**PROCEDURE B-7-1**
**(formerly referenced by 15-08)**

# Determination of Contaminant Limits and Attenuation Zones

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## 1.0 Introduction

In this document, the reasonable use concept is applied to: (a) determining quantitatively the acceptable levels of various contaminants originating in disposal sites and impinging on adjacent properties; and (b) assessing the suitability of a contaminant attenuation zone, and a disposal site. Terms are specifically defined in Section 3.0.

## 2.0 Ministry Responsibility and Authority

The Ministry is charged with the conservation of the groundwater 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 disposal sites should be placed in environments where their impact will be limited, 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:

(a) Issue a Certificate of Approval which would permit the use of property for contaminant attenuation or treatment. Discharge to neighbouring property must have no more than a negligible or trivial effect on the existing and potential reasonable use of this property. This is accomplished by limiting any increases in contaminant levels caused by this discharge to those specified in Section 5.1. 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.

(b) Prevent the owner of a disposal site, or a proposed disposal site, from using the sub-surface beneath the site for waste disposal purposes if this use is not felt to be in the public interest.

This management authority is subject to the limitations and qualifications in Guideline B-7, "Incorporation of the Reasonable Use Concept into MOEE Groundwater Management Activities."

## 3.0 Definition of Terms

For the purpose of this document, the Ministry will consider three areas in assessing waste disposal proposals: the disposal site, the contaminant attenuation zone, and the adjacent property. These are defined in the following Sections.

### 3.1 The Disposal Site:

For the purposes of this document the term "disposal site" includes, but is not limited to the following:

(a) a "waste disposal site" under Part VI of the Environmental Protection Act (EP Act) and a "landfilling site" as defined in O. Regulation 309;
(b) an "exfiltration lagoon" defined as a "sewage works" under the Ontario Water Resources Act (OWRA); and,
(c) a "large subsurface sewage disposal system" under Part VIII of the EP Act and as defined in Notice 3/87, July 15 1987.

The intention is to identify the areas that receive waste and the adjoining land that is necessary for proper site operation. For example, in the case of a landfill, the disposal site or waste disposal site comprises the area on or in which wastes are deposited, (the "fill area"), and any bordering land, (the "peripheral area"), as shown on the accompanying diagram. In the case of an "exfiltration lagoon" or a "large subsurface sewage disposal system," terminology is defined in the appropriate guidelines.

The following comments apply to a disposal site:

(a) Future use of the land should be strictly controlled. Based on technical considerations, such control should be permanent or continued until it can be shown that such control is no longer necessary (see Section 46, EP Act).

(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 disposal site and that there be appropriate monitoring and contingency plans. 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 5.0 of Guideline B-7.

### 3.2 The Contaminant Attenuation Zone

The purpose of a "contaminant attenuation zone" is to allow 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 disposal site.

Where appropriate, a contaminant attenuation zone may be supported. It is outside of the 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 Guideline B-7, Section 3.2 and in order to meet the criteria specified in Section 5.1, below, contaminant levels in the contaminant attenuation zone may impair some uses of that zone. The operator of the

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 4.0.

### 3.3 The Adjacent Property

The "adjacent property" is the land bordering the disposal site or the contaminant attenuation zone. Discharge of contaminants 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 groundwater will not be contaminated to a degree which would impair its reasonable use, as addressed in Guideline B-7 (Section 3.2).

## 4.0 Circumstances and Environments Suitable for a Contaminant Attenuation Zone

The Ministry may support an application for a disposal site involving the acquisition of land or an easement for a contaminant attenuation zone only under the following circumstances:

### 4.1 Alternate Sources of Water Available

An application may be supported 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 groundwater 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 or insignificant, because that groundwater 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; or

(b) where good supplies of water are available, either from surface water sources or from municipal systems, and the groundwater supplies in a particular unit are marginal with respect to their quality and/or their quantity, the Ministry may support the use of that groundwater as a contaminant attenuation zone.

### 4.2 Contaminant Zone Limited

An application may be supported 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 groundwater flow such as may be present in flood plains, as contaminant attenuation zones despite their physical ability to yield groundwater in "useful" quantities.

### 4.3 High Levels of Dissolved Solids Present

An application may be supported, 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 groundwater and as a result, the limits imposed in Section 5.1 can not be met (see situations described in Section 5.2, examples 2 and 3). It is necessary to assess on a case-by-case basis because:

(a) unlike the case in surface waters, concentrations of iron, manganese and total dissolved solids commonly in excess of the Ontario Drinking Water Objectives are naturally present in Ontario groundwaters, and these groundwaters are routinely used for domestic supplies;

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

(c) it is not practical to eliminate waste disposal in a large percentage of the Province where the presence of iron, manganese and total dissolved solids naturally occurs in excess of the Ontario Drinking Water Objectives.

### 4.4 Areas Suitable in the Judgment of the Regional Director

An application may be supported where, in the judgment 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.

## 5.0 The Determination of Limits for Proposed Disposal Sites

### 5.1 Basic Approach

In accordance with the appropriate criteria for particular reasonable uses, such as those specified in the Guideline B-1: "Water Management -- Guidelines and Procedures of the Ministry of Environment and Energy", a change in quality of the groundwaters 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 in the case of 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 Ontario Drinking Water Objectives for non-health related parameters and in excess of 25% of the difference between background and the Ontario Drinking Water Objectives for health-related parameters. Background is considered to be the quality of the groundwater prior to any man-made contamination."

This approach imposes a permanent upper limit to the amount of contamination that the owner of the adjacent property should have to tolerate. In accordance with Section 2.0, it is the Ministry's judgment that such increases in contaminant levels will have no more than a negligible or trivial effect on the existing or potential reasonable use of the adjacent property.

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

### 5.2 Examples of the Application of the Concept

Examples of the application of this concept to three different situations are provided below:

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

Example 2 -- Where the designated reasonable use of the groundwater is drinking water and the groundwater quality is presently better than the Ontario Drinking Water Objectives, a lowering of water quality on the adjacent property will be acceptable in accordance with the formula stated above.

Example 3 -- Where one or more groundwater quality parameters are currently at concentrations greater than the limits specified in the Ontario Drinking Water Objectives, but the groundwater is nonetheless in use as a drinking water source, then no further increase in the levels of these water quality parameters will be acceptable (see Section 4.3 for possible exception). Under these circumstances, increases in other parameters may be allowed in accordance with Section 5.1.

### 5.3 Examples of the Calculations

Two calculations are required to determine the amount of contamination that can discharge from a 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 disposal site.

The maximum concentration (Cm) of a particular contaminant that would be acceptable in the

groundwater 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 groundwater before it has been affected by human activity (Section 5.1). 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 guideline be present in the groundwater. This value is dependent on the use (reasonable use) to be made of that groundwater (see Guideline B-7). 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 x is 0.5 for non-health related parameters or 0.25 for health related parameters. For other reasonable uses it is 0.5 (Section 5.1).

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 disposal site with contaminant discharges which would cause this level to be exceeded.

The maximum concentration of a particular contaminant (Cw) originating in the 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 groundwater at the time of assessment, (i.e. the present background). This water may already contain some contaminants (Section 5.1). These contaminant levels must be subtracted to determine the contaminant increment that can be permitted from the disposal site.

Co — This is the potential contaminant increase from other sources with a high degree of probability (see Guideline B-7, Section 4.1(b)). For example, potential chloride contamination from a highway under construction next to the site must be subtracted to determine Cw.

Using chloride from a landfill as an example, the maximum allowed chloride level (Cm) in the

groundwater beneath the adjacent property and the maximum chloride discharge (Cw) to the adjacent property from a hypothetical landfill are calculated as follows:

(a) The reasonable use of the groundwater beneath the adjacent property has been determined to be for domestic supplies.

(b) The Ontario Drinking Water Objective for chloride 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:

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

The maximum concentration of chloride (Cw) from the disposal site that can be permitted to reach the adjacent property, in accordance with the relationship $Cw = Cm - Cp - Co$ is therefore:

$$130 - 40 - 20 = 70 \text{ mg/L}$$

It should be noted that the chloride ion may not be the critical contaminant (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 several factors including the characteristics of the wastes and the hydrogeologic environment and is determined on a case-by-case basis.

### 5.4 Site Assessment

The assessment of the proposed disposal site should be carried out in accordance with any pertinent Ministry guidelines. In addition, Section 4.0, "The Technical Basis for the Reasonable Use Approach," of Guideline B-7 should be considered with particular reference to those parts

relating to the provision of a safety margin in making estimates of contaminant discharges (Section 4.2).

## 6.0 Limits for Operating Disposal Sites

An operating disposal site is handled as follows:

(a) An operating site should meet the same limits for contaminant discharge (Section 5.1) as a proposed site.

(b) The judgement as to the amount of off-site impact that the site will produce may be based on actual off-site measurements of contaminant levels or on predictions of off-site contaminant levels which are based on on-site measurements. This reduces the requirements for a safety margin in calculations (Guideline B-7, Section 4.2).

(c) If contaminant concentrations exceed the limits specified in Section 5.1, the site should be closed in a manner to minimize environmental damage, or the operation should be modified. It is acceptable to modify the operation of the disposal site, for example in the case of a landfill by collecting a part of the leachate, in order to meet the specified limits. However, if these levels are exceeded, all waste disposal, except that done in conjunction with a reasonable plan for closure or with remedial activities, should be terminated until the specified limits have been met, or until monitoring data indicate that these limits will be met. Determinations on the replacement of contaminated water supplies and the abatement of the contaminant plume must be made on a case-by-case basis in accordance with Guideline B-9 (formerly 15-10) entitled: "Resolution of Groundwater Quality Interference Problems."

## 7.0 Limits for Disposal Sites Requesting Approval for Expansion

An Approval for a disposal site requesting expansion will be handled in the same manner as an Approval for a new site or a proposed site (i.e. it must meet the limits specified for contaminant discharge in Section 5.1).