

CONSOLIDATED HEARINGS BOARD

IN THE MATTER OF Sections 2 and 3 and 6 (3) of the Consolidated Hearings Act, 1981, S.O. 1981, c.20;

— and —

IN THE MATTER OF Section 12(2) of the Environmental Assessment Act, R.S.O. 1980, c.140;

— and —

IN THE MATTER OF Sections 30, 35 and 38 of the Environmental Protection Act, R.S.O. 1980, c.141, as amended;

— and —

IN THE MATTER OF Sections 24 and 61 (2) of the Ontario Water Resources Act, R.S.O. 1980, c.361, as amended;

— and —

IN THE MATTER OF Section 28 (3) of, and Regulation 164 under, the Conservation Authorities Act, R.S.O. 1980, c.85, as amended;

— and —

IN THE MATTER OF Section 40(12) of the Planning Act, S.O. 1983, c.1, as amended; in connection with site plan control of the sanitary landfill site;

— and —

IN THE MATTER OF Section 22(1) of the Planning Act, 1983 in connection with a referral to this Board by the Honourable Bernard Grandmaitre, Minister of Municipal Affairs, on a request by the Regional Municipality of Halton to amend the Official Plan for the Town of Milton to redesignate a parcel of land comprising Part Lots 3 and 4, Concession 2 N.S. in the Town of Milton from "Agriculture" and "Conservation and Hazard Lands" to permit the construction, operation and maintenance of a landfill site, Minister's File No. 24-OP-0208-A01;

— and —

IN THE MATTER OF Section 34(11) of the Planning Act, 1983 in connection with an appeal to this Board by the Regional Municipality of Halton for an order directing an amendment to By-law 61-85 of the Town of Milton to rezone the lands situated at Lot 3 and part of Lot 4, Concession 2 N.S., in the Town of Milton from "Agriculture" to permit a regional sanitary landfill site and ancillary uses;

— and —

IN THE MATTER OF Section 15(1) of the Planning Act, R.S.O. 1980 ch.379 in connection with a referral by the Honourable Claude F. Bennett, Minister of Housing on a request by Tremaine Britannia Citizen's Group for consideration of part of the Official Plan for the Halton Planning Area with respect to Sections 1 to 5 inclusive, 7, 9 and 10 of Part III D3 Solid Waste Management, Minister's File No. OPC-0026;

— and —

IN THE MATTER OF Section 64 of the Ontario Municipal Board Act, R.S.O. 1980, c.347 as amended in connection with an application by the Regional Municipality of Halton for an order approving:

- a) the acquisition of land for the construction, operation and maintenance of a sanitary landfill site to contain 7.96 million cubic metres of waste in the Regional Municipality of Halton and to do so by one of two alternative methods as follows:

- (i) landfilling at the site referred to in Halton's Environmental Assessment as Site F in the City of Burlington;
- (ii) landfilling at the site commonly referred to in Halton's Environmental Assessment as Site D in the Town of Milton

at an estimated cost of \$12,775,000.00, and the borrowing of money by way of temporary advances not exceeding in the aggregate such estimated cost pending the sale of debentures, and

- (b) the issuance of necessary debentures to a maximum of \$12,775,000.00 for a term not to exceed fifteen years;

— and —

IN THE MATTER OF Section 193(5) and Paragraph 84 of Section 210 of the Municipal Act, R.S.O. 1980, c.302, as amended;

— and —

IN THE MATTER OF Sections 6, 7 and 8 of the Expropriations Act, R.S.O. 1980, c.148;

— and —

IN THE MATTER OF an undertaking of the Regional Municipality of Halton to provide facilities for the purpose of receiving, dumping and disposing of waste as required by section 137 of the REGIONAL MUNICIPALITY OF HALTON ACT, R.S.O. 1980, c.436, as amended, by acquiring the land for, constructing, operating and maintaining a landfill to contain 7.96 million cubic metres of waste in the Regional Municipality of Halton.

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OFFICIAL REPORTERS

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WITNESSES:

ALFRED A. SOBANSKI (Resumed)

JAMES BEECHINOR (Resumed)

Examination in chief by Mr. Lederer (Cont'd)

E X H I B I T S

<u>No.</u>	<u>Description</u>	<u>Page No.</u>
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Nethercut & Co. Ltd.

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BEFORE:	H. H. Lancaster, Q.C.	-	Chairman
	Dr. D.J. Kingham	-	Member
	S. Tanner	-	Member



Nelhercut & Co. Ltd.

Toronto, Ontario

Hearing conducted at The Oakville
Granary Commercial Centre, 105 Robinson
Street, Oakville, Ontario, on
June 10, 1987

VOLUME 20

APPEARANCES:

T.R. Lederer and
H.D. Hodgson

for the Regional
Municipality of Halton
(Proponent)

J.R. Tidball

for the Ministry of the
Environment

T. Vigod
J.F. Castrilli

for the West Burlington
Citizens Group

D. Estrin,
F.E. Leitch and
H. Dahme

for the Corporation of the
Town of Milton

S.R. Garrod and
A. Nurvo

for the Milton Area Citizens
Coalition and several
affected Milton area
landowners

R.B. Tuer, Q.C.
E.A. Cronk and
F. Perrier

for National Sewer Pipe
Limited

L.F. Longo

for Azova Investments
Limited

M.J. McQuaid, Q.C.
and C.J. Tzekas

for the City of Burlington

C. Mansfield

for the Ministry of Natural
Resources

P. Renaud

for Cumis



Nethercut & Co. Ltd.

Toronto, Ontario

APPEARANCES (Cont'd):

1	C. Stevenson	for Framgard Holdings,
2	P. Hancock	Fosseri Investments
3		Limited, Seriphos
4		Investments Limited and
5		Topic Investments
6		
7	J.H. Olah	for the Halton Region
8		Conservation Authority
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Per: C. F. Nethercut, C.V.R.



1 ---Upon commencing at 9:30 a.m.

2 THE CHAIRMAN: Good morning, thank
3 you, please be seated. Before we get started this
4 morning, the building has asked me to announce that
5 anyone leaving the building at 5:00 or 5:15, make
6 sure the doors are locked behind you. The last couple
7 of nights they have been open all night and there is
8 no security in the building at night and they don't
9 lock automatically. Those who have keys, make sure
10 they are locked when you leave behind you.

11 ALFRED A. SOBANSKI (Resumed):

12 JAMES BEECHINOR (Resumed):

13 EXAMINATION IN CHIEF BY MR. LEDERER (Cont'd):

14 MR. LEDERER: We are without a witness
15 but he will be here in a moment. This is another
16 unique opportunity to get some information before you.

17 THE CHAIRMAN: Do you want to fill in?

18 MR. LEDERER: I would be happy to if
19 you would accept my evidence, but I think my expertise
20 would be challenged.

21 I might just say one thing in this
22 brief pause. The question was raised by Dr. Kingham
23 as to where on Site D at what level the excavations
24 were to take place and I raised the point that we
25 were talking about the conceptual designs as they



1 existed at the Phase 2, Stage 2C stage, and indicated
2 that both designs had moved closer to finalization
3 is a fair way of putting it in the design and
4 operations report to which Mr. Hiraishi will be speak-
5 ing.

6 However, with respect to the very
7 specific point you asked, you will find the answer
8 to that on page 51 of Exhibit H-41.

9 Q. Mr. Sobanski, at the end of the
10 day yesterday you had explained to the Board the
11 meaning of the word porosity and the definition of the
12 words effective porosity and, with that in mind, I
13 wonder if you could indicate to the Board, and I
14 suspect it is fairly clear by now, but for the
15 purposes of the record, if nothing else, could you
16 indicate how identifying porosity assists you in
17 identifying ultimately groundwater flow regimes
18 and groundwater flow velocities?

19 MR. SOBANSKI: A. We saw in the
20 equation that it ties in as a divisor, so the
21 porosity that we use for various hydrostratigraphic
22 units affects the velocity with which groundwater
23 contaminants might flow.

24 Q. What do you do to identify
25 porosities in this kind of study?



1 A. In this type of a study we
2 have gone to literature and some of the values
3 could be measured in the lab with difficulty,
4 depending upon the types of materials you are dealing
5 with.

6 Q. All right. Can you indicate
7 to the Board the porosity values you identified for
8 the hydrostratigraphic units that you have defined in
9 the Side D study?

10 A. For the lowest hydrostrati-
11 graphic unit, the shale bedrock, we have assumed a
12 porosity of .001 which is a fracture-type porosity.
13 For the lower till we have assumed a porosity of .25
14 which is 25 per cent porosity. For the granular
15 units, .3 which is 30 per cent porosity, porosity
16 being expressed in a fraction of one and one being
17 100 per cent porosity and .3 being 30 per cent.

18 For the upper unweathered till a
19 porosity similar to that for the lower till of 25
20 per cent or .25 and, finally, for the upper weathered
21 zone a porosity of .001 or 1/10th of one per cent
22 to reflect its fractured nature.

23 Q. I am not sure if this is
24 necessary but, Mr. Beechinor, could you pull down
25 the pages Mr. Sobanski used yesterday in describing



1 the porosity. I think I want the next one actually.

2 Are you able to relate these percentage figures to
3 the formulae you demonstrated to the Board yesterday?

4 A. Yes. We looked at the range of
5 values we would be using in this report and the .3
6 is 30 per cent porosity. The 10^{-3} , which is 0.001,
7 is one/tenth of one per cent porosity.

8 Q. I would like for a moment to look
9 at the two granular units. Can you indicate to the
10 Board whether or not the penchant for water to move
11 through those granular zones would be higher or lower
12 than in the tills or the hydrostratigraphic units
13 that surround them?

14 A. It would be higher because of
15 their higher hydraulic conductivity.

16 Q. With that in mind, did you do
17 any analysis to see whether those granular units
18 would be the source of water for any wells in the
19 area?

20 A. Yes, we did. We ran pumping
21 tests on both of these zones and perhaps I could
22 refer to Table 6 in the report on page 46. This
23 table summarizes the parameters that we found by
24 conducting pumping tests on each of these zones, in
25 each of the granular units on Site D. On the left-



1 hand side we have the upper granular unit which
2 was test pumped for a 40-hour period in that
3 observation well, and perhaps I can locate it-- the
4 pumping well rather.

5 Q. Just so it is clear in the
6 record, could you indicate the drawing number?

7 A. Yes, this is drawing 5 in the
8 report, H-39, and it is entitled "Location of
9 Drilling Sites and Observation Wells." Pumping
10 well 2 is located on the northern leg of the L-shaped
11 property on the eastern side about midway between the
12 north and south edges of the northern leg of the
13 property, in the vicinity of HC 2-85 and, on the map
14 it is identified, or the well is identified as pump
15 well 2 or PW2.

16 This well was tested for a period of
17 49 hours and observations were made in numerous
18 observation wells in the area. The wells we are
19 showing in the report are the effects which were
20 observed on HC 2-85, which is located near the
21 pumped well, and also the effects that were observed
22 in OW2.

23 In the Comcor well, OW2, which is
24 located somewhat to the west, when we test pumped
25 this well we observed the effects out as far as HC 2-85



1 located in the southern fields on the site. The
2 lower granular unit was test pumped from pump well
3 No. 1 identified as PW1 on the figure, and since this
4 was a silty unit it only had a local effect and
5 we observed effects only in HC 4-85 which is located
6 nearby.

7 The table shows two different types
8 of analyses that we used on it and these are standard
9 methods in hydrogeology, a Theis curve match, a
10 Jacob approximation and then we took the mean
11 values for the various units. From these we see our
12 hydraulic conductivity of the upper granular units
13 being estimated as 8.2×10^{-3} which is used in the
14 report and for the lower granular unit we have
15 the hydraulic conductivity of about 3.3×10^{-4} .

16 Q. Can you indicate to the Board
17 the results of this work insofar as the identification
18 of groundwater users was concerned?

19 A. Yes, we interpreted the upper
20 and lower granular units to be the sources of water
21 supply for at least two wells in the area located
22 on the west side of the site.

23 Q. Now, can we turn to page 47
24 of the report and, Mr. Sobanski, when you have
25 identified hydrostratigraphic units and when you have



1 assessed values for things such as hydraulic
2 conductivity and porosity, are you able to determine
3 groundwater flow regimes?

4 A. Yes, we are.

5 Q. Can you indicate to the Board
6 generally how this was done and then what I would
7 like you to do is review what you found with respect
8 to the bedrock regimes and then -- well, with respect
9 to the bedrock regimes, both regionally and locally?

10 A. Mr. Beechinor described how
11 these drawings are constructed.

12 Q. Again, what drawing are we
13 referring to?

14 A. We are now referring to drawing
15 15 of Site D, the regional bedrock potentiometric
16 contour map, and the method we employ is similar to the
17 one I described yesterday in terms of how we map the
18 bedrock in terms of its elevation.

19 We take again the Ministry well
20 records, or information that we have that is maybe
21 more site-specific, and we have an approximation
22 of the elevation of the top of the wells and we
23 subtract from that the depth to the water in the
24 wells and that gives us a water level elevation and
25 we are now talking bedrock wells in which we have



1 wells that are constructed in the rock and so this
2 tells us where the water level head is within the
3 bedrock well.

4 These are then plotted on a map.

5 For example, and I don't have a well number, but this
6 is well No. 5823 from the Ministry of the Environ-
7 ment waterwell records, and taking the surface
8 elevation that the Ministry gives us on the well
9 records and subtracting the depth to the water in
10 the well, it gives us an elevation of the potentio-
11 metric surface of 190 metres, and we do that for
12 all of the wells in the area for which we have
13 information.

14 First of all, we want to be sure that
15 we always use rock wells whenever possible, so we try
16 to use the Ministry records and quite often we don't
17 know where a bored well or an unidentified well terminates,
18 some of the older wells do not have records. We
19 then contour the package giving us in the first case
20 we talked about lines of equal elevation on the rock
21 and here we are talking about lines of equal elevation
22 on the potentiometric surface or the water level
23 surface in the bedrock, and we now contour them, a
24 three point problem, just a small geometry problem,
25 and we look between the wells as to what the elevations



1 are and then we draw these lines so that they are
2 approximately at equal elevations throughout their
3 length.

4 We can then determine or estimate
5 the direction of groundwater flow in these units
6 because groundwater moves down-slope at right angles
7 to the equipotential lines and that is why you can
8 see the groundwater lines or the flow lines curve,
9 and at the intersection with the equipotential line
10 it makes a right angle. This is the least energy
11 requirement for groundwater and it tries to follow
12 this path, the line of least resistance.

13 We can see from this map in terms
14 of the regional flow system, the groundwater is
15 moving in general towards discharge in the major
16 creeks on either side of the landfill area. Here is
17 Sixteen Mile Creek on the east and Bronte Creek on
18 the west and this makes sense because there are
19 bedrock exposures in Sixteen Mile Creek, for example,
20 in the vicinity of Lower Baseline Road and for some
21 distance up the bedrock is actually exposed, and so that
22 creek is deriving part of its groundwater flow from the
23 rock regime.

24 Q. Before we leave that drawing,
25 I notice there is a fairly large space between the



1 contours just in the area of the site and can you
2 indicate to the Board what that means or what that
3 indicates?

4 A. We are not absolutely sure,
5 there has either been a change in the permeability
6 in the rock in that area indicating a higher
7 permeability, or it may reflect the presence of the
8 bedrock depression in the area which may exert some
9 influence on the groundwater flow in that area.

10 Q. Can you take us to drawing 16
11 and indicate to the Board please your findings with
12 respect to the local bedrock groundwater flow regime?

13 A. For the record I am now
14 referring to drawing 16 of H-39 and the title on the
15 figure is "Local Bedrock Potentiometric Contour
16 Map" and this was in April of 1986. So, these are
17 then, or this map is constructed in the manner I
18 described for the regional map except that in this
19 case we are using groundwater levels that are
20 recorded on site and we have used in this case nine
21 observation wells installed to the overburden/bedrock
22 contact and here we have firmer data in that we
23 have now measured the elevations of the tops of the
24 wells and we can now by subtraction get accurate
25 groundwater levels within this zone.



1 The general direction of flow is
2 similar to what we described before. We find here
3 that there appears to be a groundwater divide occurring
4 beneath the property with groundwater flow going
5 somewhat to the east and the west away from this
6 mounded area of groundwater. When you get down to
7 the more detailed level, you can see some little
8 anomalous features like a potentiometric high in the
9 vicinity of HC 6-85 and probably reflecting local
10 permeability in the rock where it doesn't move away
11 quite as quickly and it allows the water to rise a
12 little higher in that area.

13 Again the local system generally
14 reflects the regional system with groundwater moving
15 towards Sixteen Mile Creek and also to Bronte Creek.

16 Q. Mr. Sobanski, did you do any
17 work to determine the groundwater regime in the over-
18 burden?

19 A. Yes, we did.

20 Q. Could you review with the Board
21 your findings with respect to that investigation,
22 please?

23 A. Yes. We found two dominant
24 groundwater pathways for landfill contaminant
25 migration and these were the shallow weathered zone



1 of the upper till and the other was the upper and
2 lower granular units contained within the lower till.
3 The results of this work is shown in drawings 17 and
4 18.

5 The first drawing we are looking at
6 is drawing 17 which is entitled "Local Water Table
7 Contour Map" and this is based on the April 1986
8 data. The water elevations were measured in the
9 standpipes on the site over a long period, as
10 Mr. Beechinor had suggested, and this map then is
11 constructed from the shallow wells which are installed
12 to measure the elevation of the water table.

13 We can see from this information that
14 there is again a groundwater divide on the site that
15 occurs through this area of high potential. The
16 direction of groundwater flow reflects surface
17 topography in the area to a large degree, with
18 movement being generally away from the groundwater
19 divide near the centre of the site and then somewhat
20 to the northwest -- sorry, to the northeast to a
21 tributary of Sixteen Mile Creek and also to -- and
22 it is a little difficult to describe the situation
23 here -- but to the northwest towards a small
24 tributary of Bronte Creek which we discussed as
25 one of the engineering problems on the site. That



1 creek, I should point out, traverses onto the site
2 at about the pipeline location which is on the north
3 end of the property and it comes down the site on the
4 west side and then exits the site at about west of a
5 well called Morrison Beatty MB (IN)OW-4 and then
6 it flows down the road and finally exits to the
7 west.

8 We can see in the shallow flow
9 system this shallow stream feature which is not a
10 permanent stream does still influence groundwater
11 flow and so there is from all directions locally a
12 component of flow towards that small tributary of
13 Bronte Creek.

14 Q. Perhaps you could take us to
15 drawing 18 since you referred to it, and give us
16 your conclusions from an examination of that photo-
17 graph?

18 A. Drawing 18 is entitled
19 "Local Potentiometric Contour Map - Upper Granular
20 Unit, April, 1986." On this map we are looking
21 at the potentiometric surface now and direction
22 of groundwater movement in the upper granular unit
23 which I will remind the Board is a sand and gravel
24 unit that is fairly thin, but of reasonably wide
25 lateral extent on the site although it doesn't cover



1 the whole site. The limits of the zone are shown
2 by the dark line that runs from south of HC 1-85
3 and from there easterly to the vicinity of pump
4 well No. 2, southerly to pump well No. 1 and then
5 it exits the site in the vicinity of Morrison Beatty
6 MB (IN) OW-2.

7 So, we have an aquifer of limited
8 extent. The map is constructed in the same manner
9 as the others and in this case we have four wells
10 constructed within this unit upon which we have
11 drawn the potentiometric contour map.

12 Now, in this case the groundwater
13 moves somewhat to the southeast. Now, it is
14 interesting to note that from this map and as best
15 we can tell, that the pumping of the wells on the
16 west side of the site, the domestic wells which are
17 located potentially within this same unit are not
18 affecting the flow path of this unit. We don't see
19 a swing of the flow lines towards those wells but
20 they are oriented to the southeast of the site and
21 so the pumping of these wells, although they are deriving
22 some of their water, it is not exerting a major
23 influence on that unit.

24 The groundwater gradient within the
25 unit is very low and it seems to be a slow, sluggish



1 system having an average horizontal gradient of
2 .001, again reflecting its encapsulation within
3 the glacial till unit. It has gradients similar
4 to the till itself.

5 Q. Mr. Sobanski, after you have
6 identified the groundwater flows in the bedrock and
7 the groundwater flows in the overburden, are you able
8 to relate those regimes to each other?

9 A. Yes, we are.

10 Q. Could you review with the Board,
11 please, the results of that investigation?

12 A. I would like to refer to Table
13 7. As I mentioned yesterday, Mr. Chairman, groundwater
14 flows in three dimensions and we have been looking
15 at one of them, which is the horizontal component, and
16 by installing the wells in nests as we discussed we
17 can determine and we can get some idea of the vertical
18 distribution of groundwater flow. For that we are
19 looking at the vertical gradients at the site in
20 Table 7 and that is the gradients that would move
21 water in a vertical direction.

22 You will recall a moment ago on
23 drawing 18, there we discussed very low gradients,
24 in the order of .001, and so when we now look at this
25 table we can get some impression of what some recharge



1 can do and the types of gradients we can measure
2 in a recharge situation, and it also shows us that
3 the recharge gradients are significantly greater
4 than the horizontal gradients.

5 On the left-hand side of the table
6 we have geology and the other two columns on the
7 right-hand side indicate the vertical groundwater
8 gradient. Between the fractured and the unfractured
9 upper till, this would be a piezometer installed
10 as a standpipe or rather this would be a standpipe
11 which is measuring the water table and then we
12 would have a piezometer deeper within this unit and
13 now what we are going to measure -- we now the
14 vertical distance between the units and we know the
15 head difference, what the head differential is by
16 measurement, and we can calculate what the gradient
17 is.

18 We can measure the water level here
19 in the standpipe and the water level in the piezometer,
20 and this is the head difference or Δh . The
21 distance over which that head drop occurs, and it is
22 debatable on a piezometer just where it is, but
23 it can be taken as this distance to there and to
24 there and that is Δl , the length through which
25 this water is having to move.



1 So, the head difference over the
2 length difference is the drop in hydraulic head
3 over that section. So, what this table says and
4 when we look at the mean value for the difference
5 between the fractured and unfractured upper till,
6 is that for every foot of depth you go down you
7 lose .3 of a foot in head. So, the driving force
8 in terms of gradient is .34 versus much lower
9 gradients that we saw when we looked at the shallow
10 flow system.

11 The next system we looked at is the
12 hydraulic gradient between the upper till and the
13 upper granular unit which has a mean value of about
14 .28 and similar to the value we measured above.
15 Between the upper granular unit and the bedrock
16 contact the gradient is quite a bit lower, averaging
17 about 0.01. I believe this reflects the higher
18 hydraulic conductivity of the sandy till unit which
19 can move water under a lower gradient.

20 In general on this site we are
21 measuring decreasing hydraulic heads with depth and
22 in general it is a groundwater recharge area. We
23 do have some small upward gradients that were
24 measured locally in the shallow zone around the
25 creek on the west-hand side of the side, HC 2-86,



1 and I am referring to drawing 5, and I apologize
2 but I was thinking of another well. We had a small
3 upward gradient at HC 2-86 located in this field and
4 some local condition probably caused by permeability
5 contrast.

6 We also saw a small upward gradient
7 at HC 4-85 in this area where again we had a small
8 granular gravelly till unit on top of the rock and
9 it may reflect a higher transmissivity between one zone
10 and the other but other than those two small
11 anomalies, basically it is a groundwater recharge
12 area.

13 The vertical gradients exceed,
14 or greatly exceed the horizontal gradients and this
15 indicates there is a greater groundwater flux
16 downwards than there is laterally at this site.

17 For purposes of our calculations
18 and conceptualizations, we have done our calculations
19 using that dominant downward gradient as being
20 generally representative of site conditions.

21 Q. I want to see if I can summarize
22 that. As a result of all this work you determined
23 that the dominant gradient is downward with a few
24 localized areas of upward gradients, but for the
25 purposes of calculation the dominant downward



1 gradient has been the appropriate one to use?

2 A. That is correct.

3 Q. Quite apart from looking at the
4 way water flows, did you do any work to establish
5 the quality of the groundwater and did you do any
6 analysis of groundwater chemistry?

7 A. Yes, we did. We sampled ten
8 observation wells at the site and had these samples
9 analyzed and we did this in order to give us some
10 indication of the background groundwater chemistry
11 in some of the strata at Site D. }

12 The chemical results are documented
13 in Appendix 11 and that would be H39-A.

14 Q. H39-A.

15 A. I apologize, but we seem to
16 have overlooked making an overhead of this informa-
17 tion. To examine the chemical variations in the
18 overburden we prepared chemistry profiles of the
19 anions and cations that are shown in drawings 20 and
20 21. If we look at drawing 20A, for example, we can
21 see on the left-hand side a scale which indicates
22 the depth in metres from which the sample was
23 collected and across the "X" axis of that graph we
24 have plotted the alkalinity of the water, the sulphate
25 and the chloride, all expressed in milligrams per



1 litre. These are the anions, the non-metallic
2 ions, and we can see little logarithmic scales of the
3 concentrations that we found in these -- at the various
4 depths at HC 1-85.

5 In drawing 20B we show the same
6 data for HC 5-85, alkalinity, sulphate and chloride,
7 and we can see some general trends and alkalinity,
8 for example, is decreasing with depth and sulphate
9 is increasing with depth and the chloride is
10 increasing at depth.

11 If I could refer to drawing 21A
12 which is a couple of drawings farther on, we now
13 look at the equivalent of drawing 20A and we are
14 looking now at HC 1-85 again, but now we are
15 looking at the cations, the metallic ions, and
16 on the left-hand side the depth below surface in
17 metres and across the "X" axis we have four graphs
18 that are split up and we have calcium, magnesium,
19 sodium and potassium. In terms of groundwater
20 chemistry, the anions and cations that we are looking
21 at, the calcium, magnesium, sodium and potassium and
22 in anions the alkalinity, sulphate and chloride,
23 usually constitute much of the chemistry of the
24 groundwater samples and these are used for ion
25 balance purposes.



1 Now, in terms of HC 1-85 if I could
2 refer to drawing 21A, we can see that the scale
3 again is the same and it is all in milligrams per
4 litre and the top three have logarithmic scales
5 and the bottom one has a linear scale because the
6 values for potassium are fairly low. We can see
7 from that figure at HC 1-85 there is a decline in
8 calcium concentration within increasing depth and
9 so on for the other wells which were analyzed and we
10 have similar figures for the nests.

11 We also prepared a trilinear drawing
12 which is shown in drawing 19 and this is a Piper
13 diagram and it is not an easy diagram to explain.
14 It has three major fields of plotting. On the right-
15 hand side we are plotting from the little (c) in the
16 very middle over to the (b) on the right-hand side
17 on the bottom of the axis, we are plotting chloride
18 and the percentage of chloride expressed in equivalent
19 parts per million for various samples.

20 On the right-hand side we have
21 sulphate going from zero at the right-hand side
22 of the diagram to 100 per cent at the little (a)
23 and then bicarbonate, the alkalinity, going from the
24 little (a) in the middle on the right-hand side on
25 the graph down to the bottom in the middle of the



1 bottom of the graph.

2 Now, within that field we would take
3 or would calculate the equivalent parts per million
4 of chloride and sodium and bicarbonate and determine
5 their percentages and then plot them on here in terms
6 of in fact a triple type of plot and each one of
7 these points representing the percentage or roughly
8 percentage that each of those samples of bicarbonate,
9 sulphate and chloride.

10 On the right-hand side we do this for
11 the metals, for the calcium and the magnesium,
12 calcium being on the bottom of the graph and
13 magnesium on the left-hand side and on the right-hand
14 side the sodium and potassium.

15 Again, what we are looking at, is
16 we are trying to look for similarities of water
17 and there are then ways of classifying the types
18 of water that we have. For example, if we look
19 at drawing 19 we can see on the anion side dealing
20 with the sulphates and the chlorides and the
21 alkalinity, that most of them are plotting up in
22 an area towards the upper part of the graph and again
23 that little triangle, that darkened triangle being
24 really an individual graph. We can see that most
25 of them if we look along the axis where the sulphate



1 is, we can look at them and say in terms of chloride
2 along the bottom, the chloride percentage is varying
3 from zero to about 40, but the sulphate, however,
4 is in the 60 to 100 per cent range of this sample.

5 This allows us generally, as we will
6 discuss in a moment, to classify this as a sulphate-
7 dominant water and this likely arises from the
8 gypsum that we have identified in the shale which
9 forms part of the crushed material of these glacial
10 tills and so we are dealing with sulphate-type water.

11 There are ways of breaking this
12 into more complicated series of water types,
13 but I won't go into that right now.

14 The fourth field is again -- I am
15 sorry -- the third field, the area between the two
16 bottom triangles, really forms simply -- here we
17 are plotting a whole -- all of them together, all the
18 anions and cations and we are combining them and
19 they are formed by projecting the data from the
20 other two little diagrams to the appropriate point.

21 The main things when we talk about
22 classifying groundwaters, they are done on the anions
23 and cations which are shown in the two bottom triangles.

24 Q. Now, having described to the
25 Board where you find these results, can we



1 break them down into areas. Could you return to
2 page 53 of your report and could you indicate to the
3 Board specifically, and I think this is probably
4 clear, but did you do any work with respect to ground-
5 water chemistry in the upper till?

6 A. Yes, we did. Mr. Chairman,
7 we sampled the shallow, some several shallow over-
8 burden wells which were drilled to a depth of
9 approximately five metres below the ground surface
10 and the results are shown in Appendix 11.

11 Q. Can you indicate to the Board
12 just generally whether you found anything noteworthy
13 in that work.

14 A. We found that in one of the
15 wells we had a high chloride concentration, HC 1, of
16 nearly 1000 milligrams per litre near ground surface.
17 This could reflect road salting practices which may
18 in fact be carried out along the road and we haven't
19 tracked that down, but we had nearly 1000 milligrams
20 per litre of chloride in that well.

21 The Ministry of the Environment
22 drinking water quality criteria for chloride is
23 250 and so this is about 4 times above that. However,
24 for the other wells we sampled, the concentrations
25 were relatively low and we would likely interpret



1 that to be due to road salting.

2 The other thing we did find that
3 was rather interesting were the sulphate concentra-
4 tions and at this relatively shallow depth we found
5 they were variable, but one well gave us a value
6 of 126 milligrams per lite and the other two, one
7 gave us about 2100 milligrams per litre and the
8 other gave us 4540 milligrams per litre. These
9 are very high concentrations for such shallow depths.

10 As a comparison to the Ministry
11 criteria, if we took the average of those values
12 it is around 2000 and the Ministry's drinking
13 water criteria is around 500. The Ministry's
14 criteria is around 500.

15 The significance of sulphate is that
16 you can certainly get used to it, but it has a
17 laxative effect on people if the concentrations
18 are too high and it is similar to Epsom Salts.

19 Now, in terms of the classification
20 of the water, we would classify the water as being
21 sulphate-dominant as we saw on the trilinear plot
22 for those wells.

23 In terms of the cations and hardness,
24 the sodium concentrations were relatively high as
25 well and they varied from 80 milligrams per litre



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1 to 319 milligrams per litre.

2 Now, the province does not have a
3 standard for sodium. However, in their general
4 guidelines they suggest that if the sodium concentra-
5 tion exceeds 20 milligrams per litre in water
6 supplies, one might consult or should consult the
7 Medical Officer of Health. Apparently there is a
8 relationship between sodium and heart disease.

9 DR. KINGHAM: Could you explain to
10 us about Appendix 2 and what the numbers underneath
11 each of the observation wells mean to you? I mean
12 you have 1, 2, 3 and 4 under HC 1-85 and then you
13 have many different results beneath that, different
14 results for sulphate and they differ by a factor
15 of 10. Are they different samples from different
16 depths?

17 MR. SOBANSKI: Yes. Our numbering
18 system, since first of all we number the wells that
19 we are referring to and we could call it any number,
20 but HC 4-85 for example and at that hole, or at
21 that borehole location we will have four wells
22 installed and so if we use as an example HC 5-84, then
23 HC 5-84-1 is the deepest well.

24 DR. KINGHAM: Perhaps you could
25 refer to HC 1-85 and are you saying you put four wells



1 down in that region and then got four different
2 columns of numbers, but how far apart are those
3 wells?

4 MR. SOBANSKI: These wells are located
5 in an area the size of this table.

6 DR. KINGHAM: When you go to sulphate
7 which you were talking about it does not surprise
8 to find 262 and a few feet away it being 2090
9 milligrams per litre?

10 MR. SOBANSKI: These are different
11 depths within the profile and the No. 4 well in our
12 numbering system, the highest number, is the
13 standpipe and the first well we put in -- the reason
14 we call it No. 1 is first we drill the hole right
15 to the bottom, wherever we are going, right to
16 shale, and we examine the stratigraphy and then have
17 to make a fairly rapid decision on where the other
18 observation wells will be installed.

19 The first well drilled is the deepest
20 and this is the one that drills to the bedrock
21 contact and it is labelled as HC 1-85-1. The next
22 well which may be constructed, and I am not sure
23 exactly where this well is, but for argument's sake --
24 15.8 metres? What was No. 1? This is 29.8 metres
25 deep, the No. 1 well. The No. 2 well is 15.8 metres



1 deep and No. 3 well is 9.8 metres deep and No. 4
2 well is 5.5 metres deep.

3 So, what we are looking at here
4 is the chemistry in a well nest and it is from these
5 datas that those profiles we discussed a few
6 moments ago were prepared.

7 MR. LEDERER: Q. What we have looked
8 at...

9 MR. SOBANSKI: A. We were on
10 sodium and let me finish that off if I may.

11 Q. Sorry.

12 A. The other parameter that we
13 looked at was total hardness which ranged from
14 about 560 to 4000 milligrams per litre and this is
15 very high values, high mineralization for a shallow
16 zone. The Ministry has a desirable, and this doesn't
17 affect health, but 4000 milligrams per litre won't
18 allow you to use soap very easily as it destroys
19 soap's characteristics and perhaps it might have taste
20 problems already with it in that you could taste
21 the mineralization.

22 The Ministry sets a maximum desirable
23 or a desirable concentration based on aesthetics of
24 about 500 milligrams per litre and so these waters
25 even at shallow depths are up to 8 times the



1 Ministry's desirable criteria. This sort of thing
2 won't hurt you, people get used to it, but in terms
3 of municipal supplies they would certainly would
4 be concerned about those types of concentrations.

5 Q. Would you tell us now what
6 you found in the lower till, in the deeper observa-
7 tion wells?

8 A. Yes. The next topic is the
9 lower tills which we looked at and these occur at
10 depths of approximately 10 metres below ground
11 surface. Here again we find the high sulphate
12 concentrations and we have gone from five metres and
13 we are down now to the 10 metre depth and we are
14 finding sulphate concentrations varying from about
15 660 to about 4000 again, and this data is shown
16 on page 56.

17 Again, all of the values we found
18 at this depth exceeded the Ministry's aesthetic
19 criteria of 500 milligrams per litre. Now, based
20 on these high sulphates the dominant groundwater
21 hydrochemical faces is the sulphate and this is a
22 sulphate-dominant water. In terms of the major
23 cations we found again that the sodium is relatively
24 high in the 200 to 350 milligram per litre range.

25 In terms of hardness there is an



1 apparent decrease in the water hardness at deeper
2 depths and you will recall that calcium seemed
3 to be dropping off as we went down which was part
4 of the hardness and when we compare this level
5 with the shallower zones there has been an apparent
6 decrease in hardness.

7 Q. Can you take us to the third
8 level which is on page 57 and indicate to the Board
9 what you found at the overburden/bedrock contact
10 zone?

11 A. Again the results are shown
12 in Appendix 11 on pages 57 and 58 which are being
13 referred to. These are wells now that are about --
14 more than 15 metres below ground level, and we are
15 looking at depths of 5 metres and then 10 metres and
16 then in the 15 metre range which is near the overburden/
17 bedrock contact, and, in fact, this is the overburden/
18 bedrock contact but they are 15 metres deep, so we
19 have gone down in about 5 metre increments.

20 In terms of the major anions, we
21 found the chloride was variable and one well had
22 about 100 milligrams per litre, HC 6, and the other
23 two varied from about 390 to about 567 milligrams
24 per litre. The Ministry of the Environment criteria
25 for chloride again is about 250, so these waters



1 can exceed in the shale bedrock, the shale bedrock
2 waters, they exceed the Ministry's drinking water
3 quality criteria.

4 Sulphate concentrations were lower
5 than we had found above in the higher zones, but they
6 were still significantly high. One was at about
7 260 milligrams per litre, which is less than the
8 500 standard, and the others exceeded it and one
9 was about 1100 at HC 5-85 and HC 6-85 was nearly
10 2700 milligrams per litre, so something in the order
11 of 5 times the Ministry's objective for that
12 parameter.

13 The groundwater again is sulphate
14 dominant because of the high sulphate. In terms of
15 the cations...

16 MS. CRONK: Excuse me, but could you
17 indicate what page you are referring to again?

18 MR. SOBANSKI: We are in the vicinity
19 right now of 57 and 58.

20 MS. CRONK: Thank you.

21 MR. SOBANSKI: With respect to the
22 cations, the major cations, again the sodium
23 concentrations are relatively high, being in the
24 200 to 350 milligram per litre range. The hardness
25 varies and it varied from a low of about 326, which



1 is not too bad, fairly normal groundwater, to 1950
2 milligrams per litre at HC 6-85.

3 We found the water to be far more
4 variable and far more difficult to typify in terms
5 of the anions, and on page 58 it says it varies
6 from sodium-dominant to sodium-calcium dominant to
7 calcium-magnesium dominant and so we have a
8 mixed bag of types of water quality in the rock.

9 MR. LEDERER: Q. Now, turning to
10 page 59 of the report, Mr. Beechinor indicated to
11 us yesterday that as part of your chemical analysis
12 you undertook some tritium testing and could you
13 review with the Board again the significance of
14 tritium testing?

15 MR. SOBANSKI: A. I believe
16 Mr. Beechinor gave a good description yesterday and
17 I hope I am not too repetitive, but tritium
18 enters the atmosphere from two sources, and one is
19 natural cosmic radiation affecting the chemicals
20 in the upper atmosphere and producing tritium which
21 is a radioactive isotope of hydrogen, and this is
22 picked up in water, it is soluble in water, and it
23 falls on the land and therefore enters the groundwater
24 flow system.

25 The other source we have are



1 thermonuclear devices that were exploded in the
2 atmosphere in 1952, or commencing in 1952 and
3 more affectionately known I guess as the hydrogen
4 bomb. The normal atomic bombs don't create this
5 kind of a problem. However, with the atomic bombs
6 where we are using hydrogen fusion, we create tritium
7 when the bombs go off. This resulted in a dramatic
8 increase in the tritium levels in the atmosphere
9 and into the hundreds and thousands of tritium
10 units as a result of these tests.

11 Interestingly enough, I haven't
12 followed back on why it was done, but the federal
13 government in Ottawa started doing tritium analysis
14 on rainfall back in about 1952 when the bombs
15 were going off and they have a long-term record on a
16 monthly basis from that time to the present of
17 what the tritium values are for rainfall in Ottawa.

18 Now, before 1952 the background
19 tritium has been estimated by investigators to have
20 been in the 5 to 20 tritium unit range and a tritium
21 unit as we define on page 59 is a relatively small
22 value, it is only one tritium atom in 10^{-18} atoms
23 of hydrogen, and so that is one followed by 18
24 zeroes and they picked out one, and as a matter of
25 fact they can now measure to one in 10^{-19} by special



1 techniques employed in the States.

2 The half-life of tritium is given as
3 12.3 years which means if I have a given tritium
4 concentration of 50, after 12.3 years the tritium
5 concentration will be half of that or 25 and after
6 12.5 more years or 12.3 years it will be down to
7 12.5, and so on down the scale . So, we have to apply
8 this decay factor to tritium as we do for radio-
9 active elements.

10 If we consider the 5 to 20 units as
11 being the tritium in the pre-52 waters, then we
12 would expect to have present concentrations in the
13 order of 2 to 4.

14 Tritium is a conservative tracer
15 according to Cherry and it can be used in groundwater
16 studies, and when I say conservative it is like a
17 chloride ion which enters the groundwater flow
18 system and does not enter into any reactions with
19 the soils and moves freely, so we can use it as a
20 reasonably good tracer to distinguish between pre-
21 52 waters and post-52 waters.

22 For pre-52 waters, the best value
23 that we have from the literature is that it would be
24 around 2.3 tritium units a day and we would have
25 to look back at what other people said for 1952



1 waters or pre-1952 waters and then decay it ourselves
2 to the present time. If I was doing this analysis
3 today, I would be giving you a different value
4 for tritium than we are going to discuss because of
5 this natural radioactive decay factor.

6 DR. KINGHAM: You say it doesn't
7 enter into any reactions with soils?

8 MR. SOBANSKI: Apparently not.

9 DR. KINGHAM: And any reactions with
10 organic materials are not of concern?

11 MR. SOBANSKI: Apparently not and the
12 data we have is that it moves freely, but that is a
13 good question, it being part of the organic complex
14 and the basic building blocks, but apparently, and
15 apparently from what we can gather from the literature
16 it does not complex and it does move. It doesn't
17 seem to be grabbed by the carbon type molecules.

18 MR. LEDERER: Q. Can you take us
19 to drawing 22 and review with the Board what
20 you discovered with respect to your tritium
21 analysis at Site D? I might just say that the
22 narrative, if you like, of this evidence is at page
23 61 of the report.

24 THE CHAIRMAN: 61?

25 MR. LEDERER: 61.



1 MR. SOBANSKI: For this work we
2 constructed a special nest of wells identified
3 on drawing 5, location of drilling sites and
4 observation wells, and these wells are near pump well
5 No. 1, roughly in the middle of the site. They are
6 constructed by special techniques. You have to be
7 concerned that you may contaminate these wells with
8 present surface waters which contain higher tritium
9 values than the tritium values we were looking for.

10 Our current tritium is in the range
11 of about 40 tritium units or so, 40 to 50, it varies.
12 So, when we construct these wells we want to make
13 sure we don't contaminate them as we drill them and
14 so they must be very carefully constructed and even
15 then we could run into some problems with them, but
16 you pick dry periods to construct these wells and
17 we drill them with hollow-stem augers and we
18 construct the wells as piezometers in a conventional
19 manner with one exception.

20 We construct them with bentonite
21 seals, the swelling clay we use, and we fill the hole
22 from top to bottom with bentonite to absorb any
23 waters we might have moved which would allow potential
24 for water to trickle down the hole and then the
25 wells are carefully developed and are flushed



1 several times and finally they are sampled and even
2 the samples have to be handled very carefully in that
3 even fluourescent lighting might affect some of these
4 parameters.

5 So, they are handled carefully and
6 then they were sent off in this case to the United
7 States where they were able to detect tritium at
8 lower levels than we are by special concentration
9 techniques.

10 If we look at the results of the
11 tritium profiles here, our base mark for tritium
12 used in this report is going to be 2.3 tritium
13 units as being representative of pre-1952 waters.
14 At a depth of about 3 metres in the hole we find a
15 concentration of about 15.7 tritium units which is
16 well above the background concentration that we are
17 looking for of 2.3. At a depth of 4 metres it is
18 16.1 tritium units, again well above the background
19 we are looking for. At about 6 metres we are into
20 a questionable area as to whether or not this is
21 affected by post-1952 waters. Using the strict
22 criteria of 2.3 it is, but given uncertainties we
23 can't be sure that that isn't pre-1952 waters.
24 Below that, however, we come into much lower values
25 and I will refer to my notes on that if I may.



1 As we get below a depth of about
2 5 metres we get into values of which are lower than
3 the value we are looking for and indeed at a depth
4 of about 12 metres we are as low as 0.2 at a depth
5 of 16 metres which is representative of the lower
6 granular unit, we are at .18 tritium units and this
7 indicates that post-52 waters have not reached the
8 lower granular unit and in fact they have come down
9 perhaps into the 5 metre depth range according to the
10 tritium profile.

11 The differences between having a
12 low value and a high value, or a higher value at
13 two locations is perhaps not surprising because
14 more than likely even the background tritium at some
15 time had some variations within it.

16 So, the lower granular unit, conclud-
17 ing on this, the lower granular unit contains post-
18 1952 waters. The upper granular unit we didn't
19 measure, but it is in the general range of these
20 units which contain about 2 tritium units and about
21 .02 tritium units, so it likely also contains the
22 pre-1952 waters.

23 Q. Now, Mr. Sobanski, what did
24 you use this for in the context of this study?

25 A. It assists us in a couple of



1 things. No. 1, we can look at our groundwater
2 velocities as to whether they are realistic and
3 frequently it is an issue as whether glacial tills
4 are solid or whether they are fractured and if
5 glacial tills are fractured, groundwater velocities
6 through fractures are higher than through the matrix
7 and consequently we could get leachate, for example,
8 from the landfill moving to the upper and lower
9 granular units by some unknown pathway. So, we
10 use tritium to give us an indication of whether or
11 not we have fairly recent waters in here, in the lower
12 units. This assists us in verifying our vertical
13 groundwater velocities to a certain degree.

14 The second thing that we have used
15 it for in the report, and incidentally we did
16 conclude that the medium is not fractured down to
17 those units on the basis of this information, but
18 the other thing that we have used it for in the
19 report is to give us an estimate of the hydraulic
20 conductivity of the upper till unit.

21 Q. How did you calculate
22 the hydraulic conductivity?

23 A. It requires some assumptions
24 and this is shown on pages 62 and 63. We start with
25 the general Darcy relationship here which in this



1 case is the velocity relationship which has been
2 reorganized for us to calculate permeability, and
3 we now make some assumptions to see whether or not
4 the assumptions we have made to date that this material
5 has the permeability of 1×10^{-5} centimetres per
6 second and an effective porosity of 0.001 and whether
7 that holds. Here we have put in the effective
8 porosity of .25 which is the assumed porosity for
9 the unweathered zone and we use the measured vertical
10 gradients and we have used the average linear
11 velocity that would take the tritium down about five
12 feet -- five metres rather, so that is 33 years or
13 so have passed and we can multiply and divide that
14 through and we would come up with an average ground-
15 water velocity of 5×10^{-7} and we put that into the
16 equation and came up with a hydraulic conductivity of 3×10^{-7}
17 centimetres per second and this is only about a half
18 an order of magnitude higher than what we have
19 measured in the unweathered zone and not the two
20 or three orders of magnitude higher than previously
21 estimated. This gave us an indication that the
22 effective porosity of the weathered till may be
23 similar to the unweathered till.

24 Q. Did you consider whether or
25 not all of this was open to some alternate



1 interpretation?

2 A. Yes, I have. I reflect on these
3 reports daily as I come to a hearing and there is
4 an alternative interpretation and that would be
5 that the weathered zone is thinner.

6 Now, the type of interpretation we
7 have looked at so far says that the two units, the
8 weathered and unweathered here, and we have by
9 claculation have said that if we make those assumptions
10 of porosity and permeability it would move to a
11 point there as shown by our tritium profiles. An
12 alternative interpretation would be that the
13 weathered zone we have assumed is in fact a little
14 thinner and that the weathered zones occurs up here,
15 about a metre and a half higher or 1.2 metres higher,
16 and now what you can do is generate the same tritium
17 profile by very rapidly moving tritiated water
18 to this new interface which is solid till and then
19 allowing the tritium to move downward by normal
20 slow groundwater velocity, which over the 30-some
21 year period that we had between '52 and the present,
22 or at least the preparation of the report, it could
23 have moved about 1.2 metres and this would be an
24 alternative interpretation to the data.

25 That would then indicate that what



1 we have said for the upper unit of 10^{-5} centimetres
2 per second and the low effective porosity would
3 still hold.

4 Q. Assuming for the moment the
5 alternate interpretation, what impact does that
6 have on your interpretation and conclusions?

7 A. It wouldn't have any impact
8 because in any case in the report we have assumed
9 the worst case would be weathered upper till of
10 10^{-5} centimetres per second and an effective porosity
11 of .001.

12 Q. Having looked at the direction
13 of the water and having looked at the quality of the
14 water, can you indicate to the Board whether you
15 would do any work with respect to the quantity of
16 the water and did you look at water balances?

17 A. Yes, we did.

18 MR. LEDERER: Mr. Chairman, you will
19 find this on page 64 or beginning on page 64 of the
20 report.

21 THE CHAIRMAN: Might this be a good
22 breaking point?

23 MR. LEDERER: As good as any other,
24 I can think of, sir, yes.

25 DR. KINGHAM: As we do, you used the



1 words "margin of safety" on page 63 and you have
2 just been telling us in this last minute you arrived
3 at the 1×10^{-5} centimetres per second and an
4 effective porosity of .001, but these things all
5 relate to what you said in terms of your calculation
6 of 5×10^{-7} and in fact you have allowed a factor
7 of 20 and is that what all that means?

8 MR. SOBANSKI: Yes, but even in the
9 reinterpretation you keep the same assumptions,
10 that it is potentially a contaminant transport
11 route and the calculations are based on that premise,
12 that it is a contaminant transport route of higher
13 permeability than the massive till and also with a
14 higher groundwater velocity in the massive till.

15 DR. KINGHAM: Thank you.

16 ---Recess

17 THE CHAIRMAN: Please be seated.

18 Mr. Lederer?

19 MR. LEDERER: If I could just have
20 a moment, Mr. Chairman.

21 Q. Mr. Sobanski, I think I would
22 like to stop for a moment and have you explain to the
23 Board what it is the study is attempting to do and to
24 take us slowly through the steps of the study,
25 starting at the beginning and taking us through to the



1 end. First of all, what are you trying to determine,
2 looking at the study as a whole?

3 MR. SOBANSKI: A. On the whole we
4 are trying to determine what impact landfilling on
5 this site would have on the aquatic environment.

6 Q. Are you trying to determine
7 how any contaminants from a prospective landfill
8 site will flow in water?

9 A. Yes. The report, and I have
10 tried to write reports that sort of tell a story if
11 possible and follow some sort of a logical progress-
12 ion. When we start these studies we talk about
13 the screening process that brings us to the selection
14 of sites for detailed study. At this stage we want
15 to now look at the geology of the site in detail;
16 the geology which is key to the hydrogeology of the
17 site. We now make measurements of the various
18 geologic units and, in that manner, we try to define
19 the hydrostratigraphy. How is groundwater going
20 to move within the geology, the framework of geology
21 that we have defined for the site?

22 The next step, and the steps aren't
23 necessarily all sequential, but we want to look at
24 the quality of the water and what we are going to
25 possibly be putting the leachate into. We have then



1 done some work discussing -- from the hydrogeologic --
2 from the hydrostratigraphic framework we have defined
3 now which directions groundwater are moving and
4 we are working also on how fast they are moving
5 so that we can see what impacts landfilling would
6 have on the various units, but how are they moving and
7 which ones must we be concerned about? Are any of
8 them important or are they all unimportant? How
9 do they tie into the regional wells in the event
10 that leachate enters the natural environment?

11 So, we have looked to the chemistry
12 which we have talked about and as I mentioned how
13 is that going to be affected and do we have good
14 chemistry on the site or bad chemistry on the site?
15 What impacts are we going to have from that point
16 of view?

17 We have gone through the tritium, a
18 relatively new area in hydrogeology, and we have used
19 it as a potential method of looking at our calculations of
20 velocity and our feelings for the hydrostratigraphic
21 units, but are they reasonable or are they fractured
22 or unfractured and are groundwater velocities pretty
23 much the way we predict? That pretty well brings
24 us up to the stage we are at now in discussing the
25 progression towards ultimately defining how this site



1 is going to affect or might affect water resources.

2 Q. So, we know now what the
3 geology is and from that we know what the hydro-
4 stratigraphy is and we know now from that generally
5 the directions in which water flows at this
6 prospective site, and we also know -- we have confirmed
7 that in some way with this new technique of tritium
8 analysis and we have done some work to assess the
9 quality of the water we are dealing with and to which
10 we are going to add whatever contaminants arise from
11 this site. Where do we go from here?

12 A. The next thing we want to look
13 at is a water balance for the site. We now want
14 to come up with some idea of how much water is
15 moving in the various parts of the hydrologic
16 cycle and how much contaminated water we might have
17 to deal with at this site.

18 Q. Let's look at the issue of how
19 much water we may have to deal with. Can you indicate
20 to the Board please what -- first of all, what
21 is a water balance and let's start with that.

22 A. The equation for the water
23 balance is shown on page 64. When we drew our little
24 hydrogeology map the other day of what a water table
25 looked like, the hydrologic cycle was shown on that



1 drawing, the features we have to be concerned
2 with. The equation says that precipitation which
3 falls on land goes to four possible sources and one
4 is to evapotranspiration and evaporation, and that
5 is the use by the plants, so just evaporation from the
6 water surface or from the land surface and the second
7 is runoff, as a portion of it runs off to streams,
8 and then we have a groundwater recharge factor,
9 how much moves into the subsurface and, finally, we
10 have what we call a change in storage.

11 If you look at pumpage in the short-
12 term or water reservoirs or lakes in the short-term,
13 there can be changes in storage and in the long-term when
14 we look at in terms of 10 to 20 years, we would
15 normally exclude that factor because things tend
16 to even out in the hydrologic cycle. To work
17 with this equation we have collected climatological
18 data and this is a term obtained from environmental...

19 Q. Can I interrupt you to see if
20 I understand this properly. A water balance is
21 basically what happens to the rain that falls in an
22 area?

23 A. Precisely.

24 Q. Would I also be correct that
25 the figure that interests you most here is the figure



1 for groundwater recharge and you want to know how
2 much water will enter into a prospective landfill?

3 A. That is correct.

4 Q. Can you review with the Board
5 what you do to calculate the water balance and what
6 you did here?

7 A. I started into the climatological
8 data which we got from Environment Canada, and here
9 we have used the annual norms of precipitation and
10 evapotranspiration that Environment Canada developed,
11 and it is based on a 10-year average and reported
12 in Appendix 6.

13 From that data we find for the Milton
14 area, page 64 where you see an average of 953
15 millimetres of precipitation which falls in the
16 area, of which about 512 millimetres is returned to
17 the atmosphere by evapotranspiration. Since we are
18 using long-term averages, we ignore the delta S term,
19 the storage changes, and we are looking at this over
20 a period of years and considering there won't be
21 changes in groundwater storage for example.

22 The groundwater recharge and the
23 surface runoff amount then to the difference between
24 the precipitation and the evapotranspiration, which
25 means that we have accounted for 512 millimetres of



1 of the rainfall so far and now we have to account
2 for the remaining 444 millimetres, what occurs to
3 it, the two totalling the original rainfall of about
4 953 millimetres.

5 I see a typo there, I think that
6 should be 956 according to the calculation I do at
7 the bottom; in the second last paragraph on page 64,
8 that should be 956.

9 So, we will now try and break out
10 how much goes to surface water and how much goes
11 to groundwater. There are different ways of doing this,
12 but doing a water budget is not exact and what
13 we have done in this case is we are going to look
14 at the groundwater flux and we will take that hydro-
15 stratigraphy we defined and we can now calculate
16 flow rates through the various units and we are going to
17 find out how much water we can put into this hydro-
18 geologic stratigraphy.

19 I would like to refer to Figure 3
20 which is a schematic of our water balance and if
21 I could, if you could look at this figure I would
22 like to catch a couple of typos. The balance is okay
23 but there are a couple of typos in it which we did
24 not pick up.

25 Now, the second Qv you see, that



1 should be .178 as opposed to .180. The third value
2 of Qv of .178 should be .176 and, finally, the next
3 Qv which is .176 should be .135, and it doesn't
4 affect the overall balance, it crept into the process
5 somehow.

6 To describe this figure, we have our
7 main hydrostratigraphic units as being the weathered
8 upper limit or the weathered zone in the upper till,
9 we have the upper till, the lower till, the upper
10 granular unit, the lower granular unit and, finally,
11 the bedrock. Now, using a rough area for the
12 potential landfill being the proper area to look at
13 and routing the water down using Darcy's Law, which
14 is $Q=KIA$; Q being quantity, K being hydraulic
15 conductivity and I being the gradient both horizontal
16 and vertical which are being considered here, and
17 A being the area on which the water falls.

18 What we are looking at is how much
19 water moves vertically downwards through the section
20 under the existing vertical gradients, how much water
21 moves laterally under the existing horizontal
22 gradients. So, a certain amount of infiltration
23 comes in at the top and some is siphoned off through
24 the weathered zone and more goes through the base
25 of the weathered unit into the massive unit and some



1 more is siphoned off through the massive unit and so
2 on down the section and with each unit taking a
3 piece of the water away to the environment and
4 ultimately we come down to calculating how much is
5 getting down through the overburden into the bedrock.

6 We talked about this difference
7 in vertical and horizontal gradients and the main
8 flux we thought would be downward, but when we balance
9 out these numbers, what they say is that the re-
10 charge rate to satisfy this groundwater flow
11 system is about 9.6 millimetres which actually gets in
12 and starts into that zone and arriving at the
13 rock we still have quite a bit of that water left,
14 about 70 per cent of it, and it is 6.9 millimetres.
15 9 millimetres is relatively low and these soils are
16 certainly relatively impermeable.

17 So, we now come back into our water
18 balance having used this method and we come up with an
19 infiltration rate through the units and we have
20 now defined our groundwater recharge term as being
21 about 10 millimetres per year. We now subtract that
22 from the 444 that we started with and we have 434
23 which we now attribute to surface runoff. So, the
24 balance ends up as is shown at the bottom of page
25 67 and we start with our precipitation of 956



1 millimetres...

2 Q. Page 67?

3 A. 65, I am sorry, page 65.

4 We start with our precipitation of 956 millimetres
5 and we assumed the change at the bottom is zero and
6 we can ignore that, so precipitation goes to three
7 places essentially and a large portion of it, over
8 half of it is evapotranspired and goes back into the
9 atmosphere by evaporation process and plant processes,
10 living plants, 512 millimetres. Surface runoff on
11 these tight clay soils is relatively high at 434
12 millimetres per year and it amounts to nearly half
13 of the precipitation that falls on the land and final-
14 ly the groundwater recharge rate is relatively low
15 in these tight soils at about 10 millimetres per year.

16 Q. Now we have the general direction
17 of flow and the quality of the water and the quantity.
18 Can you indicate to the Board whether or not at this
19 stage you are ready to investigate the actual migra-
20 tion of contaminants?

21 A. Yes, we are.

22 Q. Can you review with the Board
23 what mechanisms there are in nature that may affect
24 the migration of contaminants in leachate coming from
25 some prospective site, landfill site?



1 A. There are quite a few factors
2 involved in this. If we look at the transport
3 mechanisms, we would talk in terms of advection,
4 we will talk in terms of diffusion, we will talk
5 in terms of dispersion and those are the three
6 mechanisms which will move contaminants into the
7 environment. There are numerous mechanisms that
8 counteract these forces which are trying to move
9 contaminants and the main one we are going to consider
10 in our calculations is adsorption.

11 There are other contaminant
12 attenuation mechanisms which potentially defy
13 calculation, but these are essentially the mechanisms
14 associated with bacterial degradation of various
15 organics and also inter-reactions, chemical inter-
16 reactions between the various chemical species within
17 leachate.

18 So, if we consider briefly advection,
19 advection can be described as the movement of
20 contaminants due to the velocity of groundwater
21 itself.

22 Table 10, which is found on page
23 88, provides us with a summary of the linear ground-
24 water velocities calculated for these units. If I
25 might, as I go, I hope I can pick up a few of the



1 typos. If we could take the per cent out of effective
2 porosity on the tables, just scratch that out because
3 this is not a percentage, its the percentage expressed
4 as a faction of one and so .25 is 25 per cent and
5 so if we could just take out the value of per cent.

6 The system we are looking at now
7 is to look at the types of groundwater velocities
8 we have in these various units and we are looking
9 then as advection as our final stopping point in this
10 discussion. There we assume there is no leachate
11 collection system in operation and that we dig a
12 hole and put the garbage into the ground and we
13 generate leachate and what happens to it in the
14 groundwater flow systems.

15 Across the top we have the hydro-
16 stratigraphic unit we are considering; we have which
17 direction the groundwater flow will occur in, its
18 dominant direction and this could effect off-site
19 uses; then the hydraulic conductivity for the unit
20 which we have described in some detail ; the
21 hydraulic gradient is in the next column, the slope
22 on the water table, vertical or horizontal; the
23 effective porosity which we discussed yesterday as
24 well and, finally, the linear groundwater velocity
25 both in centimetres per second and in metres per year.



1 The linear groundwater velocities
2 are calculated from these other three factors and
3 it is determined by multiplying hydraulic conductivity
4 times the gradient and dividing by the effective
5 porosity. That results then in the linear groundwater
6 velocity in centimetres per second and then we
7 multiply that by the number of seconds in a year and
8 multiply the centimetres to convert it to metres and
9 come up with the right-hand side, the linear ground-
10 water velocity in metres per year.

11 In terms of the weathered upper till,
12 our concern would be lateral migration out from the
13 landfill through this more permeable zone at the top
14 of the site and near the property boundaries. The
15 hydraulic conductivity was 10^{-5} centimetres per
16 second, the mean hydraulic gradient was .004 and the
17 effective porosity was a fracture of porosity of
18 .001 and this results in a linear groundwater
19 velocity of about 13 metres per year.

8A 20 In terms of the upper weathered till,
21 we are concerned here that leachate generated at the
22 bottom of the site will move downward through the
23 upper till towards the granular units which serve
24 as a source of water supply for some residents in the area
25 and here we will now calculate the downward movement



1 through that zone, its velocity, and after applying
2 the various factors we come up with a linear ground-
3 water velocity of 0.09 metres per year, a
4 relatively low velocity in this material because
5 of its low permeability.

6 We then move through the upper
7 reaches of the lower till unit, which is now a sandy
8 silt unit, and we are going to route the contaminants
9 downward through that zone in terms of how quickly
10 would it move if contaminants were to arrive at the
11 top of the lower till, how long would it take to reach
12 the granular units? We have a linear ground-
13 water velocity relatively low at 0.08 metres per
14 year.

15 In the granular units we are going
16 to change direction and the contaminants which
17 arrive at the groundwater units, we are not worried about
18 how they will move laterally to landfill boundaries
19 and so we calculate horizontal movement in this unit
20 and the vertical movement would be relatively rapid
21 because they are fairly thin, and the lateral move-
22 ment would take it off the site at about 8.4 metres
23 per year.

24 Finally, we look at the water through
25 the lower units of the till at .03 metres per year



1 because there is a reduction of hydraulic gradient
2 below the granular units...

3 Q. I am sorry, but you are blocking
4 the last column.

5 A. I am sorry. Finally in the
6 shale bedrock the lateral movement to the site
7 boundary is considered and we use a fractured medium
8 and we are concerned with lateral flow and we are
9 now talking about linear velocities of about 3.2
10 metres per year.

11 Q. Can I summarize this by saying
12 that the first contaminant migration mechanism that
13 you have investigated is advection which is a
14 function of groundwater velocity?

15 A. That is correct.

16 Q. And you have assessed the values
17 you have presented to the Board in Table 10?

18 A. That is correct.

19 Q. I believe you mentioned the
20 next mechanism was diffusion and could you
21 indicate to the Board please what diffusion is
22 and then what your considerations were with respect
23 to this site with regard to that mechanism?

24 A. Diffusion is the movement of
25 contaminants by concentration gradients. Now, we are



1 not talking about it moving along with the ground-
2 water, we are talking about the possibility of move-
3 ment of a highly concentrated solute with high
4 checmial -- many species that have high chemical
5 concentrations and diffusing them by molecular
6 diffusion to a less concentrated area, a concept
7 as we all recall of the ideal gas laws where if one
8 or two are mixed together they are fairly uniform,
9 so the concentration wants to be more uniform.

10 Q. Let's try that on a simpler
11 plane.

12 DR. KINGHAM: You are talking about
13 entry.

14 MR. LEDERER: I am close to being
15 lost here.

16 Q. Am I right that what we are
17 talking about here is not talking about the contaminants
18 flowing within the water as a leaf does along a
19 stream, but rather the natural occurrence of more
20 concentrated elements to move into areas where there
21 is less concentration.

22 MR. SOBANSKI: A. That's correct.

23 Q. Like we know that things rush
24 to fill a vacuum?

25 A. Something in that order or



1 putting a drop of dye in a bucket and it will spread
2 through if you give it enough time and this is
3 another force. It is only important where soils --
4 where we are dealing with very low velocities and it
5 can be a significant factor in clays, for example,
6 Mr. Lederer, in truly clayey materials and
7 usually it is important where the groundwater
8 velocities are in the range of several centimetres
9 per year or less.

10 DR. KINGHAM: Would you say a
11 useful analogy would be a bit of perfume in a room?

12 MR. SOBANSKI: That's a good
13 analogy; it permeates the room. This has been an
14 important factor in the consideration of some sites
15 in clay areas. Here we did not measure diffusion,
16 a diffusion/coefficient at the site and the types
17 of materials we did not feel would warrant it or
18 that the velocities would be high enough that the
19 advective forces would prevail, and so we used
20 past studies that had been done in Ontario and they
21 vary within a fairly narrow range and, based on
22 studies by Desaulniers we have used or assumed
23 an effective diffusion coefficient of 6×10^{-6}
24 centimetres squared per second for the upper till
25 at Site D.



1 MR. LEDERER: Q. Are we ready for
2 the third mechanism which I understand is dispersion,
3 and can you indicate to the Board please what
4 dispersion is and how that functions in nature?

5 A. There are more detailed write-
6 ups in the report and I am trying to just sort of
7 synopsise this. Dispersion is the spreading of
8 contaminants due to inhomogeneities in geologic
9 materials and they occur both laterally and vertically
10 and it is a tortuosity effect of the various
11 channels which connect the pore spaces within the
12 porous media which tend to allow it to spread a
13 bit laterally and a bit vertically.

14 This tends, or the value tends
15 to increase with the increase in contaminant
16 transport distance. There isn't a good basis
17 for assessing and evaluating this factor, and the
18 laboratory cases and field cases, I understand
19 from my discussions from people who work with it,
20 don't often match. However, we have attempted to
21 take it into account and it can vary from values,
22 as shown in the report, of 5 to 50 per cent of the
23 transported distance.

24 So, for this assessment we have
25 assumed values of dispersivity of 5 per cent for the



1 upper till where the velocities are relatively low,
2 10 per cent for the granular units and 30 per cent
3 for the bedrock.

4 The 10 per cent refers really to the
5 linear distance that a material moves. If I move
6 a material -- if I were to move a contaminant 100
7 metres through the upper till, I would apply a 5
8 per cent factor to that and that becomes 5 metres
9 and that would be input into an equation later on in
10 the analysis which would help us define how a contaminant
11 front moves and spreads.

12 Q. Dispersion is really the
13 spreading of the contaminant as it moves along?

14 A. It is the spreading of the
15 contaminant at the contaminant front.

16 MR. ESTRIN: I am sorry, but the
17 witness mentioned under diffusion he assumed a certain
18 number under his dispersivity I had another number but
19 I don't see these numbers specifically in the report,
20 but perhaps they are in an appendix?

21 MR. SOBANSKI: Page 89.

22 MR. LEDERER: It is a bit easier
23 to understand if you realize that the way in which
24 the report is drafted, it is to define these terms
25 generally and then to go through them with respect



1 to this site and we are really combining two parts
2 of the report and we are defining and giving the
3 values at the same time.

4 Q. I understood you a few minutes
5 ago, Mr. Sobanski, you indicated that quite apart
6 from transportation mechanisms, mechanisms that move
7 contaminants, there are also attenuation mechanisms
8 and you mentioned one as adsorption and is that a
9 factor here?

10 A. It is.

11 Q. Can you define for the Board
12 what adsorption is and how does it function in
13 nature?

14 A. It is a process by which
15 contaminants can be removed from the groundwater
16 and bound on to the surfaces of soil and rock
17 particles. At this site, the adsorption will
18 generally be a significant attenuation mechanism for
19 the inorganics where the geologic strata have a
20 sufficient cation exchange capacity and where the
21 pH of the groundwater is 6 to 7 or higher.

22 Q. Let's go slowly. We are talking
23 about inorganics and what is the cation exchange
24 capacity?



1 A. The cation exchange capacity
2 is a measure of the ability of soils to remove metals
3 from a solute.

4 Q. Did you examine the cation
5 exchange capacity in the upper till here and in the
6 bedrock?

7 A. Yes, we did. The results of
8 the cation exchange capacity are shown in Appendix
9 3. For the upper till we measure a cation exchange
10 capacity in milliequivalents per 100 grams of about
11 40 to 45. This would be considered to be a good
12 attenuation capacity, or a high cation exchange capa-
13 city. One can see as we move from the materials that
14 contain the finer grained soils, the clays, that--
15 and come into the granular units, that the cation
16 exchange capacity is quite a bit lower, only about
17 5 milliequivalents. The lower till has a cation
18 exchange capacity in the order of perhaps averaging
19 about 35 milliequivalents and these are relatively
20 high values. The shale bedrock was also tested
21 and has a cation exchange capacity of 65 milli-
22 equivalents per 100 grams.

23 Q. You said, if I understood you
24 correctly, that another way of assessing adsorption
25 potential is by looking at the pH of the water?



1 A. Yes.

2 Q. Did you do that here?

3 A. Yes. We have looked at the
4 carbonate mineral content here to assess what
5 effects this might have on leachate migration.
6 Carbon dioxide is one of the many gases produced
7 in a landfill and precipitation absorbs carbon
8 dioxide and creates a weak acid. This acidity can
9 mobilize heavy metals if the acidity exceeds something
10 in the order of about 5 or so, 5 or 4 as the acidity
11 gets lower and heavy metals start to mobilize and
12 there is a curve shown in here for the effect of pH
13 on some of the metal mobilities.

14 In Ontario we are sort of -- we are
15 not sort of -- but we are blessed in terms of the
16 soils we have and it has to do with the question of
17 acid rain where our lakes in the southern area, the
18 southern lakes aren't affected as much by acid rain
19 because pH is neutralized by our limey soils,
20 the limestones and dolomites that occur naturally in
21 our southern areas, but in the north where we get out of
22 these areas and where our lakes are being damaged
23 by acid rain, and this is an analogy and it is the
24 same for leachate.

25 We mix these soils with the garbage



1 and we can actually provide an attenuating mechanism
2 in that if soils contain carbonate materials,
3 calcite and dolomite, these will neutralize the
4 acids formed within the landfill leachate. That
5 occurs not only in soils we mix with the materials
6 as cover, but also as it starts to move into the
7 lower zones and the fact that we have relatively
8 high carbonates in Ontario accounts for I believe
9 one of the good reasons we seldom find heavy metals
10 contaminant migration from our landfills.

11 Here is the carbonate mineral
12 content at Site D and measured in various soil samples.
13 The upper till contains a total by weight of
14 roughly 20 to 30 per cent of carbonate minerals.
15 The lower till is about 24 per cent and the shale
16 bedrock is about 25 per cent, roughly the same
17 amount as the overlying till. That means that these
18 soils indeed have a lot of carbonate material which
19 in terms of attenuation neutralizes the acidic
20 solutions that a landfill would generate.

21 Q. So pH is a function of the
22 measure of the acidity of the water?

23 A. Yes. pH is a measure of the
24 acidity of the water.

25 Q. These figures indicate the



1 ability of the waters to maintain or the soils to
2 maintain a high enough level of acidity to assist
3 in attenuation?

4 A. Yes, it isn't a direct measure-
5 ment that is used, it is an analysis of the soils to
6 see whether they have this capability.

7 Q. Looking at what you found about
8 cation exchange capacity... perhaps I had better
9 come at the question another way. Given what
10 you have found about cation exchange capacity and
11 about the acidic measures in these soils, were you
12 able to draw any conclusions about the ability of these
13 soils to attenuate inorganic contaminants?

14 A. We feel that these soils have
15 large neutralization capacity. They comprise a
16 very large proportion of carbonate minerals and we
17 believe this would encourage the adsorption of the
18 inorganic contaminants and would help neutralize
19 any acidic leachates which are formed.

20 Q. Did you also examine the
21 ability of these soils through adsorption to attenuate
22 organic contaminants?

23 A. If we could refer to Appendix
24 3, the adsorption of the organic contaminants will
25 be related to the amount of organic carbon material



1 present in the soils and we measured the organic
2 carbon contents of soils which are shown on page 91
3 with a description in words, and -- this is from
4 Appendix 3 of the second volume of the report and
5 this is shown among the various soil analyses.

6 Organic carbon is referred to as the per cent on a dry
7 weight basis, and it is called FOC as well in the
8 report which I believe refers to fraction-organic
9 carbon. For the upper till, the values range from
10 a low of .06 to a high of .54 and for the lower
11 granular unit they are quite low at .03 and in the
12 lower till they are relatively high, in the .29 to
13 .64 range.

14 Finally in the shale bedrock itself
15 we have some organic carbon which is at a value of
16 .18. When we look at the adsorption in general,
17 considering the factors, the two factors we have
18 looked at, the cation exchange capacity and the
19 organic carbon content of these materials, we should
20 have good adsorption capacity for inorganics and
21 organics in the till and bedrock. They have high CDC's
22 and fairly high organic carbon contents and we would
23 expect to have low adsorption of organics and in-
24 organics in the granular units. These have low
25 CDC's and low organic carbon contents.



1 Q. If I can just summarize that,
2 adsorption of organic contaminants is a function
3 of the total organic carbon content?

4 A. Yes.

5 Q. You have measured that and your
6 conclusion is in the tills the attenuation will be
7 good but in the granular units lower?

8 A. That is correct, yes.

9 Q. With these mechanisms analyzed,
10 did you evaluate the migration of contaminants at
11 Site D?

12 A. Yes, we did. As a starting
13 point we first evaluated the potential contaminant
14 migration at Site D without a leachate collection
15 system in place. We used an accepted equation
16 developed by Ogata-Banks which considers the effects
17 of the migration mechanisms we have talked about,
18 which are advection, dispersion and diffusion, and
19 it also considers attenuation due to adsorption.

20 The equation is shown on page 92,
21 and this is not page 92, so if we could again pick
22 up a couple of typos, there is equation 10 and the
23 "r" shown in your book should be an "n". This is
24 equation 10 on page 92.

25 MR. ESTRIN: Which "r"?



1 MR. SOBANSKI: The little "r" should
2 be a little "n" and on the bottom, equation 11, the
3 capital "K" should be a capital "R". Now, this
4 equation ...

5 MRS. TANNER: There are two little
6 "r's" and are you talking about the "r" in the first
7 line.

8 MR. SOBANSKI: Equation 10 and they
9 are numbered on the right-hand side. So, the little
10 "r" should be a little "n" and in equation 11 the
11 capital "K" should be a capital "R". I can also
12 hear some comments going on and I am advised that
13 the small "v" shown on the equation should in fact
14 be a large "V".

15 MR. McQUAID: Equation 11?

16 MR. SOBANSKI: Equation 11.
17 So, here we have what appears to be a fairly complica-
18 ted equation and these values will be input. We use
19 a computer obviously to solve the equation. It is
20 not really extremely complicated, it looks that
21 way and it can be done on a Vik-20. I have a hand
22 calculator that can do it, for the problem-solving
23 for this complementary error function which is
24 really just an area under a curve. What this
25 equation is solving for is a term called "C" over



1 "Co" and "C" over "Co" is the relative concentration
2 as it says here at distance "x" and time "t".
3 This is the concentration and it is expressed as
4 a fraction of one and it is a fraction of what the
5 original concentration was within a contaminating
6 unit.

7 If I can explain, you have a landfill
8 cell with a contaminant concentration in here of
9 "Co" and we will now solve this equation a whole
10 bunch of times to develop some curves and see how
11 that contamination moves with respect to time.

12 MR. LEDERER: Q. To make it clear,
13 what does "Co" stand for?

14 A. That's the initial concentration
15 of anything within the landfill cell. As an example
16 we will see in here for chloride we are using the
17 value of about 1500 parts per million, but this varies
18 and you must remember that this concentration can
19 vary, it is a relative thing, and it could be one part
20 permillion of something. It is a concentration, a
21 starting point concentration that you have to
22 consider. We are not going to calculate the
23 relationship that occurs at various distances with
24 various times and we are going to come up with a
25 total curve which comes out of the upper till unit.



1 We are going to look at how this material fluxes
2 through the unit. I am getting a little ahead of
3 myself, but let's come back to "C" over "Co". If
4 we have "C" over "Co" and the value is equal to
5 0.1...

6 Q. Again to be clear, what does
7 "C" stand for?

8 A. This is the relative concentration
9 and I will describe that right now. It is described
10 as "C" over "Co" as being .1 and that means that it is
11 .1 of the original value, and that would equate to
12 a concentration of 150 milligrams per litre if
13 we put a concentration in.

14 "C" is the concentration of the
15 contaminant at a point and "Co" was the original
16 concentration that we started with somewhere at the
17 source.

18 Q. All right. Now how many times
19 did you run the equation with respect to Site D?

20 A. We did six solutions for the
21 equation and we looked at six individual components
22 of the groundwater flow system for Site D for the
23 scenario with no leachate collection system in place.

24 Q. Is that one run of the equation
25 for each of the hydrostratigraphic units?



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A. That is correct.

Q. In running the equation for these units could you indicate to the Board what contaminants you were analyzing?

A. We are looking at about page 93 and except for the weathered till and the shale we modelled for a non-adsorption contaminant such as chloride which moves freely with the groundwater, we modelled for a weakly adsorbed organic contaminant such as methyl ethyl keytone or methylene chloride. We also modelled for a moderately adsorbed contaminant such as xylene or trichloroethylene. In the upper weathered till in the bedrock for conservatism we modelled only for chloride, making the assumption that in the fractured medium we would have little adsorption.

Perhaps I could refer to Figure 7, Mr. Lederer, and just tie these two things together on the pathways we are going to look at. We have a landfill situated now within the soils and no leachate collection system in operation and we are going to look at migration using Ogata-Banks laterally through the upper weathered till. This is one calculation that we are going to do.

Next we are going to look at



1 migration downward through the upper till, another
2 calculation, and we are going to assume the contamin-
3 ants are at these zones and work them as though they
4 are just starting to move through. Then, through the
5 lower till and down to the granular units and
6 finally laterally through the granular units. Then
7 we will consider lateral migration through the
8 lower till and lateral migration through the shale
9 bedrock.

10 Q. Would you take the Board to
11 page 96 and, starting there, would you review please
12 the six results of the application of the Ogata-
13 Banks equation?

14 A. Just to be clear again, these
15 are individual calculations for the individual
16 pieces of the flow system. They are not combined
17 into any sort of an all-encompassing calculation
18 at this time. They are individual. It is assumed
19 that a contaminant front would start here and what
20 we are looking at is if a contaminant front starts
21 here, when does it arrive at the base and how does
22 it behave? If a contaminant front arrives at this
23 lower till unit, how does it behave when it reaches
24 the bottom and so on through the system including
25 migration through the granular unit, the lateral



1 migration and migration through this, and so we are
2 looking at individual parts to the model.

3 I shouldn't really call it a model,
4 but it is a calculation of an equation that is
5 fairly complicated.

6 First of all, if we look at -- I
7 should show one more thing so let's look at Figure 8.
8 For first arrival times we are going to use a
9 "C" over "Co" of .1. In other words, we will have
10 enough change that we can recognize that a change
11 has occurred within whichever unit we are concerned
12 with. Figure 8 is the solution of Ogata-Banks
13 and it says "uncoupled" which says it is considered
14 all on its own and it says there is a constant
15 contaminant input, which means "C" over "Co" is a
16 constant and it doesn't change.

17 So, this is assuming that the
18 concentration in a landfill, for example, would be
19 1500 parts per million of chloride or some such
20 concentration forever. The groundwater velocity
21 here through the upper weathered till, and this is
22 moving horizontally to the property boundary, is
23 4×10^{-5} centimetres per second. The distance
24 to the site boundary is 100 metres and the
25 dispersivity is 5 metres.



1 Now, let's now look at the curve
2 itself...

3 Q. Let's return to make absolutely
4 sure we all know what we are talking about. What
5 is dispersivity?

6 A. We talked about it being a
7 percentage of the lateral distance travelled and
8 in this case we said we were going to use 5 per cent
9 for this unit, 5 per cent of the 100 metres which is
10 5 metres which goes into the equation.

11 DR. KINGHAM: Have you just upped
12 the groundwater velocity from what you told us it
13 was earlier in your estimate of hydraulic
14 conductivity of the weathered till. Did you give
15 us a number of 1×10^{-5} as your conservative estimate?

16 MR. SOBANSKI: We will go back to
17 Table 10 and here is where we run into this problem
18 of hydraulic conductivity versus actual groundwater
19 velocity which we discussed.

20 DR. KINGHAM: I want to know what
21 you are using.

22 MR. SOBANSKI: We will come back to
23 this. We are now talking about the effects of a non-
24 retarded contaminant which will move at the velocity
25 of groundwater; so when we come to the upper weathered



1 till and input is effective porosity, we now have
2 4×10^{-5} centimetres per second in terms of
3 velocity.

4 So, what this table shows is on the
5 left-hand side we have "C" over "Co", and I am not
6 sure if that is still well understood, and hopefully
7 by the time we are finished it will be, but it is
8 a concentration relative to the source concentration.
9 Across the horizontal axis we have the time in years
10 and I might mention to the Board to watch the
11 horizontal axis because as the time increases we
12 change the bottom time scale and so you just can't
13 overlay one curve on another. Here we are dealing
14 with a time factor of from 0 to 25 years because
15 it is convenient to be able to expand the curve
16 to look at it.

17 "R" is equal to 1.0 and that means there is
18 no retardation and it is a non-adsorbed contaminant.
19 Our first arrival time using the .1 is about 5
20 years and this says that if we input the contaminant
21 concentration at the landfill under the calculations
22 and assumptions used for the upper weathered till units,
23 the first arrival time of contaminants 100 metres
24 away from the side of the landfill is about 5 years.

25 The concentration you can see



1 continues to build from there on and at a value
2 of 1.0 we now have "C" being equal to "Co". In
3 other words, the concentration at the boundary is
4 the same as it is at the source, in the landfill.
5 This occurs in a period of about 15 years.

6 The second flow path that will be
7 considered is the migration downward through the
8 unweathered upper till, Figure 9.

9 MR. LEDERER: Q. So we all know where
10 we are, if you would go to, I believe, and I am
11 going from memory, but Figure 7, the board you have,
12 and could you show us which of the six components
13 you are dealing with now?

14 A. The first component is a
15 calculation from the base of the landfill through the
16 upper till down to the face of the lower till, and so
17 in effect we are now going to calculate the effect
18 of exposing the upper till to contaminants and we
19 are looking at the effect in terms of time and
20 concentration on what occurs at the interface between
21 the upper till and the lower till and how a contaminant
22 will move through this unit to this point and "this
23 point" being the junction of the upper till and the
24 lower till.

25 What we are doing is looking at



1 contaminants moving, potential contaminant movement
2 through each of these zones individually first.

3 In the first case we saw that we had one curve and
4 here we have three curves shown on Figure 9 and we
5 are now going to consider retardation factors on the
6 weakly adsorbed contaminants and the moderately
7 adsorbed contaminants which are various organics we
8 have discussed.

9 This is uncoupled, a calculation that
10 stands on its own, and here the thickness of the
11 upper weathered till is four metres and the dis-
12 persivity is .2 metres and the coefficient of
13 molecular diffusion, which we discussed a little
14 earlier, is 1.5×10^{-6} . The value given, and
15 there is a little mathematics done on this unit,
16 but that is a bit of a change from what we said in
17 the report because the report says 6×10^{-6} and 6×10^{-6} is
18 multiplied by the porosity factor to give you the
19 coefficient of molecular diffusion, which is $1.5 \times$
20 10^{-6} centimetres squared per second. So
21 modeller has taken us one jump ahead here in that
22 value and that is what is going into the model.

23 Again we are looking at the
24 contaminant concentration at the base of the
25 till and again without a leachate collection system.



1 Here the first arrival time for a weakly adsorbed
2 contaminant at "R", 1.24 for a non-adsorbed contaminant
3 such as chloride where "R" is equal to 1 are
4 essentially the same. The retardation, being relative-
5 ly low here because first of all that is a parameter
6 that moves reasonably well and we have a fairly
7 shallow thickness of this material -- not so shallow,
8 but 4 metres, and this affects the shapes of many
9 of these curves. The first arrival time is
10 approximately 25 years for the non-adsorbed
11 contaminant and the weakly adsorbed contaminant.

12 Now we can see the effect on a
13 moderately adsorbed contaminant where we start to
14 again look at the bottom scale and instead of dealing
15 with 0 to 25 years we are dealing with 0 to 750
16 years. We are now talking first arrival
17 times of a moderately adsorbed contaminant being
18 in the order of 250 years.

19 Again, since we are considering the
20 source feeds contaminants into the system forever
21 at a constant rate, all of the curves eventually
22 reach a "C" over "Co" of 1.0 and this occurs in the
23 case of weakly adsorbed and moderately adsorbed
24 contaminants in the order of 100 years -- weakly
25 adsorbed and non-adsorbed are 100 years and for



1 the moderately adsorbed contaminant some time in
2 excess of 750 years.

3 The third pathway is migration
4 downwards through the lower till to the granular
5 units, and again a simple calculation or a single
6 calculation showing us how this unit will behave
7 on its own as contaminants pass from its upper
8 boundary to its lower boundary. We are now looking
9 at the movement of contaminants which are exposed
10 to a source and what happens at the lower boundary
11 of the lower till. Here our inputs are the ground-
12 water velocity of 2.4×10^{-7} centimetres per
13 second, the thickness of the lower till above the
14 granular units of about 3 metres, a dispersivity of
15 .15 metres and the coefficient of molecular
16 diffusion is again 1.5×10^{-6} centimetres squared
17 per second.

18 A new scale along the bottom,
19 Mr. Chairman, so that we can demonstrate how these
20 curves behave, and we are now dealing with 0 to 400
21 years for this particular unit. Again, we concede
22 that the first arrival times for the weakly adsorbed
23 and the non-adsorbed contaminants are about the same,
24 in the order of about 20 years, and the first arrival
25 time for the moderately adsorbed contaminants is in



1 the order of about 200 years, and again the curves
2 rise to a "C" over "Co" of 1.0.

3 The fourth migration path is lateral
4 migration through the granular units and the
5 groundwater velocity is 2.7×10^{-5} centimetres per
6 second, the distance to the site boundary is the
7 same as for the weathered till, 100 metres, and the
8 dispersivity is 10 metres. Here we have modelled
9 the three different types of contaminants and we
10 can see that the first arrival time of non-adsorbed
11 and weakly adsorbed are essentially identical, some-
12 thing in the order of about 5 or 6 years, and we can
13 see now too the effect of the organic carbon
14 content which is not retarding the moderately adsorbed
15 organics as much as we saw in the other cases where
16 we had high organic carbons and the breakthrough
17 time for the moderately adsorbed is about twice that
18 of the others, and so we are up to in the order of
19 ten years.

20 DR. KINGHAM: Could you clarify for
21 us, for this figure and others, other than your
22 very first figure in this set, is "C" not now --
23 it would be at the point of commencement of that
24 lateral migration arrow.

25 MR. SOBANSKI: That is correct.



1 DR. KINGHAM: So you put this figure
2 in tandum, as it were, behind the other two or three
3 and the contaminant only reached there 50 years down
4 the road and then this starts 50 years down the road.

5 MR. SOBANSKI: We are going to
6 couple it and it is even a bit more complicated
7 than that because the "Co" initially at this point,
8 when we get to the coupled model, the "Co" is in
9 fact much lower than the "Co" in the landfill and
10 it starts at a very low value and then starts to
11 build and we will go through that process here,
12 but that is the premise, that it is exposed to
13 something and it could be the landfill or it could
14 be anything, and now we are just developing this
15 equation because a "Co" is a relative factor or
16 relative concentration and any value you choose
17 to put on it works.

18 I guess we have covered that one.
19 So, the first breakthrough time at the granular
20 units in terms of the non-adsorbed and weakly
21 adsorbed contaminants is about 6 years and thereafter
22 the concentration builds and after a period of
23 about 30 years we would have a "C" over "Co" of
24 1.0. It is a little longer for the moderately
25 adsorbed contaminants, the breakthrough time being



1 ten years, and the two reaching about the same level
2 of one after a period of in the order of 45 or 50
3 years. They merge very closely.

4 The fifth path is going to take us
5 to the bedrock surface and we are going to consider
6 the same model migrating downward through the lower
7 till unit to the weathered shale bedrock. Now, our
8 downward groundwater velocity is 8×10^{-8}
9 centimetres per second and reflecting the relatively
10 low hydraulic gradient between this unit and the
11 bedrock.

12 The thickness of this lower till,
13 lower, lower till unit if I can call it that, is
14 about 12 metres and the dispersivity we have
15 applied is .6 metres and the coefficient of molecular
16 diffusion is 1.5×10^{-6} centimetres squared per
17 second. You will notice the chart is set up in the
18 same way, but the time scale now should also be
19 noted, and we are now dealing with a time scale into
20 the thousands of years to move some of the types of
21 contaminants we might find in the landfill into the
22 lower units.

23 For first arrival times, in this
24 case the non-adsorbed or weakly adsorbed contaminants,
25 the non-adsorbed again being represented by chloride,



1 is about 300 years. For the moderately adsorbed
2 contaminants, and again we are only considering
3 adsorption and not any sort of biological activity
4 on any of these contaminants, but the arrival time
5 is about 2300 years. That is just through this
6 unit (indicating).

7 Finally, we come to the sixth part
8 of the flow pattern which is the migration now through
9 the shale bedrock and here reflecting the higher
10 effective porosity of this unit or the lower effective
11 porosity of this unit and the higher velocities,
12 and we can see the time scale has now changed to
13 only a 60-year timespan.

14 The groundwater velocities, the
15 distance to the site boundary and the dispersivity
16 are given as a 1×10^{-5} centimetres per second,
17 100 metres, and 30 metres respectively. Again you
18 see here we have just the one curve and this is
19 for a non-adsorbed contaminant and we are not
20 considering attenuation retardation for the organic
21 indicators that we were using.

22 Here, once contaminants arrive
23 at this zone, approximately 10 years would be
24 required to see a change in water quality at the
25 property boundary after it has moved 100 metres



1 laterally through this zone. The "C" over "Co" of 1
2 is not quite reached in 60 years. It is somewhat
3 longer than that, perhaps 100 years or so, but again
4 we go back to "C" over "Co" of 1 in about
5 approximately 100 years.

6 MR. LEDERER: Q. Mr. Sobanski,
7 could you take us to page 102 of your report and
8 to the heading there of "Discussion" and could you
9 indicate to the Board please the conclusions of
10 your work with the equations to this point?

11 A. If we add these various first
12 arrival times together with respect to the dominant
13 pathways that have been identified at the site,
14 which are lateral migration in the upper weathered
15 till, lateral migration in the granular units and
16 lateral migration in the shale bedrock, the first
17 arrival times at the property boundaries would be about
18 five years for the weathered till, about 60 years
19 for the granular units and about 360 years for the
20 shale bedrock.

21 Q. What are the predominant
22 pathways?

23 A. It is evident from this type
24 of a prediction, mathematical prediction, that the
25 zones we need be concerned about on a normal landfill



1 would be the upper weathered till and the granular
2 units. These would have contaminants in terms of tens
3 of years to deal with, whereas the shale bedrock in
4 terms of first arrival, we are talking 360 years and
5 we feel that we not be concerned about the shale
6 bedrock at this site but we need to be concerned about
7 the shallower zones which is lateral migration through the
8 upper weathered till and lateral migration through
9 the granular units.

10 Q. You used these equations or
11 used the Ogata-Banks work that has been done to
12 indicate the total flows through each of the path-
13 ways. Is there work you can do with the equations
14 to reflect that result.

15 A. Yes, we can look at coupling the
16 models, which is covered on page 105 of the report.
17 For the weathered, the migration through the upper
18 weathered till, we just have the one model for that
19 which has already been presented, that's the one
20 calculation which was shown in Figure 8, and this
21 is a model or calculation which stands on its own,
22 Figure 8, and that is lateral migration through the
23 weathered upper till.

24 The second one is to now integrate or
25 add the effects of these various models that we



1 prepared, or the individual calculations we prepared
2 for the upper till, the lower till and the granular
3 units and see what happens to "C" over "Co" here in
4 terms of time. I would like to refer to Figure 14.
5 This is a coupled model and it is based on chloride
6 concentration and this is with no retardation factor
7 involved and we are assuming a constant chloride input
8 of 1500 milligrams per litre and we have taken "C"-
9 "Co" out of it for the moment and this incorporates
10 the unweathered till model, the lower till and the
11 granular unit.

12 Here we can see now that the first
13 arrival time, which would be at about 150 milligrams
14 per litre, occurs in about 70 years and if my
15 numbers in my report and if my transcript varies
16 it is only because I am picking numbers off the
17 graph. "C" over "Co" at the property boundary would
18 be reached in about 170 years, and so the first
19 arrival times, again at the property boundary in
20 terms of this coupled calculation, are something in
21 the order of about 70 years and which can be obtained
22 by adding up those individual components and,
23 finally, the full concentration hitting us in about
24 170 years.



1 this in your evidence, but it assumes that the
2 chloride concentrations will have a constant input
3 and can you indicate to the Board is that what
4 happens in nature?

5 A. No, it is not what happens in
6 nature and we have tried to take that into account,
7 or we have taken it into account, and actually we
8 have looked at decline curves which one could expect,
9 and this is based on information from various landfills
10 around the province on which we have information, and
11 in fact what happens at a landfill is that the
12 contaminants are leached from the site and ultimately
13 the site will stabilize and become a source of just
14 low level contamination.

15 Initially the concentrations will
16 be high as precipitation infiltrates through the
17 garbage, it will pick up the contaminants, it will
18 move them into the environment or into a collection
19 system and slowly the concentrations will fall off.
20 The projected decline in the chloride concentration
21 we have used is that initially the concentration will
22 be 1500 milligrams per litre in the landfill and
23 that over a period of 50 years will decline to a
24 constant concentration in the order of about 100
25 milligrams per litre.



1 If we look now at Figure 16 we are
2 going to impose these concentrations now on the other
3 curves and look at lateral migration of contaminants
4 through the weathered zone and we will see the
5 effects of this.

6 THE CHAIRMAN: Mr. Lederer, anytime
7 you think the witness can agree on a break, because
8 it is hard to separate these.

9 MR. LEDERER: We are very close to
10 the end of this part of the report and the work
11 undertaken and that is the matter of contaminant
12 migration and what we can expect, and I was going to
13 ask the Board to adjourn for lunch at that point
14 because then in the afternoon we can take it and
15 transpose it into the considerations for landfill
16 design as a result of those conclusions.

17 THE CHAIRMAN: I will leave it to you.

18 MR. LEDERER: Thank you, sir.

19 Q. Now, Mr. Sobanski, in undertaking
20 this work and in considering the declining chloride
21 inputs, could you review with the Board what pathway
22 or pathways you were looking at and which parameteres
23 you were considering?

24 MR. SOBANSKI: A. We are considering
25 the two major pathways which is lateral migration



1 through the upper weathered till and lateral migra-
2 tion through the granular units. If we first look...

3 Q. Paramaters; which paramaters?

4 A. We are using chloride and we are
5 using the moderately and weakly adsorbed contaminants.

6 Q. Could you give us the results
7 then of this use of the equation?

8 A. This shows the coupled calculation
9 for the weathered zone at the site boundary in the
10 weathered upper till.

11 Q. This is the pathway which goes
12 laterally?

13 A. Laterally 100 metres to the site
14 boundary. We can see the effects now of decreasing
15 the contaminant input as we have shown. We have
16 now taken C/Co out of the calculation and
17 we have let the computer calculate what C/Co means
18 in terms of concentration. Here we are looking at
19 an initial concentration of chloride of 1500 milligrams
20 per litre. So, at the site boundary following break-
21 through in about six years, the chloride concentra-
22 tion would increase in the weathered zone to a value
23 of about 1200 milligrams per litre after about 10
24 years.

25 It would then decline to the assumed



1 final concentration in the landfill of about 100
2 milligrams per litre and this would occur in the
3 period of about 55 years.

4 Q. Just to be clear, and I am not
5 sure you said this , but where did you get the
6 figure of 1500 milligrams per litre as the initial
7 concentration?

8 A. It is an assumed concentration
9 and it varies from landfill to landfill depending upon
10 the types of materials that are disposed. It is a
11 value that we commonly use in Ontario for assessing
12 landfills. I believe it was relatively consistent with
13 the data that was being found at the Burlington site.

14 MRS. TANNER: Is that a one-shot
15 application or a continual application?

16 MR. LEDERER: I am not sure if I
17 understand the question, I am sorry. It is constant,
18 so it is a constant production of 1500 milligrams
19 per litre and, as Mr. Sobanski has -- what he has said
20 is, it comes first of all from experience in the
21 province and, secondly, it is consistent with what we
22 see in the present regional landfill which is the
23 one just to the west of the proposed Site F.

24 DR. KINGHAM: While we are having
25 this little break, there is one other assumption. It



1 is clear from the schematic that you assume no
2 leachate collection system in operation but it is
3 not clear what you assumed throughout these calcula-
4 tions in terms of covering. Are you assuming
5 penetration of rainwater is as through weathered till on
6 the top of this site and through everything you have
7 given us in the last hour?

8 MR. SOBANSKI: Yes, we are assuming
9 at this time that the hydrogeologic properties that
10 are in place would prevail at this time. We haven't
11 considered mounding perhaps within the landfill or
12 changing hydraulic gradients, we are considering how
13 the landfill would behave if we put it in there and
14 it filled up to roughly the ground surface with
15 leachate, what would happen to the contaminants
16 that would migrate from this site.

17 DR. KINGHAM: You have not allowed
18 for some kind of cap to reduce rain infiltration?

19 MR. SOBANSKI: No. As we will find
20 out, we have a budget that goes through the soils
21 which was about 10 millimetres and capping it, even
22 with a cap on, we expect the infiltration rates
23 would be higher and we believe what will happen is
24 that this system will take under normal conditions
25 the 10 millimetres of water, but even with a cap, the



1 infiltration rates will be much higher than that and
2 what can happen at some landfill sites constructed
3 in low permeability materials, it fills up like a
4 bathtub and ultimately you would end up with too
5 discharges of leachate along the sides of the site
6 if leachate wasn't collected and, in fact, the infil-
7 tration rate through the cover material will exceed
8 the 10 millimetres that the groundwater flow system
9 will accept.

10 MR. LEDERER: Mr. Sobanski, if we
11 can now return to this final application of the
12 equations.

13 Q. Can you review with the Board
14 the results of considering now declining chloride
15 input through these pathways?

16 A. I believe we have considered
17 this one, so let's consider the next parameter in this
18 weathered unit which is shown on Figure 17. This
19 is the lateral migration through the weathered zone
20 using a weakly adsorbed organic contaminant. Now,
21 what have we done here and where did this come from?
22 What we have said is that we are not considering
23 any retardation of the organics, but we are looking
24 at the migration that would occur within the weathered
25 till unit without any adsorption, both for a weakly



1 adsorbed organic, I believe, and for -- pardon me --
2 this is a weakly adsorbed contaminant. At the
3 Burlington landfill we have fairly high concentrations
4 of organics which were measured in one of the analyses
5 and a typical value being 1000 micrograms per litre
6 and so in this model what we have done is there is
7 no basis at this time to know how organics will
8 decay with time in leachate, and we have a better
9 feeling for chlorides because they have been measured
10 traditionally, but organics are a fairly new field
11 in contaminant hydrogeology.

12 So, what we have assumed is that the
13 curve will be similar to that observed for the
14 chloride and in this case we are looking at a high
15 initial input of about 1000 parts per billion, and
16 this is not parts per million but you will notice it
17 is a "u" instead of an "m" in the term "ug/L" and
18 that is micrograms per litre which is parts per
19 billion and we have assumed that will decline to
20 in the order of 50 or 60 over the life of the site,
21 about the same time period, about 50 or 60 years.

22 Now, these values, as you will see
23 in the next graph, these are not typical of leachates
24 in Ontario, this is a relatively high concentration
25 found at the site on this sampling occasion.



1 If we now look at its movement, it is very similar
2 to chloride since there is no retardation factor and
3 it would rise to a peak of about 800 after a period
4 of about 10 years or so and the initial breakthrough
5 time again is relatively short, it would be again
6 five or six years, and then the peak would decline
7 similar to that shown in the chloride calculation.

8 This is the same calculation for a
9 more likely concentration of these moderately --
10 weakly adsorbed contaminants where we would have an
11 initial input of about 200 parts per billion and
12 again declined in a manner similar to that for
13 chloride and now declining to in the order of 10
14 parts per billion after a period of about 50 years.

15 The first arrival times are the same
16 and the calculations are similar and here the peak
17 concentrations would be about 160 micrograms per
18 litre and declining to the assumed lower limits of
19 about 10 or 15 after 60 years.

20 Figure 19 takes us to the lateral
21 migration through the granular units out to the
22 property boundaries, and now we have coupled already
23 the figure for chlorides and the arrival curve for
24 chlorides as they move through this unit to the
25 property boundary and we are now, however, going to



1 consider the declining input of chlorides through the
2 coupled model to the landfill property boundaries.

3 Again, we have taken out C/Co and
4 put in the actual concentration, the initial being
5 1500. The first arrival times as indicated are
6 about 60 years and now we find that after we have
7 put it through this system and diffused it and
8 essentially stretched it out that we have a chloride
9 concentration of around 350 milligrams per litre at
10 the property boundary in a period of about 100 years.

11 So, about 100 years from now, if we
12 did nothing at this site, leachate moving from the
13 landfill cells and out to the property boundaries
14 would arrive in about 60 years and then would peak
15 at a concentration of about 350 milligrams per litre
16 after 100 years and thereafter it would decline, and
17 in a period of about 180 years from now we would be
18 back to the constant concentration input that we
19 assumed of about 100 milligrams per litre.

20 The next coupled model we will look
21 at is for the weakly adsorbed organics and this
22 illustrates the declining input from 1000 parts
23 per billion, or micrograms per litre, on the site
24 boundaries. The first impacts would occur in about
25 80 years; the value would peak in about 120 years



1 at a concentration of about 200 micrograms per litre
2 and thereafter would decline.

3 Now, I am showing the both of these
4 because we considered them in the first case. This
5 is the next calculation which shows the more reali-
6 stic input we feel at 200 parts per billion and
7 the first arrival time is about the same, in the
8 order of about 80 years, and peaking now at a concentra-
9 tion at about 40 parts per billion in about 120 years
10 and thereafter declining to the constant concentration
11 we assumed.

12 Q. One further question before
13 we break. Could you turn please to page Roman Numeral
14 X, and this is the Executive Summary at the front of the
15 report, and could you review with the Board your
16 conclusions as to the migration of contamination
17 without leachate control?

18 A. The first arrival times for
19 non-adsorbed contaminants such as chloride at the
20 site boundary through this deeper granular unit
21 would be in the order of 60 to 70 years. The arrival
22 times for weakly adsorbed organic contaminants is
23 in the order of 80 to 100 years. These arrival times
24 are slightly greater than for chloride because of
25 adsorption, that is the arrival times of the



1 organics. However, they are still similar.

2 The first arrival time for contamin-
3 ants at the site boundaries will be the same whether
4 the contaminant input from the landfill is constant
5 or whether we decline it with time. For the declining
6 inputs, the peak contaminant concentrations will be
7 significant less than the peak input from the land-
8 fill. The maximum chloride concentration at the
9 property boundary was estimated to be 350 milligrams
10 per litre.

11 Now, without leachate collection
12 and treatment, the movement of these contaminants
13 through the granular units could contaminate adjacent
14 wells in time and this would take 70 or more years.
15 Similarly, without proper control the groundwater
16 contaminants could discharge to surface water streams
17 by lateral migration through the upper weathered till.

18 MR. LEDERER: Thank you. Mr. Chairman,
19 this would be a good point.

20 THE CHAIRMAN: Very well. We will
21 break until 2:30.

22 ---Luncheon adjournment at 1:03 p.m.

23 ---Upon resuming at 2:30 p.m.

24 THE CHAIRMAN: Please be seated as
25 you come in. Mr. Lederer.



1 MR. LEDERER: Q. Mr. Sobanski, if
2 you could turn to page 119 of H-39, the Site D
3 technical study. Having completed your analysis
4 of contaminant migration at this site, having
5 completed your hydrogeologic assessment, can you
6 just summarize for the Board perhaps with
7 reference to this page, the hydrogeologic factors
8 to be considered in designing a landfill at Site D?

9 MR. SOBANSKI: A. Yes.
10 Mr. Chairman, a landfill founded on Site D would
11 be founded in the clayey till at the site. Our
12 tests have shown that this material has good
13 attributes for waste disposal. It is fine-grained
14 in terms of soil size, it is fine-textured, it has
15 a low hydraulic conductivity and it has good cation
16 exchange capacity and has organic carbon in it and,
17 therefore, with the hydraulic -- considering the
18 hydraulic properties, it forms a sort of natural
19 landfill liner under the underlying glacial strata.
20 It is a good medium to found a landfill site in.

21 We have to consider there is poor
22 groundwater quality here, even at relatively shallow
23 depths. We have recharge characteristics, but there
24 is slow groundwater movement in general.

25 The vertical gradients at the



1 site are generally downward and we are in a re-
2 charge area and if we had mounding within the fill,
3 we would disturb the soils and increase the infiltra-
4 tion rate and we would get leachate migrating away
5 from the site if we don't engineer it and ultimately
6 that would migrate laterally through the weathered
7 till and laterally through the granular units and
8 ultimately it would arrive at the shale bedrock.

9 Q. Perhaps you could just stop
10 for a moment and Mr. Beechinor, could you take down
11 Site D, and I don't know if we have had any discussion
12 of what is meant by "mounding" and perhaps you could
13 take a moment to explain that to the Board?

14 A. This is somewhat out of scale,
15 Mr. Chairman, but I think it will indicate the
16 principles involved. We determined from the water
17 budget, something in the order of 10 millimetres of
18 precipitation will enter the deep groundwater flow
19 systems and this includes really everything, it
20 includes the lateral migration through the various
21 units and finally lateral migration through the
22 rock. When we disturb these soils, and right
23 now they are in a compacted state and compacted
24 by 2 miles of ice, other than the weathered zone
25 which has some additional features built into it due



1 to weathering, but it has been well compacted and
2 it is very dense. When we take that material and
3 disturb it and put a cover on the site, this
4 material is relatively permeable with respect to the
5 original 10^{-7} centimetres per second permeability
6 that we have in the virgin material, the native mater-
7 ial.

8 Landfills settle because of
9 degredation and cracks can form in the cover material
10 and sometimes we will get depressions and these must
11 be looked at and looked after, but what I am coming
12 to is that the infiltration rate through the cover
13 material will be much larger than the 10 millimetres
14 per year and this only amounts to a half an inch a
15 year.

16 The Ministry of the Environment, in
17 fact they like to use conservative estimates in their
18 design and this value of how much actually comes
19 through the cover, and we call this the recharge
20 leachate production rate, and everything that goes
21 in will make leachate and it is a question of
22 considerable debate as to how much this value is.

23 Here in the situation in Halton where
24 we have a sewage treatment plant, we can be sort of
25 liberal with this number and use the high values and



1 we can treat whatever infiltrates, but the number
2 the Ministry likes us to use for design purposes is
3 through the final cover material 12 inches per year.
4 It is obvious that the groundwater flow system can't
5 take that much leachate generation. As I say, this
6 value is debated considerably and this kind of value,
7 considering we are using a clayey soil, is very high
8 because these are the leachate recharge rates we
9 get into our sand and gravel aquifers. However, for
10 design purposes we have used this 12 inches per year,
11 but if there is any excess of infiltration over this
12 number, and if it is two inches a year we still have
13 an inch and a half per year that we will have to deal
14 with, and what happens is that slowly the leachate
15 level in the cells will build up and it will mound
16 within the refuse and actually form a water table of
17 leachate within the refuse if it went this high and
18 you could contain it.

19 So, in a situation that occurs like
20 this, this is the bathtub effect I was referring to,
21 and we can look at the kind of numbers we may have
22 to deal with and that the Ministry is requesting
23 we use 12 inches for design purposes, but in open
24 cells where the cells are open without final cover
25 they request we use 18 inches per year and that is



1 included in our calculations as well.

2 So, for a small cell area that is
3 open and hasn't got a final cover on it, we assume
4 an infiltration rate of 18 inches per year, a large
5 rate, and so the groundwater flow system cannot
6 handle it and you would need a very permeable
7 environment, a poor attenuating environment in order
8 to keep the leachate from rising within the fill.

9 So, as a result if this were allowed
10 to happen, we would get side slope discharges of
11 leachate and our predictions on the groundwater
12 flow system would be similar. They would change a
13 bit because we are imposing greater gradients on the
14 system than we have under natural conditions, but
15 because it is very tight below the site, this amount
16 would not change very much and now we have the
17 concern of the toe discharges of leachate or possibly
18 even side slope discharges of leachate coming from
19 the fill.

20 Q. Just to return to page 119,
21 could you continue with your review for the Board of
22 those hydrogeologic factors which would govern or
23 play a role in a landfill design undertaken at that
24 Site D?

25 A. The contaminant pathway



1 analysis we have done at the site indicates there are
2 four pathways by which leachate might migrate with
3 groundwater. There is the lateral migration through
4 the weathered upper till. There is vertical migra-
5 tion through the upper granular unit and lateral
6 migration off the site. There is vertical migration
7 to the lower granular unit -- both the upper and
8 lower and they are different pathways, but for the
9 model we have lumped them as one because they are
10 only separated by a thin layer of till; so we could
11 first of all have lateral migration through the
12 weathered zone, lateral migration through the upper
13 granular unit, lateral migration through the lower
14 granular unit and, finally, lateral migration through
15 the bedrock.

16 But, for the model again, Mr. Chairman,
17 we have lumped the two units together in terms of
18 the overburden.

19 Our hydrogeologic analysis of the
20 various pathways has shown that these units are
21 not major aquifers from which municipal supplies
22 can be obtained. However, the protection of the water
23 quality in these zones should be addressed in terms
24 of the site design.

25 Q. Now, can you review with the



1 Board, perhaps with reference to the top of page 121,
2 what method of operating a landfill you would foresee
3 as being proposed at this site?

4 A. We would propose a conventional
5 landfill for Site D. It would be a combination of
6 the trench and area fill methods. First deep
7 excavations would be dug to provide a portion of the
8 required landfill capacity below grade and provide
9 soil for cover material and earthworks on the site.
10 The trenches would be progressively filled with waste
11 and then on top of that we would construct an area
12 fill above the trenches that had been dug, and these
13 trenches we are talking about quite large extensive
14 areas, but Mr. Hirachi will deal with that.

15 The waste will be spread in thin
16 layers, it will be compacted and it will be covered
17 with earth daily in the manner of a sanitary landfill
18 site.

19 Q. Are you proposing as part of
20 this site some form of leachate control?

21 A. Yes, we are.

22 Q. Why?

23 A. The impact models we have
24 developed, calculations of migration through the
25 various units, will exceed in time, some distant time,



1 the Ministry of the Environment reasonable use
2 criteria at the property boundary. So, to ensure
3 that the landfill impacts are kept to an acceptable
4 level, we would propose to engineer the site to
5 collect leachate.

6 Q. Can you indicate to the Board
7 the kind of leachate control system being proposed?

8 A. This is shown on page 123. We
9 propose a hydraulic containment concept referred to
10 as a hydraulic trap. As a preamble, we recognized
11 early in the study that an underdrain leachate
12 collection system would be desirable or is desirable
13 at large landfills to ensure their long-term
14 integrity. We have mentioned and showed you how in
15 good soils the leachate will mound within the waste
16 and could create problems, and therefore given also
17 the Ministry's reasonable use criteria, large landfills
18 will likely require -- not this type of control
19 system, but a leachate collection system. When
20 we developed the hydraulic gradient data for this
21 site, it became evident to us that a hydraulic
22 containment system or the hydraulic trap would be
23 feasible at this site. In this type of a system
24 all the subsurface leachate and some groundwater
25 is captured by the tile collection system.



1 The general principle of the hydraulic
2 trap is to install the tiles in the base of the cell
3 deep enough that the hydraulic potential in the tiles
4 and in the waste is lower than that in all of the
5 surrounding and important hydrogeologic units.

6 In this case with the recharge area, or with the
7 recharge zone being in effect -- the lowest hydraulic
8 potential occurs within the bedrock and so
9 the idea now is to lower the fluid levels within the
10 landfill below the fluid levels within the bedrock
11 and this causes all of the leachate which comes
12 through the top cover to enter the drainage tiles
13 and some groundwater, a small amount and we would
14 know by the hydraulic conductivity of the zones,
15 to move into the landfill from all of the zones
16 so there will be potential for some groundwater
17 even from the bedrock to move upward into the
18 hydraulic trap.

19 DR. KINGHAM: Mr. Sobanski, you
20 used the term aquifer again and you used it a minute
21 ago and I see it on the map here, but you don't mean
22 to imply aquifer in the sense you told us yesterday,
23 as an aquifer that provides thousands of gallons per
24 minute for a community.

25 MR. SOBANSKI: That is correct.



1 DR. KINGHAM: You mean water table
2 here?

3 MR. SOBANSKI: Aquifer is still a
4 correct term and it is an aquifer that yields only
5 sufficient supplies for domestic purposes. As
6 we have mentioned, a couple of residents do obtain
7 their supplies from these two sand units and to them
8 it is an aquifer. It doesn't yield a lot of water
9 but it yields enough for their purposes and it is not
10 really possible to avoid them in the province and it
11 would be very difficult. Our whole rural community
12 is supplied from some form of either a small or
13 large aquifer, and the same for the bedrock zone,
14 it does provide some domestic supplies. It is
15 defined as that loose definition we talked about,
16 but in terms of an individual it is an aquifer and
17 in terms of a municipality or industry there wouldn't
18 be enough water and to them it would be a dry hole.

19 MR. LEDERER: This schematic
20 does not appear anywhere and it might be useful
21 if it were exhibited.

22 THE CHAIRMAN: Related to H-39.

23 MR. LEDERER: It would become H-39-B,
24 I believe.

25 ---EXHIBIT NO. H-39-B: Schematic chart "Hydraulic
Trap"



1 THE CHAIRMAN: I suppose I could
2 call it a "Hydraulic Trap Diagram"?

3 MR. LEDERER: That would be
4 appropriate, sir.

5 Q. Mr. Sobanski, before we leave
6 what is H-39-B, could you indicate what impact such
7 a system would have on the migration of contaminants
8 in this area.

9 MR. SOBANSKI: A. This type of a
10 system would essentially stop all movement of
11 contaminants from the site. It would also collect
12 not only the leachate as I have mentioned but small
13 quantities of groundwater from the surrounding zones
14 which would be induced to flow towards the trap.

15 Q. Can you indicate what the impact
16 would be on water quantity at local wells?

17 A. Since we are withdrawing water from
18 all of these zones, the hydraulic trap within the
19 landfill is acting like a well itself and extracting
20 some water, but through the low permeability
21 materials. So, this will create a lowering of
22 water levels within the units affected by the
23 trap. The maximum impact that we have calculated
24 is in the upper granular unit which supplies domestic
25 wells about 150 metres to the west of the site and our



1 calculations of that impact on those wells is shown
2 in Appendix 16. The inflow from the upper granular
3 unit would be about .8 of a gallon per minute into
4 the landfill. This is approximately the water-
5 taking from a normal domestic well. We have done
6 some calculations on the effects that that would have
7 on taking water continuously into the hydraulic
8 trap and discharging it to a sewage treatment plant
9 and taking the leachate from the trap to a sewage
10 treatment plant, and we estimate it would only have
11 a marginal effect on area wells and it may reduce
12 their yield in the order of 6 per cent.

13 We do not feel that this would
14 unreasonably interfere with the use of groundwater
15 in the area.

16 Q. All right. Can you indicate
17 to the Board what happens should your predictions
18 turn out to be incorrect?

19 A. The water levels in the area will
20 be monitored and a monitoring system would be
21 installed around the site and off-site wells would
22 be monitored as well. If it becomes evident that
23 the domestic wells will be adversely impacted, then
24 we would take remedial action such as deepening
25 their wells to ensure that an adequate supply is



1 maintained.

2 These changes in groundwater
3 fluctuations or levels as a result of the trap should
4 be very slow because the bulk of the movement or
5 the main movement is occurring through this very
6 low permeability till and so there should be lots
7 of warning in order to restore any supplies if the
8 trap affects nearby wells in terms of their ability
9 to yield water.

10 Q. Can we turn to page 130 of the
11 report and could you review with the Board the
12 contingency plans that are in place or which would
13 be in place in the event of some form of failure of
14 the leachate control system?

15 A. There are two levels of
16 contingency provided with this concept and the first
17 is a primary system which is natural attenuation and
18 this would be the attenuation afforded by the clay
19 till itself. The Ministry of the Environment requires
20 that a contingency control system be considered and
21 conceptualized for all landfill sites and so,
22 first of all, before we talk contingency I may be ahead
23 of myself, but Site D will be equipped with this
24 primary system to protect the environment and then
25 natural attenuation would serve as the first level



1 of contingency control in the event that we had
2 some interruptions in the system.

3 This in turn can be backed up with
4 a tile drain to protect water quality in the
5 weathered zone or, if contaminants were to arrive
6 at the deeper zones, we could install what are called
7 purge wells and this could be considered a purge
8 well here, whereby we would pump contaminants from
9 the zone and transmit the water to a sewage treatment
10 plant for treatment.

11 So, we have here then two levels
12 of contingency, one natural and the other mechanical.

13 Q. All right. Then, can we turn
14 to the final section of the report on page 136, and
15 can you review with the Board the monitoring and
16 reporting which would be part of the operation of
17 the landfill at this site?

18 A. First of all, the goals of a
19 monitoring program are to assess the adequacy of
20 a landfill design and the second is to protect
21 local groundwater supply zones and surface water
22 from impairment due to unforeseen circumstances.
23 Data from groundwater monitoring wells located close
24 to the landfill cells and wells located within the
25 property boundaries would be regularly assessed for



1 trends indicating any adverse changes in groundwater
2 quality.

3 The study of contaminant migration
4 at landfill sites, because groundwater moves so
5 slowly, is a study of trends to see whether or not
6 changes are taking place. If there were an
7 unacceptable level of impairment, then the contingency
8 programs would be implemented as needed to restrain
9 any off-site migration of contaminants.

10 Surface water sedimentation lagoons
11 and storm water capture from within the landfill cells would
12 similarly be monitored in order to ensure that the
13 quality is suitable for discharge to water -- to
14 surface watercourses and leachate quality within
15 the landfill cells would also be monitored both
16 in terms of its level and quality in selected
17 manholes. The nature of the soils at this site,
18 being that they are fine-grained lead us to conclude
19 that a gas control system will not be required, but
20 we will install gas probes near any monitors we install
21 to make sure there are no off-site boundary impacts
22 from landfill gas.



1 We are proposing a 20-year active
2 landfill monitoring period and a 20-year post-
3 closure phase of monitoring to ensure that the site
4 is safe and, alternatively, the program will be carried
5 on until the Ministry of the Environment is satisfied
6 that the site doesn't pose any long-term or short-
7 term environmental hazards.

8 With respect to the groundwater
9 monitoring, we would include, as I have said, both on-
10 site monitors and off-site monitors; on-site we
11 would install nests of standpipes and piezometers
12 to measure the weathered zone of the upper till,
13 the upper and lower granular units and the shale
14 bedrock as warranted, depending upon which location
15 of the site we are on and whether the zone is present
16 or not, and off-site wells would comprise the local
17 domestic wells in the area and we would monitor
18 some of those as well.

19 The on-site wells would be constructed
20 in some cases singly and in other cases -- in
21 single nests -- and in other cases we would stagger
22 several nests towards the property boundary so we
23 could identify chemistry versus any changes in
24 chemistry versus distance that may be occurring.

25 When the wells are installed and



1 developed, we would collect samples for detailed
2 chemical analysis and we would establish in these
3 areas a fairly poor groundwater quality where we
4 have considerable fluctuation perhaps in chemistry,
5 but how much fluctuation there is in the background
6 chemistry and subsequent analysis would be carried
7 out routinely on a semi-annual or quarterly basis
8 and, at that time, we would analyze for the main
9 contaminant indicators that indicate that landfill
10 contaminants are moving and these are shown on page
11 138 and they include conductivity, pH, alkalinity,
12 chloride, sulphate, calcium, sodium, magnesium,
13 potassium, phenol and dissolved organic carbon.

14 The type of analyses we are running
15 here allow us also to do the major anion and
16 cation balance so that by comparing any of these
17 analyses with one another, from the past we can see
18 whether there may be changes in the type of ground-
19 water we are looking at occurring; in other words,
20 contaminants may show up as a change in the basic
21 chemical species of the groundwater, and we would
22 propose to monitor the off-site private wells only
23 annually and the main monitoring will be within the
24 property boundaries and we feel if there are no
25 changes there that the contamination or any



1 contaminant front arriving from some unknown
2 direction would be relatively slow.

3 We would establish surface
4 monitoring stations as well and they would be located
5 upstream and downstream of the landfill on the
6 intermittent tributary of Bronte Creek on the west
7 side of the site and on the tributary of Sixteen
8 Mile Creek located on the east side of the site.

9 We would again establish detailed
10 chemistry prior to any disposal taking place on the
11 landfill.

12 After establishing those parameters
13 we would undertake a routine monitoring program
14 similar to that for the groundwater and on the
15 same basis, or for roughly the same parameters, and
16 for surface water one might want to add a few others
17 like BOD, the biochemical oxygen demand.

18 We would also, as mentioned in the
19 preamble, monitor the sediment ponds on the site
20 to make sure that surface water contaminants from
21 nearby sources, the nearby source being the landfill,
22 are not discharged. We would monitor leachate as
23 well and we are proposing a hydraulic trap and
24 consequently we are interested in the fluid level
25 within the cells and we would select several manholes



1 on the cells to serve as monitoring stations to
2 determine whether the fluid level in the landfill
3 is achieving the hydraulic containment system and
4 the levels measured within the cells can be compared
5 to levels measured in the monitors in the shale
6 bedrock.

7 We would also measure the leachate
8 quality at the site. By measuring leachate quality
9 at the site we can, first of all, refine our calcula-
10 tions with respect to contaminant migration for the
11 species we have identified as being representative
12 of the contaminants from the site and also it would
13 allow us to examine the relationship that we have
14 discussed on the decline in concentration with
15 respect to time.

16 In terms of reporting, we would
17 propose to use the system that is currently in place
18 at most landfill sites, where an annual report
19 would be prepared summarizing all of the monitoring
20 activities and results, to evaluate the trends in
21 chemistry, and it would evaluate any changes that
22 may be occurring.

23 It would include an interpretation
24 of all of the data collected with respect to water
25 levels and chemistry and it would contain



1 recommendations for any additional monitoring that
2 may be required, depending upon what we find from
3 our initial sets, and also any remedial measures
4 that may be required in terms of implementation of
5 contingency systems.

6 This report would be provided to
7 the Ministry on an annual basis as is done with all
8 landfill sites.

9 MR. LEDERER: That really concludes
10 the evidence, more or less, with respect to Site D.
11 Now, we will return to the Site F study and proceed
12 in a similar fashion through it. It will take just
13 a few moments to rearrange the material and it is
14 a bit early for a break and we could either rise
15 for a few moments...

16 THE CHAIRMAN: The Board could use
17 that for a specific purpose, so it might be 10 or
18 15 minutes.

19 MR. LEDERER: Thank you, sir.

20 ---Recess

21 THE CHAIRMAN: Please be seated.

22 Mr. McQuaid.

23 MR. MCQUAID: Mr. Chairman, I would
24 like to address the Board about a problem that I think
25 was alluded to earlier in the proceedings, but on one of



1 the periods where Mr. Tzekas was here I was
2 engaged in another Ontario Municipal Board hearing
3 before Mr. Thompson sitting as Chairman in that
4 case, and that was five days which was set aside
5 for hearing and during the course of the proceedings,
6 unfortunately Mr. Thompson through a health problem
7 in his family was called away from the hearing and
8 had indicated at that point in the proceedings that
9 he would try and get a couple of days for a
10 continuation later in the month of June.

11 He returned from the appointment
12 desk and indicated that he could sit on June 11
13 and 12, and those were the only two days for the
14 remainder effectively for the rest of the summer
15 until the fall. I explained to him that I thought
16 I would be required here on June 11 and I understand
17 there was some contact with you at that point about
18 the potentiality of the problem that might be created
19 by my being required to finish that case as well
20 before another panel of the Board.

21 I have been hoping for a break
22 in Mr. Thompson's scheduling, but we have had contact
23 with the Secretary of the Board and have been in
24 contact pretty much all day and there is really not
25 any other availability until some time in very late



1 August or in the fall sometime and, as a result, and
2 we have not been able to get ahold of Mr. Thompson,
3 he is out of town on a hearing, so as a result I am
4 scheduled to be there before him tomorrow to finish
5 that particular case and, as a result, I guess I am
6 in no other position but to ask for an adjournment
7 of these proceedings.

8 I do so very reluctantly and I
9 understand the problems that might pose for the
10 Region and my fellow counsel and the witnesses,
11 but there doesn't seem to be any other way out of
12 this situation.

13 So, I hope that that explanation
14 will be received by the Board and by my friends.
15 The only other suggestion I might offer, and I have
16 discussed it with most other counsel, and if I have
17 missed anybody I apologize, but we might, because we
18 have a short week next week, we might pick up the
19 day a week from Friday which would be the 19th and
20 you may want to poll counsel and I guess the
21 witnesses as well to see if that were a possibility.

22 I apologize for that request for
23 an adjournment, but there seems to be no alternative.

24 THE CHAIRMAN: It is quite under-
25 standable, Mr. McQuaid. Mr. Lederer.



1 MR. LEDERER: Mr. Chairman, I think
2 this is a situation which we all face from time
3 to time and there is no reasonable purpose in my
4 objecting, although I do want to say to the Board,
5 as I have in the past and as I undoubtedly will in
6 the future, the Region is anxious to have this matter
7 proceed as expeditiously as it can be arranged, but it
8 would not be reasonable to insist that we sit
9 tomorrow in these circumstances and given the
10 evidence that will be called. I suspect before
11 this is over someone will face this kind of
12 difficulty again.

13 THE CHAIRMAN: It is awkward and
14 certainly it is beyond the ability of Mr. McQuaid.

15 MR. LEDERER: Having said we want
16 to keep going, we appreciate the possibility that
17 we may be able to reclaim this lost time and I
18 must say the 19th isn't the best day personally,
19 but we would prefer to have the Board sit than not so
20 we could make up this lost time.

21 THE CHAIRMAN: There is also the
22 question of whether we should continue today or
23 adjourn before we start Site F.

24 MR. LEDERER: On the assumption we
25 are going to adjourn tomorrow, it seems to me wise



1 that we simply adjourn for the day now and I don't
2 know what would be gained by an introduction into
3 Site F at this point and, secondly, I think it will
4 help us all to have a break to absorb what has
5 come into evidence, and I suspect that will make it
6 easier for everyone when we get to Site F because
7 the evidence will simply parallel what you have
8 already heard, or in large part parallel it.

9 THE CHAIRMAN: As I mentioned, the
10 situation arose through no fault of Mr. McQuaid
11 or his clients, it is a Municipal Board situation
12 which could not be avoided and I was aware of what
13 it was and I told Mr. McQuaid at the time that if
14 it was necessary we would work around the problem
15 or we would adjourn.

16 The next point is regarding Friday
17 the 19th. Is that possible with everybody?

18 MR. GARROD: Mr. Chairman, I
19 obviously have no objection to adjourning now or
20 for tomorrow and I don't object strongly to sitting
21 on the 19th, but I do have other matters already
22 arranged that certainly can be cancelled and I
23 would obviously do that, but I would just like
24 to comment that obviously it is difficult to run
25 a practice of law and accommodate a hearing of this



1 type with the demands it makes in terms of other
2 clients and all I would add, I guess, is it appears
3 to me we are not likely to finish with the panel
4 of witnesses before the major break at the end
5 of June in any event, whether we sit on Friday or
6 not, and if we are to sit that day I guess I would
7 hope it would be at least a full day in order to
8 justify the cancelling of other arrangements and,
9 my preference would be to not sit that day, quite
10 frankly, because of the difficulties in scheduling
11 other matters, but I certainly could do it if the
12 consensus was that it would be desirable to sit
13 that day.

14 THE CHAIRMAN: Does anyone else
15 have a comment?

16 MR. ESTRIN: I have no comments on
17 what has been raised specifically, but I guess this
18 may be the opportunity to advise the Board that I
19 have had some discussion with other counsel and
20 some of the Board may be aware that due to a long-
21 standing commitment in the week of June 22nd I am
22 unavailable on the 23rd and 24th and 25th, although
23 possibly I could make some other arrangements for
24 the 25th, but certainly the 23rd and 24th I am in
25 a seminar with Mr. Jeffrey on a matter of some long-



1 standing and in fact it is the only commitment I
2 have on my calendar other than this hearing that
3 would conflict in any way with this hearing as
4 far as I can see.

5 Insofar as I may commence -- it
6 would be expected, I think, that I would commence
7 cross-examination if indeed Milton does cross-
8 examine first ...

9 THE CHAIRMAN: That would be the order.

10 MR. ESTRIN: On this issue, and I
11 do commence next week and it may well be I won't
12 be finished by the 23rd and 24th, in which case it
13 may be that some of the parties who are of the
14 same interest may be able to jump in at that point,
15 if the Board doesn't mind an interruption in my cross-
16 examination, but they may not take the two days
17 themselves. I am just saying that, depending on the
18 circumstances, and obviously we will know better
19 where we are on the 19th and I think we will have
20 a better idea, but I may have to rise again on the
21 19th and there may be an interregnum in which
22 I may be forced to request a 24-hour adjournment or
23 more, unless Mr. McQuaid and those from Burlington
24 or those in that interest might be ready to start
25 cross-examination ahead of Milton and that is



1 another possibility and I have not discussed that
2 with him.

3 THE CHAIRMAN: Any other comments?

4 MS. CRONK: Very briefly, I personally
5 have no difficulty with the 19th and obviously the
6 adjournment being requested today, but a number of
7 us didn't have an opportunity to consult with various
8 experts who have been in attendance and it seems
9 there is a problem with at least one not being able
10 to be here next Friday, and given that that is the
11 balance of Mr. Sobanski's evidence in chief, and
12 particularly with respect to Site F...

13 The only point I was going to make
14 is if we could have two minutes to check with the
15 various experts in the room before we give the
16 Board a final indication as to whether the 19th
17 will cause difficulties, because a number of us
18 didn't have a chance to do that and it could cause
19 problems for them.

20 I indicated to Mr. Sobanski several
21 times that there have been more of them in the room
22 than lawyers and perhaps they should be consulted.

23 THE CHAIRMAN: Yes. Are there any
24 other comments.

25 MR. ESTRIN: I am sorry, but I



1 spoke to an assumption I may go first in cross-
2 examination and I had omitted to say that I had
3 some discussions with Mr. Tidball and we had
4 agreed that he would actually be the first one to
5 begin cross-examination. I didn't mean to change
6 that order so that he indeed would go first, but
7 I still assume I would be cross-examining in that
8 period following.

9 MR. LEDERER: I am not sure what
10 we are working up to and I don't want to talk
11 anymore about Thursday or the 19th, but I do not
12 want to foreclose myself from objecting to an
13 adjournment around the problems that Mr. Estrin
14 has raised because I think at the moment I see
15 it as being quite different. He said himself it is
16 a long-standing commitment and we all have those
17 kind of commitments and all have had to make
18 adjustments, but there are three lawyers there from
19 Milton and Mr. McQuaid's problem is a peculiar
20 one and one we all face from time to time and we
21 don't have the problem yet, but I don't want to be
22 taken from what I said to be foreclosing a
23 different position if there is another request
24 at another time by some other party with respect
25 to an adjournment.



1 THE CHAIRMAN: That is why I did
2 mention that Mr. McQuaid was thrust into this
3 situation.

4 MS. CRONK: On the concern I raised,
5 the 19th can be accommodated.

6 THE CHAIRMAN: Mr. Estrin, as far
7 as your problem is concerned, we will try and work
8 around your problem as best we can.

9 MR. ESTRIN: Thank you. I think
10 we can address it again at the end of next week and
11 as I see it I am sure I understand why Mr. McQuaid
12 might feel that it would be prejudicial to even
13 consider him going first, but, on the other hand, I
14 don't see any magic to this issue insofar as both
15 sites are said to be suitable in that context or
16 perhaps he would indulge me in some other way, but
17 we will have a chance to discuss it.

18 THE CHAIRMAN: Yes.

19 DR. KINGHAM: We are trying to see
20 if we have all of this quite clear. We understood
21 from some comments made that you expect to be
22 finished with the main evidence Monday?

23 MR. LEDERER: Yes, that would be
24 my hope.

25 DR. KINGHAM: Did I overhear that



1 correctly? We understood Mr. Estrin's problem
2 centred around the 23rd, 24th and 25th, but if
3 we meet on Friday the 19th, there are two days
4 available there for cross-examination and that should
5 provide the necessary window. I guess we are hoping
6 what we can work out is that this could happen
7 without inconveniencing anybody and maybe you can
8 work that out.

9 MR. LEDERER: That is obviously
10 what we are all hoping for.

11 THE CHAIRMAN: Then, there remains
12 Mr. Garrod's concern regarding the 19th. I would
13 respectfully agree to sit that day and we will,
14 if you gentlemen could move aside for a moment,
15 we will sit a full day to make it worth your while.

16 MR. GARROD: I appreciate that,
17 Mr. Chairman.

18 THE CHAIRMAN: Are there any other
19 comments regarding this particular problem?

20 Then, we will adjourn now until
21 next Monday and we will sit on Friday, June 19th,
22 commencing at 9:30 in the morning, the usual time.

23 MR. McQUAID: So, we are here
24 on the 18th and 19th next week. We are here
25 Monday the 15th and then the 18th and 19th?



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THE CHAIRMAN: Monday and Thursday
plus Friday. You did speak to your experts,
Ms. Cronk?

MS. CRONK: That was the intent
of my second remark.

THE CHAIRMAN: No further comments?
Thank you for your co-operation and we will see you
next Monday at ten.

---Adjournment at 3:47 p.m.

Certified Correct


C. F. Nethercut, C.V.R.

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