Lake Scapa

Risk Based Drinking Water Management System

Bowmore Shire Council
Version 3.0
March 2012

Document Status	Final Version		
Document History:	Risk Consultant	Version 1.0	August 2011
	Client Review	Version 2.0	December 2011
	Final Version	Version 3.0	March 2012
Review	This document is due for review by March 2013		
File Name:	Lake Scapa DWQMS _ Deidentified V3 .docx		

Executive Summary

Plan Purpose

This document and the supporting systems demonstrate Bowmore Council's compliance with the requirement in the Public Health Act 2010 to develop a Quality Assurance Plan in line with the Framework for Drinking Water Quality Management in the Australian Drinking Water Guidelines. This document acts as a roadmap of the activities that Council undertakes to ensure the provision of safe drinking water to its customers.

Critical Control Points

The day to day safety of the water is maintained to critical control points. The critical control points for the Lake Scapa system are shown in the table below.

Control Point	Hazard	Control Parameter	Target	Operational Limit	Critical Limit
Lake raw water pumps	Algae	Pre DAF turbidity	<100 NTU	<500 NTU	1000 NTU
DAF	Algae, Turbidity	Post DAF turbidity	<3 NTU	5 NTU	10 NTU
Membranes	Algae, Turbidity	Post membrane turbidity	0.1 NTU	0.3 NTU	1 NTU
	Pathogens	Membrane integrity (SCADA permeability alarm)	Check weekly		
Chlorine contact	Pathogens	Chlorine residual at reservoir exit	1 mg/L	0.5 mg/L	0.2 mg/L
		pH at reservoir exit	Less than 7.5	8	8.5
Reservoir	Pathogens (recontamination)	Reservoir inspection	Daily	Minor damage	Major damage

Action Plan

A number of actions were identified through the risk assessment and plan development. These have been assigned to staff members and contractors/consultants to follow-up. The action plan is reviewed regularly as actions are completed and as part of the annual planning cycle.

Plan Review

This plan should be reviewed internally on an annual basis and by an independent party every 3 years (subject to NSW Health advice).

This document is designed for printing double-sided

CONTENTS

1 INTRODUCTION

The NSW *Public Health Act 2010* (the Act) was passed by Parliament at the end of 2010. The Act includes the requirement for water suppliers to produce a *Quality Assurance Program* (QAP). This document forms Bowmore Council's response to the development of a QAP for Lake Scapa and is based on the 12 Elements, 32 Components and 76 Actions of the Framework. This document can be extended to incorporate other supplies within the shire as required.

2 PURPOSE

This document acts as a roadmap of the activities that Council undertakes to ensure the provision of safe drinking water to its customers.

The document is supported by a range of procedures, registers, data management systems, flow diagrams and process and instrumentation diagrams which are all referenced at the appropriate points in this document.

This plan and the supporting documentation are living documents that should be reviewed and updated in a timely manner.

3 ELEMENTS ROADMAP

3.1 ELEMENT 1: COMMITMENT TO DRINKING WATER QUALITY MANAGEMENT

3.1.1 Drinking water quality policy

- Formulate a drinking water quality policy, endorsed by senior executives, to be implemented throughout the organisation.
- Ensure that the policy is visible and is communicated, understood and implemented by employees.

While Council does not have a formal drinking water quality policy, Objective 3.5 of Councils 2010 - 2014 Management Plan is *"To ensure urban communities have access to high quality and reliable water supplies and sewerage services."*

Water can also be considered as part of the sustainable services within Council's mission statement:

To meet the needs of the community by providing sustainable services and establishing a long-term strategy that leads to the social and economic success of Bowmore Shire.

The mission and the objective are communicated to staff through the strategies within the Management Plan, particularly those relating to staff development (Strategy 1.1.1 and 3.5.5).

3.1.2 Regulatory and formal requirements

- Identify and document all relevant regulatory and formal requirements.
- Ensure responsibilities are understood and communicated to employees.
- Review requirements periodically to reflect any changes.

Council does not currently have an up-to-date register of regulatory and formal requirements. This should be developed as part of the strategic business plan. A preliminary register is outlined below.

TABLE 3-1. KEY FORMAL REQUIREMENTS RELATING TO WATER QUALITY

Instrument	Jurisdiction	Type	Relevance
AS/NZS 3500.0 to 4:2003 - Plumbing and Drainage Set	National	Standard	Largely for management of the distribution system including standards for plumbing and drainage issues
Plumbing Code of Australia 2004	National	Standard	Largely for management of the distribution system including standards for plumbing and drainage issues
Australian Drinking Water Guidelines 2011	National	Guideline	Sets frameworks and guidance for the provision of safe, quality drinking water
Local Government Act 1993	NSW	Statute	Urban water services and management/review of on-site sewage management systems; Have only persons licensed or certified under the Home Building Act 1989 (or supervised by such a person) carry out any water supply work, sewerage work or stormwater drainage work. Preparation of Asset Management Plans
Public Health Act 2010	NSW	Statute	Protection of public health, follow any advice issued from the Chief of Health regarding drinking water safety to the public; sample drinking water in accordance with NSW Health recommendations. Prepare a drinking water management system
Public Health (General) Regulation 2002	NSW	Regulation	Requirement to notify the Medical Officer of Health if Council believes a situation has arisen from a water quality context which poses risk, or is likely to pose risk to public health
Protection of the Environment Operations Act 1997	NSW	Statute	Environmental protection including licensed discharges
NSW Water and Sewerage Strategic Business Planning Guidelines	NSW	Guidelines	Prepare Strategic Business plans including a review of the operating environment and IWCM which should identify key water quality issues in the catchment.
NSW Health Drinking Water Monitoring Program	NSW	Guidelines	Free-of-charge testing for water supply system monitoring of indicator bacteria and health-related inorganic chemicals. Includes NSW Health Response Protocols for chemical and microbial quality, treatment failure and *Cryptosporidium* and *Giardia.*

GAP: Develop an up to date register of regulatory and formal requirements.

GAP: Communicate regulatory and formal requirements to the staff and review requirements on an annual basis

3.1.3 Engaging stakeholders

- Identify all stakeholders who could affect, or be affected by, decisions or activities of the drinking water supplier.
- Develop appropriate mechanisms and documentation for stakeholder commitment and involvement.
- Regularly update the list of relevant agencies.

Council does not currently have an up to date stakeholder register. This should be developed as part of the strategic business plan. A preliminary stakeholder register is shown in Table 3-2 below:

TABLE 3-2. KEY STAKEHOLDER REGISTER

Name	Organisation	Role	Contact
	NSW Health	Environmental Health Officer	
	NSW Office of Water	Inspector	
	Bowmore Council	Director - Technical Services	
	Bowmore Council	Operations Engineer	
	Bowmore Council	Manager - Utilities	
	Catchment Management Authority	Riparian Activities	

GAP: Develop an up to date register of stakeholders.

3.2 ELEMENT 2 - ASSESSMENT OF THE DRINKING WATER SUPPLY SYSTEM

3.2.1 Water supply system analysis

- Assemble a team with appropriate knowledge and expertise.
- Construct a flow diagram of the water supply system from catchment to consumer.
- Assemble pertinent information and document key characteristics of the water supply system to be considered.

This was undertaken as part of the Risk Assessment Workshop on the 24th and 25th August 2011. A summary is shown in Table 3-3 in this section (See Appendix B for more information).

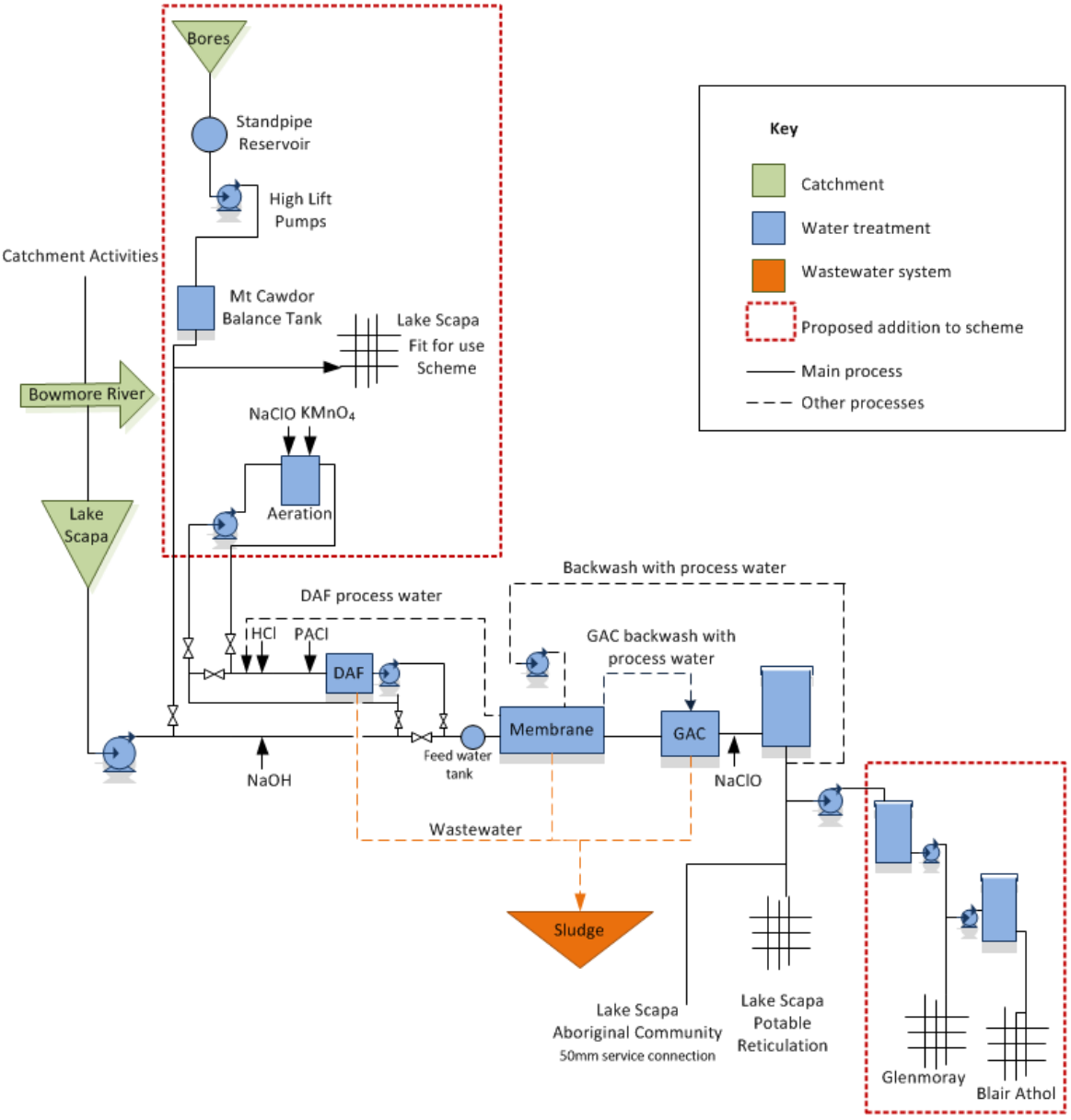
TABLE 3-3. SYSTEM SUMMARY

Characteristic	Data
Surface Source	Bowmore River
Catchment	Primarily agriculture (beef & wool production, viticulture, cotton wheat & other cereals). Major upstream towns include Pancor, Ganton & Dundra
Extraction Point	Lake Scapa

Characteristic	Data
Groundwater Source	Cawdor Borefield
Treatment Process	Oxidation (groundwater only) DAF, pH correction ultramembrane filtration, GAC filters, chlorination
Treatment Plant Capacity	4.5ML/d
Customers	Lake Scapa 800 connections Lake Scapa Aboriginal community (50mm connection) Non-potable supplies: Blair Athol and Glenmoray Trunk main 80 connections Blair Athol township 126 connections

The process flow diagram used for the risk assessment is shown in Figure 3-1.

FIGURE 3-1. PROCESS FLOW DIAGRAM USED IN THE RISK ASSESSMENT



3.2.2 Assessment of water quality data

- Assemble historical data from source waters, treatment plants and finished water supplied to consumers (over time and following specific events).
- List and examine exceedances.
- Assess data using tools such as control charts and trends analysis to identify trends and potential problems.

This was assessed as part of the Risk Assessment Workshop on the 24th and 25th August 2011 (See Appendix B). Water quality data was extracted from the NSW Health verification monitoring database for testing carried out on Lake Scapa over the period 1-1-2001 to 31-1-2011. Water was tested for 38 quality parameters. An analysis of the results against the Australian Drinking Water Guidelines 2011 is provided in the tables below. Table 3-4 provides statistics for common parameters.

TABLE 3-4. SUMMARY OF WATER QUALITY DATA FOR LAKE SCAPA (NSW HEALTH DATA).

Parameters	Number of Samples	Min	5th %ile	Mean	95th %ile	Max	ADWG value	No. of exceed-ances
pH	76	7.2	7.4	7.8	8.05	8.2	6.5 - 8.5	0
True Colour (HU)	14	1.3	0.5	2.3	4.1	5.4	15	0
Turbidity (NTU)	78	0.0	0.0	1.2	2.1	42.0	5	2
Iron (mg/L)	14	0.01	0.01	0.12	0.22	0.26	0.3	0
Manganese (mg/L)	16	0.006	0.003	0.01	0.03	0.06	0.5	0
Thermotolerant Coliforms (cfu/100mL)	68	0.0	0.0	2.5	21.3	42.0	0.0	9
E. coli (cfu/100mL)	499	0.0	0.0	0.5	0.0	66.0	0.0	13
Total Hardness (mg/L as $CaCO_3$)	14	5.7	106.6	223	364	518	200	9

3.2.3 Hazard identification and risk assessment

- Define the approach and methodology to be used for hazard identification and risk assessment.
- Identify and document hazards, sources and hazardous events for each component of the water supply system.
- Estimate the level of risk for each identified hazard or hazardous event.
- Evaluate the major sources of uncertainty associated with each hazard and hazardous event and consider actions to reduce uncertainty.
- Determine significant risks and document priorities for risk management.
- Periodically review and update the hazard identification and risk assessment to incorporate any changes.

This was assessed as part of the Risk Assessment Workshop on the 24th and 25th August 2011 (See Appendix B for more information). Risks were assessed as both uncontrolled (i.e. maximum risk) and controlled (i.e. residual risk).

The workshop identified twenty two very high risks. Three of these remain very high even with control in place:

- Power failure
- Failure of telemetry monitoring devices
- Ingestion of non potable water at Blair Athol.

The workshop identified five very high risks that are reduced to high risk with the application of control measures. These were:

- Algae, turbidity from failure of DAF system
- Taste and odour or toxins due to GAC bypass open
- Chlorine sensitive pathogens due to underdosing of chlorine (<0.5mg/L leaving reservoir)
- Pathogens due to topping up reservoir by water carting
- Backflow/cross connection leading to water contamination events in the distribution system

The workshop participants considered actions to improve the management of these risks (See Element 12 and the action plan in Appendix C).

The workshop identified eleven very high risks that are reduced to moderate risk with the application of control measures. These were:

- High levels of nutrients in the water leading to algal blooms
- High levels of nutrients in the water, causing algal toxins
- High levels of nutrients causing algal blooms that cause taste and odour problems
- Turbidity / suspended solids (other than algae) from the river tributary and local wave action
- Pathogens in the lake from upstream agriculture & human inputs
- Pathogens in the lake from onsite sewage systems
- Fe/Mn from overdosing of NaOCl / NaOH
- Mn from overdosing of permanganate system
- Algae, turbidity or pathogens in treated water due to partial failure of membrane
- Insufficient water for backwashing due to lack of water in reservoir
- Human error

The workshop identified three very high risks that are reduced to low risk with the application of control measures. These were:

- Taste and odour or toxins from exhaustion of GAC system
- Taste and odour or toxins due to short circuiting affecting contact time for GAC
- Pathogens due to recontamination of treated water by vermin

The identified controls are important for maintaining the reduced risk. Monitoring and actions around critical control points (see Elements 3 & 4) are essential to maintaining the safety of the water.

3.3 Element 3: Preventive Measures for Drinking Water Quality Management

3.3.1 Preventive measures and multiple barriers

- Identify existing preventive measures from catchment to consumer for each significant hazard or hazardous event and estimate the residual risk.
- Evaluate alternative or additional preventive measures where improvement is required.

This was assessed as part of the Risk Assessment Workshop on the 24th and 25th August 2011 (See Appendix B). The control measures are listed in the worksheet. Additional actions are listed as part of Element 12.

3.3.2 Critical Control Points

- Assess preventive measures from catchment to consumer to identify critical control points.
- Establish mechanisms for operational control.
- Document the critical control points, critical limits and target criteria.

This was assessed as part of the Risk Assessment Workshop on the 24th and 25th August 2011 (See Appendix B). A summary of the critical control points is shown in Table 3-5.

Table 3-5. Critical Control Point Summary Table

Control Point	Hazard	Control Parameter	Target	Operational Limit	Critical Limit
Lake raw water pumps	Algae	Pre DAF turbidity	<100 NTU	<500 NTU	1000 NTU
DAF	Algae, Turbidity	Post DAF turbidity	<3 NTU	5 NTU	10 NTU
Membranes	Algae, Turbidity	Post membrane turbidity	0.1 NTU	0.3 NTU	1 NTU
	Pathogens	Membrane integrity (SCADA permeability alarm)	Check weekly		
Chlorine contact	Pathogens	Chlorine residual at reservoir exit	1 mg/L	0.5 mg/L	0.2 mg/L
		pH at reservoir exit	<7.5	8	8.5
Reservoir	Pathogens (recontamina-tion)	Reservoir inspection	Daily	Minor damage	Major damage

3.4 Element 4: Operational Procedures and Process Control

1.1 Operational Procedures

3.4.1 Identify procedures required for processes and activities from catchment to consumer.

- Document all procedures and compile into an operations manual.

Operational procedures including O&M manuals are kept on the technical services section of the computer system (//techservices/Operating_procedures/). This is accessible by operators at the plant and engineering staff both remotely and at the office.

Key operational information can be found in Appendix A. This includes:

- Daily plant checklist
- Dosing pump drop test
- Plant security checklist
- Reservoir inspection checklist
- Daily sampling schedule

3.4.2 Operational Monitoring

- Develop monitoring protocols for operational performance of the water supply system, including the selection of operational parameters and criteria, and the routine analysis of results.
- Document monitoring protocols into an operational monitoring plan.

Key operational information can be found in Appendix A.

A monthly sampling plan has been developed. Operators record daily sampling results directly into the spreadsheet. These results are reviewed weekly by the operations engineer. (//techservices/sampling_results.xls).

Operation monitoring schedules include:

- Daily plant checklist
- Dosing pump drop test
- Plant security checklist
- Reservoir inspection checklist
- Daily sampling schedule

3.4.3 Corrective Action

- Establish and document procedures for corrective action to control excursions in operational parameters.
- Establish rapid communication systems to deal with unexpected events.

Critical control points, limits and corrective actions can be found in in Appendix A:

- CCP Overview
- CCP Raw Water Turbidity
- CCP Post DAF Turbidity
- CCP Membrane Integrity
- CCP pH
- CCP Post Membrane Turbidity
- CCP Chlorine
- CCP Reservoirs

3.4.4 Equipment capability and maintenance

- Ensure that equipment performs adequately and provides sufficient flexibility and process control.
- Establish a program for regular inspection and maintenance of all equipment, including monitoring equipment.

Key operational information can be found in Appendix A.

Council maintains an asset register: (//techservices/Assets/). The daily checklist supports the key activities for routine maintenance.

3.4.5 Materials and chemicals

- Ensure that only approved materials and chemicals are used.
- Establish documented procedures for evaluating chemicals, materials and suppliers.

Council purchases chemical through reputable chemical suppliers. There are a limited range of suppliers due to their location.

Chemical deliveries are attended by trained water treatment plant operators. A certificate of analysis is required by Council for each batch of chemical supplied. This is compared to quality criteria specified in Chapter 8 of the ADWG, prior to the commencement of unloading. The risk of delivery error is reduced both by the presence of the operator and by controls on filling points, such as labelling and fittings.

Key operational information can be found in Appendix A.

3.5 Element 5: Verification of drinking water quality

3.5.1 Drinking water quality monitoring

- Determine the characteristics to be monitored in the distribution system and in water as supplied to the consumer.
- Establish and document a sampling plan for each characteristic, including the location and frequency of sampling.
- Ensure monitoring data is representative and reliable.

Verification monitoring in the reticulation is scheduled weekly. Three sample sites are selected at the edges of the town (McInness St, Milburn St, Highland Park Ave). Samples are also taken at the hospital and at a random site in town. These samples are tested at the Water treatment plant for chlorine residual.

NSW Health sampling of the distribution system provides ongoing independent verification of the treatment process. These samples are taken at Lake Scapa Caravan Park, Lake Scapa Depot and Blair Athol Park. Council also undertakes simultaneous in-house sampling for pH, free chlorine, total chlorine and turbidity.

This information is stored in the excel spreadsheet – sampling_results.xls stored in the technical services directory (//techservices/sampling_results.xls).

3.5.2 Consumer satisfaction

- Establish a consumer complaint and response program, including appropriate training of employees

Council has a customer service section for all requests for maintenance. The call centre records who called (contact details) and ascertain the nature of the problem. The appropriate person to attend to the call is e-mailed or the Operations Engineer or Asset Manager is notified. Council has protocols for attending to broken mains.

The call centre will escalate calls to the Technical Director's Officer Manger to follow up on higher problems. The Officer Manger has a coordinating role on the request and is responsible to following up and ensuring the request has been fulfilled.

If a person wishes to make a complaint that they wish Council to act on, they are requested to make their complaint in writing. This is then registered in Council's TRIM document management system and forwarded to the responsible officer for actioning. The TRIM system has set timeframes in which action must be undertaken and actions taken are recorded and referenced against the original complaint document registration number. Exception reports are produced periodically for the General Manager and Directors in order to verify that the relevant actions have been undertaken and completed.

3.5.3 Short term evaluation of results

- Establish procedures for the daily review of drinking water quality monitoring data and consumer satisfaction.
- Develop reporting mechanisms internally, and externally, where required.

The daily log sheet for the plant operators is used to guide the operator in the daily review of drinking water quality monitoring data. This data is reviewed weekly by the Operations Engineer.

Water quality data recorded in the NSW Drinking Water Database is reviewed on a monthly basis.

3.5.4 Corrective action

- Establish and document procedures for corrective action in response to non-conformance or consumer feedback.
- Establish rapid communication systems to deal with unexpected events.

Key operational protocols and communication procedures are documented in Appendix A. The NSW Health Drinking Water Monitoring program provides response protocols for the microbiological quality, physical and chemical quality, treatment failure and *Cryptosporidium* and *Giardia*.

These operational and communication protocols are displayed in the WTP control room and located electronically at //techservices/CCPs/

3.6 Element 6: Management of incidents and emergencies

3.6.1 Communication

- Define communication protocols with the involvement of relevant agencies and prepare a contact list of key people, agencies and businesses.
- Develop a public and media communications strategy

Contact lists for emergencies are held at Council for the Local Emergency Response Committee (LEMC Emergency Contact list no 4/1/2011) and the Regional Emergency Management District Contact Manual (27th April 2011). The local DISPLAN is run through the local emergency management committee.

Algal alerts are handled through the Regional Algal Co-ordination Committee (RACC).

Communication for water quality incidents are found in the NSW Health Drinking Water Monitoring Program. Council will follow the NSW Health protocols should a water quality incident occur.

3.6.2 Incident and emergency response protocols

- Define potential incidents and emergencies and document procedures and response plans with the involvement of relevant agencies
- Train employees and regularly test emergency response plans
- Investigate any incidents or emergencies and revise protocols as necessary

Council will follow NSW Health response protocols, where applicable, for microbiological quality, physical and chemical quality, treatment failure and Cryptosporidium and Giardia.

GAP: Council does not currently have a business continuity plan. See the Action Plan (Appendix C).

3.7 Element 7: Employee awareness and training

3.7.1 Employee awareness and involvement

- Develop mechanisms and communication procedures to increase employees awareness of and participation in drinking water quality management

Council is committed to maintaining a workforce structure that meets service requirements in the community. Council has a policy in place detailing the method by which Council recruits staff.

Council is committed to creating a "Learning Organisation" through supporting staff to develop their own individual skills that compliment and facilitate organisational success. Council provides for this through the following:

- Employment and training of apprentices and trainees.
- Supporting access to training that enables employees to develop and attain excellence in their current roles as well as develop for the future.

- Provision of training that supports safe working practices for all.
- Developing employees across a wide range of activities using formal (conferences, tertiary education) and informal (networking, one to one job instruction) mechanisms that allow employees to take control of their own growth. (Council Management Plan 2010-2014)

Every three weeks there is a formal meeting with senior staff (to Operations Engineer level). Agenda and minutes of the meetings are stored: //engineering/minutes/.

There is a monthly meeting between the Technical Director and the field employees. Details of those meetings are stored: //engineering/minutes/.

3.7.2 Employee training

- Ensure that employees, including contractors, maintain the appropriate experience and qualifications
- Identify training needs and ensure resources are available to support training programs
- Document training and maintain records of all employee training

There is a position description for all positions. This description is updated prior to advertising the position and following staff appraisal. The staff appraisal base document is updated by HR every year prior to the staff appraisal period. There is also a probationary appraisal document.

The annual staff appraisal is undertaken by the employee and their supervisor. Training needs are identified and signed off by the supervisor and the Technical Director. Training requirements are documented as part the appraisal process Annual training plans are prepared to ensure staff meet statutory requirements and corporate goals. HR contacts the RTO to organise the training. HR also maintains records of that training in an access database customised by the IT department. HR receives a transcript when each module is finished. This information is stored: //HR/training_records/.

3.8 Element 8: Community involvement and awareness

3.8.1 Community consultation

- Assess requirements for effective community involvement.
- Develop a comprehensive strategy for community consultation.

Council is currently developing their community strategic planning. A consultant will be engaged to assist with the community engagement section. Community surveys have been undertaken in the past.

Council sends yearly notices where non-potable water is supplied in accordance with NSW Health policy (e.g. Blair Athol).

3.8.2 Communication

- Develop an active two-way communication program to inform consumers and promote awareness of drinking water quality issues.

Council has a documented communication strategy. The public are encouraged to participate in the Council meeting process and submit suggestions to Council. Any matter to be included in the business paper must be in the hands of the General Manager by 9.00 am on the Wednesday of the week preceding the meeting.

Ordinary meetings of Council are normally held in the Council Chambers on the third Wednesday of each month commencing at 9.00 am. Annually a meeting is held at Lake Scapa, twice a year a Council Meeting is held at Blair Athol and Glenmoray.

Residents and ratepayers can also bring their views to the attention of Council by talking with Councillors or Staff members, or by writing to the Mayor or General Manager.

A Public Forum Session is also available to the public to participate in Council Meetings. Members of the public are invited to address Council on any relevant issue and can contact the General Manager prior to a Council Meeting. If there is an unusual event discussed at the council meeting a media interview will occur afterwards.

There are strong local communities; the General Manager and Technical Director attend community meetings as requested (a near weekly event). These meetings cover a broad range of community issues (not just water).

A monthly report from the water section is tabled at the Council meeting.

3.9 Element 9: Research and development

3.9.1 Investigative studies and research monitoring

- Establish programs to increase understanding of the water supply system.
- Use information to improve management of the water supply system.

As part of Council's annual planning process, the Operations Engineer and Manager Utilities develop the capital and maintenance program for the upcoming year. This includes programs to improve water quality through equipment upgrades, additional monitoring and process changes and trials.

Council can access investigative monitoring programs through the NSW Health Drinking Water Monitoring Program if required.

Council receives the Public Health Bulletin and is a member of the Local Government Water Directorate through which projects can be undertaken collectively and information disseminated to members.

3.9.2 Validation of processes

- Validate processes and procedures to ensure that they are effective at controlling hazards.
- Revalidate processes periodically or when variations in conditions occur.

NSW Health sampling of the distribution system provides ongoing validation of the treatment process. These samples are taken at Lake Scapa Caravan Park, Lake Scapa Depot and Blair Athol Park. Council also undertakes simultaneous in-house sampling for pH, free chlorine, total chlorine and turbidity.

These results are stored in //techservices/sampling_results.xls).

3.9.3 Design of equipment

- Validate the selection and design of new equipment and infrastructure to ensure continuing reliability.

Council engages external consultants and experience contractors for upgrade works to ensure new or modified treatment works are suitable. A Section 60 approval for upgrade works also ensures validation of equipment and infrastructure.

3.10 Element 10: Documentation and record keeping

3.10.1 Management of documentation and records

- Document information pertinent to all aspects of drinking water quality management.
- Develop a document control system to ensure current versions are in use.
- Establish a records management system and ensure that employees are trained to fill out records.
- Periodically review documentation and revise as necessary.

Objective 2.2 of the 2010-2014 Management Plan is "to ensure that Council's record keeping meets legislative requirements and is appropriate for Council's needs." Council uses TRIM as a record management system.

Specific information including WTP manuals and electronic log sheets is held in the technical directory of the server: //techservices/

Council contributes to the annual performance data collection and reporting required by the NSW Office of Water.

NSW Drinking Water Database holds water quality information for the samples taken for independent testing. The database is used to manage drinking water quality results tested by NSW Health.

Council refers to the NSW Health website for the most recent documents and records.

3.10.2 Reporting

- Establish procedures for effective internal and external reporting.
- Produce an annual report to be made available to consumers, regulatory authorities and stakeholders.

Daily water quality results are entered into the spreadsheet (//techservices/sampling_results.xls).

A water report is provided to the monthly Council meetings. //Council/Water_reports/

Water quality reports for the samples tested by NSW Health can be retrieved from the NSW Drinking Water Database.

3.11 Element 11: Evaluation and audit

3.11.1 Long term evaluation of results

- Collect and evaluate long-term data to assess performance and identify problems.
- Document and report results.

Council reviews and submits data as part of the New South Wales Office of Water annual performance reporting.

Actions to improve compliance with this element are captured in the Action Plan.

3.11.2 Audit of drinking water quality management

- Establish processes for internal and external audits.
- Document and communicate audit results.

An external Gap Analysis audit of Lake Scapa's water supply system was undertaken 11th August 2011. The results of the Gap Analysis were used to facilitate development of this document.

The NSW Health Drinking Water Database is used to document water quality results and was interrogated as part of the preparation for the risk assessment workshop on 24th -25th August 2011.

Informal inspections of the system are carried out by operators. The reservoirs are inspected by a reputable reservoir cleaning company inside and out every year.

External inspections of the system are carried out by NSW Office of Water inspectors. Reports of findings are provided by the inspectors and are used to help direct works.

The internal and external audit frequency will be determined in consultation with the Public Health Unit. For external audit, Council will engage an independent auditor approved by the Public Health Unit.

Actions to improve compliance with this element are captured in the Action Plan.

3.12 Element 12: Review and continual improvement

3.12.1 Review by senior executive

- Senior executive review of the effectiveness of the management system.
- Evaluate the need for change.

Water quality and quantity is reported to Council on a monthly basis against Objective 3.5 of the Management Plan (To ensure urban communities have access to high quality and reliable water supplies and sewerage services).

This Drinking Water Management System and its implementation will be reviewed regularly (at least annually) to ensure that it maintains currency with the water supply operation and management.

3.12.2 Drinking water quality management improvement plan

- Develop a drinking water quality management improvement plan.
- Ensure that the plan is communicated and implemented, and that improvements are monitored for effectiveness.

The improvement plan is captured in Appendix C. The operations engineer is responsible for the action plan. Individual actions are assigned to the appropriate organisation. The actions are categorised as

- Major Works for Investigation
- Minor Works to be Undertaken
- Major Procedure or Protocol to be produced
- Minor Procedure or Protocol to be produced
- Service Maintenance to be Undertaken / Ongoing
- Training to be devised and provided

The improvement plan is used by the operations engineer to monitor the implementation of the Drinking Water Management System. The improvement plan is subject to 12 monthly reviews with the Manager Utilities.

APPENDIX A –OPERATIONAL INFORMATION

This appendix contains the following operational information:

- CCP Monitoring Quick Reference Guide
- CCP Raw Water Turbidity
- CCP Post DAF Turbidity
- CCP Membrane Integrity
- CCP Clear Water pH
- CCP Post Membrane Turbidity
- CCP Clear Water free chlorine
- CCP Reservoirs
- Plant Checklist
- SOP Liquid dosing pump drop test
- SOP Plant security & maintenance
- SOP Reservoir Inspection
- SOP Walkaround and Visual Inspections

Critical Control Points Monitoring Quick Reference Guide

These are the critical parameters for safe management of your system. Ensure that these parameters are monitored regularly

	Target Criteria	Adjustment Limit	Critical Limit
Raw Water Turbidity	100 NTU	500 NTU	1000 NTU
Post DAF Turbidity	3 NTU	5 NTU	10 NTU
Post Membrane Turbidity	0.1 NTU	0.3 NTU	1 NTU
Membrane Integrity	Regularly Tested	1 week without testing	Loss of Integrity
Clear Water Free Chlorine	1 mg/L	0.5 mg/L	0.2 mg/L
Clear Water pH	7.5	8.0	8.5
Reservoir Integrity	Secure and Vermin Proof	Evidence of Breaches	Breach not Rectified, or Serious Breach

Target Criteria — This is where you should be operating. Aim to keep the system operating at this value.

Adjustment Limit — If you reach this limit, refer to CCP management sheet and try to get back to the operational target. Increase monitoring until returned to normal.

Critical Limit — If you reach this limit, you have lost control of your system. Refer to CCP management sheet and try to return to operational target as a matter of urgency.

CCP – Post Membrane Control Valve

What is the control point?	**Post membrane control valve**
What are the hazards?	**Turbidity, pathogens**
What is being measured?	**Post membrane filtered water turbidity (daily sampling and testing)**

Operational Target 0.1 NTU	Adjustment Limit 0.3 NTU	Critical Limit 1 NTU
• WTP Water sampling and testing • Plant walkaround and visual inspection • Membrane integrity test • Chemical enhanced backwash (CEB) • Instrument calibration	• Contact Operations Engineer (XXXX XXX XXX) • Test post DAF turbidity and inspect DAF system • Test post membrane turbidity of individual membranes to try and isolate problem • Test reservoir outlet turbidity to determine extent of problem • Membranes engineering inspection • Repeat operational procedures • Increase backwash and CEB frequency • Manually initiate backwash • Test post membrane turbidity hourly, and other parameters as needed	• Contact Manager - Utilities(XXXX XXX XXX) • Contact PHU (XXXX XXXX) • Repeat operational and adjustment procedures • Consider plant shutdown • Consider boil water alert

CCP – DAF System

What is being measured?	**Post DAF Turbidity**
Where/how is it measured?	Outlet of DAF tanks / daily sampling and testing
What is the control point?	DAF inlet
What are the hazards?	Turbidity, pathogens, algae

Target Criterion **3 NTU**	Adjustment Limit **5 NTU**	Critical Limit **10 NTU**
• WTP Water sampling and testing • Carry out jar test • Adjust dosages if necessary • Plant walkaround and visual inspection • Equipment checks • Drop testing and dosing rate checks • Instrument calibration • Algae monitoring	• Contact Operations Engineer (XXXX XXX XXX) • DAF and dosing systems engineering inspection • Repeat operational procedures • Test post DAF turbidity hourly, and other parameters as needed • Consider alternative supply	• Contact Manager - Utilities (XXXX XXX XXX) • Repeating operational and adjustment procedures • Consider plant shutdown • Consider boil water alert

CCP – Membranes

What is being measured?	**Membrane integrity**
Where/how is it measured?	Membranes / permeability alarm on SCADA
What is the control point?	Membrane inlet
What are the hazards?	Turbidity, pathogens

Target Criterion **Regular testing**	Adjustment Limit **1 week without testing**	Critical Limit **Loss of integrity**
• Membrane integrity testing is carried out regularly	• Carry out urgent integrity test • Arrange for repairs as necessary	• Contact Manager - Utilities (XXXX XXX XXX) • Shut down problematic skid • Arrange for urgent repairs as necessary • Sample and test individual and combined post membrane turbidity

CCP – Chlorine dosing pump

What is being measured?	**Clear Water Free Chlorine**
Where/how is it measured?	Outlet of clear water reservoir / daily sampling and testing
What is the control point?	Chlorine dosing pump
What are the hazards?	Chlorine sensitive pathogens

Target Criterion **1 mg/L**	Adjustment Limit **0.5 mg/L**	Critical Limit **0.2 mg/L**
• WTP Water sampling and testing • Plant walkaround and visual inspection • Equipment checks • Dosing rate checks • Instrument calibration	• Contact Operations Engineer (XXXX XXX XXX) • Repeat operational procedures • Chlorine dosing system engineering inspection • Increase chlorine dosage • Sample and test clear water colour • Inspect DAF and membranes for issues • Sample and test clear water free chlorine half-hourly, and other parameters as needed	• Contact Manager - Utilities (XXXX XXX XXX) • Contact local PHU (XXXX XXXX) • Repeat adjustment and operational procedures • Sample and test free chlorine in reticulation • Consider shock dosing of reservoir • Consider plant shutdown • Consider boil water alert

CCP – Reservoirs

What is being measured?	**Integrity of Reservoirs**
Where/how is it measured?	Reservoir condition / visual inspection
What is the control point?	Reservoirs
What are the hazards?	Chlorine sensitive pathogens (recontamination)

Target Criterion **Secure and vermin proof**	Adjustment Limit **Evidence of breaches**	Critical Limit **Breach not rectified**
• Visual reservoir inspection • Regular reservoir maintenance • WTP security procedures	• Contact Operations Engineer (XXXX XXX XXX) and organise for repairs • Conduct thorough reservoir inspection • Sample and test reservoir for free chlorine and pH • Sample reservoir water for bacteriological tests • Monitor daily until rectified	• Contact Manager - Utilities (XXXX XXX XXX) • Contact PHU (XXXX XXXX) • Arrange for urgent repairs • Repeat adjustment procedures • Consider boil water alert

CCP – Membranes

What is being measured?	**Post Membrane Turbidity**
Where/how is it measured?	Outlet of membranes / daily sampling and testing
What is the control point?	Membrane feed pumps
What are the hazards?	Turbidity, pathogens

Target Criterion **0.1 NTU**	Adjustment Limit **0.3 NTU**	Critical Limit **1 NTU**
• WTP Water sampling and testing • Plant walkaround and visual inspection • Membrane integrity test • Chemical enhanced backwash (CEB) • Instrument calibration	• Contact Operations Engineer (XXXX) • Test post DAF turbidity and inspect DAF system • Test post membrane turbidity of individual membranes to try and isolate problem • Test reservoir outlet turbidity to determine extent of problem • Membranes engineering inspection • Repeat operational procedures • Increase backwash and CEB frequency • Manually initiate backwash • Test post membrane turbidity hourly, and other parameters as needed	• Contact Manager - Utilities (XXXX XXX) • Contact PHU (XXXX XXXX) • Repeat operational and adjustment procedures • Consider plant shutdown • Consider boil water alert

CCP – Acid Dosing Pump

What is being measured?	**Clear Water pH**
Where/how is it measured?	Outlet of clear water reservoir / daily sampling and testing
What is the control point?	Acid dosing pump
What are the hazards?	Chlorine sensitive pathogens

Target Criterion **7.5**	Adjustment Limit **8.0**	Critical Limit **8.5**
• WTP Water sampling and testing • Plant walkaround and visual inspection • Equipment checks • Drop test and dosing rate checks – daily if acid in use, weekly if not in use • Instrument calibration	• Contact Operations Engineer (XXXX XXX XXX) • Repeat operational procedures • Acid dosing system engineering inspection • Increase acid dosage • Sample and test pH at other plant locations to isolate problem • Sample and test clear water pH half-hourly, and other parameters as needed	• Contact Manager - Utilities (XXXX XXX XXX) • Repeat adjustment and operational procedures • Consider switching to alternative supply

Plant Walkaround and Visual Inspection

Description:	Regular visual inspection of whole WTP and basic equipment, and checking of listed systems
To be carried out by:	Plant Operator
Frequency:	Daily

1. **Whole of plant inspection**
    a. General plant security □
        i. Detailed check weekly, see **Plant Security & Maintenance SOP**
    b. Reservoir integrity □
        i. Detailed check weekly, see **Reservoir Inspection SOP**
    c. Water leaks □
    d. Chemical leaks □
2. **Aeration system inspection**
    a. Booster pumps □
    b. Aeration tower □
3. **DAF system inspection**
    a. Alarms and Faults - PanelView □
    b. Air system □
    c. Saturator level (min 30 cm) □
    d. Drain condensate □
    e. Recycle pumps □
    f. Flocculators □
    g. Float □
    h. Roller/scraper/sprays □
    i. Sludge system □
    j. Transfer pumps □

4. **Mechanical equipment**
    a. Main engine room □
    b. Air system □
    c. Amiad screens □
5. **Diesel generator**
    a. Power Wizard □
    b. Fuel and oil □
    c. Power fail ATC changeover (weekly) □
6. **Skid room and GAC**
    a. Leaks □
    b. Valve operation □
    c. Membrane integrity (weekly) □
7. **Chemical systems**
    a. Acid system □
    b. Hypo system □
    c. Coagulant system □
    d. $KMnO_4$ system □
    e. NaOH system □
    f. Dosing pump drop tests (each pump once weekly) □
        i. See **Dosing Pump Drop Test SOP**
8. **Switchboard**
    a. Faults □
    b. SCADA □
9. **Blair Athol Pumping Station** □

SOP - Liquid Dosing Pump Drop Testing

What:	Drop testing of liquid dosing pumps to ensure they are dosing correctly
Who:	Plant Operator
How often:	Weekly

Insert picture of dosing pump and drop tube, label valves

1. Get the following from the lab
    a. Drop test recording sheet, stopwatch, safety glasses, safety gloves
    b. Write down current pump setting (stroke) from plant diary on recording sheet
2. Check calibration tube is clean and clear, and gradations can be read. Clean tube if necessary.
    a. If cleaning is required, get bottle brush, fill tube part way with chemical, scrub with brush, wash and replace brush.

3. If plant is running, switch selected pump to Auto. If plant not running, switch selected pump to manual.

4. Open inlet valve to calibration tube, fill to near top.

5. Close tank outlet valve, level in calibration tube should begin to drop.

6. Measure drop (volume) over 1 minute measured on stopwatch, and record reading on recording sheet.

7. Repeat twice more, **and ensure level in tube doesn't reach bottom**. If tube empties, refill from storage tank. Record all results. Check consistency of readings and retest if necessary.

8. Open tank outlet valve and close calibration tube inlet valve, ensure pump has liquid feed at all times.

9. If pump is in manual, return to auto.

10. Clean and return equipment to lab.

11. Calculate average volume per minute (mL / minute) and write answer on recording sheet.

12. Compare results with current setting and calibration curve in lab.

    a. If point is not on curve, carry out calibration and derive new curve.

Reservoir Inspection

Description:	Regular inspection of treated water reservoir for any signs of damage, forced entry, or animals.
To be carried out by:	Operators
Frequency:	Weekly

Insert picture of reservoir

1. **Inspection of grounds around reservoir**

    a. Check ground for any signs of thrown items, such as big rocks, smashed glass bottles, bullets

    b. Check ground for any animal faeces or other signs of animals

2. **Inspection of reservoir – walk all the way around**

    a. Check for any signs of leaks (staining, damp patches, puddles)

    b. Check for damage to the walls from rocks or other items

    c. Check mesh/netting for any holes

    d. Check for any signs of animal entry, particularly birds nesting

    e. Check roof for signs of damage or entry (monthly)

SOP - Liquid Dosing Pump Drop Testing

What:	Drop testing of liquid dosing pumps to ensure they are dosing correctly
Who:	Plant Operator
How often:	Weekly

Insert picture of dosing pump and drop tube, label valves

1. Get the following from the lab
    a. Drop test recording sheet, stopwatch, safety glasses, safety gloves
    b. Write down current pump setting (stroke) from plant diary on recording sheet
2. Check calibration tube is clean and clear, and gradations can be read. Clean tube if necessary.
    a. If cleaning is required, get bottle brush, fill tube part way with chemical, scrub with brush, wash and replace brush.

3. If plant is running, switch selected pump to Auto. If plant not running, switch selected pump to manual.

4. Open inlet valve to calibration tube, fill to near top.

5. Close tank outlet valve, level in calibration tube should begin to drop.

6. Measure drop (volume) over 1 minute measured on stopwatch, and record reading on recording sheet.

7. Repeat twice more, **and ensure level in tube doesn't reach bottom**. If tube empties, refill from storage tank. Record all results. Check consistency of readings and retest if necessary.

8. Open tank outlet valve and close calibration tube inlet valve, ensure pump has liquid feed at all times.

9. If pump is in manual, return to auto.

10. Clean and return equipment to lab.

11. Calculate average volume per minute (mL / minute) and write answer on recording sheet.

12. Compare results with current setting and calibration curve in lab.

    a. If point is not on curve, carry out calibration and derive new curve.

APPENDIX B – RISK ASSESSMENT PAPER

Lake Scapa Water Supply

Risk Assessment Workshop Output Paper

Bowmore Shire Council

Version No. 3.1

March 2012

Document Status	Final Version 3.1		
Document History:	Created by: Risk Consultant	Version 1.3	4/8/2011
	Client Draft	Version 2.0	9/7/2011
	Final Draft	Version 2.1	5/12/2011
	NSW Health Final	Version 3.0	13/1/2012
	Final	Version 3.1	20/2/2012
Authors	Risk Consultant		
File Name:	Risk Assessment Output Paper v3_1_Deidentified.docx		

This document is designed for printing double-sided

EXECUTIVE SUMMARY

RISK ASSESSMENT WORKSHOP BACKGROUND

The *Public Health Act 2010* has been passed by Parliament and is expected to commence in 2012. The Act will require drinking water suppliers to establish, and adhere to, a quality assurance program. NSW Health is currently undertaking a pilot program to develop risk based management systems for four schemes. Lake Scapa is one of these schemes.

In developing a management system, water suppliers should undertake a risk assessment from catchment to consumer and develop critical control points to ensure that unsafe water is not released into distribution systems and that it is protected from contamination during distribution. This was undertaken as a workshop on the 24th – 25th August 2011.

WORKSHOP OBJECTIVE

The objectives of the risk assessment workshop were to:

- Understand the system from catchment to tap from a water quality perspective;
- Understand and prioritise the hazards and risks to drinking water consumers;
- Identify the control measures in place for addressing the identified hazards and risks;
- Identify any additional controls or actions which may be required to improve the risk management of the scheme; and
- Identify critical control points for the scheme.

RISK SUMMARY

A total of sixty two hazardous events were identified for the Lake Scapa Scheme. Twenty two of these risks were assessed as being very high uncontrolled risks. Table S1 documents these risks and the workshop assessment of the controlled risk.

TABLE S1 – CONTROLLED RISK RANKING OF EVENTS ASSESSED AS VERY HIGH UNCONTROLLED RISKS

Controlled Risk	Hazardous Event
Very High	• Power failure • Failure of telemetry monitoring devices • Ingestion of non potable water at Blair Athol
High	• Algae, turbidity from failure of DAF system • Taste and odour or toxins due to GAC bypass open • Chlorine sensitive pathogens due to underdosing of chlorine (<0.5mg/L leaving reservoir) • Pathogens due to topping up reservoir by water carting • Backflow/cross connection leading to water contamination events in the distribution system
Moderate	• High levels of nutrients in the water leading to algal blooms • High levels of nutrients in the water, causing algal toxins • High levels of nutrients causing algal blooms that cause taste and odour problems • Turbidity / suspended solids (other than algae) from the Bowmore tributary and local wave action • Pathogens in the lake from upstream agriculture & human inputs • Pathogens in the lake from onsite sewage systems • Fe/Mn from overdosing of NaOCl / NaOH • Mn from overdosing of permanganate system • Algae, turbidity or pathogens in treated water due to partial failure of membrane • Insufficient water for backwashing due to lack of water in reservoir • Human error

Controlled Risk	Hazardous Event
Low	• Taste and odour or toxins from exhaustion of GAC system • Taste and odour or toxins due to short circuiting affecting contact time for GAC • Pathogens due to recontamination of treated water by vermin

Forty one actions were identified during the workshop to improve the management of the risks.

Critical Control Points

The critical control points and critical limits identified to manage the risks are shown in Table S2 below.

Table S2 Critical Control Points and Parameters

Control Point	Hazard	Control Parameter	Target	Operational Limit	Critical Limit
Lake raw water pumps	Algae	Pre DAF turbidity	<100 NTU	<500 NTU	1000 NTU
DAF outlet	Algae, Turbidity	Post DAF turbidity	<3 NTU	5 NTU	10 NTU
Membranes	Algae, Turbidity	Post membrane turbidity	0.1 NTU	0.3 NTU	1 NTU
	Pathogens	Membrane integrity (SCADA permeability alarm)	Check weekly		
Reservoir outlet	Pathogens	Chlorine residual at reservoir exit	1 mg/L	0.5 mg/L	0.2 mg/L
		pH at reservoir exit	7.5	8	8.5
Reservoir	Pathogens (recontamination)	Reservoir inspection	Daily	Minor damage	Major damage

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CONTENTS

1 INTRODUCTION

The Australian Drinking Water Guidelines (ADWG) (NHMRC/NRMMC, 2011) set out a holistic approach to drinking water management including understanding where sources of contamination may arise and how contamination may find its way to the consumer. The approach is termed the Framework for the Management of Drinking Water Quality (the Framework).

A significant component of the Framework is understanding and managing the risks to drinking water. This was undertaken as a workshop on 24th -25th August 2011. The workshop attendees are listed in Table 1-1.

TABLE 1-1. WORKSHOP ATTENDEES.

Name	Role	Signature
	Technical Director	
	Manager Utilities	
	Engineer Water & Sewer	
	Operator	
	NOW Inspector	
	NSW Health Representative	
	Independent Technical Advisor	
	Workshop Facilitator	
	Workshop Recorder	

2 WATER QUALITY RISK ASSESSMENT – A BACKGROUND

2.1 ADWG RISK ASSESSMENT COMPONENTS

Element 2 of the ADWG Framework provides the following framework for undertaking a risk assessment on a water supply system. The section(s) where the framework is addressed in this paper are shown in brackets.

Water supply system analysis;

- Assemble a team with appropriate knowledge and expertise (Table 1-1).
- Construct a flow diagram of the water supply system from catchment to consumer (Section 3.3).
- Assemble pertinent information and document key characteristics of the water supply to be considered (Sections 3 & 4).

Assessment of water quality data;

- Assemble historical data from source waters, treatment plants and finished water supplied to consumers (Appendix A).
- List and examine exceedances (Section 4 and Appendix A).
- Assess data using tools such as control charts and trend analysis to identify trends and potential problems (Appendix A).

Hazard identification and risk assessment,

- Define the approach and methodology to be used for hazard identification and risk assessment (Section 5);
- Identify and document hazards, sources and hazardous events for each component of the water supply system (Appendix B);
- Estimate the level of risk for each identified hazard or hazardous event (Appendix B);
- Evaluate the major sources of uncertainty associated with each hazard and hazardous event and consider actions to reduce uncertainty (Appendix B); and
- Determine significant risks and document priorities for risk management (Appendix B, Table 7-1).

3 System Description

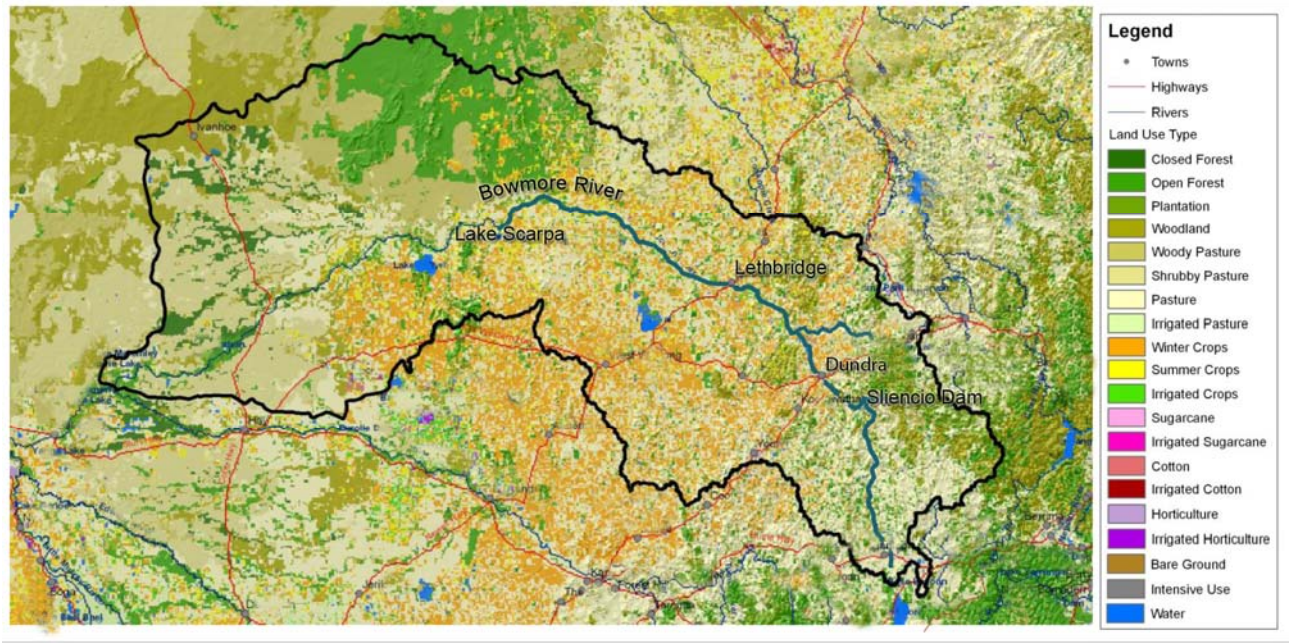
Bowmore Shire Council provides potable water to 1,300 consumers at Lake Scapa as well as the Lake Scapa Aboriginal Community through a 50mm service line. The villages of Glenmoray and Blair Athol also receive a reticulated non-potable supply from this source.

The source water for the scheme is from Lake Scapa. Council is commencing a project to bring three bores from Cawdor into the source mix. These were considered as part of the risk assessment.

3.1 Catchment Characteristics

Lake Scapa is a shallow off-river storage located in the mid-section of the Bowmore River. It is managed by as drought storage and a town water supply and is kept at around 70% capacity under normal circumstances. The filling and releasing of water from the lake is generally a steady process. Figure 3-1 shows the Bowmore catchment, Bowmore River, major landuses and Sliencio Dam - the major regulating structure of the river (adapted from CSIRO).

Figure 3-1. Bowmore Catchment.



The key catchment statics are summarised in Table 3-1. This data has been sourced from DSNR (2003a, b), Bureau of Meteorology and 2006 Census data.

Table 3-1. Key catchment statistics.

Parameter	Data
Major towns	Pancor (7,100), Dundra (8,400), Ganton (9,800), Lethbridge (7,000)
Land Use	Agriculture: beef and wool production, viticulture, cotton, wheat, & other cereals
Upstream storages	Sliencio Dam (2,050,000 ML), Carcoar Dam (35,800ML), Lake Scapa (63,000 ML)
Rainfall	Lake Scapa 422mm, Elevated eastern part of the catchment 1 200 mm
Evaporation	Potential average evaporation exceeds average annual rainfall over the entire catchment (DLWC 1997 in DSNR 2003a)
Temperature	Lake Scapa - Winter average of 10.9 ^{o}C and summer average 25.1 ^{o}C Elevated eastern part of the catchment - Winter average minimum of 0^{o}C and summer average maximum of 27^{o}C

Future Sources

A bore water source is currently being adding into the Lake Scapa supply from Cawdor. This water can be considered to be surface connected; although the bores are approximately 50 m deep, they are predominately through gravel and sand (alluvial).

3.2 Treatment and Distribution

Raw water is pumped from the lake to the dissolved air flotation (DAF) pre-treatment system via submersible pumps operating in a duty/standby arrangement. Polyaluminium chloride (PACl) coagulant for colour and turbidity removal and hydrochloric acid for pH control are dosed into the raw water pipeline. An in-line mixing arrangement disperses the chemicals in the water. The DAF removes a range of contaminants including algae, turbidity, iron, manganese and colour. The raw water design limits for the DAF are shown in Table 3-2.

Table 3-2. DAF raw water design limits.

Parameter	Average Maximum	Maximum
Algae (bio volume)	45.0 mm^3/L	334 mm^3/L
Apparent Turbidity	209 NTU	975 NTU
pH	8.0 – 9.6	8-10

After the DAF the water is treated through an ultrafiltration membrane plant (0.05µm). There are two units each with 10 membranes to provide a daily peak production capacity of 4.5 ML. There are four pressure transmitters per UF units monitoring transmembrane pressure during filtration and backwash cycles. The membrane feed water quality required is shown in Table 3-3.

Table 3-3. Membrane feed water quality.

Parameter	Requirement
True Colour	≤ 10 Hazen Units
Turbidity	≤ 5 NTU 95% of the time, ≤ 10 NTU 100% of the time
pH	7.2 – 8.0

Following the membrane granular activated carbon (GAC) is used for the removal of taste odour and algal toxins. Two vessels operate in series as a single unit. Three units operate in parallel with an average contact time of 12 minutes (O&M Manual).

Disinfection is achieved through the use of sodium hypochlorite immediately after the GAC. Contact time is achieved in the reservoir. There is no online monitoring of chlorine residual.

Lake Scapa township is supplied from the reservoir. Water is pumped from the reservoir to the Blair Athol distribution system via the 6 Miles pump station and reservoir.

There are a number of raw water pumps for non-potable uses from the lake to private, local and state government properties which pose a cross connection risk. Cross connection risks may also arise from industrial properties and RV dump points (see risk Ds3 in Appendix B).

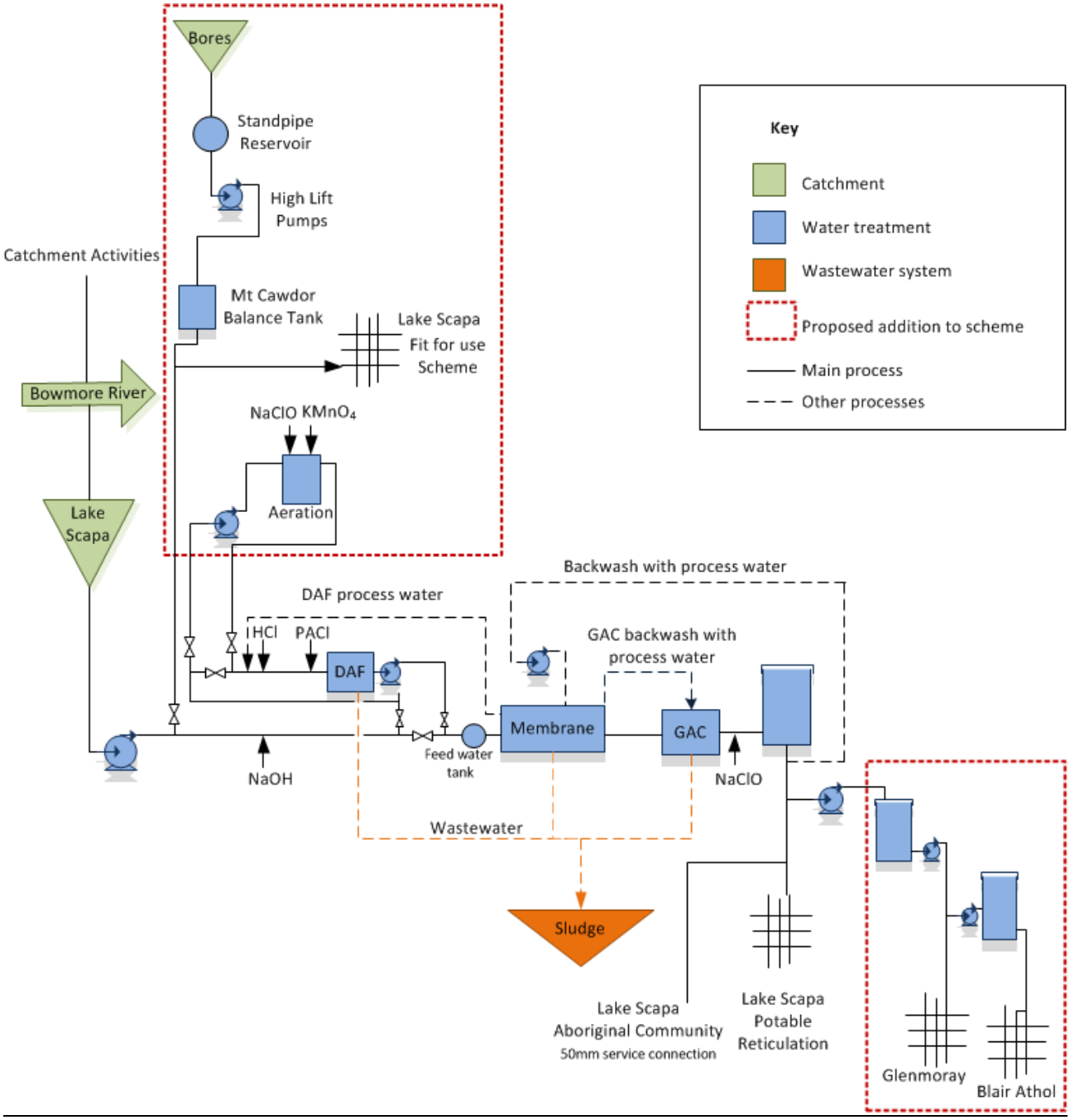
Future Treatment

The bore water will be mixed with potassium permanganate and sodium hydroxide and treated via spray aeration to oxidise soluble iron present in the water. Clarification and filtration of the oxidised iron and manganese will be achieved at the existing water treatment plant.

3.3 Process Flow Diagrams

A conceptual flow diagram for the system is shown in Figure 3-2. The purpose of this diagram is to show key inputs, steps and flow direction.

Figure 3-2. Conceptual process flow diagram of Lake Scapa Treatment Plant and Supply System.



4 WATER QUALITY SUMMARY

4.1 RAW WATER QUALITY

Lake Scapa is shallow, eutrophic, turbid and has frequent blue-green algal blooms. Raw water extracted from the Lake Scapa storage has exhibited turbidity at times as high as 974 NTU and algal counts have been as high as 45,000,000 cells/mL with a biomass equivalent volume of 334 mm^3/L (Commerce 2009).

Blooms may be seeded from the two small storages along the inlet channel, Sheet of Water and Curlew Water. These two shallow water bodies are wind protected and blooms have been observed on both storages before blooms are detected in Lake Scapa (DSR 2003a).

4.2 RISKS IDENTIFIED THROUGH WATER QUALITY ANALYSIS

Water quality data was extracted from the NSW Health verification monitoring database for testing carried out in Lake Scapa over the period 1-1-2001 to 31-1-2011. To allow statistical formulae to handle the full body of data, non-detects were transformed to half the detection limit and values above the upper dynamic range of the assay to twice the upper limit AGWQMR (2000).

Water was tested for 38 quality parameters. An analysis of the results against the Australian Drinking Water Guidelines 2011 is provided in the tables below. Table 4-1 provides statistics for common parameters, and Table 4-2 provides descriptions for all parameters where any exceedences were recorded. Graphs of the water quality parameters can be found in Appendix A. The water quality parameters are summarised in Table 4-3 - Table 4-4 below.

TABLE 4-1. SUMMARY OF WATER QUALITY DATA FOR LAKE SCAPA (NSW HEALTH DATA).

Parameters	Number of Samples	Min	5th %ile	Mean	95th % ile	Max	ADWG value	No. of exceed-ances
pH	76	7.2	7.4	7.8	8.05	8.2	6.5 - 8.5	0
True Colour (HU)	14	1.3	0.5	2.3	4.1	5.4	15	0
Turbidity (NTU)	78	0.0	0.0	1.2	2.1	42.0	5	2
Iron (mg/L)	14	0.01	0.01	0.12	0.22	0.26	0.3	0
Manganese (mg/L)	16	0.006	0.003	0.009	0.03	0.06	0.5	0
Thermotolerant Coliforms (cfu/100mL)	68	0.0	0.0	2.5	21.3	42.0	0	9
E. coli (cfu/100mL)	499	0.0	0.0	0.5	0.0	66.0	0	13
Total Hardness (mg/L as $CaCO_3$)	14	5.7	106.6	223	364	518	200	9

TABLE 4-2. WATER QUALITY ISSUES FOR LAKE SCAPA.

Issue	Frequency	Comment
E. coli	Occasionally	13 positive results for E.*coli* were found from 499 samples, the most recent in 2004.
Turbidity	Rare	2 exceedances for turbidity were found from 78 samples.
Total Dissolved Solids	Rare	1 exceedance was found for total dissolved solids (in 2005) from 14 samples.
Aluminium	Occasionally	3 low range exceedances were found for aluminum from 14 samples.
Chloride	Rare	1 exceedance was found for chloride (in 2005) from 14 samples.
Iodine	Occasionally	2 exceedances were found for iodine from 16 samples, the most recent in 2006.
Sodium	Rare	1 exceedance was found for sodium (in 2005) from 16 samples.
Total Hardness	Often	Hardness is often close to or higher than the guideline value of 200 mg/L. 9 exceedances were found from 14 samples.
Zinc	Rare	1 exceedance was found for zinc (in 2005) from 14 samples.

TABLE 4-3. SUMMARY OF WATER QUALITY DATA FOR BLAIR ATHOL (NSW HEALTH DATA).

Parameters	No. of Samples	Minimum	Mean	95th‰	Maximum	ADWG value	No. of exceed-ances
pH	41	7.0	8.1	8.2	8.5	6.5 - 8.5	0
True Colour (HU)	9	1.0	2.6	3	3.8	15	0
Turbidity (NTU)	41	0.0	0.2	0.3	2.7	5	0
Iron (mg/L)	9	0.01	0.03	0.04	0.09	0.3	0
Manganese (mg/L)	9	0.005	0.003	0.004	0.008	0.5	0
E. coli (cfu/100mL)	196	0.0	0.1	0	4.0	0	13
Total Hardness (mg/L as $CaCO_3$)	9	155	218	239	290	200	7

TABLE 4-4. WATER QUALITY ISSUES FOR BLAIR ATHOL.

Issue	Frequency	Comment
E. coli	Occasionally	Occasional positive results for *E. coli* have been recorded
Total Hardness	Always	Hardness is almost always above guideline limit of 200 mg/L

5 Risk Assessment

5.1 Risk Assessment Methodology

Risks were assessed for each process step. For each risk participants were asked to identify the:

Hazardous event	A hazardous event is an event that introduces contaminants (hazards) to the water.
Hazard	A hazard is a physical, chemical or biological agent in the water with the potential to cause an adverse effect.
Controls in place	Controls are practices and equipment that reduce the hazard or the frequency of the hazardous event.
Controlled Risk	This was assessed by identifying the likelihood and consequence of the hazardous event occurring with the control in place (residual risk). The risks was be assessed as Likelihood (Table 5-1) x Consequence (Table 5-2). A risk assessment matrix (ADWG, 2011) was be used to assess risks (Table 5-3).
Maximum Risk	This will be assessed by identifying likelihood and consequence of the hazardous event occurring if the controls were to fail.

Table 5-1. Likelihood table (modified from ADWG, 2004).

Level	Descriptor	Example description
A	Almost certain	Is expected to occur in most circumstances – Multiple times per year
B	Likely	Will probably occur in most circumstances – Once a year
C	Possible	Might occur or should occur at some time – 1 to 5 years
D	Unlikely	Could occur at some time – 5 to 20 Years
E	Rare	May occur only in exceptional circumstances – less than 20 years

Table 5-2. Consequence table (Modified from ADWG, 2004).

Level	Descriptor	Example description
1	Insignificant	Insignificant impact, little disruption to normal operation, low increase in normal operation costs
2	Minor	Minor impact for small population, some manageable operation disruption, some increase in operating costs
3	Moderate	Minor impact for large population, significant modification to normal operation but manageable, operation costs increased, increased monitoring
4	Major	Major impact for small population, systems significantly compromised and abnormal operation if at all, high level of monitoring required
5	Catastrophic	Major impact for large population, complete failure of systems

TABLE 5-3. RISK MATRIX (ADWG, 2004).

	1 Insignificant	2 Minor	3 Moderate	4 Major	5 Catastrophic
A (almost certain)	Moderate	High	Very high	Very high	Very high
B (likely)	Moderate	High	High	Very high	Very high
C (possible)	Low	Moderate	High	Very high	Very high
D (unlikely)	Low	Low	Moderate	High	Very high
E (rare)	Low	Low	Moderate	High	High

5.2 RISK ASSESSMENT OUTCOMES

Sixty two risks were identified. The uncontrolled risks are shown in Table 5-4 and the controlled (residual) risks are shown in Table 5-5. A description of the main risks follows after the tables.

TABLE 5-4. UNCONTROLLED RISK PROFILE.

Process Step	Very High	High	Moderate	Low	Uncertain	Unranked	Total
Lake Scapa catchment	6	4	1	1			12
Bore		1	2	2	1		6
Bore/Lake					1		1
Transfer from bore to plant		1		1			2
New plant aeration system	2	3	1				6
DAF	1	4	1				6
Membrane	2						2
GAC	3				1		4
Disinfection	1			1			2
Reservoir	2	2				1	5
Distribution	1	2	1		1	1	6
Fit for purpose				1			1
Blair Athol reservoir	1						1
Whole of Plant	3	1					4
Total	**22**	**18**	**6**	**6**	**4**	**2**	**58**

TABLE 5-5. CONTROLLED RISK PROFILE.

Process	Very High	High	Moderate	Low	Uncertain	Total
Lake Scapa catchment		1	9	2		12
Bore			1	4	1	6
Bore/Lake					1	1
Transfer from bore to plant				2		2
New plant aeration system			4	2		6
DAF		1		5		6
Membrane			2			2
GAC		1		2	1	4
Disinfection		1		1		2
Reservoir		1	1	3		5
Distribution		3		2	1	6
Fit for purpose				1		1
Blair Athol reservoir	1					1
Whole of Plant	2	1	1			4
Total	**3**	**9**	**18**	**24**	**4**	**58**

5.3 KEY RISKS

The workshop identified twenty two very high risks. Three of these remain very high even with control in place:

- Power failure
- Failure of telemetry monitoring devices
- Ingestion of non potable water at Blair Athol.

The workshop identified five very high risks that are reduced to high risk with the application of control measures. These were:

- Algae, turbidity from failure of DAF system
- Taste and odour or toxins due to GAC bypass open
- Chlorine sensitive pathogens due to underdosing of chlorine (<0.5mg/L leaving reservoir)
- Pathogens due to topping up reservoir by water carting
- Backflow/cross connection leading to water contamination events in the distribution system

The workshop participants considered actions to improve the management of these risks (See Element 12 and the action plan in Appendix C).

The workshop identified eleven very high risks that are reduced to moderate risk with the application of control measures. These were:

- High levels of nutrients in the water leading to algal blooms

- High levels of nutrients in the water, causing algal toxins
- High levels of nutrients causing algal blooms that cause taste and odour problems
- Turbidity / suspended solids (other than algae) from the river tributary and local wave action
- Pathogens in the lake from upstream agriculture & human inputs
- Pathogens in the lake from onsite sewage systems
- Fe/Mn from overdosing of NaOCl / NaOH
- Mn from overdosing of permanganate
- Algae, turbidity or pathogens in treated water due to partial failure of membrane
- Insufficient water for backwashing due to lack of water in reservoir
- Human error

The workshop identified three very high risks that are reduced to low risk with the application of control measures. These were:

- Taste and odour or toxins from exhaustion of GAC system
- Taste and odour or toxins due to short circuiting affecting contact time for GAC
- Pathogens due to recontamination of treated water by vermin

The identified controls are important for maintaining the reduced risk. Monitoring and actions around critical control points (see Section 6) are essential to maintain the safety of the water.

6 Critical Control Point Identification

Critical control points are the operational core of the drinking water management system. For a control point to be considered critical it must:

- Control hazards that represent a significant risk and require elimination or reduction to assure supply of safe drinking water.
- Have a parameter (surrogate) that can be measured in a timely manner for the hazardous event
- Be able to have a correction applied in response to a deviation in the process

The key hazards from the risk assessment were reviewed and the critical control points were identified (Table 6-1).

Table 6-1. Identified Critical Control Points.

Control Point	Hazard	Control Parameter	Target	Operational Limit	Critical Limit
Lake raw water pumps	Algae	Pre DAF turbidity	<100 NTU	<500 NTU	1000 NTU
DAF	Algae, Turbidity	Post DAF turbidity	<3 NTU	5 NTU	10 NTU
Membranes	Algae, Turbidity	Post membrane turbidity	0.1 NTU	0.3 NTU	1 NTU
	Pathogens	Membrane integrity (SCADA permeability alarm)	Check weekly		
Chlorine contact	Pathogens	Chlorine residual at reservoir exit	1 mg/L	0.5 mg/L	0.2 mg/L
		pH at reservoir exit	7.5	8	8.5
Reservoir	Pathogens (recontamination)	Reservoir inspection	Daily	Minor damage	Major damage

7 ACTIONS

The workshop identified forty five actions, shown in Table 7-1. The risk number corresponds to the risk number in Appendix B. Eight of these actions will be completed by Consulting Engineer as part of the Drinking Water System development. Council should prioritise the remaining actions and assign personnel to oversee the completion of the actions.

TABLE 7-1. ACTIONS FROM THE RISK ASSESSMENT.

Action No.	Follow-up Actions	Contaminant	Risk No	Who
RA1	Add weekly testing of the generator to the checklist	N/A	WoP2	Consulting Engineer
RA2	Consider a clear water tank for the plant	Pathogens	R1,M1	Council
RA3	Consider CCTV and review gate with swipe card and lockable access after hours	Various	R3,R4,WoP1	Council
RA4	Consider implementation of an online turbidity meter before membrane plant	Algae, turbidity, pathogens	M1	Council
RA5	Consider implementing a flow switch or other alarm to identify if GAC is being bypassed	Taste and odour, toxins	G4	Council
RA6	Consider modifying the daily test sheet to include appearance of raw water (daphina)	Daphnia	C10	Council
RA7	Consider power back-up for the Cawdor system and WTP generator	Various	WoP2	Council
RA8	Consider relocation of reservoir	N/A	WoP3	Council
RA9	Consider writing a manual operational procedure for the DAF system	Algae, turbidity, pathogens	D6	Council
RA10	Council to ensure compliance with the plumbing code	Various	Ds3	Council
RA11	Design audit and design safety audit should be undertaken to look at the entire aeration project	N/A	A1	Council
RA12	Develop a checklist to ensure the current treatment barriers are maintained	Algae, toxins, taste & odour, inorganic turbidity, pathogens, iron, manganese	C5 –C8	Consulting Engineer
RA13	Develop a service maintenance plan	Organics	G3, G1	Council / Consulting Engineer
RA14	Develop CCP and underlying procedures for treatment processes	Cryptosporidium, pathogens, iron, manganese	C12, C14, B1	Consulting Engineer
RA15	Develop procedures (frequency and details) and checklist for the Mount Cawdor reservoir	Pathogens	TB2, R2	Consulting Engineer
RA16	Develop procedures to change water source	Dissolved organic carbon, inorganic turbidity, pathogens	C9, BL1	Contractor
RA17	Develop trigger point to change to alternative supply	Dissolved organic carbon, inorganic turbidity, pathogens	C9	Contractor
RA18	Document procedures for jar testing, turbidity testing, drop testing	Algae and turbidity	D5,D6,D4	Consulting Engineer
RA19	Document procedures for visual inspection for GAC	Taste and odour, toxins	G1,G3	Council

Action No.	Follow-up Actions	Contaminant	Risk No	Who
RA20	Emergency procedures manual should be developed - modify the NSW Health response protocol (including changes in source water) and include this scenario (i.e. chlorine residual management)	Cryptosporidium, pathogens	C13	Consulting Engineer
RA21	Ensure yearly inspections of on-site sewage management systems	Pathogens	C13	Council
RA22	Formalise procedures for the screen cleaning	Daphnia	C11	Council
RA23	Formalise the sampling and testing for breakthrough / GAC effective operation	Taste and odour, toxins	G1,G3	Consulting Engineer
RA24	Incident and emergency response plan to be developed	Pathogens	WoP3	Consulting Engineer
RA25	Investigate gas chlorination to improve chlorination efficacy	Pathogens	Df2	Council
RA26	Consider a chlorine residual analyser (not to control)	Chlorine sensitive pathogens	Df2	Council
RA27	Investigate if there is data / history on the Lake Scapa incidence of algal blooms producing toxins	Chlorine sensitive pathogens	C6	Council
RA28	Management procedure for telemetry failure	Various	WoP4	Council
RA29	On-going monitoring of current training	Various	WoP5	Council
RA30	Develop procedure for Council to continue flushing of all mains to ensure hydrants work efficiently when needed	Taste and odour, pathogens	Ds4, Ds5	Council
RA31	Procedure required to refill reservoir with minimal risk of contamination	Various	M2	Council
RA32	Procedure to be developed on when $KMnO_4$ is to be used (Only be used if chlorine doesn't work)	Mn	A4	Contractor
RA33	Re-engineer the reservoir to reduce the critical limit	Various		Council
RA34	Review location of permanganate system dosing point	Mn	A3	Council
RA35	Review manganese overdosing risk as part of the design review	Fe/Mn	A2	Council
RA36	Review procedures for mains breaks (WIOA Manual)	Pathogens	Ds2	Council
RA37	Review NaOCl dosing to remove the irregularity that has occurred in the past	Fe/Mn	A1	Council
RA38	Set service maintenance intervals for reservoirs and GAC	Taste and odour, toxins, pathogens	TB2 G1 G3 R2	Council / Consulting Engineer
RA39	The risk of water source changeover should be reranked once the source has been developed	Various	BL1	Council
RA40	Malicious contamination of the reservoir should be handled through IEP	Various	R3	Council / Consulting Engineer
RA41	Written procedures for membrane integrity testing and plugging burst fibres should be developed	Pathogens	C13	Council

Action No.	Follow-up Actions	Contaminant	Risk No	Who
RA42	Review the procedure and method for notifying the community that the water is non-potable	Pathogens		Council
RA43	Consider a booster chlorination plant	Pathogens	T1	Council
RA44	Consider implementing chlorination for Blair Athol	Pathogens	T1	Council
RA45	Follow up compliance with the NSW Plumbing code & NSW Health guidance for non-potable water	Pathogens	T1	Council

8 REFERENCES

ADWG (2011) NHMRC/NRMMC (National Health and Medical Research Council/ Natural Resource Management Ministerial Council) Australian Drinking Water Guidelines (ADWG) National Water Quality Management Strategy. ISBN Online: 1864965118 4.

AGWQMR (2000) Australian and New Zealand Environment and Conservation Council, Agriculture and Resource Management Council of Australia and New Zealand Australian guidelines for water quality monitoring and reporting.

CSIRO Acd 2011 10/8/2011 http://adl.brs.gov.au/water2010/pdf/catchment_XXX_summary.pdf

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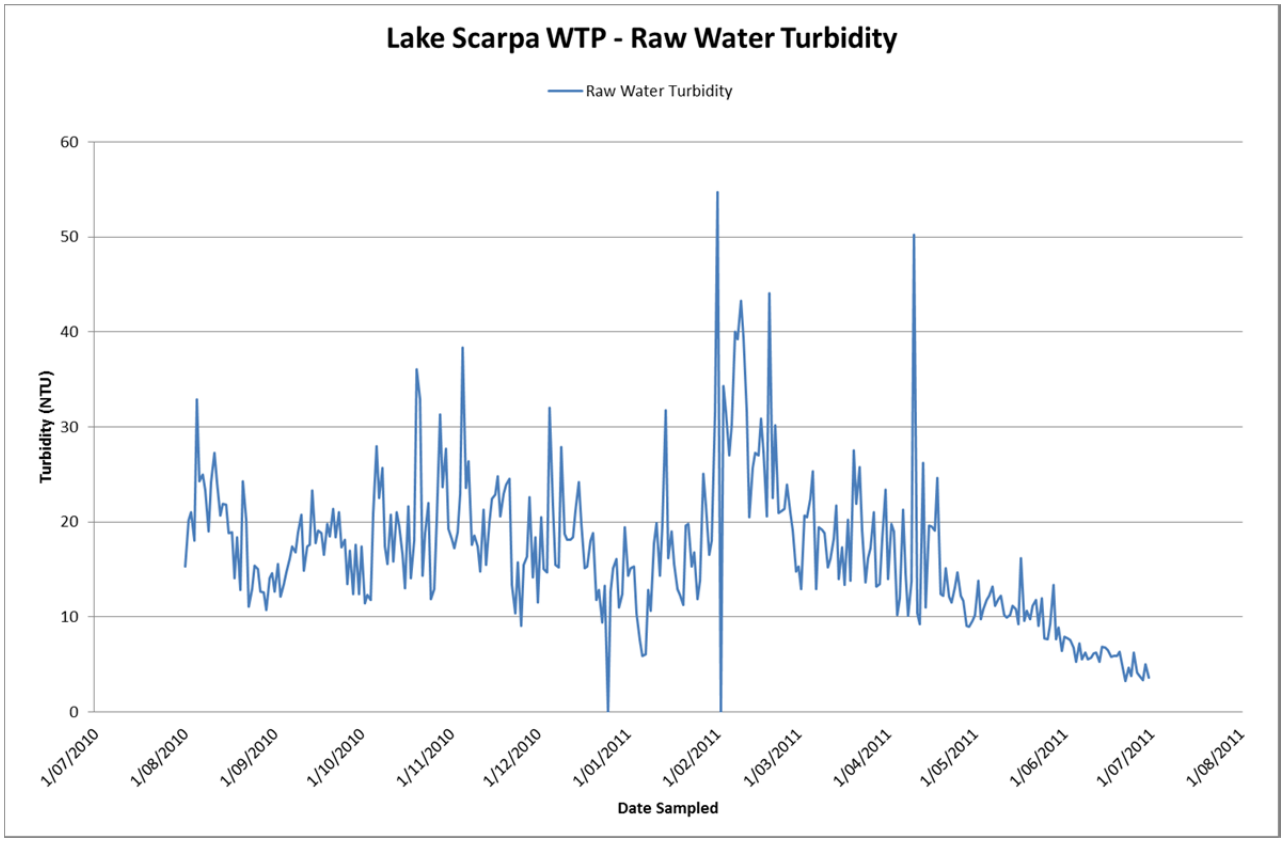
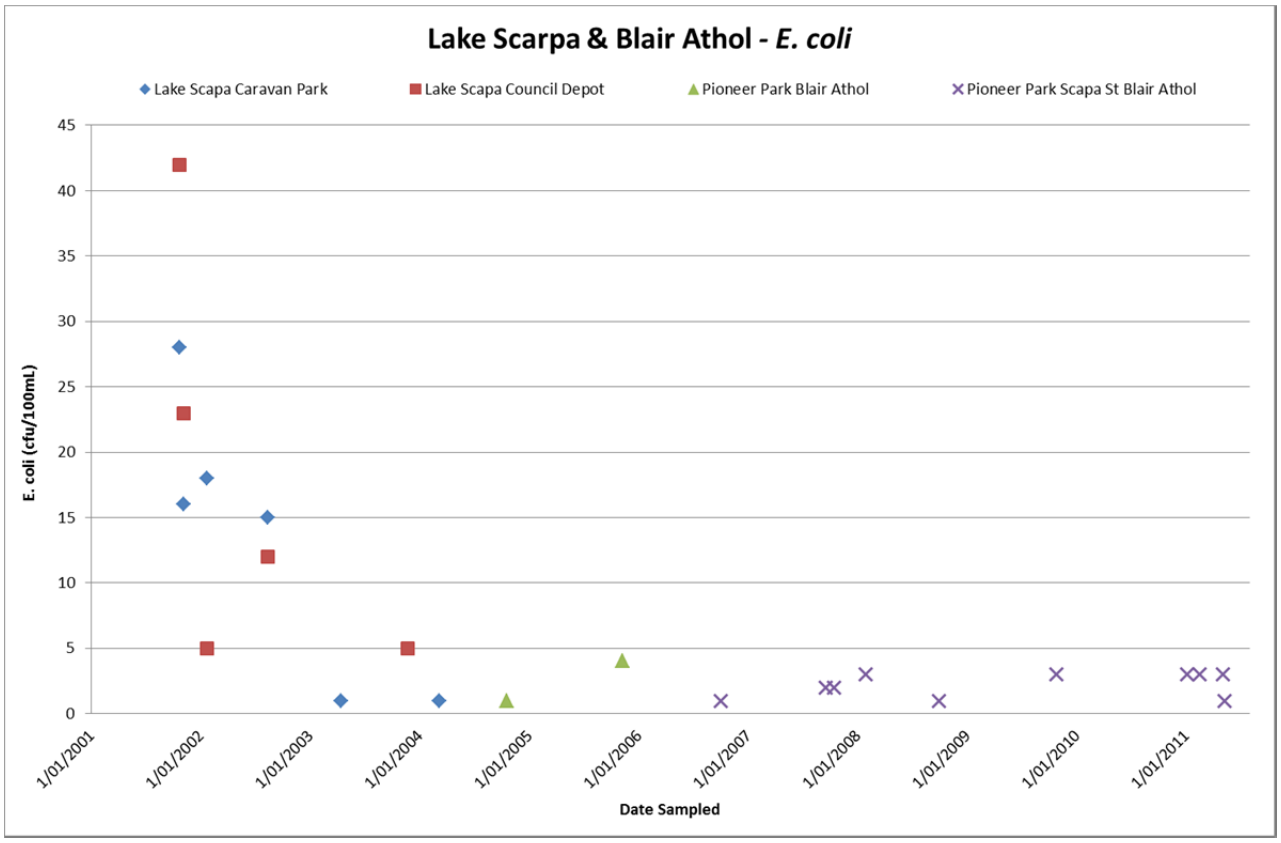
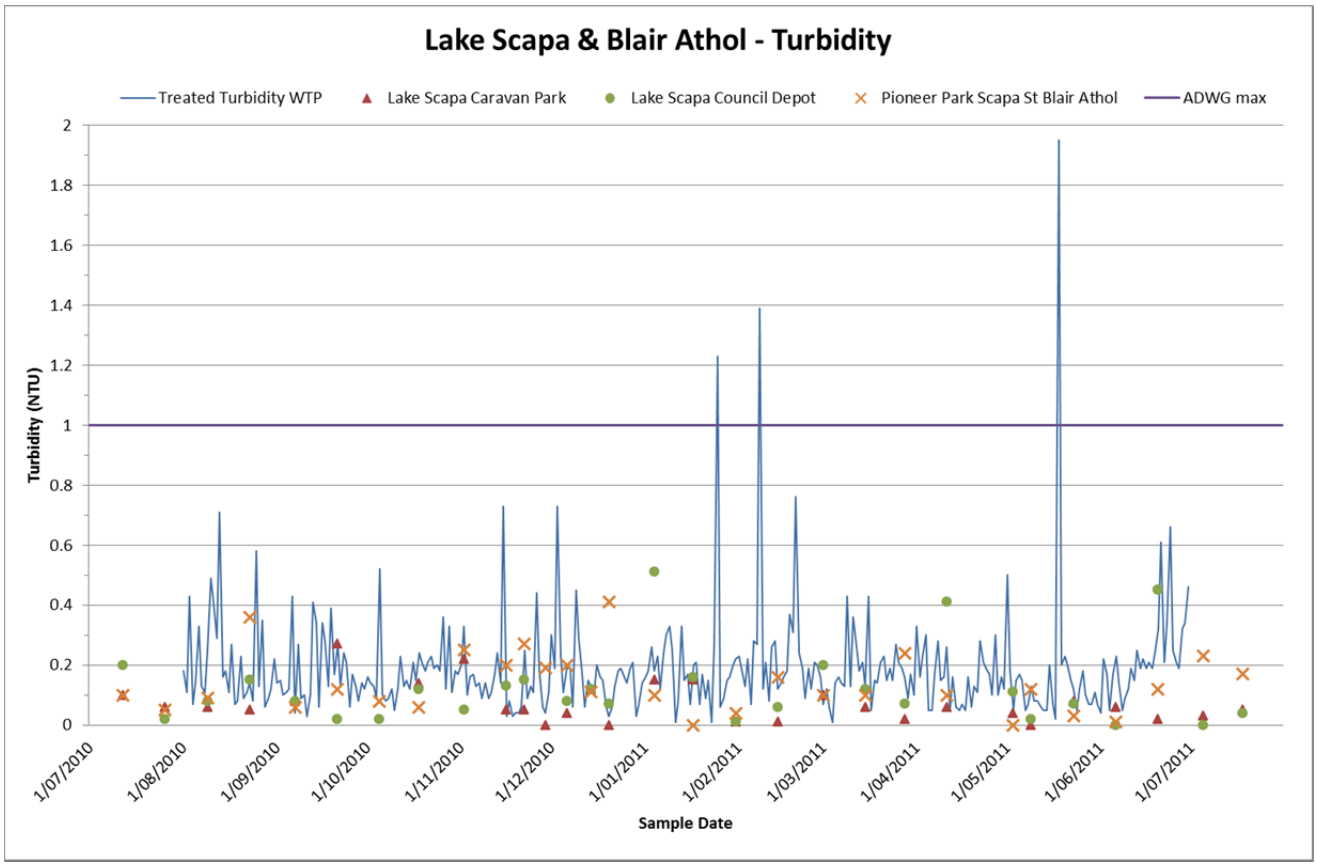
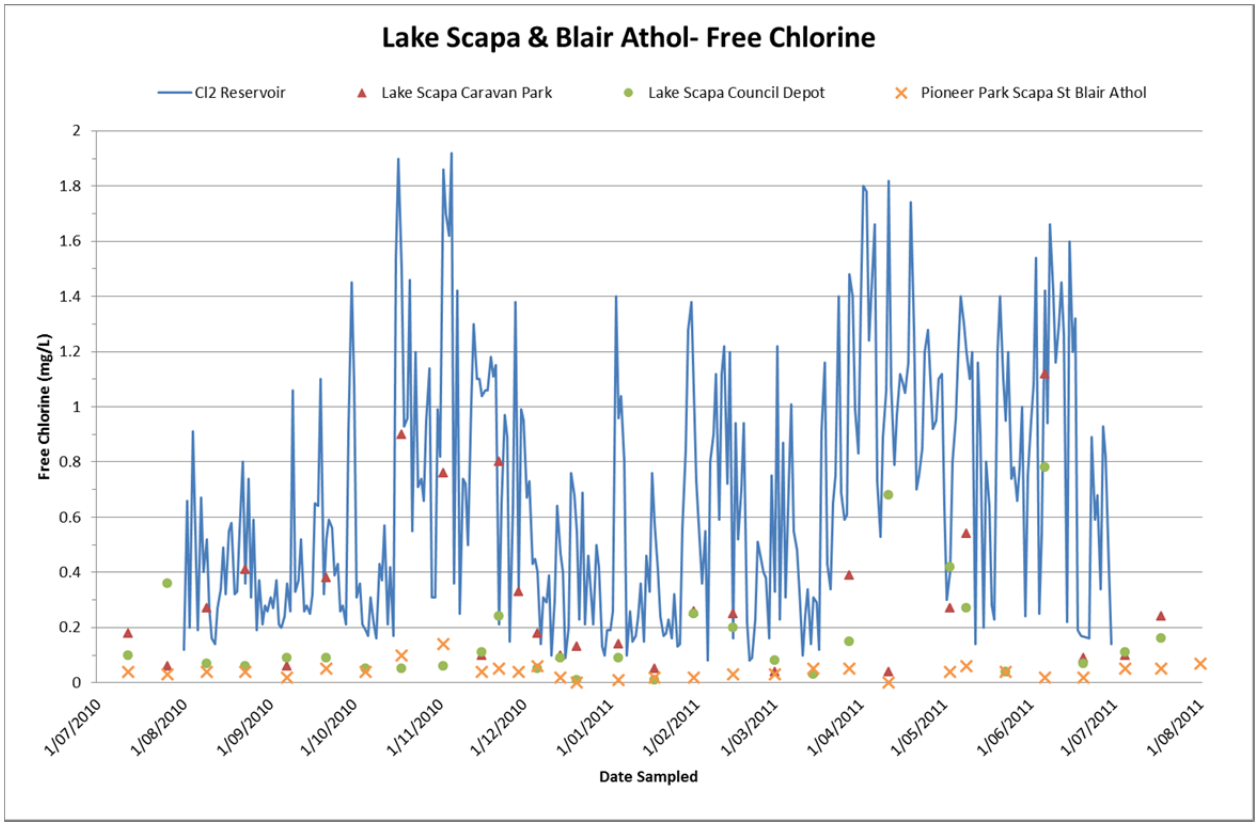
APPENDIX A – WATER QUALITY DATA






Lake Scapa & Blair Athol - Turbidity
Treated Turbidity WTP
Lake Scapa Caravan Park
Lake Scapa Council Depot
Pioneer Park Scapa St Blair Athol
ADWG max
Turbidity (NTU)
Sample Date
0
0.2
0.4
0.6
0.8
1
1.2
1.4
1.6
1.8
2
1/07/2010
1/08/2010
1/09/2010
1/10/2010
1/11/2010
1/12/2010
1/01/2011
1/02/2011
1/03/2011
1/04/2011
1/05/2011
1/06/2011
1/07/2011


Lake Scapa & Blair Athol- Free Chlorine
Cl2 Reservoir
Lake Scapa Caravan Park
Lake Scapa Council Depot
Pioneer Park Scapa St Blair Athol
Free Chlorine (mg/L)
Date Sampled
0
0.2
0.4
0.6
0.8
1
1.2
1.4
1.6
1.8
2
1/07/2010
1/08/2010
1/09/2010
1/10/2010
1/11/2010
1/12/2010
1/01/2011
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1/03/2011
1/04/2011
1/05/2011
1/06/2011
1/07/2011
1/08/2011

APPENDIX B – RISK ASSESSMENT

No.	Process Step	How can the hazard be introduced?	Contaminants	What control measures are currently in place	Responsibility to manage risk	Controlled			Uncontrolled			Basis/Notes	Follow-up Actions
						Likeli-hood	Conse-quence	Risk	Likeli-hood	Conse-quence	Risk		
C1	Lake Scapa catchment	Water hardness from Lake water		Manage pH for optimum levels. Bore has low hardness.		A	1	Moderate	A	1	Moderate		
C2	Lake Scapa catchment	High levels of nutrients in the water leading to algal blooms	Algae	DAF, Membrane system, use of bore water (alternative supply), use of drought emergency management when Lake is at low levels (below 20%) only available until March 2012.	BSC	A	1	Moderate	A	5	Very High	Note that they occur regularly - summer and winter	Develop a checklist to ensure the current treatment barriers are maintained.
C3	Lake Scapa catchment	High levels of nutrients in the water, causing algal toxins	Toxins	GAC, use of bore water (alternate supply), DAF, chlorination	BSC	A	1	Moderate	A	5	Very High	There is uncertainty surrounding the incidence of toxin developed from an algal bloom in Lake Scapa. Based on research/experience - Toxic levels that cause acute illness are not expected. Rare anywhere in Australia that toxicity would reach a critical level.	Investigate if there is data / history on the Lake Scapa incidence of algal blooms producing toxins. Develop a checklist to ensure the current treatment barriers are maintained.
C7	Lake Scapa catchment	High levels of nutrients, causing algal blooms that cause taste and odour problems	Taste and odour	GAC, use of bore water (alternate supply), DAF	BSC	A	1	Moderate	A	3	Very High		Develop a checklist to ensure the current treatment barriers are maintained.
C8	Lake Scapa catchment	Turbidity / suspended solids (other than algae): Bowmore tributary and local wave action	Inorganic turbidity, pathogens	Treatment process, alternate supply	BSC	A	1	Moderate	A	5	Very High		Develop a checklist to ensure the current treatment barriers are maintained. Develop trigger point to change to alternative supply. Develop procedures to change water source.
C9	Lake Scapa catchment	Wet catchment reflush leading to increased dissolved organic carbon in the source water	Dissolved organic carbon	Treatment process, alternate supply	BSC	B	1	Moderate	B	2	High	Can occur multiple times in a wet year where existing water stores are flushed into the river in a storm. Then will not occur in drought years. The major consequence is taste and odour	Develop a checklist to ensure the current treatment barriers are maintained. Develop trigger point to change to alternative supply. Develop procedures to change water source.
C10	Lake Scapa catchment	Daphnia in the lake (shrimp) being drawn into the plant	Daphnia	Screen filters between DAF and membranes, regular backwash process and manual cleaning in severe instances.	BSC	A	2	High	A	2	High	More common / increased breeding activity in warmer months when the already shallow lake drops in water level.	Consider modifying the daily test sheet to include appearance of raw water (daphina). Formalise procedures for the screen cleaning.
C11	Lake Scapa catchment	Daphnia in the lake (shrimp) being drawn into the plant	Daphnia	Alternate water supply	BSC	A	1	Moderate	A	2	High	Occurred in March 2012	Consider modifying the daily test sheet to include appearance of raw water (daphina). Formalise procedures for the screen cleaning.

No.	Process Step	How can the hazard be introduced?	Contaminants	What control measures are currently in place	Responsibility to manage risk	Controlled			Uncontrolled			Basis/Notes	Follow-up Actions
						Likeli-hood	Conse-quence	Risk	Likeli-hood	Conse-quence	Risk		
C12	Lake Scapa catchment	Pathogens in the lake from upstream agriculture & human inputs	*Cryptosporidium*, other pathogens	Treatment process	BSC	A	1	Moderate	A	5	Very High	This could happen by membrane breakdown at the WTP	Develop CCP and underlying procedures.
C13	Lake Scapa catchment	Pathogens in the Lake from Lake Scapa sewage overflow	*Cryptosporidium*, other pathogens	Water treatment process, overflow policy for sewage, maintenance and EPL licensing	BSC	E	1	Low	E	5	High	Consequence is low due to the dilution factor	Emergency procedures manual should be developed - modify the NSW Health response protocol (including changes in source water) and include this scenario (i.e. chlorine residual management). Written procedures for membrane integrity testing and plugging burst fibres.
C14	Lake Scapa catchment	Pathogens in the lake from onsite sewage systems	*Cryptosporidium*, other pathogens	BSC Health and Building requirements of private septic systems, implementation of septic management by individuals, council treatment process, inspections and licensing	Private user, BSC	A	1	Moderate	A	5	Very High	Controls may not be effective as they come down to the individual. Uncertainty over number and location of septic tanks.	Develop CCP and underlying procedures. Ensure yearly inspections of on-site sewage management systems.
C15	Lake Scapa catchment	Agricultural pesticide in the catchment and Lake	Pesticides	Water treatment process, agricultural practices to minimise chemical use.	Private user, BSC	D	1	Low	D	1	Low	Recent monitoring of pesticides for Lake Scapa. Low concentration levels. Dilution in the Lake. Pesticides are chronic exposure.	
B1	Bore	Iron and manganese in the aquifer being drawn into the raw water	Iron, manganese	Oxidation, aeration, DAF, Filtration	BSC	A	1	Moderate	A	2	High		Develop CCP and underlying procedures checklist.
B2	Bore	Flooding events on the river recharging the aquifer with pathogen contaminated water	*Cryptosporidium*, other pathogens	Water treatment process, sealed bore head, clay layer over aquifer, 450mm bore height (above flood level), secure bore head, NO RURAL CONNECTIONS ALONG PIPELINE.	BSC	E	1	Low	E	2	Low	Aquifer is a surface connected supply	
B3	Bore	Unsuitable water quality in the aquifer	Pesticides, chemicals	Monitoring / testing prior to bore establishment, ongoing monitoring for bore water,	BSC	E	1	Low	E	1	Low	Note - monitoring for pesticides, chemicals has been completed for the bore	
B4	Bore	Development of other bores leading to contamination (e.g. backflow into the aquifer from another)	Various	Water treatment plant, licensing by NSWOW providing initial regulation and comment by BSC	BSC			Uncertain			Uncertain	Uncertain risk therefore chose not to rank	

No.	Process Step	How can the hazard be introduced?	Contaminants	What control measures are currently in place	Responsibility to manage risk	Controlled			Uncontrolled			Basis/Notes	Follow-up Actions
						Likeli-hood	Conse-quence	Risk	Likeli-hood	Conse-quence	Risk		
B5	Bore	On-site sewage systems leading to contamination of the aquifer	*Cryptosporidium*, other pathogens,	Water treatment plant, bore integrity (design and construction)	BSC	E	1	Low	E	3	Moderate	3 houses within 4km from the bore, catchment drains away from the bore. Recharge area for the bore is clay 10m depth, 40 to 60m of sand and gravel. Recharge was determined to be from rain and river.	
B6	Bore	Recharge from the river & lake to the bore	Various	Travel time through ground to the aquifer, water treatment plant	BSC	E	1	Low	E	3	Moderate		
TB1	Transfer from bore to plant	Illegal access to pipeline	Various	Monitoring pressure and flow to notice differences, water treatment plant	BSC	E	1	Low	E	1	Low	Pressure on the mains at all times.	
TB2	Transfer from bore to plant	Contamination of reservoir by vermin	Pathogens	Roofing, inspection, treatment plant	BSC	E	1	Low	E	5	High		Develop procedures (frequency and details) and checklist for the reservoir. Set service maintenance intervals.
BL1	Bore/Lake	Water source changeover causing water quality issues	Various	None				Uncertain			Uncertain		Procedures to be developed. This risk should be re-ranked once the source has been developed.
A1	New plant aeration system	Underdosing of NaOCl	Fe/Mn	Operator monitoring, equipment maintenance, SCADA, DAF	BSC	C	2	Moderate	A	2	High		Investigate gas chlorination to improve chlorination efficacy. Review the NaOCl dosing to remove the irregularity that has occurred in the past. Design audit and design safety audit should be undertaken to look at the entire aeration project.
A2	New plant aeration system	Overdosing of NaOCl / NaOH	Fe/Mn	Operator monitoring, equipment maintenance, SCADA	BSC	C	2	Moderate	A	3	Very High		Review overdosing risk as part of the design period.
A3	New plant aeration system	Underdosing of permanganate system	Mn	Operator monitoring, equipment maintenance, SCADA, DAF	BSC	C	2	Moderate	A	2	High		Review location of dosing point.
A4	New plant aeration system	Overdosing of permanganate system	Mn	Operator monitoring, equipment maintenance, SCADA	BSC	C	2	Moderate	A	3	Very High	Pink water	Procedure to be developed on when manganese is to be used (Only be used if chlorine doesn't work)
A5	New plant aeration system	Failure of aeration system	Fe, turbidity	Operator monitoring, equipment maintenance, SCADA, duty/standby pump	BSC	E	2	Low	B	3	High	Including pump + duty standby	Formalise operator checklist (daily, weekly, monthly checks)
A6	New plant aeration system	Bypass of aeration system while using bore water	Fe/Mn	Operational procedure, training, SCADA, operator monitoring, DAF	BSC	D	2	Low	C	2	Moderate		
D1	DAF	Underdosing HCl	Algae and turbidity	Membranes, GAC, operators, operational monitoring of pH after DAF, SCADA	BSC	D	2	Low	B	2	High		Formalise operator checklist (daily, weekly, monthly checks). Calibration procedures for pH and photometer.

No.	Process Step	How can the hazard be introduced?	Contaminants	What control measures are currently in place	Responsibility to manage risk	Controlled			Uncontrolled			Basis/Notes	Follow-up Actions
						Likeli-hood	Conse-quence	Risk	Likeli-hood	Conse-quence	Risk		
D2	DAF	Overdosing HCl	pH <6.5, coagulant, algae and turbidity	Operational monitoring of pH after DAF, SCADA	BSC	E	1	Low	B	1	Moderate	Coagulation might be compromised if pH <6, but this is unlikely with pump configuration	
D3	DAF	Underdosing PACl	Algae and turbidity	Membranes, GAC, operators, operational monitoring of PACl after DAF, SCADA,	BSC	D	2	Low	B	2	High		Document procedures for jar testing, turbidity testing, drop testing.
D4	DAF	Overdose PACl	Coagulant carry over, expense for materials, flocculation in reservoir	Operational monitoring (drop testing), residual Al after DAF	BSC	D	1	Low	B	2	High		Document procedures for jar testing, turbidity testing, drop testing.
D5	DAF	Failure of DAF system	Algae, turbidity	Maintenance, spare equipment in stock, duty stand by on some equip, jar testing, membrane, chlorination	BSC	D	4	High	C	4	Very High	If the existing turbidity is low, DAF won't create as greater risk	Document procedures for jar testing.
D6	DAF	Bypass of DAF system	Algae, turbidity, pathogens	Membrane, operational monitoring (feed water quality), chlorination, Alternative supply	BSC	E	2	Low	E	4	High	If lake water turbidity is less than 40, not a significant problem. Ranked low because of the alternative supply	Consider writing a manual operational procedure for theDAF.
M1	Membrane	Partial failure of membrane	Algae, turbidity, pathogens	Operational monitoring, SCADA, chlorination & DAF, integrity testing (weekly), membrane replacement based on manufacture recommendation of design life	BSC	E	3	Moderate	C	5	Very High	Chlorination & DAF reduces the consequence. Membrane life = 5 to 6 yrs, control means replacement before failure.	Consider implementation of an online turbidity meter.
M2	Membrane	Insufficient water for backwashing due to lack of water in reservoir	ALL	40% target / alarm for water reservoir, procedure to isolate reservoir,	BSC	D	3	Moderate	D	5	Very High	If level in reservoir reduces below 25%, backwash of membranes becomes ineffective. Pipe break can cause this.	Consider a clear water tank for the plant. Procedure required to refill reservoir with minimal risk of contamination. Re-engineer the reservoir to reduce the critical limit.
G1	GAC	Exhaustion of GAC system	Taste and odour, toxins	Operational monitoring, membrane, chlorination, alternate supply, complaint system, timed maintenance for visual inspection (3 mth) and replacement (5yr) unless required.	BSC	E	1	Low	C	5	Very High	Samples can be taken to see if there is ever breakthrough during high algal blooms. Controlled risk is based on immediate swap to alternate supply in the event of algal bloom.	Document procedures for visual inspection for GAC. Formalise the sampling and testing for breakthrough / GAC effective operation. Develop a service maintenance plan. Set service maintenance intervals.
G2	GAC	Choice of GAC not optimal for water type	Taste and odour, toxins	To be managed through purchasing and operational control.	BSC			Uncertain			Uncertain		

No.	Process Step	How can the hazard be introduced?	Contaminants	What control measures are currently in place	Responsibility to manage risk	Controlled			Uncontrolled			Basis/Notes	Follow-up Actions
						Likeli-hood	Conse-quence	Risk	Likeli-hood	Conse-quence	Risk		
G3	GAC	Short circuiting affecting contact time for GAC	Taste and odour, toxins	Operational monitoring, alternate supply, membrane, chlorination, complaint system, timed maintenance for visual inspection (3 mth) and replacement (5yr) unless required, visually evident with GAC coming out in backwash.	BSC	E	2	Low	D	5	Very High	Previous failure was a manufacturer defect.	Document procedures for visual inspection for GAC. Formalise the sampling and testing for breakthrough / GAC effective operation. Develop a service maintenance plan - Set service maintenance intervals.
G4	GAC	Bypass open	Taste and odour, toxins	Removal of handle on valve, Operational monitoring, membrane, chlorination, complaint system, SCADA	BSC	E	5	High	D	5	Very High	Handled through control and security measures. Backwash will give an indication that bypass is open.	Consider implementing a flow switch or other alarm for security.
Df1	Disinfection	Overdosing of chlorine leading to high levels in finished water	DBPs, taste & odour	Limitation on how much the pump can deliver, operational monitoring	BSC	D	1	Low	D	1	Low		
Df2	Disinfection	Underdosing of chlorine (<0.5mg/L leaving reservoir)	Chlorine sensitive pathogens	Operational monitoring	BSC	C	3	High	A	5	Very High	New pump has just been installed, 1 month of data obtained only. Good contact time in reservoir (min 3-4hrs avg) Aiming for between 0.5 mg/L (min) to 1.0 mg/L leaving the reservoir and a minimum of 0.2 mg/L at the furthest extension of the mains line. Flushing of the lines is less common in drought, leading to build up of biofilms.	Investigate gas chlorination to improve chlorination efficacy Consider a chlorine residual analyser (not to control).
R1	Reservoir	Topping up reservoir by water carting	Pathogens	Use registered potable water carters, sourced from potable water stand pipes, leave reservoir offline and increase chlorine contact time, only cart as much water as you need.	BSC	D	4	High	C	4	Very High	Controlled consequence is rated for operational reasons.	Consider a clear water tank for the plant.
R2	Reservoir	Recontamination of treated water by vermin	Pathogens	Chlorine residual, reservoir inspection and maintenance (wkly at ground level, 3mthly from top), entry gate and hatches secured with padlocks.	BSC	E	2	Low	C	5	Very High		Develop procedures (frequency and details) and checklist for the reservoir. Set service maintenance intervals.
R3	Reservoir	Malicious contamination	Various	Locked hatches and gates, access stairs are locked.	BSC	E	3	Moderate	E	5	High		Consider CCTV and review gate with swipe card and lockable access after hours. This scenario should be handled through IEP.

No.	Process Step	How can the hazard be introduced?	Contaminants	What control measures are currently in place	Responsibility to manage risk	Controlled			Uncontrolled			Basis/Notes	Follow-up Actions
						Likeli-hood	Conse-quence	Risk	Likeli-hood	Conse-quence	Risk		
R4	Reservoir	Access to reservoirs by unauthorised personnel	Various	Locked hatches and gates, access stairs are locked.	BSC	E	2	Low	E	4	High		Consider CCTV and review gate with swipe card and lockable access after hours.
R5	Reservoir	Divers enter the reservoirs to inspect and/or clean them while they are on line with no additional chlorination taking place resulting in risks to water quality	Pathogens	Only use certified divers, site management of divers.	BSC	E	2	Low			Unranked		
Ds1	Distribution	Aging infrastructure leading to ingress and water quality issues	Pathogens	Asset management plan, mains and valve replacement program, chlorination, flushing.	BSC	E	2	Low	C	2	Moderate		
Ds2	Distribution	Mains break or perforation (air valves etc.) leading to water quality issues	Pathogens	Asset management plan, mains and valve replacement program, chlorination, flushing.	BSC	B	2	High	A	2	High		Review procedures for mains breaks (WIOA Manual).
Ds3	Distribution	Backflow/cross connection leading to water contamination events	Various	Council processes providing water to the meter, DA requirement & Australian Standard for backflow prevention, integral DCV on all 20mm mains (future works), chlorine.	BSC	A	2	High	A	5	Very High		Council to ensure compliance with the plumbing code.
Ds4	Distribution	Dead end in reticulation systems leading to stagnation	Taste and odour, pathogens	Flushing, program to remove dead ends.	BSC	B	2	High	A	2	High		Procedure for Council to continue flushing of all mains to ensure hydrants work efficiently when needed.
Ds5	Distribution	Use of fire hydrants stirring up the system and causing water quality incidents	Pathogens, chemicals	Flushing.	BSC	E	1	Low			Unranked	Impact of not flushing the lines with the hydrants is worse, so lines are flushed.	Procedure for Council to continue flushing of all mains to ensure hydrants work efficiently when needed.
Ds6	Distribution	Illegal connections resulting in introduction of unknown hazards	Various		BSC			Uncertain			Uncertain	Risk has been identified but there is not enough data to make a rating.	
Wo P1	Whole of Plant	Malicious contamination leading to water contamination	Various	Security, locked access.	BSC	E	5	High	E	5	High	5 is based on manpower to manage the situation and cost to rectify any damage/ contamination.	Consider CCTV and review gate with swipe card and lockable access after hours.
Wo P2	Whole of Plant	Power failure	Various	Online monitoring, critical systems preservation power supply, Essential Energy on emergency call basis to repair power connection	BSC	C	5	Very High	C	5	Very High	Actions are based on asset preservation rather than water quality	Consider power back-up for the Cawdor system and WTP generator. Add weekly testing of the generator to the checklist.

No.	Process Step	How can the hazard be introduced?	Contaminants	What control measures are currently in place	Responsibility to manage risk	Controlled			Uncontrolled			Basis/Notes	Follow-up Actions
						Likeli-hood	Conse-quence	Risk	Likeli-hood	Conse-quence	Risk		
Wo P3	Whole of Plant	Failure of telemetry monitoring devices	Various	Manual monitoring and operations, maintenance, mirrored server and standby configuration through Telstra, calibration of devices,	BSC	A	4	Very High	A	5	Very High	Dependant on Telstra and internet, if there is a firewall failure the system won't work etc.	Management procedure for telemetry failure.
Wo P4	Whole of Plant	Human error	Various	Operator training and training program, documented procedures	BSC	C	2	Moderate	C	5	Very High		On-going monitoring of current training.
T1	Blair Athol reservoir	Ingestion of non-potable water	Pathogens	No chlorination, a residual of CL is at the 16 mile in winter, but no detection in Blair Athol. Water treated upstream, consumer is sold the product as non-potable, public taps are in the process of being labelled as non-potable. DA requirement for rainwater tanks as potable supply, purchase certificates include notification about non-potable supply. Roof on reservoir.	BSC	A	3	Very High	A	5	Very High	Cross connection, residual build up in existing pipes.	Review the procedure and method for notifying the community that the water is non-potable. Consider a booster chlorination plant. Consider implementing chlorination for Blair Athol. Follow up compliance with the NSW Plumbing code & NSW Health guidance for non-potable water.
F1	Fit for purpose	Ingestion of non-potable water	Pathogens	Industrial and irrigation of recreational facilities purpose only, removal of taps / access points in public spaces. Consumer compliance with plumbing code, Council to inspect / approve.	BSC & consumer	E	2	Low	E	2	Low		

APPENDIX C – ACTION AND CONTINUOUS IMPROVEMENT PLAN

Action Type Key

Maj Wor = Major Works for Investigation
Min Wor = Minor Works to be Undertaken
Maj proc = Major Procedure or Protocol to be produced
Min Proc = Minor Procedure or Protocol to be produced
Serv = Service Maintenance to be Undertaken / Ongoing
Tran = Training to be devised and provided

Outcomes Implementation Program

Action Type & Action Comment Colour Key

Purple = Action Complete or in Progress
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Black= General comments

Action No.	Follow-up Actions	Risk No	Body Responsible For Outcome	Type of Action	Action Comment	Status Filter	Final Implementation Date	Twelve Month Review	Review Sign Off By
RA1	Add weekly testing of the generator to the checklist	WoP2	Council	Min Proc	Complete	C	18/10/2011		
RA2	Consider a clear water tank for the plant	R1,M1	Council	Maj Wor	Under Investigation	IP			
RA3	Consider CCTV and review gate with swipe card and lockable access after hours	R3,R4,WoP1	Council	Maj Wor	Under Investigation	IP			
RA4	Consider implementation of an online turbidity meter before membrane plant	M1	Council	Min Wor	Work in Progress	IP			
RA5	Consider implementing a flow switch or other alarm to identify if GAC is being bypassed	G4	Council	Min Wor	Investigation Complete not Feasible at this time	NF	18/10/2011		
RA6	Consider modifying the daily test sheet to include appearance of raw water (daphina)	C10	Council	Min Proc	Work in Progress	IP			
RA7	Consider power back-up for the Cawdor Bore system and WTP generator	WoP2	Council	Maj Wor	Investigation Complete not Feasible at this time	NF	18/10/2011		
RA8	Consider relocation of reservoir	WoP3	Council & Engineering Consultant	Maj Wor	Under Investigation	IP			
RA9	Consider writing a manual operational procedure for the DAF system	D6	Council	Maj Proc	Work in Progress	IP			
RA10	Council to ensure compliance with the plumbing code	Ds3	Council	Maj Proc	Currently occurs on all new DA's	C	TBA		
RA11	Design audit and design safety audit should be undertaken to look at the entire aeration project	A1	Council & Engineering Consultant	Maj Proc	Part of Cawdor Bores Project will be covered in SOP Manuals	IP			
RA12	Develop a checklist to ensure the current treatment barriers are maintained	C5 –C8	Engineering Consultant	Maj Proc	Procedure received for review from Engineering Consultant	IP			
RA13	Develop a service maintenance plan	G3, G1	Council & Engineering Consultant	Serv	Plan in development some procedures received from Engineering Consultant	IP			
RA14	Develop CCP and underlying procedures for treatment processes	C12, C14, B1	Engineering Consultant	Maj Proc	Procedure received for review from Engineering Consultant	NS			
RA15	Develop procedures (frequency and details) and checklist for the Mount Bowen reservoir	TB2, R2	Engineering Consultant	Maj Proc	Part of Cawdor Bores Project will be covered in SOP Manuals	NS			
RA16	Develop procedures to change water source	C9, BL1	Contractor & Engineering Consultant	Maj Proc	Part of Cawdor Bores Project will be covered in SOP Manuals	NS			
RA17	Develop trigger point to change to alternative supply	C9	Contractor & Engineering Consultant	Min Proc	Part of Cawdor Bores Project will be covered in SOP Manuals	NS			
RA18	Document procedures for jar testing, turbidity testing, drop testing	D5,D6,D4	Engineering Consultant	Train	Procedure received for review from Engineering Consultant	IP			
RA19	Document procedures for visual inspection for GAC	G1,G3	Council	Serv	Work in Progress	IP			
RA20	Emergency procedures manual should be developed - modify the NSW Health response protocol (including changes in source water) and include this scenario (i.e. chlorine residual management)	C13	Engineering Consultant	Maj Proc	Procedure received for review from Engineering Consultant	IP			
RA21	Ensure yearly inspections of on-site sewage management systems	C13	Council	Maj Proc	Consult with Council Enviro/ Health Dept to develop procedure	NS			
RA22	Formalise manual procedures for the screen cleaning on AMIAD Devices	C11	Council	Min Proc	Work in Progress	IP			

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RA23	Formalise the sampling and testing for breakthrough / GAC effective operation	G1,G3	Engineering Consultant	Maj Proc	Procedure received for review from Engineering Consultant	IP			
RA24	Incident and emergency response plan to be developed for catastrophic loss of reservoir	WoP3	Engineering Consultant	Min Proc	Procedure received for review from Engineering Consultant	IP			
RA25	Investigate gas chlorination to improve chlorination efficacy	Df2	Council	Maj Wor	Investigate in conjunction with NOW	IP			
RA26	Consider a chlorine residual analyser (not to control)	Df2	Council	Maj Wor	Investigate in conjunction with NOW	IP			
RA27	Investigate if there is data / history on the Lake Scarpa incidence of algal blooms producing toxins	C6	Council	Min Proc	Pending Investigation	NS			
RA28	Management procedure for telemetry failure	WoP4	Council	Maj Proc	Currently being developed	IP			
RA29	On-going monitoring of current training	WoP5	Council	Train	Complete ongoing	C			
RA30	Develop procedure for Council to continue flushing of all mains to ensure hydrants work efficiently when needed	Ds4, Ds5	Council	Train	Complete ongoing	C	1/01/2011		
RA31	Procedure required to refill reservoir with minimal risk of contamination	M2	Council & Engineering Consultant	Maj Wor	Under Investigation	IP			
RA32	Procedure to be developed on when $KMnO_4$ is to be used (Only be used if chlorine doesn't work)	A4	Contractor & Engineering Consultant	Maj Proc	Still in Design Phase	IP			
RA33	Re-engineer the reservoir to reduce the critical limit		Council & Engineering Consultant	Maj Wor	Under Investigation	IP			
RA34	Review location of permanganate system dosing point	A3	Contractor & Engineering Consultant	Maj Proc	Still in Design Phase	IP			
RA35	Review manganese overdosing risk as part of the design period	A2	Contractor & Engineering Consultant	Maj Proc	Still in Design Phase	IP			
RA36	Review procedures for mains breaks (WIOA Manual)	Ds2	Council	Train	Training plan in development to modify handbook principles to suit local conditions and resources	IP			
RA37	Review the NaOCl dosing to remove the irregularity that has occurred in the past	A1	Contractor & Engineering Consultant	Maj Proc	Still in Design Phase	IP			
RA38	Set service maintenance intervals for reservoirs and GAC	TB2 G1 G3 R2	Council & Engineering Consultant	Serv	Complete ongoing	C	17/10/2011		
RA39	The risk of water source changeover should be re-ranked once the source has been developed	BL1	Council	Maj Proc	Will be done at completion of Cawdor Bores Project	NS			
RA40	Malicious contamination of the reservoir should be handled through IEP	R3	Council & Engineering Consultant	Maj Proc	To be Investigated and handled in conjunction with Action No RA3	IP			
RA41	Written procedures for membrane integrity testing and plugging burst fibres should be developed	C13	Council	Maj Proc	Complete ongoing	C	Manual Date Unkown		
RA42	Review the procedure and method for notifying the community that the water is non-potable		Council	Maj Proc	Complete ongoing	C	17/10/2011		
RA43	Consider a booster chlorination plant for the Blair Athol system	T1	Council	Maj Wor	Under Investigation	IP			
RA44	Consider implementing chlorination for Blair Athol	T1	Council	Maj Wor	Under Investigation	IP			
RA45	Follow up compliance with the NSW Plumbing code & NSW Health guidance for non-potable water	T1	Council	Maj Wor	Under Investigation	IP			

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Action No.	Follow-up Actions	Risk No	Body Responsible For Outcome	Type of Action	Action Comment	Status Filter	Final Implementation Date	Twelve Month Review	Review Sign Off By
Gap 1-1	Develop an up to date register of regulatory and formal requirements	-	Council	Maj Proc	Will occur as part of Strategic Business Plan	IP			
Gap 1-2	Communicate regulatory and formal requirements to the staff and review requirements on an annual basis	-	Council	Min Proc	Ongoing	IP			
Gap 1-3	Develop an up to date register of stakeholders.	-	Council	Min Proc	Will occur as part of Strategic Business Plan	IP			
Gap6-1	Develop a business continuity plan	-	Council	Maj Proc	Under Investigation	NS			

Total Action Items *49*

Action Types

Maj Wor	11
Min Wor	2
Maj Proc	21
Min Proc	8
Serv	3
Train	4
Total	49

Responsible Body

Council	=	29
Council & Engineering Consultant	=	7
Contractor & Engineering Consultant	=	6
Engineering Consultant	=	7
	Total	49

Action Status

Completed	=	7
In Progress	=	32
Not Started	=	8
Not Feasible	=	2
	Total	49

APPENDIX D – OTHER FORMAL REQUIREMENTS RELATING TO WATER QUALITY

Instrument	Jurisdiction	Type	Relevance
Environment Protection and Biodiversity Conservation Act 1999	Commonwealth	Statute	Catchment management in particular for areas of national environmental significance
Competition and Consumer Act 2010	Commonwealth	Statute	Fitness for purpose of drinking water, evaluate capacity for third party access within Council's operations
Water Act 2007	Commonwealth	Statute	Under Part 7 of the *Water Act 2007*, the Bureau of Meteorology is required to collect, hold, manage, interpret and disseminate Australia's water information. Section 126 of the Act places an obligation on persons specified in the Regulations to give certain water information to the Bureau.
Water Regulations 2008	Commonwealth	Regulation	The Regulations define who must give specified water information to the Bureau and the time and format in which it must be supplied.
AS ISO 22000-2005 Food safety management systems-Requirements for any organization in the food chain	National	Standard	Analogous to the ADWG Framework but would allow certification to that standard if sought
ISO31000:2009 Risk Management	National	Standard	Includes guidance on the use of risk assessment and management
Water Services Association of Australia Water Supply Codes	National	Best practice	Includes methodologies for undertaking a range of water supply works including distribution system management
Catchment Management Authorities Act 2003	NSW	Statute	Catchment management
Environmental Planning and Assessment Act 1979	NSW	Statute	Planning activities which require assessment
Fair Trading Act 1987	NSW	Statute	Includes provisions for goods (and services) to be fit for purpose
Fisheries Management Act 1994	NSW	Statute	Protection of fish habitats (including threatened and protected species management) and aquaculture management
Food Act 2003	NSW	Statute	Need to maintain water quality
Forestry Act 1916	NSW	Statute	Management of state forests
Mining Act 1992	NSW	Statute	Possible extraction of resources within catchment areas
Native Vegetation Act 2003	NSW	Statute	Native vegetation management (in the context of catchment

			management)
Natural Resources Commission Act 2003	NSW	Statute	Catchment management
Plantations and Reafforestation Act 1999	NSW	Statute	Regional forest agreements
Local Government (General) Regulation 2005	NSW	Regulation	Audit and management of onsite sewage management systems (protects water quality from leaking sewage)
Protection of the Environment Operations Regulation 1998	NSW	Regulation	Submit annual National Pollutant Inventory (NPI) returns if any of the specified reporting thresholds are exceeded (water contamination issues)
Rivers and Foreshores Improvement Act 1948	NSW	Statute	Protection of rivers and lakes
Roads Act 1993	NSW	Statute	Planning of roads (and how they might impact on source waters)
Soil Conservation Act 1938	NSW	Statute	Soil management (in the context of catchment management)
Threatened Species Conservation Act 1995	NSW	Statute	Catchment management
Water Industry Competition Act 2006	NSW	Statute	Could allow a private company to access Council's reticulation systems
Water Industry Competition (General) Regulation 2008	NSW	Regulations	Sets out the requirements to be addressed in a WICA licence
Water Management Act 2000	NSW	Statute	Water management, drainage, water licences, water/river management committees, strategic business planning;
Wilderness Act 1987	NSW	Statute	Catchment management