

Vol. 7 & 7A Hydrogeologic - Hydrologic Assessment and Conceptual Design

Comments by H. Keplin, Mar. '85

Introduction

- Purpose: The "preliminary" assessment and "generic conceptual site development plans" are insufficient when "identification of a preferred landfill site ... is the overall purpose of the study."
- More comprehensive evidence than that given is required for an "identification", especially when the summary ~~result~~ is stated (P. Walker, public meetings) to result in small differences in site rankings.

Scope of investigation

Re. "appropriate ... level of detail" (cont'd):

"However, there was no attempt, during Stage 2C, to develop on any site the level of detail required for approval of a facility under the Environmental Assessment Act." - (p.4) -

- In other words, this procedure selects a site first, although on insufficient grounds, before looking at important details (more on that below). That is clearly prejudging the end results insofar as selecting a site is concerned, saying "we choose first and show sufficient evidence later"
- On the other hand (p.3) "The preparation of conceptual plans ... must be predicated on a level of hydrological

Investigation suitable for E.A. purposes. -
 If that level is insufficient for approval ("there was no attempt..."), then the recommendation for site selection is obviously also on insufficient grounds.

• --- a comparable level of detail for hydrogeological investigations must be developed from original testing on some sites" (p.1) --- The details reported are (Vol. 7A):

Site	A	B	C	D	E	Ave. F
Borehole logs	9	8	9	8	3	7.4
Soil grain distribution curves	10	4	7	11	10	8.4
Well construction details	19	15	18	15	-	13.4
Groundwater elevations	36	14	34	42	-	25.2
Groundwater chemistry	5	4	4	5	2	4.0
Hydraulic conductivity	1	1	1	1	-	0.8
Water well records	92	92	92	55	26	71.4
Total data (sets) reported	172	138	165	137	41	130.6
Grand total = 658	A	B	C	D	E	A-E Ave.

The "comparable level of detail" is not given for F vs. A to E, although much more is available for F, more than "Previous Work" and Appendix F3 list. (*)

Site F is "most preferred" (p. 63) although the information reported for F is only 5/130.6, or less than 4% of the average information reported for sites A to E.

The info. for F is $5/658 = 0.76\%$ of the grand total.

Previous Work (p. 3-4) and Appendix F3, "Sources..."

- (a) The list does not agree with Appendix F3, although it refers exclusively to the Burlington study area.
- ⊕ • (b) of 8 sources referenced (net, less duplication), only 2 can be considered "at arm's length", the other 6 sources are proponents of landfill at F, i.e. not objective.

- (c) The passing of technical info. on F in Vol. 7A is indicating a bias in view of the sources available & quoted.
- (d) The data reported for F do not reflect the undisputed underground leachate contamination already existing in the study area of site F.
- NOTE: This report does not refer to the "study area" and it thereby avoids dealing in any detail with the adjacent dumps and landfill and associated problems.
- (e) The claim that the proposed landfill would improve existing leachate problems (p. 60 and p. 83) is not substantiated by any evidence.

- NOTE: Dr. Clary observed that the leachate plume from Bayview extended to the deepest levels sampled, i.e., 0W-12 on NSP Rand described by Bayview, but this report does not mention 0W-12, see Fig. F3
- "Previous Work" came together at the 1984 EPA hearing (site expansion); there all experts rule. There if proponents agreed that no dump/landfill should have been started in the first place, considering the given hydrogeology. - This report (for a present) neglects to provide that necessary finding.
- "Previous Work" does not include the 1980 report by Dr. Clary "Hydrogeological Suitability of the NSP Landfill Site, Burlington, Ontario" See NOTE under (e) above and attached excerpts.

Selection Criteria (p. 4-8)

- "Attenuation Capacity" fails to describe fractured shale (site F), although a major consideration; also high permeability and leachate attenuation.
- This omission would appear more than an oversight (Site F = #1)

- The term "bedrock" used later, is not mentioned here, either (applicable at F, collected #1).
- Overburden thickness: "Areas underlain with these sequences of sandstones provide better environmental security..." (p.5) and "...contaminant transport in fractured rock is often not predictable. In addition, the attenuation capacity of a fractured rock environment is less..." (p.6) are correct, but this is not reflected in TABLE 1 - Site F (p.75): "Poor attenuation" is rated as "moderate to high" (constraint), "Complexity of groundwater flow system" - "Complex groundwater flow systems in this report refer to areas possessing both recharge and discharge conditions..." to correct that the site F rating (p.75) ignores the fact that the site has both: water (recharge) goes deep at Bayview but is likely to surface in the wet flatland south of Hwy. 403. The rating "low" for stratigraphic complexity (constraint) is therefore inconsistent with the facts and the report itself.
 - NOTE: This report consistently limits its views to site plans instead of study areas, i.e. its context is not consistent with the overall (Walker's) procedure. In doing so, off-site contamination questions are consistently not dealt with, although off-site contamination that constitutes a major concern for F (which has for the other site), is not considered suitable for further investigation as opposed to other "General pits and quarries" (p.8). - Thus site F was singled out "as an alternative to using agricultural land" (p.8), although no clear hydrological evidence was presented against other pits and quarries. The bias for selecting site F stems from that party demanded

- process of selecting first including pits and trenches and then nothing aside all but the site F.
- (b) Re. setback from perennial streams "There is a potential danger that contaminants may leach from landfill, and migrate to surface water" (p. 7) is true for site F. The site slopes, dropping 61 in (200 ft) in elevation, causing liquid propane to build up in the lower part and leaching out of the cover. This is frequently the case at the present landfill, causing surface water contamination. This report does not mention these leachate springs, although this effect alone should rule out such a "leached site". Ignoring that fact constitutes a serious bias for F as #1. In the 1984 EPA hearing, the plan "Exhibit 64" showed (only) 14 leachate springs on the lower part of the present landfill, and it was subsequently ordered that better records be kept to log all of them.

Use of Selection Criteria (p. 8)

- "The Ministry of the Environment requires that leachate impacts from landfills be kept relatively low or as not to affect off-site uses" is not needed when only site plans (not larger "study areas") are considered in this report.
- "In some instances... site conditions... do not meet criteria established in the evaluation factors, for example, the evaluation on part of Candidate Site B and no answer from the desired criteria." - The fact that site F has virtually no overburden is ignored, here, but that site F is #1, notwithstanding.
- Continuing "... designs have been developed... to

attenuate landfill contaminants to acceptable levels!" - For site F, that means no attenuation at all, but instead leachate drains are connected to city sewers for quick removal from the site and to the Bay - something the report completely neglects to mention. Again, off-site effects are ignored.

General Engineering Criteria (p. 9) - as numbered:

- These criteria are not general: The site F design breaches them:

① "Landfills are to be surrounded by 100m wide buffer zones ---" - See Fig. F5:

- (1) No buffer zone is provided on the SW side of site F. Later rationalized as bordering the existing landfill site (p. 55), that lack of a buffer would make it impossible to deal with future leachate problems, i.e.

(a) to trace the source of the problem, and
(b) to carry out corrective work.

- so what
- (2) No buffer zone is provided around the Bayview site. That is rationalized in the same way (p. 55) and is unacceptable for the same reasons as (1) above.

- (3) The buffer toward the power line at the south is reduced to 50m wide. The width of the Ontario Hydro corridor, already off-site, is quoted as protecting the Hwy. 403 right of way (p. 54), obviously a desperate argument to achieve the target capacity.

- (4) The northern end of the site borders on King Rd. without a buffer zone, and no rationale is offered there: It is yet another breach to gain capacity that the site really does not provide.

(General Eng'g Criteria)
(Dcont'd)

-7-

Notes re. Ontario Hydro and Hwy 403: These lands are already contaminated with leachate from the Bayview dump (Dr. Cherry, 1980);

No.
What
basis
for
saying
this.
Reply would
be that
leachate
collection
system would
be placed
to collect
leachate from
both
Bayview and
Site F

• Since that leachate passes under the site F land, landfill on the site F would permanently obstruct access to the area where remedial work (such as intercept wells or drains) must be located near the source to have any chance of effectively capturing that leachate. Corrective action dealing with the existing problems is what is indeed needed there, and not that the existing problems be buried under yet another deposit that makes remedy impossible and adds even more leachate, part of a much larger source. Considering that leachate will probably be generated for hundreds of years (Dr. Cherry, 1980), a landfill at site F is simply an unconscionable legacy to leave future generations.

On these grounds alone, site F is not a feasible choice at all. See more reasons below.

- "... service areas are to be within the landfills". This is breached at F by "... with probable access along the access to the existing Burlington landfill" (p. 58), because the hauling of garbage and cover material is incompatible with the park concept for the present site's afteruse.

- ② "Depth of cut is to average about 4.5 m, and the maximum height of fill is to be 15 m across the landfills", and Proposed Landfill Design, p. 57, "... it is our opinion that a liner to protect groundwater resources is not required at this site" — The 1984 EPA hearing on the

(Depth of cut, cont'd)

expansion of the present landfill has established that a landfill sole 1.5 m deep or more of undisturbed clay soil is required to prevent leachate from entering the fractured shale.

The 4.5 m depth of cut obviously would expose the fractured shale at F, and heavy infiltration would occur without a sole liner. This makes site F unsuitable.

- A clay sole much deeper than 1.5 m would be required to achieve the equivalent of 1.5 m of undisturbed clay, and for every 1.5 m of sole depth, the site capacity would be reduced by about 10%.
- Site capacity calculations show that no sole volume allowance has been made in the proposed design.
- "It would appear that the '--- opinion that a liner --- is not required at this site' (p.57) is based simply on the capacity shortage (discussed on p.54), setting aside the authors' hydrogeological expertise."
- The expected escape of leachate is acknowledged by "In this hydrogeological environment it can be assumed that some of the leachate generated by a landfill would leave the site via the deep groundwater flow system" (p.55). However, the reference to "deep groundwater" speaks of the site only, ignoring the fact that it is known to surface in the flatland to the south of the site.
- The "opinion that a liner --- is not required..." cites as considerations (a) low quality groundwater, (b) no users (of wells) and (c) drains discharging to sewers. "In conclusion, we can see no technical reasons not to reduce the buffer zone --- and a liner is not required at this site. These conclusions form the basis of the landfill design..." (p.57).

In other words, this site F Landfill design is based on:

(a) Technical considerations (mainly capacity) rather than

Public Health and Safety (first priority category); (b) that it would be acceptable to further contaminate (leachate)

bad groundwater already polluted by existing sources;

(c) that it need not be considered where the groundwater

emerges off-site, e.g. surfacing in the flatlands to the

south, including stream beds and built-up city areas;

(d) that it need not be considered what happens to leachate

in the sewage treatment process;

(e) that it need not be considered what (synergistic) effect

leachate chemicals have on water quality in the Bay and

False Custeria;

(f) that it is acceptable to use information almost exclusively

produced by or for landfill proponents, ignoring even

the 1984 hearing consensus that it was a mistake to

begin with its deposit garbage there;

(g) that it is acceptable to ignore the warnings of the few

experts with no personal interest in the matter;

(h) that it is acceptable to ignore the warnings of

environmental scientists to act on the side of

caution because the single or synergistic health effects

of many chemicals is not sufficiently understood to say

what is safe or unsafe;

(i) that it is acceptable to square required capacity "with

a site of ordinarily about half that capacity by

reducing or eliminating environmental safeguards;

(j) that it is acceptable to choose a landfill site out of

500 candidate sites while presenting less than 1% of

supporting technical data for the chosen site;

(k) that it is acceptable to ignore the slope of the site

and the leachate pressure ("springs") and surface water contamination caused by that slope;

(f) That it is logical and rational to eliminate from consideration all pits and quarries as inherently too difficult for adequate leachate control, except one, and then prefer that over normally acceptable sites;

(m) That it is acceptable to not allow for shipping in to site F appropriate (clay) cover material when almost nothing but crushed shale is available from excavating the landfill area; - note that the cover is supposed to be waterproof as much as possible, and broken shale is not.

(n) also, that switching the need to transport cover material to this site affects the environment of other factors as well, e.g., traffic, costs, air quality and social impact;

(o) That it is acceptable not to consider separately drained refuse cells for the landfill structure;

(p) That it is acceptable to place landfill over the areas which above would allow access for controlling existing underground leachate problems of other deposits.

This list of questions and objections in the basis of the landfill design, while not exhaustive, makes these points:

- The design basis is usefully inadequate, and it sacrifices environmental concerns for meeting a predetermined objective, and

- therefore the ranking of site F as the best choice of the air candidate sites is totally unacceptable from either the technical or the Public Health and Safety point of view.

- The section on potential environmental effects, risk mitigation and ranking of sites, only follows the faulty basis of the assessment.

Atchd: Dr. Cherry (excerpts)

Heaven Kepler
Mar. '85

EXTRACTS FROM: Hydrological Suitability of the NSPL Landfill Site,
Burlington, Ontario

± 1983 update (paper on tracer methodology)

By: John A. Cherry and Donald L. Lush

October 1980

"The current guidelines and policies of the Ministry of the Environment are not specific with regard to the hydrogeological aspects of the problem and therefore recommendation made by consultants on landfill suitability and design are unavoidably problematic."

"Regardless of the choice, many contaminants will eventually end up in Hamilton Bay."

C "It is necessary to assume leaching will occur for hundreds of years under a relatively high flow, and design the landfill accordingly." (p11)

"Based on the existing hydrogeological data from the Bayview landfill, it appears that a large plume of leachate-contaminated groundwater has developed in the shale and that the zone now extends beneath and beyond Highway 403." (1980)

D "These zones are migrating towards an urban section of Burlington and in future years they may cause gradual changes in the quality of streamflow in Burlington." (p12)

"Some emphasis should be placed on analysis of toxic organic chemicals and their breakdown products in addition to the inorganic constituents that have been included in previous monitoring of the area. There is reason to believe that numerous toxic organic compounds occur in landfill leachate and that some of these constituents may be relatively mobile in some groundwater flow systems. At present little is known about the types and concentration levels of organic compounds in

leachate from landfills."

(A) "The decision with regard to whether or not a site is hydrogeologically suitable is, to a significant degree, a matter of personal judgement. Personal judgement is an important factor largely because the Ontario Ministry of the Environment has almost no regulations, policies, or guidelines that are specific in a hydrogeological context." (p21)

"Based on the Gartner Lee report and the Phase II report by Morrison Beatty Associates Limited, it is expected that leachate that seeps downward beneath the landfill into the shale will gradually move at some depth, along primarily horizontal flow paths toward the southeast (i.e. towards Hamilton Bay)."

"The inclusion of interceptor drains in the proposed landfill may be expected to alter the quantity of leachate which reaches the streams but not its quality. Quality may be expected to be a function of the types of material placed in the landfill, the flow path both within the ground and surface water system, and time."

(B) "In the (Bayview) seepage areas the phenol equivalents were comparable to some of the highest groundwater values and accordingly these also exceeded the provincial objectives for surface waters. High phenol equivalent values persisted down into Burlington. Analyses carried out by MOE for chlorinated hydrocarbon compounds such as PCB's, herbicides, and a variety of pesticide residues indicated that these compounds are all at low but detectable levels and do not exceed federal maximum

acceptable surface water concentrations although their concentrations do exceed Ministry of the Environment surface water objective concentrations. The presence of these materials, many of which have been suggested as being carcinogenic, may result in public objection to any further landfill development unless it can be shown that water quality will improve as a result of future development." (p41)

"A sanitary landfill site of the type proposed for the NSPL property may be expected to have deposited within it either intentionally or unintentionally a variety of materials hazardous to life. These contaminants may be broadly classed into organic and inorganic materials. The organic materials are composed of a variety of pesticides, herbicides, and industrial products such as PCB's. The inorganic materials may be expected to consist of compounds of lead, zinc, copper, arsenic and other elements such as those which have been detected leaching from the closed Bayview landfill." (p47)

"Once in Hamilton Harbour most contaminants are expected to enter the sediment at some time in the future (and to be removed) from biological systems."

(As we know from Mercury in Northern lakes, Sediment seldom results in final removal - recycling through fish is long term)

"The total concentration of several metals in the Rambo-Hager Diversion are at present higher than that deemed to be acceptable by the federal and provincial governments."

Dr. Cherry: Survey Update, August 1983

"Several diagnostic compounds have been identified in the (Bayview) groundwater. These compounds are common chlorinated hydrocarbons produced by the chemical industry. A summary of the results pertaining to three of these compounds is provided in a table included with this letter.

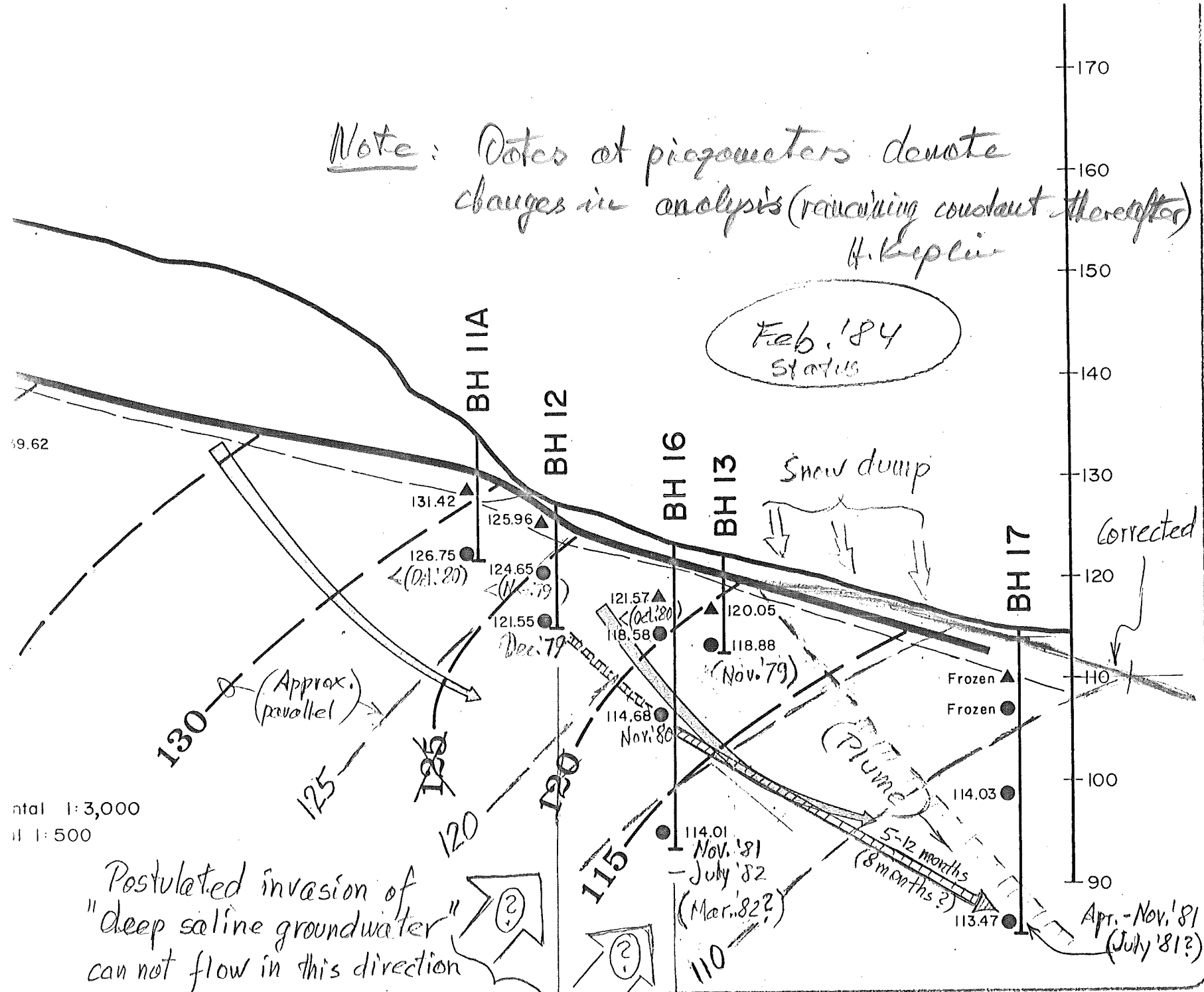
The results indicate that a zone of leachate influence extends from the landfill at least to piezometer nest OW12 ^(half way to 403 from Bayview) and that the zone of influence extends to the deepest piezometers in the nests that were sampled. Of the various nests that were sampled, OW12 is the farthest from the landfill.

At present we do not have sufficient data to predict the fate of the chlorinated hydrocarbons in the hydrologic system."

	OW12. ppb	background	Δ (ppb)
Chlorobenzene	0.8	0.05	+0.75
Paradichlorobenzene	0.05	ND	+0.05
1,1,1 trichloro ethane	10.0	0.5	+9.5

Note: Dates at piezometers denote changes in analysis (remaining constant thereafter)
H. Replin

Feb. '84
Status



- 150 INFERRED PIEZOMETRIC GROUND WATER CONTOUR (m.a.s.l.)
- PROBABLE GROUND WATER FLOW PATH
- STRATIGRAPHIC CHANGE

NOTE: 1) Flow Net based on Water Level Data Feb. 3, 1984
2) Flow Net is a representation of the actual system and is shown on an exaggerated scale.

GROUND WATER FLOW CROSS SECTION B-B'		0-17
Hydrogeological Study Halton Region BURLINGTON LANDFILL SITE Continued Use		
Project 85-05		Gardiner Lee Associates Limited