Use and Effectiveness of Municipal Irrigation Restrictions During Drought

Executive Summary

Alliance for Water Efficiency

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This report was developed and prepared as a partnership
between Western Policy Research and Maddaus Water Management, Inc.

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EXECUTIVE SUMMARY

Drought conditions prompt dramatic actions by water utilities to curb customer water demand. These actions are typically focused on limiting the frequency of lawn watering and, in more severe cases, may extend to mandatory curtailment. However, effectiveness of different actions or levels of implementation remain poorly understood or documented. The *Use and Effectiveness of Municipal Irrigation Restrictions During Drought* study was undertaken by the Alliance for Water Efficiency (AWE) to bridge this information gap.

The main purpose of the study was to explore how drought response measures have been implemented and water demand reductions have been achieved across different water suppliers in California, Texas, Arizona, and Nevada. This research study provides new information on the range of approaches used and lessons learned during a water shortage through a review of recent experiences in these four states. This Executive Summary offers an overview of the findings published in the full report[1] on the practice and impact of voluntary municipal irrigation restrictions applied during dry year conditions and mandatory restrictions subsequently required during more severe water shortages.

AWE sponsored this two-year research study, selecting Peter Mayer of Water Demand Management to serve as AWE's project manager. The study was conducted by Anil Bamezai, PhD of Western Policy Research along with Lisa Maddaus and her team at Maddaus Water Management, Inc. (Research Team).

Research Questions

The key questions addressed in the research include:

1. What demand reductions can be achieved through different levels of mandatory and voluntary restrictions?
2. How do messaging and enforcement programs influence effectiveness of restrictions?
3. During times of drought, what can water suppliers do to maximize the effectiveness of outdoor restrictions?
4. What is the longevity of demand reductions after the end of a drought?
5. What are the different forms of mandatory and voluntary irrigation restrictions typically implemented by North American water providers?

[1] The full research report is available to AWE members as a member-only benefit. Copies can be requested at: www.allianceforwaterefficiency.org/impact/our-work or by emailing info@a4we.org.

Summary of Findings and Conclusions

Recently, droughts of varying length and intensity impacted the provision of adequate water in the four states that participated in this study. In response to these droughts, municipal water providers have both chosen and been required to implement a variety of demand management measures. This study's key findings are largely based on the drought experiences and responses of eight retail water utilities: two from Texas and six from California. Key findings also include the experiences of three regional/wholesale water suppliers. The full report documents all these case studies in detail. Each case study participant faced intense multi-year shortages, lasting five and nine years for the two Texas case studies, and from three to four years for the six California case studies. All of the analyzed drought episodes ended in the first half of 2017 (or earlier, in the case of the two Texas case studies). This study's analytic timeframe was deliberately extended through the end of 2018 to provide a longer observation period to evaluate demand rebound after the end of the California drought.

During the analyzed drought episodes, dry year supply conditions and drivers of irrigation demand (such as evapotranspiration rates) fluctuated within each case study. Water suppliers adapted accordingly, adopting less or more stringent restrictions on irrigation accompanied by additional prohibitions on water waste and enforcement.[2] This variation in the level of restrictions over time within a case study, as well as across case studies, is leveraged to evaluate the differences in effectiveness by: 1) the stringency of restrictions, 2) the season during which restrictions were enforced, and 3) the degree to which restrictions were supported by messaging and enforcement.

What demand reductions can be achieved through different levels of mandatory and voluntary usage restrictions?

It is common practice for suppliers to ask for voluntary conservation at the first appearance of dry year supply conditions. After a few months, if supply conditions warrant, suppliers may transition to mandatory restrictions. Although not common, if drastic changes in supply conditions occur, suppliers may skip through water shortage continency plan stages. Within this study, the evaluation of restrictions on water demand indicated that calls for voluntary conservation did not generate statistically significant savings (i.e., estimated savings are indistinguishable from zero). However, mandatory restrictions did yield significant savings. The tighter the level of irrigation restrictions, the greater the savings, especially during summer months when irrigation is typically at its highest level. From pre-drought to the worst year of the drought, case study participants successfully reduced annual demand by 18%-30% and peak monthly demand by 20%-42%.[3] This was done while operating in Stage 2 or 3 of their Water Shortage Contingency

[2] Water waste that is typically prohibited and subject to penalty includes visible runoff from irrigation onto streets and sidewalks; watering at the wrong time of day or on an undesignated day; and other measures specific to the water provider.

[3] Includes total savings number from all efforts, inclusive of irrigation restrictions and any other implemented measures.

Plans (WSCPs). Despite severe drought conditions, none of the participants reached their WSCP's maximum stage or a point where irrigation was completely prohibited.

Case Study Finding - LADWP

Examination of GPCD data from the Los Angeles Department of Water and Power (LADWP) shows that water demand reached its lowest point during 2016, declining 18% between 2013 and 2016 (131 GPCD to 107 GPCD) at the annual level and by 20% at the peak monthly level (155 GPCD to 124 GPCD). Demand remained depressed during 2017 and 2018 as irrigation restrictions remained in place.

Key Takeaways

1. None of the water providers in this study reached the maximum stage of their contingency plan when irrigation would be completely banned.
2. Case study participants successfully reduced annual demand by 18%-30% and peak monthly demand by 20%-42% through a combination of mandatory demand management measures.
3. Within this study, voluntary conservation did not generate statistically significant savings (i.e., estimated savings are indistinguishable from zero).

Source: RWA, 2016.

How do messaging and enforcement programs influence effectiveness of restrictions?

Messaging and enforcement are essential components of successful drought response strategies. Comparisons across case studies reveal only a few instances where water agencies implemented similar levels of irrigation restrictions, but then buttressed them with varying levels of messaging and enforcement programs. In such comparisons, statistically significant savings were generally only detected in the presence of effective messaging **and** enforcement programs.

Two case studies also permitted the evaluation of drought surcharges linked with customer budgets on water demand, which is one form of an enforcement strategy. In both cases, a strong effect of surcharges on demand could be detected. This provides clarity that WSCPs should be carefully designed to include the following best practices as implementation strategies: messaging, enforcement, irrigation day-of-week and/or time-of-day restrictions, drought surcharges, and possible financial incentives. To be effective, these plans need codified rulemaking to include provisions that are enforceable on non-compliant customers. In addition, a well-developed implementation plan with associated staffing and budget resources should be prepared for each stage in a WSCP, including accounting for anticipated revenue shortfalls due to demand curtailment by customers.

Case Study Finding – Plano, Texas

In the City of Plano cumulatively, between the latter half of 2012 and the fall of 2014, 2-3% of 83,000 connections were subject to irrigation lockouts by the City, while roughly 19% received a violation letter.

Key Takeaways

1. Messaging and enforcement are viewed as best practices and essential components of a successful drought response.
2. WSCPs should include all of these components: messaging, enforcement, irrigation day-of-week and/or time-of-day restrictions, drought surcharges, and implementation strategies.
3. To be effective, WSCPs need codified rulemaking to include provisions that are enforceable on non-compliant customers.
4. The level of messaging and enforcement employed across the case studies was quite different.
5. In two case studies, drought surcharges linked with customer-specific water budgets were found to be highly effective in achieving desired demand reductions.

During times of drought, what can water suppliers do to maximize effectiveness of outdoor restrictions?

The results from this study suggest water suppliers can undertake many actions to improve the effectiveness of their outdoor restrictions. Here are some recommendations:

1. **In the planning process, the design of irrigation restrictions should be specific to the local region.** Determine what level of weekly irrigation is normal for an area given its weather patterns (evapotranspiration, rainfall) and what landscape choices best fit the local environment. Only with this understanding can a water provider set effective, progressively tighter irrigation restrictions to achieve the level of demand reduction required. For example, limiting irrigation to just 3 days/week is only mildly constraining in most of California. Similarly, in Texas, 2 days/week restrictions are only mildly constraining because Texas water providers receive more frequent rainfall in a more evenly distributed pattern. Neither of the two Texas case study participants would have found 3 days/week restrictions to be effective at all since 2 days/week was only moderately effective.
2. **Voluntary conservation alone did not generate significant compliance in this study.** Thus, water suppliers should consider strengthening provisions in their local municipal codes to target water waste, such as irrigation runoff and violation of water restrictions, and to enable the use of surcharges. As drought conditions emerge, increased enforcement of these code provisions can supplement activation of the first stage of a WSCP, which may be voluntary in nature. Of course, suppliers also may consider adding more mandatory drought measures to the first stage of their WSCPs. The mandatory measures in the first stage need not necessarily be day-of-week

irrigation restrictions. They could include prohibitions on water waste and irrigation runoff, time-of-day limits on irrigation, prevention of installation of new landscapes, and so forth. In addition, earlier adoption of drought surcharges should be stressed as that is often the most effective tool for achieving water savings. It also may be useful to be flexible regarding when and how drought surcharges are separately adopted as part of a multi-layered approach to drought-stage declaration. Without mandatory measures, either in the municipal water code or the first stage of a WSCP, it is difficult to enforce pro-conservation behavioral change among residents and businesses throughout the community.

3. **The water provider is an important source of reliable information during a drought.** Effective outreach and messaging programs should educate residents about emerging drought conditions, offer tips about how to reduce demand in the short-term, and guide residents toward resources that can help them lower demand in a more direct and hopefully permanent way. This can be accomplished in many ways, such as tailored customer water-use information readily available with new AMI technology, promotion of higher-efficiency fixtures and appliances through rebates, and landscape transformation programs.

Case Study Finding – RWA

During the recent California drought, the Regional Water Authority (RWA) Water Efficiency Program (WEP) in Sacramento implemented a public outreach campaign that catered to two audiences: local water suppliers and the general public.

For local water suppliers, the regional program provided templates for talking points for communicating with customers, social media posts, weekly editorial calendars, and customer newsletter text. The program also shared a photo gallery, "top ways to save" tips with associated water savings estimates, sample bill inserts, and tabletop informational cards for restaurants. Finally, the WEP also provided staff support for informational booths at a variety of public outreach events throughout the region, including Harvest Day and the Home and Garden Show.

For the general public, RWA maintains a website (www.bewatersmart.info) which includes an interactive drought map featuring outdoor watering guidelines, water waste hotlines, and rebates for all member water suppliers. This website received heavy traffic during the drought. In 2015, the program partnered with local ABC News and their Chief Meteorologist to provide viewers with water conservation tips during her weather segments (Figure 4-19). WEP also partnered with the Sacramento River Cats, the region's semi-professional baseball team, to post advertising in season programs and on the back of restroom stall doors in the stadium to take advantage of a "captive audience" (RWA, 2015).

Key Takeaways

1. Design restrictions according to local conditions and ensure that what is planned for will actually constrain demand.
2. Voluntary conservation alone did not generate significant compliance in this study. Water suppliers should have strong provisions in their local municipal codes to target water waste, such as irrigation runoff and restriction violations, and to enable the use of surcharges.
3. The water provider is an important source of reliable information during a drought and should keep residents informed and educated with regard to emerging conditions; suggest ways to reduce demand in the short-term; guide residents toward resources that can help them lower demand; and leverage peer pressure through social media to discourage water waste.

What is the longevity of demand reductions after the end of a drought?

Per capita water demand has been declining in most parts of North America because of long-term investments in water use efficiency and the accumulating effects of water pricing and plumbing and appliance efficiency standards. As a result, while demand still rebounds after a drought, it rebounds toward a long-term downward trendline, not back to pre-shortage levels. In addition, if suppliers undertake specific actions to change the status quo during or after a drought episode, such as making irrigation restrictions permanent (e.g., Austin, LADWP), there may be little or no rebound. Permanent actions also can change the distribution of water demand by end-uses: This needs to be evaluated and factored into planning for a future drought.

Key Takeaways

1. Per capita water use has declined across North America since the 1990s because of pricing, plumbing codes and standards, and investments in long-term efficiency.
2. Due to declining demand trends, demand rebounds after a drought toward a long-term declining trendline, not the pre-drought level.
3. In two case studies, demand reductions achieved during the drought were maintained with little rebound through the on-going implementation of restrictions.

Case Study Finding – Demand Rebound

After the end of the recent California and Texas droughts, several case study participants made irrigation restrictions permanent (Austin, LADWP, Sacramento, and Visalia), while others lifted them (Hayward, Plano, SSWD, Santa Cruz). Austin and LADWP exhibited very low levels of rebound. So did Santa Cruz, even though restrictions had been lifted, perhaps because rationing in Santa Cruz has generated longer-lasting residual effects. Visalia's demand rebound is a little higher than Sacramento's in spite of comparable per capita demand because Visalia adopted 3 days/week permanent restrictions compared to Sacramento's 2 days/week permanent summer restrictions.

What are the different forms of mandatory and voluntary irrigation restrictions typically implemented by North American water providers?

A 4-stage WSCP seems to be the most common configuration that water suppliers follow in the west and southwestern United States. A few may have 3-, 5-, 6-, or even 7-stage plans, but a 4-stage format is more prevalent. Among the 4-stage WSCPs, over two-thirds rely on voluntary conservation in the first stage of their WSCP. By the second stage, this picture quickly changes with almost 60% adopting mandatory day-of-week irrigation restrictions. In the highest stage of drought response, outdoor irrigation is often banned except in designated high-value areas or by permit. None of the utilities participating in this study reached the highest stage of response.

Research Finding – Water Shortage Contingency Plans – On-line Utility Survey

Utility survey results from this study show that the most common configuration is a WSCP with 4 shortage stages. Over 95% of respondents reported having between 3 and 5 stages. None reported having fewer than 3 stages. One respondent reported having 7 stages.

Out of 29 retail water supplier respondents with WSCPs, 6 reported having adopted permanent restrictions. Often denoted as Stage 0, this stage is not included in the total number of stages in a WSCP reported above. Most of these permanent restrictions involve prohibitions on water waste and irrigation runoff, as well as time-of-day limits on irrigation. Only 1 of the 6 respondents reports having day-of-week irrigation restrictions on a permanent basis.

Approximately 30% of retail water supplier respondents, all from Texas, include triggers in their WSCPs for dealing with excessively high water demand conditions (in addition to the traditional supply-shortage stages).

Recommendations for Water Providers

Before a Drought or Water Shortage

- Prepare a water shortage response plan which includes response tiers, messaging, and enforcement, and which reflects local conditions and values.
    - The study found that the design of day-of-week restrictions should be specific to the region in which it is being implemented.
    - The tighter the level of irrigation restrictions, the greater the savings, especially during summer months when irrigation is typically at its highest. Within this study, the evaluation of restrictions on water demand indicated that mandatory conservation generates statistically significant savings, but voluntary restrictions do not.
- Prepare and pass ordinances necessary to implement and enforce the plan when the time comes. This study found that plans need codified rulemaking to include provisions that are enforceable on non-compliant customers and to target water waste, such as irrigation runoff and excessive use.
- Educate the community. In this study, statistically significant savings were only detected in the presence of effective and persistent messaging and enforcement programs.

During a Drought or Water Shortage

- All droughts are different. Monitor conditions closely leading up to and during a drought.
- Adopt surcharges early. Increasing rates is often the most effective tool for achieving water savings. In addition, it may be useful to be flexible regarding when and how drought surcharges are separately adopted as part of a multi-layered approach to drought-stage declaration.
- Effective outreach and messaging programs must educate residents about emerging drought conditions, offer suggestions for reducing short-term demand, and provide residents the resources needed to help them reduce demand in a more direct and permanent manner.

- Adapt the drought response as necessary. Water providers should be prepared to respond as required to changes in conditions.

After a Drought or Water Shortage

- Publicly announce and clearly communicate to the public the end of the drought or shortage event and the lifting of restrictions.
- Lift any surcharges imposed promptly.
- Thank the community for participation and compliance.
- Monitor demand trends, but don't be surprised if demand doesn't fully rebound. This study found that while demand does rebound after a drought, because of ongoing long-term efficiency investments, it rebounds toward a long-term downward trendline, not back to pre-shortage levels.

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Don't miss out on all the detailed findings and analysis from this research. The full 200-page research report is available to AWE members as a member-only benefit. Copies can be requested at www.allianceforwaterefficiency.org/impact/our-work or by emailing info@a4we.org.

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