

# Piped distribution – network

## A. GENERAL INFORMATION

### A.1. Network information<sup>a</sup>

**Network location** (e.g. village, town, community, parish, district, province, state)

**Additional location information**

State the reference system and units, if using coordinates  
(e.g. national grid reference coordinates, GPS coordinates)

**Name of entity responsible for the management of the network**

(e.g. name of water utility, private operator, community group)

**Source of the network water<sup>b</sup>**

Tick (✓) the appropriate box(es) and provide further information where applicable

☐ Surface water   ☐ Borehole   ☐ Spring  
☐ Other. Describe:

**Total number of storage tanks present in the network**

**Total number of tapstands present in the network**

**Approximate population supplied by this network** (if known)

**Number of household connections** (if known)

**Number of commercial connections** (if known)

**Average water supply service times**

..... hours per day  
..... days per week

**Average total volume of water distributed per week**  
(if known, including units)

**Network pipe material**

Tick (✓) the appropriate box(es) and provide further information where applicable

☐ Ductile iron (DI)   ☐ High density polyethylene (HDPE)   ☐ Polyvinylchloride (PVC)  
☐ Ferrocement   ☐ Lead   ☐ Other. Describe:

Circle the options below

If **Yes**, describe (e.g. what happens, how often, for how long)

**Is the network affected by flooding?**

Unsure   No   Yes

**Is the network affected by drought?**

Unsure   No   Yes

Circle one of the options below

If **Yes**, describe (e.g. how long it has been in place)

**Does the responsible management entity have a Water safety plan in place** (or an equivalent risk management approach)?

Unsure   No   Yes

### A.2. Weather conditions during the 48 hours before inspection

Circle the temperature and precipitation options below to indicate the main conditions during the 48 hours before the inspection. More than one option may be circled if conditions changed during this time. Record additional information in Section C if needed.

<b>Temperature</b>	<0 °C	0–15 °C	16–30 °C	>30 °C
<b>Precipitation</b>	Snow	Heavy rain	Rain	Dry

**A.3. Water quality sample information**

Record details of any water quality samples taken during the inspection. Include information for any parameters tested. Add **NA** if information is not applicable. Record additional information in Section C if needed.

Sample taken? Circle <b>No</b> or <b>Yes</b>		Sampling location		Sample identification code		Other information					
No (go to A.4)	Yes										
Parameter tested		<i>E. coli</i> <sup>c</sup>		or Thermotolerant (faecal) coliforms <sup>c</sup>		Additional parameter		Additional parameter		Additional parameter	
Results and units		Results	Units	Results	Units	Results	Units	Results	Units	Results	Units

**A.4. Water treatment**

Tick (✓) the appropriate box(es) and provide additional information as needed.

Location	Is the water treated?			If <b>Yes</b> , describe (e.g. type of treatment, chlorine dose, frequency of dosing, if known) <sup>d</sup>
Before the distribution network (e.g. at a water treatment plant)	<input type="checkbox"/> Unsure	<input type="checkbox"/> No	<input type="checkbox"/> Yes	
Within the distribution network	<input type="checkbox"/> Unsure	<input type="checkbox"/> No	<input type="checkbox"/> Yes	
Downstream of the distribution network (e.g. household water treatment)	<input type="checkbox"/> Unsure	<input type="checkbox"/> No	<input type="checkbox"/> Yes	

- <sup>a</sup> Depending on the size of the piped distribution network, the inspector may check all, or part, of the network during the inspection. Record in Section C how much of the network was inspected (e.g. name/number of service areas inspected or estimated percentage of the network inspected). The network may be inspected on a rotational basis using additional forms, where the network is too large to cover during each inspection.
- <sup>b</sup> Carry out sanitary inspections using the corresponding sanitary inspection packages.
- <sup>c</sup> The presence of *E. coli* (or thermotolerant [faecal] coliforms) suggests recent faecal contamination. If detected, further action is needed, such as increased disinfection upstream of the network (e.g. at a water treatment plant, storage tank), additional sampling and investigation of potential sources of contamination, and/or household water treatment advisories (e.g. boil water notice). *Note* – thermotolerant (faecal) coliforms are distinct from “total coliforms”, where total coliforms do not necessarily indicate recent faecal contamination.
- <sup>d</sup> Where chlorine is applied, the free chlorine residual concentration in the drinking-water should be tested and the result recorded in Section A.3. Where possible, turbidity and pH should also be measured. For guidance on adequate chlorine disinfection, see the *Management advice sheet*.

**General note**

- If water from the network feeds a storage tank, tapstand, kiosk or filling station, or if users collect and store water in the home, carry out an inspection using the corresponding sanitary inspection package.

**B. SANITARY INSPECTION****IMPORTANT:** Read the following notes before completing the sanitary inspection

- Tick (✓) the appropriate box for each question. For guidance, refer to the numbered risk factors in Figure 1; the numbers in the figure are linked to the questions. Record any additional risk factors present in Section C. Refer also to the *Technical fact sheet* for information on the individual components of the network. *Note* – the questions in this section are example risk factors only, which can be used as a starting point for adapting the form to the local context.
- Tick the **NA** (not applicable) box if the question **does not apply** to the network being inspected.

3. Tick the **No** box if the question does apply to the network being inspected, but the risk factor *is not present*.
4. Tick the **Yes** box if the risk factor *is present*. For important situations that require attention, record the corrective actions to be taken in the last column. These notes can be used to develop a detailed improvement plan, documenting what will be done, who will do it, by when it will be done and what resources are required. For guidance, refer to the *Management advice sheet*. Where possible, address the most serious risk factors first, considering low-cost or no-cost improvements that can be made immediately.
5. If a question cannot be answered because access to a component is not possible, tick the **Yes** box. Record these issues in Section C for further investigation.



**Figure 1.** Typical risk factors associated with a piped distribution network

Sanitary inspection questions		NA	No	Yes	If Yes, what corrective action is needed?
<b>1</b>	<b>Are valve box or break-pressure tank covers absent or in poor condition?</b> Contaminants could enter the network, particularly after rain, if valve box or break-pressure tank covers are absent (or open or unlocked). This could also happen if the covers are damaged (e.g. broken, missing sections, severely corroded, deep cracks).	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
<b>2</b>	<b>Are there any exposed network pipes visible?</b> Exposed network pipes (e.g. caused by soil erosion from surface water, traffic or footfall) in public places are at risk from damage and illegal connections. This could result in contaminants entering the water supply (e.g. surface water entering the network via cracked pipes), or water loss through leakages.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
<b>3</b>	<b>Are there any water leakages visible from the network assets (e.g. pipes, valves, fittings)?</b> Contaminants could enter the network from leaking pipes or valves. This can also result in water loss. <i>Note</i> – underground leakages may be indicated by water ponding on the surface along the network pipelines. Unusual vegetation growth in dry areas may also indicate leakages. In both cases, the source of the water in these areas should be further investigated.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
<b>4</b>	<b>Is there vegetation present that could damage network assets?</b> Contaminants could enter the network if roots penetrate and damage network components (e.g. break-pressure tanks, pipes). This could also result in water loss from leakages.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
<b>5</b>	<b>Are there problems with illegal connections within the network?<sup>e</sup></b> Contaminants could enter the network via illegal connections (i.e. where users connect to the network without permission from the relevant authority). These connections may be poor quality, and are not on routine inspection or maintenance programmes. Leakages from illegal connections can also result in water loss.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
<b>6</b>	<b>Are there problems with cross-connections within the network?<sup>e</sup></b> Contaminants could enter the network directly via cross connections (i.e. when drinking-water pipes are connected to pipes containing contaminants, such as a sewer pipe).	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	



Sanitary inspection questions		NA	No	Yes	If Yes, what corrective action is needed?
<b>7</b>	<b>Are there problems with backflow within the network?<sup>e</sup></b> Contaminants could enter the network directly via backflow (e.g. the flow of contaminated water from household or commercial premises into the network).	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
<b>8</b>	<b>Does the network have intermittent supply?<sup>e</sup></b> Contaminants can enter the network during intermittent supply outages due to low pressure conditions within the network pipes (e.g. resulting in contaminated water entering the network pipes).	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
<b>9</b>	<b>Is the network excluded from routine maintenance and quality control programmes?<sup>e</sup></b> Failure of the responsible management entity to routinely inspect, maintain and monitor the quality of water in the network may result in unsafe drinking-water being supplied.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
<b>10</b>	<b>Does the network water lack disinfection?<sup>d,e</sup></b> Failure to adequately disinfect water with chlorine (or provide an alternative appropriate means of disinfection, such as ultraviolet [UV] or ozone) can result in unsafe drinking-water being supplied.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
<b>Total number of Yes responses</b>					

<sup>e</sup> Risk factor is not illustrated in Figure 1. To answer this question, interview the operator or management entity as appropriate. Check activity log books for confirmation. Provide further information in Section C to support your answer if necessary.

Include any additional risk factors,<sup>f</sup> recommendations, observations or remarks from users of the network (e.g. problems with the taste, odour or appearance of the water, water source reliability). Attach additional sheets and photographs if needed.

[illegible]

#### D. INSPECTION DETAILS

Signature: \_\_\_\_\_ Date: \_\_\_\_\_

Signature (if available): \_\_\_\_\_ Date: \_\_\_\_\_

Website: <https://www.who.int/health-topics/water-sanitation-and-hygiene-wash>



# Piped distribution – network

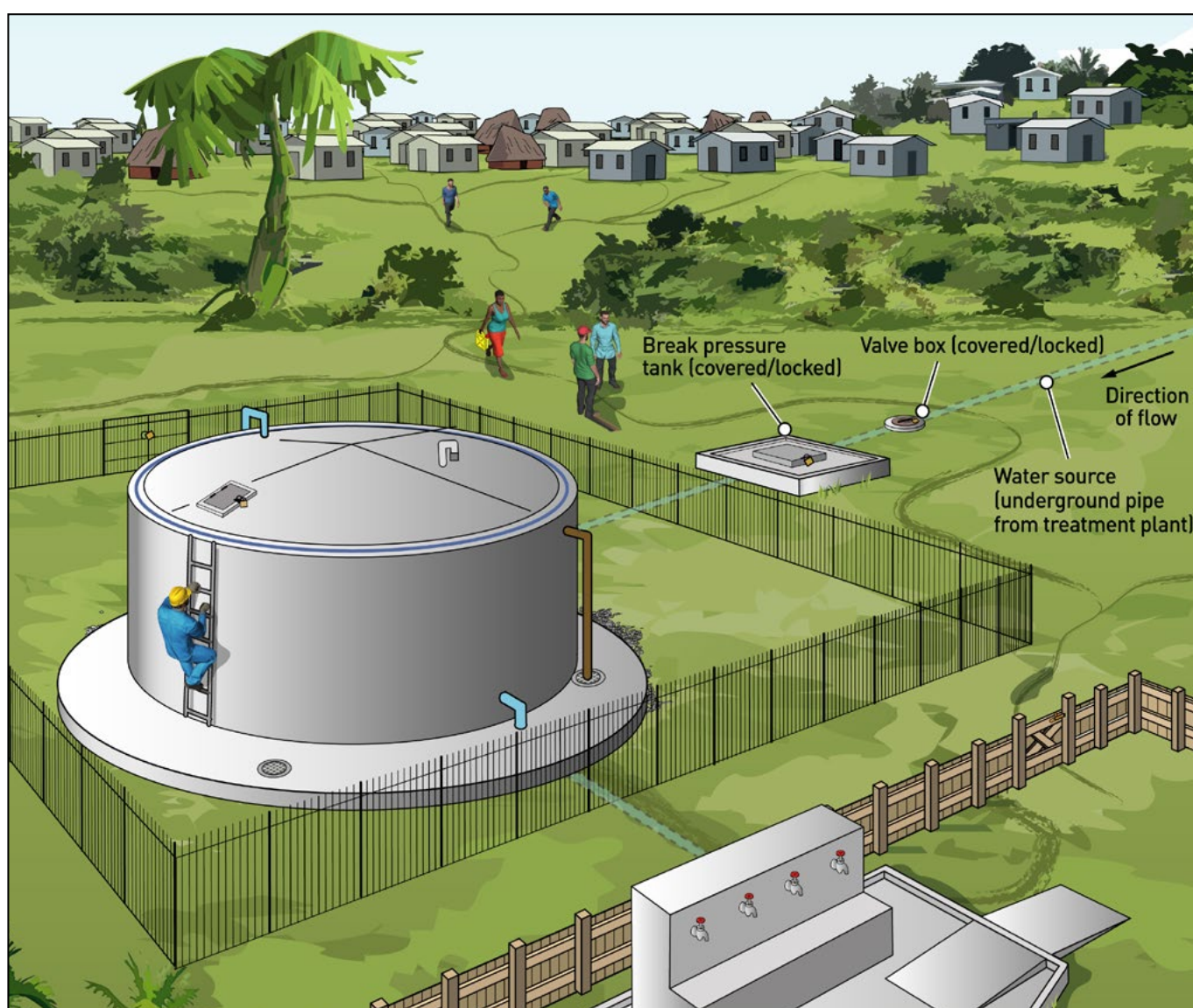
**This technical fact sheet provides background information on a piped distribution network, which supports the sanitary inspection of a drinking-water supply.**

A piped distribution network delivers water (e.g. from a water treatment plant) to designated points of delivery (e.g. tapstand, household connection). A typical piped distribution network includes distribution pipes, break-pressure tanks and associated valves.

The scale of piped distribution networks varies widely, ranging from networks supplying a single communal collection point (e.g. a tapstand), to more complex networks supplying large numbers of communal collection points, and household and commercial connections.

Water supplied from piped distribution networks should be appropriately treated/disinfected, and distributed in a sanitary way (i.e. in clean pipes that are maintained in good condition). If chlorine disinfection is practised, the network water should have an adequate disinfection residual to help protect the water from harmful microorganisms during distribution.<sup>a</sup>

Figure 1 shows a typical small-scale piped distribution network. This figure shows a typical design. Other designs can also provide safe drinking-water.



**Figure 1.** A common piped distribution network in a sanitary condition

*Note* – For guidance on the storage tank and tapstand components, see the corresponding sanitary inspection packages.

<sup>a</sup> For guidance on adequate chlorine disinfection, refer to the *Management advice sheet*.

Typical risk factors associated with piped distribution networks are presented in the corresponding *Sanitary inspection form*.

Piped distribution networks typically include the following main components.

- **Network water source:** Typically extracted from groundwater or surface water sources in small drinking-water supplies. The network water source should be treated/disinfected (e.g. at a water treatment plant) to ensure it is safe for human consumption.
- **Break-pressure tank:** Allows hydraulic pressure to be reduced in the network to protect downstream assets from damage (e.g. valves, pipes). The tank should be covered and have a lid that is tightly fitting and lockable. This will help to stop contaminants entering the network and unauthorized access by people.
- **Network pipe:** Distributes water to points of delivery to users. Pipes are typically constructed of ferrocement, ductile iron (DI), high density polyethylene (HDPE) or polyvinylchloride (PVC).
- **Valve box:** Protects network valves from contamination and unauthorized operation or vandalism. The valve box should be covered and have a lid that is tightly fitting and lockable. This will help to stop contaminants entering the network and unauthorized access by people.

### Additional considerations

Before new pipes are used to distribute drinking-water, cleaning, disinfection and flushing is required (e.g. with chlorine). Ideally, water quality testing should then be conducted before the pipes are commissioned

to confirm the water is safe for consumption. Periodic disinfection of the pipes and testing may also be required (e.g. after maintenance).

When constructing new sections of the network or rehabilitating old ones, all materials used should be safe for contact with drinking-water (e.g. using materials approved through an appropriate certification scheme, including for lead-free or low-lead materials).

Piped distribution networks should be designed to avoid “dead legs” (i.e. sections of the network where water does not flow through) and areas of low flow, as both of these can affect water quality (e.g. via contamination from harmful microorganisms as a result of chlorine decay, formation of disinfection by-products, taste and odour issues). If there is a risk from dead legs or low flow sections of the network, consult with a local engineer to determine appropriate corrective actions.

For larger networks, “booster” (or secondary) chlorination stations may be required within the network to ensure the free chlorine residual concentration is adequate throughout the entire network.<sup>a</sup> Network pH control may also be required to ensure effective residual disinfection, and to manage corrosion issues.

Connections to user premises, in particular commercial premises, should be fitted with an appropriate backflow prevention device, to minimize the risk of contaminated water entering the piped network (e.g. during low-pressure events such as a mains break or supply outage). This should be supported by an ongoing inspection and maintenance programme (see the *Management advice sheet*).

### World Health Organization

Water, Sanitation, Hygiene and Health Unit  
Avenue Appia 20, 1211 Geneva 27, Switzerland

Email: [gdwg@who.int](mailto:gdwg@who.int)

Website: <https://www.who.int/health-topics/water-sanitation-and-hygiene-wash>





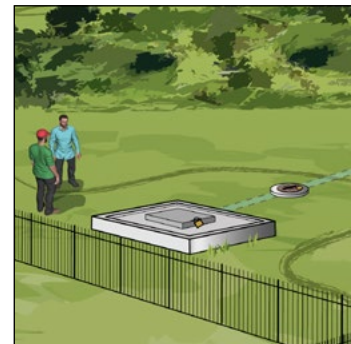
# Piped distribution – network

**This management advice sheet provides guidance for the safe management of a piped distribution network, which supports the sanitary inspection of a piped distribution system.**

Guidance for typical operations and maintenance (O&M) activities is provided in Table 1, including suggested frequencies for each activity. These activities are important for keeping the network in good working condition and protecting drinking-water quality.

Table 2 lists potential problems that may be identified during a sanitary inspection, and provides basic corrective actions to consider for each problem.

This management advice sheet can also support routine management and monitoring practices, which are required to help ensure the ongoing safety of the water supply.



## A. OPERATIONS AND MAINTENANCE

Basic O&M can usually be carried out by a trained network operator (e.g. checking the free chlorine residual concentration, cleaning/flushing network pipes). Larger repairs and maintenance tasks (e.g. valve maintenance, back-flow prevention device inspection) may need skilled labour which can be provided by local craftspeople, or with support from outside of the local area.

The condition of the network components should be inspected routinely to help prevent contaminants entering the network. Any damage or faults should be repaired immediately (e.g. leaking pipes, seized valves, exposed pipework from soil erosion). Standard operating procedures (SOPs) should be developed for important O&M tasks (e.g. leak detection, management of low-pressure events in the network). These should be followed by trained individuals so the work is carried out safely and the water supply is not contaminated during the work.

Particular attention should be given to sanitary pipe maintenance practices (e.g. pipe repair, replacement, reinstatement of supply). SOPs should include the use of dedicated drinking-water tools only (e.g. tools colour-coded blue to avoid cross contamination with sewer network tools), trench dewatering, and pipe flushing and final water quality checks before the water supply is reinstated. Minimally, water quality checks should include a visual observation that the water from the affected section of the network is clear (e.g. the water appears clear in a white bucket). Ideally, this should also include a turbidity and free chlorine residual measurement to confirm these parameters are within acceptable limits before supply is reinstated (e.g. a free chlorine residual concentration of at least 0.2 mg/L).<sup>a</sup>

Drinking-water pipes should be stored in a sanitary way before they are used (e.g. stored off the ground with the ends of the pipe capped to prevent contamination during storage).

<sup>a</sup> Where chlorine disinfection is practised, the free chlorine residual concentration should be at least 0.2 mg/L at the point of use. This means that the free chlorine residual concentration in the network should ideally be between 0.2 and 0.5 mg/L - this can allow for chlorine decay during distribution, and subsequent storage and handling at the household level. Note that chlorine effectiveness is impacted by several factors including turbidity, pH and temperature. Chlorine doses or contact times will need to be adjusted to ensure adequate chlorine residual concentrations based on the local context. The free chlorine residual concentration in the water should also consider user acceptability. For more information, refer to [Technical notes on drinking-water, sanitation and hygiene in emergencies: measuring chlorine levels in water supplies](#) (WHO & WEDC, 2013).

During outbreaks of waterborne disease, or when faecal contamination of a drinking-water supply is detected, the free residual chlorine concentration should be increased to at least 0.5 mg/L throughout the network as a minimum immediate response pending further investigation. *Note* – the concentration of chlorine should always be less than 5 mg/L in drinking-water prior to consumption.

Adequate treatment/disinfection are required before consuming the drinking-water. Where chlorine disinfection is practised, operators should make sure there is an adequate free chlorine residual concentration throughout the network by monitoring at regular intervals (see Table 1) and the results recorded (e.g. in a log book).<sup>a</sup> Monitoring locations should ensure geographic spread throughout the network, and include vulnerable populations (e.g. schools, healthcare facilities) and locations where there are known water quality issues (i.e. “hot spots”).<sup>b</sup> As needed, upstream disinfection (e.g. at a water treatment plant) should be optimized and/or batch chlorine disinfection of storage tank water should be carried out. Chemicals (e.g. chlorine) or testing reagents should be used before their expiry date and stored appropriately according to manufacturer’s instructions.

A routine programme of pipe cleaning (e.g. flushing, air scouring or pigging) should be undertaken to maintain the network pipes in a sanitary condition. This can remove “slimes” (i.e. microbial biofilms) and accumulated sediment from the pipes. In particular, dead leg or low flow sections of the network should be proactively maintained to minimize water quality issues. Abnormal flow events in the network (e.g. high-flow events or changes in the direction of flow) should be avoided where possible, as this may release slimes or resuspend sediment in the pipe. To avoid valves seizing, or valve leakages, a routine programme of valve inspection and maintenance should be undertaken.

Where possible, piped distribution networks should always be pressurized and operate with continuous supply (i.e. water supplied 24 hours per day, 7 days a week). This can help to avoid negative pressure in the network and issues associated with intermittent water supply (e.g. entry of contamination during periods of no service or low pressure, challenges maintaining an adequate free chlorine residual concentration, higher maintenance costs).

Pipe freezing and thawing can lead to pipe breaks, with subsequent leakages or water outages. This can be prevented by burying pipes at a depth that is below the likely ground frost-level, and maintaining a constant flow through the network pipes during very cold conditions. During periods of drought, vigilance is required (including leak detection programmes) to ensure that soil movement does not break network pipes. Water suppliers should also consider programmes to improve water efficiency (e.g. reducing the amount of wash-water produced at a water treatment plant that goes to waste, leak reduction in the network) as well as measures to reduce demand (e.g. user education on water conservation).

Where lead-containing materials are present in a network and/or elevated concentrations of lead are detected in drinking-water, appropriate corrective actions should be considered. This may include the use of corrosion inhibitors, network flushing, advisories on point of use treatment, and the progressive replacement of lead containing components.<sup>c</sup>

If not already in place, the responsible management entity should work towards the development of a water safety plan (or equivalent risk management approach). This should cover the entire water supply (i.e. source/catchment, water treatment plant (if present), distribution and storage, and user practices). This will help ensure the safe management of the water supply. The water safety plan should reflect the complexity of the water supply and the local resources and capacity (e.g. a more basic water safety plan is appropriate for simple piped supplies where resources and capacity are limited).<sup>d</sup>

<sup>b</sup> For basic guidance on optimizing and monitoring chlorine disinfection in piped distribution networks, refer to [Principles and practices of drinking-water chlorination: a guide to strengthening chlorination practices in small-to medium sized water supplies](#) (WHO SEARO, 2017).

<sup>c</sup> For information on managing lead in drinking-water, refer to [Lead in drinking-water: health risks, monitoring and corrective actions](#) (WHO, 2022).

<sup>d</sup> For information on water safety planning, refer to [Water safety planning for small community water supplies: step-by-step risk management guidance for drinking-water supplies in small communities](#) (WHO, 2012).

Table 1. Guidance for developing an operations and maintenance schedule

Frequency	Activity
Daily to weekly	<ul style="list-style-type: none"> <li>Where chlorination of the water supply is practised, check that the free chlorine residual concentration throughout the network is adequate.<sup>a</sup> Optimize the upstream chlorine concentration as needed (e.g. by increasing the chlorine dose at the water treatment plant, batch dosing a storage tank). Once the chlorine concentration has been optimized, flush the affected sections of the network as needed until an adequate disinfection residual is obtained.<sup>e</sup></li> </ul>
Ongoing routine programmes	<ul style="list-style-type: none"> <li>Conduct network pipe cleaning (e.g. flushing or scouring of network pipes).</li> <li>Inspect and maintain critical network components (e.g. break-pressure tanks, valve boxes, valves) to ensure they are in good working order.</li> <li>Conduct leak detection and pipe repair/replacement in the network.</li> <li>Inspect the network to assess and manage vulnerabilities from:               <ul style="list-style-type: none"> <li>backflow</li> <li>ageing pipework</li> <li>cross connections</li> <li>illegal connections</li> <li>vegetation growth.</li> </ul> </li> </ul>
As the need arises <sup>f</sup>	<ul style="list-style-type: none"> <li>Perform maintenance tasks (e.g. pipe maintenance).</li> <li>Monitor water distribution to identify changes (e.g. during periods of drought).</li> <li>Replace any eroded earth around exposed pipework.</li> <li>Ensure procurement of any materials in contact with drinking-water and water treatment chemicals (where used) are safe for drinking-water use.</li> </ul>

<sup>e</sup> In water scarce areas, consult with local health authorities before flushing to make sure that the risk to water quality justifies the loss of water. Alternative water supply arrangements may then be needed to ensure that users have sufficient water quantity to meet domestic needs.

<sup>f</sup> See Table 2 for potential problems that could trigger these activities.

### General notes

- The suggested frequencies in Table 1 are a minimum recommendation. The frequency of activities may need to be increased depending on the local context. A suitable O&M schedule should be made for each site, including who is responsible for performing the work. Completion of activities as per the O&M schedule should be recorded, including additional details for any problems identified and corrective actions undertaken.
- Only people with relevant training and skills should undertake the activities in Table 1. Care should be taken when handling disinfection products.
- For guidance on appropriate frequencies for monitoring (e.g. sanitary inspections, water quality testing), refer to [Guidelines for drinking-water quality: small water supplies](#) (WHO, 2024).

## B. PROBLEMS AND CORRECTIVE ACTIONS

Each problem in Table 2 is linked to the same question number in Section B of the *Sanitary inspection form*. Where relevant, corrective actions should be completed by trained individuals according to SOPs. Where needed, develop awareness raising and education programmes, and if necessary, local rules or regulations, to support safe drinking-water management in the context of the guidance provided in Table 2.

If problems are identified that represent an immediate threat to drinking-water safety (e.g. likely presence of faecal contamination in the water supply, positive *E. coli* detection), consider what immediate actions should be taken to minimize the risk to public health (e.g. advise users to seek an alternative safe drinking-water source, disinfect the water at the point of use).

Table 2. Common problems associated with a piped distribution network, and suggested corrective actions

Question	Problem identified	Corrective actions to consider
<b>1</b>	Valve box or break-pressure tank covers are missing (or open, unlocked), or in poor condition (e.g. deep cracks, severely corroded, does not fit tightly when closed), which could allow contaminants to enter the network (e.g. via surface water, entry of animals).	<ul style="list-style-type: none"> <li>• If the cover is missing, or it is in poor condition, provide a temporary cover to minimize entry of contaminants. Repair or replace the cover as soon as possible.</li> <li>• If the cover is open or unlocked, communicate the importance of closing and locking the cover securely when it is not in use.</li> </ul>
<b>2</b>	There are exposed pipes within the distribution network, which could allow contaminants to enter the network.	<ul style="list-style-type: none"> <li>• Where pipes are exposed unintentionally (e.g. ground cover has been washed away), cover the pipes (e.g. with earth). Investigate the cause of the pipe exposure and take appropriate action to prevent the issue from happening again (e.g. divert upstream surface water flow to a drainage gully).</li> <li>• If exposed pipes are damaged, repair or replace the affected sections immediately.</li> </ul> <p><i>Note</i> – Pipes that are intentionally aboveground should ideally be buried for their protection where possible, or minimally, fenced-off to the public.</p>
<b>3</b>	There are water leakages from network assets, which could allow contaminants to enter the network, or result in water loss.	<ul style="list-style-type: none"> <li>• Repair or replace the leaking network component in accordance with SOPs.</li> <li>• Implement a proactive leak detection programme.</li> </ul>
<b>4</b>	There is vegetation present that could damage network assets (e.g. fallen branches, damage from roots), which could allow contaminants to enter the network, or result in water loss.	<ul style="list-style-type: none"> <li>• Remove any vegetation that may damage network assets.</li> <li>• Implement a proactive vegetation management programme to prevent damage to network assets from vegetation.</li> </ul>
<b>5</b>	There are illegal connections present in the network, which could allow contaminants to enter the network, or result in water loss.	<ul style="list-style-type: none"> <li>• Implement a programme to detect illegal connections to identify and eliminate unauthorized connections in the network.</li> <li>• Raise awareness in the community on the potential health risks associated with illegal connections.</li> <li>• Where possible, ensure that alternative authorized connections are provided, especially for vulnerable and disadvantaged groups (e.g. provision of tapstands in informal settlements).</li> </ul>
<b>6</b>	There are cross-connections present in the network, which could allow contaminants to enter the network.	<ul style="list-style-type: none"> <li>• Liaise with the relevant local authority (e.g. those with responsibility for sanitation services) to implement a cross-connection detection programme to identify and eliminate cross-connections.</li> <li>• Raise awareness with the relevant local stakeholders (e.g. plumbing association) on the potential health risks associated with cross connections. Provide education programmes on how the issue can be avoided.</li> </ul>



Table 2. ...continued

Question	Problem identified	Corrective actions to consider
<b>7</b>	There are backflow issues present in the network, which could allow contaminants to enter the network.	<ul style="list-style-type: none"> <li>Establish a backflow detection programme to identify high-risk connections to premises within the network, and fit the appropriate backflow prevention devices.</li> <li>Ensure an ongoing inspection and maintenance programme is established for backflow prevention devices at high-risk premises.</li> <li>Raise awareness with the relevant local stakeholders (e.g. plumbing association) on the potential health risks associated with backflow. Provide education programmes on how the issue can be avoided.</li> </ul>
<b>8</b>	There is intermittent water supply, which can allow contaminants to enter the network.	<ul style="list-style-type: none"> <li>Routinely monitor and optimize the free chlorine residual throughout the network to the fullest extent possible.</li> <li>Conduct regular mains cleaning to minimize contamination from microbial biofilms and sediments (which can be resuspended when intermittent service returns).</li> <li>Conduct education programmes for users on point of use treatment and safe household storage practices.<sup>9</sup></li> </ul>
<b>9</b>	The network is excluded from routine maintenance and quality control programmes.	<ul style="list-style-type: none"> <li>Develop and implement an appropriate routine maintenance and quality control programme, liaising with relevant authorities if appropriate.</li> <li>Where needed, ensure adequate provision is made for water quality testing equipment and consumables, alongside appropriate SOPs and training for operators.</li> </ul>
<b>10</b>	The water in the network is not adequately disinfected. <sup>a</sup>	<ul style="list-style-type: none"> <li>Develop the necessary SOPs and provide operator training on adequate disinfection practices (including on the use of free chlorine residual test kits where chlorination is practised, and turbidity and pH where possible).</li> <li>Ensure adequate provision is made to procure chlorine (or an appropriate alternative means of disinfection), along with water quality testing equipment and consumables for monitoring.</li> <li>Ensure disinfection is practised correctly and consistently, and is optimized through routine monitoring and water quality testing.</li> </ul>

<sup>9</sup> In addition to these corrective actions, parallel work should also be undertaken at a higher-level with stakeholders (e.g. local government representatives responsible for water supply, sanitation and health) to achieve the necessary improvements in infrastructure and management practices, towards the ultimate provision of a continuous water supply.

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