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Tweed Shire Council

# Memorial Gardens
# Recycled Water Management Plan

June 2008

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| **Quality Assurance Statement** | |
|---|---|
| Tweed Shire Council<br>**Memorial Gardens**<br>**Recycled Water Management Plan** | **Prepared by:**<br>B Arrowsmith<br>**Reviewed by:**<br>Natarsha Woods |
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| **Revision Schedule** | | | | | |
|---|---|---|---|---|---|
| Rev. No | Date | Description | Prepared by | Reviewed by | Approved by |
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**Tweed Shire Council**

**Memorial Gardens**
**Recycled Water Management Plan**

## Contents

## Appendices



## List of Tables



## List of Figures

# 1 INTRODUCTION

## 1.1 SITE IDENTIFICATION

This Recycled Water Management Plan (RWMP) covers the site known as Memorial Gardens located at Tweed Heads South. Property description and related details for the subject land is as follows:

**Table 1 Lot Description**

| Lot Number | D.P | Zone | Tenure | Shire |
|---|---|---|---|---|
| 7067 | 1053029 | 5(a) Special Uses | Cemetery | Tweed |

The land is owned by Tweed Shire Council, used as a cemetery and is zoned 5(a) Special Uses under the Local Environmental Plan.

## 1.2 SITE AND LOCALITY OVERVIEW

Memorial Gardens is located at the end of Sunshine Street, Tweed Heads South, NSW. The Memorial Gardens are surrounded by large bush buffer zones, except in the South East corner where an open buffer zone with high embankment exists separating the Memorial Gardens from the nearby residential area. It provides peaceful and attractive surroundings for remembrance of the decreased.

The Tweed Heads Crematorium and Memorial Gardens are public space. However access is restricted at night times with high security fencing and via a locked security gate. This agrees with the use of above ground irrigation at night time with the requirements of a 4 hour drying period before the gate is re-opened. As the opening hours of the memorial gardens are between 0730 and 1800 hours, above ground irrigation can occur anytime between 1800 and 0330.

Geotechnical, groundwater and an acid sulphate soil assessment by Butler Partners Pty Ltd 2007 were carried out to determine the suitability for receiving recycled water. In brief, the soil parameters indicated some limiting factors for recycled water irrigation. However, MEDLI modelling (Modelling for Recycled Water Disposal Using Land Irrigation) analysing the risks associated with the application of recycled water to the site by MWH in 2007 determined that:

- Irrigation is sustainable in the short term (up to ten years) for all application rates, and an application rate of up to 10 ML/year is recommended as sustainable for Memorial Gardens

Irrigation application methods and scheduling were considered as part of the initial concept design of the site. This Recycled Water Management Plan (RWMP) incorporates management controls for the use of sprinkler irrigation on the memorial gardens and its potential impacts on surrounding bush, waterways and residential areas.

## KEY SITE FEATURES


| | |
|---|---|
| **Recycled Water Use Purposes** | *Memorial Gardens* |
| **Existing Water Sources (Potable, Bore, Other)** | *Potable*<br>*Not existing irrigation system* |
| **Total Property Area (Ha)** | |
| **Recycled Water Irrigation Area (Ha)** | *2.0 Ha* |
| **Maximum Irrigation Requirement / Annum in Average Climate Year (ML)** | *10 ML/annum* |
| **Average Daily Recycled Water Use (mm/day) December** | *1.84 ML/month 2.96mm/day* |
| **Average Daily Recycled Water Use (mm/day) June** | *0.63 ML/month 10.7 mm/day* |
| **Recycled Water Watering Times** | *1800 to 0330* |
| **Peak Flows (l/s)** | *12 l/s* |
| **Method(s) of Irrigation** | *Surface Spray* |
| **Soil Profile/Types (topsoil & subsoil)** | *Billinudgel (bi) and Kingscliff variant (kib).* |
| **Adjacent Sensitive Land Uses** | *The Memorial Gardens are surrounded by large bush buffer zones, except in the South East corner where an open buffer zone with high embankment exists separating the Memorial Gardens from the nearby residential area.* |
| **Drainage Outlets & Nearest Surface Waters (name & buffer distance)** | *Surface drainage to Terranora Creek 500m away* |
| **Public Access (Hrs of Opening)** | Between 0730 and 1800 hours |

# 2 THE RECYCLED WATER MANAGEMENT PLAN

The following guidelines were used to develop this Recycled Water Management Plan (RWMP):

- NSW Department of Environmental and Conservation (2004) *Environmental Guidelines: Use of Effluent by Irrigation*
- National Resource Management Ministerial Council, Environmental Protection and Heritage Council, and Australian Health Ministers Conference (2006) *National Water Quality Management Strategy: Australian Guidelines for Water Recycling – Managing Health and Environmental Risks (Phase 1)*
- ANZECC The Australian and New Zealand Environment Conservation Council *(2000) Australian and New Zealand Guidelines for Fresh and Marine Water Quality*
- National Health and Medical Research Council (2004). *Australian Drinking Water Guidelines* 6. Chapter 3
- AS/NZS 3500-2003 Plumbing and Drainage Code

This RWMP covers the management of the recycled water from the point of reception at the site to the point of distribution of the recycled water across the fields by sprinklers. However, to ensure the quality of the water received at the site is meeting all licensing and regulatory requirements a complete recycled water system analysis is provided within this plan. Environmental, occupational health and safety risks and public health risks are also addressed.

This is a dynamic document, allowing for continual improvement with increased knowledge and experience.

## 2.1 COMMITMENT TO RESPONSIBLE USE AND MANAGEMENT OF RECYCLED WATER QUALITY

Tweed Shire Council (TSC) aims to maximise recycled water use and replace current potable water irrigation uses on Public Open Space.

The NSW Department of Environment and Conservation (DEC) encourages substituting recycled water for potable water wherever it can be substituted for a purpose which is acceptable.

Tweed Shire Council's commitment includes:

- Commitment to responsible use of recycled water, and the application of a risk management approach
- Recognition and compliance with relevant regulations and other requirements
- Communication and partnership arrangements with agencies with relevant expertise, and with users of recycled water
- Communication and engagement with employees, contractors, stakeholders and the public
- Intention to adopt best-practice management and a multiple-barrier approach
- Continuous improvement in managing the treatment and use of recycled water

### 2.1.1 REGULATORY AND FORMAL REQUIREMENTS

**Banora Point Wastewater Treatment Plant**

Under Schedule 1 of the *Protection of the Environment Operations Act 1997* the Banora Point WWTP is listed as a NSW Environmental Protection Agency (EPA) licensed activity No.1411 "processing by small plants (<10 000 ML per year) Licence (Appendix A).

**Irrigation System**

Council sought approval from the NSW Department of Environment and Climate Change incorporating the Environmental Protection Agency for the irrigation of Class C recycled water on the Memorial Gardens. The irrigation system is approved and licensed under the existing Banora Point (Appendix A).

### 2.1.2 MANAGEMENT ORGANISATIONAL STRUCTURE AND RESPONSIBILITY

The management of the recycled water assets are shared between two TSC business units as follows:

**Table 2 Business Unit and Management Responsibilities**

| BUSINESS UNIT | MANAGEMENT RESPONSIBILITIES |
|---|---|
| **Water Unit** | To supply recycled water suitable for irrigation, maintain and operate recycled water transport system including external to irrigation site recycled water storage tank |
| **Recreation Services Unit** | To maintain and operate the irrigation network system |

The organisational structure with names and positions of personnel, together with their roles and responsibilities is provided in Table 2.1.2 and Table 2.1.3.

**Table 3 Water Unit Organisational Structure and Responsibilities**

| POSITION | INCUMBENT | ROLES AND RESPONBILITIES |
|---|---|---|
| **Manager Water** | David Oxenham | Responsible to Council for the sustained public health of the community through the provision of recycled water facilities. |
| **Operations Engineer** | Peter Haywood | Responsible to the Manager Water to ensure that the Memorial Gardens is implemented and maintained and to ensure that the Environment Protection Licence framework of these facilities is met. |
| **Site Manager** | Gary Pain<br>Green Keeper and Parks Foreman | Responsible to the Operations Engineer for the operation of the recycled water supply in an environmentally responsible manner and to ensure that the RWMP framework is met. |
| **Water Quality Monitoring Supervisor** | Bill Millar<br>Qualified Plumber | Responsible to the Memorial Gardens Site Manager to ensure all controls, monitoring, operation reporting, maintenance, incident reporting and corrective action are carried out. |

The Operations Engineer is responsible to ensure that the RWMP is implemented and maintained including the updating of the organizational structure outlining resources, roles, responsibility and authority.

**Table 4 Recreational Services Unit Organisational Structure and Responsibilities**

| POSITION | INCUMBENT | ROLES AND RESPONBILITIES |
|---|---|---|
| **Manager Recreation Services** | Stewart Brawley | Responsible to Council for the sustained public health of the community through the provision of recreational facilities. |
| **Memorial Gardens Site Manager**<br>**(Irrigation Overseer)** | | Responsible to the Manager Recreation Services for the operation of the irrigation supply in an environmentally responsible manner and to ensure that the RWMP framework is met. |
| **Irrigation Technicians** | Maintenance Workers | Responsible to the Memorial Gardens Site Manager to ensure all irrigation controls, monitoring, operation reporting, maintenance, incident reporting and corrective action are carried out. |

### 2.1.3 ENVIRONMENTAL MANAGEMENT TRAINING

Tweed Shire Council shall ensure that any persons(s) performing tasks for it or on its behalf that have the potential to cause a significant environmental impact(s) identified by the organization is (are) competent on the basis of appropriate education, training or experience, and shall retain associated records.

The Memorial Gardens Site Manager, Irrigation Manager and Irrigation Technician have completed the training as shown in **Error! Reference source not found.**, which is relevant to the operations and maintenance of the sprinkler system using recycled water.

**Table 5 Qualifications and Training of Staff for Operations and Maintenance of Memorial Gardens Recycled Water Irrigation System**

| Qualifications | Site Manager | Irrigation Manager | Irrigation Technician |
|---|---|---|---|
| | yyyy | yyyy | yyyy |
| | yyyy | yyyy | yyyy |
| | yyyy | yyyy | yyyy |
| | yyyy | yyyy | yyyy |
| | yyyy | yyyy | yyyy |
| **Training** | | | |
| Site Induction | yyyy | yyyy | yyyy |
| Familiarisation with RWMP | yyyy | yyyy | yyyy |
| Environmental Emergencies Response | yyyy | yyyy | yyyy |

Note: All site employees and subcontractors are to be made aware of the Environmental Training Register (Appendix F).

## 2.2 ASSESSMENT OF THE RECYCLED WATER SYSTEM

### 2.2.1 SOURCE OF RECYCLED WATER AND INTENDED USE

The quality of recycled water produced by Banora Point STP like any other STP is subject to variable water quality from time to time. Therefore, there is need for a safe usage and management plan.

## 2.2.2 RECYCLED WATER SYSTEM ANALYSIS

The Memorial Gardens Recycled Water Irrigation System includes the following specifications:

- Recycled water is delivered to the Tweed Heads Memorial Gardens storage tank from the Banora Point Sewage Treatment Plant (STP)
- The storage tank is filled by tapping into the existing outfall main upstream of the online booster pumps and its level is controlled by a level control valve and probe
- The irrigation pump is used to reticulate recycled water to Arkinstall Park and Memorial Gardens but on different schedules (no pump nor irrigation at present)
- The system operates when the outfall main from Banora Point is operating to ensure that the tank can be refilled for the next irrigation event / activity
- Irrigation takes place in the evening and will not be undertaken in case of a power failure.

A brief overview of the Memorial Gardens irrigation system and associated infrastructure is provided in Figure 2.1. with design parameters outlined within Appendix J.

## 2.2.3 ASSESSMENT OF WATER QUALITY DATA

**Banora Point STP Recycled Water Quality**

Banora Point STP strives to produce recycled water to a quality that when used, as a minimum complies with those parameters of the *NSW Environmental Guidelines for Use of Effluent By Irrigation (2004)* considered relevant to the nature of its receivable, treatment and/or distribution operations. These guidelines compliment other guidelines such as the ANZECC *(2000) Australian and New Zealand Guidelines for Fresh and Marine Water Quality.* Current licence load limiting applied to the Banora Point STP is outlined in Table 2.2.1 below.

**Table 6 Banora Point STP Current Licence Load Limiting**

| Parameter | Units | 90th Percentile Concentration | 100th Percentile Concentration |
|---|---|---|---|
| **Requirements for environmental discharge (to Terranora Inlet)** | | | |
| Volume Limit | ML | n/a | n/a |
| Biological Oxygen Demand | mg/L | 15 | 35 |
| Total Suspended Solids | mg/L | 20 | 40 |
| Oil & Grease | mg/L | | 10 |
| Faecal coliforms | cfu/100mL | | 10 000 |
| pH | - | | Range 6.5 to 8.5 |

An analysis of the quality of recycled water from Banora Point STP found that the “Classification of Effluent for Environmental Management” of the ‘DEC (NSW) Environmental Guidelines: Use of Effluent by Irrigation’ classifies the recycled water produced by the Banora Point STP as low strength. Water quality data (from years 2002 and 2005) are compared against the NSW DEC ‘Low Strength’ classification in Table 2.2.2

**Table 7 Comparison of Banora Point STP Water Quality and NSW DEC Classification**

| Constituent | Low Classification (NSW DEC) (average concentration mg/L) | Banora Point STP Recycled Water Aug 2002- Nov 2005 (average concentration mg/L) | | | | |
|---|---|---|---|---|---|---|
| | | Low | Mean | High | 50%ile | 90%ile |
| Total nitrogen | <50 | 1.1 | 5.3 | 13.8 | 5.4 | 5.8 |
| Total phosphorus | <10 | 0.40 | 4.74 | 25.45 | 4.64 | 6.2 |
| $BOD_5$ | <40 | 0.5 | 3..7 | 42 | 2.1 | 4.46 |
| TDS | <600 | | | | | |
| Grease and Oil | < 1,500 | 0.1 | 2.9 | 18.2 | 2 | 6.8 |
| Thermotolerant coilforms | | | | | | |
| - municipal uncontrolled access | <10 | | | | | |
| - municipal control access | <1,000 | 1 | 2758 | 1102,000 | 10 | 944 |
| - agricultural non-food (turf) | <10,000 | | | | | |

NB: The above constituents were the only measures that enabled direct comparison with the Guideline.

Sprinkler irrigation scheduled during the evening with controlled access, removes the risk of contact with human population making the recommended recycled water quality for irrigation of turf as municipal control the most relevant guide. The recommendation is for thermotolerant coliform levels of less that 1,000 cuf/100ml[4] which corresponds with the Banora Point Treatment Plant licence level. Exceedances were related to wet weather flows which will be avoided by the practise of not irrigating during wet weather nor when wet weather is imminent.


**Figure 2.1 Memorial Gardens Recycled Water Irrigation Scheme and Associated Infrastructure**

## 2.3 HAZARD IDENTIFICATION AND RISK ASSESSMENT

### 2.3.1 ASSESSMENT METHOD

The following summarised hazard identification and risk assessment methodology was used to minimise risk associated with the use of recycled water to irrigate the Memorial Gardens:

- Hazard identification and risk assessment considering both public health, ecological health and Occupational Health & Safety.
- Identification and documentation of the hazards and hazardous events for each component of the recycled water system.
- Estimation of the level of risk for each identified hazard or hazardous event.
- Determination of significant risks and document priorities for risk management
- Evaluate the major sources of uncertainty associated with each hazard and hazardous event consider actions to reduce uncertainty
- Periodical review and updating of the hazard identification and risk assessment to incorporate any changes

### 2.3.2 ACTIVITY IDENTIFICATION AND RISK ASSESSMENT

A preliminary hazard identification and risk assessment was undertaken prior to the commencement of the construction and operation of the irrigation system (See Appendix G Activity Risk Assessment and Control Table). Risk assessment categories were obtained from the National Health and Medical Research Council, Australian Drinking Water Guidelines 6, 2004; Chapter 3. This hazard identification process also aims to cover all OH&S considerations associated with the process both during the construction and he operational phases.

#### 2.3.2.1 Identified Activities

1. Activation of the Banora Point STP pump to fill the Memorial Gardens storage tank
2. The Memorial Gardens recycled water storage tank
3. Irrigation system pump station
4. Filtration risk level
5. The computerised irrigation control system
6. Distribution of recycled water risk
7. Hazard signage
8. Document control
9. Roles and responsibilities
10. Emergency preparedness
11. Personnel training

2.3.2.2 Human Health

Hazard identification and risk assessment for human health found the following:

| Human Health Hazard Identification and Risk Assessment |
|---|
| **Activation of the Banora Point STP pump to fill the Memorial Gardens Storage Tank** |
| • Water quality not in accordance with quality assurance limits |
| Memorial Gardens Storage Tank |
| • Water quality not in accordance with quality assurance limits |
| • Inappropriate recreational activity at the tank or surrounding areas by patrons or trespassers |
| **Memorial Gardens Park Irrigation System and technical expertise** |
| • Excessive pressure leading to system leakages and potential human exposure |
| • The Memorial Gardens staff arrive after the system has operated and are not alerted to observe the sprinkler system in operation and any obvious risks |
| • Inadequate staff training regarding safe practices in recycled water reuse facilities |
| **Recycled Water Public Health Distribution Risks** |
| • Humans may be exposed to recycled water through direct contact, accidental ingestion, handling recycled water contaminated objects, or through the inhalation of aerosols |
| • Cross connection of potable and recycled water supplies |
| • Confusion as to source water from taps |
| **Public perception and requirements** |
| • Missing signs in areas of potential human contact and for areas of 'no go' |

2.3.2.3 Environmental Performance

Hazard identification and risk assessment for the environment found the following:

| Environmental Hazard Identification and Risk Assessment |
|---|
| **Banora Point STP Recycled Water Supply to Site** |
| • Water quality not in accordance with quality assurance limits |
| • Leakage to the environment of supply pipe from STP to the storage tank |
| **Memorial Gardens Storage Tank** |
| • System failure and storage tank levels overflowing |
| • Water quality not in accordance with quality assurance limits |
| • Odours from low dissolved oxygen conditions |
| • Blooms of harmful algal species |
| • Contamination of groundwater |
| **Memorial Gardens Irrigation System and technical expertise** |
| • Excessive pressure leading to system leakages |
| • Inadequate staff training regarding safe practices in recycled water reuse facilities |

**Recycled Water Environmental Distribution Risks – Environmental Risks**

- Surrounding water bodies may be polluted by excessive application created by inappropriate irrigation practices and water movement by run-off from hills on site.
- Erosion may occur from excessive or prolonged application of irrigation on slopes
- Ponding of recycled water may occur in certain areas
- There may be leakage of recycled water from the irrigation system pipe work to ground water
- There is the possibility that the continued use of recycled water may have an adverse impact on soil condition or plant life (e.g. salinity or pH problems and/or excess nutrients in soil).
- Failure to deliver irrigation water as per selected irrigation regime resulting in poor maintenance of turf and gardens, increasing the risk of erosion, and run-off
- Surface water runoff entering nearby water body i.e. eutrophication
- Surface water ponding during irrigation and during periods of rainfall
- Effect of the recycled water infiltration on any specific native species grown in the municipal area
- Effect of any aquatic or terrestrial biota within the vicinity of the site

## 2.3.3 PREVENTATIVE MEASURES FOR RECYCLED WATER MANAGEMENT

### 2.3.3.1 Human Health

Preventative measures to manage risk to human health include:

| Human Health Preventative Measures |
|---|
| **Activation of the Banora Point STP pump to fill the Memorial Gardens Storage Tank** |
| • Banora Point Plant supervisor to inform irrigation manager of any exceedences in water quality. This includes licence exeedance and faecal coliform readings of higher than 1,000 cfu/100ml4. |
| **Memorial Gardens Storage Tank** |
| • Irrigation Manager to visually inspect storage tank daily as precaution and to test with NTU meter every 3 months. |
| • Irrigation Manager to report to Banora Point STP an NTU level greater than 5 |
| **Memorial Gardens Irrigation System and technical expertise** |
| • All site employees and subcontractors to be aware of this RWMP |
| • All staff receive timely awareness training regarding safe practices in recycled water reuse facilities with training details noted on the employees file |
| • In order to see any obvious issues with the irrigation system, the irrigation manager is to check controller reporting and to test the system monthly |
| **Recycled Water Public Health Distribution Risks** |
| • Any plumbing connecting work to be carried out at the Memorial Gardens must be carried out by a licensed plumber and receive the approval of the Site Manager. |
| • All new line and fittings carrying recycled water must be colour coded (lilac is the standard colour) and have written identification |
| • The irrigations system is to be activated at a convenient time in the evening. As the site is secured with no public access during the evening, the system is able to operate between 1800 and 0330 hours without any issues of contact with the general public. |
| • Usage under windy conditions is automatically managed or avoided. Fencing and buffer zones of the irrigated area will be inspected at least monthly to ensure the risk of exposure to outside parties has not increased. |
| **Public perception and requirements** |
| • No irrigation is carried out in the presence of the public |
| • Irrigation occurs only on areas clearly identified as using Recycled Water for irrigation |
| • There is signage throughout the grounds advising that recycled water is in use |

### 2.3.3.2 Environmental Performance

Preventative measures to manage risks to the environment include:

| Environmental Preventative Measures |
|---|
| **Activation of the Banora Point STP pump to fill the Memorial Gardens Storage Tank** |
| • To maintain water quality assurance the Banora Point Plant supervisor is to inform irrigation manager of any exceedences in water quality. This includes licence exceedance and faecal coliform readings of higher than 1,000 cfu/100ml4. |
| • To avoid overflow the Banora Point STP pump shuts down on level control valve activated by probe. Manual isolation valve prior to tank. |

| Environmental Preventative Measures |
|---|

**Memorial Gardens Storage Tank**

- Irrigation Manager to visually inspect storage tank daily as precaution and to test with NTU meter every 3 months.
- Irrigation Manager to report to Banora Point STP an NTU level greater than 5 in the storage tank
- Maintain freeboard in tank by use of a level probe to mitigate against overflow
- To prevent groundwater contamination the tank is lined
- Algal management plan to incorporate a one off dose disinfection by chlorination according to visual inspection and NTU>5
- Storage covered to prevent algal growth
- Adequate ventilation

**Memorial Gardens Irrigation System and technical expertise**

- The system is fitted with pipes and fittings installed to relevant Australian Standards and by certified installation contractors.
- Pressure switches installed to automatically shut down at pressures above 700 kpa (adjustable)
- From time to time the irrigation pipe lines may leak and it is important to detect and repair any leak as soon as possible, i.e. within 24 hours of reporting to minimise groundwater contamination. The irrigation controller is linked to a water meter and it can report abnormal flows which will trigger an alarm.

**Recycled Water Environmental Distribution Risks – Environmental Risks**

- In order to minimise the ponding of recycled water, sprinkler run times are set to avoid saturation and subsequent ponding.
- Sprinkler precipitation rates do not exceed the ability of the soil to absorb the recycled water in most locations, thereby avoiding ponding and erosion from run-off. However on the top of hills, sprinkler precipitation rate may exceed infiltration rates of the shallow soils which overlay heavier soils and irrigation run times must be limited and or utilize a 'cycle and soak' approach to these areas to avoid saturation, ponding and run-off and subsequent erosion.
- Irrigation with recycled water does not occur when rainfall is imminent or during rain events. The irrigation program is automatically suspended and rescheduled to suit the site.
- The irrigation system can operate under mild wind conditions. However in the event the prevailing wind speeds exceed 10 km/hr, a 'wind click' or anemometer will suspend the irrigation controller. Once winds drop, the system will resume, with the controller re-starting the pump.
- Tweed Shire Council to monitor the condition of surrounding waterways and have the task to investigate elevated nutrient levels or change sin the biological profile of waterways
- Installation of soil moisture probes to shut off irrigation system at a set soil moisture level/depth
- Visual inspection by site staff for any ponding
- Irrigation Manager to inspect the system for malfunction. The irrigation computer will display alarm messages in the event of abnormal irrigation flows.
- Fertiliser application reduced to account for nutrients in water
- Fertiliser application determined by soil/leaf testing

## 2.3.4 CRITICAL CONTROL POINTS

A critical control point is defined as an activity, procedure or process where control can be applied, and that is essential for preventing hazards that represent high risks or reducing them to acceptable levels. Identification of critical control points is system specific, being based on knowledge of potential hazards and associated risks, and preventive measures.

A preliminary hazard identification and risk assessment including preventative measures was undertaken prior to the commencement of the construction and operation of the irrigation system (See Appendix G Activity Risk Assessment and Control Table).

The following questions were asked for each hazard identified as representing a moderate to very high risk and requiring removal or reduced exposure to assure supply of safe recycled water.

| | | |
|---|---|---|
| Q1. Do preventative measures exist to reduce the hazard/risk to an acceptable level? | **No →** | Identify preventative measure |
| **YES** ↓ | | |
| Q2. Is the preventative measure specifically designed to substantially reduce the risk presented by the hazard? | **No →** | Not a critical control point |
| **YES** ↓ | | |
| Q3. Can operation of the preventative measure be monitored and corrective actions be applied in a timely fashion? | **No →** | Not a critical control point |
| **YES** ↓ | | |
| Q4. Would failure of the preventative measure lead to immediate corrective action or possible cessation of supply? | **No →** | Not a critical control point |
| **YES** ↓ | | |
| **Critical Control Point** | | |

The key critical control points of the entire Memorial Gardens Recycled Water Irrigation System include:

**Critical Control Points**

**Activation of the Banora Point STP pump to fill the Memorial Gardens Storage Tank**

- Level probe setting 200mm below overflow with alarm activation on 100mm level
- Banora Point STP water quality test criteria
- Correlation between incoming recycled water and outgoing irrigation volumes, taking into consideration un-used volume in on-site storage. Meter readings recorded by irrigation computer. Flow variation greater than 10%.

**Memorial Gardens Storage Tank**

- Any alteration and or damage to componentry by behaviour
- Public nuisance complaint
- Turbidity levels greater than 5 NTU
- Piezometer and sampling of ground water indicate salinity greater than 1400ppm
- Leakage causing ponding which exceeds bunding height limit of 150mm
- Pump shut down automatically pressures above 700 kpa
- Failure of sensors, controls, no water in tank

**Filtration**

| Critical Control Points |
|---|

- Activation of filter cleaning not occurring when pressure differential >50 kpa
- Major component failure and/or flush valve failure leading to run-off

The Computerised Irrigation Control System

- Soil moisture monitoring indicates soil moisture levels at less than 50% of soil Total Available Water Capacity (TAWC)

**Distribution of Recycled Water**

- Anemometer shut-off of distribution for wind speed >10 km/h
- Low pressure shut-off set to 500 kpa at pump such that if pressure at AP boundary falls below 390 kpa – shutoff
- When EC exceeds 780 micro siemens per cm
- Water component levels which are outside the moderate parameters for impact. Not a key critical control unless two or more parameters exceed limits.
- Turf browning off out of season, exposed soil surface, compaction (difficult for shovel to penetrate, EC tests > 2 dS/m)
- System flow rates drop by move than 10% of nominal or corresponding system pressure change according to pump curve that is above nominal at pump for the irrigation shift
- Signage missing for more than two days

| Supporting Programs |
|---|

**Document Control**

- Inability to provide latest version of documents, and follow trail

Roles and Responsibilities

- Copies of checklist and reports not signed off within one week

Emergency Preparedness

- Conflict of responsibilities

**Personnel Training**

- Inability to cope within an appropriate time frame
- Emergency due to lack of training and/or preventative action

## 2.4 OPERATIONAL PROCEDURES AND PROCESS CONTROL

### 2.4.1 OPERATIONAL PROCEDURES

Even short periods of sudden change and suboptimal performance in a recycled water supply system can represent a serious risk to public health or the environment. Therefore, it is vital to ensure that all operations are optimised and continuously controlled, and that preventative measures are functional at all times.

Operational procedures identified and documented for all processes and activities for the irrigation system and the implementation of this RWMP include:

- Procedure RW - 1 - Recycled Water Supply to Site
- Procedure RW - 2 - Recycled Water Storage Tank
- Procedure RW - 3 - Recycled Water Irrigation Pump Station
- Procedure RW - 4 - Distribution of Recycled Water

- Procedure RW - 5 - Irrigation Planning and Scheduling
- Procedure RW - 6 - Environmental Impact of Activity - Air Quality
- Procedure RW - 7- Environmental Impact of Activity - Noise Control
- Procedure RW - 8 - Environmental Impact of Activity - Erosion Control
- Procedure RW - 9 - Environmental Impact of Activity - Site Contamination
    - Prevention of contamination of groundwater
    - Prevention of contamination of surface water
    - Prevention of contamination of soils
- Procedure RW - 10 - Emergency Contacts and Response
- Procedure RW - 11 - Environmental Management Checklists and Reporting
- Procedure RW - 12 - Document Control

All Operation Procedures 1 - 12 incorporating monitoring and corrective actions where required are documented and included within Appendix I of this RWMP.

## 2.4.2 OPERATIONAL MONITORING

### 2.4.2.1 WATER QUALITY MONITORING

**Banora Point Sewage Treatment Plant**

To minimise risks to water quality and safety, Banora Point STP has a monitoring system that provides 24-hour feedback on plant performance. Banora Point STP recycled water is unfiltered and as such all recycled water can contain various pathogens in various amounts from time to time. This is partly because unfiltered recycled water contains particles that are large enough and plentiful enough to shield pathogens from disinfectant damage. Additionally, unfiltered recycled water is also capable of containing chlorine resistant pathogens. Information on the day-to-day quality of the recycled water leaving the plant is available by from the Plant Supervisor on a daily basis. The 'DEC (NSW) Environmental Guidelines: Use of Effluent by Irrigation' recommends the monitoring of recycled water as outlined in Table 2.4.1

**Table 8 Banora Point Sewage Treatment Plant Monitoring Parameters**

| Recycled Water Parameter | Recommended Monitoring or Control | Comment |
|---|---|---|
| pH | Monthly | Sampled daily at STP |
| SS | Monthly | Sampled daily at STP |
| Thermotolerant coilforms | Weekly | Sampled daily at STP |
| Disinfection system[6] | Daily | Sampled daily at STP |

Note: Disinfection systems refer to chlorination, ultraviolet irradiation or other disinfection systems. Monitoring requirements may include checking chlorine residual or operational checking of UV equipment. Monitoring frequency for pond and lagoon systems will be site-specific and dependent on factors such as detention time.

The following parameters, as identified in Table 2.8, should be monitored on a periodic basis as specified.

**Table 9 Memorial Gardens Storage Tank Monitoring Parameters**

| Parameter | Frequency |
|---|---|
| Total and available N | Monthly |
| Total and available P | Monthly |
| Electrical conductivity | Monthly |
| Exchange cations | Monthly |

| | |
|---|---|
| Chloride | Monthly |
| Chemical contaminants | Monthly for anything which is specific and a possibility, otherwise quarterly |
| Visual inspection for algal growth | Weekly, especially during the algal bloom periods of late March/April and Sept/October |
| Turbidity (NTU) | Monthly, the seasonal nature of algal blooms may require a weekly test if the monthly test indicates increasing turbidity |

#### 2.4.2.2 IRRIGATION SYSTEM AND ASSOCIATED MONITORING REQUIREMENTS

Monitoring of the water and soils associated with the irrigation of the Memorial Gardens is required to provide advance warning in the event of a developing problem due to the accumulation of nutrients in the soil profile and the pollution of the surface, or groundwater.

The following monitoring regimes are recommended for the recycled water irrigation system and associated components:

**Table 10 Recycled Water Irrigation System Monitoring Parameters**

| Parameter | Frequency |
|---|---|
| Ponding | Daily |
| Adequate Irrigation | Daily |
| Correct Schedule | Weekly |
| Valve Operation | Monthly |
| Filter Screen | Monthly |
| Pump operation | Monthly |
| Isolation Valve operation | Quarterly |
| Rain Switch | Monthly |
| Anemometer | Monthly |

**Table 11 Soil Monitoring Parameters**

| Parameter | Frequency |
|---|---|
| pH | Annually |
| Total and available P | Annually |
| Electrical conductivity | Annually |
| Exchange cations | Annually |
| Chloride | Annually |

**Table 12 Groundwater Monitoring Parameters**

| Parameter | Frequency |
|---|---|
| Total and available N | 6 monthly |

| | |
|---|---|
| Total and available P | 6 monthly |
| Electrical conductivity | 6 monthly |
| Exchange cations | 6 monthly |

**Table 13 Turf (leaf foliage) Monitoring Parameters**

| Parameter | Frequency |
|---|---|
| Total N | Quarterly |
| Total P | Quarterly |
| Visual inspection of the health of playing fields | Daily |

Phosphorus is a nutrient which could accumulate in the reuse site soils. Given that the level of phosphorous in the recycled water is lower than the uptake levels of the turf, it is quite likely that additional phosphorous may need to be applied as fertilizer for plant health. Where the above monitoring program shows an increased accumulation of phosphorus, remedial action is required to reduce the fertilizer application rate.

## 2.4.3 OPERATIONAL CORRECTIVE ACTION

### 2.4.3.1 Human Health

In relation to human health, corrective actions include the following:

| Human Health Corrective Actions |
|---|
| If biochemical oxygen demand (BOD) exceeds 40mg/L or total, dissolved solids (TDS) exceed 600mg/L the performance of the plant is to be investigated and problems rectified. |
| If thermotolerant coliform levels above 10,000 cuf/100ml[4] exceeding the 90$^{th}$ percentile the performance of the plant is to be investigated and problems rectified. |
| Irrigation system to stop until detected faults repaired. |
| Non-compliance with critical limits could result in irrigation being stopped or a requirement for installation of a disinfection system |
| Non-compliance with irrigation times rectified by maintenance and repair of timing mechanisms |

### 2.4.3.2 Environmental Performance

In relation to the environment, corrective actions include the following:

| Environmental Performance Corrective Actions |
|---|
| If TDS increased above 600mg/L, cause should be investigated and rectified |
| If piezometer and sampling of ground water indicate salinity greater than 1400ppm, cause should be investigated and rectified |
| Water meter readings correlation outside accepted (+/-5%) range for tank supply, cause should be investigated and rectified |
| Soil moisture monitoring indicates soil moisture levels at less than 50% of soil Total Available Water Capacity (TAWC), cause should be investigated and rectified |
| Wetting front moves below 400mm, cause should be investigated and rectified |
| Water test is EC greater than 780 µS/cm, cause should be investigated and rectified |
| If inspections reveal faults in irrigation procedures, remedial action is implemented |

If inspections identify poor performance or health of plants and grass, causes should be investigated.

Non-compliance with critical limits could result in irrigation being stopped

## 2.5 RECYCLED WATER MANAGEMENT PLAN EVALUATION

Internal environmental evaluation of the procedures outlined in this RWMP associated with the operations of the Memorial Gardens Recycled Water Irrigation System shall be undertaken annually by the Memorial Gardens Site Manager to ensure that the objectives of this RWMP are upheld. The scope of the evaluation will be to verify the completeness of the following actions as provided in Table 2.9.1.

**Table 14 Scope of Environmental Evaluation**

| DESCRIPTION | FUNCTION | REFERENCE |
|---|---|---|
| Environmental Management Structure | To ensure that the roles and responsibilities of the listed personnel are being met. | |
| Annual, Exception and Performance Reporting | The timely submission of reports to the Banora Pt STP Operations Engineer | |
| Level and Applicability of Skills of Personnel | Particular attention to the recognition of any skill-gaps and training needs. | |
| Emergency Contacts | The accuracy of details and contact numbers. | |
| Environmental Schedules | Execution of relevant checklists reports and registers. | |
| Relevance of Operating Procedures | Update operating procedures according to lessons learnt through implementation | |
| RWMP Audit | Continuous improvement through monitoring and non-conformance reports | |

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