

Water Safety Plan: An effective tool for drinking water quality management

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Importance of water supply and sanitation

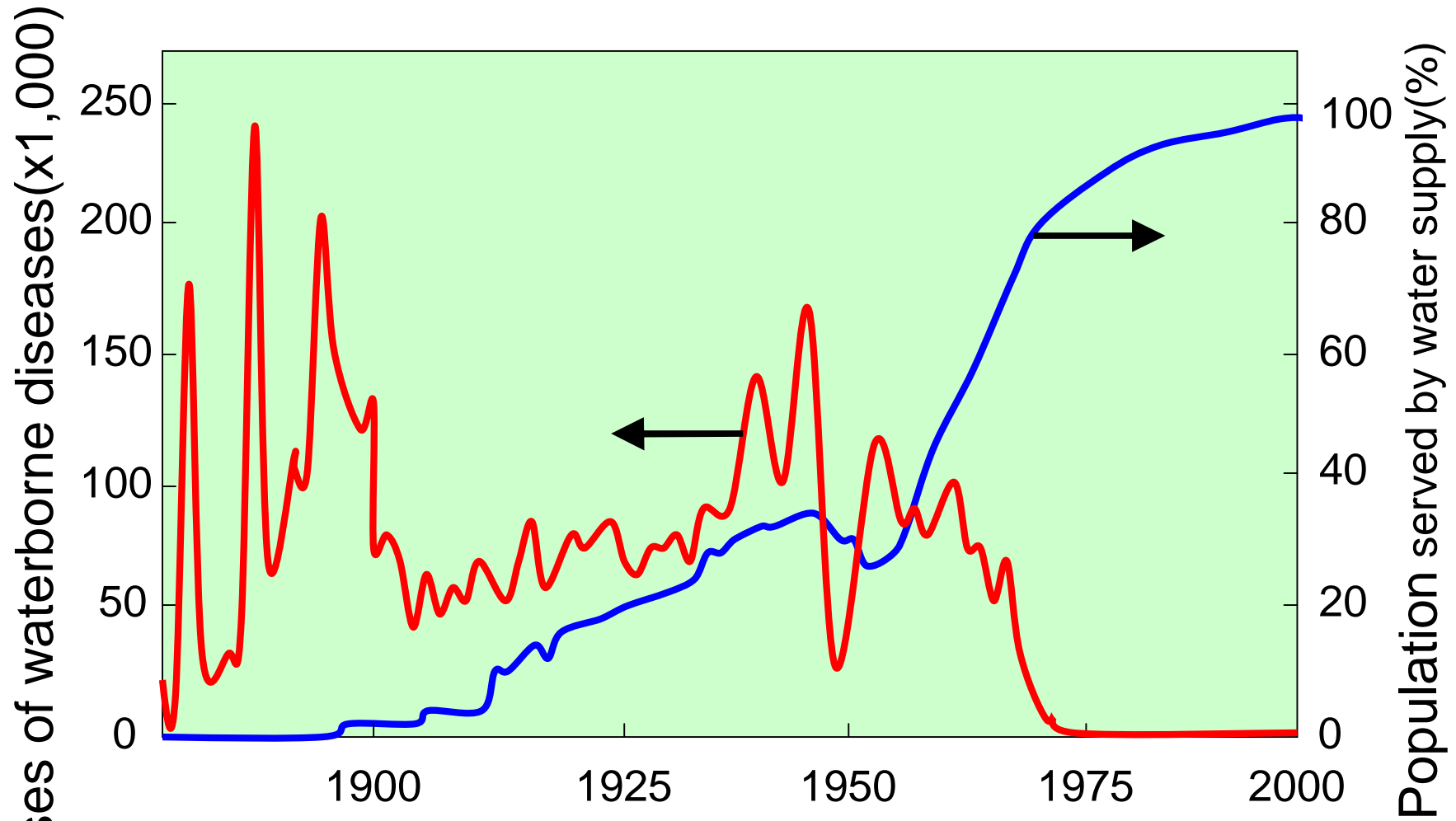
“Water and Sanitation is one of the primary drivers of public health. I often refer to it as “Health 101”, which means that **once we can secure access to clean water and to adequate sanitation facilities for all people**, irrespective of the difference in their living conditions, **a huge battle against all kinds of diseases will be won.**”

Dr LEE Jong-wook

Director-General, WHO

Health hazards of poor water supply and sanitation

- 4 billion cases of diarrhoea each year
- 1.8 million deaths by diarrhoeal diseases
- 10% of the developing world population affected by intestinal worms
- 6 million people are blind from trachoma
- 200 million people in the world are infected with schistosomiasis.



Water supply development and waterborne diseases in Japan

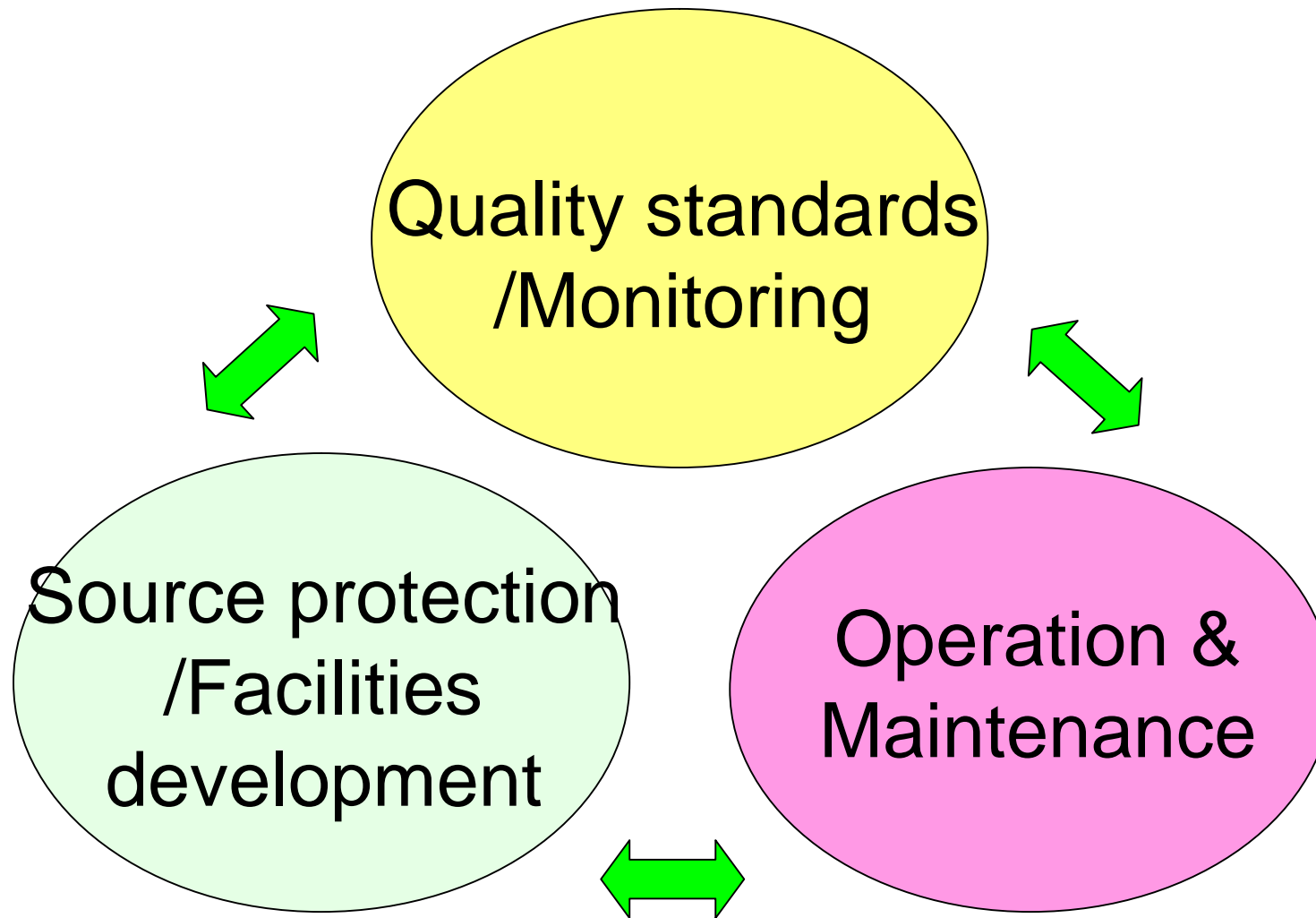
Mission of drinking water supply

■ Continuous supply of:

- Adequate quantity of water
- With good quality

Microbiologically/Chemically safe
and acceptable

- At an appropriate pressure



Measures for drinking water safety

Health effects of pathogens in drinking water

- ◆ The uptake of pathogens even at one time can cause infection.
- ◆ Many children are dying mostly in developing countries due to unsafe drinking water.
- ◆ Many outbreaks of waterborne diseases can be avoided by drinking water disinfection.

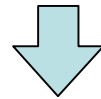
Health effects of chemicals in drinking water

- ◆ Chemical uptake through drinking water is a part of its total uptake.
- ◆ Arsenic, fluoride and nitrate as priority chemicals
- ◆ Long-term effects are of concern for most chemicals.
- ◆ Short-term effects are of concern for nitrate.

Water Safety Plan

(WHO Guidelines for Drinking-water Quality, 3rd Ed.)

- A management tool
- Uses a comprehensive risk assessment and risk management approach encompassing all steps in water supply
- From water source (catchment) to consumer

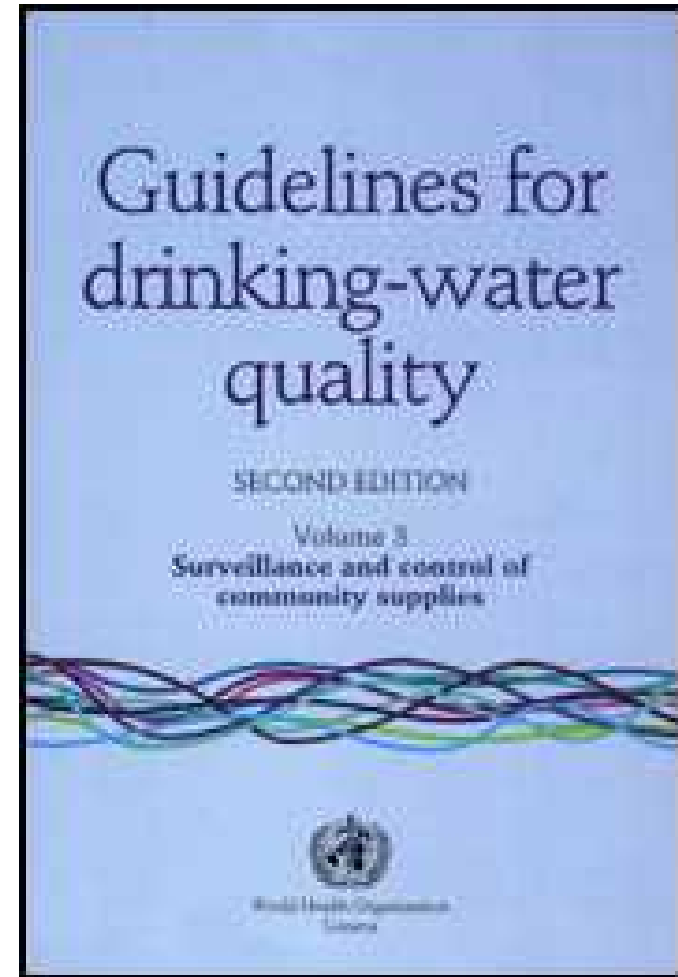


Objectives

- Minimize contamination of source water
- Remove contamination through treatment
- Prevent re-contamination during storage, distribution and handling of drinking-water

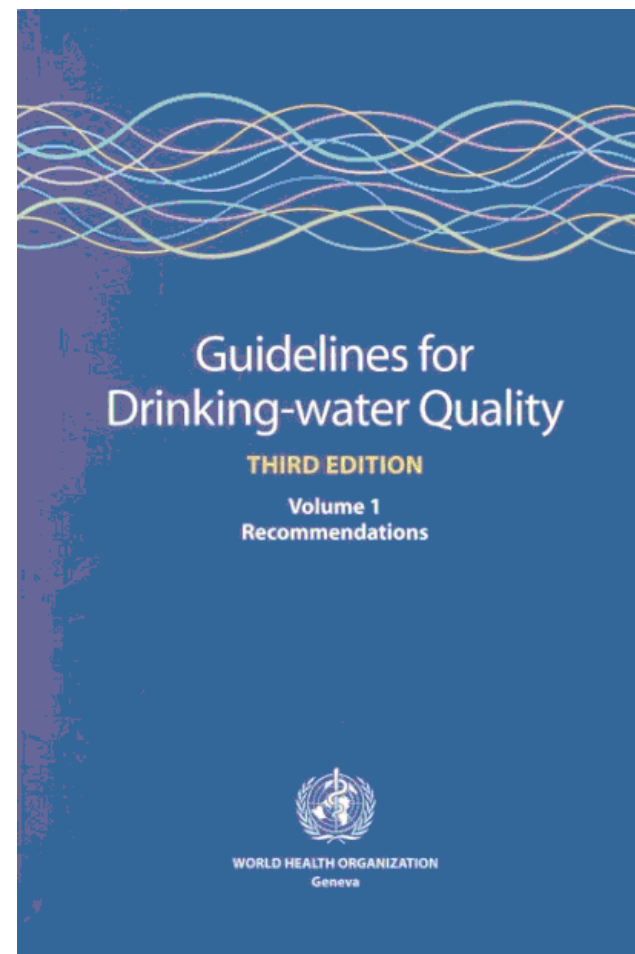
WHO Guidelines for Drinking Water Quality 2nd Edition

- Output monitoring: measuring parameters in product water
- Monitors compliance to standards
- *Reactive rather than proactive*
- *Absence of indicators does not mean absence of risk*
- *In 1978-1986, 502 outbreaks of waterborne disease in the USA - most had no total coliforms or E. coli (Sobsey 1987)*

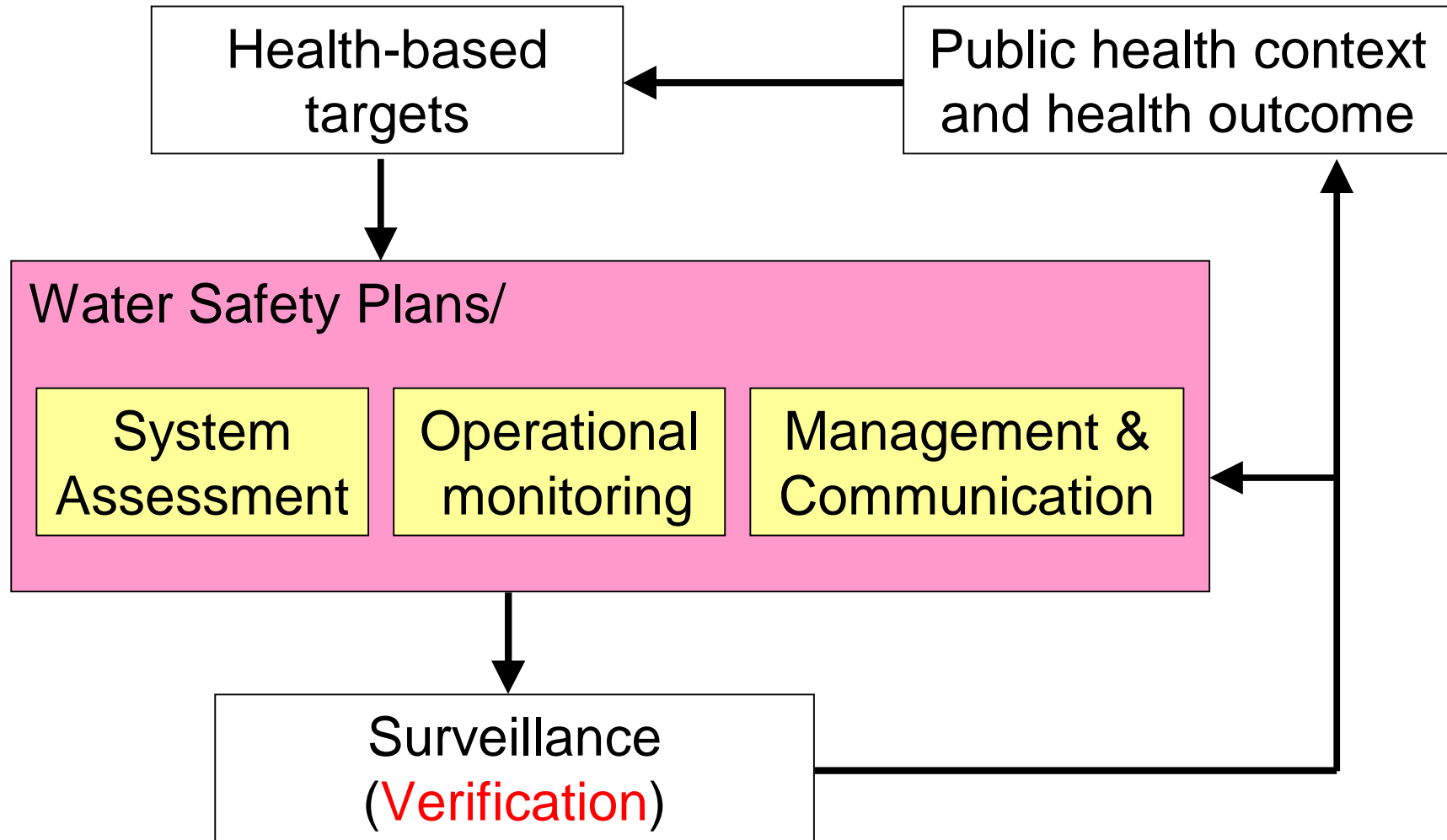


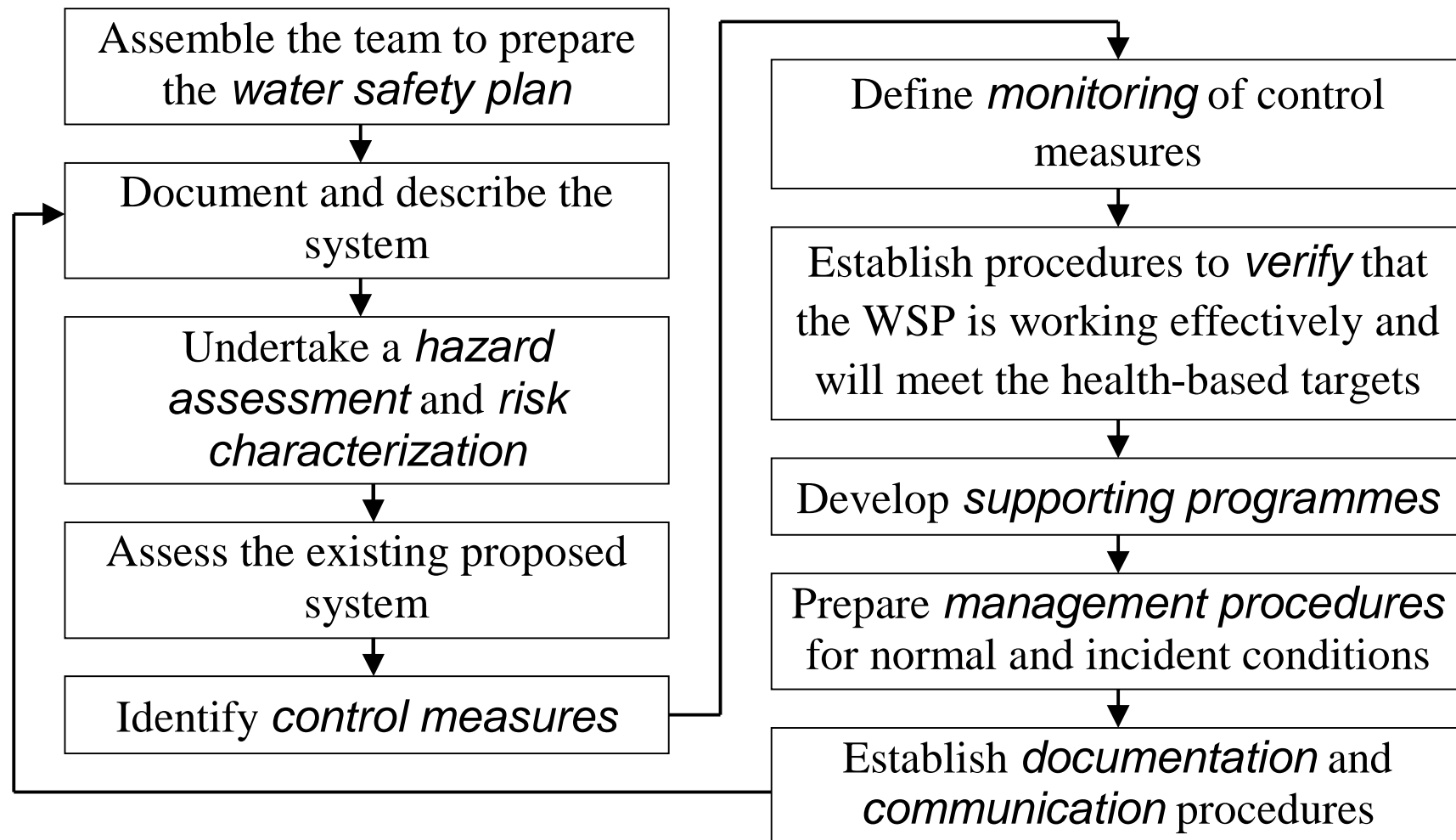
WHO Guidelines for Drinking Water Quality 3rd Edition

- Input monitoring: measuring parameters to show that the system is working
- Meeting health-based targets
- Use of risk management
- Use of multi-barrier approach (HACCP principles)
- Application of water safety plan
- Independent surveillance



Framework for Safe Drinking-water





Key steps in developing a Water Safety Plan (WSP)

WSP application in the world

- “Bonn Charter” (IWA, 2004)
- Incorporation in the regulatory framework in New Zealand and United Kingdom
- Trials in Germany
- Use in international cooperation by the US
- Application in many developing countries

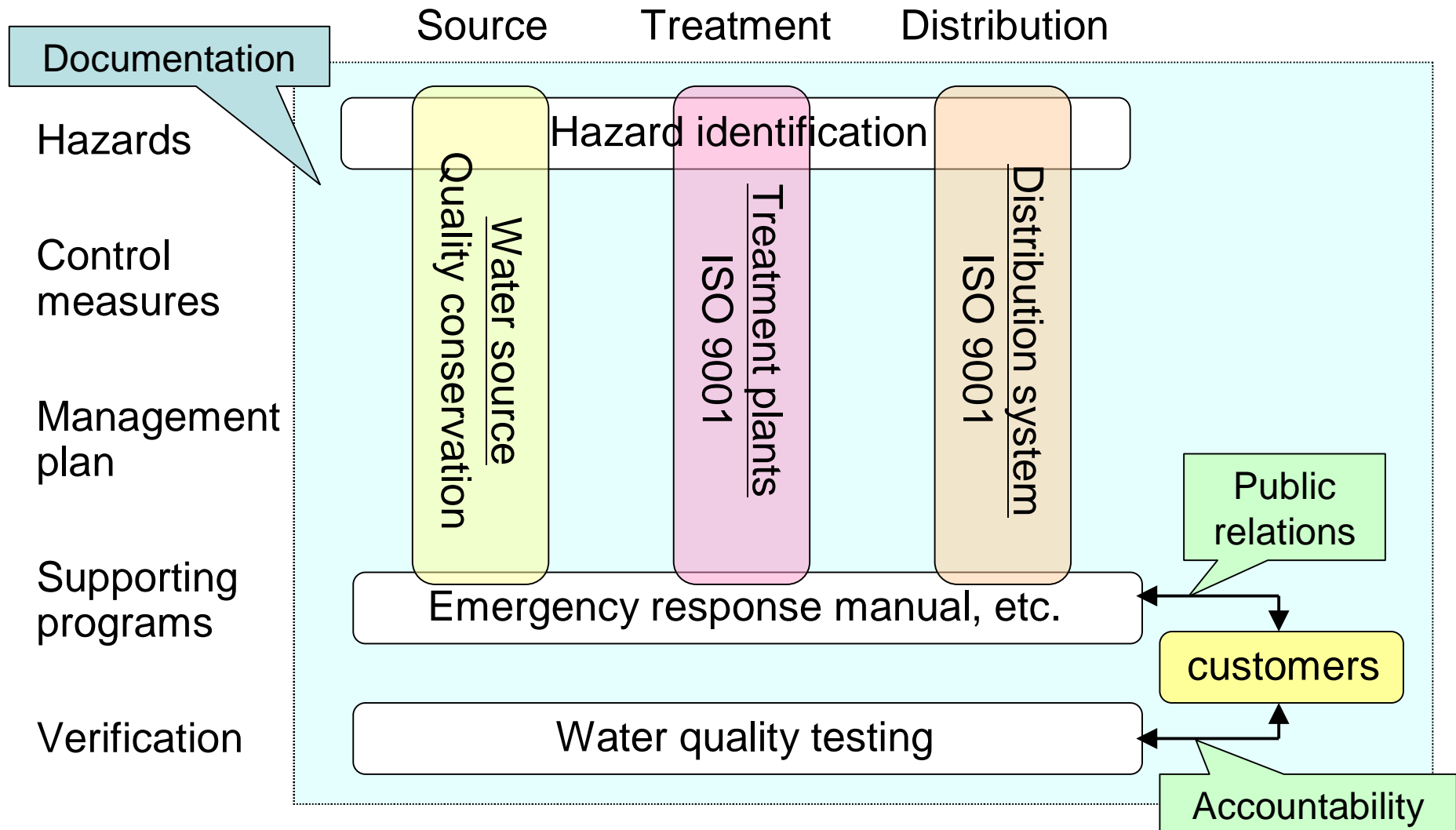
WSP: Japan's approaches

- Introduction into drinking water quality management in Japanese water supplies
 - A research study on WSP application in municipal water supplies
 - Development of guidelines on WSP application
- Dissemination to developing countries through international cooperation

A research study on WSP application

- Research period of FY2004-2006 (for three years)
- Funded by a grant of MHLW
- Case studies on WSP application to drinking water quality management in municipal water supplies; Tokyo, Yokohama, Osaka and Kobe
- Contribution to streamlining and upgrading their current drinking water quality management programs

WSP application in Osaka City Water Supply



Development of guidelines on WSP application

- Period of FY2005-2007 (for three years)
- Provision of a fund by MHLW
- Organization of a committee for guideline development in JWWA
- Small water suppliers as main audience
- Guidelines being simple, user-friendly and easy to improve
- Reference to New Zealand's approach

Classification of drinking water supply systems according to the Water Works Law

Category	Definition	Systems
Public water supply		
Large water supply	>5,001 persons	1,811
Small water supply	101-5,000 persons	8,068
Bulk water supply		107
Private water supply	>101 residents or Max. >20 m ³ /d	7,473
Service tank system		
Large system	Tank capacity >10 m ³	Many
Small system	Tank capacity <10 m ³	Many

Small water supplies in Japan

Population served	Systems	Proportion (%)
>4,000	465	5.5
3,000-4,000	344	4.1
2,000-3,000	528	6.3
1,000-2,000	1,116	13.2
500-1,000	1,435	17.0
<500	4,540	53.9
Total	8,428	100.0

Population served of less than 1,000 persons:
Approx. 6,000 systems

Note: 1) Data as of FY2003.

2) The population served by a “small water supply” is nominally 101 to 5,000 according to its definition.

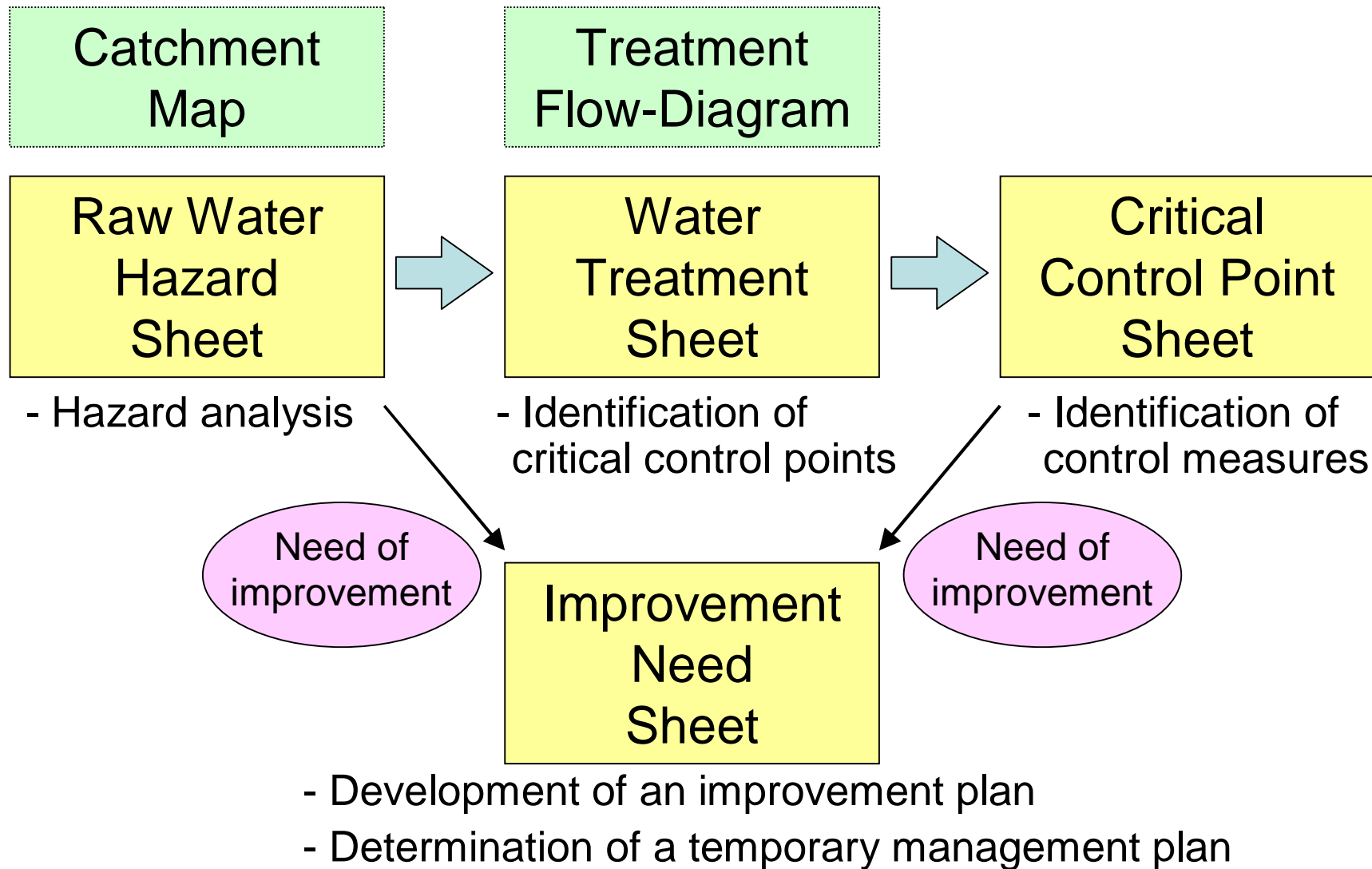
Importance of WSP for small water supplies

- Inappropriate facility maintenance
- Necessity of limited source prioritization
- Inadequate operation manuals
- Inadequate record keeping
- Necessity of existing system improvement
- Need of operator's awareness raising

Health-related incidents caused by drinking water contamination in Japan

	Water source	Hazard	Cases	Year
1	Well water	<i>E. coli</i> , O157	2 children died	1990
2	Service tank water	<i>Cryptosporidium</i>	461	1994
3	Pipe-supplied water	<i>Cryptosporidium</i>	8,812	1996
4	Well water	Nitrate	1 baby	1996
5	Well water	<i>Shigella</i>	821	1998
6	Well water	Organic arsenic	Some	2003
7	Pipe-supplied water	Norovirus	29	2005

It should be noted that many of waterborne disease outbreaks could be avoided by disinfection.



(Draft) WSP worksheets for small water supplies

(Draft) Example of a Raw Water Hazard Sheet

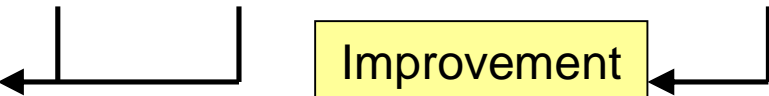
<Surface water>

Item	<i>E. coli</i>	<i>Crypto</i>	Pest.	NO ₃	As	Oil	Remarks
Source <u>Households</u> -On-site -Off-site <u>Industrys</u> <u>Agriculture</u> -Runoff -Livestock <u>Others</u> -Waste landfill -Accidents -Wild animals -Natural sources							Sites Sites Contents Pesticides Number Dom./Ind.
Contamination level	High	High	?	Low	Low	?	
Treatment need						x	

From a Catchment Map

Water Treatment Sheet

Improvement Need Sheet



(Draft) Example of a Water Treatment Sheet <Rapid sand filtration system>

From a Raw Water Hazard Sheet

Process or facility	Hazard	
	<i>E. coli</i>	<i>Crypto</i>
Intake		
Receiving well (Prechlorination system)		
Polyaluminum chloride dosing		
Rapid mixing		
Flocculation		
Sedimentation		
Rapid sand filtration		
Post-chlorination		

From a Treatment Flow-Diagram

Note:

- 1) The number of critical control points may not exceed two for one hazard.
- 2) Priorities should be given to:
 - chemical dosing,
 - filtration, and
 - those with frequent failures.

: Critical control point

(Draft) Example of a Critical Control Point Sheet

From a Water Treatment Sheet

Item		Hazard	
		<i>E. coli</i>	<i>Crypto</i>
Process		Post-chlorination	PAC dosing Rapid sand filtration
Control parameter		Residual chlorine	Pump operation Turbidity
Control limit		0.5-0.8mg/l	No disorder <0.1unit
Calibration		Weekly	Monthly Weekly
Monitoring/ Recording	Monitoring		
	Alarming		x
	Recording		x
Factors of deviation and its preventive measures <Examples>		Insufficient dose Dose increase	Pump failure Inspection/ Maintenance Fluctuation of raw water pH pH adjustment
Remedial actions when the limit is exceeded	Treated water reservoir	Additional chlorination	Water transmission interruption and reservoir cleaning
	Distribution reservoir	Additional chlorination	(Not applicable)
	Consumer	Boiling	Boiling

Those given a sign of "x" should be referred to in a Improvement Need Sheet.

The Health (Drinking Water) Amendment Act 2007 (1)

Drinking-water in New Zealand <http://www.moh.govt.nz/water>

- The New Zealand Drinking Water Standards
 - Mandatory
- Register of Community Drinking-Water Supplies in New Zealand
 - More than 2,000 supplies; registration in WINZ; mandatory
- Public health grading of community drinking-water supplies
 - An incentive to the improvement of drinking water quality management; to be implemented by District Health Boards

The Health (Drinking Water) Amendment Act 2007 (2)

- Water Information New Zealand (WINZ)
 - Water supply database; limited use
- Public Health Risk Management Plans (PHRMP)
 - NZ version of Water Safety Plan; mandatory
- Annual Report on the Microbiological and Chemical Quality of Drinking-Water Supplies in New Zealand
- Guidelines for Drinking-Water Quality Management in New Zealand
- Others

Public Health Risk Management Plan: Small Drinking-water Supplies

[Step 1: Flow chart]

1. Catchment and intake, 2. Treatment, 3. Storage and distribution

[Step 2: Worksheets]

For each of the above:

1. Potential hazards, 2. Are they under control?, 3. If not, needs of urgent attention.

[Step 3: Plan to Manage the 'Needs Urgent Attention']

1. Improvement schedule, 2. Temporary way to know water quality deterioration, 3. Temporary contingency management plan

Public health grading of community drinking-water supplies in New Zealand

The purpose is to provide a public statement of the extent to which a community drinking-water supply achieves and can ensure a consistently safe and wholesome product.

Drinking-water Assessor (DWA)

Ministry of Health

District Health Board

- ISO/IEC17020 certification by the International Accreditation New Zealand (IANZ)

Drinking-water Assessor

(=Health Protection Officer)

- Responsible for the monitoring of drinking water quality analysis and its result by drinking-water supplies, their public health grading, and the evaluation of the effectiveness of their public health risk management plans
- Qualified and trained by the Ministry of Health

Source and treatment grading

- A1 Completely satisfactory, negligible level of risk, demonstrably high quality
- A Completely satisfactory, extremely low level of risk
- B Satisfactory, very low level of risk when the water leaves the treatment plant
- C Marginally satisfactory, low level of of microbiological risk when the water leaves the treatment plant, but may not be satisfactory chemically
- D Unsatisfactory level of risk
- E Unacceptable level of risk

Distribution zone grading

- a1 Completely satisfactory, negligible level of risk, demonstrably high quality
- a Completely satisfactory, extremely low level of risk
- b Satisfactory, very low level of risk
- c Marginally satisfactory, moderate level of risk
- d Unsatisfactory level of risk
- e Unacceptable level of risk

Minimum requirements
according to the scale of
a community water supply

Population served	Source and treatment	Distribution zone
More than 10,000	B	a
5,001-10,000	B	b
Less than 5,000	C	c

Source/Treatment grading: once not “A” but “E”
in Masterton Drinking-water Supply
(Kaituna Treatment Plant)



Conclusions

- WSP is essential for ensuring drinking water safety.
- Hazard identification is a key of WSP.
- Catchment management should be paid more attention to by drinking water suppliers.
- The way of WSP application may be different according to the situations.

Acknowledgement

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