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Submission to the Environmental Hearing
Burlington landfill expansion, 1984 application.

Thank you for giving me the opportunity to speak to you directly: I feel that I can help you resolve some recurring questions by shedding new light on them -

My subject is mainly the question of the underground plume of leachate, but you might also regard it as a question of credibility.

1. At issue is the claim by Gartner Ltd for the proponents that the leachate plume can not be traced because extremely bad groundwater quality is masking or obscuring its presence.
2. This claim goes back to their monitoring reports: In their first report for 1979/80 they had defined and mapped a fairly extensive plume, but in their second report, on the year 1981, they speak of difficulties with interpreting the analyses from the boreholes measured as some show extremely high concentrations compared to all others. This they have attributed to what they call "deep saline groundwater",

and they have postulated ever since that this special water enters the boreholes downhill of the landfill. That happens to be precisely the area in which one would expect the leachate plume to be; the reason given for the postulated invasion of these boreholes is that these high concentration levels exceed those of the leachate samples obtained from the fill and the drains. Obviously they feel that leachate cannot become more concentrated in the shale than it is in the landfill.

And this is the crucial question to which I will return later: Can concentrations be increased underground?

3.1 That interpretation ran into difficulties, though, because the postulated "deep saline ground water" was not detected uphill of the landfill. This, they argued, was due to those wells being not as deep. However, if you check that as I have done, you find that BH-1 and BH-2 monitors are not exactly matching the depths of, say BH-12, BH-13, BH-16 and BH-17, but they reasonably match them. Moreover, the so-called "deep saline ground water" was not occurring anywhere else but where the plume should be, and to this day has not been found in any of the other boreholes.

The invasion of this special groundwater must therefore be labelled as "not proven", or "speculative".

3.2 Another problem with this interpretation is that the earliest analyses from the downhill boreholes had the same low groundwater concentrations as elsewhere, and that they increased, using their own words, "dramatically" in later samples. The answer Gartner Lee offered for that puzzle was that probably mistakes were made in preparing and sampling the boreholes at the earlier times, also "speculative".

3.3 Further, the fact that shallow monitors of the downhill boreholes remained at low concentrations was attributed to an invasion of surface water, although at the same time it was claimed that dumping of road snow in that area was a major source of chloride ions, which then inexplicably appeared only at great depth.

3.4 This shows indeed that there are difficulties with that interpretation of the results, and the point I want to make is that ~~the~~ it is the interpretation that is at fault, but not the results themselves: The analyses and all other hard facts are completely consistent with each other and the laws of nature, I submit, if only interpreted correctly.

4. As mentioned earlier, the crucial question is whether or not the leachate contents can become more concentrated after entering the shale.

And the answer to that question is: Yes, indeed they can, and it is logical to expect that to happen.

4.1 The mechanism by which the chemicals become more concentrated underground is the very same often quoted in favor of landfills, namely "attenuation", the lowering of concentrations by interaction with the soil. The difference is merely that one is the flip side of the other, but of the same coin: Attenuation works by trapping the chemicals, leaving the carrier (water) to go on partly stripped of its contents. By the same token, the chemicals must therefore be accumulated where the soil traps them, though, and one cannot take place without the other. This is then how the original leachate concentrations can and will be increased; and it is a sufficient interpretation for a unified explanation of all the hard facts.

4.2 What I submit by this reasoning is that the high concentrations found ~~there~~ in the deeper monitors of downhill boreholes advertise "concentrated leachate", plain and simple.
That view is supported by a number of indications:
(1) The time sequence of drastic increases in concentrations flawlessly traces the logical

advance of a front moving southeasterly downhill at some depth.

(2) Concentrations rise sharply when they do, but then remain at a remarkably constant plateau; that is consistent with reaching a saturation level which is virtually fixed by the soil type and its interaction with the chemicals present.

(3) Monitors in the same soil stratum exhibit nearly identical saturation levels (see (2), above).

(4) The analyses before the rise in concentration are consistent with and similar to the analyses out of the upfill "background" monitors and all others that one can reasonably expect to be unaffected by leachate: This is the natural ground water composition, all right.

(5) The postulated "deep saline ground water" showed up nowhere else except where leachate has to be expected: This type of water simply does not exist!

(6) Significant vertical or horizontal concentration gradients occur only where the borders of a plume can be expected.

4.3 There are more indications, but this should suffice. Should more detail of explanation or reference be needed, I would gladly supply that or attend meetings, be crossexamined etc.

5.1 My conclusion, and I hope it will be yours, too, is that leachate migrating downgradient leaves in its path a zone of saturated concentrations and that this zone is steadily growing larger. The chemicals found in it are the same family contained in the original leachate, which is the source of most of the total mass trapped, while groundwater makes a minor contribution to that mass. The trapping by shale probably depends largely on the process of adsorbing chemicals on its surface, which holds them in a relatively loose bond, allowing chemicals to re-enter into solution. That mode would most readily account for maintaining a concentration equilibrium between solid and liquid phases. If that is the case, it should also be possible to purge the contaminated zone and clean it up, provided the supply of leachate is halted.

5.2 This view of the facts not only removes discrepancies, it also provides additional answers: By outlining the plume of high concentration, we can also track its progress over time and determine its speed of advance: Typically, if the front emerged from under the fill in, say, 1973 and first reached BH-17-I in 1981, the front averaged about 45 m/year.

Although the rate of leachate supply (increasing) and plume spreading will affect the speed of advance, the plume front may well have advanced another 135 m past the North Service Road since 1981., and it could reach the nearest residences in the 1990-s. The water carrying the plume moves even faster, of course.

5.3 Concerning the supply of leachate, please note the recently supplied information on leachate springs observed earlier in 1984. This shows not only an alarming number of leachate breakouts through the cover of the lower end of fill, but these points include springs at elevations that come close to the top of that part. That means that an alarming build-up of liquid has occurred in the low end of the fill which must put great pressure on the unprotected sole and driving leachate literally into the ground, feeding the plume at an accelerated rate. It may well be that the sole has been broken by now due to the "channeling" effect that enlarges small passages as liquid is rushing through them, if there ever was a sole of any substance.

5.4 It must also be concluded that the peripheral drains of the lower part are simply not handling the amount of leachate entering; inasmuch as infiltration from the upper portion is most likely seeping into

the lower part, it is not surprising that the lower drains cannot cope with the combined flow from the upper and lower parts. As it stands now, the landfill resembles a shoe with water in it; the heel is higher and the water ends up in the toecap, of course. The lower part of the landfill was originally not meant to be extended this much either. Unfortunately the planning of the earlier extensions lacked foresight again. And now the current plans once more fail to provide separation to isolate the lower part from leachate invasion out of the upper part.

6. Considering as well that the underground leachate plume is vastly larger and vastly more concentrated than we were given to believe, the present state of this landfill is truly a disgrace to the proponents and consultants that have worked with it for many years by now. And the plans for the proposed further expansion (in area and depth) would clearly make matters even worse. This is what I meant at the start by referring to credibility, and I believe that I have offered a plausible and compelling picture of what the real state of affairs is. I am confident enough of my views to invite the proponents to refute them by better evidence.

Accordingly, I propose and recommend:

(1) That expansion or continuation of this landfill NOT BE PERMITTED on the basis that the proponents and their consultants have failed to properly (a) understand, (b) assess, (c) engineer and (d) operate safely this landfill, thereby causing a much larger and much more concentrated plume of contamination to migrate off the site without taking steps to prevent it.

(2) That steps be ordered to be taken to the effect of
(a) halting the supply of leachate into the existing underground plume of leachate contamination, and
(b) removing that plume of contamination, having determined its true extent.

(3) That off-site monitoring programs be established in respect to the possibilities of
(a) leachate surfacing in the vicinity of the contamination plume, and
(b) leachate entering streams and being carried off;
further, that in the event that surface or stream contamination takes place, the Region be obliged to notify the City of Burlington and to fence off and post any affected areas, in addition to removing the contamination.

(cont'd)

(propose & recommend, cont'd)

(4) That in the event of a dispute over the Region's landfill being the source of contamination to be dealt with, or another similar source, it shall be assumed or imputed that the Region's landfill is the source, unless there is positive proof to the contrary.

(5) That in the event of a dispute over the interpretation of evidence or over the factuality of evidence regarding the effects of contamination from this landfill, the onus of proof of safety shall be on the Region, but the Region shall absorb the cost of reasonable professional assistance to the party disputing the safety.

(6) That the Region be advised and urged to obtain different or additional services of consultants regarding this landfill, especially regarding the hydrogeological aspects of it.

However, should any expansion or continuation of this landfill be permitted, contrary to (1) above, I propose and recommend:

(7) That such permit (5) be granted only on condition of

(propose & recommend, cont'd)

Complying with items (2), (3), (4), (5) and (6) above.

(8) That the northwesterly expansion of landfilling be limited to include a safe setback from the groundwater divide in that area; and that this setback distance be at least equal to the depth of the Falcon Creek ravine in that area.

(9) That additional steps be taken as a precaution against leachate entering Falcon Creek along the westerly flank of the landfill, regardless of whether consultants deem this an imminent threat or not.

(10) That the depth of refuse deposited over top of earlier deposits be limited to the effect that the combined depth of old and new deposits does not exceed 20 metres (65 feet).
This is based on a recommendation by the Region's engineers that landfills in Halton limit the depth of refuse to 15 metres (50 feet) — see Appendix of Walker Wright Young report "Phase 2B" re. long term landfill sites under the EAA.

(11) That for additional landfill at this site the deposits of refuse be made into deposit cells that are isolated from each other and drained separately.

(propose & recommend, cont'd)

(12) That control over refuse deliveries be tightened to include
(a) visual inspection of loads where they are unloaded;
(b) immediate reloading of items or loads not permitted;
(c) recording the origin and carrier of loads other than municipal garbage, and requiring certification that the load complies with the principal regulations about substances not permitted, before proceeding to the unloading area.

(13) That no subsequent expansion or continuation of this landfill will be permitted.

These recommended conditions, I believe, are both necessary and reasonable. They may well be inadequate, though, in view of the fact that the "state of the art" accepted as little as 10 years ago has turned out in many instances to be falling woefully short of being safe. By contrast, this landfill will probably remain active as a source of pollution for another 100 years or longer, a dubious legacy to the future.

May 29, 1984 Hans F. Kreplin, P. Eng.