**Recommendations from the Sierra Club, Eastern Canada Chapter
For the Walkerton Inquiry
On the Potential Contamination of Drinking Water and
Drinking Water Standards**

The Sierra Club, Eastern Canada Chapter believes that the protection of drinking water sources is paramount. Ontario presently does not have an appropriate system of ensuring groundwater quality protection and this needs to be remedied. Once the source is contaminated, technological fixes are costly and are not always available. The relative cost of appropriate planning and public education is low compared to the cost of clean up. Groundwater is a valuable environmental resource as well as a drinking water resource. Good quality and quantity of groundwater baseflow to streams needs to be protected to ensure the integrity of the ecosystem. The value of public confidence in a safe and adequate drinking water supply should not be underestimated.

Although the Sierra-ALERT Coalition has concentrated on the regulation of agricultural practices at the Walkerton Inquiry, the coalition strongly believes that Ontario needs to make significant headway in protecting groundwater and surface water quality from many types of potential contaminating land uses. The framework proposed in the document entitled “A Proposed Framework for Managing the Impact of Agriculture on Groundwater” puts forth a strategy by which groundwater resources can be prioritized. This strategy can be equally applied to the approval of industrial and residential land uses as it can be applied to agricultural land uses. It stands to reason that some parts of Ontario contain sensitive groundwater resources and these areas should be protected. This does not mean that no development should be allowed in these areas but that special care must be taken in the types of development allowed and the specific waste and chemical handling practices conducted in these areas.

Ritter, 2001 presents a detailed discussion of the risks presented by various contaminants in the environment. Some of the high-risk compounds are ones that are not voluntarily released to the environment such as lead or industrial chemicals. Obviously if these chemicals are found in our drinking water supply then action should be taken. However Ritter’s hazard quotient for nitrate in rural areas represents in part the continued and accepted application of nitrogen to the land surface in the form of fertilizers and manure. Ritter’s findings are substantiated by surveys of rural water well quality that have shown that 14% of wells sampled contained excessive amounts of nitrate (Agriculture Canada, 1993). Other contributions of nitrogen must also be examined such as septic systems, sewage sludge spreading, cosmetic fertilizer applications and atmospheric deposition.

The amount of nitrogen produced by septic systems is much less than the production from an intensive livestock operation. The average person is responsible for 400 L per day of septic system effluent containing 40 mg/L nitrate, or 3.6 grams of nitrogen per day. Using data from Goss et al. (2001) the average livestock unit in Huron County produced 120 g per day in 1996. Comparing these values, a single 4,000 hog farm (800 livestock units) produces 96,000 grams of nitrogen a day, which is the same as approximately 26,600 residents serviced by a septic system.

A typical corn crop in Southern Ontario receives 150 kg/ha in a year of nitrogen fertilizer. Although the plant takes up the majority of the nitrogen, the excess may be leached to the groundwater. If 20% of the nitrogen applied to one hectare, or 30 kg/ha, leached to the groundwater it would equal the nitrogen contributed via the septic system by a family of four. In fact the total contribution of nitrogen to the environment from the 675,000,000 litres of septic effluent estimated to be generated in Ontario in 1982 amounts to approximately 27,000 kg of nitrogen per year, the amount that would be spread on 180 acres of corn. These figures suggest that the mass of nitrogen applied in fertilizers and manure is far more significant than septic systems.

An even more disturbing problem is that manure application also adds bacteria to the environment. Fewer surveys have investigated bacteria in groundwater but those that have found startling results. Conboy and Goss (1999) found that almost 60% of the wells sampled had fecal coliform concentrations exceeding the drinking water standard. Agriculture Canada's survey found approximately 30% containing excessive bacterial concentrations. The findings of the Walkerton Inquiry have shown that bacterial contamination of Walkerton's water supply wells was not an isolated event.

Tile drainage of farm fields in many cases results in the quick transport of manure components to surface water bodies. Lammers-Helps (1997) sites several studies where surface applied manure was detected in tile drainage within five minutes of application. The contamination of Ontario streams has been sited as a cause for the widespread bacterial contamination of the Great Lakes beaches.

All groundwater contamination should be taken very seriously, however the magnitude of the nitrate and bacterial contamination problem suggests that our system of adding these contaminants to the environment needs to be addressed and promptly. Waiting for voluntary changes to agricultural practices is insufficient given the magnitude of the existing problem. The increasing density of animals on some farms is approved with little or no examination of the contributions of bacteria and nitrate to the groundwater.

The farming community can rightfully point out that the solutions have not been clearly recommended to them and that there are often conflicting environmental interests that must be addressed. However we must move forward in regulating this problem and prioritizing land based on the inherent ability of the subsurface (in the case of groundwater) to attenuate contaminants is a reasonable method of determining where high risk land uses could be or should not be located.

Krewski et al. (2001) describes the problems with measuring bacterial concentrations in drinking water. They conclude that "General agreement that drinking water should be free of pathogenic microbial contaminants but analytical methods are expensive, often unreliable and difficult to standardize. The approach adopted is therefore based on water treatment and monitoring for indicators of microbial activity and turbidity." Krewski sums it up by stating that "The most effective approach for managing microbiological risks from drinking water is source water protection…the advantage of good source water protection is that it is a means of preventing water contamination as opposed to requiring the need to address a pollution problem". The Province of Ontario should implement a proactive source water protection program.

On April 23 and 24, 2001 an expert meeting was conducted to discuss the protection of drinking water sources. This meeting focussed on the sources of microbial pathogens and chemical contaminants in drinking water as well as drinking water standards and regulations. This document addresses the various issues raised at that meeting and puts forth recommendations regarding sources of pathogens in drinking water and sources of chemical contamination of drinking water. The questions included in this document are those raised at the meeting. In addition to the actual concerns put forth at the expert meeting, all papers submitted to the inquiry regarding the topic were reviewed and addressed where and if appropriate.

1. Sources of Microbial Pathogens – Human Waste

1.1 What waterborne pathogens arise in human wastes and are relevant to Ontario drinking water?

1.1.2 Is pathogen contamination of water sources from human wastes a problem in Ontario?

Pathogen contamination of water sources from human waste is a problem in Ontario. Septage and wastewater treatment plants have the potential to contaminate surface and groundwater resources. Rural communities with individual septic systems contaminate potable groundwater downgradient from each septic bed. Too often, the location of neighbouring septic systems and groundwater flow directions are not accounted for when siting a well. Many small communities in Ontario now suffer from chronic well water contamination.

Malfunctioning septic beds and wastewater treatment plants are a source of pathogens to surface water bodies. This may impair not only drinking water but also bathing water quality along many beaches in Ontario.

1.1.3 Do we have and appropriate indicator for E. Coli O157, even at low levels, with existing testing methodologies?

Testing for specific pathogens, including *E. Coli O157*, is not required as long as pathogens can be detected at low levels. There is a need to develop a faster technique to quantify all pathogens, or known groups of pathogens, in water.

1.2.1 *What do we know about pathogen survival capacities?*

The variability of microorganisms and environments make it difficult to generalize about the survival capacities of pathogens. Particular species of microorganisms prefer aerobic environments, while others prefer anaerobic environments, and still others prefer only a slightly aerobic environment. The variability in soil is nearly impossible to characterize as well. The soil environment millimetres apart may drastically differ in water content, carbon availability, oxygen concentration, temperature, pore sizes etc. These differences will impact the survival time, ability to reproduce and mobility of bacteria. Current research suggests that *E. coli* can survive, exposed in the environment, for 13 years (Sjorgen, 1995). Pathogen survival and transport in groundwater has not been extensively studied in Canada. Since temperature is a significant factor (lower temperatures usually resulting in longer survival times), pathogen transport and survival in Ontario environments should be investigated.

We recommend that studies should be undertaken to determine the ability of pathogens to transport and survive in Ontario's groundwater systems.

1.2.2 *To what extent does Ontario use direct application (spreading) methodology of human waste products as means to disposal?*

Ontario applies twice as much sewage sludge compared to other provinces combined, rather than incinerating or landfilling. Sewage sludge application to land amounted to approximately 1.5 billion litres compared to 29 billion litres of manure and 675 million litres of septic system effluent.

We recommend no land application of sewage sludge. We also recommend that a publicly accessible database be constructed to catalogue the location and amount of manure spreading in Ontario. The goal of this database would be to prevent over application of wastes to lands and increase public awareness of potentially contaminated water bodies.

1.2.3 *Are there any examples of contamination directly linked to direct application of human sludge?*

We agree with Dr. Goss and OFEC that septic systems should not be over looked as a direct source of water contamination. Poor urban planning (in the absence of a municipal sewage infrastructure) has needlessly resulted in neighbour to neighbour contamination of well water in many Ontario communities. There are many communities in Ontario where nitrate contamination (and likely bacteriological contamination) is arising from the aggregation of many water wells in relatively close proximity to septic systems. Research has shown that nitrate plumes from septic systems can extend for over 100 metres and likely more (Harman et al., 1996; Robertson and Cherry, 1992; Robertson et al., 1991).

1.2.4 *To what extent are miscellaneous sources, for example portable toilets etc., regulated? Are all operators licensed? How are we tracking the land-applied sludge and pathogenic content?*

The practice of land farming untreated septage from septic tanks still occurs in Ontario. Private haulers of septage are turned away from municipal sewage treatment plants for a variety of reasons (limited capacity, incompatible offloading mechanisms etc.). This leads to the periodic spreading of untreated human waste on privately held lands (with or without a Certificate of Approval). In turn, municipal treatment plants desperately need to rid themselves of treated sludge, which often goes into the neighbouring countryside. There needs to be a reciprocal agreement between rural and urban entities to ensure treatment facilities are available for rural septic tank septage.

Certificates of Approval should be reviewed for the current operators, to ensure that Certificates have been obtained and that the operator is abiding to the conditions of the Certificates. All wastes from miscellaneous sources should be treated prior to disposal.

We recommend that sewage sludge and untreated septage not be applied to land.

1.2.5 *What are the proposed strategies to decrease water contamination risks from direct application of human wastes?*

Human wastes, including septage and sewage sludge, should not be applied to land.

We agree with the consensus items on this point but would add the following:

- A database on the extent and potential contamination from land application as well as data on the characteristics of sewage treatment plant discharge is needed. We would add that this database should be in conjunction with a similar manure database to monitor the application of waste across Ontario.

- Much of the septic tank land application is not for agricultural purposes but is merely for the disposal of material. Unlike chemical fertlizers, sewage sludge is not solely nutrients they contain compounds that can only be considered contaminants. Sewage sludge should not be applied to land.

1.4 *How effective is the current capacity in municipal wastewater treatment plants?*

1.4.1 *What implications do extreme events (i.e. heavy rainfall or spring flow) have for current treatment/disinfection capacities?*

Heavy rains and spring melt conditions prevent adequate treatment of wastewater all too often resulting in the discharge of poorly treated waste into receiving bodies. Treatment plants should increase their capacities in order to adequately deal with these events.

We agree with OWWA/OMWA that multi-barrier approaches are the best design for the treatment of pathogens and that monitoring and resources should be spent on sudden or short-term events rather than just general conditions. Conditions attached to Certificates of Approvals should focus on the general conditions as well as events (such as bypasses) which will have a greater effect on the environment.

We agree with Mr. Hrudey that source control within a multiple use environment cannot and will not eliminate the need for water treatment. However, where possible, source protection provides a better approach than water treatment.

We also agree with Conservation Ontario, that in determining the significance of types of waste, we must identify specific variables for a local area including local characteristics - soils, watershed conditions. Loading risks must consider local assessment and this should be built into the system (planning processes, certificates of approval) and cumulative implications.

2. Sources of Microbial Pathogens: Agriculture Waste and Wildlife

2.2 What is known about the comparative scale of pathogen contamination from these sources compared to human waste (elsewhere in Ontario)?

We agree with Mr. Hrudey that we should not assume that "pristine" water is not potable water in Ontario, but that it seems implausible that wildlife are a huge contributor of pathogens relative to livestock and human wastes.

The view of waste as nutrients is important to address. When considered a nutrient, manure and sewage sludge will be applied with regard only for plant uptake. The degree of nutrient leaching to groundwater after nutrient application is not well understood and therefore, it is difficult to prevent excessive applications. All unconfined aquifers in agricultural settings described in the literature examined by Burton and Ryan (2000) had excessive nitrate concentrations. Nutrients can therefore have negative environmental impacts.

The bacteria content of manure and the bacteria and metals content of human wastewater sludge, suggests that these substances cannot be simply labeled nutrients. Consideration must be given to the possible negative aspects of their use. Although crops across the province require nutrients, the groundwater environment in some parts of the province may make use of these substances unsuitable or at the very least may dictate lower rates of manure application. We recommend sewage sludge not be land applied.

We recommend that more information be collected on sites that have received sewage sludge and manure to demonstrate the soil and groundwater concentrations of pathogens and that a central database be established.

The extensive use of hormones and antibiotics in livestock agriculture and by the human population suggests that we may be unable to even test for some of the most important compounds contained in these wastes (Ritter, 2001). More information should be collected regarding these and other compounds prior to continued spreading in areas where the groundwater and surface water are susceptible to impacts from spreading.

2.3 *What means can be effective at source?*

2.3.1 *What impact do different types of on-farm manure management practices have on the pollution of source water?*

The following table outlines the manure management practices, impacts and recommendations we believe to be pertinent.

Management Practice	Impacts	Recommendations
Over Application	High runoff, higher potential for groundwater contamination	Greater enforcement of manure application through site inspections and nutrient management plans
Tile drainage	Quick transport of contaminants to tile drains and surface water bodies	Treat tile drain water at times of manure spreading or retain water in tiles (Fleming and Bradshaw, 1992) Limited manure application on tiles that flow year round
Winter Application	High runoff rates, little use of nitrogen	No winter application
Application during times of inactive plant growth	Leads to little plant uptake of nutrients	Mandatory 365 day storage, to allow for late spring and early summer applications
Application on Permeable Overburden	Rapid infiltration and transport of contaminants through unsaturated zone to groundwater flow system	Avoid extensive spreading on highly vulnerable areas and well-head recharge areas
Incorporation of manure into soil	Lower runoff, higher nitrogen utilization,	More research is required to estimate the optimum

	possibly less pathogen die-off	spreading conditions for pathogen die off

2.3.2 Should we change the feed lot regimes in Ontario to potentially create a less hospitable environment for pathogens?

The production of livestock in close quarters increases the spreading of pathogens throughout the population (Halverson, 2000). Occasional sampling of feedlots for pathogens such as *E. coli O157* and *Cryptosporidium* would increase our understanding of how common they are and whether or not they are more common in intensive operations.

Consensus:

- There is nothing unique about agriculture and wildlife and the pathogens they contribute

- Wildlife is a lower source of pathogen contamination compared to agricultural and human waste.

- Contamination from agriculture depends on time of application, amount of application, size of operation, type of operation and manure management.

- Research has indicated that higher levels of pathogens are contributed by liquid manure spraying.

- Data limitations prevent generalizations about different sources and impacts of different management practices.

3. Sources of chemical contaminants: Point sources

3.1 Are there point sources of chemical contaminants that are likely to be relevant in Ontario?

3.1.1 What consensus exists on point sources of chemical contaminants?

We agree on the following point-sources of chemicals: underground storage tanks, land fills, buried waste, industrial sites and abandoned contaminated sites, high natural fluoride sites, spills, sewage sludge. We would add: manure storage facilities, and intensive livestock operations to that list.

3.2 What chemical contaminants are important to human health? Which appear to be clear health priorities?

3.2.2 *What consensus exists on high profile chemical contaminants that need attention?*

We agree with the listed chemicals that need more attention, however, we would like to add the following. The impacts of nitrate of fish populations should also be addressed. There appears to be concern regarding nitrate concentrations in cold water fisheries above 3-5 mg/L. The Maitland Valley Conservation Authority and Grand River Conservation Authority are two examples of organizations which consider nitrate above 4 mg/L to be excessive and are deleterious to fish populations. We would also like to add sodium and chloride to the list due to widespread road salting and the health effects which sodium (circulatory system) and chloride (potential to cause carcinogens) can impose.

Ritter (2001) points out that many chemicals have not been analyzed in the past like fluorinated surfactants and pharmaceuticals. Our energies should be directed at chemicals that we might be ingesting unknowingly. Chemicals that are already included on the drinking water objectives are being tested regularly and in general are not present at excessive concentrations in our municipal drinking water supplies.

3.3 What is known about the scale and scope of health risk that chemical contaminants may pose in Ontario's drinking water?

We agree that there will always be a need to consider new contaminants that are not currently recognized as a problem and that pharmaceutical residuals are one of these concerns.

3.4 What are the prospects for improving or refining our stock knowledge on these areas?

We recommend a review of how other jurisdictions are dealing with areas that we have little experience with (i.e. antibiotics in groundwater). In cases where guidelines are organized to deal with future problems, we should adopt other's strategies as interim strategies until we are able to determine if these substances represent a risk in Ontario or that we are able to develop a more appropriate strategy.

4. Sources of Chemical Contaminants: Non-Point Sources

4.1 Are there non-point sources of chemical contaminants that are likely to be relevant in Ontario?

4.1.1 What consensus exists for non-point sources of chemical contaminants?

We agree with the consensus sources for non-point pollution: agricultural wastes, urban stormwater drainage, groundwater infiltration of surface contaminants, pesticides, spills, road cover, road salting and fuel emissions. We would add chemical fertilizers and pesticides.

4.2 What non-point source chemical contaminants are important to human health? Which appear to be clear health problems?

The Ontario Drinking Water Standards outline contaminants that are important to human health and at what levels these contaminants are no longer acceptable in drinking water.

We agree that pesticides, lead, nitrate, and mercury are clear health problems, which is why monitoring and planning initiatives address these contaminants. The challenge is to incorporate new found contaminants into existing monitoring programs as well as to continually update chemicals or pathogens which are detrimental to human health.

We agree with the consensus that there are deficiencies in drinking water monitoring for pesticides as well as other widespread contaminants (i.e. nitrate, chloride, and sodium).

4.3 What is known about the scale and scope of health risk that they may pose in Ontario?

Nutrients, pesticides and pathogens may also present a risk to human health when they enter drinking water supplies (Ritter et al., 2001). Goss et al. (1998) found that 14% of wells sampled in Ontario contained nitrate concentrations above the Ontario Drinking Water Standard. Ripley et al. (1998) observed that 20% of rural wells sampled contained pesticide residues. Although the concentrations of pesticides found were below Ontario Drinking Water Standards, the results from both studies indicate the wide spread impact to human health from non-point source pollution.

We recommend that a provincial database be assembled to properly analyse and address water quality trends in Ontario.

4.3.1 What additional issues are related to the monitoring of non-point source chemical contaminants?

We suggest that the monitoring of non-point source chemicals should include the receiving body. The impacts of agricultural pollutants on groundwater and on surface water bodies through groundwater discharge are substantial. Adequate groundwater and surface water monitoring programs would be able to ascertain the quantity of pollutants reaching Ontario's groundwater and surface water and provide enough information to determine the impact on the ecology within lakes, rivers and streams.

We agree with CELA, that epidemiological research is inadequate and under funded to provide good findings regarding substance persistence and exposure. Also, that a precautionary approach be adopted which would prevent exposure (to humans or the environment) from occurring – requiring a "proof of no harm" rather than a "wait and see" approach.

The lack of monitoring of individual domestic wells could result in some portion of the population consuming water that is seriously impaired. The government should monitor a subset of rural wells in their drinking water surveillance program to ensure that serious problems are not developing in rural well water quality.

How precautionary is precautionary and how much cost is acceptable? Vulnerable areas should be more rigorously protected from all land uses that are known to carry a high risk of groundwater contamination.

Precautionary measures should be based on the industrial activity and hazardous materials involved. For example, spilling a 45-gallon drum of Trichloroethylene (TCE), a common de-greaser, has the potential to impair 5.5 billion litres of potential drinking water. Strict precautions regarding the storage and handling practices of materials such as TCE are warranted.

Precautions should be based on the sensitivity of the local environment, the industrial practices and the chemical or microbial agents involved.

4.4.1 What are the major concerns with chemical contamination of drinking water for the group?

Contaminants:

Any chemical that is presently not measured or the health effects of which have not been adequately studied are of particular concern. We believe that the body of knowledge regarding the majority of the list put forth by the group is reasonable well developed. Efforts need to be extended to antibiotics, hormones, and other "endocrine disrupters"

- Lead
- Nitrate/nitrite
- Fluoride (naturally occurring)
- Disinfection by-products
- Water treatment chemicals

- Chloride
- Sodium

Sources:

- Leaking underground storage tanks
- Contaminated sites
- Buried/Abandoned waste
- Landfills/ash heaps
- High natural fluoride sites
- Agricultural Activities
- Intensive Livestock Operations

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