (4 years) and 2012-2015 (4 years). The past 30 years includes the 1987 to 1994 drought period which is considered the worst drought of record over the 115 years of recorded flows of the Truckee River. Historically, TMWA has used the 1987-1994 drought for drought response planning.

Groundwater

TMWA tracks groundwater levels in the nine hydrographic basins where its production wells are located to monitor aquifer health. Using its Supervisory Control and Data Acquisition (SCADA) system, TMWA can track water levels and pumping data in real-time at its production wells. In addition, TMWA has a large network of monitoring wells where staff regularly monitor aquifer levels and water quality.

3.3 Water Use Monitoring and Reporting

TMWA monitors water use and provides updates to its Board and the Western Regional Water Commission (WRWC) on recent water use trends and projections compared to available supplies. Production figures are compiled daily from TMWA's surface WTPs and wells. This production data is provided to the Nevada State Engineer on a quarterly basis. TMWA provides diversion records for its treatment plants to the US Water Master. TMWA also tracks its ASR program and provides recharge values to the State Engineer.

3.3.1 Drought Situation Thresholds

TROA defines a Drought Situation based on Lake Tahoe's elevation and on the loss of Floriston Rates. When a Drought Situation exists under TROA, TMWA has four categories for the severity of the drought, which are based on when TMWA's upstream drought storage is projected to be needed to meet customer demands later in the year. If the release of upstream storage is projected to be needed in June, July, and August, those correspond to drought severity levels 4, 3, and 2, respectively, with 4 being the most-severe. If upstream storage is not projected to be needed until after Labor Day, then, despite being in a Drought Situation under TROA, TMWA's drought severity is a level 1. When the drought severity is a level 4, 3, or 2, TMWA implements enhanced conservation during the summer months when customer demands are high due to outdoor irrigation. When the drought severity is a level 1, enhanced conservation is not required and standard conservation practices are used. Figure 3-1 provides a flowchart of the triggers required for each of TMWA's drought severity levels.

During Drought Situations, TMWA is in close communication with the US Water Master to use its allocation of Truckee River flows in coordination with the other water rights holders on the river.

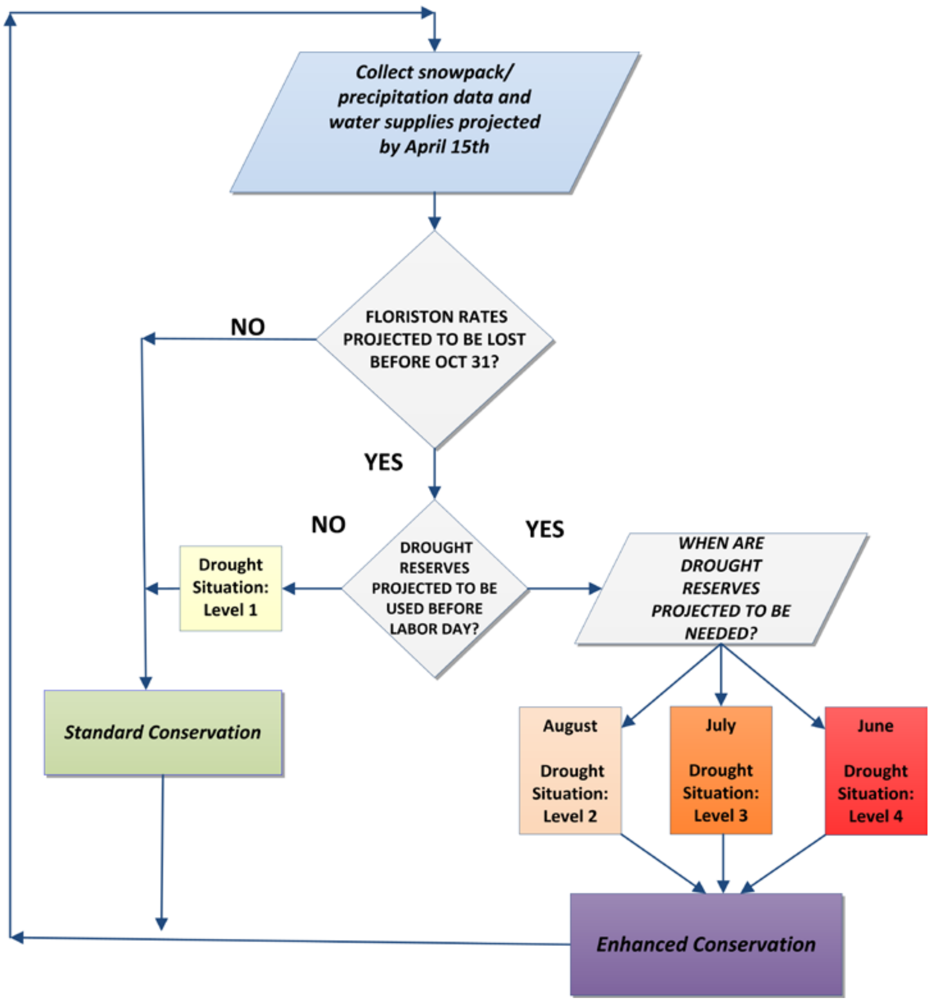

Figure 3-1 TMWA Drought Severity Level Flowchart

4 Vulnerability Assessment

Historically, TMWA has considered the hydrology of 1987-1994 (the worst drought on record) in planning for drought mitigation and response. For this DCP, TMWA assessed climate change studies and analyzed how a more-severe future climate change scenario may affect water supply availability for municipal water demand within the TMSA. This section also outlines the associated risks and vulnerabilities within the TMSA.

4.1 Climate Change Risks

While the climate of the Truckee Meadows is characterized by cyclic patterns of flood and drought, changing climatic conditions may prove more challenging for water supply reliability in the future throughout the American West (Gonzalez et al. 2018, Karl et al. 2009). Climate change is defined as shifts in global or regional weather conditions that persist over multiple decades or longer (Gonzalez et al. 2018).

Regional temperatures are expected to warm, which is consistent with warming trends observed in the state over the past several decades (see Figure 4-1). In the Tahoe Basin, the number of days when air temperature averages below freezing has declined by approximately 30 days since 1911 (Schladow 2018). A 2018 study completed by the University of California Los Angeles (UCLA) Center for Climate Science predicts that by 2041-2060, the Sierra Nevada will warm by 4 degrees Fahrenheit on average (Reich et al. 2018). A concern identified in multiple studies is the impact of warmer temperatures on the timing of snowpack melt and the subsequent filling of storage reservoirs (USBR 2015). Most climate models predict earlier snowmelt and changing streamflow patterns as spring temperatures increase (Reich et al. 2018). Currently, peak runoff from snowmelt to rivers and streams in the Truckee River basin typically occurs in May or June. With increased temperatures, peak runoff in the Sierra Nevada could begin to shift as early as March or April by the end of the twenty-first century (Reich et al. 2018). Since 1961, the commencement of snowmelt has shifted earlier an average of 16 days in the Tahoe Basin (Schladow 2018).

Higher average annual temperatures also lead to higher evaporation rates on lakes and reservoirs, thereby potentially reducing the available water supply (Huntington 2015, USBR 2015). Evaporation on Lake Tahoe is expected to increase by an estimated 3% by 2050 and 5% by 2080 (Huntington et al. 2015). However, these evaporation increases could be offset by precipitation and inflow increases in some climate change scenarios.

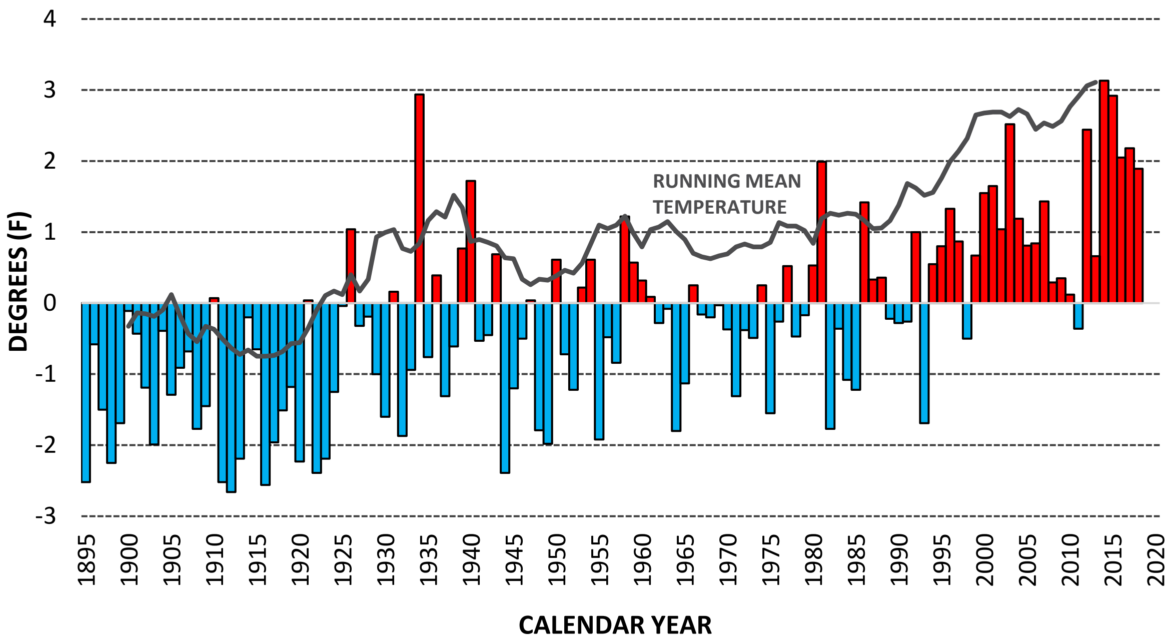

Figure 4-1 Mean Temperature Departure for Nevada from 1895-2018 (Source: Western Regional Climate Center)

There is a lack of consensus and a high degree of uncertainty about future annual precipitation in the Truckee River watershed. Many climate models suggest that the northern Sierra Nevada may receive more precipitation in the future, while others suggest that the region may receive less (BOR 2015, Lynn et al. 2015). However, in addition to the quantity of precipitation, the distribution, timing, and type of precipitation is projected to vary. Warming trends will likely result in more precipitation falling as rain instead of snow which has the potential to decrease the region's winter snowpack leading to snow droughts (Harpold et al. 2017, Cooper et al. 2016, Hatchett et al. 2017). Snow levels have already been increasing in elevation in the Sierra Nevada, with more rain falling at mid-elevations from 5,000-8,000 feet which historically received more snow (Hatchett et al. 2017, Reich et al. 2018). Snow droughts can occur in years with average annual precipitation, but with low snow water equivalent (SWE) (Hatchett et al. 2018).

Snowpack is typically variable in the Truckee River system (see Figure 4-2), but a prolonged or permanent decrease in snowpack would impact the water supply, as mountain snow acts as a reservoir that melts throughout the spring and summer during the highest demand periods. Additionally, climate change has the potential to increase the severity and frequency of extreme weather events, such as atmospheric rivers and droughts (Cayan et al. 2001, Dettinger et al. 1995). Several large atmospheric river events during the winter of 2017 caused flooding throughout the Truckee Meadows region; these heavy precipitation events and the associated flooding may become more common in the Sierra Nevada in the future. The frequency of prolonged droughts may also increase (Cayan et al. 2010). Frequent shifts, or hydrological cycle intensification between extreme dry years (e.g. 2015) and extreme wet years (e.g. 2017) are predicted, which may make water resource operations more complex (Swain et al. 2018).

TMWA also relies on groundwater to supply water to its customers which serves as a “buffer” during dry times because it acts as a huge storage reservoir underground. Several studies have investigated implications of climate change on groundwater systems in the western U.S. with wide-ranging results. Estimates range between declines to little change, to even slight increases in groundwater recharge and associated groundwater resources (Meixner et al. 2016, Huntington et al. 2012, Pohll et al. 2018). The uncertainty in the groundwater recharge estimates largely rests on the large uncertainty in future precipitation estimates. Regardless, TMWA’s ASR program increases groundwater recharge through ongoing injection of treated surface water during non-drought periods. This strategy ensures sustainable management of groundwater resources under a wide range of future climate conditions.

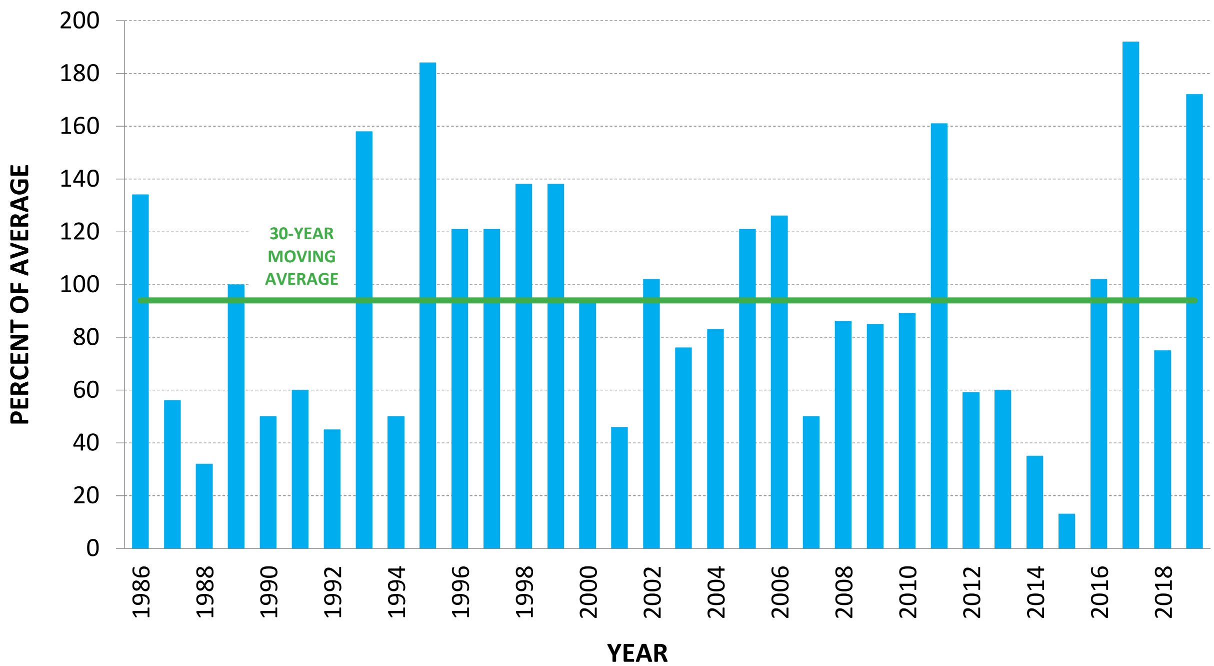

Figure 4-2 Truckee River Basin Average April 1 Snowpack from 1986-2019

4.2 Future Conditions of Critical Resources for Drought Supply

Exposure to extended periods of drought has associated risks and vulnerabilities to the local community. As noted above, changes in the climate globally are expected to increase temperatures within the Truckee Meadows region (BOR, 2015). These changes could potentially alter the severity and duration of drought within the Truckee River Watershed. The potential effects of climate change on the regional drought cycle are related to increased regional temperatures and annual precipitation cycle changes. Increases in temperature and changes in the form, quantity, and timing of precipitation create challenges to the management of water resources, specifically in capturing, storing and delivering water when it is needed. Regionally, the largest risk from climate change to water resource management is uncertainty regarding future water supplies. Impacts to water resources from drought related to climate change include reductions in river and stream flow, reservoir levels and groundwater supplies. Risks to water supplies have associated adverse impacts, such as declines in economic viability, damage to property and assets, and environmental and recreational degradation. These vulnerabilities are exacerbated as uncertainty regarding the availability and reliability of future water supplies grows.

The Task Force identified various risks and vulnerabilities within the Truckee Meadows related to supplying water for municipal use. These include reduced surface water supplies, reduced snowpack, and the inability to capture runoff to fill reservoirs. Overall, there were concerns that temperature increases could lead to a consistently below-average snowpack, thus decreasing the total runoff available to TMWA. There were also concerns that increased temperatures could change the timing of runoff leading to problems with capturing water when it is available. Task Force members were concerned that under these conditions, TMWA's available water resources might not be sufficient to meet demands over an extended drought period.

Additionally, the risk of depletion of groundwater supplies was identified. Increased temperatures and decreased precipitation could reduce natural recharge in groundwater basins TMWA uses for supply. Moreover, there were concerns that should surface water availability become problematic, groundwater would be too heavily relied on during times of drought. There were also concerns that reduced surface water flows might hinder TMWA's ability to use ASR as part of its conjunctive management strategy.

Table 4-1 List of Risk and Vulnerabilities within the TMSA

1.	Water supply shortages
2.	Inability to fill upstream reservoirs
3.	Inability to capture runoff when it is available
4.	Adequacy of groundwater supplies
5.	Inability to artificially recharge groundwater resources
6.	Inefficient conservation during drought
7.	Water demand hardening

4.2.1 Scenario-based Planning

Scenario-based planning in water resource management can be highly effective for long-term planning and decision-making when uncertainty about future outcomes is high (BOR, 2015). To investigate the extent to which the risks and vulnerabilities outlined above might be exacerbated by hydrologically-plausible drought resulting from climate change, TMWA developed a Decision Support System (DSS) model. The DSS used in this DCP was developed in partnership with the University of Nevada, Reno (UNR), the Desert Research Institute, and USGS.

The purpose of the DSS is to simulate monthly water supply allocations given a hypothetical drought scenario that may occur over the next few decades. The model utilizes future surface water flows, groundwater pumping capacities and customer demands as inputs. The underlying solver of the DSS is a Linear Program (LP). Many water resource planning problems have been formulated using an LP approach (Hsu, Cheng, 2002). Constraints are defined within the model as rules that govern how the system must operate. These constraints include: 1) water supplied must equal water demand; 2) upper and lower capacity constraints for each facility (e.g., water treatment plants ability to treat raw water) and sources of supply (e.g., well capacities, reservoir capacities, etc.); and 3) institutional rules and regulations (e.g., available water rights, operational requirements under TROA and TMWA conservation policies).

The goal of the DSS is to balance TMWA's water supplies with customer demands. This model estimates the impact a long-term drought could have to TMWA's water supplies. It also allows TMWA to estimate the benefit of various levels of enhanced conservation on its water supplies under the scenario. If the DSS cannot balance supply and demand during any time over the planning horizon, it estimates the appropriate level of temporary reductions in water demand from drought sustainability over the planning horizon. To measure the benefit of demand reduction, the model can trigger conservation when Floriston Rates cannot be maintained. Initially, a 10% demand reduction is used since this target reduction was requested by TMWA during the most recent Drought Situation. This level of conservation serves as a baseline from which alternative models with more or less conservation can be compared against. Refer to the Drought Response Actions in Section 6 for further discussion on TMWA's conservation policy, its enhanced conservation schedule and measures of effectiveness

The planning horizon of the model is 15 years. The model considers monthly timesteps, which equates to 180 (12 months x 15 years) unique time periods in which TMWA had to meet demands. It is important to note the DSS model is a macro-level rendition of the TMWA system, but it is not a daily operational model such as Riverware. Its level of resolution only lends the model insight into the feasibility of managing water supplies to meet demands given a specific hydrologic scenario. Moreover, individual parts of the system are aggregated into a the whole. For example, TMWA has 89 production wells within the TMSA, each of which has an individual pumping capacity and associated water rights. However, within the DSS there is only one constraint on well pumping capacity equal to the combined total monthly pumping capacity of all wells within the TMSA. Likewise, constraints on aggregated groundwater rights available to TMWA are imposed within the model. Therefore, while the DSS is useful for planning purposes, the DSS cannot produce highly detailed information such as that generated using RiverWare. Moreover, the scenario evaluated in this study is hypothetical. Actual management decisions regarding the priority of use of TMWA's sources of supply, as well as overall reservoir and surface water levels, would be different given factors not captured in the model. Appendix A details the methodology of the DSS model.

4.3 Potential for Future Supply Shortfalls

The drought scenario included within the DSS model, referred to as Scenario 1, may occur within the TMSA over the next few decades due to changes in the regional climate. Scenario 1 is the combination of two of the worst droughts on record. Scenario 1 begins with an average precipitation year, then the 2012-2015 drought and the 1987-1995 drought, ending with one more average precipitation year. The hydrologic ensemble creates a 15-year study period.

Overall, the results of the DSS are positive with respect to future shortfalls. The model suggests TMWA's supplies are adequately robust over the duration of the 12-year long drought, indicating that no water shortages occur during any time period over the study period. On average, during non-drought years, surface water provides 91% of the total municipal demand with groundwater making up the remainder. During drought years, surface water accounts for 45-85% and groundwater accounts for 14-29% of the supply. Drought reserves account for as little as 0-26% of total supply and are not required until the third year of the drought. The DSS also estimates the amount of groundwater recharging that can potentially occur each month of the study period. Potential for groundwater recharging is a function of the amount of surface water flows less demand and the total capacity of well injection within the TMSA. This difference in surface flows and total demand must not exceed the total capacity of the wells to inject water into the ground. Table 4-2 provides aggregated results of annual demand and sources of supply for Scenario 1. In this scenario, the model imposes a short-term, 10% reduction in customer demands during months when a Drought Situation is declared.

Table 4-2 Scenario 1: Annual Demand and Sources of Supply

Planning Horizon Year	Annual Demand[1]	10% Reduction in Demand[2]	Surface Water Production	Groundwater Production	Drought Reserves Production	Total Production	Potential Groundwater Recharge[3]	Water Supply Shortage
2017	84,589	0	86,996	4,130	0	91,126	6,537	0
2018	85,999	0	88,004	4,175	0	92,180	6,181	0
2019	87,213	0	87,931	4,723	0	92,653	5,440	0
2020*	88,254	-4,624	59,426	21,586	6,259	87,270	3,640	0
2021*	89,184	-5,595	47,656	31,033	7,920	86,609	3,020	0
2022*	90,129	-5,654	45,179	26,369	16,725	88,273	3,798	0
2023*	91,221	-5,722	51,741	25,796	11,583	89,119	3,620	0
2024*	92,379	-3,727	80,637	12,506	733	93,876	5,224	0
2025*	93,383	-4,893	61,234	23,297	7,647	92,179	3,688	0
2026*	94,283	-3,804	68,541	17,626	9,223	95,390	4,910	0
2027*	95,083	-5,965	45,479	26,369	20,906	92,754	3,636	0
2028	95,866	0	77,749	16,209	5,930	99,887	4,021	0
2029*	96,774	-6,071	44,611	26,369	23,603	94,583	3,879	0
2030	97,703	0	95,638	7,389	0	103,027	5,324	0
2031	98,608	0	96,069	7,647	0	103,715	5,108	0

*Indicates a Drought Situation exists

1-Includes a 6-percent system loss factor.

2-10% reduction occurs only in months between May and September when surface water flows are not met under TROA.

3-The DSS estimates the potential for recharge activities to occur and is a function of available surface water flows minus demand and well injection capacity.

Below is a discussion of the model results with respect to the risks and vulnerabilities outlined previously.

1. *Water Supply Shortages* – Overall, the model suggests the risk of a water supply shortage in the near-term is unlikely given the drought scenario considered. The results indicate demands can be met with the available water supplies during every month of the planning period. In months when surface water is limited, the results show groundwater being used to make up the bulk of the difference. In months when normal surface flows and groundwater are not enough to satisfy demands, a combination of drought reserves and customer conservation is implemented.

2. *Inability to fill upstream reservoirs* – Given the scenario considered, the DSS results show reservoirs can fill sufficiently during dry years to ensure drought supplies help offset deficiencies that result from reduced surface flows. These results support recent observations. During the drought of 2015, regional snowpack was approximately 5% of average. Despite the reduced snowpack, inflows into TMWA's reservoirs, Donner and Independence Lakes, were such that drought reserves were adequate to supplement normal river flows. Moreover, TROA allows for additional "credit

storage" of water in Federal reservoirs, namely Boca, Stampede and Tahoe, every year and the ability to carry that water over to the next should a Drought Situation exist. The model results show that as the drought persists, drought reserves can build over the course of the study period. Drought reserves can build up over time, because during drought years TMWA can hold back upstream storage that would be released otherwise. Figure 4-3 illustrates the model's estimated drought reserves over the course of the 15-year study period.

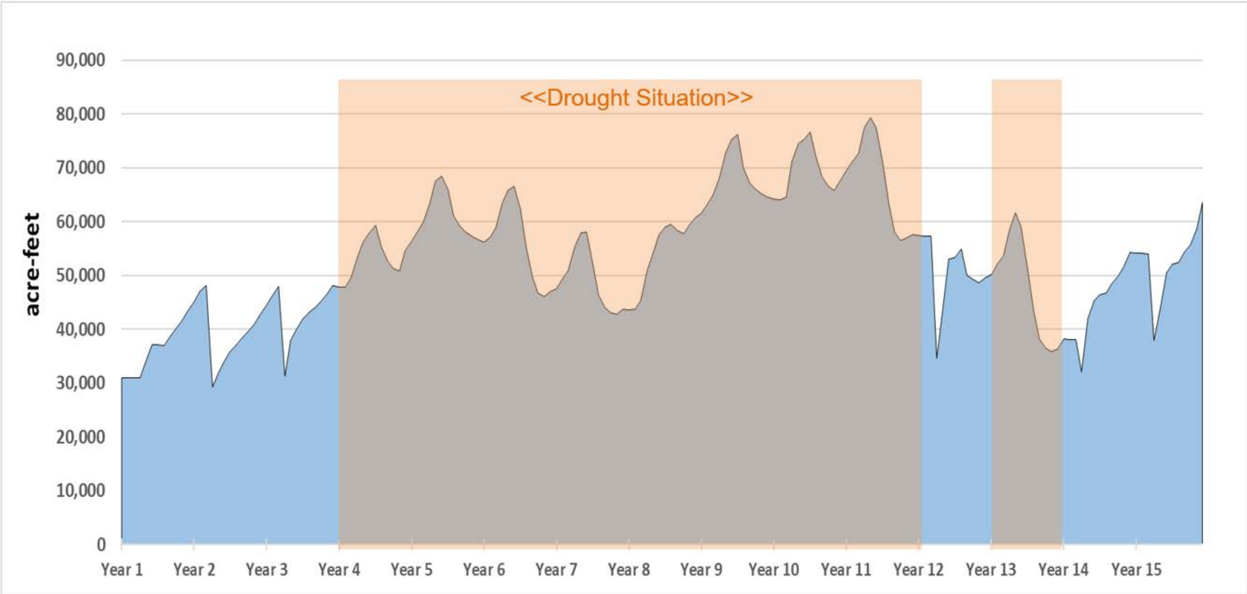

Figure 4-3 Estimated Drought Storage Accumulation Over 15-Year Study Period

3. *Inability to capture runoff when it is available* – Despite concerns that climate change would alter the timing of snowpack runoff, i.e., melt-off occurs earlier than it has historically, the model indicates sufficient runoff retention is possible while still complying with all requirements under TROA and Federal flood control requirements. This result is attributed to the fact that under Scenario 1 temperature increases are not enough to significantly alter the timing of snowpack melt beyond the current trend.

4. *Adequacy of groundwater supplies* – The model results show a reliance upon groundwater supplies to meet peak demands in every year of Scenario 1, especially during drought. However, the water rights available to TMWA and the overall capacity to withdraw groundwater are sufficient to manage through the drought modeled. These results indicate that TMWA's current groundwater rights are adequate to meet peak demands during a drought. However, prolonged use of production wells during drought means that continual maintenance and rehabilitation of groundwater infrastructure is a key component of drought resiliency. Furthermore, prioritizing capital improvement projects that increase overall well capacity is prudent to ensuring longevity of infrastructure under sustained pumping operations. Table 4-2 provides the DSS results on groundwater production over the study period.

5. *Inability to artificially recharge groundwater supplies* – The model indicates artificial recharge could take place in every year of the study period. While the results show recharge does not take place during months when either customer demands are high or surface water availability is limited (typically June through October), overall it indicates TMWA would have the potential to store an average of approximately 5,000 AF of treated surface water underground annually over the course of the study period. This result assumes adequate water rights are in place. Table 4-2 provides the DSS results on potential ASR recharge operations over the study period.

6. *Inefficient conservation policy* – Much of the resiliency to drought under this scenario can be attributed to the implementation of TROA (which more than doubles total drought reserves). In this model, the results show a 10% reduction in demand that is triggered during months when (1) a Drought Situation exists and (2) drought reserves are needed to avoid a shortage is sufficient to manage through this severe, multi-year drought. Moreover, conservation during a Drought Situation reduces the amount of groundwater and drought reserves required.

7. *Water demand hardening* – In general, per-capita water use has been declining over the past decade within the TMSA. This decline is due, in part, to TMWA's on-going conservation programs. While per-capita water usage has declined within the TMSA, the share from indoor water usage has remained relatively constant over time. This would suggest the likelihood for water demand hardening within the TMSA over the study period is low, i.e., there is still capacity by those that have already taken permanent conservation measures, such as turf removal or xeriscaping, to save through efficiencies gain indoors. Moreover, efficiency gains from water-saving technology are not likely to decline anytime soon, suggesting per-capita water usage could still be trending downward.

The scenario used in the DSS model indicate that TMWA has sufficient drought reserves to manage a 12-year drought. TROA allows TMWA to store additional resources in upstream reservoirs, which helps TMWA greatly in Drought Situation years. While TMWA recognizes that it has adequate resources to meet future demand under this model, it also acknowledges that there are other feasible scenarios, particularly further into the future, that could impact its water supply. As part of its 2020-2040 WRP, TMWA is analyzing additional climate change scenarios to further stress test its system.

4.4 Opportunities to Reduce Regional Drought Vulnerability

For the purposes of this DCP, drought strategies are defined in the following ways:

- **Drought mitigation measures** are actions, programs, and strategies implemented during non-drought periods to reduce potential drought-related impacts when a drought event occurs. TMWA's drought mitigation measures involve supply and distribution improvements such as: expanding or repairing existing assets, identifying new water resources, and constructing new facilities for additional storage or water treatment. Mitigation measures also include ongoing demand management programs. Drought mitigation measures are outlined in Section 5.

- **Drought response actions** are actions triggered during specific drought stages to manage limited or reduced water supplies and decrease the severity of immediate impacts to TMWA's drought reserves. TMWA's drought response actions are described in Section 6.

5 Drought Mitigation Measures

Contending with drought often means mitigating the risks of a drought *before* they occur. TMWA implements a variety of conservation programs designed to help its various customer classes manage demand, every year. It also has capital improvement projects that ensure water is stored and delivered efficiently to its customers. Supply-side programs consist of maintenance to the delivery system (i.e., proactive leak detection and system repair) and water supply enhancement (i.e., expanding storage capacity). TMWA's proactive approach to identifying and stopping leaks within its delivery system has been effective at reducing system losses. Moreover, TMWA's careful prioritization of system components that require upgrading is key to reducing the likelihood of leaks.

5.1 Ongoing Conservation Programs

5.1.1 Water Conservation Education and Outreach Program

TMWA has numerous educational initiatives designed to help customers learn the benefits of water conservation while providing tools, tips, and techniques to foster smart water use. These educational initiatives include:

- A free workshop and tour series. Workshops include irrigation start-up and maintenance, landscape planning and design, tree care and irrigation winterization. A list of all events can be found at tmwa.com/meeting/.
- A landscape planting guide designed specifically for the Truckee Meadows region This book is available in print or online at tmwa.com/landscape.
- A formal, one-week lesson plan on water conservation, targeting fifth grade students. This lesson plan contains information designed to show students how water is used in and around their home as well as where their water comes from. It also contains a homework box of water-saving devices that, with the help of their parents, students can install in their homes. Annual enrollment in the program is approximately 1,000 students.
- Partnerships with other public agencies and non-governmental organizations that provide water resource, water quality, and watershed protection activities to students.
- Participation in public presentations and events (speaking engagements, Earth Day festivals, school field trips and other community activities).
- Xeriscape, tree care, and smart-watering-tips information provided at all events.
- A YouTube channel containing how-to videos on fixing leaks and conducting water audits at home. Please visit https://www.youtube.com/channel/UCQA0ylEgBh1hu2Vl5pQkDkA to view the videos.
- A website with online resources regarding the programs listed above. Please visit https://tmwa.com/our-environment/water-conservation/ for more details.

TMWA engages in a year-round outreach campaign which strives to promote useful and seasonally-relevant information and programs to all customers. These communication channels include:

- Direct communication to customers via bill inserts, and e-newsletters.
- TV, radio, newspaper, and local magazine advertisements.
- Social media engagement including Facebook, Twitter, and Instagram.

5.1.2 Water-Efficiency Codes

TMWA's Rule 2 provides water-efficiency codes to which customers must adhere.[1] These codes have been effective at managing customer demands over time. As a condition of service, customers must not engage in any act which results in excessive use of water (i.e. no waste). The rule requires that customers follow an assigned, three-day-a-week irrigation schedule for lawns. Assigned-day watering helps prevent overwatering and reduces peak-day demand. Customers with even addresses may water Tuesday, Thursday, and Saturday and those with odd addresses may water Wednesday, Friday, and Sunday. No watering is allowed on Mondays to allow the distribution system to adequately recover. Additionally, lawn irrigation is not permitted between 12 p.m. and 6 p.m. from Memorial Day through Labor Day. Drip systems and hand watering are allowed anytime, so long as no waste occurs. Variances to water anytime will be granted annually for newly seeded lawns or newly laid sod, lawns in public parks, playground, athletic fields, common areas, and parkways (if done in a non-wasteful manner).

5.1.3 Water Pricing Structure

TMWA has an inverted, tiered-rate billing structure in which customers are charged increasing rates based on the amount of water they use. This billing structure provides a "price signal" to customers whose usage crosses into a higher tier, thereby encouraging efficient use of water. In 2015, TMWA's Board approved the conversion of all remaining flat-rate customers to a metered rate (applicable if a meter existed at the service location). At that time, TMWA also made an effort to install meters on all remaining unmetered services (when possible). Since that time, only a small number of flat-rate customers remain.

5.1.4 Water Usage Review (WUR) Program

The WUR Program assists TMWA customers with issues with their water meter or their water delivery system related to high consumption. When a WUR is requested, TMWA staff review the usage history of the service to determine water usage behavior. Then staff go onsite to check meter accuracy as well as detect potential leaks in the customer's system. If a leak is detected, staff provide the customer direction in identifying and fixing the leak. When completed, staff consult with the customer regarding their watering habits and note any leaks that were detected at the meter. Finally, they make recommendations on how to reduce water consumption and teach customers how to monitor for future leaks. On average, TMWA provides over 2,000 WURs annually and has conducted over 28,000 WURs since 2003.

[1] For more information, please refer to *https://tmwa.com/wpcontent/uploads/docs/Customer_Services/rules/Rule02_20120119.pdf.*

Table 5-1 Number of Water Usage Reviews Conducted (2015 – 2018)

Year	WURs conducted
2015	1,958
2016	2,025
2017	1,911
2018	2,410

5.1.5 Water Watcher Program

To monitor water-efficiency codes outlined in Rule 2, during the outdoor watering season TMWA hires seasonal staff and trains them regarding TMWA's water use rules and techniques for using water efficiently. Staff is tasked with monitoring the TMSA to ensure that customers are following watering restrictions. They also respond to water waste reports submitted by the public and provide customers with information about TMWA's water-efficiency codes and identify any observed leaks or sources of water waste. The rule also allows for a fee assessment for repeat offenders of TMWA's water-efficiency codes (from $25 up to $75). TMWA also distributes water-saving devices such as low-flow showerheads, automatic hose nozzles, and hose timers. Annually, staff has several thousands of interactions with the community. Table 5-2 provides the number of contacts water watching staff has made with customers regarding improving water efficiency, between 2015 and 2019.

Table 5-2 Number of Water Watcher Contacts Made (2015 – 2019)

Year	Water Watcher Contacts
2015	5573
2016	7496
2017	5821
2018	6053
2019	7025

5.1.6 Landscape Retrofit Fund

The Landscape Retrofit Fund provides financial support for approved local government projects that improve water efficiency. The fund supports landscape-augmentation projects which reduce water requirements and educational programs designed to inform about drought-tolerant landscaping (e.g. xeriscape) and conservation practices. Prior projects supported under this program include replacement of traditional turf grass with drought-tolerant vegetation/native vegetation, tree conservation via free arborist consultants to customers, and educational classes and workshops targeted toward smart landscaping, such as the WaterSense-approved Qualified Water Efficient Landscaper class.

Table 5-3 Qualified Water Efficient Landscaper Class Funding

Fiscal Year	Funding Level
2015	$77,586
2016	$154,187
2017	$34,350
2018	$52,714
2019	$55,033

5.1.7 Measuring Effectiveness

Since 2003, per-capita water usage has declined within the TMSA. Overall, water production has also declined in recent years. Between 2003 to 2018, daily per-capita water usage has dropped by 30%. Much of this reduction in customer demand can be attributed to the ongoing conservation initiatives outlined above. Figure 5-1 provides TMWA's population served and per-capita water usage between 2003 and 2019. Table 5-4 provides estimates of gallons saved annually as a result of TMWA's conservation programs.

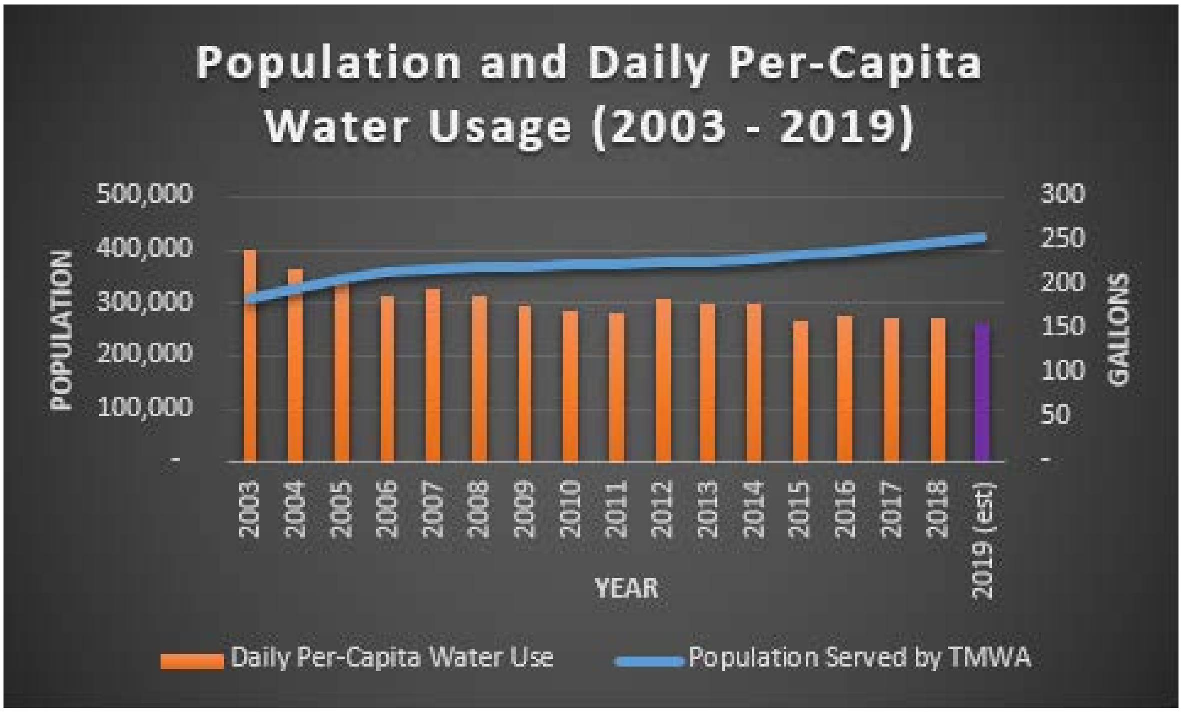

Figure 5-1 Per-Capita Water Usage Population Served (2003 – 2019)

Table 5-4 Conservation Programs Measures of Effectiveness

Conservation Program	Estimated Savings (gal/year)	Comments
Education and Outreach Program	2,850,759	This estimate is based on the 5th grade Water Smart Education program only (see appendix A for details). Additional savings as a result of the program are not quantifiable.
Water-Efficiency Codes	-	Savings as a result of this program are unknown at this time.
Water Pricing Structure	-	Savings as a result of this program are unknown at this time.
Water Usage Reviews	35,632,800	This estimate on analysis performed water usage data on customers before and after a WUR was performed.
Water Watchers Program	-	Savings as a result of this program are unknown at this time.
Landscape Retrofit Fund	3,834,000	This estimate is based on water usage data before and after implementation of retrofit projects funded under this grant.

5.2 Potential Future Drought Mitigation Projects

Capital improvement projects are a central component of TMWA's drought mitigation strategy. These projects can be made to improve surface and groundwater supplies, improve the water distribution and storage systems as well as administrative outlays. Table 5-5 provides a list of potential future projects TMWA can implement to mitigate drought. Projects identified either create new supply, increase capacity, increase reliability during a drought, or reduce risk of water loss. More information on these projects can be found in TMWA's Capital Improvement Plan (CIP).

5.2.1 Groundwater Supply Improvement

New Well Development

Because of the merger with South Truckee Meadows General Improvement District (STMGID) and Washoe County Department of Water Resources (WDWR) in 2015 and the acquisition of West Reno Water Company in 2019, TMWA has expanded its groundwater well count to 89 active production wells in 9 hydrographic basins. TMWA plans to increase well capacity from its current capacity of approximately 63 MGD to 77 MGD over the next 20 years, primarily to meet peak demands. It is highly likely that development of new groundwater sources will require treatment facilities as TMWA expands its well network into areas of poorer water quality.

TMWA replaces existing wells when declines in efficiency and/or a wells physical condition necessitate new well construction. When a well is replaced, the new well is often drilled in proximity to or on the same parcel as the existing well. In areas where there are no existing wells, exploratory drilling programs will be implemented to characterize the groundwater capacity and quality. If results of these future exploratory drills prove favorable, the site may be developed for full-scale production well drilling.

Existing Well Retrofit

TMWA has been expanding its existing ASR program by equipping existing wells for recharge. Over the last several years, TMWA has been retrofitting wells in Spanish Springs, South Truckee Meadows, and Pleasant Valley to increase ASR capacity. In Spanish Springs, Desert Springs Wells 1 and 2 have recently been equipped for ASR. In the South Truckee Meadows and Pleasant Valley, Arrowcreek 2, Tessa East Well, and STGMID 11 have been equipped for ASR. TMWA plans to continue expansion of its retrofit program to additional well sites in the coming years.

Advanced Purified Reclaimed Water

Reclaimed water is derived through the process of treating wastewater, or effluent, into water suitable for use for other purposes. Reclaimed water has been used for irrigation throughout the Truckee Meadows for years. One of the local benefits of the use of reclaimed water is that it conserves potable water and provides a reliable, drought-resistant water source, even in times of restriction and conservation. In 2016, Nevada adopted new regulations to permit the use of "Category A+" reclaimed water, or advanced purified water, for groundwater augmentation. These new regulations have the potential to provide many benefits for the Truckee Meadows region. TMWA is a key partner in OneWater Nevada. The goal of OneWater Nevada is to evaluate treatment technologies and to determine if advanced purified water can offer long-range regional benefits and opportunities to the Truckee Meadows' water portfolio. While new to the Truckee Meadows, advanced purified water has been used to replenish underground aquifers and surface water reservoirs throughout the United States for over 40 years.

OneWater Nevada is assessing the feasibility of multiple field-scale advanced water treatment demonstration projects. The feasibility study will occur over 2-3 years and consists of technical, social, environmental, and financial analyses; regulatory compliance; public engagement; advanced treatment pilot testing; geotechnical investigations; and field-scale treatment demonstration projects. UNR is leading the treatment technology demonstrations with multiple demonstration trailers that will be equipped with advanced water purification treatment technology including filtration, ozonation with biologically activated carbon, ultraviolet light (UV) and advanced oxidation process, and granular activated carbon. These treatment trailers, most recently located at the Reno-Stead Water Reclamation Facility and previously at the South Truckee Meadows Water Reclamation Facility, will be operated as a technology demonstration project with each demonstration project envisioned to operate for 9-12 months. Following treatment, about 14 GPM of purified water will be injected in and recovered from a controlled, test-site aquifer to confirm that the water quality meets all potable requirements.

IPR is a process whereby highly purified water is stored in an environmental buffer such as a lake or aquifer before eventually re-entering the drinking water supply. Conceptually, an IPR project might be well suited for areas such as the North Valleys or the South Truckee Meadows, since the water reclamation facilities for these areas do not return the treated water to the Truckee River. Purified water could be recharged using infiltration basins or injection wells in areas generally isolated from domestic wells and blended with ambient groundwater. Months or years later, the stored water would be recovered using TMWA's municipal wells, providing "banked water" for future use. TMWA is exploring two potential areas where the hydrogeology may be favorable to create a water bank. Two possible water banking projects are Bedell Flat and American Flat, which are discussed below.

Bedell Flat

As part of TMWA's overall conjunctive use management strategy, TMWA is working with the City of Reno, Washoe County, and the USGS to evaluate the feasibility of an integrated ASR program in Bedell Flat. Bedell Flat is located about 13 miles north of Stead and was identified in a previous analysis performed by the City of Reno in 2007 as having potentially favorable geologic conditions for storage of advanced purified water.

Bedell Flat is a relatively small (53 square miles), undeveloped hydrographic basin comprised of federal lands administered by the Bureau of Land Management. Depths to water range from less than 5 feet in the northwest, where surface drainage exits the basin, to at least 180 feet near the middle of the basin. Additionally, geologic materials appear favorable and nearly impermeable playa sediments are notably absent.

Several water resource ASR options are under consideration within Bedell Flat. These options include: injection of potable water using ASR wells off the existing North Valleys Importation Project pipeline; infiltration of advanced purified water along a natural drainage referred to as Bird Spring Wash; infiltration of advanced purified water through a proposed engineered infiltration gallery, also known as a spreading basin or rapid infiltration basin; or a combination of these. Hydrogeologic investigations and environmental clearance and permitting work are underway to gain an understanding of the feasibility, scope, and cost of a water banking program in Bedell Flat.

American Flat

Similar to the Bedell Flat project, TMWA is actively working on an ASR feasibility study at the north end of west Lemmon Valley. The purpose of the study is to characterize aquifer storage potential through localized field testing, data acquisition, and groundwater modeling. Specific activities completed as part of the characterization efforts include geophysical surveying, well siting and drilling, small-scale pump/injection testing, and groundwater flow and transport modeling. Preliminary results of the study indicate the site may be favorable for storage, transmission, and recovery of water. TMWA will continue to collect pertinent information to determine if a full-scale ASR program can be implemented and sustained at the site. Should the site be deemed suitable for full-scale ASR program implementation, it will enhance TMWA's ability to safely store, recover, and distribute an alternative water resource that could be utilized in the region.

5.2.2 Treatment Plant Improvements

Longley Lane Water Treatment Plant

With a capacity of approximately 4 MGD, TMWA's Longley Lane WTP is not currently in use for water treatment; however, it is used as a booster pump station serving the Hidden Valley area. TMWA recently completed a preliminary design report which defines necessary improvements to allow Hidden Valley Wells 3 and 4 to be brought back online. These improvements consist of UV treatment at Hidden Valley 4 for pathogen inactivation and blending with Hidden Valley Well 3 to reduce arsenic concentrations to acceptable levels. In the future, when needed for either drought protection TMWA plans to modify the Longley Lane WTP with magnesium dioxide pressure filters to remove iron and manganese from the WTP well and a future well to meet TMWA's drinking water quality goals.

Mt. Rose Water Treatment Plant

Creeks throughout the south Truckee Meadows represent a valuable resource that TMWA can use to increase off-river reliability of its water supply. TMWA will be diverting Whites Creek water to the Mt. Rose WTP, being completed in 2020, to decrease reliance on groundwater in that area. The Mt. Rose WTP will be a relatively small surface water treatment plant that will produce up to 4 MGD when sufficient creek flows are available. Due to historic pumping in that area, groundwater levels had been declining. The Mt. Rose WTP will be used to provide treated water for ASR and will also allow for passive recharge of the aquifer by allowing production wells to rest when Whites Creek water is available to serve customers.

Sparks Groundwater Treatment Plant

TMWA has four production wells and two additional potential well sites in Sparks that have not been used due to water quality issues, including elevated levels of arsenic, iron, and manganese. These wells are not currently equipped but will be needed in the future to provide additional peaking capacity to serve future growth and to enhance TMWA's ability to provide reliable service during drought or emergency conditions affecting the Truckee River. Water from these wells will be treated in the proposed Sparks Groundwater Treatment Facility (GWTF), located along East I Street and East Prater Way. The Sparks GWTF will be designed with magnesium dioxide pressure filters to remove arsenic, iron, and manganese to meet federal and state drinking water quality standards. As described in TMWA's 2015-2035 Water Facility Plan, the Sparks GWTF is scheduled to be built in two phases beginning around 2030. Phase 1 will produce up to 7.6 MGD and Phase 2 will add another 4.3 MGD of treated water production capacity.

5.2.3 Distribution Supply Improvements

TMWA continually improves the existing distribution infrastructure to reduce the risk of water loss, increase capacity and increase reliability of water deliver during a drought. System improvements for drought mitigation include replacement of street and highway water mains, galvanized and poly service lines, as well as, old meter pits. Additional improvements to a booster pump station is also planned in the near future. The project will provide a supplemental source to the Mt. Rose WTP that will back up plant production on the maximum day during drought and will also provide another source of supply for implementing conjunctive use in the area.

5.2.4 Administrative Outlays

Automated Metering Infrastructure

TMWA will be implementing automated meter infrastructure across its entire service territory. This multi-year project will help customers manage their demand by providing them leak alert notifications as well as more hourly data on water usage.

Administrative Changes to Upstream Surface Storage Operations
In 2019, TMWA was awarded a grant by the BOR that proposed an adjustment to wintertime reservoir flood storage limits, modifications to existing flood control rule curves and a revision to downstream flow thresholds as a response to climate-change induced risk in the Truckee Basin. This would also require a complete revision to the Army Corps of Engineers' Water Control Manual. Using the latest forecasting technology available would allow for a more adaptive approach to reservoir management which would lead to reduced risks of wintertime flooding on the Truckee and enhanced upstream water supplies.

5.2.5 Measuring Effectiveness

TMWA's CIP ensures its infrastructure is maintained on a regular basis. TMWA also complies with system pressure regulations set forth under Nevada Administrative Code (NAC) 445a.[2] Water balance studies conducted annually estimate TMWA's unaccounted-for water (i.e. non-revenue water) is 6-8%, which is well below the national average of 16% (EPA 2013) [i]. These drought mitigation measures equate to a saving of approximately 2,541,641,130 gallons annually.

[2] NAC 445a states "The zones of pressure of a distribution system must be designed in such a manner that the static pressure at the lowest ground elevation of the zone does not exceed 100 psi. If a zone of pressure may potentially exceed that pressure, the head in the zone must be controlled by the installation of a pressure regulator downstream from the service connection for each user of water in the zone" (NAC 445A.6711).

Table 5-5 Potential Future Projects

Project Type	Description	Reduction in Drought Vulnerability	Implementation Period (FY)	Total Cost	Priority*
Groundwater Water Supply Improvements	Indirect Potable Reuse feasibility study	New supply	2020-2024	$1,000k	2
Groundwater Water Supply Improvements	Double Diamond #5 Equipping & Blending Main	Increase capacity	2020,2021,2023,2024	$1,700k	1
Groundwater Water Supply Improvements	Campello Capacity Increase	Increase capacity	2020	$70k	1
Groundwater Water Supply Improvements	Callamont Well South Equipping	Increase capacity	2022,2023	$1,200k	2
Groundwater Water Supply Improvements	Bedell Flat Water Bank	New supply	2020-2024	$2,000k	3
Groundwater Water Supply Improvements	Lemmon Valley Well #8 Replacement	Increase capacity	2024	$1,000k	2
Groundwater Water Supply Improvements	Spring Creek Well #7 Recharge	New supply	2020	$425k	1
Groundwater Water Supply Improvements	Spring Creek Well #8 - Donovan	New supply	2022-2024	$2,000k	2
Treatment Plant Improvements	Longley Treatment Plant Improvements	New supply	2020-2021	$1,340k	2
Treatment Plant Improvements	Mount Rose Surface Water Treatment Plant	New supply	2020-2021	$13,000k	1
Treatment Plant Improvements	Glendale Diversion Emergency Flood Repairs (FEMA)	Increase capacity	2020	$1,600k	1
Distribution System Improvements	STMGID Tank #4 BPS / Transmission Line	Increase capacity	2020-2022	$3,000k	1
Distribution System Improvements	Gear, Vine, Washington Main Replacement	Reduce water loss	2020	$2,000k	1
Distribution System Improvements	Booth, Sharon Way, Monroe 24" Main Replacements	Increase capacity	2020-2023	$5,200k	1
Distribution System Improvements	Spanish Springs Main Replacement	Reduce water loss	2020	$1,200k	2
Distribution System Improvements	Stead Golf Course Main Replacement	Reduce water loss	2023	$2,470k	2
Distribution System Improvements	Boomtown to TMWA Connection	Increase reliability	2020-2021	$1,930k	1

Distribution System Improvements	STMGID Conjunctive Use Facilities	Increase reliability	2020-2022	$2,100k	1
Distribution System Improvements	Meter Pit Replacements	Reduce water loss	2020-2024	$725k	1
Distribution System Improvements	Service Line Replacements	Reduce water loss	2020-2024	$1,250k	2
Customer Service Outlays	Automated Meter Infrastructure	Increase supply	2020-2024	$10,150k	1

*Priority 1 indicates mandatory spending, projects in progress, or regulatory; Priority 2 indicates necessary spending; Priority 3 indicates contingent spending.

6 Drought Response Actions

Based on the Drought Situation thresholds identified in 3.3.1, drought response actions are actions TMWA can take to either bring awareness to drought conditions within its service area, and in extreme cases or severity, promote short-term reduction in demands to limit drought supplies necessary to meet those demands.

6.1.1 Drought Response Triggers

When a Drought Situation is determined, additional conservation measures may be needed. If drought reserves are not needed prior to Labor Day, the severity of the drought is so minimal that no additional response actions are needed. If drought reserves are needed before Labor Day, response actions are taken in the form of enhancing existing programs, and in extreme cases temporary water curtailment can be requested. Table 6-1 provides a schedule for enhanced conservation implementation, given corresponding triggers of drought reserve usage.

Table 6-1 Drought Response Gant Chart

	Outdoor Watering Months					
Level of Severity	**May**	**June**	**July**	**August**	**September**	**October**
	Drought reserves are not needed **before** Labor Day					
Level 1	Standard Conservation					
	Drought reserves are needed **before** Labor Day					
Level 2				Drought Reserves Needed		
	Standard Conservation		Enhanced Conservation			Standard Conservation
Level 3			Drought Reserves Needed			
	Standard Conservation	Enhanced Conservation				Standard Conservation
Level 4		Drought Reserves Needed				
	Enhanced Conservation					Standard Conservation

6.1.2 Enhanced Conservation Implementation

When a Drought Situation is identified, depending on the severity TMWA can enhance its existing conservation programs to help bring awareness to the drought. In some cases of extreme severity, TMWA can request temporary cutbacks in water usage by its customers. These enhanced actions are prioritized based on when Floriston Rates are lost, the amount of drought reserves available and estimated customer demands.

Table 6-2 Conservation Actions and Drought Situation Severity

CONSERVATION INITIATIVE	DROUGHT SITUATION LEVEL OF SEVERITY	
	Level 1	**Level 2 - 4**
Communication and Outreach Campaign	Standard campaign	Enhanced campaign
Water Efficiency Codes	Time-of-day watering: 12a.m. to 6p.m.	Time-of-day watering: 11a.m. to 7p.m.
Water Watcher Programs	Standard staffing level	Increase staffing level
Water Usage Review Program	Standard staffing level	Standard staffing level
Landscape Retrofit Fund	Standard funding level	Standard funding level
Temporary Cutback*	No cutback request	Temporary cutbacks may be requested
Water Pricing Structure**	Standard pricing structure	Drought rates or increased fines may be implemented

*The exact amount of curtailment requested is determined based on projected demand levels, drought storage availability and estimated surface and groundwater available.

**While historically this measure has never been used in the Truckee Meadows, increasing the price of water during a drought has been an effective measure used by other water purveyors.

6.1.3 Measuring Effectiveness

Effectiveness in TMWA's drought response is measured by analysis of water demand during prior droughts. In April of 2015, due to the worst snowpack on record, Floriston Rates were projected to not be met by June of that year, indicating a drought severity level 4. In response, TMWA began enhanced conservation in May of that year. A broad outreach campaign was launched notifying the public of the drought conditions and customers were asked to reduce their water use in the coming months. TMWA's enhanced conservation during 2015 included:

- A request to customers to reduce their use by at least 10% (compared to their 2013 usage).
- Additional advertising on all media outlets throughout the watering season to heighten awareness of the drought.
- Creation of a webpage dedicated to conservation (tmwa.com/save).
- Increased staffing of the seasonal Water Watcher program.
- Increased visibility in the community via vinyl wraps on conservation vehicles.
- Providing restaurants with table tents stating water was served upon request.
- Providing stickers in commercial restrooms reminding people to save 10%.
- Increased media interviews.
- Sending letters to HOAs requesting they not penalize residents who let their lawns turn brown during the drought.

Analysis of retail water sales between 2013 and 2015 indicates that the enhanced conservation campaign was successful. Table 6-3 compares the average retail water sales for the months of June through September, between 2013 and 2015. The results show all customer classes were able to achieve some level of reduction in summertime water consumption. On average, customers reduced their use from 9% to 16%, compared to their 2013 usage during the summer months.

Table 6-3 Average Monthly Retail Water Sales Comparison through September 2013 and 2015

	2013 USE (x1000 gal)		2015 USE (x1000 gal)		PERCENT CHANGE	
Customer Class	**Median**	**Mean**	**Median**	**Mean**	**Median**	**Mean**
Residential	78	89	61	70	-19.70	-16.40
Commercial	92	423	71	368	-10.00	-8.70
Irrigation	437	853	350	681	-18.00	-15.10

Note: This study included only water services with 2013 & 2015 usage data.

The severity of the 2015 drought provided a stress test of TMWA's ability to respond to the lowest snowpack year on record. The analysis conducted after the fact indicates the level of effectiveness of TMWA's enhanced conservation measures. The results show water demands were markedly lowered over the course of the summer without asking customers to make significant changes in watering behaviors.

7 Operational and Administrative Framework

TMWA is tasked with the role of being the primary water purveyor within the TMSA. Its operational and administrative framework is set by institutional and legal directives including the Joint Powers Agreement and TROA. TMWA is responsible for drought monitoring, implementing mitigation and response actions, and updating its WRP every five years (per NRS 540.131).

7.1 Operational Considerations

As discussed in Section 2, the Truckee River is operated under TROA. All actions and measures taken by TMWA are in accordance with the rules and regulations set forth in that agreement.

7.2 Administrative Considerations

TMWA is a joint powers authority formed in November 2000, pursuant to a Cooperative Agreement (as amended and restated as of February 3, 2010, among the City of Reno, the City of Sparks and Washoe County, Nevada.

7.3 Initiating Drought Mitigation Actions

As outlined in Section 5, capital improvement projects are an important part of TMWA's drought mitigation strategy. Guidance for identifying and scheduling projects in the CIP is provided by TMWA's Water Facility Plan (WFP) and WRP. TMWA updates its CIP annually and its WFP and WRP every five years. Guidance for project implementation is set forth in a priority ranking. This ranking can be found within Table 5-5.

7.3.1 Key Steps

Implementation of drought mitigation projects first involves the design and permitting process. Funding is main consideration when planning and prioritizing drought mitigation projects. As stated earlier, TMWA has a 5-year funding plan that feeds into the CIP. This DCP outlines the sources of funding and projected revenue needed to complete all future projects. If needed, any environmental documentation or approval as well as inter-agency agreements are completed before construction can begin. For certain projects, such as the Mt. Rose WTP or ASR expansion, water rights must be considered. Water rights are discussed in the next section. In some cases, water rights transfers are required, or new rights are acquired. Once secured, water rights permitting is conducted for new projects. In some cases, public outreach is done to gather public comment or notify affected customers about a project's scope and duration of construction. Finally, construction can begin, and once completed the project moves into the operational phase.

7.3.2 Water Rights

TMWA's water rights portfolio contains a mix of Truckee River, creek water, and groundwater resources. Water from the Truckee River makes up most of the water supply for the Truckee Meadows. With the implementation of TROA, TMWA has more flexibility to store additional water in upstream reservoirs to be released as needed. Through conjunctive use, TMWA maximizes the use of surface water in wet years, thereby reserving groundwater capacity for high demand periods. In dry years, TMWA can utilize a combination of groundwater and drought reserves when surface water flows are reduced. While TMWA maximizes its existing resources, it will continue to evaluate additional, viable resources to ensure that the region has a resilient and sustainable water supply to meet increased future demands expected for the Truckee Meadows. Conjunctive use operations of TMWA's resources include the utilization of normal mainstem surface water flows, upstream storage, and groundwater pumping. TMWA provides water for municipal use throughout the Truckee Meadows, in addition to using water for ASR to improve aquifer water levels.

TMWA has acquired and converted to municipal use approximately 79,000 AFA of irrigation rights to meet the wholesale and retail will-serve commitments of its customers. These transferred irrigation rights are used in conjunction with TMWA's other groundwater and storage rights to create its water supply.

7.3.3 Funding

All drought mitigation programs and projects rely on various funding sources. The majority comes from revenues generated from water sales, hydroelectric, and other operating sales. In certain cases, developer contributions are used for certain construction projects for expanded water system capacity. Investment income is also available to augment other revenue sources but is minor in relation to other funding sources. TMWA may rely on the issuance of new debt to fund large levels of capital spending in a particular period. Currently, capital improvement projects outlined in this report likely will not require funding from new debt at this time.

7.4 Initiating Drought Response Actions

7.4.1 Key Steps

1. Drought Situation and severity level are determined based on when reserves will likely be needed. Drought Situations are declared by the US Water Master by April 15 of each year.
2. Drought response actions are implemented by TMWA. All actions are evaluated internally with staff and prioritized to determine appropriate level of response.
    a. E.g. Increased conservation staffing, more media advertisement, the need to request temporary cutbacks, etc.
3. Response plan is brought to the TMWA Board of Directors (Board) for direction on an as-needed basis.
4. Response plan is implemented starting with communication outreach to customers and key stakeholders 1 month prior to reserves being needed.
5. Ongoing analysis of supply, demand and use of drought reserves during the drought.
6. Post-drought analysis to determine level of response by customers and projection of drought reserves should the drought continue.

7.4.2 Reporting

Each month during the drought, the Board will be provided a water supply update as an agenda item during the board meeting. They will also be provided an overview of the communication campaign as an attachment to the General Manager's report as requested.

7.4.3 Emergency Response

Natural disasters and other unforeseen events can interrupt TMWA's available water supplies. These include floods, extreme low precipitation years, earthquakes, equipment failure, or distribution system leaks. Sometimes the events are localized within the distribution system and sometimes the whole community can be affected in which cases the government can declare a state of emergency. Under such cases, TMWA's goal is to minimize service disruptions and, when necessary, the community is asked for, and has responded favorably to, enhanced conservation messages and calls for water use reductions and restrictions. Some of the enhanced conservation measures used during a state of emergency include mandatory water conservation (i.e., once-per-week or no outside watering during summer months, reduced laundry at commercial properties, use of paper plates in restaurants, no use of potable water for non-potable purposes, heavy fines for water wasters, temporary drought rates, etc.).

TMWA's personnel train for management operations under various emergency situations. This training has proven successful as water supply interruptions have been mitigated as swiftly and efficiently as possible such as the April 2008 earthquake in Mogul which destroyed the Highland Flume thereby precluding gravity-fed delivery of water to the Chalk Bluff WTP. TMWA mitigated the incident by 1) turning on its Orr Ditch Pump Station and installed temporary pumps to feed Chalk Bluff, 2) turning on its Glendale WTP, 3) turning on its wells as needed for irrigation demands, and 4) installing temporary piping around the Highland Flume failure to deliver more water to Chalk Bluff. These actions avoided any water supply interruptions for TMWA customers.

Increased conservation by TMWA customers during emergencies is just one element of successfully managing water supply interruptions.

8 Update Process

8.1 Drought Monitoring

As stated in Section 6, TMWA is tasked with the role of monitoring for drought within the TMSA using data for the NRCS and USGS. The US Water Master is responsible for declaring a Drought Situation as defined under TROA. This process of data collection, surface water modeling and drought assessment occurs in the springtime, each year, prior to April 1.

8.2 Drought Mitigation Actions

TMWA has the role of implementing all drought mitigation projects either internally or through contractors. Once approved for construction and funding requirements have been met, CIP projects are scheduled for implementation. Pre-construction meetings are held as needed to discuss daily operations. Updates on CIP projects are provided internally to management via monthly meetings. TMWA staff also engages in quarterly operations and engineering meetings to discuss project timelines. Key project updates are provided to TMWA's Standing Advisory Committee (SAC) and the Board a couple times each year.

TMWA has the role of implementing most of the ongoing conservation efforts with the exception of programs under the Landscape Retrofit Fund. That program provides assistance via a financial agreement to other local governments to carry out proposals approved under the Landscape Retrofit Fund. Ongoing conservation efforts such as the Water Watcher Program, Water Usage Review Program and select programs under the Landscape Retrofit Fund are tracked and reported on, monthly. This monthly report is provided to all TMWA staff, the TMWA Board and is available to the public online via the General Manager's report. Ongoing conservation actions are monitored, analyzed and evaluated on an annual basis. Conservation actions are updated and modified on an as-needed basis depending on their overall effectiveness and ability to meet the goals of TMWA.

8.3 Drought Response Actions

TMWA has the role of implementing drought response actions when a Drought Situation level 2-4 is determined by the US Water Master. Response actions are evaluated and prioritized based on the level of severity of the drought. At the end of each year of a Drought Situation, customers' response to TMWA's enhanced conservation is evaluated by comparing water usage to previous average years' demand levels. Actions are updated and modified as needed based on this analysis.

8.4 Update of DCP

The DCP will be updated in tandem with TMWA's WRP, which is updated every five years. In years 2-4 conservation policies are evaluated for effectiveness, potential drought mitigation projects are identified and prioritized. Response actions that occurred during any Drought Situation are evaluated for effectiveness. In year 4-5 the DCP is updated and put through the approval process. Figure 8-1 provides TMWA's process for implementing, evaluating, and updating the DCP. Any new local, state or federal conservation initiatives are considered when drafting a new DCP. Stakeholder engagement is conducted included presenting the draft DCP to the Board and SAC as well as the general public via open houses and online postings. All comments are welcome before the final draft is presented to the Board for approval.

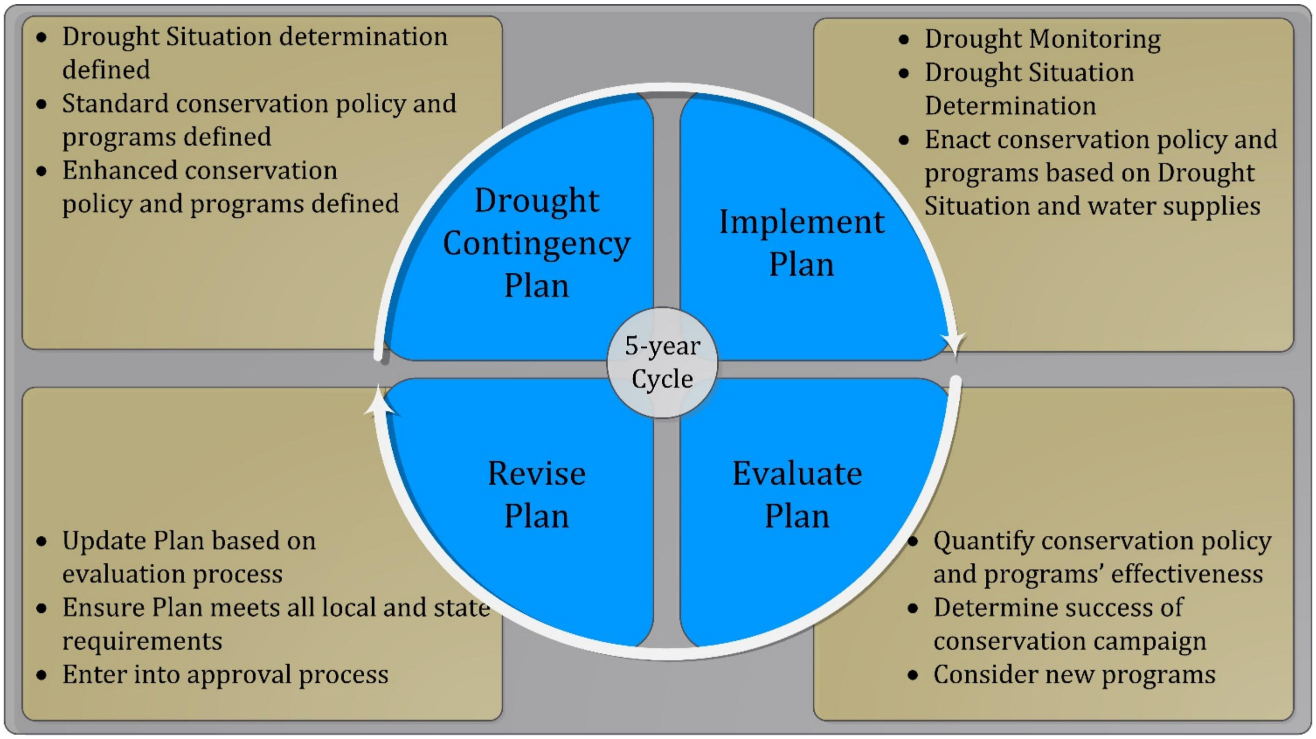

Figure 8-1 Drought Contingency Planning Lifecycle

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10 Appendix A: Dynamic Decision Support System: Technical Reporting