This technical memorandum is a conceptual draft working document. It is undergoing agency review and is intended for discussion purposes. It sets forth potential tools that might be useful in meeting the 20% reduction target. Also presented are estimates of the amounts of water that might be conserved by implementing some of the tools. We would appreciate your ideas on: 1. the tools identified; 2. any additional tools that may prove useful; 3. the estimated conservation savings; and 4. how we might quantify conservation savings for the "non-quantified" tools. The information in the draft will be updated and presented at our next workshop. Please submit comments by December 5, 2008, to 2020comments@ccp.csus.edu.

Conceptual Draft Technical Memorandum
Task 5 – Potential Conservation Savings from New Actions

November 12, 2008

The previous Technical Memorandum (TM 4) showed that if California pursues water conservation within the existing framework that has been in place since the early 1990s, the state will not be able to achieve its 20% reduction goal by 2020. What will it take to achieve this goal? Here, we explore some of the strategies that can be pursued to help the state achieve the goal.

1 Bridging the Gap

We now turn to quantifying several additional sources of water that were not included in TM 4. These include savings from retrofit of non-efficient clothes washers with more efficient washers, retrofit of residences with weather-based irrigation controllers, several new technologies evaluated by CUWCC as part of its Potential Best Management Practice review. In addition, we explore savings likely if for a specific subset of BMPs (Programmatic BMPs), water suppliers aim to achieve maximum coverage instead of goals stated in the MOU. Finally, we quantify the impact of pursuing aggressive water loss control programs (beyond BMP 3), restricting residential irrigation to only two or one day per week, and promoting recycled water.

1.1 Efficient clothes washers

On February 4, 2004, by a Commission Vote of 5-0, the California Energy Commission adopted water efficiency standards for clothes washers. It is a tiered standard based on the "water factor" of the clothes washer, which is the number of gallons per cubic foot of drum capacity. In 2007, the maximum water factor to be allowed was 8.5 per machine. By 2010 the standard would have been further reduced to 6.0. Conventional washers have a water factor of about 13.3, thus the standards would reduce per-load water use 36% by 2007 and 55% by 2010. Federal approval is still required, as the Federal Energy Policy Act of 1992 allows only the federal government to regulate residential clothes washers unless a state waiver is approved. California is currently appealing before the Ninth Circuit US Court of Appeals the US Department of Energy's denial for a waiver of federal preemption for the State's water efficiency standards for residential clothes washers.

Several MOU signatories since 2005 have begun to promote efficient clothes washers through rebate programs (BMP 6), and market forces are also transforming the models retailers are offering to consumers. The impact of all these factors remains uncertain and difficult to model. For the purpose of this TM, we estimate savings in the following way: We first estimate savings assuming that the abovementioned efficiency code had gone into effect as intended; but then we halve this estimate under the assumption that active rebate programs and natural turnover will get us half way to where the efficiency codes would have taken us by 2020. This "half" estimate roughly works out to 3 GPCD.

1.2 Residential weather-based irrigation controllers

We assume that the top quarter of single-family homes in terms of landscape area can be cost-effectively fitted with weather-based irrigation controllers. Many suppliers are experimenting with this measure even though it is not specifically included in any BMP. Savings from this measure work out to between 3-4 GPCD by 2020.

1.3 Accelerated Coverage Goals for some BMPs

Instead of implementing BMPs within the existing voluntary framework, the State can require that certain basic conservation measures be pursued by all water suppliers regardless of cost-effectiveness, to the maximum coverage goal. For example, the State can require that no residential or commercial building can have a non-efficient toilet, urinal, or showerhead by 2020. This would generate additional savings since active programs and natural turnover are not expected to raise the saturation of these devices to 100% by 2020. Since the requirement would apply to all, it would be fair. And it would force suppliers to act even in regions where the avoided cost of water is still erroneously perceived to be low.

For the purpose of quantification, we have included the following measures and corresponding 2020 coverage goals in our list of affected BMPs:

- Saturation of non-efficient toilets and urinals in residential and commercial buildings is made to drop below 5% in each hydrologic region
- Saturation of non-efficient showerheads is made to drop below 5% in each region (this is expected to happen due to natural turnover anyway, so including this requirement does not contribute incremental savings, but we include it to ensure that such a basic item automatically becomes subject to a field verification program)
- Efficient clothes washer saturation is made to reach a level it would have in the presence of the State's efficiency code (roughly 85%)
- All unmetered connections are converted to metered connections before 2020
- Unaccounted for water is brought down to no more than 10% of total production where at present it is greater than 10% - BMP 3 would be mandatory

Just these five measures are forecasted to save between 7 and 17 GPCD (depending upon the region) over and above what codes, locally cost-effective implementation, and grant funding achieve. The actual data by region are shown later.

Several regulatory initiatives described later could augment agency efforts in achieving these accelerated coverage goals. These include: (1) legislating that all unmetered connections be converted to metered connections before 2020; (2) requiring replacement of non-efficient toilets and clothes washers with latest cgeneration models upon resale; (3) requiring partial or total conservation offsets for new construction; and (4) establishing a certification program for supplier water use efficiency.

1.4 Aggressive water loss control beyond BMP 3

Leak detection and repair in California is still in its infancy. Within most utilities a considerable amount of savings are possible that currently remain unrealized. The new water audit structure promoted by the American Water Works Association and the CUWCC includes a more rigorous standard than BMP 3. Most utilities currently use a percentage of production to evaluate losses, but this does not account for variations in climate and usage.

BMP 3 has already been analyzed in previous sections, which aims to reduce unaccounted for water to 10% of production. However, these goals can be exceeded, as other countries have demonstrated. For example, in the United Kingdom the target for unaccounted water is 30 gallons per connection per day.

Table 1-1 derives estimates of savings that can be achieved by more aggressive water loss control programs. The first two rows show baseline and unaccounted for water in GPCD terms, developed in TM 1. In each hydrologic region, unaccounted for water exceeds 10% of total production. The excess over 10% we expect BMP 3 to tackle. Instead we take 10% of baseline GPCD consumption and convert it into losses per connection by assuming each connection is residential in nature, catering to 2.89 individuals (statewide average household size). So, for example, 10% of North Coast baseline usage amounts to 17 GPCD, which translates into 48 (17 x 2.89) gallons per connection per day. Across the ten hydrologic regions, these losses range between 45 and 100 gallons per connection per day. Then we estimate GPCD savings under two scenarios, one where these losses have been brought down to 40 and the other to 30 gallons per connection per day. The latter scenario yields savings from a low of 5 GPCD for Central Coast to a high of 24 GPCD for the Colorado River regions. The savings potential thus appears considerable.

Table 1-1: Estimated Savings From Water Loss Control Programs Exceeding BMP 3

HR Number	1	2	3	4	5	6	7	8	9	10
HR Name	North Coast	SF Bay	Central Coast	South Coast	Sacramento River	San Joaquin	Tulare Lake	North Lahontan	South Lahontan	Colorado River*
Baseline GPCD	165	157	154	180	253	248	285	248	237	346
Unaccounted Water (GPCD)	24	18	20	22	33	30	39	54	31	50
GPCD Losses not tackled by BMP3 (10% of baseline)	17	16	15	18	25	25	29	25	24	35
Losses per connection gals/conn./day	48	45	45	52	73	72	82	72	68	100
GPCD savings from reducing losses to 40 gals/conn./day	3	2	2	4	11	11	15	11	10	21
GPCD savings from reducing losses to 30 gals/conn./day	6	5	5	8	15	14	18	14	13	24

*NOTE: Data about SFR irrigation in North Lahontan is less reliable. Data about Colorado River region in general is less reliable.

Table 1-2: Estimated Savings From Irrigation Restrictions

HR Number	1	2	3	4	5	6	7	8	9	10
HR Name	North Coast	SF Bay	Central Coast	South Coast	Sacramen to River	San Joaquin	Tulare Lake	North Lahontan	South Lahontan	Colorado River*
Baseline SFR Irrigation GPCD	36	36	36	43	76	73	83	36	96	133
Reduction in GPCD										
Once every 3 days (17% reduction)	6	6	6	7	13	12	14	6	16	23
Twice a week (30% reduction)	11	11	11	13	23	22	25	11	29	40
Once a week (55% reduction)	20	20	20	24	42	40	46	20	53	73

*NOTE: Data about SFR irrigation in North Lahontan is less reliable. Data about Colorado River region in general is less reliable.

1.5 Irrigation scheduling restrictions

Irrigation restrictions can be a very useful tool for reducing water use especially in the high demand summer months. In many areas water use doubles when customers start to irrigate their landscapes. Many utilities use irrigation restrictions during a prolonged drought or when water reservoirs run low. This can be practiced all year to improve water conservation and reduce GPCD. Most of the year-round irrigation restrictions are new policies enacted in response to prolonged drought conditions. South Florida Water Management District and its member cities have recently adopted two-day per week irrigation restrictions. The city of Abilene, Texas has also passed a similar ordinance. Due to the recent nature of these year-round ordinances no detailed effectiveness data are yet available. However, data are available from summer-month restriction programs within the United States (although none from California).

A 2004 study in Colorado (Kenney et al., 2004) offers initial insight into the level of savings that may be possible. Irrigation scheduling restrictions were varied between allowing watering once every three days, twice a week, and once a week. The average savings from these restricted schedules was 17%, 30% and 55% respectively as a percent of total household use from May to August, *but only when the restricted scheduling was mandatory*. Voluntary restrictions did not show any significant savings.

We combine the above percent savings estimates with region specific residential irrigation estimates (in GPCD terms) to derive likely GPCD savings associated with irrigation restrictions (Table 1-2). This is more conservative than the Kenney study which evaluated savings relative to total household water use (although just during the summer months). Also, our estimates do not include the impact of such restrictions on non-residential irrigation.

Using the mid range value which allows twice a week watering, savings are estimated to be between 11 and 40 GPCD depending on the region. If irrigation were restricted to once per week, then the range would be 20 to 73 GPCD.

In practice, irrigation restrictions will probably have to be combined with subsidies that incentivize users to convert their turf into drought-tolerant landscapes, and/or to install drip irrigation. Such “cash for grass” programs have been implemented in California and other states, for example, Nevada.

Irrigation restrictions are most often called into play during times of water shortages. Drought declarations affect investments in water use efficiency, by both the water suppliers as well as the water users. During such times, water suppliers draw from emergency funds and increase rates to support conservation activities. Water users reach deeper into their pockets to replace appliances and fixtures to stay within their water allocations. Both short term and long term measures are employed that often result in permanent water savings. While we cannot project the potential savings associated with response to water shortages, we can anticipate that water shortages will occur between now and 2020 and that water savings will be realized as a result.

1.6 Recycled water

We have collected data from Department of Water Resources and the State Water Resources Control Board to quantify the amount of recycled water likely to be available in each region for offsetting urban use by 2020. These data are presented later in our overall summary (Table 1-4).

1.7 Expected Savings from New Technologies

On the new technology front, several were screened by CUWCC over a three year period between 2004 and 2007. Expert opinion was used to screen out the least promising ideas. The set that remained was subject to a more comprehensive assessment. Some of the evaluated technologies, such as pre-rinse spray valves and steam sterilizers are already being phased in, and therefore were included in TM 4. High efficiency toilets and urinals were also dealt with in TM 4. Other promising technologies such as, residential weather-based irrigation controllers with potentially large impacts were dealt with above. Here we present data for the remainder, where initial assessment indicates the availability of cost-effective, albeit not large savings. These include:

- On-premise laundries (e.g., hotels, hospitals, universities, prisons, etc.)
- Building cooling systems
- Efficient residential dishwashers for new construction
- Vehicle wash systems
- Residential hot water distribution systems for new construction
- Commercial ice machines
- Waterless urinals

Table 1-3 shows expected GPCD impacts of these six new conservation technologies[1]. Taken together they are expected to reduce per-capita demand by approximately 1.2 gallons and 1.6 gallons per day by 2015 and 2020, respectively.

Several points should be noted about this table. First, since these technologies were evaluated at different points in time, the number of units installed and expected annual savings reflect estimates as of the evaluation year. Rather than scale up the number of units installed (stock) using projected rates of population growth, we have simply divided expected acre-feet savings by population in the year for which stock data were available to estimate GPCD impacts. If the number of installed units of each evaluated technology scales upward at the same rate as population growth—and we possess no other data to improve upon this supposition—then converting acre-feet savings into GPCD estimates in this way introduces no errors. Furthermore, the saturation level of each technology by 2015 or 2020 remains uncertain, and swamps uncertainty in how stocks of each technology will grow over time.

The second point to note is that we have no better way of distributing the statewide acre-feet savings potential to each hydrologic region other than by population proportions.[2] This of course implies that the statewide GPCD savings estimate applies equally to each of the ten hydrologic regions.

Third, some regulatory action may be necessary to promote these new technologies. For example, water cooled commercial ice machines would have to be banned to achieve the projected savings for this measure. But Federal preemption may make such state regulation unfeasible in the foreseeable future.

Finally, there are additional technologies, each with small individual impacts that can generate some additional savings. For example, savings from replacing non-efficient urinals with high-efficiency urinals (HEUs using 0.5 gallons per flush) were captured in TM 4. But, if waterless urinals are used as replacements instead of HEUs, savings would roughly increase by an additional 0.2 GPCD by 2020. Savings from other devices, such as pressurized water brooms and dry vacuum pumps, could contribute

[1] *A Report on Potential Best Management Practices, Annual Report-Year 2*, January 2006, prepared for the California Urban Water Conservation Council.

A Report on Potential Best Management Practices, Annual Report-Year 3, January 2007, prepared for the California Urban Water Conservation Council.

A Report on Potential Best Management Practices, Annual Report-Year 3.5, June 2008, prepared for the California Urban Water Conservation Council.

[2] In theory, we could estimate counts of hotels, hospitals, prisons and universities to allocate savings attributed to, say, on premise laundries. Similarly, we could collect data on car washes by region. But the increased allocation accuracy would not be worth the effort given the relatively small GPCD savings associated with each measure.

roughly 0.1 GPCD. Total impact from all these myriad conservation measures can thus be expected to roughly equal 2 GPCD, which is what we use in our final accounting, presented in Table 1-4.

Table 1-3 Analysis of the Future Impact of 6 PBMP Measures

	Conservation Measure						Total from 6 actions
	On-Premise Laundries	Building cooling Systems	Residential Dishwashers[3]	Vehicle Wash Systems	Residential Hot Water Distribution	Commercial Ice Machines	
Total estimated savings potential (acre-ft)	182,000	200,000	118,000			361,505	
years of equipment life	20	20	10			8.5	
Annual savings (acre-feet)	9,100	10,000	11,800	27,600		42,530	
...at assumed penetration rate of	100%	100%	100%	100%		100%	
Baseline Year of Estimates	2006	2006	2006	2020	2006	2007	
California baseline population in mid-year	37,300,000	37,300,000	37,300,000	44,100,000	37,300,000	37,800,000	
Total Potential Gallons Per Day	8,127,671	8,931,507	10,539,178	24,650,959		37,985,699	
Gallons Per Capita Per Day	0.218[4]	0.239	0.283[5]	0.559[6]	3.610[7]	1.005[8]	
Likely penetration rate of item by 2015	30%	20%	75%	75%	3%	40%	
Likely penetration rate of item by 2020	40%	30%	90%	90%	5%	50%	
Realized GPCD savings in 2015	**0.1**	**0.1**	**0.2**	**0.4**	**0.1**	**0.4**	**1.2**
Realized GPCD savings in 2020	**0.1**	**0.1**	**0.3**	**0.5**	**0.2**	**0.5**	**1.6**

[3] Savings assumes the naturally occurring 5500AFY plus an additional 6300AFY from lowering the WF by 1.0 gallon per cycle.
[4] Without legislative or other regulatory mandates
[5] Savings based upon the current transition from inefficient to efficient machines; expect to be approximately 5.0 gallons per cycle by 2020.
[6] Savings assumes requirement for reclaim systems in all in-bay automatic and conveyor systems; certification not mandatory; refer to PBMP report.
[7] Based upon 2.77 persons per California household in 2000; using 10 gallons per household per day of wasted water (best available estimate); achieving more than 5% "penetration" in housing would require a change to the building codes and some degree of new regulation.
[8] Requires regulatory action prohibiting the installation of water-cooled ice machines.

Table 1-4 Summary of 2020 Savings From All Evaluated Measures - GPCD

HR Number	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
HR Name	North Coast	SF Bay	Central Coast	South Coast	Sacramento River	San Joaquin	Tulare Lake	North Lahontan	South Lahontan	Colorado River*
Savings (Basic Measures)										
Code *	7	7	7	6	19	17	12	7	6	6
80% of locally CE BMPs *	3	12	8	13	0	3	2	6	8	36
Grant funded	11	1	12	1	3	8	13	15	24	8
Efficient clotheswashers	3	2	3	2	3	3	3	3	3	3
Residential ET controllers	4	3	3	3	3	3	3	4	3	3
TOTAL (basic measures)	28	26	32	24	28	33	32	36	43	56
Savings goal **	30	14	21	36	78	75	104	75	66	152
Savings shortfall	**2**	**-12**	**-11**	**12**	**50**	**42**	**72**	**39**	**23**	**96**
Savings (Additional Measures)										
Accelerated coverage goals	11	8	10	7	17	13	14	14	17	17
Recycling	4	7	1	4	3		1			6
Water loss control (30 g/conn./day)	6	5	5	8	15	14	18	14	13	24
Irrigation restrictions (1 day/week)	20	20	20	24	42	40	46	20	53	73
Miscellaneous PBMPs	2	2	2	2	2	2	2	2	2	2
TOTAL (additional measures)	**43**	**42**	**37**	**43**	**79**	**69**	**80**	**49**	**85**	**122**

*Taken from TM 4
**Taken from TM 2

2 Assessment of New Regulatory Initiatives

2.1 Quantitative Assessment

Accelerate metering deadline from 2025 to 2020

The *Water Use Efficiency Comprehensive Evaluation* estimates that there were slightly over 800,000 unmetered single family residences in California as of 2000 not subjected to the Central Valley Project Improvement Act. California Water Code Sections 525-527 provide that water meters shall be installed on all new connections on or after January 1, 1992. Water meters are required on all water services by January 1, 2025. An accelerated schedule is required for water suppliers served by the Central Valley Project, for which water meters are required for all water services by January 1, 2013. Almost half of these non-CVP unmetered accounts fall within the Sacramento River hydrologic region, and a quarter within the San Joaquin River hydrologic region. Advancing the metering deadline so that all unmetered accounts are metered prior to 2020 would likely reduce 2020's consumption by 5, 1, and 1 GPCD in the Sacramento River, San Joaquin River, and Tulare Lake regions, respectively.[9] But this measure would not have a significant impact statewide as most of the state's urban water users are already metered. Note that these savings are already included under accelerated coverage goals (Table 1-4).

Require toilet replacement on resale

Our analyses suggest that the plumbing codes and BMP 14 (residential ultra-low-flush toilet replacement program) will bring the saturation rate of non-efficient toilets rated at 3.5 gallons per flush or more, to around 20% of the total stock of toilets in 2020. Obviously, instituting a statewide retrofit-upon-resale ordinance will lower these saturation rates further. For example, if legislation were to reduce the above saturation from 20% to 5% by 2020, water use would be lower by roughly 2-3 GPCD. In principle, retrofit-upon-resale legislation could be extended to cover additional plumbing fixtures and appliances as well, such as, showerheads, faucet aerators, and clothes washers. The legislation could also mandate that homes with over 2,500 square feet of landscape (same threshold as the Model Landscape Ordinance) undergo an audit to remedy irrigation system deficiencies. This approach would offer considerable support to water suppliers if accelerated coverage goals are required. The only caveat is that home resale rates may remain depressed for the next several years. The impact of accelerated coverage goals with respect to toilets and clothes washers is already included in Table 1-4.

Strengthen the Model Landscape Ordinance

In 2005, the AB 2717 Landscape Task Force examined how outdoor water use efficiency could be increased. They made several recommendations including: (1) reducing the ET adjustment factor stated in the Model Landscape Ordinance; (2) requiring local ordinances to be revised and made as strong as the Model Ordinance; (3) requiring dedicated irrigation meters in large landscapes; (4) promoting the use of smart controllers; (5) expanding and strengthening the California Irrigation Management Information System (CIMIS) system; and (6) educating and certifying landscape professionals. Given that most of the residential savings through 2020 will have to come from the outdoor sector, a concerted effort needs to be made to implement the Landscape Task Force's recommendations. AB 1881 has already set in motion the process for revising the Model Ordinance by 2010 that incorporates the above-mentioned recommendations.[10]

[9] This estimate is based on the assumption that service areas with unmetered connections will take until the 2025 deadline to fully retrofit their service areas with meters. If these service areas intend to retrofit at a faster pace than was assumed by the Comprehensive Evaluation, then the above estimates may not hold.

[10] http://www.owue.water.ca.gov/landscape/ord/ord.cfm

We estimate that reducing the ET adjustment factor from 0.8 to 0.7 (12.5% reduction) will roughly generate savings of 1-2 GPCD by 2020. This estimate is derived as follows. The American Housing Survey provides information about lot sizes and footprint of the house situated on it. Assuming only half of the difference between the two represents landscape, we estimate that roughly 50% of newer single-family homes have developer-installed landscapes exceeding 2,500 square feet (the Ordinance's eligibility threshold), and that among this subset, average landscape area is roughly 6,000 square feet. Based upon population projections, roughly 1 million single-family homes can be expected to be built between 2010 and 2020. We also assume that average annual ET requirement of residential landscapes is 48 inches per year. Based upon these parameters we estimate new residential landscapes alone to generate extra savings of roughly 35,000 acre-feet per year. We double this estimate to capture savings from landscapes in non-residential settings and in homeowner associations. These total savings of 70,000 acre-feet per year when normalized by the projected 2020 population (43.8 million) yields between 1 and 2 GPCD.

Our estimate only captures the extra savings that will result from lowering the ET adjustment factor, not the total savings from having a landscape designed according to the Ordinance and irrigated within budget relative to a landscape not designed and irrigated according to the Ordinance. There is very little data available to quantify these *total* savings, which ought to be much higher if the Ordinance were properly enforced. We have also not included the above savings estimate in Table 1-4 for fear of double-counting with savings attributed to weather-based irrigation controllers and irrigation restrictions.

Require partial or total conservation offsets for new development

Requiring conservation offsets can be a useful mechanism for promoting new development with a low-water foot print, and of course by definition it keeps total water use in an area level (assuming total offsets are in effect). Estimating savings is straightforward. For example, if population is expected to grow by 10% in a given time period, but all new housing and new commercial construction is required to offset through conservation their entire projected water use, then GPCD at the end of this time period will be lower by 9% (1÷1.1). If population grows by 20%, GPCD will decline by roughly 17% (1÷1.2), and so on.

Several details require sorting out, however. Total offsets may raise the price of new housing significantly in a state where affordable housing is already an issue. Requiring offsets for projected indoor water use that exceeds what might be considered "efficient" indoor use, and for all of projected outdoor use may be a possible compromise. On the other hand, plumbing codes are already at work improving indoor water use efficiency, while outdoor water use is subject to the constraints of the Model Landscape Ordinance. Would including offsets over and above these existing requirements alter the design of new construction significantly, making them even more water efficient? It is difficult to predict. Certainly, requiring offsets would generate a stream of revenues to fund conservation programs in existing construction, which would be a benefit. We are assuming that requiring offsets will not mean that developers literally have to run their own conservation programs, but that they pay into a fund the monetized value of the offset water, which is then used by the water supplier to implement conservation programs in existing construction. Should this water be valued at existing rates or using estimates of future avoided costs? Do mechanisms need to be put in place to ensure that these offset-based revenues are in fact used for conservation programs? What if under the SB 221/610 law a water supplier certifies that adequate supplies are available? Would the offset be viewed as an unjustified infrastructure impact fee, leading to legal challenges? All of these details and more would need to be worked out before such a legislative proposal could be put on the table.

2.2 Qualitative Assessment

Strengthen the "loading order" in the Water Code

In theory, the concept of "loading order" is sound, and appears to have had significant success in the energy sector. The concept essentially prioritizes how future supplies will be generated. For example, California's energy code states that future energy demand will first be met by increasing energy use efficiency and peak load shaving, then by renewable and distributed generation resources, and only then by clean fossil-fuel based generation technologies. Such a prioritization is not at odds with the notion of cost-effectiveness. The problem with depending only upon cost-effectiveness as a decision rule is that data are rarely available to fully capture externalities. A loading order thus streamlines the choice set available to suppliers.

For the water supply industry, a loading order may specify, for example, that future supplies must first be developed through improved water use efficiency, then through augmentation of local water supplies (storm water capture, recycling, water loss control), and only after that through development of new infrastructure. The existing structure of the MOU is not at odds with the loading order concept. We expect utilities to exercise due diligence in choosing a least-cost mix of sources, and for that reason MOU signatories have been expected to adopt only cost-effective conservation measures. But we also know that "least cost" water may not always be the most efficient in either energy or overall water resource management terms because of the problem of unmeasured externalities.

The loading order idea deserves to be studied and developed further, but in a way that recognizes key differences between the energy and water sectors. The diversity of the water industry stands in stark contrast to that of the energy industry. While 6 energy utilities account for over 90% of California's urban energy demand, it takes approximately 400 water utilities to reach that proportion. The appropriative rights of these water suppliers differs considerably since these rights are subject to Water Law not simply market forces.

De-couple revenue generation from sale

To maximize profits, for-profit water utilities have an incentive to increase sales instead of investing in water use efficiency, since their rates are based upon projected instead of actual sales. Setting up revenue balancing accounts where revenue shortfalls are credited to the utility, excesses are refunded to customers, and water use efficiency costs are allowed as pass-throughs have been suggested as a corrective measure for these adverse incentives. Most water suppliers tend to be not-for-profit enterprises, however—only 15% of Californians are served by for-profit water companies as per the AB 2717 Landscape Task Force report—so this reform will likely have a limited impact.

The California Public Utilities Commission (CPUC) has already begun to initiate these reforms. As part of its 2005 Water Action Plan, the CPUC's Water Conservation Order Instituting Investigation (OII) Phase 1a hearings and subsequent decisions introduced trial (two and three tier) conservation rate designs for combinations of both residential and non-residential accounts in six Class A utilities. Furthermore, Phase 1b of the Water Conservation OII decoupled revenue from the volume of water sold through the introduction of Water Rate Adjustment Mechanisms (WRAM) and Modified Cost Balancing Accounts (MCBA). The precise design of the accounting and cost balancing instruments differ slightly across some of the utilities. The six participating Class A utilities (Cal Water, Park Water, Suburban, Cal-Am L.A., San Jose, and Golden State) have trial WRAMs in place to generally remove the risk of lost revenue as a consequence of successful water conservation by permitting the utilities to recover or credit the difference between actual and adopted quantity charge revenues. Four of the six utilities have MCBAs in place to permit the recovery or crediting of the difference between actual and adopted variable costs for purchased power, purchased water, and pump taxes. Established as part of the settlement of Phases 1a & 1b of the Water Conservation OII, these trial programs are scheduled to be in effect until the next general rate revision. The CPUC Water Division is collecting data from participating utilities to monitor the performance of WRAMs, MCBAs, and conservation rate structures.

Require more aggressive water conserving pricing structures

The first step in sending price signals to customers is to install meters, and then to bill them frequently (at least bimonthly, preferably monthly). Conversion of unmetered connections to metered connections is already underway. The next stage is to reduce fixed charges and obtain a larger portion of an agency's revenues through volumetric rates. BMP 11 included in the MOU is designed to take the water industry up to a point where at least 70% of total revenues are generated through volumetric rates instead of fixed charges. Beyond this point, however, consensus does not yet exist about how and whether to implement aggressively tiered rate structures. This is partly because deviation from cost-of-service principles can lead to legal challenges, and partly because aggressive tiered pricing may end up generating more revenue in the short run than is justified by costs. To ensure that these surplus revenues fund water use efficiency programs, instead of becoming a spur to inefficient operations, will likely require the creation of an institutional oversight architecture that at present does not exist. While tiered water rates certainly incentivize customers to conserve, by themselves tiered rates are not likely to eliminate more than a small fraction of waste, for two reasons: first is the relatively inelastic response of water demand to price; and second is because customers do not understand their conservation options. Numerous price elasticity studies have shown that retail customers reduce their demand for water at a rate between 2 and 3 percent for every 10 percent increase in price. Since tiered rate structures shift unit costs of water in both directions, reducing the price of the initial units of water consumed while raising the price of the highest tiers of water consumption, precise demand and cost data is required to produce an accurate estimate of the potential for water savings due to tiered pricing regulations.[11] In addition, it is very important that customers understand their rate structure and its relationship to changes in their water demand.

In the real world, backing up price signals with well designed demand-side-management programs still remains the key to effective conservation. Finally, customer acceptance of tiered rates is much greater when the upper tiers are perceived as punishment for inefficient use, not simply high use, which means tiers need to be tied to water budgets by customer or customer class, a significant implementation challenge. The AB 2717 Landscape Task Force recommended that state agencies should support the development of water budgets and expansion of the CIMIS system, a precursor to tiered rates that deserves greater attention. Another implementation challenge involves billing system capabilities—many retail suppliers may have to upgrade billing system software or the entire system itself to be able to handle tiered rates.

Require volumetric pricing for sewer services.

Sewer rates in many instances are higher than water rates, so resorting to volumetric pricing for sewer services could potentially double the strength of the pricing signal, making indoor conservation measures that much more cost-effective from the customer's perspective. The challenges are mostly on the implementation side. Since sewer fees would be tied to billed water consumption, this is bound to increase revenue uncertainty for sewer districts, for which they may not be institutionally prepared. This would have to be remedied. And where the water supplier and the sewer district are separate entities, institutional, regulatory, legal impediments if any to billing coordination would have to be identified through stakeholder input. Voluntary efforts to engage in such cooperation though the Council's BMP process have largely been unfruitful, suggesting that statewide legislation or regulation is an appropriate mechanism for enforcing such coordination.

[11] For a literature review regarding price elasticity of water demand, please see "Designing, Evaluating, and Implementing Conservation Rate Structures," prepared by A&N Technical Services, Inc. for the California Urban Water Conservation Council.

Require UWMPs to address specific higher levels of uncertainty in supplies

Given that California's goal is to provide a reliable, least cost, environmentally sound, and sustainable water supply, Urban Water Management Plans must deal with uncertainty. Requiring these plans to deal with increased levels of uncertainty on account of projected climate change, or on account of our improved understanding of weather history as revealed by tree ring studies, is entirely warranted. Perhaps, different hydrologic regions ought to be assigned different levels of uncertainty. If water shortages and delivery restrictions are required in the future, that would be the clearest indication that too little uncertainty is being planned for by California's water suppliers.

Improve coordination between land planning and water planning

Several initiatives have been undertaken on this front already. The Model Landscape Ordinance was adopted to promote outdoor water use efficiency via improved landscape design. It applies to all landscapes over 2,500 square feet in size. However, the water savings impact of this Ordinance remains unknown. The US Green Building Council through its Leadership in Energy and Environmental Design (LEED) program promotes both energy and water efficiency by design. SB 221 and SB 610 were adopted to improve coordination between land use and water planning decisions by making new development contingent upon certification by the appropriate water supplier that adequate supplies would be available.

SB 610 requires land-use agencies and the water supplier to prepare a long-term water supply assessment during a project's environmental review phase. The assessment "must address whether the projected supply for the next 20 years—based on normal, single dry, and multiple dry years—will meet the demand projected for the project + existing and planned future use, including agricultural and manufacturing uses." SB 221 requires written verification of long-term water supply by the utility that will serve the project (or, in its absence, by the city or county) at a later stage, prior to the approval of the final subdivision map. Whereas SB 221 is focused almost exclusively on residential development, SB 610's provisions extend to industrial and commercial developments as well. SB 221 exempts infill development from review to promote smart growth. In the case of residential development, both laws are triggered when a subdivision with greater than 500 units is proposed, or when proposed project is expected to increase a water supplier's demand by 10% or more.

A study completed in 2005 (Hanak, 2005) suggests that compliance with the SB 610/221 initiative has been high, and that integration between land use agencies and water suppliers is not as poor as is often thought.[12] According to this study, six out of ten city and county land use agencies participate in the planning activities of their respective water suppliers. And local statutes exist that predate the state's SB 610/221 initiative, triggering at thresholds well below those specified in the SB 610/221 legislation, to ensure water supply adequacy. According to Hanak (2005), unrealistic assumptions buried in the Urban Water Management Plans (UWMP) may be the bigger problem. Greater quality control and validation of UWMPs to eliminate "paper water" may be the more important, and at present the missing ingredient, that is required to better integrate land use and water planning decisions.

Encourage reduction in connection fees for low-impact development

Low impact development is not a water conservation measure. It is a water management measure for combined purposes of augmenting water supply, managing flood flows, and protecting water quality. It does not affect water demands. Urban development has increased the amount of precipitation runoff, as well as excessive irrigation. Consequences include increased flooding during storms, reduced natural percolation to replenish groundwater, and water quality problems in streams receiving the runoff and

[12] Hanak, E. (2005). *Water for Growth: California's New Frontier*. Public Policy Institute of California, San Francisco, California.

associated pollutants. The best approach to reducing irrigation runoff is to apply best management practices for irrigation. Options for storm water runoff can include retention of precipitation within developments such that it will percolate, capture and storage of the runoff at or near the site of origin for later irrigation use (such as cisterns), or capture and possible treatment and delivery in an urban dual distribution system. These options essentially are new sources of water supply and do not reduce water demands. If the captured water is used directly on the site of origin or will be percolated into an aquifer used for urban water supply, there would be a direct or indirect benefit to water utilities by reducing the purchase of potable water to meet some of the water demand on the property, or augmenting the groundwater available for community water supply. Thus, utilities may want to encourage new developments to incorporate design features that will capture and store the water for later use, or to enhance percolation. An incentive to accomplish this could be reduced water connection fees for new low impact developments. Because potable water deliveries are used as the benchmark for measuring the 20 percent urban water demand reduction, this measure will only focus on low impact development/storm water management that would reduce potable water demand at the site of storm water capture.

Establish a certification program for water supplier efficiency performance

In 2002, the CALFED Bay-Delta Program issued a draft conceptual framework for an urban water conservation certification program. The conceptual framework was developed jointly with urban water suppliers, environmental organizations, and CALFED Agencies. The framework outlined a quasi-regulatory program for certifying urban water supplier compliance with the MOU. The impetus for the proposal came from the CALFED Record of Decision, which called on CALFED Agencies to "implement a process for certification of water suppliers' compliance with the terms of the Urban Memorandum of Understanding (MOU)." The draft framework addressed program jurisdiction and schedule of implementation, processes and criteria for determining MOU compliance, incentives for compliance and disincentives for non-compliance, CALFED Agency roles and responsibilities, potential program cost, and linkages to other regulatory processes. The conceptual framework was developed to ensure implementation of all cost-effective BMPs, a goal that the CALFED Water Use Efficiency Comprehensive Evaluation concluded was not being achieved under the present voluntary MOU process. The Comprehensive Evaluation estimated that had urban water suppliers implemented all locally cost-effective conservation measures, total urban sector water savings by 2007 (the end of Stage 1 of the CALFED Record of Decision) would have been about two and a half times greater than what was forecast to be achieved. The *Comprehensive Evaluation* estimated that statewide implementation of cost-effective BMPs by all suppliers could reduce urban water use by about 15 GPCD by 2020.

Proposed changes to the MOU and BMPs

Revisions are proposed for 11 of the 14 BMPs currently in the MOU. This revision process was proposed by the Council to address the 10-year timeframe incorporated in the 1997 BMP revisions, which ends in 2008. The three BMPs excluded from the above process have been addressed in other ways: for example, BMPs 4 & 11 were revised in 2007, while BMP 3 was already in process of revision prior to 2007 when the overall revision process was initiated.

Several proposed changes to the 1997 BMP document which are notably significant are summarized here:

- Grouping of BMPs into categories of programmatic similarity;
- Creation of Programmatic BMPs, expected to be implemented by all water agency signatories as a permanent commitment to water conservation;
- Elevation of water savings goals to new importance;
- Refocusing of BMP activities onto the activities which save water as compared to those which are focused on how a program is implemented;
- Introduction of flex track menu options;

- Combination of former Coverage Requirements and Criteria sections into Coverage Requirements.

Perhaps the most significant change in the BMPs is the addition of new metrics for determining compliance. In addition to the traditional BMP approach focused on specific measure and fixtures, there is a flex track option which focuses on achieving the same or greater amounts of water savings. A third option which is envisioned by the draft is a reduction in GPCD over time. The final wording for this option is still being discussed by Steering Committee of the CUWCC.

This document may change before its scheduled vote on December 10, 2008; the MOU allows for a final proposal to be submitted to the members 60 days in advance of a vote; and a written ballot to be distributed 30 days prior to the vote.

The Council anticipates that if these changes are adopted, water suppliers will be able to achieve and document a higher level of water conservation through a less burdensome reporting process. As of the writing of this TM, no estimates have been made regarding potential reductions in GPCD related to this proposed BMP revision.

Conservation Credits Trading

Cap and trade regimes have been successfully implemented for the control of noxious emissions. They provide a flexible framework where participants can choose between undertaking emission reductions themselves, or paying others to reduce their emissions, depending upon which of the two is cheaper. The net result is that participants in a cap-and-trade regime retain flexibility, while overall goals are achieved at least cost.

A similar framework can be proposed for water conservation in California. Some water suppliers have accomplished a lot of water conservation to date. For them additional reductions in per capita consumption can be expected to cost more per acre-foot. Others have done less, so still have low hanging fruit available. Cost effectiveness standards have been used in the past to measure the appropriateness of water conservation activities. Thus, communities with cheaper water have had less of an incentive to conserve. As a result much 'low-cost' conservation remains to be achieved in some parts of the state. Therefore, one way for regions to meet their targets is to fund conservation in other regions where savings can be had at a lower price. For such a trading mechanism to deliver on the statewide savings goal of 20% GPCD reduction, however, some regions would have to be willing to exceed their savings targets, the excess financed by regions that wish to do less.

Several requirements would have to be met to facilitate a conservation credits trading regime. These include:

- Common metrics for measurement of savings
- Verifiable conservation that can be observed in water production data
- Enforceable contracts
- Data management and transparency
- Regulator that oversees water banking as well as intra- and inter- regional trades

The last bulleted item deserves elaboration. If one region meets its GPCD goals by funding conservation in another region, it is possible that total consumption in the former could rise because of population growth. A central vetting authority would have to certify that the water conveyance infrastructure would be able to handle these increased demands in said region.

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