

# Using recycled water for strawberry production

## Overview

Recycled water is available in nearly all Australian states for horticultural production. Recycled water irrigation schemes offer a number of benefits, including:

- Providing an alternative source or supplement to conventional irrigation water
- Adding valuable nutrients
- Providing an alternative sustainable use for the community
- Security for investment where water is scarce.

There are four classifications of recycled water which must be approved and endorsed by Environment Protection Authorities and health departments, prior to local water authorities making it available to the community, industry and agricultural enterprises.

The four classifications are: A, B, C and D, which are based on the level of treatment and water quality.

**Class A recycled water:** Class A is the highest rating for recycled water used for irrigation and is equal to the most stringent guidelines worldwide. Australian standards for Class A recycled water exceed those recommended by the World Health Organisation for irrigation of food crops.

State Departments of Human Service and Environmental Protection Authorities (or the equivalent) set these strict guidelines to ensure the safety of producers irrigating with recycled water, as well as the produce grown with recycled water.

**Class B recycled water:** Class B recycled water may be used to irrigate sports fields, golf courses and dairy cattle grazing land. It can also be used for industrial wash down as well as for the uses listed for Classes C and D, but has restrictions around human contact.

**Class C recycled water:** Class C may be used for a number of uses including for cooked or processed human food crops including wine grapes and olives. It can also be used for livestock grazing and fodder and for human food crops grown over a meter above the ground and eaten raw such as apples, pears, table grapes and cherries. It can be used by councils for specific purposes but there are restrictions around human contact.

**Class D recycled water:** Class D has received the least amount of treatment of all four classes and may be only used for non-food crops such as instant turf, woodlots and flowers.

Strawberries can only be irrigated with Class A recycled water.



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A summary of the recycled water (also known as reclaimed water) classes and acceptable uses in horticulture crops is outlined in Table 1.

**Table 1: Recycled water classes and acceptable uses in horticulture crops**

REUSE CATEGORY	MINIMUM WATER CLASS	IRRIGATION METHOD	KEY MANAGEMENT CONTROLS FOR USE E.G. WITHHOLDING PERIOD
<b>Raw human food crops exposed to reclaimed water</b>			
Crops grown close to the ground and consumed raw (such as strawberries)	Class A	Unrestricted	
Root crops consumed raw (such as carrots, onions, radish)	Class A	Unrestricted	
<b>Human food crops cooked (&gt; 70°C for 2 minutes) or processed before human consumption, or consumed raw but with edible parts not exposed to reclaimed water</b>			
Crops which are skinned, peeled or shelled before consumption (such as corn, peas, pumpkin, garlic, potato)	Class A Class C	Unrestricted Flood, furrow, drip, sub-surface	Produce should not be wet from reclaimed water irrigation when harvested Dropped produce not to be harvested
<b>Non food crops</b>			
Crops not for consumption (e.g. woodlots, turf growing, flowers)	Class D	Unrestricted	Restrict public access to application area. Harvested products not to be wet from reclaimed water when sold

Source: Use of Reclaimed Water EPA Victoria

The required reclaimed water grade for irrigation of human food crops (detailed in Table 1) depends on the potential for the edible portion of the crop to come into direct contact with the reclaimed water. This reflects both the irrigation method (such as spray, drip, flood, subsurface, or hydroponic systems), the crop involved (that is, whether the produce is grown in contact with the soil, or the produce has a protective and inedible covering), and the level of processing or cooking of the food prior to consumption.

## Guidelines for recycled water

Extensive guidelines for use of recycled water have been developed and enforced by Environmental Protection Authorities and health departments in most states of Australia. These departments provide the endorsements, guidelines and regulations concerning the use, environmental impact, food quality and safety of recycled irrigation water.

This guarantees a particular water class has the appropriate water quality parameters to fit the purpose the water is intended to be used for, such as irrigating horticultural crops. The guidelines ensure the microbiological and chemical safety of recycled water, and the quality of food and vegetable crops grown with it.

Guidelines specify the minimum water quality treatment objectives. Minimum objectives per water quality class are summarised in Table 2.

**Table 2: Water quality objectives and agricultural uses per class**

CLASS	WATER QUALITY OBJECTIVES	RANGE OF AGRICULTURAL USES - USES INCLUDE ALL LOWER CLASS USES
A	< 10 E coli org/100mL Turbidity < 2 NTU pH 6 - 9	Human food crops consumed raw
B	< 100 E coli org/100mL < 30mg/L suspended solids pH 6 - 9	Dairy and cattle grazing
C	< 1000 E coli org/100mL < 30mg/L suspended solids pH 6 - 9	Human food crops cooked/processed, grazing/fodder for livestock
D	< 10000 E coli org/100mL < 30mg/L suspended solids pH 6 - 9	Non-food crops including instant turf, woodlots, flowers

Source: Use of Reclaimed Water EPA Victoria

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## Potential issues with recycled water

Recycled water often has elevated salts and nutrients compared to conventional irrigation water. This can be helpful (through addition of extra nutrients) or can create potential issues such as increased soil salinity due to excessive sodium or chloride.

### Salinity

Recycled water often has higher salinity levels e.g. sodium and chloride than surface or groundwater sourced irrigation water. It is important to remember that the salinity levels of recycled water must suit the crop grown, soil irrigated and the irrigation equipment used.

The presence of chloride will impact on yield even at very low levels. Chloride levels in water provided by drip irrigation should not exceed 145 mg/L.

High salinity in the water and soil can affect the ability of plants to extract water from the soil, especially in stressful conditions such as high temperatures. Recycled water may need to be shandied (mixed) with alternatively sourced irrigation water to reduce salt concentration.

Strawberries are very sensitive to salts.

Table 3 identifies the level at which salinity parameters can create issues. High salinity parameters in recycled water used to irrigate strawberries may affect soil health and the growth, production and quality of crops.

**Table 3: Water quality and nutrient thresholds for strawberries**

ANALYTE	PROBLEM ARISES
pH (water)	> 8.2
Chloride mg/L (using drip irrigation)	> 145
Electricity Conductivity $\mu\text{S}/\text{cm}$	> 700
Total Dissolved Solids (TDS) mg/L	> 450
Sodium mg/L (using drip irrigation)	> 70
Boron mg/L	> 0.75
Sodium Adsorption Ratio (SAR)	> 3

Source: Haifa

### pH

A high water pH can reduce the ability of plants to absorb certain nutrients, such as zinc, iron, manganese, or expose plants to greater risk of toxicity from specific ions, particularly sodium, boron and aluminum.



### Sodicity

Sodicity refers to the amount of sodium in the water or soil. This is usually measured in soil as the Exchangeable Sodium Percentage (ESP), which is the proportion of sodium as a percentage of all the exchange cations (such as calcium, magnesium, potassium).

The sodicity of water is measured as the Sodium Adsorption Ratio (SAR). In strawberry crops the SAR should not exceed 3 as this could lead to foliar damage or sodicity in the soil where soil structure and drainage issues may arise. To reduce high levels of sodium in soils gypsum applications are often used.

### Boron

Higher concentrations of boron are often found in recycled water compared with bore and surface irrigation water. Strawberries should not be irrigated with water that has a boron concentration higher than 0.75 mg/L.

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## Nutrients

High levels of nutrients can be inadvertently applied when irrigating with recycled water. The amount depends on the source of the recycled water, treatment process (e.g. if nitrogen and phosphorus are removed) and amount of recycled water irrigated per crop. Table 4 shows a quick way of calculating the nutrients applied via irrigation water. If, for example, the irrigation water contains 10 mg/L of nitrogen and 5 mm of water is applied, then the amount of nitrogen applied to the soil is 0.5 kg/ha.

**Table 4: Nutrient applied (kg/ha) in irrigation water (mm) of different nutrient concentration (mg/L) (note: mg/L = ppm)**

WATER APPLIED (mm)	CONCENTRATION OF NUTRIENT IN WATER (MG/L)				
	1	5	10	15	20
1	0.01	0.05	0.10	0.15	0.20
5	0.05	0.25	0.50	0.75	1.00
10	0.10	0.50	1.00	1.50	2.00

Source: Good Practice Guide 2007 vegetablesWA

## Further information

Each local water authority that supplies recycled water for irrigation of horticulture crops offers a monthly analysis rundown of the water quality which is available on their web site or from their office.

Further information is available through Environmental Protection Authority or your local water authority/supplier.



## Resources

- Using Recycled Water in Horticulture: A growers Guide 2006 DPI Victoria  
<http://www.recycledwater.com.au/uploads/File/documents/Growers%20Guide%20web.pdf>
- Guidelines for Environmental Assurance. Horticulture for Tomorrow. 2nd Edition 2014 Chapter 2 Water Management, Horticulture Australia Limited  
<http://hoho3216.staging-cloud.netregistry.net/manage/wp-content/uploads/2014/04/EAG-2014-Chapter-2-Water-management.pdf>
- Australian Guidelines for Water Recycling: Managing Health and Environmental Risks (Phase 1) 2006  
<http://www.agriculture.gov.au/water/quality/nwqms/nwqms-australian-guidelines-water-recycling-managing-health-phase1>

## References

- EPA Guidelines for Environmental Management; Disinfection of Reclaimed Water, 2003, Publication 730.1
- EPA Guidelines for Environmental Management, Use of Reclaimed Water, Publication 464.2
- Southern Rural Water, Soil Health – Recycled Water Fact sheet
- Ward, AS, Advisory Bulletin Water Quality Assessment for Irrigation, NSW Department of Agriculture
- Vegnotes, Irrigating Vegetable Crops with Recycled Water, 2004, Horticulture Australia Limited
- Good Practice Guide. Nutrient Management, 2007, vegetablesWA
- Haifa, 2014, “Strawberry crop guide: special sensitivities of strawberries”