GUIDANCE AND TIPS

Emergency response plans for community water systems

WATER RESEARCH COMMISSION

Obtainable from:
Water Research Commission
Private Bag X03
Gezina
0031

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Production editor: Lani van Vuuren
Design and layout: Anja van der Merwe
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CONTENTS

INTRODUCTION

Emergencies can drastically affect the water-supply system and the community that depends on it. Each emergency has unique effects on different parts of a water-supply system, requiring evaluation based on the actual event.

All water services systems irrespective of size, location etc. should have emergency response plans (ERP) to guide officials, stakeholders and consumers through emergencies as one way of managing risks in the water-supply system. Emergencies in the water-supply system may result from natural disasters, equipment failure, human error, and intentional acts (such as vandalism).

This booklet provides tips on how to develop a water safety plan and an emergency response plan. While it is not comprehensive, the booklet aims to help communities that do not have formal water provision systems to understand:

- How to protect their resources and /or water-supply system infrastructure against contamination
- How to manage certain water-related challenges that may lead to emergencies

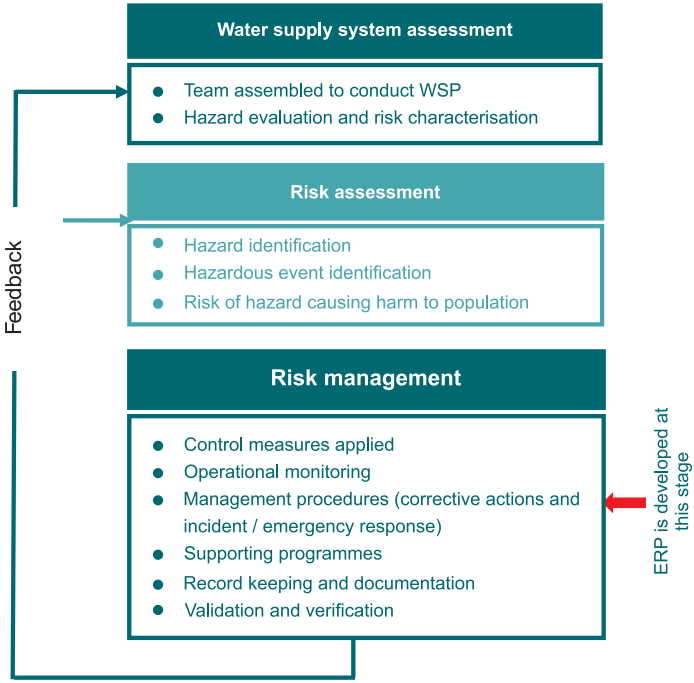
The booklet is intended for use by any community water-supply system and/or water service institution.

What is an emergency response plan?

An emergency response plan prepares the organisation for emergencies and specifies instructions about what to do if there is an emergency situation that may affect the water system.

EMERGENCY RESPONSE PLANNING

Emergency response planning is an essential part of managing a drinking water system and is a key component of water safety planning. Water safety planning is a risk management tool which encompasses the water management chain from catchment to consumer. The approach adopted when developing a water safety plan typically comprises the following sequential steps:



Water safety planning steps.

DEVELOPING A WATER SAFETY PLAN

Below are examples of simplified steps to develop a water safety plan for a community water system.

STEP 1: ASSEMBLE THE WATER SAFETY PLAN TEAM

A water safety plan team is responsible for developing and facilitating implementation of water safety plans within their institution. It is recommended that, if possible, the team comprises the following persons:

- Water services managers, engineers and technical personnel
- Operational staff of treatment plants
- Water quality manager/specialists
- Catchment managers
- Water service providers
- Environmental, public health or hygiene professionals
- Consumer representatives

When an emergency occurs, there can be confusion, lack of coordination and poor communication if there is no designated person to coordinate the emergency response effort. Therefore, a person who is the 'first contact' (who is likely to coordinate) during an emergency should be identified.

STEP 2: DOCUMENT AND DESCRIBE THE WATER SUPPLY SYSTEM

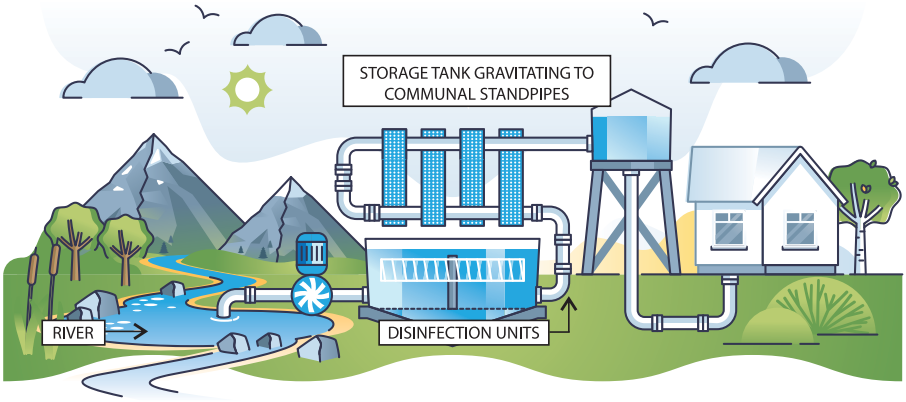
Each water-supply system has different components and designs. The components of the system should be identified, described and recorded in order to ensure that when preparing for emergencies, all components are included. Examples of what can be considered in order to understand the system can be seen below. If the community water supply is not documented, map up your area and draw your water-supply system.

- **Identify all the components in the system, their capacities, type, make and how they function and their condition.**
- **In cases where there is more than one source, names and/or number of sources should be indicated with the total capacity**
- **If your water supply is not documented, map up your area and draw your water-supply system.**

Table 1. Example: Documenting the system

Water supply system	Source	Treatment	Storage	Network
Name	Mpefeni River	Gqobonco treatment		
Owner	Department of Water and Sanitation	Batho municipality	Batho municipality	Batho municipality
Treatment methods	River	Disinfection only	Jojo tank	PVC pipes/brass taps
Size		2000 L/day	2500 L	40 mm pipes
Villages served	Gqobonco, Mpefeni & Ncokazi villages	Gqobonco village only	Gqobonco village only	Gqobonco village only
Location	Gqobonco (GPS coordinates)	Gqobonco (GPS coordinates)	Gqobonco (GPS coordinates)	3 taps: 1 – clinic; 2 – near Veza SSS; 3 – near the Jojo tank
Condition	Quality – fair Quantity - good	Good	Good	Good
System protection measures	None	Fenced, far from community	Fenced, tanks closed	Pipes underground
Comments	Raw water is always sufficient	The treatment system is new and well protected	The tanks are new and still in good condition	

Example of drawing of supply system



STEP 3: ASSESS THE WATER-SUPPLY SYSTEM

An assessment of the community water system is conducted to obtain an idea of the typical hazards / hazardous events faced at each component. This exercise includes:

- Identification of potential pollution sources at each component (e.g. livestock, human activities at water source)
- Identification of hazards associated with the water contamination / unavailability / excess should be considered and listed. The table below is an example of an assessment of a water-supply system.

Table 2. Examples of water-supply system related threats, vulnerabilities and risks

Emergency category	Possible threats / vulnerabilities / challenges (emergency triggers)	Possible threat impacts
Source		
Water quality	Children swimming at the source	People may get sick due to faecal contamination Children may drown
Water quality	Evidence of illegal dumping near or at the source	Solid waste may enter the source water
Water quality	The well or spring is located on the floodplain	Wells or springs may get sediments after heavy rain Dongas and gullies may form around the source
Treatment		
Water quality	No fencing, inadequate security	Treatment facility could be sabotaged or vandalised
Water quality	No alternative power supply in case of power failure	Lack of power may lead to system shutdown
Water quality and quantity	Treatment infrastructure is old and more prone to breakdown	This may lead to excessive water losses at the facility
Distribution		
Water quality	Storage tanks are easily accessible to the public	Possibility of vandalism and contamination
Water quality	Poor maintenance of reservoirs / storage tanks	Poor maintenance of the storage tanks may cause contamination of water in the tank
Water quantity	Pipes above the ground	Lifespan of the pipes may be reduced due to exposure. This may lead to water losses

Emergency category	Possible threats / vulnerabilities / challenges (emergency triggers)	Possible threat impacts
Point of use: Rainwater harvesting		
Water quality	Rusty gutters and roofs	May lead to water with unusual taste and/or cloudy or reddish looking water
Water quality	Water collected in the tank after long periods without rain	Rainwater may contain dust from the air
Point of use: Household		
Water quality	Water stored in open containers	Water may become contaminated
Water quality	Unhygienic practices when handling water	Water may become contaminated

Illegal dumping may lead to contamination of the water source.

Care should be taken that rain is not harvested from rusty gutters or roofs.

STEP 4: UNDERTAKE A HAZARD ASSESSMENT AND RISK CHARACTERISATION

Determining the risk associated with the hazards identified is about considering the likelihood (probability) (e.g. is it likely to happen, has it happened in the past?) and consequence (impact should it happen) of a potential hazardous event. The reason for analysing the possible events / challenges is to understand the level of protection required to avoid or minimise the chances of an emergency.

When determining the risk, the following should be considered:

- Is it possible that the hazardous event (emergency trigger) may cause contamination or unavailability of water in the system?
- How frequently does an emergency trigger happen or is it likely to happen?
- What would be the emergency trigger effect?

For a community water system, a simple risk matrix to identify likelihood and effect, can be used as shown in the table below.

Table 3. Example: Risk matrix

Likelihood	Effect
Daily Weekly	*Quality*
	Mild irritation (e.g. skin)
Monthly Seasonally	People may get sick
	People may die
Yearly Rarely (once in 3 years) Never	*Quantity*
	All houses have water
	Most houses (>50%) have water
Likelihood rating	Some houses (<50%) have water
	No houses have water
Daily/weekly = high Monthly/seasonally = medium Yearly/rare/y/never = low	*Aesthetic*
	Slight unusual taste, smell and appearance
	Staining of clothing/deposits on household appliances (e.g. kettle)
	Unpleasant taste / smell and appearance
	Offense taste / smell and appearance (cannot drink)

If the user is uncertain about determining the emergency rating, the table below can be used as a guide. This process assists in determining the emergency triggers that require more urgent attention (for example, high and medium), so that appropriate actions are taken. Using the likelihood and effect and risk rating tables as a guide, a risk related to each hazardous event or emergency trigger can be determined as shown in Table 5.

Table 4. Risk rating

Likelihood x Effect	Emergency rating
High x High	High
High x Medium	High
Medium x Medium	Medium
High x Low	Medium
Medium x Low	Medium
Low x Low	Low

Table 5. Example: Undertaking hazard and risk assessment

Possible hazardous events that may lead to emergencies	Likelihood/ Possibility	Effect	Risk rating
Source			
Children swimming at the river	Seasonal	People may get sick. Children may drown.	Medium High
Significant drop in water level	Seasonal	Some houses (<50%) may have water Slight unusual taste/smell/odour	Medium
Treatment unit			
Unavailability of operation and maintenance manual	Daily	Unpleasant taste, odour and appearance. People may get sick.	High
Treatment system is not easily accessible due to poor access roads	Daily	People may get sick	High
Distribution			
Old, broken distribution pipes	Once in 3 months	Unusual colour, smell and taste. Some houses (<50%) may have water.	Medium
Vandalised standpipes	Once in 3 years	No houses have water	Medium

Vandalised infrastructure is one of the hazards that have to be considered when risk assessments are undertaken.

STEP 5: IDENTIFY CONTROL MEASURES

Control measures include consideration of what needs to be done to rectify the situation. Control measures should be developed for each and every hazard and hazardous event (for example, alternatives, backups, etc). An example of identification of control measures and/or corrective actions is provided in the table below.

Table 6. Example: Identification of control measures and/or corrective actions

Possible hazardous events that may lead to emergencies	Risk rating	Suggested control measures / corrective actions
Source		
Children swimming in the river	High	Raw water should be appropriately treated. Conduct community awareness to educate children about effects of swimming at the source. Conduct community awareness about home-based water treatment.
Significant drop in the water level	Medium	Drought emergency plan. Conduct community awareness on water saving methods.
Treatment unit		
Unavailability of operation and maintenance manual	High	Develop and implement operation and maintenance manual. Develop and implement an operational monitoring programme.
Treatment system is not easily accessible due to poor access roads	High	Communicate with roads department about the issue. Identify community member who stays close to the facility. Train community member to operate the system.
Distribution		
Old, broken distribution pipes	Medium	Develop and implement pipe replacement programme.
Vandalised standpipes	Medium	Educate community about effects of vandalism.

Sampling and monitoring should be considered as one of the control measures. Water quality testing of raw water assists in identifying the appropriate treatment method required. Water quality testing of treated water provides an indication of whether the water is fit for consumption or not. SANS 241 provides guidance on sampling and monitoring requirements and water quality standards.

STEP 6: VERIFY THAT THE WATER SAFETY PLAN IS OPERATIONAL

Validation is the process of obtaining evidence on the performance of control measures. The efficiency of each control measure should be determined and verified to ensure that it does make a difference and has a purpose. In the process of verification, the following should be considered and understood:

- What should I be checking on a regular basis to make sure my control measures are effective?
- Development of a risk-based monitoring programme.

An example of verification of control measures is shown in the table below.

Table 7. Example of verification of water safety plan

Risk rating	Hazardous event / Emergency trigger	Action plan	Effective (Y/N)	Residual risk rating*	Suggested actions if existing actions are not effective
High	Children swimming at the source	Raw water should be appropriately treated. Conduct community awareness to educate children about effects of swimming at the source. Conduct community awareness about home-based water treatment.	Yes, treated drinking water quality meets SANS standards. Incidents of children swimming at the source have been reduced.	Low	Continue with community awareness
High	Unavailability of operation and maintenance manual	Develop and implement operation and maintenance manual. Develop and implement an operational monitoring programme.	Yes, treated drinking water quality meets SANS standards	Low	Not applicable
Medium	Significant drop in the water level	Drought emergency plan. Conduct community awareness on water saving methods.	No, there is no alternative source identified	Medium	Identify an alternative source in case the primary source water level drops significantly

Risk rating	Hazardous event / Emergency trigger	Action plan	Effective (Y/N)	Residual risk rating*	Suggested actions if existing actions are not effective
Medium	Old, broken distribution pipes	Develop and implement pipe replacement programme	No, no budget for implementing the programme	Medium	Include the plan into the IDP and budget for the programme

** This refers to the risk rating after the action plan is implemented*

STEP 7: DEVELOP SUPPORTING PROGRAMMES

Supporting programmes are actions that do not directly affect drinking water quality, however, they are important in ensuring drinking water safety. These are activities that ensure the operating environment, equipment used and the people themselves do not become an additional source of potential hazards to the drinking water supply. Examples of supporting programmes are provided below.

Staff training requirements

It is essential that the water safety plan teams be trained in order to be able to respond appropriately to the types of threats, vulnerabilities and risks that may occur. Training could include briefing sessions, classroom sessions or mock exercises. Refresher training should be done on a regular basis. Trainees should understand:

- The components of the emergency response plan and
- The various roles and responsibilities during an emergency

Personnel safety preparedness

During an emergency, personnel may be at risk of harm, injury or even death. Therefore, directions on how to safely implement a variety of response actions for specific situations should be clearly provided.

Chemical replacement

Based on the knowledge of the system and its operational and maintenance requirements, an understanding of where and how to find 1) equipment, 2) spare parts and 3) chemicals should be established. The emergency response plan should therefore identify equipment that can significantly lower the impact of an emergency on public health and protect the safety and supply of drinking water. A procedure to manage resources should be developed.

STEP 8: PREPARE MANAGEMENT PROCEDURES

The purpose of management procedures is to avoid emergencies occurring of minimise the chances of emergencies. You should not wait for an emergency to happen, rather plan ahead so that when/if it happens you are better prepared to deal with it. This means that the plans/ programmes/procedures developed should not only focus on an emergency, but should include day-to-day procedures and protocols that will minimise the likelihood of emergencies.

This is the step where emergency response plans are developed (see the next section for more details).

STEP 9: ESTABLISH DOCUMENTATION AND COMMUNICATION PROCEDURES

Documentation of all aspects of drinking water quality management is essential. Documents should describe activities that are undertaken and how procedures are performed (see the next session).

STEP 10: REVIEW THE WATER SAFETY PLAN

This step is about putting all the material in the water safety plan steps together so that it becomes a working document and includes:

- Identification of what is needed to ensure the water safety plan steps together so that it becomes a working document, improved continuously
- Review and updating the water safety plan document whenever there are changes in staff, roles and responsibilities, contacts or changes in infrastructure
- Verify the water safety plan document after events to check if protocols and procedures are effective
- Understand what needs to be changed, what needs to be reviewed, and what needs to be added

DEVELOPING AN EMERGENCY RESPONSE PLAN

This section provides guidance in developing and implementing emergency response plans. The purpose of this plan is to be prepared to managed anticipated incidents and emergencies in a structured and planned way. It is a regulatory requirement that all water service systems, including community water systems, irrespective of size, must have emergency response plans to guide them through emergencies in order to manage risks in the water supply system.

Developing an emergency response plan is about planning for anticipated emergencies, which includes:

- Identifying a range of possible threats, hazards and emergency causes, as well as appropriate plans of actions for responding
- Preparation and implementing of emergency management plans

The following should be considered when planning for emergencies:

- Assign roles and responsibilities to the emergency team
- Develop communities protocols (for example, between the community and the municipality, between clinics and the municipality, and between the municipality and the community)
- Develop emergency response procedures (step by step what to do or how to react)
- Review the emergency response plan (for example, are there new procedures that should be developed?)

ASSIGN ROLES AND RESPONSIBILITIES

A multi-disciplinary team (stakeholder team) that is likely to have different roles and responsibilities in case of an emergency should be identified. In most cases, this is the same team as a water safety plan

team. Responsibilities should be clearly defined for personnel involved during normal operations and an emergency to sped up the response time. The roles and responsibilities of the emergency team could include:

- Conducting regular/daily checks according to the operations and maintenance plan
- Communicating emergency reports received
- Immediately conducting an assessment of the emergency
- Ensuring that emergency programmes are followed accordingly
- Facilitating public announcements, if or when necessary

PROTOCOL TO RESPOND TO FAILURE

One of the methods of developing a protocol to respond to failure is through identification of alert levels. Failure can be categorised according to:

- Failure to provide services, and
- Failure of water quality

Alert levels should be set for both situations. Identifying alert levels relates to categorising the severity of an emergency according to its intensity or result at different levels (see the example below).

Table 8. Example: Categorising alert levels

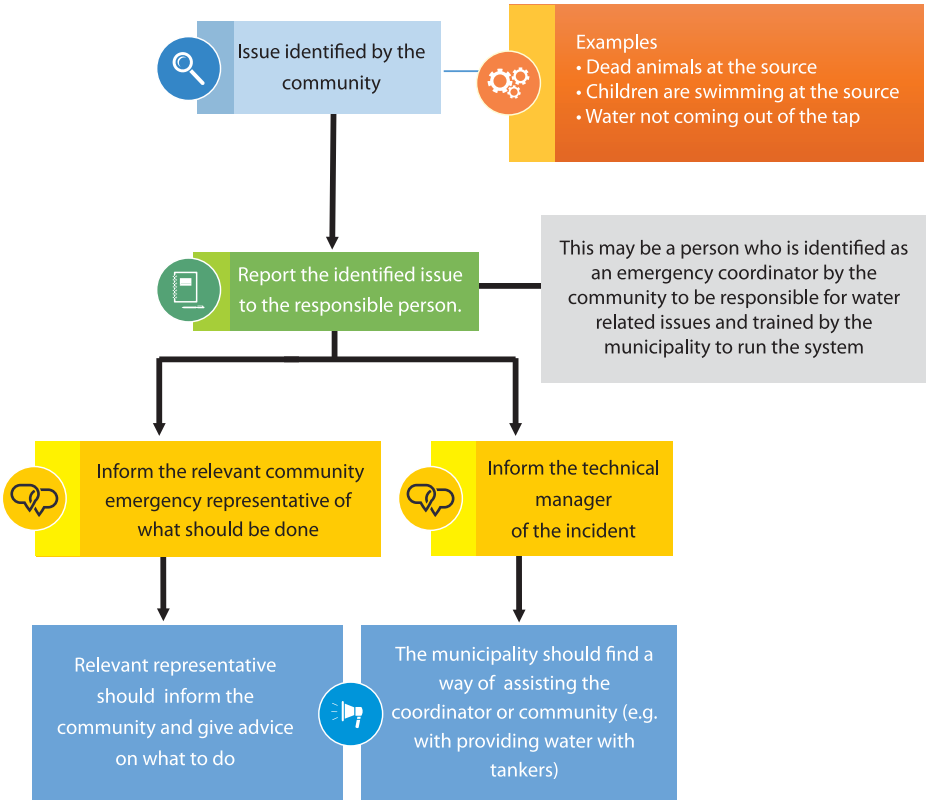
Intensity	Emergency trigger	Alert level	Responsible person	Action plan
Low	Leaking pipes	<2 hours limited supply	Network supervisor	Maintenance personnel should follow maintenance procedures to solve the issue
Low	Power outage	<24 hours	Emergency coordinator and area manager	Emergency coordinator to inform the area manager and the community

Intensity	Emergency trigger	Alert level	Responsible person	Action plan
Medium	Vandalised storage tank	Tank water with unusual colour, smell or taste 24 hours limited water supply	Environmental health practitioner (EHP) Network supervisor	EHP to inform the network supervisor Maintenance personnel should follow maintenance procedures to solve the issue
Medium	No raw water treatment	Drinking water with unusual colour, smell or taste E.coli between 1 and 5 count/100 ml	Top management Customer care EHP	Water treatment options should be investigated The community should be aware of the health impacts and advised on what to do
High	Naturally occurring chemicals	Water quality results (nitrates) exceeding drinking water standards	Top management	Top management to plan for a suitable treatment system to remove the chemical Find an alternative source
High	Broken infrastructure	No water supply for more than 3 days People are sick	EHP Network supervisor	Maintenance personnel should follow maintenance procedures to solve the issue

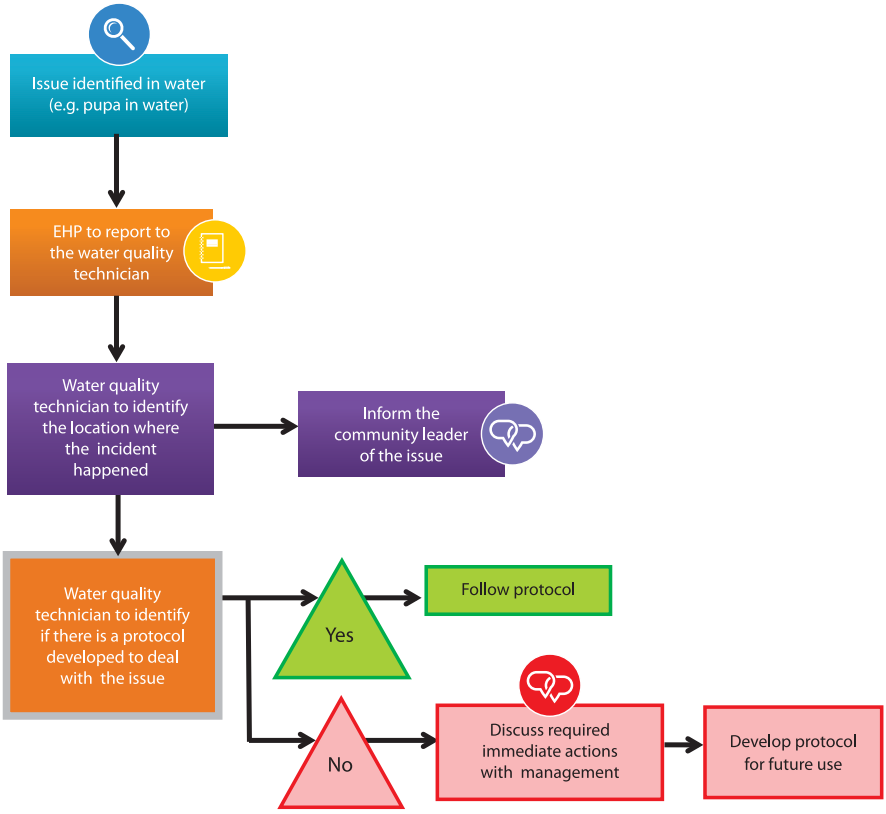
DEVELOP A COMMUNICATION PROTOCOL

This defines clear lines of authority and responsibilities for the emergency team and/or affected parties who have roles and responsibilities during an emergency. Develop community protocols for different incidents (see the examples below). The community needs to know who to report the emergency to, whilst the emergency response team needs to understand who manages the emergency, who makes decisions, and what their own responsibilities are.

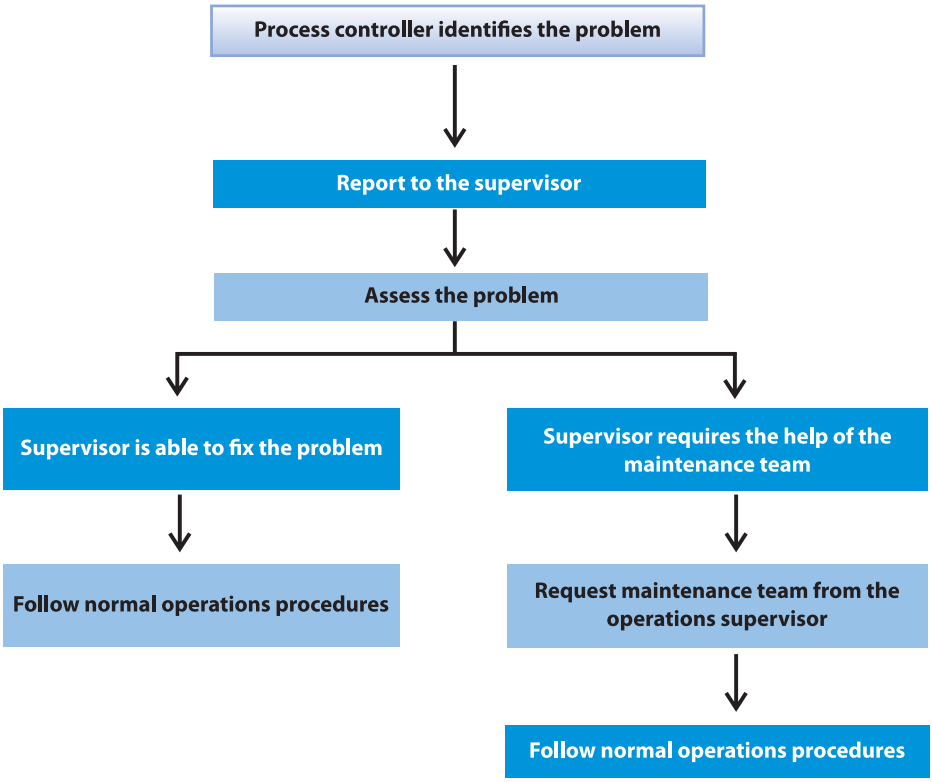
Example 1: Generic communication protocol



Example 2: A communication protocol for a water contamination emergency



Example 3: An example of a communication protocol in the case of a water system operational failure emergency

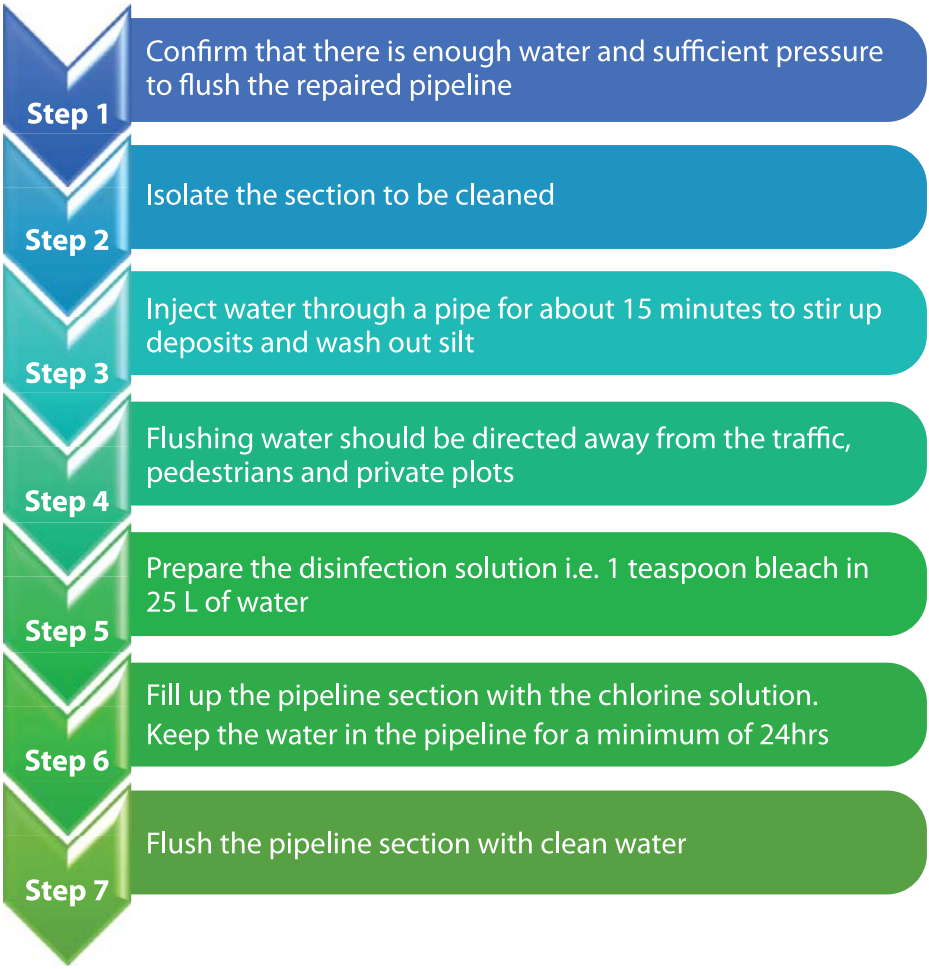


In some instances, the emergency may require that relevant or specialised external institutions are notified. In circumstances where an external (contractor) water system operator is required, it is necessary that a contact list for emergency service/repair personnel is developed.

DEVELOP EMERGENCY RESPONSE PROCEDURES

The recommended method of developing emergency response procedures is to consider all the possible hazardous events, threats, vulnerabilities (emergency triggers) along the various stages of the community water-supply system (i.e. at source, through the treatment system, within the distribution network and at point of consumption), that were identified in the water safety plan. A procedure for dealing with each of the identified possible emergencies should be developed (see examples on the next page).

Example 1: An emergency response procedure for cleaning the distribution pipes at specific times or when the water from the pipe looks dirty



Example 2: An emergency response procedure for responding to a power outage at a pump station

System Component	Pump station pumping to Neka Treatment system and Vela village
Describe the issue	Power outages that may last for several days are sometimes experienced in the area. This is more frequent in summer when the region experiences thunderstorms. The system does not have a back-up generator but has an arrangement with a service provider/supplier to rent a generator for the system.
Immediate Action	• Process controller to assess whether the outage is likely to last more than a day. If no, be on alert for changing conditions and monitor storage tanks. If yes, complete the following steps. • Process controller to inform the technical manager about the situation • Technical manager to obtain generator. • Process controller and operations and maintenance team to install the generator and operate the treatment system.
Notification	• Municipality to let Eskom know that a CWS is experiencing an outage and that the generator will be turned on until power is restored. • Water quality technician to inform the community leader about the situation. • The community leader to inform the community to cut back on water usage until the power is restored.
Returning to normal operation	• Operations and maintenance representative to turn off and disconnect back-up generator. • Return system to general power supply. • ERP co-ordinator to inspect storage tanks and pumping facility to ensure proper operation. • ERP co-ordinator to inform the municipality to collect the generator. • Municipality to collect the generator and return to service provider/ supplier. • ERP team to update ERP as needed.

In the case of water contamination or unavailability, alternative sources should hae been identified during the process of risk assessment. The table below provides an example of alternative source identification.

Table 9. Alternate source(s) of water to be used in cases of emergency

Alternative sources	Name of supplier	Phone	Availability	Is the water safe for drinking?
Tanker trucks in the area available to deliver bulk water for potable use	ABC tankers	(025) 876-8787	During working hours	Yes, water is collected from Nxuba water treatment works

FURTHER READING

U. Jack & P. de Souza. 2013. Guidelines on using the refined and translated web-enabled Water Safety Plan Tool (2013 version), (**WRC report no. TT 581/13**)
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