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Tweed Shire Council

Arkinstall Park
Recycled Water Management Plan

June 2008

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Quality Assurance Statement	
Tweed Shire Council **Arkinstall Park** **Recycled Water Management Plan**	**Prepared by:** B Arrowsmith **Reviewed by:** Natarsha Woods
Project Manager: Mark Hunting	**Approved for issue by:**

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Tweed Shire Council

Arkinstall Park
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 Arkinstall Park located at Tweed Heads South. Property description and related details for the subject land is described in Table 1-1.

Table 1-1 Lot Description

Lot Number	D.P	Zone	Tenure	Shire
296	755740	6(a) Open Space	Community Land	Tweed
1	780163	6(a) Open Space	Community Land	Tweed

This Community Land is owned by Tweed Shire Council and is zoned 6(a) Open Space under the Local Environmental Plan.

1.2 SITE AND LOCALITY OVERVIEW

Arkinstall Park is located on the corner of Cunningham and Oxley Roads, Tweed Heads South, NSW. The site provides a popular community amenity and includes playing fields and open space parkland. The site is surrounded by residential areas without vegetated buffer zones or security fencing. Previously the site was irrigated with potable water on the football field.

Geotechnical, groundwater and acid sulphate soil assessments were carried out by Butler Partners to determine the suitability of the site to receive recycled water. Summarising the report, the soil parameters indicated some limiting factors for recycled water irrigation. MEDLI (Modelling Effluent Disposal Using Land Irrigation) modelling, undertaken by MWH, analysed the risks associated with the application of recycled water to the site and determined that:

- Irrigation is sustainable in the short term (up to ten years) for all application rates (up to 190 ML/annum) and an application rate of up to 120 ML/year is recommended as sustainable for Arkinstall Park

Subsurface drip-irrigation is the recommended method of irrigation, due to the lack of security fencing, absence of vegetated buffer zones and spray drift from surface sprinkler systems at the site.

1.3 KEY SITE FEATURES

The following site features are listed in Table 1-2

Table 1-2 Site Characteristics

Recycled Water Use Purposes	*Sport and Recreational Fields – (Grass)*
Total Property Area (Ha)	*11.6*
Recycled Water Irrigation Area (Ha)	*6.17 ha*
Maximum Irrigation Requirement per annum in Average Climate Year (ML)	*120*
Average Daily Recycled Water Use (mm/day) December	*4.44 ML (2.52mm/day)*
Average Daily Recycled Water Use (mm/day) June	*1.6 ML (0.87mm/day)*
Preferred Watering Times	*Evening*
Peak Flows (l/s)	*7.13 l/s (with 39 rows of 2.35 l/h dripline)*
Method(s) of Irrigation	*Subsurface Drip Irrigation*
Soil Profile/Types (topsoil & subsoil)	*Billinudgel (bi) and Kingscliff variant (kib).*
Adjacent Sensitive Land Uses	*Residential to the North and South Sides. Schools to the East and West.*
Nearest Surface Waters (name & buffer distance)	*Drainage outlet along the full length of the south side boundary to Terranora Inlet – Ukerebagh Passage.*
Public Access (Hrs of Opening)	*Unrestricted 24 hours.*

2 THE RECYCLED WATER MANAGEMENT PLAN

The following guidelines were used to develop this RWMP.

- NSW Department of Environmental and Climate Change (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 recycled water from the point of reception at the site to the point of distribution across the fields by use of subsurface drip irrigation. 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 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 Climate Change (DECC) 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 the use of more than one preventive measure as a barrier against hazards (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).The Licence conditions are provided in 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 Arkinstall Park. The irrigation system is approved and licensed under the existing Banora Point Licence (Appendix A).

2.1.2 MANAGEMENT ORGANISATIONAL STRUCTURE AND RESPONSIBILITY

The management of the recycled water assets are shared between two TSC business units and described in Table 2-1.

Table 2-1 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, including names and positions of personnel, together with their roles and responsibilities is provided in Table 2-2 and Table 2-3.

Table 2-2 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 Arkinstall Park is implemented and maintained and to ensure that the Environment Protection Licence framework of these facilities is met.
Arkinstall Park Site Manager	Gary Pain 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 Qualified Plumber	Responsible to the Arkinstall Park Site Manager to ensure all controls, monitoring, operation reporting, maintenance, incident reporting and corrective action are carried out.

The Operations Engineer is responsible for ensuring that the RWMP is implemented and maintained. This includes the updating of the organisational structure and outlining resources, roles, responsibility and authority.

Table 2-3 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.
Arkinstall Park Site Manager (Irrigation Overseer)	Gary Pain Green Keeper and Parks Foreman	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 Arkinstall Park 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 organisation is (are) competent on the basis of appropriate education, training or experience, and shall retain associated records.

The Arkinstall Park Site Manager, Irrigation Manager and Irrigation Technician have completed the training as shown in Table 2-4, which is relevant to the operations and maintenance of the subsurface drip-irrigation system using recycled water.

Table 2-4 Qualifications and Training of Staff for Operations and Maintenance of Arkinstall Park 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 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 Arkinstall Park 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
- Subsurface irrigation takes place twice daily under normal operating conditions and will not be undertaken in case of a power failure.

A brief overview of the Arkinstall Park 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, complies with those parameters in 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 complement other guidelines such as the ANZECC *(2000) Australian and New Zealand Guidelines for Fresh and Marine Water Quality.* Current licence load limits applied to the Banora Point STP are outlined in Table 2-5.

Table 2-5 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 2-6.

Table 2-6 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.

The 'DEC (NSW) Environmental Guidelines: Use of Effluent by Irrigation' recommends that recycled water used to irrigate municipal land with uncontrolled access has thermotolerant coliform levels of less that 10 cuf/100ml. Arkinstall Park has uncontrolled public access. The use of sub surface irrigation removes any contact that the public would have with the recycled water. Irrigation of municipal lands with control public access is recommended to have thermotolerant coliform levels of less that 1,000 cuf/100ml[4]. Recycled water from the Banora Point STP exceeded this level for 10% of samples. Generally, these exceedances were related to wet weather flows.

Subsurface irrigation removes the risk of contact with human population making the recommended recycled water quality for irrigation of turf as a non-food crop the most relevant guide. The recommendation is for thermotolerant coliform levels of less that 10,000 cuf/100ml[4] which corresponds with the Banora Point Treatment Plant licence level. Exceedences were related to wet weather flows which will be avoided by not irrigating during wet weather nor when wet weather is imminent.

Figure 2.1 Arkinstall Park 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 Arkinstall Park:

- 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 is 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

Activities identified as part of the Arkinstall Park Recycled Water Management System include:

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

The hazard identification and risk assessment for human health identified 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 current licence load limits
Memorial Gardens Storage Tank
• Water quality not in accordance with quality assurance limits
Arkinstall Park Irrigation System and technical expertise
• Inappropriate recreational activity at the tank or surrounding areas by patrons or trespassers
Recycled Water Public Health Distribution Risks
• Human exposure to direct contact with recycled water • Accidental ingestion of recycled water • Handling recycled water contaminated objects • 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 current licence load 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 NSW Environmental Guidelines: Use of Effluent by Irrigation • Odours from low dissolved oxygen conditions • Blooms of harmful algal species • Contamination of groundwater
Arkinstall Park Irrigation System and technical expertise
• Excessive pressure leading to system leakages
Recycled Water Environmental Distribution Risks – Environmental Risks
• Contamination of groundwater from over watering, especially with the sandy nature of the soils at Arkinstall Park • Surface water runoff entering nearby water body i.e. eutrophication • Surface water ponding during irrigation an during periods of rainfall • Erosion due to excess application and surface water runoff • Excess nutrients in soil • Impacts on soil conditions and plant life i.e. impact on the species of grass used on the oval associated with site-specific nutrient balances • 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

Arkinstall Park Irrigation System and technical expertise

- All site employees and subcontractors to be aware of this RWMP

Recycled Water Public Health Distribution Risks

- The irrigations system is to be activated at a convenient time in the evening. As the system is sub-surface, the system is able to operate at any time without any issues of contact with the general public or sports players.

Public perception and requirements

- No irrigation is carried out during scheduled use of the playing fields by the public. Irrigation occurs only on areas clearly identified as using Recycled Water for irrigation.

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 it is recommended that the Banora Point Plant supervisor is to inform irrigation manager of any exceedences in water quality. This includes licence exeedance and faecal coliform readings of higher than 1,000 cfu/100ml.
- To avoid overflow the Banora Point STP pump shuts down on a level control valve activated by probe. There is a manual isolation valve prior to the tank.

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

Arkinstall Park 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
- The irrigation system has the following automated operations checks to minimise risks of leakage and unplanned events

Recycled Water Environmental Distribution Risks – Environmental Risks

Environmental Preventative Measures

- Installation of soil moisture probes to shut off irrigation system at a set soil moisture level/depth
- The soils of Arkinstall Park are well drained and therefore it will be important to limit deep percolation by carefully managing irrigation run times and scheduling of irrigations.
- Visual inspection by site staff for any ponding
- Rain switches shut down irrigation if rainfall occurs to prevent 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 (CCP) 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 are 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 Arkinstall Park Recycled Water Irrigation System include:

Critical Control Points
CCP 1: 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%.
CCP 2: Memorial Gardens Storage Tank
• Any alteration and or damage to componentry – i.e. vandalism • 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
CCP 3: Filtration
• Activation of filter cleaning not occurring when pressure differential >50 kpa • Major component failure and/or flush valve failure leading to run-off
CCP 4: The Computerised Irrigation Control System
• Soil moisture monitoring indicates soil moisture levels at less than 50% of soil Total Available Water Capacity (TAWC)
CCP 5: Distribution of Recycled Water

- Rain switch set to match turf evaporation rate to allow controller re-start. Replace with failure of rain switch to shut-off irrigation after 3.5mm of rainfall.
- Irrigation only between 10pm and 6am outside public hours, except for maintenance and testing
- If ingestion occurs, Irrigation Manager advises immediate corrective action
- Wetting front moves below 400mm
- Low pressure shut-off set to 500 kpa at pump such that if pressure at AP boundary falls below 390 kpa – shutoff
- Flow rates >10% above nominal flows
- Pressures in no drain dripline falls to zero
- When EC exceeds 780 micro siemens per cm
- Criteria for water test is EC greater than 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 periodically. 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 2-7.

Table 2-7 Monitoring and Control Requirements for Municipal Reuse with Controlled Public Access

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 2-8 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 Arkinstall Park 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 in Table 2-9 to Table 2-12 are recommended for the recycled water irrigation system and associated components:

Table 2-9 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 2-10 Soil Monitoring Parameters

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

Table 2-11 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 2-12 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 STP is to be investigated and problems rectified.
- If thermotolerant coliform levels above 10,000 cuf/100ml[4] exceeding the 90th 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 Arkinstall Park Recycled Water Irrigation System shall be undertaken annually by the Arkinstall Park 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 2-13.

Table 2-13 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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