DRINKING WATER SAFETY: A TOTAL QUALITY MANAGEMENT APPROACH

Network *for* Environmental Risk
Assessment *and* Management

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Final Report

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1 Introduction

A Conference on Drinking Water Safety: A Total Quality Management Approach was convened by the Network for Environmental Risk Assessment and Management (NERAM) on September 23-25, 2002 to review best practice in drinking water systems safety and identify priority actions to ensure safe drinking water in Canada. The conference was attended by more than 150 delegates representing, in order of number of attendees, federal and provincial governments, water quality scientists, municipal water service representatives and their private sector suppliers, and public interest groups. More than 30 speakers presented papers addressing frameworks and approaches for total quality management of drinking water systems and technical aspects of water quality testing and treatment. Delegates considered the recommendations of the Walkerton and North Battleford inquiries, multi-barrier approaches to safe drinking water in Canada and Australia, and perspectives of scientists, regulators, operators and suppliers concerning key measures to ensure robustness in drinking water management systems.

The Walkerton Inquiry Part 2 report (O Connor, 2002) provides a starting point for a Canadian strategy for safe drinking water. Justice O Connor s 93 recommendations address various dimensions of the water system including governance, source protection, standards and technology for treatment and monitoring, quality management of operations, and governance. However, it is not practical to implement fully all of the 93 recommendations in the short term. The objective of the conference was to consider the broad scope of recommendations and identify priority actions for implementation over the next 5 to 10 years to improve drinking water safety in Canada. A conference discussion document was prepared in advance of the conference to provide delegates with a summary of background information and existing recommendations on 7 major issues for total quality management of drinking water systems: governance and oversight, quality control and assurance, human resources, source protection, emerging threats, best practice, and research and innovation.

This report provides guidance on best practice in the key elements of a total quality approach to drinking water management based on the conference presentations and discussions. The report is organized in two sections. Section 2.0 presents perspectives of water managers and suppliers, water quality scientists, risk management experts, and Federal and Provincial government representatives on state of the art approaches to total quality management of drinking water. Section 3.0 presents the approach and results of a structured process to identify collective opinion on priority actions for drinking water safety in Canada.

2 Best Practice in Drinking Water Quality Management

2.1 The Australian Framework [1]

Dr. Martha Sinclair of Monash University and the Cooperative Research Centre for Water Quality and Treatment presented the Australian Framework for Drinking Water Quality Management (National Health and Medical Research Council of Australia, 2001). The Framework was developed by the Australian National Health and Medical Research Council for incorporation into the Australian Drinking Water Guidelines. The Australian Framework illustrates best practice in the design and implementation of comprehensive total quality management systems for drinking water. The Framework draws on a number of established quality management and risk management systems including ISO 9001, ISO 14001, HACCP, AS/NZS 4360 and Partnership for Safe Water of the American Waterworks Association / USEPA, and supplements these with additional elements to provide a comprehensive drinking water quality framework. Development of the Framework was undertaken through a process of (1) stakeholder consultation including water industry representatives, federal and state health regulators, catchment and environmental organizations and the Australian Consumers Health Forum (2) desktop trial by diverse water supply systems across Australia and (3) public consultation. The Australian Drinking Water Guidelines have been revised extensively to incorporate the Framework as their central focus.

The Australian Framework challenges the widespread tendency to assume that intensifying compliance monitoring or lowering compliance limits is an effective public health protection approach. A significant limitation of a compliance monitoring approach is that it promotes reactive management, generally after consumers have received the non-complying water and can not provide timely information to prevent exposure of consumers to pathogens.

Several other limitations of a compliance monitoring approach to protecting public health were identified:

- It is not technically nor economically feasible to monitor every possible chemical, physical and microbiological parameter. Indicator organisms such as E. coli do not correlate well with risks from viruses and protozoa;
- Contamination can occur between sampling events and be missed by the monitoring program;
- There are limitations in current knowledge of the relationship between numerical guideline values and public health outcomes. Monitoring is not an effective response to known contaminants without a prescribed numerical guideline or established method of analysis or to unknown contaminants.

[1] This section is based on Sinclair, M., and Rizak, S. (2002). Drinking Water Quality Management: The Australian Framework. Paper presented at the NERAM Conference Drinking Water Safety: A Total Quality Management Approach. September 23-25, 2002. Ottawa, ON.

The Australian Framework is designed on the premise that the most effective means of assuring drinking water quality and public health protection is through adoption of a preventive management approach that encompasses all steps in water production from catchment to consumer. The Framework integrates quality and risk management principles, and provides a comprehensive, flexible and proactive means of optimizing drinking water quality and protecting public health.

Key Elements of the Australian Framework

The Framework addresses the following four key areas and twelve individual elements (see Table 1):

- Establishment of operating procedures to maintain system control, and setting of operational limits with appropriate monitoring and corrective responses to detect and correct deviations from optimum performance
- **Commitment to Drinking Water Quality Management** — successful implementation requires the support and commitment of senior management and employees to drinking water quality management and a supportive organizational philosophy. Water authorities should identify key stakeholders and develop appropriate mechanisms for their commitment and involvement.
- **System Analysis and Management** — effective management requires an understanding of the entire water supply system, the hazards and events that can compromise drinking water quality, and the preventive measures and operational controls necessary for assuring safe and reliable drinking water
- **Supporting Requirements** — this includes basic elements of good practice to ensure that the system has the capacity to operate and adapt to meet challenges. This includes employee training, community involvement, research and development, validation of process efficacy and documentation and reporting systems.
- **Review** — this includes ongoing evaluation of water quality data and audit processes and their review by senior executive to ensure that management system is operating satisfactorily and to provide a basis for continual improvement.

The following are key features of the Quality Management Framework:

- Verification of drinking water quality through compliance monitoring as well as assessment of consumer satisfaction and the establishment of corrective action procedures when monitoring indicates non-compliance
- Development of appropriate incident and emergency response protocols in consultation with relevant regulatory agencies and stakeholders
- Maintenance of appropriate skill levels and training of employees
- Community involvement and consultation during decision-making processes and active, two-way communication with the community
- Research and development to increase understanding of the water supply system and to optimize plant performance
- Appropriate documentation and reporting of drinking water quality management practices and activities

- Regular evaluation/audit of activities and the drinking water quality management system
- Senior management review to identify opportunities to continual improvement

Table 1. Australian Framework for Management of Drinking Water Quality

COMMITMENT TO DRINKING WATER QUALITY MANAGEMENT		
	Element 1	**Commitment to Drinking Water Quality Management**
		Drinking Water Quality Policy
		Regulatory and Formal Requirements
		Engaging Stakeholders
SYSTEM ANALYSIS AND MANAGEMENT		
	Element 2	**Assessment of the Drinking Water Supply System**
		Water Supply System Analysis
		Assessment of Water Quality Data
		Hazard Identification and Risk Assessment
	Element 3	**Preventive Measures for Drinking Water Quality Management**
		Preventive Measures and Multiple Barriers
		Critical Control Points
	Element 4	**Operational Procedures and Process Control**
		Operational Procedures
		Operational Monitoring
		Corrective Action
		Equipment Capability and Maintenance
		Materials and Chemicals
	Element 5	**Verification of Drinking Water Quality**
		Drinking Water Quality Monitoring
		Consumer Satisfaction
		Short-term Evaluation of Results
		Corrective Action
	Element 6	**Management of Incidents and Emergencies**
		Communication
		Incident and Emergency Response Protocols
SUPPORTING REQUIREMENTS		
	Element 7	**Employee Awareness and Training**
		Employee Awareness and Involvement
		Employee Training
	Element 8	**Community Involvement and Awareness**
		Community Consultation
		Communication
	Element 9	**Research and Development**
		Investigative Studies and Research Monitoring
		Validation of Processes
		Design of Equipment
	Element 10	**Documentation and Reporting**
		Management of Documentation and Records
		Reporting
REVIEW		
	Element 11	**Evaluation and Audit**
		Long-term Evaluation of Results
		Audit of Drinking Water Quality Management
	Element 12	**Review and Continual Improvement**
		Review by Senior Executive
		Drinking Water Quality Management Improvement Plan

The Framework emphasizes prevention, the importance of risk assessment, maintaining the integrity of water supply systems and the application of multiple barriers to assure protection of public health. The Framework is intended to be sufficiently flexible for application to all water supply systems regardless of size or degree of treatment.

2.2 Perspectives from the Walkerton Inquiry

Justice O Connor concluded in his Part 2 report of the Walkerton Inquiry that perhaps the most significant recommendations in this report address the need for quality management through mandatory accreditation and operational planning. The Part 2 report identifies the following essential elements of an appropriate quality management system (O Connor, 2000, p. 226)

- Adoption of best practices and continuous improvement
- real time process control (e.g. continuous monitoring of turbidity, chlorine residual, and disinfectant contact time) wherever feasible
- effective operation of robust multiple barriers to protect public health
- preventive rather than strictly reactive strategies to identify and manage risks to public health
- effective leadership

Dr. Steve Hrudey, Professor of Environmental Health Sciences at University of Alberta and member of the Walkerton Inquiry Research Advisory Panel identified a set of guiding risk management principles to achieve a total quality management strategy recommended by the Walkerton Inquiry[2]. These were first articulated for a workshop in October 1999 that sought the participation of the drinking water industry and regulators for developing the Australian framework. With the occurrence of Walkerton a little over 6 months later, the question arises whether Walkerton could have been prevented if these had been followed in Ontario.

1. **Anticipate and prevent harm; do not just react**. Reliance on compliance with output quality standards is a fundamentally reactive approach
2. **Set priorities based on risks rather than hazards**. Hazard is the potential to cause harm; risk is the probability that a hazard will cause harm.
3. **Use risk assessment to inform risk management; seek the greatest overall reduction of risk.** Recognize that risk management always involves risk tradeoffs. Seek to do more good than harm. Recognize that risk can never be reduced to zero and pursuit of zero may simply increase other risks.
4. **Recognize the role of human behaviour; maintain vigilance and fight complacency.** Complacency appears to be a major factor in waterborne disease outbreaks. Critical systems must be robust enough to limit the consequences of human error.

[2] These are the views of Dr. Hrudey, not the views of Justice O Connor or the Research Advisory Panel.

5. **Know your system and convert hindsight into foresight.** Systems must be in place to provide feedback to facilitate learning from errors.
6. **Seek leadership and invest in knowledge.** Safe drinking water requires quality science and technology. Water authorities must enhance and promote their knowledge-based culture rather than focusing only on business values or political expediency.

Dr. Hrudey concluded that complacency appears to be a major contributor to water quality failures. This conclusion was based on a comprehensive review of waterborne outbreaks that occurred in the developed world over the past 30 years. The review[3] was prepared for the Research Advisory Panel to the Walkerton Inquiry to provide perspective on the failures that occurred at Walkerton. Many common features of previous outbreaks were shown to be in common with the failures at Walkerton and North Battleford. Creating a risk management-based Total Quality Management approach can demonstrate to all parties an effective commitment to assuring drinking water safety.

Dr. Harry Swain, Chairman of the Walkerton Inquiry Research Advisory Panel offered his own views[4], on policy issues regarding water supply in Ontario. The mandate of the Inquiry focused on public health objectives. Dr. Swain concluded that broadening the mandate to include environmental sustainability and economic efficiency objectives would not have substantially changed the Walkerton Inquiry recommendations. With respect to environmental sustainability, the recommendations might have been extended from the requirement for farm plans and watershed plans to perhaps include sewage treatment plant effluents. The Inquiry analysis indicated that there are clear links between governance, public health and economic efficiency. Dr. Swain noted that the price that consumers pay for water is currently mostly volume related, but is low and does not consider a wide variety of environmental externalities. The high demand for water has a high cost in terms of unnecessary infrastructure. The analysis conducted for the Inquiry showed that systems that are good for public health and safety contain a great deal of engineering and financial management detail. This detail has illustrated that the Ontario municipal world is enormously conservative in its approach to finance, which has slowed expenditures to improve water safety.

Governance is a system of public policy, regulatory oversight, system operations and finance, and the accountability regime that surrounds it all. In the case of Walkerton failures were found at every level. A series of underlying latent factors included a compromised well; ignorant, deceitful and complacent operators; no automatic shut-down system (automatic chlorine residual monitor); inadequate inspection, partial failure of risk communications; and PUC/municipal oversight failure. Dr. Swain noted that Walkerton s underlying problems are latent in other smaller operators that do not have all

[3] Hrudey, S.E., P.M. Huck, P. Payment, R.W. Gillham and E.J. Hrudey. 2002. Walkerton: Lessons Learned in comparison with Waterborne Outbreaks in the Developed World. *Journal of Environmental Engineering and Science.* In press.

[4] These are the views of Dr. Swain, not the views of Justice O Connor or the Research Advisory Panel.

the competences for safe, or efficient operations. Dr. Swain identified the following characteristics of an effective water utility as identified by a background paper prepared for the Walkerton Inquiry by CH2M Hill and Diamond Management:

- Well trained operators
- Fast, exclusive access to testing labs and to microbiological, public health and engineering expertise
- Planning, engineering and financial management capabilities
- Excellent customer relations
- Transparency and accountability
- Internal learning and continuous improvement
- Back-up

The Inquiry called for a new quality management water standard to be met by water suppliers as a condition of license. Dr. Swain indicated that the first step that should have been undertaken by the province is the development of the quality management standard. The task for Ontario municipalities is to begin thinking about regionalization to internalize the competencies that are necessary or contracting with private suppliers. Dr. Swain indicated that capital is not the first problem as a careful analysis of existing systems can lead to cost savings.

Federal government policy is to apply the most stringent standard in any of their installations. Practice does not live up to policy. The most serious problem is on Indian Reserves. Parks and military bases are also at issue. There are many opportunities for the federal, provincial and Indian governments to cooperate on improving the safety of water supplies on reserves.

Dr. Swain concluded that the roadmap ahead to achieve drinking water safety is straightforward and there is a wonderful opportunity for a government that says it is keen about environmental matters and public health to set a good example.

Dr. Daniel Krewski of the McLaughlin Centre for Population Health Risk Assessment provided a review of a paper commissioned by the Walkerton Inquiry on Managing Health Risks From Drinking Water (Krewski et al., 2002). The review provided a comprehensive review of the scientific basis for drinking water risk assessment and of strategies for managing these risks. The review concluded that scientific basis underlying Ontario s drinking water standards appears to be comparable to that in other jurisdictions, including the United States, Australia, and the World Health Organization. Dr. Krewski concluded with the following recommendation for strengthening drinking water safety in Ontario:

- enhancing population health surveillance;
- developing and applying new scientific methods for characterizing microbiological risk;
- improving source water protection;
- adopting a total quality management approach to drinking water safety.

2.3 The Multi-Barrier Approach to Drinking Water Safety

2.3.1 The Multi-Barrier Approach as a Risk Management System

Dr. William Leiss, Research Chair in Risk Communication at the University of Calgary and member of the Walkerton Inquiry Research Advisory Panel[5], discussed how the multi-barrier approach to drinking water safety, which was adopted in the Report of the Walkerton Inquiry is a risk management strategy that is consistent with the approaches to risk management used for other health and environmental risks. Dr. Leiss noted that the failures in risk management and risk communication occurred at every level in the Walkerton drinking water system as follows:

- the water system operators: fundamental deficiencies in basic knowledge of risk factors and in relevant training; failure to warn public health authorities of unchlorinated water source;

- The water system owners (the Walkerton PUC and the municipality): failures in oversight of operators and failure to secure Well 5 from surface water contamination over many years;

- The provincial Ministry of Environment; failure to require continuous chlorine/turbidity monitors on a known risky source, failure to follow up on problems discovered repeatedly in inspections, failure to ensure proper training of operators, serious deficiencies in regional office in knowledge about risk factors;

- The government of Ontario: failure in the approval system for wells; failures in ensuring the effectiveness of voluntary approaches for regulatory compliance; failure to enact a notification regulation (requiring notification of public health officials when water testing showed problems) after provincial laboratories were privatized; failure to understand that certain types of budgetary reductions imposed on MOE resources and personnel would lead to unacceptable levels of risk to drinking water

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Dr. Leiss provided the following overview of the five levels of the multi-barrier approach, identifying examples of the types of hazards and risk management approaches associated with each level:

[5] These are the views of Dr. Leiss, not the views of Justice O Connor or the Research Advisory Committee.

Table 2: An Example of the Multi-barrier Approach (O Connor, 2002)

Hazard	**Barrier**	**RM Approach**
Pathogens, chemicals, radionuclides, etc.	Source Protection	Watershed protection plan, etc.
Pathogens, chemicals, disinfection products	Treatment	Chemical/UV/other, disinfection, filtration
Infiltration, pathogen regrowth	Distribution System	Chlorine residual, system pressure, etc.
Undetected system failure	Monitoring	Automatic monitors, alarms, shut-offs, etc.
Failure to act or communicate well	Response	Emergency response plan

Dr. Leiss concluded that the multi-barrier approach is a classic risk management strategy because it incorporates the following fundamental principles of risk management:

- The approach is systematic;
- Distributing risk reduction resources across a number of dimensions provides significantly greater health protection benefit than would be achieved by seeking an unattainable level of safety in any one dimension;
- There are unique risk factors in each dimension which must be assessed in order to identify the most cost-effective management options for a desired level of risk reduction.

Dr. Leiss noted that the new provincial drinking water legislation must be a seamless structure to cover the following dimensions of risk that are in the system, at a level that is acceptable to the public:

Source protection risk issues: surface water and groundwater contaminants; abandoned wells; farm environmental management plans; watershed area designations and management plans for the entire province (Conservation authorities); unification of land use planning, zoning, water taking authority, effluent from sewage treatment, industrial permits, and farms;

Treatment risk issues: multiple barriers (filtration, treatment); choice of treatment technologies based on source water characteristics and prevalence of contaminants; a new standard-setting exercise; certification, training, inspection, compliance; an organizational culture of seeking best practices; competitive environment among operators to ensure continuous improvement;

Distribution risk issues: decaying and decayed infrastructure; new technologies for refurbishing older systems; system design parameters for reducing risks of new or recontamination of treated water while it is in the distribution network;

Monitoring risk issues: time lapse between taking samples and getting reliable results; the chlorine residual; what should be tested for? (total coliform, etc.); new testing technologies, new pathogens; the importance of a capacity to keep abreast of recent developments around the world;

Emergency response risk issues: the capacity to design clear messages to influence behaviour; the capacity to deliver those messages in a timely fashion to the recipients who need them.

2.3.2 Managing Drinking Water in Canada from Source to Tap

Michele Giddings of Health Canada presented the development of two guidance documents for management of drinking water supplies in Canada from source to tap based on the concept of a multi-barrier approach. The documents were developed by the Federal-Provincial-Territorial Subcommittee on Drinking Water (DWS) in collaboration with the Water Quality Task Group of the Canadian Council of Ministers of the Environment) (CEOH/CCME, 2002). The multi-barrier approach consists of three main elements: source water protection, drinking water treatment and drinking water distribution system. These elements are addressed through monitoring and management of water supplies, legislative and policy frameworks, public involvement and awareness, guidelines, standards and objectives, research and development of science and technology solutions as illustrated in Figure 1 below:

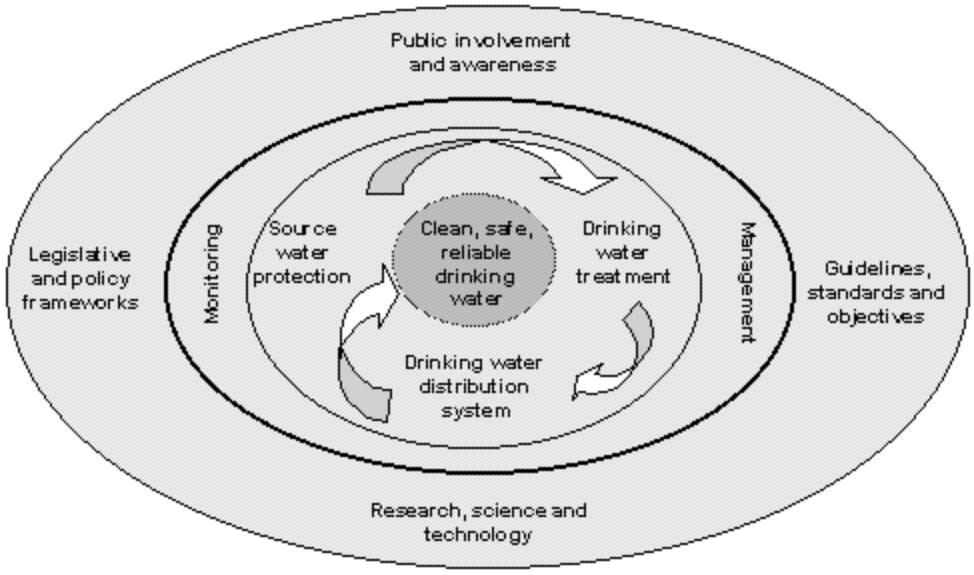

Figure 1: The Multi-barrier Approach

Key components of the three basic elements are as follows:

Source water protection: watershed delineation, inventory of land use and contamination, vulnerability assessment, watershed plan.

Drinking water treatment: treatment systems must be designed based on source water assessments and must consider treatment processes require, treatment components, equipment design, chemicals used, treatment efficiency, monitoring procedures; criteria for design and operation of treatment systems need to be developed; the key to protecting public health remains disinfection.

Drinking water distribution system: must maintain quality of the treated water throughout the distribution system; design and construction must take into account:

- Local or provincial bylaws, best management practices, and regulations
- Prevention of access by wildlife and unauthorized personnel;
- System capacity;
- Emergency water storage;
- Contact time required for disinfection;
- Minimization or elimination of dead ends;
- Cross connection controls; and
- Drinking water materials.

Comprehensive technical supporting documents are under development to provide guidance to authorities in implementing the Source to Tap approach in communities across Canada.

2.3.3 New Brunswick s Drinking Water Protection Programs

Kim Hughes, Director of Sustainable Planning Branch, New Brunswick Environment and Local Government presented New Brunswick s comprehensive approach to protection and management of source drinking water supplies. Key objectives and vision for the department include:

- Healthy environment and strong communities
- Safe drinking water
- Water quality and quantity management
- Integration of land, air and water planning
- Watershed as a basic planning unit
- Coastal zone management
- Comprehensive land use planning
- Air resource management areas

Integrated planning and the multi-barrier approach are key aspects of total quality management of drinking water in New Brunswick. Each aspect of the multi-barrier approach is supported by a regulatory framework.

The source protection component is the cornerstone of the New Brunswick Drinking Water Quality Management Strategy. Regulatory mechanisms provide the basis for implementation of a comprehensive approach to source protection through four program

areas: Water Classification, Watershed Protection, Wellfield Protection, and Water Well Protection.

The *Water Classification Regulation* under the New Brunswick Clean Water Act provides specific designation of surface drinking water supplies, and no land-based activities may degrade water quality in these systems. Water supplies are classified into one of six categories for management. Each class has water quality and aquatic life standards. Classification requires baseline work to be undertaken.

The *Watershed Protection Program* (Watershed Protected Area Designation Order) provides for surface drinking water protection by defining the types of activities that can take place within a watershed. The entire watershed is divided into three management zones, the water, a 75 m buffer, and the rest of the watershed. If a proposed activity is not specifically identified in the Designation Order it is not permitted without a request for exemption.

The *Wellfield Protection Program* (Wellfield Protected Area Designation Order) provides groundwater source protection by defining zones of protection around a wellhead that provides a source of municipal drinking water. As with the Watershed Protection Program, three zones are established for each wellfield based on site specific travel times for contaminants, and activities on lands in the zones are restricted with the goal of protecting the wellfield from potential sources of contamination.

The *Water Well Protection Program* (Water Well Regulation and Potable Water Regulation) provides an approach to managing the water well industry and providing private well owners with information on properly managing their water supply.

Implementation of these initiatives has been supported through new Regional Water Planning Officer positions.

Mr. Hughes concluded by identifying the following key elements of total quality management of drinking water systems:

- Multi-barrier approach is essential
- Source protection remains a cornerstone of New Brunswick s Drinking Water Management Strategy
- Planning drinking water protection objectives can be best achieved with a comprehensive integrated approach
- Co-ordination of science, planning and assessment components is critical
- Outreach and partnering is critical for better management of resources

2.3.4 Quality Indicators for Multiple Barriers: Protecting Public Health

Dr. Judy Isaac-Renton, Professor of Pathology and Laboratory Medicine at University of British Columbia and Director of Laboratory Services at British Columbia Centre for Disease Control discussed the need to apply quality indicators at each stage of a multi-barrier framework. Dr. Isaac-Renton described laboratory and non-laboratory based

quality indicators as the *Check* in the *Plan, Do, Check, Act* sequence of quality management.

Dr. Isaac-Renton proposed that while some tools (such as results from drinking water testing laboratories) are applied across the barriers, specific quality measures vary with each barrier, possibly from water system to water system. The following quality indicators were identified:

- Source protection: indicators may include a process for evaluation of the ongoing success of an integrated watershed management plan. Other watershed based indicators include surveillance of land usage impacts, monitoring for extreme weather events, raw water specific pathogens and microbial load (and host source) monitoring.
- New developments include remote biosensing linked to electronic public health and consumer alerts.
- Closer to the tap: ongoing evaluation of treatment equipment operation, operator competency monitoring and consumer education and feedback.

Dr. Isaac-Renton emphasized that the critical role played by laboratories in all steps of a quality indicator chain must not be underestimated; results must be reliable and reported in a timely fashion. Enhanced Quality Assurance, particularly a rigorous microbiology program (peer review and educational), is critical.

2.3.5 The Importance of Robustness in Drinking Water Systems

Dr. Peter Huck, Professor and NSERC Chairholder in Water Treatment at the University of Waterloo presented the concept of robustness and its application to understanding the Walkerton and North Battleford outbreaks.

Robustness is an extension of the multiple barrier concept. The five elements of providing safe drinking water are:

- start with the best possible sources
- design adequate treatment and operate it adequately on a day to day basis
- make sure the distribution system is secure
- conduct appropriate monitoring
- respond appropriately to an adverse monitoring result

This assumes that there is an appropriate regulatory framework in place and a supportive corporate culture. A robust system is one that gives excellent performance under normal conditions and deviates minimally from this when challenged. The system needs to have an overall level of robustness, but there has to be a certain minimum level of robustness for each element in the system. There can be tradeoffs, for example ground water sources under minimal influences of surface water may require less robust treatment and less robust monitoring programs. Robustness is a well established concept that can be used in the water industry to improve system performance.

Dr. Huck provided an assessment of the relative importance of robustness across the five elements of the multi-barrier approach (darker shading = greater important):

Table 3: The Aspects of Robustness — Relative Importance

Element	Technical Aspects	Institutional Support	Human Aspects
Source			
Treatment-Design			
Treatment — Operation			
Distribution			
Monitoring			
Response			

Dr. Huck offered the following recommendations for enhancing robustness in drinking water systems:

- make the initial focus on treatment, monitoring and response
- source protection issues are important, but can not provide public health protection in the short term
- distribution is important but can not counter the effects of inadequate treatment
- the risk depends on raw water quality
- we need to find a way to quantify robustness of sources, treatment operations and institutional and human elements

Dr. Huck described the failures associated with the North Battleford and Walkerton incidents in terms of robustness of systems. This provide as a qualitative way of identifying weaknesses that can be used in the assessment of other drinking water systems.

Table 4: Robustness of North Battleford and Walkerton Systems

Element	North Battleford	Walkerton	
		Then	Now
Source	LOW (surface water, sewage plant upstream)	LOW (3 wells, potentially all vulnerable to surface water contamination)	HIGH (the least vulnerable well remains in service, one new well added nearby)
Treatment	MODERATE (skill required)	LOW (chlorination only, low dose and contact time, even proper chlorination would not have handled Cryptosporidium)	VERY HIGH Improved chlorination plus membrane filtration (absolute barrier to bacteria, Giardia and Cryptosporidium)
Distribution		LOW TO MODERATE Low to very low disinfectant residuals	MODERATE TO HIGH Higher residuals, partial pipe replacement
Monitoring	LOW	LOW Not continuous, problems identified by Inquiry	HIGH Continuous (real time)
Response	LOW	LOW	HIGH New instrumentation, training, new corporate culture

Dr. Huck identified the following non-sustainable elements of current practice:

- The management culture is not sustainable. There needs to be a way in which people become internally motivated to do what needs to be done and be rewarded appropriately.

- The knowledge levels within the system are not sustainable, both at the operator level and at the level of staff and management (there are notable exceptions)

- The regulatory environment is not sustainable. There is a need to move to an internally driven quality management approach rather than an approach where we simply meet standards that may be out of date.

- Funding levels are not sustainable. There has to be greater funding provided.

- Consumption has to be reduced, and that will be a function of pricing.

Dr. Huck concluded that the robustness of water treatment systems is increasingly important. Robustness can be used to qualitatively examine incidents and identify non-robust systems so that improvements can be made. Further work is required to bring human and institutional elements into the robustness framework.

2.4 Strategies for Total Quality Management

Dr. Michele Pr vost, NSERC Industrial Chair on Drinking Water and Professor of Civil Engineering at Ecole Polytechnic de Montreal, discussed the components of safe drinking water production. She noted the importance of shifting the focus of water quality efforts from drinking water treatment to a multi-barrier approach that encompasses source, treatment and distribution systems and includes quality operations. The following key elements to ensure the safe production of drinking water were identified:

- **Standards and enforcement**. This includes revised standards for water quality, operations, materials and chemicals, and testing/certification of technologies. Standards should be based on sound science, risk analysis and, to a reasonable degree, on the principle of precaution.
- **Best source water and source protection**. Source protection is essential to maintaining high quality source water. Watershed management programs are desirable.
- **Appropriate technologies**. The most appropriate technology to address the level of risk should be implemented, rather than best available technology. Technologies should be cost effective, flexible, reliable and robust to adapt to changes in water quality or in regulations. The benefits and appropriateness of technologies must be evaluated within a global and more complex context from source water to tap. Disinfection remains the major objective of treatment in most cases, but it is not the sole objective. The removal of hardness, particles, disinfection-by-product precursors, NOM, color, iron, manganese, taste and odor, trace contaminants, etc. must also be considered when selecting the best treatment solutions.
- **Best disinfection strategy**. All chemical disinfectants produce undesirable by-products that must be minimized to lower long-term risk while providing immediate disinfection and other water quality benefits. The current regulations in Canada only limit the formation of chlorination by-products, creating a regulatory void that may cause undesirable shifts from one oxidant to another.

- **Distribution**. Distribution system integrity and disinfectant residual maintenance are integral parts of a comprehensive and efficient disinfection strategy. The perception that pressurized systems are resistant to contamination has been challenged by recent scientific evidence and by outbreaks related to ingress in distribution systems. Corrosion control, flow distribution, maintenance procedures to prevent ingress and proper quality control procedures for system replacement to avoid contamination are real problems in aging distribution systems.
- **Quality Operations**. Quality operations are central to risk control. Certification, continuous training and quality control procedures are essential. Several models have been applied including ISO 9002, ISO 14001, ISO/TS/P 194, AWWA QualServe and HACCP.
- **Monitoring**. Proper monitoring should embrace the HACCP approach and on line measurements with real time feedback loops. Investments are needed in molecular based detection methods and low cost on line reliable indicators. The challenge is that better detection will increase public concern.
- **Research and Development**. An ongoing program of research is required for methods development, optimization of processes, identify innovative technologies, investigate safe operations, quantify/mitigate emerging risks (new pathogens & chemicals, global warming, etc.

Dr. Pr vost provided the following concluding observations:

- Drinking water frameworks must include some level of watershed management.
- Regulations must address Cryptosporidium and full range of DBP — turbidity for conventional.
- Affordable adequate treatment is based on quality operations.
- New technologies offer outstanding barriers to microbials.
- Federal government must play its role to avoid duplication of effort and wasting of scarce resources. This includes the setting of standards, total quality management approaches and certification of new technologies.

Adel Shalaby of Health Canada[6] described the following key elements of an integrated approach to drinking water management based on lessons learned from Walkerton, North Battleford, expert discussions and best practice exchanges.

1. **Watershed Management.** Coherent, integrated watershed-based source protection cuts across previously perceived jurisdictional boundaries and relies on the establishment of common goals among stakeholders including individuals, industry, commerce, agriculture, municipalities and regulators**.**

2. **Treatment and Distribution** Treatment and distribution technologies and innovation must be widely shared and vetted with a view to economic

[6] Views expressed are those of the authors and do not necessarily represent the views of Health Canada. The material in this section is based on Shalaby, A., Beattie, T., and Plant, R. 2002. Towards a New Frontier in the Protection of Drinking Water. Paper presented at the NERAM Conference on Drinking Water Safety: A Total Quality Management Approach. September 23- 25, 2002. Ottawa, ON.

sustainability and reliability. Aging infrastructure and a relatively under-priced resource present a challenge. Awareness of current and latent health risks associated with treatment technologies should drive innovation in this sector. Collaborative partnerships are required to merge technical expertise, health and science-based knowledge of risk management, and economic considerations.

3. **Organizational Quality Management Systems.** The Walkerton and North Battleford inquiries demonstrate that formalized organizational quality management systems must evolve within the drinking water industry. Just as the safety of the food supply is supported by the globally recognized Hazard Analysis and Critical Control Point (HACCP) quality framework, the provision of drinking water would benefit from a universal quality model capable of validating activities ranging from organizational commitment to the procedural reduction or elimination of risks. The water industry associations (e.g. the Canadian Water and Waste Water Association and its provincial organizations) are in a key position to play a role in the adoption and implementation of comprehensive quality models. A national strategic approach for safe drinking water would rely heavily on diverse partnerships that could validate a Canadian approach to the Total Quality Management of drinking water.

4. **Monitoring, Reporting, Inspection.** These activities have been reaffirmed as an important layer of verification for drinking water systems as breakdowns in the flow of information and the verification of processes and practices have contributed to recent failings. Information sharing and innovation in the delivery of inspection and monitoring are crucial components of a safe drinking water system. Creative solutions are required support smaller, remote communities spread across a vast geography.

5. **Governance.** Governance must be based on a regulatory regime that establishes clear roles and responsibilities and clearly sets out the accountabilities. Renewed frameworks which promote principles that are science-based, set achievable standards, and are developed through risk management will allow the overall governance function to improve.

6. **Communication.** The recent water tragedies have confirmed that communications, emergency preparedness, and contingency planning were not well developed. A co-ordinated emergency response strategy should be developed collaboratively to identify clear roles and interrelated response mechanisms. Broad based communication of water quality and awareness information to restore public confidence in drinking water should be a significant area of communication activity.

7. **Research and Development.** A substantial federal role is in research and development. A strengthened level of support in this area will be essential to understand emerging pathogens and risks posed by treatment methods or materials which come into contact with drinking water and to develop methods to

reliably serve the monitoring and testing requirements of small communities. In the interests of source water protection and the protection of public health, new solutions must be found to more adequately treat wastewater. Research in the social sciences could enhance the implementation and achievement of total quality management within organizations.

8. **Partnership Building.** An increased standard of care in the management and provision of drinking water requires all stakeholders to form effective partnerships that facilitate the implementation of science-based policies guided by risk-managed practices, comprehensive governance structures, and continuous improvement of organizations. Federal departments and agencies involved directly or indirectly in activities related to the provision of drinking water are collaborating to generate coherent drinking water management practices. A key Federal challenge lies in establishing a mechanism which brings the principles learned from the Walkerton and North Battleford inquiries to the benefit of all Canadian.

2.5 Perspectives of Water Utility Services

2.5.1 Key Elements for Excellent Performance of Water Systems

Dr. Les Gammie, Director of Quality Assurance, EPCOR Water Services provided a water industry viewpoint on key elements for excellent performance of water systems.

Attitude/Culture

- Work to improve the overall attitude/culture to aim for excellent performance
- Need everyone to buy into the importance of high quality drinking water
- Highlight the fact that a safe drinking water supply is a critical public health protection service
- Get away from the attitude that meeting the regulations is enough
- Get rid of the attitude if its not regulated, we don t have to do it
- Need to overcome complacency about the adequacy of the system if nothing is visibly wrong
- Buy into water that is better than it has to be
- Benchmark against leading industry standards
- Encourage external audits to find problems (auditors need to be skilled) (e.g. QualServe)
- Set internal operating guidelines much tighter than current regulations
- Encourage ongoing optimization of processes, and continuous improvement
- Important to get this culture message across to utility managers, utility staff, but also to municipal administrators, and to regulators
- Utility managers need to lead this by example
- Municipal administrators/councilors need to believe in this to authorize budgets/improvements

- Need to get this message out repeatedly and continuously (from all major stakeholders)

Water Utility Operations

- Design plants for peak quality load conditions
- Know how to deal with peak loads, and extreme conditions
- Monitor raw water for critical parameters
- Investigate watershed for contaminants
- Use Multiple-barrier treatment (don t rely on one process)
- Talk to local Health Authority about waterborne disease cases and surveillance programs
- Set tight internal operating standards (lower than regulations), and act on those limits
- Run plants to obtain a continuous stable effluent (no spikes, no variations)
- Continuous monitoring for turbidity on all filters (catch the maximums, look at the variability)
- Use online particle counters to optimize filters below 0.1 NTU
- Filter-to-waste on all filters for startup
- Bypass water to waste it if is not acceptable
- Backup or multiple online monitors for critical parameters (chlorine residual)
- No recycling of filter backwash wastewater without additional treatment
- Continuous optimization of plant processes (turbidity, particles, colour, odour, TOC removal)
- Emergency plans in place for all (?) contingencies (Health Dept contacts in place for Boil Water plans)
- Use NSF approved chemicals and materials only
- Hydrant flushing programs in place for whole distribution system
- Minimize or flush dead ends in system
- Watermain replacement program for mainbreaks and water quality problem areas
- Program to clean water reservoirs regularly (e.g. a 5 year cycle)
- All operators certified, plus take ongoing training
- Internal training manuals should be developed for all operational procedures

Operations — Remote

- Smaller facilities — manned 8-hr days/5-day weeks
- Put online continuous (24-hr) monitors in place
- SCADA Data linked by internet to a central control site (24-hr) which can monitor status
- Night alarms handled by central site support staff, page operator for local control if necessary
- Central support staff available for operations, maintenance, lab/QA assistance and audits
- Support can be provided by regulators, larger utilities, or grouping of smaller utilities

Monitoring

- Continuous monitoring for critical parameters
- Adequate monitoring to characterize water quality
- Monitor during events (runoff, heavy rain, spills)
- Tracking of historical trends in a SCADA system
- Backup/multiple monitors for critical parameters
- Validation of monitor performance (error, drift)
- Monitor corrosion potential of treated water
- Sampling plan for plants and distribution system
- Sample reservoirs, deadends, complaints, after mainbreak repairs (4 samples a month not enough)
- Investigate complaints, and check quality
- Report all parameters to regulatory authority (immediate notification for violations)
- Provide results to customers regularly (website, or by mail, to public library, or newspapers)

Lab Data, Quality Assurance

- Lab to be CAEAL accredited (internal/external)
- Operators bench data — full QA program (methods, calibration, standards, audits, troubleshooting)
- Online data — full QA, checked against bench instruments, cleaned/calibrated regularly
- Very important for operator s regulated reporting to be QA d — chlorine, turbidity, fluoride
- Actions in place for non-compliant results
- Grab samples or backups if unit out of compliance
- Test external performance standards

Dr. Gammie noted that in Alberta filtration/disinfection for all surface water plants has been in place for more than 14 years and have been practiced in the major cities for more than 60 years. Operator certification has been a requirement for more than 19 years. Revisions to Alberta Standards & Guidelines for Water &Wastewater are expected this year. A Lab Data Quality Assurance Policy was issued in 2001. A public website for all utility water quality data will be in place by year end 2002. A Water for Life consultation process has been set up to look at water supply, quality, watershed planning, allocations, and sustainable ecosystems (draft plan by Dec. 2002).

Dr. Gammie concluded by identifying the following most pressing needs for improving water system safety:

- Develop the Total Quality Management Plan
- Define optimum governance for the system

- Have a Plan endorsed by Health Canada, Environment Canada , then the Provinces
- Set provincial regulations in tune with the Plan
- Sell the culture of operational excellence
- Fund needed improvements (full cost accounting)
- Develop support mechanisms for smaller utilities

2.5.2 Infrastructure Considerations

Carl Yates, General Manager of Halifax Regional Water Commission, focused on infrastructure implications of drinking water safety. Infrastructure includes the watershed, treatment plant(s), transmission and distribution system — everything from source to tap. Infrastructure condition is impacted by several factors including age, size, material, bedding, subsurface conditions, soil and groundwater chemistry, and linings. The bottom line is that we have to know the condition of the infrastructure before we propose how to manage it. Infrastructure condition is influenced by changing water quality standards, new material standards, consumer concerns and expectations of service levels.

Mr. Yates proposed the following key actions to improve water quality:

- Live the multiple barrier approach
- Assess the vulnerabilities and contributions from each barrier to protect public health
- Prioritize needs to make the best value improvements
- Consider the symbiotic relationships between source, treatment plant and distribution system

In terms of the specific elements of the Multibarrier Approach the following actions were recommended:

Watershed Protection

- Buy, hold and prosper (capital investments in land where practical
- Watershed based planning
- Regulations or by-laws to designate watershed as a protected area
- Active watershed management (hire a watershed manager and foster partnerships)

Treatment Plants

- If you have a surface water source, get on with building a filtration plant
- If you have a filtration plant, optimize and enhance it to meet future requirements (be proactive)
- If you have a groundwater source, options are available (protect the aquifer and/or build a plant)

Transmission and Distribution System

- Maintain, renew or rehabilitate (it is not just an economic analysis of direct costs)
- We need to develop better in-situ diagnostic tools
- Consider Trenchless Technology (e.g. cleaning and lining or structural lining)
- Adopt water leakage strategies
- Leakage management has four strategic fronts: active leak detection, speed and quality of repairs, pipe and asset management, pressure management
- Instrumentation and monitoring; SCADA has so much to offer
- Cross connection control program

Common Issues

- Adopt best practices without reinventing the wheel
- Invest in employee training
- Create a continuous improvement culture
- Measure what s important; reward what you measure

2.5.3 Practical Considerations and Implementation Challenges

Mike Murray, Commissioner of Transportation and Environmental Services with the Regional Municipality of Waterloo, provided an overview of practical considerations and implementation challenges to providing safe drinking water.

Water Resources

- Source water quality is highly variable
- Treatment and monitoring requirements vary significantly (groundwater, surface water, groundwater under the influence of surface of water, rural, urban and industrialized areas)
- Post-Walkerton regulatory requirements for daily colour and temperature monitoring in groundwater wells did not increase health protection

Technology

- Treatment, instrumentation and controls are evolving and improving
- New technologies (e.g. ozone, membranes) are complex and must be properly designed, operated and maintained
- There are accuracy and reliability issues and operation and maintenance issues (e.g. instrument calibration)
- Regulatory issues concerning what constitutes a violation, how to interpret turbidity spikes from continuous on-line monitoring, what to do with the data?
- Lead time is significant, especially for major capital works
- We need to look at what is appropriate for small systems

People

- Overall lack of skilled/trained/experienced people
- Some operators have outdated training and outdated skills

- Small systems lack resources at a technical, managerial level, financial issues, operational issues
- People will make mistakes — important to design for this in management and technical systems
- Operational and professional staff are under a high level of scrutiny, potentially leading to stress/burnout
- People and technical systems need to be robust incorporating multiple barriers and various checks and bullets
- Need careful training/recertification program to maintain current staff
- Need better job of training and mentoring water professionals
- Need special arrangements for small systems (sharing specialist expertise?)

Financing

- Significant costs to upgrade systems — capital; O&M
- Competition for scarce public funds, especially in municipalities
- Need user-pay; full-cost recovery
- Public is willing to pay for good value
- Significant rate increases have occurred (e.g. Toronto, Hamilton, Ottawa 10 to 15% increases) and will continue
- Small systems lack resources

Politics

- Aggressive provincial regulation and enforcement to rebuild public confidence
- Municipalities want to provide safe water, avoid negative publicity and minimize tax increases. These goals are sometimes in conflict.
- Public opinion polls show that the public is very concerned about drinking water quality and don t necessarily trust governments to protect their interests

Mr. Murray summarized the key issues and challenges faced by the water industry in ensuring safe drinking water:

- Changes need to be pragmatic, recognizing and addressing root causes of problems rather than knee jerk reactions
- Challenge is to rebuild public confidence
- There is a shared responsibility and shared goal among consultants, municipal utilities, regulators, scientists to ensure safe drinking water now and in the future

3 Priorities for Drinking Water Safety

3.1 Process for Identifying Collective Expert Opinion on Priorities

Prior to the conference, participants received a discussion document which provided a structured basis and a starting point for the break-out session discussions and the recording of expert opinions on the most pressing issues to be faced to ensure safe drinking water in Canada. The discussion document organized the recommendations of the Walkerton Inquiry and the North Battleford Saskatchewn Inquiry into seven main topic areas: Governance and Oversight, Quality Control and Assurance, Human Resources, Water Sources, Emerging Threats, Best Practice and Research, and Innovation. Participants were assigned to one of three break out groups to ensure that the issues discussed would reflect a diverse range of interests and points of view. Delegates were permitted to switch group assignments upon request.

Break out group discussions were held on the afternoon of Day 2 (150 mins) and the morning of Day 3 (75 mins). The task for the first break out session was to identify 3 or 4 priority actions pertaining to the assigned discussion theme. Rapporteurs reported the findings in plenary session the following morning. On Day 3 delegates considered the range of proposed priorities from all of the seven areas and were asked to identify the top 3 or 4 priority actions for ensuring safe drinking water in Canada. A handout was provided which summarized the rapporteur reports from Day 2. Rapporteurs presented the collective opinions of the groups in plenary session. Delegates were encouraged to bring forward any points missed by the rapporteurs and express minority viewpoints. Following the rapporteur reports, the final Session Chair, Dr. Peter Huck, identified an initial set of common themes and invited other comments and viewpoints from the floor. The rapporteur presentations were recorded on audiocassette and presentation overheads were provided to the conference organizers as a record of the discussions. The results were synthesized into a draft conference statement for review and comments by the conference planning committee. The initial version was revised considering the planning committee comments and suggestions and a revised draft was circulated to the conference delegates for approval. The final conference statement identifying priorities for drinking water safety in Canada is provided in the following section. Transcripts and overheads from the three rapporteurs' presentations are provided in Appendix A. The list of conference participants is provided in Appendix B.

3.2 Conference Statement on Priorities for Drinking Water Safety in Canada

DRINKING WATER SAFETY CONFERENCE: A TOTAL QUALITY MANAGEMENT APPROACH

International Conference on Water and Health

September 23-25, 2002.

CONFERENCE STATEMENT

A Conference on Drinking Water Safety: A Total Quality Management Approach was convened by the Network for Environmental Risk Assessment and Management (NERAM) on September 23-25, 2002 to review best practice in drinking water systems safety and identify priority actions to ensure safe drinking water in Canada. The conference was attended by more than 150 delegates representing, in order of number of attendees, federal and provincial governments, water quality scientists, municipal water service representatives and their private sector suppliers, and public interest groups. Delegates considered current information on drinking water protection such as: i) the recommendations of the Walkerton and North Battleford inquiries; ii) the multi-barrier approach to safe drinking water including the Canadian source to tap guidance document developed by the Federal-Provincial-Territorial Subcommittee on Drinking Water and the Canadian Council of Ministers of the Environment s Water Quality Task Group; iii) the Australian drinking water quality management framework; and iv) perspectives of

scientists, regulators, operators and suppliers concerning key measures to ensure robustness in drinking water management systems.

As governed by an appropriate regulatory framework, the reliable provision of safe drinking water requires using the best possible source, designing and operating appropriate treatment facilities, providing secure distribution, conducting appropriate monitoring, and responding in an appropriate and timely manner to adverse monitoring results. Thus mechanical, human and institutional elements (including an appropriate knowledge base) of drinking water systems are all important. The objective of the conference was to consider these elements and identify priority actions to improve drinking water safety in Canada. The following four priority actions reflect the results of the final plenary session in which the rapporteurs from the three break-out groups reported the results of their group deliberations. This was followed by plenary discussion to identify key areas for action. The recommendations include long-term initiatives as well as short-term actions to improve the safety of drinking water systems. It is critical that efforts to implement both the long-term and short-term actions be initiated in parallel and begin immediately.

Recommendation 1: It is essential to develop and implement a National comprehensive, risk-based framework for total quality management of drinking water across Canada. The Framework should be developed through a consultative, collaborative process involving all levels of government, water suppliers/operators and industry organizations (CWWA)

and the public.[7] The Framework should be adopted across Canada, and include legislative tools to ensure that it is uniformly enforced to provide equal access to safe drinking water for all Canadians.

Recommendation 2: It is essential to adopt an integrated, ecosystem-based, watershed management approach within the National water quality management framework for effective source protection. The definition of watershed includes surface water, groundwater and recharge areas. Water conservation measures should be included as a key aspect of watershed management. Provincial legislation is required to encourage and support watershed-based source management protection across Canada.

Recommendation 3: There is a need to immediately improve the robustness of existing systems through the enforcement of existing standards, mobilization of existing expertise, and implementation of best practice for total quality operation of drinking water systems. The most critical immediate needs are within small systems in Canada, and therefore there is a need to increase support for small systems through partnerships, aggregation of systems, and shared expertise. Best practice includes:

- adaptive and vigilant monitoring of disinfectant residuals, turbidity and, if possible, particle counts;
- organizational systems which are able to rapidly respond to adverse monitoring results;

[7] Agreement was not reached on a recommended mechanism for undertaking this effort. In plenary, several delegates emphasized the need for Federal leadership in developing the Framework. Others disagreed with this view, in favour of an equal partnership among stakeholders.

- continued development of methods and technology for treatment, monitoring and management of systems.

It is critical that the Federal government and provinces ensure that effective mechanisms are in place for consistent implementation of best practice.

Recommendation 4: Continued support for research and development is essential for effective water quality management. This includes:

- the collection of baseline data (operational and financial) to identify vulnerabilities and measure performance of drinking water systems;
- the collection of data for risk assessment at the watershed level;
- the development of methods and technology for water treatment and distribution;
- optimization of management systems; and
- quantification and mitigation (where necessary) of emerging risks.

4 REFERENCES

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APPENDIX A Rapporteur presentations

Group 1 Rapporteur Presentation Overhead

National Consultative/Multistakeholder Forum New or Evolve?
Establish Framework — Risk Based

Short Term Improve Robustness Via Enforcing Compliance Duty of Care +
Mobilize Existing Expertise i.e. CWWA

Long Term — Walkerton, TQM
Source Water
Coherence

Group 2 Rapporteur Presentation Overhead

The group convened to identify priority recommendations for source water protection and managing emerging threats. The components of Source Water Protection as defined in Figure 3 of pg. 70 and the Threats to Water Sources , Figure 4 (pg. 71) of the Program Guide were discussed.

The group selected the following four priorities for source water protection and for the management of emerging threats to water sources.

In all cases, it was decided that:

> IT IS ESSENTIAL TO ADOPT AN INTEGRATED ECOSYSTEM BASED WATERSHED MANAGEMENT APPROACH FOR EFFECTIVE SOURCE PROTECTION AND CONSERVATION. THE DEFINITION OF WATERSHED INCLUDES SURFACE WATER, GROUNDWATER AND RECHARGE AREAS. This supports Walkerton Inquiry Recommendation S1.

1. ADEQUATE SCIENTIFIC DATA IS ESSENTIAL TO SUCCESSFUL SOURCE WATER PROTECTION. THE CAPACITY AND CHARACTERISTICS OF WATERSHED MUST BE BASED ON FACTUAL, SCIENTIFIC DATA. THIS MUST BE IN PLACE BEFORE EFFECTIVE WATERSHED PLANNING AND MANAGEMENT CAN BE ACHIEVED.

2. ALL LEVELS OF GOVERNMENT, PARTICULARLY AT THE FEDERAL LEVEL (ENVIRONMENT CANADA, HEALTH CANADA, AGRICULTURE CANADA) AND STAKEHOLDERS MUST BE COMMITTED TO SOURCE PROTECTION. LEGISLATIVE TOOLS MUST BE IN PLACE TO ACHIEVE EFFECTIVE WATERSHED MANAGEMENT IN EVERY PROVINCE. THERE IS A NEED FOR AN ANNUAL REPORT CARD ON THE STATUS OF WATERSHED MANAGEMENT.

3. RISK ASSESSMENT IS ESSENTIAL FOR EFFECTIVE WATERSHED MANAGEMENT. PROTOCOLS AND MODELS EXIST FOR THIS PROCESS TO

BE INITIATED. HOWEVER, THERE IS A LACK OF DATA IN MANY CIRCUMSTANCES, AND THEREFORE IT IS IMPERATIVE THAT WATERSHED CHARACTERIZATION AND DELINEATION BE ACCOMPLISHED FIRST. This supports Walkerton Inquiry Recommendation P3.

4. IT IS NECESSARY TO CREATE AND IMPLEMENT ADAPTIVE MONITORING (PHYSICAL, CHEMICAL, BIOLOGICAL, SOCIAL) AND MANAGEMENT SYSTEMS THAT WILL DETECT AND RESPOND TO EMERGING THREATS. THESE SYSTEMS WILL ONLY BE EFFECTIVE IF THEY ARE DEVELOPED WITH COMMUNITY AND STAKEHOLDER INVOLVEMENT AND BUY-IN. This supports Walkerton Inquiry Recommendation T1.

Group 3 Rapporteur Presentation Overhead

1. Develop and implement a risk-based watershed management approach including all stakeholders
    - Goal of source water protection
    - Include surface and groundwater
    - Assess key water quality degraders
    - Proactive approach

2. Implement best practice for monitoring drinking water systems, reporting and assessing date
    - Establish stable system performance
    - Operating continuously where possible (e.g. Turbidity and chlorine residual)
    - Includes QA of product and of process
    - Harmonized reporting formats
    - Regulator to assess incoming data — needs resources
    - Requires increased support for smaller systems (e.g. Through partnerships, aggregation and shared resources)

3. Responsible authorities to implement BMP for controlling key performance in indicators
    - Turbidity
    - Parasites
    - Future indicators

Transcript of the Concluding Session Break-out Group Rapporteur Reports and Delegates Comments — Wednesday September 25, 2002 11:45 — 12:30 pm

Group 2 Report presentation by Grahame Farquhar, Canadian Water Network

Group 2 reconvened as requested and charged but found it very difficult to deviate from its mandate of the previous day and while it considered options that were proposed to look at all the Walkerton recommendations, it after doing so in a cursory fashion decided that the recommendations that it had landed on yesterday were pretty much the ones that it wanted to speak to again today. We thought about our recommendations and attempted to address the comments that were offered for them and we changed the wording of them a little bit I m sure that you can t read it and I apologize for that but we still believe that it is essential to adopt an integrated ecosystem watershed based management approach for effective source protection and conservation. We think that that s absolutely essential and that definition includes surface water, groundwater and recharge. This very much supports Walkerton Inquiry recommendation S1. We feel in order to carry that out, the next three actions should be undertaken. The first one is quite similar to the manner in which it was originally constituted. Adequate scientific data is essential to successful source water protection. Capacity and the characteristics of the watershed must be based on factual scientific data and we strongly adhere to that. This must be in place before effective planning and management can be achieved. We recognize that watersheds do have plans, many of them now, but it is not a process that s in stasis its one that is going on and without adequate scientific direction it is difficult to make progress.

The number two bullet was our number three one previously but we stress the importance again of all levels, particularly Federal, and we followed along the comments that came from Michele Prevost and others who said that we really do need guidance and leadership from the Federal government, that support at that level is essential in order for us to carry out adequate source protection. We retained the concept that the legislative tools must be in place to achieve it. We very much endorse the concept that watershed based planning and source protection must be done. We acknowledge that not all watersheds have functional authorities, whatever their title must be, and we agree that that is the place to start. The enabling legislation must be there to encourage and support watershed-based activities to take place if they are going to happen at all. Ministries of the Environment or their equivalents in provinces where the legislation mostly lies and control authority lies must be mandated to review and perhaps to approve source water protection plans. One member of the group suggested and we agreed that some sort of an annual report card is going to be required to make sure that the plans are up to date and the procedures going on within the watershed are effective.

Our third bullet again addresses risk assessment and this supports Walkerton recommendation P3. We modified it to recognize as some of you have told us that the tools and the protocols for risk assessment are there. We can begin that process within

watersheds because we know a lot of what needs to be done. But we link back to point number one that without adequate scientific data it will be difficult to achieve effective risk assessment and risk management. We link that back to point number one. It does indeed support the Walkerton Inquiry recommendation. All of that leads to the business of watershed based source management protection.

The fourth bullet supports Walkerton Inquiry recommendation T1. We looked at the information that was presented to us in the document. We could not take umbrance with any of the hazards that were identified them. We tried to prioritize them, are endocrine disruptors the most importance thing? but we really couldn t come down on anything there. What we really need to plan for now and implement are adaptive monitoring systems. By monitoring we are not just talking about the physical, chemical and biological world, but also the social world within our communities. Management systems that will detect and respond to these emerging threats, we don t know what they are, we saw with Michele Provost that if we use the traditional techniques to measure pathogens or pathogen indicators in water quality we get a certain set of low numbers in the data that she presented, but in fact there is foggy information in the back that indicates other microbial activity and that has given rise only because there are more sophisticated tools and techniques that are emerging as we speak. Somehow we need to have in place systems that are vigilant, systems that are flexible, systems that recognize that things are changing in the world of hazards. We need to be cognizant of that and some sort of a system needs to be in place. In order to do this, the only way to get it done is to have community and stakeholder buy-in.

We re saying in our comments here that recommendation S1 the business of source water protection, recommendation P3 to put in place a risk assessment- risk management system and recommendation T1 the business of being alert to emerging hazards are things that we think are activities that require action. Thank you.

Group 1 report presentation by Jane Inch, Environment Canada

We do have some consistency and interlinking of the recommendations here. Our group was back up at a broader level. The first recommendation we had was that yes we do indeed need a National forum, a National body that s multi-stakeholder, that s consultative that will establish a framework, a risk-based framework, that can be used to carry on the recommendations of Walkerton to fully set up principles for total quality management. That was a very broad-based statement and there was a lack of agreement on whether this could evolve from the existing structures or whether we need a totally new body and secretariat, but there was clear agreement that we needed something that had those characteristics. We recognize that it wasn t enough to say something that involved just a governance structure, we really needed to do something in the ground to ensure that the quality was out there right now in the water delivery. So to do that we said that this body should ensure that its first task was to improve the robustness of the systems on the ground. We looked at why hasn t this happened already, what are any new drivers that could be used to do that and we said well we do have mechanisms, we re just not enforcing them. We really do need to enforce the existing standards and to impose

that duty of care on decision-makers. That s a big stick to do, and it perhaps can impose a very demanding burden so we recognize that in conjunction with that, we need to mobilize the existing expertise that s out there that right now isn t shared. Perhaps the Canadian Wastewater Association, but certainly through a co-ordinated mechanism in a National manner. We tried to look at both long-term, consistent standards, consistent frameworks and also the need to do something right now to help out with quality. Other notes we had, in the long term this is where we see the source water protection issue fitting in, that that s part of the national framework. We ve had lots of detail on how to do that coming from the other group. Overall what we re striving for is more coherence in management for better quality delivery. It was very interesting in our group we had differences of opinion, but I think we had civilized disagreements.

Group 3 Report presentation by Stephen Brown, Queen s University

In Group 3 we went through the entire list of topics and tried to pick out three that we could hang our hats on as the priority ones and we ended up coming up with four. We started out with an overall statement that came out of the very first point from Group 1 in yesterdays summary sheet and that is the statement that there should be established an overall National collaborative risk-based management model for safe drinking water in Canada to be adopted by all provinces, territories and other jurisdictions. We pulled that statement together and agreed it was more of a motherhood overall statement so we wanted to put that as an initial statement but then under that have priority goals. We came up with three statements or three priority points. The first to develop and implement a risk-based watershed management approach including all stakeholders. This was our effort to distill almost the entire section from group 2 into a single statement that would cover the most important aspects that we saw in watershed or source water protection. So we have a goal of source water protection as a stated purpose for this risk-based watershed management model including surface and ground water, and we could have added recharge areas as well, to assess key water quality degraders. The point there was that in some watersheds you can find almost point sources that account for most of the difficulties that the watershed might be encountering in others that is not the case. So that should be assessed. And finally that this be a proactive approach, in other words that there be a look ahead function in assessing the watershed and making decisions to preserve that for a long term. So that we thought was the most important of any of the specific items that we could pull out of the summary sheets from yesterday.

The second point is one that came out of our group discussions yesterday and that is to implement best practice for monitoring drinking water systems, reporting, and assessing data. I won t go over the bullets again, you ve seen those on the summary sheets for the first five of them. I will highlight the last one, that s a point that we discussed quite a bit was that one of the problems with risk-assessment based approaches really comes in when you start considering smaller systems. We wanted to highlight that this would require increased support for smaller systems and some of the mechanisms they would have to use are things like partnerships or aggregation of system resources, sharing of resources and so on. We could change monitoring to operating systems, yes that s a fair point.

The third point is to implement best practice for controlling key performance indicators. If you have hot button issues like turbidity, parasites, bug of the week, you need an overall mechanism to cope with those aside from the fact that the specific indicator will change maybe from week to week. (End of tape Next side) That s it. Anything else from the group? So we really actually fairly quickly arrived at a consensus on these as the three topics that specific things that jumped out of that overall statement that we could look at the list and say these three things would be the ones we would tackle first.

Peter Huck - Identification of Common Themes:

In listening to the presentations it seems to me that a couple of key words were common to them all. One was the concept of a risk-based approach. That certainly seemed to be a common thread. Something else was that the approach needs to be very much watershed based. Another thing was that there was a definite need for Federal involvement, not to neglect the involvement of the other levels of government, but that came through very strongly. The other point was the need for adaptive or proactive monitoring and organizational frameworks. So not only is the monitoring able to be ahead of the curve so to speak but also that the organizational framework then is able to deal with the issues that may come up. So those are the commonalities that caught my attention. Are there other commonalities perhaps that I ve missed or maybe some of these aren t as common in other people s views?

Comments from the Floor:

- Peter I might suggest maybe one or two other ones that seem common just listening to it. One is collaborative. I think that s a theme that keeps coming up. There are multistakeholders and multi levels of government and we all have to work on it together. The second one is an acknowledgment that there are some long-term things we need to work on but there are also some short-term things that we can and should do. So an idea of parallel tracks, the quick wins, do things we can do in the short term and initiate the longer-term things that we should be working on.

- While you re jotting things down Peter, I detected a great deal of agreement between groups one and three in the initial need to adopt and identify and move forward with a total comprehensive framework that achieves coherence coast to coast. It is captured but I think perhaps the word comprehensive or total quality management which addresses the entirety of activities that relate directly or indirectly to the provision of water.

- Earlier I heard points saying federal, I thought I was hearing points saying National.

- Federal involvement could bring about National scope.

- Most of the things are this overall framework, I wasn t sure if you were going to get into other things. We certainly believe that finding mechanisms for implementation of

best practice is really critical. The Feds or the provinces or whoever have to come up with models for how they re going to get best practice implemented. Whether its enforcement or regionalization there are a whole lot of ways of doing it but they have to put those on the table and decide how they re actually going to do it. There is information out there on how to do it right now but it is not happening. It s the implementation of best practice that really needs to come to the fore.

- I would like to add the continuing importance of science, not only in understanding watersheds and setting guidelines, practices etc.

- One of the common themes that kept coming up in our group and I think we can t forget particularly in light of Walkerton is that the biggest vulnerabilities and the largest immediate needs are targeted towards small systems and the remoteness aspect which are particular Canadian vulnerabilities.

- One thing which I want to reemphasize although it is hidden in the wording of our group report is that conservation is very strongly linked to water quality in a variety of areas both in the amounts of water and the amount of surge you have to treat. To leave conservation out of our wording and discussions would be a mistake.

- My comment relates to where this report will be going. I think the worse possible thing that could happen would be that it simply goes into a peer reviewed journal. That will ensure that no one pays any attention to it whatsoever and it simply becomes continuing academic discussion. It has to go to decision-makers, it has to go to private sector, it has to go to the community. So perhaps two or three different types of versions including press releases and some sort of advocacy campaign if we want to accomplish anything.

- My issue is that we talk about national policy, but the question is how does the national policy affect the international policy of Canada. In this forum here there is unquestioning support for public ownership of water utilities everywhere, whereas the latest issue of world business council on sustainable development very strongly promotes public-private partnerships for ownership of water utilities in foreign countries. The question is how does Canadian water policy influence international policy on ownership of utilities etc.

- I think something that came up on our group and I think came up in your group as well is the need for some baseline data. What we are really talking about is improving performance and we don t know whether it s better or not unless we know what the baseline is. So we need not just scientific data, but also operational, financial data as well.

- I agree with all the points there except one. We seem to single out the Federal involvement. I d rather see the statement removed and just simply stick with require inputs of collaborative effort from all of the stakeholders.

- I thought what we were talking about is strong Federal leadership in getting this done but that there would be involvement from provincial, industrial academic. We were pushing for strong Federal leadership.

- I wonder if in the desire for leadership people really aren t asking for consistent application and consistent development and if that is a collaborative process or a co-operative process or if a single agency takes the lead and it arrived at that sort of consistent application then that would still be a good thing.

- But we re looking for a National framework, that s the thing.

- I think I heard one of the comments under the National great debate we re having here was that across the country you would have access to equal safe water. So whether you re in Newfoundland or on a First Nation reserve the program would be uniform and National so that it could apply across the country and that all Canadians would have access to safe water. That s what I heard, when they mentioned about having a uniform, national program that was enforced uniformly across the country. I think it s sort of captured there but that s some of the phrasing I heard.

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