The Residential Runoff Reduction Study

Municipal Water District of Orange County

Irvine Ranch Water District

July 2004

Study Participants

A & N Technical Services

CalFed Bay-Delta Progam

California Department of Pesticide Regulation

California Environmental Protection Agency

California Regional Water Quality Control Board

HydroPoint Data Systems, Inc.

Irvine Ranch Water District

Metropolitan Water District of Southern California

Montgomery Watson Labs

Municipal Water District of Orange County

National Water Research Institute

County of Orange

Southern California Coastal Water Research Project

State Water Resources Control Board

United States Department of the Interior Bureau of Reclamation

Executive Summary

Study Background and Rationale

In 2001, the Irvine Ranch Water District (IRWD), the Municipal Water District of Orange County (MWDOC), and the Metropolitan Water District of Southern California (MWD) completed a small-scale study of weather-based evapotranspiration (ET) irrigation controllers. This study, known as the "Westpark Study," tested the effectiveness of ET controller technology in residential applications. After 40 such controllers were installed in the Westpark neighborhood of Irvine, California, water demand and runoff in the study area were measured. The resulting average water savings for this study were 37 gallons per day, or 7 percent of total household water use and 18 percent of irrigation water use.

Based upon the findings of the Westpark Study, IRWD and MWDOC partnered on new research, the Residential Runoff Reduction (R3) Study, in which the number of sites studied was increased, a baseline area where no changes were made was included, and an "education only" area where printed educational materials were distributed was also included. This made the R3 Study one of the first studies to attempt to quantify the effectiveness of public education alone versus a technology-based plus education approach to reducing residential irrigation water usage. Figure ES-1 presents the study participants and their respective roles within the R3 Study.

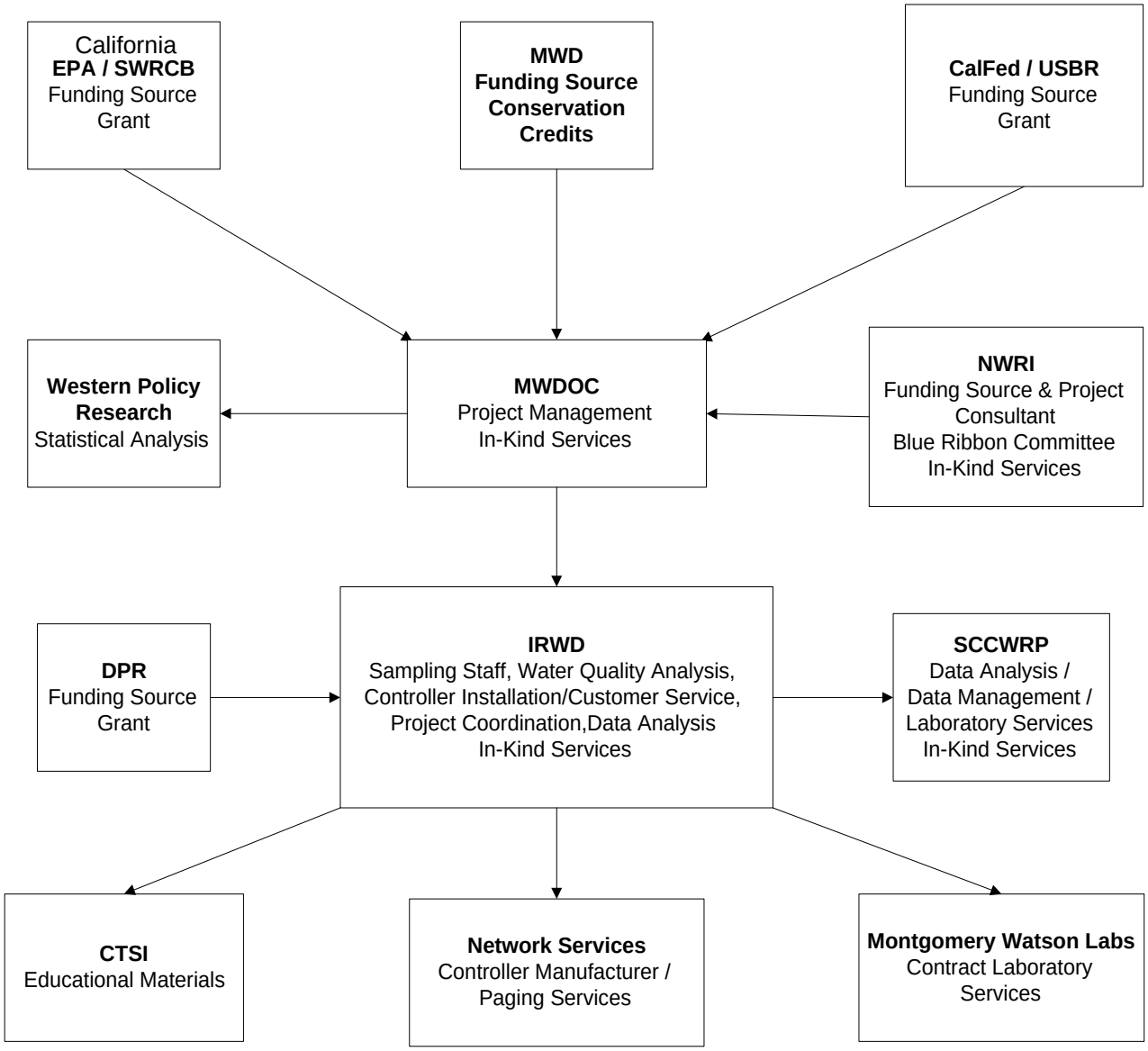
The R3 Study had four primary purposes:

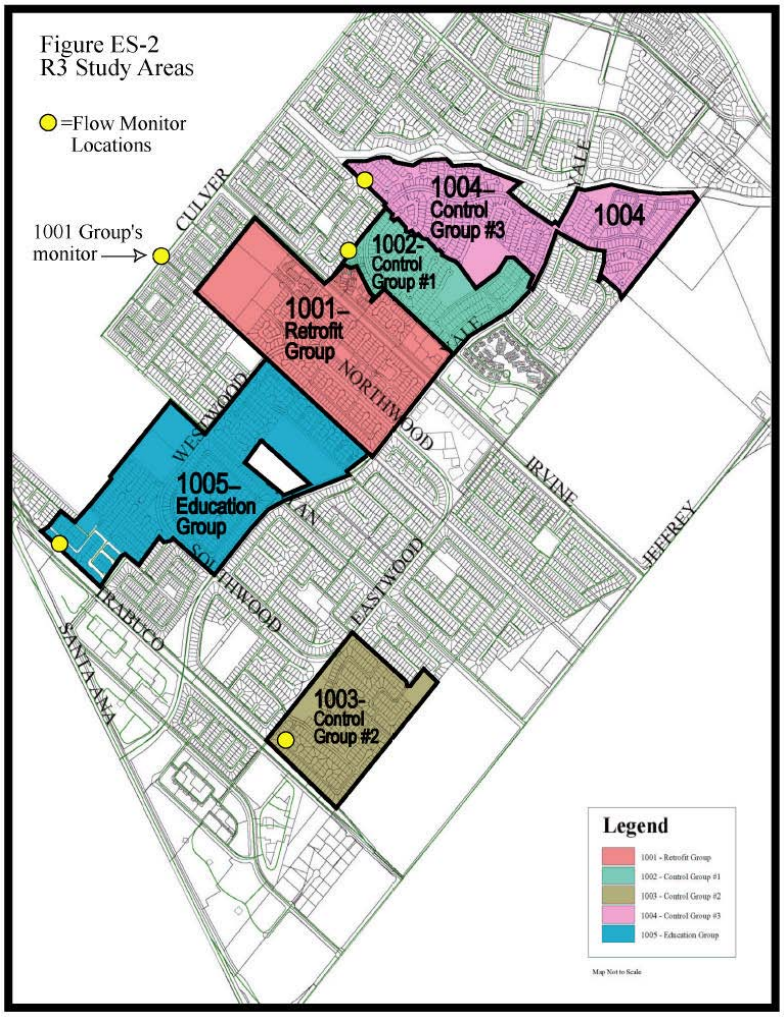
1) To test the use of weather-based irrigation technology, also known as ET controllers, to manage irrigation water for residential homes and large landscape areas;
2) To evaluate the effectiveness of a targeted education program on residential homeowners;
3) To determine the correlation between proper water application in landscape irrigation and the quantity and quality of urban dry-season runoff; and
4) To gauge the acceptance of water management via the controller technology.

Study Methodology

The R3 Study area included five similar neighborhoods (Sites 1001 through 1005) in Irvine, California, each with its own single point of discharge into the urban storm drain system. The five sites are shown on Figure ES-2. At these points of discharge from each study area, the runoff volume was monitored and water quality samples were taken. The five sites were divided into three separate areas. The first area, Site 1001 (retrofit group), used ET controller technology and public education. The second area, Site 1005 (education group), received educational materials, but did not receive controllers. The third area (control group) consisted of three separate neighborhoods (Sites 1002, 1003, and 1004), which received neither ET controllers nor educational materials.

Figure ES-1
R3 Study Participants





Evaluation Results

After the initial 18-month study period was completed, the data was compiled and evaluated for water conservation savings, dry season runoff changes, and changes in the quality of the dry season runoff water. The following summarizes the results:

a) Water Conservation Savings

Water conservation savings from the typical participant in the retrofit group were 41 gpd, or approximately 10 percent of total household water use. The bulk of the savings occurred in the summer and fall (Figure ES-3. Residential Water Savings: Technology + Education). The education group residential customers saved 26 gpd, or about 6 percent of total water use. The savings from this group were more uniform throughout the year (Figure ES-4, Residential Water Savings, Education Only). The retrofit group also included 15 dedicated landscape accounts (ranging in size from 0.14 acres to 1.92 acres), which showed average water savings of 545 gpd. The net result was eight times more water savings than with the single-family residential controller, strongly indicating that the larger the landscape, the better the savings per controller.

Figure ES-3
Residential Water Savings: Technology + Education

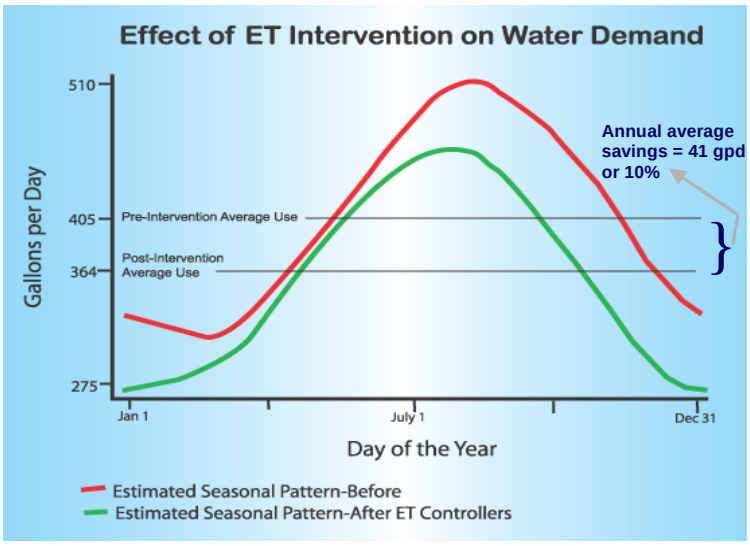


Figure ES-4
Residential Water Savings: Education Only

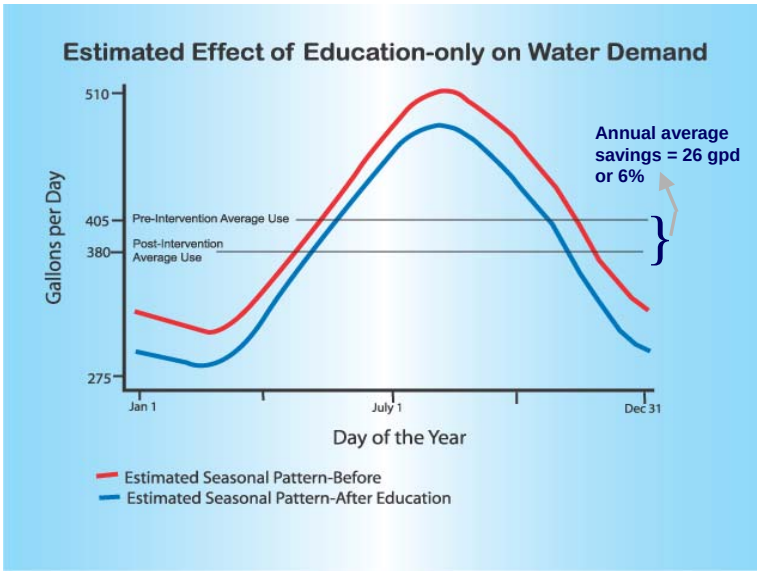


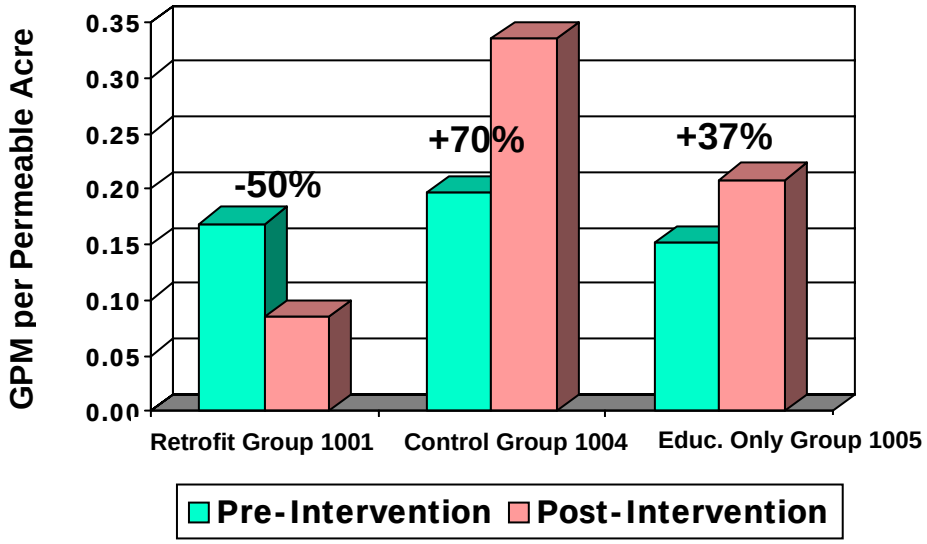
Figure ES-5
Changes in Runoff Within Each Site

b) Dry Season Runoff Changes

The retrofit group experienced a 50 percent direct reduction in water runoff (pre-intervention runoff compared to post-intervention runoff) during dry season periods. When the retrofit group is compared to the control group, the dry season runoff shows a statistical reduction of approximately 71 percent. In contrast, a comparison of direct pre-intervention and post-intervention runoff from the education group increased 37 percent,

while runoff increased 70 percent within the control group. Other than the presence of an ET controller, the primary difference between these groups is the participation of the 15 landscape accounts in the retrofit group. These accounts irrigated approximately 12 acres of landscape versus between 4 to 5 acres of total irrigated area for the 112 residential homes. Figure ES-5 presents R3 Study changes in runoff within sites.

Figure ES-5
Changes is Runoff Within Each Site



Note: It is also possible to compare post-intervention runoff *between* the study sites. These comparisons suggest a higher reduction in runoff for Site 1001 (between 64 and 71 percent) than was observed for the "within site" pre and post comparison, and a reduction in runoff of 21 percent for Site 1005. However, as described more fully in the text, these comparisons are less reliable than the "within site" pre and post comparisons shown here.

c) Changes in Runoff Water Quality

The study gathered a great deal of information on the water quality constituents present in urban runoff. In almost all cases, the data showed no changes in the concentration of these constituents in the runoff. The most significant fact to come out of the urban runoff water quality data is that the decrease in runoff volume from the retrofit group did not appear to result in an increase in the concentration of pollutants in the runoff. Thus, it is probable that a reduction in total pollutant migration could be achieved by reducing total dry season urban runoff.

d) Public Acceptance of Water Management

While there were some customer service-related issues, the retrofit group had a generally positive response to the ET controller, with 72 percent of participants indicating that they liked the controllers. The retrofit group also found that the controller irrigation either maintained or improved the appearance of the landscape. This has very positive implications. The water district customers receive a desired benefit of a healthy landscape, and the community receives several important environmental benefits from

the conservation of valuable and limited water resources and the reduction in dry season urban runoff.

Findings, Conclusions, and Recommendations

The R3 Study showed that weather-based irrigation controllers, which provide proper landscape water management, resulted in water savings of 41 gpd in typical residential settings and 545 gpd for larger dedicated landscape irrigation accounts. The observed reduction in runoff from the retrofit test area was 50 percent when comparing pre-intervention and post-intervention periods and 71 percent in comparison to the control group. The education group saw reductions in water use of 28 gpd, and a reduction in runoff of 21 percent in comparison to the control group. Water quality parameters in both study areas were highly variable, and very few differences in the level of monitored constituents were detected. In terms of water savings per controller (and cost-effectiveness), the study clearly indicated that larger landscape areas (parks and street medians) should provide the initial targets for the expansion of similar programs.