3

Organising the development of water safety plans

This chapter outlines the initial steps in the development of a water safety plan, including commitment to the approach, setting up a water safety plan team and the description of the intended use of the water.

3.1 COMMITMENT TO THE WATER SAFETY PLAN APPROACH

While many drinking-water supplies provide adequate and safe drinking-water in the absence of a water safety plan, the formal adoption of a water safety plan and associated commitment to the approach can have a number of benefits. Major benefits of developing and implementing a water safety plan for these supplies include the systematic and detailed assessment and prioritisation of hazards and the operational monitoring of barriers or control measures. In addition, it provides for an organized and structured system to minimize the chance of failure through oversight or lapse of management. This process increases the consistency with which safe water is supplied and provides contingency plans to respond to system failures or unforeseeable hazardous events.

For the successful implementation of the water safety plan, management commitment is vital. There are a number of features of water safety plan adoption and implementation that can be attractive to management, including:

- water safety plans represent an approach that demonstrates to the public, health bodies and regulators that the water supplier is applying best practice to secure water safety;
- the benefits that arise from delivering a more consistent water quality and safety through quality assurance systems;
- avoidance of the limitations associated with relying on end-product testing as a means of water safety control;
- potential savings as a result of adopting the water safety plan approach (see Chapter 15);
- potential for significant improvements in asset management; and
- potential for marketing of services, to new and existing customers, of an improved product.

Implementation of a pilot water safety plan project, alongside existing water quality management approaches, as a means of demonstrating the feasibility and advantages of the approach may facilitate acceptance of the method.

3.2 DEVELOPMENT OF A WATER SAFETY PLAN

As outlined in section 1.4 a water safety plan essentially consists of three components;

- system assessment;
- operational monitoring; and
- management plans, documentation and communication.

In developing a water safety plan these can be broken down into a series of steps as shown in Figure 3.1, with the relevant chapter number shown in brackets next to each individual step. This chapter details the first of these steps (i.e., assembling the team). It is important to note, however, that this is not a one-off process but is iterative and progressive as illustrated in Figure 3.1.

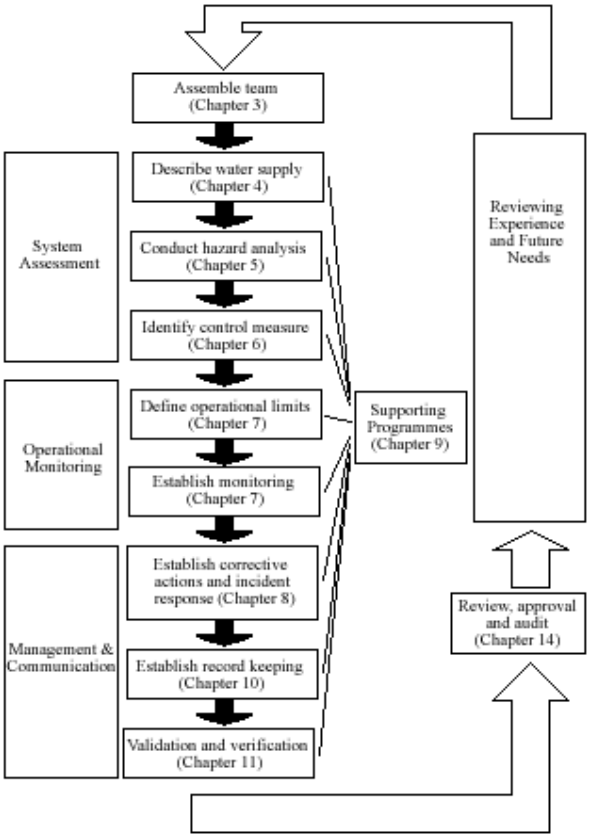

Figure 3.1: Steps in the development of a water safety plan

3.3 ASSEMBLE THE WATER SAFETY PLAN TEAM

The preliminary step is to assemble a team to develop the water safety plan. For large supplies, a multi-disciplinary team of key people should be assembled to develop the plan. This should include managers, engineers (operations, maintenance, design, capital investment), water quality controllers (microbiologists and chemists) and technical staff involved in day-to-day operations. All members of the team should have a good knowledge of the system. As discussed in Chapter 13, water safety plans for small supplies may be developed generically rather than for individual supplies.

A team leader should be appointed to drive the project and ensure focus. The team leader should have the authority, organisational and interpersonal skills to ensure the project can be implemented. In situations where required skills are unavailable locally, the team leader should explore opportunities for external support. This can include benchmarking or partnering arrangements with other organisations, national or international assistance programmes and internet resources.

It is the team's responsibility to define the scope of the water safety plan. The scope should describe which part of the water supply chain is involved and the general classes of hazards to be addressed.

The team should develop each step of the water safety plan in accordance with the steps outlined in Figure 3.1. Other desirable features of the water safety plan team include:

- knowledge of the water supply system and the types of drinking-water safety hazards to be anticipated;
- authority to implement any necessary changes to ensure that safe water is produced;
- inclusion of people who are directly involved with the daily operations; and
- having sufficient people on the team to allow for a multi-disciplinary approach, but not so many that the team has difficulty in making decisions. Team numbers will vary according to the size of the organisation and complexity of process. The use of sub-teams is common and might for example include, water harvesting, water treatment and distribution operations.

The membership of the team should be periodically reviewed with new or replacement members brought in if required. Table 3.1 illustrates the activities and responsibilities associated with development of a water safety plan in a developing country.

Table 3.1: Activity / responsibility matrix (Godfrey *et al*.2003)

		NWSC				
Activity	Responsible	WQCD	HQ	OSUL	MAK	WEDC
System Assessment						
Identification and printing of maps	Senior ngineer	I	A	R	I	A
Field work	Engineers	I	A	I	R	A
Reporting and data analysis	Engineers	I	A	I	R	I
Transport arrangements	Principal Analyst	R	A	A	A	I
Management of logistics	Principal Analyst	R	A	A	A	I
Coordination	Principal Analyst	R	A	I	I	I
Water Quality Assessment						
Laboratory analysis	Principal Analyst	R	A	A	I	I
Sampling	Principal Analyst	R	A	A	I	I
Transport	Principal Analyst	R	A	A	A	A
Coordination	Principal Analyst	R	A	I	I	I
Report and data analysis	Principal Analyst/ Quality control manager	R	A	I	I	I

Activity	Responsible	NWSC		OSUL	MAK	WEDC
		WQCD	HQ			
Logistics	Principal Analyst	R	A	A	I	I
Training for WQ analysis	Consultant	I	A	A	I	R
WQ assessment preparation	Consultant	I	A	I	I	R

R - Responsibility, I - Involved, A - Aware
NWSC – National Water and Sewerage Corporation (the utility responsible for the production and distribution of piped water)
WQCD – Water Quality Control Department of NWSC
HQ – NWSC head quarters
OSUL – Ondea Services Uganda Limited (responsible for operating the distribution system)
MAK – Makerere University
WEDC – Water, Engineering and Development Centre (Loughborough University)

3.4 INTENDED WATER USE

For general purposes, water safety plans will apply to domestic potable use of drinking-water. The expected use of the product should, however, be determined and documented by the water safety plan team. Factors that need to be considered include:

- what consumer education is in place for water use and how is this communicated, including how consumers are notified of potential contamination?
- who is the water intended for and what is its intended use?
- what special considerations are in place for vulnerable groups such as infants, hospitalised patients, dialysis patients, the elderly and immuno-compromised? Are there any groups for whom the water is specifically not intended?
- the numbers of people served by different service levels (communal, yard, within-house – see Tables 3.2 and 3.3); and
- socio-economic status of different communities served.

This information is important, as it will be used in the hazard analysis to determine the hazard potential of the water.

Table 3.2: Summary of requirement for water service level to promote health (from Howard and Bartram 2003)

Service level	Access measure	Needs met	Level of health concern
No access (quantity collected often below 5 l/c/d)	More than 1000 m or 30 minutes total collection time	Consumption – cannot be assured Hygiene – not possible (unless practised at source)	Very high
Basic access (average quantity unlikely to exceed 20 l/c/d)	Between 100 and 1000 m or 5 to 30 minutes total collection time	Consumption – should be assured Hygiene – handwashing and basic food hygiene possible; laundry/bathing difficult to assure unless carried out at source	High

Intermediate access (average quantity about 50 l/c/d)	Water delivered through one tap on-plot (or within 100 m or 5 minutes total collection time	Consumption – assured Hygiene – all basic personal and food hygiene assured; laundry and bathing should also be assured	Low
Optimal access (average quantity 100 l/c/d and above)	Water supplied through multiple taps continuously	Consumption – all needs met Hygiene – all needs should be met	Very low

Table 3.3: Water supply access data for 1990 and 2000 by no access, access to improved sources and piped supply (from WHO and UNICEF 2000)

Year	No access (millions)	Access to improved sources within 1 kilometre (millions)	Access through household connections (millions)
1990	23% (1203)	77% (4060)	48% (2549)
2000	17% (1074)	83% (5150)	52% (3232)

An example description of an intended use is provided in Box 3.1. This description provides the team with further understanding of the nature of the population served and any particular characteristics that may increase vulnerability to waterborne disease.

Box 3.1. Example 'intended use' description

Example 1
Water utility X provides water to the general population.
The water supplied is intended for general consumption by ingestion. Dermal exposure to waterborne hazards through washing of bodies and clothes, and inhalation from showering and boiling are also routes for waterborne hazards.
Foodstuffs may be prepared with the water.
The intended consumers do not include those who are significantly immunocompromised or industries with special water quality needs. These groups are advised to provide additional point-of-use treatment.

Example 2
Utility Y provides water to approximately half the population.
The water is intended for general consumption by ingestion. Dermal exposure to waterborne hazards through washing of bodies and clothes, and inhalation from showering and boiling are also routes for waterborne hazards.
Foodstuffs may be prepared from the water and market sellers use the water for freshening produce.
About half the population served rely of water supplied from public taps, with a further significant proportion relying on tanker services filled from hydrants.
The socio-economic level of the population served by public taps is low and vulnerability to poor health is consequently high.
A significant proportion of the population is HIV positive, which increases vulnerability further.

3.5 CASE STUDIES

Two cases studies are presented below, one outlining a water safety plan from a water utility in a developed country (Melbourne Water, Australia) and one from a developing country (Uganda). Elements drawn from each of these are presented in each chapter in order to illustrate the various steps in the water safety plan process. In addition, the water safety plan for selected elements of the Gold Coast Water system is shown in Appendix A.

3.5.1 Melbourne Water case study

Melbourne Water is located in Victoria, Australia and was the first bulk water supplier in Australia to implement and achieve HACCP certification. The case study examples presented have been drawn from Melbourne Water's Drinking-Water Quality Management System (adapted slightly to the water safety plan methodology).

3.5.1.1 Intended use

Water supplied by Melbourne Water to the retail water companies must meet the customer and product specific requirements defined in the Bulk Water Supply Agreement The Agreement defines the water quality targets to be achieved at interfaces with the retail company (refer to the finished product specifications, section 3.5.1.2).

The water quality risk issues must also be managed consistent with the intended use of the product supplied to end-users by the retail water companies. That is:

- for immediate consumption by the general public, with no further treatment or boiling by the consumer;
- for other domestic and commercial uses;
- meeting the water quality requirements of the Retail Company licences; and
- considering the latest developments in drinking-water quality research and Australian best practice for operating water supply systems.

The Australian Drinking Water Guidelines, developed through the Australian National Health and Medical Research Council), are based on the WHO Guidelines. Supply-by-agreement services provided to retail company customers directly from Melbourne Water's infrastructure have no guarantee of water quality or quantity. These supplies are not intended for drinking or domestic uses where the water may be ingested.

3.5.1.2 Finished product specifications

As defined in the Bulk Water Supply Agreement (BSWA) for:

- Effective chlorination: Chlorine contact time (CT) ≥ 15 mg/l.min. Standards and action levels for water quality parameters including total coliforms.
- Monitoring Point (annual performance)
- E.coli: 99% of samples <1 org/100mL
- Trihalomethanes: all samples ≤ 0.15 mg/L
- Monochloroacetic acid: all samples ≤ 0.15 mg/L
- Dichloroacetic acid: all samples ≤ 0.10 mg/L
- Trichloroacetic acid: all samples ≤ 0.10 mg?l

95% upper confidence limit on the mean:
Turbidity

Apparent Colour pH

Limits for these three criteria based on historical erformance and set within the aesthetic guidelines specified in the Australian Drinking Water Guidelines.

Iron	≤ 0.15 mg/l
Manganese	≤ 0.05 mg/l
Aluminium (acid soluble)	≤ 0.1 mg/L

The above BWSA specifications for water quality are set to enable the retail water companies to meet their licence requirements for water quality and deliver a safe, aesthetically acceptable product with their current operating systems for managing detention times and product quality. Other parameters, including chemical residues, should meet the specifications of the Australian Drinking Water Guidelines, where limits for drinking-water are defined.

Procedures for responding to failure of these specifications are documented in the BWSA and Melbourne Water's standard operating procedure for Microbiological Water Quality Monitoring Exceedence.

3.5.1.3 Team

Multi-disciplinary teams were formed to develop the company (Hazard Analysis Critical Control Point) HACCP (Water Safety) plan and comprised members from Melbourne Water and representatives from the three retail water companies (City West Water, South East Water and Yarra Valley Water) supplied by Melbourne Water. Team members (outlined in Table 3.4) participated in a one-day training course, and the plan was derived during a series of workshops.

Table 3.4: Team members

Job title	Work team	Expertise
Team Leader Senior Engineer	Water Quality Planning	Water Quality Engineering
Water Supply Operator	Water Harvesting Team	Operations – Upper Yarra Reservoir
Process Support – Service Delivery	Operations – North Area	Water Treatment Specialist
Water Supply Operator	Westernport Area Team	Operations – distribution/treatment
Section Leader Water Treatment	Treatment Systems	Treatment plant asset management
Operations Contractor	Operations – South Area	Water supply engineering
Water Supply Operator	Thomson Reservoir Team	Operations – Thomson Reservoir
Process Engineer	Operations – North Area	Water supply engineering
Water Supply Operator	Silvan Reservoir Team	Treatment plant operations
Water Supply Operator	Maroondah-Winneke Reservoir team	Sugarloaf Reservoir, Winneke Treatment Plant and Maroondah Reservoir area
Principal Scientist	Water Quality Planning	Microbiology
Section Leader Headworks	Operations	Catchment operations
Scientist from retail water company	Retail Water Company	Water quality specialist/chemist
Engineer from retail water company	Retail Water Company	Water quality engineering (distribution)
Engineering manager from retail water company	Retail Water Company	Water quality planning

3.5.2 Kampala case study

This is largely taken from Godfrey *et al*. 2003. Kampala is the capital city of Uganda in East Africa. The piped water supply is managed by the National Water and Sewerage Corporation (NWSC) with distribution operation let by management contract to Ondeo Services Uganda Limited (OSUL). Kampala was the first water supplier in Africa to develop a water safety plan, which was achieved with technical assistance from the Water, Engineering and Development Centre (WEDC) UK and funding from the Department for International Development (DFID) UK through their Knowledge and Research programme.

3.5.2.1 Intended use

Water supplied by NWSC Kampala supply must meet the Uganda national standards for drinking-water that were set based the WHO *Guidelines for Drinking-Water Quality, 2nd edition* (1993). Furthermore, the national statute that covers NWSC operations requires that NWSC should ensure that the water supplied is potable and safe to drink by the general public without further need for treatment or boiling by the consumer and for all other registered commercial and industrial users.

3.5.2.2 Team

A multi-disciplinary team was formed to develop the water safety plan and risk maps of the distribution system. This included representatives from NWSC, OSUL, Makerere University Public Health and Environmental Engineering laboratory and WEDC. Team members (outlined in Table 3.5) participated in a series of workshops and field activities to develop the water safety plan.

Table 3.5: Team members

Job title	Work team	Expertise
Water Quality Control Manager	Water Quality Control	Water quality analysis and control
Principal Analyst	Water Quality Control	Water quality analysis and control
Chief Engineer Planning and Capital Development (NWSC)	Planning and Capital Development	Water engineer
Manager Operations (NWSC)	Operations	Water engineer
Senior Engineer (OSUL)	Distribution management	Water engineer
Analysts (NWSC)	Water quality control	Water quality analysis
Gaba treatment works manager	Water production	Water treatment engineer
Engineers (OSUL)	Distribution management	Water engineers
Manager GIS (NWSC)	Information management and mapping	GIS and mapping
Lecturer Makerere University	Public Health and Environmental Engineering	Environmental engineer
Analyst Makerere University	Public Health and Environmental Engineering	Water quality analysis
Assistant Programme Manager (WEDC)	Water, Engineering and Development Centre (UK)	Water engineer
Programme Manager (WEDC)	Water, Engineering and Development Centre (UK)	Water quality management and monitoring
Senior Research Fellow	Robens Centre for Public and Environmental Health	Water quality analysis and monitoring

NWSC – National Water and Sewerage Corporation
OSUL – Ondeo Services Uganda Limited
WEDC – Water, Engineering and Development Centre