**Title**
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**Journal**
California Journal of Politics and Policy, 8(3)

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**Publication Date**
2016

**DOI**
10.5070/P2cjpp8331954

THE CALIFORNIA *Journal of*
Politics & Policy

# Overcoming the Challenges to Using Tiered Water Rates to Enhance Water Conservation

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## Introduction

### The Record-Breaking Drought and Urgent Need for Conservation

In 2015, California entered its record breaking fourth year of drought. Along with the associated scant rainfall and high temperatures, California's snowpack hit the lowest level in recorded history at five percent on April 1, 2015.[2] Snowpack, which replenishes the reservoir naturally in advance of the dry summer and fall months, provides one-third of California's urban and agricultural water requirements. Based on historical data and modeling, the California Department of Water Resources projects that by 2050 the Sierra snowpack will experience a 25 to 40 percent reduction compared to its historic average (California Department of Water Resources (DWR) 2008).

There is a scientific consensus that record-high temperatures have exacerbated water scarcity, sapping moisture from soils and preventing snow from building up in the Sierras' frozen reservoir (Griffin and Anchukaitis 2014). Declining snowpack and below average runoff in eight of the last nine years have resulted in chronic and significant shortages to municipal, industrial, agricultural, and aquatic ecosystem demands. According to a recent report by the Department of Water Resources, California's groundwater resources are at historically low levels with some basins facing shortages (DWR 2014).

Roughly half of urban water use is for residential and commercial landscaping. Outdoor water use accounts for an estimated 54 percent of single-family water use across the city of Los Angeles.[3] There is a great potential for water savings in the urban sector in landscape irrigation, but realizing it will require a shift in behavior, not just adoption of new technology (California Department of Food and Agriculture 2014). The impact of this drought on both the urban and agricultural sector has been severe. As of early 2015, the total cost to the state from the current drought is estimated to range from $1.0 to $1.3 billion, and $28 to $36 per person.[4]

[1] We would like to acknowledge Attorney Kelly J. Salt from Best Best and Krieger and Dr. Kenneth Baerenklau (Associate Professor) from the School of Public Policy, UC Riverside for their valuable input on the manuscript at it's preliminary stage.

[2] California Department of Water Resources, <http://www.water.ca.gov/waterconditions/>.

[3] Caroline Mini, "Residential Water Use and Landscape Vegetation Dynamics in Los Angeles," Ph.D. Dissertation, University of California, Los Angeles, 2013.

[4] Executive Order B-29-15 State of Emergency Due to Severe Drought Conditions Economic Impact Analysis, Prepared for the State Water Board by M. Cubed and ERA economics.

On April 1, 2015, in response to continuing drought emergency conditions since 2014, Governor Jerry Brown issued Executive Order B-29-15, which directed the State Water Resources Control Board (SWB) to take a variety of actions to help California conserve water. On May 5, 2015, in the first mandated cutback in US history, the SWB adopted an emergency regulation for statewide water conservation that implemented Executive Order B-29-15 Directives 2, 5, and 6 to achieve a statewide 25 percent reduction in potable urban water use at least through February 2016 and announced the need for commercial, industrial, and institutional entities to contribute to the water savings mandate.

In keeping with the effectiveness of conservation pricing as a tool to prevent wasteful water use, Directive 8 of the executive order directed the SWB to promote water conservation pricing mechanisms by directing urban water suppliers to develop rate structures and other pricing mechanisms to maximize water conservation consistent with the statewide water use restrictions. Soon after the governor issued the executive order, the final ruling on the San Juan Capistrano (SJC) lawsuit was released on April 20, 2015. In the SJC lawsuit Capistrano Taxpayers Association sued the city of SJC for not being able to justify their tiered water rate structure[5] based on Proposition 218 requirements.[6]

Proposition 218 was a voter approved initiative in 1996 that limited local government agencies ability to raise rates without a direct nexus between the fees and the increased cost of service. This ruling complicated the implementation of Directive 8 as the appellate court's decision went in favor of the Capistrano Taxpayers Association, emphasizing that tiered rates, unless directly related to the cost of services at a given level of usage, are unconstitutional in California based on Proposition 218. This resulted in significant confusion for several water agencies that were working on rate structures and pricing mechanisms to incentivize conservation during the drought.

The large number of meetings and public workshops on conservation pricing that occurred after the SJC case demonstrated the pressing need to identify rate structures that are robust and encourage conservation. Since the SJC case, many water agencies are reassessing their current or proposed rate structures to determine whether they are adequately linked to cost of service. On July 8, 2015, the State Water Board conducted a public workshop to receive information and public input regarding the efficacy of conservation pricing, implementation of conservation price signals consistent with Proposition 218, and defining required actions to promote conservation water pricing.

The court decision has demonstrated that tiered rates must be tailored to costs of service to maintain consistency with Proposition 218. This will be a challenging task requiring robust methodology. Passing on the incremental costs of supply to the upper tiers and inefficient water users through tiered rates is challenging but feasible under the SJC Proposition 218 ruling. Assessing the complexity of these issues as well as their potential impact on tiered pricing in California going forward comprise the primary objectives of this study.

The two main objectives are to highlight the efficacy of pricing mechanisms compared to other conservation tools in achieving water conservation goals based on theoretical and empirical evidence and to suggest possible methodologies for setting tier structures consistent with cost of service and the legal requirements of Proposition 218.

[5] A tiered rate structure imposes higher rates per unit of water usage as the level of water consumption increases.

[6] We discuss Proposition 218 in more detail later in the paper.

# II. BACKGROUND

## Evidence of Effectiveness of Tier Pricing

The efficacy of tiered pricing in achieving conservation goals is supported by empirical evidence. The Irvine Ranch Water District reports that in the 13 years following the introduction of allocation based rates in the early 1990s, average per acre water use declined by 61 percent.[7] An empirical analysis (Baerenklau et al., 2014b) based on the Eastern Municipal Water District (EMWD) of the Inland Empire Region in southern California shows that tiered pricing reduced water demand by 10 to 15 percent compared to a uniform rate structure with the same average price level.

The same study on EMWD found the demand for efficient users was reduced by five percent whereas demand for inefficient users was reduced by 25 percent due to the tiered pricing structure. The model simulations in this study showed the average real price of water rose three percent under EMWD's tiered rates but 30 percent under uniform rates would be needed to achieve the same observed reductions. So tiered rates actually resulted in customers saving money. Another study found price increases for water to be an effective means of reducing demand. A 10 percent increase in the marginal price of water is expected to diminish demand in the urban residential sector by three to four percent (Olmstead et al. 2007).

## A Comparison of Price vs. Nonprice Water Conservation Policies

In addition to pricing mechanisms, nonpricing mechanisms are available to agencies to encourage conservation. Nonprice demand management policies include watering restrictions, low-flow fixtures and appliances, turf removal subsidies, and information/education campaigns. As nonpricing mechanisms are dependent on behavioral changes, these types of policies vary widely in effectiveness, ranging from zero to significant water savings (Olmstead et al. 2007). Empirical evidence indicates pricing mechanisms have various advantages over nonpricing mechanisms.

## Impact on Demand

More stringent mandatory and well-enforced policies (e.g., penalties on exceeding water allocations) or price increases have stronger effects than nonpricing mechanisms such as voluntary policies and education programs. A study focused on the Los Angeles region found that the combination of mandatory watering reductions and a price increase reduced water use 23 percent, where voluntary reduction alone led to a six percent reduction.[8]

Although nonpricing conservation mechanisms achieve some water savings, the savings are usually smaller than expected and are influenced by behavioral responses. Customers may take longer showers with low-flow showerheads, flush twice with low-flow toilets, or water lawns longer under day-of-week or time-of-day restrictions. Effective water pricing can reduce demand by providing stronger economic incentives for consumers to conserve (Olmstead et al. 2007).

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[7] Kenneth A. Baerenklau, Kurt A. Schwabe, and Ariel Dinar, "Allocation-Based Water Pricing Promotes Conservation While Keeping User Costs Low," *Agricultural and Resource Economics Update* 17 (6) (2014b): 1–4.

[8] Caroline Mini, "Residential Water Use and Landscape Vegetation Dynamics in Los Angeles," Ph.D. Dissertation, University of California, Los Angeles, 2013.

## Cost-Effectiveness

Research shows that price-based approaches to water conservation are more cost-effective than nonprice-based approaches. Pricing as an incentive for conservation allows households the flexibility to respond to increased prices in the manner of their choice, rather than by installing a particular technology or reducing particular uses as prescribed by nonprice approaches (Olmstead et al. 2007). A study of 13 urban areas in California's Central Valley found that pricing strategy is more cost-effective than mandatory low-flow appliance regulations implemented to achieve water conservation.[9]

A recent study of 12 cities in the United States and Canada included a conservation comparison between the effectiveness of pricing and watering restrictions. Researchers found that replacing two-day per week outdoor watering restrictions with drought pricing could achieve the same level of aggregate water savings, along with an $81 cost saving on the water bill per household per summer drought.[10] It is expected that utilities with nonprice demand management programs will experience an increase in total costs (due to implementation, monitoring, and enforcement of the programs) as well as a decrease in total revenue if there is a reduction in water demand.

By contrast, utilities will see an increase in total revenue at the current estimates of price elasticity if they implement price increases to reduce demand (Olmstead et al. 2007). The utilities' adoption of Increased Block Pricing may help them increase the fraction of consumption priced at Long Run Marginal Cost, which is equivalent to the market efficient price while avoiding the chances of excess generation of profit if all units of water supplied were charged at the long-run marginal cost (LRMC).

The LRMC curve shows for each unit of output the added total cost incurred in the long run, that is the conceptual period when all factors of production are variable so as to minimize long-run average total cost. Stated otherwise, LRMC is the minimum increase in total cost associated with an increase of one unit of output when all inputs are variable.[11]

## Monitoring and Enforcement

Monitoring and enforcement requirements of a price increase are far lower than those of nonprice approaches. A common type of price-based approach is block or tiered pricing. Under block or tiered pricing, the marginal price depends on the quantity of water consumed. There can be two types of block pricing: Increasing Block Pricing (IBP) and Decreasing Block Pricing (DBP). An IBP structure charges higher marginal prices for larger quantities consumed and a DBP structure charges lower prices for higher quantities consumed. We will focus on the IBP structure as it is more effective than DBP in encouraging conservation and is widely followed by various water suppliers for setting rates (Olmstead, 2007).

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[9] C. Timmins, "Demand-side Technology Standards under Inefficient Pricing Regimes: Are They Effective Water Conservation Tools in the Long Run?" *Environ. Resour. Econ.* 26 (2003): 107–24.

[10] E. T. Mansur and S. M. Olmstead. "The Value of Scarce Water: Measuring the Inefficiency of Municipal Regulation," NBER Working Paper, No. W13513, National Bureau of Economic Research, Cambridge, MA, 2007.

[11] Robert L. Sexton, Philip E. Graves, and Dwight R. Lee, "The Short- and Long-Run Marginal Cost Curve: A Pedagogical Note," *Journal of Economic Education* 24 (1) (1993): 34. [Pp. 34-37 (press +)].

## III. Complexity of Rate Setting (Proposition 218) and the San Juan Capistrano Case

Rate setting is a complex undertaking that involves numerous local determinations in any regulatory setting. Rate setting in California, especially with the intention of pricing water for conservation, is especially constrained due to the presence of Proposition 218. Voters approved Proposition 218, the so called "Right to Vote on Taxes Act," in 1996 and amended the California Constitution by adding article XIII C, governing the imposition of taxes, and article XIII D, governing assessments and a new category of fees referred to as "property-related fees."

For the provisions governing property-related fees, the main objective of Proposition 218 was to make sure that rates are set such that they do not exceed and are proportionate to the cost of services provided. Proposition 218 was intended to curb perceived abuses in the use of assessments and property-related fees, specifically the use of these revenue-raising tools to pay for general governmental services rather than property-related services. Water service fees fit the definition of property-related fees under Proposition 218.

The changes brought about by Proposition 218 relevant to water rates are listed below:[12]

(i) Revenues derived from the fee or charge shall not exceed the funds required to provide the property related service.

(ii) Revenues derived from the fee or charge shall not be used for any purpose other than that for which the fee or charge was imposed.

(iii) The amount of a fee or charge imposed on any parcel or person as an incident of property ownership shall not exceed the proportional cost of the service attributable to the parcel.

(iv) Standby charges, whether characterized as charges or assessments, shall be classified as assessments and shall not be imposed without compliance with Section 4 [of Article XIII D].

(v) The burden is on the public agency imposing the fee to demonstrate compliance with the substantive and procedural requirements of Proposition 218. This is an important change that affected rate-setting in water agencies because it clarified the water agencies' legal burden of proof to justify a rate structure. The limitations imposed on water rates with Proposition 218 described above demonstrate the need for careful tailoring of conservation water pricing.

### SJC Tiered Rate Structure and Court Ruling[13]

The need for water suppliers to carefully construct and document their rate structures to comply with the constitutional limitations of Proposition 218 was upheld by a Fourth District Court of Appeal opinion in *Capistrano Taxpayers Association, Inc. v. City of San Juan Capistrano (SJC)*, 235 Cal. App. 4th 1493 (2015). The court agreed with a group of taxpayers who sued the city of SJC claiming that their water rates violated Proposition 218 and declared the tiered rates as illegal under the constraints of Proposition 218.[14]

The court found that the agencies could only use tiers if they could justify their tiered rates based on the incremental cost of providing the services at a given level of usage. This finding has led to a need for some agencies, which were planning to use tier pricing as a major tool for their

[12] A History of Rate-Setting under California Law: Proposition 13 Through Proposition 26, Michael G. Colantuno, Esq., 2012.

[13] Fourth Appellate District, Division Three, Court Ruling: Capistrano Taxpayers Association, Inc., v. City Of San Juan Capistrano (G048969), April 2015.

[14] The tiered rates for San Juan Capistrano are provided in Table 7 in the Appendix.

conservation efforts, to reassess their approach to ensure they comply with the cost of service ruling in the case.

The city of SJC adopted an allocation-based rate structure in August 2012. The rate structure consisted of four tiers, with the rates in each tier based on predetermined water usage budgets. The upper two tiers were based on the amount of water the city concluded to be excessive or overuse of water, respectively. The city was also in the process of constructing a recycled water treatment plant and related facilities funded in part through the potable water service fees.

First, the Court of Appeal held that the city's rates were not proportional to the cost of service because the city did not calculate the incremental cost of providing water at the level of use represented by each tier. Specifically, the court criticized the city for not correlating its rates within each tier to the prices of water used within each tier. The court concluded that the administrative record justifying the city's rates did not contain any breakdown as to the relative cost of each source of supply and therefore did not justify an ascertainable cost attributable to specific parcels.

Second, the court rejected the city's argument that rates in tiers three and four did not have to be cost justified because higher tiers were intended to be penalties and were structured consistent with article X, section 2 of the California Constitution. However, the Appellate Court sided with the city that Proposition 218 allows public water agencies to pass on the capital costs of improvements to provide additional water to all customers even if not all customers will receive the actual new water produced. A legally robust approach to passing on these costs to customers remains unclear as the court questioned whether residential ratepayers with very low consumption should be charged for recycling facilities that may not have been necessary if no customers were above average consumption. The court sent this portion of the decision back to the trial court for further investigation.[15]

## IV. Best Practices in Rate Structure

The SJC rate decision provides an opportunity for other water agencies with tiered rate structures to review their rates. As we identify the potential issues highlighted by the court in SJC rates, it is critical to discuss the options agencies have in setting a tiered structure so they do not violate Proposition 218. In this section we look into the strategies followed by three agencies in their rate setting. We discuss the fundamental methodology followed in rate setting by the Irvine Ranch Water District (IRWD), Moulton Niguel Water District (MNWD), and Los Angeles Department of Water and Power (LADWP). Both IRWD and MNWD were chosen as best practices in rate setting by the SWRCB; LADWP manages a very large customer base in southern California and is one of the largest municipal utility agencies in the nation.

### IRWD Rate Design Analysis

IRWD developed a rate structure that proportionately recovers costs of service from customers. Two components are necessary to calculate rates, Costs and demands, as discussed above. The rate can be calculated using the functional cost category divided by applicable demand.[16]

[15] Best Best and Krieger Legal Alert (Attorney Kelly Salt) <http://www.bbklaw.com/?t=40&an=38991&format=xml>.

[16] Cost of Service Study, Irvine Ranch Water District, May 2015.

IRWD employs a unit cost service-based approach to rate setting, the functional cost is divided by the number of billing units (in one hundred cubic feet [CCF]) of the projected water sales in the tier or tiers to which a functional cost is attributed. The rate for the low-volume tier is based on the lowest cost water supply source and the regular conservation cost.

The base-tier rate utilizes the melded cost of water and the regular conservation cost. In addition to the conservation cost, the cost of imported water and water banking are incorporated into the inefficient-tier rates. The wasteful tier is most expensive as this tier is charged based on the cost of the Natural Treatment System (NTS) and Targeted conservation. The Natural Treatment System (NTS) is an environmentally sound method for treating dry weather runoff.

Man-made wetlands use natural ecosystems to remove sediment, nutrients, pathogens, and other contaminants from dry weather runoff and prevent the contaminants from reaching upper Newport Bay and the ocean. Targeted conservation is a conservation cost specifically targeted to reduce wasteful use and is added to water rates long with the cost of imported water, water banking, and regular conservation.

Forecasting water sales and purchases is another important component of the IRWD rate setting process. Lacking enough local groundwater to meet its demand IRWD purchases imported water at a very high cost. In its budget process, the district forecasts the expected cost of water based on historical demands, proposed changes to rates, regulatory impacts, and the weather. The forecast cost for water purchase is compared to the forecast revenue and rates are set to recover the cost.

Water supply costs are divided by units[17] of water (demand) in the potable water system. Service costs are based on the number of meter equivalents. This step allows the district to develop unit-cost structures based on customer characteristics. This is an important process for establishing tiered rates, as increasing usage incurs marginal costs that make each unit of water more expensive to provide.

The consumption forecast in each tier is a function of historical usage and overall water conservation. IRWD follows an allocation-based tier structure designed to recover commodity costs. Customers receive individualized water allocations based on their defined reasonable indoor and/or outdoor needs. Allocations are based on property characteristics and include factors such as the number of occupants, size of irrigated area, and local climate data, based on the IRWD cost of service approach.

Table 1 provides information on the IRWD rate structure. A comparison of IRWD rates in 2014 and 2015, before and after the SJC case is in Table 2. The number of tiers was reduced to four in 2015 from five tiers in 2014 and earlier.

Excessive and wasteful tiers were combined into a single wasteful tier in the 2015 rates. In 2014 rates, the "excessive" tier was 151–200 percent of historical use and the "wasteful" tier was anything at or above 201 percent. In 2015, anything at or above 131 percent was classified as wasteful.

**Moulton Niguel Water District (MNWD) Rate Design Analysis**

While MNWD follows allocation-based rates similar to IRWD, some aspects of their rate design methodology differ. The rate structure for water service fees in MNWD has five customer classes: residential, multifamily, commercial, irrigation, and recycled. The rate structure of

[17] One unit of water is equal to one hundred cubic feet or 748 gallons of water.

**Table 1. FY2015-16 Unit Cost By Tier- Irvine Ranch Rate Area**

| Cost Basis | Low-Volume | Base | Inefficient[18] | Wasteful[19] |
|---|---|---|---|---|
| Lowest Cost Water | $1.06 | | | |
| General Conservation | $0.05 | $0.05 | $0.05 | $0.05 |
| Melded Cost | | $1.57 | | |
| Purchased Water Cost | | | $2.76 | $2.76 |
| Water Banking | | | $1.11 | $1.11 |
| Targeted Conservation and NTS | | | | $10.61 |
| Rate ($ / CCF)[20] | $1.11 | $1.62 | $3.92 | $14.53 |

**Table 2. IRWD 2014 (Pre SJC) and 2015 (Post SJC) Rates**

| Tier | Percent of allocation | Cost per CCF (2014) | Cost per CCF (2015) |
|---|---|---|---|
| Low Volume | 0-40 percent | $0.91 | $1.11 |
| Base Rate | 41-100 percent | $1.27 | $1.62 |
| Inefficient (2014) | 101-150 percent | $2.86 | |
| Inefficient (2015) | 101-130 percent | | $3.92 |
| Excessive (2014) | 151 -200 percent | $4.80 | |
| Wasteful (2014) | 201 percent + | $9.84 | |
| Wasteful (2015) | 131 percent + | | $14.53 |

MNWD has two components: (1) a fixed monthly charge (the "service" charge); and (2) a variable volumetric consumption charge ("volumetric charge").

Rates for the fixed monthly service charge are based on the size of the water meter serving a property and calculated to recover a significant portion of the district's fixed costs, such as water facility repairs and replacements, meter reading, billing, and customer service. Rates for the variable volumetric charge are based on the number of units of water delivered to a property and consist of five tiers that result in higher rates as consumption increases (one unit of water equals one hundred cubic feet or 748 gallons).

As discussed below, each type of customer is allocated a reasonable amount of water based on the customer's needs. This allocation is referred to as a water budget. It is similar to the volumetric approach followed by IRWD. MNWD measures customer demands on various levels based on the notion of cost causation. Essentially, cost causation means that the district incurs a

[18] For Tier 3, there is a possible second step increase to $9.30 if targeted SWRCB reductions are not met.

[19] For Tier 4, there is a possible second step increase to $19.91 if targeted SWRCB reductions are not met.

[20] Rate is calculated as sum of above cost components.

cost for providing service as a result of particular kinds of demand. Customer demands are measured under the following categories:

- *Base Costs*: Base demands for customer classes are measured as each class average daily demand.
- *Extra-Capacity Costs*: Costs incurred as a result of having to meet rate of use requirements in excess of the average daily demands. Extracapacity costs are measured as maximum-day ("max-day") and peak hour ("max-hour") costs. MNWD suggests the demands have significant cost of service implications because the infrastructure for water supply and distribution needs to be sized to provide not just the average water demand, but peak demands. This infrastructure includes transmission pipes, meters, pump stations, pressure-reducing stations, storage, and distribution pipes. Customers with high seasonal use, such as summer irrigators, tend to have the highest maximum day and peak-hour demands.
- *Customer and Meter Costs*: Customer and meter costs include the costs of meter reading, meter maintenance, customer accounting, general and administrative costs, and other related costs. Meter costs vary based on the size of the meter.
- *Fire Protection Cost*: Costs incurred because of sizing the distribution infrastructure in order to be able to serve both public and private fire protection infrastructure.

In addition to the common allocation factors, the district adds water use efficiency costs attributable to managing the water supplies through conservation efforts and efficiency programs, as tracked by the district's dedicated Water Use Efficiency (WUE) fund. MNWD charges these costs of conservation only to the upper two tiers of customers who have a higher demand. As a result, the upper tiers are more expensive than the others.[21]

**LADWP Rate Design Analysis**

The LADWP's first step in setting their rates was to functionalize the cost of service based on a marginal cost approach.[22] All functional cost components are identified, after establishing the test year in which rates will be set. Costs components are primarily associated with providing service and include transmission, supply, local pumping, water quality and regulatory, water purification, O&M, distribution, customer service, administration and general. Marginal related costs associated with providing service for each functional component are then determined.

The unit marginal cost is calculated based on the following factors:[23]

a. Coincident Peak (peak ccf): These costs are incurred as a result of maximum seasonal water consumption requirements and allocated among customer classes on the basis of seasonal peak consumption (peak ccf).
b. Water Usage (ccf): Some costs, such as water supply operations and maintenance (O&M), water distribution, pumping cost, treatment operating costs, and certain other O&M expenses, are directly related to the quantity of water consumed. These costs are allocated based on the water consumption volume the system must supply to serve them. The costs are variable

[21] Cost of Service Analysis, Moulton Niguel Water District, 2015.

[22] Marginal cost is the change in the total cost arises when the quantity produced is incremented by one unit.

[23] Water Service Cost of Service Study, Los Angeles Department of Water and Power, 2015.

commodity costs (e.g., pumping costs, treatment, O&M, and other costs related to the quantity of water consumption).

c. Number of Customers: These costs reflect the marginal costs of customer connections to the distribution system and various customer services and are allocated on the basis of the number of customers in each class.
d. Proportionate to Other Costs: These costs typically cannot be allocated to customer classes based on direct cost causative factors. Instead, costs like administrative and general costs are allocated in direct proportion to total costs using an indirect cost causative allocation approach.

As a next step, the marginal cost revenue requirement for each customer class (single-dwelling residential, multidwelling residential, commercial, industrial, etc.) is calculated by distributing the functionalized costs to customer classes. The estimated marginal cost revenue requirement is then used to develop rates and rate structures to collect customer-class revenues appropriate for each class. Tier 4 is the most expensive as it requires the most costly sources of water to meet demand. Table 3 provides a comparison of residential tiered water rates for LADWP, IRWD, and MNWD.

## V. Potential Options for Setting Tiered Rates Consistent with Proposition 218 and Meeting Water Conservation Goals

### Set Rates Based on Different Sources of Water Supply

Agencies can link their tier rates with the cost of supplying different types of water.[24] Several agencies hold a diverse portfolio of water supplies, including groundwater, recycled water, imported water, desalinated water, etc. The cost of supplying varies with the type of water. It will be a lower cost service if it is a cheaper water supply source (e.g., high quality groundwater) and it can be high if it's an expensive water supply source (e.g., advanced treatment recycled water, desalinized water, etc.).

Tapping expensive water supplies is needed to meet some customers' high demand. Agencies recover their costs from these expensive water supplies by tying them to the rates of customers with higher demands in upper-tier rates. IRWD has functionalized their cost of service based on their portfolio of water supplies. In IRWD, the costs associated with low-volume use are tied to their cheapest source of water, which is groundwater, and the incremental costs are added as customers increase their usage.

The incremental cost is usually the melded cost of water in the second tier and the cost of imported water. Water banking and Natural Treatment System (NTS)[25] costs are added to the third and fourth tier.[26] Table 3 above shows that the fourth tier of IRWD is the most expensive compared to the highest tier of LADWP and IRWD.

Setting up a tiered rate structure consistent with Proposition 218 can become particularly challenging if agencies depend on a single source of supply rather than a portfolio of water sup-

[24] "San Juan Capistrano: Is This the End of Tiered Rates?" Kelly J. Salt, Southern California Water Dialogue Meeting, June 2015.

[25] Natural Treatment System (NTS) is a cost-effective environmentally sound method for treating dry weather runoff. See <http://www.irwd.com/services/natural-treatment-system> for more information.

[26] Please see the Appendix for more information on the IRWD rates.

**Table 3. Comparison of Tiered Water Rates for Residential Customers Across Agencies**[27]

| LADWP Tiers | | |
|---|---|---|
| **Tier** | **Usage (per person per day)** | **Price** |
| 1 | Up to 8ccf | $4.45 / ccf |
| 2 | 45 percent ETAF[28] | $5.41/ ccf |
| 3 | 135 percent ETAF | $6.31/ ccf |
| 4 | Excessive use (requires mostly costly sources of supply) | $7.91/ccf |
| **IRWD Tiers** | | |
| **Tier** | **Usage (per person per day)** | **Price** |
| 1 | ~ upto 4 ccf | $1.11/ccf |
| 2 | ~ 4.14 to 6.68ccf | $1.62/ccf |
| 3 | ~ 6.81 to 8.69ccf | $3.92/ccf |
| 4 | ~> than 8.75ccf | $14.53/ccf |
| **MNWD Tiers** | | |
| **Tier** | **Usage (per person per day)** | **Price** |
| 1 | Up to 8.7 ccf | $1.41/ccf |
| 2 | [Actual Evapotranspiration (inches)]x[Irrigation Area ($ft^2$)x[0.8(Plant Factor)][29] | $1.61/ccf |
| 3 | Exceeding 25 percent of Tier 1 + Tier 2 budget | $2.49/ccf |
| 4 | Exceeding 50 percent of Tier 1 + Tier 2 budget | $4.25/ccf |
| 5 | All remaining water usage | $9.04/ccf |

plies. The best way to deal with this issue is to isolate particular costs within their utility.[30] For example, the costs involved in a conservation coordinator position, educational efforts, and enforcement efforts can be attributed to upper tiers. Costs related to peaking characteristics of different customer classes can be used to spread rates across and within a customer class.

Existing metering techniques or smart meters can track water usage peaking and the cost could be incorporated into the rates of customers. MNWD uses an AWWA manual method to include peaking costs in daily as well as seasonal demand, as part of their extra capacity costs.

[27] We compare only residential tiers in this table.

[28] ETAF implies Evapotranspiration Adjustment Factor. ET is the amount of water that is lost due to evaporation and plant transpiration. ET will vary due to factors such as wind, humidity, and temperature. The evapotranspiration adjustment factor (ETAF) is a coefficient that adjusts reference evapotranspiration (ETo) values based on a plant factor (PF) and irrigation efficiency (IE) and is used to calculate the maximum amount of water that can be applied to a landscape.

[29] Irrigation Area ($ft^2$) is the amount of irrigated area per parcel, based on county assessor parcel data and the district's Geographic Information System (GIS), site measurements for all nonresidential accounts, and aerial imagery where appropriate. The plant factor reflects the water needs of specific types of plants. Currently the district uses a plant factor of 0.8, which is associated with water-thirsty turf grass.

[30] California Urban Water Council, Michael Colantuono (Colantuono, Highsmith, and Whatley PC), May 2015, <http://mavensnotebook.com/2015/07/23/water-rate-making-after-capistrano-taxpayers-association-v-san-juan-capistrano/>.

LADWP takes seasonal peaking into account as part of their cost of service.[31] The cost of distribution and ongoing supply can be tied into rates under Proposition 218 limitations. Agencies can incorporate these marginal costs imposed on the system (e.g., higher pumping requirements, depreciation, operations and maintenance) into customer rates that cause a spike in the demand.

The appellate court concluded in the SJC ruling that the trial court erred in stating that Proposition 218 does not allow public water agencies to pass on capital costs of improvement to provide additional increments of water such as building a recycling plant. The court clarified that "service" cannot be read to differentiate between recycled water and traditional potable water. The appellate court found that the capital improvement cost can be passed on to customers to provide additional water for immediate and future continued water supply. IRWD follows a similar approach in passing their cost of capital improvement to customers and, based on the above ruling, their approach should be immune to Proposition 218 challenges.

**Set Rates Based on the Costs Associated with the Production, Storage, Supply, Treatment, and Distribution of Water.**

The appellate court further clarified in the SJC ruling that Proposition 218 allows passing on any costs associated with the production, storage, supply, treatment, and distribution to customers. This implies that as long as the agencies can justify their rates with these costs, their rate structure should not be vulnerable to a Proposition 218 challenge.

Production costs might include building a water recycling or desalination plant, treatment costs can include the cost of treatment required for different levels of water quality, and distribution costs may include building new supply pipelines to meet higher demand or fixing old pipelines that have deteriorated due to pressure on the system (EPA finds high water pressure increases the likelihood of leaking pipes).[32] MNWD and LADWP have functionalized their cost of service based on most of the above components and allocated the costs based on customer service characteristics.

**Setting Rates Based on the Longer Timeframe of Capital Cost**

To accurately functionalize cost based on various components of water supply, long run costs associated with production, distribution, etc., must often be incorporated into rates. For example, a recycling or desalination plant requires a longer time frame for construction and operation than a residential customer's normal billing cycle. The court emphasized[33] that there is no need to conclude that rates for a recycling plant have to be figured on a month-to-month basis. The court's opinion implies the agencies can consider the time frame in calculating overall capital costs in generating a new supply and pass on these costs to customers.

[31] Water Service Cost of Service Study, Los Angeles Department of Water and Power, 2015.

[32] EPA, 2010, <http://www.epa.gov/owow/nps/nps-conserve.html>.

[33] The appellate court cites *Morgan v. Imperial Irrigation District (2014)* 223 Cal.App.4th 892, in clarifying that the time period for the calculation of the true cost of water can be, given capital improvements, quite long. The court also cites *Howard Jarvis Taxpayers Association, v. City of Roseville,* 97Cal. App. 4th 637, 647-648(2002) and Water Code section 53756 that contemplates time frames for water rates that can be as long as five years.

### Set Rates Considering the Cost of Water Conservation and Efficiency Programs

Conservation is often the most cost effective way to generate additional water supplies and meet higher demand,[34] and agencies can incorporate the costs of conservation into the cost of supply.[35] As conservation provides benefit for all water users, theoretically the cost should be passed on to all customers. However, some agencies tie their conservation charges only to upper-tier customers. If all customers used water at the tier 1 levels, there would be no need for comprehensive water conservation programs.

A 2015 State Water Board workshop on conservation pricing highlighted the need to allocate a greater portion of water conservation and efficiency program costs to those who create the demand. We found agencies differ in how they allocate conservation costs to customers. IRWD allocates a fixed cost to all tiers. MNWD allocates conservation costs only to the upper two tiers. LADWP incorporates their cost of conservation into the long-run marginal cost (LRMC). To estimate long-run marginal supply costs, LADWP identifies the incremental marginal supply source during peak season and allocates the cost to customer classes based on seasonal peak characteristics.

Every user is a marginal user, and each of us imposes the same marginal external cost on society of water scarcity with our demand for every additional unit of water. Inefficient water users in "wasteful" tiers impose a larger negative externality or scarcity cost on society by leading to faster depletion of water resources. This is especially true for groundwater, which can take years, decades, or even centuries to recharge depending on the location and degree of overdraft.

This scarcity cost is not currently accounted for in setting rates for upper tiers. Studies are needed to quantify these costs so they appropriately reflect the significant additional cost that results from decreasing or even eliminating groundwater supplies. As groundwater is generally among the cheapest available water sources, its elimination through overdraft would lead to significant cost increases as agencies would need to source all water from more expensive supplies. A possible avenue to include this cost is to incorporate it as an additional conservation cost or an additional necessary infrastructure cost (e.g., greater surface storage needs if aquifer storage declines) and charge it to the upper tiers that are imposing the larger negative externality on society.

The lower tiers don't contribute to significantly faster depletion of the resource and should not be assessed the cost. This approach may be a bit challenging as it can be countered with a reasoning that the overall demand generated by all tiers drives the scarcity of water resource and hence all tiers should be charged. Whether tying a fixed conservation cost to all tiers or charging it to the customers with greater demand is the most effective approach to conservation is an issue that needs more analysis and discussion. In either case, rates should be proportional to cost of service as required by Proposition 218.

### Incorporate Fixed Costs as a Higher Percentage of Water Rates

Revenues earned from charges on water consumption currently constitute the largest part of utility revenue. However, current mandatory conservation efforts have demonstrated the vulner-

[34] Tchobanoglous and Raucher, "The Opportunities and Economics of Direct Potable Reuse, Water Reuse Research Foundation," 2014.

[35] "San Juan Capistrano: Is This The End Of Tiered Rates?" Kelly J. Salt, Southern California Water Dialogue Meeting, June 2015.

ability of long-term revenue stability when rates are tied to consumption.[36] Keeping this vulnerability in mind, recent research has shown that with a different kind of revenue model, conservation can be pursued without putting revenue at risk.

Fixed costs currently constitute a very small portion of total revenues even though infrastructure costs constitute the bulk of the fixed costs and there is a continued need for better infrastructure to keep the water flowing reliably (Eskaf et al. 2014). Hence, there is a need to raise the fixed costs to generate enough revenue to fund capital improvements and the operation and maintenance of existing infrastructure even as conservation increases. Fixed revenues range from one percent to 93 percent of total revenues, with most utilities ranging from 20 to 65 percent.[37]

Utilities can likely shift to newer revenue models such as the Peak Set Base Model, which has the potential to drastically increase revenue stability without completely sacrificing conservation pricing. The Peak Set Base approach shifts the majority of revenue requirements to a base charge that is annually reset for each customer based on historic usage linked to cost of service (Eskaf et al. 2014). The rationale for this is that residential customers' historic use, particularly peak use, has a closer relationship to the capacity demands a customer puts on a system than the maximum flow-through capacity of a residential meter.

The MNWD approach contains a similar methodology to incorporate these costs into their rates as the "extra-capacity cost," which is similar to the peak set base charge. As discussed earlier, the costs of distribution and ongoing supply can be tied to rates under Proposition 218 and thus these marginal costs could be incorporated into the rates of customers with higher demands.

**Rates Should Incorporate Penalties for Excessive Water Use**

Another option agencies may consider to help achieve conservation goals under Proposition 218 constraints is to incorporate penalties in the rate structure. If agencies set a rate structure with a justifiable water budget and apply penalties for exceeding the budget, the approach is consistent with Proposition 218. However, the penalty structure needs to comply with other state laws and must be justified.[38]

There are different ways agencies can incorporate penalties to prevent wasteful water use. The city council of Santa Monica adopted a penalty system to encourage compliance and penalize noncompliance. When a responsible party exceeds an applicable water use allowance, a penalty may be imposed through administrative action. The first violation penalty is $250, the second (within 12 months of the first) is $500 and the third penalty (within 12 months of the second violation) will be approximately $1,000. Chronic violators can have their water physically reduced or shut off.[39]

The city also established residential water conservation thresholds to reward customers that have already taken conservation measures. Customers using less than or equal to the threshold

[36] The city of Santa Barbara stands to lose $5 million in revenue if the city hits the 20 percent target. <http://bigstory.ap.org/article/a9cd47e649b2459a9960e4fab3c68291/california-water-rates-rise-cities-lose-money-drought>.

[37] Peer Survey: Revenue Structure of Various Wholesale Water Agency, Metropolitan Water District of Southern California, 2011.

[38] CA: Governor Brown Emergency Drought Declaration, <http://www.water.ca.gov/ waterconditions/declaration.cfm>.

[39] Water Shortage Response Plan, City of Santa Monica, 2015.

will not be required to reduce 20 percent from their 2013 water usage baseline.[40] IRWD proposed a second step increase to the inefficient and wasteful tiers to be applied if customer demands for water in these tiers exceed the SWRCB required reductions, as these demands could require IRWD to pay penalties to the state or other additional costs for not achieving its targeted reduction.[41] Advances in technology can help agencies track and penalize wasteful use of water. For example, East Bay Municipal Utility District (EBMUD) installed real time meters for wasteful users to track their peak water use in real time.

**Rates Must Be Justifiable**

Several different court decisions have pointed out that there can be different methods of setting rates. In the *Griffith v. Pajaro Valley Water Management Agency* case, the court noted that Proposition 218 does not require that property-related fees be calculated on a parcel-by-parcel or individual basis. Rather, the court determined that grouping similar users together (i.e., calculating fees class by class) is a reasonable method of allocating the cost of service.

Based on this ruling, coast allocation may be done at the customer class level and not necessarily at the parcel level.[42] Thus, both the individual and collective benefit of a class should be considered while fixing rates. There is no "one rule" for setting a rate structure that is cost-justifiable. Rates will vary largely by location depending on water use, geographical characteristics, and water supply sources in that location.[43]

The agencies can follow different methodologies to functionalize their costs as long as they are justified. IRWD, MNWD, and LADWP cost of service methodologies have similarities and differences. In some cases the agencies pass on incremental costs to upper tiers through the commodity cost (e.g., cost of water per acre-feet [IRWD]) and sometimes through the service cost (MNWD, LADWP).

Besides sending a far stronger and more effective conservation signal, literature suggests that IBP is a more equitable pricing structure than uniform rate pricing. Uniform rates typically increase by an equal percentage across all user and income groups, which can create a burden on low users or low-income groups. The Environmental Protection Agency considers it to be a high burden if households spend more than two percent (US EPA)/1.5 percent (Cal-EPA) of their income on paying water bills.[44] With IBP, households with smaller water consumption pay a lower marginal price than households with higher water consumption (Olmstead, Hanemann, and Stavins 2007).

[40] Santa Monica Rent Control Board, 2015.

[41] Irvine Ranch Water District, Cost of Service Study, May 2015.

[42] "San Juan Capistrano: Is This the End of Tiered Rates?" Kelly J. Salt, Southern California Water Dialogue Meeting, June 2015.

[43] Caroline Mini, "Residential Water Use and Landscape Vegetation Dynamics in Los Angeles," Ph.D. Dissertation, University of California, Los Angeles, 2013.

[44] <http://www.capradio.org/58711?utm_source=feedburner&utm_medium=feed&utm_campaign=Feed percent3A+CapitalPublicRadioLatestNewsRSS+ percent28Capital+Public+Radio percent3A+Latest+News+RSS percent29>, Fisher, Sheehan & Colton Public Finance and General Economics.

## VI. Conclusions

The SJC court ruling can pose a possible impediment to using a tiered rate pricing strategy as an effective conservation tool. In a statement released in April, Governor Brown said, "The practical effect of the court's decision is to put a straitjacket on local government at a time when maximum flexibility is needed."[45]

The urgency of decreasing water demand through conservation strategies requires a pricing mechanism that can have a direct and immediate impact on reducing excessive demand of the scarce resource. Academic research findings and practical efforts by the agencies have shown that tiered rates are an extremely valuable tool for reducing inefficient use of water and helping in more water savings, both of which are critically needed during California's current drought conditions.

The court's recent decision on the SJC case may act as a major deterrent in using this valuable tool towards water conservation. The SJC case may have the consequence of flattened tiered rate structures that don't send a strong enough economic signal to reduce consumption by profligate water wasters. Setting up a direct correlation of rates with cost of service is not an easy task and will require a significant amount of time and resources. Agencies such as IRWD, MNWD, and LADWP have demonstrated some of the best practices to set IBR while complying with Proposition 218 requirements.

In this paper, we suggest several potential ways to set rates that can help agencies address the Proposition 218 limitations and achieve conservation goals. The suggested strategies include setting rates based on the cost of different sources of water, isolating different types of costs involved in supplying water, incorporating the cost of conservation into the rates, considering the time frame involved in setting up a infrastructure for new supply or distribution, including fixed cost as a higher percentage of the rate, adding penalties for excessive water use, and strongly justifying the rates cost structure.

Finally, considering the effectiveness of pricing tools in achieving conservation goals, a future amendment to Proposition 218 would make the development of conservation-based rate structures far easier to develop and approve in a manner that can withstand legal challenge. At a time when we need the most efficient management of resources and quick action to conserve water, water agencies are investing significant resources trying to limit their liability under Proposition 218 instead of investing in more effective conservation efforts.

[45] <https://www.gov.ca.gov/news.php?id=18928>.

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