2021–2022 MARIN COUNTY CIVIL GRAND JURY

A ROADMAP TO WATER RESILIENCE FOR MARIN MUNICIPAL WATER DISTRICT

June 13, 2022

SUMMARY

For most of 2021, people living within the Marin Municipal Water District (MMWD) anxiously faced the prospect of the District literally running out of water.[1] Luckily, the worst-case scenarios did not materialize, thanks to unexpected and historic amounts of rainfall in late 2021. But the drought has not ended. Nor has the likelihood of future droughts, which experts agree will be more frequent and severe as greenhouse gasses continue to heat our climate.

Last year's drought emergency could have been avoided, if MMWD had taken sufficient measures to provide for a resilient water supply. With the mounting challenges posed by climate change, the mistakes of the past cannot be repeated. MMWD must establish a roadmap for achieving water supply resilience without delay. In this report, the Grand Jury addresses the reasons why a roadmap is necessary, the options for achieving water supply resilience, and the financial commitments needed to secure resilience. This report also discusses the importance of prioritizing drought-proof water supplies, which are less vulnerable to the statewide competition for water that the future may hold. Finally, it addresses the likely financial commitments and rate increases necessary to fund resilience measures.

As an initial step, the Grand Jury calls upon MMWD to commit to securing a four-year supply of water, amounting to an additional 10,000 to 15,000 acre feet per year. If MMWD is able to publicly share its position regarding this commitment in the near term, it would enable public debate and discussion on this critical issue in advance of upcoming District elections in November 2022.

Adoption of a roadmap to resilience will require more time. As this report reflects, there are a number of water supply options that deserve serious consideration. These include such near term options as increasing imports from Sonoma County or the Central Valley, as well as longer-term options that emphasize drought-proof supplies from water recycling and desalination. MMWD is due to receive a Water Resilience Assessment by July 2022, which will presumably address these and perhaps other resilience options. But while studies are necessary, they are not sufficient. MMWD should commit to a transparent process for evaluating credible water supply options, and a timeline for producing an actionable roadmap.

The time has come for MMWD to take action and ensure that the District has a sound plan to secure adequate water supplies in the face of an uncertain future.

[1] In 2020, Marin Municipal Water District adopted the new name "Marin Water." This report will use the more commonly known "Marin Municipal Water District" or "MMWD."

APPROACH

Over 12 months, the Marin County Civil Grand Jury reviewed official documents, attended public meetings, conducted detailed interviews, on-site inspections, and reviewed secondary sources.

The jury read dozens of MMWD documents, including the 2020 Urban Water Management Plan, the Water Resources Plan 2040, the 10-year Financial Plan, and District agreements with the Sonoma County Water Agency. Documents addressing climate change were also reviewed. Jurors attended MMWD public meetings and workshops in person, virtually, and through recordings. The research included inspections of district facilities and systems. Jurors visited other water districts and sanitation facilities to understand best practices that might apply to the operation of MMWD. Numerous water experts and leaders were interviewed.

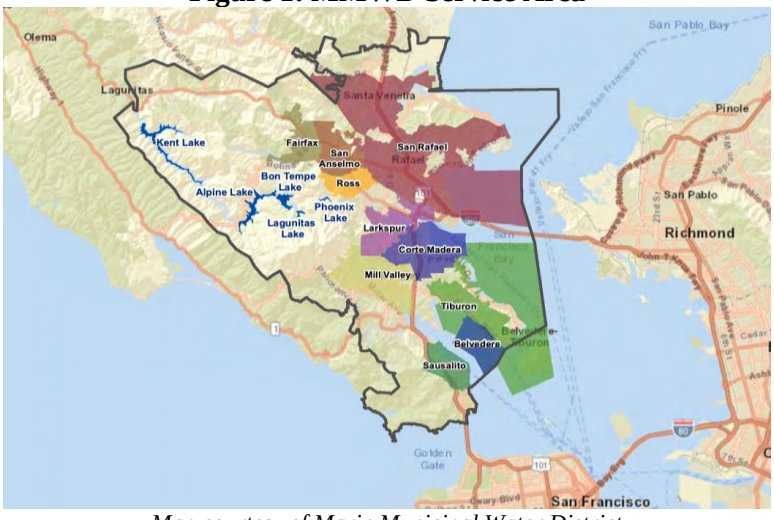
The jury also studied local, state, and national news reports, opinion pieces, and reader letters on water supply, drought, climate change, conservation, water recycling and reuse, desalination, aquifers, and more. The findings and recommendations herein are based on this work.

BACKGROUND

Except in a few circumstances of extreme drought in the past, MMWD has successfully supplied water to most of Marin County since it was established as California's first municipal water district in 1912. Successive drought years from 2019 to 2021 exposed MMWD to the risk of running out of water in 2022. This prompted the Marin Civil Grand Jury to investigate the reliability and resiliency of MMWD's water supply as well as the District's financial ability to potentially expand and diversify its water portfolio. MMWD serves some 191,000 users through more than 61,000 connections in an approximately 147 square mile area stretching from below the Novato city limits to the San Francisco Bay on the east and south and through San Geronimo Valley on the west.

The District includes the cities and towns of Belvedere, Corte Madera, Fairfax, Larkspur, Mill Valley, Ross, San Anselmo, San Rafael, Sausalito, and Tiburon. MMWD is bordered on the north by the North Marin Water District and in West Marin by smaller water agencies serving various coastal communities.

Figure 1: MMWD Service Area



Map courtesy of Marin Municipal Water District

MMWD's Water Sources

MMWD annually relies on local rainfall for about 20,000 acre feet (AF) or 75 percent of its consumed water.[2] Rainfall is collected from a 64-square-mile watershed and stored in seven reservoirs, including Lagunitas, Bon Tempe, Alpine, Kent, and Phoenix lakes on the slopes of Mount Tamalpais as well as Nicasio and Soulajule reservoirs in West Marin north of the district's service area. Together, these reservoirs can hold up to 79,566 AF or about 25.9 billion gallons of water.

Under contracts initiated in 1976, MMWD imports about 25 percent of its water from the Sonoma County Water Agency (SCWA), which collects and stores water from the Russian River in Lake Mendocino and from Dry Creek in Lake Sonoma. MMWD also gets about 750 AF of recycled non-potable wastewater annually from the Las Gallinas Valley Sanitary District for landscape irrigation, cleaning, cooling systems, and other purposes. MMWD does not collect or distribute recycled water from any of the other sanitary plants in Marin County.

Historical Water Storage Expansions

Over the years, MMWD has enhanced its storage capacity, which is still only enough to satisfy historical customer water demand and required environmental demands for a little more than two years. MMWD's customers currently consume about 25,500 AF of water per year. The District built reservoirs at Lagunitas Lake in 1873, Phoenix Lake in 1905, Alpine Lake in 1918, Bon Tempe Lake in 1948, Kent Lake in 1953, and Lake Nicasio in 1960. The District added Soulajule Reservoir in 1980 using bond money approved in response to the severe 1976-77 drought. MMWD completed its last storage expansion project in 1982 when it doubled the capacity of Kent Lake by raising Peters Dam 45 feet.

Rainfall Trends

The District's water supply depends almost exclusively on rainfall in the California coastal range extending from Marin County northward into the watershed drained by the Russian and Eel rivers. Average annual rainfall across this extended watershed is 47 inches, with most falling from October through April. MMWD's watershed typically gets more rainfall than the rest of this area.

Average annual rainfall within the MMWD service area is 52 inches, according to measurements taken since the 1879-80 rainy season at Lake Lagunitas. In 142 years of record keeping, MMWD's annual rainfall has ranged from 19 inches in 1925-26 to 112 inches in 1889-90. Except for 1925-26, 2020-21 was the driest year in MMWD's rainfall records with just 20.4 inches of rain. While MMWD's draft 2020 Urban Water Management Plan observes that "annual rainfall is unpredictable," the second half of that measuring period has been dryer than the first.

Past Grand Jury Reports on MMWD's Water Resilience

Water resilience is not a new issue for MMWD or the Marin County Civil Grand Jury. The 2004-05 Grand Jury issued a report recommending stepped up conservation programs with a goal of reducing water use by 10 percent.[3] That report also called for the development and publication of

[2] An acre foot is the volume of water to cover one acre one foot deep, or approximately 325,850 gallons. An acre foot of water will meet the total annual need of 2-3 households.

[3] Marin County Civil Grand Jury 2004-2005, *Water, Water Anywhere? A Review of Marin's Water Resources*, April 27, 2005. https://www.marincounty.org/-/media/files/departments/gj/reports-responses/2004/water_anywhere.pdf

water resiliency plans and a districtwide vote on desalination or pipeline expansions. The 2007-08 Grand Jury published another report finding that global warming was accelerating and water demand was outstripping supply.[4] This report also noted that the District was taking appropriate measures to balance supply and demand with conservation programs and giving consideration to a desalination plant, which was never pursued.

DISCUSSION

Early heavy rainfalls in the 2021-22 rain season undoubtedly elicited a sigh of relief within the Marin Municipal Water District. But a severe drought that raised the real possibility of MMWD reservoirs running dry in the summer of 2022 exposed serious shortcomings in the District's ability to offer its customers a reliable supply of water. This drought shook public confidence and raised significant questions about the adequacy of MMWD's water resilience planning as well as the necessary leadership by the District's board. Adding to these concerns is recent state legislation mandating new housing construction that will require thousands of new water hookups in the District.

Water Resilience Planning

Climate change impacts on the reliability of MMWD's water supply are considered in the District's 2040 Water Resources Plan, which was presented to the District's board in 2017, and in the draft of its state mandated 2020 Urban Water Management Plan. Urban water management plans must be completed and submitted to the California Department of Water Resources every five years.[5] Longer-term water resources plans are intended to address water resilience issues and are recommended to be updated every five years in conjunction with urban water management plans.[6]

MMWD's plans call attention to the risk of extended drought as well as water quality issues caused by more intense storm runoff, wildfire in the watershed, and contamination from sea level rise. The Urban Water Management plan states that "with less frequent, more intense storms, there also will be extended dry periods that may have a significant impact on available water supply for the District."

While climate change is addressed in these plans, key long-term projections have proven to be erroneous. "There are no predicted shortages with projected demand through 2040 under climate change conditions," according to MMWD's Water Resources Plan. This plan goes on to incorrectly state that "total storage in the District's current system may reach as low a level as 16,000 AF in the most extreme case, compared to a low level of 40,000 AF under historical hydrology." The practice of relying on historical precipitation to predict the future has proven to be flawed in light of climate change. In fact, the possibility of reservoirs running dry is much higher than anticipated. As recently as October 2021, MMWD's Board was presented with

[4] Marin County Civil Grand Jury 2007-2008, *Sustaining Marin's Fragile Water Supply,* May 20, 2008. https://www.marincounty.org/-/media/files/departments/gj/reports-responses/2007/sustaining_marins_water.pdf

[5] California Department of Water Resources, "Urban Water Management Plans." https://water.ca.gov/Programs/Water-Use-And-Efficiency/Urban-Water-Use-Efficiency/Urban-Water-Management-Plans

[6] Marin Municipal Water District, *Water Resources Plan 2040,* March 2017, p. 1-3.https://www.marinwater.org/sites/default/files/2020-09/Water%20Resources%20Plan%202040.pdf

Phoenix Lake
Photo Courtesy of Will Carroll

credible scenarios showing the possibility of reservoirs dropping to less than 10,000 AF by mid-2022.[7]

MMWD also has a comprehensive Hazard Mitigation Plan that identifies risks, including earthquake, wildfire, drought, and landslides. It estimates that the financial risk to MMWD facilities alone is $1.9 billion.[8] In addition to devastating downstream communities, dam failure would cause the loss of a massive amount of water. Wildfire, an escalating risk in Marin, could pollute water supplies and cause power outages that disable MMWD's pumping and treatment facilities. These risks are exacerbated by MMWD's lack of strong regional partnerships with neighboring water agencies that might be needed for emergency supplies.

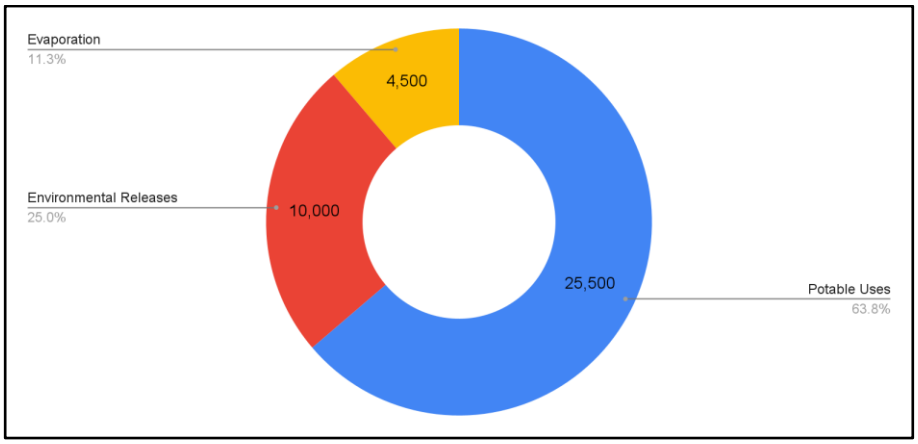
A Four-Year Water Supply

Experts advise water districts in areas with significant variations in annual rainfall to have access to a four-year supply of water, and many districts use this benchmark. A four-year supply would include total reservoir capacity as well as available imports and water produced through recycling or desalination plants. Annual water consumption in MMWD totals 40,000 AF per year, consisting of 25,500 AF in water sales as well as another 14,500 AF in evaporation and required environmental releases into creeks.

[7]Marin Municipal Water District, Drought Update, Board of Directors Meeting, October 5, 2021. https://www.marinwater.org/sites/default/files/2021-10/10-05-2021%20Drought%20Update.pdf
[8] Marin Municipal Water District, *Hazard Mitigation Plan*, September 2021, p.16-4. https://www.marinwater.org/sites/default/files/2021-09/2021-09_MarinMuniWaterHMP_PublicReviewDraft.pdf

Based on MMWD's annual consumption, the District would need access to 160,000 AF of water to establish a four-year supply. The District's current four year supply is about 120,000 AF, including 80,000 AF of reservoir capacity and 40,000 AF available through annual imports of 10,000 AF from Sonoma. To establish an adequate four-year supply, MMWD would need at least another 40,000 AF of water, or another 10,000 AF per year. However, an additional 10,000 AF may not be enough to satisfy demand from future growth. Given climate change, drier years, the likelihood of underfilled reservoirs, and future housing construction, MMWD should plan for accessing 10,000 to 15,000 AF of water per year to establish a long-term resilient supply. A significant portion of this ought to come from drought-proof sources.

Figure 2: Typical MMWD Water Uses, Acre Feet per Year



Source: Marin Municipal Water District

The Grand Jury assessed options to improve the water supply-demand balance, including new sources of supply and conservation, from the long-term perspective of how MMWD could expand its annual water supply by 10,000-15,000 AF per year.

MMWD's Resilience Options

The 83-page Appendix F to MMWD's 2040 Water Resource Plan lists more than 35 options for improving MMWD's water resilience.[9] These include conservation, residential rainwater and greywater collection, wastewater reuse, and increased water imports from Sonoma County, the Central Valley, or Humboldt County. The plan also looks at reservoir dredging, raising Soulajule dam, and sourcing groundwater from the Ross Valley and the Lagunitas watersheds within the District as well as from aquifers in Sonoma County. These options are described in detail together with their required facilities, estimated capital, operational and acre-foot costs, and the amount of water they would add to supply. With these options for additional supply having been known to MMWD's board for the last five years, the Grand Jury questions why the District has not moved forward more aggressively with any of them.

The Grand Jury researched several of these options, including conservation, increasing imports from the Central Valley and Sonoma County, and developing long-term drought-proof water sources from new recycling and desalination plants.

[9] MMWD, *Water Resources Plan 2040,* Appendix F, pp.1-83.

Conservation

MMWD and its customers have achieved significant water savings through ongoing conservation programs. There is potential to add to these savings through additional conservation efforts, including by investing in a districtwide Advanced Metering Infrastructure, also known as "AMI." However, additional conservation alone will not be sufficient to meet MMWD's long-term resilience needs.

Annual water sales for MMWD are 25,500 AF, with about 18,000 AF going to single and multi-family homes and the balance going to businesses, governments, and other institutions. In 2015, MMWD water use averaged 149 gallons per person per day, according to MMWD's 2020 Urban Water Management Plan.[10] As a consequence of active conservation programs and the use of more efficient plumbing fixtures, MMWD's consumption dropped to 124 gallons per person per day by 2021, including both indoor and outdoor uses by all customer segments. Plan tables show MMWD's water consumption is in line with other water districts in the North Bay.

With continued conservation efforts, MMWD's 2020 urban water management plan projects annual total residential water use will decrease by 3.5 percent from 2020 to 2045, while the district population increases by 10.8 percent. For the same period, the plan projects that the number of housing units in the district will increase by 8,800 to total 90,300. To serve more people with additional water hookups and still meet state mandated conservation goals, MMWD's plan projects that indoor residential per capita water use must drop another 12.5 percent, from 56 gallons per day in 2020 to 49 gallons per day in 2040.

To achieve its needed savings, MMWD will have to continue conducting aggressive conservation campaigns aimed at changing the way its customers use water. Even with a highly successful conservation effort, the savings will be largely offset by increased demand from a larger population. Consequently, MMWD will remain exposed to the risk of running dry during extended droughts.

Advanced Metering: An Under-Utilized Conservation Tool

Advanced Metering Infrastructure is another missed opportunity to improve MMWD's water resilience and conservation efforts. Advanced metering automatically transmits customers' real-time water use data to the District for billing purposes. It also flags wasteful system leaks that need repair and cuts meter reading costs. It enables customers to monitor and adjust their water use in real time to achieve conservation goals.

Advanced metering is widely used among Bay Area water districts, including the North Marin Water District. Unfortunately, MMWD stopped short of a districtwide installation, electing to pilot advanced metering in a select area. Today, most MMWD customers must wait for water bills to check and modify their consumption. Alternatively, MMWD customers can pay for a Flume device to see real-time consumption data that is not shared with the District. MMWD subsidies for its Flume program could be better spent on a more equitable districtwide installation of advanced metering.

In 2019 alone, MMWD lost 2,788 AF of water, including 1,964 AF in real losses from leaks in its distribution system and another 823 AF of apparent losses from meter inaccuracies, data

[10] Marin Municipal Water District, *Urban Water Management Plan 2015 Update*, June 2016, p. 5-10. https://www.marinwater.org/sites/default/files/2020-09/2015%20UWMP%20Final%20Report.pdf

errors, and water theft.[11] Using advanced metering, consumers could more closely monitor and reduce their consumption, and MMWD could potentially save more than 2,000 AF of water per year by quickly identifying and repairing leaks in its distribution system.

Water Imports

In the near-term, MMWD will likely need to import water from the Central Valley or Sonoma while it is developing long-term drought-proof supplies. MMWD has already taken some steps to plan for an East Bay pipeline and to immediately increase imports through the Sonoma County Water Agency (SCWA). There are additional opportunities to improve the reliability of MMWD's water supply by strengthening the District's relationship with SCWA.

East Bay Pipeline

Lack of action on water resilience options and the prospect of reservoirs running dry in mid-2022 forced MMWD to initiate emergency planning for purchasing and importing up to 10,000 AF of Central Valley water via a new $100 million pipeline to the East Bay. The District has already spent about $10 million on plans and materials and initiated a $1.5 million environmental impact report on this option. Heavy rainfalls at the end of 2021 alleviated the emergency by refilling MMWD's reservoirs, but a worrisome dry start to 2022 and the long timeline needed to implement other drought-proof resilience measures leave this option on the table.

Richmond-San Rafael Bridge
Photo courtesy of Marin Municipal Water District

The East Bay pipeline intertie plan calls for building an eight mile pipeline via the San Rafael-Richmond Bridge. A similar pipeline allowed MMWD to access water during the severe 1976-77 drought, but was later removed. Under an agreement already negotiated by MMWD, at least 10,000 AF of Central Valley water could be purchased annually from the Yuba Water Agency. Water released by Yuba agency dams would travel more than 100 miles down the Sacramento River where it would be collected and purchased by the Contra Costa Water District on behalf of MMWD. Contra Costa Water District could store the MMWD water in the Los Vaqueros Reservoir or pipe it directly through the East Bay Municipal Utility District (EBMUD) to Richmond, where it would be pumped over the bridge into Marin. MMWD's proposed pipeline could import up to 10,000 AF per year, which amounts to almost 25 percent of the District's annual water use.

[11] MMWD, *2020 Water Management Plan, Public Review Draft*, May 2021, Section 4.1.4. https://www.marinwater.org/sites/default/files/2021-06/Draft%20MMWD%20UWMP%202020-1.pdf

Contra Costa Water District's annual estimate for purchasing, collecting, and transporting MMWD's water import from the Central Valley is about $8 million, or $800 per AF. MMWD would have to pay additional costs for transporting water through the East Bay Municipal Utility District and pumping it over the bridge into Marin. Estimates for the total cost of buying and transporting water into Marin run up to $2,500 per AF.

To be implemented, the East Bay pipeline would require approvals from numerous agencies including the State Water Resources Board, the Contra Costa Water District, EBMUD, the City of Richmond, CalTrans, and several others. Project approval is not guaranteed. It is already opposed by some members of the EBMUD board, and EBMUD has identified a set of restrictions which could significantly limit MMWD's ability to import water through the pipeline. Additionally, a group of Richmond residents has expressed concerns about the location of the pumping station for moving the water into Marin.

The East Bay project has also been opposed in a lawsuit filed by environmental advocates concerned about impacts on the Sacramento-San Joaquin River delta. MMWD initially pursued the East Bay pipeline as an emergency measure, without the requirement for an environmental impact report. Heavy rains at the end of 2021 refilled critically low reservoirs and ended the emergency status. Negative impacts on the delta, including saltwater intrusion caused by overdrafting and too many water diversions, could cause the State Water Resources Board to prevent the Yuba Water Agency from selling water for MMWD to the Contra Costa Water District. The risk of this cutoff would be heightened during extended droughts.

While it is faced with challenges, the East Bay pipeline could improve MMWD's water resilience in several ways. Besides adding substantially to MMWD's water supply, the pipeline would:

- Give MMWD the ability to store an additional 15,000 acre feet of water in Los Vaqueros reservoir, thus bringing the district's total storage capacity up to 95,000 acre feet without dredging or raising an existing dam

- Enable MMWD to access drought-proof water by partnering in more affordable regional desalination projects that offer economies of scale

- Create opportunities for broad partnerships such as the Bay Area Regional Reliability Plan that could help MMWD and other water districts improve regional resilience, particularly during disasters such as dam failures caused by earthquakes

- Significantly expand the size of the total watershed and the number of potential water sources available to MMWD in dry years.

Investing in an East Bay pipeline could significantly improve MMWD's long-term water resilience in a comparatively short period of time.

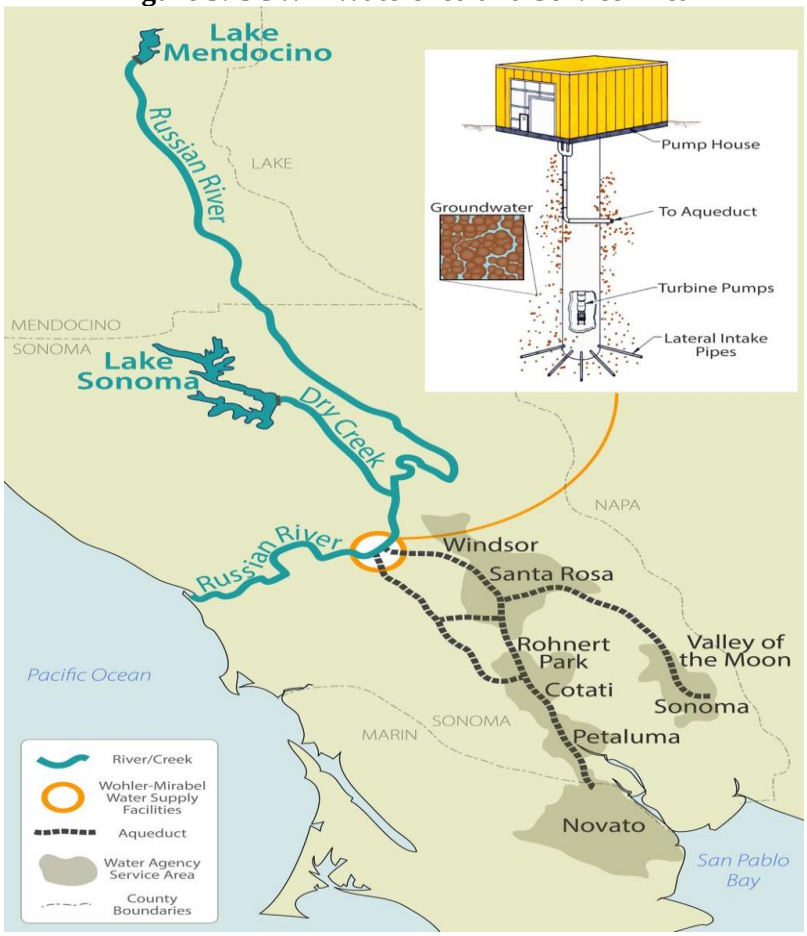
Increasing Sonoma Water Imports

MMWD may have an opportunity to expand its relationship with Sonoma County Water Agency (SCWA) in order to increase water imports from the Russian River and potentially share storage capacity in groundwater aquifers. Over the long-term, a stronger regional partnership could lead to the development of a regional desalination facility to support North Bay needs.

SCWA was created as a special district in 1949 by the California Legislature to provide flood protection and water supply services to the North Bay.[12] SCWA manages and maintains a water transmission system that provides naturally filtered Russian River water to nine cities and special districts that in turn deliver drinking water to more than 600,000 residents.

The Russian River originates in central Mendocino County, approximately 15 miles north of Ukiah. It drains 1,485 square miles including much of Sonoma and Mendocino counties, and reaches the Pacific Ocean at Jenner, 20 miles west of Santa Rosa.[13]

Figure 3: SCWA Watershed and Service Area



Map courtesy of Sonoma County Water Agency

SCWA's primary customers include Cotati, Petaluma, Rohnert Park, Santa Rosa, Sonoma, and Windsor as well as the Valley of the Moon and North Marin water districts. MMWD is a customer of SCWA, but its contractual purchasing rights are subordinate to those of other customers. Under its existing contracts with SCWA, MMWD can buy up to 14,300 AF per year, subject to certain conditions and seasonal limitations. In the event of a shortage curtailing SCWA access to Russian River water, contracts give SCWA the right to proportionally reduce its deliveries to its customers, including MMWD. In fact, SCWA cut MMWD's imports (along with its other customers) by 20 percent in the 2020-21 drought year. Given ongoing severe drought

[12] Sonoma Water, "About Us." https://www.sonomawater.org/about-us
[13] Sonoma Water, "Water Supply." https://www.sonomawater.org/water-supply

conditions and low levels in Mendocino and Sonoma lakes, there is a real possibility of additional cutbacks this year.

MMWD has not historically purchased anywhere near the maximum amount of water available from SCWA. Over the last five years, MMWD water purchases from SCWA have averaged less than 6,000 AF per year of the 14,300 AF contractually available to it. MMWD's usual practice has been to prioritize the use of lower-cost water from its own reservoirs before purchasing imported water from SCWA.

Infrastructure Bottlenecks

In addition to having contractual limitations on SCWA imports, MMWD imports have been constrained by its infrastructure. SCWA water flows to MMWD and the North Marin Water District via the Petaluma Aqueduct (pipeline), through the Kastania pumping station, and then to MMWD's treatment and distribution system in Ignacio. This system is too small to accommodate the needs of both MMWD and North Marin Water District, which owns the aqueduct and imports 75 percent of its water from SCWA. An additional physical limitation is that MMWD's distribution system south of Ignacio cannot transport more than 10,000 AF per year.

Kastania Pump Station, built in 1977 by MMWD just south of Petaluma, was able to support the historic import needs of both of Marin's water districts. However, the pump station was thought to be unnecessary when the aqueduct was enlarged and relocated during the Highway 101 expansion in the Novato narrows. Once the Kastania Pump was taken offline, the flow rate dropped and MMWD was unable to import the full volume of water contractually available to it.

MMWD responded to the aqueduct's new limitation by investing $1.9 million in 2021 to rebuild the pump station and enable it to import approximately 11,000 AF per year while still allowing North Marin Water District to meet its needs. However, this still falls short of the 14,300 AF per year of Russian River water that is contractually available to MMWD.

Even with the rebuilt Kastania Pump Station, MMWD's infrastructure in the Ignacio area lacks the capacity to transport the full amount of water that could contractually be imported into the District. Elimination of the known choke points or system weaknesses would enable MMWD to import the full amount contractually available from SCWA.

Additional Water from the Russian River

There is potentially more water available from the Russian River than is actually being diverted. The SCWA is allowed by the California State Water Board to divert up to 75,000 AF per year from the Russian River. However, the state retains the discretion to reduce this amount to account for drought or other conditions. Due to conservation by North Bay consumers, the aggregate demand on the Russian River is currently only 50,000 to 55,000 AF per year.

During heavy winter rains, the Russian River has excess flows that could be tapped for Sonoma and Marin customers. This "winter water" could be captured, treated, and put directly into distribution to MMWD water customers, or else piped and stored in MMWD's reservoirs or in Sonoma County aquifers.

MMWD has in-county storage capacity with its seven reservoirs which together with North Marin Water District's Stafford Lake are not always full. A pipeline linking Russian River water

directly to Marin's reservoirs could enable mutual storage partnerships between MMWD and SCWA as well as North Marin Water District when the reservoirs have available capacity. This could be useful for capturing and storing excess water during infrequent storms in drought periods when reservoir levels are low.

A "river to reservoir" pipeline between Marin reservoirs and Sonoma County would be costly. However, it offers the potential of Marin pumping water back to Sonoma during drought periods and increasing regional water resiliency. This longer-term option could benefit all of the North Bay water agencies.

Groundwater Banking

MMWD could potentially supplement its water reserves by partnering with one or more Sonoma County water agencies to access and bank water in their underground aquifers. This has been under discussion among water agency staff members for both MMWD and the SCWA. In such a partnership, MMWD would agree to pump some of its purchased Russian River water into Sonoma's aquifers in return for the right to use a portion of it in the future. Recharging Sonoma's aquifers could be mutually beneficial when MMWD reservoirs are full but more storage is needed to maintain a resilient regional supply of water. Potentially, this could be among the more cost effective options for increasing storage capacity.

Clearly there is value to enhancing the partnership between water agencies in the North Bay. Sonoma and Marin counties should, because of geography and geology, collaborate more closely to enhance their water resiliency. This could include storage agreements involving reservoirs and aquifers, capturing more available water from the Russian River, and exploring the feasibility of a regional desalination facility.

Drought-Proof Sources

The high likelihood of continuing climate change and more extended dry periods places a premium on the development of supplies of water that can be maintained through extended periods of drought. For example, millions of gallons of readily available treated wastewater are being pumped into San Francisco Bay every day. Marin also has an inexhaustible source of ocean or bay water as well as brackish groundwater from the Petaluma River basin for potential desalination. While these drought-proof sources would require extensive capital investment and take years to implement, they could add thousands of acre feet to MMWD's annual water supply and provide some of the resilience needed to survive extended dry periods.

Water Recycling and Reuse

As declared in its official policies, MMWD recognizes that recycled water "is an integral part of its water supply."[14] Despite statements extolling the importance of recycled water, the reality has been somewhat different. In fact, the District's production of recycled water has languished at around 750 AF per year. Two factors suggest the time has come for MMWD to reconsider its restrained approach to recycling. First, the likelihood of more frequent, more severe droughts places a premium on the development of drought-proof sources of water such as recycling. Second, forthcoming statewide regulations will for the first time allow the production of recycled water for potable reuse.

[14] MMWD Board Policy No. 2, "Recycled Water" (revised 5/21/97).

While there are many issues to work out, there is little question that potable reuse has the potential to serve as a cost-efficient means of vastly increasing MMWD's production of recycled water. The time has come for MMWD to fully evaluate and pursue development of this drought-proof source of water.

Recycled Water Under Utilized

To date, MMWD has produced only modest amounts of recycled water, all of it for non-potable uses such as irrigation.[15] The scope and scale of recycling for non-potable use is constrained by a "purple pipe" distribution system, which transports recycled wastewater without any contact with drinking water supplies or pipes. Due to the cost of constructing and maintaining these separate purple pipe systems, they are best deployed to transport non-potable recycled water to large industrial users or large-scale irrigation customers such as agricultural users and golf courses. Marin has few such large consumers of recycled non-potable water. Instead, recycled water is used principally by smaller customers for small-scale irrigation, toilets, or car washes. Because of its geographically diffuse customer base and challenging topography, MMWD faces relatively steep costs in extending purple pipes to new service areas.[16]

Largely due to these constraints, MMWD's production of non-potable recycled water remains relatively small. The District distributed only 748 AF of recycled water in 2020, which amounts to about 2.7 percent of the District's total water use.[17] The District's planners see little prospect for increasing these amounts. Indeed, MMWD has recently projected that total recycled water will remain *flat* at 750 AF per year over the next 25 years.[18]

While MMWD has addressed different scenarios for increasing its production of non-potable recycled water, it has consistently rejected them as too costly. In January 2016, MMWD and the Central Marin Sanitation Agency released a joint "Recycled Water Feasibility Study" which evaluated possible recycling projects originating out of the sanitation agency's wastewater treatment facility in San Rafael. After considering no less than 17 alternatives, the study recommended a project to extend purple pipe to San Quentin Prison to provide recycled water for non-potable uses at the prison. None of these projects was pursued after the study concluded that the District's supply portfolio was sufficient to meet demands, and there was no immediate need to invest in infrastructure to secure additional resilience.[19]

In sum, while MMWD continues to tout the desirability of recycling, it has yet to identify a path forward that would result in significant production of recycled water, nor any meaningful role recycling could play in fulfilling the District's long-term water supply needs. These outcomes may yet be attainable but getting there will require MMWD to change its focus. The time has come for the District to take a more serious and comprehensive look at the potential that now exists in recycling for potable reuse.

The Emerging Role of Potable Recycled Water

It is becoming increasingly common in California and elsewhere to use advanced treatment facilities to purify wastewater to meet drinking water standards. "Potable water reuse" refers to the use of highly treated wastewater to recharge groundwater aquifers or fill reservoirs (referred

[15] MMWD, *2020 Water Management Plan, Public Review Draft*, May 2021, Section 6.5.3.
[16] MMWD, *2020 Water Management Plan, Public Review Draft*, May 2021, Section 6.5.3.
[17] Id., p. 31.
[18] Id., Table 6-5, p. 57.
[19] MMWD, *Water Resources Plan 2040*, p. 1-2.

to as "indirect potable reuse,") or to directly connect to drinking water distribution systems (referred to as "direct potable reuse"). Potable water reuse enjoys at least one clear advantage over traditional water recycling for non-potable use: it does not require construction of costly purple pipe networks. The potential for potable water reuse is vast: roughly 30 percent of all wastewater collected in California—or about 50 percent of the wastewater discharged to the ocean—could be used for potable reuse projects.[20]

Both direct and indirect potable reuse entail the initial processing of wastewater at an advanced treatment facility, where it undergoes a process of microfiltration, reverse osmosis, and exposure to UV light, along with additional treatment. Indirect potable reuse requires storage and filtration of the treated water in an environmental buffer such as a groundwater aquifer or surface water reservoir. Injection of treated wastewater into groundwater aquifers has been used to augment drinking water supplies in Southern California for decades. Unfortunately, due to its lack of suitable groundwater aquifers, this form of indirect potable reuse is not feasible in Marin.

Indirect potable reuse by means of storage and natural filtration in surface water reservoirs has come onto the scene much more recently, following adoption of the required regulations by the State Water Board in 2018. Southern California is again leading the way in adopting this new approach to potable water reuse.[21] Given MMWD's multiple reservoirs, indirect potable reuse through surface water augmentation could be feasible in Marin. However, it faces two principal drawbacks: the cost of constructing and maintaining the infrastructure needed to transport treated wastewater to a suitable reservoir storage site and the limited storage capacity of Marin's reservoirs.

Neither of the above-mentioned drawbacks applies to direct potable reuse ("DPR"), which does not require storage of treated water in reservoirs. With DPR, highly treated wastewater can be introduced directly into the District's potable water distribution system, thus avoiding the infrastructure costs and storage limitations of indirect potable reuse. Due to the absence of the necessary regulatory framework, no DPR facilities currently exist in California. However, with the anticipated adoption of statewide regulations governing DPR by the end of 2023, a new and promising avenue for achieving water supply resilience will be opened.[22]

Direct Potable Reuse Gaining Traction

Direct potable reuse is becoming a reality in several locations. Prompted by severe local drought conditions, the country's first DPR facility opened in 2015 in Big Spring, Texas. Texas regulators have recently approved a much larger project for El Paso. Multiple demonstration-scale DPR facilities are currently under construction in Florida. Other states, including Nevada and New Mexico, are at various stages of direct potable reuse planning and implementation.

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[20] *Framework for Direct Potable Reuse*, WateReuse Project Number: 14-20, (WateReuse Research Foundation: Alexandria, Vir.: 2015), p.2 https://watereuse.org/wp-content/uploads/2015/09/14-20.pdf

[21] Work is currently underway on two projects that will use highly treated wastewater to augment surface water reservoirs in San Diego County. The projects are expected to be completed in the 2025-time frame Moulton Nigel Water Dist., *Urban Water Management Plan, 2020*, p.55 https://www.mnwd.com/wp-content/uploads/2021/06/2020-Urban-Water-Management-Plan_Adopted.pdf

[22] The California Water Board is enacting these regulations in compliance with AB 574, a 2017 state law that established a deadline of December 31, 2023 for the development of statewide regulations for raw water augmentation, including DPR.

With the pending adoption of DPR regulations in California, water and sanitation districts in Los Angeles and San Diego are planning DPR facilities capable of producing, in the aggregate, 91,000 AF per year of potable purified wastewater.[23] Water agencies in San Francisco, Ventura, and Santa Clara are also studying potential DPR projects.[24]

In Marin, MMWD and the Central Marin Sanitation Agency have launched an evaluation of a DPR project that would build an advanced treatment facility to produce purified wastewater for direct introduction into MMWD's potable water distribution system.[25] The project's recently released draft DPR Feasibility Study estimates the new facility could produce approximately 4,500 AF per year of purified recycled water, at an estimated cost of $2,700 per acre foot.[26] The timeline for project completion is approximately ten years, so DPR is not a quick fix. However, as this study clearly demonstrates, DPR can play a central role in strengthening Marin's water supply resilience over the long term, furnishing a local, drought-proof source of potable water that could amount to over 15 percent of the District's total annual needs from a single facility.

Because there is a finite amount of wastewater available for processing at any sanitation facility, it is important to compare the relative costs and merits of a non-potable purple pipe project (such as San Quentin) to a DPR project before committing to either one. MMWD's most recent Financial Plan includes projections for two purple pipe projects, which need to be reconsidered in light of the potential for more cost-efficient DPR projects.

More generally, cost comparisons between DPR and non-potable recycling projects as well as with other resiliency measures such as desalination and new pipelines need to be more fully developed. In addition to a larger DPR facility at the Central Marin Sanitation Agency, smaller advanced treatment facilities could be added at Marin's other sanitation district sites, thus presenting an incremental, scalable means of building DPR capacity. MMWD could partner with one or more of these sanitation districts to pursue feasibility studies addressing such facilities. More generally, cost comparisons between DPR and non-potable recycling projects – and with other resiliency measures such as desalination and new pipelines – need to be more fully developed. But in considering these financial analyses sufficient weight also needs to be given to the advantage DPR can offer in providing a substantial, completely local, drought-proof supply of potable water that is sustainable over the long term.

[23] "Potable Reuse Projects" WaterReuse California (June 23, 2020)
[24] "Alternative Water Supply Program Quarterly Report" (June 2021) prepared by Water Resources Division, San Francisco Water Power Sewer, available at https://www.sfpuc.org/sites/default/files/programs/0_Alt%20Water%20Supply%20Planning%20Quarterly%20Report_June2021_FINAL.pdf
[25] Central Marin Sanitation Agency, *Direct Potable Reuse Feasibility Study*, (Draft, March 2022) ("DPR Feasibility Study")
[26] Id. at p. ES-6.

Central Marin Sanitation Facility in San Rafael
Photo courtesy of Central Marin Sanitation Agency

Public Acceptance

Successfully implementing potable reuse as a meaningful source of drinking water depends in part upon public perception, which can be cultivated with effective public information programs. In fact, public acceptance of recycled water is growing.

Beginning in the early 1990's, various Southern California jurisdictions encountered public and political opposition to their plans to recharge groundwater aquifers with highly treated wastewater.[27] Fueled by inflammatory catchphrases such as "toilet to tap," opponents sought to amplify consumers' reflexive reluctance to embrace this new water source.[28] Learning from these early setbacks, subsequent efforts adopted a more proactive approach, featuring extended public outreach and education aimed at demonstrating the efficacy of the latest wastewater treatment technologies in producing safe and pure drinking water. As more jurisdictions have deployed potable recycled water to augment their drinking water supplies, public acceptance has grown.

In the past, MMWD's strategic planning has reflected a high degree of skepticism, observing that DPR will be "extremely challenging, if not infeasible, from both permitting and public acceptance perspectives."[29] With statewide regulations on the horizon, it is now clear that a lack of permitting should not render DPR "infeasible." Five years ago, MMWD acknowledged that "public acceptance of recycled water and potable reuse has changed as a result of the severity of the [2011-2017] drought."[30] In evaluating the feasibility of DPR in Marin, MMWD should again

[27] Smith, C. "California Invests in Recycled Water as Droughts Take a Toll" available at https://www.governing.com/_preview?_cms.db.previewId=0000017b-0cba-df66-af7b-1dfe3e2b0000&_date=
[28] Id.
[29] MMWD, *Water Resources Plan 2040,* Resiliency Options, pp. 6 of 83, 9 of 83, 12 of 83.
[30] MMWD, *Water Resources Plan 2040,* p. 9-3

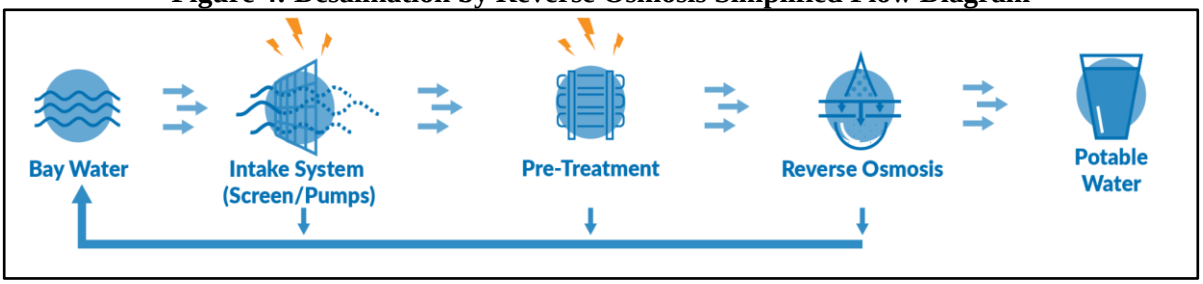
take stock of shifting public attitudes, and consider how it and other stakeholders can further impact those attitudes with effective outreach and education. Undue skepticism about the public's willingness to accept potable reuse need not hinder progress.

Desalination

Desalination is a potential drought-proof source of water that could supplement rainwater supplies, although not without high relative costs and potential operating and environmental issues. Partnership with other districts could mitigate these cost burdens and make this option more attractive. Multi-agency partnership for a regional desalination plant should be on the table as an option for MMWD. The economies of scale from larger multi-jurisdictional desalination projects could make them preferable to going it alone.

Desalination of salt water to produce potable water has been used for thousands of years. Originally desalination required boiling and then recondensing water, leaving salt solids behind. In the late 1950's, membrane technology was developed to enable scalable desalination of salt water by filtering. Reverse osmosis technology has made membrane desalination less energy-intensive and more cost-effective, requiring about half of the energy per volume of water as the most efficient distillation method. Reverse osmosis is the predominant method of desalination used today.[31]

Figure 4: Desalination by Reverse Osmosis Simplified Flow Diagram



Graphic courtesy of Marin Municipal Water District

The energy required and thus the cost to desalinate water is directly proportional to the amount of salt and other solids present. For example, desalination of seawater can require almost four times as much energy as desalting brackish water in river deltas or in underground aquifers where salt and freshwater mix.[32]

Challenges to desalination include initial construction costs, impact on marine life from the saltwater intake, high energy requirements, operating complexity, inability to cycle the plant on and off, and disposal of the concentrated salt byproduct called brine. These challenges can be mitigated by creating economies of scale with high volume production, and by carefully selecting the location of the unit–for example in proximity to a power plant, with large amounts of electricity available and cooling water for diluting the brine. Neither of these two mitigating factors would be available to a local desalination plant serving MMWD exclusively because of low throughput and challenging location.

[31] David L. Sedlak, *Water 4.0: The Past, Present and Future of the World's Most Valuable Resource* (New Haven: Yale University Press, 2014), pp. 218-224.
[32] Manseh Kumar, Tyler Kulp and Yuexaio Shen, *Water Desalination: History, Advances and Challenges*, Frontiers of Engineering: Reports on Leading-Edge Engineering from the 2016 Symposium (Washington D.C.: The National Academies Press, 2017), p. 56.

Carlsbad Desalination Plant
Photo courtesy of Poseidon Water

Large scale desalination plants that produce potable water for major population centers are in use around the world. A notable example is a plant in San Diego County that produces 50 million gallons per day or more than 56,000 AF per year. The plant, pictured at left, is situated on 95 acres adjacent to the Encina Power Station and owned and operated by Poseidon Water. The Poseidon plant started operation in 2015 and reports that it produces water for ½ cent per gallon, or $1,600 per AF, in large part due to its high volume.[33]

MMWD undertook a much smaller desalination pilot project located near the Marin Rod & Gun Club in San Rafael in 2005-2006. The pilot plant produced 5 million gallons per day, or more than 5,000 AF per year. Because the pilot plant was not intended to be permanent, it was dismantled at the conclusion of the successful trial period. The 2007-08 Marin Civil Grand Jury recommended making a yes or no decision about proceeding with a permanent desalination project in its report *Sustaining Marin's Fragile Water Supply*.[34] In response to public concerns about the cost, environmental impact, and other issues associated with desalination, the District placed Measure S on the ballot, which was approved by the voters in 2010. Measure S requires "voter approval before the Marin Municipal Water District approves constructing, or financing the construction of, a desalination facility."[35] Since the passage of Measure S, the issue of building a desalination project has not been brought before Marin's voters.

In 2010, a consortium of the five largest water districts in the Bay Area funded a regional desalination study, and a pilot plant was built and operated in Pittsburg, Contra Costa County, treating brackish delta water. This study envisioned a plant capable of producing 22,000 AF per year at this location, with an estimated cost of $200 million in 2010 dollars. The Pittsburg location was chosen for its lower salinity and its proximity to power plants and major water pipelines.[36] MMWD was not a partner in this project. It could consider joining the consortium if the project were to be reactivated in the future, but only if a pipeline to the East Bay is built.

In 2021, MMWD considered an emergency drought relief project to install a portable desalination unit of about 5 million gallons per day capacity at the same site as the 2006 project. Due to the relatively small capacity and high cost, this option has not been pursued beyond feasibility studies.

MMWD's 2040 Water Resources Plan lists three potential Marin sites for a 5 million gallon per day seawater desalination plant. The estimated capital costs range from $170 million to $220 million and annual operating costs from $2 million to $4 million, resulting in delivered water costs from $2600 to $3500 per AF.

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[33] Claude "Bud" Lewis Carlsbad Desalination Plant, "Homepage." https://www.carlsbaddesal.com
[34] Marin County Civil Grand Jury 2007-2008, *Sustaining Our Fragile Water Supply*, May 20, 2008, p. 15.
[35] Marin County Elections Department, Past Elections Results and Information, November 2, 2010, Measure S. https://www.marincounty.org/-/media/files/departments/rv/elections/past/2010/november/ballot-measures/measures.pdf
[36] Bay Area Regional Desalination Project, "Homepage." https://www.regionaldesal.org

Partnership in an East Bay regional desalination project is also shown as an option in the Water Resources Plan 2040.[37] This option has the highest estimated cost at $4,500 per AF because it includes not only MMWD's share of the desalination plant cost, but also the full cost of a pipeline across the Richmond-San Rafael Bridge.

Potential Sonoma Desalination Partnership

An additional opportunity for collaboration could exist with the Sonoma County Water Agency in the development of a desalting facility for brackish groundwater in the Petaluma Valley Aquifer located near the mouth of the Petaluma River. Groundwater desalting is similar to brackish water desalination in that the input water has lower salinity than seawater. A 10 million gallon per day groundwater desalting plant operated by the Alameda County Water District has been in operation in Newark since 2003.[38] Similar plants are being used to remove salts from groundwater throughout California.[39] The Petaluma Aquifer project would likely be a long-term, multi-agency endeavor. While it has not yet been thoroughly evaluated, it has real potential and presents a promising opportunity for further exploration.

Because of the high initial investment and operating costs of desalination, MMWD would be better served by partnering with other water agencies to develop such a project. Partnering with another district or districts would give a desalination project sufficient scale to improve its viability. MMWD should prioritize its investigation into opportunities for a long-term drought-proof desalination partnership.

Financing Water Resilience

For MMWD to achieve acceptable water resilience will require a substantial capital investment. This will likely necessitate multiple rate increases together with new bond issues, and an aggressive pursuit of federal and state grants. The cost of acquiring a reliable supply of an additional 10,000 to 15,000 AF per year over the next decade is beyond MMWD's current financial capacity. There is an urgent need to develop and communicate an actionable plan for financing water resilience.

Based on outdated cost estimates in MMWD's 7-year-old 2040 Water Resources Plan as well as more recent studies, capital projects needed to achieve a four year supply of water could cost $100 million to over $200 million. For example, among the listed projects are:

- A water reuse facility at the Central Marin Sanitation Agency to purify recycled water for delivery directly to the MMWD distribution system, at a recently estimated capital cost of $122 million to produce 4,500 AF per year
- A Richardson Bay desalination plant at a projected capital cost from the Water Resources Plan of $171 million to produce 4,000 AF per year
- A pipeline across the Richmond San Rafael Bridge with a more-recently estimated capital cost of $100 million to supply up to 10,000 AF per year.

[37] MMWD, *Water Resources Plan 2040,* Appendix F pp. 68-77.
[38] Alameda County Water District, "Newark Desalination Facility." https://www.acwd.org/383/Newark-Desalination-Facility
[39] Devika G. Bansal, "Desalination of Aquifers Offers Drought-weary California New Hope," *San Jose Mercury News*, February 5, 2017. WATER 2-5 Desalination of aquifers offers drought-weary California new hope

These cost estimates will be updated in a study recently commissioned by MMWD to review water resilience options with a delivery date of July 2022.

Impact on Water Rates

Financing resilience will require an additional level of capital investment on top of MMWD's current cost structure and rate levels which are concentrated on operations and infrastructure maintenance. District customers will have to pay more for water resilience.

Capital projects are typically funded through the issuance of long-term bond debt that is repaid over time by district customers through water rates and special fees. For example, MMWD recently outlined a plan for financing a $100 million bond for the Richmond Bridge pipeline with an assumed interest rate of 3 percent, requiring a 4 percent increase in water rates to service that debt. A $200 million bond could require a water rate increase on the order of 8 percent.

The capacity of MMWD to issue debt is limited. For MMWD to maintain its AA bond rating needed to qualify for optimal interest rates, the District's revenue levels and cash reserves must meet a minimum 1.25 debt service coverage ratio, meaning 125 percent of the amount required to make the annual debt payments. Revenue declines adversely impact the capacity to issue additional bonds.

MMWD currently has $139 million in outstanding bond debt. The District has the capacity to raise up to an additional $150 million for water resilience, provided it increases rates and fees to compensate for inflation and declining water sales from conservation.

MMWD's water sales revenue declined by 35 percent through February of Fiscal Year 2022, versus the comparable prior year period. This caused the District to draw down its reserve funds by as much as $20 million. As a result of the revenue declines, the District's debt service coverage ratio has dropped from over 2 to a current 1.4.

Taken together, the conservation-driven loss in revenue, the need to continue funding infrastructure maintenance, and a push to improve water resilience will require a significant increase in water rates. For example, maintaining the optimal AA bond rating and funding resilience projects of $150 million could require water rates to increase in the range of 7 to 10 percent.

California Proposition 218 prescribes a process for rate increases.[40] Rate increases must be justified by a Cost of Service Analysis and cannot be opposed by more than 50 percent of the ratepayers. This process can take up to one year to complete. MMWD would benefit from developing a comprehensive resilience plan, including the necessary supporting rate increases.

MMWD has an established Capital Maintenance Fee specifically dedicated to finance maintenance of its infrastructure, including dams and its aging distribution network. This fee raises about $18 million per year. A similar fee could be established to help fund water resilience. It would not be subject to revenue declines from lower water sales. Money raised by such a fee could be used exclusively to service water resilience bonds.

[40] California Legislative Analyst's Office, "Understanding Proposition 218," December 1996. https://lao.ca.gov/1996/120196_prop_218/understanding_prop218_1296.html

Grants

The federal Infrastructure and Jobs Act of 2021 provides $48.5 billion over five years for drinking water and wastewater spending.[41] Included in this bill is $1 billion for water recycling projects and $250 million for water desalination projects as well as $8 billion for pipeline projects, $100 million for enhancing storage capacity, and $400 million for resilience projects that contribute to drought resilience and environmental protection. Some of these funds could be available to MMWD for many of the options it has for strengthening its water resilience. Additional money may be available from the State of California.

To compete for federal and state grant funding, MMWD would benefit by collaborating with other water agencies such as the North Marin Water District, SCWA, and East Bay agencies with larger served populations. MMWD has historically operated for the most part as an independent agency that serves a relatively small population. Only recently has the District tasked a staff member with government relations and the pursuit of grants.

A Water Resilience Action Plan

MMWD needs to do more to improve its water resilience. The District came perilously close to running out of water in 2022 and rainfall projections have proven to be faulty in the face of continuing climate change. Conservation is essential but it is not enough to ensure a reliable water supply, particularly with state mandates for thousands of new homes. MMWD is updating its plans for expanding its water supplies. These plans include options for adding reliable drought-proof sources from water recycling or desalination. They also include short-term options for enhancing supply by expanding MMWD's relationship with Sonoma water agencies or by rebuilding a Bay Bridge pipeline to import water from the Central Valley. It will be up to the District to put these updated plans to use in identifying and executing an effective strategy for securing water resilience. Planning, while necessary, is not enough. What's urgently needed now is decisive action.

Upon receipt of the updated resiliency cost projections expected in July, the Grand Jury urges the District to promptly identify the most effective strategy for acquiring additional long-term drought proof water sources. Once these preferred sources have been identified, the District should prepare and publicly disseminate a Water Resilience Action Plan fully describing its strategy and including a credible financing plan for addressing projected costs and establishing a means of payment.

FINDINGS

F1. The prospect of Marin Municipal Water District's reservoirs running dry within a year shows that the District has fallen short in its efforts to ensure a long-term resilient supply of water for its customers. The District and its ratepayers are vulnerable to the increasing likelihood of water shortfalls.

F2. Due to a failure to fully develop and act on long-term water resilience plans, Marin Municipal Water District left itself with only the expensive Richmond Bridge pipeline

[41] U.S. Congress, "H.R. 3684 - Infrastructure Investment and Jobs Act," 117th Congress (2021-2022). https://www.congress.gov/bill/117th-congress/house-bill/3684/text

option for responding to the drought emergency, which could have preempted pursuit of other means of establishing long-term water resilience.

F3. Marin Municipal Water District has not adequately addressed climate change in developing its long-term water supply plans to date. Relying on historical data to predict future rainfall is not sufficient given ongoing and future changes in the climate.

F4. Even with ongoing successful conservation efforts, Marin Municipal Water District will need additional sources of water and storage capacity to provide a long-term reliable water supply for its ratepayers.

F5. Marin Municipal Water District has been slow to adopt proven Advanced Metering Infrastructure technology, which could enhance conservation by providing the District and its customers with real time data on water use and repairable leaks.

F6. Marin Municipal Water District could enhance its water resilience by constructing an East Bay pipeline for importing additional water. This option would also enable MMWD to participate in a regional desalination project and add storage capacity in the Los Vaqueros Reservoir.

F7. Marin Municipal Water District could improve its water supply resilience by restructuring its relationship with the Sonoma County Water Agency in order to increase imports and potentially develop additional storage capacity.

F8. Drought-proof supplies of water will become increasingly important in the coming years, with climate change-induced droughts expected to become more frequent and severe.

F9. Marin Municipal Water District has failed to place sufficient priority on development of drought-proof sources of water, such as recycling programs and regional desalination projects.

F10. The use of direct potable reuse presents a reliable, drought-proof, and cost-effective option for securing a substantial volume of additional potable water from within the Marin Municipal Water District.

F11. The use of direct potable reuse is a potentially more efficient and impactful use of wastewater, as compared to recycling that wastewater for non-potable use in a “purple pipe” system.

F12. Desalination is a feasible, drought-proof option for producing additional water for the Marin Municipal Water District.

F13. Marin Municipal Water District participation in a large-scale regional desalination project is likely the most feasible desalination option that could provide an additional drought-proof source of water.

F14. The measures needed to secure long-term water resilience will require additional funding and higher water rates for Marin Municipal Water District’s ratepayers.

F15. Marin Municipal Water District would improve its chances of receiving federal and state water resilience grant money by participating in regional partnerships.

F16. Marin Municipal Water District could significantly enhance water supply resilience and improve risk management during droughts, earthquakes, and other natural disasters by increasing its participation in regional partnerships with other water agencies.

RECOMMENDATIONS

R1. By September 30, 2022, the Marin Municipal Water District should commit to securing 10,000 to 15,000 AF per year of additional water supply before 2035.

R2. By December 31, 2022, Marin Municipal Water District should develop and act on a detailed long-term roadmap to resilience by identifying and prioritizing sources of additional supply.

R3. In its resilience roadmap, Marin Municipal Water District should prioritize the development of drought-proof sources of water, including direct potable reuse and regional desalination.

R4. In its resilience roadmap, Marin Municipal Water District should include strategies for collaborating with other Bay Area water districts to enhance its competitiveness in seeking federal and state grants.

R5. By December 31, 2022, Marin Municipal Water District should adopt a near-term plan for increasing Russian River imports and expanding the District's relationship with the Sonoma County Water Agency.

R6. By December 31, 2022, the Marin Municipal Water District should commit to completing a District-wide installation of Advanced Metering Infrastructure by the end of 2024.

R7. By December 31, 2022, Marin Municipal Water District should develop a long-term plan for financing the prioritized resilience options and communicate this information to ratepayers.

REQUEST FOR RESPONSES

Pursuant to Penal code section 933.05, the grand jury requests responses as follows:

From the following governing body:

- Marin Municipal Water District Board of Directors (F1-F16, R1-R7)

The governing body indicated above should be aware that the comment or response of the governing body must be conducted in accordance with Penal Code section 933 (c) and subject to the notice, agenda, and open meeting requirements of the Brown Act.

Note: At the time this report was prepared information was available at the websites listed.