Performance Standards for Demonstrating Urban Water Conservation

A Briefing Book
prepared for

California Urban Water Agencies

June 1997

by

Thomas W. Chesnutt

Performance Standards for Demonstrating Urban Water Conservation

Some water agencies have expressed concerns about both individual Best Management Practices (BMPs) and alternative sets of BMP's. Viewed in their entirety, the collection of revised BMP's have struck some as overly prescriptive. Instead of this "action-based" approach, a more "performance-based" approach has been advocated for demonstrating the implementation of effective conservation programs. This suggestion, of course, is not new. Different types of performance standards (1) were considered and rejected in the original development of California's *Memorandum of Understanding Regarding Urban Water Conservation in California* (MOU), (2) have been used to regulate water purveyors in other areas of the country, and (3) have been incorporated in existing BMPs [1]. This briefing book:

- briefly discusses the idea of performance standards,
- provides a concrete description of alternative performance standards,
- describes measurement issues associated with each alternative,
- discusses implementation issues related to compliance monitoring, and
- provides a summary of the advantages and disadvantages of each performance alternative.

By coming to a better understanding of the logic behind performance standards and their practical strengths and limitations, this briefing book offers alternative models for demonstrating appropriate conservation performance. In going through this process, we seek to better delineate the role of measurable and real water conservation in helping to resolve California's long term water resource problems.

I. Introduction - The idea of performance standards

Performance standards are based on a relatively simple idea. Performance-based standards emphasize ends over means: It is the result that matters, not how that result is obtained. Clearly this places a great deal of emphasis on both the definition of a

[1]The BMP for residential ultra-low-flush toilet replacement, for example, is specified as a quantity of water to be saved over time. Water agencies using better program targeting can place ULF toilets where the toilet saves more water, thereby fulfilling this BMP using fewer toilets. See Exhibit 6, *Assumptions and Methodology for Determining Estimates of Reliable Water Savings from the Installation of ULF Toilets*, of the MOU.

standard and the measurement of performance. In order to fit within the ongoing consensus-based process on urban water conservation, existing stakeholders—including the Environmental Water Caucus and California Urban Water interests—would need to agree on a concrete alternative to the current or proposed BMPs: choosing a measuring stick, setting the height of the bar on that stick, and paying for the cost of measuring performance. Presumably, any urban water agency that could prove that a non-BMP alternative showed more water savings at less cost would leave the environmental community with little cause for complaint.

Performance standards can preserve flexibility in achieving a goal by placing greater emphasis on goal achievement. Where measurement of performance goals can be done accurately, reliably, and in a cost-effective manner, they may prove more attractive than action-based standards. The setting of performance standards then becomes the heart of a broad policy question—How much is enough? Environmental interests may express more skepticism if they cannot rely on easily monitored agency actions to determine appropriate levels of conservation implementation. Urban water agency interests, on the other hand, would likely express concerns about the open-ended commitment required by a performance standard. The equal achievement dictated by a performance standard can necessitate unequal amounts of effort on the part of water agencies [2].

In addition to addressing the problems of setting acceptable performance standards, the viability of any performance-based conservation standard will turn on its practicality and the ease of monitoring compliance. A performance standard that cannot be quantified or enforced does not constitute much of a standard. The development of a standard for implementing effective conservation does involve inevitable tradeoffs. The existing set of Best Management Practices constitutes one evolving standard. By reviewing a range of other alternative performance standards, this briefing book aims to clarify the exact nature of these tradeoffs. The following section defines the practical steps necessary to enact a conservation performance standard.

---

[2]Attempts to ensure equality of effort require an approach that monitors effort/actions. Performance standards, by their very nature, ignore the amount and distribution of effort required.

II. Enacting a Performance Standard - Practical Steps

Enacting a performance standard involves several practical steps. First, one must define a measuring stick--a metric along which performance is measured. Second, one must set the performance standard--what point along the measuring stick determines sufficient performance. Third one must monitor performance and compare that achievement with the performance standard. Last, one must decide what are the consequences for under performance. Thus, the short list of steps to be discussed include:

- Defining the Measure - What is the measure of conservation performance?
- Setting the Target - How high is the measuring stick placed?
- Monitoring Performance - How close is actual performance to the target?
- Enforcement and Consequences - What are the rewards and penalties if actual performance differs from the target?

Defining the Measure: The definition of "performance" lies at the heart of any performance-based standard. For the case of urban water conservation, several questions need to be addressed. Is the performance standard measured in absolute units (acre-feet) or is it measured in relative terms (percent reduction)? What is the time dimension given to the performance standard? Is their a phased in compliance period?

Setting the Target: Once the measuring stick has been chosen, one must define how high the performance bar should be set on the stick. Is there a uniform standard for performance? Are any allowances to be made for differing local conditions? To what extent does each urban agency have input into the definition of their own target?

Monitoring Performance: Performance based monitoring places a special burden on measurement. How accurate and reliable is the measurement of achieved conservation performance? How expensive is it to improve the measurement of performance? Can cost-effective measures of cost-effectiveness be developed in a broadly acceptable manner? How much money should be spent on monitoring conservation performance versus technical assistance in improving conservation performance?

Enforcement and Consequences: To the extent that performance measurement is imprecise or costly, verification and enforcement can be contentious and expensive.

What are the consequences to under performance or over performance? If there are negative consequences to underachievement, should there also be rewards for over achievement? Is there any incentive for early implementation? Many of the same issues of enforcement and consequences also apply to the existing set of BMP's.

There will be tradeoffs in the practical implementablity of these steps. Some performance standards will be easy to define in theory but difficult to enact in practice. Other standards may be simple to define, easy to measure and, perhaps by consequence, patently unfair[3]. Still other more ambitious standards may attempt to address more concerns yet, by the complexity of method, admit more political controversy. The next section proposes four alternative performance standards and examines practical tradeoffs among these steps.

[3]The simplest standard—a constant percentage reduction from a base year use—is the best example of an eminently simple standard that is has been perceived as unfair. This standard could hardly be any simpler; it also punishes any agency that implemented conservation programs prior to or in the base year.

III. Four Alternative Performance Standards

This section defines four alternative performance standards. These standards include:

- Alternative 1 - Percentage cutback
- Alternative 2 - Per capita targets
- Alternative 3 - Percentage reduction of forecast demand
- Alternative 4 - Cost-effectiveness of conservation practices

The first alternative is arguably the simplest and possesses an historical track record of implementation during recent drought emergencies. The second alternative, per-capita targets, is slightly more complicated in that the standard is adjusted for population growth. Per capita targets have also been implemented in other areas.
The third alternative, Percentage reduction of a demand forecast, is a more general performance standard that allows for more general adjustments to the target. The fourth alternative, cost-effectiveness of conserved water, provides a direct comparison to the existing BMP process.

For each alternative, this section discusses the four practical steps (1) definition of the measure, (2) setting the target, (3) monitoring performance, and (4) enforcement and consequences. Where possible, implementation examples are provided. Any assessment of these alternatives necessarily relies on profession judgment. The author has been involved in demand forecasting, empirical measurement of conservation, and institutional arrangements for implementing water conservation for the last decade. The assessments of this briefing book, though necessarily subjective, reflect that experience.

A. Alternative 1 - Percentage cutback

Defining the Measure: The percentage demand reduction is a relative measure. The amount of conservation is defined relative to some base year demand. The percentage reduction target and percentage reduction achievements are highly contingent on the absolute level of demand that constitutes the denominator of the percentage ratio:

$$Percent\ Reduction \equiv \frac{Conservation\ Target}{Base\ Year\ Demand} \qquad (1)$$

Setting the Target: A constant percentage reduction has some appeal as a simple and uniform performance standard. The use of a baseline demand denominator attempts to adjust for persistent differences among agencies. Agencies would quickly point out that a uniform percent reduction target would unfairly affect regions experiencing high growth. (While the target adjusts for population differences in the base year, it does not adjust for any differences in *population growth* after the base year.)

Monitoring Performance: It is relatively straight forward to monitor any changes in water use relative to a base year.

Enforcement and Consequences: Though percentage curtailments adjust for differences among agencies by standardizing to a base year, this base year demand will also include any differences in historical conservation. Thus any water agency implementing conservation programs early-on would be punished for its foresight.

Current Example: Some water agencies have implemented short term water curtailment rules based on percentage cutback from a base year. Few claim that percentage cutbacks constitute a satisfactory measure of long-term conservation performance. The objectives of emergency curtailment rules obviously differ from that of long-term monitoring of conservation performance.

B. Alternative 2 - Per capita targets (GPCD)

Defining the Measure: A per capita performance target—such as gallons per capita per day, or GPCD—can be thought of as a water demand target that embeds an adjustment for changes in population. Thus if a region experiences rapid growth, an adjustment would be made to their total conservation target:

$$Target \equiv \frac{Total\ Demand\ (\text{gallons})}{Total\ Population\ (\text{persons})} = Gallons\ per\ Capita\ per\ Day \qquad (2)$$

Note that the consumption units are arbitrary in this measure. One may equivalently, if not as easily, speak in terms of acre-feet per person.

Setting the Target: A per capita target can be set at a specific value or given as a range. Any constant per capita target imposes the assumption that the composition of water use, after scaling for population, is also constant. Needless to say, this assumption is unlikely to hold up in practice. Areas having a heavy industrial base, without the corresponding residential base, will exhibit relatively high GPCD use. Areas having high residential densities or limited nonresidential water use will exhibit relatively low GPCD use. If the GPCD target is set relative to some base year, then areas experiencing changes in growth patterns that are not consistent with the base year demand pattern will experience anomalies. The GPCD measure, simple in construct, does not admit simple fixes that would well adapt it to local conditions.

Monitoring Performance: A GPCD performance standard is, in principle, relatively easy to monitor. The construct of per capita water use is fairly simple—total water production is divided by total population in the service area. Complications include potentially large errors in estimating intra-census year population and year to year swings in consumption due to weather and other nonconservation-related factors.

Enforcement and Consequences: Given the temporal swings in population, standardized water consumption—GPCD use—it is difficult to determine if an agency has temporarily or permanently drifted outside of a target range. Penalties could be based on a multiple year exceedance of the GPCD target. The difficultly of reliably measuring achieved performance against the performance standard renders enforcement problematical.

Current Example: The state of Arizona currently uses GPCD targets in its oversight of urban water suppliers. Few of the stakeholders we interviewed expressed any enthusiastic support—many suppliers believed the targets arbitrary and state government representatives believed the targets were fair but difficult to enforce.

C. Alternative 3 - Percentage reduction of forecast demand

Defining the Measure: The percentage demand reduction is a relative measure. The amount of conservation is defined relative to some level of demand. The base level of future demand is then, necessarily set to some baseline demand forecast. Clearly,

percentage reduction targets and percentage reduction achievements are highly contingent on the absolute level of demand that constitutes the denominator of the percentage ratio:

$$Percent\ Reduction \equiv \frac{Conservation\ Target}{Baseline\ Demand\ Forecast} \quad (3)$$

Setting the Target: A constant percentage reduction has some appeal as a uniform conservation performance standard. But a uniform standard does not imply a uniform effort; agencies having difficulty saving water would be forced by a uniform performance standard of investing more to meet the standard. Performance standards focus on obtaining a uniform result, even if this requires uneven effort.

Another practical difficulty lies in the definition of the baseline demand forecast. The baseline demand would usually be presumed to account for population growth. In addition, demand forecasts meeting minimum standards typically adjust for changes in the composition of demand, fluctuations in weather, and changes in other long term determinates (income, density, and water rates).

Monitoring Performance: Once set the percent reduction is easy to understand. Most of the controversy surrounding conservation achievement is usually related to the estimate of baseline demand: what would demand have been absent any plumbing code changes, conservation programs, or unusual weather.

Enforcement and Consequences: The definition of a baseline demand tends to make cross service area comparisons of conservation performance difficult if not impossible. Without a consistent baseline demand forecast across the state, comparisons between two agencies would tend to reflect differences in demand models (functional form, estimated coefficients, values of predictor variables in the future, and forecast period) more than differences in performance. Given the uneven standards of implemented water demand models across the state, it is unlikely that the problems induced by methodological differences will be resolved in the near term. Practical implementation of this alternative would likely require implementation of a consistent water demand forecasting method statewide.

Current Example: Individual agencies have estimated conservation effects using baseline demand forecasts that adjust for predictable changes in the determinants of water demand.

D. Alternative 4 - A cost-effectiveness standard

Defining the Measure: A uniform cost-effectiveness performance standard bears some resemblance to the existing BMP process. Agencies would begin by investing in the most cost-effective conservation programs and continue implementing less cost-effective programs until cost per acre foot of saved water reached some target level. , perhaps the cost of alternative new water sources. If perfectly implemented, each agency would implement conservation programs until the water saved per dollar spent would adhere to the same standard state-wide [4].

Setting the Target: The target level could be set to a uniform state-wide level, that is implement conservation programs up to 400 dollars per acre foot. Alternatively, regional difference could be set or the entire decision of the target cost effectiveness level could be left to individual agencies, perhaps set to the cost of alternative new water sources.

Monitoring Performance: The practical impediment to this alternative is the simple fact that most agencies do not face a well-defined "supply curve" of conservation[5]; many have difficulty giving a precise rank order to the cost-effectiveness of their existing programs. A literal reading of a cost-effectiveness standard would require water

---

[4]Practically speaking, of course, the end result of this standard may not be that different from the current BMP process. Instead of implementing the most cost-effective and stopping at the point where programs become cost-ineffective, the current process allows agencies to exempt themselves from specific BMPs that can be shown to be cost-ineffective. The remaining set of BMP's would presumably be the cost-effective set. Whether these two standards do, in fact, achieve the same result, turns on the precise implementation of the cost effectiveness standard. The current BMP process dedicates considerable effort to the definition of the exemption process. See *Guidelines for Preparing Cost-Effectiveness Analyses of Urban Water Conservation Best Management Practices, California Urban Water Conservation Council, September 1996.*

[5]Complications in quantifying cost-effectiveness include: economies of scale (programs that are cost-ineffective when piloted, but cost-effective when fully ramped up), economies of scope (programs that are more/less cost-effective when performed together), and uncertain projections of participation and implementation rates.

agencies to invest considerable resources in quantifying the cost-effectiveness of all existing and potential conservation programs. It could be argued, that a more cost-effective implementation of a cost-effectiveness performance standard would resemble the current BMP-process: A set of practices is assumed cost-effective unless shown otherwise.

Enforcement and Consequences: The lack of reliable measurement of the actual or potential cost-effectiveness of individual conservation programs or combinations of programs would make this standard, like the existing BMP process, difficult to enforce.

Current Example: The existing CUWCC BMP process is a form of a cost-effectiveness performance standard.

IV. Assessment of Alternatives: Strengths and Limits

Performance alternatives share some common strengths and limits. Strengths include the focus of a performance measure on achievement of an end result, preservation of maximal flexibility of action in achieving that result, and avoidance of the costs of monitoring actions. Limits include practical difficulties of setting, measuring, monitoring, and enforcing the performance standard, an open-ended commitment to achieve the result regardless of the difficulty or cost of attainment (that is, uneven effort may be required), and an insensitivity to any local conditions not explicitly accounted for by the performance measure.

A. Alternative 1 - Percentage cutbacks

Strengths:

- Simple to define and measure.
- Easy to monitor.

Limits:

- Makes no allowance for service area growth or any other change in water demand.
- Because a percentage cutback punishes agencies who have conserved early, they are unlikely to find consensus support.

B. Alternative 2 - Per capita targets (GPCD)

Strengths:

- Simple to understand.
- Relatively cheap to measure.
- Makes a crude first order correction for service area growth.
-

Limits:

- Subject to considerable demographic measurement error.
- Due to short term demand fluctuations, will be an unreliable annual indicator of long-term demand behavior.
- Does not adjust for any changes in water demand not proportional to population growth.
- Difficult to enforce due to lack of reliable measurement.

C. Alternative 3 - Percentage demand reduction

Strengths:

- More theoretically defensible
- Attempts to correct for predictable changes in water demand.

Limits:

- Not straightforward to explain or understand.
- Entails potentially large investments in measurement. Enforcement would require technical review of modeling
- Subject to measurement error in all predictor variables.
- Modeling differences across agencies will render cross-agency comparisons problematical.

D. Alternative 4 - A cost-effectiveness standard

Strengths:

- Cost-effectiveness is appropriate standard for public expenditures.
- Allows considerable flexibility for changing local conditions.
-

Limits:

- Not straightforward to explain or understand.
- Entails potentially large investments in measurement. Enforcement would require technical review of cost effectiveness analyses.
- Costs and quantities subject to measurement error.

Conclusion: Performance Standards and Existing BMP's

The development of alternatives to the existing Best Management Practices method of defining appropriate conservation implementation must necessarily subject itself to the same performance standards: would an alternative performance standard preserve more flexibility and thereby save as much or more water at lower cost than the current alternatives? The superiority of BMP's is not a foregone conclusion; many in the environmental community have pointed to the difficulty of measuring compliance and enforcing consequences for noncompliance for the current set of BMP's.

One implementation alternative for coupling performance standards to the existing BMP exemption process would add a strict performance-based standard to the existing list of BMP's. Compliance with this BMP would exempt the water agency from compliance with all of the other measurement BMPs (all those except for BMPs No. 2, No. 3, and if a wholesale agency, No. 9). One thorny issue would be setting the target for the performance BMP: What is the total amount of water savings that would preserve consensus in this process? Of course, this problem reoccurs with most performance based standards.

Another idea for incorporating performance ideas into the existing BMP setup would provide a method for quantifying water savings targets for each BMP. Agencies would then be free to count additional water saved under one BMP toward another BMP. This would constitute a more formal implementation of the original "at least as effective as..." clauses in the original MOU. This proposal for inter-BMP flexibility would not circumvent the technical issues associated with developing valid, reliable, and comparable measures of BMP water savings.

There is no intrinsic reason why developing a new performance-based alternative to some of the existing BMP's would necessarily lessen the commitment to conservation by urban water agencies. To the contrary, the existing BMP's can be viewed as a form of a cost-effectiveness performance standard. If performance standards were implemented effectively and in good faith, they could serve a number of

useful purposes: it would more naturally set the stage for the development of "better" measures; it would allow estimates of water savings to be taken more seriously by resource planners; it would allow for meaningful inter-agency comparisons; and it would allow for greater local flexibility.

It is hoped that revisions to the BMP process or changes to its implementation can work toward more effective conservation results. The choice of appropriate conservation standards will inevitably turn on practical tradeoffs among the alternatives. By describing and assessing alternative performance standards, this papers builds the basis for more informed discussion on how to make conservation programs more effective.