CITY of LAGUNA NIGUEL
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May 15, 2009

Mr. John Robertus, Executive Officer
San Diego Regional Water Quality Control Board
9174 Sky Park Court, Suite 100
San Diego, CA 92123

Re: City of Laguna Niguel Comments on the Draft Municipal Storm Water Permit for South Orange County – Revised Tentative Order No. R9-2009-0002, NPDES CAS0108740

Dear Mr. Robertus:

The City of Laguna Niguel appreciates the opportunity to comment on the March 13, 2009 Draft Municipal Storm Water Permit for South Orange County (Revised Tentative Order No. R9-2009-0002, NPDES CAS0108740). The City incorporates by reference its written comments on a prior version of the Tentative Order (No. R9-2007-0002) to the extent that they have not been addressed by the current version (No. R9-2009-0002). The City also reserves the right to provide additional comments on the Tentative Order prior to the close of the public comment period.

City Concurrence with Comments submitted by the County of Orange as Lead Permittee and the City of Dana Point as Co-Permittee

The City has reviewed the legal, technical and monitoring comments to be submitted by the County of Orange as Lead Permittee. The City has also reviewed the legal comments to be submitted by the City of Dana Point as Co-Permittee. The City concurs with the comments, concerns, and recommended deletions and modifications to the Draft Permit that have been submitted by the County of Orange and the City of Dana Point.

General Comments and Areas of Concern

The Draft Permit Continues to be Overly Prescriptive

The current Storm Water Permit for South Orange County (Order No. R9-2002-0001) imposed a very comprehensive and prescriptive set of storm water management and regulatory requirements on the City of Laguna Niguel and the other Co-Permittees. The Draft Permit substantially expands the requirements and prescriptions of the Current Permit without clear or compelling supportive findings, evidence of rationale. As a general comment, the City believes that the Draft Permit remains too prescriptive and

limits the discretion and flexibility of the City to implement storm water management programs and practices that are appropriate, sensible and practical for our community. The City requests that the Regional Board carefully review and reconsider the new requirements of the Draft Permit. Wherever possible, maximum storm water management and program discretion and flexibility should be left to the Co-Permittees.

Comparison of Draft Storm Water Permit for South Orange County to Current Storm Water Permit for San Diego County

A cursory comparison of the Draft Storm Water Permit for South Orange County and the Current Storm Water Permit for San Diego County reveals material differences and many new regulations and requirements that are proposed to be imposed on the South Orange County Co-Permittees. These include, but are not limited to, the following:

- Removal of the word "urban" to describe the runoff discharge that is regulated by the Storm Water Permit
- Removal of landscape irrigation, irrigation water and lawn watering from the categories of non-storm water discharges that are not prohibited by the Storm Water Permit
- Establishment of Non-Storm Water Dry Weather Numeric Effluent Limits
- Establishment of Storm Water Municipal Action Levels
- Implementation of a Retrofitting Program for Existing Development
- Requirement to submit a Municipal Storm Water Funding Business Plan

The City requests that the Regional Board cite the specific legal authority for the proposed inclusion of each of the above-referenced items in the proposed Storm Water Permit for South Orange County. The City further requests that the Regional Board identify the specific water quality issues and conditions that differentiate South Orange County from San Diego County and warrant the imposition of these new and different requirements on the South Orange County Co-Permittees.

Impacts on New Development

The Draft Storm Water Permit imposes additional requirements on New Development and Significant Redevelopment Projects. The current International/National/State economic climate suggests that this is a most inappropriate time to saddle the development community with costly new requirements such as Low Impact Development Site Design and Treatment Control BMPs, and Hydromodification Assessments and Management Strategies. The City requests that the Regional Board carefully review and reconsider the necessity, appropriateness and timing of these new requirements.

Porter Cologne Act and Unfunded State Mandates

The City believes that many of the new regulations and requirements in the Draft Storm Water Permit exceed the requirements of the Clean Water Act. As such, these new regulations and requirements must be considered and evaluated in accordance with

applicable provisions of the State Porter Cologne Act. If such regulations and requirements are included in the Final Storm Water Permit, the City believes that they would constitute unfunded State mandates.

Impacts on Municipal Co-Permittee Budgets

As mentioned above, the imposition of new regulations and requirements on the private development community could not come at a worse time in light of the current economic climate. The same can be said about the financial impacts of the Draft Storm Water Permit on the Municipal Co-Permittees. Many of the Co-Permittees are anticipating year-over-year declines in municipal revenues in numerous revenue categories (i.e. Property Tax, Sales Tax, Real Property Transfer Tax, Planning and Building Fees, Interest Income). Yesterday, the Governor proposed a FY 09-10 State Budget Alternative that may "borrow" $2 Billion from local government property tax revenues for up to three years. Against this backdrop, it will be challenging for the Co-Permittees to maintain current funding levels for our existing Storm Water Management Programs. This may be an appropriate time to extend the current South Orange County Storm Water Permit for an additional 3-5 years without burdening the Co-Permittees with new requirements and costs. At the very least, the Regional Board should make every effort to ensure that the new South Orange County Storm Water Permit is "cost-neutral" to the Co-Permittees.

Specific Comments and Areas of Concern

B.2. – Non-Storm Water Discharges

The Draft Storm Water Permit removes landscape irrigation, irrigation water and lawn watering from the categories of non-storm water discharges that are not prohibited. In effect, this change requires the Co-Permittees to enact and enforce ordinances that prohibit any water from leaving private or public property and entering the MS4, apparently under a zero-tolerance standard rather than to the maximum extent practicable. The City questions the legal authority of the Regional Board to unilaterally declare that these categories of urban runoff are now to be deemed prohibited discharges. The City further believes that these changes will not be accepted or tolerated by the general public and may compromise continuing public education and pollution prevention programs. The City requests that the Regional Board keep these non-storm water discharges in the non-prohibited categories.

C. – Non-Storm Water Dry Weather Numeric Effluent Limits
D. – Municipal Action Levels
I. – Total Maximum Daily Loads

The Draft Storm Water Permit proposes to incorporate enforceable numeric effluent limits at the end of every pipe for both dry weather and storm flows for numerous constituents, including those subject to TMDLs. Available data already suggest that these provisions will place the Co-Permittees in immediate and continuous violation of the Permit. This situation leaves the Co-Permittees responsible for greatly expanded

monitoring, as well as vulnerable to penalties and third-party litigation. It is unknown and uncertain whether it is technically or economically feasible to bring all discharges into full compliance. The City believes that these proposed new requirements greatly exceed and overreach the Co-Permittee's basic legal obligations under the Clean Water Act to implement an iterative sequence of BMPs to reduce the discharge of pollutants to receiving waters to the maximum extent practicable. It is our understanding that no other MS4 permit in the entire country imposes numeric effluent limits at the end-of-pipe for such a broad range of constituents. The City requests that the Regional Board delete these provisions from the Permit.

F.1.d.(4) – Low Impact Development Site Design BMP Requirements

The City is concerned about the appropriateness of encouraging Site Design BMPs that "infiltrate" or "filter" runoff close to the source of runoff. Many areas of Laguna Niguel and South Orange County have experienced slope failures and landslides attributable to storm water and non-storm water causes. Given local soil and geological conditions, it may be more appropriate to discourage Site Design BMPs that "infiltrate" or "filter" runoff. As mentioned before, the City is also concerned about the financial impact of such requirements on New Development and Significant Redevelopment Projects. The City requests that the Regional Board carefully review and reconsider the necessity, appropriateness and timing of these new requirements.

F.3.d – Retrofitting Existing Development

This section requires each Co-Permittee to implement a retrofitting program that solves chronic flooding problems, reduces impacts from hydromodification, incorporates Low Impact Development, supports stream restoration, systematically reduces downstream channel erosion, reduces the discharges of storm water pollutants from the MS4 to the MEP, and prevents discharges from the MS4 from causing or contributing to a violation of water quality standards. First, it is difficult to imagine the scope and cost of performing the retrofitting evaluation required by Section F.3.d. Second, even if such an evaluation was performed, the Co-Permittees have no legal authority to compel private landowners of existing developments to implement or cooperate on retrofit projects. The City requests that the Regional Board delete Section F.3.d from the Storm Water Permit.

H.3 – Business Plan

This section requires each Co-Permittee to submit a Municipal Storm Water Funding Business Plan that identifies a long-term funding strategy for the Storm Water Management Program. Since the Co-Permittees have no legal authority to impose new, significant Storm Water Program revenue sources without voter or property-owner approval, the long-term funding strategy for most Co-Permittees is limited to using existing General Fund revenues to support the local Storm Water Program. This is an unnecessary administrative requirement that will not provide any useful information to the Regional Board or Co-Permittees. The City requests that the Regional Board delete Section H.3 from the Storm Water Permit.

The City appreciates the opportunity to submit these comments and respectfully requests that our comments be fully considered by the Regional Board and Staff.

Yours truly,

Tim Casey
City Manager

Cc: Mayor and City Council
City Attorney
Director of Public Works/City Engineer
Director of Community Development
Senior Water Quality Manager

From: "Nancy Palmer" <npalmer@ci.laguna-niguel.ca.us>
To: <bneill@waterboards.ca.gov>
Date: 3/26/2009 10:49 AM
Subject: SEEP grant findings summary
Attachments: MWDOC SEEP Conference Paper-SDJ 3-24-09.pdf; Conference Paper Cover Letter.pdf

MessageHi Ben,
As we discussed, attached is the summary report for the SEEP grant project just completed by the South Orange County CoPermittees in partnership with the water supply agencies.

What's interesting about the findings is they suggest that, in this region due to peculiarities of local geology, reducing the volume of landscape irrigation runoff may increase the relative proportion of subsoil water seepage in the storm drains, and end of driving the concentrations of certain geologically-derived constituents UP, even while overall discharge loads go DOWN. The SEEP study shows this effect for phosphates. The County has done some source investigations showing that the same may be true in some locations for several metals (cadmium, nickel, zinc).

Also: How are you coming along with the idea of releasing the Fact Sheet for the revised Tentative Order, sooner rather than later?

Thank you,
Nancy Palmer
City of Laguna Niguel
949-362-4384

MUNICIPAL WATER DISTRICT OF ORANGE COUNTY

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March 25, 2009

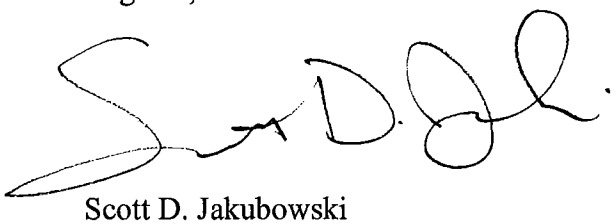
To Whom It May Concern:

The Municipal Water District of Orange County (MWDOC) is pleased to provide this SEEP Conference Paper prepared for the 2009 StormCon Conference in Anaheim, CA. The information contained in this paper is not considered a finished or a published product and shall not be published in any form without the explicit written permission of MWDOC.

Please note the data contained within this paper are not considered finalized and therefore are subject to change. MWDOC will publish the finalized information contained in this paper in the form of a final report as soon as possible.

Please direct all inquires to Scott Jakubowski at (714) 593-5017 or sjakubowski@mwdoc.com.

Regards,



Scott D. Jakubowski
Water Use Efficiency Programs Coordinator
Municipal Water District of Orange County

EVALUATION OF THE SMARTIMER AND EDGESCAPE EVALUATION PROJECT (SEEP) TO REDUCE WATER CONSUMPTION AND DRY WEATHER URBAN RUNOFF IN SOUTHERN ORANGE COUNTY, CALIFORNIA

Stephan C. Hedges and Scott D. Jakubowski - Municipal Water District of Orange County
Nancy Palmer – City of Laguna Niguel

INTRODUCTION

Faced with ongoing drought and impacted surface water resources in a high-demand context, water supply and NPDES managers in coastal southern California have come under increasing pressure to reduce water consumed for ornamental landscape irrigation and to reduce dry-weather urban runoff caused by inefficiently maintained automatic irrigation systems. To this end, the Residential Runoff Reduction ("R3") Study completed in 2004 had demonstrated the potential efficacy of evapotranspiration-driven irrigation controllers (generically dubbed 'SmarTimers') in achieving significant reductions in both water consumption and runoff under homogeneous physiographic and land use conditions. The purpose of the SmarTimer and Edgescape Evaluation Project (SEEP) was to confirm the R3 findings while testing the appeal and efficacy of a broadened set of irrigation and landscape BMPs under more-diverse land use and physiographic conditions. The study area for R3 was an existing single-family residential neighborhood built on the flat alluvial plain in Irvine, CA. The 23 SEEP study areas included single- and multi-family residential, business and park land uses located on hillsides and canyon bottomlands in 10 cities from the coastal bluffs of Laguna Beach to the inland foothills of the Santa Ana Mountains in Rancho Santa Margarita. While the R3 evaluation was limited to SmarTimers, the project BMPs for the SEEP included (A) replacement of conventional timer-based units with "smart" automatic controllers; (B) adjustments, repairs and/or change-outs of inadequate irrigation distribution equipment components; and (C) replacement of existing grass lawn areas next to pavements with strips of "edgescaping" (e.g., separately-valved zones of low-precipitation-rate irrigation, new drought-tolerant plants and permeable groundcovering). In Summer 2007, prior to retrofit with the BMPs, each of the 23 SEEP study areas was monitored for water consumption, dry-weather urban runoff flow rate, and runoff quality parameters including nitrogen (N), phosphorus (P), fecal indicator bacteria (FIB), dissolved organic carbon (DOC), and conductivity. The 3 sets of BMP improvements were respectively implemented in designated study areas between Fall 2007 and Spring 2008, after which the consumption and runoff monitoring sequence was repeated in Summer 2008. This paper describes the project implementation process and findings from the monitoring data.

BMP IMPLEMENTATION

Twenty-three study assessment areas were selected for SEEP based on land use, drainage to storm drains that were relatively easy to monitor, and distribution across ten partner cities within the San Juan Hydrologic Unit in south Orange County. All assessment areas had been fully developed for at least 15 years. The nine single-family neighborhoods, four multifamily developments, six parks and four business complexes, ranging in size from 0.6 to 91.5 acres, were each assigned to one of four BMP Groups. "Commercial" (COM) areas (i.e., single-operator areas equipped with one or a few large commercial-type irrigation controllers, as well as single-family-residential (SFR) areas (i.e., multi-operator areas characterized by many small residential-type controllers) were represented in each Group, as presented in Table 1.

Group A: SmarTimer controllers only		Group A:- SmarTimers + irrigation distribution system improvements		Group ABC: SmarTimers + irrigation improvements + turfgrass replacement		Control Group – Not Retrofitted	
SFR	COM	SFR	COM	SFR	COM	SFR	COM
2	2	2	4	2	4	3	4

Table 1: BMP Group Assignments by Land Use/Controller Types

For COM areas that were privately owned, agreements for project BMP implementation were secured prior to initiation of pre-retrofit monitoring; assuring COM participation was 100%. The nature of COM BMP improvements, including SmarTimer manufacturers/models, extent of irrigation changes, and re-planting schemes, varied from site to site. For SFR areas, participation was solicited only after the pre-retrofit monitoring period, via a time-limited offering of voluntary rebates to homeowners. Allowable SFR BMP improvements were cost-limited and more standardized, requiring a specific SmarTimer model, a limited range of other irrigation equipment modifications, and edgescape strips of defined widths and landscape treatments. The ultimate SEEP SFR participation rate ranged from 6.5 to 22.9% and averaged 9.91% of households across the 6 SFR neighborhoods, with the highest participation rate attracted by the Group AB program. Remaining grant SFR budget funds were expended on retrofitting BMPs on City properties within the SFR drainage boundaries. Per-square-foot BMP installation costs for SFR and COM areas ranged from $0.03 to $0.57 for "A" improvements, $0.08 to $0.71 for "B" improvements, and $1.15 to $7.79 for "C" improvements. Average costs per square foot were 30-58% higher, on average, for the SFR program compared to the COM program.

In most of the study areas in both the SFR and COM categories, the BMP implementation did not extend to the entire irrigated acreage within the area's drainage boundary. As shown in Table 2, SEEP BMP coverage achieved was generally higher in the COM than in the SFR areas.

Area ID		Total Area, acres	Total Irrigated Area, acres	BMP coverage area, acres	BMP coverage as % of Irrigated Area	BMP coverage as % of total area
COM	A Areas	114.1	17.1 (15%)	6.48	37.9%	5.7%
	AB Areas	88.4	28.24 (32%)	14.15	50.1%	16%
	ABC Areas	13.09	5.6 (43%)	3.764	67.2%	28.7%
	COM Controls	128.61	34.5 (27%)	0	0%	0%
SFR	A Areas	94.1	42.5 (45%)	10.03	23.6%	10.7%
	AB Areas	26.85	8.5 (32%)	1.6	18.8%	4.3%
	ABC Areas	79.34	39.6 (50%)	1.48	3.7%	1.9%
	SFR Controls	79.0	38.5 (49%)	0	0	0

Table 2 – BMP Implementation Summary

EFFECTIVENESS MONITORING METHODOLOGY AND RESULTS

Three different data sets were planned in order to evaluate the effectiveness of the BMP retrofit program: 1) water consumption by parcel based on sales volume determined via water purveyor customer billings; 2) urban runoff flow volume measured through continuous-field-monitoring flow gauges installed in storm drains; and 3) concentrations of constituents (FIB, N, P, DOC, and conductivity) determined from laboratory analysis of field grab samples collected twice weekly from each area's runoff. Pre-retrofit data were collected for each assessment area over 12 weeks starting in May 2007, and post-retrofit data were collected for another 12 weeks starting in May 2008 after the BMPs were installed in the assessment areas. Analyses and findings are summarized below.

Dry Weather Runoff Flow Reduction– Dry weather flow measurements were taken continuously for twelve weeks pre-retrofit from May to August 2007 and again post-retrofit in May-August 2008. Three of the assessment areas produced no measurable flow either year, and four areas had less than measurable flow under post-retrofit conditions. For the remaining areas, a regression-modeling framework was used to measure both the mean change in flow volume and the uncertainty surrounding the mean change. In order to account for site-area and year-to-year variability, Table 3 shows the pre- and post-retrofit runoff coefficients for the evaluated BMP Group COM areas relative to the 2007 pre-retrofit runoff mean for the COM Control areas. The un-retrofitted COM Control sites experienced a mean pre-to-post retrofit decline in runoff of 0.069"/day from the total site area.

Assessment Area	2007 runoff coefficient, inches/day per unit area	Std err	t	P>t	2008 runoff coefficient relative to pre-retrofit control mean	Std err	t	P>t	Internal change in runoff rate, 2007-2008 in inches/day per unit area
Control Areas, Mean	**0.080**	.011	7.13	0	-0.069	.016	-4.35	0	**-0.069**
Group A									
RSMB3	-0.075	.018	-4.22	0	-0.078	.017	-4.35	0	-0.002
LWC6	-0.079	.021	-3.87	0	-0.072	.019	-3.76	0	+0.007
Group AB									
RSMB4	-0.066	.018	-3.65	0	-0.080	.017	-4.65	0	-0.013
LFP7	-0.073	.037	-1.98	.048	-0.062	.037	-1.66	.096	+0.011
DPC1	-0.050	.027	-1.86	.063	-0.069	.027	-2.55	.011	-0.019
Group ABC									
LHC3C	-0.075	.033	-2.29	.022	-0.075	.032	-2.31	.021	+0.001
LHP6	+2.390	.033	72.37	0	+0.0002	.032	+0.01	.995	-2.390
LBP1	-0.075	.033	-2.31	.021	-0.055	.033	-1.67	.095	+0.021

Table 3: COM Area Runoff Rates

All but one of the COM BMP Group areas demonstrated somewhat lower 2007 runoff than the Control mean in 2007. Only one of the retrofitted COM areas could be said to have experienced a pre-to-post retrofit runoff decrease in 2008 significantly greater than the decrease from the COM Control areas, but confidence in the findings at even the one site is not high. The magnitude of internal pre-to-post-retrofit changes were relatively small at all the other retrofitted sites. It appears that the COM Control and BMP Group areas may not have been matched well enough to determine conclusive results.

Table 4 shows the pre- and post-retrofit runoff coefficients for the SFR areas relative to the pre-retrofit 2007 runoff mean for the SFR Control areas. The SFR Control areas experienced a mean decline from 2007 to 2008 of 0.068"/day from the total site area.

Assessment Area	2007 runoff, inches/day per unit area	Std err	t	P>t	2008 runoff, "/day relative to 2007 control mean	Std err	t	P>t	Internal change in runoff rate, 2007-2008, "/day
Control mean	**0.112**	.010	10.58	0	-0.068	.015	-4.55	0	**-0.068**
Group A									
MVH8	-0.049	.018	-2.64	.008	-0.089	.019	-4.77	0	-0.041
MVH13	+0.947	.020	48.06	0	-0.087	.020	-4.39	0	-1.034
Group AB									
MVH12	+0.154	.023	6.48	0	-0.098	.024	-4.11	0	-0.252
LNH15	-0.030	.024	-1.24	.215	-0.070	.025	-2.84	.005	-0.040
Group ABC									
LNH14	-0.095	.020	-4.63	0	-0.045	.020	-2.23	.026	+0.049
MVH9	+0.534	.019	28.43	0	-0.105	.019	-5.55	0	-0.640

Table 4: SFR Area Runoff Rates

Half of the participating SFR areas demonstrated higher 2007 runoff than the Control SFR areas. After retrofit, all but one of the participating SFR areas showed a greater decrease relative to the pre-retrofit Control mean than the control sites, with three areas – one in each BMP Group – showing internal pre-to-post retrofit decreases significantly greater than the Control mean decrease. Overall, the retrofitted SFR areas achieved a lower average post-retrofit runoff rate than the Control areas despite starting out with a higher average pre-retrofit runoff rate. That five out of the six retrofitted SFR areas appeared to show decreased runoff post-retrofit is encouraging, considering that the vast majority of the households in the retrofitted areas did not implement SEEP BMPs.

In order to compare the SEEP SFR findings to the metric used in the earlier R3 Study, the SEEP runoff coefficients were converted into inches per day assuming runoff all came from the irrigated

portion of each drainage area. The R3 Study reported a pre-retrofit SFR runoff rate averaging 0.009"/day dropping to a post-retrofit runoff rate of 0.0045"/day. In contrast, the comparable pre-retrofit average runoff for SEEP SFR areas was 0.876"/day and the post-retrofit average was 0.058"/day. Average SFR runoff reduction achieved by R3 was -0.0045", while the SEEP SFR BMP Groups achieved a reduction of –0.678"/day, relative to -0.140"/day reduction at the SEEP Control areas. It should be noted that some or most of the difference between the 2004 R3 and 2008 SEEP SFR results may have been caused by year-to-year evapotranspiration variability, and/or may have been influenced by the Governor's declaration of a statewide drought alert in June 2008. Nevertheless, it seems reasonable to speculate that some part of the difference may be attributable to topography and soil type. The R3 Study was conducted in the alluvial flatlands of Irvine, while the SEEP SFR areas were terraced into the hilly clay-loam sedimentary region of south Orange County. The SEEP findings suggest that for future irrigation BMP rebate programs, targeting sloped areas with low-infiltration rate soils may offer a higher overall return on investment (in terms of reducing both consumption and runoff) than comparable efforts in the flatlands. The anticipated findings from the next-generation study currently being conducted in the hilly Poche residential area of San Clemente may help confirm this hypothesis.

Conductivity and Subsurface Flows - Conductivity ranges from about 600 to 1800 µmhos/cm in south Orange County potable and reclaimed water supplies, and has been observed to be 5 to 10 times higher in some local groundwaters. The SEEP study examined conductivity as a possible tool for estimating the percentage of subsurface soil moisture seepage (entering the storm drain indirectly via unsealed pipe joints or sub-drain systems) compared to direct surface irrigation runoff in the storm drain flow. Available pre-and post retrofit conductivity data are summarized in Table 5.

Assessment Area		2007 conductivity mean ± std. dev., µmhos/cm	Estimated % seepage, 2007	2008 conductivity mean ± std. dev. , µmhos/cm	Estimated % seepage, 2008
SFR	MVH8	1083±249	0-4%	2724±1997	13-27%
	MVH13	1278±470	0-13%	1745±521	0-13%
	MVH12	1468±1648	0-11%	1278±470	0-11%
	LNH15	1634±452	0-12%	1354±525	0-8%
	LNH14	2478±2324	9-23%	4457±2324	37-51%
	MVH9	1009±290	0-3%	2599±2085	11-25%
COM	LWC6	5283±981	48-62%	2187±1924	5-19%
	RSMB4	851±51	0%	4955±3466	44-58%
	DPC1	2012±514	4-17%	4143±2395	33-46%
	LHP6	3459±345	23-37%	2956±885	16-30%
	LBP1	7596±634	81-94%	5699±3207	52-66%

Table 5: Conductivity and Seepage

In 7 out of 11 cases, the conductivity and estimated seepage percentage were inversely related, increasing from the pre- to post-retrofit period as the total flow rate from irrigated areas decreased, or vice versa. In the other cases the direction of conductivity shift relative to flow rate change was variable. These results suggest that conductivity could not be used as a proportional seepage-estimating tool without confirmation via other parameters.

Water Consumption Savings - The Project Assessment and Evaluation Plan for the SEEP established targets to reduce potable water consumption by an average of 7 to 21% at SFR sites and an average of 5 to 15% at COM sites, based on customers' water meter billings including both interior and exterior uses. Unfortunately, the post-retrofit period allowed for monitoring water consumption under the funding grant was too brief to draw conclusions based on meter billings. However, the general magnitude of exterior landscape water consumption savings accomplished via the SEEP may be roughly estimated by inference from the mean runoff reduction volume data from Control versus retrofitted sites. The Control sites saw an overall volume reduction of -55%, compared to –89.6% reduction at retrofitted

sites. It should be noted that this method does not account for potential consumption savings (or increases) not reflected in the runoff rate, such as year-to-year evapotranspiration variability, modified overspray or infiltration characteristics, groundwater proportions, or other factors.

Area ID		Mean Runoff Flow, L/day, 2007	Mean Runoff Flow, L/day/ 2008	2007-2008 Change, L/Day	Percent Change
COM - retrofitted	LWC6	1,837	32,942	+31,105	+17930%
	DPC1	19,047	7,061	-11,986	63%
	LHP6	805,427	20,348	-785,079	-98%
	LBP1	7,561	11,781	+4,220	+56%
SFR – retrofitted	MVH8	352,903	127,849	-225,054	-64%
	MVH12	199,184	11,581	-187,603	-94%
	LNH15	140,951	54,436	-86,515	-61%
	LNH14	112,903	315,721	+202,818	+279%
	MVH9	4,211,109	28,056	4,183,053	-99%
Total - retrofitted		5,850,922	609,775	**-5,241,147**	**-89.6%**
Total – All Controls		1,025,886	461,557	**-564,329**	**-55%**

Table 6: Estimated Landscape Water Consumption Change

Runoff Water Quality Improvement – The mean change in concentration of FIB, nutrients, DOC and conductivity over all sites are summarized in Table 7.

Water Quality Grab Sample Indicator	2007 Mean	2008 Mean	Percent Change	Difference	Std Error	t-statistic
Total Coliform (cfu/100 ml)	16092	137507	755%	121415	9122	13.31
Fecal Coliform (cfu/100ml)	6366	26701	319%	20334	3720	5.47
Enterococcus (cfu/100ml)	21307	20187	-5%	-1120	2471	-0.45
Orthophosphate-P (mg/l)	0.5595	0.6437	15%	0.0842	0.0336	2.50
Conductivity (µmhos/cm)	2264	2651	17%	387	144.7	2.68
Total Nitrogen-N (mg/l)	9.8143	4.5559	-54%	-5.2583	0.1868	-28.14
Total Phosphorus (mg/l)	0.5964	0.6801	14%	0.0836	0.0350	2.39
Dissolved Organic Carbon (mg/l)	19.9571	24.9237	25%	4.9666	1.8231	2.72
Ammonia-N (mg/l)	3.2592	1.8646	-43%	-1.3946	0.1320	-10.56
Nitrate-N (mg/l)	6.5508	2.6803	-59%	-3.8705	0.1038	-37.27

Table 7: Pre- to Post- Retrofit Mean Water Quality Parameter Concentrations Over All Areas

The greatest measured change from 2007 to 2008 was in Coliform bacteria concentrations, which overall increased by an order of magnitude, possibly supported by a concurrent 25% concentration increase in the food sources represented by DOC. In the context of the substantial daily flow volume reduction, overall Total Coliform daily load increased only about 33%, while Fecal Coliform daily load actually decreased by about 35%, and Enterococcus load decreased by about 85%.

Nitrogen compound concentrations decreased at all 14 sites while mean phosphorus concentration increased at over half the sites. These changes resulted in an overall shift of the mean N:P concentration ratio downward from 16:1 to 7:1, which is considered beneficial from a regulatory standpoint. Mean Total Nitrogen and Total Phosphorus concentration data were combined with total mean runoff volume to arrive at inferred loads for the two summer seasons (see Table 8).

Assessment Area		Total Nitrogen Load in Kg, 2007	Total Nitrogen Load in Kg, 2008	Total Phosphorus Load in Kg, 2007	Total Phosphorus Load in Kg, 2008
SFR BMP Groups	MVH8	109.3	25.0	5.37	3.22
	MVH12	107.2	2.7	8.53	0.58
	LNH15	87.1	22.3	4.32	6.46
	LNH14	39.1	63.5	2.38	3.95
	MVH9	729.5	2.4	32.20	0.25
SFR Controls	MVH7	337.6	54.1	40.4	3.9
	MVH11	226.0	70.8	19.09	13.23
COM BMP Groups	LWC6	1.9	13.8	0.10	1.09
	RSMB2	1.4	1.3	0.06	0.21
	DPC1	8.0	3.0	1.16	0.13
	LHP6	774.5	7.1	19.90	1.40
	LBP1	2.4	1.9	0.09	0.05
COM Controls	LHC3A	61.7	3.18	2.32	0.60

Table 8: Nitrogen and Phosphorus Loading

In the context of overall post-retrofit flow reduction, the overall nitrogen load by weight from the SEEP areas decreased by 99%, from 24,856 kg in Summer 2007 to 271 kg in Summer 2008. The overall phosphorus load also decreased, but to a lesser extent (from 136 to 35.5 kg, or 74%).

CONCLUSIONS

Overall, this study concluded that:

a) Retrofitted SEEP SFR areas achieved a pre-to-post-retrofit area-weighted average runoff reduction from irrigated areas of –0.678"/day (-92%) greater than the reduction from un-retrofitted SEEP Control sites, compared to an average reduction of –0.0045"/day (-50%) achieved under the R3 Study.

b) In 7 out of 11 cases, conductivity appeared to be useful as an indicator for estimating the proportion of surface irrigation runoff versus subsurface seepage influents in the storm drain,. The estimated seepage proportion varied widely between sites and year to year, ranging from 0% to 94% of the dry weather flow.

c) Mean daily runoff volume from all retrofitted areas declined 89.5% from 2007 to 2008, compared to a 55% decline at un-retrofitted Control areas.

d) Runoff flow reduction helped achieve an estimated 99% reduction in total nitrogen load by weight and an estimated 74% reduction in total phosphorus load overall from the SEEP areas.

e) The limited number of SEEP study areas and the variability between areas did not allow for any clear conclusions to be drawn regarding the relative runoff or pollutant load reduction effectiveness of the three SEEP BMP Groups (A, AB and ABC).

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