

**Secondary Nutrient Removal:  
ANOXIC TANK 2**

Anoxic Tank 2 is designed to reduce nitrogen level and is only mechanically mixed, not aerated. The autotrophic bacteria further consume all the remaining available oxygen from the nitrate, thus reducing the total nitrogen discharged to those approaching the lowest levels achieved anywhere in the world.

**SUBMERGED MEMBRANE  
FILTRATION**

This is the next and most advanced step in the wastewater treatment process. The submerged membrane tanks operate with very high solids levels (range 15—20,000 mg/L), well above the levels of a normal activated sludge system. The size of the pores in the submerged membrane are 0.1 microns. Sludge is held in this system for 30 days and the bio-flora growth on the membrane will enhance the membrane performance to less than 0.1 microns.

The bio-flora is kept to a fine film by the scouring action of air and activated sludge flowing upwards past the membrane. The treated wastewater passes through 1120m<sup>2</sup> of membrane plates. This permeate (wastewater treated by the membrane process) is then chlorinated and stored in a one million litre tank.

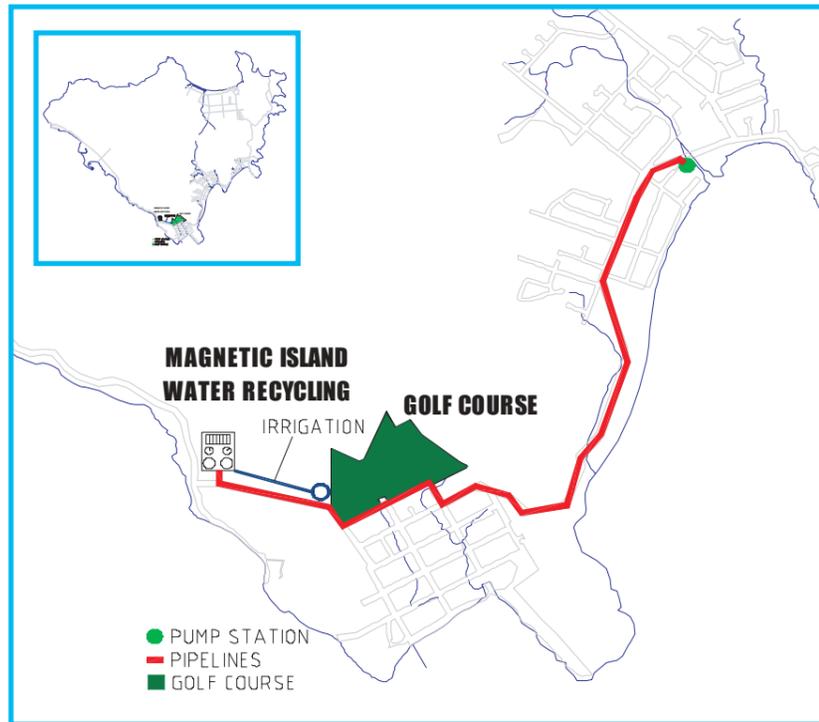
**REUSE / RECYCLE**

The high quality wastewater produced in this treatment plant is a valuable resource and is then pumped to the Magnetic Island Golf Course, for irrigation purposes. At the golf course, this permeate is pumped to an operational tank and then to an irrigation system that was installed using the latest technology in effluent application and computerised control.

Treating the wastewater produced in Magnetic Island to world's best standards and recycling it for irrigation purposes at the golf course has many advantages:

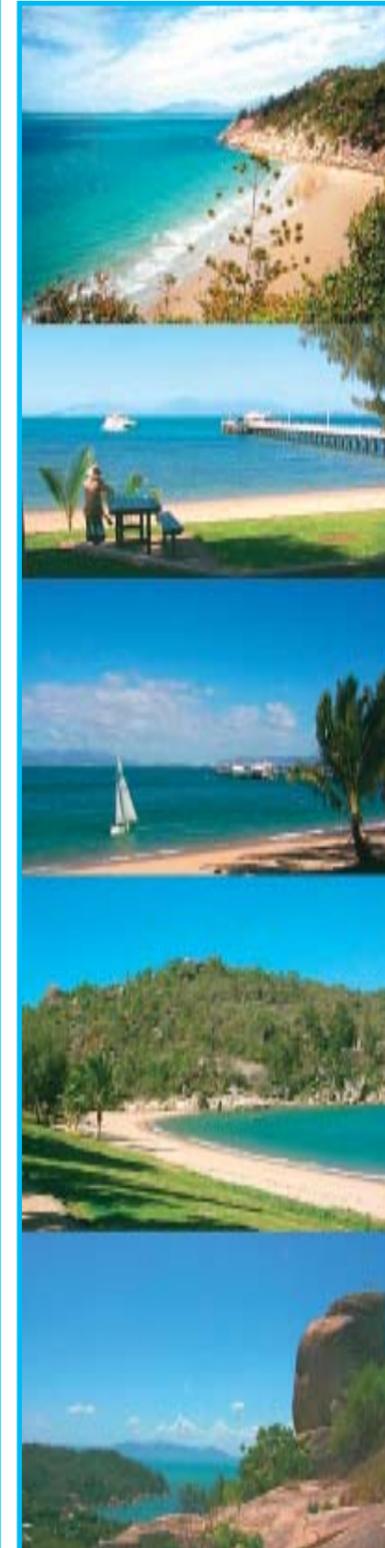
- it enhances the use and presentation of the golf course,
- it conserves fresh treated water that is delivered to Magnetic Island
- it avoids an ocean outfall discharge, thus maintaining the health of the Marine Park.

Citiwater is committed to evaluate and adopt alternatives that are ecologically sustainable, socially responsible and economically feasible. Construction of the MIWR and the recycling of wastewater demonstrate Citiwater's commitment to the principles of sustainable development and protection of our natural environment.



**CITIWATER**  
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*Magnetic Island Water Recycling*



Magnetic Island is located 8km north from the Townsville mainland. The island is surrounded by the waters of the Great Barrier Reef Marine Park and is World Heritage listed. Most of the island is National Park. Four urbanised bays are suburbs of Townsville from which residents can commute to the mainland for work and school.

Magnetic Island does not have its own water source and residents are predominantly dependent on water supplied from mainland Townsville. Treated water is supplied through a 375mm diameter high density poly ethylene (HDPE) submarine pipeline that extends for 5.6km from Pallarenda on the mainland to Bolger Bay reservoir. From Bolger Bay reservoir, water is distributed to other reservoirs on the island and finally to the island's properties. Fresh water, on the island, is also used to irrigate the Magnetic Island Golf Course. In order to reduce fresh water consumption and to avoid an ocean outfall, the recycling of treated wastewater for irrigation purposes became a sustainable and responsible option.

**MAGNETIC ISLAND WATER  
RECYCLING**

Magnetic Island Water Recycling (MIWR) is the new wastewater treatment facility. MIWR incorporates a Kubota membrane biological reactor (bioreactor) which removes nitrogen, phosphorus and solids at a high level. The bioreactor filters out very small particles that would not be removed in conventional treatment. The Kubota process uses simple flat sheet membrane panels housed in glass reinforced plastic (GRP) cases and is aerated by a coarse bubble diffuse system below each case. The bioreactor combines conventional biological treatment with membrane separation.

The membrane separates wastewater from the mixed liquor by submerging the membranes in the biological reactor. The processes occur in significantly less space than conventional treatment. They also produce lower sludge and a substantially better wastewater quality. Carbon and nitrogen are removed by the activated sludge process in conjunction with nitrification and denitrification processes. Phosphorus is removed by biological treatment and chemical dosing. The level of nitrogen and phosphorus is reduced to lowest levels possible. This is world's best practice.

Most of the treated wastewater will be used to irrigate the Magnetic Island Golf Course. Construction of the MIWR cost approximately seven million dollars. An additional five hundred thousand dollars were spent to provide irrigation infrastructure from MIWR to the golf course.

Wastewater from this plant travels through various stages of treatment that includes primary treatment, secondary nutrient removal, submerged membrane filtration, chemical disinfection and sludge removal. The plant also has a balance tank for emergencies and pollution control. These processes are all controlled by state-of-the-art computerised systems. In addition there is a laboratory on site to test the quality of the wastewater.



*Kubota Flat Sheet Membrane Panels*

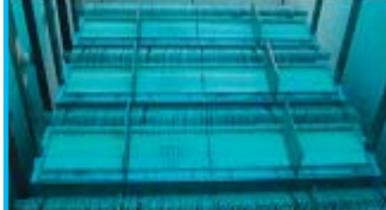


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## PRIMARY TREATMENT

Wastewater entering MIWR flows through a screen where any solids above 3mm in size are removed. Removing solids from the wastewater is the first step needed in order to protect mechanical equipment of downstream systems.

The wastewater then moves on to a grit removal system where diffused air is used to separate grit particles from the

wastewater. Diffused air separation is where small air bubbles are injected into the wastewater to separate oils, grits and greases.

Oils and greases float to the surface and these are skimmed off into a hopper which are then transported off site for treatment.

## BALANCE TANK

The balance tank is used when the flow to the plant becomes greater than five times the average dry weather flow. A flow-controlled valve is closed slowly as the flow to the plant increases forcing primary treated wastewater into the balance tank.

As the flow decreases to the plant, balance tank pumps lift the stored wastewater back into the plant as the flow control valve opens. This reduces and balances the hydraulic loading through the plant.

## Secondary Nutrient Removal: ANOXIC TANK 1

Anoxic (no air) Tank 1 receives primary treated wastewater and recycled activated sludge from the aerobic tank downstream.

Anoxic Tank 1 is continually mixed by mechanical mixers. Autotrophic bacteria are produced in this tank by using the oxygen from nitrate and this process

reduces nitrogen (a nutrient) levels. Excess nitrogen is often responsible for causing algae blooms around Australian rivers and coasts.

## Secondary Nutrient Removal: AEROBIC TANK 2

The activated sludge travels to Aerobic (contains oxygen) Tank 2 where dissolved oxygen (DO) is supplied to this tank by three variable frequency drive (VFD) blowers. DO levels are controlled by computer. DO is the concentration of oxygen in the wastewater and is measured in milligrams per litre (mg/L).

Measuring and maintaining the levels of DO is an important activity. It ensures the activity of the heterotrophic and autotrophic bacteria that help to reduce organic compounds and nutrients (such as ammonia, nitrate and phosphorus) resulting in a cleaner wastewater.

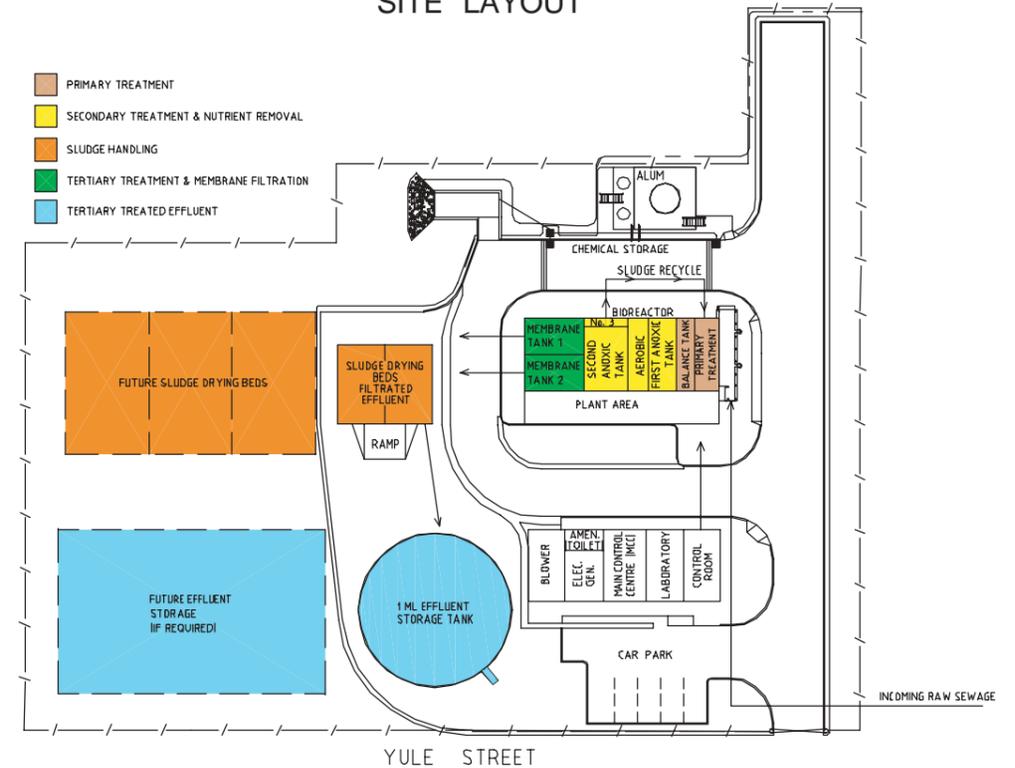
Excess phosphorus is reduced by the dosing of aluminium sulphate. Low pH levels can be corrected by caustic dosing. Protozoan and more advanced form life are present and they feed on the heterotrophic and autotrophic bacteria. This process reduces pollutant load of the raw wastewater, which results in a cleaner wastewater.

## FINAL WASTEWATER CHARACTERISTICS

Parameter	Effluent Quality Requirements	Unit
BOD <sub>5</sub>	< 5	mg/L
Suspended Solids	< 5	mg/L
Ammonia	1	mg/L
Total Nitrogen	3	mg/L
Total Phosphorus	0.1	mg/L
pH	6.5 – 8.0	-
Turbidity	2	NTU
Faecal Coliforms	5	Unit per 100 ml

NTU = Nephelometric Turbidity Unit  
BOD = Biochemical Oxygen Demand mg/L = Milligram per Litre

## MAGNETIC ISLAND WATER RECYCLING SITE LAYOUT



## MAGNETIC ISLAND WATER RECYCLING FLOW DIAGRAM

