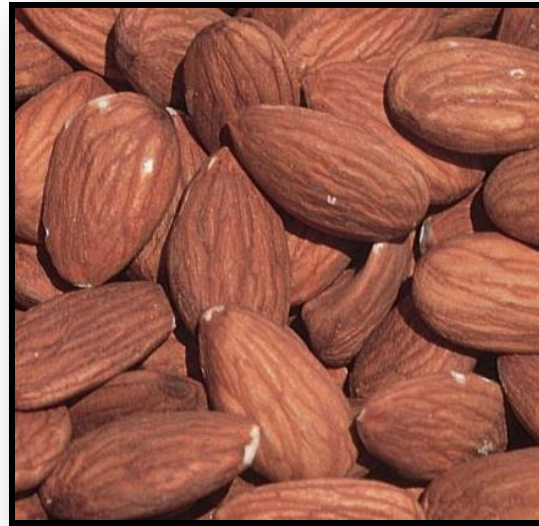


## FRE-FLO™ Percolation Test Results Almond Trees - Vernalis, CA



# FRE-FLO™ Percolation Test Results

## Almond Trees - Vernalis, CA

A FRE-FLO™ water conditioning unit was installed on one block of irrigated almonds but not on the adjacent block, setting up a FRE-FLO™ TEST and CONTROL comparison opportunity for the evaluation of the FRE-FLO's ability to increase soil permeability and improve irrigation efficiency.

Pictured at right is the FRE-FLO™ test unit. Test unit is supplying water to a single row in the orchard. The remainder of the orchard is grower's standard practice.



C-PROBE Soil Moisture Sensors were installed at varying soil levels to record irrigation water percolation.

Two C-PROBE Data Recording Stations were installed, with one monitoring the FRE-FLO™ equipped (TEST) block and the other monitoring the NON-EQUIPPED (CONTROL) block.

# TECHNICAL OVERVIEW



## Bill Wilson Environmental Planning, LLC

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May 30, 2017

### USE OF THE FRE-FLO™ WATER CONDITIONING DEVICE & REGENERATION OF AGRICULTURAL SOILS

Amendments like gypsum or elemental sulfur – and even sulfuric acid - are commonly used in agriculture in an effort to correct soil pH and mitigate sodic soils. These measures have varying degrees of effectiveness, long-term side effects, and are costly.

Use of a FRE-FLO™ device to pre-condition irrigation water can effectively obviate the need for such repeated applications. By causing a reduction in surface tension and inducing soluble calcium ions, water applied through a FRE-FLO™ continuously enhances both soil quality and uptake of water and nutrients in crops. The results are quantified by an increase in crop quantity and quality, and a significant reduction in irrigation demand.

These are some of the dynamics and effects that have been documented from the use of FRE-FLO™ in agriculture over the last several decades:

- Soluble calcium replaces sodium in soil. Calcium has almost 50 times the flocculation capability in soil, contributing to the rapid drop in sodic conditions, SAR, and conductivity, and increase in CEC.
- As the soil becomes less dispersed and increasingly reflocculated, percolation of irrigation water and rainwater improves. This is a contributing factor to the documented reduction in direct irrigation demand, and also especially important to the infiltration of rainwater and reduction in agricultural runoff a focus of increasing environmental regulation.

- Because of mismatched conductivity between rainfall and sodic soils, low-conductivity rainwater can shed without infiltrating, leading to irrigation demand even after a rain event. Reflocculated soils absorb rainwater, resulting in soil storage, deep infiltration, and a further reduction in irrigation demand.
- FRE-FLO™ conditioned irrigation water, with soluble calcium, begins to break up accreted calcium and mitigate conditions like caliche hardpans that have accumulated over years of unfavorable dynamics.
- FRE-FLO™ regenerated soils generally do not exhibit the expansion-contraction cycles and cracking that are typical in sodic soils.
- Once CEC is restored, water and nutrient uptake by crops is improved, resulting in a reduction of fertilizer and other additions, and increased crop health, growth rate, and overall production.

There are a number of other demonstrated beneficial results brought about in crop production from the use of FRE-FLO™, but this summary lays out some of the direct effects on soil structure.

For a comprehensive tutorial by Dr. Jim Walworth from the University of Arizona on these issues (including the importance of quality of irrigation water on soil and the impact of calcium and sodium in influencing soil structure), see his fascinating PowerPoint:

J. L. Walworth, Ph.D. (2006). Soil Structure: The Roles of Sodium and Salts. University of Arizona Cooperative Extension Publication, University of Arizona, Tucson, AZ. <http://cals.arizona.edu/pubs> (then enter Publication Number az1414).

Bill Wilson

# FRE-FLO™ Percolation Test Results

## Almond Trees - Vernalis, CA.

### Harvest Results

Non FRE-FLO™ treated  
almond crop.



FRE-FLO™ Treated almonds  
showing 20% increase yield  
and quality greatly improved.



Research by Crop Production Services, Inc.  
Visalia, CA Branch. Bill Galli, CCA (559) 287-3980

## FRE-FLO™ Percolation Test Results

### Almond Trees - Vernalis, CA

- The C-PROBE data recorded 3 irrigation cycles, with deeper water percolation in the FRE-FLO™ equipped block.
- Irrigation water applied to the CONTROL block exhibited ponding and produced run-off and irrigation had to be discontinued. This irrigation water ran off or would puddle on top of the soil, only to evaporate, leaving the minerals behind to further reduce the soil quality. No leaching was taking place.
- By contrast, irrigation water in the FRE-FLO™ equipped block absorbed into the soil during the observation period.

## FRE-FLO™ Percolation Test Results

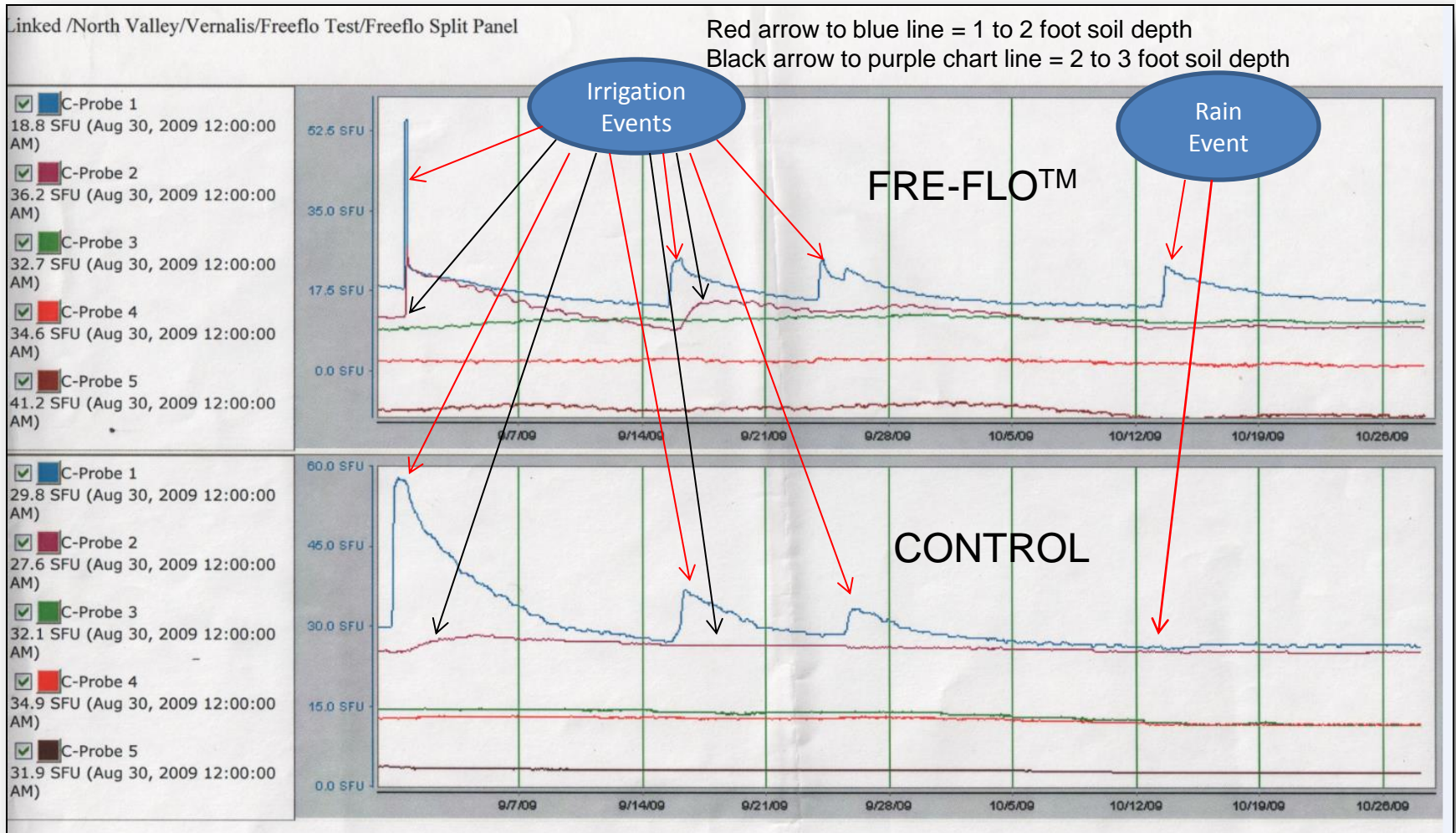
### Almond Trees - Vernalis, CA

- In mid-October, a 2-inch rainfall event occurred. The rainfall was absorbed into the FRE-FLO™ equipped block to a depth of 2 feet, but was not absorbed by the CONTROL block. The failure to absorb rainfall, which has low EC, is indicative of soil conditions impacted by sodium and diminished CEC and elevated SAR.



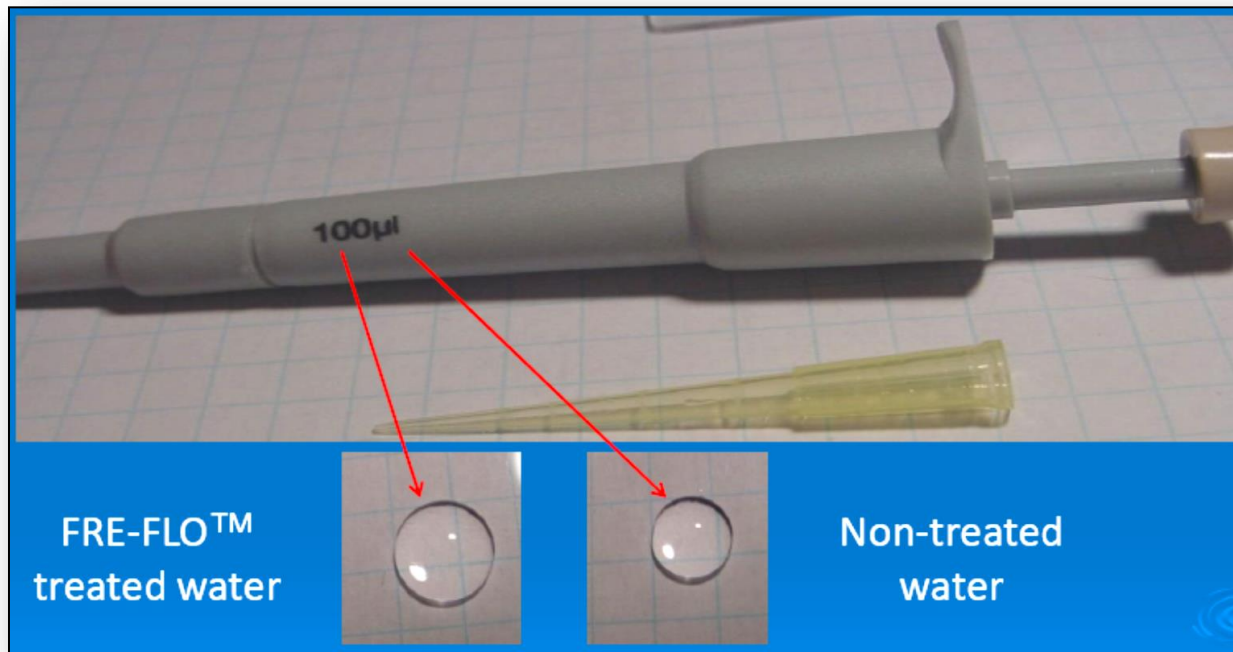
# FRE-FLO™ Percolation Test Results

## Almond Trees - Vernalis, CA



*“The affect of the FRE-FLO™ water conditioning is two-fold: One, as shown by the surface tension comparisons and the water drop diameter observation, the ability of the water to hydrate calcium ions is improved by the decrease in bond strength between water molecules.”*

Conclusions and Summary by Bill Wilson, Associate, Carlile Macy,  
Environmental Engineering & Sustainability





# FRE-FLO™ Percolation Test Results

## Almond Trees - Vernalis, CA

- “Secondly, calcium hardness in the water is mobilized to increase the efficacy of soluble calcium cations to balance SAR, increase CEC, and to displace Sodium, resulting in favorable flocculation of clay particles in the soil, resulting in increased infiltration rates and better uptake by plants.”
- “The data plot from the C-PROBES for the rainfall event document rejection of rainfall with its characteristic low EC on the CONTROL block, a classic symptom of an alkaline dispersed soil with high SAR. The high infiltration rate on the FRE-FLO™ irrigated block indicates that this condition has been corrected.”
- “This result has important implications for both increased irrigation efficiency and water conservation, and for reduction of agricultural run-off and Non-Point Source water quality impacts.”

# FRE-FLO™ Percolation Test Results

## Almond Trees - Vernalis, CA

### SUMMARY:

- “Several synergistic things are taking place: Less surface tension in the water (weaker water-to-water bonds); better hydration of calcium cations; increased calcium solubility; repair of dispersed and/or sodic soils.”
- “One way of characterizing this observation is that the FRE-FLO™ conditioned water is acting as an ion exchange water softener in reverse in impacted soils that have become ‘dispersed’ and lost their structure. The sodium is being displaced, leached out, and replaced with calcium, re-flocculating the soil.”

FRE-FLO™ WATER SYSTEMS, INC  
(909) 841-8083  
[www.reflowater.com](http://www.reflowater.com)

### REFERENCE:

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