

Comments on
**Alberta Environment's "Consultation Draft" of
"Standards for Landfills in Alberta"**

Comments submitted by
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In the spring of 2009, on behalf of the Concerned Citizens of Thorhild County, Alberta, Canada, we reviewed groundwater quality protection aspects of the landfill proposed by Waste Management (WM) for siting in Thorhild County, Alberta. We presented our findings to the Concerned Citizens:

Lee, G. F., "Comments on Waste Management's Thorhild Landfill Re-Zoning Application Binder Dated February 2009," Report to Concerned Citizens of Thorhild County, Alberta, CAN, submitted by G. Fred Lee & Associates, El Macero, CA, April 24 (2009). <http://www.gfredlee.com/Landfills/CommentsWMThorhildLF.pdf>

and to the Thorhild County Council:

Lee, G. F., "Summary of Comments on Waste Management's Thorhild Landfill Re-Zoning Application Binder," PowerPoint Slide Presentation to Thorhild County Council, Alberta, CAN, April 24 (2009).
<http://www.gfredlee.com/Landfills/Thorhild-Powerpoint.pdf>

WorleyParson submitted comments to the Concerned Citizens on WM's inadequate characterization of the hydrology of the area of the proposed Thorhild Landfill. That report:

WorleyParsons, "Hydrogeological Review of Proposed Landfill Facility, Thorhild County, NW 18 & 19-61-20 W4M," Report submitted to the Concerned Citizens of Thorhild County, Alberta, Canada April 23 (2009).
http://www.gfredlee.com/Landfills/worleyparsons_thorhild.pdf

provides important discussion of the types of hydrology and groundwater characterization information needed for the proper assessment of the groundwater quality concerns presented by that, as well as other, proposed landfills.

Our review of the WM-proposed Thorhild landfill included review of Alberta Environment's 2007 draft revised landfill siting, development, operation closure and postclosure requirements. As we discussed in our reports, even if the proposed landfill had met the requirements of the 2007 draft regulations (which was, itself, questionable), the development of that landfill would pose a significant threat to public health, groundwater resources, and the interests of those in the sphere of influence of the proposed landfill owing to inadequacies of the regulations. According to Alberta Environment:

“The July, 2009 consultation draft replaces the “Draft Alberta Standards for Landfills (2007)” effective immediately. Availability at (http://www3.gov.ab.ca/env/waste/municipal_waste.html) will be limited to the consultation period. After the consultation period, the document will be revised as required, and reposted.”

Since the Thorhild County Council action on the proposed WM Thorhild County Landfill is under review and since that landfill, if permitted by Alberta Environment, would likely be under the July 2009 draft regulations and any subsequent revisions, it is important that the adequacy of the proposed Alberta Environment landfill regulations for ensuring the protection of groundwater quality, be examined. It is for that purpose that we have prepared these comments on those draft regulations.

As discussed below, a landfill’s meeting the draft 2009 landfill standards does not ensure protection of public health, groundwater resources, or environmental quality from pollution by waste-derived constituents. An overview of major deficiencies in those regulations for providing for such protection is presented below.

Summary of Significant Deficiencies in Environment Alberta July 1, 2009 Consultation Draft Standards for Landfill – Selected Recommended Changes

- 25-year post-closure period is grossly inadequate to protect public health, groundwater and surface water quality and the interests of those in the sphere of influence of the landfill.

Leachate composition not a reliable parameter for establishing the post-closure period for landfill monitoring and maintenance.

Draft regulations should specify that the post-closure period for landfill shall continue for as long as the waste in the landfill can potentially generate leachate that can pollute groundwater or surface waters.

- Clay liners and natural clay deposits specified in draft regulations will not be protective of groundwater quality for as long as the wastes in the landfill can generate leachate. The specified clay deposits and packed clay liners only delay groundwater pollution; they do not prevent.
- Groundwater monitoring wells spaced up to 200 metres apart at the compliance boundary will have a low probability of detecting leachate-polluted groundwater when it first reaches the compliance boundary.

To improve the likelihood of early detection of leakage of leachate, a double-composite liner with a leak-detection layer between the composite liners should be required. When leachate is found in the leak-detection layer, the landfill cover needs to be improved to stop leachate from entering the leak-detection layer.

- 30 metres of buffer land between the landfill-waste footprint and adjacent property lines is grossly inadequate to prevent trespass of waste-derived materials and landfill gas, including odors, onto adjacent properties. Allowing such a limited amount of buffer land will be a health threat to those who own/use adjacent and nearby properties. At least a mile (several kilometers) of buffer land should exist between wastes deposition areas and adjacent property lines.
- Landfill gas subsurface migration provisions should recognize that subsurface migration of landfill gas can be a significant cause of groundwater pollution. Gas migration direction does not depend on the direction of groundwater flow; gas migration can cause groundwater quality problems up-gradient from the landfill.
- Surface water quality monitoring should continue for as long as the wastes in the landfill can generate leachate when contacted by water, in order to detect when seeps (breakout) of leachate occurs from the sides of the above-ground surface of the landfill.
- The end of the post-closure period report should contain the detailed results of the studies that were conducted to show that the wastes in the landfill no longer have the potential to generate leachate when contacted by water.

Background to These Comments

Our report and presentation slides cited above contain extensive information on our qualification to offer these comments. In brief, Dr. G. Fred Lee has been involved in reviewing the potential water quality and public health impacts of more than 80 landfills since the mid-1960s, including landfills in Nova Scotia, New Brunswick, Quebec, Ontario, Manitoba, and Alberta. Many of his landfill reviews have included developing a report on the characteristics of the landfill and their ability to protect public health, groundwater quality, and the environment for as long as the wastes in the landfill will be a threat to pollute the environment. Those reports are available for review on our website [www.gfredlee.com] in the Examples of Specific Landfill Studies section [<http://www.gfredlee.com/plandfil2.htm#examples>].

That website also contains information on Dr. Lee and Jones-Lee's expertise and experience in reviewing landfills and landfill regulations [<http://www.gfredlee.com/landfill.htm>]. Dr. Lee has been asked to serve as an advisor to regulators in several US states, including California, Michigan, and Texas, to review existing and proposed landfill regulations for improving their ability to protect public health, groundwater resources, and the environment. During his 30-year faculty career in university graduate-level teaching and research, he conducted research for the US EPA on landfill liners and taught graduate-level courses on landfill development to engineers and scientists. The appendix to the Thorhild Landfill comments cited above contains additional information on our qualification to submit these comments.

Among our papers and reports on our website that address public health and environmental quality protection from landfilled wastes, is a comprehensive, 93-page review of the literature and our findings and experience regarding environmental quality issues pertaining to landfilling of wastes:

Lee, G. F., and Jones-Lee, A., "Flawed Technology of Subtitle D Landfilling of Municipal Solid Waste," Report of G. Fred Lee & Associates, El Macero, CA, December (2004). Updated September 2009.
<http://www.gfredlee.com/Landfills/SubtitleDFlawedTechnPap.pdf>

This "Flawed Technology" report was originally developed in the early 1990s and is periodically updated as new literature and information become available; it now contains approximately 100 references to the literature on landfill impact issues. The Landfill-Groundwater section of the Lee and Jones-Lee website [<http://www.gfredlee.com/plandfil2.htm>] contains many of the downloadable papers and reports, and references to their publications on landfill issues, several of which are cited in these comments. Several of these papers/reports developed by Drs. Lee and Jones-Lee are reviews of the literature with references to the publications of others on the topic discussed.

Review of Alberta Environment Draft Regulations

Overall Requirements

The Alberta Environment website [<http://environment.alberta.ca/856.html>] presents information on Landfills and Security that includes the statement:

The applicant must provide information regarding closure of the facility and an estimated cost of closure and post-closure monitoring/site maintenance, demonstrating an ability to cover the cost of facility closure and post-closure care.

That statement would, at first glance, appear to offer protection, until the conditions specified in the details of the proposed regulations are examined. As discussed herein the proposed requirements for siting, design, closure and especially the postclosure requirements will not lead to the development of landfills that will be protective of public health, groundwater resources, air quality, the environment and the interests of those who own or use property in the sphere of influence of a landfill. Basically the proposed regulations perpetuate the development of landfills that will enable urban communities to dispose of their municipal solid wastes for cheaper-than-real costs to the primary waste generators at the expense of the health and welfare of those in the region of the landfill. While it may be possible to develop a landfills at some locations that initially conform to the specific requirements of proposed landfill regulations, in time, at many locations, those landfills can be expected to pollute groundwater, and, at some locations, surface waters, with hazardous and otherwise deleterious chemicals that are a threat to the health of those near the landfill and the environment.

In developing these draft regulations, Alberta Environment has ignored the long-term potential of an MSW landfill to release waste components and their degradation products to groundwater and air to threaten the health and welfare of the people and the environment of the landfill area.

Landfill Closure/Post-Closure

On its website [<http://environment.alberta.ca/856.html>], Alberta Environment presented a summary of its Landfill Closure Requirements:

The Code of Practice for Landfills (COP) issued by Alberta Environment includes these requirements to properly close a landfill.

2. A post-closure plan for a period of 25 years from the final closure of the landfill or as long as leachate does not exceed the performance criteria, and addressing the following:

- maintenance of the integrity of the final cover, the surface drainage systems; including a twice a year inspection program (COP, 9(6)(a));*
- maintenance and operation of the groundwater monitoring, leak detection, leachate collection and gas venting systems (COP, 9(6)(b));*
- maintenance and protection of the benchmarks (COP 9(6)(c));*
- establishment and maintenance of security for the landfill site; and*
- annual reporting describing monitoring, maintenance activities and results (COP, 10(4))*

A review of the draft landfill standards states that the groundwater “**performance criteria**” are to be established on a site-specific basis. It is not possible to determine if that approach for developing these criteria will be protective of groundwater resources, and for those situations where leachate-polluted groundwater surfaces, surface water quality.

The prescribed 25-year post-closure planning period is grossly inadequate to cover the period of time during which an MSW landfill will be threat to generate leachate that can pollute groundwater and surface waters. As discussed in the Lee and Jones-Lee (2009) “Flawed Technology” review, landfills can be a threat to pollute groundwaters by leachate for very long periods of time. In the US there is general concern that the US EPA Subtitle D regulations only provide for 30 years of assured postclosure funding for monitoring and maintenance of the closed landfill. MSW landfills that could be developed under the proposed landfill regulations are similar to the minimum design US EPA Subtitle D landfills and suffer from many of the same deficiencies, many of which are discussed in our “Flawed Technology” (2009) review. Of particular concern is their attempt to create a “dry tomb” environment for the landfills that is designed to try to isolate wastes in liner/cover systems, including systems that could be developed under the proposed July 1, 2009 draft regulations.

The US National Academies of Science and Engineering appointed a National Resource Committee (NRC) to review the expected performance of landfill liners. The National Resources Committee developed a report of its findings:

NRC Committee to Assess the Performance of Engineered Barriers, “Assessment of the Performance of Engineered Waste Containment Barriers,” National Research Council, 134 pages, (2007). available from the National Academies, <http://www.nap.edu/catalog/11930.html>

The NRC Committee discussed the inadequacy in funding for postclosure monitoring as it exists for US landfills. The NRC (2007) Committee report stated with regard the monitoring periods and its post-closure funding:

“The optimum time for monitoring varies with the facility, type of waste, climate, and the observed performance. Yet funding is often not available to continue monitoring until the

site no longer poses risk to human health and the environment, and no national policy exists to assure that such funding will be available.”

Recommendation 6: EPA should develop financial assurance mechanisms to ensure that funding is available for monitoring and care for as long as the waste poses a threat to human health and the environment.”

The US Congress General Accounting (now Accountability) Office (GAO, 1990), in the Executive Summary of its report, stated:

Funding of Postclosure Liabilities Remains Uncertain,” under a section labeled “Funding Mechanisms Questionable,” concluded that, “Owners/operators are liable for any postclosure costs that may occur. However, few funding assurances exist for postclosure liabilities. EPA only requires funding assurances for maintenance and monitoring costs for 30 years after closure and corrective action costs once a problem is identified. No financial assurances exist for potential but unknown corrective actions, off-site damages, or other liabilities that may occur after the established postclosure period.

Further, the US EPA Inspector General (US EPA, 2001b) in a report, “RCRA Financial Assurance for Closure and Post-Closure,” reached similar conclusions:

There is insufficient assurance that funds will be available in all cases to cover the full period of landfill post-closure monitoring and maintenance. Regulations require postclosure activities and financial assurance for 30 years after landfill closure, and a state agency may require additional years of care if needed. We were told by several state officials that many landfills may need more than 30 years of post-closure care. However, most of the state agencies in our sample had not developed a policy and process to determine whether post-closure care should be extended beyond 30 years, and there is no EPA guidance on determining the appropriate length of post-closure care. Some facilities have submitted cost estimates that were too low, and state officials have expressed concerns that the cost estimates are difficult to review.

As indicated by J. Skinner, former Executive Director of SWANA (Solid Waste Association of North America)

The problem with the dry-tomb approach to landfill design is that it leaves the waste in an active state for a very long period of time. If in the future there is a breach in the cap or a break in the liner and liquids enter the landfill, degradation would start and leachate and gas would be generated. Therefore, dry-tomb landfills need to be monitored and maintained for very long periods of time (some say perpetually), and someone needs to be responsible for stepping in and taking corrective action when a problem is detected. The federal Subtitle D rules require only 30 years of post-closure monitoring by the landfill operator, however, and do not require the operator to set aside funds for future corrective action. Given the many difficulties of ensuring and funding perpetual care by the landfill operator, the responsibility of responding to long-term problems at dry-tomb landfills will fall on future generations, and the funding requirements could quite likely fall on state and local governments.

The current Executive Director of SWANA recently reviewed long-term problems with Subtitle D landfills in,

Obrien, J, SWANA ARF Disposal Group Report on the Long Term Potential Problems of Subtitle D Landfills, MSW Management June (2009).
<http://www.mswmanagement.com/june-2009/environment-landfills-risks.aspx>

There it was stated:

Subtitle D regulations require that the postclosure care period—during which the landfill site is maintained and the environmental protection systems are managed and monitored—be 30 years in length. During the service lives of Subtitle D landfills, landfill owners are required to set aside or otherwise ensure that funds will be available to cover the costs of these postclosure management, maintenance, and monitoring tasks.

Of primary importance in this regard is the responsibility (and authority) given to state governments to extend or reduce the postclosure period—as warranted—to ensure that human health and the environment are protected for as long as the landfill poses a threat.

O'Brien (2009) stated:

To date, the EPA has not provided any guidance to state governments on how to make this determination or how to promulgate regulations that will ensure that funds are available—should the postclosure period be extended—to cover the required management, maintenance and monitoring tasks beyond the prescribed 30-year postclosure period.

O'Brien (2009) also stated,

Certain environmental groups have claimed that closed Subtitle D landfills constitute major ongoing environmental risks to the communities in which they are located and that the postclosure care period should never end.

One of the most important deficiencies of the Alberta Environment July 1, 2009 draft landfill regulations is its specification of only 25 years of planned post-closure monitoring and maintenance. Those regulations should state explicitly that the post-closure planning period for landfill monitoring and maintenance, as well as groundwater remediation, should extend as long as the wastes in the landfill have the potential to generate leachate when contacted by water to potentially pollute groundwater and surface water impairing their use for domestic water supply or be adverse to aquatic life.

The draft regulations propose to judge the potential for a landfill to no longer pollute groundwaters based on the composition of the leachate as collected from the leachate collection system. That is not a reliable approach because landfill owners can control, for a period of years, the generation of leachate by establishing and maintaining an effective landfill cover to keep the waste dry, i.e., to keep moisture from entering the landfill. However, that merely delays the generation of leachate until such time as moisture does enter the landfill and generate leachate.

As discussed in Lee and Jones-Lee (2009) “Flawed Technology” review, Waste Management has attempted to convince regulatory agencies that if no leachate is being generated, the landfill

owner should be relieved of further responsibility to funding post-closure monitoring and maintenance. The state of California Integrated Waste Management Board rejected that approach, understanding that as the low-permeability characteristics of the landfill cover deteriorate and water enters the landfill, leachate will again be generated that can pollute groundwaters.

The cover of the “Consultation Draft” of the “Standards for Landfills in Alberta” on the Alberta Environment website states:

“APPLICATION OF THE STANDARDS FOR LANDFILLS The Alberta Standards for Landfills (Standards) outline the minimum requirements for development, operation, monitoring, closure and the post-closure of Class I, Class II, and Class III landfills. The Standards are intended to minimize the cumulative effects of waste management and provide public assurance regarding the protection of groundwater and surface water, and the appropriate management of nuisances associated with landfill development.”

Those familiar with the near-term and long-term characteristics of MSW landfills know that the proposed regulations do not provide a basis for the “...*public assurance regarding the protection of groundwater and surface water, and the appropriate management of nuisances associated with landfill development.*” Those regulations provide significant justification for those in the area of a proposed landfill to vigorously oppose the development of a landfill that meets these regulations as justified NIMBY (not in my backyard) based on the adverse impacts of releases of wastes and waste derived materials from the landfill. Such propaganda misleads urban-dwellers to believe that those who oppose developing a landfill in their area are simply practicing unjustified NIMBY. If the proposed landfill regulations were truly protective, landfills could, and should rightly, be located in the urban areas where the wastes are generated. Such a proposal would, no-doubt, be met with vigorous opposition by urban dwellers near the urban location as justified NIMBY, even though it was their own waste.

Alberta Environment should start over in developing landfill regulations to outline provisions that would allow a landfill to be sited in urban areas where the wastes are primarily generated and be protective of the urban dwellers. Rural land owners/users deserve the same degree protection as is now given to urban communities by siting landfills outside their areas.

Additional comments on deficiencies in the proposed July 1, 2009 draft landfill regulations are presented below.

Clay Liners

The draft regulations state in SECTION 2: LANDFILL DEVELOPMENT AND SITING STANDARDS devoted to **Natural Environment Separation:**

- c) *A new landfill or the new waste footprint of a laterally expanding landfill shall not be situated at a location where there exists one or more of the following conditions:*
 - (i) *there is less than 30 metres of geologic materials between the lowest part of the liner and an exceptional underlying aquifer where the geologic material has an equivalent hydraulic conductivity greater than 1×10^{-8} metres/second;*

It should be understood, based on the information that is provided by Workman and Keeble (1989):

Workman, J., and Keeble, R., "Design and Construction of Liner Systems," Chapter 5.1 IN: Christensen et al. (eds), Sanitary Landfilling: Process, Technology and Environmental Impact, Academic Press, New York, pp. 301-309 (1989).

<http://www.gfredlee.com/Landfills/Workman-Keeble.pdf>

that 30 metres of 1×10^{-8} metres/second clay with a porosity of 0.2 can be penetrated, under one foot of head, in about 19 years. Therefore this requirement is not protective of groundwaters, but only delays groundwater pollution.

This section of the draft regulations also states,

- (d) *A new landfill, or the new waste footprint of a laterally expanding landfill, shall only be situated at a location where:*
 - (i) *there is a 5 metre thick layer of a clayey deposit having an equivalent hydraulic conductivity less than 1×10^{-8} metres per second immediately beneath the lowest part of the liner, and*
 - (ii) *the natural geologic materials immediately beneath the clayey deposit consist of:*
 - a. *5 metres of material having an equivalent hydraulic conductivity less than 1×10^{-8} metres per second; or*
 - b. *at least 3 metres of material providing equivalent or better protection to the requirements in 2.1 (d)(ii)a.*
- (e) *The clayey deposit in 2.1(d)(i) may include one or more layers of a material with a hydraulic conductivity greater than 1×10^{-8} metres per second provided that any such layers do not extend beyond the compliance boundary.*
- (f) *The depth of the clayey deposit 2.1 (d)(i) may be attained by addition of compacted earthen materials with an equivalent hydraulic conductivity less than 1×10^{-8} metres per second;*

Section devoted to 3.2 Design of a Class II Landfill states in subsection,

- (iii) *there is a 5 metre thick layer of a clayey deposit having an equivalent hydraulic conductivity less than 1×10^{-8} metres per second immediately beneath all waste deposited at or below the original grade; and*
- (iv) *the natural geologic materials immediately beneath the clayey deposit consist of: a 5 metres of material having an equivalent hydraulic conductivity less than 1×10^{-8} metres per second; or b. at least 3 metres of material providing equivalent or better protection to the requirements in 3.3(b)(iv)(a);*

Five (5) metres of 1×10^{-8} metres per sec clay layer can be penetrated with 1 ft of head and a porosity of 0.2 in about 3 years. Five metres of compacted clay in a landfill setting provides essentially no protection of groundwater pollution by landfill leachate.

Sections 3.2, 3.3 Design of a Class II and Class III Landfill specifies in,

(d) *If the new or laterally expanding landfill is to be constructed with a composite liner, the composite liner shall be constructed with a geomembrane placed directly on the surface of:*

(i) *a liner that is comprised of earthen material with a hydraulic conductivity of less than 1×10^{-9} metres/second compacted to a thickness of not less than 0.6 metre, measured perpendicular to the slope, or*

(ii) *a liner that is comprised of earthen materials with a hydraulic conductivity greater than 1×10^{-9} metres/second compacted to a thickness greater than 0.6 metre that will achieve an equivalent performance to 3.5(d)(i), or*

(iii) *a liner that is comprised of a geosynthetic clay liner and earthen material compacted to a thickness of not less than 0.6 metre, measured perpendicular to the slope, that will achieve a combined equivalent performance to 3.5(d)(i).*

This specification is essentially the same as the minimum landfill liner design specified in the US EPA Subtitle D MSW landfilling regulations. The Lee and Jones-Lee (2009) “Flawed Technology” review and the NRC Committee (2007) report provides detailed information on why this approach is a flawed technology for landfilling of MSW; it will not prevent groundwater pollution by landfill leachate for as long as the wastes in the landfill are a threat to generate leachate.

Groundwater Monitoring Well Spacing

The draft regulations in Section 2.2 states:

(e) *The boreholes completed for the Technical Investigation Program shall be distributed at:*

(i) *an evenly distributed spacing of not more than 200 metres; or*

(ii) *a minimum of five evenly distributed locations for landfills with a waste footprint smaller than 5 hectares.*

This highlights another significant deficiency of the proposed draft regulations. Monitoring wells spaced up to 200 metres apart have a very low probability of detecting groundwater pollution by landfill liner failure when it first reaches the “compliance boundary” and before off-site groundwater pollution occurs. This issue was discussed in the Lee and Jones-Lee (2009) “Flawed Technology” review. As discussed by Dr. J Cherry of the University of Waterloo discussed in his paper:

Cherry, J. A., “Groundwater Monitoring: Some Deficiencies and Opportunities,” In: Proc. of the 10th ORNL Life Sciences Symposium, Gaitlinburg, TN, Hazardous Waste Site Investigations; Towards Better Decisions, Lewis Publishers, B.A. (1990). [Available from gfredlee@aol.com as LF019]

the initial leakage of plastic-sheeting landfill liners will be from limited areas of the landfill footprint, that will generate finger-like plumes that can pass undetected by a line of monitoring wells spaced hundreds of feet apart. Each monitoring well has a zone of capture of only about 1 ft around the well. Similar initial leakage from clay-lined landfills will be from limited areas of the landfill footprint. With wells spaced 200 ft apart, there are 198 ft between wells through which the initial leachate plumes can pass without being detected.

Einarson discussed these issues in his presentation:

Einarson, M., "Site Characterization and Monitoring in the New Millenium," Presented at CA Department of Toxic Substances Control and US EPA, "Remediation Technology Symposium," May 14 (2008).
http://www.dtsc.ca.gov/hazardouswaste/upload/einarson_remsymp_presentation.pdf

and pointed out the unreliability of groundwater monitoring wells to detect initial groundwater pollution by landfills.

Detailed information on these issues is provided in the Lee and Jones-Lee "Flawed Technology" review.

The Lee and Jones-Lee (2009) "Flawed Technology" review recommended that state of Michigan landfill liner failure detection approach that incorporates a double-composite liner with a leak detection layer between the composite liners, be used to detect landfill liner failure.

Buffer Lands

SECTION 3: DESIGN AND CONSTRUCTION in section 3.1 Design Plan and Specification states in subsection , (ii) engineering design maps and plans that provide:

"(c) a minimum 30 metre separation between the waste footprint and the landfill property line;"

Only 30 metres of buffer land between where wastes can be deposited and a property line is grossly inadequate and contributes to justified NIMBY. Typically, airborne releases including landfill odors can extend over a mile (several km) from a landfill. Providing only 30 metres of buffer land will, without question, enable trespass of landfill-derived waste components and waste-derived releases to the atmosphere onto off-site properties. The Lee and Jones-Lee "Flawed Technology" (2009) review discussed that typically there needs to be at least one mile of landfill-owner-owned buffer land containing no waste, extending from where wastes are deposited and the property boundary to enable dissipation of the waste-derived constituents on the landfill property.

Lee and Jones-Lee (2009) "Flawed Technology" review provides discussion of the fact that landfill odors are more than a nuisance. There is considerable medical evidence that landfill odors are a significant cause of illness for some of those who experience the odors. Lee and Jones-Lee also discuss that landfill odors are an indicator of other hazardous chemicals which while typically non-odorous, can cause cancer in people.

Landfill owners should not be permitted to allow the trespass of waste-derived constituents onto adjacent properties at the property line. Alberta Environment should explicitly require that landfills be located with adequate buffer lands between where the wastes are deposited and adjacent property lines. These regulations should specify that if the landfill owner does not control offsite odors and other waste-derived materials at the property line with no repeated violations that the landfill should be closed.

The draft regulations state in section 4.5 Nuisance Management,

- (a) *The person responsible for a landfill shall take all necessary measures to control nuisances such as litter, fires, disease vectors, odours and dust, including but not limited to:*
- (i) *erecting artificial barriers, utilizing natural barriers, or other effective measures to control access to the site;*
 - (ii) *covering solid waste that is disposed in the landfill with soil or other alternative cover material at a frequency specified in the Operating Plan;*
 - (iii) *maintaining areas for storage, processing or recycling of segregated waste in a clean and orderly manner;*
 - (iv) *establishing and maintaining litter controls to minimize the escape of waste from the landfill site;*
 - (v) *retrieval of litter that accumulates on the landfill site; and*
 - (vi) *retrieval of litter that is washed, blown, or transported onto adjacent properties, provided the consent of the owner of the adjacent property is first obtained.”*

These requirements give the appearance of being protective; most regulatory agencies have similar regulations that are supposed to protect nearby land owners/users from landfill-derived waste releases. However, there are typically significant problems with offsite trespass of landfills odors and other waste-derived constituents such as papers when there are inadequate buffer lands. The regulations governing offsite releases must specify that severe penalties including forced closure will be enacted if the landfill owner fails to control off site releases of waste derived constituents.

It is inappropriate for Alberta Environment to characterize landfill-derived odors as a “nuisance.” As discussed above it has been well-established that such odors are health hazards to some individuals.

Compliance Boundary

Section 5.3 devoted to **Compliance Boundary** states,

- (a) *The person responsible shall establish Compliance Boundary at locations that are:*
- (i) *at least 20 metres inside the property boundary of the landfill; and*
 - (ii) *at least 10 metres, but not more than 60 metres from the waste footprint;*

Those requirements are similar to the US EPA Subtitle D regulations for the compliance point for groundwater monitoring. Ensuring compliance with drinking water standards at this compliance point/boundary will not be possible with monitoring wells spaced up to 200 metres apart when landfill leachate-polluted groundwater first reaches this location.

Landfill Gas

Section 5.11 Implementation of the Subsurface Landfill Gas Contingency Plan focuses on controlling explosions due to methane in the gas. At least as important is the potential for offsite migration of landfill gas to cause illness, including cancer, in humans and wildlife. As discussed in Lee and Jones-Lee (2009) “Flawed Technology” there is substantial medical evidence that landfill gas is a significant health threat. If landfill gas odor is evident in offsite property, landfill gas-associated constituents can be a health threat.

Another issue that needs attention in managing subsurface migration of landfill gas is the potential for landfill gas to cause groundwater pollution. Groundwater pollution upgradient of the direction of groundwater migration by landfill gas pollution is well-known (see discussion by Lee and Jones-Lee for references to studies of this issue).

Surface Water Monitoring

Section 5.6 Surface Water Monitoring Program specifies that the surface water monitoring program shall end with the end of the post-closure period. The draft regulations could enable cessation of monitoring at the end of the post-closure while the wastes in the landfill could still generate leachate when contacted by water. Consideration should not be given to ending the post-closure period until representative samples of the wastes taken from the landfill do not leach chemicals that can pollute groundwater and/or surface water when it seeps (breakout of leachate in the above ground surface part of the landfill) when it is contacted with water. This would not be expected to occur in a dry tomb landfill until long after closure, as maintaining dry conditions in the landfill delays the generation of leachate.

Post-Closure

Section 6.3 Post-closure has been discussed in part above with the focus on the grossly inadequate provision: “The Post-Closure shall be a minimum period of 25 years following the final closure of the landfill.”

That section also states,

- (b) *In addition to 6.3(a), Post-Closure shall continue until the following circumstances occur:*
 - (i) *groundwater quality performance standards are met within the compliance boundary;*
 - (ii) *subsurface landfill gas concentrations are below explosive limits set out in Table 5.4 at subsurface gas monitoring locations; and*
 - (iii) *the leachate constituents are below the upper groundwater quality control limits established for the facility; or*
 - (iv) *the accumulated volume of leachate is equal to or less than the previous years accumulated volume of leachate for five consecutive years;*

As discussed above, landfill owners can mislead regulatory agencies to achieve control of leachate generation by controlling the integrity of the landfill cover. Rather than (iv) being based on leachate volume as a means of determining the duration of post-closure funding it should be based on the period of time that the wastes in the landfill can generate leachate when contacted by water.

- (c) *During Post-Closure, the person responsible, at a minimum, shall:*
 - (i) *protect and maintain the integrity of the final cover and surface water drainage systems;*
 - (ii) *make repairs to the cover system as necessary to correct the effects of settling, subsidence, erosion, leachate break-out or other such events within one year of discovery of any problem; and*
 - (iii) *protect, maintain, operate and monitor the following components where they are part of the landfill design:*
 - a. *groundwater monitoring system;*

- b. *leachate collection system; and*
- c. *landfill gas control system.*

As worded now, this approach is not protective. All of these post-closure responsibilities for post-closure maintenance activities should occur for as the wastes in the landfill are a threat to generate leachate that can pollute (impair the use of) groundwater/surface water.

Section 7.7 End of the Post-Closure Report needs to be expanded to include a detailed report that presents the data on the sampling of the wastes in the landfill and the testing with water to determine that the wastes no longer can generate leachate that has the potential to pollute groundwaters and surface waters so that they are a threat to human and animal health or impair other beneficial uses of the water.

References

Cherry, J. A., "Groundwater Monitoring: Some Deficiencies and Opportunities," In: Proc. of the 10th ORNL Life Sciences Symposium, Gaitlinburg, TN, Hazardous Waste Site Investigations; Towards Better Decisions, Lewis Publishers, B.A. (1990). Available from gfredlee@aol.com as LF019.

Einarson, M., "Site Characterization and Monitoring in the New Millenium," Presented at CA Department of Toxic Substances Control and US EPA, "Remediation Technology Symposium," May 14 (2008).

http://www.dtsc.ca.gov/hazardouswaste/upload/einarson_remsymp_presentation.pdf

GAO, "Hazardous Waste Funding of Postclosure Liabilities Remains Uncertain," US General Accounting Office, Report to Congress, RCED-90-64, Washington D.C., June (1990).

Lee, G. F., "Summary of Comments on Waste Management's Thorhild Landfill Re-Zoning Application Binder," PowerPoint Slide Presentation to Thorhild County Council, Alberta, CAN, April 24 (2009). <http://www.gfredlee.com/Landfills/Thorhild-Powerpoint.pdf>

Lee, G. F., "Comments on Waste Management's Thorhild Landfill Re-Zoning Application Binder Dated February 2009," Report to Concerned Citizens of Thorhild County, Alberta, CAN, submitted by G. Fred Lee & Associates, El Macero, CA, April 24 (2009). <http://www.gfredlee.com/Landfills/CommentsWMThorhildLF.pdf>

Lee, G. F., and Jones-Lee, A., "Comments on 'Assessment of the Performance of Engineered Waste Containment Barriers' Prepared by National Research Council Committee to Assess the Performance of Engineered Barriers, National Academies Press, Washington, DC (2007)," Report of G. Fred Lee & Associates El Macero, CA, September (2009). http://www.gfredlee.com/Landfills/NRC_EngrBarriers.pdf

Lee, G. F., and Jones-Lee, A., "Flawed Technology of Subtitle D Landfilling of Municipal Solid Waste," Report of G. Fred Lee & Associates, El Macero, CA, December (2004). Updated September 2009. <http://www.gfredlee.com/Landfills/SubtitleDFlawedTechnPap.pdf>

NRC Committee to Assess the Performance of Engineered Barriers, "Assessment of the Performance of Engineered Waste Containment Barriers," National Research Council, 134 pages, (2007). available from the National Academies, <http://www.nap.edu/catalog/11930.html>

O'Brien, J, SWANA ARF Disposal Group Report on the Long Term Potential Problems of Subtitle D Landfills, MSW Management June (2009). <http://www.mswmanagement.com/june-2009/environment-landfills-risks.aspx>

US EPA, "RCRA Financial Assurance for Closure and Post-Closure," Audit Report, 2001-P-007, US Environmental Protection Agency, Office of Inspector General, Washington, D. C., March 30 (2001).

WorleyParsons, "HYDROGEOLOGICAL REVIEW OF PROPOSED LANDFILL FACILITY, THORHILD COUNTY, NW 18 & 19-61-20 W4M, " Report submitted to the Concerned Citizens of Thorhild County, Alberta, Canada April 23, (2009). http://www.gfredlee.com/Landfills/worleyparsons_thorhild.pdf