participate in the program (conservation-based rate structure). Without a strong conservation-based rate structure, the true potential of the funding invested in the other measures will not be realized, and more money will have to be spent on the other measures to get less of a return.

Based on the savings of other water agencies with the implementation of a strong, multi-tiered conservation-based rate structure, and a strong public-outreach/media effort, it is believed that the District has a large potential for water and money savings.

While some water suppliers have experienced 15% and greater water use savings after the implementation of a strong conservation-based rate structure, the expected water use savings is related to the amount of "pocketbook incentive" the rate structure supplies.

If the District was to experience a 15% decrease in seasonal water use alone, it would translate to significant saving.

(Table 13) SFR Savings from 15% decrease in seasonal water use:

Total AF (SFR) savings over 20 years:	4769.21
Average AF savings:	256.13
Total NET $$$ savings over 20 years:	$14,754,153.56
Average AF/Y savings:	737,707.68
% Water Savings (AF/Y)	6.92%
Savings:Cost ratio	1109.7:1
Years to pay off initial investment:	<0.5

In addition, with 15% of the SFR category's seasonal water use, over 20 years, the total decrease in in-flow to the wastewater treatment facility would be approximately 2600 AF (847 MG), and a yearly average of approximately 130 AFY (42 MG/Y).

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Table 13: *PROJECTED COSTS* AND SAVINGS OF CONSERVATION-BASED RATE PRICING, WITH A 100% MARKET PENETRATION, SINGLE-FAMILY RESIDENCE CATEGORY, SEASONAL USE, OVER 20 YEARS (SAVINGS: 5% 2008, 10% 2009, 15% 2010)

Year	#SFR Meters	#SFR Meters w/100% MP	Estimd. Popul. w/100% MP	SFR AFY (Seasonal) Required w/o Measure	Saved: AFY, SFR Meters (5-10-15%)	Cost of Water/AF w/3% inflat.	$$Savings/ Year (w/ 3% infl/yr)	Rebate ($0.00 ea)	5% Share of Shared Program Costs	Office Admn Costs (10% of Prg.Costs)	Total Costs	NET SAVINGS (Total Savings minus Total Costs)	Years to Pay Off Original Invest. (Rebates, Costs)
2008 - 5%	3647	3647	12,545.65	1290.210	64.51	$2,060.00	$132,891.61	$0.00	$3,445.00	$344.50	$3,789.50	**$129,102.11**	**<0.5**
2009 - 10%	3764	3764	12,949.62	1331.755	133.18	$2,121.80	$282,571.67	$0.00	$344.50	$34.45	$378.95	**$282,192.72**	
2010 - 15%	3886	3886	13,366.59	1374.637	206.20	$2,185.45	$450,630.89	$0.00	$354.84	$35.48	$390.32	**$450,240.57**	
2011 - 15%	4011	4011	13,797.00	1418.900	212.84	$2,251.02	$479,095.44	$0.00	$365.48	$36.55	$402.03	**$478,693.42**	
2012 -15%	4140	4140	14,241.26	1464.589	219.69	$2,318.55	$509,357.99	$0.00	$376.44	$37.64	$414.09	**$508,943.90**	
2013 - 15%	4273	4273	14,699.83	1511.749	226.76	$2,388.10	$541,532.09	$0.00	$387.74	$38.77	$426.51	**$541,105.58**	
2014 - 15%	4411	4411	15,173.16	1560.427	234.06	$2,459.75	$575,738.51	$0.00	$399.37	$39.94	$439.31	**$575,299.20**	
2015 - 15%	4553	4553	15,661.74	1610.673	241.60	$2,533.54	$612,105.61	$0.00	$411.35	$41.14	$452.49	**$611,653.12**	
2016 - 15%	4699	4699	16,166.05	1662.536	249.38	$2,609.55	$650,769.87	$0.00	$423.69	$42.37	$466.06	**$650,303.81**	
2017 - 15%	4851	4851	16,686.60	1716.070	257.41	$2,687.83	$691,876.40	$0.00	$436.40	$43.64	$480.04	**$691,396.36**	
2018 - 15%	5007	5007	17,223.90	1771.328	265.70	$2,768.47	$735,579.46	$0.00	$449.49	$44.95	$494.44	**$735,085.02**	
2019 - 15%	5168	5168	17,778.51	1828.364	274.25	$2,851.52	$782,043.08	$0.00	$462.98	$46.30	$509.28	**$781,533.80**	
2020 - 15%	5335	5335	18,350.98	1887.238	283.09	$2,937.07	$831,441.61	$0.00	$476.87	$47.69	$524.56	**$830,917.05**	
2021 - 15%	5506	5506	18,941.88	1948.007	292.20	$3,025.18	$883,960.45	$0.00	$491.17	$49.12	$540.29	**$883,420.16**	
2022 - 15%	5684	5684	19,551.81	2010.732	301.61	$3,115.93	$939,796.70	$0.00	$505.91	$50.59	$556.50	**$939,240.20**	
2023 - 15%	5867	5867	20,181.38	2075.478	311.32	$3,209.41	$999,159.89	$0.00	$521.09	$52.11	$573.20	**$998,586.70**	
2024 - 15%	6056	6056	20,831.22	2142.308	321.35	$3,305.70	$1,062,272.83	$0.00	$536.72	$53.67	$590.39	**$1,061,682.44**	
2025 - 15%	6251	6251	21,501.99	2211.291	331.69	$3,404.87	$1,129,372.35	$0.00	$552.82	$55.28	$608.10	**$1,128,764.25**	
2026 - 15%	6452	6452	22,194.35	2282.494	342.37	$3,507.01	$1,200,710.29	$0.00	$569.41	$56.94	$626.35	**$1,200,083.94**	
2027 - 15%	6660	6660	22,909.01	2355.991	353.40	$3,612.22	$1,276,554.35	$0.00	$586.49	$58.65	$645.14	**$1,275,909.22**	
			TOTALS:	**36,704.737**	**4769.21**	**n/a**	**$14,767,461.09**	**$0.00**	**$12,097.76**	**$1,209.78**	**$13,307.54**	**$14,754,153.56**	
			AVERAGES:	**1747.845**	**256.13**	**n/a**	**$738,373.05**	**$0.00**	**$604.89**	**$60.49**	**$665.38**	**$737,707.68**	

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It is uncertain what percentage savings the District would get from conservation in the other customer categories, based on conservation-based rate structure alone.

(Table 14). However, the average seasonal (peak summer) water use (percentage of annual use) for years 2003-2006, for all categories is 69.15%. If all categories decreased an average of 15%, it would translate to:

(Table 14) All-category savings from 15% decrease in seasonal water use:

Total AF (all categories) savings over 20 years:	7102.51
Average AF/Y savings:	381.44
Total NET $$$ savings over 20 years:	$21,979,026.77
Average AF/Y savings:	$ 1,098,951.34
% Water Savings (AF/Y)	10.31%
Savings:Cost ratio	1652.6:1
Years to pay off initial investment	<0.5

In addition, with 15% of the all-category's seasonal water use, over 20 years, the total decrease in in-flow to the wastewater treatment facility would be approximately 3351 AF (1157 MG), and a yearly average of approximately 177 AFY (57 MGY).

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Table 14: *PROJECTED COSTS* AND SAVINGS OF CONSERVATION-BASED RATE PRICING, WITH A 100% MARKET PENETRATION, ALL CATEGORIES, SEASONAL USE, OVER 20 YEARS (SAVINGS: 5% 2008, 10% 2009, 15% 2010)

Year	SFR #Meters	(SFR) #Meters w/100% MP	Estimd. Popul. w/100% MP	SFR AFY (Seasonal) Required w/o Measure	Saved: SFR AFY/SFR Meters (5%)	Cost of Water/AF w/3% inflat.	$$Savings/ Year (w/ 3% infl/yr)	Rebate ($0.00)	5% Share of Shared Program Costs	Office Admn Costs (10% of Prg.Costs)	Total Costs	NET SAVINGS (Total Savings minus Total Costs)	Years to Pay Off Original Invest. (Rebates, Costs)
2008 - 5%	4256	4256	14,642.09	1921.436	96.072	$2,060.00	$197,907.86	$0.00	$3,445.00	$344.50	$3,789.50	**$194,118.36**	<0.5
2009 - 10%	4393	4393	15,113.56	1983.306	198.331	$2,121.80	$420,817.81	$0.00	$344.50	$34.45	$378.95	**$420,438.86**	
2010 - 15%	4535	4535	15,600.22	2047.168	307.075	$2,185.45	$671,098.79	$0.00	$354.84	$35.48	$390.32	**$670,708.47**	
2011 - 15%	4681	4681	16,102.54	2113.087	316.963	$2,251.02	$713,489.41	$0.00	$365.48	$36.55	$402.03	**$713,087.39**	
2012 -15%	4832	4832	16,621.05	2181.128	327.169	$2,318.55	$758,557.69	$0.00	$376.44	$37.64	$414.09	**$758,143.60**	
2013 - 15%	4987	4987	17,156.24	2251.361	337.704	$2,388.10	$806,472.74	$0.00	$387.74	$38.77	$426.51	**$806,046.23**	
2014 - 15%	5148	5148	17,708.67	2323.855	348.578	$2,459.75	$857,414.40	$0.00	$399.37	$39.94	$439.31	**$856,975.09**	
2015 - 15%	5314	5314	18,278.89	2398.683	359.802	$2,533.54	$911,573.84	$0.00	$411.35	$41.14	$452.49	**$911,121.35**	
2016 - 15%	5485	5485	18,867.47	2475.920	371.388	$2,609.55	$969,154.31	$0.00	$423.69	$42.37	$466.06	**$968,688.25**	
2017 - 15%	5661	5661	19,475.01	2555.645	383.347	$2,687.83	$1,030,371.91	$0.00	$436.40	$43.64	$480.04	**$1,029,891.87**	
2018 - 15%	5844	5844	20,102.10	2637.937	395.690	$2,768.47	$1,095,456.38	$0.00	$449.49	$44.95	$494.44	**$1,094,961.94**	
2019 - 15%	6032	6032	20,749.39	2722.878	408.432	$2,851.52	$1,164,651.98	$0.00	$462.98	$46.30	$509.28	**$1,164,142.70**	
2020 - 15%	6226	6226	21,417.52	2810.555	421.583	$2,937.07	$1,238,218.39	$0.00	$476.87	$47.69	$524.56	**$1,237,693.83**	
2021 - 15%	6427	6427	22,107.16	2901.055	435.158	$3,025.18	$1,316,431.69	$0.00	$491.17	$49.12	$540.29	**$1,315,891.40**	
2022 - 15%	6633	6633	22,819.02	2994.469	449.170	$3,115.93	$1,399,585.41	$0.00	$505.91	$50.59	$556.50	**$1,399,028.91**	
2023 - 15%	6847	6847	23,553.79	3090.891	463.634	$3,209.41	$1,487,991.62	$0.00	$521.09	$52.11	$573.20	**$1,487,418.43**	
2024 - 15%	7068	7068	24,312.22	3190.417	478.563	$3,305.70	$1,581,982.10	$0.00	$536.72	$53.67	$590.39	**$1,581,391.71**	
2025 - 15%	7295	7295	25,095.07	3293.149	493.972	$3,404.87	$1,681,909.59	$0.00	$552.82	$55.28	$608.10	**$1,681,301.48**	
2026 - 15%	7530	7530	25,903.13	3399.188	509.878	$3,507.01	$1,788,149.09	$0.00	$569.41	$56.94	$626.35	**$1,787,522.74**	
2027 - 15%	7772	7772	26,737.22	3508.642	526.296	$3,612.22	$1,901,099.31	$0.00	$586.49	$58.65	$645.14	**$1,900,454.17**	
			TOTALS:	**54,662.263**	**7102.51**	**n/a**	**$21,992,334.31**	**$0.00**	**$12,097.76**	**$1,209.78**	**$13,307.54**	**$21,979,026.77**	
			AVERAGES:	**2602.965**	**381.44**	**n/a**	**$1,099,616.72**	**$0.00**	**$604.89**	**$60.49**	**$665.38**	**$1,098,951.34**	

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The following is recommended:

Single-Family Residence, multi-family residence categories: It is requested that the Board adopt a multi-tiered, inclining block rate structure to provide District customers with the "pocketbook incentive" to stimulate water conservation.

All other categories: It is requested that the Board adopt an inclining block rate structure for all non-residential customers.

Results of this tier system will be tracked for results and modified as necessary to meet the goals.

SUMMARY: The NCSD and its customers are facing water challenges that can only be met with proper planning and customer support. Water conservation plays a vital role in meeting these challenges. Fortunately, there is a wealth of information and statistics compiled by those who have been down this road before us. We can gain the benefit of their experience in designing a rate structure that provides customers incentive to use water efficiently, and make choices and change habits that are in line with the reality of California's limited water supply.

A conservation-based rate structure has been shown to induce significant water savings, and is considered to be the cornerstone of water conservation programs. Without the monetary incentive to save water, other elements of a conservation program will produce less benefit and more money will have to be spent in public outreach, advertising, and other support measures.

The water-use savings following the implementation of a multi-tiered conservation-based rate structure will depend on the strength of the rate structure, and the amount of "pocketbook incentive" the rate structure provides to customers.

The District's adoption of a strong conservation-based rate structure will communicate to our customers both the scarcity and value of water, and give them the feedback they need when making budgetary choices which are impacted by the costs of water.

1.2. PUBLIC OUTREACH MATERIALS AND EFFORTS

1.2.1. Informative statements, printed materials, bill stuffers, direct mailings
1.2.2. Communication through the media (advertisement, press releases)
1.2.3. Customer promotional/giveaway items

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1.2.1. Informative statements, printed materials, bill stuffers, direct mailings.

To produce sustainable water conservation and reduction in demand, a well-organized water conservation education program, complementing the implementation of specific conservation measures, is crucial. An effective conservation program helps water customers change their water use habits. If customers do not permanently change how they use water, many conservation successes can be easily erased as customers revert to old habits. Evidence of this is the immediate rebound of water consumption occurring after the effects of a drought resolve and media attention to local water scarcity disappears.

Statements: To help provide customers with the tools they need to achieve water conservation goals, an informative water use statement (bill), going beyond simply providing the basic information and

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use, is an important part of the public outreach program.[67] Ideally, meter reading should be done on a monthly basis. This not only enables easier customer budgeting for their water bills, but also provides more immediate feedback to habit changes that result in increases or decreases in customer water use. Water bills should be part of the education/outreach process, and assist customers in reducing their use. By making the customer's water bill part of a public education program, customers are provided another habit-changing reminder or trigger, at little to no extra cost.

Each customer's bill should provide a comparison of current year versus prior years water usage, the fixed charges and commodity charges for water, the amount of water used and the costs incurred at each step of the rate schedule, the customer's use relative to other customers' water use (i.e., "During this billing cycle you used 20% more [or less] than the average water customer"), reminders of seasonal programming changes needed for irrigation systems, internet websites and other references for saving water.[68]

Currently the customer statements are sent out on a bi-monthly basis. The information on the statement includes a history of charges and payments, a comparison between the current and previous year's usage, and a figure representing the average usage.

Printed Material: To accomplish the change in habits necessary to produce long-term water conservation success, frequent prompts and reminders must be part of the water conservation program.

To provide integration and cohesiveness to the multi-method approach to public education, the "Water Use It Wisely" logo will be featured on materials and in advertisement. This colorful yet simple logo provides a simple message: use water wisely. Materials will be focused on informing the customers of the tools available to them for water conservation. However, out of all the water conservation tools available, the number-one, most important element is the person using the tool, and this will also be communicated to customers.

A variety of printed materials, delivered in a variety of ways, will provide the periodic prompts and reminders necessary to produce long-term water conservation habits. These materials will be provided as bill stuffers, direct mailings, at events, at schools, in the District's office lobby, and distributed to businesses.

RECOMMENDATIONS: To take full advantage of low- or no-cost opportunities to present water conservation reminders to customers, the following is recommended:

- Conversion to monthly billing cycle when feasible.
- Include on the statement:
    - Comparison between the customer's current and past years' usage;
    - The costs incurred for each step of the tiered rate structure;
    - Delineation of fixed charges and commodity charges;
    - Reminder of seasonal programming changes needed for irrigation systems;
    - Internet websites and other references for water conservation information.

See *Appendix III* for the proposed customer water billing statement.

COST: The estimated costs for changing the information on the customer water statements are unknown at this time, but are estimated to be less than $500.

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[67] *Fact Sheet: Water Conservation Measures.* National Drinking Water Clearinghouse. December 1998.
[68] *Utah's Water Resources: Planning for the Future.* May 2001. State of Utah Division of Natural Resources.

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The budgeted funding for brochures, mailings, and other printed public-outreach materials is **$28,600.**
ONE-TIME COST: One-time cost for rights to use the "Water Use It Wisely" logo is **$2500.**

1.2.2. Communication through the media (advertisement, press releases).

Communication through the media, in the form of advertisements and press releases, also successfully communicate the message to our customers. Press releases are free; advertisement is not. It is believed that regular advertisements in the Adobe Press will be a strong reinforcement of the District's water conservation message.

RECOMMENDATION: Regular advertising in the *Adobe Press* and *Times Press-Recorder*, with special-event-linked advertising approximately four times a year.

COST: **$12,000.**

1.2.3. Customer promotional/giveaway items.

Educational promotional items can provide another prompt to remember the need for water conservation, and impart information. Imprinted with the District's name and contact information, they also can serve as a link between the District and its customers. At events, it is the promotional items that draw event attendees to the booths. For an informational "vendor" like the NCSD, event booths really need the promotional items to draw the attendees to the booth.

RECOMMENDATIONS: Educational promotional items for use at events and other public functions.

COSTS: **$8000.**

1.3. PUBLIC OUTREACH AND EDUCATIONAL EVENTS

- **1.3.1. Workshops**
- **1.3.2. School outreach program**
- **1.3.3. Community events**

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1.3.1. Workshops.

To assist our customers in saving water and money by efficient use of water in the landscape, two sets of workshops are planned. Each set of workshops will have four workshops each. The topics will be:

- **Irrigation.** Basics on irrigation, including assessing landscape for water needs, choosing emitters/heads, timing and duration of irrigation cycles, need for monthly maintenance and reprogramming to fit climatary needs.
- **Soil/Compost**. Basics of soil physics and biology, composting as a way to increase soil fertility and water-holding capacity, assessing for needs for amendments, fertilizer basics.
- **Drought-tolerant/Xeriscape Plants.** Use and selection of drought-tolerant plants in the landscape, grouping for hydrozones.
- **Principles of Landscaping**. Following the 7 principles of xeriscape (see *Appendix II*).

To assist our customers in basic water conservation measures, one set of workshops is planned. The topics will be:

- **Water conservation in the home.**

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- **Water conservation in the landscape.**

To assist our customers in making fire-resistant landscaping choices, one workshop is planned. The topic will be:

- **Fire-resistant landscaping.**

The workshops will serve both as education and outreach, but some workshops will also be required as a condition of some water-conservation measure rebates.

RECOMMENDATIONS: Two sets of four workshops (a total of eight workshops), scheduled two to four weeks apart.

COSTS: Budgeted funds for eight workshops (speaker stipends, hospitality, giveaways) is **$6700.**

1.3.2. School outreach program.

Included in the school outreach program will be funding for the yearly student art contest (prizes, publicity/ads, reception, and production of winners' art-work into calendars for distribution to school classrooms), and materials for classroom support (financial support of the Nipomo High School Envirothon, student books and other materials, the initiation of a District lending library of DVDs, available for use by teachers for classroom activities, and provision of Science Discovery demonstrations/classes for selected elementary school classrooms).

RECOMMENDATIONS: Provision of education/outreach school support measures.

COSTS: Budgeted funds for these outreach efforts is **$6900.**

1.3.3. Community events.

The District's participation in events serves to both inform and educate those who attend the events, and are a good opportunity to build connections in the community.

The majority of the "hardware" for events (canopy, tables, etc.) has been purchased. Funding will be for entry fees, costs of the events, and banners as needed.

RECOMMENDATIONS: Participation in community events.

COSTS: Budgeting for events is **$1500.**

1.4. NCSD LANDSCAPE/DEMONSTRATION GARDEN.

The current NCSD facility landscaping was not designed to be water-efficient, and includes an invasive species of groundcover (*Hedera helix*). Some of the trees have been planted in areas near buildings or sidewalks that will suffer damage as the trees mature.

In order to provide both an example and an inspiration to our customers, and to "practice what we preach," a redesign of the District's landscape to a water-efficient landscape is in process.

The new landscaping will be designed to demonstrate landscaping approaches to different landscape needs (sunny slope, bordering a walkway, under a shady tree, etc.). It will be installed in phases, with the first phase to incorporate the front of the District facility and the area near the back exit driveway.

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The project is currently out for landscape-design proposals. Once the decision has been made on the design, removal of existing plant material and installation of new plant material and irrigation system elements will begin.

RECOMMENDATIONS: Continue District landscape redesign, with the initiation of Phase I of the project.

COSTS: This will be part of the landscape redevelopment program.

1.5. TECHNICAL ASSISTANCE

- **1.5.1. Water audits, assist in leak detection**
- **1.5.2. Provision of free, small-area landscape designs (i.e., design for an 8' shady border)**
- **1.5.3. Provision of a list of xeriscape-knowledgeable landscapers, landscape designers, and nurseries**
- **1.5.4. High-use letters offering assistance (water audit, information) and explaining rate schedule**
- **1.5.5. Low-use letters congratulating water efficiency**

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1.5.1. Water audits, assist in leak detection. (BMP 1)

The California Urban Water Conservation Council's Best Management Practice 1 recommends water survey programs (including water audits) for 15% of single-family residential and multi-family residential customers within 10 years.

Water audits are very important to any water conservation program. Water audits identify leaks and water use inefficiency, educate customers, serve as a public-outreach measure, and sometimes include installation of water-efficiency devices or plumbing retrofits. Some water-conservation measures, such as provision of irrigation controllers to customers, have been demonstrated to be unsuccessful without first accomplishing a water audit and bringing the existing system up to optimum performance and uniformity.

According to the California Department of Water Resources, most water audits of residential landscapes find a distribution uniformity of 50% or less (recommended uniformity is >70%).[69]

Most irrigation inefficiency occurred during the fall. Sites maintained by contract landscapers were irrigated less efficiently. Sites less than two acres achieved the highest percentage water savings. Water audit savings diminished over time (20.1%, 7.6%, and 6.5% over three years.)[70]

Water audits are performed to assess for leaks and inefficiency of water use (i.e., absence of distribution uniformity of landscape irrigation systems, where the amounts of water delivered to areas of the landscape are unintentionally without uniformity).[71]

Residential. Studies show that home water audits can result in water savings when plumbing retrofit devices are installed and customers are given practical guidance about more efficient outdoor water-use practices, particularly for lawn irrigation. Results of water audits vary, but those that involve

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[69] Vickers, Amy. *Handbook of Water Use and Conservation.* Amherst, MA: Water Plow Press. 2001.
[70] Whitcomb, J.B. *Landscape Water Audit Evaluation.* Contra Costa Water District. August 1994.
[71] Vickers, Amy. *Handbook of Water Use and Conservation.* Amherst, MA: Water Plow Press. 2001.

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installing some kind of efficiency device and spending time with the customer to educate them about reduced outdoor water use have reported savings for combined indoor and outdoor use ranging from 20 to 30 G/D per SFR. A trained technician can accomplish an indoor water audit in less than an hour (excluding follow-up analysis and paperwork). The cost of contracting a water auditor varies from $40 to $75 per home.

An indoor water audit should contain an explanation of the purpose of the audit, a determination of the water use, test and repair leaks, provision of retrofit devices, follow-up analysis and recommendations, with education of the customer.[72]

Residential landscape. A residential landscape water audit takes about 1.5 hours. The highest yield of water savings usually occurs for both residential and nonresidential customers who rely on irrigation controllers that are incorrectly programmed or who have malfunctioning or poorly designed irrigation systems. Audits that educate customers one-on-one about water efficiency concepts, recommend site-specific conservation measures, and provide or install an efficiency device along with back-up technical support should result in a 10% to 15% reduction in landscape water demand. The most successful water audits should require an explanation of the purpose of the audit, review of outdoor water use, evaluation of lawn, landscape and irrigation features, measurement of water use of the irrigation equipment (distribution uniformity), provide landscape water-efficiency recommendations, leaving information and installation of conservation devices, and post-audit follow-up[73].

Large landscape. Water audits of large landscapes can take up to 8 hours. The Cachuma Resource Conservation District (USDA Service Center in Santa Maria) performs these specialty water audits for free. The service provides the audit and detailed recommendations, but does not do follow-up to verify that the recommended changes and fixes have been accomplished.

DISCUSSION: Water audits are staff-time-intensive, and current staff is not sufficient to perform the anticipated requests for water audits. At this time staff is researching options for accomplishing this important part of the water conservation program. Options include temporary contracting of students, who will need to be trained before they can perform the audits, and contracting for the audits. The Atascadero Mutual Water Company hires two temporary staff each year to perform the audits in spring and summer, and this program has worked well for them. The City of San Luis Obispo has two full-time staff performing water audits and other services for the city's water conservation program.

Estimates for two scenarios were prepared:

Contracting with a part-time intern, 4 hours/day, for 12 weeks. This intern would have their own vehicle. Pay would be $12/hour for 240 hours, over 12 weeks. Car stipend would be $10/day. This intern in three months would be expected to perform 180 water audits over the 12-week period. Included is administrative cost of 20% of total intern costs. Audits would be restricted to landscape audits because of issues of having an intern enter resident's home. Contracting with a part-time intern would cost $23.20 per audit.

Benefits. Lower cost.

Drawbacks. Utilizing an intern would require considerable staff effort for training, support and supervision. It would also place more liability on the District because, unlike a contractor with their own business, the intern would not have their own liability insurance. The public perception of the credibility of the work done by an intern-in-training might be less than that for a professional contractor with their own business. Finally, an intern would be restricted to landscape audits only.

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[72] Vickers, Amy. *Handbook of Water Use and Conservation.* Amherst, MA: Water Plow Press, 2001.
[73] *Ibid.*

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Contracting with a professional certified water auditor. This contractor would contract per audit, and all costs (including for vehicle and appropriate insurance) would be covered by the per-audit charge. Cost is estimated at $75/audit for 120 water audits. Administrative costs of 5% of total audit costs would be added, for a total of $78.75 per water audit. Each water audit would include indoor plumbing check and landscape audits. Public perception may be better with a certified professional contractor. There would be less liability involved.

RECOMMENDATION: Contract with a professional certified water auditor for up to 470 water audits.

COST: **$14,175.00**

1.5.2. Provision of free, small-area landscape designs (example: design for an 8' shady border).

It is believed that many District homeowners may be open to changing landscaping and decreasing lawn size, but do not want to hire a landscape designer and may not want to do the entire project at once. Providing free small-area landscape designs to meet the needs of different landscape settings would give homeowners basic designs from which to work.

The District would pay a landscape designer experienced in xeriscape designs to create a series of small landscape designs for, as an example, an 8-foot walk-way border or four corners to use in decreasing a larger, rectangular lawn to a smaller, ovoid lawn.

RECOMMENDATIONS: Provision of free small-area landscape designs to District SFR customers.

COST: Budgeting is for **$1000.**

1.5.3. Provision of a list of xeriscape-knowledgeable landscapers, landscape designers, and nurseries

A common complaint from homeowners wishing to change their landscapes to a more water-efficient environment is the inability to locate knowledgeable landscape professionals and plant nurseries. By maintaining lists of landscape maintenance specialists, landscape designers and nurseries which have experience in supporting a water-efficient landscape, the District's customers will have additional tools by which they can succeed in conserving water.

RECOMMENDATIONS: Maintenance and provision of lists of landscape professionals knowledgeable in water-efficient/xeriscape landscapes.

COST: **Negligible**; staff will be compiling these lists anyway.

1.5.4. High-use letters offering assistance (water audit, information) and explaining rate schedule

1.5.5. Low-use letters congratulating water efficiency

Many sources speak highly of the impact of personal contact with customers in effecting water conservation goals.

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According to Ron Munds (City of San Luis Obispo), measures which provide one-to-one contact with customers are very effective in promoting water conservation and reducing water usage. In his experience, high-use letters to customers produce over time a decrease in water consumption of those contacted, even if the customers don't take advantage of any of the offers for information or services that accompany the letters.

It is believed that the District would benefit from this measure, which would be easy to accomplish and take minimal staff time.

RECOMMENDATION: Monthly provision of letters to high-use customers, offering services (water audits, leak detection) and providing information for decreasing water use. In addition, monthly letters to the low-use customers, congratulating them for their wise use of the District's water resources, will serve as a reinforcement for desirable behavior.

COST: **Variable but minimal**, related to preparing addresses for merging with a form letter and charges for postage.

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2. *"UNACCOUNTED FOR LOSSES," NON-REVENUE WATER.*

2.1. Supply-side (District) monitoring for increase in District's unaccounted-for losses; if the amount rises to 10%, consider formal system-wide audit for leaks and other problems.

2,2, Demand-side (customer) leaks, non-point-of-use losses.

2.2.1. "Oops" door-hangers.

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2. *"UNACCOUNTED FOR LOSSES," NON-REVENUE WATER.*

The American Water Works Association recommends the term "non-revenue water" to replace the previous, inaccurate term, "unaccounted-for losses."

Refer to Table 1 on page 17.

Water system uses of water are divided into two categories:

1. Revenue water consumed has two categories:
   a. Billed metered consumption (SFR, MFR, CI, Landscape, Agriculture customers).
   b. Billed unmetered consumption. None.

2. Non-revenue water is the difference between the amount produced by the system and the billed authorized consumption, and includes three categories:
   a.. Authorized but unbilled consumption: Unbilled metered consumption (water used at NCSD office facilities), unbilled unmetered consumption (hydrant water used for fighting fires, water used for flushing lines).
   b. Apparent Losses: Unauthorized consumption, theft, customer metering inaccuracies, data handling errors.
   c. Real Losses: Leaks in transmission and distribution mains, leaks and overflows at utility tanks, leaks at service connections up to the point of customer metering.[74]

The amount of water used for fire-fighting and flushing lines and fighting fires is usually considered relatively small.[75]

Water not accounted for by metered consumption can be, but may not be, attributable to leaks in the water system. Theft and other unauthorized consumption, for instance, also contribute to the amount of water that cannot be accounted for by metered consumption.

For the years 2001-2006, the District produced a total of 16,197.78 acre-feet of water (average of 2699.63 acre-feet/year), delivered a total of 15,202.42 AF (average of 2533.74 AF/Y), and percentage of loss was a total of 995.36 AF (average of 165.89 AF/Y). The percent losses averaged 6.21% per year (Table 1).

Using the $2000/AF estimated next-increment cost of water, the yearly average monetary loss from unaccounted losses in the distribution system is $331,780.00.

The total percentage increase in production from 2001 to 2006 was 13.85% (average production increase each year was 2.31%).

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[74] *Water Audit Methodology*. America Water Works Association, 2007.
[75] Vickers, Amy. *Handbook of Water Use and Conservation*. Amherst, MA: WaterPlow Press, 2001.

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2.1 Supply-side (District) monitoring for increase in District's unaccounted-for losses; if the amount rises to 10%, consider formal system-wide audit for leaks and other problems.

The percent loss is compared to the cost-effectiveness standard set by the American Water Works Association (AWWA).[76] The current standard suggests that if a system's percent unaccounted-for-losses exceeds 9%, a distribution system audit could be cost effective. Based on the District's production information, the average yearly system loss was 6.21%, which is within the current AWWA standard; therefore, a distribution system audit would not be expected to be cost effective. In addition, the 6.21% average loss is below the 10% threshold in the California Urban Water Conservation Council (CUWCC) Best Management Practice 3 for unaccounted losses.[77]

2.2. Demand-side (customer) leaks, non-point-of-use losses.

A faucet leak of one drop per second results in a loss of 2400 gallons per year; based on the number of SFR District meters in 2006, that would equal 25.211 AF/Y. Leaks in the home and residential landscape can result in losses of, on average, 14% (9.5 G/C/D) of the home water use.[78] For each 5% (182 homes projected in 2008) of the District's SFR customers' water leaks which are located and corrected, projected over 5 years, it would translate into a total savings of 89.47 AF, and $175,913.12 in water costs. Average annual savings over 5 years would be 17.89 AF, $35,182.62 in water costs. Included in the estimation is $100 for each residence in estimated water audit costs, and $1,820 in initial office administrative costs. Note that the projections were only made for 5 years because savings have been shown to decrease with time until a new audit and leak correction is performed. Note also that this is only for one 5% SFR account increment that underwent water audit with subsequent corrections. Each year that this increment was performed would provide a new batch of savings (and costs).

Residential leaks can be located by the customer or by the District. It is anticipated that, given the correct instructions and tools (dye tabs for toilet leaks, etc.), that some customers would be willing and able to find and fix their own leaks, but some customers would not.

Leaks, once located, can be corrected by the customer or the District. Some water suppliers make this the responsibility of the customer. Other water suppliers believe that the increase in compliance and resulting water-loss savings justifies having the water supplier pay.

Residential water audits (indoor and outdoor) would identify leaks, as well as educate the customer and provide water-saving measures/fixtures to further decrease water usage in the homes. Water audits would also benefit other non-core program measures ("smart" controller, turf-replacement), and would benefit all measures by educating and establishing contact with customers on water conservation.

Water audits of commercial, large landscape, and agriculture accounts may result in water savings, as well. The state-funded Cachuma Resource Conservation District (USDA Service Center, Santa Maria) will provide, free of charge, water audits for large landscape and agriculture accounts. A water audit of Nipomo Park has already been performed, and demonstrated that, just by bringing the irrigation system up to 70% or greater uniformity would save them over $24,000/year in water costs. Contacting customers in these two categories with the offer of a free water audit may benefit both the District and the customer in saving water and money spent on irrigation, especially if pocketbook-

[76] *Water Conservation Programs—A Planning Manua, M52I.* American Water Works Association, 2006.
[77] *Memo of Understanding, BMP-3.* California Urban Water Conservation Council, 2007.
[78] Vickers, Amy. *Handbook of Water Use and Conservation.* Amherst, MA: WaterPlow Press, 2001.

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incentive (conservation-based rate structure) and staff follow-up is provided as incentive to get the recommendation changes made.

Of special interest is the fact that the Cachuma Resource District now has access, once the water audit has been performed by the CRD, to funding for bringing large irrigation accounts up to irrigation efficiency

2.2.1. "Oops" door-hangers.

In an effort to assist SFR customers to use water efficiently, the District has instituted an "Oops!" doorhanger program by which SFRs with obvious water use problems (broken/geysering sprinkler, irrigation water flowing into the street, etc.) receive a friendly notification. Currently the utility crew places these hangers as they encounter problems during the course of their regular duties.

Expansion of the program by devoting staff time to the effort, as part of the public outreach program, would be expected to increase the efficacy of the program.

To date there have been no complaints about the doorhangers, which were designed to be friendly and helpful. One residence where a doorhanger was placed the next reading had an $800 water bill. When the customer called about the amount of the bill, she said she had received the doorhanger, but had not done anything about it. In this case, notification was accomplished but customer action was not. Therefore, an expansion of the program to include recording addresses and dates the doorhangers were left would allow for appropriate follow-up to offer information or help where appropriate.

RECOMMENDATIONS:

1. Because the District's percent loss is 6.21%, at this time a formal distribution system water audit may not be cost effective. However, the level of losses should continue to be regularly monitored. If water losses were to increase to 10%, a full-scale system audit may be warranted.
2. SFR leaks, if located and corrected, could produce substantial water savings. When combined with other water-conservation program measures, such as using the opportunity to provide low-flow showerheads and other plumbing retrofits, even more water savings can be accomplished. It is recommended that a goal be set to provide water audits to 5% of SFR customers. The District can consider making simple repairs, such as replacing a toilet flapper-valve.
3. There is potential for water and money savings in the large landscape and agriculture accounts which are not now irrigating at maximum efficiency. Recommendation is made for contacting these accounts with the offer of the free water auditing services provided by the State of California. Simple, non-intrusive follow-up, offering information and assistance, opening a line of communication with these accounts, would be beneficial to the District, and is recommended.
4. It is believed that expansion of the "Oops!" doorhanger program would increase both the impact of the program and the compliance with fixing the problem. If staff is brought on for another reason (assisting in water audits, for example), the "Oops!" doorhanger program could become part of the staff's responsibilities.

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COMPARISON AND DISCUSSION OF CORE WATER CONSERVATION PROGRAM MEASURES

The core water conservation program measures work together to form a supportive matrix by which each core measure is supported by, and supports, the other core measures. The core program measures also form the bedrock upon which other, non-core measures rely.

The majority of the core measures are considered vital, yet not-quantifiable-in-savings, parts of the entire water conservation program. These are:

- Public outreach materials and efforts.
- Public outreach events.
- NCSD landscape/demonstration garden.
- Technical assistance (including "Oops!" doorhangers).

The multi-tiered conservation-based rate structure's efficacy in decreasing water use will depend on the strength of the rate structure chosen by the Board of Directors.

One of the core measures, leak detection and correction, has demonstrable savings.

Table 15: SAVINGS FROM LEAK DETECTION AND FIXING

Measure	Target Category	Total Savings Avg. AFY	Avg. AFY Consum. For All Categ,s	% AF Savngs for All District Categ's	Total $ (not NET) Savings	Total$ Costs	Savings: Costs Ratio	Years to pay off Initial Invest.
Leak detection, fixes	SFR (10%)	17.89	3698.743	0.48%	$196,351.48	$20,438.36	9.6:1	<1.0

Multi-tiered, conservation-based rate structure. This measure can be, by far, the most cost-effective of all of the measures offered. Other districts with strong conservation-based rate structures (usually three- or four-tiered) have shown significant savings. The District's customers (all categories) would be anticipated to save over 10% of their water use by a strong rate structure. The savings on the District's rate structure will depend on the structure chosen.

Since the costs implementing a conservation-based rate structure are very low, the savings:cost ratio is usually high. The strength of the ratio would depend on the strength of the conservation-based rate structure.

The goal of conservation-based rate structure is to place "pocketbook incentive" on the customers who are at the high end of amount of water use. It is this latter category of customers which are the greatest burden, per customer, on the system, and which force expansion of facilities sooner than other users.

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Conservation-based rate structure for the residential categories is the top priority, although equity of responsibility for conserving water in the District, across all categories of consumers, is important. The SFR category uses, as a category, the highest percentage of water and, it is estimated, have the greatest potential to save an impressive amount of water. It is estimated that the majority of the customers in the other categories can also conserve water, but it is not as easy to predict how much can be saved by the non-residential categories. Studies have shown that the majority of water customers, in all categories, respond to a strongly tiered conservation-based rate structure by using less water. Even if the rate structure simply triggers the customer to undergo a water audit and make the changes necessary to optimize water use efficiency, it is the pocketbook-based incentive that triggers the greatest and most predictable change.

An inclining-block, multi-tiered conservation-based rate structure is recommended for SFR, MFR, landscape and commercial categories.

Leak detection, fixes. This measure also has specific findings for water savings. However, as is the case with all measures, these savings are dependent on appropriate public education and other supportive measures. If 5% of the SFR category underwent water audit each year, the savings would be almost 0.5% of the annual use of all categories combined, with a 9.6:1 savings:cost ratio, and the initial investment would be paid back in less than one year. This measure's savings decreases with time, as new leaks or irrigation distribution uniformity problems arise; therefore, the projected total savings is limited to five years.

3.1 CORE PROGRAM DISCUSSION AND RECOMMENDATIONS.

1. **Multi-tiered, conservation-based rate structure for SFR, MFR, landscape and commercial categories is recommended.** The savings in water and expenditure for supplemental water will depend on the strength of the conservation-based rate structure chosen by the Board.
2. **Full-system, formal water audit of the District's production and delivery system is not recommended at this time.** Because the District's percent loss is 6.21%, at this time formal distribution system water audits may not be cost effective. However, the level of losses should continue to be regularly monitored. If water losses were to increase to 10%, a full-scale system audit may be warranted.
3. **SFR water audits and assistance, where possible, with leak fixes, is recommended, with a goal of water audits in 5%-of-SFR household increments.** SFR leaks, if located and corrected, could produce substantial water savings. When combined with other water-conservation program measures, such as using the opportunity to provide low-flow showerheads and other plumbing retrofits, even more water savings can be accomplished. The District can consider making simple repairs, such as replacing a toilet flapper-valve.
4. **An outreach program to non-residential customer accounts, with the offer of free water audits, and then non-intrusive follow-up, is recommended.** There is potential for water and money savings in the large landscape and agriculture accounts which are not now irrigating at maximum efficiency. Simple, non-intrusive follow-up, offering information and assistance, opening a line of communication with these accounts, would be beneficial to the District, and is recommended.
5. **The "Oops!" doorhanger program should be expanded.** It is believed that expansion of the "Oops!" doorhanger program would increase both the impact of the program and the compliance with fixing the problem. If staff is brought on for another reason (assisting in water audits, for example), the "Oops!" doorhanger program could become part of the staff's responsibilities.

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IX. Water Conservation Program: *Non-Core* Program Measures

IX. Water Conservation Program: *Non-Core Program Measures*

1. ***HARDWARE RETROFITS AND REBATES FOR RESIDENCE***
   - **1.1. Toilet replacement rebates/mitigation**
   - **2.2. High-efficiency washing machine rebates**
   - **2.3. Provision of plumbing retrofit kits**

2. HARDWARE RETROFITS AND REBATES FOR LANDSCAPE

- **2.1. Smart irrigation controller provision or rebate**
- **2.2. Rebates for conversion from turf to drought-tolerant plantings**
- **2.3. Provision of landscape irrigation efficiency items**

BENEFITS AND COSTS OF RESIDENTIAL WATER CONSERVATION

A number of benefits occur for utilities, residential customers, and nonresidential property-owners who conserve water.

BENEFITS:

- Water savings.
- Reduced wastewater flows.
- Reduced costs for water, sewer, and associated electric and gas utility services.
- Reduced costs for clothes-washing and dishwashing detergents.
- Reduced size and extended septic system life.
- Improved safe yield and pumping reliability in wells.
- Improved local environment (instream flows, wetlands protection, topsoil preservation).
- Pollution prevention (reduced energy combustion by-products and chemical use).

COSTS:

- Price of conservation device (hardware).
- Cost to install device.
- Cost of any necessary renovation of existing plumbing, appliances, or related connections.
- Changes in water-use habits.[79]

1. HARDWARE RETROFITS AND REBATES FOR RESIDENCES (BMP 1, 2)

Hardware retrofits and rebates, in general, produce immediate results that persist over the life of the hardware. Unlike behavioral modification approaches (taking shorter showers, turning off water while brushing teeth, etc.) re-education and reinforcement are not necessary to continue the benefit.[80,81]

[79] Vickers, Amy. *Handbook of Water Use and Conservation.* Amherst, MA: Water Plow Press. 2001.
[80] Vickers, Amy. *Handbook of Water Use and Conservation.* Amherst, MA: Water Plow Press, 2001.

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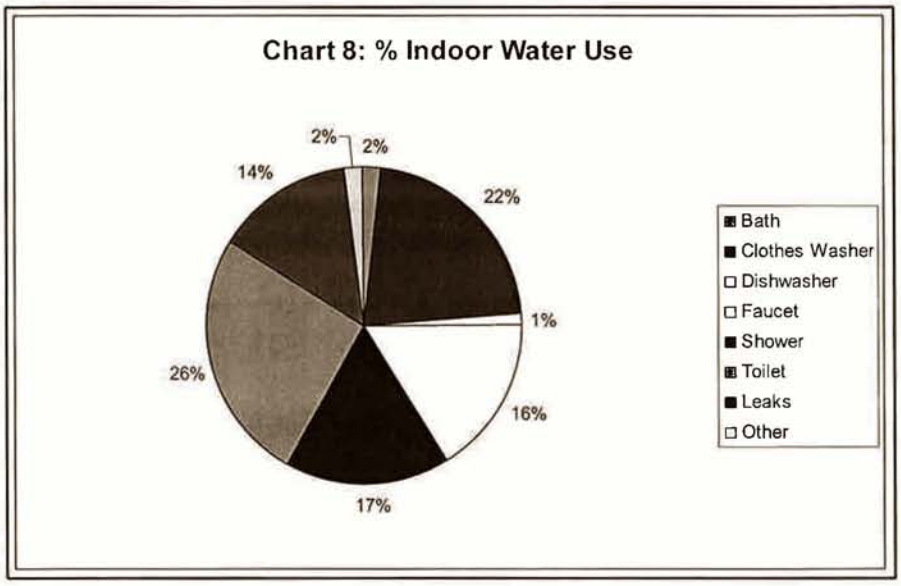
The County of San Luis Obispo has certified a Level of Severity III (the highest level) for the water supply water for the Nipomo Mesa. The County has passed two ordinances which require plumbing retrofitting to mitigate the water use from new development. This program will be designed and administered by the County. There are no anticipated costs to the District.

1.1. Toilet rebates/replacements residential:

Studies done have repeatedly demonstrated dependable savings from replacement of high-flow toilets with low-flow toilets. Indeed, when the City of San Luis Obispo instituted a water conservation program, they found that toilet replacement was a cornerstone of their program, and has produced since its initiation in 1994 an annual water savings of 1,400 acre-feet.[82]



Toilet replacement measures are the most rewarding in water savings when the measure is first implemented in the city or district. As more toilets are replaced by the program, and as time passes and toilets are replaced by homeowners and businesses because of failure or owner decision, the market becomes "saturated" and there is less opportunity for the replacement program to be used. However, the savings from toilet conversion to low-flow devices are remarkable, and worth having in the program.[83]

Savings are estimated for targeted households at 32.2 gpd, and untargeted households 21 gpd. Costs and savings depend on the scale of the program (rebate, distribution, or direct installation).[84]

The Metropolitan Water District of Southern California's low-volume toilet program showed an average net savings per single-family residence (SFR) of 41.2 gallons/household/day (G/H/D). Mean savings were 29.9 G/H/D with one 1.6 gallons/flush (G/F) toilet, 20.6 G/H/D with two 1.6 G/F toilets, and 19.1 G/H/D with three 1.6 G/F toilets. Estimated net savings per 1.6 G/F toilet installed was 21.6 gallons/day (G/D). Multi-family residences (MFR) demonstrated an average net savings of 44.0 G/H/D. Mean savings were 44 G/H/D with one 1.6 G/F toilet and 34 G/H/D with two 1.6 G/F toilets (toilets installed in a household after the first one usually show less savings because usually the most heavily used toilet is replaced first). Estimated net savings per 1.6 G/F toilet installed was 40.3 G/D. A toilet-replacement program by the Tampa Water Department demonstrated an average savings per SFR of 38 G/H/D. In New York City, New York, average water savings of 9.3 gallons/capita/day

[81] A&N Technical Services, Inc. *BMP Costs and Savings Study: A Guide to Data and Methods for Cost-Effectiveness Analysis of Urban Water Conservation Best Management Practices.* The California Urban Water Conservation Council, March 2005.
[82] Henderson, Gary, Munds, R. *City of San Luis Obispo 2006 Water Resources Status Report, June 2006.*
[83] Vickers, Amy. *Handbook of Water Use and Conservation.*
[84] A&N Technical Services, Inc. *BMP Costs and Savings Study: A Guide to Data and Methods for Cost-Effectiveness Analysis of Urban Water Conservation Best Management Practices.* The California Urban Water Conservation Council, March 2005.

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(G/C/D) in households with 1.6 G/F toilets were demonstrated. In El Paso, Texas, their household savings from low-volume toilets was 8% reduction in monthly residential water consumption. In the City of Barrie, Ontario, Canada, the mean savings from low-volume toilets in a SFR was 16.38 G/C/D.[85]

COST-BENEFIT ANALYSIS: Refer to Table 16 for detailed accounting.

Since this is not a habit-modification measure, continual follow-up is not required, the costs of the program (rebate, shared program costs, office administration costs) are a one-time expenditure, at the beginning of the program, and the benefits continue to accrue over years.

Since the County will be administering this program, there will be no costs to the District. Should the County's program retrofit 365 toilets a year (the equivalent of one toilet in 10% of District's SFR homes), for ten years, the following could be expected:

Savings in AF over 10 years:	\$88.31
Average AF/Y savings:	8.83
Total net savings in $$$ over 10 years:	\$208,554.35
Average net $$$/year savings:	\$ 21,765.05
Years until costs are paid off:	0
% Water savings (AF/Y)	0.24%
Savings:Cost ratio	100%

This measure could also be expanded by including the poor-performing, previously-placed ULFTs in the rebate program.

[85] Vickers, Amy. *Handbook of Water Use and Conservation.* Amherst, MA: Water Plow Press. 2001.

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Table 16: PROJECTED COSTS AND SAVINGS OF LOW-VOLUME-FLOW TOILET REFIT PROGRAM WITH A 10% MARKET PENETRATION, OVER 10 YEARS (SINGLE-FAMILY RESIDENCE, 21.6 GPHD SAVINGS)

Year	SFR #Meters	(SFR) #Meters w/10% MP	Estimd. Popul. w/10% MP	SFR AFY Required w/o Measure	Saved:SFR AFY/All Customers (21.6 gphd avg)	Cost of Water/AF w/3% inflat.	$$Savings/ Year (w/ 3% infl/yr)	Costs to District	Shared Program Costs	Office Admn Costs (10% of Prg.Costs)	Total Costs	NET SAVINGS (Total Savings minus Total Costs)
2008	3647	365	1,256	214.255	8.83	$2,060.00	$18,192.30	$0.00	$0.00	$0.00	$0.00	**$18,192.30**
2009				214.255	8.83	$2,121.80	$18,738.07	$0.00	$0.00	$0.00	$0.00	**$18,738.07**
2010				214.255	8.83	$2,185.45	$19,300.21	$0.00	$0.00	$0.00	$0.00	**$19,300.21**
2011				214.255	8.83	$2,251.02	$19,879.22	$0.00	$0.00	$0.00	$0.00	**$19,879.22**
2012				214.255	8.83	$2,318.55	$20,475.60	$0.00	$0.00	$0.00	$0.00	**$20,475.60**
2013				214.255	8.83	$2,388.10	$21,089.86	$0.00	$0.00	$0.00	$0.00	**$21,089.86**
2014				214.255	8.83	$2,459.75	$21,722.56	$0.00	$0.00	$0.00	$0.00	**$21,722.56**
2015				214.255	8.83	$2,533.54	$22,374.24	$0.00	$0.00	$0.00	$0.00	**$22,374.24**
2016				214.255	8.83	$2,609.55	$23,045.46	$0.00	$0.00	$0.00	$0.00	**$23,045.46**
2017				214.255	8.83	$2,687.83	$23,736.83	$0.00	$0.00	$0.00	$0.00	**$23,736.83**
			TOTAL:	**2,142.550**	**88.31**	**$23,615.59**	**$208,554.35**	$0.00	$0.00	$0.00	$0.00	**$208,554.35**
			AVERAGE:	**214.255**	**8.83**	**$2,361.56**	**$20,855.43**					**$21,765.05**

RECOMMENDATIONS: Administration and monitoring by the County.

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1.2. Provision of plumbing (non-toilet) retrofit kits.

This usually involves replacement of showerheads, installation of faucet aerators, provision of leak-detection tablets, and other water-conservation support items. In the past, when SLO City's water conservation program was initiated, showerheads were considered a "cornerstone" of the program.[86]

The results of showerhead replacement vary depending on saturation (the number of devices already in place) and retention of the showerhead. Showerhead replacement works best when the new showerhead is of good quality, when the old showerhead is removed from the premises (i.e., replacement or rebate to homeowner after installation, in exchange for the old showerhead) and when the new showerhead is actually installed[87].

Expected water savings for showerheads are from 5.2 to 5.8 G/D, for toilet dams (to decrease the amount of water in the toilet tank) 4.2 G/D, for aerators 1.5 G/D, and for leak tablets 8 G/D with a leak, 0.64 G/D overall.

Expected energy savings depend on whether the household refitted has an electric or gas water heater. In homes with an electric water heater, when a high-flow showerhead is replaced with a low-flow unit, and when a low-flow aerator is placed on a high-flow kitchen faucet, 1,568 kWh in annual savings can be expected. In homes with gas water heaters, 86 therms in savings can be expected.

Cost of retrofit kits vary, depending on quality and quantity ordered, as well as the number of items in each kit, starting as low as $2.00.[88]

RECOMMENDATIONS: Provide interested customers with an indoor-plumbing refit kit consisting of a showerhead, Teflon tape, toilet leak detector, faucet aerator, and shower timer. The price for each set would be $24.84 each (plus delivery), with an initial order of 250 sets. The total for these kits would be $6210.00.

The savings for the showerheads would be estimated at 5.8 G/D each and for the leak detection 0.65 G/D each overall (taking into account those that identified a leak and those that didn't). The savings from the Teflon tape and shower timer would be in support of the shower-savings program. The kitchen faucet aerator would be estimated to provide 1.5 G/D water savings. A total of 7.3 G/D for each kit would be estimated.

COST-BENEFIT ANALYSIS:	Refer to Table 17.
Savings in AF over 10 years:	20.443
Average AF/Y savings:	2.044
Total net savings in $$$ over 10 years:	$33,822.47
Average net $$$/year savings:	$ 2,357.97
Years until costs are paid off:	Less than 3 years.
% Water savings AF/Y:	0.06%
Savings:Cost ratio	3.3:1

[86] Henderson, Gary, Munds, R. *City of San Luis Obispo 2006 Water Resources Status Report, June 2006.*

[87] Vickers, Amy. *Handbook of Water Use and Conservation.* Amherst, MA: Water Plow Press. 2001.

[88] A&N Technical Services, Inc. *BMP Costs and Savings Study: A Guide to Data and Methods for Cost-Effectiveness Analysis of Urban Water Conservation Best Management Practices.* March 2005. The California Urban Water Conservation Council.

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Table 17 : *PROJECTED COSTS AND SAVINGS* OF INDOOR SMALL-ITEM PLUMBING RETROFIT (EXCLUDING TOILET); 6.15% MARKET PENETRATION, OVER 10 YEARS (SINGLE-FAMILY AND MULTI-FAMILY RESIDENCE CATEGORIES) (7.3 gallons/meter/day Estimated Savings)

Year	(SFR & MFR) #Meters	Estimd Popul. w/6.15 % MP	SFR AFY Required w/o Measure	Saved: SFR AFY	Cost of Water/AF w/3% inflat.	$$Savings/ Year (w/ 3% infl/yr)	Cost of Equip.	10% Share of Shared Program Costs	Office Admn Costs (10% of Prg.Costs)	Total Costs	NET SAVINGS (Total Savings minus Total Costs)	Years to Pay Off Initial Invest.
2008	250	860	137.810	2.044	$2,060.00	$4,211.18	$6,250.00	$6,890.00	$1,314.00	$14,454.00	-$10,242.82	<3
2009	One-time investment, with benefits reaped over years.		137.810	2.044	$2,121.80	$4,337.52	$0.00	$0.00	$0.00	$0.00	$4,337.52	
2010			137.810	2.044	$2,185.45	$4,467.64	$0.00	$0.00	$0.00	$0.00	$4,467.64	
2011			137.810	2.044	$2,251.02	$4,601.67	$0.00	$0.00	$0.00	$0.00	$4,601.67	
2012			137.810	2.044	$2,318.55	$4,739.72	$0.00	$0.00	$0.00	$0.00	$4,739.72	
2013			137.810	2.044	$2,388.10	$4,881.91	$0.00	$0.00	$0.00	$0.00	$4,881.91	
2014			137.810	2.044	$2,459.75	$5,028.37	$0.00	$0.00	$0.00	$0.00	$5,028.37	
2015			137.810	2.044	$2,533.54	$5,179.22	$0.00	$0.00	$0.00	$0.00	$5,179.22	
2016			137.810	2.044	$2,609.55	$5,334.60	$0.00	$0.00	$0.00	$0.00	$5,334.60	
2017			137.810	2.044	$2,687.83	$5,494.64	$0.00	$0.00	$0.00	$0.00	$5,494.64	
TOTAL:			**1378.100**	**20.443**	**$23,615.59**	**$48,276.47**	**$6,250.00**	**$6,890.00**	**$1,314.00**	**$14,454.00**	**$33,822.47**	
AVERAGE:			**137.810**	**2.044**	**$2,361.56**	**$4,827.65**	**$625.00**	**$689.00**	**$131.40**	**$1,445.40**	**$2,357.97**	

The highest estimations of savings for this measure is when they are provided as part of a water audit and installed for the homeowner. Neither one of these measures is recommended as a condition of receiving the kit. However, when a water audit is performed it would certainly be efficient to offer the kit at the same time to reinforce the benefit of the water audit, and when a kit is offered it would be efficient to ask if they would like to have a water audit performed.

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1.4. High-Efficiency Clothes Washer (HEW). (BMP 6)

High-efficiency washing machines are designed to save both energy and water. The San Diego County Water Authority reports that these machines 65% less water and 55% less energy per load than standard machines. The SDCWA offers $175 rebates.[89] They may or may not be front-loading. The difference in cost between low- and high-efficiency washing machines is estimated to be between $400 and $1,000. Savings are estimated at 85-109 gallons per week per machine, 14.4 to 28.7 gpd/machine SFR and 53.8 to 107.7 gpd/machine MFR.[90]

The Oak Ridge National Laboratory did a field study of high-efficiency washers for the U.S. Department of Energy, and found there was a 37.8% combined savings of water and energy use and impact on wastewater system. Rebates from the agencies involved in the study ran between $25 and $150, although it is noted that the agency offering the $25 rebate had requested more funding to raise the amount of the rebate, to make it more attractive to customers. The Consortium for Energy Efficiency (CEE) started a high-efficiency washing machine rebate program. The CCE reported an average savings of 13 gallons per load. The CEE estimated the savings potential from high-efficiency washers to be up to 59%, or about 9,000 gallons annually. A Tampa Water Department study found a 46.8% decrease in water use in washing machines. The Seattle Home Water Conservation Study found 37.7% water savings for high-efficiency washers.[91]

The Santa Cruz Water Conservation Office reports that newer front-loading machines use 20 to 25 gallons per load (a savings of at least 15 gallons per load). A typical family of four does 400 loads of wash each year. A household of four, doing seven loads of laundry a week, can save 5000 gallons or more each year. Santa Cruz offer $100 rebates.[92]

The California Urban Water Council reports that, for both residential and commercial machines, resource-efficient clothes washers use 35%-50% less water and approximately 50% less energy. They offer a $150 rebate for residential washers, and $400 for commercial washers.[93]

The Los Angeles Metropolitan Water District is offering up to $340 per high-efficiency commercial machine purchased.[94] Puget Sound Energy offers $200 for commercial HEWs.[95] The Contra Costa Water District offers up to $200 per commercial HEW to commercial customers.[96]

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[89] *High-Efficiency Clothes Washer Voucher Incentive Program.* San Diego County Water Authority. http://www.sdcwa.org/manage/conservation-hew.phtml.

[90] A&N Technical Services, Inc. *BMP Costs and Savings Study: A Guide to Data and Methods for Cost-Effectiveness Analysis of Urban Water Conservation Best Management Practices.* March 2005. The California Urban Water Conservation Council.

[91] A&N Technical Services, Inc. *BMP Costs and Savings Study: A Guide to Data and Methods for Cost-Effectiveness Analysis of Urban Water Conservation Best Management Practices.* March 2005. The California Urban Water Conservation Council..

[92] *High-Efficiency Clothes Washer Rebate Program.* Santa Cruz City Water Conservation Office. http://www.ci.santa-cruz.ca.us/wt/wtcon/clotheswasher.html

[93] *Product News: Welcome to the Smart Rebates Program!* Council on Urban Water Council. http://www.cuwcc.org/smartrebates/smartrebates_fixtures.lasso#Residential.

[94] *Save Water, Save a Buck: High-Efficiency Clothes Washers.* L.A. Metropolitan Water District. http://www.mwdsaveabuck.com/laundry.htm

[95] *Energy Efficiency Rebate Programs.* Puget Sound Energy. http://www.pse.com/solutions/rebateComWasher.aspx.

[96] *Water Conservation: Rebates.* Contra Costa Water District. http://www.ccwater.com/conserve/rebates.asp

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COST-BENEFIT ANALYSIS, RESIDENTIAL: (Table 19)

Savings in AF over 20 years:	127.70
Average AF/Y savings:	6.721
Total net savings in $$$ over 20 years:	$331,730.25
Average net $$$/year savings:	$ 16,586.51
Years until costs are paid off:	Approx.2.5
% Water savings, all meters:	3.45%
Savings:Cost ratio:	9.2:1

RECOMMENDATIONS: It is recommended that the District undertake this measure for the SFR category, with a 10% MP of the SFR of customers. The rewards per investment are encouraging and, if follow-up analysis of the program warrants it, it would be recommended that the program be expanded in future years until saturation becomes evident.

The commercial laundromat in town has recently upgraded its washers to HEW models. Therefore, no incentive program for the commercial sector is needed at this time.

COSTS: $36,500.

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Table 19: *PROJECTED COSTS* AND SAVINGS OF HIGH-EFFIENCY CLOTHES WASHER PROGRAM WITH A 10% MARKET PENETRATION, SINGLE-FAMILY RESIDENCE CATEGORY, OVER 20 YEARS (SAVINGS: 6000 GALLONS/HOUSEHOLD/YEAR)

Year	#SFR Meter	(SFR) Meters w/ 10% MP	Estimd. Popul. w/10% MP	SFR AFY Required w/o Measure	Saved: SFR AFY/All Meters (6000 Gal/ Meter/Yr)	Cost of Water/AF w/3% inflat.	$$Savings/ Year (w/ 3% infl/yr)	Rebate ($100 ea)	5% Share of Shared Program Costs	Office Admn Costs (10% of Prg.Costs	Total Costs	NET SAVINGS (Total Savings minus Total Costs)	Years to Pay Off Original Invest. (Rebates, Costs)
2008	3647	365	1,256	214.255	6.72	$2,060.00	$13,844.98	$36,500.00	$3,445	$344.50	$40,289.50	**-$26,444.52**	~2.5
2009				221.154	6.72	$2,121.80	$14,260.33	$0.00	$0.00	$0.00	$0.00	**$14,260.33**	
2010				228.275	6.72	$2,185.45	$14,688.14	$0.00	$0.00	$0.00	$0.00	**$14,688.14**	
2011				235.626	6.72	$2,251.02	$15,128.78	$0.00	$0.00	$0.00	$0.00	**$15,128.78**	
2012				243.213	6.72	$2,318.55	$15,582.64	$0.00	$0.00	$0.00	$0.00	**$15,582.64**	
2013				251.044	6.72	$2,388.10	$16,050.12	$0.00	$0.00	$0.00	$0.00	**$16,050.12**	
2014				259.128	6.72	$2,459.75	$16,531.63	$0.00	$0.00	$0.00	$0.00	**$16,531.63**	
2015				267.472	6.72	$2,533.54	$17,027.58	$0.00	$0.00	$0.00	$0.00	**$17,027.58**	
2016				276.084	6.72	$2,609.55	$17,538.40	$0.00	$0.00	$0.00	$0.00	**$17,538.40**	
2017				284.974	6.72	$2,687.83	$18,064.56	$0.00	$0.00	$0.00	$0.00	**$18,064.56**	
2018				294.150	6.72	$2,768.47	$18,606.49	$0.00	$0.00	$0.00	$0.00	**$18,606.49**	
2019				303.622	6.72	$2,851.52	$19,164.69	$0.00	$0.00	$0.00	$0.00	**$19,164.69**	
2020				313.399	6.72	$2,937.07	$19,739.63	$0.00	$0.00	$0.00	$0.00	**$19,739.63**	
2021				323.490	6.72	$3,025.18	$20,331.82	$0.00	$0.00	$0.00	$0.00	**$20,331.82**	
2022				333.907	6.72	$3,115.93	$20,941.77	$0.00	$0.00	$0.00	$0.00	**$20,941.77**	
2023				344.658	6.72	$3,209.41	$21,570.02	$0.00	$0.00	$0.00	$0.00	**$21,570.02**	
2024				355.756	6.72	$3,305.70	$22,217.13	$0.00	$0.00	$0.00	$0.00	**$22,217.13**	
2025				367.212	6.72	$3,404.87	$22,883.64	$0.00	$0.00	$0.00	$0.00	**$22,883.64**	
2026				379.036	6.72	$3,507.01	$23,570.15	$0.00	$0.00	$0.00	$0.00	**$23,570.15**	
2027				391.241	6.72	$3,612.22	$24,277.25	$0.00	$0.00	$0.00	$0.00	**$24,277.25**	
			TOTAL:	**5,887.696**	**127.70**	**n/a**	**$372,019.75**	**$36,500.00**	**$3,445.00**	**$344.50**	**$40,289.50**	**$331,730.25**	
			AVERAGE:	**294.385**	**6.721**	**n/a**	**$18,600.99**	**$1,825.00**	**$172.25**	**$17.23**	**$2,014.48**	**$16,586.51**	

RECOMMENDATIONS: Initiation of the high-efficiency clothes washer rebate program.

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GENERAL BENEFITS AND COSTS OF LANDSCAPE WATER CONSERVATION

BENEFITS:

- Reduced peak water demand.
- Reduced groundwater consumption-greater-than-discharge and contamination.
- Reduced water costs.
- Improved long-term water utility revenue stability and less frequent rate adjustments.
- Smaller water-supply and wastewater facilities.
- Reduced runoff, soil erosion, and costs for stormwater management.
- Creation of distinctive, attractive properties.
- Reduced use of chemicals (fertilizers, pesticides, and herbicides).
- Reduced energy costs for landscape maintenance (electric and gasoline mowers, blowers and edgers).
- Reduced air pollution and noise from gasoline-powered mowers and landscape equipment.
- Extended life for lawn-mowing equipment and irrigation systems.
- Reduced labor costs for mowing and landscape maintenance.
- Increased native plant diversity.
- Preservation of wildlife habitat and instream flows.
- Reduced plant disease, rot, and mortality caused by overwatering.
- Reduced need for construction and operation of alternative supply systems.

COSTS:

- Resistance to changing outdoor water-use habits, despite long-term benefits.
- Increased time and care for maintenance during the transition from a conventional to a water-efficient landscape.
- Difficulty in accepting the look of low-water-use and native plants compared with water-intensive turf and exotic imported plants.
- Potential reductions in business among conventional green industry product and service providers who do not offer water-wise and natural landscaping services.
- Potential short-term water utility revenue instability and more frequent rate adjustments during the years when outdoor demand drops as a result of conservation.[97]

2. HARDWARE RETROFITS AND REBATES FOR LANDSCAPE

- **2.1. Smart irrigation controller provision or rebate**
- **2.2. Rebates for conversion from turf to drought-tolerant plantings**
- **2.3. Provision of landscape irrigation efficiency items**

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2. HARDWARE RETROFITS AND REBATES FOR THE LANDSCAPE. (Possibly BMP 5) The difference between the amount of water used in the peak (summer) and trough (winter) billing periods is considered "seasonal water use." This is also typically considered to be the amount of water used on the customer's landscape. The water used in the winter/trough months is considered to be indoor water use (irrigation usually does not take place, or is greatly

[97] Vickers, Amy. *Handbook of Water Use and Conservation.* Amherst, MA: Water Plow Press. 2001.

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decreased, during cold, rainy months). The water used during the peak (warmer summer) months is considered to have a portion attributable to landscape irrigation. There is more potential for water savings in the outdoor/landscape portion of a customer's water use than there is in the indoor portion of their use. [98]

There is an increase in summer water use for all District customer categories. The average District customer's seasonal water use is 69.15% of their entire annual water use. The two categories that are candidates for water conservation in the landscape are the SFR and Landscape categories. The SFR category has an average of 62.18% seasonal water use, and the Landscape category has an average of 48.26% seasonal water use. (Table 5).

If the District's customers were able to save 15% of their seasonal water use alone the savings would be significant (Tables 8, 9). Based on the year 2006, one year's savings for SFR would be 187.508 AF ($375,06.84), Landscape 21.599 AF ($24,326.49), and for all categories 245,427 AF ($490,853.25) (Table 8,9).

Projected out 20 years, with the year 2006 as the baseline, 3.22% annual growth in number of meters (average for the years 2001-2006), and 3% increase in water price (with the marginal water price baseline of $2000), the total savings would be 7176.141 AF ($83,885,673.82).

2.1. Irrigation "Smart" Irrigation Controller Provision or Rebate.

(Related to BMP 1, 2)

Poor irrigation scheduling (watering too often and for too long) is the primary source of water waste associated with landscape irrigation[99].

According to the California Department of Water Resources, most water audits of residential landscapes find a distribution uniformity of 50% or less (recommended uniformity is >70%).[100]

"Smart" Irrigation Controllers are designed to make adjustments to the system programming to match the demands of the climate. After the initial setup and programming, the controllers get their programming-adjustment cues from a variety of sources: CIMIS weather stations, satellites, or other data-broadcasting systems. The better ones are quite sophisticated in variations of the programming. The majority of the programming is set up upon installation (or changed during the recommended maintenance checks), and the broadcast climate information adjusts the frequency and amount of water applied.

There are large water savings that can be achieved by the proper installation and programming of a "smart" controller, either as an initial irrigation controller installation or a replacement of an existing "non-smart" controller. All irrigation systems will fail to produce maximum savings if the "set it and forget it" approach is taken. To be dependably efficient in using water, irrigation systems must be regularly checked (at least once a year) for distribution uniformity, and must receive programming changes to meet the landscape's needs as climatary changes occur and as the needs of the plants change. For old-style, non-satellite-programmed systems, it is up to the homeowner or landscaper to make these frequent changes. For "Smart" controllers, the programming changes are delivered automatically by satellite or other data feed.

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[98] A&N Technical Services, Inc. *BMP Costs and Savings Study: A Guide to Data and Methods for Cost-Effectiveness Analysis of Urban Water Conservation Best Management Practices*, March 2005. The California Urban Water Conservation Council.

[99] Vickers, Amy. *Handbook of Water Use and Conservation.* Amherst, MA: Water Plow Press. 2001.

[100] Vickers, Amy. *Handbook of Water Use and Conservation.* Amherst, MA: Water Plow Press. 2001.

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The vast majority of lawns are overwatered. Overwatering can cause an increase in disease and pests, and damp blades of grass can provide a habitat for mosquito larvae. Overwatering can also result in increased water bills, degradation of asphalt in streets and parking lots, and damage to fences and other hardscapes.

The increase in the presence of diseases and pests can lead to applications of pesticides and herbicides, and any portion of landscape irrigation that flows down the sidewalk, into the gutters, and into storm drains will carry the chemicals applied to the landscape.

The amount of lawn chemicals applied to residential properties is significant: homeowners apply nearly 10 times more pesticide per acre of turf than farmers use on crops.[101] Turf grass planted on residential, commercial and government properties covers an estimated 30 million to 50 million acres in the United States, an area larger than Pennsylvania and greater than the acreage used to grow any single U.S. agricultural crop. An estimated 600 million gallons of gasoline are used annually for lawn mowing equipment in the U.S.[102]

The issue of overwatering is not just pertinent to excessive water use and higher costs to both the water supplier and the customer, but is an important factor in stormwater management. The County of San Luis Obispo is about to adopt a new ordinance by which it will be illegal to cause anything but clean rainwater to enter a storm drain. An overwatered lawn and landscape has a higher potential of causing water to leave the intended landscape and flow down the gutter to the nearest storm drain. With this landscape water is carried the residuals of fertilizers, pesticides, herbicides and other chemicals applied to the lawn and landscape.[103]

Contrary to what many homeowners believe, watering a lawn "deeply" does nothing for the lawn. Most turf grasses have fibrous roots about 4" in depth, so any irrigation beyond a 4" depth does nothing for the lawn. It increases the water bill, however. For lawns that are watered by hose and sprinkler, to optimally water a lawn the irrigator would have to water the lawn two or three times a week, moving the sprinkler every 5 to 15 minutes, to achieve very basic uniformity and saturation. Optimal, efficient irrigation of lawn needs to be done far more frequently and in lower volumes than is required by trees, shrubs, and drought-tolerant plant material.

To reach the level of accuracy of a "smart" controller, the irrigator would have to first, before each irrigation, access CIMIS or other climate-data resource, download the latest data, and then do calculations to determine how much water the turf (or other plant material) had lost since the last irrigation, then, using the rate of water application from the garden hose and sprinkler and the crop coefficient for each type of plants to be watered, ascertain how long the sprinkler had to run on each section before moving it.

If the lawn or other plant material is growing in soil with a high amount of clay (especially if any landscape slope is involved), for optimum, efficient irrigation, each application should be split into smaller increments to allow adequate time for the water applied to soak into the soil.

For the older-model automatic irrigation systems, where seasonal changes in irrigation timing and frequency must be set by hand, and where the "set it and forget it" approach is often used,

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[101] Vickers, Amy. *Handbook of Water Use and Conservation.* Amherst, MA: Water Plow Press, 2001.
[102] Vickers, Amy. *Handbook of Water Use and Conservation.* Amherst, MA: Water Plow Press, 2001.
[103] *An Ordinance Amending Title 8 of the San Luis Obispo County Code to add Chapter 8.68 regarding Stormwater Pollution Prevention and Discharge Control.* IDDE Ordinance Public Hearing Draft, 08/21/2007.

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turf is often overwatered. Few homeowners or landscapers perform periodic water audits for uniformity of the coverage of the irrigation system, nor do they, as recommended, check and change programming, if warranted, on a monthly basis. They discover there is a problem with uniformity usually when an area of the turf turns brown. Many homeowners or landscapers would not, at this point, do a water audit to assess for uniformity and amount being delivered to the turf. Instead, they would turn up the irrigation system amount for that station (or, worse yet, for ALL stations). If the brown spot in the turf didn't turn green, they might even try turning up the system some more. If the brown spot was due to insufficient irrigation, eventually the system would be turned up for all sprinklers in that station enough that the station with the brown spot would turn green. Once again, the entire lawn would be green, but all of the turf except for the previous brown spot would be overwatered.

The economic and environmental costs associated with a heavily irrigated, manicured green lawn are especially high. The U.S. Environmental Protection Agency has estimated that about 70 million pounds of lawn chemicals are applied in the U.S. annually, and this amount increases by 5% to 8% every year.[104]

There have been many studies of water savings with "smart" controllers. The savings can be very high, and this incentive stimulates cities, universities, government agencies, and "smart" irrigator companies to do lots of studies.

Over the years, these studies have demonstrated that, while there are very gratifying savings to be obtained from Smart irrigation systems, a program which is not well constructed—even if the controllers are handed out for free—will not get very impressive results.

The City of SLO believes that advancements in irrigation technology appear to a major source of water savings.[105]

Simple measures such as installing a rain sensor, which shuts off the irrigation system when it rains, can, for irrigation systems that continue to irrigate even when it is raining, save 16% of water used for landscape irrigation, and cost around $25.[106] More sophisticated weather-sensing systems save considerably more, have more potential to save water, but also require maintenance to obtain and retain savings[107,108,109]

Smart controllers, or ET (evapotranspiration) controllers, adjust irrigation systems' scheduling and run times by real-time measures of evapotranspiration and/or temperature, rainfall, soil

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[104] Vickers, Amy. *Handbook of Water Use and Conservation.* Amherst, MA: Water Plow Press. 2001.
[105] Henderson, Gary, Munds, R. *City of San Luis Obispo 2006 Water Resources Status Report, June 2006.*
[106] *Rain Sensor Devices.* WAV, Providing and Preserving Water. (www.wavh20.com)
[107] Irrigation controllers: timers for the homeowner. July 2003. US Environmental Protection Agency et al. http://www.epa.gov/owm/water-efficiency/index.htm.
[108] Hunt, T.; Lessick, D. et al. *Residential weather-based irrigation scheduling evidence from the Irvine "ET Controller" study. Irvine Ranch Water District.* June 2001. (http://www.irwd.com/welcome/FinalETRpt.pdf)
[109] Bamezai. *A. Los Angeles Dept. of Water and Power weather-based irrigation controller pilot study.* August 2004. LADWP. (http://www.cuwcc.org/uploads/product/LADWP-IrrigationController-Pilot-Study.pdf).

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moisture, and sunlight intensity. These systems access information by a satellite pager and/or telephone lines.[110]

According to the Municipal Water District of Orange County, switching to a "smart" irrigation controller can save 20% to 25% of water use and customer water bills, and reduces urban runoff of up to 50%. The Metropolitan Water District of Orange County offers rebates of $60 per active valve (maximum rebate of $540), not to exceed the cost of the "smart" controller.[111]

The City of Newport Beach, to address both water conservation and storm runoff problems, has initiated a program in which free water audits and installation of WeatherTrak Smart controllers, as well as the monthly $4 data-broadcast charge, are provided to residents primarily in the south-coast area of the city. The installation and water audits are funded by the City and performed by a trained landscaper.[112] The homeowner is responsible for correcting any problems identified in the water audit before the WeatherTrak is installed.

The Irvine Ranch Water District and the Metropolitan Water District of Orange County did a seven-year study of "smart" (ET) controllers and the impact on the change in metered water consumption and reduction in measured urban runoff. The four foci of the study were to investigate ET controllers used both in residential landscapes and large landscape areas; to evaluate the effectiveness of an educational program targeting residential homeowners; to study the relationship between proper irrigation of landscapes and dry-season runoff; and to assess the acceptance level of controller-technology-based water management. They found that for accounts using ET controllers water use was decreased an average of 41 gallons per day per SFR (approximately 10% of total household water use). The majority of the savings were found in the summer and fall periods. Fifteen large landscape sites with dedicated irrigation meters (0.14 to 1.92 acres) showed an average water reduction of 545 G/D. Regarding runoff, comparing the control group to the group having undergone controller retrofit, there was a 71% reduction in dry-season runoff. Regarding acceptance of the ET controllers, 72% of the participants reported they liked the controllers, and 70% ranked their landscape as looking good to excellent.[113]

The IRWD conducted the "ET Controller Study" which tested a controller system that automatically adjusted according to the weather, using a broadcast signal. In addition to the group that received the ET controllers, there was a control group and a group that received postcards with ET information but no automatic controller adjustments. The group with the automated ET controllers saved an average of 37 gallons per household per day.[114]

Aqua Conserve in a study published in 2002 reported that ET controllers adjusted with historical data and temperature sensors conserved water for high-volume residential customers in California and Colorado. The study was based on post-intervention consumption related to five years' historical consumption, and the study included a control group. In Denver, total outdoor

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[110] A&N Technical Services, Inc. BMP Costs and Savings Study: A Guide to Data and Methods for Cost-Effectiveness Analysis of Urban Water Conservation Best Management Practices. March 2005. The California Urban Water Conservation Council.
[111] Municipal Water District of Orange County, *Smart Timer Rebate Program*. www.mwdoc.com.
[112] Brennan, Pat. *Newport Rolls out Robot Sprinklers*. The Orange County Register, 12/05/2006.
[113] A&N Technical Services, Inc. BMP Costs and Savings Study: A Guide to Data and Methods for Cost-Effectiveness Analysis of Urban Water Conservation Best Management Practices, March 2005. The California Urban Water Conservation Council.
[114] A&N Technical Services, Inc. BMP Costs and Savings Study: A Guide to Data and Methods for Cost-Effectiveness Analysis of Urban Water Conservation Best Management Practices, March 2005. The California Urban Water Conservation Council.

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water saved was 21%, with an average savings per participant of 21.47%. In Sonoma, California the total savings were 23%, and an average savings per participant of 7.37 %. Valley of the Moon Water District showed a total savings of 28% and an average savings per participant of 25.1%.[115]

A study in 2003 by Aquacraft of WeatherTRAK controller installations in Colorado indicated that the 10 sites in their study (combination of volunteer and high-volume sites, all residential except for one commercial) averaged savings of 26,000 gallons per year per site. The five largest-saving sites' savings were 68,000 gallons per site. For the group, the controller water-application was 94% of ETo (28 inches of water).[116]

Bamezai in 1996 reported in a study for the Los Angeles Department of Water and Power an average savings of 34% (with controls for climate and landscape size) for multiple sites connected to a central ET controller that controlled irrigation based on ET for each meter. Interestingly, most of the savings were achieved for diverse plant materials on sloped landscape areas.

Limitations include proper maintenance and operation which is necessary to receive the full benefits from ET controllers. In some cases outdoor water consumption was estimated because the sites did not have separate landscape meters. High-use customers and volunteers were more frequently targeted. This group tended to achieve large absolute savings figures (but not necessarily larger percentage of savings), and they tend to be more receptive to conservation than the average customer. The cost of equipment may be related to the number of purchases and installations. The extent of the tailoring of the program design for each site is important, as are the different levels of outreach and support over time. Another factor is the accuracy of the local CIMIS station in reflecting the microclimate of the irrigation site. The Nipomo Mesa has a CIMIS station located in the Woodlands.

Program costs can (if purveyor shares the costs) include for the purchase, installation, operation and maintenance. In addition, costs can include administration, contractors and marketing costs.

According to the IRWD study of 2001, ET controllers cost approximately $100 per unit to buy, and $75 to install. There is a monthly signal fee of $5. The expected life is 10 to 15 years.

The 2003 Aquacraft study of WeatherTRAK Smart controller installations indicated that it took between 2.25 and 4 hours per site to install the ET controllers, and some sites included moisture sensors.

Another study reported regarding controllers with soil moisture sensors total costs "for repairs and replacements" were $270. Average annual repairs and replacement was approximately $12 per controller.[117]

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[115] A&N Technical Services, Inc. BMP Costs and Savings Study: A Guide to Data and Methods for Cost-Effectiveness Analysis of Urban Water Conservation Best Management Practices. March 2005. The California Urban Water Conservation Council.

[116] A&N Technical Services, Inc. BMP Costs and Savings Study: A Guide to Data and Methods for Cost-Effectiveness Analysis of Urban Water Conservation Best Management Practices. March 2005. The California Urban Water Conservation Council.

[117] A&N Technical Services, Inc. BMP Costs and Savings Study: A Guide to Data and Methods for Cost-Effectiveness Analysis of Urban Water Conservation Best Management Practices. March 2005. The California Urban Water Conservation Council.

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Table 20: ANALYSIS OF SMART CONTROLLERS FOR IRRIGATION ADEQUACY AND EXCESS (Center for Irrigation Technology)[118]						
	Irrigation Adequacy			Irrigation Excess		
Controller	**Min. of 6 Test Zones**	**Max. of 6 Test Zones**	**Mean/Average Of 6 Test Zones**	**Min. of 6 Test Zones**	**Max. of 6 Test Zones**	**Mean/Average of 6 Test Zones**
AlexTronic Enercon Plus	100%	100%	100%	0%	3.6%	1%
Alex-Tronix Smart Clock	100%	100%	100%	0%	1.1%	0.2%
Calsense ET2000e-24-GR-RB with RB-1 Tipping Rain Bucket	100%	100%	100%	0%	0%	0%
ETwater Smart Controller	100%	100%	100%	0%	6.3%	1.5%
Hunter ET System with Pro-C 300 Controller	100%	100%	100%	0%	2.3%	0.5%
Irritol Smart Dial*	100%	100%	100%	0%	0%	0%
Rain Bird ET Manager with ESP-TM Controller	100%	100%	100%	0%	0%	0%
Toro IntelliSense*	100%	100%	100%	0%	0%	0%
Weathermatic SL1600	100%	100%	100%	0%	2.3%	0.4%
WeatherTrak	100%	100%	100%	0%	0%	0%

*Uses WeatherTrak ET Everywhere ET/rainfall data and WeatherTrak Scheduling Engine to provide custome schedule.
WeatherTRAK ET Everywhere delivers daily ET updates via a wireless network for self-adjusting irrigation scheduling based on changing weather; collects data from more than 14,000 weather stations across the U.S. including the NOAA network, state and local networks, and private weather stations.
Applies scientific modeling techniques to validate local weather to 1 km^2.
WeatherTRAK Scheduling Engine calculates irrigation schedules based on zone-specific, Irrigation Association recommended parameters including plant, soil, slope and sprinkler type; supports user-defined water windows, water days, and manual watering; built-in and customizable plant settings; automated cycle and soak times according to soil and slope settings.

[118] *Smart Controller Efficiency Testing.* Irrigation Assocation. http://www.irrigation.org/SWAT/Industry/ia-tested.asp.

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Table 21: ANALYSIS OF SMART CONTROLLERS FOR STANDARD FEATURES (Center for Irrigation Technology)						
Controller	**Installation**	**Data Source**	**Data Link**	**Initial Purchase**	**Add'l Hardware**	**Additional Fees**
Alex-Tronix Enercon Plus	Replaces existing controller or is installed on a new system.	Tested with on-site temp. sensor w/optional rain sensor.	Hardwired	Purchase price includes temp. sensor mounted within pedestal.	*Rain mount. *Rain and temp sensors pole-mount. *Latching solenoid. *Lightning protection.	None.
Alex-Tronix Smart Clock	Replaces existing controller or is installed on a new system.	Tested with on-site temp. sensor w/optional rain sensor.	Hardwired	Purchase price includes temp. sensor.	*Rain switch pole mount. *Rain and temp. sensors pole mount. *Latching solenoid. *Stainless stell pedestal mount.	None.
Calsense ET2000e-24-GR-RB with RB-1 Tipping Rain Bucket	Replaces existing controller or is installed on a new system.	SWAT tested w/wireless internet link to CIMIS weather station #80.	Wireless network (optional hardwire, phone, radio, Ethernet, WiFi)	Purchase price based on # of zones and other options.	*Optional RB-1 tipping rain bucket. *Optional on-site ET gauge. *Optional wind gauge.	Additional charges dependent upon selected communication option.
ETwater Smart Controller	Replaces existing controller or is installed on a new system.	Local weather station through ETwater server.	*Model 100: Residential-Internet via landline phone (add'l charge for wireless cell phone option) *Model 200: Commercial-Interent via landline or wireless cell phone	*Purchase price is based on # zones initially activated. *Additional zones may be activated at a later time at an additional cost.	Residential: One-time optional hardwere purchase allows phone connection through household electrical wiring rather than direct-wired phone.	*First year of internet-based scheduling is free. *3-year subscription or discounted lifetime service purchase options are available thereafter.

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Hunter ET System with Pro-C 300 Controller	Retrofit to Hunter SmartPort enabled controllers.	ET system onsiet sensor suite.	Direct low-voltage wiring into Hunter SmartPort	ET System must be purchased separately from compatible Hunter controller model: SRC, Pro-C, ICC.	ET WIND is an optional anemometer for measuring wind speed.	None.
Irritol Smart Dial*	May replace existing controller or be installed on a new system.	Contractor or end-suer calls to activate WeatherTRAK ET Everywhere.	Wireless network	Purchase price is based on #of zones. Wireless receiver is integral.	Optional wired or wireless rain sensor and wireless rain/freeze sensor.	Annual subscription signal fee. Multi-year package prices available.
Rain Bird ET Manager with ESP-TM Controller	Retrofits with an existing controller or installs on a new system.	Weather Reach Signal Provider accesses a weather station and sends local weather information hourly to the ET Manager.	Wireless paging.	ET Manager wireless receiver is integral.	*Optional tipping bucket rain guage. *Optional external antenna. *Outdoor enclosures.	Varies depending on Weatehr Reach Signal Provider.
Toro IntelliSense*	May replace existing controller or be installed on a new system.	Contractor or end-user calls to activate WeatherTRAK ET Everywhere	Wireless network	Purchase price is based on # of zones. Wireles receiver is integral.	Optional wired or wireless rain sensor and wireless rain/freeze sensor.	Annual subscription signal fee; multi-year package prices available.
Weathermatic SL1600	Replaces existing controller or is installed on a new system	Weathermatic on-site weather monitor.	Direct low-voltage wire or wireless.	Purchase price is based on #of zones. Weather monitor is an add'l cost.	None required	None.
WeatherTrak	May replace existing controller or be installed on a new system.	Contractor or end-user calls to activate WeatherTRAK ET Everywhere.	Wireless network	Purchase price is based on # of zones. Wierless receiver is integral.	Optional wireless rain or rain/wind/ freeze/flow sensor.	Annual subscription signal fee. Multi-year package prices available.

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Table 22: ANALYSIS OF SMART CONTROLLERS FOR ADDITIONAL FEATURES (Center for Irrigation Technology)					
Controller	**Zones**	**Time of Day**	**Day of Week**	**Other**	**If Data Link is Discontinued**
AlexTronic Enercon Plus	Available in a base model of 4 zones; can control up to 24 by installing add'l station modules in groups of 4.	Capable of restricting the time of day for watering.	Capable of restricting watering days by selection or interval.	*Multiple start times. *Programmable rain delay. *5-yr battery life with low battery indication.	May be used as a standard irrigation controller including %adjust and 4 independent programs w/multiple start times.
Alex-Tronix Smart Clock	Available with 6 zones.	Capable of restricting the time of day for watering.	Capable of restricting watering days by selection or interval.	*Multiple start times. *Programmable rain delay. *5-yr battery life with low battery indication.	Smart Clock may be used as a standard irrigation controller including %adjust and 4 independent programs w/multiple start times.
Calsense ET2000e-24-GR-RB with RB-1 Tipping Rain Bucket	Available in 6, 8, 12, 16, 24, 32, 40, 48 zone models	Capable of restricting the time of day for watering.	Capable of restricting watering days by selection or interval.	*Flow monitoring and mngmt. *Optional integrated radio remote. *Cycle and soak. *Shared weather data using personal computer and *Command CENTER software.	Calsense controllers feature a historical ET database that is used in the event communication is interrupted. It may also be used as a standard irrigation controller, including cycle and soak features.
ETwater Smart Controller	Model 100: Residential, 3-12 zones. Model 200: Commercial, 12-48 zones. Both models are activated via the internet.	Capable of restricting the time of day for watering.	Capable of restricting watering days by selection or interval.	*Sets initial watering schedule based on user's landscape profile. *Remote monitoring and mngmt. Via 2-way internet interface. *Unlimited number of programs. *Unlimited cycle and soak start times. *Water budget only when connected to internet-based scheduling. *Max. water time unlimited. *Rain sensor capable.	If the ETwater Smart Controller Internet-based scheduling is discontinued it may be used as a standard irrigation controller with cycle and soak capability.

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Hunter ET System with Pro-C 300 Controller	Original Hunter controller may have up to 48 zones, depending on the model.	Separately programmale start times for ET controlled zones. Note: ET System WiltGard will override time of day restrictions.	ET System has day of week, even/odd date, and interval day scheduling (up to 31 days). Note: ET System WiltGard will override day of week restriction.	*WiltGard technology enables it to trigger protective watering when extreme conditions threaten plants. *ET information combines w/each zone's particular plant, soil, sun and sprinkler data. *Easiy upgrades most Hunter controllers to weather-based control with no high-voltage AC wiring required. *Non-volatile memory.	If wiring to on-site ET system sensor is removed, system displays fault message and operates on lawst full 24-hr ET average. Traditional controller schedules may be selected manually if sensor service is required.
Irritol Smart Dial*	SmartDial: 6,9,12 stations. Indoor and Outdoor Mount options.	Capable of restricing the time of day for watering.	Capable of restricting watering days by selection or interval.	*Includes copy button to simplify programming. *Remote internet-based irrigation mngmt. Via 2-way wireless. *Standard program mode for plant establishment. *Alert functionality. *Unlimited cycle and soak, and # of programs.	If the ET Everythwere scheduling is discontinued it may be used as a standard irrigation controller w/water budget and cycle and soak capability.
Rain Bird ET Manager with ESP-TM Controller	Available # of zones contingent upon type of interconnected controller.	Capable of restricting watering time to a user-defined water window, independent of connected controller.	Capable of restricting watering days by odd, even or custom, independent of connected controller.	*ET Manager Scheduler software included. *ET Manager resource CD included. *Compatible w/virtually any standard sprinkler controller. *Built-in historical weather database. *Programmable delay for excessive weather conditions (wind, rain, freezing). *Based on IA recommended ASCE formula for determining ET using all required weather parameters.	The ET Manager features an historical weather database that is used in the event the Weather Reach Signal is interrupted.
Toro IntelliSense*	TIS-612: 6,9,12 stations; inddor and outdoor mount options. TIS-24: 24 stations.	Capable of restricing the time of day for watering.	Capable of restricting watering days by selection or interval.	*Includes copy button to simplify programming. *Remote internet-based irrigation mngmt. Via 2-way wireless. *Standard program mode for plant establishment. *Alert functionality. *Unlimited cycle and soak, and # of programs.	If the ET Everywhere scheduling is discontinued it may be used as a standard irrigation controller w/water budget and cycle and soak capability.

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Weathermatic SL1600	Available in 4-8, 4-24, 12-48 zone models.	Capable of restricing the time of day for watering.	Capable of restricting watering days by selection or interval.	*Built-in valve locator feature. *calculates irrigation schedules based on zone-specific, Irrigation Assoc. recommended parameters including plant, soil, slope and sprinkler types. *On-board multi-meter.	If weather monitor is discontinued it may be used as a standard irrigation controller with water budget and cycle and soak capability.
WeatherTrak	WeatherTrak: 9-48 stations; indoor and outdoor mont options.	Capable of restricing the time of day for watering.	Capable of restricting watering days by selection or interval.	*Includes copy button to simplify programming. *Remote internet-based irrigation mngmt. Via 2-way wireless. *Standard program mode for plant establishment. *Alert functionality. *Unlimited cycle and soak, and # of programs.	If the ET Everywhere scheduling is discontinued, it may be used as a standard irrigation controller w/cycle and soak capability.

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RECOMMENDATION: Recommendation is not made for a "RainClick" or other rain-sensing add-on attachment to existing irrigation systems. In California, the majority of our rainfall is during just a few months, during the cooler months of the year. It is easy for homeowners or landscapers to simply turn off the irrigation system during those months. The savings, therefore, would be only those homeowners/landscapers who did not turn off their systems during the rainy, cooler months of the year. In addition, a "RainClick" addition to a system, without first conducting a water audit to assess for distribution uniformity, would be much less likely to return the anticipated savings.

If this measure is selected for inclusion in the program, far greater savings are capable with the installation of a Smart controller. While all of the ones evaluated have potential for savings, it is believed that the WeatherTRAK would be the best choice for the District. It is easy to program, has advanced features such as "cycle and soak" (splitting the irrigation duration into increments, with off periods in between, to allow for clay soils to absorb the water), ensuring efficient irrigation and no run-off, and "slope" which allows programming for degree of slope and location of valve on the slope.

Another advantage to the WeatherTRAK system is the fact that locally the Shea Trilogy homes have these systems in place, and have already had informational presentations regarding the "smart" controllers. It would be anticipated that with a greater local presence there would be more trained landscapers and more company support available.

The WeatherTRAK systems have three components: a network of weather stations that can be downloaded remotely, a central data processing and communications hub, and the WeatherTRAK ET controllers at each landscape site. Information sent to the controller is via a pager-like technology. Information can be sent as one message to a group of landscape sites (i.e., for a group of sites all sharing the same ET information), and to individual sites (by serial numbers). The WeatherTRAK controllers have crop coefficients built in which modifies the climate data sent from the communications center.

The WeatherTRAK helpline has information available in both English and Spanish, and some adjustments can be made remotely.

In a study done in Colorado, the typical time to install the WeatherTRAK controller on site was 1.25 hours, and an hour to analyze the site for square footage and plant type. A water audit would typically take another 1.25 hours. In total, it would typically take 3.5 hours to perform the water audit, analyze the square footage and plant type, and install the controller. The amount of time for addressing the problems in uniformity and leakage identified on water audit would vary depending on the number and extent of the problems.

The City of Newport Beach, in their WeatherTRAK program, is paying for the WeatherTRAK controller, the water audit and the installation, as well as a portion of the monthly signal-broadcast charge.

For a "smart" controller to be maximally efficient, the water audit and installation/initial programming must be correctly performed, and the landscape brought up to uniformity efficiency before the controller is installed. Typically, programs that simply offer a rebate or even give away the controllers do not have a high rate of return in water savings. The best results appear to be obtained when water audit, installation and initial programming is done by a trained professional.

The following "smart" controller program is recommended:

1. A small, initial pilot program of only 10 single-family residences selected to fine-tune the program and assess for efficacy of the program.

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2. Purchase of WeatherTRAK controllers for the 10 pilot sites: approximately $400 each (for <100 purchased at a time).
3. Pay for a trained landscaper to perform a water audit, identify irrigation problems in the current system, to certify (once homeowner, at homeowner's cost, has corrected problems identified in the water audit) that problems have been corrected, and pay for installation of the WeatherTRAK controller and initial site programming: approximately $275, based on Newport Beach's experience.
4. Pay for first year of ET broadcast subscription: approximately $48 to $60.

Depending on the savings demonstrated, the District could elect, year to year, to continue paying the nominal ET broadcast subscription fee. Since subscription to the programming broadcast system is integral to receiving maximum benefits from the program, the District could view paying the subscription fee as an investment in getting the best return for the program's initial investment.

To qualify for the WeatherTRAK controller program, recipients would be required to:
1. Be a District SFR customer (one rebate-program participant per customer).
2. Have 1000 ft^2 or greater of turf.
3. Have a below-ground, automatic irrigation system currently in place.
4. Undergo a water audit, correct all identified problems, and bring existing system up to 70% or greater distribution uniformity.
5. Attend all four District landscape workshops.
6. Commit to subscription to ET information broadcast service by which the controller is adjusted for climatary changes.
7. Sign appropriate agreement outlining expectations and benefits of program.

It is believed that the District's payment for the water audit, installation, and monthly charge for ET broadcast subscription will accomplish the following:
- Communicate to the customer program recipients, and non-recipients, the worth and desirability of using the latest technology to save water in landscape irrigation.
- Ensure more participants in the program. Recipients would have to make a significant commitment and investment to qualify for the program, and to bring their current irrigation system up to par (uniformity and absence of leaks). Having part of the costs underwritten by the District would provide the financial incentive to encourage customers to make this commitment and expenditure.
- Accomplish water audits and correction of problems in residential landscapes which may not have otherwise been accomplished.
- Communicate to customers the District's on-going commitment to both water conservation and making the conservation easier to accomplish by customers.
- Serve as a positive public-relations outreach opportunities.

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Table 23: *PROJECTED COSTS AND SAVINGS* IN SEASONAL WATER USE OF ET-CONTROLLER PILOT PROGRAM, .27% MARKET PENETRATION, SINGLE-FAMILY RESIDENCES , OVER 15 YEARS

Year	SFR #Meters	(SFR) #Meters in Pilot Study (.27%)	Estimd. Popul.	SFR AFY (Seasonal) Required w/o Measure	Saved: AFY w/ measure (25%)	Cost of Water/AF w/3% inflat.	$$Savings/ Year (w/ 3% infl/yr)	Cost of Equip, Install, Audit ($735 ea)	20% Share of Shared Program Costs	Office Admn Costs (10% of Prg.Costs)	Total Costs	NET SAVINGS (Total Savings minus Total Costs)	Years to Pay Off Original Invest. (Rebates, Costs)
2008	3647	10	34	3.650	0.912	$2,060.00	$1,879.73	$7,350.00	$13,780.00	$1,378.00	$22,508.00	**-$20,628.27**	<11
2009	**Initial investment in equipment with benefits reaped over years.**			3.650	0.912	$2,121.80	$1,936.12	$0.00	$1,378.00	$137.80	$1,515.80	**$420.32**	
2010				3.650	0.912	$2,185.45	$1,994.21	$0.00	$1,419.34	$141.93	$1,561.27	**$432.93**	
2011				3.650	0.912	$2,251.02	$2,054.03	$0.00	$1,461.92	$146.19	$1,608.11	**$445.92**	
2012				3.650	0.912	$2,318.55	$2,115.66	$0.00	$1,505.78	$150.58	$1,656.36	**$459.30**	
2013				3.650	0.912	$2,388.10	$2,179.13	$0.00	$1,550.95	$155.10	$1,706.05	**$473.08**	
2014				3.650	0.912	$2,459.75	$2,244.50	$0.00	$1,597.48	$159.75	$1,757.23	**$487.27**	
2015				3.650	0.912	$2,533.54	$2,311.83	$0.00	$1,645.40	$164.54	$1,809.94	**$501.89**	
2016				3.650	0.912	$2,609.55	$2,381.19	$0.00	$1,694.77	$169.48	$1,864.24	**$516.95**	
2017				3.650	0.912	$2,687.83	$2,452.62	$0.00	$1,745.61	$174.56	$1,920.17	**$532.45**	
2018				3.650	0.912	$2,768.47	$2,526.20	$0.00	$1,797.98	$179.80	$1,977.78	**$548.43**	
2019				3.650	0.912	$2,851.52	$2,601.99	$0.00	$1,851.92	$185.19	$2,037.11	**$564.88**	
2020				3.650	0.912	$2,937.07	$2,680.05	$0.00	$1,907.47	$190.75	$2,098.22	**$581.83**	
2021				3.650	0.912	$3,025.18	$2,760.45	$0.00	$1,964.70	$196.47	$2,161.17	**$599.28**	
2022				3.650	0.912	$3,115.93	$2,843.26	$0.00	$2,023.64	$202.36	$2,226.00	**$617.26**	
			TOTAL:	**54.749**	**13.69**	**n/a**	**$34,960.98**	**$7,350.00**	**$37,324.95**	**$3,732.50**	**$48,407.45**	**-$13,446.47**	
			AVERAGE:	**3.650**	**0.91**	**n/a**	**$2,330.73**	**$918.75**	**$2,488.33**	**$248.83**	**$3,227.16**	**-$896.43**	

COST-BENEFIT ANALYSIS, PILOT PROGRAM: (Table 23)
If this water-conservation measure is selected, it is recommended that an initial pilot (10 residences) project be performed before expanding the program to greater numbers of residences. It is projected that the following savings would be achieved from the pilot program (Table xxx).

Note that costs for the pilot program are more per participating account, and the costs take longer to pay back, because the shared program and administrative costs are distributed across only 10 accounts.

Savings in AF over 15 years:	13.69
Average AF/Y savings:	.91
Total net savings in $$$ over 15 years:	$-13,446.47
Average net $$$/year savings:	$ -896.53
Years until costs are paid off:	<11
% Water savings, all meters:	.0246%
Savings:Cost ratio:	0.7:1

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Table 24: *PROJECTED COSTS AND SAVINGS* IN SEASONAL WATER USE OF ET-CONTROLLER PROGRAM, 5% MARKET PENETRATION, SINGLE-FAMILY RESIDENCES , OVER 15 YEARS

Year	SFR #Meters	(SFR) #Meters (5% MP)	Estimd. Popul.	SFR AFY (Seasonal) Required w/o Measure	Saved: AFY w/ measure (25%)	Cost of Water/AF w/3% inflat.	$$Savings/ Year (w/ 3% infl/yr)	Cost of Equip, Install, Audit ($735 ea)	20% Share of Shared Program Costs	Office Admn Costs (10% of Prg.Costs)	Total Costs	NET SAVINGS (Total Savings minus Total Costs)	Years to Pay Off Original Invest. (Rebates, Costs)
2008	3647	182	627	66.557	16.639	$2,060.00	$34,276.92	$134,027.25	$13,780.00	$1,378.00	$149,185.25	**$114,908.33**	**<5**
2009				66.557	16.639	$2,121.80	$35,305.23	$0.00	$1,378.00	$137.80	$1,515.80	**$33,789.43**	
2010				66.557	16.639	$2,185.45	$36,364.39	$0.00	$1,419.34	$141.93	$1,561.27	**$34,803.11**	
2011				66.557	16.639	$2,251.02	$37,455.32	$0.00	$1,461.92	$146.19	$1,608.11	**$35,847.21**	
2012				66.557	16.639	$2,318.55	$38,578.98	$0.00	$1,505.78	$150.58	$1,656.36	**$36,922.62**	
2013				66.557	16.639	$2,388.10	$39,736.35	$0.00	$1,550.95	$155.10	$1,706.05	**$38,030.30**	
2014				66.557	16.639	$2,459.75	$40,928.44	$0.00	$1,597.48	$159.75	$1,757.23	**$39,171.21**	
2015	**Initial investment with benefits reaped over years.**			66.557	16.639	$2,533.54	$42,156.29	$0.00	$1,645.40	$164.54	$1,809.94	**$40,346.35**	
2016				66.557	16.639	$2,609.55	$43,420.98	$0.00	$1,694.77	$169.48	$1,864.24	**$41,556.74**	
2017				66.557	16.639	$2,687.83	$44,723.61	$0.00	$1,745.61	$174.56	$1,920.17	**$42,803.44**	
2018				66.557	16.639	$2,768.47	$46,065.32	$0.00	$1,797.98	$179.80	$1,977.78	**$44,087.54**	
2019				66.557	16.639	$2,851.52	$47,447.28	$0.00	$1,851.92	$185.19	$2,037.11	**$45,410.17**	
2020				66.557	16.639	$2,937.07	$48,870.69	$0.00	$1,907.47	$190.75	$2,098.22	**$46,772.47**	
2021				66.557	16.639	$3,025.18	$50,336.82	$0.00	$1,964.70	$196.47	$2,161.17	**$48,175.65**	
2022				66.557	16.639	$3,115.93	$51,846.92	$0.00	$2,023.64	$202.36	$2,226.00	**$49,620.92**	
			TOTAL:	**998.357**	**249.59**	**n/a**	**$637,513.52**	**$134,027.25**	**$37,324.95**	**$3,732.50**	**$175,084.70**	**$462,428.82**	
			AVERAGE:	**66.557**	**16.64**	**n/a**	**$42,500.90**	**$16,753.41**	**$2,488.33**	**$248.83**	**$11,672.31**	**$30,828.59**	

COST-BENEFIT ANALYSIS, <u>EXPANDED</u> PROGRAM: (Table 24)
If the pilot program proves successful, and the demonstrated savings warrant the District's resource expenditure, it is recommended that an expanded program of 5% of SFRs (182 homes) be initiated, expanding the program to greater numbers of residences. It is projected that the following savings would be achieved from the expanded program (Table xxx).

Savings in AF over 15 years:	249.59
Average AF/Y savings:	16.64
Total net savings in $$$ over 20 years:	$462,428.82
Average net $$$/year savings:	$ 30,828.59
Years until costs are paid off:	<5
% Water savings, all meters:	.45%
Savings:Cost ratio:	3.6:1

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2.2. Rebates for conversion from traditional landscape plantings to drought-tolerant.

> *"The landscape of the United States will shift drastically in the next few decades. Western states are running out of water. Baby boomers everywhere are worked up about chemicals on the lawns where their kids play. And a traditional lawn sometimes just takes too much time to care for."*
>
> --Margaret Roach, garden editor of *Martha Stewart Living.*

Replacement with artificial turf. A recommendation for replacing turf with artificial turf will not be made at this time because of concerns of contamination of stormwater and groundwater by heavy metals (zinc, copper, barium and chromium).[119,120] In addition, there are concerns about increased occurrence of multi-drug-resistant bacterial abscesses and infections in players who play sports on artificial turf,[121] and these methicillin-resistant infections may be spread to others both from the contaminated turf itself as well as in a locker-room setting.[122]

Replacement with drought-tolerant plant material. A reduction of 25% to 40% of water used for landscape irrigation could be realized by landscape management, landscape design and hardware improvements. Improving efficiency and increasing water savings are the most economical, easiest and least destructive tools that can be used to meet California's water needs in the future.[123]

A turf-replacement rebate program produced reported savings of 398 gallons per day participant-weighted average savings of both commercial and residential accounts.[124] This translates to an average savings of 145,270 gallons per year, 194.18 units per year, and .438 acre-feet per year.

In Austin, Texas after the initiation of a turf-replacement rebate program, the average water savings per participant site was 214 gallons per day in the summer when compared to water use for the previous landscaping.[125]

A xeriscape conversion study performed for the Southern Nevada Water Authority(SNWA) found that its Smart Landscape Program yielded a 37% positive return, bringing in $1.58 for each $1.00 spent in rebates and incentives. Conversion from lawn to xeriscape produced average water savings of 33%, with the greatest savings in the summer. The average cost to convert was $1.55/square foot. The average area of turf replaced was 2160 ft^2. The average savings in maintenance was about 2.2 hours a month, both in hours and direct costs, for the whole property when xeriscape principles (See *Appendix 2*) were applied, translating to $206/year in costs (or $7.80/hour).[126]

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[119] Ashktorab, H. *Artificial turf.* February 2005. Santa Clara Valley Water District. Personal correspondence.
[120] HJK 2003. *Environmental Compatibility of Sports Surfaces.* 2003. (www.isss.de/publications/UVP/HistoryHJK.pdf)
[121] Seppa, Nathan. *There's the Rub: Football Abrasions Can Lead to Nasty Infections.* Science News Online. www.sciencenews.org. 02/05/2005.
[122] *Pro Football Players Pass Staph Infections.* WebMD. www.webmd.com. 02/02/2005.
[123] Gleick, P.H., Haasz, D. Waste not, want not. Pacific Institute. 2003 (http://www.pacinst.org/reports)
[124] Padilla, A., and D. Torres. *Water Savings from a Turf Rebate Program in the Chihuahuan Desert.* AWWA Water Resources Conference Proceedings, 2004.
[125] City of Austin, Texas. *Xeriscaping: Sowing the Seeds for Reducing Water Consumption."* Prepared for the U.S. Bureau of Reclamation, Austin, Texas. May 1999.
[126] Sovocool, Kent A. *Xeriscape conversion study final report.* Southern Nevada Water Authority, 2005.

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According to the *Source Book on Natural Landscaping for Public Officials*, "The major savings of natural landscaping is the lost cost of landscape maintenance. The combined costs of installation and maintenance for a natural landscape over a ten-year period may be one-fifth of the costs for conventional landscape maintenance."[127]

Shifting to xeriscape plants in the landscape produces considerable savings. In a study of SFRs, presented at an American Water Works Association conference, xeriscape plants used 17% less water than traditional landscapes.[128]

SNWA entices its customers to conserve water in the landscape by offering them a wide range of rebates and support services, including $1/ft^2$ for conversion from turf to xeriscape, rebates for clock upgrades, a list of water-smart landscapers, and a landscape awards program.[129]

Cathedral City, California offered its water users $500 to convert their lawns to xeriscape.[130]

In 2004, Clark County (Nevada) began considering a program of removal of approximately 2 million ft^2 of turf, replacing it with xeriscape landscaping, estimating that 60 million gallons of water a year could be saved.[131]

The Metropolitan Water District has devoted millions for its campaign to get consumers to switch to xeriscape plants.[132]

RECOMMENDATION:
A rebate-assisted program for replacement of turf by drought-tolerant ("xeriscape") plants is recommended, following basic principles of:

- Sound landscape planning and design.
- Limitation of turf placement to appropriate areas.
- Use of drought-tolerant plant material.

TEXT BOX 1

TURF-XERISCAPE CONVERSION PROJECTION

STUDY UPON WHICH 16% ESTIMATES ARE BASED:
Based on min. 500 ft2 turf conversion to xeriscape, or new xeriscape installation; trees to cover 50% of property with canopy when mature;non-gravel/rock; in-ground irrigation system in place; cap of 2000 ft2; rebate $.48/ft2. Produced 30% savings of total water use, with highest savings in summer. (SNWA Xeriscape study).

Average amount converted: 2160 ft^2

Average monthly savings: 30% of water bill.

Average monthly savings per ft^2 converted: .0153%

(Sovocal, Kent A. *Xeriscape Conversion Study, Final Report, 2005.* Southern Nevada Water Authority.)

Adjusting SNWA evapotranspiration rate to Nipomo's ET rate (by dimensional analysis):

SNWA ET rate = 90 in/yr
NCSD ET rate = 47.4 in/yr

$$\frac{90"}{30\%} \times \frac{47.44"}{}$$

15.81%=Nipomo % estimated savings.

Rebate cap: 1000 ft^2 ($528.00)
Rebate min: 500 ft^2 ($264.00)

[127] *A Sourcebook on Natural Landscaping for Public Officials.* U.S. Environmental Protection Agency. http://www.epa.gov/glnpo/greenacres/toolkit/index.html.
[128] Nelson, J.O.; Kruta, J.C. *Water saved by single family xeriscapes.* 1994 Annual conference proceedings; American Water Works Association, June 1994.
[129] Water Smart Rebates and Services. Southern Nevada Water Authority, 2003. (http://www.lvvwd.com/html/ws_rebates.html).
[130] Bowles, *J. Anti-drought push gets funds.* Riverside Press-Enterprise, October 2004.
[131] *Vegas-area schools consider removing turf to save water.* September 2004. WaterWiser, American Water Works Association from US Water News. (http://www.awwa.org/waterwiser/watch/archive.cfm).
[132] Bowles, J. *Anti-drought push gets funds.* Riverside Press-Enterprise, October 2004.

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- Efficient irrigation.
- Soil amendments.
- Use of mulches.
- Proper landscape maintenance procedures

If this program is selected, it is recommended that a limited pilot program of 10 SFR homes be selected for the program, with subsequent expansion of the program if outcome analysis warrants it, and after the details of the program have been fine tuned.

Participant eligibility:

- Must be District SFR customer (one rebate-program participant per property or account).
- Submission by customer of drawing (with measurements) indicating dimensions of entire yard and dimensions and location of landscape area to be converted to drought-tolerant planting, including placement and basic canopy size of trees to be conserved.
- Submission of representative photographs of the areas to be converted to drought-resistant landscape.
- Completion of a series of NCSD free workshops on water conservation in the landscape, drought-resistant plants (selection and maintenance), composting and soil amendments, irrigation, and basic landscape design.
- Submission of a basic proposed turf-replacement landscaping plan, indicating plant names, numbers of plants, and location in the landscape.
- Sign a contract representing the requirements and benefits of programs.

Customer Benefits of Program:

- Assistance in obtaining a beautiful, integrated landscape.
- Assistance with part of the costs of converting turf to drought-resistant plants.
- Discount from local nurseries for plants purchased for the turf-replacement project.
- Instruction on basic principles of landscaping (soil/compost, irrigation, plant selection, landscape design).
- Follow-up with horticulturist during and after project.
- Availability of horticulturist to answer questions/assist with problem-solving.
- Free software (while available) on drought-resistant plants and landscaping.
- Pride in supporting community efforts to conserve water and protect the Nipomo Mesa aquifer.
- Eligibility for yearly Nipomo Water-Wise Landscape of the Year Contest.

Program Design: Based on the much referenced study, *Xeriscape conversion study final report*, Southern Nevada Water Authority, 2005, with adjustments of percentage savings for Southern Nevada's 90'/year evapotranspiration rate to Nipomo's 47.4" ET/year (see Text Box 1 for specifics).

- Rebate: $0.48/ft2, minimum of 500 ft2 and maximum of 1000 ft2 rebated.
- Percentage of Shared Program Costs: 10% ($5120).
- Number of enrollees: Minimum of 10, maximum of 50, per year.
- Workshops Required for Enrollees: 4.
- Contract outlining basic requirements and benefits of program.

This program will be conducted in two phases:

1. A small (10 homes) pilot program to fine-tune program design and assess for costs and savings.
2. Subsequent 5% (182 or less homes) increments, assessing for efficacy and feasibility of the program after each increment is completed.

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