THE INCORPORATION OF THE REASONABLE USE CONCEPT INTO THE GROUND WATER MANAGEMENT ACTIVITIES OF THE MINISTRY OF THE ENVIRONMENT

ONTARIO MINISTRY OF THE ENVIRONMENT
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1.0 INTRODUCTION

1.0 PURPOSE AND OBJECTIVE

The basic purpose of this document is to establish procedures for the determination of what constitutes reasonable use of ground water on property adjacent to sources of contaminants and to explain the role of a reasonable use approach in the Ministry's various activities related to ground-water quality. This is needed to facilitate implementation of the ground-water quality management policies and procedures contained in "Water Management Goals, Policies, Objectives and Implementation Procedures of the Ministry of the Environment," November, 1978 (Water Management), which are based on protecting existing and potential, reasonable uses of water. The reasonable use concept applies only to ground-water quality management. The Ministry's surface water quality management policies are presented in the booklet "Water Management".

This document addresses the levels of contaminant discharges considered acceptable by the Ministry and the levels of contamination in water supplies which would warrant the restoration of those water supplies. Acceptable levels are addressed in the booklet titled "Ontario Drinking Water Objectives", by the Ministry of the Environment.

It is important to remember that this document identifies the Ministry's perception of the issues addressed and the solutions which the Ministry will employ or endorse. The Ministry can only insist on utilization of its own policies and guidelines when matters are under the Environmental Protection Act or the Ontario Water Resources Act, but its actions, even there, are usually subject to appeal. When the Environmental Assessment Act or the Consolidated Hearings Act is utilized, the Ministry does not have

the power to make decisions incorporating Ministry policies and perceptions; the decision-making power is elsewhere and the Ministry can only suggest and recommend.

In Section 2 the administrative and technical basis for adopting the Reasonable Use approach is outlined and discussed. In Section 3, terms are defined and the Reasonable Use concept is applied to the issuance of Certificates of Approval for the following Ministry-regulated activities; proposed landfills, operating landfills, landfills requesting approval for expansion, exfiltration lagoons and large subsurface sewage systems. The document also applies to the restoration of ground-water supplies that have been contaminated by operating landfills, closed landfills, spills or other activities.

2.0 ADMINISTRATIVE AND TECHNICAL BASIS FOR THE REASONABLE USE APPROACH

2.1 Ministry Policy

The Ministry's policy as presented in the November, 1978 publication "Water Management" referred to reasonable uses of ground water, to clearly indicate that the Ministry would require sufficient levels of environmental control to protect reasonable uses of the ground water.

Potential reasonable uses are also specified to indicate that the Ministry has concern not only for present but for future uses of ground waters in the Province. This policy applies both to situations where contaminants are already present, as a result of events such as accidental spills, as well as cases where facilities such as proposed landfills have the potential to produce contaminants. The policy is intended to assist in making decisions about current, and future activities of the Ministry. It is not intended that all waste disposal facilities be investigated immediately to determine if they meet the levels for contaminant discharge described in this document.

2.2 Determination of Reasonable Use

The Ministry's decision as to what constitutes reasonable use and potential use of ground water on land associated with or adjacent to waste disposal sites or contaminant spills will be made on a case-by-case basis. This is necessary because the wide variation in the quality, quantity and availability of ground water makes a fixed, standard approach impractical.

The responsibility for deciding what constitutes the reasonable use of the ground water and what uses should be protected will normally rest with the Regional Director. The Director will base his decision on input from a proponent and/or an assessment by his staff. If his decision becomes a major issue in a specific case, it could be made the subject of a public hearing.

Reasonable use and potential use must be established with respect to specific soil and water-bearing units in the subsurface and would apply to all of the ground lying beneath a particular property. As is discussed later in this Section, in most cases, the reasonable use of ground water will be for domestic consumption. However, when it can be demonstrated that there is some other reasonable use of ground water with different water quality requirements, then criteria appropriate to that use will be applied.

The decision as to the reasonable use of the ground water at a particular location shall be based on three major considerations:

a) the present use of the ground water,
b) its potential use, and
c) the amount and quality of the ground water that is available.

a) The present use of ground water in the vicinity. This is easily determined by a survey of the uses being made of the ground water by nearby land owners and from data in the Ministry's files. In most instances, the present use will be taken as the reasonable use.

present use is reasonable use.

b) Potential use of ground water in the vicinity. Where there is no current use of the ground water in the vicinity, criteria will be established on the basis of the potential use of that water. The judgement of potential reasonable use of the ground water will be based on the quality and quantity now present in the vicinity, and the current use of that particular resource in the general area. In addition, the work of planning agencies etc. may provide input to determine potential land use in the vicinity as this might affect the use of the ground waters.

c) The existing quality and quantity of the ground water in the vicinity. The existing quality of the ground water in the vicinity and the amount of that water which would be available to wells must be assessed. This can be accomplished by using data in the Ministry's files and a general knowledge of the hydrogeology in the area.

The potential use of ground water in Ontario will almost always be for domestic consumption. This is because:

a) There are virtually no parts of Ontario where the quantity of ground water that could be collected by a well will not meet the basic needs of a single family.

b) Although there are parts of Ontario where the quality of the ground water does not meet the Ontario Drinking Water Objectives, in most cases, individual owners have used such waters on a continuing basis over many years (Section 3.4).

The presence of piped or surface water supplies is not necessarily justification for considering that there is no potential use for the ground water. However, it may be a contributing factor (Section 3.4) where other considerations, such as naturally poor quality, would detract from the usefulness of the ground water.

The desirable qualities of drinking water are specified in the document "Ontario Drinking Water Objectives". Water quality objectives for protection of fish and aquatic life and for agricultural use are stipulated in Tables 1 and 5 of "Water Management". Each publication contains, in addition to the numerical objectives, directions as to their application. In those instances where there is no Ministry of the Environment objective for a given parameter, the Regional Director may specify what is considered to be an appropriate objective based on current scientific evidence.

2.3 Other Land Uses

Related land uses which could be affected by contaminants transported by ground water, and which are compatible with a reasonable use approach, include: the use of the soil for agricultural activities, the use of the sub-surface for facilities such as sewers, electrical conduits or building foundations, or the use of the soil as fill.

2.4 General Technical Considerations

A number of general technical considerations have been taken into account in the development of this document.

A. The Ministry considers that the following positions represent good ground-water management practice:

   i) There are suitable environments in Ontario and adequate technology is available so that it is not necessary to degrade any subtantial ground-water resource by waste disposal.

   ii) Allocation of all of the attenuation capacity in a particular area to a single source of contaminants may not be prudent. This is because it may not be possible to prevent additional contaminant loadings in the future. This anticipated additional contaminant loading must be assessed on a case-by-case basis.

iii) Provision should be made, in the form of contingency plans, for alleviating unacceptable environmental impacts, in so much as possible, should this prove to be necessary in the future. Experience in the identification of previously unsuspected contaminants has shown that such a need should be anticipated.

B. It is not generally possible with present technology, to estimate accurately the quantity or the quality of contamination which will discharge from a waste-disposal facility or spill site. Uncertainty factors on the order of at least five times are common in the measurement of parameters such as hydraulic conductivity. Therefore large safety margins should be incorporated into all estimates of contaminant discharge.

The safety margin that is appropriate would have to be assessed on a case-by-case basis depending on the complexity of the hydrogeologic environment, the degree of uncertainty in the assessment, and the consequences of failure of the system.

There is a higher level of certainty when an existing contaminant plume is present and can be used in an assessment than when no plume is present.

C. There are some practical differences in the hydrogeologic aspects of solid and liquid waste-disposal facilities. These differences are associated with monitoring (the initiation and appearance of contaminant discharge) and contingency measures (the removal of the waste).

D. The use of land adjacent to a waste-disposal facility or a spill, in addition to those uses associated with water supplies, can be affected by liquid or gaseous contaminants transported by the ground water or moving through the unsaturated zone in the subsurface. The protection of these uses is also the responsibility of the Ministry.

2.5 Environments Unsuitable for Waste Disposal

The Ministry may not support proposals for waste disposal facilities in the following environments:

1. Where no appreciable attenuation can be provided in the subsurface and an excessive amount of the attenuation required for acceptable discharge must be provided by dilution in surface waters.

2. Where only a relatively small amount of natural attenuation will be provided by the environment and an unusually large area is required for the attenuation of contaminants as compensation for that poor environment. For technical reasons, environments where this is necessary are generally quite expensive to evaluate and contingency plans in such environments are seldom practical.

3. Where the subsurface beneath the facility is particularly suited for a better use. For example, waste disposal may not be supported in an esker of sand and gravel where the esker might be needed at some future date for the development of a water supply.

4. Where the consequences of failure are unacceptable. For example, waste disposal may not be supported where failure or contaminant discharge might affect the sole source of a community water supply to an unacceptable degree.

3.0 THE APPLICATION OF THE REASONABLE USE APPROACH TO MINISTRY ACTIVITIES

3.1 Introduction

In this Section, the reasonable use concept is applied to:

(a) determining quantitatively the acceptable levels of various contaminants originating in Waste Disposal Sites and impinging on Adjacent Properties and the levels of contaminants from spills and waste disposal activities that may justify the restoration of affected water supplies.

(b) assessing the suitability of a Contaminant Attenuation Zone, and a Waste Disposal Site.

Terms are specifically defined in Section 3.3 and are illustrated in an accompanying schematic diagram.

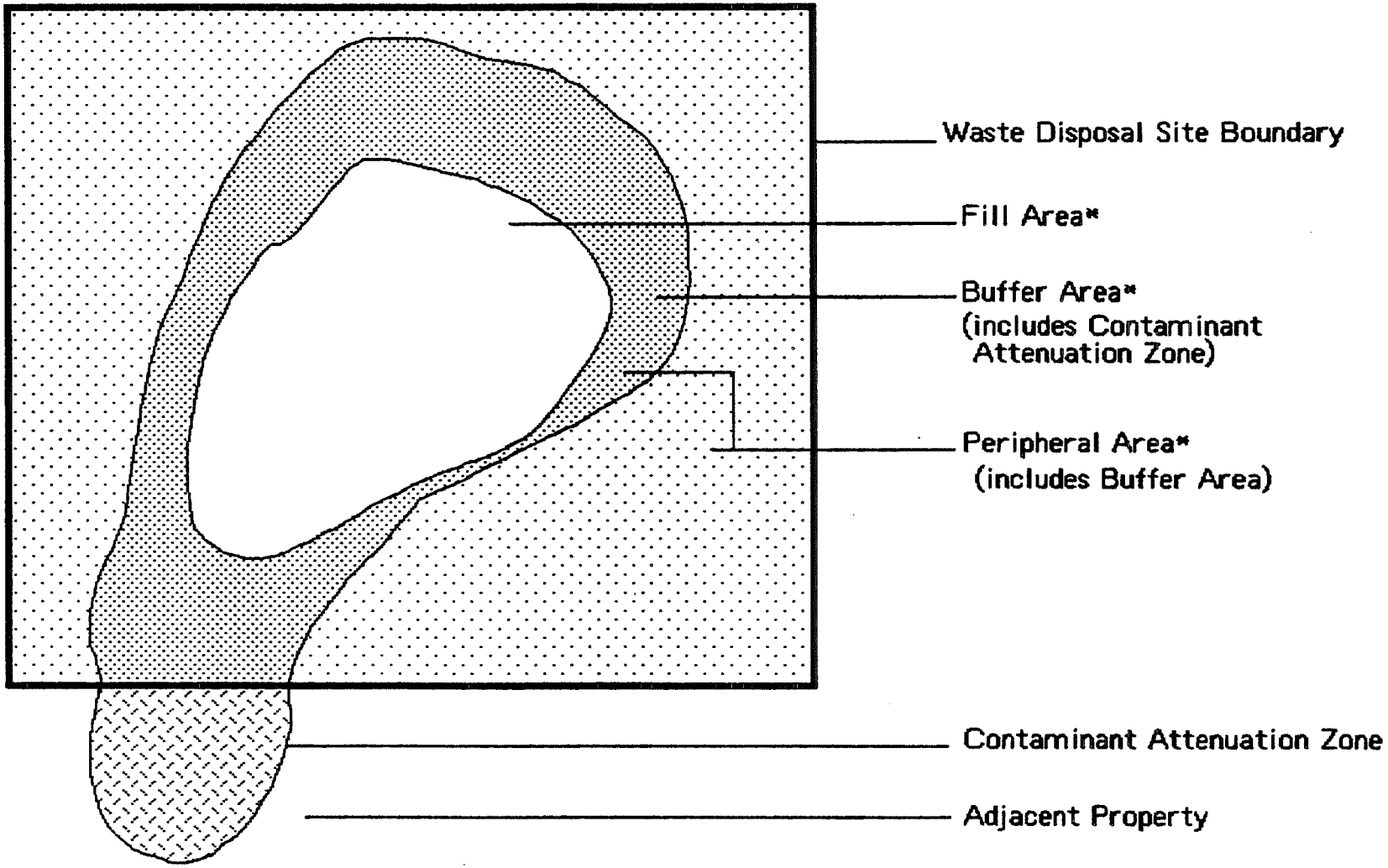
3.2 The Ministry of the Environment's Responsibility and Authority

The Ministry of the Environment is charged with the conservation of the ground-water resources of the Province and the control of the use of these resources in an effective manner for the public good. To this end, the Ministry may wish to discourage the use of some environments for waste disposal and encourage the use of other environments. The Ministry position is that Waste Disposal Sites should be placed in environments where their impact will be minimized, that acceptable disposal methods should be used and that these methods should be compatible with those particular environments.

For waste disposal activities the Ministry has the management authority to:

1) Issue a Certificate of Approval which would permit the use of property for contaminant attenuation or treatment. Discharge

SOLID WASTE DISPOSAL SITE– SCHEMATIC VIEW



* See MOE document *Land Use and Waste Management Definitions* for definitions of terms

to neighbouring property must have no more than a negligible effect on the use of this property. The question of whether the effect is negligible, if challenged, could be established by the courts, which would decide if there is damage and how it can be measured in terms of dollars. This is inherent in the approach used by the Ministry in other situations, such as the issuance of air approvals.

2) Prevent the owner of a Waste Disposal Site from using the sub-surface beneath his property for waste disposal purposes if this use is not felt to be in the public interest.

This management authority is subject to the limitation and qualifications in Section 1.0.

3.3 Definition of Terms

For the purpose of this paper, the Ministry will consider three areas in assessing waste disposal proposals:

1. The Waste Disposal Site;
2. The Contaminant Attenuation Zone;
3. The Adjacent Property

These are illustrated in the accompanying diagram and defined in the following sections.

The terminology used in this discussion is adapted from the Ministry document titled "Land Use and Waste Management Definitions".

3.3.1 The Waste Disposal Site

For the general purposes of this Ministry, "Waste Disposal Site" is defined in Part 5 of the Environmental Protection Act to mean any land where waste is disposed or processed and includes any machinery, equipment or operations required for the treatment or disposal of the waste. Thus, a Part V Certificate of Approval for a Waste Disposal Site is issued for a parcel of land larger than the

area where the waste will be deposited, as the adjoining land is necessary for proper site operations.

For the purposes of this paper, we are not considering Part V Waste Disposal Sites where treatment takes place, but only sites where disposal of the waste occurs. Also, for purposes of this paper, we will use the term Waste Disposal Site to include a large sub-surface sewage system or an exfiltration lagoon.

The most common Part V Waste Disposal Site at which disposal takes place is defined as a "Landfilling Site" in Regulation 309. The Waste Disposal Site comprises the area on or in which wastes are disposited, (the "Fill Area"), and any bordering land, (the "Peripheral Area"), as shown on the accompanying diagram.

Large sub-surface sewage disposal systems are described in Article 14.1 of the Manual of Policy, Procedures and Guidelines for Private Sewage Disposal Systems.

The following comments apply to a Waste Disposal Site:

a. Future use of the land should be strictly controlled. Based on technical considerations, such controls should be permanent or continued until it can be shown that such control is no longer necessary.

b. As there are environments which the Ministry does not believe are appropriate for waste disposal, the Ministry will either oppose the use of such environments or will insist that stringent safeguards be incorporated in any design for the Waste Disposal Site. These safeguards may include provision for the collection and treatment of any contaminants which will be produced. Guidelines for identifying environments unsuitable for waste disposal are presented in Section 2.5 of this document.

3.3.2 The Contaminant Attenuation Zone

The purpose of designating a "Contaminant Attenuation Zone" is to allow, in exceptional cases, the limited impairment of use of off-site property by means of easements or other methods without imposing the severe restrictions on land-use which apply to the Waste Disposal Site.

Where appropriate, a Contaminant Attenuation Zone may be designated. It is outside of the Waste Disposal Site and it is defined both with respect to the area of land which it underlies and also with respect to the depth at which it lies.

In the Contaminant Attenuation Zone, it is intended that contaminants will be naturally attenuated to levels compatible with the reasonable use of the Adjacent Property as discussed in Section 2.2 and in order to meet the criteria specified in Section 3.5.1.1. Contaminant levels in the Contaminant Attenuation Zone may impair some uses of that Zone. The operator of the Waste Disposal Site must obtain the right to the use of this Zone by reaching agreement with the property owner. The agreement should be registered on the title to this land.

Circumstances and environments favouring the designation of a Contaminant Attenuation Zone are discussed in Section 3.4.

3.3.3 The Adjacent Property

The Adjacent Property is the land bordering the Waste Disposal Site or the Contaminant Attenuation Zone. Discharge of contaminants (leachate) to Adjacent Property will have no more than a negligible effect on the present or potential reasonable use of that property. This will ensure that:

a) the presence of the contaminant will not interfere with the construction, installation or good operation of any usual facility in the subsurface, such as utility conduits;

b) the soil will not be contaminated to a degree which would interfere with its use;

c) the ground water will not be contaminated to a degree which would impair its use, where:

(i) it is presently of acceptable quality;
(ii) it is in a location from which it could be practically obtained;
(iii) there is a potential use of the ground water for other purposes.

3.4 Circumstances and Environments Considered Suitable for a Contaminant Attenuation Zone

The Ministry may support an application for a Waste Disposal Site involving the acquisition of land or an easement for a Contaminant Attenuation Zone only under the following circumstances:

1. Where an alternate source of water is far superior to any associated with a Contaminant Attenuation Zone. Here the Ministry may support the use of the ground water for dilution and attenuation in a Contaminant Attenuation Zone and take the position that the effect on reasonable uses on Adjacent Property would be negligible because that ground water would not need to be used in any case.

   This circumstance could arise as follows:

   a. Where two water-bearing units are present, one being far superior to the other with respect to the quality, quantity and the accessibility of the water contained in it, the Ministry may accept the inferior unit as a Contaminant Attenuation Zone, provided that this will not interfere with the use of the superior unit.

   b. Where good supplies of water are available, either from surface water sources or from municipal systems, and the

ground-water supplies in a particular unit are marginal with respect to their quality and/or their quantity, the Ministry may support the use of that ground water as a Contaminant Attenuation Zone.

2) Where only an acceptably small, clearly defined and hydrogeologically restricted portion of a subsurface unit will be degraded and this subsurface unit is not likely to be required for a higher use.

This procedure would allow the Ministry to support the use of certain Crown Lands in Northern Ontario or well defined zones of ground-water flow such as may be present in flood plains, as Contaminant Attenuation Zones despite their physical ability to yield ground water in "useful" quantities.

3) Under special circumstances and on a case-by-case basis where naturally high levels of iron, manganese and/or total dissolved solids (where these are associated with hardness) are present in the ground water and as a result, the limits imposed in Section 3.5.1.1 can not be met (see situations described in Section 3.5.1.2, Examples 2 and 3). This is because:

   a) Unlike the case in surface waters, concentrations of iron, manganese and total dissolved solids commonly in excess of the Provincial Drinking Water Objectives are naturally present in Ontario's ground waters. These ground waters are routinely used for domestic supplies.

   b) These parameters are not related to health, at the levels stated in the Provincial Drinking Water Objectives, and in addition can be removed from a water supply with commonly available techniques.

It is not practical to eliminate landfilling in a large percentage of the Province because of the natural presence of iron, manganese and total dissolved solids in excess of the Provincial Drinking Water Objectives.

4. Where, in exceptional cases in the judgement of the Regional Director, the most appropriate use of that environment would be as a Contaminant Attenuation Zone, although it is suitable for other purposes as well.

3.5 Landfills

3.5.1 The Assessment of Proposed Landfills.

3.5.1.1 Basic Approach - In accordance with the appropriate criteria for particular reasonable uses, such as those specified in "Water Management", a change in quality of the ground waters on the Adjacent Property will be acceptable only as follows:

> Quality cannot be degraded by an amount in excess of 50% of the difference between background and the quality criteria for any designated reasonable use except drinking water. In the case of drinking water, the quality must not be degraded by an amount in excess of 50% of the difference between background and the Provincial Drinking Water Objectives for non-health related parameters and in excess of 25% of the difference between background and the Provincial Drinking Water Objectives for health-related parameters. Background is considered to be quality of the ground water prior to any man made contamination.

In accordance with Section 3.2 it is the Ministry's judgement that such increases in contaminant levels will have no more than a negligible effect on the use of the Adjacent Property.

In assessing the amount of degradation that is acceptable, consideration is given to the natural, uncontaminated quality of the ground water, the present quality of the ground water and potential contamination of the ground water from all sources.

3.5.1.2 Examples of the Application of the Concept - Below are given examples of the application of this concept to three different situations:

Example 1 - Where the designated reasonable use of ground water allows no change in quality, no change is acceptable.

Example 2 - Where the designated reasonable use of the ground water is drinking water and the ground-water quality is presently better than the Provincial Drinking Water Objectives, a lowering of water quality on the Adjacent Property will be acceptable in accordance with the formula stated above. (See Section 3.4, Part 3. for possible exception)

Example 3 - Where ground-water quality is currently poorer than the Provincial Drinking Water Objectives, but the ground water is nonetheless in use as a drinking water source, then no decrease in water quality will be acceptable. (See Section 3.4, Part 3 for possible exception).

3.5.1.3 Examples of the Calculations - Two calculations are required to determine the amount of contamination that can discharge from a Waste Disposal Site onto the Adjacent Property. The first calculation addresses the total contaminant impact at that location from all sources of contamination. The second addresses the permissible impact from the particular Waste Disposal Site.

The maximum concentration (Cm) of a particular contaminant that would be acceptable (Section 3.2) in the ground water beneath the Adjacent Property is calculated in accordance with the following relationship:

$$Cm = Cb + x(Cr-Cb)$$

The terms are defined as follows:

Cb - This is the background concentration of the particular contaminant in the ground water before it has been affected by man (Section 3.5.1.1). This allows consideration to be given to the amount of increase in contaminant level.

Cr - This is the maximum concentration of the particular contaminant that should, in accordance with the Province's water management policy be present in the ground water. This value is dependent on the use (Reasonable Use) to be made of that ground water (Section 2.2). It allows consideration of the total amount of contamination.

x - This is a constant that reduces the contamination to a level that is considered by the Ministry to have only a negligible effect on the use of the water. For drinking water is 0.5 for non-health related parameters or 0.25 for health related parameters. For other reasonable uses it is 0.5. (Section 3.5.1.1).

Levels of contamination greater than Cm may have an appreciable effect on the use of the Adjacent Property and the Ministry will not support an application for a Certificate of Approval for Waste-Disposal Site with contaminant discharges which would cause this level to be exceeded.

The maximum concentration of a particular contaminant (Cw) originating in the Waste-Disposal Site that can be permitted to reach the Adjacent Property and still not cause Cm to be exceeded can be calculated in accordance with the following relationship:

$$Cw = Cm - Cp - Co$$

The terms are defined as follows:

Cp - This is the concentration of the particular contaminant in the ground water at the time of assessment, (i.e. the present background). This water may already contain some contaminants (Section 3.5.1.1). These contaminant levels must be subtracted to determine the contaminant increment that can be permitted from the Waste-Disposal Site.

Co - This is the potential contaminant increase from other sources with a high degree of probability (Section 2.4, Part A, ii). For example potential chloride contamination from a highway under construction next to the site must be subtracted to determine Cw.

Using chloride as an example, the maximum allowed chloride level (Cm) in the ground water beneath the Adjacent Property and the maximum chloride discharge (Cw) to the Adjacent Property from a hypothetical Waste Disposal Site are calculated as follows:

a) The reasonable use of the ground water beneath the Adjacent Property has been determined to be for domestic supplies.

b) The Ontario Drinking Water Objective for chloride (Water Management, P.52) is 250 mg/L. This represents Cr.

c) The natural uncontaminated background concentration of chloride is estimated to have been 10 mg/L. This represents Cb.

d) The measured concentration of chloride at the time of the assessment is 40 mg/L. This represents Cp.

e) The expected additional chloride increase from a nearby highway that is presently under construction is estimated to be 20 mg/L. This represents Co.

f) Chloride is considered to be a non-health-related parameter and therefore the constant (x) is 0.5.

The maximum allowed concentration (Cm) of chloride beneath the Adjacent Property, in accordance with the relationship $Cm = Cb + x(Cr-Cb)$ is therefore:

$$10 + 0.5\ (250-10) = 130\ mg/L$$

The maximum concentration of chloride (Cw) from the Waste Disposal Site that can be permitted to reach the Adjacent Property, in accordance with the relationship Cw = Cm - Cp - Co is therefore:

130 - 40 - 20 = 70 mg/L

It should be noted that the chloride ion will seldom be the critical contaminant parameter (i.e. the contaminant parameter which will most closely approach its maximum allowed value, Cm, and thus represent the limit to which the site is designed). However it is commonly used in contaminant investigations because of its usefulness as a "tracer". The critical contaminant is dependent on the characteristics of the wastes and the hydrogeologic environment and is determined on a case-by-case basis.

3.5.1.4 Site Assessment - The assessment of the proposed Waste Disposal Site should be carried out in accordance with any pertinent Ministry guidelines. In addition, Section 2.4 of this document "General Technical Considerations" should be considered and in particular those parts relating to the provision of a safety margin in making estimates of contaminant discharges. (Part B.)

3.5.2 The Assessment of Operating Landfills

An Operating landfill is handled as follows:

a) An operating landfill should meet the same limits for contaminant discharge (Section 3.5.1.1) as a proposed landfill.

b) The judgement as to the amount of offsite impact that the landfill will produce may be based on actual offsite measurements of contaminant levels or on predictions of offsite contaminant levels which are based on onsite measurements. This reduces the requirements for a safety margin in calculations (Section 2.4, Part B).

c) If contaminant concentrations exceed the limits specified in Section 3.5.1.1 but are less than 100% of the particular water quality criteria, the landfill should be closed in a manner to minimize environmental damage, or the operation should be modified. It is acceptable to modify the landfill operation, for example, by installing a cover with low hydraulic conductivity, in order to meet the specified limits. However if these levels are exceeded, it may be prudent to require all landfilling, except that done in conjunction with closure or remedial activities, be terminated until the specified limits have been met, or until monitoring data indicate that these limits will be met.

d) If contaminant discharge exceeds 100% of the particular water quality criteria and modifications in the design in accordance with c, above cannot be accomplished, the landfill should be closed. Determinations on the replacement of contaminated water supplies and the abatement of the contaminant plume must be made on a case-by-case basis.

3.5.3 The Assessment of Landfills Requesting Certificates of Approval for Expansion.

A Certificate of Approval for a landfill requesting expansion will be handled in the same manner as would the Certificate of Approval for a new landfill or proposed landfill (i.e. it must meet the limits specified for contaminant discharge in Section 3.5.1.1).

3.5.4 The Assessment of Closed Landfills

A closed landfill discharging contaminants at levels in excess of 100% of the particular water quality criteria is to be judged on a case-by-case basis, in the same manner as a spill.

3.6 Exfiltration Lagoons and Large Subsurface Sewage Disposal Systems

Exfiltration lagoons and large subsurface sewage disposal systems must meet the same criteria for operation, closure, and water supply replacement as landfills. (Section 3.3.1.1)

3.7 Spills

Decisions regarding the need for the restoration of a contaminated water supply will be made in accordance with the Reasonable Use approach. Restoration will be required if the quality of the water supply is degraded beyond 100% of the particular water quality criteria.

Decisions regarding the clean-up of a contaminant plume will be handled on an a case-by-case basis, considering present users, potential users, the rate of natural attenuation, etc. Decisions regarding clean-up are not related to this Reasonable Use document.

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