Business Procedure

Biological Water Hazard Management
Document Number – OHS-PROC-223

This document applies to the following site/s:

All Sites ☒	

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1.0 Purpose

To outline Stanwell's guidelines for managing biological water hazards, specifically with regards to drinking water quality, legionella, blue-green algae and modified site specific biological water hazards.

2.0 Scope

This Business Procedure applies throughout Stanwell, all its sites and all activities under Stanwell's control. It applies to all Stanwell employees and contractors, including visitors to Stanwell workplaces.

This Business Procedure does not identify all potential biological water hazards. Rather, it provides information about the micro-organisms most likely to present a risk at Stanwell workplaces. Specific safety controls have been provided where possible for the identified hazards. Generic safety controls have also been included that can be applied to situations where workers are exposed to water sources to ensure that the risk of exposure to potential biological water hazards (whether identified or not) is minimised.

3.0 Actions

Biological water hazards relevant to each site are to be identified by the risk assessment process described below. The hazard identification process is to identify what activities may put workers or members of the public at risk of exposure to biological water hazards.

Each site is required to develop, document, maintain and review their own site-specific biological water hazard management documentation.

Specific risk assessments and control measures for task level activities should be progressively captured through Safe Work Method Statements (SWMS).

In relation to activities or situations where workers may be exposed to potential biological water hazards, a safe work system will be implemented to control risks to health and safety arising from such hazards and issues.

3.1 Risk Management

Risk Management of biological water hazards will occur via the following process:

<u>Identification</u>

Determine the biological water hazards relevant to the identified water bodies or sources on site. This will require knowledge from a number of sources including:

- site history and experience;
- current guidelines and standards;
- expert advice;
- safety alerts;
- information or feedback from other (similar) generation sites; and

To assist with determining biological water hazards:

- What is the primary purpose of the water?
- Where did the water source originate from?
- How do the plant / site processes impact on the water?
- What are the natural influences on the water (e.g. is it a stagnant body or continuous flow etc.)?
- What treatment is performed on the water?
- What monitoring is conducted on the water?
- Is the water subject to contamination (e.g. receives influent water from sewerage plant discharge, wildlife impacts etc.)?

Identify the tasks and activities that potentially expose workers to these risks. This focus should be on the most common or routine tasks that occur on the site.

Assessment

Assessing the risk will require consideration of the characteristics of the water body such as:

- its use (recreational vs. industrial use such as water bodies that are or were heated from industrial processes);
- its visual characteristics (stagnant pools, visible surface scum that may indicate a blue-green algae bloom, clarity etc.);
- chemical characteristics (e.g. nutrient loading)
- its smell; and
- past history of contamination.

To do this assessment, it will also require an understanding of the types of microbiological species that may be present in such water conditions.

In assessing the risk to health from exposure to waters that may contain biological water hazards, the following questions should be considered:

- What are the potential exposure pathways for a person undertaking these activities (inhalation, ingestion, skin and eye contact)?
- What is the likelihood of exposure?
- What is the extent of the exposure (drift, spray, inundation etc.) and what is the duration of the exposure?
- What are the health consequences of exposure to the biological water hazards?
- What is the number of workers and other persons at risk of exposure?
- What is the level of knowledge and training of workers regarding biological water hazards such as safe work procedures and standard precautions (i.e. use of personal protective equipment (PPE) and good hygiene)?
- Are there individual risk factors for the worker/s that need to be considered (e.g. medical conditions that cause damaged/broken skin such as dermatitis or eczema, susceptible individuals etc.)?
- What are the current risk control measures? Are they adequate? What additional control measures are needed?
- What PPE is in use (e.g. rubber gloves, eye goggles and face shields)? Is it appropriate? Has it been maintained properly? Are there any risks associated with the storage of the water?
- What other factors might contribute to exposures (e.g. availability of equipment / resources, the nature of work, weather conditions, climate etc.).

3.2 Control

Standard safety controls and hazard specific safety controls (some of which are outlined in the following sections) are to be implemented in conjunction with routine water monitoring. Control measures selected are to be documented in the appropriate procedure, management plan or SWMS.

Standard safety controls include the following general personal hygiene practices:

- Impermeable gloves are to be available and worn when a worker is likely to be exposed to contaminated water.
- Protective eyewear is to be worn where eyes may be exposed to splashes or sprays of contaminated water.
- Appropriate respiratory protection (P2 or higher) is to be worn in environments where biological hazards are present.

- Cuts or abrasions on any part of a worker's body must be covered with impermeable dressings at all times where there is a risk of infection.
- Hands are to be washed using potable water and soap or sanitised before eating, drinking or smoking.

Details of hazard specific safety controls may be found within the Attachments section of this document.

- Attachment 1: Legionella
- Attachment 2: Microbiological Quality of Potable Water (Drinking Water)
- Attachment 3: Blue-Green Algae (Cyanobacteria)

3.2.1 Water Monitoring

Information from water monitoring results may be relevant to all stages of the risk management process.

The requirement for routine water monitoring is generally based on legislative guidelines that take into account the application of the water, the environment and the potential for human exposure. Attachment 4 outlines the minimum routine water monitoring requirements of water systems at Stanwell workplaces.

Where results of water monitoring exceed a particular guidance or alert level specified within this Business Procedure (or the applicable guidelines if not explicitly stated in this document), there is an increased risk of adverse health effects occurring. The extent to which the level is exceeded will largely determine the likelihood of adverse health effects occurring in the exposed individuals.

The monitoring of potable (drinking) water is applicable to sites that produce their own drinking water from a supply source (i.e. Raw Water Supply Dam and CW Dam). Records of water monitoring results are to be kept.

3.3 Contingency Planning and Communications

Contingency plans are to be developed for biological water hazard related emergency situations such as when monitoring results indicate that drinking water may pose a health risk. The contingency plan can be integrated into the site specific management plans for the identified biological water hazards.

The contingency plans are intended to be working plans to address probable events/outcomes that would arise from utilising relevant guideline limits and standards for action levels and response points. Site experience would also be incorporated into the plans.

It is not the intent of these contingency plans to capture activities for response to extreme events such as natural disasters, floods or unusual incidents (e.g. spills in the catchment), damage to treatment plants and /or distribution systems, and human actions (strikes, sabotage). It is expected that these types of events will be addressed through site specific Emergency Response systems although there may be elements of the specific contingency plans that may be drawn upon to aid in responding appropriately.

A communication and notification plan is to be developed in conjunction with the contingency plan. The plan is to consider responses to events of varying seriousness and describe in detail:

- communications coordination responsibilities;
- the personnel to be informed of the issue;
- how they will be informed; and
- the content of the message.

Attachment 5 provides guidance on site communications and notifications.

3.4 Review and Audit Requirements

An annual review of each site's biological water hazard management performance shall be undertaken, and as a minimum consider:

- results from performance monitoring (where applicable);

- effectiveness of control measures;
- effectiveness of corrective actions; and
- implementation of contingency plans.

Key personnel for this review would include:

- site Chemist;
- site Health, Safety and Environment; and
- site Water Superintendent.

3.5 Personnel Exposure

If a person experiences any unusual health symptoms after contact with potentially contaminated water, the Event Notification Form is to be completed and immediate medical advice is to be sought. The Legionellosis Infection Response OHS-WI-22 is to be used as a guide to address suspected cases of Legionellosis at Stanwell sites.

The treating doctor is responsible for the required pathology testing and issuing a Workcover Certificate if required in addition to any public health notification processes required.

The site shall ensure that a Rehabilitation Coordinator is engaged, who will initiate the rehabilitation process where required.

Stanwell shall maintain a record of all notified illnesses / diseases for a period of 30 years.

3.6 Training and Competency Requirements

It shall be ensured that all personnel involved in work tasks that may expose them to biological water hazard risks are trained and competent in accordance with Stanwell's requirements.

4.0 Review, Consultation and Communication

Review:
This Document is required to be reviewed, as a minimum, every 5 years.

Consultation:
This Business Procedure will be reviewed through consultative processes if significant material changes to content are proposed or required.

Communication/Requirements after Update:
This Business Procedure will be communicated to sites vian an approved communication method by Health, Safety and Environment Systems & Strategy team and on GenNet.

5.0 References (Including Information Services)

Source	Reference
Legislation	• Queensland Work Health and Safety Act 2011 • Queensland Work Health and Safety Regulation 2011 • Workplace Health and Safety Queensland Guide to Legionella Control in Cooling Water Systems, including Cooling Towers (November 2018) • AS/NZS 3666:2011 (series) Air Handling and Water Systems of Buildings – Microbial Control. • AS 5059:2006 Power Station Cooling Tower Water Systems – Management of Legionnaires' disease Health Risk. • Australian Drinking Water Guidelines (ADWG) 2011 (Updated August 2018) • ASNZ Food Standards Code 2020
Business Procedures	• Risk Management Framework GOV-PROC-37

Work Instruction	• Legionellosis Infection Response OHS-WI-22
Stay Safe	• Legionella Management OHS-PROC-223B • Blue Green Algae OHS-PROC-223A
Other	• Chorus I & Bartram J (Eds.) *Toxic Cyanobacterium in Water: A Guide to their Public Health Consequences, Monitoring and Management*, published on behalf of the World Health Organisation, 1999 • National Health and Medical Research Council *Guidelines for Managing Risks in Recreational Water (Chapter 6, part 6.4 Guidelines for Freshwater Bodies)* 2008 • World Health Organisation *Guidelines for safe recreational water environments, Vol 1, Coastal and Fresh Waters, Chapter 4 – Faecal Pollution and Water Quality and Chapter 5 – Free-living microorganisms*, 2003 • Queensland Health *Legionnaire's Disease Fact Sheet*: http://conditions.health.qld.gov.au/HealthCondition/media/pdf/14/33/87/legionnaires-disease-v8 • Queensland Department of Natural Resources and Mines 2014 Queensland *Harmful Algal Bloom Operational Procedures*, 2014
Tools	• Nil

6.0 Definitions

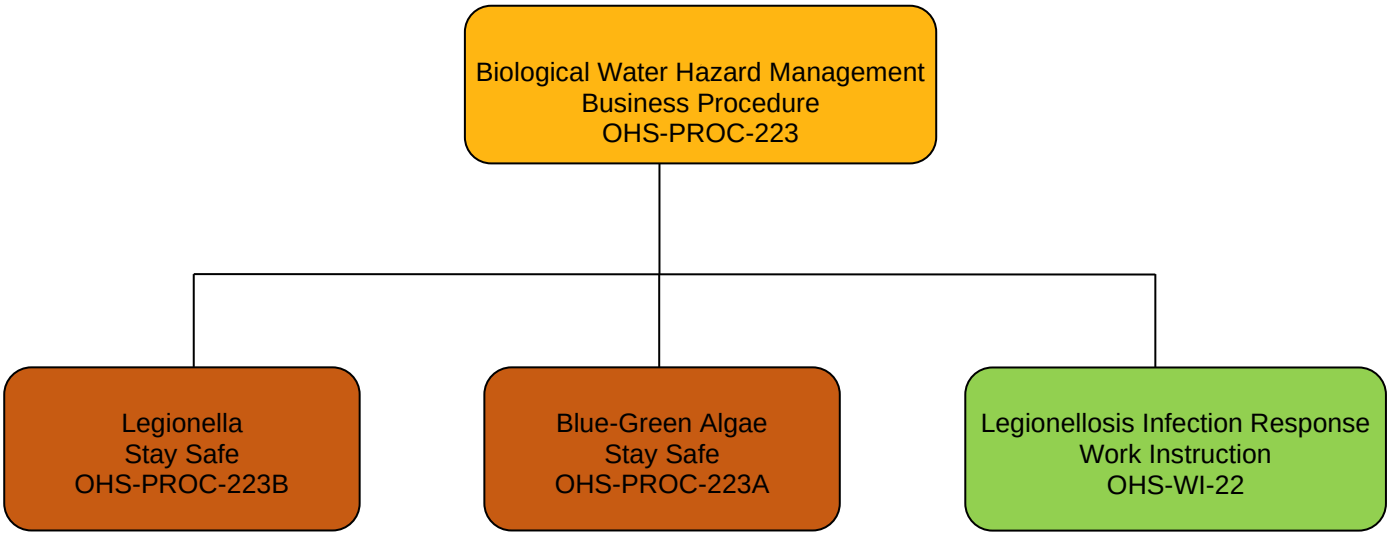
Term	Meaning
Aerosol	Refers to very small water droplets or dust particles of size 0.001μm to 50 μm, which are invisible and are suspended in air. When inhaled, an aerosol can penetrate to the alveolar gas exchange region of the lungs. Water aerosol is produced wherever splashing of water occurs and is present in water mists and spray water. Aerosol can drift lengthy distances from the source before evaporation.
Biocide	A physical or chemical agent that kills bacteria and other microorganisms.
Biological water hazard	A disease-causing micro-organism that causes infection in humans through waterborne transmission.
Micro-organism	A minute living thing that individually is too small to be seen with the naked eye. Micro-organisms are present almost everywhere. Most require water at an appropriate temperature and nutrients to survive. Some can cause serious infections in humans. The main groups of micro-organisms are viruses, bacteria, fungi, algae, and protozoa.
Non-potable water (other than drinking)	For the purposes of this procedure, non-potable water is not used for human consumption, bathing or showering. It is lower quality water than potable water and may be used in industrial processes, washing/cleaning plant and equipment and in other non-consumption applications.
Potable water (drinking)	For the purpose of this procedure, potable water is defined as water intended primarily for human consumption, but which has other domestic uses. It may be consumed from the tap, or indirectly in beverages or foods prepared with water, and among its other uses are bathing and showering.

7.0 Revision History

Rev. No.	Rev. Date	Revision Description	Author	Endorse/Check	Approved By
0	06.11.2015	Procedure created	Jan Fullard	Michael Joy / Trevor Hooper/ Steve Kerr	Ian Gilbar
1	19.04.2021	Scheduled 5 year review	Letitia Lucke	Kriss Ussher	Michael Joy

8.0 Appendices

8.1 Appendix A: Biological Water Hazard Document Flowchart



9.0 Attachments

9.1 Attachment 1: Hazard Specific Safety Controls - Legionella

Legionella bacteria is very widespread and can survive and multiply in natural fresh water systems such as rivers, lakes and underground water systems, and can readily enter man made water systems. It proliferates in the presence of sludge, scale, rust, algae and, most importantly, in water of temperature in the range of 20°C to 45°C. Absolute exclusion of these particular bacteria from water systems, is not necessary, and finding the bacteria does not by itself indicate that a source presents a risk.

Given the ubiquitous nature of Legionella, contact between humans and Legionella in both natural and urban environment would seem inevitable and is very common but rarely results in illness. The infection pathway for Legionella bacteria is most commonly via the lungs through the inhalation of an aerosol containing an infective dose of virulent Legionella species. Infections have also been known to occur by ingress through open wounds.

Illness resulting from Legionella infection (referred to as Legionellosis) takes several forms:

- Legionnaire's disease – a potentially fatal pneumonia caused by Legionella pneumophila (L.pneumophila) serogroup 1. The incubation period of the disease is from two to ten days and symptoms include influenza-like illness, malaise, muscle pain, headaches, high fever, dry cough and shortness of breath. In severe cases, the pneumonia is accompanied by multiple organ failure resulting in death. While this is the strict medical definition of Legionnaire's disease, similar medical conditions can arise due to infection with other serogroups of Legionella pneumophila and a number of other species of the genus Legionella.
- Pontiac fever – a non-invasive illness associated with respiratory exposure to Legionella or their antigen. Pontiac fever has an incubation period ranging from four hours to several days and presents as influenza with headache, tiredness, fever, mental confusion and sometimes nausea but no pneumonia. It is a non-life-threatening illness that lasts two to three days followed by full recovery.

The main risk factors for an outbreak of the disease caused by water systems are:

- the presence of Legionella bacteria;
- conditions suitable for multiplication of the organisms: suitable temperature (20°C to 45°C) and a source of nutrients such as sludge, scale, rust, algae and other organic matter;
- a means of creating and spreading breathable droplets, such as the aerosol generated by a cooling tower; and
- exposure of susceptible people to these aerosols (people most at risk of infection are those over 50 years of age who smoke cigarettes and people with a weak immune system, for example, those with a medical condition such as chronic lung disease, kidney disease, diabetes or cancer).

In power station environments the water systems where Legionella species may be present include:

- unit cooling water systems;
- unit cooling water blowdown;
- general purpose raw water systems/service sater systems;
- fire hydrant and fog systems;
- small auxiliary cooling towers serving compressor plant and the like;
- cooling water towers in building air-conditioning systems; and
- infrequently used potable hot water systems.

Risk Management

There are three types of Legionella environments that are to be managed as per relevant Australian Standard guidelines:

1. Main cooling tower water systems of power stations (Refer AS 5059:2006); and
2. Air handling and water systems of buildings, or other relatively smaller cooling tower water systems (Refer AS/NZS 3666:2011 series); and
3. Other general water systems. For example, raw water systems, service water systems and fire fighting systems. Management measures should only apply to those water systems where Legionella amplification is a credible outcome (i.e. presence of risk factors such as heat, nutrients, poor water quality, stagnant environment etc.) AND there is the likelihood of personnel exposure to aerosols that may result in disease formation. (Refer AS/NZS 3666:2011 series)

The Workplace Health and Safety Queensland *Guide to Legionella Control in Cooling Water Systems, including Cooling Towers,* 2018 is to be considered when developing guidelines for the management of Legionella in cooling water systems.

As far as reasonably practicable, all Legionella risks shall be identified by a competent person.

The following categories of critical risk for Legionella growth in water systems and resultant infection of people shall be considered:

- stagnant water;
- nutrient availability;
- poor water quality;
- deficiencies in the cooling tower; and
- location of the cooling tower system near the public and/or close to other air handling services.

A number of risk factors come under the five critical risk categories (as set out in Section 5 of AS 5059:2006 and Sections 4 and 5 in the Queensland *Guide to Legionella Control in Cooling Water Systems, including Cooling Towers*, 2018). Each risk factor shall be considered systematically in the process of identification, assessment and analysis of risk. For each water system, sites shall engage a competent person to assess each of the critical risks (as detailed above) and associated risk factors.

A risk assessment for all identified Legionella risks shall be performed. The risk assessment shall identify activities that have the potential to put workers or members of the public at risk of exposure to Legionella.

The risk assessment shall be undertaken and documented according to all relevant legislation and Australian Standards as listed in the reference section of this document.

Workers who smoke, have chronic lung disease, have suppressed immune systems from bacterial infections, medications or other diseases such as cancer, kidney failure and diabetes are prohibited from working in areas where they may be exposed to Legionella bacteria. It shall be ensured that workers with cuts or abrasions will have these covered with waterproof dressings at all times when potentially exposed to Legionella bacteria. A risk assessment is to be carried out on workers prior to entry into identified Legionella areas to determine risk factors and ensure appropriate control measures.

Safety Guidelines for Inspection and Maintenance Of Air-Handling And Water Systems

The highest level of control is to not expose workers to areas of high risk. For example: in cooling towers, conduits and water boxes. However, when it is absolutely necessary for work to be carried out in high risk areas, engineering, administration and personal protective equipment (PPE) precautions to remove avenues of exposure to Legionella bacteria are to be employed, regardless of Legionella concentrations.

Legionella Management Plan

Where there is a risk of exposure to Legionella, sites shall develop, document and maintain a Legionella Management Plan that refers to each applicable water system.

The purpose of the Legionella Management Plan is to make sure that the risks associated with Legionella are controlled and managed. The plan shall be compliant with all relevant legislation and Australian Standards as listed in the References section of this document.

In particular, sites shall operate and maintain a cooling tower water system within the requirements of *AS/NZS 5059:2006 Power Station Cooling Tower Water Systems – Management of Legionnaires' Disease Health Risk*; and any other ancillary cooling water system such as building air conditioning systems within the requirements of *AS/NZS 3666:2011 (series) Air-handling and water systems of buildings.* The principles of these standards should be applied broadly to any other water system identified as being a potential source of Legionnaires disease health risk.

As a minimum, the Legionella Management Plan shall include:

- the identification and risk assessment of most critical risks;
- the requirements to minimise microbial multiplication by ensuring an adverse growing environment through appropriate water treatment and plant cleanliness;
- the requirement to maintain a biocide program in the water system where the desired outcomes includes the elimination of Legionella in the water;
- the requirements for water quality management including monitoring, assessment (against established performance criteria) and control including remedial actions where results fall outside established performance criteria and operating control ranges, to bring the concentrations within the established control range before the next monthly monitoring and assessment;
- the requirement to minimise the production and release of aerosols;
- operational controls and work procedures that ensure people are not exposed to Legionella bacteria, regardless of Legionella concentrations. For example, the requirements and process for when it is absolutely necessary that workers work in areas where a Legionella risk exists, the wearing of personal protective equipment in work areas where there could be higher risk e.g. water blasting screens, working in condenser water boxes, and handling cooling tower sludges and bio-films are known to present increased risk;
- site specific responsibilities in relation to the risk assessment, Legionella Management Plan and overall management of Legionella;
- internal and external reporting requirements as required by the relevant legislation and/or Australian Standards; and
- notification, escalation and communication requirements, including internal and external stakeholders.

9.2 Attachment 2: Hazard Specific Safety Controls – Microbiological Quality of Potable Water

Introduction

Potable water should not contain organisms capable of causing disease. The most common and widespread health risk associated with drinking water is contamination, either directly or indirectly, by human or animal (including bird) excreta, and with the micro-organisms contained in faeces. If the contamination is recent, and if among the contributors there are carriers of communicable enteric diseases (diseases of the gut), some of the micro-organisms which cause these diseases may be present in the water. Drinking this water or using it in food preparation may cause new cases of infection.

For the purpose of this procedure, potable water is defined as water intended primarily for human consumption, but which has other domestic uses. It may be consumed from the tap, or indirectly in beverages or foods prepared with water, and among its other uses are bathing and showering.

The Australian Drinking Water Guidelines (ADWG) 2011 provide a framework of acceptable water quality characteristics. Chapter 4 of the ADWG, 'Framework for the Management of Drinking Water Quality- Application to Small Supplies' discusses how the guidelines apply to Stanwell sites' reticulation systems (where relevant). Chapter 5, 'Microbial Quality of Drinking Water' discusses the microbiological aspects of drinking water quality. The targets and limits recommended in these guidelines are intended to meet the needs of consumers and apply at the point of use, for example at the tap. The guidelines are applicable to any water intended for drinking (except bottled or packaged water*) irrespective of its source (municipal supplies, rainwater tanks, bores, point-of-use treatment devices etc.) or where it is used.

*Packaged water (and ice) is regulated by Part 2.6.2 of the ASNZ Food Standards Code 2016. It is recommended that water dispensers (e.g. plastic well water coolers) are regularly cleaned. Occasional sampling of water from such cooling / dispensing devices is also recommended to check that the cleaning regime is adequate. Cleaning of water dispensers may be a service negotiated into water supplier contracts.

Health Effects and Exposure Pathways

As stated above, this water is intended primarily for human consumption; therefore any exposure pathway is possible (although direct ingestion and skin contact are the most probable). Potable water therefore has the potential to become a substantial health risk to people if the water quality or the management of the system fails.

Risk Management

Risk management for sites should be broken down into two aspects:

1. Management of raw water supply dams, catchment areas, water treatment plant and storage facilities (including rain water tanks used for drinking water) – specifically for sites that manage the production of their own potable water.
2. Management of the Site Distribution System – for both site-produced and municipal supplied potable water – sites are to ensure that the quality of water in the distribution system meets the ADWG guidelines.

For sites with municipal supplied potable water, monitoring is normally undertaken by the water authority from a service pipeline directly off a water main selected to represent the quality of water in the system. However, on occasions it may be necessary to check the water quality at the consumer's tap to confirm that chosen distribution sampling points are representative for microbiological monitoring. For municipal supplied sites, this testing may be arranged through the water authority. For site-produced potable water, the requirement for distribution system testing is to be an element of the overall water management system.

Monitoring of Water Supplies

Where applicable, sites are to develop a drinking water monitoring program as per the ADWG. The following principles apply to the monitoring of water supplies:

- Regular testing of drinking water quality should be regarded as only one step in a broader treatment and surveillance program to ensure that water is safe for use and as a check that the water management system is working.

- Monitoring for the presence of specific pathogenic organisms is appropriate for special investigations, and in the face of evidence of outbreaks of water-borne disease. However, these are not recommended for routine monitoring of water supplies, due to the complexity of testing, associated cost, and, very commonly, poor reliability of detection. Therefore in monitoring for microbiological quality, reliance is placed on relatively rapid and simple tests for the presence of indicator organisms.

Guidance Levels and Recommended Actions

The microbiological quality of water is by far the most important factor in determining the safety of water supplies from a health perspective. Microbiological quality in small water supplies can be determined by monitoring for microbiological indicator organisms as outlined in Attachment 4.

The following table outlines the recommended actions to take if indicator organisms are detected through this process.

Indicator Organism	Guideline	Actions
Thermotolerant coliforms (or alternatively E. coli)	No sample should contain any thermotolerant coliforms (or alternatively E. coli). Minimum sample 100mL	If thermotolerant coliforms (or alternatively E. coli) are detected, then irrespective of the number of organisms, the following steps should be taken immediately: 1. Alternative drinking water arrangements will need to be made until corrective action is taken and water quality is confirmed to be suitable for drinking. A site communication should be made advising personnel of the current status of the potable water and any actions they need to be aware of. Refer to Attachment 5 - Guidance on Site Communications and Notifications. 2. Another sample (a repeat sample) should be taken from the same site and tested for the presence of both thermotolerant coliforms (alternatively E. coli) and coliforms. ▪ If the repeat sample is negative for both thermotolerant coliforms (alternatively E. coli) and coliforms, then routine sampling can resume, but only after step 3 below has been completed. ▪ If the repeat sample is positive for either thermotolerant coliforms (or E. coli) or coliforms, then increased disinfection and a full sanitary survey should be implemented immediately. The sanitary survey should include a review of the integrity of the system. 3. Disinfection should be increased and/or an investigation undertaken to determine possible sources of contamination. These might include a breakdown in disinfection, a mains break, interruption to the supply, surges in supply, or deliberate or accidental contamination of the system. The investigation may include a visual inspection of the system and associated service reservoirs by trained personnel. When found, the source of contamination should be eliminated.
Total coliforms	No sample should contain any coliform organisms. Minimum sample 100mL	If coliforms are detected in any sample, then irrespective of the number of organisms, the following action should be taken immediately: 1. Alternative drinking water arrangements will need to be made until corrective action is taken and water quality is confirmed to be suitable for drinking. A site communication should be made advising personnel of the current status of the potable water and any actions they need to be aware of. Refer to Attachment 5 - Guidance on Site Communications and Notifications.

Indicator Organism	Guideline	Actions
		2. Another sample (a repeat sample) should be taken from the same sample site and tested for the presence of coliforms and thermotolerant coliforms (or E. coli). ▪ If the repeat sample is negative for both coliforms and thermotolerant coliforms (or alternatively E. coli), then routine sampling can resume, and no further action is required unless local knowledge of a system dictates an increased response. ▪ If the repeat sample is positive for either coliforms or thermotolerant coliforms (or alternatively E. coli), then corrective action, such as increasing disinfection dosage, an investigative survey, and follow-up action, should be undertaken immediately.

Sites that Manage the Production of their Own Potable Water

This section is applicable to sites that have their own raw water supply dam that is used to derive a potable water source.

Water Management System

To ensure the microbiological quality of potable water produced at sites is safe, a site-specific water management system is to be developed that includes:

- effective treatment processes, including disinfection;
- effective barrier mechanisms to prevent the entry and transmission of pathogens throughout the system;
- regular inspection and maintenance of the system;
- practices that identify likely external sources of contamination;
- ongoing evaluation and refinement of the overall operation of the system;
- monitoring programs which assess water quality throughout the system, and which can identify the location and nature of any water quality problem within the system;
- validation procedures for sampling and laboratory testing programs;
- the use of monitoring information both to facilitate day-to-day management of the supply, and to assess its performance over time;
- appropriate procedures for:
  - immediate correction of any serious water contamination; and
  - resolution of longer-term water quality problems which might be costly to address;
- defined lines of responsibility for remedial action;
- use of appropriately skilled and trained personnel;
- transparent auditing procedures; and
- reporting to consumers.

Note: This procedure only relates to the microbiological quality aspects of a site-specific water management system. However, the above dot points can be applied to managing the other characteristics of drinking water quality described in the ADWG (physical, chemical and radiological quality).

Disinfection of Drinking Water

Sites must develop a water treatment program that includes disinfection (with rainwater tanks being the exception as the ADWG has no reference that requires water from a rainwater tank to be disinfected. For further guidelines on the management of water qualities in rainwater tanks refer to section below).

The physical quality (particularly turbidity and pH) of the water should be improved before disinfection to decrease the likelihood that disease-causing organisms will be harboured in suspended matter, and to increase the efficiency of disinfection.

The ideal disinfectant should:

- effectively remove pathogens over a range of physical and chemical conditions;
- produce a disinfectant residual which is stable and easily measured;
- produce no undesirable by-products;
- be easily generated, safe to handle, and suitable for widespread use; and
- be cost-effective.

None of the disinfectants currently used meet all of these requirements. Choosing the optimum process often involves a series of compromises, and the choice will be based on the quality of the source water, the origin of the contaminating micro-organisms, the length and complexity of the system, and the size of the population served.

Agents and processes that have been used to disinfect water include chlorine, chloramines, chlorine dioxide, ozone, bromine, bromine chloride, iodine, silver and silver compounds, ultraviolet and ionising radiation and filtration.

It is recommended that sites refer to the ADWG and consult a water quality specialist for guidance in developing a site specific water treatment program.

Rainwater Tanks

For small / remote sites that consume rainwater tank water, water quality should be protected by the use of barrier systems and maintenance programs. The quality of water from rainwater tanks can be affected by roofing and tank materials, paints, atmospheric contaminants, leaves, dust, animal and bird droppings. Brochures on barrier systems and maintenance of rainwater tanks are available from state and local government authorities. When considered necessary, sites should have their rainwater tested for health characteristics identified as being of local concern.

The principles of rainwater tank water quality management are detailed below:

- Provided sites are following the rainwater tank manufacturer's instructions on correct set up, usage and maintenance, the rainwater should not be exposed to contamination sources therefore the risk of harmful organisms being present would be low.
- Rainwater is generally safe to drink providing it is clear, has little taste or smell, and is from a well maintained system. If any of these qualities change then immediate additional control measures are to be taken (such as changing to bottled water) until the contamination source is investigated, disinfection and/or tank cleaning is carried out and water quality sampling is conducted to confirm that the water is safe to drink.

9.3 Attachment 3: Hazard Specific Safety Controls –Cyanobacteria (Blue Green Algae)

Cyanobacteria are true bacteria, although they are often called 'blue-green algae' because they have some of the characteristics of bacteria and of algae (i.e. they resemble green algae in morphology, habitat and photosynthetic ability). They can occur singly or grouped in colonies and can increase to such large numbers that they colour the water (a 'bloom') and form highly visible thick scums.

Algal blooms are common seasonal phenomena occurring throughout Queensland in fresh, estuarine and coastal marine waters. The organisms largely involved in these outbreaks include cyanobacteria, diatoms and dinoflagellates. Algal blooms may be potentially toxic thus posing a direct threat to human and animal health.

Conditions that may promote an algal bloom include:

- low turbidity waters;
- warm water temperatures;
- adequate sunlight; and
- stable water conditions/long residence times; and
- an increase in the nutrient levels in the water (e.g. from the aeration of a dam or riverbed by releasing nutrients trapped in the dam sediment, runoff etc.).

Health effects and exposure pathways:

Many species of cyanobacteria and microscopic algae have the potential to produce toxins that present a hazard to human health. Ingestion, inhalation and skin or eye contact with water with high levels of algae and/or toxins can produce a range of adverse health effects. Toxic cyanobacteria in a water body do not necessarily pose an environmental or human hazard as long as the cells remain thinly dispersed. Mass developments, especially of surface scums, pose the largest risks. The severity of a reaction to algae and/or its toxins is dependant upon the species in the bloom, the magnitude of the bloom and the length of exposure.

Exposure Pathway	Effect
Ingestion of water containing blue-green algae cells	Diarrhoea, vomiting, ulcers, liver damage, possibly promotes the growth of tumours, death.
Ingestion of water containing toxins	Possibly promotes the growth of tumours
Inhalation of water containing blue-green algae cells	Asthma attacks
Skin contact with water containing blue-green algae cells	Rashes. Note that skin irritant effects are particularly enhanced in those areas of the body covered by bathing or wet suits. This is due to the cells becoming trapped in the fabric of the suit resulting in prolonged contact with the skin.

Risk management

Individual sites / workplaces are to develop procedures to ensure the growth of blue-green algae in workplace water sources is managed effectively.

The following information indicates some of the key issues that need to be considered in the risk management process.

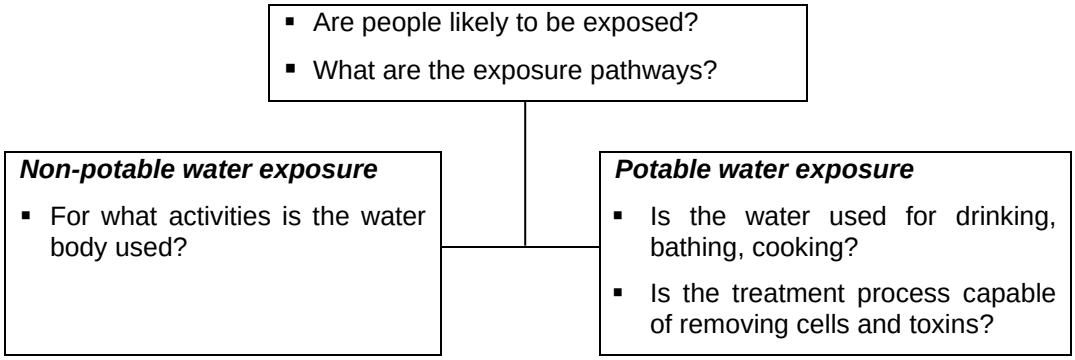
HAZARD IDENTIFICATION

- What species of blue-green algae are present in the water?
- What is the concentration of cells in the water at various sampling locations?
- Are any of the species potentially toxic? If so, are they producing toxin and what is the level of total toxin (cellular and soluble)?

If the water is to be used for potable uses, levels of cells and toxin/s in the source and treated water should be determined.

Sites may require the expertise of a competent person to provide advice on the identification of a potentially toxic algal bloom. Refer to *Queensland Department of Natural Resources and Mines (2014) Queensland Harmful Algal Bloom Operational Procedures* for a list of local authorities and major water storage operators in Queensland who can assist with identification, risk assessment and management. Often visual inspection by an experienced officer will determine if the bloom is potentially harmful or just a general water quality or water weed issue. If the site is given advice that the bloom may be a harmful algal bloom, they are to arrange for the sample to be sent to the appropriate laboratory, usually in Brisbane, for analysis to confirm and quantify any toxins present. Generally the laboratory will determine the most relevant and optimal methods for sampling and analysis, and the appropriate risk assessment framework against which analysis results will be interpreted (see Appendix 4 of the *Queensland Harmful Algal Bloom Operational Procedures 2014).*

EXPOSURE ASSESSMENT



- Is it possible to estimate the extent to which people are exposed?
- Have any adverse effects been reported from using the water?
- Is anyone particularly at risk of greater exposure?

RISK ASSESSMENT

The analytical laboratory can assist in determining the most appropriate analysis for the type of sample(s) provided and the appropriate guidelines (i.e. drinking water, recreational water, etc.) against which the laboratory results can be assessed. Refer below for a list of Queensland Government Laboratories available for the analysis of harmful algal blooms.

RISK CHARACTERISATION

Overall risk is based on concentration of cells and/or toxin, the extent of the bloom/contamination, the type of activities/work the water body is used for and the amount of contact the workforce or public may have with the water body.

MITIGATION AND MANAGMENT

In many cases there is little that can be done to safely remove the bloom from the waterway. Separation of workers and the public from affected waterways is required until the bloom has reduced to a safe level. Note: Blue-green algal blooms often persist for several weeks, depending mainly on the weather or flow conditions. Cooler, windy weather or increased flow may reduce or prevent blooms from occurring.

As the bloom dies, the cells tend to become 'leaky'. If the bloom contains species that produce toxins, these will be released into the surrounding water. Once released, some toxins may persist for more than three months before sunlight and the natural population of bacteria in the water degrade them.

(Reference: Queensland Department of Natural Resources and Mines *Queensland Harmful Algal Bloom Operational Procedures 2014*)

Queensland Government Laboratories available for advice and the analysis of Harmful Algal Blooms

Organisation	Phone Number
Department of Science, Information Technology, Innovation and the Arts Ecosciences Precinct 41 Boggo Road, via Loading Dock 3 Joe Baker Street Dutton Park Qld 4102	(07) 3170 5545
Department of Health Queensland Health Scientific Services, 39 Kessels Road, Coopers Plains QLD 4108	(07) 3274 9111 Health Protection Unit: (07) 3328 9310
Department of Agriculture, Fisheries and Forestry Biosecurity Sciences Laboratory, 39 Kessels Road, Coopers Plains QLD 4108	(07) 3276 6062

Monitoring Guidelines - Blue-Green Algae

Sites are to conduct routine monitoring so that specific recommended actions can be implemented if alert level concentrations are reached.

Guidance Levels and Recommended Actions

The non-potable water alert levels are set at higher algal cell concentrations than the alert levels for potable water. This is because non-potable water is not intended for consumption. The following tables outline the alert levels and recommended actions for waters which contain blue green algae cells for non-potable and potable water.

Non Potable Water Guidelines

Reference: From *Table 6.2 Interpretation of cyanobacterial alert levels for recreational water* from National Health and Medical Research Council (2008) *Guidelines for Managing Risks in Recreational Water (Chapter 6, part 6.4 Guidelines for Freshwater Bodies).*

Non Potable Water Guidelines			
Guidance Level No.	**Guidance level or situation**	**Health risks**	**Recommended Action**
1	20 000 cells/mL or 10 µg/L chlorophyll-a with a dominance of blue-green algae	Short term adverse health outcomes unlikely.	▪ Signs to indicate blue-green algae either absent or present at low levels.
2	100 000 cells/mL or 50 µg/L chlorophyll-a with a dominance of blue-green algae	Short term adverse health outcomes e.g. skin irritations, gastrointestinal illness, probably at low frequency.	▪ Watch for scums. ▪ Restrict water contact. ▪ Signs to indicate MODERATE alert level – increased risk for water contact activities. ▪ Inform relevant health authority.
3	Blue-green algae scum formation	Short term adverse health outcomes such as skin irritations or gastrointestinal illness following contact or accidental ingestion. Severe acute poisoning is possible in worst ingestion cases.	▪ Immediate action to prevent contact with scums. ▪ Signs to indicate HIGH alert level – warning of danger for water contact activities. ▪ Inform relevant health authority.

Potable Water Guidelines

The following are recommendations made in the ADWG for notification of algal blooms to water and health authorities. In all cases, cell numbers should only be used as preliminary signals and as triggers for toxin testing to enable assessment of potential health risks.

For more detailed information, refer to *Cyanobacteria and their Toxins Factsheet* in the ADWG.

It is recommended that sites use these guidelines to develop appropriate site based responses to algal blooms in water bodies where potable water is sourced.

Potable Water Guidelines		
Drinking water guidelines action	Algal number (refer to guidelines below table)	Site based action
Initial notification to health authority	≥ 2000 cells L^{-1}	▪ Trend towards increasing numbers, or maintenance of moderate numbers of blue-green algae. ▪ Water may be unsuitable for drinking without suitable treatment. ▪ Consider alternative water supply options. ▪ In drinking water supplies, toxin testing to be initiated, particularly if the sample is predominated by a known toxic species – repeat on weekly basis. ▪ Low risk of skin irritation or gastrointestinal illness from contact. ▪ Continue weekly blue-green algae counts and issue advisory notices to the workforce.
Alert issued	≥6500 cells mL^{-1}	▪ Persistently high numbers of potentially toxin cyanobacteria widespread throughout the water source, and/or visible localised scums forming. ▪ Water unsuitable for drinking. ▪ In all storages, toxin testing to be initiated and/or continued on a weekly basis. ▪ Switching to an alternative water supply should be initiated if available. ▪ Weekly sampling for blue-green algae counts to continue. ▪ Increasing risk of adverse health effects from contact. ▪ Upgrade advisory notices to the workforce to the highest alert level.

Monitoring program associated with cyanobacterial alert levels

Cyanobacterial alert level	Monitoring requirement
Surveillance mode (Green level)	Routine sampling to measure cyanobacterial levels.
Alert mode (Amber level)	Investigations into the causes of the elevated levels and increased sampling to enable the risks to recreational users to be more accurately assessed.
Action mode (Red level)	Local authority and health authorities to warn the public that the water body is considered to be unsuitable for primary contact recreation.

Guideline Criteria to Enter or Downgrade an Alert Level

Cell counts for an algal bloom can proliferate rapidly between sampling intervals and alert levels are often entered and exited quickly or not at all (particularly the lower alert levels). In the same way, blooms can subside rapidly often within a matter of days. Therefore the following points are recommended to be considered before implementing a contingency plan:

- Consideration should be given to the detected species – identified potential toxic species should be treated much more conservatively than non-toxic species.
- The criticality of the water system should be taken into account – any blooms with the potential to impact on (for example) the domestic water system should be treated with the uttermost priority.

- In all cases, the bloom must be watched closely. If there is any uncertainty about managing the bloom, then expert advice should be sought (refer above for a list of contacts).

To downgrade an alert level the following aspects must be considered:

- Three consecutive weeks of results which meet the criteria for the lower alert level.
- The results must have continued to drop or showed no change for algae counts or toxin levels.
- Prevailing/expected weather conditions (rainfall, temperature etc).
- What the water body is doing (stable or fluctuating levels, turn over etc.)
- Historic characteristics of the bloom i.e. the duration or stability of the bloom.

Once a decision has been made based on the above considerations monitoring and actions can revert to the appropriate level. Site Management should be informed of the change in algae levels and where appropriate, site personnel should be informed of the current advice (particularly if there are issues with high exposure waters such as domestic water or service water). Refer to Attachment 5 - Guidance on Site Communications and Notifications.

9.4 Attachment 4: Minimum Monitoring Requirements for Water Systems

Water Use	Hazard	Monitoring requirement	Guidelines	Reference	Additional Information
Potable Water Drinking Water	Microbiological Activity Micro-organisms capable of causing disease in drinking water (such as e.coli, cryptosporidium and giardia).	Refer to Chapter 4 ADWG for guidelines on the frequency of monitoring for small water supplies. The monitoring frequency of site produced drinking water (for small water supplies) is generally determined at the site's discretion based on expert advice and historical drinking water quality data. Monitoring frequency should be based on the principle that it is much more effective to test for a narrow range of key characteristics as frequently as possible, supplementing this with sanitary inspection, than to conduct comprehensive but lengthy (and possibly largely irrelevant) analyses less often.	The ADWG recommends as a minimum, small community supplies should be monitored for the four characteristics which best establish the hygienic state of the water and the potential for other problems to occur: - microbiological indicator organisms (thermotolerant / faecal coliforms, or alternatively E. coli; and total coliforms) - disinfectant residual - pH - turbidity	The Australian Drinking Water Guidelines 2011 (ADWG)	The monitoring frequency guidelines are based on the ADWG classification of a "small water supply" i.e. serving less than 1000 people.
	Blue green algae	Water supplies are to be monitored routinely for the presence of blue green algae on a quantitative basis. When the concentration of algal cells reaches the levels indicated in Attachment 3 (sourced from the Australian Drinking Water Guidelines) the toxin concentrations of a bloom should be tested and monitored on a weekly basis.	Attachment 3 provides a summary of the Australian Drinking Water guidelines for the management of blue green algae in drinking water. These guidelines are applicable to source/raw water (not treated drinking water). It is important to note that the Alert Levels are monitoring and management action sequences that can be used to provide a graduated response to the onset and progress of a blue-green algae bloom.	The Australian Drinking Water Guidelines 2011 (ADWG)	The frequency of algal monitoring is dependant on observations or predictions of blooms. The frequency may decrease during winter (e.g. based upon observations), when algal numbers are generally low, and increase (e.g. fortnightly) in summer when algal numbers are generally high. Advice on the frequency of monitoring should be determined by consultation between the local water supply authority and the relevant local Health Authority.

Water Use	Hazard	Monitoring requirement	Guidelines	Reference	Additional Information
Non-Potable Water Generic Waters	Microbiological Activity	Where the potential exists for people to routinely be in contact with a water supply, then that water supply shall be monitored regularly for the presence of microbiological hazards. The decision on the type and frequency of water analysis will be influenced by the origin of the water and the sources of contamination likely to occur.	No specific guidelines exist for non-potable waters sourced from stormwater run-off or process water reuse. However it may be appropriate to draw a comparison of the measured water quality values against the ADWG for potable waters and the WHS (Qld) guidelines for Recycled Water sourced from sewerage treatment plants to gauge the relative quality of the water.	Workplace Health and Safety Queensland: "Guide to workplace use of non-potable water including recycled waters" Version 1 – June 2007. National Health and Medical Research Council (2008) Guidelines for Managing Risks in Recreational Water (Chapter 6, part 6.4 Guidelines for Freshwater Bodies)	
	Blue green algae	Where the potential exists for people to be in contact with a water supply, then that water supply shall be monitored routinely (refer Additional Information) for the presence of blue green algae on a quantitative basis. .	Refer to Attachment 3: Guidelines for Non – Potable Water.	National Health and Medical Research Council (2008) Guidelines for Managing Risks in Recreational Water (Chapter 6, part 6.4 Guidelines for Freshwater Bodies)	The frequency of algal monitoring is dependant on observations or predictions of blooms. The frequency may decrease during winter (e.g. based upon observations), when algal numbers are generally low, and increase (e.g. fortnightly) in summer when algal numbers are generally high. Advice on the frequency of monitoring should be determined by consultation between the local water supply authority and the relevant local Health Authority.
Non-Potable Water Cooling Tower condensing water systems and major auxiliary plant cooling water systems of power stations.	Legionella	A representative sample of water (in power station cooling tower water systems) is to be taken at least once per month, or more frequently as determined under the risk management plan and tested for the presence of Legionella and other heterotrophic bacteria (Total Bacteria Count).	As outlined under the relevant Legionella Management Plan prepared in compliance with AS 5059:2003 and appendix 1.	Australian Standard AS 5059:2003 – Power station cooling tower water systems – Management of legionnaire's disease health risk	The risk assessment may provide for variations to monitoring frequency, e.g. additional monitoring during summer months and reduced frequency of monitoring during winter, as appropriate to the site.

Non-Potable Water Other work environments (other than power station cooling tower water systems). This provision applies only where the water is a credible Legionella amplification environment and its use results in potential generation of aerosols with reasonable expectation of exposure for personnel.	Legionella	Test for Total Bacteria Count (TBC) in system water regularly (at least monthly), to assess effectiveness of the water treatment system and general system cleanliness. Regular examination of water for the presence of Legionella bacteria is not usually warranted.	Ideally, the Total Bacteria Count (TBC) should be below 100 000 cfu/ml of water sample. However, this may not be practical in all circumstances. Concentrations above 100 000 cfu/ml indicate that conditions in the system are favouring bacterial multiplication.	Australian Standard AS/NZS 3666.2:2002 - Air-handling and water systems of buildings- Microbial control Part 2 Operation and Maintenance, and its supporting document SAA/SNZ HB32 - Control of microbial growth in air-handling and water systems of buildings. OR AS/NZS 3666.3:2000 Air-handling and water systems of buildings – Microbial control Part 3 Performance-based maintenance of cooling water systems	Culturing for Legionella bacteria may be appropriate if carried out for a specific purpose such as establishing an effective water treatment regime, to trace the source of an infection, or to establish that decontamination procedures have been properly carried out.

9.5 Attachment 5: Guidance on Site Communications and Notifications

Some considerations before distributing site-wide and/or external communications should include:

Establish the Scope of the Issue	▪ Identify the primary cause of the issue and not just symptoms or secondary problems. ▪ Determine / establish the extent of the contamination / incident. ▪ Determine the extent of the impact and potential consequence. ▪ What, when, how are control measures being implemented. ▪ How much actual monitoring data has been collected. ▪ Verify the facts – follow-up samples, retests etc. ▪ Identify who needs to be notified – personnel, contractors, external parties etc. ▪ Identify whether the issue qualifies as a crisis in accord with Stanwell's Corporate Crisis Leadership Plan.
Internal notification	▪ Stanwell site specific policies / protocols for notifying and briefing management on the issues. ▪ Engage management endorsement prior to any site wide communication (unless extreme circumstances that require instant actions). ▪ Do public health authorities need to be notified? – discuss with management prior to proceeding. ▪ Be aware of IR issues associated with the issue (particularly with drinking water) and how to manage these appropriately. Establish whether the Crisis Leadership Team should assume corporate management of the issue in accord with aforementioned Crisis Leadership Plan.
External Notification	▪ Stanwell policies / protocols for notifying external parties on sensitive issues. ▪ Establish specific communication protocols for stakeholder notification to ensure consistency of key messages and centralised communications. ▪ Ensure Chief Executive endorsement of protocol.
Seek Additional Support	▪ What is the current advice from experts? (e.g. public health expert from the health department or a water quality expert from the relevant water authority in your state). ▪ Be mindful not to disclose information that may be commercially or legally sensitive or contentious.
Preparation of the Communication	▪ Ensure that the objective of the communication is clear to help formulate the development of specific key messages that inform receivers of the magnitude and consequence of the problem and requests their attention to required actions. ▪ Describe the problem and the consequences. ▪ Describe who or what is impacted / affected. ▪ Describe what actions are required by site personnel. ▪ Describe what actions are being taken to resolve the issue. ▪ Provide advice on expected timeframe of issue. ▪ Determine what the expected communication frequency will be during the event/issue. ▪ Who to contact with queries?
Distribution of the Communication	▪ Ensure that the most appropriate modes of communication are deployed in consideration of the desired receivers, this should include more than one communication method such as email, Health, Safety and Environment Advice posted on notice boards, flyers or direct meetings etc. ▪ Maintain a consistent information focal point (as much as possible) for both site communications and contact queries, to ensure consistent, clear, and centralised communications targeted to stakeholders.
Follow-up	▪ Monitor the Feedback. ▪ Keep a record of the communication (or ensure the communication is documented and filed in the corporate information management system).