FLOW RESTRICTORS: AN EFFECTIVE TOOL FOR WATER CONSERVATION?

Las Virgenes Municipal Water District

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November 2023

During California's latest drought from 2020 through 2022, many water agencies were faced with unprecedented reductions in available water supplies[1]. Las Virgenes Municipal Water District (LVMWD, District) was one of these agencies, and its water supply was curtailed a staggering 73% by water wholesaler, Metropolitan Water District of Southern California (MWD). Entering a third year of drought with no end in sight – and with drought messaging, pricing incentives, and monetary penalties having limited success – LVMWD developed and implemented its Flow Restrictor Program (FRP). The scale that the FRP was implemented, at least for water conservation purposes, was something that had never been done before by any other agency. But was the use of flow restrictors effective in achieving water conservation targets? This whitepaper explores the merits of utilizing flow restrictors to assist water agencies with curbing wasteful water use, achieving conservation mandates, or simply – to finally – get customers to use water more efficiently.

During the drought, LVMWD was not achieving desired results with traditional messaging, pricing signals via tiered rates, and monetary penalties. While these tools have been, and continue to be, important components to encourage conservation and the efficient use of water, LVMWD needed to take another step – the use of flow restrictors. The conclusion drawn in this white paper is that flow restrictors can be economically deployed to help water agencies be successful in meeting conservation mandates.

Cason Gilmer, Field Customer Service Representative for LVMWD, peaks through the 1/16-inch hole of a flow restrictor (photo courtesy Mel Melcon / Los Angeles Times)

Though the FRP did yield positive results, implementation at a larger scale and/or over a longer period would likely yield even better results. During the drought, the FRP is estimated to have increased water conservation by another 3.4% on an annual basis with indications that even higher levels of conservation can be achieved compared to other agencies without an FRP. The amount of additional conservation likely correlates to the level of implementation and the duration of time that a FRP is in place. The data suggests that at least 6% additional conservation can be achieved after an FRP has been in place for at least 9 months and, if implemented on a large enough scale and for a longer period, more than 10% additional conservation is very possible. Ultimately, more agencies need to implement a large scale FRP and more data is needed to better understand the impact that a FRP can have on water conservation.

LVMWD has some unique challenges in achieving water conservation targets. The service area is home to many affluent individuals and celebrities with large properties and an abundance of immaculate lawns. Some customers have no qualms paying hundreds or even thousands of dollars every month for their water service and even indicated that mandates to conserve water do not apply to them. The wealthy are somewhat immune to the cost of water and rate hikes, which are supposed to encourage people to use less water[2]. Having learned from previous droughts that one can simply buy their way out of conservation mandates, LVMWD's leadership sought ways to level the playing field.

Fairness and equity are principal elements of LVMWD's business culture. These values also strike a chord with

most of its customers that are not celebrities or uber-wealthy. During past droughts, the majority of LVMWD customers diligently conserved and did their part, but a small minority did not. Some of these customers would ask: “Why should I conserve so that my neighbor can keep his lawn lush and green?” Customers that continue to ignore conservation mandates – and have the financial means to buy their way through a severe drought – infuriate those that make the effort. This can ultimately have a snowball effect, and before you know it, more and more customers stop making a concerted effort to conserve.

After implementation during the last drought, LVMWD’s FRP was deemed so successful that its Board of Directors requested that it continue to be utilized even during times of abundant water supply. The District’s Administrative Code was modified after the drought ended and watering restrictions were lifted. After all, old habits die hard and it’s only a matter of time that the next drought hits. Aside from the water savings, customers generally appreciate it when an agency holds everyone equally accountable.

What is a flow restrictor and how does it work?

In its simplest form, a flow restrictor is nothing more than a thin, round stainless-steel plate with a small hole installed at a water meter. Normally, a 3/4-inch water meter will allow anywhere from 3 to 20 gallons per minute of water to pass through depending on the pressure at the meter. With a restrictor that has a 1/16-inch diameter opening, less than one gallon per minute can pass through. Essential indoor needs are met, including showering, albeit not in a very satisfying manner. Multiple appliances cannot run at the same time (i.e., dish washer and clothes washer). Landscape irrigation, especially high-volume sprayers used on lawns, is not possible. Fire suppression/sprinkler systems will not function as intended.

BACKGROUND

Many agencies have had and continue to have the ability to use flow restrictors for customers that repeatedly waste water and fail to do their part to conserve. However, they are seldom used. Instead, water agencies have come to rely more on pricing signals by using tiered rates and/or financial penalties to encourage efficient water use. “Water pricing can reduce demand by providing an economic incentive for consumers to conserve water. Many water suppliers have established rate structures to incentivize water conservation”.[3] LVMWD is no exception and has been utilizing tiered rates and monetary penalties for years. However, tiered rates and monetary penalties for wasteful water use have their limits. They certainly have less impact on water-use habits for some of the more affluent customers with the financial means to pay for them.

In early 2020, LVMWD began utilizing flow restrictors for another purpose. With the onset of COVID-19, California Governor Gavin Newsom issued Executive Order N-42-20 on April 2, 2020 in response to concerns that citizens would not have access to water in their homes during a major pandemic resulting from non-payment.

District Field Operations Technicians regularly encounter incidents hwere water is needlessly wasted, often without the customers knowledge.

The Order prevented water agencies from shutting off residential water services for non-payment. Delinquencies in paying utility bills were anticipated to rise due to impacts to businesses and jobs during the pandemic. The City of Oceanside, California started using flow restrictors to encourage customers to pay their water bills despite potential hardships. This was to keep water use to a minimum and ultimately so that the outstanding balance of uncollected water bills would not spiral out of control. The use of the flow restrictors allowed for essential needs such as showering, flushing the toilet, and filling up a glass of water. But with their use, water pressure in homes was reduced and the inability to run multiple appliances at the same time created an inconvenience. Showers tended to be somewhat unsatisfying as well. This either prevented customers with hardships from using more water than they really needed (i.e., overwatering landscapes) or would encourage those customers that were not actually experiencing a hardship to settle their debts with the water agency.

LVMWD followed Oceanside's lead. Few, if any, other water agencies implemented this practice. LVMWD's use of flow restrictors to help keep uncollected amounts to a minimum was largely successful. While the running balance of "non-pays" quadrupled during its peak, the magnitude of the increase was noticeably less than what many other agencies were experiencing. With the pandemic ending, the Executive Order was lifted. Coincidentally, the drought and water supply condition in Southern California worsened. The idea to then morph the use of flow restrictors for water conservation purposes was born.

Service Area and History

LVMWD, a retail water agency, provides water, wastewater, recycled water and composting services to approximately 70,000 residents that reside in the incorporated cities of Hidden Hills, Calabasas, Agoura Hills, Westlake Village and unincorporated areas of western Los Angeles County, California. There are over 21,000 water service accounts spread out over 120 square miles of land, in which single family residential homes account for about 76% of total water demands, while multi-family residents make up about 7%[4]. The remainder are primarily commercial accounts including restaurants, small office buildings, hotels/motels, and a variety of retail stores.

LVMWD serves an area with scarce local water supplies. The region is situated geographically within the Santa Monica Mountains north of the City of Los Angeles. The Santa Monica Mountains do not include any productive groundwater basins that could be drawn from. In the 1950s, prior to any substantial development, the small number of groundwater wells that existed would often run dry by the afternoon, and water service to small communities would cease until the next day after levels recharged from natural percolation through the rocky terrain. Ground-

LVMWD's water supply is more than 95% State Water Project fed by precipitation in the Northern Sierra Mountains and less than 5% Colorado River.

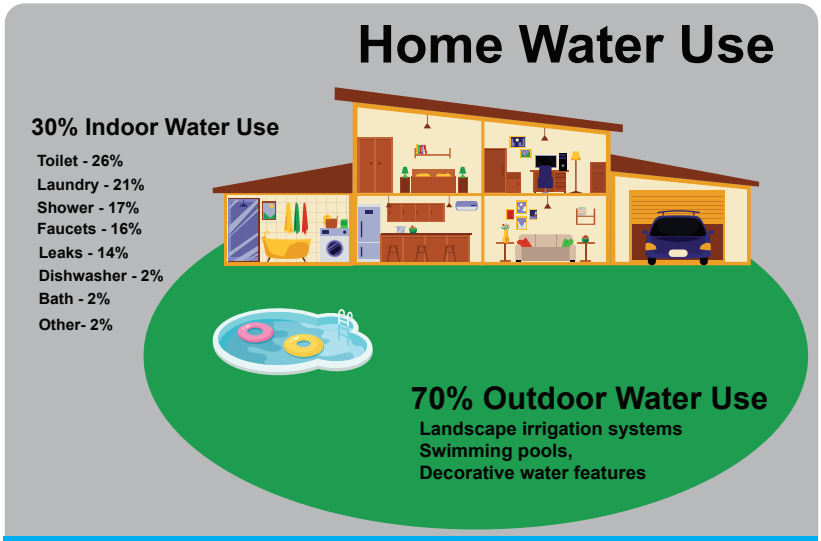
water quality is also extremely poor, containing high concentrations of minerals, manganese, iron, and hydrogen sulfate. LVMWD was created because of this deficiency in local water supplies

In 1958, after locals banded together, it officially became a municipal water district and a member of the largest water wholesaler in the United States, Metropolitan Water District of Southern California (MWD). After constructing several miles of pipeline in the northern San Fernando Valley that connected LVMWD to MWD, water from the Colorado River was provided. However, after decades of more urban development within MWD's service area and after the construction of the California State Water Project (SWP) in the 1970's, LVMWD's water supply shifted away from the Colorado River and to this day is served almost entirely with SWP water. Due to increased water demands over time and a lack of infrastructure that connects LVMWD to other water supplies – including the Colorado River – LVMWD became one of three water agencies in the northern fringe of MWD's service area that are considered "State Water Project dependent". There is no other water supply, other than SWP water, which can meet normal demands within LVMWD's system.

Water Budgets – An Equitable Billing System

The District initially developed and implemented "water budgets" for its customers in 2016. The creation of water budgets was due in part to issues regarding efficient water use and conservation requirements during the 2014-2017 drought. "The concept of water budget-based rates has considerable appeal as a mechanism to encourage efficient water use practices and to distribute revenue responsibilities equitably within customer classes."[5] The District, having a variety of very large and very small parcels, was compelled to address inequities associated with tiered water rates that did not always coincide with efficient water use. A customer can be a very high-water user but still be efficient, and vice versa, depending on their watering needs (i.e., large lot versus small lot).

The water budget system is complex but does the job of allocating an efficient amount of water to each customer. Each customer's property was assessed via aerial photography to determine the square footage of irrigated area (including pools). Customers were also required to fill out a form that included information on the number of residents in each household. The combination of indoor needs – based on 55 gallons per person per day – and outdoor irrigation based on irrigated area, daily evapotranspiration rates or ET, and a uniform plant factor of 0.8 is used to develop each customer's water budget each month. The amount changes each month since weather and evapotranspiration rates vary daily. The average ET value in each monthly billing period is used in the calculation.



Most residential water use in LVMWD's service area is for outdoor landscape irrigation. The amount needed for each home depends on the size of the lot.

The development of water budgets proved helpful in determining when a customer is being "wasteful". Without unique water budgets, a high-water user (a customer with a large piece of property) may not necessarily be wasteful and could in fact be very efficient. Being able to identify wastefulness utilizing each customer's monthly water budget as a benchmark was important for the success of the FRP. In fact, it may be more challenging to implement an FRP that is fair to customers, unless a water agency has a water budget-based rate and billing structure.

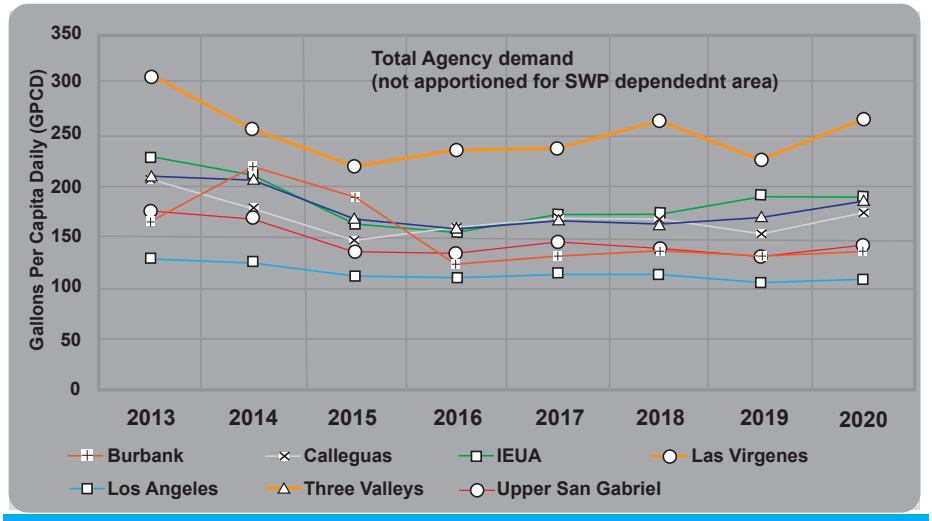
When LVMWD modified its Administrative Code in November 2021, it established new thresholds for determining when a customer is considered wasteful. These exceedance levels depend on what stage of the Water Shortage Contingency Plan (WSCP) is activated. Prior to the drought, the threshold level was 200% or double a customer's monthly water budget. However, with the latest Code modifications, the threshold or exceedance level is 150% during a Stage 3 declaration. During Stage 4, LVMWD's highest stage of drought, the threshold is 120% (20% over budget). By going over these amounts in any given monthly billing period, a customer is considered wasteful, subject to monetary penalties that could grow to an additional $10 per unit (hundred cubic feet) of water use above the threshold amount, plus the installation of a flow restrictor. Water budgets make it possible to determine wastefulness and therefore implement a FRP that targets only wasteful users.

The conundrum in asking all customers to reduce by a certain percentage, compared to their historical use, is that it is very unfair to those customers that have already reduced. Mandating an across-the-board percent reduction for each customer only benefits those customers that have been inefficient or wasteful in years past. Agencies that don't have water budgets in place have instead tended to move towards prescriptive restrictions that have their own challenges to monitor and enforce, such as a maximum three-day, two-day or even one-day per week watering.

Demographics

One unique characteristic of LVMWD's service area is that income levels are substantially higher than the average or median for the state of California (and most other parts of the country). For example, the median income of households in Agoura Hills in 2021 was $132,838 compared to the State average of $84,097. Because of this, fewer customers respond to traditional pricing signals with tiered rates and monetary penalties that are imposed in conjunction with higher and wasteful water use. Many LVMWD customers have the financial means allowing for greater discretionary spending. Communities with low or lower median incomes may not need a FRP to achieve desired conservation levels – at least not on a large scale.

Another characteristic of the service area is that water consumption has historically been quite high. The graph (right) provides some context and illustrates the gallons per capita (person) per day (GPCD) and includes both indoor and outdoor water use. Compared to six other agencies in Southern California, LVMWD (Las Virgenes) has had the highest water use as shown in yellow. This is in part due to larger-sized lots that also support more landscaping, and therefore need more water for irrigation. Many homes also include equestrian facilities that require water for dust control. But there is also a tendency for some of the more affluent customers to hire gardeners that will err on the side of caution to keep landscapes lush. Allowing brown or even lighter shades of green appearing on lawns is a sure-fire way to lose a client. To be safe, lawns tend to be overwatered.



Data and chart courtesy of Metropolitan Water District of Southern California, State Water Project Dependent Area Coordination Meeting. March 24, 2022.

The combination of high household incomes, large lots that require lots of water, and the social status associated with having a well-groomed, picturesque landscape contribute to LVMWD's comparatively higher GPCD. Messaging and pricing through water rates and penalties to curb excessive water use have their limits.

Drought

Drought and conservation mandates have come and gone over the past several decades. However, the worst of the droughts over a three-year period from 2020 through 2022 had the biggest impact to LVMWD's ability to deliver "normal" supplies to customers. The State Department of Water Resources (DWR) allocated just 20% of water rights to SWP contractors in 2020, 5% in 2021 and 5% in 2022 – the lowest allocations in a consecutive three-year period[6]. Rainfall and snowpack in the Northern Sierra Mountains, where the majority of SWP water originates, was at historic lows. The average allocation over the past 20 years has been close to 50% and most agencies only need about 30 to 35% of their entitlement to meet normal demands within their service areas.

In 2021, after DWR declared a paltry 5% allocation to State Water Contractors, LVMWD initiated conservation messaging and began formulating a plan in response to a second year of drought. The District formed a Drought and Water Efficiency Committee, comprised of a team of staff from each department along with the General Manager, which met on a regular basis to brainstorm and develop strategies for combating inefficiencies with water use. Through this effort, a Strategic Communication Plan for Drought Messaging was developed and implemented[7].

In November of 2021, with the prospect of a third dry year and little response to calls for voluntary conservation from the State, further action was needed. The Board of Directors escalated the Water Shortage Contingency Plan (WSCP) from Stage 2 to Stage 3, which called for mandatory conservation. District staff also recommended to the Board the idea of installing flow restrictors on customer meters that were ignoring calls to use water efficiently. Having used flow restrictors on customer accounts with outstanding balances during the Covid-19 Pandemic, staff were familiar with their use. However, the use of the devices for conservation purposes required a modification to LVMWD's Administrative Code.

Although no official tally, most lawns died during the drought, either because the customer complied with the one-day-per-week watering restriction or a flow restrictor was installed during the summer or early autumn.

The amount of water that needed to be conserved was exceedingly high compared to historical use. LVMWD customers used about 23,690 acre-feet of water in 2013, and 20,006 acre-feet in 2020 – a 15.5% residual reduction due to measures and altered habits from the previous 2014-2017 drought. The amount of reduction target in 2022 equated to a whopping reduction of 35% from water use in 2020 and over 50% reduction from water use compared to 2013. This was going to be difficult

to achieve with just messaging, pricing signals and monetary penalties alone. With Code changes in place that allowed for implementation of the FRP, customers were immediately notified of the new program, and that they could receive a flow restrictor if they repeatedly exceeded their water budget by more than 50% during activation of Stage 3 of the WSCP. The monthly counts for these exceedances started in the billing period of December of 2021.

The drought dragged on through the winter, and by the start of April 2022 when the snowpack in the Northern Sierra typically peaks, DWR announced another 5% allocation for the second year in a row. With LVMWD's sole dependence on the SWP, and extraordinarily little connectivity to the rest of MWD's water system that could bring in other sources, the District was later allocated 73% less water compared to historical amounts beginning June 1, 2022. Restrictions placed on LVMWD from MWD also included a maximum one-day-per-week watering schedule for outdoor landscaping, along with other major watering restrictions (i.e., no watering of non-functional turf on commercial property). This was a death sentence to outdoor landscaping – especially grass lawns in the heat of the summer and early autumn months of 2022.

SOLUTION

Policy Change

The concept of the Flow Restrictor Program, along with modifications to the LVMWD Administrative Code, were unanimously approved by the Board of Directors on November 16, 2021. But the details of how the FRP would be implemented were not yet developed. The only controversial component of the policy revolved around concern related to liability to the District but was resolved after receiving a legal opinion on the issue. Details of how the FRP would be developed and implemented were a collaboration between the Department Director for External Affairs and staff with input provided by the Drought and Water Efficiency Committee. Section 3-4.202 of the Administrative Code spells out the use of flow restrictors and can be located by visiting https://www.lvmwd.com/the-district/board-of-directors/las-virgenes-municipal-water-district-code

Initial Considerations for Program Development

Staff were not aware of any other agencies that were using flow restrictors, at least on a large-scale for conservation purposes. There were no tried and true best practices to use as a template. The American Water Works Association (AWWA) does not have a standard design or practice for them either. The closest AWWA standard, AWWA G480-20 – Water Conservation and Efficiency Program Operation and Management, does not mention their use as a means for water conservation. However, the culture at LVMWD has historically been to take calculated risks and to try out new and innovative business practices that could help meet its objectives, in this case, to reduce water consumption during a drought emergency.

There were two critical aspects to consider for the FRP. It needed to be relatively easy and inexpensive to implement, not stress available staff resources, and not take too much time from their other important job assignments. It also needed to give customers additional opportunities to comply and to not exceed the threshold for wasteful water use. This was necessary to be fair and transparent, but also to limit LVMWD's exposure to liability by providing ample warnings and opportunities. These two criteria were somewhat in conflict with one another because providing additional opportunities created the need to establish and track behavioral changes, which became an exercise in maintaining and analyzing an extensive amount of data for several thousand customers on a month-to-month basis – a time intensive prospect that could strain staff resources.

Another constraint was that flow restrictors would only be used on single family residential accounts – not com-

mercial or multi-family accounts. For commercial accounts, businesses were just coming off the heal of the Covid-19 Pandemic. Many businesses saw reduced sales. Fewer customers visiting establishments like restaurants meant businesses used less water. For commercial accounts, water budgets are based on the rolling two-year average water use. This means that with the drought in full swing, and businesses opening back up, water demands from businesses would not align with – and would generally be higher than – their water budgets. For this reason, commercial accounts were off limits with regards to the use of flow restrictors – at least for the time being. But they were still subject to tiered rates and penalties, which could be appealed and would likely be granted given the impacts of the Pandemic.

As for multi-family residential accounts that serve condominium and apartment complexes, it would not be fair to install a flow restrictor on the master meter. Most of these accounts only have a single large master meter. It's reasonable to expect some occupants of multi-family complexes to be wasteful and others efficient. To penalize all occupants by installing a flow restrictor at the master meter would not be appropriate. Additionally, most water waste is due to excessive outdoor use, and many of the multi-family properties have separate stand-alone irrigation meters. These irrigation meters could be shut-off completely as opposed to installing a flow restrictor.

The biggest hurdle with the FRP was determining whether it would present exposure to an unacceptable level of liability for LVMWD. There is always the potential for a reverse condemnation lawsuit due to property losses from dead or dying landscapes on which customers spent thousands of dollars. The same could be said for a structure fire – or worse – that could have been minimized if a fire suppression system was functional were it not for the installation of a flow restrictor. Most homes in the service area were built prior to the 1990's, and do not have fire suppression systems. Newer homes do, as the State required their installation beginning in 2011[8].

Homes built during and after the 1990s typically have fire suppression systems (sprinklers) as part of building code requirements.

Staff had already solicited an opinion from legal counsel for the use of flow restrictors during the Pandemic for non-pays and circled back with a follow-up opinion for using them to curb wasteful water use. The legal opinion did not change. While not yet tested in court, and with no case law at hand, the opinion was that if there is an overarching need to reduce water use within the service area, (i.e. drought and limited supply of water) and/or if customers are not complying with the established standard of using water efficiently despite repeated warnings and opportunities, LVMWD's liability would be limited, if not eliminated altogether. It was also widely recognized that customers already get shut off for non-payments, in which case there is no water supply

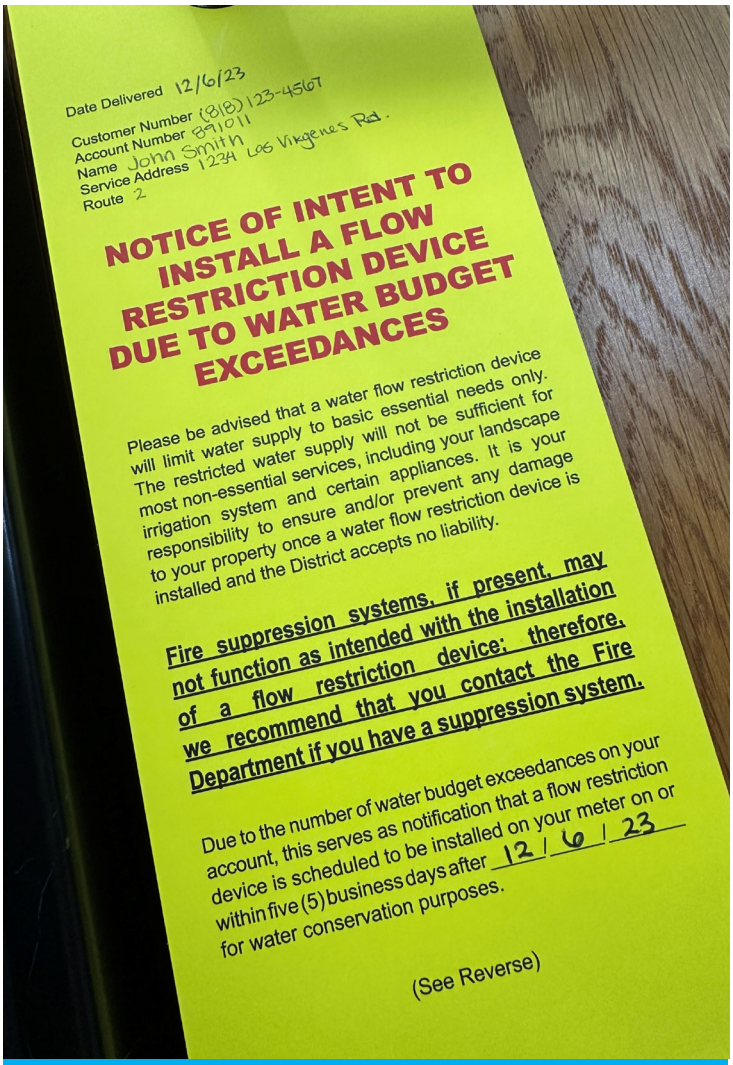
Another consideration was the cost to implement the FRP. Theoretically, the FRP "pays for itself" via Proposition 26 compliant fees that are imposed for door tagging, installing, and removing the flow restrictor. LVMWD had already adopted these standard fees for the COVID Program. But in implementing the FRP, other work was not getting done. The real issue was letting other activities fall by the wayside, at least temporarily. For this reason, it was decided to limit installations to no more than 20 accounts per week.

Program Elements

After initial concepts were explored, staff drafted a detailed implementation plan. The original Flow Restriction

Device Implementation Plan for 2022 and supporting documentation can be viewed and downloaded from www.lvmwd.com/FlowRestrictor. The original Plan has several components that outline criteria for identifying the top wasteful customers and the steps necessary before a customer has a flow restrictor installed. The Plan establishes the objective, identifies responsible parties for implementing various components, spells out the methodology for determining how to rank the worst offenders and prioritize installations, the issuance of warnings, how customers can defer an installation by pledging to reduce water use, how to appeal, door-tagging requirements, the duration of installations, and other details.

Water exceedance limits were already established when the Code was modified. Normally, when the WSCP is either not activated or under Stages 1 and 2, the exceedance or wasteful water use threshold is double a customer's unique monthly water budget. During Stage 3, the threshold for being considered wasteful and subject to a flow restrictor is 150% of a customer's water budget. Stage 4, the highest level of the WSCP, sets a threshold level of 120% of the water budget.


Date Delivered 12/6/23
Customer Number (818) 123-4567
Account Number 891011
Name John Smith
Service Address 1234 Las Virgenes Rd.
Route 2

NOTICE OF INTENT TO INSTALL A FLOW RESTRICTION DEVICE DUE TO WATER BUDGET EXCEEDANCES

Please be advised that a water flow restriction device will limit water supply to basic essential needs only. The restricted water supply will not be sufficient for most non-essential services, including your landscape irrigation system and certain appliances. It is your responsibility to ensure and/or prevent any damage to your property once a water flow restriction device is installed and the District accepts no liability.

Fire suppression systems, if present, may not function as intended with the installation of a flow restriction device; therefore, we recommend that you contact the Fire Department if you have a suppression system.

Due to the number of water budget exceedances on your account, this serves as notification that a flow restriction device is scheduled to be installed on your meter on or within five (5) business days after 12 | 6 | 23 for water conservation purposes.

(See Reverse)

Door tags are the final warning before a customer receives a flow restrictor.

Customers were warned about the implementation of devices for wasteful water use via a news release and website updates as soon as the District's Administrative Code was modified in November 2021. Customers began getting warnings on monthly bills as early as the following January if they exceeded 150% of their unique water budget. The Plan also called for both hard mailing and e-mailing 2nd and 4th exceedance notices. The first batch of formal notices went out in February of 2022.

The first time a customer exceeded their monthly water budget, they would receive a warning on their bill stating that they could be subject to penalties of up to $10 per unit of water above the exceedance threshhold, plus the installation of a flow restrictor for continued exceedances. The 2nd and 4th time a customer exceeds, they would receive a hard and e-mail copy of the notices.

In both exceedance notices, customers were provided with a plethora of information on ways they can reduce water use, as well as resources to take advantage of rebate programs, such as a discounted weather-based irrigation device. Customers could also submit an appeal if they believe they should be provided another chance (i.e., they had a leak) and they can sign and submit a pledge formally titled "Request for Water Use Evaluation and Commitment to the Efficient Use of Water". This pledge commits the customer to a variety of actions, including getting a free on-site evaluation to identify inefficient uses of water, promising to review and understand a Water Efficiency Checklist that is available on the District's website, installing a weather-based irrigation device (for long-term water efficiency), and signing up for WaterSmart (the software that allows customers to monitor water use and set up leak alerts). They were also warned about how a flow restrictor will impact their homes, allowing for basic indoor water use but rendering irrigation and fire sprinkler systems nonfunctional.

Signing and submitting the pledge form provided customers with additional time (up to seven months total) to get their water use below the exceedance level (150% of budget). If they still exceed their budget after a total of seven occurrences, they may receive a device at any time depending on where they land in the pecking order. The worst offenders were prioritized. If a customer exceeded the threshold too many times, but there were 200 customers that have been exceeding the thresholds by a larger amount, that customer was in luck since the maximum number of installations was set at 20 devices per week.

If a customer is selected to receive a flow restriction device, it's because they will have had at least four exceedances and didn't submit a pledge, or they've had seven or more exceedances and submitted a pledge. During the peak of installations when there were hundreds of accounts that qualified, being selected to receive a device also meant that they were in the top 80 most wasteful customers based on water consumption data for the previous month. At this point they received a door tag and the installation of a flow restrictor was imminent.

A door tag notice was developed to include several valuable information items, such as when the flow restrictor would be installed, what effect it would have on the use of water, how long it would remain in place, the cost for installation/removal and the fine for tampering with the device. It also gave the direct line for the District's customer service manager in case the customer wanted to appeal if they had not already. If customers were unresponsive to the two warning letters, the door tag effectively got their attention.

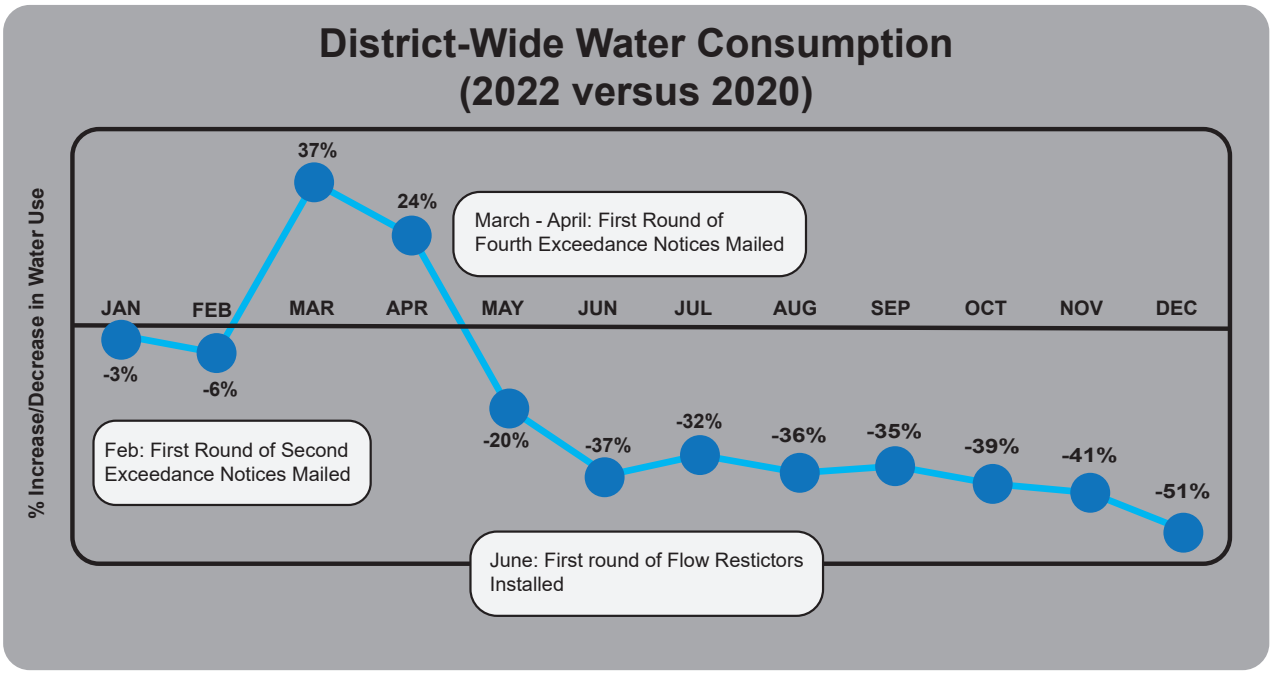
When the use of flow restrictors was codified, the concept of when they would be removed had to be explored. During the water shut-off prohibitions of the Covid-19 Pandemic, a flow restrictor would be removed as soon as a customer paid off their past due account balance. But it didn't make sense to apply this protocol for water conservation purposes. Its use is both punitive but also intended to reduce water waste. In installing the device, customers would be inconvenienced and change their wasteful water use habits.

The Code called for varying installation durations depending on whether it was the first time it had to be installed or subsequent times. The device would remain in place 14 to 30 calendar days for the first time at staff's discretion, 90 days the second time, and 180 days the third and subsequent times. Each time a customer ignored the call for efficient water use, the device would remain in place for a longer time. Also, the flow restrictor would not be removed prior to the established duration. Staff opted to install flow restrictors the first time for only 14 days but would consider leaving them in place for the full 30 days if a customer was uncooperative. The only way it would be removed is if there were a mistake made on the District's end. The concept of paying another fee to have it removed sooner was not a consideration as one of the principles for using the flow restrictor was that it was a last resort to curb water use without allowing a customer to "pay their way out of conservation".

Implementation and Results

Roll-out was relatively smooth, but over time, managing the data associated with several thousand accounts became cumbersome, time-consuming, and even frustrating for staff. The FRP needed to be simplified. Adjustments included eliminating tracking pledge forms, especially once seven months had passed. Instead of tracking the forms and verifying if customers fulfilled the requirements, it was offered to customers as a tool to arm them with ideas to reduce their water use. It was also reassurance for the customer that they would have more opportunities to reduce their water use. Given the high number of accounts that had at least seven exceedances, the pledge form was irrelevant from the standpoint of prioritizing the pecking order for installing flow restrictors.

	January	February	March	April	May	June	July	August	September	October	November	December	Total
2nd Exceedance Notices	0	1813	2524	894	320	253	161	186	259	302	583	456	8021
4th Exceedance Notices	0	0	10	974	624	582	116	181	327	332	422	405	3913
Door Tags	0	0	0	0	20	100	80	40	60	80	80	40	500
Flow Restrictor Devices	0	0	0	0	0	30	19	7	6	69	60	17	208



The graph (above) illustrates that from January through April, there was little to no reduction in water use. Rather, usage increased by 32% on average during this period, particularly during March and April. The data indicates that May was the first month that customers started to significantly reduce their water use – soon after the first round of 4th exceedance notices were mailed out. By June, water use dropped significantly. This was also the same month in which there was significant media attention, with the first flow restrictors being installed on June 1 along with one-day-per week watering mandates coincidentally starting the same day. During the summer months and early fall, from June through November, there was a relatively consistent reduction in water use at an average of 37% compared to the same months in 2020. This slightly exceeded the District's target of 35%. December's reduction of 51% increased the average for June through the rest of the calendar year to 39%.

The first round of seven or more exceedances occurred in June 2022, growing to 374 in August, 657 in October and 1,083 in December of 2022.There was no shortage of accounts eligible for flow restrictors. By January of 2023, one year after implementation, there were 56 customers with 12 exceedances – one for every month of the year. Only 30 of these customers actually received a flow restrictor with the balance "lucking out" because, although usage in all 12 months exceeded the threshold, they didn't exceed by enough to put them to the top of the list.

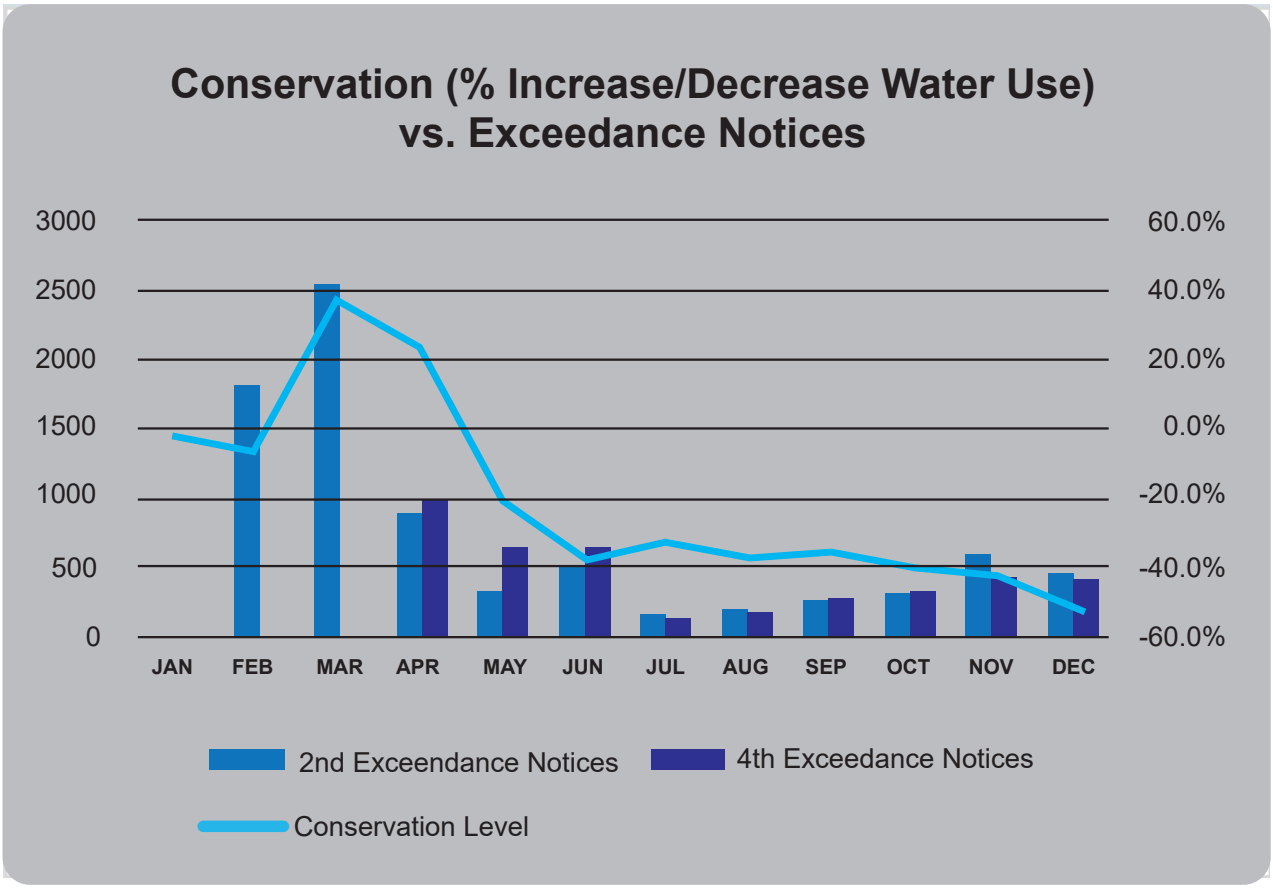
Analysis

There are several variables that can impact conservation, and an analysis of these variables was necessary to determine the amount of conservation likely associated with the implementation of an FRP. Conservation success could be a combination of messaging, media attention on the flow restrictors, and the warnings and actual use of flow restrictors. Conservation is also subject to weather conditions.

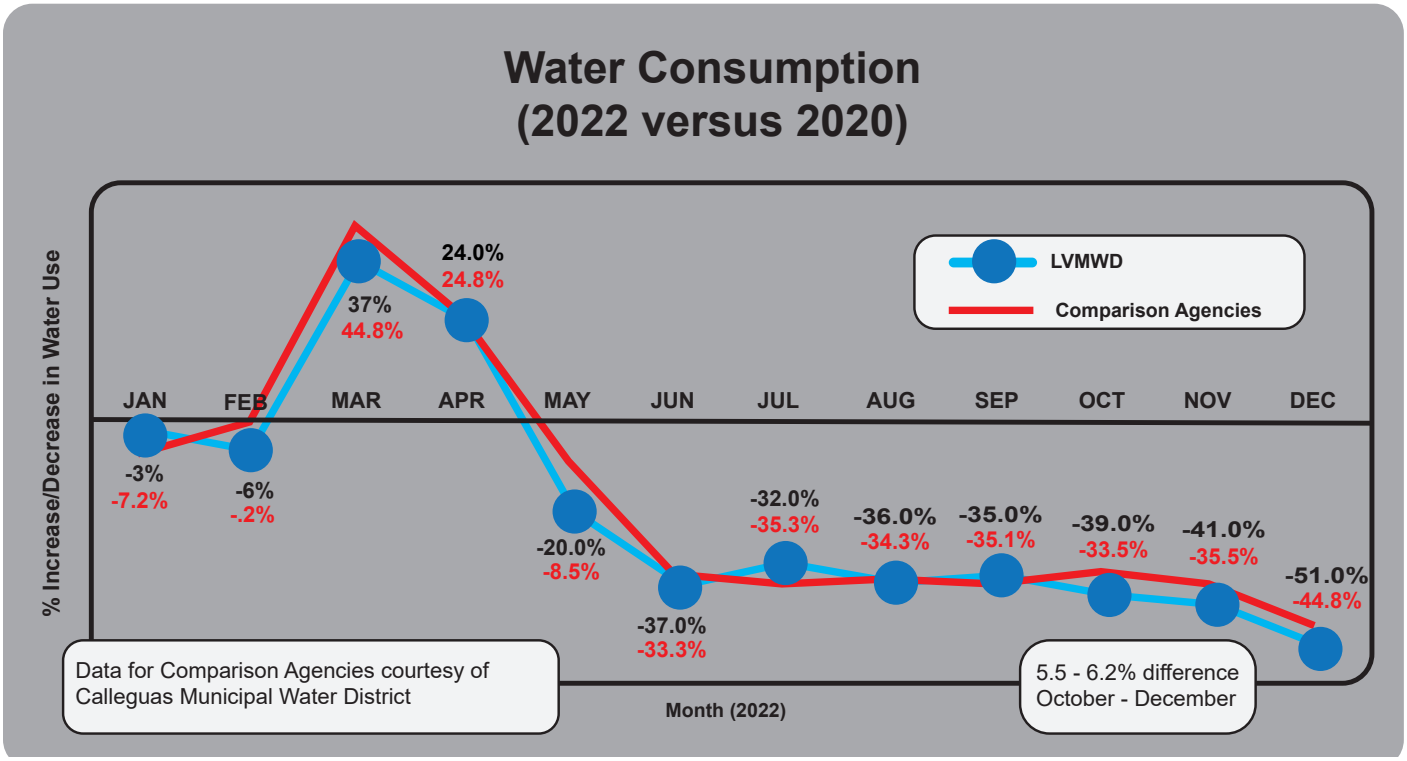
The chart (below) illustrates that after initial exceedance notices were sent in February and March, there was a significant decline in both water consumption and the number of 2nd notices starting in April. There were initially 974 4th exceedance notices in April, which dropped to just 116 in July and gradually rose back to 422 in November. The trends don't necessarily mean that customers were getting the message, rather, if a customer tended to be wasteful in their water habits, they were more likely to get one of the initial 2nd exceedance notices. Fewer customers that bordered between exceeding the threshold from month-to-month eventually got a notice, even if it was not until later in the year. Increases in exceedances are expected in the autumn months due to the temperature change from summer to fall and customers continuing to water as if it were still summer.

One variable that can – and often does – dictate how much water a customer uses on any given day is evapotranspiration rate, or ET. A higher ET value is associated with warmer and dryer weather, while a lower ET is associated with cooler/wetter weather. LVMWD's water budgets take ET into consideration, as the average is used to calculate the monthly water budget for each customer. The table below shows the average service area-wide ET for each month of 2022 compared to 2020. A positive % indicates that the weather was warmer/dryer than the same month in 2020. March of 2022 stands out as having a significantly higher ET than in the same month of 2020. The difference in ETs explains an increase in water consumption in March and a high conservation (lower water use) level in December. But there were months starting in June that had significantly high conservation rates despite the ET being higher. This indicates that customers started using less water because of the call for conservation, not because of weather differences that impacted ET values.

ET Value	January	February	March	April	May	June	July	August	September	October	November	December
2020	2.03	2.30	2.44	4.15	5.47	5.02	7.33	5.80	5.34	4.62	2.37	2.05
2022	1.99	2.56	3.44	5.51	5.01	5.96	9.03	7.13	6.00	4.64	2.51	1.68
2020 vs. 2022 (% change)	-2%	11%	41%	33%	-8%	19%	23%	23%	12%	0%	6%	-18%



To discern the impact that flow restrictors had on top of messaging and other factors, the District collected information on water savings from other SWP-dependent agencies that also had robust messaging. These neighboring agencies were also seeing significant conservation levels but did not implement a full-scale FRP. Other comparison agencies include the City of Thousand Oaks, Oak Park via Triunfo Water and Sanitation District (TWSD), Newbury Park via California-American Water Company, and Westlake Village (Ventura County) via California Water Service Company. Like LVMWD's predicament, these four retailers do not have any other source of water supply other than the SWP. They were subject to the same one-day per week watering restrictions and have similar weather and relatively similar socio-economic demographics to LVMWD's service area. The City of Thousand Oaks was getting ready to install large numbers of flow restrictors, but ended up installing only one before it could get the program going right as drought relief came in early 2023.



The graph above shows water usage for 2022 versus 2020 for both LVMWD and the average of four comparison agencies. In analyzing the difference in conservation between LVMWD and the comparison agencies, both tracked very closely but with some notable differences in several months of the year. Comparison agencies had 7.2% less water consumption in January versus LVMWD at 3% less. The level of conservation flipped in February, with LVMWD conserving 6% versus only 0.2% for the comparison agencies. For the remainder of the year, LVMWD conserved at a greater level than the comparison agencies, except for the months of July (32% versus 35.3%) and September (35% versus 35.1%). In March, with abnormally hot and dry weather, the comparison agencies used 44.8% more water versus LVMWD's 37% – a difference of 7.8%. In May, the difference grew to 11.5%. For the summer months in June through August, both LVMWD and the comparison agencies were within 3.7% of each other.

When analyzing these differences, LVMWD's FRP appears to have contributed to a relatively small amount of additional conservation – 3.4% on average for the entire year. However, with LVMWD customers becoming more aware of the FRP as more customers received flow restrictors – with a handful of customers receiving restrictors a second time – the last three months of the year indicate an average of 5.7% (5.5-6.2%) more conservation for LVMWD versus the comparison agencies. Until more water agencies implement similar programs and more data

becomes available, it is difficult to know exactly how much more water conservation can be achieved with a FRP that is implemented on a larger scale and/or for a longer duration.

Despite these numbers, customer perception of an FRP should be considered. According to a district-wide survey of customers, one common criticism was that there is a perceived inequity and inconsistency in how LVMWD conducts business. Some customers felt it unfair that they received warnings, notices, penalties, and the threat of a flow restrictor while their neighbor down the street watered all hours of the day to maintain a lush green lawn. Customers generally want to know that their affluent and/or non-engaged neighbors are not buying their way out of doing their part to conserve. If a water agency wants to receive higher customer satisfaction ratings, it needs to have programs in place, like an FRP, that level the playing field by holding all customers equally accountable. While available resources may make this a challenge, the effort in and of itself will go a long way to bolstering trust and confidence in an agency's efforts to be fair and consistent.

CONCLUSION

Flow restrictors are one of many tools that can be successfully deployed to help water agencies align water use with available supplies or to get customers to use water more efficiently. Logistically, available staffing and financial resources will inhibit deployment of flow restrictors on all wasteful water users. However, many of these customers are likely to respond, even when they don't receive a device out of concern that they could eventually receive one. Just knowing that their water utility is installing the devices and takes water conservation seriously, and holds everyone accountable, can be enough to yield additional water savings throughout the service area.

An estimated annual average of 3.4% additional water conservation was achieved with the FRP. However, LVMWD tracked closer to 6% more conservation compared to similar agencies without FRPs after it had been in place for 9 months. While not overly impressive, most customers do support a program that holds all customers equally accountable to meet water conservation mandates, which can build trust in their water provider as evidenced by a customer survey that was conducted in May of 2023[9]. Customers want to know that their efforts to conserve are not merely providing more water for their wealthier and/or less engaged neighbor to waste.

An FRP is an effective tool for water conservation. For LVMWD, additional conservation was achieved with the FRP with only a grand total of 208 flow restrictors installed (less than 1% of LVMWD's customers). As many as 3,913 or 19% of customers were eligible to have a flow restrictor installed. An additional amount of conservation with a higher number of installations could easily exceed 10% - and potentially more. Of course, the additional amount of conservation with an FRP also depends on how efficient customers for a particular agency are to begin with, the size of landscaped properties, and other factors. More agencies need to implement a large scale FRP and more data is needed to better understand the maximum potential of an FRP.

As of the date of this white paper, the FRP continues to be implemented. LVMWD customers used 30% less water year to date in 2023 versus 2020. For 2022, during the drought, customers reduced by 20% compared to 2020. While this phenomenon in continued and even higher levels of conservation is likely due to a variety of reasons including messaging, the use of the FRP is undoubtedly a factor.

Having no other industry best practices to refer to in developing and implementing an FRP, LVMWD staff learned several lessons and has since incorporated changes to its business practices that will only make the FRP more efficient and effective over time. Agencies interested in a FRP are encouraged to learn more by requesting "Considerations in Developing and Implementing a Flow Restrictor Program" by e-mailing: Joe McDermott, Director of Engineering and External Affairs at jmcdermott@lvmwd.com or Customer_Service@lvmwd.com

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