The Walkerton Inquiry

Detailed Notes on the Expert Meeting on:

Treatment, Distribution and Monitoring of Drinking Water

May 9-10, 2001
6th Floor Boardroom
123 Edward Street
Toronto, Ontario

Chair: Michéle Prévost

Topics of Discussion:

The Need for Adequate Water Quality Data for Surface and Groundwater Sources
Setting Water Quality Goals and Selection of Adequate Treatment Barriers
Approaches Underlying the Selection of Treatment Barriers
Best Treatment Barriers to Meet Multiple Water Quality Objectives
Trade-off Between Disinfection and Undesirable Disinfection By-products
Tool Box of Technologies
Operation and Monitoring of Treatment Facilities to Minimize Risk of Failure
Safe and Cost Effective Technical Solutions in Small Systems
Distribution Systems
Monitoring
Role of Government in Providing Technology Assistance

The detailed notes for this expert meeting have been prepared to brief the Commissioner and to facilitate participation in Part 2 by those who were not present at the meeting. The notes are intended to represent the major items of discussion and positions put forward by participants. They are based on notes taken by Rapporteurs and are not intended to be an official report or transcript of the meeting. They do not represent the views of the Commissioner.

Meeting Attendees and Affiliation

Chair	Michéle Prévost
Issue Paper Author: University of Ottawa	Ken Roberts
Issue Paper Authors: Delcan	Robert Andrews David M. Bagley Edward Doyle Ron Droste Ron Hofmann Douglas Langley Michael Loudon André Proulx Joe Stephenson Hugh Tracy
Ontario Ministry of the Environment (MOE)	Bill Gregson Jim MacLean Fran Carnerie
Government of Ontario (Smith Lyons)	John Callaghan Jim Ayres
Ministry of Health	Deborah Pieters
Office of the Chief Coroner (OCC)	David Gruber Thomas Wilson
Association of Local Public Health Authorities (ALPHA)	Andrew Papadopoulos
Association of Medical Officers (AMO)	Nicola Crawhall Gail Alleyne
Ontario Society for Professional Engineers (OSPE)	Steve Bonk Bob Goodings Joyce Rowlands
Concerned Walkerton Citizens/ Canadian Environmental Law Association (CELA)	Paul Muldoon Fe de Leon
Ontario Water Works Association/ Ontario Municipal Water Association (OWWA/OMWA)	Joe Castrilli Erika Hargesheimer Rod Holme
Sludgewatch/Issue Paper Author	Maureen Reilly

Member of Public	Henry Malec
Chair, Research Advisory Panel	Harry Swain
Research Advisory Panel Members	William Leiss George Connell Allison McGeer
Inquiry Staff	James Van Loon
Rapporteur Team Leader	Carolyn Johns
Rapporteurs	Rachel Melzer Judith Muncaster

Meeting Summary

The agenda, prepared for the meeting by the Chair and amended to reflect additions proposed by meeting participants, provided the framework for the report. The meeting notes summarize the main points of contention and agreement between the parties under the eleven themes and related questions on the agenda, concluding with a summary of the major points of consensus that emerged from the meeting.

1. The need for adequate water quality data for surface and groundwater sources: There was general agreement on the need to protect source water and to characterize raw water quality, as well as support for new MOE regulations that require monitoring for trends. Discussion focussed on whether the system in place is adequate, and whether regulations or guidelines for raw water are appropriate.

2. Setting water quality goals to ensure the selection of adequate treatment barriers: Ontario must move to continuous improvement systems in water treatment. Simply meeting minimum standards is insufficient, and not all parameters can be regulated (e.g., Cryptosporidium). New MOE standards are recognised as moving in the right direction, requiring source water characterisation and promoting a proactive approach to water safety. Redundancy, which is key to safety, can be achieved through not only infrastructure/design but also by operational approaches. Treatment must go beyond the regulations to address unregulated parameters such as *Cryptosporidium*, but no consensus was reached on how decisions should best be made on unregulated parameters and whether current design approaches were sufficient. Some emerging concerns, such as endocrine disruptors, must be addressed at the stage of source protection rather than only at the treatment stage. Concerns were raised about the ability of small systems to pay the costs of higher water standards. The role of the public in selecting treatments, and the problem of hollow invitations to the public to participate, were also discussed.

3. Approaches underlying the selection of treatment barriers: The focus was on the special needs and challenges faced by small systems, including costs of service and limited capacity to handle emergency situations. A regional water officer, together with one or two technical support staff, modelled on the medical officer of health, was proposed as a resource to small systems. Redundancy, through design or operations (or both), was seen as essential. The significance of combined-sewer overflows as challenges to treatment plants was debated.

4. Framework and methodology to define best treatment barriers to meet multiple water quality objectives: Discussion centred on where expertise/decision-making resides in setting treatment barriers, particularly for unregulated parameters, given the changing roles of the MOE. The MOE's past emphasis on setting design guidelines has shifted to a role of reviewing and approving designs based on achievement of results to meet the new regulations. In addition, a long-term solution to the shortage of qualified engineers in the water business is needed.

5. The trade-off between adequate disinfection and the production of undesirable disinfection by-products (DPBs): Microbials, rather than DBPs, must drive process selection, but DBPs are a real concern. The implications of increased use of bottled water were debated. Trihalomethane (THM), a DBP, is an important long-term concern which every system must address, regardless of regulated levels. There are simple methods (e.g. removal of organic material) for reducing THM, which are not universally applied. *Cryptosporidium*, which chlorination does not inactivate, was also discussed.

6. Tool box of technologies: Conventional treatments can be optimised to address most water quality problems. Source protection, conservation and procedural approaches are also important tools. More support is needed for research and development, and for innovative technologies. Regulations, enforcement, performance-based MOE approvals, potential markets and public concern all drive the development of new technologies. Support for research and development is key to creating new technologies, but Ontario is not seen as supportive of its own technologies. Regulation (and enforcement) drives the demand for new technologies. The role of the MOE approvals, and whether the process is a barrier to innovation, was debated. New modes of designing the treatment plant, such as design-build, has encouraged the use of new technologies - the design engineer is supported by the guarantees of the proprietary equipment supplier.

7. Operation and monitoring of treatment facilities to minimize the risk of failure: Quality management is the key to good efficient operation, which must be driven by senior elected politicians and public servants. This has been seriously lacking in Ontario for many years. Continuous improvement, which requires constant training and upgrading of skills, is a very important component of quality management. There are several programs that could be applied to Ontario, including ISO and Partnership for Safe Drinking Water (U.S. EPA/ AWWA and other Water Associations); however, there is no consensus regarding the most appropriate model. Partnering is generally agreed to be a good option for small communities. Treatment monitoring is very important, but operators must have the appropriate training to use the systems properly. The lack of qualified human resources poses a problem, especially in small communities. In determining monitoring frequency, a key question is "How long can a community tolerate having a failure?" There is general agreement that filter-to-waste is preferable to filter-backwash recycle. Quality programs and MOE requirements for engineers' reports can ensure reviews and audits of treatment facilities. Efficient remedial measures to correct treatment failures may include expert systems, simulators, regional water officer emergency support or partnering.

8. Small and very small systems: Small operations face particular pressures that must be addressed; cost of infrastructure to meet new requirements, and especially limited operational expertise/capacity. Cost may be a significant factor for small systems, but funding should not be in the form of grants which reward systems in financial crisis and penalize others for better planning to meet water costs. Regional water officers and/or other sources of advice, expertise and emergency operational support for small/isolated operations are necessary. Point of use mechanisms could provide a cost effective solution for small and very small systems. It is easier to install the devices in new homes, more difficult in existing ones due to space limitations. Maintenance could be achieved by water main operators who would be trained to do so. There are some associated economic and political issues which must be considered with this option.

9. Distribution systems: Cross connection and back siphoning are key issues that must be managed. Back-flow prevention and air gaps were discussed as part of the solution. There is some contention regarding the use of storage tanks and reservoirs. Most concerns centre on long residence time of treated water, lack of mixing, and freezing, although sound design and well planned operational methods can address these problems. Disinfectant residual maintenance is necessary with special attention to main replacement/repair as a potential site of ingress into the system. Disinfection demand in the distribution system and the level of disinfectant needed, should be stipulated (limited). Jurisdiction is a problem for corrosion control measures, while asset maintenance and sustainable long-term investment is critical.

10. Monitoring to ensure water quality: It was noted that the Inquiry has not commissioned an Issue Paper to deal exclusively with Water Quality Monitoring and there are a number related issues which should be discussed in greater detail or added to the agenda. MOE now requires that all laboratories be accredited. Quality control is necessary for good data. The integrity of monitoring results depends on good calibration, which in many systems is lacking; new regulations and the CAEAL (Canadian Association of Environmental and Analytical Laboratories) can assist in rectifying calibration problems. There is a need to understand the extent of on-line monitoring being done, how it is done and whether it is used effectively to increase water quality. The EU is more progressive that North America in its on-line monitoring policies. Quarterly reporting will make monitoring test data more readily available to the public but information must be understandable, dependable/accurate and useful. Public participation and public access both to expertise and to relevant, accurate information are important. There is lack of consensus regarding the concept of "groundwater under the influence of surface water' in both Ontario and United States. MOE is working to define it and recommend appropriate treatment.

11. The role of government in providing technology assistance: There was no discussion specifically focussing on this topic, although it arose in various contexts throughout the meeting. Political leadership is lacking, which costs Ontario in terms of water quality as well as in economic losses as innovation and technology development-related employment are lost. Political leadership should include political accountability at all levels. There was a consensus that there is a need for more information and a need for more support of new technologies.

Discussion of Substantive Issues

1. THE NEED FOR ADEQUATE QATER QAULITY DATA FOR SURFACE AND GROUNDWATER SOURCES

Source water quality facilitates the economical production and treatment of drinking water and enhances its safety.

1.1 Does the current system provide access to data characterizing the quality of drinking water source water to understand the vulnerability and sensitivity of our drinking water sources? What programs could be considered to increase knowledge of source water quality?

1.1.1 What is the importance of source water data and protection?

- Data needed to track changes in raw water quantity and quality over time. (Delcan; Doyle)
- Data needed to determine treatability, ensure that contaminant parameters are not exceeded (Delcan; Doyle), and know if something goes wrong. Some surveys in place but need sanitary surveys of source waters - surface and groundwater but primarily surface waters. Data needed to design for worst water quality and treatment decisions (Delcan; Proulx)
- Protection is often far cheaper than treatment, e.g. in New York City example (Roberts)

1.1.2 What are the current regulations protecting source water, and is this adequate protection?

- Source water quality is already protected under existing waste water treatment plant (WWTP) regulations that prevent the degradation of water quality (Delcan; Tracy). However, these only cover surface water. Regulations to protect groundwater and wellheads are needed (OSPE; Bonk). Tracy agrees, supports regulations dealing with groundwater infiltration, cites example set by Region of Waterloo. OSPE highlights that small municipalities however require assistance. OWWA/OMWA agrees source water should be protected but through criteria not regulations for raw water quality. OWWA/OMWA cites principles of the Drinking Water Safety Program (DWSP) that include observing trends.
- Ontario regulations are moving in the right direction by requiring data on raw water. The required engineers’ reports on drinking water facilities include a characterization of the raw water. There is also a requirement to periodically monitor raw water quality as part of Engineers' Reports. The European model legislating an integrated water quality approach is where we should be going (Delcan; Doyle)
- Land use planning is key to source protection, and a definition of source protection should include not only MOE regulations, but giving tools to municipalities to protect sources. There is a lack of emphasis on groundwater/ environmental protection in the provincial policy statement guiding municipalities. (Sludgewatch; Reilly)

- Municipalities now have to test for many new parameters, and pesticides in particular are very costly. If the area is not agricultural and for several years no pesticides are detected, allow municipalities to reduce those tests and focus resources elsewhere (AMO; Crawhall). Such provisions, to allow dropping off testing for parameters not seen, were in older drinking water objectives (Roberts) but have since been removed (MOE, AMO).
- There is a need for protection of private systems and rural sources need to be brought into the discussion. Examples; nitrogen should be returned as a parameter; required notice for changes in land use - perhaps under municipal by-laws or EBR process. Statutory provisions for separation distances of biosolid sludges from wells are weakened in practice by allowing a negotiated minimum about 75% below the statutory minimum distance. (Sludgewatch; Reilly)
- Land use tools can be improved and the OWRA has provisions for this. In terms of surface water, the province has done a lot of vulnerability mapping, but recharge areas a long way from aquifer use may not be under the jurisdiction of the affected municipality. (Roberts)

1.1.3 What programs are in place for monitoring and data collection?

- Most monitoring is of surface water to determine trends, not compliance (Roberts). The DWSP was originally designed to get background data and observe trends over time (OWWA/OMWA; Holme) and primarily focuses on treated water rather than source water (Delcan; Proulx).
- The frequency of testing for DWSP has been gradually reduced by the ministry (Delcan; Proulx). This reflects the role of DWSP, which is not a compliance program. It started with more-frequent testing, which was reduced once background data was in place, in order to focus resources on getting more plants into the program (Roberts). However, the shift from testing once a month to twice a year reduces the value of information (Delcan; Proulx)
- Support for DWSP is gradually increasing in scope as communities join the voluntary program, and now covers about 88% of Ontario's population. The MOE analyses about 200 parameters in its labs (Goodings) and DWSP annual reports are available on the MOE website. (MOE; MacLean)
- The Water Well Information System, an MOE registry of private and public wells, is an invaluable resource, with some quality and lots of quantity information, useful for susceptibility mapping (Roberts). The MOE is trying to digitize the information to make it available through Land Information Ontario.
- A new program announced a year ago looks at watersheds, especially in Southern Ontario, to examine quantity and to some extent quality of groundwater sources. We're currently putting over 400 monitors into wells to sample groundwater quality. Conservation Authorities are partners on the operational side, maintaining the network. This information will automatically be captured and sent to an accessible database. (MOE; MacLean)
- Under the Provincial Water Protection Fund there is funding for 35 or 40 municipal studies on groundwater sources, again to be put into the database (MOE; MacLean).

- Although there is no funding from the province to support testing requirements, the regulation is structured around differential testing frequencies for at least some parameters, depending on the size of municipalities and types of waterworks (MOE; MacLean). The Drinking Water Information System is increasing in scope. This voluntary program, covering about 88% of the population , requests municipalities collect the information with some incentives under new regulation.(MOE)

1.1.4 What monitoring programs or policies should be adopted, created or restored?

- The emphasis for many years has been on treatment. Protection of source water and integrity of distribution infrastructure deserve equal attention (OWWA/OMWA; Holme)
- The Drinking Water Monitoring and Compliance Information System is increasing in scope. Regulation 459/00 requires municipalities to test their water and requires laboratories to report the results to the Ministry (MOE).
- Online monitoring for basic parameters would be very helpful (OWWA/OMWA; Hargesheimer)
- Small/isolated communities need provincial support for source quality surveys (OSPE; Bonk)
- Programs for monitoring should be designed to reflect the priorities of the region (AMO; Crawhall, Delcan; Droste). If a contaminant level is near the allowable threshold, higher sampling frequency is needed. People are not prone to report undesirable activities, so monitoring needs to be intelligent (Delcan; Droste)
- For rural well protection, MOE and health units should cooperate to guide well owners in understanding their source water quality and choosing appropriate treatment options. Free testing no longer includes nitrogen, which test should be reinstated because of concerns around nitrates. OMAFRA [Ontario Ministry of Agriculture, Farming and Rural Affairs] baseline well test program provides inexpensive, fairly comprehensive tests. Confidentiality is essential to encourage accurate testing; the current arrangement entails well owners handing their well information over to the regulators. (Sludgewatch; Reilly)
- Landowners should be given advance notice of land uses that may affect ground water quality (e.g. biosolids application), with information posted through EBR process. The Freedom of Information route is too slow. (Sludgewatch; Reilly)
- Adverse Water Quality reports are useful, but the public needs to know how to access these and what they mean. (Sludgewatch; Reilly)
- Land-use planning for protection is needed. Ontario has seen a weakening in provisions to protect source water, both in policy statements on paper, under OMB decisions and in the application of protections in practice. As a practical/institutional issue, ministry reviews of development proposals were once routine and considered wellhead protection by providing extra comments on things like drinking water source effects. Such oversight capacity has been lost (CELA; Muldoon)
- Programs need to be designed based on region for surveillance programs (Delcan; Droste).

- The chain of custody of information and its accuracy are important. DWSP is known for reliability and accuracy, in contrast with the U.S. system. OWWA/OMWA supports the access of the public to good data. (OWWA/OMWA; Holme). (Delcan; Proux) adds that DWSP focuses on treated water and responsible organisation must not be 'hand-in-hand' with labs - too many handlers presents risks regarding the quality of the data. Roberts argues that DWSP does include raw water and that although frequency was reduced, coverage of plants has increased.

1.2 Should source water criteria be set?

- OWWA/OMWA is against criteria in the form of regulations (OWWA/OMWA; Holme)
- In Italy, source water criteria differ depending on the licensing conditions of the particular water treatment plant. Online monitoring for upstream turbidity and contaminants is in place, and when the source water conditions of the license for a plant are exceeded, that license is suspended. Not all plants have to be designed to be capable of dealing with every kind of source water problem (OWWA/OMWA; Hargesheimer). Caution, the efficacy of this approach depends on the criteria put in the operating approvals; what about unexpected spills not covered by these criteria? (Roberts)
- Not sure there's a consensus to set criteria in stone, but the latest regulations are moving in the right direction by requiring data (Delcan; Doyle)

1.3 Should the benefits of source protection be recognized in regulations?

- OWWA/OMWA stated benefits should be recognized with a system of credits; regulation should be practical and achieve specific results, not be regulation for regulation's sake (Holme)
- In Europe, legislation on raw water quality at the EU level requires all member states to characterise every river basin or groundwater source, submit this data into a registry, and monitor over time (Delcan; Doyle).
- Some provinces have enacted source water protection regulations, e.g., New Brunswick, the US Safe Drinking Water Act plus enhancements by some states suggests a trend to regulating source protection; municipal capacity to address source protection through land use policy is also an issue (CELA; Muldoon)
- There is a scale/jurisdiction problem - regulations have to be directed at someone, and it could be problematic to include all of the actors that a source water regulation would need to address. Land use planning is central to source protection, which can involve a jurisdiction beyond the area covered by the owner of the waterworks (MOE, Gregson)
- If we are to regulate, we also need to consider DFO [Department of Fisheries and Oceans]/federal regulations and not contravene them. (Delcan; Proulx)

1.3.1 There is a difference between regulating source water, and setting source water criteria for design/treatment categorisation. For the purposes of this meeting, do we need to include criteria regarding source water quality as one element on which to base our decisions? (Pr•vost)

- Blue Book [Ontario Drinking Water Quality Objectives 1994] requirements are sufficient criteria. Tracy doesn't think additional regulations are needed and advocates the existing approach; technological/engineering solution together with existing approval process. (Delcan; Tracy)
- The mechanism is in place now. If we're looking at a process to maintain water quality vs. focussing on the specific needs of a certain plant at a given time, the new regulations address this reasonably well. They list parameters that have to be checked to characterize raw water before allowing a Certificate of Approval for a waterworks. (Delcan; Doyle)
- **Point of contention:** Malec calls for trihalomethane formation potential (THMFP) criterion for assessing raw water sources, citing the need to choose optimum water rather than relying on treatment solutions. Also calls for a lowering of maximum THM levels as has been done in the U.S. Doyle (Delcan) agrees that THM formation is a problem, but disputes utility of the THMFP measures. In the engineers' report to the MOE, THMFP is commented on, but the measure varies from one time of year to another, and alternative treatment measures are possible, so the THM formation potential measure shouldn't automatically disqualify a water source.

2.0 WATER QUALITY GOALS AND SELECTION OF ADEQUATE TREATMENT BARRIERS

2.1 How should water quality goals be set to ensure the selection of adequate treatment barriers? Should we include unregulated parameters to define treatment and distribution or should only regulated parameters be considered?

- Yes. There's an obligation to go beyond regulated parameters, to know what else research is addressing right now, and to consider the risks in particular raw water sources. Both chronic and acute parameters should be considered, e.g. both THM and cryptosporidium. (Delcan; Proulx)
- Unregulated parameters are already being taken into account, e.g., if a plant showed high colour and organics, we would look very carefully at chlorine addition even though THMs are unregulated (MOE; Gregson)
- Engineers/professionals should consider these factors rather than necessarily regulating (Delcan; Proulx)

2.1.1 If parameters that are not standards are to be included as basis for design, who should draw the line and make decisions?

Point of contention: are unregulated parameters already sufficiently/ satisfactorily addressed?

- Doyle (Delcan) suggests the phrase “considered” rather than “included” as basis for design, and asserts that generally they are considered.
- Proulx (Delcan) disagrees, suggesting that in the approximately 80% of systems that serve 20% of people, levels of protection are all over the map.
- Doyle (Delcan) - there is a need to differentiate between design of new plants and current operation of existing plants. Engineers today wouldn’t disregard Cryptosporidium in designing new plants, but this differs from the operation of plants that are already in existence.
- Relying on engineers requires that we place higher value on engineers. Reduced use of professional engineers in the field means that fewer students are going into civil engineering. (OPSE; Goodings)

2.2 Should the removal of Cryptosporidium be a water quality goal even if it is not included in the current Ontario regulations? Adding the removal and inactivation of Cryptosporidium significantly influences the choice and cost of treatment.

General agreement that Cryptosporidium should be considered (Pr•vost), but the following points were raised:

- Cryptosporidium monitoring is not reliable. Rather than relying on pathogen monitoring, you should assume that you have the problem and proceed accordingly. (OWWA/OMWA; Holme)
- In the U.K. there is a cryptosporidium standard where particle size is used. In Australia, the Sydney Inquiry looked at the data and decided against creating a standard. The problem is not solved by creating standards for something that cannot be accurately measured. A performance approach is necessary. OWWA/OMWA participated in the U.S. process to come up with new standards, but not all members agree that Cryptosporidium deserves so much attention relative to other issues. (OWWA/OMWA; Holme)
- You can focus on the ability to remove every particle above a certain size (Delcan; Doyle). In the U.S. there is a 2-log [99% removal] criterion using other surrogates e.g. turbidity (Roberts)

2.2.1 How would small systems pay for the added treatment costs?

Has there been consideration of phasing in requirements and delivering funding for small systems? How do they meet these challenges? (OWWA/OMWA; Hargesheimer)

- There are funding programs targeted at small communities to bring them into compliance with new regulations. They are triggered by new Certificate of Approval applications and engineers’ reports on how municipalities propose to meet their new requirements, especially around disinfection and filtration , there is also funding for preparation of the engineer's reports (MOE; MacLean)

- In the US regulations are the same for rural systems, but compliance timelines are flexible. Does the timing for coming into compliance differ? (OWWA/OMWA; Holme)
- There is concern that the availability of grants tends to perpetuate problems, in that funding is systematically missing. Need to get away from a system which rewards bad actors while penalizing those who have planned, funded and fixed (OWWA/OMWA; Holme)

2.3 Should emerging water quality parameters such as endocrine disruptors be considered?

- OWWA/OMWA calls for coordinated research and sound science. There are time constraints - available research is not keeping pace with the need for regulations, to back regulations up with sound science. Ontario should be participating with other jurisdictions in researching this (Holme)
- CELA outlines that the endocrine disruptor issue has been around for a decade, and although there's no consensus, the literature is mounting that it is a serious problem. CELA agrees with the need for sound science. Cites the Canadian Environmental Protection Act and debates on how to deal with long-term hazards and requirement for periodic review (Muldoon)

2.3.1 Are endocrine disruptors removable? What are the treatment options? (Swain)

No clear answer is forthcoming, however:

- Membranes may be an option (Roberts).
- In the E.U., new regulations will be in place next year that require membranes to treat for endocrine disruptors, without bringing in regulations for testing in source water. (Pr•vost)
- The only real way to protect against endocrine disruptors is to prevent the pollution. Similarly with other chemicals such as dioxins. Need to recommend that treatment is a second-best alternative, and the best is prevention. Operationalizing prevention has not yet happened, strong language notwithstanding. Treatment is second best alternative (CELA; Muldoon). OWWA/OMWA agrees that drinking water should have priority and that source water should be protected from such toxins, although not all other players in the big picture agree.
- One could argue that other concerns (Cryptosporidium, combined sewer overflows) should be addressed before endocrine disruptors. (Pr•vost) Roberts notes that stakeholders should be involved in making such choices.
- Swain notes that endocrine disruptors include synthetic and natural hormones used in birth control pills which pass through treatment and end up in surface waters. Removing such chemicals from use has enormous social consequences. Muldoon (CELA) notes that he was referring to pesticide rather than pharmaceutical sources. Reilly (Sludgewatch) agrees that source protection is

necessary for many of the major disruptors such as nonophenol, which is produced chiefly by certain industries.

- Swain asks whether endocrine disruptors can be removed in wastewater treatment. Stephenson (Delcan) replies that studies have demonstrated that well-designed, well-operated plants are capable of removing endocrine disruptors, although the category is very broad, including hundreds or thousands of compounds including even detergents. Crawhall (AMO) argues that sewage systems themselves are chief sources, as nonophenols are rendered more dangerous/persistent by a chemical change caused by treatment. Droste (Delcan) concedes that research into removals is in its seminal stages but that good removals have been attained.

2.3.2 How adaptable is our regime to include emerging issues?

- How precautionary and how adaptable is our system? What happens when new concerns emerge? A threshold for action is needed. (CELA; Muldoon)
- Adaptiveness in existing legislation requires that waterworks be reviewed every three years. (MOE; Gregson)
- Emerging issues - there is the intent to look at parameters that may have emerged during that time, and review standards. (MOE; Gregson)

2.4 Should aesthetic parameters, such as taste, odour and colour, be included to increase customers' acceptance and support of the implementation of treatment?

- Cites Toronto experience [summer of 1998] with taste/odour problems and the use of activated carbon to solve the problem. There are benefits too, but it's not a trivial matter to buy that consumer confidence. (Delcan; Tracy) Should that money be put into health priorities instead? (Pr•vost)
- However, public confidence is an issue with aesthetic impairments. Bad taste/smell/colour causes loss of confidence (Roberts; Delcan; Doyle)

2.5 Should the public be involved in the choice of treatment options? How can we secure stakeholder participation in defining water treatment goals and preferred treatment choices?

2.5.1 Is public involvement currently adequate?

Point of contention:

- The public already has access to decision-making through the environmental assessment (EA) process, environmental study reports, etc. (Delcan; Tracy)
- Muldoon (CELA) disagrees that public access is adequate. There is a pretense of public involvement, but substantive involvement and the ability to access the

expertise necessary for meaningful participation has diminished recently. In terms of choice of treatment, members of the public need a forum and the ability to retain experts to advise them. The intervenor funding act has expired, and citizens have lost that access to hiring technical and expert backup for participation. In terms of the EA process, it is very difficult to get something bumped up to a full assessment. There is a lack of emphasis on giving the public notice of decisions being made and opportunities to participate. Lack of public involvement means that decisions lack legitimacy; even if they're the right decisions, the public may not support a decision because they don't understand it (CELA).

- OWWA/OMWA (Holme): we strongly support public involvement, and it is in our policies, though we recognise the difficulty that Muldoon has raised.
- AMO (Crawhall) also supports this point, emphasizes costs/risks to public for getting involved, and cites example of citizens ordered to pay costs to developers because in the OMB's judgement they had brought a frivolous challenge.
- Malec endorsed CELA's observation of public powerlessness, and cited Muskoka example of public involvement in three different design and location options for WTP to point out that decisions are sometimes presented as technical/scientific but are actually the outcomes of closed political processes.
- In small towns, compared to larger ones, it may be easier to get the public input (through public debate, budget processes, etc) on balancing costs and safety. (AMO; Crawhall)

2.5.2 What issues merit public participation in decision-making?

- Example, in setting up Vancouver plants, the public was called upon through a voting process to make decisions on balancing ecosystem protections, treatment options and the long-term risks of disinfection byproducts. (Pr•vost)
- Some issues are regulated and not debatable. Technology options shouldn't become a grab-bag where the public can shop for what sounds appealing and costs least (Delcan; Tracy). People can debate the standards *upwards,* but not downwards on the basis of cost. (Delcan; Doyle) We can't give up on safety; but on aesthetic considerations, which are a question of levels of service, the public can be involved in making decisions. (OSPE; Goodings)
- Reilly (Sludgewatch), however, calls for mechanisms for community input into regulatory standards.
- It is important not to err on the side of too much public input/responsibility for treatment decisions in small rural systems. For private rural wells and small communities, decisions are too often made by the owner in consultation with self-interested private industry and with insufficient government support. There tends to be either over treatment or no treatment. (Sludgewatch; Reilly). Tracy (Delcan) adds that the MOE needs to take a leadership role and impose standards, using regulations to compel small communities to protect rather than relying on the power of persuasion and leaving them to make treatment decisions based on cost.

3. APPROACHES UNDERLYING THE SELECTION OF TREATMENT

BARRIERS

3.1 Special needs of smaller systems?

- Arguably, the larger systems don't have a problem, it's the small systems that we need to discuss (AMO; Crawhall)

Point of contention: is price an issue for smaller systems?

- Goodings (OSPE) states that according to his research, small communities pay the same unit cost as larger ones – and adds that in all cases people are paying too little and should be able to pay $50/month instead of $16. Price is an overstated problem.
- Crawhall (AMO) disagrees, explaining that rates are subsidized, and more so in small towns. There are indications that these subsidies will be removed, and small towns will be hit hardest with 200% increases in water bills in some cases. For people on fixed incomes, such increases in annual water bills (together with rate hikes for gas, electricity, etc) as a result of moving to full-cost recovery can have a large effect on a household. New standards will add to costs.
- Impact of rate increases is important, and should not be dismissed (OWWA/OMWA; Holme)
- In other countries, there is a several fold cost difference between small systems and large, because small systems need to invest in automated systems instead of being able to afford operations people. There is a need to differentiate cost from price (Pr•vost)
- Hargesheimer notes that AWWA will be submitting a paper ("Cost data on cost of implementing sate-1 microbial/DBP rule and the interim enhanced surface treatment rule in the U.S.")
- Tracy (Delcan) notes that in terms of capital costs, groundwater is much cheaper than a surface water plant, so the MOE has tended to encourage communities toward well use.

3.1.1 Is there a size below which risk of failure necessarily climbs? What solutions are there for small systems? (Pr•vost, Swain)

- Many small systems would face grave difficulties meeting standards, even with money thrown at the problem, because of problems with size of system, levels of expertise, etc. Is there a minimum size a water provision system ought to be, below which they face awful difficulties and should be encouraged to combine? I suspect that in water systems, under normal conditions any system can work well, but when they come under pressure the small systems are more likely to fail. (Swain).
- Agreement about the nature of the problem. Most of the time, in big or small plants, everything works well. But in an emergency, smaller utilities tend to lack the resource base of people who have training, education, and experience, as well as lacking the funding, to deal with the issue (Delcan; Doyle). For example, in a small system if your online turbidity meter is broken, there might be no one

around to recognize and fix the problem for a long time (OWWA/OMWA; Hargesheimer)

The 'circuit rider' approach:

- (Delcan, Doyle) disagrees about the amalgamation solution: hooking up physically or operationally with other systems isn't always going to work. Some systems are so far apart that they really are islands. We proposed that a resource be made available to these communities, someone to call in the middle of the night when suddenly something happens and they don't know what it means or what to do. B.C. has come up with a similar solution - community-based drinking water officers.
- (Delcan; Tracy) concurs that operational support is a point of risk in the system, when operators don't know what to do.
- (OSPE; Bonk) agrees about a need for support, and cites the U.S. circuit-rider system, in which experts are supported by the federal government to tour rural areas to assist very small systems with operational problems. (OWWA/OMWA; Holme) agrees that this is a useful system, and adds that it is run by the National Rural Water Association.
- The person who holds this office should also have some teeth in a regulatory way. Someone familiar with the small systems would be in the best position to know what was going on, and it would be best if that person's recommendations could not be easily ignored (parallel with medical officer of health) (Delcan; Doyle)
- Another split between types of systems is that between small systems on groundwater and those on surface water. Groundwater systems should have few problems because the groundwater is approved as meeting MOE requirements, and the treatment is simply disinfection. Small systems on surface water are the problem (MOE; Gregson)

3.2 What does the multiple barrier concept really mean?

Multiple treatment barriers? Process and operations barriers? Barriers provided by all parts of a system or for source water protection, treatment and distribution?

- There was little discussion dealing explicitly with this issue, but see sections 3.3.1 and 3.5, below.
- Tracy (Delcan) noted that while technological barriers are reasonably well-understood, support for the barriers provided by process optimization and plant operations has declined over the years.
- Consider procedures as barriers, and system shutdown as a barrier (Roberts)

3.2.1 What level of redundancy should be built in systems? Should flexibility for meeting future regulations be an important criterion?

- Redundancy is a huge issue, crucial to safety in the case of acute issues. (Delcan; Proulx)

- In the case of cities, some, but not all, have the redundancy. In small-town Ontario, many systems don't have reservoirs and backups so if the power goes out, the pump and treatment system are out. Power redundancy is critical. (Delcan; Proulx)
- The most at-risk are those that have only a single well system, no storage and only one chlorinator with no spare, nor even a spare diaphragm for the chlorinator pump. Do MOE's new requirements include having standby chlorination? (OSPE; Bonk) Yes, in keeping with the "Ten States Standard" (Gregson, MOE)
- MOE standards are based on the Recommended Standards for Water Works by the Great Lakes Upper River Board of State and Provincial Public Health and Environmental Managers. This manual is commonly referred to as the "Ten State Standards" as is prepared jointly by a board including ten mid-western states and the Province of Ontario.
- Another problem is that some communities don't check their chlorinators for a month at a time. A simple protection would be to build in a system whereby if the chlorine cuts out, the well goes offline (OSPE; Gooding).

On the issue of automation:

- Plants tend to want to save costs by staffing only during regular business hours, and leaving operations on autopilot the rest of the time. (OSPE; Gooding). Technology is used to eliminate continuous operating supervision, but the requirements for doing so are not well-policed or well-regulated (Delcan; Tracy)

3.2.2 What are the industry standards and "best practices" for redundancy?

- The MOE has good guidelines – storage for power outages, backup of treatment systems (coagulation, filtration, etc). But it's unrealistic for small systems to spend that kind of money. A "best practice," when costs are considered, might not be the best investment of a community's money. (Delcan; Proulx)
- The "Ten State Standards" has fairly well-research industry standards for redundancy (OWWA/OMWA; Holme)
- Another option is operational redundancy, e.g. notification systems to make sure everyone is informed if the system fails. A community that can't afford a second system for treatment might decide that boil-water notices are acceptable. (Delcan; Proulx). (OSPE; Gooding) agrees that we need to focus on process. The issue is safety, not level of service, and water that is not safe should never be sent through the system.
- Point-of-use devices might make sense in some cases (Delcan; Proulx)

3.2.3 Should we focus our efforts to reduce the source of contamination, control of combined sewer overflow (CSO), increased wastewater treatment and elimination of untreated sources or on building additional barriers in drinking water treatment?

- At one point there was a trend to separation of sewer systems, but it was found to be costly, and didn't necessarily solve the problem because stormwater is also heavy polluted. In the old city of Toronto, the systems aren't separated but they are taking steps to reduce pollutant loadings by reducing CSOs. The real driver, however, is environmental impact rather than drinking water source protection) (Delcan; Tracy).

Point of contention: on whether CSOs are a significant challenge to water treatment?

- Hargesheimer (OWWA/OMWA) cites North Battleford example where there were sewer overflows challenging that treatment plant.
- Tracy (Delcan) notes that both the water plant and sewage plant failed simultaneously.
- Pr•vost asserts that CSOs do pose a challenge to water treatment plants
- (Delcan; Proulx) argues that barriers must still be at the treatment facility, as other factors (e.g. animal faeces in spring runoff) will also challenge the treatment system.
- The biggest advantage to be obtained by source water protection is at the non-point sources, not at point sources (OWWA/OMWA; Holme).
- (Reilly; Sludgewatch) disagrees, sewage treatment plants are a significant source; according to federal nutrient management reports, they are the number one nutrient pollution source in Canada (*reference?*). This needs to be addressed, not simply confounded with manures and other issues.
- (OSPE; Goodings) adds that the principle of not treating sewage adequately, just extending the source water pipe, is distasteful.
- (Delcan; Tracy) responds that although sewage treatment is important for environmental reasons, the key issue being discussed here is drinking water.

3.3 Should the design of treatment barriers be based on the absolute worst situation rather than on average conditions?

- Engineers have always tried to design for the worst, taking variation in raw water quality into account. The practicalities of responding to worst situations/maximum values is usually not that complicated. Responding on time can be an issue, however. (Delcan; Tracy)
- There are also issues around reporting spills. Communities on rivers do not always have formalized systems for knowing what's going on upstream. (Delcan; Tracy)
- The answer is not always to introduce more treatments/barriers to deal with the worst. We need contingency plans to respond to conditions that change, including just shutting the plant down when there may be a problem coming down the river. Raw water storage is used in some situations where that is a common occurrence. (OWWA/OMWA; Holme). Also supports the use of the term "maximum" rather than "absolute worst."

In relation to this agenda item, the Chair read a statement submitted by Ken Roberts:

“ I hereby declare that I support the principle of source categorization with respect to defining treatment requirements following the concepts outlined in the Agreement in Principle signed by the United States EPA FACA Rulemaking Panel for the M/DBP in September 2000 (AWWA are participants).

Accordingly it is recommended that the MOE consider development of a source categorization methodology that will tie into required treatment for the various levels of source categories. It is also recommended that MOE develop criteria to define Ground Water Under the Direct Influence of Surface Water in order to specify treatment requirements for such sources.”

4. METHODOLOGY OR FRAMEWORK TO DEFINE THE BEST TREATMENT BARRIERS TO MEET MULITPLE WATER QUALITY OBJECTIVES

When evaluating options for water treatment, several options may be possible. Several systematic approaches have been proposed to identify the best solutions.

4.1 What are the best practices to select treatment around the world? How is process selection done in Ontario?

- Decide on your goals first, what it is you have to achieve, and that determines your options, e.g. a goal of removing endocrine disruptors would mean fairly specific treatment options (Delcan; Doyle)
- Selection used to be done by persuasion. The new MOE regulations include a positive move to regulate treatment, rather than relying on persuasion to achieve water safety. This is a positive move. (Delcan; Tracy)
- Engineering reports are one way but operational options are available (OWWA/OMWA).
- Expertise resides in MOE. Our engineers are professionals who wouldn’t give approval if they did not think it was appropriate. In case of understaffing, turnaround time would increase but we would not irresponsibly issue an approval. (Gregson, MOE). Swain observed that MOE had been hiring private consultants for the approval process. Gregson replied that this was necessary because 40 highly qualified, experienced engineers were needed for the approvals and recruiting is an issue.
- A couple of decades ago, the MOE was a driving force setting standards and defining standardized specifications, disseminating design and best practices (through MOE design manuals). This has fallen by the wayside, as the ministry’s focus seems to have shifted more narrowly to regulation. OCWA was spawned to separate ‘doing’ from ‘regulating.’ The old green design manuals are still a good reference, but today we wouldn’t go to MOE for direction and guidance on design issues as we once would (Delcan; Tracy)
- OCWA cannot take over the role of driving the standard or helping companies standardise in the province or a centralized information role, since they are in

competition with private industry. AWWA publications are now probably the best source (Delcan; Tracy)

- MOE guidelines limited innovation. Things designed in Ontario had to be sold in Europe before they would be accepted here (OSPE; Gooding**).** MOE (Gregson) contests this, explaining that guidelines are not standards, and that there was always room to allow designers to deviate from the guidelines.
- Pr•vost notes that the MOE approvals department needs some very high-level engineers to make such determinations. Do you still have them? MOE (Gregson) replies that they have a couple of world-class people, plus access to experts from other MOE branches, and that their engineers are very experienced at reviewing water plants.

4.1.1 Should the engineers who design plants be responsible for accounting for extremes in raw water quality?

- Need to also take into account operational barriers (Delcan; Proulx)
- Ontario is a full member of "10-States," and we do contribute to the technical committees. We have used 10-States in the context of the engineers' report, and are contemplating adopting it as a provincial guide (MOE; Gregson)
- A long-term solution to the shortage of qualified engineers in the water business is needed. We need to recruit more engineers and pay them better. (Delcan; Langley and Doyle). In this profession costs drive selection too much (Delcan; Langley)

4.1.2 Does this practice produce the best and safest solutions? How can it be improved?

- More money (from provincial and federal tiers) must be put into research (Delcan; Langley, OSPE; Bonk) and they must get more involved as well (Delcan; Proulx).
- (OWWA/OMWA; Holme) notes that his organisation strongly endorses more research, but not duplication of efforts, and that AWWA is involved in subscriber funded research but endorsed the need for more research coordination.

5. TRADE OFF BETWEEN DISINFECTION AND PRODUCTION OF UNDESIRABLE DISINFECTION BY-PRODUCTS.

Disinfection is a process designed to reduce the number of pathogenic micro-organisms and reduce the risk of infection. However the very application of disinfectants causes the production of undesirable disinfection by-products causing the greatest dilemma in water treatment.

5.1 What should be the drivers of treatment design: microbials or disinfection by-products?

- Microbials. They are acute, compared to chronic/long-term effects of disinfection by-products (DPBs). (Delcan; Doyle)

5.2 Are the current regulations ensuring the adequate disinfection of drinking water?

- Doyle (Delcan): Yes, current regulations are adequate.
- Muldoon (CELA): No. We need to be concerned with chronic effects of trihalomethanes (THMs) on vulnerable populations. One of the consequences of DBPs is a surge in bottled water. People are willing to pay to avoid DBPs. Some of the health-conscious prefer bacterial to toxic contaminants. This is a social equity issue, a two-tiered water system.
- There are more problems in smaller systems. The larger ones are doing a good job here (Delcan; Doyle)
- Standards for THM, HAA were kept the same (Pr•vost) but are being measured at a point in the system where levels tend to be higher (Holme, OWWA/OMWA) so that the worst rather than the average is now being regulated.

5.2.1 What does increased bottled water use indicate/imply?

- Misinformation drives people to bottled water. It's not regulated and is a health risk (Delcan; Droste). Mineral water and spring water have Health Canada guidelines. Speaking as a former President of a major commercial environmental testing lab, Langley outlined that commercial labs performed most of the testing for bottled water companies and that bottled water companies do extensive testing and publicize their findings. As expected, we found on rare occasions that some bottled water was not as clean as tapwater, however, most bottled water tested was found to be of high quality (Delcan; Langley)
- Muldoon (CELA) agrees, but people do not understand that and are willing to pay for it under the perception that this is better water. Example, cancer patients not drinking tap water because of THMs (AMO; Crawhall)
- Swain, does this suggest the need for public education?
- Holme (OWWA/OMWA) outlined that such issues drive consumer confidence. People assume that every system has the same problems. Public education is important. Online provision of information is an opportunity for education.
- In Europe, drinking water from the municipality has lost out to bottled water already because historically, given the disastrous state of continental Europe's rivers, tap water had a very poor reputation. (Delcan; Doyle)
- When comparing what people will pay for bottled vs. tap water, remember that if municipalities were to treat only the 3% of tap water that people drink, they too could afford the methods to treat to taste standards of bottled water. (Delcan; Doyle)
- It is also a marketing issue (OWWA/OMWA; Holme). The water/engineering profession has not done enough public relations to make people realise how good our drinking water is. The large municipalities have a lot to be proud of in the quality of their water (Delcan; Doyle)

- The mounting resistance to chlorine is not only because of mounting evidence of health effects, but also because for too long chlorine has been the panacea and we relied on it too much. It doesn't deal with some issues, and ozonation and U.V. have historically been inadequately considered (Sludgewatch; Reilly)
- Bottled water is not a major concern; largely a convenience issue (Delcan; Tracy)
- There is a public perception that groundwater is safer than it is, which may explain both why people drink bottled water and why small communities tend to resist chlorination (Coroner's Office; Gruber)

5.2.2 What about Crytosporidium? Is ozone a solution?

- The *Cryptosporidium* problem has not been solved to anyone's satisfaction yet unless we demand ozone in every treatment facility. Filtration is the first step. U.S. bodies have given up on disinfecting *Crypto* with chlorine. (Delcan; Doyle)
- Ozone seems to work for *Cryptosporidium* (Delcan; Proulx) but it does have disinfection by-products (Swain, Pr•vost) and the long-term effects of by-products are not well known compared to chlorine which has been around for years. No to stymie innovation, but caution is needed. (Delcan; Proulx)
- U.V. seems to have potential. As research proves it to work, I think it will be adopted in designs for municipalities (Delcan; Proulx)
- France, and now Quebec, have gone to ozonation (OSPE; Gooding). Ozone has been used for nearly 100 years in Europe. It was brought in for taste and odour reasons as well as disease (Pr•vost)
- Three countries have approached regulating for *Cryptosporidium.* (Delcan; Doyle)
  - The U.S. has the "0.3, 95%" regulation [EPA "Enhanced Surface Water Treatment Rule," requires average finished water turbidity of less that 0.3, in at least 95% of samples per month]. Roberts: The new U.S. standards will include U.V. if necessary depending on raw water. This implies a need for data to track changes to know whether to go to U.V. (Pr•vost)
  - England and Wales have a system whereby plants that do not filter particles below one micron, and are judged to have a significant risk of distributing infectious water, are required to sample continuously at a rate of at least 40 litres/hr, and less than 1 oocyst/10 litres should be found [Water Supply (Water Quality) (Amendment) Regulations, 1999].
  - New Zealand has adopted CT standards for inactivation [contact/time standards; see Water Standards for New Zealand 2000, New Zealand Ministry of Health] for chlorine dioxide and ozone.

5.3 Can we avoid this dilemma?

- Look at research being done elsewhere, and regulations from elsewhere that may be informed by more research dollars and research results, e.g., U.S. research (Delcan; Doyle)
- Removal of organics is key to preventing formation of by-products (Delcan; Proulx)

- A potential future response might be a completely different system, such as point-of-use devices, publicly-run trucking (OWWA/OMWA; Holme)
- Regardless of levels of THM, it is the obligation of every water utility to reduce those levels (OSPE; Bonk; general agreement). There are simple methods and it is not being done everywhere.

6. TOOLBOX OF TECHNOLOGIES

Technologies can be considered as tools in the toolbox to assemble the proper treatment barriers.

6.1 How can we better use conventional technologies to meet multiple water quality objectives? Can conventional treatment suffice as regulations evolve and include parameters based on the precautionary principle as seen in Europe?

- The major changes have been not in technology, but in how well the technology is controlled: improvements through automated control, feedback, backwash control, coagulant rates, settling, etc (Delcan; Doyle)
- In most cases as the requirements of standards and regulations rise, we seem to be succeeding by optimizing conventional treatments. (OWWA/OMWA; Holme) If we have source water that cannot be treated with conventional technologies we look for a different source (Delcan; Doyle)
- Roberts cites 1995 optimization program [1995 AWWARF workshop "Optimizing Surface Water Treatment Plant Performance" - *reference?*] as demonstration of flexibility of conventional technology.
- Filter-to-waste during backwash should be addressed to optimize plants (Delcan; Tracy). In the U.K., any plant that does not do filter-to-waste must automatically perform *Cryptosporidium* sampling and testing (Delcan; Doyle)
- Define technology broadly. Prevention is also part of the toolbox. Nutrient management, source reduction, and conservation to potentially divert monies from expansion to quality improvements are all important. No clear position on credits to plants for source protection, but sees it all as part of the package. Cites example of downspout-disconnect program in Toronto as attempted alternative to building the western tunnel. (CELA; Muldoon) Gregson (MOE) cautions against giving credit such that one barrier is eliminated in favour of another (rather than adhering to a multi-barrier approach)
- Swain agrees about looking at technologies in terms of conservation, and adds that there is a range of procedural options that rather expands the notion of technology. Cites mistake that the U.S. made with energy, which we should avoid making with water.
- OWWA/OMWA wants to see "efficiency" on the agenda for this meeting (Holme)

6.2 Can we identify innovative technologies that would offer better quality, greater reliability or lower costs, e.g. membrane systems and alternative oxidation technologies such as UV disinfection?

- There is an emergence of membrane technologies (Delcan; Doyle)

6.3 How can we add innovative technologies to our toolbox?

Can we ensure timely and safe introduction of innovative technologies to provide opportunities for better water quality and lower cost? Can Ontario and even Canada draw on data and experience abroad to build on existing information rather than repeat the whole evaluation process?

- Holme (OWWA/OMWA) cites the Partnership for Safe Water (EPA, AWWA and other organisations) as an excellent voluntary program, very beneficial to the agencies that participated. Originally based on EPA requirements, it is now exportable and adaptable – Quebec and Australia have adopted it.
- Need to compare cost of optimizing existing technologies or retrofitting/add-ons to outright replacement of plants (Delcan; Doyle, OWWA/OMWA; Holme). With few new plants being built, there are limited options for upgrades to existing plants (Gregson, MOE)
- Gregson (MOE) warns that new technologies have their own potentially catastrophic limitations and problems, and may be at a higher risk of failure. Bonk (OSPE) concurs. Conventional systems sometimes have more "forgiveness" in the face of adverse conditions.
- Pr•vost comments that in the case of membranes, they are actually more reliable than conventional filtering technology.
- Example: Collingwood responded to a *Cryptosporidium* outbreak by installing membranes. Gregson (MOE) explains that this was the second plan that Collingwood proposed. There were concerns with potential cross-contamination in an earlier design.
- Example: In North Bay, the MOE was prepared to consider a design using UV only on the basis of filtration policies developed by the USEPA (Gregson). Crawhall (AMO) pointed out that part of the frustration in North Bay was the lack of a more proactive position from the MOE. You have to go through the design and approvals process. Need an endorsement/certification process for new technologies.
- There is a process in the MOE (Gregson), but (AMO; Crawhall) notes that it is only for private companies, and the results do not seem to be publicly available. The issue of "equivalent technology" is also not clear in the new regulation (AMO).
- Gregson (MOE) explains that when companies approach municipalities, the municipalities want to know what the MOE thinks, so MOE created a program to generically review the technology in terms of performance circumstances. Gregson emphasizes that the perception of an extensive review process is a myth, and MacLean (MOE) adds that MOE can be approached early in the process.

6.3.1 Given problems with HAAs, THMs, Cryptosporidium, where should we look for additional barriers or new technologies? What else do we need in our toolbox to address Cryptosporidium concerns?

- Are conventional technologies not sufficient to deal with *Cryptosporidium*? (Delcan; Doyle). Conventional approaches have limits compared to microfiltration, UV, etc (Pr•vost, Swain)

6.3.2 When do you know you need a new system or new technologies?

- When the system is no longer doing what it's supposed to do (Delcan; Droste)
- Need criteria for raw water in order to know when conventional, well-operated systems are not enough and more advanced technologies should be introduced. Advocates "BINS" system adopted by EPA. Not a perfect system, but useful (Pr•vost - *reference?)*
- OWWA/OMWA is against regulations for things to which numbers cannot be set (e.g., IJC/SOLEC criterion of "drinkability"), and suggests that the MOE terms of reference have the right word, "characterization," i.e. criteria without regulation. (Holme). Tracy (Delcan) agrees, if you see trace organics in raw water, you notice and react.

6.4 What is the role of research and development to ensure the development and timely application of innovative technologies? Is the current level of governmental support (federal, provincial and municipal) sufficient?

- There is general consensus that research effort has fallen off, and that R&D is essential.
- (OSPE; Goodings) suggests possibility of taxing the waterworks to fund technical development such as the pilot plant project. (Delcan; Proulx) notes that historically Ontario has initiated some of the best pilot projects in the world.
- There is a perception that Ontario is not promoting/supporting its own technologies (AMO; Crawhall)
- Swain notes that a century of optimization of conventional technologies has raised the barrier very high against new technologies. What is the mechanism for investing in an emerging technology that shows potential?
- The need to test source water is driving development of new tools (Roberts). Regulations drive technology, but Canada is considered soft on regulation and enforcement (Langley).
- Private industry drove developments such as UV, membranes (Delcan; Tracy). Most emerging technologies are driven by the private sector, with some help/funding from governments (Delcan; Tracy). Publicly-funded research appears to have been replaced by private companies developing proprietary technology (Pr•vost)
- Langley (Delcan) cites the Environmental Technology Verification Program through which Environment Canada assists commercial developers in verifying technologies for domestic and export sales. Canadian technology companies cannot sell to conservative local municipalities unless they have been in use in

Canada. (OWWA/OMWA; Holme) agrees about local conservatism regarding new technologies.

- Research is a critical part of continuous improvement initiatives. OWWA/OMWA does well at funnelling information to those involved. Research partnerships are necessary, e.g. NSERC, AWWARF. (Delcan; Proulx)
- Swain asks if there is evidence that R&D effort has declined? Roberts indicates that provincial and federal budgets would indicate this. Swain notes that there is some government money for R&D, federal funding, health and welfare, NSERC chairs, Ontario Ministry of Energy, Science and Technology (MEST), and the initiative by MOE to digitize the information it has. Maclean (MOE) adds that the advisory councils of MEST funds are suffering from lack of good proposals.
- Pr•vost questions whether all the money is going into research for proprietary purposes. Swain inquires about the availability of data on R&D for water and sewage treatment in Canada. Connell tables Statistics Canada as a possible source.
- CELA outlines that prevention is a technology that is not being discussed. Need to move the discussion beyond treatment, conservation is another technology. Reilly agrees and states there is a need for programs to promote source water protection and wastewater recycling, e.g. installing innovative water/wastewater technologies in some demonstration homes being built on city margins (Sludgewatch; Reilly). CELA flags the issue of water-efficient toilets, which have been mandated in the U.S., and Reilly suggests government approval/endorsement of certain composting toilets. Swain outlines that the Canadian Standards Association would likely have a role.

6.5 What would be the proper structure and procedures to keep this process dynamic while ensuring safety?

- Need to start with proof of concept (Delcan; Doyle).
- What level of proof of concept is necessary to be brought into MOE standards? (Swain)
- There is a performance standard of "equivalent technology," but how do you tell what that is? (AMO; Crawhall). Performance is the criterion for "equivalence" (MOE; Gregson/Maclean)
- Bonk (OSPE) notes the problem of resistance to change in the water industry.
- MOE asserts that it is a misperception that approvals are hard to get; the process is actually open and flexible (MOE; Gregson)
- Continuous improvement initiatives are needed, to address research, quality certification programs, self-assessments and peer review. Continuous improvement works out to be a savings, rather than a cost. (Delcan; Proulx)
- Regulations are necessary to drive improvements (Pr•vost) but we also need everyone at the table – the public, regulators, research partners (Delcan; Proulx)
- We don't want to just regulate one number, but to drive toward improvement. Example, in the U.S. when turbidity rates exceed the 0.3 threshold, the consequences depend on how bad it gets. (OWWA/OMWA; Holme)

- OWWA/AWWA developing programs that aim in part to drive the culture such that utilities will anticipate changes (OWWA/OMWA; Holme)
- Important to think of it as a system, rather than only as a water treatment facility. Consideration should encompass pipelines, water mains, sewer systems, use and conservation, leakage. (OSPE; Goodings)

7. OPERATING AND MONITORING TREATEMENT FACILITIES TO MINIMIZE THE RISK OF FAILURE

One of the major causes of outbreaks is transient treatment failure. The efficacy of most treatment process barriers is completely dependant on adequate operations. Treatment failures, even of short duration, constitute a health risk. It is now widely recognized that quality programs are key to elements of safer operations.

7.1 Several quality programs are applied around the world. What is their role in ensuring safety in treatment?

There was considerable agreement regarding the responsibility of senior management to lead quality programs:

- There is consensus that good efficient operation (quality management) is the responsibility of senior politicians and bureaucrats, and that too often these people have hidden from responsibility in cases of failure and allowed operators to take the blame. While the vision must be driven by all of society, it requires leadership at the senior level to communicate the vision. That vision can be supported by society, making it a long term goal that transient politicians are less likely to be able to drop. Over the last six years, funding cuts at MOE have sent the wrong message; the vision has not been communicated. (Langley, Roberts). Caution should be applied in putting too much reliance on the design of systems. Management is critical. If there is no support for operating, training, repairs, a system won't work. (Delcan; Proulx) The Harvard Business Review March, 2001 article "The Nut Island Effect: When Good Teams Go Wrong" is a good example of the management-operators disconnect. (OWWA/OMWA; Hargesheimer)
- Quality management is essential to ensure continuous improvement, to align culture with goals for utilities. (Roberts) Commitment to continuous improvement requires constant training and upgrading of skills (Langley, Pr•vost)
- There is a need for systematic methods of identifying and organizing priorities to maximize investments in treatment systems (OWWA/OMWA; Hargesheimer)
- Several programs have relevance: ISO 9000/14000, Partnership For Safe Drinking Water were mentioned

7.2 Which model is considered the best and could be applied to Ontario? ISO, Partnership for Safe Drinking Water, etc.?

No consensus was achieved regarding one particular model which would be best for Ontario. However, the discussion did reveal positive and negative aspects of several models.

- There was general consensus regarding the Partnership for Safe Drinking as a program potentially applicable for Ontario. Put together by USEPA, AWWA and other major water associations, it is a voluntary program that provides a framework for best practices. The program has four stages, with a certificate provided upon completion. Its emphasis is on particulate removal (driven by the desire to deal with Cryptosporidium) and on optimization of existing treatment systems to deal with that. Originally it was developed in the United States, where it covers over 90 million people and is highly successful. (Pr•vost, OWWA/OMWA; Holme) It has since been adopted by Australia and also translated into French, with Quebec taking the lead. (OWWA/OMWA)
- There was some disagreement with respect to the ISO programs. Shortcomings of the program include: a high level of bureaucracy (documentation given that water treatment plants already tend to document well); and guidelines that are generic (not industry specific). (Delcan; Tracy) Moreover, a level of expertise is required to support ISO/continuous improvement initiatives and not all plants may have it. There is currently a document developed in Australia/New Zealand (Steve Hrudy was involved) which comments on current limitations of the program with respect to drinking water. (Delcan; OWWA/OMWA; Holme) Notwithstanding these concerns, it was pointed out that ISO's third party (external review) is a very important component to the process as is continuous improvement and training (OWWA/OMWA; Hargesheimer, Delcan; Langley).
- ISO 14001 does not provide specific guidelines and leave it up to the industry to adapt general guidelines. When the Canadian Blood Agency converted to ISO guidelines, it reported a profound cultural change. (Connell)
- MOE has been encouraging development of sectoral guides for ISO 14001 implementation and sees much benefit to environmental management systems. (MOE)
- Calgary is in the process of certifying to ISO 14001 for the entire municipality which should be completed by 2002, after it originally was required by the Alberta provincial government to certify its waterworks following a serious chlorine discharge episode. (OWWA/OMWA; Hargesheimer)
- Again, an issue for small operations (OSPE; Goodings).
- The Regional Water Officer team approach, as suggested in the Delcan Report, Issue Paper 8, could provide general support for water treatment facilities, in addition to emergency assistance. (Doyle) Partnership program also works for smaller systems (OWWA/OMWA; Hargesheimer).
- Consensus that it is recommended that province explore these models that are adaptable (Pr•vost).

7.3 How do we implement these programs in Ontario utilities? Are quality programs applicable to small and very small systems?

- There was discussion regarding the appropriateness of ISO and its requirements for small systems in that there is a level of expertise as well as resources needed to support the program which may not be available at small plants. There was general agreement that partnerships are a good option for small systems and that size is not an obstacle to partnering.

7.4 What is the role of treatment monitoring to ensure reliable treatment (on-line and offline process monitoring)? What should it include, online turbidity meters on each filter, particle counting?

- Standards and regulations are in place, but often failure occurs because they have not been applied properly. Higher standards do not guarantee against failure (Delcan; Doyle)
- Resource availability (more staff, training and experience in different circumstances) is not the same in small plants as in larger plants. Resources are dependent on funding, which is less forthcoming in smaller places where funding for treatment is not a political priority (Doyle) because the process rarely varies (it works) for 95% of the time
- Understanding of source water, treatment barriers, and operational barriers is critical. Automation/monitoring are important tools in effective treatment of drinking water but operators must be trained on how to use the systems and how to react to changed circumstances (pH, turbidity, particle counting), to know written procedures and how to respond to written procedures. It is important to hire qualified people and keep them trained (Delcan; Proulx). There was some disagreement whether staff in Ontario's treatment plants generally have this type of expertise and training (Doyle, Proulx). The problem appears to be that the level of staff expertise is not uniform from plant to plant.
- The stability of rural water supplies poses a problem. In cases of a rapid change (for instance pH balance), operators don't always know what the change means or what the appropriate response is (Delcan; Tracy). They do not analyse data which they are collecting on an on-going basis and don't know how to interpret it, especially in small systems. Operators should be trained to do this; if not, one possible solution is that skilled people should be required to handle changes in process. In Rochester, N.Y., there is a requirement to have certified operators (different people than those who normally run operations) handle any process change. There is some question whether that is a legislated requirement in the United States. It is not legislated in Canada (OSPE).
- Most decisions to shut down are not automated but rather made by operators and most only have a handle on chlorine residual based shutdown. Tracy questioned how well this is this regulated by MOE? In larger plants, monitoring occurs on raw water and throughout the treatment process to ascertain how the process is working (multiple barrier approach is aimed at this). A key problem in small systems is that there is often only one monitor (chlorine), at the end of the system - monitoring should occur up front. In fact, monitoring should occur at every stage (every filter, all influent points) of the process (multi-barrier): if one process

fails, a decision can be made whether it is critical enough to shut down. (Delcan; Proulx)

- One example is Ottawa's Britannia plant which was monitored closely and shut down when necessary due to runoff problems after rainfalls. The problem was eventually solved by extending the intake, but keys to managing the situation were: 1) it was a site specific problem, and 2) the system had the capacity to allow for shut down of part of it. An issue especially in small places is lack of attention to duplicating equipment, which would allow shutdown of one half of the treatment plant while the other is still in use. (OSPE; Bonk)
- In determining monitoring frequency, a key question is: how long can a community tolerate having a failure? How can the risk inherent with less frequent testing be justified, especially when the technology is readily available? (OWWA/OMWA)
- There is on-going discussion about coagulation controls: aluminum residuals vs. optimum pH balance in the Great Lakes (Ontario is more interested in aluminum residual than the EPA). Most places in Ontario balance coagulation/stabilization and pH adjustments appropriately to attain low levels of residual aluminum. Disinfection is important but particle destabilization is important in the long term, because of the aluminum residual. (Roberts) A major focus should be better control of coagulation (Pr•vost). It is one of the prime reasons for support of the regional water officer concept - people who are knowledgeable available to assist municipalities (Delcan; Tracy)
- There is general consensus that filter-to-waste is now recognized as a very important procedure and the separate issue of recycling filter-backwash water has numerous potential disadvantages. (OSPE) This process can be achieved by a retrofit in plants. MOE should require it as a condition of its certificate of approval. (Delcan; Tracy) Phasing-in of the process should be considered until the process has been fully developed, including tests with action plans to manage problems. (OWWA/OMWA)

7.5 How can we ensure periodic adequate and constructive reviews and audits of the treatment facilities?

- Both the Partnership for Safe Drinking Water and ISO programs have built in third party review processes which would address this issue
- MOE requirements for Engineers' Reports every three years provides another framework.

7.6 How can we implement efficient remedial measures to correct any treatment failures?

- One tool which could be effective for site specific problems (in smaller systems) is automation and expert systems which have programmed algorithms and historical data gleaned from people who have worked at the plants for many years and are familiar with its specific problems. Pilot projects in Ottawa, Windsor and Brampton used simulations to allow operators to 'tinker ' with operations without disturbing the real plant. These initiatives are necessary to avoid complacency, keep operators interested and prepare them for emergency/unusual situations. (Roberts). MOE contracted University of Toronto several years ago to create knowledge-based expert systems which could be easily instituted at plants of various sizes around the province. Artificial neural networks are not too sophisticated for small plants if the proper system is developed and put online. This would provide the operator with guidance regarding operation (Andrews)

- Completely automated systems which can be operated from a distance, although expensive, may address human resource constraints. (Pr•vost)
- Operations simulators (could be developed which) would allow operators to learn about specific sensitivities/impacts/outcomes (Andrews) It is possible to put local experience into simulators. Simulation of emergencies is a very good idea as it helps to get small operations focused on next steps: should be strong recommendations for this. (Delcan; Doyle, Bagley)
- Expert systems are based on knowledge built up in the system "as is" and in systems that need fundamental change, this can't be done by building on many years of experience of that system as it was. (Pr•vost)
- Some caution should be exercised with expert systems: systems are still in their infancy (Proulx) and automation is prone to failure. Good up-to-date operating manuals containing all contingency procedures are necessary. (OSPE) Operating manuals tell "how" to do something; operator training needs to tell "when" to do something. (Delcan;Tracy) Manuals tend to be shelved; all expert systems and advice won't work without an organizational culture that encourages excellence (OWWA/OMWA; Holme)
- Emergency resources to a small plant undergoing a failure under transient conditions could include a SWAT team or an emergency telephone number of someone (knowledgeable) who could be available quickly to assist. When a small facility fails, there is often a short response time for dealing with these problems, therefore rapid notification becomes important. (Delcan; Doyle)

8. CHALLENGES OF PROVIDING SAFE AND COST EFFECTIVE TECHNICAL SOLUTIONS IN SMALL SYSTEMS

There was some discussion of when private systems become small public systems. A definition of 5 cubic meters per day or 5 or more residences on a system was defined as a small public system. The discussion included these as very small systems and small municipal systems.

8.1 How can we propose treatment and distribution solutions adapted to the constraints of scale (complexity of treatment and operations)?

8.2 How do we ensure quick and adequate remedial response to risk generating events in small and very small systems?

8.3 Should Point of Use or Point of Entry systems be considered as an alternative for very small systems?

The discussion did not follow the questions specifically. The issue of small systems was discussed throughout. The following are some additional salient points:

- The definition of 'small' varies among jurisdictions, does the term relate to size, remoteness, etc.?
- Many of the smaller areas (i.e. Northern Ontario, First Nations reserves) have raw water quality and quantity problems. Treatment systems have been installed in these areas with no accompanying training or plan for maintenance, thus dooming the systems. (Delcan; Tracy) Without expertise, a system should be simple, could be centralized (i.e. membranes), modular and foolproof (OWWA/OMWA; Holme)
- A possible alternative might be to use point of use systems however, maintenance is critical for such devices. They could be maintained by an individual who is also responsible for maintaining water meters (Delcan; Tracy)
- It is easier to put point of use devices in new homes or developments as they are being built. It is very difficult to do so in existing homes. Moreover, there are sensitive issues around entering individual private homes to maintain the devices.
- Should legislation or regulation consider this option? (Delcan; Tracy) The Canadian Drinking Water Safety Act has been drafted and not passed into law. However, it covers certification of chemicals and devices but not maintenance issues. (OSPE; Goodings, Roberts)
- Use of point of use devices may require cultural change for those who are used to drinking lake water (Connell). The proposed Canadian Drinking Water Safety Act covers enforceable standards for direct additives (chemicals added to drinking water), indirect additives (all components of a drinking water system that are in contact with the drinking water - piping, tank linings, etc.) and point-of-use/point-of entry water treatment devices. (OSPE) Maintenance issues were not mentioned. The Act has been shelved several times in the past few years however Roberts confirmed that the act was not "dead" and could be reintroduced sometime in the future.

9. DISTRIBUTION SYSTEMS

The purpose of a water distribution system (DS) is to deliver water in sufficient quantity and of acceptable quality. Distribution systems are complex systems and act as enormous biological and chemical reactors. Poorly maintained distribution systems have been shown to be a source of measurable illness in Canada.

9.1 What are the most important sources of risk in DS? Intrusion through cross-connection, back siphonage, poor replacement practices, inadequate system maintenance, open reservoirs?

- Cross connection and back siphoning are key issues, and air gaps are critical. There is a danger when people wish to maintain their own wells in addition to using the municipal supply (e.g., Ottawa where backflow prevention and air gaps were required for those who wished to keep their own systems). In large systems, backflow prevention is critical. (Delcan; Proulx)

- There is a need for clear and direct policy on distribution systems, specifically, use of fire hydrants and any water service that could have an impact on the system: residential (i.e. wells), and industry which needs a process with inspections, not just by-laws (e.g., buildings with fire-prevention systems with stagnant water in them) (Proulx, OWWA/OMWA)
- The Canadian Water & Wastewater Association has clear policies on cross connection (Delcan; Proulx) but there is a lack of mandatory cross connection programs in Canada (OSPE) Moncton, N.B., United States have them, residual maintenance is a must (Roberts).
- Water main repair is another important source of risk (OSPE)
- In some municipalities in Ontario, cross connection can be under two different organizations: the Building Code (regulating plumbing inspections) is managed by the local municipality or in some cases by the region. There are jurisdictional issues here.(Delcan; Loudon). OWWA/OMWA outlined that it noticed a lack of attention to cross connection issues in the commissioned issue papers.
- There was also some discussion of leakage (Swain, Goodings, Bonk) but it was agreed that while unaccounted-for water is about 10-15% in many Ontario systems, with perhaps half of that being loss through leakage, there is poor info on leaks.

9.2 Traditional design of DS and storage is based on capacity and fire flows. This approach is costly and may accentuate water quality deterioration during distribution unless corrective measures are taken. Does this approach have significant negative impacts on WQ? Can we shift away from this approach that leads to over design?

There is some contention regarding the use and location of storage tanks and reservoirs.

- MOE guidelines are very conservative on the sizing of storage tanks. Balancing storage is needed to take out peaks. The tanks also provide capacity for fire prevention. The net result is a relatively huge volume in small systems in particular, in which the water sits (example is given of a mostly-frozen reservoir in which only a small volume of water is actually available for use). Ice can lead to catastrophic failure. Other methods could be found for ‘start/stop pump’ function and protection for pressure surges. (Delcan; Tracy)
- Tanks are important and should be retained (i.e. for uses such as protecting against pressure surges) (Delcan; Proulx). Operators support tanks (OSPE; Bonk)
- Long residence time and lack of mixing are big problems in reservoirs. The tanks could be sized smaller in new systems that are built, but mixing would also be a simple method for existing systems to decrease residence time in tanks and improve the residual in the system. (Delcan; Andrews)
- The issue of stagnation is being reviewed as part of the engineering reports required by the province. There are comparatively simple systems (e.g., mixing) which are used to introduce recirculation and newer facilities are being

built in that fashion. Freezing is also being better considered in new systems (OWWA/OMWA; Holme)

- There is some concern that the engineers' reports don't deal with the distribution system except for sampling. (OSPE) However, MOE had to start somewhere and deal with what was quickly achievable. It was an excellent starting point. It can now start to look at how to improve (from residual to distribution marker programs) (OWWA/OMWA). MOE didn't include distribution system immediately due to the limited timelines available for the first round of these reports. (MOE)
- MOE will inquire whether municipalities would allow their engineering reports to be provided publicly. The terms of reference for the engineers' reports (standards) is available on the ministry web-site (MOE)

The discussion then focussed on the engineers' reports and the possibility of conflict of interest affecting the quality of these reports (*sample report on MOE website and to be provided to the Inquiry*):

- The conflict arises because the municipality for which the report has been written is paying the engineer, and engineers must compete to win these assignments. Because the terms of reference are external, from the ministry and not the municipality, this leads to a bare-minimum approach by many municipalities of just meeting the regulations rather than looking at ways to improve MOE should fund the whole process to eliminate potential conflict. (Delcan; Tracy, Proulx)
- Notwithstanding that the engineer is operating under a code of ethics, there is a need for specific guidelines for different situations which the engineer is required to report. (OWWA/OMWA). There should be legislation to protect engineers whose reports indicate problems in the system (OSPE)
- If the entire report is made available to the public there may be reluctance on the part of the authors to phrase problems honestly. (OWWA/OMWA; Hagersheimer)
- MOE relied heavily on the professionalism of engineers in these reports. It also asked for a declaration in order to protect the engineer by allowing them to refer to the Terms of Reference. (MOE) There is some funding available for smaller municipalities to pay for the engineers' reports.
- It is evident which of the engineer reports have been prepared by the low bidder (i.e. sometimes reports are skimpy). The reports are to be prepared to the satisfaction of the director [of MOE], and the ministry is reviewing those situations which require it to get considerably more information than that which is included in a report. (MOE). Roberts notes that a review process for such reports still does not result in the best reports, and the process is problematic.

9.3 The distribution system is the last barrier before the consumer. Post disinfection is practiced to provide an additional protection during the transit of water. Major differences in DS disinfection practices exist worldwide. The North American practice calls for the maintenance of a chlorine residual as a preventive measure, whereas the European practices focus on minimizing the use of chlorine (minimal residual or no residual). What approach should we adopt in Ontario?

- Disinfection residual maintenance is necessary, especially where there is danger of contamination at main replacement/repair sites. (OSPE) In North America chlorine residuals are relied on, and that is demonstrated to work. If we decide to change, we need to be careful of how we transition so as not to create a hazard. (OWWA/OMWA; Holme)
- OSPE emphasized the need for a good residual because of the very harsh and unavoidably unsanitary conditions at the scene of most water main breaks. Roberts commented that he would put little faith in a typical residual of combined chlorine to deal with contamination in water main break zones. OSPE strongly disagrees and argues that any level of protection is better than none at all. Pr•vost argues that this may give a false sense of security.
- OSPE has some information regarding record of breaks but it is not particularly good data. Monitoring is necessary at the site of repairs; microbial tests can be done (kits are available) (OWWA/OMWA; Hargesheimer). There are excellent procedures set out by AWWA for water main breaks whereby staff does swabs for micro and chlorine residuals. This is voluntary, not a regulated procedure. A 1996 study in the United States showed that 78% of municipalities don't take samples after such repairs. (OWWA/OMWA; Hargesheimer)
- Legislating residual maintenance in the distribution system is treating a symptom. The European system is good. The problem is disinfectant demand. System disinfection demand should be stipulated in the distribution system. This would solve several problems: disinfection residuals, improved water treatment, pathogen control in the treatment facility, disinfection by-product problems. (Andrews) This measure should apply not to the bulk water per se, but to the system as a whole, which also invokes the issue of corrosion control (Delcan; Andrews, Pr•vost). OWWA/OMWA does not have an official position, but (OWWA/OMWA; Holme) supports Andrews' call for consideration of system disinfectant demand.
- Some discussion occurred regarding the focus of the regulatory terms of reference on microbial contamination specifically rather that a more balanced focus between microbial contamination and disinfection guidelines. MOE focused first on acute issues in its regulations but will address the chronic issues as a factor in the next set of engineers' reports in three years. (MOE). (OWWA/OMWA; Hargesheimer) suggests a need for a more balanced approach, but McGeer disagrees, noting that the major risks are microbial. (McGeer) It is important to pay attention to the implications of enhanced microbial control under details of the new CT standards [concentration-time tables for disinfection using chlorine] which Ontario has adopted, and the balance between disinfection and DBPs. Example: plants that double chlorine to meet inactivation goals, ignoring the fact that they are doubling AOX [adsorbable organic halides] and hiking THMs from 40 to 90, since that is still within the regulated limit (Delcan; Andrews).
- Roberts, (OWWA/OMWA; Holme) disagree that engineers would fail to take such effects into account, and note that comment on potential for forming DBPs is part of the terms of reference of the engineers' reports. Also, there is still a

requirement that the drinking water produced by a plant meet all regulation standards before a certificate of approval will be issued (MOE).

9.4 Corrosion of iron and the release of lead and copper are significant water quality issues in DS. Corrosion control is mandatory in several countries whereas Ontario regulations set a standard for lead. Should full corrosion control be included in the regulations? How can corrosion control be best achieved?

- Jurisdiction is a problem because of private plumbing and the problems which can be created in those systems. One possibility is making sure water isn't corrosive. Any recommendation must be implementable in different jurisdictions, and asset maintenance is critical (OWWA/OMWA; Holme).

10. MONITORING TO ENSURE WATER QUALITY

10.1 Current microbiological quality indicators provide information on water quality after a significant delay. Should better indicators be developed and serve as the basis of compliance monitoring?

10.2 Current monitoring of inorganic and organic contaminants is limited in frequency. Should we re-evaluate the level of protection provided by this monitoring and adjust its frequency?

(OWWA/OMWA; Hargesheimer) noted that the Walkerton Inquiry has not commissioned an issue paper to deal exclusively with Water Quality Monitoring. A number of related issues were suggested for inclusion in the meeting agenda, as follows:

1. Design of monitoring programs
   - Coliform monitoring program
   - Standard operating procedure for main replacement repair
2. Definitions of 'Small Systems'
3. Engineering Reports
   - Physical inspection of monitoring equipment
   - Assessment of 'state of readiness' of utility to undertake the recommended monitoring regime
4. Microbial, physical and chemical monitoring
5. Storage and transport issues for samples
   - Delay time for samples of microbial analysis
   - Transport of samples
6. Use of on-line monitors for small systems

Several of these items are addressed in the ensuing discussion. Salient points of discussion on water monitoring include:

Accreditation of Labs

- There was no accreditation for environmental testing labs until the mid-90s. While the greatest resistance to accreditation came from the public sector, there is now a program in place and all major public labs are accredited (general accreditation, plus accreditation for specific analyses). There is a large body of knowledge on accreditation as it relates to sampling and the credibility of data coming out of labs. To ensure good quality, legally defensible data, a quality control program is required around the monitoring activity, specific to the project. Only one in ten labs produces legally defensible data as routine operating procedure because of the increased cost associated with the need to include spikes, blanks, duplicates and information on variance, etc. Some MOE programs have had data introduced in courts, which was ruled to be legally indefensible because of weak quality control. With no quality control the data is not good. (Delcan; Langley)
- As of six months ago, every regulatory laboratory was accredited or in the process of accreditation. All of the big utilities have labs which are accredited or they use outside accredited labs. (Langley)
- The MOE changed the standards for sampling with last year's legislation. Samplers have to now be certified as "water quality analysts" even for turbidity analysis (Proulx)
- With reference to the 'Nut Island Effect' case, team members may be reluctant to reveal problems which are discovered through monitoring of individual systems. The most successful systems in Alberta are those where a different person collects samples in the distribution system than the person who operates the plant. The person testing turbidity and chlorine residual in the distribution system is different from the person operating the plant. This allows for cross comparison of results. (OWWA/OMWA; Hargesheimer)
- There is a gap between the work done at accredited labs and the work which is done at utilities. Much of the monitoring at utilities is for regulatory purposes. For example, operators are required to collect samples every 4 hours for daily average turbidity, to comply with regulations. In some cases, the turbidimeter is calibrated wrong. Calibration of systems is also critical because there is requirement for less sampling if an operation does on-line monitoring. It is questionable if anyone is overseeing the quality of data coming from online systems and on-site sampling. (OWWA/OMWA; Hargesheimer)

Calibration of Monitoring Equipment

- The terms of reference for engineers' reports require that they look at whether calibration is done. The engineers may or may not be asking the right questions about calibration. There is currently no satisfactory system which assures that online monitors are properly calibrated. (Delcan; Proulx, OWWA/OMWA) There is probably quite a lot of on-line instrumentation which may not be calibrated or which should be calibrated more frequently (OWWA/OWCA; Holme).

- Training is required to learn how to calibrate systems. (OSPE, Delcan; Proulx, Tracy)
- There is an auditing requirement to check calibrations. However, there is no real way of knowing if the results coming from treatment plans are being confirmed. Equipment does have requirements for calibrating and recalibrating frequently. The equipment supplier is sometimes hired to monitor calibrations. (Proulx)
- To make sure the results coming from treatment plants are being confirmed, is it reasonable to have someone check on these instruments? (OWWA/OMWA) That is a role which could be undertaken by the 'rural water officer' as proposed in the Delcan Issue Paper 8 (Delcan). Partners (i.e. inspection teams trained in this field) could be of assistance (OWWA/OMWA). A potential solution is to incorporate with the CAEAL and make it a requirement, as it has a check sample program to verify calibration of instruments. The CAEAL program can be adapted to municipalities and to small labs. (Delcan; Langley)

Communication of Results/Transparency of Process:

Discussion focused on public availability of data, and the need to present information that is understandable, accurate, useful and engaging.

- The purpose of monitoring is not just from a public safety but also a public confidence perspective. In the United States, a lot of data is released. Not only does this allow the public to review the raw data, it also makes the operators more conscientious about monitoring the data to ensure quality (CELA). The public should have access to information which is accurate (OWWA/OMWA)
- MOE regulations now require quarterly reports to be accessible to the public; utilities are making both quarterly reports and lab data available through their offices. Large utilities (over 10,000) are required to post the information on their web-sites and the smaller ones are being encouraged to bring the information on-line (it's a big challenge to even get them to submit formal reports). All accredited labs are reporting their data to MOE electronically. (MOE)
- There are some difficulties with getting information into a common format so that it can be communicated, and with designing a reporting format which a diverse audience can understand. (MOE) An example of one practical problem is the question of how to present data including spikes that occur during recalibration. (Tracy) This could be remedied by explanation notes for every peak. (Pr•vost)
- Information must be presented in a way that will engage people. Engagement of the public is one important method of capturing the attention of elected representatives. Examples were discussed such as the red/green/yellow program for restaurants sponsored by Toronto's Health Department and the water quality index in England. Each has some drawbacks. (MOE, Roberts) There was general concensus that information has to be understandable, dependable and useful. (ALPHA; Pr•vost)
- The format of the quarterly reports is fashioned after consumer confidence reports; they are designed to provide an overview of how the system is and any changes which may have occurred. Most of the reports are very standard from quarter to quarter. What changes, by design, is the educational material and any

reports of exceedences. The reports are only part of what should be made public; lab results should also be publicly available. The reports are by quarter, instead of annual, largely because of public interest in response to the situation which occurred in Walkerton in 2000.

- OWWA/OMWA strongly supports the consumer confidence report approach. When it was first introduced in the United States, there was reluctance to do them. One initial problem was the compulsory (standardized) language which the EPA required in the reports which caused confusion. Eventually the reports have come to be seen not as threatening but as an opportunity to educate the consumer.
- There is consensus that there are insufficient safeguards in the system to prevent falsifying results. It would not be difficult to build in some checks and balances such as simple statistical analysis of incoming data by the MOE.

What monitoring is on-line and how good is the information?

- There is a need to know how many systems in Ontario have online monitors, how they are used and if they are effective for increasing water quality (OWWA/OMWA)
- OSPE remarked that small systems would have difficulty dealing with the equipment involved.
- What should be monitored on-line? In small systems, staff may not know what technologies would be most helpful, and often even basic online instrumentation isn't being used to best advantage (Alberta example) (OWWA/OMWA)
- For small and very small systems, dealing with *methylmeters ?* and other continuous monitoring equipment is a concern. It must be simple and reliable. (OSPE) Should there be a minimum requirement as to what instruments operators have at their disposal?
- There is a practical problem with online chlorine residual testers for small systems. The buffer solution discharge is a disposal problem: where does it go? This is the biggest barrier to installing chlorine residual monitors on some systems. Some alternatives are currently being developed. Manufacturers are competing by offering different features but are ignoring some of the things that are required. (OWWA/OMWA)
- Turbidimeters and chlorine analyzers are not a huge investment and could easily be made a regulatory requirement (Tracy).
- Another serious practical problem in a well house is the location of the sampling line; the chlorine injection and the sample sites must not be too close to each other (Tracy)
- Gruber (OCC) poses the question: Which is more problematic, online or manual testing? Tracy concedes that manual testing may be done in a very amateurish way

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On-line Technology: What is in Use and How Effective is It?

- North America appears to be far behind the technology and online systems that Europeans have in place. There, requirements for on-line instrumentation are linked to source water quality. The instrumentation is used to run the system or shut it down if necessary. EU is moving toward on-line data for regulatory purposes, and is moving away from maximum limits allowable to standards around amount of time in compliance (i.e. readings must be below NTU limits 98% of the time). Does seems to provide better protection than grab samples taken every four hours, as regulations require in Alberta (OWWA/OMWA)

- There are a lot of particle counters installed across the country and much data being generated. Many plants indicate that they are not using the data. (Andrews). Having particle counters doesn't guarantee better water quality. They are excellent if water quality is consistently below .2 NTU but many utilities haven't reached that level. Probably utilities are not using the data that they are getting from turbidimeters enough to optimize the plant; systems have online tools that are not being used to optimize their operations (OWWA/OMWA)
- Question: Is there a difference in qualifications for operators of facilities in Europe, as well as attendant salary/compensation compared to Ontario and Alberta? Would higher pay drive a need for more automation? No answer.
- In monitoring, what is the relationship of operations to safety? Water monitoring is important but the amount sampled is very small in relation to the overall volume of use. Operational monitoring (not necessarily pathogen monitoring) can indicate that the process is working well which gives assurance regarding water quality. (OWWA/OMWA) It allows for optimization and continuous improvement. (Roberts)
- There is some contention regarding the efficacy of streaming current. Streaming current could be used on-line for continuous control of coagulation. Failure to destabilize the particles properly represents a failure to treat water properly. It is done by eye now, yet the technology is available to do it properly in small or large plants. (Tracy) Streaming current has been used, as has zeta-potential analysis, before particle counting was used. The testing is problematic and these technologies do not give the information which is needed (OWWA/OMWA, Pr•vost)
- On-line particle counters and turbidimeters are problematic in that they can't be calibrated on-line. While particle counters are excellent for process in that they show changes which may occur, they are not useful as a regulatory tool (OWWA/OMWA). Instead of absolute numbers, changes in particle count could trigger a response (Andrews, Pr•vost)
- When turbidity is very low, perhaps instead of working to push it lower, that barrier should be recognized as functioning well and improvements should be sought through other sorts of barriers such as ozone (Pr•vost)
- On-line monitoring is not useful for Cryptosporidium, which requires collection of 1000 litres to find a few oocysts. It is a very labour intensive process and by the time the tests are completed, the water has been in the system already for 12 hours or more. It is an unreliable test. (OWWA/OMWA)
- That charge does not apply equally to other microbiologial measures. The purpose of E. coli monitoring is to detect fecal contamination, while Cryptosporidium is straightforward pathogen monitoring. There is a need for E. coli monitoring because it is fast and reliable. Current regulations specify that

25% of samples must be measured for heterotrophic plate count but perhaps it should be measured in all samples. Measuring E. coli does not provides statistical analysis of water quality since results are usually at zero. Heterotrophic Weight Count may not be an indication of coliforms or fecal bacteria, but the test shows trends which provides for a better understanding of that is happening in the distribution system. This is especially useful to monitor the distribution system during main repairs/replacements.

Ground Water Under the Influence of Surface Water

- On the issue of ‘groundwater protected’ and ‘groundwater under the influence’, US EPA first used the term around 1990, with criteria to be used as indicators. Some of the indicators have been challenged The American Water Works Association Research Foundation (AWWARF) conducted a study which wasn’t published because no concensus was achieved regarding the findings (Roberts)
- MOE is working on the concept of groundwater under the influence which probably will be defined as a combination of contaminant indicators plus hydrogeology indicators such as time of travel. It is hoped that the engineers’ reports will provide an indication of groundwater under the influence, in which case chemical filtration will be required. That condition could be modified depending on further hydrogeology reports for specific waterworks.
- Monitoring of aquifers is complex. The regulations are excellent. But they indicate that groundwater under the influence is to be considered surface water, which would require 3 log removal. How can this be regulated without further definition? In the United States, water depth, particulate matter in the well, etc were considered. It is important to know what treatment will be required at the time of the certificate of approval process because treatment could potentially be significantly more expensive and that might be a factor for smaller communities. (Doyle)
- MOE is aware of the dilemma and is working on a terms of reference for the hydrogeologist report. (MOE)
- The 3 log reduction is a guideline which for now is being left up to the individual judgement of the engineer who writes the report and the reviewer. The EPA has developed a Stage 2-bin system which relies on E. coli and not Giardia. (MOE)
- MOE standards tables appear to be applicable only to chlorine. Can these be applied to other treatments or will new standards be developed? (Andrews) MOE is not aware of any at this time, but while for most purposes chlorine will be used, the MOE is open to other alternatives as well. (MOE)

11. ROLE OF GOVERNMENT IN PROVIDING TECHNOLOGY ASSISTANCE

This agenda item was discussed throughout the meeting. The related points are throughout the notes particularly in 4.1.2 and 4.2.1.

Consensus statements (summarized by Doyle with additions from others)**:**

- **Leadership:** there is a sense that political leadership is failing. It is crucial that politicians shift from seeing provision of safe drinking water as a cost or economic drain to understanding it as an opportunity. There is an attendant opportunity for economic development: employment, and the export opportunities that will follow from the return of Ontario's reputation as a world leader. If Ontario believes in itself, politicians' approaches may follow, especially in terms of support for advice-giving and regulatory agencies who have experienced recent funding cuts.
- **Continuous Improvement:** there is consensus that Ontario must move to continuous improvement in its water treatment. There are many models and there is debate upon which is best suited for Ontario. Notwithstanding this, there is a recognized need for third party accreditation. It is not good enough to simply meet minimum standards of practice and regulations. It is necessary to address unregulated parameters as well. An example is Crytosporidium. What is 'good enough' treatment? Is conventional good enough? When do you know when you need to try additional treatments because conventional isn't good enough?
- **Different kinds of systems and situations must be taken into consideration:** There are important differences between: big and small operations; urban and rural locations; groundwater and surface water requirements; regular operations and emergency situations. How an operation responds to emergencies and what resources are available to do so are key. Using the example of Crytosporidium, how do smaller municipalities deal with it? Is it good enough just to attain very low turbidity? Should the municipality wait for regulation or go ahead of it to combat the problem? How is the cost balanced? (Doyle)
- **Support for Small Facilities:** Operations, rather than design/infrastructure, was identified as the most important point of failure in small systems. One suggestion (in Delcan Draft Issue Report 8: Production and Distribution of Drinking Water) is the creation of the position of Regional Water Officers (modeled after the Medical Officer of Health with a regulatory and advisory function) who would gain knowledge of the particular water plants in their areas as well as the confidence of their operators in order to provide assistance to them. It's unrealistic to expect all operators to be trained to operate competently under all conceivable conditions. Support mechanisms must be available to them in times of emergency. In ordinary operating conditions, operators do not need to know a lot but in adverse conditions, they need to be able to access information rapidly. Other options – training, expert systems and simulation – were also suggested. Redundancy, either in infrastructure or in operational procedures (shut-down, notification), was identified as a key protection against system failure that is often lacking, especially in small systems.
- **Funding:** there is very strong agreement that an adequate funding level must be maintained to meet the new requirements of the legislation and also to allow for the costs associated with improved distribution systems. There is a feeling that in larger municipalities, many can afford to pay for better drinking water, but there is a question of whether smaller municipalities are able to do so. Can they afford production costs, as well as capital and infrastructure replacement costs?

However, funding should not come in the form of grants which reward "bad actor" municipalities that do not have a system in place (reserve funds, user-pay system, etc.) to cover costs, and which move from crisis to crisis. One alternative is for the government to provide loans instead of grants. In the United States, there is an established revolving loans system to assist municipalities with their needs and which recognizes that municipalities have a system in place to manage themselves. In the United States some systems don't receive funding until their internal operations have been reviewed by an auditor.

- **New MOE Standards:** There is general consensus that the new Ministry of the Environment regulations go a long way in promoting a proactive approach to protecting drinking water safety. (Andrews)
- **Public Participation:** There is agreement on the general principle of an enhanced role for the public, but the appropriate point(s) of involvement were not determined and there is no consensus yet on how this principle should be operationalized. Disclosure requirements were seen as an opportunity to educate the public, to allow the public a voice in making cost-benefit decisions, and to harness public opinion as political pressure for making safe water a priority. (CELA)
- **Research and Development:** There is consensus that there should be increased support for research and development related to treatment, distribution and monitoring of drinking water in Ontario. (All)
- **Innovation:** There is consensus that innovation should be supported but no consensus on how to foster that goal. A key factor which drives innovation is regulatory enforcement. New membrane technologies, for example, were put in place through the design-build process. If the MOE regulations focused on the finished product (result) rather than the technology used (process), the development of new technologies could be facilitated. MOE has, in fact, shifted toward performance-based approvals. Links between researchers, designers and regulators are needed, to facilitate knowledge and innovative application of new technologies. Drinking water professionals have resisted change in the past, but there is a shift as customers are demanding new technologies before manufacturers are able to provide (UV is a good example). Public involvement and the Crytosporidium issue have helped to support this paradigm shift. (CELA, OSPE, Langley, Tracy, MOE)