



Managing Salinity of Recycled Water for Landscape Irrigation

The Link Between Plants, Soils, Salts, and Recycled Water

To conserve water resources, states such as California encourage the use of recycled water in place of potable water for applications such as landscape irrigation.

However, some irrigators have been reluctant to apply recycled water to landscapes because they are concerned that excess salinity in these waters will damage or harm plant life.

This brochure shows that recycled water can be safely used for landscape irrigation and that salinity can be addressed through proper management strategies.

Why Recycle?

Over the next 25 years, California will gain an additional 17 million people, bringing the population to 52 million. To meet the water demands of this growing population, water agencies are taking proactive steps in conserving and augmenting our limited water resources.

One solution is to recycle more water.

Recycled water is municipal wastewater that has been extensively treated and, in most cases, is safe to reuse for irrigation and other purposes.

Using recycled water has several benefits:

- Recycled water is abundant and reliable – which is especially important to many arid regions in California that have to import water (often, at high costs).
- It provides protection against drought.
- It is cost-effective.
- It diversifies our sources of water supply and reduces the need to develop new water supplies that are costly and energy demanding.
- It conserves the potable supply.
- It contains nutrients that reduce the need for full application of fertilizers.

Uses of Recycled Water

For over 100 years, California has been using recycled water in a variety of ways, such as for irrigating pastures and crops, flushing toilets and urinals in office buildings, making artificial snow, and replenishing aquifers.

Recycled water is also used for landscape irrigation. Golf courses are often the main customers. Other uses include the irrigation of schoolyards, parks, athletic fields, cemeteries, nurseries, roadside vegetation, and some residential areas.

The California Department of Water Resources estimates that of the 525,000 acre-feet of recycled water used annually in the state, approximately 21 percent is used for landscape irrigation.

What Is Salinity?

Referred to as total dissolved solids (TDS), salinity is the concentration of dissolved mineral salts in water. All natural waters contain dissolved salts (Table 1).

The salts enter into the water as a result of chemical weathering and other natural processes, as well as from certain agricultural and industrial purposes.

Salt Damage to Plants

The salts associated with salinity can affect the growth and health of plants in several ways.

One is referred to as the “osmotic effect,” in which salts attract water and compete with plants for it, meaning that as salinity rises, plants have to expend more energy to take in water (energy that would otherwise be used for growing, flowering, or fruiting). The end result is negative: stunted growth, wilting, and other damage.

Another major concern is that constituents making up salinity – for example, sodium and chloride ions, as well as boron – can be toxic to sensitive plants, causing severe damage, such as leaf burn, leaf drop, and plant death.

Some plants are more susceptible to salt damage than others. For instance, among turfgrasses, Colonial bentgrass is extremely salt sensitive, while Bermudagrass and Seashore paspalum are highly salt tolerant (Table 2).



Salinity in Recycled Waters

Recycled water typically is of higher salinity than freshwater but usually not high enough, however, to make it unsuitable for irrigation.

Because residential and commercial uses add salts to wastewater, increases in salinity levels of local recycled waters vary from under 400 to 900 ppm.

Sometimes, however, high levels of salinity originate with the source water itself and not the recycling process. For example, much of Southern California receives imported Colorado River water for drinking-water purposes. The Colorado River's salinity level averages about 750 ppm – high enough that, in some situations, it may be detrimental to certain salt-sensitive plants.

Salinity levels in groundwater, another source of potable water, can also vary, ranging from 200 ppm to as high as 10,000 ppm.

Thus, whether you use drinking water or recycled water for irrigation, you may end up with salt damage (especially with foliar wetting) to sensitive plants, such as rose, gardenia, and ginkgo tree.

Table 1. Salinity Levels of Natural Source Waters in California

Natural Source Water	Total Dissolved Solids (parts per million)
Snowfall and Rainfall	5 to 15
Snowmelt and Rainfall Runoff in Watersheds	50 to 100
Sacramento River at the City of Sacramento	120
Groundwater Pumped from Granitic Alluvium	200 to 400
Groundwater Pumped from Sedimentary Alluvium	600 to 10,000
Colorado River at Imperial Dam	750
Ocean Water	35,000

Table 2. Salt Tolerance of Select Species of Landscape Plants

Plant Group	Very Salt Sensitive	Moderately Salt Sensitive	Moderately Salt Tolerant	Very Salt Tolerant
Turfgrasses	Colonial bentgrass Annual bluegrass Kentucky bluegrass	Creeping bentgrass Red fescue Annual ryegrass	Perennial ryegrass Tall fescue • Kikuyugrass Zoysia grass	Bermudagrass Seashore paspalum St. Augustinegrass
Landscape Trees	Bluegum Red maple Lemon	Coast redwood Sweetgum (Liquidamber) Chinese hackberry	Aleppo pine Redgum (<i>E. camaldulensis</i>) Italian Cypress	Norfolk Island pine Mexican stone pine Casuarina
Landscape Shrubs	Abelia Camellia Cornelian cherry	Crape myrtle Oregon grape Croton	Japanese boxwood Pittosporum Escallonia	Mock orange Oleander Century plant



The Solution to Salinity

Salinity can hinder the development of plant life and, if not properly managed, salts may accumulate in the soil.

A number of management strategies are available to solve salinity problems in landscapes. For instance:

- Applying water in excess of the plant's water needs to maintain salt balance in the root zone.
- Maintaining adequate soil drainage.
- Avoiding the spray wetting of salt-sensitive plant foliage.
- Blending saline water with less-saline water.
- Adding water and soil amendments to correct sodium and alkalinity problems.
- Replacing salt-damaged plants with plants of higher salt tolerance.

Sample Management Strategies

Standing Water and Chlorosis (Yellowing) on Turfgrass – At one particular playground, the soil was accumulating sodium ions, which affected the ability of turfgrass to take in water and caused standing water. Subsequently, chlorosis resulted from the lack of soil aeration due to water logging.



The solution was to apply gypsum as a soil amendment, which supplied soluble calcium ions to replace excess sodium in the soil and resulted in increased water intake rates and improved soil aeration.

Burning on Foliage of a Conifer Tree – The pattern of damage on the needles of a conifer tree indicated that water sprayed onto the plant was too saline.

Two solutions were offered: 1) avoid wetting the conifer with sprinkler irrigation by installing bubble emitters for irrigation; or 2) replace the conifer with a more salt-tolerant species.

Defoliation and Dying Back of Leaves on Gum Tree – The typical symptoms of salt stress – leaf death and defoliation – were caused by high levels of salinity at a depth of 4 feet in the soil (and not at soil surface).

Because this was a soil salinity problem and not a water salinity problem, the solution was to heavily water the Sugar gum tree to displace salts below the root zone and minimize salt damages.

Not All Problems Are Water-Related

It is important to note that sometimes the plant damage is not related to water, recycled or otherwise.

Water quality is not always the issue. For instance, at golf courses, turfgrass damage may be caused by golfers twisting and turning while practicing their swings. In other cases, the soil may already be contaminated with natural salinity. Or perhaps the topsoil is shallow, but a plant needs to develop a deep root system, so it cannot grow well.



These few examples underscore that care must be exercised when assessing any landscape horticulture problem.

The Salt Management Guide

A new tool is available to help landscape professionals accurately diagnose and manage salt-related problems.

The *Salinity Management Guide* is an interactive, user-friendly CD that provides information varying from the basics of salinity to the design or redesign of landscape systems based on water needs, soil conditions, and the salt-tolerance of plants.

Using data and images from the Guide, landscapers will be able to compare their plants to photos of plants suffering from salt damage. With a click of the mouse, they can explore

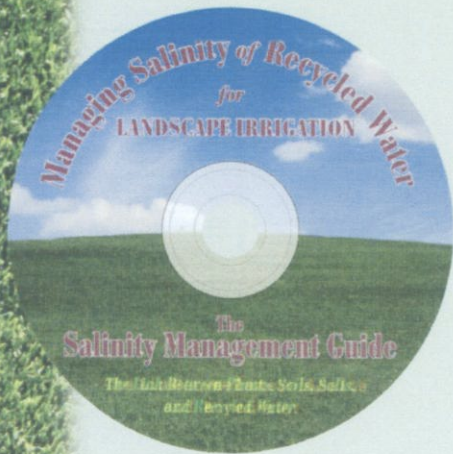
options such as selecting a more salt-tolerant plant for the landscape, checking water application rates to determine if adequate water

has been used to meet the plant's needs, or changing the water application method from one type of sprinkler to another to avoid salt damage to foliage.

It is the only CD database of its kind that provides information on the effects of water quality on plants, soils, and water application systems.



Recycled water on golf courses is increasingly common. Located in La Jolla, California, Torrey Pines Golf Course offers two of the most picturesque championship 18-hole golf courses in the world.



The Salinity Management Guide CD was funded by the following organizations:

Bureau of Reclamation
Denver, Colorado
www.usbr.gov/pmts/water/

City of Cerritos
Cerritos, California
www.ci.cerritos.ca.us

Southern California Salinity Coalition
Fountain Valley, California
www.socal.salinity.org

West Basin Municipal Water District
Carson, California
www.westbasin.com

California Department of Water Resources
Sacramento, California
www.water.ca.gov

Los Angeles Department of Water and Power
Los Angeles, California
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Water Replenishment District of Southern California
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www.nwri-usa.org

WaterReuse Foundation
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www.watereuse.org

Ordering Information

The Salinity Management Guide CD can be ordered from the WaterReuse Foundation:
www.watereuse.org | (703) 548-0830