WALKERTON INQUIRY PART II

Review of Issue #8 - Production and Distribution of Drinking Water

Prepared on behalf of the Ontario Water Works Association and the Ontario Municipal Water Association

August 2001

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APPENDICES

EXECUTIVE SUMMARY

The Ontario Water Works Association and the Ontario Municipal Water Association (OWWA/OMWA) requested assistance in the evaluation of some of the reports presented as information for Part II of The Walkerton Inquiry. This review looks at the report entitled "Production and Distribution of Drinking Water" as prepared by the Delcan Corporation (author: E. Doyle *et al*).

The Commission defined the scope of Issue # 8 as follows:

> *A major paper - integration of treatment (including disinfection, and including standard and novel technological alternatives) and measurement. Big systems: best practices in bigger cities; case examples of Toronto and one or two other North American/European cities thought exemplary in the industry; effects of source quality on cost and risk. Smaller systems: best practices, costs and risks, source quality effects on costs. Private supplies: rural homes, cottages, farms; effects of source quality on costs/outcomes. Role of ISO standards, if any. Implications of non-real-time measurement. Establishes costs, capital and operating, in some detail as a function of system scale and scope, water source, and customer density. Assessment of various estimates of the costs to bring Ontario systems up to standard.*

Although the Delcan report did a commendable job summarizing an array of drinking water related issues, it can be argued that this issue paper did not respond to all the items in the scope, most particularly to the "costs to bring Ontario systems up to standard".

The OWWA/OMWA has attempted to analyze the data presented, however, data discrepancies and the limited number of case studies presented made this quite difficult. The difficulties encountered in analyzing the data highlights the need to obtain and maintain accurate information for record keeping and benchmarking purposes.

Based on the foregoing, the OWWA/OMWA recommends that in its final report to the Ontario Government on matters related to the production and distribution of safe drinking water, the Commission recommend:

Best Management Programs

1. That any proposed legal or regulatory regime on drinking water in Ontario should recognize and encourage the identification and implementation of best management practices, including continuous improvement programs, while having regard for the programs developed by the American Water Works Association, including but not limited to: QualServe™, Partnership for Safe Water and the International Water Treatment Alliance.

   Rationale - The American Water Works Association (AWWA) is the world's largest educational and scientific association for water supply professionals. The Association believes, and the OWWA/OMWA endorse in the Canada-Ontario context, that few environmental activities are more important to public health

than ensuring the protection of water supply sources and the treatment and distribution of a safe and healthful supply of drinking water.

Founded in 1881, AWWA now has over 56,000 members dedicated to water quality and public water supply. The AWWA expertise encompasses managers and operators running public water systems, public health officials overseeing regulatory programs, engineers designing distribution systems, scientists analyzing water quality, researchers developing new treatment technologies, academicians studying innovative water management techniques and educators imparting knowledge concerning water.

AWWA's formal standards process has been used for more than ninety years to produce ANSI registered material standards that are used by the water utility industry. These standards are recognized worldwide and have been adopted by many utilities and organizations.

The AWWA further applies its knowledge and expertise to assist water utilities enhance their performance and customer service by developing policies, white papers, manuals and the above noted best management programs/practices.

The Commission's report, as prepared by the Delcan Corporation, highlighted the established programs of the AWWA. The OWWA/OMWA stand ready to share this knowledge with the Government of Ontario.

And further, that the Government of Ontario work with the OWWA to implement the International Water Treatment Alliance in Ontario.

Rationale - The International Water Treatment Alliance (IWTA) is a program adapted from the US Partnership for Safe Water for use in other jurisdictions such as Canada and Australia. As part of the program, utilities voluntarily adopt proven operational and administrative practices designed to improve treatment plant performance. It is noteworthy that the Quebec Section of AWWA received provincial funding to implement the IWTA program. The program has been a major success - within two years more than half of the Quebec population is served by plants that have joined the program.

The implementation of this program would help to re-build the public's trust in Ontario's drinking water supplies.

And further, that the OWWA/OMWA be consulted with respect to the implementation of other developing programs such as accreditation.

Rationale - It is AWWA's vision that accredited water and wastewater utilities be recognized worldwide as well operated and efficiently managed. The accreditation program that AWWA is developing is intended to serve water and wastewater utilities and their customers, owners and government regulators by

promoting improvements in the quality of services and efficient management through the establishment of standards and formal recognition of accrediting bodies.

The OWWA/OMWA stand ready to share their collective experience and expertise with the Government of Ontario to ensure best management practices and policies are considered in any future government program.

Treatment and Distribution

2. That the Government of Ontario continue to support the practices of filtration of surface water used as sources of public water supply, disinfection of public water supplies, including the maintenance of residual disinfectant in the distribution system, and adequate monitoring to assure conformance with water quality standards.

Rationale - The application of the multiple barriers noted above, to prevent contaminants from entering the water supply system and/or control transmission through the system, is universally recognized as a critical and fundamental tenet for effective drinking water quality management and for ensuring the supply of safe drinking water. The strength of multiple barrier systems is that a failure of one barrier may be compensated for by effective operation of the remaining barriers; thus minimizing the likelihood of contaminants passing through the entire treatment system and being present in sufficient amounts to cause harm to consumers. (NHMRC/ARMCANZ Co-ordinating Group).

The OWWA/OMWA support the multiple barrier concept, namely:

- selection of the purest sources of water;
- source protection to prevent or control contamination;
- filtration or removal of contamination;
- effective operation and monitoring of drinking water treatment facilities;
- disinfection to inactivate microorganisms, including an adequate disinfection residual;
- operation and maintenance of distribution systems (including storage) to preclude contamination or degradation of treated water; and
- monitoring and response to detect possible breakdowns in the barriers.

As the population continues to increase and put pressure on natural resources, finding high-quality source water will become more difficult and water treatment systems will increase in importance as a barrier to waterborne illnesses.

3. That the Government of Ontario encourage utilities to implement best management practices for water distribution systems as outlined in this review.

Rationale - The water distribution system is the last protective barrier before the consumers' tap that needs to be operated and maintained to prevent contamination of water. To ensure delivery of high quality water to each consumer, water utilities must be continually vigilant to any intrusion of contamination or occurrences of microbial degradation in the system. Water in a distribution system must be seen as a perishable product that has a shelf life, packaging and a preservative. The shelf life is the time that the water spends in the system on its way to the consumers' tap, the packaging is the complex water network, and the preservative is the disinfectant - either free chlorine or chloramines.

To avoid water quality problems, water utilities must:

- maintain positive pressures and fire flows;
- manage water age;
- maintain a chlorine residual;
- keep the distribution system clean;
- provide treatment that does not allow water to degrade in the system; and
- monitor water quality.

The five steps recommended by AWWA to achieve the above and optimize distribution system water quality include:

Step 1 - understand your distribution system and define the problems (i.e. microbial safety, disinfectant residual maintenance, taste and odour prevention, corrosion control);
Step 2 - set water quality goals and establish preliminary performance objectives;
Step 3 - evaluate alternatives and select the best approach (i.e. monitoring, operational changes, system maintenance, source water treatment, engineered solution, management - often more than one solution will be necessary);
Step 4 - implement good management practices and monitor effectiveness;
Step 5 - finalize performance standards and develop standard operating procedures.

4. That there be created, by statute, the position of Chief Water Official for each water authority in the Province.

Rationale - It is envisioned that this position would be comparable to that of the Chief Building Official required under the Building Code Act. This position is required because water utilities in Ontario currently do not have the statutory authority to take the measures necessary to control backflow hazards from private property to the public distribution system. Although plumbing codes have always prohibited any connection whereby potable and non-potable water could mix, there are few details as to the specific device to use to prevent cross connections and many connections are overlooked.

Cross connection protection is not new, but incidents of contamination and concern for legal action - in the event that a public system becomes contaminated and a death or serious illness occurs that could have been prevented by the installation of a backflow prevention device - have heightened the concern of water authorities in this regard. Water utilities should therefore have the statutory mandate to inventory and ensure cross connection control.

In addition to dealing with cross connection control issues with the Chief Building Official, the Chief Water Official should work with the Fire Chief regarding fire protection and the local Medical Officer of Health regarding water quality.

Due to the technical nature of this position and the responsibilities vis-à-vis public health and safety, this person should likely be a Professional Engineer. Professional engineers are bound, first and foremost, to protect the public per The Professional Engineers Act of Ontario. It is important that the person responsible for water understand all the ramifications of their actions and that they regard their duty to public welfare as paramount.

And further, that the Government of Ontario clarify, by statute or regulation, the roles and responsibilities of the Chief Water Official as they relate to cross connection control and other areas of potential jurisdictional conflicts related to private property.

Rationale - It is important to clarify the roles of the water utility with regard to the approvals of cross connections and other related matters.

5. That the Government of Ontario and municipalities participate in drinking water research and that participation in the AWWA Research Foundation be encouraged.

Rationale - The risk chain for drinking water involves contaminant sources, a vector (water), treatment for removal, transmission to the population, ingestion, infection and finally disease. Without a thorough understanding of this entire chain, neither the public nor the government decision-makers have a solid basis on which to judge the safety of drinking water.

It is with the above in mind that the AWWA Research Foundation has, since 1986, supported nearly 450 research projects valued at more than $100 million (US). Many of these projects have been or are being conducted by Canadian researchers. The funding of this research comes primarily from the Subscription Program. Water utilities subscribe to the research program and make an annual payment proportionate to the volume of water they produce. Consultants and manufacturers subscribe based on their annual billings.

The foundation's research agenda addresses a broad spectrum of water supply issues: resources, treatment and operations, distribution and storage, water

quality and analysis, toxicology, economics and management. The ultimate purpose of the coordinated effort is to assist water suppliers in providing the highest possible quality of water economically and reliably.

Research is critical to advance the science of water to improve the quality of life. Any research activities must be coordinated to avoid duplication of effort while ensuring research relevant to local needs.

6. That the Government of Ontario support the consumer principles outlined in this review.

Rationale - Water utilities have traditionally measured their success by the quality of the water they provide, with limited emphasis on customer satisfaction. It is important to realize and respect that customers define satisfaction not only by the product but by the services and related information they receive.

Capacity Development

7. That an analysis be conducted to determine how much additional investment will be needed over the coming decades for infrastructure upgrades. These infrastructure needs should encompass both what is required to comply with Ontario Regulation 459/00 (Drinking Water Protection), as well as what will be needed to replace and rehabilitate aging water treatment and distribution facilities regardless of regulatory mandates.

Rationale - Water is by far the most capital intensive of all utility services, mostly due to the cost of pipes - infrastructure that is buried out of sight. A large portion of the existing pipes were originally installed and paid for by previous generations. They were laid down during the economic booms that characterized the last century's periods of growth and expansion. Watermains last a long time (some more than a century) before their maintenance costs increase near the end of their useful life. The replacement of pipes installed in the latter half of the 20th Century will therefore dominate the remainder of the 21st Century.

Unfortunately for Ontario, research indicates that pipes installed between 1963 and 1975 - the construction boom for many water systems - are most likely to fail in the future. As such, it is important to assess the condition of the systems in Ontario to determine their age and "life span" and to project the future investment needs.

The need to finance the replacement of pipes in the coming decades may challenge many utilities financially, particularly those that currently do not include an infrastructure renewal allowance in their rates. In some communities, the concurrent need to finance pipe replacement along with treatment plant upgrades will significantly increase the challenge.
The Commission's report notes that "it is critical that investments in system rehabilitation be a normal part of water system expenditures. To determine

whether current levels are sufficient or what the levels should be, more detailed information on water systems is needed." (Page 30)

The OWWA/OMWA agree that this analysis should be conducted to determine how much additional investment will be needed over the coming decades for infrastructure upgrades. The central question for policy makers and utilities is whether the rate of infrastructure spending that utilities will face over the next 30 years can be financed by the utilities themselves at rates consumers can afford.

The province must anticipate future needs to ensure the financial capabilities exist to meet public expectations regarding safe drinking water. Furthermore, proper financial planning to replace physical assets must be mandated (i.e. it should be a legal requirement to include a certain percentage of asset value per year to pay for infrastructure renewal).

8. That a system viability analysis be performed and in conjunction with, or pending the results of, that analysis regulations be developed that would permit municipalities to decide how to achieve a legislative obligation to have sufficient financial, technical, managerial, and operational expertise and capacity through such options as retaining consultants, sharing resources with adjacent municipalities, or voluntarily entering into amalgamations having regard to the need to potentially protect drinking water quality on a watershed basis.

Rationale - The AWWA has a published policy on regionalization of water utilities, namely:

> *The American Water Works Association (AWWA) encourages water utilities to identify local and regional solutions to resource management and water supply service needs. If a regional program is necessary or desirable, water utilities should work with the appropriate levels of government to develop the program and promote the use of good utility management principles. State, provincial, territorial and federal agencies are encouraged to support local government efforts to develop a regional program and ensure equitable benefits to all water utilities.*

The viability of drinking water systems is critical to the protection of public health and the conservation of public resources. Viable systems are defined as self-sustaining systems that have the financial, technical, managerial, and operational expertise and capacity necessary to reliably meet all present and future requirements in a comprehensive manner that assures the continued delivery of safe drinking water. Given the number of small systems in Ontario, a system viability analysis to ensure all systems are self-supporting entities is needed. Accordingly, amalgamation of systems may be necessary to ensure the viability of some systems. The problem, as outlined in the Commission's report, is likely the 89% of the plants serving 11% of the population. In some

instances, these plants/systems may not be viable and may be the cause of varying levels of service across Ontario.

A more detailed analysis is necessary to determine: where are the small systems; what are the costs to operate these systems; is regionalization with a nearby larger system feasible; can a number of small systems operate as a "larger" regional system to achieve some economies of scale; how will the large geographic area in northern Ontario impact regionalization; does the smaller geographic areas and larger populations in the Southwestern and Eastern Regions make the consolidation of systems more feasible.

And further, that the costs necessary to develop the financial, technical, managerial, and operational expertise and capacity of water utilities be included in the cost of service.

Rationale - With the increasing complexity of water treatment and environmental conditions and more stringent drinking water regulations, system viability assessments must not only address financial considerations, but also the technical, managerial and operational expertise and capabilities of the water utility to satisfy public health and safety requirements on a long-term basis. All training and education necessary to develop the technical, managerial and operational expertise and capabilities of the water utilities must be included in the service cost.

It is noteworthy that even a well-financed water system with the most advanced treatment technologies cannot deliver its water reliably unless its staff is adequately trained. Without this investment in human resources, the implementation of the above will not be possible.

Review of Issue #8 - Production and Distribution of Drinking Water

1.0 Introduction

The Ontario Water Works Association and the Ontario Municipal Water Association (OWWA/OMWA) requested assistance in the evaluation of some of the reports presented as information for Part II of the Walkerton Inquiry. This review looks at the report entitled "Production and Distribution of Drinking Water" as prepared by the Delcan Corporation (author: E. Doyle *et al*).

The Commission defined the scope of Issue # 8 as follows:

> *A major paper - integration of treatment (including disinfection, and including standard and novel technological alternatives) and measurement. Big systems: best practices in bigger cities; case examples of Toronto and one or two other North American/European cities thought exemplary in the industry; effects of source quality on cost and risk. Smaller systems: best practices, costs and risks, source quality effects on costs. Private supplies: rural homes, cottages, farms; effects of source quality on costs/outcomes. Role of ISO standards, if any. Implications of non-real-time measurement. Establishes costs, capital and operating, in some detail as a function of system scale and scope, water source, and customer density. Assessment of various estimates of the costs to bring Ontario systems up to standard.*

There are six section in this report. Section 1 outlines the scope of the Issue #8 report. Section 2 summarizes our review of the Commission sponsored report (as prepared by Delcan). Association policies and white papers are presented in Section 3. Section 4 includes supplemental comments by OWWA/OMWA on priority issues. Conclusions are discussed in Section 5 and recommendations are submitted in Section 6. It is noteworthy that our analysis follows the layout of the Delcan report and issues have not been arranged in order of importance.

2.0 Summary of the Delcan Report

The Delcan report is divided into the following three parts:

Part I - Ontario Today: Drinking Water Treatment, Standards, Practices and Technologies;
Part II - Drinking Water in Other Jurisdictions; and
Part III - Making Ontario Water Treatment a World-Leader.

A detailed review of the Delcan report is presented in Appendix A of this report. The following summarizes some of the key findings presented in the report.

2.1 Part I - Ontario Today

a) Regionalization of Water Utilities

The Delcan report does a commendable job of summarizing the number of water systems in Ontario albeit with data discrepancies as noted in Appendix A of this report. The data, as summarized in Table 1, indicates that approximately 11% of the plants in Ontario serve 89% of

the population while the remaining 89% of the plants serve 11% of the population. The report concludes that "drinking water treatment in Ontario is therefore quite heavily polarized" (Page 4). The report also notes that "while the trend in many parts of North America is to merge [or regionalize[1]] several treatment plant and distribution systems to improve quality and supply, a large number of small individual systems remain in southwestern Ontario" (Page 4).

Table 1 - Water Treatment Plant Distribution by Region

Region	Number of Plants[1]	Number of Plants Serving			
		<1K	1K-10K	10K-100K	>100K
Central	41	7 (17.1%)	20 (48.8%)	9 (21.9%)	5 (12.2%)
West Central	45	20 (44.4%)	21 (46.7%)	1 (2.2%)	3 (6.7%)
Southwestern	247	157 (63.6%)	68 (27.5%)	18 (7.3%)	4 (1.6%)
Eastern	129	62 (48.0%)	53 (41.1%)	13 (10.1%)	1 (0.8%)
Northern	114	54 (47.4%)	49 (43.0%)	11 (9.6%)	0 (0.0%)
TOTAL	**576**	**300 (52.1%)**	**211 (36.6%)**	**52 (9.0%)**	**13 (2.3%)**
Population Served[2]	**8.8 million**	**1.0 million (11%)**		**7.8 million (89%)**	

Notes: 1) Excludes missing 53 plants.
2) Estimated from Figure 1.4.2.

While I agree with the above statement regarding the polarization of water treatment in Ontario, the data, as summarized in Table 2, indicates that the Northern Region has the smallest population but the third most plants while the smaller southwestern area has the second largest population but the majority of the treatment plants.

A review of the average number of people served per plant, also shown in Table 2, indicates that the lowest densities occur in the Northern, Southwestern and Eastern Regions, respectively. This problem may be exacerbated in the Northern Region where there are only 11 plants serving more than 10,000 people versus 22 and 14 in the Southwestern and Eastern Regions, respectively (see Table 1). None of the 11 larger plants in the Northern Region serve more than 100,000 people whereas there are four plants in the Southwestern Region that serve more then 100,000 people and one in the Eastern Region. It would be useful to know the size and location of the 53 plants missing from the data to assess whether there are more or less small systems and how these are distributed by Region.

The report also indicates that the 629 plants in Ontario are operated by 229 water authorities serving 309 municipalities (Page 20). From the data presented, one can determine the average number of people served per authority (see Table 3). Table 3 clearly highlights the small customer base in Ontario towns and villages. The polarization trend also remains obvious with

[1] Bracketed text added by the author.

85% of the authorities serving 8% of the population (excluding 36 systems as noted in the Delcan report).

Table 2 - Average Population Served per Plant by Region

Region	Population	Number of Plants	Average Number of People Served per Plant
Central	3.9 million	44	88,636
West Central	1.3 million	58	22,414
Southwestern	1.7 million	260	6,538
Eastern	1.2 million	140	8,571
Northern	0.7 million	127	5,512
TOTAL	**8.8 million**	**629**	

Table 3 - Average Population Served per Water Authority

Source Type	System Type	Authorities (#)[1]	Serviced Population	Population Per Authority
Surface Water	Regions	6	5,059,147	843,191
	Cities	17	1,290,121	75,889
	Towns	55	350,028	6,364
	Villages	25	39,837	1,593
Total - Surface Water		**103**	**6,739,133**	
Ground Water	Regions	2	384,760	192,380
	Cities	4	242,525	60,631
	Towns	37	200,442	5,417
	Villages	47	53,789	1,144
Total - Ground Water		**90**	**881,516**	

Notes: 1) Includes a total of 193 authorities out of a possible 229.

Unfortunately, the data, as presented, makes it impossible to determine how many plants each of the 229 water authorities operates and thereby assess the benefits of the currently existing level of regionalization in Ontario. The American Water Works Association (AWWA) has a published policy on regionalization of water utilities. It is presented in full in Appendix B but the concluding position of the policy is summarized as follows:

> **Policy on Regionalization of Water Utilities** (**Adopted by the Board of Directors June 15, 1980, reaffirmed Jan. 25, 1987, revised Jan. 31, 1993 and June 21, 1998)**
>
> *The American Water Works Association (AWWA) encourages water utilities to identify local and regional solutions to resource management and water supply service needs. If a regional program is necessary or desirable, water utilities should work with the appropriate levels of government to develop the program and promote the use of good utility management principles. State, provincial, territorial and federal agencies are encouraged to support local government efforts to develop a regional program and ensure equitable benefits to all water utilities.*

Based on the foregoing, a more detailed analysis should be conducted to assess whether additional system regionalization in Ontario would be beneficial. Many small systems are well operated and provide excellent water quality. As such, the number of systems that are nonviable may be quite small.

The viability of drinking water systems is critical to the protection of public health and the conservation of public resources. Viable systems are defined as self-sustaining systems that have the financial, technical, managerial, and operational expertise and capacity necessary to reliably meet all present and future requirements in a comprehensive manner that assures the continued delivery of safe drinking water. The AWWA has prepared a White Paper to assist in defining water system viability. It is included in full in Appendix C. The National Research Council in the United States (US) has also developed a "system viability review" process. It is briefly discussed in Section 4 of this report and is described in full in the text entitled "Safe Water From Every Tap - Improving Water Service to Small Communities".

b) Future Investment Requirements

The Delcan report indicates that "fully 96% of water revenues and 95% of sewer revenues are from local sources. Only $38 million or 4% of water revenues and $45 million of sewer revenues came in the form of grants from outside sources. Thus most of the costs are locally funded. Whether or not sufficient investment is currently being made in municipal water systems may be questioned. However, the recovery of current investment levels is very close to full cost recovery" (Page 19). Figure 1.10.5 highlights that the 96% of water costs recovered from local sources comprises: user rates - 80%; property taxes - 8%; other local sources - 8%. The remaining 4% comes in the form of grants from outside sources.

A recent study by the AWWA indicates that significantly more investment will be necessary in the US in the future due to "demographics". The study found that the major periods of watermain installation in the 20 US systems investigated occurred in the 1890s, the Roaring Twenties and the post-World War II (WWII) era. Because construction techniques and materials used for drinking water pipes changed over the years, pipes from different eras have different life spans. Pipe technology was such that pipe laid in the late 1880s has an average useful life of about 120 years, that buried in the 1920s about 100 years and that put in the ground after WWII about 75 years. As a result, the next 30 years will see infrastructure replacement become a top priority for water utilities (Hoffbuhr, 2001).

AWWA's study was the first to analyze specific utilities' infrastructure replacement needs, rather than relying upon survey-based estimates, to forecast infrastructure investment requirements. Using specific information about pipe age and break rates from 20 of the largest utilities, the AWWA report concluded that the US will need to invest another $250 billion over 30 years to replace aging watermains, valves and fittings. These costs are in addition to the $12 billion already being spent every year by utilities on infrastructure renewal.

This "demographic" trend means that the average utility can expect to spend three and a half times as much on replacing pipe as it does today (Scharfenaker, 2001). The challenge is how to increase utility budgets sufficiently to prepare for the upcoming replacement era while having regard for household affordability issues.

To address this challenge, AWWA recommended a new partnership for clean and safe water. This partnership would require that all levels of government and utilities play a role in working through the significant challenge ahead. Specific recommendations included the following:

- assess the condition of the drinking water system;
- strengthen research and development (i.e. to find new technological tools to solve infrastructure management problems and hence reduce costs);
- work with the public to increase awareness of the challenge ahead, assess local rate structures and adjust rates as necessary;
- build the managerial capacity of water systems;
- ensure appropriate financing methods are in place (i.e. state revolving funds).

In Ontario, many water systems were constructed in the late 1960's and early 1970's. Unfortunately, research has indicated that pipes installed between 1963 and 1975 are most likely to fail in the future, probably because of the type of material used and the poor workmanship of the period (Besner et al, 2001). As such, it is important to assess the condition of the systems in Ontario to determine their age and "life span".

The Delcan report notes that "it is critical that investments in system rehabilitation be a normal part of water system expenditures. To determine whether current levels are sufficient or what the levels should be, more detailed information on water systems is needed." (Page 30)

The OWWA/OMWA agree that this analysis should be conducted to determine how much additional investment will be needed over the coming decades for infrastructure upgrades. These infrastructure needs should encompass both what is required to comply with Ontario Regulation 459/00 (Drinking Water Protection), as well as what will be needed to replace and rehabilitate aging water treatment and distribution facilities regardless of regulatory mandates.

c) Ontario Drinking Water Standards and Regulation 459/00 (Drinking Water Protection)

The Delcan report does a commendable job of summarizing the standards, guidelines and objectives that apply to the water works community. The OWWA/OMWA agree that source water protection, effective treatment and disinfection, an adequate disinfectant residual in the distribution system and an effective system water quality monitoring program, provide the best overall protection. It is also critical that authorities responsible for water safety have policies in place for issuing and rescinding boil-water orders, and that they have a contingency plan in place to deal with a waterborne disease outbreak per our recommendation in the Issue 12 Response Paper (MacDonald, 2001).

In addition to the comments provided in the OWWA/OMWA Response Papers for Issue 5 (Gammie, 2001) and Issue 7 (Hargesheimer, 2001), the following should be clarified vis-à-vis the Ontario Drinking Water Standards and Regulation 459/00 (Drinking Water Protection):

Standards, Objectives and Guidelines - It should be clarified that the health related standards (i.e. MAC and IMAC) are enforceable whereas the aesthetic objectives (AO) and operational guidelines (OG) are not.

Variance Provisions - The following statement is included in Section 2.2 (Approval of water works) of the ODWS:

> *"Normally, the source analyses should include all physical, chemical and bacteriological parameters identified in Tables 1 through 4. However, where general knowledge and/or historical data indicate that, in the proposed water source, particular substances (e.g. radionuclides) are consistently absent or below the level of concern, these substances/parameters need not be included in the analyses, provided that such elimination has been agreed to, in writing, by the MOE."*

Since variance provisions, based on general knowledge or historical data, are included in the ODWS for the approval of a water works, a formal variance provision process should also be included in Ontario Regulation 459/00 (Drinking Water Protection) which establishes the sampling frequency for existing systems.

Responsibility for water quality - Section 2.3 of the ODWS indicates that "the municipality that distributes the drinking water is responsible for its quality." It would be useful to add the responsibilities of the local Medical Officer of Health and the Ministry of the Environment. This should include, as a minimum, the information in the Media Backgrounder entitled "Protecting Ontario's drinking water" and dated August 8, 2000, namely:

> *"The local Medical Officer of Health and the Ministry of the Environment share responsibility for protecting the public. The Medical Officer is responsible for declaring the drinking water is unsafe and advising the public of any precautions that should be taken, such as boiling water. The ministry is responsible for ensuring that the waterworks owner takes corrective action."*

Engineers' Report - The principal objectives of the Engineers' review and Report are to assess the potential for microbiological contamination of the water works (i.e. source water characterization) and to identify operational and physical improvements necessary to mitigate this potential utilizing multiple barrier concepts. In addition, a monitoring regime for the entire system will be identified to ensure compliance with the Ontario Drinking Water Standards and Regulation (MOE, August 2000 and Revised January 2001). The Engineers' Report is a comprehensive process that includes components similar to the source water assessment process included in the 1996 USEPA Safe Drinking Water Act (SDWA) Amendments and many parts of the Australian "Framework for Management of Drinking Water Quality".

The Engineer's Report process is an excellent step towards ensuring water authorities in Ontario continue to produce safe drinking water in the future. It is expected that the new consolidated Certificates of Approval will set the conditions to ensure same.

The OWWA/OMWA commends the MOE for introducing this review process. We recognize, however, that there will be room for improvement as the process evolves. Most notably, as source waters are characterized, information on significant sources of contaminants will become available (i.e. source water assessments). If these sources of contaminants can be mitigated, protection plans will be developed. If these sources cannot be mitigated, treatment enhancements will be implemented - or a combination of both options will occur. The MOE's Technical Brief on "Waterworks' quarterly reports for consumers" (August 2000) requires that

the water source section of the quarterly report include information on the source water assessments and/or protection plans if this information is available.

The province should focus on incorporating public consultation into the system review process rather than simply requiring the utility to report this information to the public. This would ensure the public is provided an opportunity to comment on the establishment of levels of service, costs, existing water quality problems, and the options for protection and improvement of drinking water quality including land use constraints, changes in treatment or infrastructure. Consumers should also be consulted on monitoring requirements and mechanisms for public reporting of system performance.

Also, since the distribution system is the last barrier before the consumer's tap, requiring sanitary surveys and/or distribution system water quality modeling for selecting sampling and monitoring locations would be another enhancement to the process. Water quality models allow utilities to better understand the dynamics of their distribution systems and the factors that can affect water quality. A clearer understanding of the reasons for water quality deterioration in the distribution system is important because research suggests that the rate of gastrointestinal illnesses increases with water quality degradation (Payment, 2001).

d) Best Management Practices

Section 3 of the Delcan report provides an excellent checklist for developing best-in-class utility operations in Ontario. The only exception is the discussion on water distribution system requirements - it does not reflect the latest goals and best management practices for system management. A whole section should have been dedicated to this topic given the importance of the water distribution system as the last protective barrier that needs to be operated and maintained to prevent contamination of water as it proceeds to the customer.

Section 3 of this review discusses a number of AWWA policies and white papers that are submitted to supplement the Delcan report. Water quality goals and best management practices for water distribution systems are presented in Section 4 of this report.

e) Water Treatment Technologies

The Delcan report discussed the following treatment processes: coagulation and flocculation; sedimentation; filtration and disinfection. Although the report included an excellent explanation of the CT concept and the balanced approaches to disinfection, there was little discussion on the difference between primary and secondary disinfection and the need to maintain a residual in the water distribution system. In addition, there was no discussion on the multiple barrier concept or other treatment processes and novel technologies.

I felt the discussion fell short of the Commission's study request (i.e. a major paper - integration of treatment, including disinfection, standard and novel technological alternatives, and measurement). A discussion starting with the components of the multiple barrier approach would have been useful. This would have allowed the authors to:

- outline the health and aesthetic aspects of water quality and treatment;
- identify the benefits of source water quality management;

- describe conventional water treatment processes (i.e. primary disinfection, coagulation and flocculation, sedimentation, filtration, secondary disinfection, fluoridation, residuals management);
- describe other treatment processes and innovative technologies (i.e. air stripping and aeration, flotation, membranes, chlorine dioxide, ozone, ultraviolet light, granular activated carbon, powdered activated carbon, particle counters, etc.);
- describe the need for process optimization (i.e. to maximize the efficiency of the multiple barriers to ensure effective removal of contaminants, particularly for organisms such as *Cryptosporidium* that are chlorine resistant);
- describe the need for effective disinfection;
- describe the need for distribution system maintenance;
- outline the need for appropriate monitoring and sanitary surveys;
- summarize the need for operator certification and training;
- describe emerging issues; and
- outline research needs/directions.

2.2 Part II - Drinking Water in Other Jurisdictions

The Delcan report does a commendable job of summarizing the standards and/or guidelines in the United States of America (Section 1), the European Union (Section 2), England and Wales (Section 3) and Australia (Section 4). It is noteworthy that water resource planning in all of these jurisdictions is based on a watershed or river basin approach. In addition, all of the regulatory processes reviewed include variance provisions, public consultation and reporting. These are three areas where Ontario's process could be clarified and/or improved.

Section 5 of the report was included to examine the effects of regulations and other influencing factors on several operating water treatment facilities in Canada and abroad. The questions to be answered included: how regulations influence water supply; do different regulatory approaches result in a significantly different quality of drinking water; what are the critical influences on production of good and safe water?

It is interesting to note the purpose of this section, because no opinion regarding the effects of regulation was provided by Delcan. A review of the water quality data provided indicates that the two plants in Ontario, that up to August 2000 operated under the guideline scenario, provide water quality as good as the regulated plants in Alberta and the US and better than the plants in Australia. Unfortunately, the two case studies presented for Ontario did not experience a range in raw water turbidity similar to the exemplary E. L. Smith Water Treatment Plant (WTP) in Edmonton and no raw water turbidity data was provided for the McCarron WTP in St. Paul, Minnesota. As such, it is difficult to draw conclusions from the information presented. The inclusion of comparable river based supplies in Ontario, such as Brantford, Windsor or Ottawa, would have better facilitated a comparison of operations.

In addition to the inclusion of a river supply system, it would have been useful if the Ontario case studies included an evaluation of a groundwater system. The evaluation of one or more systems serving less that 1,000 people would have also helped identify specific concerns related to the small system problem in Ontario.

Extensive cost information was also provided for some plants while limited information was provided for others. Table 4 summarizes the information that was provided by facility.

The information presented in the Table 4 raises a number of concerns, namely:

- some plants appear to have included an allowance for infrastructure renewal in their costs (i.e. Toronto and Edmonton) while others have not (i.e. Prescott WTP);
- to ensure future renewal of the Prescott water system, it is recommended that approximately $120,000 (or 2% of their assets which I estimated to be worth $6 million) be added to their costs on an annual basis (assuming a 50 year life cycle) - this alone would increase the unit cost from $0.20 to $0.31 per m^3 (or by 55%);
- the total annual cost to operate the Serpertine Pipehead Dam WTP is given as $368,886 (Cdn) - this is very similar to the cost provided for the Prescott WTP which has 60 times less capacity;
- the actual annual production value given for the Serpentile Pipehead Dam WTP is equivalent to the average day flow times 140 days - this leads me to believe that this plant was out of service 62% of the time which may explain the low hydro costs;
- on the other hand, the Serpentitle Pipehead Dam WTP has to pump treated water 50 kilometres to Perth and pumping generally consumes power - does it have a hydro deal;
- how can it cost more per m^3 to operate the Serpentile Pipehead Dam WTP - a plant that has no treatment other than disinfection and pumping (which it appears to be getting relatively cheaply) - than the Wanneroo WTP which has extensive treatment and high chemical use?

The above concerns, and the lack of comparable financial data, call into question any conclusions drawn from comparing these plants. Futhermore, the lack of an identified infrastructure renewal allowance for the Prescott case study raises a "big" red flag. This could have major impacts to user rates for communities that have not made provisions for same.

A further breakdown of the costs for the two Ontario plants for which details have been provided (see Table 5), excluding any capital financing stabilisation fund allowances, indicates that the top three expenses for Toronto - a large system - include: 1) debt repayment; 2) electrical power; and 3) direct labour. For Prescott - a smaller system - the top three expenses include: 1) labour; 2) electrical power; and 3) other (for which no details are provided). It is noteworthy that sampling and analysis costs currently represent in the order of 2.1% and 3.0% of the expenditures for this large and smaller system, respectively. If these costs were to double or triple, due to enhanced monitoring requirements (as a result of implementing O. Reg. 459/00), they would represent in the order of 6% to 10% of the costs.

Notwithstanding the impacts that increased sampling and analysis cost may have to systems across Ontario, the lack of infrastructure renewal funding may have a far greater impact.

As noted above, an analysis should be conducted to establish the future investment requirements to cover infrastructure replacement and regulatory upgrades over the coming decades. In addition to identifying infrastructure needs, the analysis should also review how infrastructure has been financed to date and what changes, if any, are needed to ensure water system renewal in the future assuming a user pay and fee for service approach.

Table 4 - Cost Data Provided for the Case Studies

Cost Component	F. J. Horgan WTP (Cdn $)	E. L. Smith WTP (Cdn $)	McCarron WTP (Cdn $)	Prescott WTP (Cdn $)	Serpentine WTP (Cdn $) [5]	Wanneroo WTP (Cdn $) [5]
Electrical Power	3,196,200	?	?	33,494	9,996	?
Chemicals	871,444	?	?	21,838	92,330	?
Sampling & Analysis	300,000	?	?	6,500	8,330	?
Direct Labour	2,025,932	?	?	115,405	83,300	?
Corporate Charges	892,500	?	?		24,990	?
Contracted Services	86,300	?	?	11,200	108,290	?
Debt Repayment	6,360,000	?	?	0	?	?
Other	256,550	?	?	26,284	41,650	?
Sub-Total	**13,988,926**	?	?	**214,721**	**368,886**	?
Other Plants and System [1]	139,611,074	?	?		?	?
Capital Financing Stabilisation Fund	48,400,000	?	?	?	?	?
TOTAL	**202,000,000**	**61,084,000**	?	**214,721**	**368,886**	?
Production (m^3/year) [2]	557,720,000	119,939,000	?	1,095,000	30,807,000	?
Cost ($) per cubic metre [3]	0.36	0.51	?	0.20	0.0120	0.0097
REVENUE [4]	**202,000,000**	**99,510,000**	**32,000,000**			
Serviced Population	3,125,000	830,000	395,000			
Annual Cost per Capita	**$64.64**	**$119.89**	**$81.01**			

Notes:

1) Total costs/revenues for Toronto were provided as $202million. The costs to operate the F. J. Horgan WTP were given as approximately $14 million and the Capital Financing Stabilisation Fund was noted as being in the order of $48 million. The remainder of the costs were allocated to operating the other plants in Toronto and the distribution system.

2) Production was estimated by multiplying the average day flow for 365 days per year except for Toronto and the Serpentile Pipehead Dam WTP. In Toronto's case, the flow was multiplied by four since the F. J. Horgan WTP only accounts for 25% of the production. The production value was provided for the Serpentile Pipehead Dam WTP.

3) Unit costs were calculated by dividing the total annual costs, including the capital financing stabilisation fund allowance, by the total annual production.

4) Total revenues/income were provided for Toronto, Edmonton and St. Paul. No other cost details were provided for St. Paul hence the above comparison.

5) Australian dollars were converted to Canadian dollars using an exchange rate of 0.833 (i.e. 1A$ = 0.833Cdn$).

Table 5 - Cost Breakdown by Percent and Rank for the Ontario Plants

Cost Component	F. J. Horgan WTP		Prescott WTP	
	Cost	Percent (Rank)	Cost	Percent (Rank)
Electrical Power	3,196,200	22.8 (2)	33,494	15.6 (2)
Chemicals	871,444	6.2	21,838	10.2
Sampling & Analysis	300,000	2.1	6,500	3.0
Direct Labour	2,025,932	14.5 (3)	115,405	53.7 (1)
Corporate Charges	892,500	6.4		0.0
Contracted Services	86,300	0.6	11,200	5.2
Debt Repayment	6,360,000	45.5 (1)	0	0.0
Other	256,550	1.8	26,284	12.2 (3)
Total	**13,988,926**	**100.0**	**214,721**	**100.0**

2.3 Part III - Making Ontario Water Treatment a World-Leader

The Delcan report appears to recommend the following, all of which is supported by the OWWA/OMWA:

- CT approach for *Giardia* and viruses;
- Encourage utilities to use more sophisticated methods to calculate CT;
- Groundwater Under the Influence - direction from the MOE needed;
- Clarify Section 13 of Regulation 459/00 to include source water assessments;
- Water resource management should be based on watersheds;
- Investigate the benefits of regionalization for small systems;
- Support research and development.

The Delcan report appears to recommend the following, which is not supported by the OWWA/OMWA:

- *Cryptosporidium* standard - the OWWA/OMWA suggests monitoring ongoing research until we know more (see Section 4.6).

The Delcan report appears to recommend the following, which requires further investigation and discussion to establish roles and responsibilities that can be supported by the OWWA/OMWA:

- Water Officer - this position as described by Delcan is not appropriate due to liability and enforcement issues, as well as full cost pricing concerns. To ensure system sustainability, the regulator should ensure that the skill level of the operator is commensurate with the water system process. This may require improved training or other alternative approaches to develop the technical and managerial capacity of small systems.

3.0 Policies and White Papers

OWWA/OMWA believe that in addition to the matters raised in the Delcan report, the following AWWA policies, white papers and/or best management practices should be considered in the context of drinking water production and distribution.

3.1 Water Resources Planning (The First Protective Barrier)

The AWWA policy on development and management of water resources (see Appendix D) makes the following observations that OWWA/OMWA endorse in the Canada-Ontario context:

- Each water source should be developed and managed with careful attention to the hydrologic and ecologic systems of which the particular source is a part. Surface and groundwater sources should be managed conjunctively.
- The degradation of the quality of water supply sources has damaging effects on health, welfare, the economy, and the environment. Public water supplies, as an essential factor in the economy, are entitled to a good-quality source water.

- Water is a renewable natural resource. It must be managed to best meet many needs. Every effective means to prevent and minimize waste and promote wise use should be employed by all entities, public and private, engaged in water resource activities.

The AWWA policy on quality of water supply sources (see Appendix E) makes the following observations that OWWA/OMWA endorse in the Canada-Ontario context:

- The quality of existing and potential sources of drinking water supply, including both groundwater and surface water, shall be actively and aggressively protected and enhanced.
- Where decisions regarding resource use and resource development include alternatives adversely affecting the quality of drinking water supply sources, preference should be given to the alternatives that protect or enhance the quality of the affected sources.

The AWWA policy on managing groundwater (see Appendix F) makes the following observations that OWWA/OMWA endorse in the Canada-Ontario context:

- AWWA supports improving the understanding of technical issues related to groundwater and the development of sound legislation and regulations that protect the quality and ensure the availability of groundwater.
- AWWA strongly supports groundwater planning, education, and wellhead protection efforts to identify potential threats to groundwater quality and availability and to avoid problems before they occur.
- Public education and outreach involves an understanding of the nature of the resources and development issues such as proper well siting, well design, groundwater withdrawal operations, and well maintenance and rehabilitation practices.

In addition to the above, the AWWA developed the "Integrated Resource Planning" process (IRP) to help water resource planners meet the growing demand for water using a total water management approach. The AWWA White Paper on the IRP process is provided in Appendix G. A manual of water supply practices for water resources planning (M50) is also available. The manual is an excellent guide that covers IRP topics such as water demand forecasting, alternative source evaluation, water quality (including a layperson's explanation of bacteria, viruses, protozoa and parasites), hydrologic modeling, environmental impact analysis, watershed management and groundwater protection, economic feasibility, etc.

3.2 Water Treatment and Maintenance (The Second Protective Barrier)

The AWWA policy on treatment of public water supplies and quality in distribution systems (Adopted by the Board of Directors Jan. 26, 1975, revised June 15, 1980, reaffirmed June 10, 1984 and June 19, 1988) summarizes the Association's support for the multiple barrier concept:

> *The American Water Works Association (AWWA) strongly supports the practices of filtration of surface water used as sources of public water supply, disinfection of public water supplies, including the maintenance of residual disinfectant in the distribution system, and the covering of reservoirs that store potable water for direct delivery to consumers, and adequate monitoring to assure conformance with water quality standards.*

The AWWA policy on drinking water quality (see Appendix H) makes the following observations that OWWA/OMWA endorse in the Canada-Ontario context:

- Public water suppliers should develop and implement operating programs that include water quality guidelines based on the regulatory standards that define safe water and the community's water quality goals. These water quality operating guidelines must be comprehensive and balanced. They should:
    - be responsive to regulatory requirements and suitable for implementation;
    - include input from the consumers;
    - provide for selection, protection and management of the highest-quality source of supply;
    - address the potential for changes in source water quality;
    - consider proper operation of treatment facilities;
    - provide for minimizing changes in water quality during transmission and distribution to consumers; and
    - encourage participation in research and use of improved treatment capabilities to better the final product.

The AWWA policy on chlorine for drinking water disinfection (see Appendix I) makes the following observations that OWWA/OMWA endorse in the Canada-Ontario context:

- Drinking water treatment operations must often achieve competing objectives--adequate microbial protection, reduced levels of disinfection by-products, and corrosion control--to comply with USEPA regulations.
- Balancing these competing priorities may diminish the margin of safety against waterborne disease.
- Chlorination, particularly when used in combination with adequate source water protection and well-designed, well-operated physical treatment processes, can produce water that consistently meets public health goals.

With regard to system reliability, the AWWA policy on electric power reliability (see Appendix J) makes the following observations that OWWA/OMWA endorse in the Canada-Ontario context:

- Uninterrupted utility service is an operating goal of public water and wastewater utilities.
- To achieve this goal, each public water supply and wastewater utility should compare the local probabilities of complete or partial electric utility power outages to its capabilities to provide water and wastewater utility service from storage, alternate supply, or other source.
- Should a comparison of such a determination and assessment indicate that unacceptable water and wastewater utility service interruptions could be expected when there is an electric power interruption, standby electric service facilities or capabilities should be provided.

In addition to the above, the AWWA Research Foundation (AWWARF) document entitled "Maintaining Water Quality in Finished Water Storage Facilities" is a manual designed to help utilities to operate and maintain their water storage reservoirs to prevent the deterioration of water quality. The AWWARF study found that finished water storage facilities have historically

caused water quality problems. Excessive water age was the most important factor related to water quality deterioration. The document outlines steps to avoid water quality problems and also discusses inspection and maintenance requirements, operational practices to maintain water quality and performance monitoring. It is noteworthy that in interviews with US regulators, the project team found that "large systems tend to have well-defined maintenance programs, and generally, small systems tend not to perform maintenance in an effective and timely manner" (Page 107).

3.3 Water Distribution System (The Last Barrier before the Consumer's Tap)

The distribution system is the last "protective" barrier that needs to be operated and maintained to prevent contamination of water as it proceeds to the customer. Although the Delcan report highlighted many important issues, such as reliability, fire protection capability, system maintenance and renewal, the report did not discuss the latest research regarding the deterioration of water quality in the distribution system. As previously noted, it is important to understand the reasons for water quality deterioration in the distribution system because research suggests that the rate of gastrointestinal illnesses increases with water quality degradation. Distribution system goals and best management practices are presented in Section 4 of this report.

In addition to the above, the AWWA policy on cross connection control (see Appendix K) makes the following observations that OWWA/OMWA endorse in the Canada-Ontario context:

- If appropriate backflow-prevention measures have not been taken, the water purveyor shall take or cause to be taken necessary measures to ensure that the public water distribution system is protected from any actual or potential backflow hazard.
- Such action would include the testing, installation, and continual assurance of proper operation and installation of backflow-prevention assemblies, devices, and methods commensurate with the degree of hazard at the service connection or at the point of cross connection or both.
- If these actions are not taken, water service shall ultimately be eliminated.
- To reduce the risk private plumbing systems pose to the public water distribution system, the water purveyor's backflow prevention program should include public education regarding the hazards backflow presents to the safety of drinking water and should include coordination with the cross connection efforts of local authorities, particularly health and plumbing officials.
- In areas lacking a health or plumbing enforcement agency, the water purveyor should additionally promote the health and safety of private plumbing systems to protect its customers from the hazards of backflow.

This is a very important issue for water utilities in Ontario mainly because they currently do not have the statutory authority to take the measures necessary to control backflow hazards from private property to the public distribution system. Although plumbing codes have always prohibited any connection whereby potable and non-potable water could mix, there are few details as to the specific device to use to prevent cross connections and many connections are overlooked.

Cross connection protection is not new, but incidents of contamination and concern for potential legal action - in the event that a public system becomes contaminated and a death or serious illness occurs that could have been prevented by the installation of a backflow prevention device - have heightened the concern of water authorities in this regard. An enhanced cross connection control program is needed to ensure the protection of the public water distribution system.

Who should handle the enforcement of the cross connection control program? Although the plumbing inspector is concerned about the code that prohibits cross connections, the water authority is concerned about the water quality in the public distribution system. Water authorities should therefore have the mandate to inventory and ensure cross connection controls are in place.

Water authorities that implement a complete cross connection control program involving inspections of buildings and yearly testing of devices will find the greatest benefit in the awareness created and the greatly reduced number of cross connections. An ongoing program is required because it has been found that continual piping changes and the addition of new equipment will always carry the possibility of new cross connections.

Based on the foregoing, it is recommended that there be a statutory position in the municipality responsible for water. In addition to dealing with cross connection control issues with the Chief Building Official, this individual should work with the Fire Chief regarding fire protection and the local Medical Officer of Health regarding water quality. Due to the technical nature of this position and the responsibilities vis-à-vis public health and safety, this person should likely be a Professional Engineer. Professional engineers are bound, first and foremost, to protect the public per The Professional Engineers Act of Ontario. It is important that the person responsible for water in a municipality understand all the ramifications of their actions and that they regard their duty to public welfare as paramount.

3.4 Business Operations

The OWWA/OMWA strongly support the "user pay" approach and "fee for service" concepts for the provision water services. As noted in Appendix C, the viability of drinking water systems is critical to the protection of public health and the conservation of public resources. With the increasing complexity of water treatment and environmental conditions and more stringent drinking water regulations, system viability assessments must not only address financial considerations, but also the technical, managerial and operational expertise and capabilities of the system to satisfy public health and safety requirements on a long-term basis. All training and education necessary to develop the financial, technical, managerial, and operational expertise and capacity of water utilities must be included in the service cost.

The AWWA policy on financing and rates formalizes this support for self-sustaining water authorities:

> **Policy on Financing and Rates (Adopted by the Board of Directors Jan. 25, 1965, revised Jan. 31, 1982, reaffirmed Jan. 25, 1987, revised Jan. 26, 1992 and June 21, 1998)**

The American Water Works Association (AWWA) believes the public can best be provided water service by self-sustained enterprises adequately financed with rates based on sound accounting, engineering, financial and economic principles.

To this end, AWWA recognizes the following principles towards which every water utility should strive. Implementation of these principles should be balanced against other policy objectives; however, no policies should be adopted that compromise the long-term financial integrity of the water utility or its ability to provide service to customers. Basic financing and rates principles include:

1. *Water utilities should receive sufficient revenues from water service, user charges, and capital charges, such as system development charges, to enable them to finance all operating and maintenance expenses and all capital costs (e.g. debt service payments).*

2. *Water utilities should account for and maintain their funds in separate accounts. Such funds should not be diverted to uses unrelated to water utility services. Reasonable payment in lieu of taxes and payments for services rendered to the utility may be included in the cost of providing water service after taking into account the contribution for fire protection and other services furnished by the utility to local governments.*

3. *Every water utility should adopt a uniform system of accounts based on generally accepted accounting practices. The system of accounts should generally follow the accounting procedures outlined in the water utility accounting textbook published by AWWA. Modifications may be made to satisfy the financial needs of the utility and to meet the requirements of legislative, judicial, or regulatory bodies.*

4. *Water rate schedules should be designed to distribute the cost of water service equitably among each type of service and should reflect an appropriate balance of goals and objectives essential to the public good.*

Metering of water use components full cost pricing. The AWWA policy on metering recommends the following:

Policy on Metering (Adopted by the Board of Directors Jan. 26, 1969, revised June 15,1980, reaffirmed June 22, 1986, revised June 6, 1993, and June 21, 1998)

The American Water Works Association (AWWA) recommends that every water utility meter all water taken into its system and water distributed from its system to its users. Metering of all water services is an effective means of improving and maintaining the close control of water system operations necessitated by the increasing difficulty in maintaining and providing adequate water supplies and the increasing costs of providing water service to consumers.

Metering provides a basis for assessing users equitably. Metering provides a data base for system performance studies, facility planning, and the evaluation of conservation

measures. It also improves accountability for water delivered through the system and, therefore, facilitates management decisions.

Periodic performance testing, repair, and maintenance of meters are essential part of an effective metering program that will ensure an equitable recovery of revenues based on level of service.

As noted above, metering of water use facilitates the evaluation of conservation measures. The AWWA policy on water conservation (see Appendix L) and the AWWA white paper on water conservation and water utility programs (see Appendix M) make the following observations that OWWA/OMWA endorse in the Canada-Ontario context:

- A conservation strategy, like any supply strategy, is part of a utility's overall planning and part of the integrated resource planning to ensure that all important community objectives and environmental goals are considered.
- Water conservation in the broad sense is a key element in the day-to-day management of the modern water utility. Sound management includes the following basic water conservation practices:
    - reduction of unaccounted-for water through universal metering and accounting of water use, routine meter testing and repair, and distribution system leak detection and repair;
    - cost-of-service based water rates; and
    - public information and education programs to promote water conservation and to assist residential and commercial customers with conservation practices.

3.5 Organisation Operations

The AWWA policies on diversity and non-discrimination, as well as affirmative action, are included in Appendix N.

The AWWA policy on employee compensation (see Appendix O) makes the following observations that OWWA/OMWA endorse in the Canada-Ontario context:

- The American Water Works Association (AWWA) strongly recommends that governing boards and water utility managers establish fair and equitable compensation policies that reward the critical elements of protecting public health and that are competitive with other industries, utilities, and professional services in their service area.

The AWWA policy on safety is as follows:

Policy on Safety (Adopted by the Board of Directors Feb. 2, 1997)

The American Water Works Association (AWWA) believes a safe work environment is of the utmost importance for individuals in the water industry. It is of paramount importance to protect those who safeguard their community water supplies.

It is the duty of each utility manager, supervisor, and worker to establish safety standards and to see that safety is an integral part of their daily work process. Safety must take precedence over shortcuts. As unsafe conditions are discovered, they should be addressed and corrected. Safety practices established by state, provincial, and federal agencies should be regarded as minimum standards by all individuals in the water industry.

In addition to the above, an AWWA manual entitled "Emergency Planning for Water Utility Management" (M19) is available. The manual is a guide that allows utilities to establish their vulnerability to emergencies and prepare appropriate contingency plans. The manual incorporates best emergency preparedness practices.

3.6 Customer and Government Relations

The AWWA white papers on consumer principles (see Appendix P) and consumer choices (see Appendix Q) make the following observations that OWWA/OMWA endorse in the Canada-Ontario context:

- Consumers should have access to safe, reliable, and affordable drinking water.
- Consumers should have access to an annual, accurate and complete report, in plain language, about the source and quality of their public water supply.
- Consumers should have reasonable opportunities to provide input on utility decisions affecting their drinking water.
- Consumers should have a right to personal privacy, protecting against unauthorized use of records (subject to open records laws) ensuring appropriate notice for intrusive maintenance.
- Consumers should have access to a complaints process established by the utility that resolves customer concerns and complaints accurately, promptly and courteously, with minimal inconvenience to the customer.
- It is in a utility's best interest to educate consumers about its products to enable customers to make informed choices and keep abreast of a utility's on-going efforts to provide safe water.
- Water utilities should involve appropriate local health agencies and other groups in making and publicizing these recommendations.
- When emergency situations, such as a natural disaster or waterborne disease outbreak, occur, a water utility should issue a boil-water alert to their consumers and work with public health professionals to recommend appropriate alternatives until utility operations are restored to acceptable standards.

3.7 Accreditation

The AWWA vision for accreditation is attached as Appendix R. An outline of the International Water Treatment Alliance (IWTA) is also provided. The IWTA is a program adapted from the US Partnership for Safe Water for use in other jurisdictions such as Canada and Australia. As part of the program, utilities voluntarily adopt proven operational and administrative practices designed to improve treatment plant performance. It is noteworthy that the Quebec Section of AWWA received provincial funding to implement the IWTA program. The program has been a major success - within two years more than half of the Quebec population is served by plants that have joined the program.

With respect to the developing accreditation process, accreditation standards will be developed using the AWWA's formal standards process. The latter has been used for more than ninety years to produce ANSI registered material standards that are used by the water utility industry. These standards are recognized worldwide and have been adopted by many utilities and organizations. Volunteer standards committees will establish standard practices in a uniform and appropriate format. Formal ballot procedures will be used to adopt recognized standards.

Accreditation pilots will be performed on each standard to refine and clarify the processes. Accreditation will be offered on each standard category as it becomes available. Full utility accreditation will not be available until 2004. A utility may be accredited in one or more standards or they may seek full utility accreditation, by conforming to all appropriate standards for their operation.

The standard categories relating to water and wastewater utility operation being developed by AWWA include:

- Distribution System Operation and Management;
- Water Treatment Plant Operation and Management;
- Source Water Management and Protection;
- Business and Planning Practices Management;
- Communications and Customer Relations Management;
- Wastewater Collection Systems Management;
- Wastewater Treatment Plant Operations and Management;
- Biosolids Handling and Management;
- Wastewater Pretreatment Management;
- Water and Wastewater Conservation/Reclamation Program Management.

It is recommended that the Government of Ontario work with the OWWA to implement the best management practices of the IWTA in Ontario. It is also recommended that the Government of Ontario consult with the OWWA/OMWA with respect to other developing programs such as accreditation.

4.0 Supplemental Comments by OWWA/OMWA

4.1 Health and Aesthetic Aspects of Water Quality

The AWWA textbook entitled "Water Quality and Treatment" dedicates a whole chapter to this issue. Key points include:

- health and aesthetics are the principal motivations for water treatment;
- despite many water treatment improvements, waterborne disease continues to occur;
- research suggests that the rate of gastrointestinal illness increases as water quality degrades in the distribution system;
- most waterborne disease outbreaks tend to occur in small systems;
- there is a necessary balance between disinfection and disinfection by-products.

4.2 Multiple Barrier Concept

The application of multiple barriers to prevent contaminants from entering the water supply system and/or control transmission through the system is universally recognized as a critical and fundamental tenet for effective drinking water quality management and for ensuring the supply of safe drinking water. The strength of multiple barrier systems is that a failure of one barrier may be compensated for by effective operation of the remaining barriers; thus minimizing the likelihood of contaminants passing through the entire treatment system and being present in sufficient amounts to cause harm to consumers. (NHMRC/ARMCANZ Co-ordinating Group).

The OWWA/OMWA support the multiple barrier concept, namely:

- selection of the purest sources of water;
- source protection to prevent or control contamination;
- filtration or removal of contamination;
- effective operation and monitoring of drinking water treatment facilities;
- disinfection to inactivate microorganisms, including an adequate disinfection residual;
- operation and maintenance of distribution systems (including storage) to preclude contamination or degradation of treated water; and
- monitoring and response to detect possible breakdowns in the barriers.

As the population continues to increase and put pressure on natural resources, finding high-quality source water will become more difficult and water treatment systems will increase in importance as a barrier to waterborne illnesses. Nevertheless, it is often safer and cheaper to prevent the contamination of drinking water supplies than to undertake expensive efforts to treat it after it has become contaminated. For example, remediating groundwater can be 40 times more expensive than taking steps to protect the source (AWWA, 2001).

The number of drinking water treatment barriers provided should be commensurate with the degree of contamination in the source water (EPA, 1990). It is also recommended that water utilities optimize their operation, particularly filtration, because *Cryptosporidium* is resistant to the chlorine disinfectants commonly used in water treatment.

Steps to protect and maintain the water distribution system to prevent contamination are discussed in the following section.

4.3 Water Distribution System

The purpose of a water distribution system is to supply each consumer safe drinking water that is also adequate in quantity, at sufficient pressure and acceptable in terms of taste, odour and appearance, as well as to provide fire protection. To ensure delivery of high quality water to each consumer, water utilities must be continually vigilant to any intrusion of contamination or occurrences of microbial degradation in the system. This job is made sufficiently difficult by the fact that the water distribution system is a complex network of mains, fire hydrants, valves, auxiliary pumping, chlorination substations, storage reservoirs, standpipes and service lines. Following the intrusion of microbial contamination - say, by a watermain break, backflow from a cross connection or a negative pressure at a crack in the system - any of the system components

can harbour microorganisms. The persistence and possible growth of organisms in the network are influenced by a variety of conditions that include the physical and chemical characteristics of the water (i.e. temperature), system age, type of pipe material and the availability of sites suitable for colonization (i.e. pipe joints, dead ends, areas of pipe corrosion).

Water in a distribution system must therefore be seen as a perishable product that has a shelf life, packaging and a preservative. The shelf life is the time that the water spends in the system on its way to the consumers' tap, the packaging is the complex network noted above, and the preservative is the disinfectant - either free chlorine or chloramines.

To avoid water quality problems, water utilities must:

- maintain positive pressures and fire flows;
- manage water age;
- maintain a chlorine residual;
- keep the distribution system clean;
- provide treatment that does not allow water to degrade in the system; and
- monitor water quality.

Maintaining water quality in the distribution system is a task that crosses departmental boundaries and requires clear communication between all responsible parties. Each party needs to understand their role and the role played by others. One way to facilitate better coordination amongst various departments is through development and implementation of standard operating procedures. The five steps recommended by AWWA to optimize distribution system water quality are summarized as follows. The steps are described in full in the document entitled "Guidance Manual for Maintaining Distribution System Water Quality" (AWWARF, 2000).

Step 1 - Understand your distribution system and define the problems

Distribution system water quality concerns can be attributed to: chemical/microbiological reactions within the bulk water; chemical/microbiological interactions between the bulk water and piping materials; introduction of sediment, silt, sand, turbidity, tastes, odour, colour and organisms from the source water; chemical/microbiological interaction between the bulk water and silt/sediments, etc.; direct chemical/microbiological intrusion into the distribution system.

Step 2 - Set water quality goals and establish preliminary performance objectives

To maximize distribution system water quality relative to safety and consumer satisfaction, all water utilities should have an effective water quality monitoring program in place. At a minimum, the program should:

- provide regular information about the source water quality;
- ensure that finished water entering the distribution system meets all applicable standards for disinfection and turbidity and is treated to minimize corrosion at the consumer's tap;
- monitor distribution system water quality at the frequency prescribed and look for signs of water quality deterioration;

- monitor secondary parameters throughout the distribution system to evaluate changes in water quality due to contact with distribution system materials and extended water age;
- be responsive to source water changes, treatment upsets and events in the distribution system that may impact safety, quality, or quantity.

To accomplish these tasks, the utility will need to develop a sampling plan that is based on regulatory requirements and augmented by additional monitoring that insures good source water quality, proper treatment and maintenance of water quality throughout the distribution system. Skilled and dedicated personnel along with access to a well-equipped laboratory will be needed for sample collection and analysis. The utility should have the means to electronically store and retrieve water quality data for generating reports and evaluating historical data. Regardless of system size, the proper analysis, interpretation and trending of water quality data is essential to the successful management of any drinking water supply system.

Useful parameters for determining general distribution system water quality include disinfectant residual, Heterotrophic Plate Count (HPC) bacteria, total coliform bacteria, temperature, pH, alkalinity, turbidity, colour, trihalomethanes (THMs) and odour. Utilities do not routinely monitor for all of these parameters and hence miss out on collecting easily obtainable baseline data that helps to characterize the distribution system for diagnostic purposes when a problem occurs.

Once a sampling plan is established, water quality goals for monitored parameters should be established. These may go beyond complying with the regulatory requirements. For example, a utility may wish to establish a free chlorine residual of 0.4 mg/L at all active points in the distribution system (rather than 0.2 mg/L), or it may wish to establish a threshold for HPC bacteria as an early indicator of microbiological degradation. Utilities may also establish goals for the aesthetics of water at the consumer's tap in an attempt to reduce complaints and increase customer satisfaction.

The utility should then establish specific performance standards to help meet the water quality goals (i.e. minimum pressure of 20 psi, minimum residual of 0.2 mg/L, maximum water age of 3 days, etc.).

Step 3 - Evaluate alternatives and select the best approach

This step uses the information from Steps 1 and 2 to develop, evaluate and select the preferred approach to address water quality problems. Each of the pathways noted in Step 1 can be addressed to some degree through practices related to monitoring, operations, maintenance, engineering, and/or management. For example, a water quality issue such as microbial growth in the distribution system may be the result of inadequate treatment at the source, inadequate disinfection, or poor circulation within the distribution system.

Depending on the type of water quality problem, the most appropriate solution may require changes in operations or maintenance practices, additional monitoring or an engineered solution at the source or within the distribution system. Often more than one solution will be necessary to meet water quality goals. The AWWARF document entitled "Guidance Manual for Maintaining

Distribution System Water Quality" provides an extensive list of potential solutions to address water quality problems.

It is important to note that distribution system operation and maintenance activities only help to maintain water quality conditions in the distribution system. As such, adequate source treatment is the first step towards improving distribution system water quality. Treated water should ideally be non-corrosive, chemically stable, non-scaling and should be free of pathogenic organisms. The water should also be stable from a microbiological standpoint to minimize the growth potential in the system. This generally means that the organic content should be low and that the water should be biologically stable. Parameters of concern include assimilable organic carbon (AOC) or biodegradable organic carbon (BDOC).

In addition, pH instability, which results in pH fluctuations in the distribution system, causes problems because metallic piping and aging scales exposed to varying or cyclical pH conditions are more susceptible to metal release and precipitation when compared with more stable conditions. Rapid or extensive pH fluctuations may also trigger microbial changes and releases into water (AWWARF, 2000).

Step 4 - Implement good management practices and monitor effectiveness

This step puts the recommended plan from Step 3 into action. Operating practices should be implemented to minimize the water's age, maintain positive pressure and control the direction and velocity of the water. It is important to minimize the age of the water in the distribution system because reactions within the bulk water and between the bulk water and piping materials causes water quality degradation. It is very important to maintain positive pressures throughout the system to ensure the backflow of contaminants does not occur. Various codes of good practice and manuals suggest 20 psi as a minimum pressure to maintain under extreme operating conditions such as fire flows. Utilities should also attempt to minimize rapid and/or extreme fluctuations in flow velocities and should minimize the frequency of flow reversals. These types of changes can scour sediments and bring particles into the water causing water quality deterioration.

Maintenance procedures include system flushing and cleaning. Flushing helps to remove stagnant water and to remove an unwanted contaminant that may have inadvertently entered the system. Flushing can also keep the system free of sediment if sufficient cleansing velocities are achieved. Cleaning techniques include mechanical scraping, pigging, swabbing, chemical cleaning and flow jetting. Each technique has its benefits and drawbacks and should be tailored to the specific problem. Normal utility maintenance activities also include conducting emergency pipe repairs with sanitary precautions in place. This includes keeping contaminated water out of a trench and pipe as much as possible, flushing the line in the vicinity of the break, applying disinfectant to the components that were potentially contaminated and conducting bacteriological testing of the water to confirm the absence of contamination. Sanitary practices are also necessary in the construction and release of new watermains. Disinfection practices should follow AWWA Standards.

Utilities should also have regard for water quality during system design. Dead end pipelines should be avoided or precautions taken to minimize water age (i.e. flushing). Pressure zones

should be planned or configured to reduce water age and maintain water quality. Computerized hydraulic and water quality models can be used to help in this regard. Water quality models can also be used to predict chlorine levels and evaluate the benefits of re-chlorination stations.
Diagnostic monitoring of the effectiveness of the good management practices implemented to address water quality issues may be necessary followed by routine monitoring. Adjustments to improvement results may be needed.

Step 5 - Finalize performance standards and develop standard operating procedures.

This step requires the multiple operating units within the utility to join together to develop standard operating procedures (SOPs). The preliminary performance standards proposed in Step 2 should be re-visited and changed if needed to reflect lessons learned during implementation. SOPs should be developed for each operation and maintenance function that affects system water quality, including but not limited to storage facility inspection/maintenance/operation, flushing programs, disinfection of mains, disposal of chlorinated water, etc.

The water quality goals for the distribution system and the goals for the particular function should be specifically described in the introduction of the SOP. The SOPs should include all activities needed to conduct the procedure. Standard details, tables, drawings, pictures and forms should be part of the SOP to illustrate and clarify the specific activities. The SOPs should also describe the labour, equipment and materials needed to complete the activities. Work preparation steps, actual work steps, and work completion steps should be clearly outlined and described. The activities should be periodically reviewed and modified based on input received from all affected groups to ensure SOPs remain accurate, beneficial and easy to follow.

Management should work with distribution staff to develop and implement written SOPs. This will help staff know what is expected of them, can serve as a basis for training and can help pass down knowledge from experienced staff to those who are assuming increased responsibility.

The role of management in maintaining water quality in the distribution system involves developing, applying and continuously improving an array of management practices including funding, customer relations, regulatory compliance, investing in new technologies and strategic planning. Managers need to ensure that there is a customer driven approach for managing distribution systems and that there are good communications with the customer about the condition of and need for repair of the "hidden" infrastructure.

4.4 Small Systems

The following excerpts from the text entitled "Safe Water From Every Tap - Improving Water Service to Small Communities" as written by the US National Research Council, Committee on Small Water Supply Systems, represent the situation of small systems in the US and may be applicable to Ontario as well. Options to ensure the viability of these systems and recommendations to improve water quality are discussed extensively in the text. The following complements the AWWA's White Paper on System Viability (see Appendix C):

- Meeting drinking water standards is most difficult for water systems in small communities.

- Small communities often cannot afford the equipment and qualified operators necessary to ensure compliance with safe drinking water standards.
- Increases in both the number of drinking water regulations and the number of small community water systems have compounded the problem of providing safe drinking water to small communities.
- The solution to the problem of providing safe drinking water to small communities has three elements, each equally important: 1) providing affordable water treatment technologies; 2) creating the institutional structure necessary to ensure the financial stability of water systems; and 3) improving programs to train small system operators in all aspects of water system maintenance and management.

Evaluating Technologies for Small Systems

- Whether a small system is located in a rural area or a metropolitan area, it will lack the economies of scale of larger communities in providing water service; per-person costs for water service must be higher in small communities than in larger ones to provide the same level of service because the costs are spread over a smaller population.
- Application of technology (other than disinfection) to improve water quality in a small system should be considered only after other options, such as finding a cleaner source of water or purchasing water from a nearby larger utility, have been exhausted.
- Agencies responsible for regulating water systems should assign a staff member to continually evaluate the status of knowledge relating to the performance of various water treatment processes of potential use in their jurisdictions. As more performance information [from site specific pilot testing results[2]] is generated on waters of similar quality, the extent of pre-installation testing can be reduced, thus reducing the costs to the small systems.

Ensuring Small Water System Sustainability

- Affordable technologies can help small communities provide better quality water, but technologies alone will not solve the problems of small water supply systems.
- Without adequate management and revenues, small communities will be unable to maintain even low-cost technologies.
- Many small communities lack a fee structure that is adequate to generate the necessary operating revenues, let alone funds for capital improvements.
- Lack of revenue leads to a vicious circle: without funding, water systems cannot afford to hire good managers, but without good managers, water systems will have trouble developing a plan to increase revenues.
- Institutional changes are needed to decrease the number of unsustainable water systems.
- States should provide operating permits only to water utilities that have satisfactorily completed a performance appraisal (i.e. existence of health orders, record of response to orders, violations of water quality standards, number of staff and level of training, etc.).
- If the performance appraisal uncovers problems that compromise the system's sustainability, then the water system either must improve service on its own or restructure by delegating some or all of its responsibilities to another entity.

Training Operators for Small Systems

- Even a well-financed water system with the most advanced treatment technologies cannot deliver its water reliably unless its operators are trained adequately.

[2] Bracketed text added by the author to clarify the intent of the recommendation.

- Operators of smaller systems need specific, hands-on training in only the treatment technologies their systems use.
- Training and certification programs are particularly deficient in teaching operators about water system management and administration - two areas that are as essential to small water system operation as are treatment and distribution.
- More leadership is needed to improve training programs for small water system operators.

The above summarizes many of the issues confronting small systems. A system viability assessment, or performance appraisal, should be conducted to determine the options available to ensure all small systems provide safe drinking water. The Government of Ontario should also have regard for the fact that, in many cases, small remote systems may not have the option to restructure or develop alternative water supplies. The OWWA/OMWA support the use of interest-free loans for these water systems.

4.5 Research

Drinking water research is generally conducted to provide the scientific data and analytical methodologies necessary to make sound decisions and to set risk based priorities for health and the environment. The use of best-available, peer-reviewed good science as the foundation for setting new drinking water standards requires extensive health effects research.

Research is also necessary to facilitate cost effective compliance with these requirements. If utilities are expected to invest in new technologies to address contaminants of concern in drinking water supplies, they must have assurances that the technologies work and that they will not cause new problems at some future time. Research provides this certainty and ensures that public funds are used most effectively.

Research is also necessary in the areas of analytical methods, distribution systems, disinfection and disinfection by-products and special issues such as immuno-suppressed populations, etc.

The risk chain for drinking water involves contaminant sources, a vector (water), treatment for removal, transmission to the population, ingestion, infection and finally disease. Without a thorough understanding of this entire chain, neither the public nor the government decision-makers have a solid basis on which to judge the safety of drinking water.

It is with the above in mind that the AWWA Research Foundation has, since 1986, supported nearly 450 research projects valued at more than $100 million (US). Many of these projects have been or are being conducted by Canadian researchers. The funding of this research comes primarily from the Subscription Program. Water utilities subscribe to the research program and make an annual payment proportionate to the volume of water they produce. Consultants and manufacturers subscribe based on their annual billings. Canadian utilities that are members of AWWARF include but are not limited to: Halifax, Fredericton, Charlottetown, Windsor, Brantford, Waterloo, Toronto, Peterborough, Kingston, Ottawa, Windsor, Winnipeg, Regina, Edmonton, Calgary, Vancouver, Victoria.

The foundation's research agenda addresses a broad spectrum of water supply issues: resources, treatment and operations, distribution and storage, water quality and analysis, toxicology,

economics and management. The ultimate purpose of the coordinated effort is to assist water suppliers in providing the highest possible quality of water economically and reliably.

It has been acknowledged, in the OWWA/OMWA Issue 2 and 4 Response Paper (Castrilli, 2001), that not nearly enough research is being done to address drinking water issues. The OWWA/OWMA therefore recommends that the Government of Ontario and municipalities should participate in drinking water research and encourage participation in the AWWARF. Any research activities must be coordinated to avoid duplication of effort while ensuring research relevant to local needs.

4.6 *Cryptosporidium*

Cryptosporidium has emerged as a microbial pathogen of major concern to drinking water supplies. The U. S. Centers for Disease Control, in correspondence with EPA, has pointed out that extensive research on the health implications of the pathogen and dramatic improvements in analytical methods for its detection are necessary before it is possible to evaluate the public health implications of its occurrence at low levels and determine the appropriate regulatory response. Adequate funding of research on *Cryptosporidium* is essential to protect public health.

It is recommended that the Government of Ontario support the ongoing research of the AWWARF with regards to this high priority microbe. Until accurate monitoring methods are available for *Cryptosporidium*, the Government of Ontario should encourage a risk management approach based on an assessment of the raw water in conjunction with a lower turbidity standard.

5.0 Conclusions

The Issue #8 Paper was on "Production and Distribution of Drinking Water" and was accompanied with a defined scope. It can be argued that this Issue Paper did not respond to all the items in the scope, most particularly to:

- the effects of source water quality on costs and risks;
- distribution of drinking water; and
- the costs to bring Ontario systems up to standard.

I have attempted to analyze the data presented, however, data discrepancies and the limited number of case studies presented made this quite difficult. The difficulties encountered in analyzing the data highlights the need to obtain and maintain accurate information for record keeping and benchmarking purposes. Established programs such as AWWA's self-assessment, peer review and benchmarking have defined protocols to enhance consistency.

The need to improve the statistics available for existing plants in Ontario can be tied to data obtained from the Engineers' Reports. The Engineers' Reports should document the plant processes, capacities, owner, etc. and should confirm which plants need improvements. To assess system viability this information will need to be complemented with a review of the water authorities' technical, managerial and financial capabilities.

6.0 Recommendations

Based on the foregoing, the OWWA/OMWA recommends that in its final report to the Ontario Government on matters related to the production and distribution of safe drinking water, the Commission recommend:

Best Management Programs

1. That any proposed legal or regulatory regime on drinking water in Ontario should recognize and encourage the identification and implementation of best management practices, including continuous improvement programs, while having regard for the programs developed by the American Water Works Association, including but not limited to: QualServe™, Partnership for Safe Water and the International Water Treatment Alliance.

   Rationale - The American Water Works Association (AWWA) is the world's largest educational and scientific association for water supply professionals. The Association believes, and the OWWA/OMWA endorse in the Canada-Ontario context, that few environmental activities are more important to public health than ensuring the protection of water supply sources and the treatment and distribution of a safe and healthful supply of drinking water.

   Founded in 1881, AWWA now has over 56,000 members dedicated to water quality and public water supply. The AWWA expertise encompasses managers and operators running public water systems, public health officials overseeing regulatory programs, engineers designing distribution systems, scientists analyzing water quality, researchers developing new treatment technologies, academicians studying innovative water management techniques and educators imparting knowledge concerning water.

   AWWA's formal standards process has been used for more than ninety years to produce ANSI registered material standards that are used by the water utility industry. These standards are recognized worldwide and have been adopted by many utilities and organizations.

   The AWWA further applies its knowledge and expertise to assist water utilities enhance their performance and customer service by developing policies, white papers, manuals and the above noted best management programs/practices.

   The Commission's report, as prepared by the Delcan Corporation, highlighted the established programs of the AWWA. The OWWA/OMWA stand ready to share this knowledge with the Government of Ontario.

   And further, that the Government of Ontario work with the OWWA to implement the International Water Treatment Alliance in Ontario.

   Rationale - The International Water Treatment Alliance (IWTA) is a program adapted from the US Partnership for Safe Water for use in other jurisdictions such as Canada

and Australia. As part of the program, utilities voluntarily adopt proven operational and administrative practices designed to improve treatment plant performance. It is noteworthy that the Quebec Section of AWWA received provincial funding to implement the IWTA program. The program has been a major success - within two years more than half of the Quebec population is served by plants that have joined the program.

The implementation of this program would help to re-build the public's trust in Ontario's drinking water supplies.

And further, that the OWWA/OMWA be consulted with respect to the implementation of other developing programs such as accreditation.

Rationale - It is AWWA's vision that accredited water and wastewater utilities be recognized worldwide as well operated and efficiently managed. The accreditation program that AWWA is developing is intended to serve water and wastewater utilities and their customers, owners and government regulators by promoting improvements in the quality of services and efficient management through the establishment of standards and formal recognition of accrediting bodies.

The OWWA/OMWA stand ready to share their collective experience and expertise with the Government of Ontario to ensure best management practices and policies are considered in any future government program.

Treatment and Distribution

2. That the Government of Ontario continue to support the practices of filtration of surface water used as sources of public water supply, disinfection of public water supplies, including the maintenance of residual disinfectant in the distribution system, and adequate monitoring to assure conformance with water quality standards.

Rationale - The application of the multiple barriers noted above, to prevent contaminants from entering the water supply system and/or control transmission through the system, is universally recognized as a critical and fundamental tenet for effective drinking water quality management and for ensuring the supply of safe drinking water. The strength of multiple barrier systems is that a failure of one barrier may be compensated for by effective operation of the remaining barriers; thus minimizing the likelihood of contaminants passing through the entire treatment system and being present in sufficient amounts to cause harm to consumers. (NHMRC/ARMCANZ Co-ordinating Group).

The OWWA/OMWA support the multiple barrier concept, namely:

- selection of the purest sources of water;
- source protection to prevent or control contamination;
- filtration or removal of contamination;

- effective operation and monitoring of drinking water treatment facilities;
- disinfection to inactivate microorganisms, including an adequate disinfection residual;
- operation and maintenance of distribution systems (including storage) to preclude contamination or degradation of treated water; and
- monitoring and response to detect possible breakdowns in the barriers.

As the population continues to increase and put pressure on natural resources, finding high-quality source water will become more difficult and water treatment systems will increase in importance as a barrier to waterborne illnesses.

3. That the Government of Ontario encourage utilities to implement best management practices for water distribution systems as outlined in this review.

Rationale - The water distribution system is the last protective barrier before the consumers' tap that needs to be operated and maintained to prevent contamination of water. To ensure delivery of high quality water to each consumer, water utilities must be continually vigilant to any intrusion of contamination or occurrences of microbial degradation in the system. Water in a distribution system must be seen as a perishable product that has a shelf life, packaging and a preservative. The shelf life is the time that the water spends in the system on its way to the consumers' tap, the packaging is the complex water network, and the preservative is the disinfectant - either free chlorine or chloramines.

To avoid water quality problems, water utilities must:

- maintain positive pressures and fire flows;
- manage water age;
- maintain a chlorine residual;
- keep the distribution system clean;
- provide treatment that does not allow water to degrade in the system; and
- monitor water quality.

The five steps recommended by AWWA to achieve the above and optimize distribution system water quality include:

Step 1 - understand your distribution system and define the problems (i.e. microbial safety, disinfectant residual maintenance, taste and odour prevention, corrosion control);
Step 2 - set water quality goals and establish preliminary performance objectives;
Step 3 - evaluate alternatives and select the best approach (i.e. monitoring, operational changes, system maintenance, source water treatment, engineered solution, management - often more than one solution will be necessary);
Step 4 - implement good management practices and monitor effectiveness;

Step 5 - finalize performance standards and develop standard operating procedures.

4. That there be created, by statute, the position of Chief Water Official for each water authority in the Province.

Rationale - It is envisioned that this position would be comparable to that of the Chief Building Official required under the Building Code Act. This position is required because water utilities in Ontario currently do not have the statutory authority to take the measures necessary to control backflow hazards from private property to the public distribution system. Although plumbing codes have always prohibited any connection whereby potable and non-potable water could mix, there are few details as to the specific device to use to prevent cross connections and many connections are overlooked.

Cross connection protection is not new, but incidents of contamination and concern for legal action - in the event that a public system becomes contaminated and a death or serious illness occurs that could have been prevented by the installation of a backflow prevention device - have heightened the concern of water authorities in this regard. Water utilities should therefore have the statutory mandate to inventory and ensure cross connection control.

In addition to dealing with cross connection control issues with the Chief Building Official, the Chief Water Official should work with the Fire Chief regarding fire protection and the local Medical Officer of Health regarding water quality.

Due to the technical nature of this position and the responsibilities vis-à-vis public health and safety, this person should likely be a Professional Engineer. Professional engineers are bound, first and foremost, to protect the public per The Professional Engineers Act of Ontario. It is important that the person responsible for water understand all the ramifications of their actions and that they regard their duty to public welfare as paramount.

And further, that the Government of Ontario clarify, by statute or regulation, the roles and responsibilities of the Chief Water Official as they relate to cross connection control and other areas of potential jurisdictional conflicts related to private property.

Rationale - It is important to clarify the roles of the water utility with regard to the approvals of cross connections and other related matters.

5. That the Government of Ontario and municipalities participate in drinking water research and that participation in the AWWA Research Foundation be encouraged.

Rationale - The risk chain for drinking water involves contaminant sources, a vector (water), treatment for removal, transmission to the population, ingestion, infection and finally disease. Without a thorough understanding of this entire

chain, neither the public nor the government decision-makers have a solid basis on which to judge the safety of drinking water.

It is with the above in mind that the AWWA Research Foundation has, since 1986, supported nearly 450 research projects valued at more than $100 million (US). Many of these projects have been or are being conducted by Canadian researchers. The funding of this research comes primarily from the Subscription Program. Water utilities subscribe to the research program and make an annual payment proportionate to the volume of water they produce. Consultants and manufacturers subscribe based on their annual billings.

The foundation's research agenda addresses a broad spectrum of water supply issues: resources, treatment and operations, distribution and storage, water quality and analysis, toxicology, economics and management. The ultimate purpose of the coordinated effort is to assist water suppliers in providing the highest possible quality of water economically and reliably.

Research is critical to advance the science of water to improve the quality of life. Any research activities must be coordinated to avoid duplication of effort while ensuring research relevant to local needs.

6. That the Government of Ontario support the consumer principles outlined in this review.

Rationale - Water utilities have traditionally measured their success by the quality of the water they provide, with limited emphasis on customer satisfaction. It is important to realize and respect that customers define satisfaction not only by the product but by the services and related information they receive.

Capacity Development

7. That an analysis be conducted to determine how much additional investment will be needed over the coming decades for infrastructure upgrades. These infrastructure needs should encompass both what is required to comply with Ontario Regulation 459/00 (Drinking Water Protection), as well as what will be needed to replace and rehabilitate aging water treatment and distribution facilities regardless of regulatory mandates.

Rationale - Water is by far the most capital intensive of all utility services, mostly due to the cost of pipes - infrastructure that is buried out of sight. A large portion of the existing pipes were originally installed and paid for by previous generations. They were laid down during the economic booms that characterized the last century's periods of growth and expansion. Watermains last a long time (some more than a century) before their maintenance costs increase near the end of their useful life. The replacement of pipes installed in the latter half of the 20th Century will therefore dominate the remainder of the 21st Century.

Unfortunately for Ontario, research indicates that pipes installed between 1963 and 1975 - the construction boom for many water systems - are most likely to

fail in the future. As such, it is important to assess the condition of the systems in Ontario to determine their age and "life span" and to project the future investment needs.

The need to finance the replacement of pipes in the coming decades may challenge many utilities financially, particularly those that currently do not include an infrastructure renewal allowance in their rates. In some communities, the concurrent need to finance pipe replacement along with treatment plant upgrades will significantly increase the challenge.
The Commission's report notes that "it is critical that investments in system rehabilitation be a normal part of water system expenditures. To determine whether current levels are sufficient or what the levels should be, more detailed information on water systems is needed." (Page 30)

The OWWA/OMWA agree that this analysis should be conducted to determine how much additional investment will be needed over the coming decades for infrastructure upgrades. The central question for policy makers and utilities is whether the rate of infrastructure spending that utilities will face over the next 30 years can be financed by the utilities themselves at rates consumers can afford.

The province must anticipate future needs to ensure the financial capabilities exist to meet public expectations regarding safe drinking water. Furthermore, proper financial planning to replace physical assets must be mandated (i.e. it should be a legal requirement to include a certain percentage of asset value per year to pay for infrastructure renewal).

8. That a system viability analysis be performed and in conjunction with, or pending the results of, that analysis regulations be developed that would permit municipalities to decide how to achieve a legislative obligation to have sufficient financial, technical, managerial, and operational expertise and capacity through such options as retaining consultants, sharing resources with adjacent municipalities, or voluntarily entering into amalgamations having regard to the need to potentially protect drinking water quality on a watershed basis.

Rationale - The AWWA has a published policy on regionalization of water utilities, namely:

> *The American Water Works Association (AWWA) encourages water utilities to identify local and regional solutions to resource management and water supply service needs. If a regional program is necessary or desirable, water utilities should work with the appropriate levels of government to develop the program and promote the use of good utility management principles. State, provincial, territorial and federal agencies are encouraged to support local government efforts to develop a regional program and ensure equitable benefits to all water utilities.*

The viability of drinking water systems is critical to the protection of public health and the conservation of public resources. Viable systems are defined as self-sustaining systems that have the financial, technical, managerial, and operational expertise and capacity necessary to reliably meet all present and future requirements in a comprehensive manner that assures the continued delivery of safe drinking water. Given the number of small systems in Ontario, a system viability analysis to ensure all systems are self-supporting entities is needed. Accordingly, amalgamation of systems may be necessary to ensure the viability of some systems. The problem, as outlined in the Commission's report, is likely the 89% of the plants serving 11% of the population. In some instances, these plants/systems may not be viable and may be the cause of varying levels of service across Ontario.

A more detailed analysis is necessary to determine: where are the small systems; what are the costs to operate these systems; is regionalization with a nearby larger system feasible; can a number of small systems operate as a "larger" regional system to achieve some economies of scale; how will the large geographic area in northern Ontario impact regionalization; does the smaller geographic areas and larger populations in the Southwestern and Eastern Regions make the consolidation of systems more feasible.

And further, that the costs necessary to develop the financial, technical, managerial, and operational expertise and capacity of water utilities be included in the cost of service.

Rationale - With the increasing complexity of water treatment and environmental conditions and more stringent drinking water regulations, system viability assessments must not only address financial considerations, but also the technical, managerial and operational expertise and capabilities of the water utility to satisfy public health and safety requirements on a long-term basis. All training and education necessary to develop the technical, managerial and operational expertise and capabilities of the water utilities must be included in the service cost.

It is noteworthy that even a well-financed water system with the most advanced treatment technologies cannot deliver its water reliably unless its staff is adequately trained. Without this investment in human resources, the implementation of the above will not be possible.

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