Technical Bulletin for the Safe Application of Reclaimed Water in the Southwest

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Abstract

Reclaimed wastewater irrigation is well-accepted in in the south-western United States. While this practice has many benefits, possibilities for plant injuries, change in soil properties, and environmental degradation due to high levels of salinity, toxic ions and chemicals in reclaimed water must be addressed. A technical bulletin was put forth by the Southwest States and Pacific Islands Regional Water Program and the UC Center for Water Resources to provide up-to-date knowledge about (1) federal and state regulations and guidelines on water reuse; (2) physical, chemical, and biological characteristics of reclaimed wastewaters; and (3) safe application of wastewater for landscape and agriculture.

Water Reuse in the Southwest

➢ Wastewater Reuse Opportunities

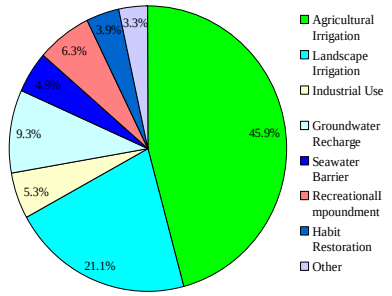
- **Urban use**: Irrigation of golf courses and parks.
- **Agricultural Irrigation**: Irrigation for non-food crops and crops grown for human consumption.
- **Recreational/environmental enhancement**: Decorative ponds and lakes; constructed or natural wetlands; augmenting stream flows; lakes used for swimming and water-skiing or fishing and boating.
- **Industrial use**: Cooling system water; air conditioners; boiler feed; construction.
- **Groundwater recharge**: Using infiltration basins, percolation ponds, or injection wells.
- **Augmentation of potable supplies**: Direct use to augment drinking water supply following high levels of treatment; indirect use after passing through the natural environment.

➢ Annual Water Reuse in the Southwest

California: 525,462 acre-feet (2003)

Arizona: 242,600 acre-feet (2003)

Nevada: 24,000 acre-feet (2004)



Water reuse in California

Federal and State Regulation and Guidelines on Wastewater Reuse

➢Federal Jurisdiction

- No federal level statute specifically covers the use of recycled water.
- Relevant programs under the Clean Water Act
  - Industrial Wastewater Pretreatment Program
  - National Pollutant Discharge Elimination System (NPDES) Program.

➢State Water Reuse Regulations

Reclaimed Water Quality and Treatment Requirements

Use Category	Parameter	Arizona	California	Nevada
• Unrestricted Urban Reuse • Agricultural Reuse--Food Crops • Unrestricted Recreational Reuse[1]	Treatment level	Secondary treatment, filtration, and disinfection	Oxidized, coagulated, filtered, and disinfected	Secondary treatment and disinfection
	BOD_5 (mg/l)			30
	Turbidity (NTU)	Average 2 and maximum 5	Average 2 and maximum 5	
	Fecal Coliforn (NPM/100 ml)	Maximum 23		▪ Average 2.2 and maximum 23[2] ▪ Average 200 and maximum 400[3]
	Total Coliform (NPM/100 ml)		Average 2.2 and 30-day maximum 23	
• Restricted Urban Reuse • Non-food Crop Irrigation • Restricted Recreational Reuse	Treatment level	Secondary treatment and disinfection	Secondary – 23, oxidized, and disinfected	Secondary treatment and disinfection
	BOD_5 (mg/l)			30
	Fecal Coliform (NPM/100 ml)	Average 200 and maximum 800		▪ Average 23 and maximum 240[6] ▪ Average 200 and maximum 400[7]
	Total Coliform (NPM/100 ml)		▪ Average 23 and 30-day maximum 240[4] ▪ Average 2.2 and 30-day maximum 23[5]	

[1]Unrestricted recreational reuse is not regulated by Arizona;
[2]Apply to unrestricted urban reuse and unrestricted recreational reuse;
[3]Apply to agricultural reuse - food crops;
[4]Apply to restricted urban reuse and agricultural reuse--non-food crops;
[5]Restricted recreational reuse;
[6]Restricted urban and recreational reuses;
[7]Agricultural reuse – nonfood crops

Physical, Chemical, and Biological Characteristics of Reclaimed Wastewaters

➢Reclaimed Wastewater Quality Characteristics

Some constituents of concern:

- **Salinity**: Total Dissolved Solids (TDS) or electrical conductivity (EC) - excessive salinity may affect crop growth through nutrient deficiencies due to high pH; toxicity of certain ions, limit plant uptake of water.
- **Sodicity**: Assessed by Sodium Adsorption Ratio (SAR). It reflects the relative concentrations of Na, Ca and Mg. Increasing SAR can cause soil permeability problems.
- **Toxic Ions**: Ions of boron, chloride and sodium are toxic to some crops.
- **Nutrients**: N and P in reclaimed water are beneficial to plants but may cause nutrient imbalances, eutrophication of surface waters, and contamination of groundwater.
- **Chlorine Residues**: Excessive available chlorine may cause leaf-tip burn and damage sensitive crops.
- **Disinfection Byproducts**: May cause cancers with long term exposure.
- **Pathogens**: Communicable diseases can be transmitted by pathogens in reclaimed water.
- **Pharmaceutically-active Chemicals and Endocrine Disruptors:** Potential for eco-toxicological consequences.
- **pH:** Affects metal solubility and alkalinity of soils.
- **Biodegradable Organics:** BOD, COD or TOC - can cause aesthetic and nuisance problems, adversely affect disinfection processes, and deplete soil oxygen.
- **Stable (Refractory) Organics**. Organic compounds resistant to degradation during conventional treatment, may be toxic in the environment; may accumulate in soils.

Reclaimed Wastewater Applications for Agriculture and Landscape

➢Safeguards for Designing a Reuse Project

- Assure reclaimed water meets water quality standards for intended uses;
- Build up seasonal storage as necessary;
- Mark or color-code the piping, valves, and hydrants;
- Install back flow prevention devices and air gap separation to prevent cross-connection between reclaimed and potable water systems;
- Bury effluent distribution lines at least 1 ft deeper than domestic water lines and operate at a lower pressure differential, in case a dual distribution system is created.

Mason Regional Park in Irvine, CA has used tertiary treated wastewater for irrigation and feeding the lake since the 1970s.

➢Strategies for Successful Use of Reclaimed Wastewater

- Use application methods and equipment that improve irrigation efficiency and soil salinity control, and minimize public health risks.
- Consider plant tolerance to salinity and boron in landscaping designs.
- Use chemical amendments (i.e. gypsum, lime, sulfur, and organic matter) to modulate nutrient availability, SAR and pH of receiving soils.
- Use buffer zones to reduce runoff where low-quality reclaimed water (secondary treatment or lower) is used.
- Blend with lower SAR or lower TDS water sources, if necessary and feasible, through seasonal use of alternate sources of water or real-time blending with such water.
- Balance fertilization application by accounting for nutrients present in the reclaimed water.
- Provide an adequate leaching fraction and good drainage.