AquaSafeSkills

Water Quality Awareness 101

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V.1

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1. INTRODUCTION

Access to safe drinking water is a fundamental requirement for life. Water that is classified as being fit for human consumption is effectively a food grade product and is required to meet specific quality standards prior to being supplied to customers.

The quality and safety of drinking water can be affected by coming into contact with various people and activities. This contact can occur both directly and indirectly and be intentional or unintentional. In extreme cases, this contact can lead to customers becoming very ill.

2. OBJECTIVE

This booklet aims to provide utilities and personnel that may interact with drinking water, some basic guidance and best practice information to protect the integrity of the water supply to ensure that water remains safe and fit for human consumption.

The information covers all processes from the raw water catchment through to the customer's tap. It aims to identify potential contamination points and adverse interactions at different stages along the drinking water supply path.

3. HOW TO USE THIS BOOKLET

The booklet is divided into two key sections:

Section 1: General Advice - which is to be read and understood by all personnel. It provides broad knowledge, guidance and information relating to common issues that could adversely impact on drinking water quality.

Section 2: Specific Advice - is aimed at individual industries and/or specific work activities in and around catchments and drinking water systems.

Within each of these two sections there is information that details:

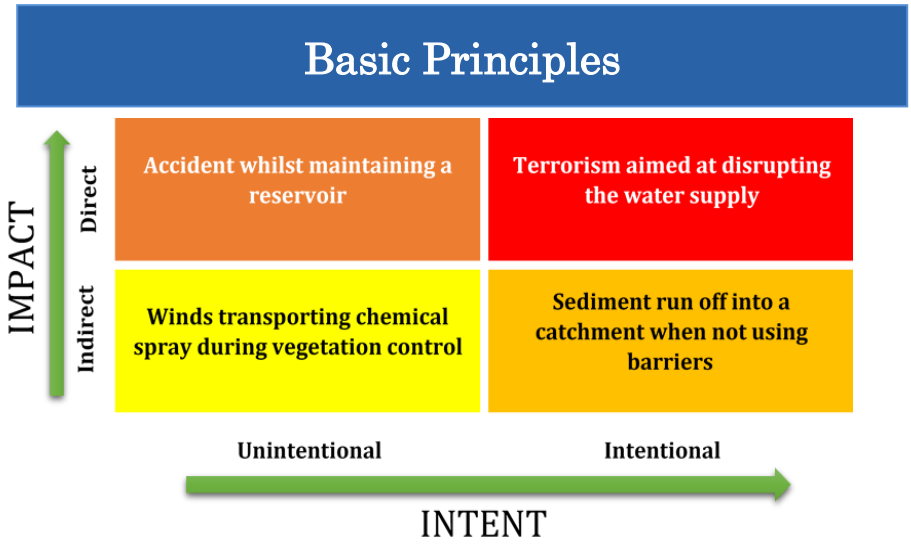
- Hazards or issues associated with a particular threat to drinking water quality
- Common causes of contamination or harmful interactions with drinking water
- Best practice solutions/options to eliminate and/or minimise the effects of these interactions on drinking water quality

4. BASIC PRINCIPLES OF HOW DRINKING WATER MAY BE COMPROMISED

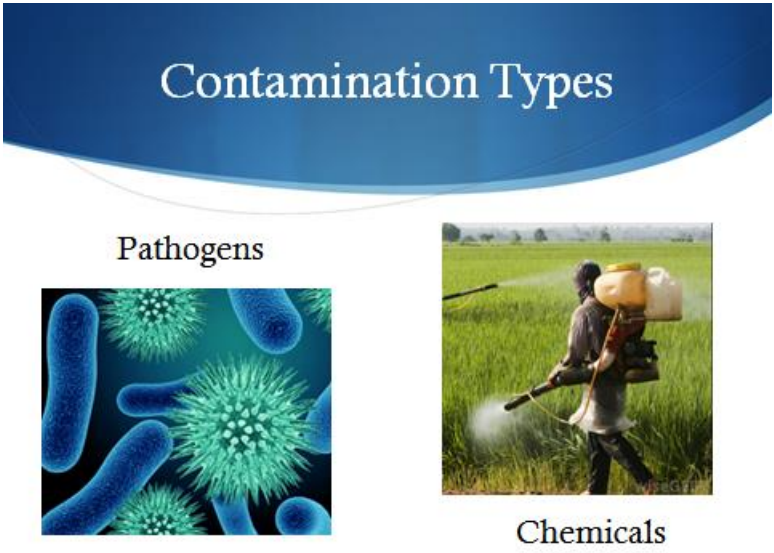
Safe drinking water may be impacted in many ways, which usually fall into two categories, **indirect** and **direct action**.

An **indirect action** is an activity that is carried out in the vicinity of, or may flow into an asset, infrastructure, catchment area or waterway and eventually leads to drinking water, or water that is destined to become drinking water, being contaminated. An accidental fuel or chemical spill is an example of an indirect action.

A **direct action** is more specific and closer to the drinking water or water that is destined to become drinking water. This includes weed and vermin eradication, pipeline repairs and everyday maintenance projects.



SECTION 1: GENERAL ADVICE



5. PATHOGENS

The most common widespread and severe health risk associated with drinking water is contamination. This can occur directly or indirectly, from contact with human or animal excreta and the pathogenic (disease causing) micro-organisms contained within the faeces.

Pathogenic organisms of concern include human infectious bacteria, viruses and protozoa. The diseases they cause vary in severity from mild gastroenteritis, through to severe and sometimes fatal diarrhoea or other types of infections.

There are many pathways by which pathogens can enter the water supply but the most relevant ones to treated drinking water are cross connections, contamination events or poor hygiene within work practices.

Every effort must be made to ensure that faecal material does not come into contact with drinking water

Drinking (potable) water that has been cleaned and adequately treated should not contain any pathogens if the treatment systems are working effectively. Therefore the only way that water can become unsafe is if the barriers protecting the water are disrupted, allowing contaminant entry.

5.1.1 Issues

- Direct entry of faecal material into the treated drinking water supply
- Lack of personal hygiene
- Wearing boots and clothing that were worn whilst working on or near sewerage systems without suitable cleaning and disinfection protocols being applied prior to working on drinking water systems
- Not washing hands between working on sewerage systems and then drinking water systems
- Using tools and equipment that were previously used on sewerage system works, then on a drinking water system without suitable cleaning and disinfection protocols prior to use

5.1.2 Solutions

Design Considerations:

- Use only materials that are designed for use in drinking water systems
- Ensure all substances in contact with the water comply with AS/NZS 4020:2005 - *Testing of products for use in contact with drinking water*
- For dual reticulation systems (drinking water and recycled water), ensure that the pipe work is correctly colour coded to eliminate potential cross connections (blue for drinking water or purple for recycled water)
- Ensure adequate labelling on pipework to minimise potential cross connections
- Ensure untreated water cannot enter treated water storages through ill-fitting, poorly designed or poorly maintained structures
- Ensure backflow prevention devices are in place and are regularly serviced

Operational Considerations:

- Wherever possible prioritise work on drinking water systems prior to work on wastewater or recycled water systems
- Wash and/or disinfect contaminated clothing and equipment before working on or around drinking water systems and assets
- Do not isolate or shut down treatment facilities or plant sections without authorisation (e.g. operate valves or interrupt power supplies)
- Test conductivity of the water in the main under repair if unsure whether it contains drinking water or recycled water (for Class A recycled water schemes only). Recycled water will give a higher conductivity reading
- Test for disinfectant (chlorine) levels of mains if unsure which is the raw water (for raw water systems only)

- Test for fluoride levels of mains if unsure which is the raw water (for raw water systems and systems with fluoride dosing only)
- Utilise calibrated in-line analysers to measure chlorine residual

Maintenance Considerations:

- Have separate clothing and tools for use on jobs on drinking water systems only
- Wash and disinfect old or restored parts and fittings before installing them on drinking water systems (tag clean items whilst in storage)
- Ensure an adequate chlorine/disinfectant residual is present after any repairs to drinking water mains to guarantee disinfection
- Flush any water pipes or mains after the completion of works to remove any debris, sediment or contaminants and restore adequate disinfection levels
- Test back flow prevention devices regularly (have a testing program in place for high risk customers and chemical dosing or transfer lines)

6. CHEMICALS

Chemical contamination of drinking water, or water intended for use as drinking water, can be both direct and indirect.

Direct contamination can come from paints, oils, lubricants etc. that can be introduced inadvertently, or deliberately into drinking water systems. Indirect introduction could occur through maintenance or wash down activities that are undertaken in, on or around drinking water storages, assets or systems. Contamination from maintenance practices are the most common cause of chemicals inadvertently entering drinking water systems. They are also the easiest to avoid by following a few basic precautions.

6.1.1 Issues

- Petrol and oils from machinery used during construction and maintenance on or around drinking water systems
- Weed spraying undertaken near or around a drinking water treatment process or storage, raw water off-take pipes, or in the catchment, where there is the potential of runoff into the source water
- Paints used in a water treatment plant, water storages and the distribution network that are not compliant with the requirements of AS4020:2005: *Testing of products for use in contact with drinking water*
- Greases from machinery and tools used during the construction, operation or maintenance of drinking water systems
- Lubricants for fittings and drinking water system parts, such as valves and pipework that are not approved under AS4020 for contact with drinking water

- Sealants used in the construction, repair or maintenance of drinking water systems, that are not AS4020 approved
- Materials used in construction of drinking water supply systems that are not compliant with the requirements of AS4020
- The incorrect chemical, or the incorrect concentration of a chemical, is used in the treatment of drinking water
- Chemical lines failing or blocking, leading to either the under-dosing or overdosing of treatment chemicals

6.1.2 Solutions

- Protect buffer zones around reservoirs and feeder streams, in order to minimise the chances of chemical runoff and subsequent contamination of raw water sources
- Ensure refuelling is conducted in a bunded or non-spill area around water infrastructure and waterways
- Ensure plant and wheel washing activities are carried out in a designated area of hard standing, at least ten (10) metres from any watercourse or surface water drain
- Ensure that all lubricants and sealants used for fittings that could potentially come in contact with treated drinking water are compliant with the requirements of AS4020
- Take care working around chemical dosing or feed lines so you do not kink, restrict solution, or cause any blockage or interruption to the dosing system or feedlines
- Audit chemical suppliers - where possible only use suppliers that have quality control and assurance systems in place, which specify and verify the specifications for chemicals in the contract
- Ensure that chemical signage, labelling and on-site management practices are robust, so it is not possible to deliver the wrong type, grade of chemical or cross contaminate chemicals during delivery or dosing
- Fit locks on chemical fill points so delivery drivers cannot fill tanks unattended
- Conduct laboratory tests on chemicals when they are delivered to determine correct strength i.e. sodium hypochlorite concentration percentage
- Ensure that chemical delivery procedures are adequate to prevent any accidental release or poor clean up practices onsite
- Ensure that all onsite stored chemicals are adequately bunded and that there is no leakage possible to the environment
- Install anti-syphon valves in pipework between chemical storage containers and pumps
- Fit lockable valves and trigger guns on pipework from storage containers

7. SECURITY

Site security of all water assets is an important part of protecting drinking water systems from source to customer. Where possible, limit access to catchment areas and control who can enter water treatment facilities, pumping stations, disinfection dosing sites and treated water storage tanks. It is important to have a security record and plan in place and be able to monitor who is accessing drinking water related sites and what activities they are carrying out on site.

Having an up to date key register and installing security cameras will allow sites to be monitored accordingly. Regularly check for evidence of unauthorised access (e.g. graffiti, fence damage, tyre tracks etc.) and inform the appropriate persons in your organisation if anything suspicious is noticed.

Know who has access to the site and what activities are conducted

SECTION 2: SPECIFIC ADVICE

This section should be read by personnel involved with specific activities involving contact, or potential contact, with treated drinking water. It is recommended that managers and supervisory personnel read all of the sections, to gain an overview of their responsibilities and requirements.

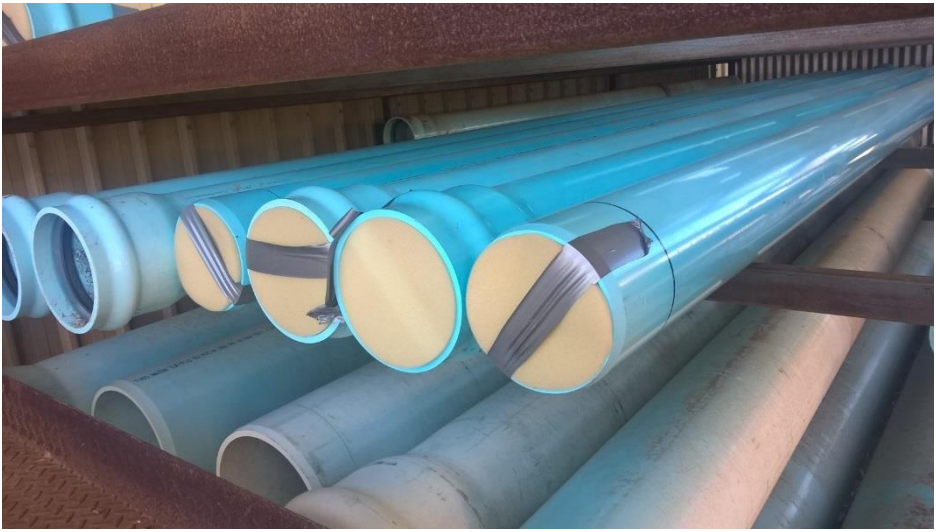
8. WATER MAIN REPLACEMENT AND REPAIR

Water mains may be repaired by water utility staff or by external contractors. Either way, there is a potential that the method of repair, or parts and equipment used during the repair, may introduce contaminants and adversely impact the safety of drinking water. If the location of the main repair is within the reticulation system, downstream of the water treatment plant, there will be no way to prevent contaminants reaching

customers before any online monitoring would detect changes to drinking water quality. In effect, anything that is introduced may go undetected and consequently result in water contamination and a risk to public health. Beyond the general advice detailed in Section 1, there are several other activities that may have a detrimental effect on the quality of drinking water within a distribution system.

8.1.1 Issues

- Spare pipes left unsealed whilst in storage, with the potential for debris, foreign material and vermin to enter the pipes



A simple solution to avoid the entry of contaminants

- Insufficient excavation size and/or shoring to prevent soil and contaminants entering open ended pipe sections during pipe laying
- The use of non-compliant gaskets and sealants to join pipes together (not compliant with the requirements of AS4020). This could be experienced where there is a difficulty pushing pipe sections together and so a lubricant is introduced to assist the process
- Cross contamination from tools, equipment and clothing being used for maintenance or repair work on both drinking water and sewerage systems

Working in a dirty environment – highlights the importance of cleaning clothes and footwear

- Reuse of fittings and piping that have previously been used in other applications (e.g. sewage systems)
- Contamination of tools, equipment and spare parts that may have occurred off site or in transit to the repair job. Storage within a supplier's premises cannot guarantee that the materials are currently fit for drinking water use

Poor pipe management - note ingress of soil and foreign matter into open pipe ends

8.1.2 Solutions

- Keep sections of new pipe sealed at both ends until they are ready to be installed
- Protect the ends of the existing open water main pipes from ingress until the repair is completed
- Keep a positive flow of water out of the pipe (where possible) to prevent ingress
- Properly excavate around the pipe repair site to minimise the possible entry of soil/water into the opened pipe sections
- Maintain a de-watering system within excavations to minimise sediment contaminated water from entering into the pipe and consequently entering the water reticulation network
- Ensure sediment control plans are developed before undertaking excavation works near drinking water reservoirs or catchments
- Only use products for any installations or repairs in drinking water systems, that are compliant with the requirements of AS4020; this includes items such as lubrication, gaskets, spare parts etc.
- Ensure all tools, equipment and other items that may come into contact with drinking water are cleaned and disinfected properly
- Ensure proper disinfection by spraying all pipes and fittings with a concentrated sodium hypochlorite solution, especially if they have been used previously or have been kept in storage
- Proactively identify and assess possible sources of cross contamination during the planning of any repair - examples include failure of back flow devices, leaking valves etc.
- Implement disinfection and flushing procedures after all repairs
- Ensure that a disinfectant residual is present and adequate before returning any drinking water main back into service

Mains flushing following a repair and a chlorine residual test being completed at nearest downstream hydrant to the repair

9. UTILITY SERVICES AND CONTRACTORS

Examples of utility services or contractors who may have access to drinking water systems:

- Gas, electrical and telecommunications entities
- Contractors engaged to work on, near or around drinking water assets, catchments or water ways
- Fitters, mechanics, plumbers or electricians engaged to work on drinking water assets or infrastructure, or undertake works in water catchment areas

In most cases the effect on drinking water is caused by indirect actions that have a consequential impact on various parts of the system.

9.1.1 Issues

- Painting water treatment plant infrastructure or water treatment assets in areas of the catchment where contamination can occur to drinking water or water destined to become drinking water
- The welding, cutting or grinding of materials, especially where dust residues are generated that could end up in source waters, or open or exposed treatment infrastructure
- Sediment from excavation or construction activities that could potentially run into a water course

Excavation works can affect drinking water storages or catchments by stirring up sediment

It is important that sufficient bunding is provided to minimise the impacts of sediment run off

9.1.2 Solutions

- Carry out suitable hazard identification and risk assessments prior to commencing a task on or around drinking water catchments/systems to identify where your interactions could have an impact on water quality
- Consult with catchment managers and treatment operators/technicians regarding proposed works to actively identify issues and plan suitable control measures
- Capturing and retrieving sediment before it enters a water course (this can be done by developing and implementing a sediment control plan)
- Prompt reporting of any issues that have occurred that could affect the quality of drinking water further down stream
- Prompt reporting of issues and incidents that may have directly affected the quality of drinking water or processes for treating water that is destined to become drinking water
- Ensuring that chemicals/fuels/paint cannot be spilled or inadvertently knocked over when working on or around drinking water assets/catchments
- Ensuring all waste from wash down, manufacturing, welding or cutting operations is captured close to the source of emission to prevent it entering the water

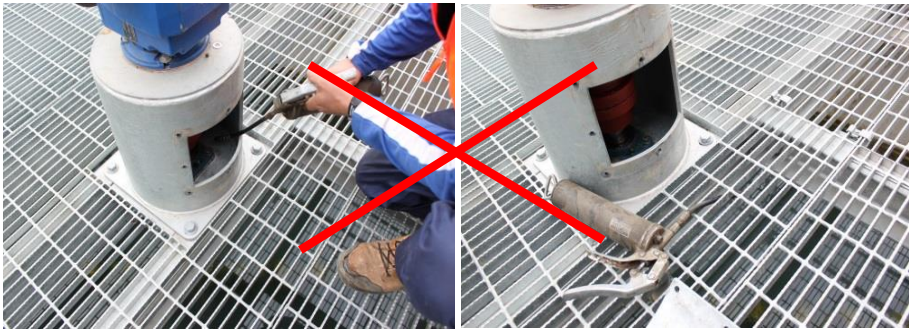
10. MECHANICAL REPAIRS, ALTERATIONS AND MODIFICATIONS

All assets require maintenance and repairs at some stage. This can range from a simple wire brush or paint, to complex repairs involving welding, cutting, grinding etc.

No matter what the repair or maintenance task, if it is performed around drinking water, or water destined to become drinking water, the interaction of the work and any potential impacts it could have on water quality must be identified and carefully managed.

10.1.1 Issues

- Petrol, oils and greases from machinery that is used during construction or maintenance activities on or around drinking water systems
- Paints and coatings that are used in a water treatment plant, that are not compliant with the requirements of AS4020. Also consideration needs to be taken of the paint used in and around water storages and the distribution network
- Sealants used during construction, repair and maintenance that are not compliant with the requirements of AS4020
- Lubricants for fittings used in drinking water systems that are not compliant with the requirements of AS4020
- Water system parts, such as valves and pipework, that are not compliant with the requirements of AS4020 for contact with drinking water
- Materials used in the of construction of drinking water systems that are not compliant with the requirements of AS4020
- Debris from maintenance activities entering the water system



Grease gun being used directly over a treated water storage - note there is no provision to prevent any tools or materials entering the water

Paint being applied from an open can directly over a drinking water supply

Filling up construction and maintenance equipment with petrol or oils directly next to a water storage without adequate spill control - note the lid left off the oil container

10.1.2 Solutions

- Thoroughly induct all persons involved in performing tasks around drinking water assets on the potential inputs of contamination from the works activity
- Ensure that suitable risk assessments for the works practice have identified all possible interactions with the drinking water and that actions to prevent/eliminate the possibility of contamination have been implemented. Where this is not possible, reduce the risk through suitable control measures
- Ensure that all lubricants and sealants used for fittings on drinking water systems are compliant with the requirements of AS4020
- Ensure that emissions from items such as grinders, welders or cutting equipment do not enter water storages or treatment processes
- Ensure that any windborne debris or particles cannot enter drinking water storages or treatment processes

- Use suitable bunding and containment to capture fuels/oils and chemicals during refuelling and servicing (e.g. use a drip tray)
- Have suitable chemical recovery systems and equipment in place in the event of an emergency (e.g. spill kits)
- When petrol, oil or chemical drums are not in use, ensure the lids are fastened when working on or around drinking water assets or storages (or remove from site if possible)

11. MAINTENANCE SERVICE PROVIDERS

This section is relevant to the following activities:

- Contractors or landscapers/gardeners engaged to maintain grounds or eradicate weeds in, on or around drinking water assets or water supply areas
- Pest controllers engaged to work in, on or around drinking water assets or water supply areas
- Persons with property adjoining water treatment or storage facilities, such as farmers, market gardeners etc.

11.1 WEEDS AND MAINTENANCE

Controlling and removing noxious weeds and plants on or around drinking water assets is required under environmental regulations. It is also an important part of dam safety, as the root systems can undermine the structural integrity of a dam.

Chemicals are often used to control outbreaks of weeds and these chemicals can be a source of contamination of drinking water. Once the product has passed the last barrier of the treatment process it is very difficult to rectify any chemical intrusion to the drinking water system, therefore creating a requirement for strict management procedures.

11.1.1 Issues

- Weed spraying undertaken near or around a water course, raw water off-takes, water treatment plants, or drinking water storages where there is the possibility for run-off into a water supply
- Wind-borne chemical residue

Decanting weed killer and spraying directly adjacent to a raw water or clear water storage

11.1.2 Solutions

- Ensure products that are used are approved and safe to use on and around drinking water systems
- Only spray herbicide/pesticide chemicals when it is not windy, to ensure that chemicals are not blown into any water treatment process or water storage area, which could then result in contamination
- Whipper snipper around drinking water assets instead of spraying chemicals
- Use alternate design technology such as matting to eliminate weeds

11.2 PEST CONTROL SERVICES

Drinking water can be compromised by the presence of pests; this may be in the form of faecal material excreted by animal, or other biological intrusions, such as deceased fauna, shredding or nesting.

Any foreign body that can enter drinking water has the potential to adversely affect its quality and make it unfit for human consumption.

11.2.1 Issues

- Pest control (pesticide application) that is undertaken near or around the catchment area, raw water off-take pipes, storages or drinking water treatment plants, with the potential for accidental run-off or entry into the supply
- Carcasses of exterminated animals entering the water supply or water storages, or poisoned fauna entering the water storage and then dying

Spraying pests in close proximity to a water treatment process

11.2.2 Solutions

- Ensure that any products that are used are safe to use on and around water treatment assets
- Only spray pesticide/herbicide chemicals when it is not too windy, to ensure that chemicals are not blown into any water treatment process or water storage area
- Do not spray pesticide/herbicide control chemicals directly onto water infrastructure, e.g. raw water pumps
- Lay rodent baits with an anchored system to prevent accidental release into a water supply area
- Consider using means other than chemicals to remove pests (brush away spider webs or use ultra-sonic devices to keep rodents away)

11.3 LANDSCAPING AND PLANTING

It is often a requirement for planning consent that infrastructure, such as water treatment plants and tanks, are screened for environmental aesthetics, to reduce their impact on the natural countryside. This can lead to issues that may affect drinking water quality if not properly planned and assessed.

11.3.1 Issues

- Tall plants and trees dropping leaves, bark and branches onto the roofs of tanks, or falling into open water storages and other infrastructure. This can also cause structural damage to roofs, as well as allowing vermin access/entry to sites (e.g. possums)
- Roots from larger plants can intrude into infrastructure or undermine the structural integrity of tanks/bunds

- Plants that require regular maintenance, pruning or pest spraying to ensure their upkeep can introduce additional hazards to water quality


Trees starting to intrude onto storage tanks, causing roof impact damage or root intrusion


Overhanging trees allow vermin access to roof areas and deposit leaf debris

11.3.2 Solutions

- Plan landscaping to minimise weed growth and the need for on-going weed maintenance
- Select plants that will not undermine tanks with root intrusion and will not deposit leaves/branches or overgrow the sites of water storages or treatment facilities
- If planting flora that will attract native wildlife, conduct a careful assessment to ensure that attracted wildlife will not subsequently impact the drinking water quality (nesting on infrastructure and defecating in and around drinking water assets)

12. INFORMATION TECHNOLOGY (IT) CONSULTANTS

- IT consultants engaged to work on drinking water systems
- Engineers, designers and personnel involved in the planning of construction and changes within drinking water treatment facilities
- Water utility management system representatives

Modern drinking water systems in Australia are controlled and monitored using some type of technology/computer software. Within water treatment/supply systems, there are often Critical Control Points (CCPs) for the monitoring and safe supply of drinking water. Information Technology plays an important role in maintaining/monitoring these CCPs.

Changes to CCPs or system monitoring and controls require careful management by water utilities; however, it is possible for inadvertent changes to be introduced. One of the most common ways that this can occur is through software introductions, upgrades and maintenance.

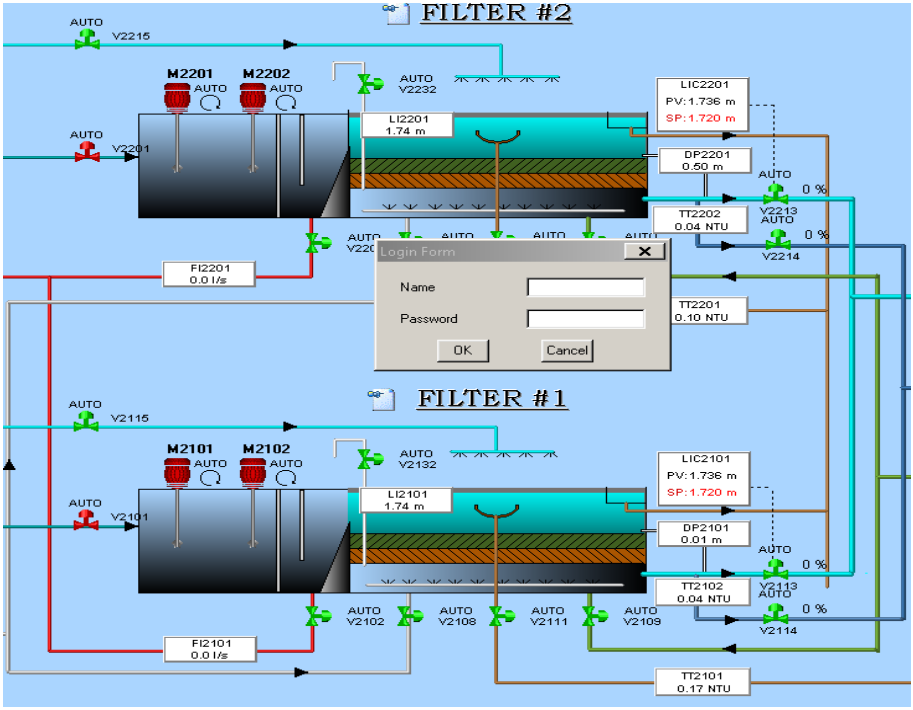
12.1.1 Issues

- Monitoring set points and CCPs being inadvertently changed without notification or tracking
- Introduced software bypassing critical limit applications within existing systems
- Impacts from set point changes that have not been fully assessed to identify all potential risks that could result from the changes
- IT personnel who have insufficient knowledge of the ongoing operational requirements of drinking water quality
- Incorrect logic controlling the key elements of a drinking water system

12.1.2 Solutions

- Conducting detailed inductions for personnel and the completion of risk assessments prior to working on any drinking water treatment system electronics
- Lock down protocols to limit access to drinking water control systems
- Careful assessment of the software interactions and the ramifications of CCP set point changes
- Security software to monitor interactions and logins, including password login protection
- Procedures for the monitoring and follow up of CCP set point changes

- Physical and electronic barriers created in series to protect downstream settings as a result of an inadvertent change
- Hardwired chemical maximum dosing set points
- Log off requirement when system is not in use



Login/password required to access any plant control

13. SUPPLY CHAIN AND STORAGE

- Plumbers or any person who stores items for use in a drinking water system
- Water utility asset managers
- Water utility distribution system workers
- Any person who is installing or replacing items on drinking water assets

It would be reasonable to assume that an item that has been stored on the shelf and is suitably sealed would be clean enough for immediate use. However, we do not always know the history of the item, where it was stored or if it has been repackaged at some point.

Some items also utilise a preserving substance to enhance the shelf life that may not be compatible with contact to drinking water. Never assume that an item is acceptable unless it is suitably packaged and labelled as fit for food grade or drinking water use.

The recycling and reusing of valves and equipment is a common practice that could potentially present a risk of cross contamination that must be carefully managed. This does not mean that a valve previously used in the sewerage network could not be reused as a valve within a drinking water system. It just means that there must be a high level of diligence to ensure that the quality and safety of the drinking water is not compromised.

13.1.1 Issues

- Chemicals stored in close proximity to equipment and materials that will be used on drinking water systems
- Contamination of equipment and materials from welding, cutting, grinding or other workshop activities
- Storing items that may have been used or have come into contact with other items used in sewerage systems
- Storage areas that allow the intrusion of pests, such as rodents and birds (faecal material from these pests creates a pathogen risk)
- Keeping tools previously used for sewerage system works close to, or in contact with, tools designed or designated for use on drinking water systems

13.1.2 Solutions

- Cleaning items that may be reused as soon as they are taken out of service and labelling them as fit for use as drinking water assets
- Tagging items to show whether they came from a dirty or a clean process
- Physically separating drinking water and wastewater tools and materials on vehicles and in workshops
- Ensuring that protective packaging is maintained wherever possible and re-package as necessary, into clean and sealed plastic bags
- Storing items in clean areas of work vehicles (isolated from chemicals) and preventing impact damage (tearing of packaging) from movement whilst in transit

Mixed fittings (water and waste) which are accumulating dirt and contaminants

Fittings stored in a vehicle - note caps on meter, chemicals sealed and fittings in sealed bags

14. EQUIPMENT AND PERSONNEL

People, materials and equipment working around water treatment plants, filter beds, water storages and pump wells. When in doubt, stop and question the actions being considered before creating an incident that could have been avoided.

14.1.1 Issues

- Pumps, pipework and fittings that have been removed and sent away for repairs should not be assumed to be fit for immediate use when returned (i.e. disinfected)
- Lifting pipework, pumps and fittings (which have been properly cleaned) into a drinking water storage with equipment such as chains and slings that may have been previously contaminated and not disinfected
- Installing Cathodic Protection anodes, sensors or instrumentation into tanks. These items can be contaminated from transport to site or from being laid out on unclean areas before installation
- Vacuum and tanker trucks cleaning out filter beds, storages and pump wells can have hoses that were previously used in unclean environments. There is also the risk of a back-flow event occurring to the area being worked upon
- Personnel or divers entering into storages, filter beds or pump wells to carry out cleaning, maintenance work or inspections. The risk of cross contamination from previous jobs cannot be underestimated - this includes the vehicles, all equipment, PPE and the personnel themselves

14.1.2 Solutions

- Clean and disinfect all items (however small) before they are used in the maintenance of drinking water facilities and storages
- Cranes that are used to lift in larger items should only use new and/or disinfected lifting equipment when working on pump wells, WTP facilities and storage tanks
- Cathodic Protection anodes, sensors or instrumentation should all be disinfected onsite before installation
- Vacuum or tanker trucks working on drinking water sites need to be carefully managed. Only new and/or disinfected hoses should be used and backflow prevention devices should be installed and tested
- Divers working inside storage tanks and treatment facilities should be drinking water dedicated (DWD) - this includes their personnel, equipment and support vehicles

15. DESIGNERS AND ENGINEERS

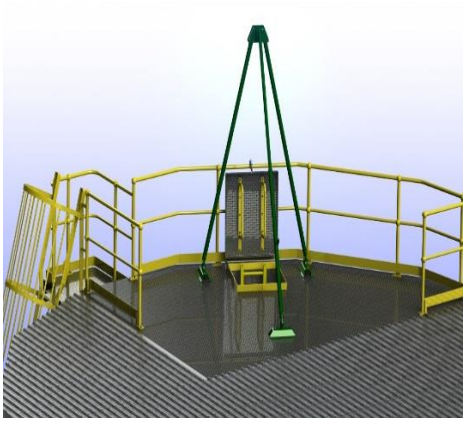
- Designers, engineers, architects and any person involved in the design, construction or renovation of any asset that is required to hold, treat or store drinking water
- Asset managers and personnel involved in change management processes to any infrastructure that holds, treats or stores drinking water

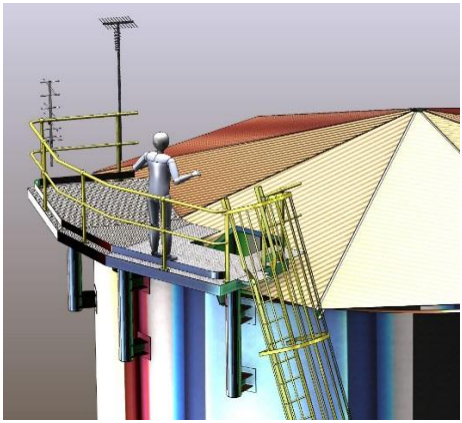
15.1.1 Issues

The design of drinking water systems should be a well understood process. Hazard identification and risk assessment, in consultation with key stakeholders is vital to ensure correct design. A balance is required to ensure that safety legislation and environmental requirements are not compromised, while maintaining the utmost protection of drinking water.

A Hazard and Operability study (HAZOP) process is an ideal forum to discuss design issues and identify the hazards detailed throughout this booklet. It is a proactive review of the design, to fully understand how it will be maintained and used along the journey of its design life and how it will interact with its environment and vice versa.

Despite all of the HAZOP and risk assessment processes that are employed throughout the planning, design and construction phase, issues may still arise from designs that can affect the quality of the drinking water. Additional hazards are also presented where retro-fitting and conducting modifications to drinking water systems occur at a later date.





Prepare clear and concise specifications for construction projects - do not create guidelines that can be misinterpreted or changed by the designers or builders

15.1.2 Solutions

Within each node of the HAZOP and within the final review, consider the following:

Pest control: will there be a requirement, and is the design suitable to block out pests?

Wildlife attraction: is the design a natural attraction for wildlife and will wildlife interaction lead to increased maintenance activities or risks to drinking water quality?

Maintenance requirements: are the materials of construction suitable - will they need on-going maintenance and are they compatible with the asset/process and all of its by-products and inputs?

Environment: will the surrounding environmental features impact on the design and cause maintenance and/or drinking water quality issues now, or in the future?

Operational maintenance and servicing: does the design minimise the need for human intervention for ongoing maintenance/servicing into the future?

Future growth and development: does the design take into account the future growth and development of the surrounding areas, and stakeholder requirements?

16. STORAGE TANKS

Storage tanks come in many shapes, sizes, designs and uses. Each structure must be suitable for the safe storage of drinking water and the way people may interact with the storage, for operational, maintenance and indirect activities.

16.1.1 Issues

- Fitting external cabinets and fixtures that compromise security and allow unauthorised access to occur
- Damaged roof sheeting and vent mesh from the installation of cabling or piping
- Gaps in roofs and platforms that could allow debris/vermin to enter tanks
- Railings and aerials that attract birds to roost close to the tank hatch opening areas or above open sections of a water treatment facility
- Roof and entry hatches or other openings that are not secured, raised or sealed against drainage and debris entry
- Recesses that collect debris and are difficult to clean
- Gutters that collect debris that could block and cause run off into water storages
- Poor design of in-tank pipework, such as inlets, that allow sediment to be disturbed within the tank, or that allow short-circuiting to occur, which compromises disinfection levels (chlorine contact time)

- Outlets that are too close to the tank floor and create a scour effect for settled sediments
- Overflow pipe outlets that are not screened, allowing vermin/animals to enter tanks
- Using materials that will degrade and adversely affect the drinking water quality, such as rotting timber, rusting metals and coatings peeling off

Poorly positioned fixtures and design allows for unauthorised entry to site

Electrical cable installation damaging vent mesh and creating vermin entry points

Gaps in storage tank roofs allow vermin and debris entry

Aerials positioned over hatches and platforms on storage tanks encourage birds to roost and defecate over the surrounding area

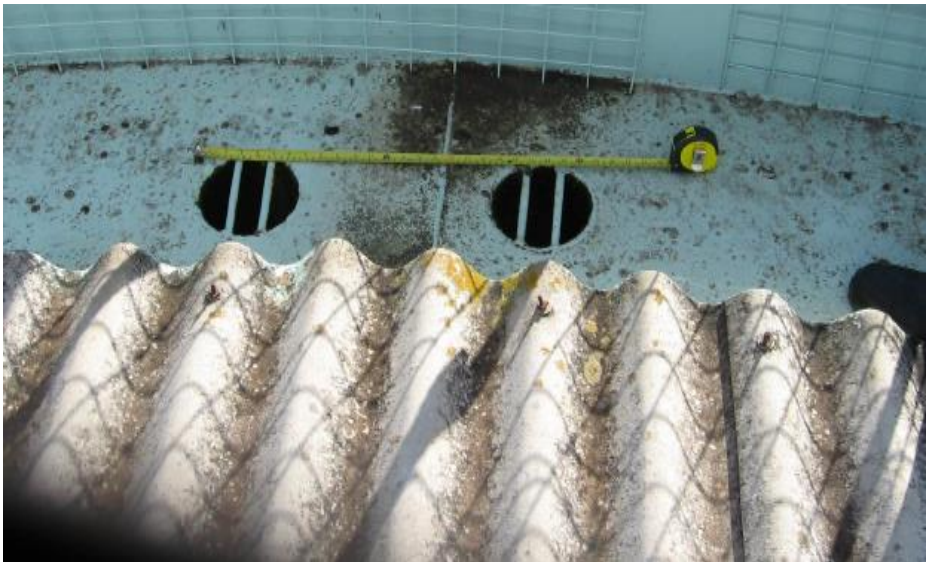
Hatches which are not raised or sealed allow bird faecal material to enter the tank

Hatch covers with gaps which allow bird, vermin or debris entry

Large mesh holes allow dust, debris, insects, birds and vermin to enter

Accumulated leaf debris entering past the coarse vent mesh and subsequently falling into the tank

Corroded infrastructure will impact the disinfection residuals and should be replaced with more suitable materials



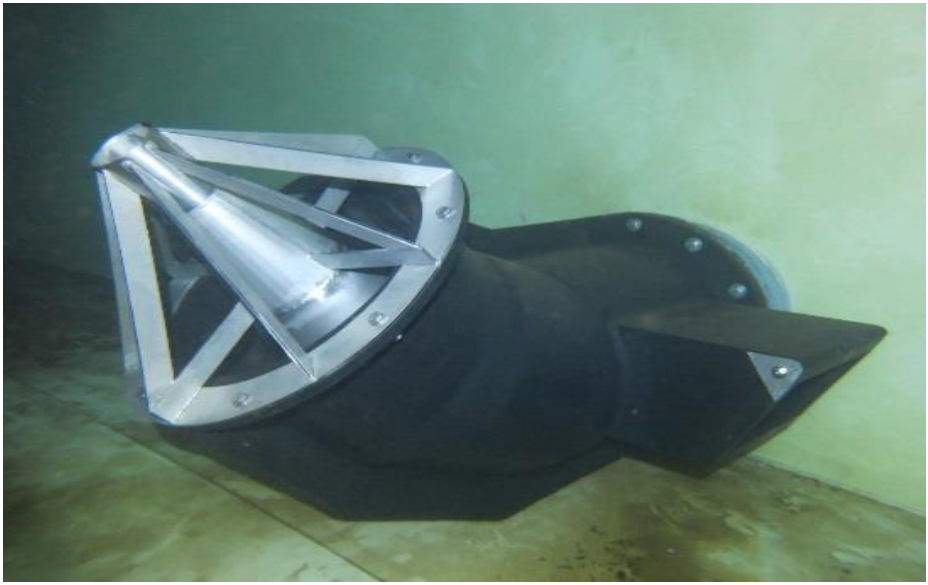
Roof drainage points not connected properly underneath, allowing storm water runoff and bird faecal material to enter the tank

Protective coatings peeling off and entering the water due to the moist, chlorine environment

Features added to a tank without thought for protecting water quality. An unsealed hole in an asbestos roof after installing additional inlet pipework

(Top) An outlet bell mouth level to the floor, scouring sediments into the downstream pipework. (Bottom) An HDPE safety screen with a sealed and raised base section solves the problem

A wall mounted inlet and outlet penetration can disturb accumulated sediments during the filling and draining cycle



Two-way directional nozzles placed over common penetrations will mix the water without disturbing sediments

16.1.2 Solutions

- Hazard identification and risk assessment practices undertaken in consultation with persons that have suitable knowledge and expertise in drinking water supply management and operation
- Ensure that tanks are suitably secured to prevent unauthorised access, including the input/ingress of materials from a natural or introduced source (suitably sized vent mesh)
- Check tanks regularly for maintenance and security, particularly after storm events (e.g. defective rotating vents or roof sheeting detachment)
- Install/retrofit hatches that do not allow debris and contaminates to enter the tank when they are both opened and closed
- Ensure suitable seals exist around tank roof areas, platforms, entry hatches, vents and other openings
- Ensure that fittings/features (e.g. davits, solar panels, aerials, lighting and security equipment) are positioned so that they do not attract birds to roost and defecate around hatches and other openings
- Install guttering (if required) that is easily cleaned and prevents debris ingress or rainwater drainage overflowing into the tank
- Check that drainage control points on the roof and platform areas are properly connected and sealed on the underside
- Use materials that can endure the humid and moist environment that they will be exposed to without degradation (chlorine is also an oxidant and will attack poorly protected metals)
- Ensure renovations, such as additional pipework and cabling installations, do not compromise the sealing integrity or vermin/bird proofing of the tank
- Outlet penetrations and foot valves should be located above the tank floor area, with sufficient stand-off space to prevent sediment accumulation being drawn into the downstream pipework
- Use directional nozzles on inlets, or common inlet/outlet pipework, to avoid sediment disturbance and to promote more effective blending of water within the tank
- Develop standard design specifications that have undergone a HAZOP review

Notes

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