White Paper: Problems in Western Municipal Water District Water Budget Planning and Shortage Emergency Plan Based on Past Performance

Brett D. Fleisch, Ph.D.

Version 1.15

Feb 3, 2015

Abstract

This discussion of the Water Shortage Emergency plan has a focus on the basics of the Western Municipal Water District strategy that uses a Water Budget Plan that is a significant source of concern as the basic treatment of all customers in the water district. This analysis is based on whether the water is turned off or turned on. The focus of this document is to discuss the serious issues in the Water Budget, how WMWD really operates, and how the issues pertain to the plan that make little scientific sense. We begin with a review of past policies and how they have affected customers. We use a single case study as the basis for review of the customer base. We provide arguments that the customer's budget is undecidable and provide an inductive proof that the cost of N gallons of water has N possible prices.

BACKGROUND

Western Municipal Water District Customers are faced with nonsensical science to discern. We begin by examining what happens to customers whose water is cut off due to an unexpected vacation or leave of absence from the residence. We then examine the general water allocation plan in detail for when the water is on. We note various problems in the science in the WMWD approach. The final analysis of their approach is that each property has to be manually examined to determine the irrigation area as shown in this white paper. We provide arguments that the customer's budget is computationally undecidable and provide an inductive proof that the cost of N gallons of water has N possible prices.

Customer Charges on Water Cutoff and Nonuse

There are several problems with WMWD policies. One significant policy departure from the norm is described as "Water customers are charged for services not provided and for services not used". Western Municipal Water customers are expected to know about any departures from their property even if unexpected. Specifically, they state "if you are going to be gone for an extended period of time, you can call us to can stop your service and you will avoid the monthly service fees. However, when you call to reactivate your service, you will be charged a $10.00 processing fee and possibly a deposit equal to two times your average bill. If you do not wish to cancel service, you will be billed for the service charges and the bills will become delinquent if not paid. Unfortunately WMWD cannot refund your bills, as the service was provided for that time period and we received no request to stop services."

The last statement is perplexing as WMWD can cut off the customer's service but blames the customer for not having cut off the service themselves. WMWD then charges the customer as though WMWD had not

cut the service off, despite disconnection. For example, the equipment cost for a customer with a 1" valve even after the water is cut off is roughly 43.00 per month whether the water is off or on. The valve is on the customer's property and the customer charges no fee to WMWD to rent the space for the valve.

WMWD "valves" are not rent free from WMWD while they are away from the property with the water cut off (perhaps due to it being cut off while away). WMWD charges the customer for the valve on the property; there is no WMWD plan for allowing the customer to purchase the valve. This would mean there would be no monthly charge while not providing water to the customer. Currently, there is strong evidence that WMWD charges customers in the Water District when there is no service provided. For example, a bill for 2013 showed that one customer had a bill which was cleared in August to 0 balance, but the water cut off in the period between August/September to 0 units usage for most of the period until Dec 14, 2013. A typical bill from Western continued to bill for the 0 units of usage at roughly 43.00 per month. The total bill for not using the water while it was cut off continued to accrue at the rate of:

i. the charge "for the valve"
ii. the charge for "reliability"
iii. the bill to restore the water which had a mere one month in arrears as it reached one month of water not paid for (but continual charges for items i and ii above).

Thus, WMWD continued charges for having a valve where the customer resided since 1992 that measures no water being used (during 3 months of cutoff) each month for 43.00/month. "Although you did not use any water from 9/3/13 to 12/2/13, there are other fixed monthly costs associated with providing water service to your property" WMWD stated.

A simple bill where Western cut off the water for nonpayment 1 month for at most minimal usage needed a 300.39 payment. The figure shows in September, October, November and until December 14 little to no water was used. These charges are listed on a monthly bill as System Charge and Water Reliability Charge and are based on the size of the water meter. Since the customer in the example has a 1-inch meter, the monthly System Charge is $37.43 and the monthly Water Reliability Charge is $4.30, for a total of $44.16. These charges are billed to customers every month whether they use water or not after WMWD cuts the water off. Further, per the District Ordinance, when an account is disconnected due to non-payment it can only be reconnected when the account is brought to a $0 balance. Table 1 shows this more clearly.

To summarize, Table 1 from a screen snapshot shows the example. The customer is blamed for not telling WMWD about being away from the property. One would expect that there are no charges especially after WMWD decides to cut off water. In this case, the customer still pays. Overall, this makes it a "race" to see who disconnects water service first.

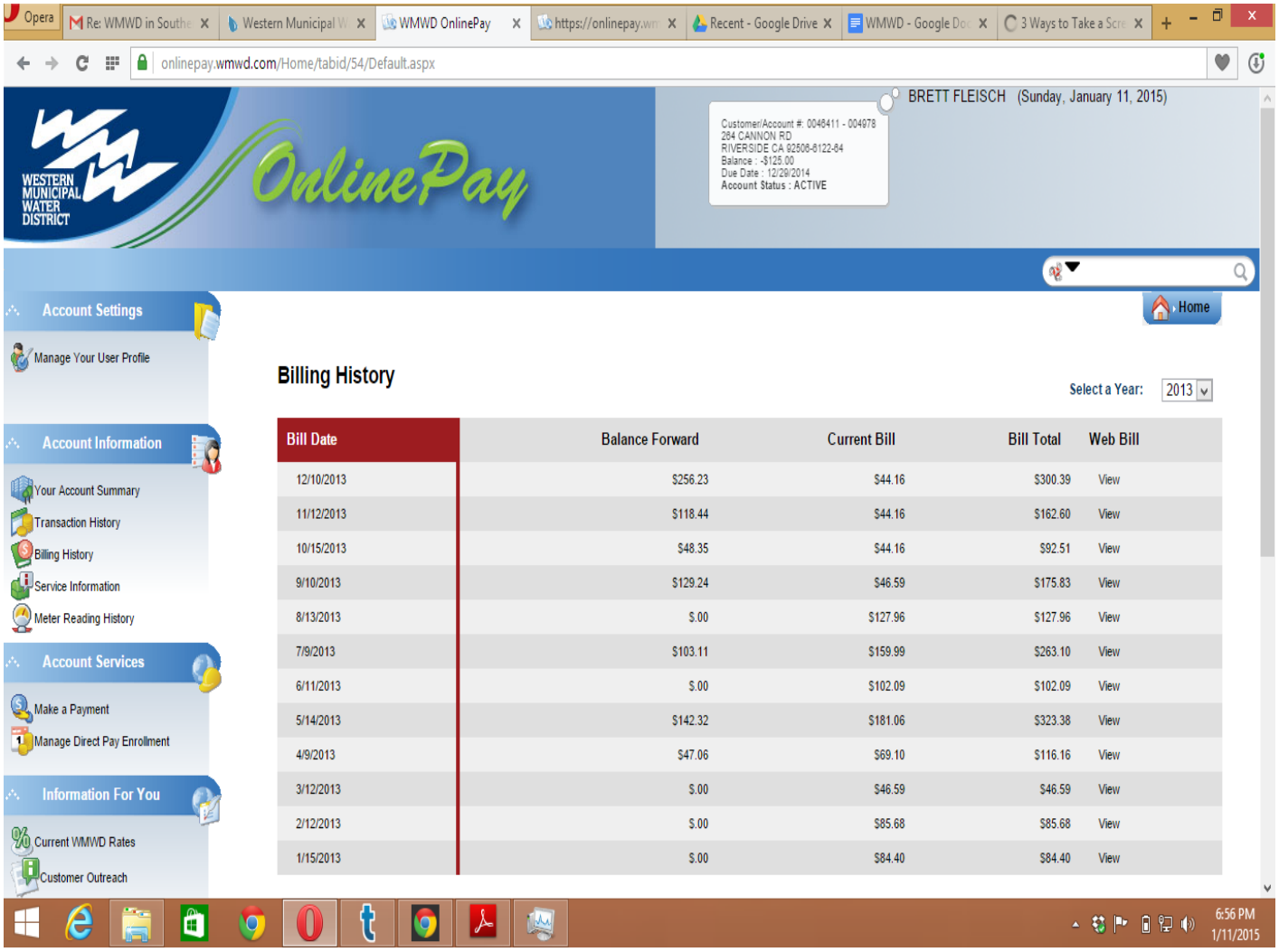

Table 1

Customer Charges for Water Use

On July 13, 2011, following a public hearing and six months of public workshops, Western's Board of Directors approved the implementation of a new water budget rate structure. The rate structure is designed to provide water customers with a signal of efficient water use based on indoor and outdoor water use metrics found in state legislation (AB 1881 and SBx7-7). Single-family residential budgets are built primarily on two factors – persons per household for indoor water use, and landscape area for outdoor water use. Additional factors, such as a swimming pool or in-home licensed child care for example, are considered through a formal adjustment process.

The bulk of the WMWD idea is to take the lot size and give a percentage if it as the permissible irrigated area unless the customer protests and files a form. The specifics are: Western used the following table, derived from the water demand model, for all customers to determine a default irrigated area:

The table below basically deprecates the amount of land one owns given in the county records. In fact, originally WMWD blamed the county for the amount of irrigated area when I inquired. However, when I checked with county officials, they clarified that county officials merely provide the amount of land I own to WMWD. WMWD backpedaled and indicated they deprecate the land according to the table. The customer is given an amount of land to irrigate as a percentage specified in the table. This is like purchasing a pie at the grocery store, paying for it, and then throwing ⅔ of it away before leaving the market and calling it "eatable area".

This policy leaves billing problems to filing a "form or declaration of malcontent" called a "Water Adjustment form". Until WMWD receives the form they will not adjust matters. After receiving the form, they provide no refunds for the previous wrong bills, wrong amounts, or wrong irrigated land use. The table above is from a "water demand model" which is merely the table above with little published science to back it up. The formula in the table would better indicate the number of cubic gallons of water needed to irrigate the area. WMWD reduces the land to a mere percent of what the customer owns. One could argue this is illegal; other argue it's just poor science.

Parcel (Property) Size Range	Irrigated Area - Percent of Known Parcel Size	Landscape Area Caps (sq. ft.)
≤ 0.19 acre	**35%**	3,000
0.2 to 1 acre	**31%**	10,890
1 – 2 acres	**34%**	10,890
2 – 3 acres	**24%**	10,890
3 – 5 acres	**15%**	21,780
5 – 10 acres	**12%**	21,780
> 10 acres	**4%**	21,780

While not around nor in town, WMWD stated "Based on the table above, your default irrigated area was estimated to be 31 percent of 8,712 square feet, or 2,701 square feet. In a customized letter dated August 17, 2011, Western explained the default factors, projected future water budgets for your property based on historical weather data, and explained how to request an adjustment if the default values were not representative of your actual site."Of course, the above letter was not received by the customer and a later billing dispute required the property be surveyed to obtain nearly 2.1 times the original amounts described be given to the customer. The specific adjustment shown below for one customer shows the original value of misbilling of 2701 had to be significantly adjusted from the default values. Specifically one customer stated(revised):

> **Dear Officials:**
>
> **I think 35% of my land being the calculated area I must irrigate is far from realistic. This formula appears to take my irrigation area and it is being pro-rated when [most of it] must be watered. I object but was not around at the time this passed (in Thailand). I think 35 percent of my land minus house footprint is far from a reasonable allocation for use. [actually square footage minus house footprint is about right]**

Item 1 – lot size

Based on County of Riverside parcel data, your home at is currently listed as 0.2 acres which is 8,712 square feet (43,560 sq. ft. per acre * 0.2 acres). In your emails you state that your property is 0.25 acres or 10,890 square feet. Western reviewed aerial imagery (see attached) and has digitally measured your property as 9,472 square feet (0.22 acres). This 432 square feet more than the irrigated area that you requested on your water budget adjustment form received by Western on June 19, 2014. Based on the digital measurement, your irrigated area is approximately 5,845 square feet. The following provides a calculation of your irrigated area.

	Item	Area (sq. ft.)
	Parcel Size	9,472
-	House Footprint	2,914
-	Concrete Areas	553
-	Patio Area	161
=	Irrigated Area	5,844

Item 2 – default irrigated area

To calculate the default irrigated area, Western divided all customers into six lot sized groups (shown in the table below), reviewed historical water demand for these customer groupings, and calculated a percent of irrigated area based on the water use within the groups. WMWD states "we explained this methodology in the public meetings leading up to the adoption of the rate structure and provided every customer the opportunity to change the irrigated area through the adjustment process. In my email to you dated June 26, I provided a copy of the letter sent to you that explained the adjustment process".

Item 3 – water budget calculation

Single family residential water budgets are comprised of two components – indoor and outdoor budgets. The indoor water budget (IWB) is determined by a customer's household size and a standard consumption per person. Western's IWB formula is as follows:

$$IWB = GCPD * HS * DS * DF_{indoor}$$

Where:

· GPCD – Gallons per capita per day. The standard consumption per person per day is set at 60 gallons based on the *AWWA Research Foundation Residential End Uses of Water,* which stated that the mean daily water use per capita is 59.8 gallons, not including leaks. It should be noted that the Water Conservation Act of 2010 (SBx7-7) sets the efficient level of indoor residential water use at 55 gallon per person per day.

· Household Size – Number of residents. The default values for household size is based on California Department of Finance Statistics for each customer class:

o Single Family: Household Size = 3 persons

· Days of Service – The number of days of service varies with each billing cycle for each customer. The actual number of days of service will be applied to calculate the indoor water budget for each billing cycle.

The formula to calculate an outdoor water budget (OWB) is as follows:

<image004.png>

Where:

· "*d*" is the number of days in the billing period.

· ET_0 is measured in inches of water during the billing period based on daily weather data acquired from HydroPoint Data Systems, Incorporated (HPDS). Western's service area has 450+ individual weather microzones and each microzone is 0.06 miles square. Western updates the actual daily ET for each microzone on a daily basis through a secure link to the HPDS FTP site. This allows weather changes to be accurately updated for every account in the District on a daily basis.

· ETAF is defined using the Table shown below.

· Landscape Area is also referred to as Irrigated Landscape Area (in square feet).

ET Adjustment Factors by Month (ETAF)

Month	Existing Account	New Service Account
Jan	0.61	0.53
Feb	0.64	0.56
Mar	0.75	0.65
Apr	1.04	0.91
May	0.95	0.83
Jun	0.88	0.77
Jul	0.94	0.82
Aug	0.86	0.75
Sep	0.74	0.65
Oct	0.75	0.66
Nov	0.69	0.60
Dec	0.60	0.52
Average	**0.80**	**0.70**

Summary of Customer Charges for Water Use

The above example shows 2701 using a percentage grid as the default (which was used for all customers) was adjusted to 5844 when an analysis of the property was given more thought by WMWD. WMWD calls the table above part of a "Water Demand Model". In reality, the table is simply poor science behind a calculation that later was empirically shown in this report to be 100% off.

Not all customers receive the correct amount of irrigated land and this leads to significant revenue for the company. Until the customer protests, the customer is billed in higher water tiers than

otherwise would be normal. This amount of overbilling is perplexing and the company would not adjust past bills for their wrong formula being used on customers and the attendant overcharges.

I was told 80% of WMWD customers have protested the irrigated water area of their property.

History: A Case Study of Congestion Manipulation in ISO California Energy Markets

> "On May 6, 2002 FERC release three memos that gave an overview of a family of schemes designed to take advantage of the California market. While some of these schemes were simply arbitrage, others involved falsifying filings at the ISO and collecting congestion fees from imaginary transactions.
>
> Stripped of their complexities, these schemes are simply a modern version of check kiting -- a way of collecting money from unsuspecting victims by creating a cycle of transactions without underlying economic or engineering substance"
>
> This case study is given at www.mresearch.com/pdfs/19.pdf
> This 17 page document describes Enron's continuing role in imaginary congestion in California's ISO (Independent System Operator) market.
>
> "All told, Enron's schemes included a number of other parties, selected for their transmission access, location, and the ability to obscure regulatory review"

The Emperor Has No Clothes

The "Water Demand Model" has merely the equivalent of tossing the customer's land out by deprecating the amount of land to a fraction of its value. The default is simply to not use satellite measurements. This showed less than half the irrigated land when using the WMWD table versus satellite measurements that approximate the property size for watering more accurately; more than twice the original value indicates a gross inaccuracy in the science. Increasing the irrigated land by a factor of two reduced the customer out of higher cost tiers that have "unsustained water use". The problem with the bad science is the amount of overage costs for the customers until corrected.

The "Water Demand Model" also has "weather microzones of .06 miles square" that measure whether there was participation in the area. This is incorporated into the formula on a daily basis through a secure link to the microzone measuring site. This allows weather changes to be accurately updated "for every account in the District" on a daily basis. This provides an aspect of real time reporting to adjust the amount of water a customer can use daily if it rains out. The accuracy of this science has not been published nor geared for accuracy in reports this author is aware of.

Schemes such as in the McCullough Research report (http://www.mresearch.com/pdfs/19.pdf) can be used to create fraud in the reporting of any result. The accuracy or "control" calibration is not explained in WMWD reports. Simply adding days that increase participation measurements when no rain occurs can increase revenue by creating an artificial overages of customer use. This is similar to Enron creating unneeded needs through the measurement system or backbone infrastructure. Security of the system being open to fraud implies "the emperor has no clothes and no protection". No protection means a lack of regulatory review.

Summary of Past Concerns

1) The billing for water "system charges" when no water was used
2) The billing in higher tiers for less land allocated when more land needs to be watered when measured carefully
3) The excessive charges from 1 and 2 above because of higher tiers
4) The lack of refunds for water overbilled even after a form is received and land size adjusted
5) The lack of scientific reports to justify the science; it appears the emperor has no clothes
6) The lack of published research to indicate where the fraud ends and the science begins
7) The possible fraud in microzones from lack of a "control" study in securing, precision and accuracy showing some granule of engineering science

PRESENT CONCERNS

A basic idea in water conservation is to set goals for customers to achieve by conserving water. Responsible water use means the customer 1) understands what water the property uses by examining past bills that measure water use and 2) the customer attempts to stay within the limits of a *budget*. Once the customer's irrigated land and indoor use are understood by both parties, the basic idea is to stick within the water budget. The customer understands how much water the household uses and knows how much the budget should reflect as *invariants* of the property.

Example [2] sets an expectation of a water budget based on the invariants of the property such as indoor and outdoor size of the property. The variants of the property include values that the customer cannot know about *a priori* and cannot budget for. This includes the amount of participation that month or the amount sunny days versus cloudy days. The customer cannot reasonably be expected to know these

factors in advance. Moreover, when rain occurs it is advantageous to turn the water off. This largely depends on how much water was measured within your "microzone". Directly across the street may have received measurably less participation; that customer may not have turned the water off assuming there was only drizzle. This variation in human behavior cannot be predicted, cannot be legislated and cannot be expected to be met as part of a budget unless it is a small perturbation in a water scheme.

Example [3] and [4] show much larger variations in the Water Budget column than expected. These are larger variations than the customer can react to. Consequently, the customer was penalized even though within the residence and able to turn the water off. A cloudy day could have been penalized as drizzle and pushed the water budget lower. Further, the Water Budget from the previous month is generally the one used to set expectations for the next month. The budget the customer must meet is not pre-announced; this is because the Water Company can't predict it accurately.

The most significant problem in the WMWD formula is the use of 1) water is a factor, 2) the budget as another factor, but 3) the same water use as last month having a variable cost. This is because the budget may have changed from under the customer's feet from the previous month as in [3][4] The customer is charged different prices each month for roughly the same water use -- in a highly variable budget and further in a penalizing manner(in different tiers).

The outcome of this is that each customer (depending on microzone) is charged a different amount for the same number of gallons of water. In a pricing model, the same commodity has a different price for different customers. The larger the outdoor property, the more the budget is expected to be for water. Smaller properties may be more sensitive to variations in weather as the budgets are slashed and higher tiers are used to penalize the same use.

Problems with Budgets

Computer scientists have well understood theoretical problems that give an indication as to why WMWD policies would be impossible for customers to adhere to. Reference [5] discusses the problem with customers predicting budgets even with the assistance of computing devices. Specifically:

> ...is that many real-world systems are chaotic, that is infinitesimal differences in their conditions at one moment in time can turn into enormous differences at a future time. This is why forecasting the weather is difficult: a small error in measurement at one weather station today (caused, perhaps by a butterfly flapping its wings) can completely change tomorrow's weather a thousand miles away. The problem with predicting the future here is that the current state cannot be measured to sufficient accuracy.
>
> So if the future is inherently, fundamentally impossible to predict, what do we mean when we talk about prediction in the context of knowledge discovery? The answer is that predictive models are not predicting a previously unknown future,

> but are predicting the recurrence of patterns that have existed in the past. It's desperately important to keep this in mind.

Past performance does not necessarily predict the future and the Turing test suggests it is not possible to calculate the correct budget *a priori*. "In computability theory and computational complexity theory, an **undecidable problem** is a decision problem for which it is known to be impossible to construct a single algorithm that always leads to a correct yes-or-no answer[6]". Determining the correct budget, even for WMWD, is undecidable and therefore customers cannot be expected to be able to determine how much water should be rationed.

Reference [6] is careful to point out the difference between two versions of undecidable. Specifically:

> There are two distinct senses of the word "undecidable" in contemporary use. The first of these is the sense used in relation to Gödel's theorems, that of a statement being neither provable nor refutable in a specified deductive system. The second sense is used in relation to computability theory and applies not to statements but to decision problems, which are countably infinite sets of questions each requiring a yes or no answer. Such a problem is said to be undecidable if there is no computable function that correctly answers every question in the problem set. The connection between these two is that if a decision problem is undecidable (in the recursion theoretical sense) then there is no consistent, effective formal system which proves for every question *A* in the problem either "the answer to *A* is yes" or "the answer to *A* is no".

In brief, it is computationally undecidable to compute the budget *a priori* given WMWD's factors and consequently impossible for customers to know what their budget is nor adhere to it monthly.

Example

In example [2] and [4] roughly the same amount of water was used. The Bar charts on each bill indicate that in fact roughly the same about of water was used each month. While there was a variance, for the purposes here let's assume they are the same amount.

Notice the tiers for the billing in [2] versus [4] are substantially different. Because the customer's budget was varied considerably the water had substantially different billing tiers. This indicates that the same product (water) has different pricing per month of the year billed for the same amount of conservation. It is unclear if this is legal.

WMWD calculates the water budget when it prints the bills and does not know what the customer's budget is each month. Again, the budget is computationally undecidable.

Is it Raining Inside My House?

WMWD calculations given in [7] explain the basic methodology to calculate the water use for the "water budget". The water budget is based on the factors that are invariants and variants.

Examining [2] and [4] we see the indoor water budget is varying per billing cycle. This implies its potentially raining inside my house because the indoor water budget was deprecated by the outdoor rain factors (e.g. DF indoor).

For example,

$$\text{Tier 1 IWB Allotment} = \frac{60 \text{ gallons/person/day} * 3 \text{ persons} * 30 \text{ Days} * DF_{indoor(100\%)}}{748 \text{ gallons/ccf}}$$

Reference [7] indicates how the Tier 1 budget is calculated. Specifically, *DF indoor* is a factor which appears to be used in WMWD calculations. Specifically:

> *DF indoor* – Indoor drought factor. This part of the budget equation will be used in extreme dry conditions only if needed because of local supply conditions or if required by regional and State agencies. A lower percentage of the typical or usual indoor water budget could be allocated during extreme drought, supply shortage or emergency conditions. Changing the drought factor will be subject to the approval of the District's Board of Directors. The indoor drought factor will be set at 100 percent, representing 100 percent water budget allotment, in times where no water shortage exist in the District's service area.

The example in reference [2] the calculation should be 60*3*35/748=8.422. The example in reference [4] is be 60*3*29/748=6.98. These are variants in three categories: number of billing days, number of people in the household and the indoor drought factor. For the most part, we are told two of the three are invariants: the number of people and the indoor drought factor.

The emergency plan does not speak about the indoor drought factor despite allowing the Board of Directors to move the customer into higher tiers. As such, the plan has deficiencies in its statement of approach. If the emergency plan is put into affect it could mean the indoor water budget is cut and the customer is potentially placed in higher tiers. In addition, this drought factor reduces the Tier 1 budget in a manner equivalent to reducing the allotment. This happens in Tier 2 by using outdoor rain factors and multiplying those factors against an outdoor water budget. In short, an indoor drought factor, while marginally different is logically equivalent to an outdoor rain factor being moved inside and reducing the indoor water budget by administrative fiat.

Factors that Nail the Customer and lower the Budget

WMWD calculations given in [7] explain the basic methodology to calculate the water use for the "water budget". Overall there are two "screw" factors. One factor is too much rain because too much rain can reduce the outdoor water budget. Another factor is too little rain because that can reduce the indoor water budget. Both of these declarations, reduction of the indoor budget and declaration of emergency are by administrative fiat of the Board of Directors of the water company or the General Director.

Undecidability and Water Budgets

What does it mean to have an undecidable water budget? What are the implications for the use of water in WMWD territory? Determining the correct budget, even for WMWD, is undecidable and therefore customers cannot be expected to be able to determine how much water should be rationed. This focus of undecidability has to do with the outdoor water budget and the "Water Demand Model" that has "weather microzones of .06 miles square". This means the microzones measure whether there was participation in the area. This is incorporated into the formula on a daily basis through a secure link to the microzone measuring site. There are no mentioned audits of the correctness of the microzones, the security of the returned values, the security of the subcontractor's methods.

If a budget cannot be determined at the beginning of the month *a priori* the lack of science is clearly indicated in the approach. The approach insists the customers be *predictive*. Customers are expected to adhere to the budget despite not knowing what the budget is. How can one adhere to a budget that is varying, unpredictable, and at best a guess from the customer to adhere to it?

> In computability theory, an **undecidable problem** is of a type of calculation which requires a yes/no answer, but where there can not possibly be any computer program that always gives the correct answer; that is any possible program would sometimes give the wrong answer or never give any answer at all. More formally, an undecidable problem is a problem whose language is not a recursive set; see decidability. There are uncountably many undecidable problems, ….[8]

One of the most famous problems that is undecidable is *the halting problem*. "In computability theory, the **halting problem** is the problem of determining, from a description of an arbitrary computer program and an input, whether the program will finish running or continue to run forever"[9].

WMWD budgets are undecidable because the outdoor water budget is couched with invariants that cannot be accurately predicted and therefore cannot be adhered to. If WMWD cannot compute the budgets at a minimum 30 days before the budget must be adhered to, the budget is not a budget. It is the optimum consumption amount based on the rain that has already fallen. Since WMWD knows the rain has fallen,

the date for which the customer can apply the on-off sprinkler safeguards has already passed because WMWD is at the end of the billing cycle; the budget cannot be adhered to.

Your Mileage May Vary

Fair pricing of the commodity should be provided to customers. Consider a customer using **N** ccf of water with a budget of **N.** This implies the price will be computed from Tiers 1 and 2, as expected. Consider the same customer using **N** ccf of water with a budget of **N-1.** This implies 1 ccf of water goes into Tiers 3/4/5. Consider the same customer using N ccf of water with a budget of N-1, N-2, N-3, N-4, etc. for each of the cases. Each creates 1 ccf, 2 ccf, etc.up to N-1 ccf that goes into Tiers 3/4/5 This shows that the same amount of water can have ~ **N** prices for the **N** ccfs of water.

Undecidability and Water Pricing Summary

WMWD is responsible for fair pricing of the commodity it provides. We have observed the budget is tied to the individual customer's calculation of the commodity price. Nonetheless, the budget is undecidable and the indoor water budget equally so. This is because the administrative whims and their expected change date and its disclosure can make the drought percentage also undecidable (in non theoretical terms -- but based on when the disclosure occurs). Moreover, this violates the tenets of Tier 1 water supply which the consultant report calls "essential indoor water use". The budget could be called OPT (for optimum) as a better name.

A pricing scheme that is unfair to customers because it discriminates based on the customer or his/her purchases may be unfair and thus illegal. This report has discussed unfair pricing policies that penalize customers unfairly with an undecidable water budget and an indoor water budget that can be altered by administrative fiat. The pricing schemes this report observes are much like driving to a gasoline station and buying ten gallons of gas at the pump in a Jaguar vs a Honda. The approach WMWD uses advocates charging different prices because the Jaguar uses more gas per gallon and can't be made to conserve for the same amount of commodity.

The legality of unequal water pricing per customer/(or equally well called a household/street address) remains questionable in terms of Federal laws. This may need additional legal opinions from the Department of Justice.

A question remains whether the concerns in this document show WMWD to be using science as specious as issues described in the Enron document[1]. A concern as simple as when WMWD reads meters influences the number of days in the billing cycle and thus the budget that month. In fact, the number of days in the month are less a concern for a customer than when the meter is read. A mere variation in the number of days in the billing cycle not being known, standardizable and plannable for is a concern whether you might be thrown into a higher tier of unsustainable water use that month.

REFERENCES

[1] http://www.mresearch.com/pdfs/19.pdf

[2] www.brettfleisch.com/WMWD-10.pdf

[3] www.brettfleisch.com/WMWD-11.pdf

[4] www.brettfleisch.com/WMWD-12.pdf

[5] https://skillicorn.wordpress.com/tag/turing-machine/

[6]http://en.wikipedia.org/wiki/Undecidable_problem

[7]http://www.brettfleisch.com/WMWD-response.pdf

[8]http://en.wikipedia.org/wiki/List_of_undecidable_problems

[9]http://en.wikipedia.org/wiki/Halting_problem

see also

www.brettfleisch.com/WMWD-8.pdf

www.brettfleisch.com/WMWD-9.pdf

BIOGRAPHY

Professor Brett D. Fleisch served as Associate Professor of Computer Science and Engineering at the University of California, Riverside. He was promoted to tenure in 1997. He received the Ph.D. degree in Computer Science from UCLA in July 1989. He received the B.A. degree in Computer Science at the University of Rochester, the M.S. degree in Computer Science at Columbia University in 1981 and 1983, respectively. He joined the UCLA computer science department in September 1983 where he served as Research Assistant in the Locus group. His dissertation was entitled "Distributed Shared Memory in a Loosely Coupled Environment".

In the past, Fleisch has served as a consultant and summer employee at Xerox Corporation's, Webster Research Center, IBM Corporation's Thomas J. Watson Research Center, the Educational Testing Service in Princeton, New Jersey, The College Board (West Coast offices) and the State of California, Department of Motor Vehicles. In addition, he has also worked at Hewlett-Packard Laboratories, Carnegie-Mellon University, Locus Computing Corporation, and has served as a teaching assistant in the UCLA Computer Science Department. In January 2003 he recently spent a six month sabbatical period at the University of Illinois, Chicago.

Fleisch was Program Director for NSF, CISE Computer Systems Research Program in 2004-2007 as IPA. His research interests are in operating systems, distributed systems, mobile systems, computer security, DSM, fault-tolerance, reliability and availability. Dr. Fleisch has been funded by the National Science Foundation, Digital Equipment Corporation, International Business Machines Corporation (IBM), Hewlett-Packard Laboratories, Computer Marketplace Incorporated, Sun Microsystems, the Office of Naval Research and the UC Micro program. Dr. Fleisch was a member of the ACM, IEEE Computer Society, and USENIX while professionally active.

See c.v. at www.brettfleisch.com/fleisch_vitae.pdf