

RECYCLED WATER MANANGEMENT PLAN

FOR RED MEAT PROCESSORS

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| PREPARED BY: | Penny Prasad1, Dr. Mike Johns2, Louis Fredheim2, Nicole Price1, Jane Gaffel11. The Ecoefficiency Group Pty Ltd2. Johns Environmental Pty Ltd |
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**Recycled Water Management Plan for Red Meat Processors**

This document is intended to be used as a template to assist red meat processing companies in the preparation of a Recycled Water Management Plan (RWMP). The template has been developed in accordance with the Australian Guidelines for Water Recycling: Managing Health and Environmental Risks (Phase 1) 2006 (NRMMC, 2006) and the Efficient Use of Water in Export Meat Establishments (DAFF, 2008). Development and implementation of an RWMP is intended to ensure the safe use of recycled water and eliminate the potential for contamination of meat product.

This document has been adapted from a template prepared for the Queensland Government (DEWS, 2008) which in turn was prepared based on recommendations from the Australian Guidelines for Water Recycling (AGWR). It has been adapted for use by Australian meat processors.

This document provides a means for Australian red meat processors to record the process of planning and managing their recycled and reuse water system. The RWMP can be utilised for a range of different purposes, including water recycling scheme management, staff training and induction and meeting regulatory requirements.

The format of this document can be tailored to suit the company’s purpose in meeting organisational or other regulatory requirements for water recycling and reuse.

It is important that it is completed in conjunction with relevant state based guidelines as well as Australian export requirements. Note also that this RWMP caters for internal recycling within the same facility. The RWMP does not cover the supply, or distribution of the recycled water to third parties – this typically requires additional work to conform with State legislation and guidelines relating to such use.

This document is supported by the AMPC Guideline for Water Recycling and Reuse (AGWRR) in Red Meat Processing, 2017.

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**Name of company**

**Recycled Water Management Plan**

Date (Month/Year)/ Version

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#  Introduction

This section should describe the context of the RWMP and include relevant background information and a brief summary of the plan.

## Purpose

Describe the purpose and scope of the RWMP including why and by whom the RWMP has been prepared.

## Regulatory background

Identify the regulatory and management framework relevant to the scheme, including the applicable legislation, standards, codes or guidelines that underpin the RWMP.

Note: Refer to Section 1.0 of the Guideline for Water Recycling and Reuse in Red Meat Processing for further information.

## Roles and responsibilities

Identify the persons directly involved in the scheme and their area of responsibility.

|  |
| --- |
| **Example: Introduction**This RWMP has been prepared by Brisbourne Meat Processing Company to meet obligations under the Australian Guidelines for Water Recycling: Managing Health and Environmental Risks (Phase 1) 2006 (NRMMC, 2006) and the Efficient Use of Water in Export Meat Establishments (DAFF, 2008).Wastewater from the meat processing facility is treated to potable standard on-site and utilised at various areas around the factory. Regulatory Framework This RWMP deals with the management of risks to human health arising from use of treated wastewater in meat processing. It incorporates regulatory requirements in accordance with:* Australian Drinking Water Guidelines (Referred to as ADWG) (NHRMC, 2011)
* Australian Guidelines for Water Recycling: Managing Health and Environmental Risks (Phase 1) 2006 (Referred to as AGWR, 2006)
* Australian Guidelines for Water Recycling: Managing Health and Environmental Risks (Phase 2). Augmentation of Drinking Water Supplies. (Referred to as ADWS, 2008) (NRMMC, 2008)
* AQIS Meat Notice: 2006 Efficient Use of Water in Export Meat Establishments
* Export Control (Meat and Meat Products) Orders 2005 (AusGovt, 2005)
* Australian Standards for Hygienic Production and Transportation of Meat and Meat Products for Human Consumption AS 4696:2007 Part 7 Premises, equipment and essential services
 |
|  |  |
| Roles and ResponsibilitiesSite Services Manager* Ensures all treatment equipment, delivery lines, valves and tanks are maintained as per regulation.
* Notifies Quality Assurance Manager of any issues.

Manager Quality & Accreditations * Ensures the planning and performing of the sampling are completed as per schedule.
* Completes method modification, development and validation of new methods.
* Verifies corrective actions implemented have been effective.
* Manages qualification and training programs.
* Regular consultation and reporting to AQIS Plant Supervisor or AQIS Area Technical Manager

Quality Assurance Coordinator (QAC)* Ensures the Quality team are conducting all testing as per schedule.
* Assess the QO team in sample collection to ensure they are following work instructions.

General Manager (GM)* Ensures all processes and procedures are followed.

AQIS On Plant Supervisor* Review any variation to the Approved Arrangement and recommend to the Area Technical Manager for approval if appropriate
* Verify monitoring carried out in accordance with the company’s Approved Arrangement and meets the requirements set out under ‘management responsibilities’ above.
* Check monitoring results weekly
* Following a treatment failure ensure proper disposal of product in accordance with the company’s Approved Arrangement.
* Deal with non-compliances through the Meat Establishment Verification System (MEVS).

Responsible entityBusiness Entity: Brisbourne Meat Processing CompanyABN: 123321Address: 1 Ward Street Brisbourne VIC 3130Phone (business): 03 9814 9814Mobile: 0432 000 000Fax: 07 9814 9814Email: info@brisbournemeat.com.au |

#  Management Commitment

## Endorsement

The RWMP should be signed and endorsed by a suitable management representative.

|  |  |
| --- | --- |
| Company name: |  |
| Scheme name: |  |
| Statement of endorsement: I, <<insert name>> hereby endorse the enclosed recycled water management plan (RWMP) at <<insert name company name and site>>. |
| Endorsed by: | Name |
|  | Position (e.g. CEO) |
|  |  |
|  | Signature Date |

## Nominee contact details

The person (nominee) that will be the primary contact responsible for the RWMP and scheme is:

|  |  |
| --- | --- |
| Name: |  |
| Position: |  |
| Business entity: |  |
| Address: |  |
| Telephone number: |  | Mobile: |  |
| Email address: |  |

## Recycled water policy statement

Include a policy statement that documents the commitment of the organisation's senior management to responsible, safe and sustainable management of recycled water. The policy statement should outline the broad principles that guide the development of more detailed guidelines and procedures for operation and management of the scheme. An example of a recycled water policy statement from the Australian Guidelines for Water Recycling (AGWR) is provided below.

|  |
| --- |
| **Example: Policy for a recycled water scheme**The organisation supports and promotes the responsible use of recycled water and the application of a management approach that consistently meets the Australian Guidelines for Water Recycling, and regulatory requirements.To achieve this we will:*//* ensure that protection of human and environmental health is recognised as being of  paramount importance*//* engage appropriate scientific expertise in developing recycled water schemes*//* use a risk-based approach in which potential threats to water quality are identified and  controlled*//* integrate the needs and expectations of stakeholders, regulators, employees and customers  into planning processes*//* establish regular monitoring of control measures and recycled water quality and establish  effective reporting mechanisms to provide relevant and timely information, and promote  confidence in the recycled water supply and its management*//* develop appropriate contingency planning and incident-response capability*//* continually improve our practices by assessing performance against corporate commitments  and stakeholder expectations.The organisation will implement and maintain recycled water management systems consistent with the Australian Guidelines for Water Recycling to effectively manage the risks to human and environmental health.Signed by responsible officer(s) Dated |

#  Assessment of the recycled water system

This section should provide detailed information and analysis pertaining to the entire recycled water supply scheme, from source to the end use or receiving environment, to enable implementation of appropriate preventive measures for the mitigation of hazards identified within the system.

## Risk assessment team

The risk assessment team, also known as the analysis team or HACCP team, will be primarily responsible for undertaking the hazard identification and risk assessment process, and is also likely to be involved in the development and implementation of various other elements of the RWMP. The members of this team will also form the basis of the team that undertakes ongoing regular reviews of the RWMP. Members should include personnel from operations, quality control, laboratory, maintenance/engineering, management, and external regulators i.e. DAFF. At least one member should have formal risk assessment training or equivalent experience or skills. It is recommended that at least one external expert with knowledge and experience in meat processing, wastewater treatment and reuse be included.

Provide a summary of the risk assessment team members, including their position within the organisation or scheme and their area of expertise or role within the team. Copies or details of relevant qualifications or experience, such as HACCP certification should be attached.

|  |
| --- |
| **Example: Composition of risk assessment team** |
| **Name** | **Position in company** | **Area of expertise** |
| Joe Johnson (Team leader) | Risk Analyst | Risk assessment (HACCP certified)\* |
| Rebecca Rose | Manager - Occupational Health, Safety and Environment  | Project management |
| Graeme Price | Quality Manager | Quality systems and procedures |
| Gale Gilles | Principal Process Engineer | Treatment processes, operations and maintenance |
| Sean Smith | Production Manager | Production, including treatment plant process and operations |
| Dale Davidson | Laboratory supervisor | Laboratory testing, quality assurance |
| Peter Nguyen | Water Quality Officer | Water quality and treatment, quality control |
| Joe Lyon | DAFF Meat Inspector | Meat export requirements |
| Dr Jane Jones | Public Health Officer, Health Department | Public health, virology |
| Michelle Smith | Consultant | Wastewater treatment, risk assessment |
| \* Appendix B contains a copy of the certification for HACCP |

##  Scheme description

The scheme description documents the details and characteristics of the main components of the scheme, which will form the basis for the risk assessment process.

* + 1. Source water characterisation

Include details of the source water characterisation for the scheme. This should include a description of the methodology used to characterise the source water and demonstrate that the methodology used is suitable to identify hazards and variability in the source water.

A short, intensive initial sampling and testing campaign across a wide spectrum of hazards is recommended to assist the risk assessment team to identify the significant hazards and eliminate negligible ones. This keeps costs of the detailed assessment down. Tables 3 & 4, Section 4 in the AMPC Guidelines for Water Recycling and Reuse (GWRR), Section 4 provide background.

High quality monitoring data must be available for all chemical and physical parameters identified as significant hazards in the risk assessment. For microbial hazards, measurements for pertinent microbial indicators suffice since monitoring for specific pathogens is usually prohibitively expensive. Data should cover a reasonable period (preferably a year to account for seasonal influences) and using a reasonable frequency to ensure hazards can be quantified to a high level of certainty. For potable recycling, the minimum data set would comprise 1 year of data for the current facility configuration (i.e. no significant changes to processing or wastewater treatment facilities) preferably at weekly sampling intervals. Care is needed to ensure that the sampling is not biased to one particular day in an operating week – all days must be tested over the period.

For non-potable reuse, the data requirement can be reduced.

The results should be presented including all analyses of data and assessment of temporal and spatial variation. Note that analysis should preferably be undertaken by a National Association of Testing Authorities (NATA) accredited laboratory. Documentation of the methodology should be included e.g. quality assurance (QA)/quality control (QC) procedures.

**Note:** Refer to Section 4 of the Guideline for Water Recycling and Reuse in Red Meat Processing (GWRR) for further information on source water characterisation.

|  |
| --- |
| **Example: Source water characterisation**Characterisation of source water involves analysis of meat processing waste water pre and post treatment. The recycled water scheme uses treated wastewater from the Brisbourne Meat Processing Wastewater Treatment Plant (WWTP). Average treatment volumes range between 1-1.5 ML per day. Source water sampling is undertaken weekly and analysed by the Brisbourne NATA accredited laboratory for the following parameters: |
| * pH
 | * Nitrite/nitrate
 |
| * Suspended solids
 | * TKN
 |
| * COD
 | * Organic N
 |
| * BOD
 | * Total N
 |
| * Ammonia
 | * Total phosphorus
 |
| * Sodium
 | * Calcium
 |
| * Chloride
 | * Magnesium
 |
| * Electrical conductivity
 | * Oil & grease
 |
| * Sulphate
 | * Total alkalinity
 |
| * Silica
 | * Aluminium
 |
| * *E. coli* or thermotolerant coliforms
 |
| Results of weekly source water monitoring are summarised in Table 1 below. **Table 1: Summary of source water monitoring results post wastewater treatment at sampling point W1, January - December 2016** |
| **Parameter** | **No. of samples** | **Minimum** | **Maximum** | **Mean** |
| pH |  |  |  |  |
| Suspended solids |  |  |  |  |
| COD/COD |  |  |  |  |
| Ammonia |  |  |  |  |
| Nitrite/nitrate |  |  |  |  |
| TKN |  |  |  |  |
| Organic N |  |  |  |  |
| Total N |  |  |  |  |
| Total P |  |  |  |  |
| *E. coli* or thermotolerant coliforms |  |  |  |  |

* + 1. Intended end uses

The intent of a risk management approach is to protect human health by ensuring that recycled water supplied is fit for use. Provide a description of the end uses and any receiving environments.

|  |
| --- |
| **Example: Intended end uses**The Brisbourne Meat Processing Company Advanced Wastewater Treatment Plant (AWTP) produces potable quality recycled water that meets standards of the Australian Drinking Water Guidelines (ADWG). Potable quality recycled water is supplied for the following uses as described below:* Initial and final cattle wash
* Carcasse wash
* Boiler feed water
* Condenser feed water
 |

* + 1. System description

This section should contain a description of the Advanced Wastewater Treatment System infrastructure and operation that demonstrates that scheme components are sufficiently well understood and documented to facilitate effective management. A description of the point of supply must be included. This is the point where the final water quality is monitored and must be representative of the water supplied. Document the infrastructure and processes used in the production and supply of the recycled water, including:

* Advanced wastewater treatment system components, including process steps, bypasses, dosing points and inputs to the system
* recycled water storages, including capacity, bypasses and overflow systems
* distribution system, including how and where recycled water is transferred to the process and the control mechanisms in place
* nominated point of supply and documentation demonstrating that the water quality at this point is representative of the quality of water supplied for processing.

**Notes:** Refer to Section 6.2 of the GWRR for a description of a typical AWTP for potable recycling. For additional guidance refer to (DEWS, 2008) and (NRMMC, 2008).

* + 1. Process flow diagram

Information in the system description should be represented in a process flow diagram. Provide a process flow diagram that clearly depicts the recycled water system from entry to the AWTP to end use and enables the nature of the scheme and relationships between components to be easily understood. Figure 1 presents an example for a potable recycling AWTP. This may include a simplified scheme diagram for risk assessment or critical control point identification purposes. An example schematic is provided below as Figure 2.



Figure 1: A typical AWTP process flow diagram for potable recycling



**Figure 2:** Simplified scheme process flow chart showing monitoring points & parameters

* + 1. Operating environment

Include details of operating conditions specific to the scheme, such as:

* irregular patterns of supply and/or demand, such as seasonal shutdowns
* planned stoppages such as during scheduled maintenance
* partnerships or contractual arrangements, or outsourced services
	+ 1. Water quality objectives

This section should identify the recycled water product and the associated water quality objectives, including any required log reduction values (LRV), for each of the intended uses. Evidence should be provided to demonstrate that the proposed water quality is appropriate, and complies with any regulated standards, for the intended uses.

An assessment of relevant existing, or historical data for the scheme should be incorporated if available; for example, data captured via ongoing operational or verification monitoring programs. Control charts can assist in analysing the data to identify trends, abnormal results and any gaps in data. The reliability of the data should also be considered. This provides a characterisation of the quality and variability of recycled water produced by the scheme and may assist in identifying potential hazards and hazardous events that may impact on recycled water quality.

**Note:** Refer to Section 5.0 of the AMPC GWRR for more details.

##  Hazard identification and risk assessment

The RWMP must document the risk assessment process undertaken by the analysis team. The risk management methodology should be clearly documented in this section. This should include conducting an initial induction to ensure that all members of the risk assessment team have a clear and mutual understanding of the process prior to commencing the assessment.

The outcomes of the hazard identification and risk assessment process should be incorporated into a summary table, including the identified hazards and hazardous events, unmitigated and residual risk rankings and control measures. An example of such a table is shown as Table 5 in Section 3.2.2 below. This table includes identification of:

*//* Hazards and Events

*//* Unmitigated Risks

*//* Significant Risks

*//* Uncertainty Levels

*//* Control Measures and Residual Risks.

**Notes:** Refer to Section 4 and 7 of the AMPC GWRR. For additional guidance refer to (DEWS, 2008) and (NRMMC, 2008).

* + 1. Methodology

Document the risk management methodology here. An example risk assessment methodology is shown below which is based on a qualitative risk assessment process using risk matrices from the Australian Guidelines for Water Recycling (NRMMC, 2006) as well as those adapted from (DAFF, 2008) and (DEWS, 2008). Many companies have their own in-house versions of risk matrices and definitions of likelihood and consequence based on risk management standards and these should be used where possible.

Likelihood is defined in terms of a probability that the potential consequences will be experienced (Table 2). Consequences are then rated as ranging between insignificant through to catastrophic (Table 3). These ratings are combined to obtain an overall risk rating (Table 4). The risks are then documented and re-assessed according to the preventive measures as shown in the Example Risk Assessment (Section 3.3.2). Section 4 and 7 of the Guideline provide additional information on the risk management process.

***Table 2: Qualitative measures of likelihood (adapted from DAFF, 2008)***

| **Level** | **Likelihood** | **Probability** | **Description** |
| --- | --- | --- | --- |
| A | Rare | Occurs less than or equal to once every five years | Do not believe will ever happen |
| B | Unlikely | Occurs more often than once every five years and up to once per year | Do not expect to happen |
| C | Possible | Occurs more often than once per year and up to once a month (12/yr) | May occur occasionally |
| D | Likely | Occurs more often than once per month and up to once per week (52/yr) | Will probably occur |
| E | Almost certain | Occurs more often than once per week (52/yr) | Almost certain to occur |

***Table 3: Qualitative measures of consequence or impact (adapted from DAFF, 2008)***

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Level** | **Descriptor** | **Quality/ system failure**  | **Stakeholder confidence & reputation**  | **Financial impact** |
| 1 | Insignificant | − No impact on customer health − Minor non-compliance − Minimal disruption to organisation routine − No long term consequences  | Issue of insignificant stakeholder or customer concern  | < $5,000  |
| 2 | Minor | − No impact on customer health− Single failure to meet internal standards or protocol − Organisational impact rapidly absorbed − No long term consequences  | Issue of minor stakeholder or customer concern  | $5,000 - $50,000  |
| 3 | Moderate | − Minimal impact on customer health − Repeated failure to meet internal standards or follow protocols − Organisational impact absorbed with significant intervention − Minimal long term consequences  | Limited damage to reputation with stakeholders or customers  | $50,000 - $250,000  |
| 4 | Major | − Significant impact on customer health − Failure to meet legislative/professional standards − Organisational impact absorbed with formal intervention by other agencies − Significant long term consequences  | Loss of credibility and confidence in organisation Media interest Significant stakeholder or customer concern  | $250,000 - $1million  |
| 5 | Catastrophic | − Major impact on customer health − Gross failure to meet legislative/professional standards − Organisational impact absorbed with significant formal intervention by other agencies − Major long term consequences  | − Major customer concern − Intervention by stakeholders- Ongoing media interest  | > $1 million  |

***Table 4: Qualitative risk estimation (DEWS, 2008)***

|  |  |
| --- | --- |
| **Likelihood** | **Consequence** |
|  | **1 Insignificant** | **2 Minor** | **3 Moderate** | **4 Major** | **5 Catastrophic** |
| A Rare | Low | Low | Low | High | High |
| B Unlikely | Low | Low | Moderate | High | Very High |
| C Possible | Low | Moderate | High | Very High | Very High |
| D Likely | Low | Moderate | High | Very High | Very High |
| E Almost certain | Low | Moderate | High | Very High | Very High |

* + 1. Example Risk Assessment

The following example is based on a qualitative risk assessment process using risk matrices from the Australian Guidelines for Water Recycling (NRMMC, 2006) and based on the likelihood (L), consequence (C) and risk (R) definitions described above. The example focuses on risks of product contamination and human health from the direct potable reuse of treated wastewater. The identified hazards shown are not exhaustive and give an indication of the output of a risk assessment process.

***Table 5: Example Risk Assessment***

| **ID** | **Source of hazard** | **Hazard or hazardous event** | **Potential impact** | **Unmitigated risk** | **Preventive measures** | **Residual risk** |
| --- | --- | --- | --- | --- | --- | --- |
| **L** | **C** | **R** | **L** | **C** | **R** |
| **1. Example Secondary Treated Meat Processing Wastewater** |
| 1.1 | Wastewater | Bacteria | Illness (chronic or acute) from exposure to contaminated meat or recycled water via end uses | E | 4 | Very high | Microfiltration, Reverse osmosis, final chlorination, user controls (signage, communication, restricted access) | A | 1 | Low |
|  1.2 | Wastewater | Human viruses | Illness (chronic or acute) from exposure to contaminated meat or recycled water via end uses | E | 5 | Very high | Segregation & exclusion of human wastes from process waste, Reverse osmosis, final chlorination, user controls (signage, communication, restricted access) | A | 1 | Low |
| 1.3 | Wastewater | Protozoa and helminths | Illness (chronic or acute) from exposure to contaminated meat or recycled water via end uses | E | 4 | Very high | Microfiltration, Reverse osmosis, user controls (signage, communication, restricted access) | A | 1 | Low |
| 1.8 | Extreme wet weather event | Hydraulic overload of treatment systems | Reduced treatment efficiency | C | 3 | High | Balance tank, emergency bypass | C | 1 | Low |
| **2. Coarse filtration** |
| 2.1 | Filter failure | Gross solids damaging treatment systems | Reduced treatment efficiency | B | 3 | Moderate | Equipment inspection and maintenance, standby filter, emergency bypass | A | 1 | Low |
| **3. Chloramination**  |
| 3.1 | Insufficient dosing of sodium hypochlorite or aqueous ammonia | Bio-fouling of membranes and ineffective disinfection | Reduced treatment efficiency | D | 3 | Moderate | On-line monitoring (NH4, ORP) & dose pump control | B | 2 | Low |
| **4. Microfiltration** |
| 4.1 | Membrane fouling | scaling of membranes (chemical and/or biological) | Reduced flux through membranes | E | 4 | Very High | Effective chloramination, membrane CIP at manufacturer prescribed frequencies, Monitor transmembrane pressure, Online turbidity monitoring of permeate, alarming and manual diversion | B | 2 | Low |
| **5. Reverse Osmosis** |
| 5.1 | Membrane breakthrough | Pathogenic micros,salts | Product water batch that does not meet specification | C | 4 | Very High | Online monitoring of EC and pH, CIP protocols, pressure decay testing, alarming.Routine inspection and maintenance | B | 1 | Low |
| 5.2 | Excessive flux | Reduced performance from overloading of membrane | Reduced treatment efficiency | C | 3 | High | Flow (flux) monitoring post-filtrationTMP monitoring | B | 2 | Low |
| **6. Softening** |
| 6.1 | Inadequate dosing of lime | Corrosive water | Damage to infrastructure | C | 4 | Very High | On-line EC & turbidity monitoring with feedback control to dosing system, off-line tests | B | 1 | Low |
| 6.2 | Inadequate hypochlorite dosing  | Pathogenic micros recolonize water | Illness from exposure to out-of-spec recycled water (staff) or contaminated meat (customers)  | D | 5 | Very high | Online monitoring for pH and ORP for dose control, additional CO2 dosing for pH control  | B | 2 | Low |
| **7. Batch storage and validation** |
| 7.1 | Regrowth of pathogens in storage tanks after extended shutdown | Pathogenic micro | Illness from exposure to contaminated meat or recycled water | C | 3 | High | Tank cleaning and product release procedures adhered to | B | 2 | Low |
| 7.2 | Out of specification batch (e.g. valve leakage) | Pathogenic microsChemical | Illness from exposure to out-of-spec recycled water (staff) or contaminated meat (customers)  | B | 3 | Moderate | Limited access, routine inspection and maintenance of storage, maintain chlorine residual, monitoring of final water quality | B | 2 | Low |

L – Likelihood, C – Consequence, R - risk

##  Identifying critical and quality control points

Appropriate mechanisms must be established for managing control measures that are essential in preventing significant hazards or reducing them to acceptable levels. This includes identification of:

* Critical and quality control points
* Critical limits
* Alert levels

This information is summarised in a table with example shown below. This example table does not contain an exhaustive list of the parameters to be monitored. Alert and critical limit criteria are intended as examples only and actual criteria must be determined for the site specific AWTP.

**Note:**  Refer to Section 8.0 of the Guideline for Water Recycling and Reuse in Red Meat Processing. For additional guidance refer to the Australian Guidelines for Water Recycling (NRMMC, 2006).

**Example Critical and Quality Control Point Identification**

***Critical control points***

To identify Critical Control Points (CCPs) and Quality Control Points (QCPs), each process step within the system was assessed with respect to significant hazards (those with an unmitigated risk of moderate to very high) using the following decision tree adapted from the AGWR (DEWS, 2008). The results of the CCP and QCP identification process are outlined in Table 6.



***Table 6: CCP and QCP identification***

|  |  |  |
| --- | --- | --- |
| **Process step** | **Decision Tree** | **CCP or QCP?** |
| **Q1** | **Q2** | **Q3** | **Q4** |
| 1. Wastewater ex BNR plant | Y | Y | N | N | QCP |
| 2. Coarse filtration | Y | Y | Y | N | QCP |
| 3. Chloramination | Y | Y | Y | N | QCP |
| 4. Microfiltration | Y | Y | Y | Y | CCP |
| 6. Reverse osmosis | Y | Y | Y | Y | CCP |
| 7. Softening | Y | Y | Y | Y | CCP |
| 7. Batch storage (Potable water) | Y | Y | Y | N | QCP |
| 8. End use (Potable water) | Y | Y | Y | Y | CCP |

***Table 7: Monitoring of critical control points – examples only***

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **CCP** | **Parameter monitored** | **Location** | **Alert level** | **Critical limit** | **Corrective actions** |
| Microfiltration | Pressure decay rateTrans-membrane pressureNo. of back flushes per day or week | Membrane units | e.g. PDR >3 kPa/minCompare with supplier recommendations | e.g. PDR >5 kPa/minCompare with supplier recommendations | Inspection and repair in accordance with operational procedures. Breach of CL’s at multiple units will result in shutdown of feed pump to microfiltration units |
| Reverse osmosis | Pressure decay ratePermeate ECNo. CIPs/day | Membrane rack & PLC systemPost RO rackMembrane rack & PLC system | e.g. PDR >3 kPa/min20 µS/cmManufacturer setting | e.g. PDR >5 kPa/min30 µS/cmManufacturer setting | Inspection and repair in accordance with operational procedures. Breach of CL’s at multiple units will result in shutdown of feed pump to product tanks; Institute membrane cleaning |
| Softening | Free chlorine | Post softening | 2.0 mg/L | < 1 mg/L | Automatic feedback to chemical dosing systems to amend the dosing to regain acceptable range |
| Final product storage – prior to end use | *E-coli* | Final product storage tank | > nil detected | > nil detected | Water batch prevented from release to end-use and is dumped or re-processed |

#  Scheme validation

Validation of the entire recycle scheme is undertaken with respect to effectiveness of treatment processes, critical limits, operational limits, final water quality and corrective actions. Validation methodologies are described in Section 10 of the Guideline. Three phases of validation need to be addressed:

1. **pre-commissioning validation** – generally undertaken during the planning and design stage to determine the combination of treatment components that will be required to meet the required water quality
2. **commissioning validation** – confirms that selected components perform as expected when operating as part of the treatment system
3. **commissioning verification** – testing of final product water to show that the system as a whole produces the expected water quality

For each stage, the validation program should be documented in a report that details the following for each item being validated; this may be in a separate report appended to the RWMP:

* the aim of the validation
* the methodology used
* the results of the validation undertaken
* the conclusion of the validation, that is, whether the aim of the validation was met
* a summary of outcomes from the validation program.

The validation process requires extensive and frequent testing and monitoring to confirm that the treatment process is capable of delivering the required product quality. Once proven, the level of monitoring can be relaxed during the operational and verification stages.

**Notes:** Refer to Section 10 of the AMPC GWRR for additional information. Note that a validation program must be developed which identifies reference pathogens and specifies log reduction requirements for the treatment process. This is discussed in Section 5.1.2 and Section 6.4 of the AMPC GWRR. For additional guidance refer to (DEWS, 2008).

#  Operational procedures and process control

This section should document the procedures for ensuring system processes and activities occur effectively and correctly to produce recycled water of acceptable quality. This information may be formalised in the organisation’s operating procedures which should be described and referenced in the RWMP where applicable.

##  Operational procedures

Operational procedures should describe process control programs for the scheme. These may be compiled in an operation manual which could be an attachment to the RWMP. Document the positions responsible for the activities in the procedures and how staff are trained in the procedures.

**Notes:** Section 11 of the AMPC GWRR lists examples of titles of operating procedures.

##  Source water monitoring

Characterisation of wastewater should be ongoing to account for changes over time, and assist identification of new or emerging hazards. Parameters and monitoring frequencies should be risk based. Provide details of the ongoing wastewater monitoring program.

##  Operational monitoring

Provide a plan that details the operational monitoring protocols, including:

* responsible personnel
* operational monitoring parameters
* criteria or performance targets
* monitoring frequency
* analysis of results to determine operational efficacy.

Operational monitoring will generally include quality control points in addition to the critical control points discussed in section 3.4. This may occur automatically and in real time or via manual sampling. Practically this information could be combined with the critical control point monitoring as shown in the example below (Table 8). Again, this example table does not contain an exhaustive list of the parameters to be monitored. Alert and critical limit criteria are examples only.

**Note:** Section 9 of the AMPC GWRR lists examples of operating monitoring parameters.

##  Operational corrective actions

Include procedures for corrective actions which establish process control, immediately when critical limits or target criteria are exceeded. These may be included as part of the operational procedures for the scheme or as separate corrective procedures.

Include the responsibilities for actions in procedures, and how reviews will occur after corrective actions are taken.

Document the communication systems to be implemented when process control is lost, including the responsibilities for executing communication protocols.

 **Table 8:** Operational monitoring plan\*

| **Treatment process** | **Activity and function of monitoring** | **Indicator parameter** | **CCP/ QCP** | **Location** | **Frequency** | **Alert level** | **Critical limit (CCP only)** | **Corrective action** |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Coarse filtration | Coarse particle screening | Turbidity | QCP | Chloramination feed | Daily  | >2 NTU | QCP – n/a | Automatic shutdown of feed pump to microfiltration units.Inspection and action in accordance with operational procedures |
| Microfiltration | Membrane function | Pressure decay rate | CCP | Membrane rack and PLC system | Daily | PDR>3 kPa/min | PDR>5 kPa/min | Inspection and repair in accordance with operational procedures. Breach of CL’s at multiple units will result in shutdown of feed pump to microfiltration units |
| No. of back flushes per day or week | CCP | Daily/ weekly | As per supplier’s advice | As per supplier’s advice |
| Trans-membrane pressure | CCP | Daily/ weekly | As per supplier’s advice | As per supplier’s advice |
| Flow | QCP | Daily | > 30 L/m2h | QCP – n/a |
| Turbidity | QCP | Daily | >1 NTU | QCP-n/a |
| Reverse osmosis | Membrane function | Pressure decay rate | CCP | Membrane rack & PLC system | Auto controlled as required | PDR> x kPa/min | PDR> 5 kpa/min | Inspect and repair in accordance with operational procedures. |
| Permeate EC | CCP | Post RO Rack | Daily | > 20 µS/cm | > 30 µS/cm |
| No. CIPS/day | CCP | Membrane rack & PLC system | Auto controlled as required | As per supplier’s advice | As per supplier’s advice |
| Softening | Residual disinfection | Chlorine residual | CCP | Post softening | Daily | 2.0 mg/L | 1.0 mg/L | Chemical addition. Inspect and repair in accordance with operating procedures |
| pH | QCP |  | Daily | Outside of 7.5-8.0 | n/a |
| Conductivity (EC) | QCP |  | Daily | > 350 µS/cm | n/a |
| Product storage | Hold tank - verification | E coli | CCP | Holding tank | Per batch | Nil detected | Nil detected | Re-process or dump batch. System audit/assessment to determine contributing problem |
| pH | QCP | Verification | Per batch | <7.0 and > 8.0 | n/a | Chemical addition |

\* Alert levels and critical limits are examples only. Equipment suppliers should be consulted for appropriate values.

##  Monitoring equipment and maintenance

Equipment used for operational monitoring needs to be capable and suitable for the monitoring task. Consequently, maintenance of the monitoring equipment is critical in the provision of consistent and reliable results and performance.

Provide details of the maintenance requirements for the equipment and infrastructure used in the scheme. This information may be available in the manufacturer’s specification and summarised in an organisation’s maintenance schedule. The following information should be included:

* Model no.
* Description
* Location
* Maintenance activity
* Frequency

#  Verification of recycled water quality and operational performance

This section will document details of ongoing verification of final water quality immediately prior to end use. Note that verification monitoring does not occur in ‘real time’, and should be independent of continuous operational monitoring. Final release of treated water should require manual intervention after final checks have been completed. In the process description provided in the AMPC Guideline for Water Recycling and Reuse in Red Meat Processing, the verification approach is described in Section 6.2.6.

##  Recycled water quality monitoring

Include the ongoing verification monitoring program for the scheme that will demonstrate final water quality meets required standards.

* **Monitoring location(s)** - document the location(s) where verification monitoring will occur. These monitoring point(s) should be indicative of final water quality.
* **Monitoring parameters** - list the characteristics to be monitored and process for selection, including demonstration that they are adequate/efficient indicators of final water quality.
* **Monitoring frequency -** describe and justify the frequency of monitoring for the identified verification monitoring parameters.
* **Sampling techniques** - provide details of procedures for the collection and handling of samples, including how samples are taken, who is responsible and the training provided to responsible personnel.
* **Sample analysis** - provide details of the facilities used to undertake analysis of samples. Ideally sample analysis should be performed by a laboratory with NATA (National Association of Testing Authorities) accreditation for the relevant analysis procedures. Where a NATA accredited laboratory is not used, documentation should be provided that details the methodology, including quality assurance and quality control procedures, used to perform the analysis.
	+ 1. Example Verification Monitoring Program

An example verification monitoring program is shown below. The parameters shown are for product verification purposes and can be carried out economically and in a timely manner on a batch by batch basis. A more extensive monitoring program analyzing a larger range of parameters should also be carried out on a less frequent basis e.g. weekly, monthly or other. Note that the level of monitoring is generally less than that required during the process validation stage i.e. at this stage the process capability has been confirmed and there is a relaxed (more infrequent) level of monitoring.

|  |
| --- |
| **Example: Verification monitoring program**Verification monitoring is carried out at the final water quality monitoring points as shown in the process flow diagram in Figure 1. Samples are undertaken as per Procedure 5: Sampling and analysis. Analysis is undertaken at the NRC NATA accredited laboratory. The parameters and frequency are in accordance with standards for Australian Guidelines for Water Recycling: Managing Health and Environmental Risks (Phase 1):Final water quality monitoring (Potable quality water): |
| **Parameter** | **Location** | **Frequency** | **Limit mg/L unless otherwise stated** |
| ***Critical control point*** |
| *Escherichia coli*  | Final product storage | Per batch  | Nil cfu/100 mL |
| pH | Final product storage | Per batch | 6.5 – 8.5 |
| ***Quality control point*** |
| Total Dissolved Solids | Final product storage | Per batch | 600 |
| Ammonia | Final product storage | Per batch  | 0.5 |
| Chlorine  | Final product storage | Per batch | 5 |
| Hardness (as CaCO3) | Final product storage | Per batch | 60 - 200 |
| Turbidity | Final product storage | Per batch | <1 NTU  |
| Odour | Final product storage | Per batch | Inoffensive  |
| Nitrite | Final product storage | Weekly | 3 |
| Nitrate | Final product storage | Weekly  | 50 |
| Hydrogen Sulphide | Final product storage | Weekly | 0.05 |
| Dissolved Oxygen | Final product storage | Weekly | > 85% saturation for aesthetics.  |
| Sodium  | Final product storage | Weekly to monthly | 180 |
| Sulphate | Final product storage | Weekly to monthly | 250 |
| Colour (aesthetics)  | Final product storage | Weekly  | 15 HU |

* + 1. Documentation and reliability

The verification monitoring program should identify the processes for establishing reliability of the data. Roles and responsibilities, sampling and analysis methodologies, record keeping and details of equipment calibration should be included. Evidence may be attached for third party certification of management systems under a relevant standard, e.g. AS/NZS ISO 9001.

* + 1. Short-term evaluation of results

Detail the process for reviewing and evaluating verification monitoring data to ensure better plan management. Document mechanisms for communication and reporting of results, both internally and externally.

* + 1. Corrective responses

Include procedures for corrective responses, including the analysis of operational procedures and monitoring in response to verification monitoring and user complaints. Ensure communication and reporting protocols are established.

#  Management of incidents

There should be a documented system for managing and responding to incidents that might occur during operation of the plan. The following sections may be covered in an incident response developed for the plan, attached to the RWMP.

##  Communication

Provide communication protocols that in the event of an incident will facilitate communication with relevant entities, including relevant agencies and customers.

##  Incident and emergency response protocols

Document the potential incidents and emergencies which may occur and the relevant response plans. Establish response actions and responsibilities. Identify the training requirements for staff involved in the execution of the protocols.

The incident and emergency protocol should identify how management of incidents and emergencies will be investigated, documented, reported and evaluated for continuous improvement of both incident response processes, and preventive measures.

#  Documentation management and reporting

##  Management of documentation and records

Include a procedure or system that provides for the management of documentation and records, including operational and verification monitoring data. This should include a method for document control, how records will be kept for easy access and integrity retention, and how staff will be trained to use systems efficiently.

##  Document review

Provide a summary of how often documents and systems will be periodically reviewed.

|  |
| --- |
| **Example: Document review**A regular review of the RWMP will be conducted at least every year to ensure the RWMP remains relevant having regard to:* the operation of the recycled water plan
* the water quality criteria for recycled water relevant to the plan
* best practice industry standards for the production and supply of recycled water.

If the review indicates the plan should be changed, Brisbourne Meat Processing Company will amend the RWMP to reflect the findings of the review and apply to the regulator for approval of the amended plan. Otherwise, findings of the review will be incorporated into the annual report for that year. |

##  Reporting

Include procedures for effective internal and external reporting, including annual and regular reporting.

#  Supporting programs

## Operator, contractor and end user awareness and training

Include an awareness and training program for operators, contractors and end users. This may be in the form of procedures attached to the RWMP as reference documents.

* Document communication procedures which increase awareness and participation in water quality management, protection of public health, and environmental protection.
* Describe the training requirements for operators, contractors and users for the different aspects of the scheme. Document the skills and experience required by operators and contractors.

## Evaluation and audit

Document the process for long-term data collection and how it will be used to assess performance and identify problems. Provide a process for internal and external audits, including frequencies, roles and responsibilities and the process for documenting and reporting results. Additionally, outline any triggers that may result from audit results (for example changes to the scheme, the RWMP or other documents).

|  |
| --- |
| **Example: Auditing**Internal audits will be conducted annually by company staff members who, as a minimum, have completed a two-day audit training course.A regular external audit of the RWMP will be conducted by a suitably qualified independent auditor (not a company employee) at least every three years.Internal and external audits will assess compliance with the RWMP and conditions of approval. Audit reports will be reviewed by the Occupational, Health, Safety and Environment Manager and if the report indicates compliance issues, the analysis team will be convened to determine appropriate action. Actions potentially triggered by audit findings include:* review of the RWMP, and amendment if necessary
* revalidation of treatment processes and critical limits
* review of risk assessment process
* review of management systems and procedures.

Audit results and reports are submitted to relevant stakeholders and approval agency and retained in accordance with document management procedures. |

## Review and continuous improvement

Document the review and continuous improvement mechanisms that will be undertaken for the plan. This should include roles and responsibilities, the documentation and communication of results and the involvement of senior management. Document the processes that may be triggered by reviews, for example commencement of a recycled water quality management improvement plan.

# References

AS4696 (2007) Australian Standards for Hygienic Production and Transportation of Meat and Meat Products for Human Consumption Part 7 Premises, equipment and essential services

DAFF. (2008). AQIS Meat Notice, 2008/06. Efficient Use of Water in Export Meat Establishments. Department of Agriculture, Fisheries and Forestry. Australian Quarantine and Inspection Services.

DEWS. (2008). Guide for preparing a Recycled Water Management Plan, Water Supply (Safety and Reliability) Act 2008. Brisbane: Department of Energy and Water Supply.

DEWS. (2008). Recycled water management plan and validation guidelines. Department of Energy and Water Supply.

NHRMC. (2011). Australian Drinking Water Guidelines (ADWG) 6, 2011 Version 3.2 Updated February 2016. National Health and Medical Research Council. Canberra.

NRMMC. (2006). Australian Guidelines for Water Recycling: Managing Health and Environmental Risks (Phase 1). (AGWR) Natural Resource Management Ministerial Council, Environment Protection and Heritage Council, Australian Health Ministers Conference.

NRMMC. (2008). Australian Guidelines for Water Recycling: Managing Health and Environmental Risks (Phase 2). (ADWS) Augmentation of Drinking Water Supplies. Natural Resource Management Ministerial Council, Environment Protection and Heritage Council, National Health and Medical Research Council.