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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I N D E X

E X H I B I T S

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

Hearing conducted at The Oakville Granary Commercial Centre, 105 Robinson Street, Oakville, Ontario, on Wednesday, October 7, 1987

VOLUME 39

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 Limited

APPEARANCES (Cont'd):

C. Stevenson P. Hancock	for Framgard Holdings, Fosseri Investments Limited, Seriphos Investments Limited and Topic Investments
J.H. Olah	for the Halton Region Conservation Authority

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Per: P. D. McQueen

--- Upon commencing at 10:30 a.m.

DR. KINGHAM: Thank you. Please be seated. Good morning, Ms Vigod.

MS VIGOD: Good morning.

ALFRED A. SOBANSKI, (resumed):

JAMES BEECHINOR, (resumed):

CROSS-EXAMINATION BY MS VIGOD, (continued):

Q. Mr. Sobanski, Mr. Beechinor, we left off where we were beginning to discuss your interpretation of the stratigraphic units.

MR. BEECHINOR: A. You gave me some undertakings last night.

Q. I would like to deal with those after lunch. I just want to finish this train of questions.

First of all, I would like to ask you who logged the cores in the appendix. Was that you, Mr. Beechinor or Mr. Sobanski, or someone else?

A. No, we had geologists in the field. Geologists and I believe a geotechnical engineer in the field to do the actual logging.

Q. They prepared the logs found in your appendices?

A. That's right.

Q. Did you supervise or did you examine

the cores and the logs together?

A. I believe both myself and Mr. Sobanski examined the cores in the lab afterwards to ascertain what the log -- to get an understanding of what the geology of the site was. So we looked at the cores, yes.

Q. Now, we were discussing HC-4. If we could turn to your Figure 2 on page 25 or page 35, I am sorry, and I am also ...

MS TANNER: Page 35 of?

MS VIGOD: H-40 and H-40A will be where I am spending at least this morning.

Q. I would like you to also turn to Appendix 2, the borehole log for HC-4. Mr. Beechinor, I am looking at your core log for HC-4.

MR. BEECHINOR: A. Yes.

Q. If we start from the top of elevation 131.3 to I believe 120 on your Figure 2, we have your moderately-fractured unit, if we can call it that.

A. Yes, on Figure 2 it shows at an elevation of 120 the fractured shale and weathered shale, the mildly-fractured and weathered shale.

Q. In your appendix if we look at the fracture frequency column, that is column 14, we can determine there are three types; very close, close and moderately close; is that correct?

A. Yes.

Q. My understanding is that the very close means more fractures?

A. Very close means ...

Q. ... more fractures?

A. Yes.

Q. Now, last week we gave you some numbers estimating the percentage of each type of fracture in your units as defined on Figure 2 for both HC-4 and HC-6. I have a typed version of that.

A. I am looking for my copy of that at the moment.

Q. Mr. Beechinor, this is a typed version of what I gave you last week.

A. I had made some notes on a copy and I am just looking for that.

Q. Perhaps, Mr. Beechinor, we could use ...

A. I have some notes to confirm the numbers and they were left here on the table last night. I thought it was going to come up today and they have now disappeared.

DR. KINGHAM: Are the notes essential?

MR. BEECHINOR: I think they are.

MR. LEDERER: This is obviously one of the difficulties that occurred. Could you ask another question and go on and if we find the document ...

MR. BEECHINOR: That would be fine with me.

DR. KINGHAM: The problem is we weren't planning a break for this morning.

MS VIGOD: I had given this to Mr. Beechinor in the hope that we would speed things up, not slow things down. My problem is this follows directly into a line of questioning that goes on for a bit.

MR. BEECHINOR: I think I know what I meant to say with it and I will just have to bring the numbers into testimony at some later moment. Why don't we proceed?

MS VIGOD: Q. Mr. Beechinor, then, first of all can you confirm that on this sheet of paper what we see is borehole log HC-4 and your geological unit 2 and unit 4, the elevations taken from your Figure 2 and the fracture frequency percentages taken from your borehole logs for that length of thickness?

MR. BEECHINOR: A. That is right.

MS VIGOD: Mr. Chairman, can we make that an exhibit?

DR. KINGHAM: WB-225.

--- EXHIBIT NO. WB-225: Sheet showing estimated percentages of fracture in units on Figure 2

MS VIGOD: Q. Would you be able to confirm looking at unit 2 in HC-4 we see a percentage of moderately close, 13 per cent; close, 65 per cent and very close, 22 per cent?

MR. BEECHINOR: A. Yes. I could confirm it if I could find my data sheet. I can't confirm it actually until I have that.

Q. Let us just take these figures for now and if there is a problem with the percentages...

DR. KINGHAM: Could you tell us, Ms Vigod, where these figures came from?

MS VIGOD: What they came from was a calculation of the percentage of close, very close and moderately close fractures which was determined by these black shadings in column 14 as a percentage of the thickness of the unit as portrayed on Figure 2. If you have the total thickness, 11.3 metres then the moderately close, you can calculate by adding up those black lines. Perhaps -- the explanatory sheet is actually at the front of the core logs in Exhibit 40A.

Q. If we go down to unit 4, can you

at least, subject to your further confirmation; moderately close, 28 per cent; close, 51 per cent and very close, 20 per cent?

MR. BEECHINOR: A. Again, I believe those numbers are correct if they are the same numbers that I reviewed before.

Q. What I would like you to do then is compare these two units. If we look at the close and very close in unit 2 we see 87 per cent and in unit 4, 71 per cent.

A. You are adding close and very close? All right, very well.

Q. Would this not suggest in fact more fracturing in the moderately-fractured unit than in the higher-fractured unit or at best a similar degree of fracturing if you want to call it that?

A. I wouldn't dispute, Ms Vigod, that the fracture frequency in what you describe as unit 2 and unit 4 are very much the same. In fact I think I indicated that when we had the core hole -- the core logs or the cores in front of the Board. Even visually I think you can get an impression that the fracturing and the number of discontinuities in the highly-fractured shale unit and the mildly-fractured and weathered shale unit are similar.

Q. And we can, just to put this -- this is based on your data in the borehole logs and we come to that conclusion?

A. Yes, and I would just like to point out one thing and this is what was on my data sheet, you have left out unit 3 in this categorization. For instance, you note here for unit 2 the moderately-close percentage is 13 per cent. That is for the mildly-fractured and weathered shale. For unit 4, the moderately-close is 28 per cent. If we had also looked at the unit 3 in this numbering scheme, the weakly-fractured shale, you would have found that the moderately-close percentages would be up in the 50 per cent range and the very-close percentages would fall down into the less than ten per cent range.

Q. But, Mr. Beechinor ...

A. My only point is there is a distinction in the frequency of discontinuity and fractures between the weakly-fractured shale units and the two fractured and discontinuity units above and below it.

Q. I appreciate that but for the purposes of my question and understanding where you have delineated this, as you call it, discrete zones, I wanted this understanding of these two units. I would like then to turn to your Exhibit H-206.

MR. HODGSON: Did this exhibit have a number?

DR. KINGHAM: It has a number, WB-225.

MS VIGOD: Q. Do you have H-206?

MR. BEECHINOR: A. Which one is that?

Q. That is your summary of interpretation used to delineate the four zones.

A. Yes.

Q. You confirm from the cover of this exhibit that this is the information that you relied on to delineate the four bedrock zones shown on Figure 2?

A. What this information -- I have tried to demonstrate over the course of the summer, we prepared a subsequent borehole log over the course of the summer to try to demonstrate how we were making the picks on Figure 2. So, this is something that came later after, for instance, the work we had done with Exhibit H-220.

Q. You are still saying that -- certainly we have looked at the borehole logs and not seen any difference in the fractures and you are saying let us look at this other RQD data?

A. What I would like to say is for getting into the RQD's the rock quality designation, there is an indicator of how we made the interpretation shown on Figure 2.

Q. My understanding is you said that RQD stands for rock quality designation?

A. Yes.

Q. My understanding is that the RQD number is the sum of the pieces of rock that are longer than four inches divided by the total length of the rock. Is that fair?

A. I think that would be fair. It is a percentage of sound or competent pieces of rock in the core run.

Q. Am I correct that the higher the number, the better the rock is; in other words, it's less broken?

A. That's right.

Q. As I understand this then the more fractured rock should be the lowest RQD?

A. Generally, that is correct, yes.

Q. First of all, I just have one question with the use of the RQD. If we had a piece of rock with fractures every four and a quarter inches then the RQD would be 100; is that correct, just a general understanding of the concept?

A. That could be.

Q. If we had a piece of rock where the fractures were every three and a half inches, the RQD would be zero because none of the pieces are greater than four inches; is that correct?

A. I believe that would be the case, yes.

Q. However, in actual fact those rocks would be very similar, would they not, in terms of fractures?

A. If you took those two extreme conditions it might be but I think, concerning a random distribution of this information, it would be unlikely that situation would arise I think.

Q. I am just trying to get an understanding of the concept and applying that formula you would agree with me?

A. That is why RQD is simply another indicator the same as the visual description of the rock was.

Q. One more example, if a rock of a hundred inches had a piece of 96 inches and a four-inch piece missing, the RQD would be very high, it would be 96 per cent; correct?

A. Run that past me again.

Q. A 100-inch piece of rock where

there was one piece of 96 inches and then a four-inch piece that was missing from that rock core and my question is that the RQD would be 96 per cent indicating a less broken rock, yet that four-inch gap could be a conduit for groundwater?

A. I don't think you can get to that detail with the RQD's. It just isn't calibrated to define such small units such as that. A governing factor also is the length that the RQD or the length the RQD was calculated over. For instance, an RQD could have been calculated for, say, five feet, the first, top two and a half feet of that five feet were relatively fractured and had a very low RQD when the bottom two and a half feet were relatively competent, had a 90 or 98 per cent RQD. The mean of the RQD over that run would be 50 per cent. So, you have to be also careful of what we are comparing here, what run we are comparing, what run length we are comparing.

Q. You would agree that certainly RQD by itself may not be a good factor in evaluating the degree of fracture?

A. I would agree with that. It is again an indicator, that is right.

Q. I would like to look then at your -- in this Exhibit 206 if we turn over to the second page where we see the RQD marked on alongside the boreholes.

A. That's right.

Q. If we look at HC-4, I would like to look first of all at your highly-fractured unit at the bottom of that borehole and we see RQD's of 72, 87 and a little part of 57; is that correct?

A. That's right. The 57, again that is the difficulty with calculating the core run with respect to a specific depth. If you refer to the Figure 2 I wrote,which is in that package of information in Figure 2, I wrote the RQD's on Figure 2 for for instance HC-4 and I think what our calculations came up with is for a moderately-fractured and weathered shale. If you look at Figure 2, Mr. Chairman, of that package of information, we had three measurements, four measurements of RQD; 69, 76, 59 and 49. Our RQD calculation in the weakly-fractured massive shale unit for HC-4 was about 100 per cent. Then the RQD's started dropping off into the highly-fractured shale unit from 57 to 87 to 72. So, there is a change in RQD's between the moderately-fractured and weathered shale from something in the order of the 50 to 60 range or 70 range into the weakly-fractured shale unit which had had up to 100 per cent RQD indicating very competent rock. Then it falls off to 57 to 87 to 72. There is a difference in RQD as we went down that borehole.

Q. Mr. Beechinor, my questions are, if we look at the highly-fractured unit, you see the 87 and 72 and if you want to call it part of 57. We see RQD's of 49, 59, 76 and 69 in your moderately-fractured unit. Isn't this the reverse really of what you would expect to see? We would expect to see lower RQD's in the higher unit and instead we see an 87 per cent in that unit which is higher than any of the percentages in your unit, moderately-fractured unit?

A. Yes, I know what you are saying but keep in mind again we are looking at relative differences here. Nothing is black and white in this bedrock environment. For the weakly-fractured massive shale unit we had an RQD of virtually 100 per cent. We got full recovery, we weren't seeing any fractures anywhere over that length. Then we move into something called the highly-fractured shale unit, we get into RQD's of 57. Granted, there is also an RQD unit in there of 87. I believe all along in my testimony I have indicated that even in the highly-fractured shale unit there are elements of the weakly-fractured unit where we do get very competent rock. I think that was illustrated by the borehole or the core hole that was brought before the Board which showed that what we had described as the highly-fractured shale unit at that particular location was relatively competent.

Q. Mr. Beechinor, let us get back to somebody who is examining this report and someone trying to understand where you developed this stratigraphy. I would like to summarize where we are at this point. On the basis of your borehole logs on HC-4 and HC-6 there is no ascertainable difference or in fact there appear to be more fractures in your moderate unit than your highly-fractured unit and then we look at your RQD's which are again, as you call them, an indicator. We see again that the highest RQD number is in a zone that you would expect to be the opposite in that the moderate and highly-fractured shale units are again not delineated?

A. Again you are missing one point when you describe the moderately-fractured unit on the top on HC-4. If you recall I think we started into this discussion yesterday. For the first 20 feet at HC-4 we augered that so we couldn't get an RQD for that particular unit. That is a fractured discontinuity that would indicate that that mildly-fractured and weathered shale unit is distinctive than the highly-fractured shale unit.

Q. Mr. Beechinor, how can we and how can the Board reach that conclusion when there is no detailed fracture analysis. I don't know whether those numbers further up that piece -- you say you can auger it up, obviously it's fractured, it may again show it is more fractured than the highly-fractured unit. On what basis can I analyze that particular piece of rock?

A. I think you would have to go to the borehole log. If you go to the appendix, HC-4-85 you will note the description of the portion we augered is there. That is the field description given by the geologist. It says red shale with occasional mottled or bends of green shale, mildly weathered, vertically fractured to six metres. Horizontal partings 50 to a hundred metres apart. There is an example for HC-6, we actually brought in in a bag an example of the augered portion of the weathered shale. It is a very broken up mass.

Q. I understand that and it seems we've had a lot of discussion about these distinct zones. It would seem, I agree with you, it appears fractured and again how can we distinguish between that unit and your highly-fractured shale?

A. I am not sure what the question is.

Q. How can we distinguish then between the moderately-fractured and the highly-fractured shale?

A. I don't think it is all that important that we do in the first place. The rationale or the interpretation indicates to us that we have a fractured and weathered unit above a weakly-fractured weathered unit which in turn is above another fractured unit. It is that characterization at this site that gives us the groundwater behaviour that we see.

Q. Mr. Beechinor, I am going to have further questions on that, on the weakly-fractured unit. Right now I am trying to focus on the stratigraphy. Let me move on then.

I want to finish up the discussion of borehole HC-4. First of all, a number of permeability tests were done in this borehole. If we turn to Appendix 11 in H-40A and again we can look at the first page of that. I have tabbed my report, that is why I get there so fast.

DR. KINGHAM: Let this be a lesson for all of us in the future that tabbed exhibits add to the efficiency.

MS VIGOD: Q. If you look at HC-4, I would first of all like to focus -- there were a number of packer rising head tests done. Can you confirm that the rising head tests done for HC-4, I guess it is OW-2 and OW-3 were done in the moderately-fractured zone?

MR. BEECHINOR: A. I would have to compare this to -- hold on.

MR. SOBANSKI: A. Mr. Beechinor is looking at H-219.

MR. BEECHINOR: A. Two is what we described from the hydrostratigraphic point of view in unit 3 and piezometer 3 at that point, at that location is what we described as hydrostratigraphic unit 2.

Q. So unit -- let me just look at HC-4-3 which is in unit 2, OW-3. That has a permeability result of 2.6 X 10^{-5}; is that right?

A. Piezometer 3, 2.6 X 10^{-5}, that's right.

Q. That is in your moderately-fractured unit, unit 2?

A. That's right.

Q. Can you also confirm a packer test done in the zone and that was done at elevation 119.1 to 122.2 and 125.8 to 128.3?

A. Right. We had done another and I indicated in testimony we had run another packer test too at that point between the two.

Q. We see again results there -- we have 1.6 X 10^{-5} and I believe your corrected result of 1.2 X 10^{-3}?

A. That's right.

Q. No pumping tests were done in that

zone; is that correct, on this well?

A. Well, we had conducted pumping test No. 2 which was a well installed adjacent to HC-4. We monitored the effect of that pumping test in HC-3, piezometer No. 2 at an elevation of about 125.

Q. We are talking about HC-4.

A. Oh, very well, I am sorry. No, we didn't. It was the pumping test beside HC-3.

Q. That is what I thought. Now, following down in Appendix 11 we note that there was a rising head test done at OW -- HC-4(OW)-1. Can you confirm that that is in the unit, your unit 4, the highly-fractured shale unit?

A. Well, it may well straddle the contact between the two.

Q. There the results were 5.6×10^{-6}?

A. Yes.

Q. Again, just to sum up where we are, the permeability results that we are seeing are from the unit 4 to the unit 2 are either similar or in fact now have unit 2 or a moderately-fractured result of 10^{-3} which is higher than your result in unit 4; is that correct?

A. Unit 4, well, we conducted, that is why we relied on the packer tests to delineate where the hydrostratigraphic unit began at the top, at the contact in between unit -- sorry -- we used the packer test information to delineate the contact between the hydrostratigraphic units 2 and 3 because it is a better test than the Hvorslev test or the rising head test. We didn't do a packer test in unit 4 in that location. We only had conducted the rising head test at that particular location.

Q. Can we ask you just one more time where that packer test that you got the result of 1.2 X 10^{-} ...

A. I think I made a note here where the range of the packer tests are. The upper one where we got the 1.2 X 10^{-3} is the first packer test we conducted between elevation 128.3 to 125.2.

Q. Mr. Beechinor, perhaps I can help you out here. If you look at your Exhibit H-220 ...

A. H-220, yes.

Q. ... I believe we actually did have some discussion on this. You will see 10^{-3} written in at the left-hand margin.

A. That 10^{-3} should be where the 10^{-7} is.

Q. All right, and that is still within your unit 2; is that correct?

A. That is in unit 2, that is correct.

Q. So here we have an order of permeability that is two orders of magnitude greater than your stated 10^{-5} for that unit and then we have a packer test done that showed that the highly-fractured shale has permeability of 10^{-6}?

A. No, we haven't conducted a packer test on the highly-fractured shale unit, hydrostratigraphic unit 4. I have mentioned before that we relied on the pumping test, PW-1 to characterize the hydraulic conductivity of the highly-fractured shale unit.

Q. Let me just see where we are. We are trying to get an understanding of first of all your stratigraphic units and how you developed your hydrostratigraphic units. Looking at all the information we have on HC-4 which is a fair bit of information I put to you, Mr. Beechinor. We see first of all that the fracture frequencies show no delineation or in fact, if anything, the moderate unit being more fractured than the highly?

A. I wouldn't agree with that at all. Even looking at the RQD's we see a unit where we got the hundred per cent RQD it falls in our hydrostratigraphic unit 3 indicating a low-fracture frequency. You didn't bring that up in the hand-out you presented.

Q. We're not talking about that right now. We are trying to get an understanding of the moderate unit and the highly-fractured unit and where this delineation came in.

A. You can't just isolate one thing from another. This is a comprehensive interpretation here.

Q. We will be getting into that unit but your testimony is that we have delineated layered units. I am trying to understand where you got that information and you also, my understanding is, that when you get into the model that your permeability in the moderate unit, you considered to be 10^{-5} and then the highly-fractured unit either 10^{-2} or 10^{-3}. Would you agree that on the information contained in HC-4 that in fact there is no basis for that two-order magnitude difference and in fact the tests that we have just discussed, the 10^{-3} packer test indicates that in fact your 10^{-5} unit may be more fractured?

A. If you are concerned about the fact that at this particular location in the hydro-stratigraphic unit 2 we did with the packer test define a zone where the hydraulic conductivity is 1.2×10^{-3}, I would agree with you. What we interpreted that to be though is an isolated zone of fractures in hydrostratigraphic unit 2. It is not something that you find throughout hydrostratigraphic unit 2.

Q. How do you know that, Mr. Beechinor, on what basis do you say that?

A. Well, we have to go back to the field program. I was going over in my mind again, this is almost two years ago I think we were doing this fieldwork. In the processes that we carried out in the field our staff was instructed and it is my understanding that it was carried out, is that what we would do, Mr. Chairman, is drill or core a 30-metre hole, take the core out, put them in the core boxes. Now we have a 30-metre open hole. Those cores were originally laid out in the field and from that we made decisions, let us do a packer test on this unit, this looks like a real fractured-up unit, a real mud seam unit. Let us do a test on it. We did that on most of the boreholes, most of the core holes on-site. So, what we were attempting to do, and all of our energy was in the instrumentation of this site was to instrument what we thought were the most permeable or fractured units. That was the philosophy of our installation. The depths where we were to instrument wasn't prefabed such as a WAT well where the ports, where they are going to be measuring permeability are designed in the lab and they are put in prefab. We were making field decisions. We have the core before us to let us know where we should be testing. That is where we did packer tests. Those are where we installed our piezometers to do the Hvorslev tests, the rising head tests. As a result of the packer test, the next stage as a result of the packer test we wanted to go to even a higher level of understanding hydraulic conductivity and lateral extent of the fractured units. So on those units that we conducted the packer tests, we then at HC-3, where we also conducted a packer test, we did a pumping test. We also conducted another pumping test at PW-1. I think the rationale for the third pumping tests is that we noticed in Ms Hewetson's work that she had found a zone of high permeability, I think 10^{-4} at WAT-5 at depth. So we decided let us do a pumping test to see if there is a major zone of fracture at that location as well.

Q. Mr. Beechinor, I will be asking you further questions about the pumping test and relating that as well. Can you answer me, isn't it standard practice to do a packer test in the entire hole so, for example in HC-4 we see there was no packer test done below about 119 elevation?

A. As I mentioned just now we did --

for instance, number one, we did a full packer test at HC-6 and that was actually a recommendation of Conestoga-Rovers and we felt that that was a good idea and we did so. At HC -- the other two packer tests we did at HC-4 and HC-3 as I pointed out our procedure was laying out the core in the field and deciding where on the major discontinuities and we did the packer tests on those. There was not much point in doing a packer test on pieces of competent rock where we could not measure any water moving into the formation.

Q. Mr. Beechinor, then my question is, why didn't you do a packer test in your highly-fractured unit at unit 4, at HC-4?

A. All I can say, and I am just trying to recall what decision we made in that situation. I think at that time, for instance, we had made this layered or horizontal hydrostratigraphic interpretation. This was unknown at that time. So, I would suspect that what we found at HC-4 when we laid the core out and when we did the drilling, that the most permeable units or the water-bearing units that we saw, the major ones, we did the packer test on and maybe it may have been at HC-4, even at the deep zone we weren't seeing a comparable fracture unit as we saw at the top of HC-4, albeit the discontinuities to show there is something there.

Q. I was going to say if we get back to the discontinuities we see similar results.

A. Standing here right now I wish we had done one at that location.

Q. We will move on, Mr. Beechinor. Just one last question on this, Mr. Beechinor. If you did packer tests, as you say, in the most permeable units, why did you get your 1.6 X 10^{-5} and I believe you have testified zero water loss in the next unit and then not go on to look either for other fractured units or do the whole hole?

A. You can't do the hole. You have to consider what is practical here as well. You can't -- if we were doing packer tests on every core hole we put on this site the drilling program would have taken a year.

Q. Are you saying, do you agree or don't agree that normal practice is to pack off the entire hole?

A. What do you mean? What normal practice are we referring to here?

Q. The normal practice is to do ten-foot sections of the hole and to pack that off and do your test?

A. We did that. At HC-6 we packed

off various units on the way down the borehole and did the packer tests on it. Now, we didn't do that on every location. We didn't think it was necessary to do that in every location. It would be totally impractical to do so.

Q. Mr. Beechinor, that leads into the next borehole I would like to look at, HC-6. Again, first of all I would like to start with the stratigraphy and if you were looking at Figure 2 again ...

A. I'm sorry, where are we now?

Q. I'm going to do a similar exercise just with HC-6.

A. Yes.

Q. First of all if we look at Figure 2 on page 35 ...

A. Yes?

Q. ... we can see that again HC-6 does seem to intersect most of the units that we are concerned about so it is a good borehole to look at. We have portions of the moderate unit, the massive unit and the highly fractured unit; correct?

A. That's right.

Q. Again, we provided, if we look at WB-225 which we just filed this morning you will see we have done a similar exercise of calculating the moderately-close, very-close fractures for about the moderate and highly-fractured unit in that borehole?

A. And you left out, though, the weakly-fractured unit.

Q. That's fine. Now, it seems that again, if we look at unit 4 we see distribution of fractures in the unit; moderately close, zero; close, 94 per cent and very close, six per cent. Would you agree again that unit 2 seems to have encountered the greater length of very-close factors than did unit 4 if we compare 30 per cent to six per cent?

A. I guess I was looking at Figure 2 and I wasn't looking at your data sheet.

Q. If we look at the data sheet, WB-225 ...

A. WB-225.

Q. ... I'm looking at borehole HC-6.

A. Again I have the same problem that until I find my notes that I did, I check the calculations on it, I can't confirm the number. I don't think -- just let me look at it. We had moderate for unit 2; we have moderately close, 27 per cent; close, 43 per cent; 30 per cent, very close. So you are saying that using that very close and close category that there is a fairly high degree of fracturing there.

Q. And similarly ...

A. Again I would point out if you had inputted unit 2 you would have found -- the weakly-fractured shale unit, you would have found the percentages for moderately close would have been 50 per cent.

Q. I'm not disputing this point.

A. I just wanted to make sure.

Q. I understand unit 2 and unit 4 delineation at this point. Again in the borehole logs, I believe your notes in the log for HC-6 also have a description of the fractured zone if we just look in Appendix 2, your borehole core log HC-6. We can see -- I am looking at sheet 1 of 6.

A. Yes.

Q. We see a note, about the sixth note down where it says fractures zones at 7.4 to 7.44 metres. Do you see that, the notes in the core log?

A. Notes in the core log.

Q. Under general description?

A. General description, okay. There are various -- the summary of the various discontinuities that we encountered in this core hole.

Q. We see that note saying fracture

zones, do you see that, at 7.5?

A. Yes, yes.

Q. Seven point four to 7.44 metres, 8.2 to 8.23 metres, 8.6 to 8.7 metres and again those would be within your moderate unit. Is that correct?

A. I don't know at this moment. I would have to compare all of those depths with the figure.

Q. Again, Mr. Beechinor, I guess part of the problem we are having it is very difficult to correlate these numbers. If we go by your Figure 2 delineations, I am just going to at this point ask you to assume that the first three fractures noted are in your moderate unit and the last two fractures noted are in the depth ranges in your highly-fractured unit. So again we are getting either similar, or if you like, more fractures in the moderate unit; is that correct?

A. Again, but you are just looking at one discontinuity there, the fracture zones. You have left out dipping joints, vertical joints, bedding spacing, the weathered portion of the shale, clay mud seams, gypsum-coated fracture, possible slickensides.

Q. Mr. Beechinor, let us just follow this through and look at your RQD results, H-206. Again looking at your Figure 2 there and, the third page in, HC-6. Again you confirm that we see the moderately-fractured unit has an RQD of 63 and that most, the highly-fractured unit has an RQD of 62.

A. That's right. The unit between those, the weakly-fractured shale unit, has an RQD of 97 and 98.

103 Q. Mr. Beechinor, if we were interpreting your hydrostratigraphy unit 4 you would see that you are getting into an area where you have 93 per cent RQD which would indicate less fractures?

A. Yes, I would agree and as I mentioned before in the highly-fractured shale unit we can get very competent units, components to it, that is right.

Q. Now, Mr. Beechinor, just to follow through this before I turn to a new topic, I would like to look just at Appendix 11, the permeability results in HC-6.

DR. KINGHAM: I'm sorry, where did you turn to?

MS VIGOD: Appendix 11 in H-40A.

Q. The results of your permeability tests in HC-6-85, could we confirm that your HC-6(OW)-4 rising head test, 5.8 X 10^{-6} and your packer test at 121.7 to 118.3 with the result of 6 X 10^{-5} are in fact in your unit 2 zone or your moderate fractured zone?

A. I will have to work that out. I can't do that in my head.

Q. It might help if you looked at your 220 as well. Mr. Sobanski, it may help -- we're just using your scale under H-220. We get one, one is at the interface of 2 and 3.

A. The packer test at the interface of 2 and 3.

Q. The other one in unit 2.

A. The packer test that is indicated here in the appendix between elevation 121.7 and 118.3 which said 6 X 10^{-5} is in the hydrostratigraphic unit 2.

Q. That's right, the moderately-fractured unit, that's what we're trying to get. Do you want to just confirm the other one, the rising head test?

A. Okay. Now we are going into the site, going at lower elevations.

Q. It is 119.6 to 120.5. Again we would think that would be in -- it appears to be right at unit 2?

A. Right at the contact there.

Q. In unit 2 or unit 3. Actually that is interesting. That permeability of course is greater than your 10^{-7} but it is close, it is around, it is 10^{-6} at that interface.

A. We indicate the geologic materials are fractured weathered shale. If you rounded it, it would be closer to 10^{-5}.

Q. So basically similar results in that unit there?

A. As compared to what?

Q. Well ...

A. There is an order of magnitude difference but ...

Q. I would like to just then look at your results in unit 4 for that well. If we look at the packer test at HC-6(OW)-1 at an elevation of 106.1 to 109.2 we see the packer test 1.5×10^{-5}?

A. That's right.

Q. And a rising head test in OW-3, 110.1 to 111.0 is 2×10^{-6}?

A. Yes.

Q. Now, again, Mr. Beechinor, these are the same order of magnitude as the tests in your unit 2 zone, aren't they?

A. I would concur with you on the point that, and I have mentioned this when we had the cores out here for HC-6 as well. What we are seeing for the highly-fractured shale unit at this location are hydraulic conductivities that are lower than one would expect for the highly-fractured shale unit. It may be that the highly-fractured shale unit is only indicated at this particular location by the packer test conducted between elevation of 109.2 and 106.1 where we had the hydraulic conductivity 1.5 X 10^{-5} but what we have done in this hydrostratigraphic interpretation is used all the information. We were finding the highly-fractured shale unit at this elevation and many of the other core holes. That is how we made that interpretation. This might be similar to a Site D situation. If a particular granular unit isn't there I don't think we are going to worry about it. If the highly-fractured shale unit isn't well demonstrated at this particular location I don't think I am too concerned about that.

Q. Mr. Beechinor, we are trying to get an understanding of where these zones are. First of all, no pumping test was done in HC-6; is that correct also?

A. That is correct.

Q. Is that how you, based on your packer test of 1.5 X 10^{-5}, is that how you then define that zone?

A. No, that is not how we defined the

zone of the highly-fractured shale unit. As I have mentioned before in testimony, the highly-fractured shale unit is indicated by the pumping test conducted at PW-1 and the effect at observation wells distant from PW-1. That gave us a horizontal continuity at a fairly consistent elevation. That led us to our interpretation that this site had a continuous unit of highly fractured at depth as well as strong, vertical downward gradients.

Q. Mr. Beechinor, what I am having a problem with, first of all on your Figure 2 we only have four boreholes mapped in terms of their fractures. We have been concentrating on HC-4 and HC-6. If we look at your Exhibit H-22 which is your hydrostratigraphic zones we also see an indication of a highly-fractured unit. I guess the question is, how did you determine the highly-fractured unit at HC-6?

A. From all the other information that is shown on Exhibit H-220 and from the indication -- well, there are two indications of it I would suggest at HC-6. One is the packer test conducted between the elevations of 109.2 and 106.1 where we did and we note in Appendix 11 a fractured shale zone with a hydraulic conductivity of 1.5 X 10^{-5}. Now, I think you could make an argument that it probably perhaps isn't as thick as I have delineated it. The reason it was delineated to that degree, I am looking now at Exhibit H-220 and HC-6, this is unit 4, hydrostratigraphic unit, highly-fractured shale unit. You can see that we came across two discontinuities in that core hole at depth. Between those two discontinuities there is a very massive unit and that has the elements of the weakly-fractured shale unit. Because there seemed to be two stringers, if you will, of fractures we lumped that section together as the highly-fractured shale unit even though, and to be fair to Ms Vigod, the packer test does indicate that even in that zone we delineated, the highly-fractured shale unit, there is very competent rock of low permeability. Our delineation of the highly-fractured shale unit really comes from the pumping test we did at at PW-1. Where you see the pink is where we were getting effects in observation wells from that. So, we had made a linear interpretation of where the highly-fractured shale unit was. So, that is the rationale for picking that.

Q. Mr. Beechinor, we will be getting to these pumping tests I assure you. Let me just follow the process through after this, after your determination of the stratigraphy you then incorporated the results of your packer tests, Hvorslev pumping tests and tritium information. That is what we are finding on Exhibit 220; isn't that right?

A. Yes, this was again raw data, our worksheet that we drew our interpretation from, yes.

Q. There are no drawings in your report similar to the ones we found in the Site D report delineating these units?

A. We made a conceptualization just as we did with Site D of the hydrostratigraphic units.

Q. That is a conceptualization you used in the model and we will be discussing that in a bit but there are no drawings or delineations of the zones similar to the drawings found at the back of the Site D report?

A. No, but we are talking about a bedrock environment here, the lithology. There is no difference in the lithology of the bedrock.

Q. What I'm getting at is on your conceptualization for instance there is no indication of where those boreholes are in relation to those units. It is very difficult to extrapolate that information on to this figure. I am just at this point discussing the fact that there is no similar type of ...

A. Not in the report I would agree with that and I think you requested that I put that information on a section and I did do that.

Q. That's what I'm getting to next. A few weeks ago you will remember in anticipation of cross-examination I asked you to provide us with delineation of those units on Drawings 6 and 7. You indicated that you hadn't done that but you would put those delineations on Drawing 6 and mark out the units and add some additional wells; is that fair?

A. What I wanted to give you and I didn't have this in front of me at the time, I wanted to give the information that we had used to make our picks of the hydrostratigraphic units.

Q. That is what became Exhibit 219?

A. That's right.

Q. The one concern I had arising out of that is I was surprised when you told Mr. McQuaid that you were then not relying on Exhibit H-219. Given that this drawing was prepared for the purposes ...

A. I don't believe I said that. I think what I had said is to the best of my ability and my recollection I put the hydrostratigraphic units that we had picked from Exhibit 220 and put it on this section for you so you would have an understanding of the rationale and generally where the hydrostratigraphic units begin and end. I want to point out one thing too. Particularly in this bedrock environment where there isn't distinct differences in lithology, it becomes interpretive. I will accept that. It becomes interpretive because that is what it is, where precisely you draw the lines between these various units. It is not a Site D situation where you can go from the till into the sand and say "Well, there is the line." Here we have to make some judgments.

Q. Until this point we really didn't have even your interpretation of where these units were.

A. Pardon?

Q. Until this point in the hearing we haven't really had your interpretation.

A. I haven't tried to hide anything.

Q. One question just before I move on is I would like to know what information then was given to the modeller to do the FLONETS model? Did he have a copy of what is now Exhibit 220?

A. That is what we generally worked from, Exhibit 220 when we were trying to decide on what thicknesses the unit should be for the contaminant transport model and generally what thicknesses are reasonable in connection with the finite element model.

Q. Until Mr. McQuaid asked you to put those unit linear delineations on Exhibit 220 there were no such delineations; correct?

A. No. We meet the picks. We made the picks from Exhibit H-220 from a scale that we had developed at that time.

Q. But, Mr. Beechinor, when we first saw H-220 we saw a number of, if you like, interlayers of permeable and less permeable zones, these pink and yellow zones?

A. Yes.

Q. I am trying to understand what information you communicated to your modeller as to where your hydrostratigraphic zones were. In other words, was he given the equivalent of H-219 with the zones marked on a drawing or how did that develop?

A. I can go through the process on how it developed. We had put this interpretation together at this time. I guess we are talking now April or May, '86 I think I have mentioned once before one of the difficulties with the sloping site where we have a significant change in elevation from the north end to the south end. Then the difficulty becomes what is an average condition at this site. The units thicknesses are quite variable on the site and some of them actually pinch out over the course of the site. So what we have done is made this hydrostratigraphic interpretation at this time and did a slice through the centre of the site which was just a bit north of HC-4-85 at an elevation of about 145. This information was projected into that elevation and we came up with 20 metres for hydrostratigraphic unit 2 which is the mildly-fractured weathered-at-surface unit. We came up with 15 metres by lumping these various yellow units together which are the massive unfractured units. We came up with a thickness of 15 metres at the centre of the site. Those thicknesses were what we used in Mr. Feenstra's contaminant transport model. I think also I indicated to the modeller, well, ensure at the centre of the site those unit thicknesses are about that in your finite element model. Once the conceptualization in Figure 4 in the text is now then projected right up to the north end of the site. Those units are at the north end of the site. What is the elevation of the north end of the site? Something about 181, 185. So that Figure 4 then shows our projection right up to the north end of the site. I think our weathered zone, mildly-fractured weathered zone at that end is about 15 metres and then the weakly-fractured shale unit is about 20 metres at that point.

Q. So, Mr. Beechinor, I would like to look at Figure 4 now, page 49 of H-40 and also look at your Exhibit 220. I believe you have already mentioned that the model of course was used for your contaminant transport model so that those thicknesses of the unit that we see on Figure 4 were used to model contaminant transport?

A. And for the finite element model to simulate the behaviour of the groundwater flow system.

Q. First of all, if we look at unit 2...

A. I am missing a report, hold on. Yes, go ahead.

Q. I am looking first of all at HC-4 on H-220. I believe you had stated in testimony yesterday that unit 2 went from elevation 137 to 125 for a thickness of 12 metres. I don't want to re-invent the wheel on this point. I took down your levels that you gave Mr. McQuaid, 137 to 125.

A. I would think that would be about right.

Q. Twelve metres. If we look at Figure 4 we see that your unit 2 is given a thickness of 30 metres, approximately 30 metres?

A. I don't know where you get that from.

Q. This is part of my problem from where HC-4 would be in relation to that.

A. I think I have mentioned in testimony before similarly to the conceptualization in Site D you can't put a specific borehole on this drawing.

It is intended to just illustrate the hydrostratigraphy that we found on the site. We have a till at the north end of the site, a till at the south end of the site. We have this mildly-fractured weathered shale unit, hydrostratigraphic unit 2. We have the weakly-fractured massive shale unit, unit 3. We have the highly-fractured shale unit, unit 4 beginning somewhere in the centre of the site to the south end of the site and so on.

Q. Mr. Beechinor, I believe you testified in answer to a question from Mr. McQuaid that somewhere in the middle of that, the centre of that figure, for purposes of trying to look at what the actual data showed and your conceptual data from 220 on your model, would it be fair to say that Figure 4 at that point your unit 2 would be 30 metres? In other words, 15 metres would be a little high?

A. Fifteen metres for unit 2 is the projection of the information on Exhibit 220 at the north end of the site.

Q. My question is though in terms of travel time, if we are looking at contaminant travel time and we have your information on 220 which says the unit is 12 metres. Your model -- I was using the figure of 30 metres. If you want to use 15, that's fine.

Wouldn't you agree that the travel time will be shorter with the thinner unit? That is the point.

A. I would agree with that. I am telling you how we made our picks of the thicknesses. We did that at the centre of the site, the centre of the site, this information projected to the centre of the site at elevation 145 gave us a thickness for unit 2 of 20 metres and a thickness for unit 3, the weakly-fractured shale unit, of 15 metres.

MR. SOBANSKI: A. It wouldn't be hugely different because you are dealing with the upper unit, unit 2. The velocity through unit 2 if relatively fast. The controlling unit is unit 3. That is the controlling unit in terms of most of the model.

Q. I am going to get to that, Mr. Sobanski. Just back up one minute. If your boreholes, from what I am understanding there, Mr. Beechinor, can't be marked on Figure 4, how can you then determine your discharge zone?

MR. BEECHINOR: A. I am sorry, you would have to clarify that question for me.

Q. You indicated a moment ago that you can't delineate your boreholes on this Figure 4. What I am asking is how could you then delineate your discharge zone from this figure, Figure 4?

A. Figure 4 was cut off at Highway 403 at the south end of the site. It doesn't go far enough. One b is supposed to be indicative of the discharge zone till. On Exhibit H-220 where we describe the discharge zone till area is shown here where the highly-fractured shale unit at HC-14 and HC-5, the pink unit sub-crops the overburden and the thickness of the discharge zone till was an average of the overburden thickness at HC-14 and HC-9.

Q. How can you be certain where it is when you have this cutoff at 403? Mr. Beechinor, this is an area my clients are quite concerned about, is where this discharge zone is. I am trying to get an understanding of how we and the Board can find how you determined this.

A. I think in the interrogatories I provided to the Canadian Environmental Law Association we have some supplementary stratigraphic sections that delineate south of Highway 403 our interpretation of where the highly-fractured shale unit is; is that right?

Q. I will get to that point. Just back to this Figure 4, am I correct there is no way -- if we can't find the boreholes on it, how do we delineate?

A. I think you can go to the text here.

Why don't we do that? It is in the interrogatories and the text. I think if we go to page 50 in the text we have a description of what we were perceiving as the discharge zone till. I will read it:

"South of Site F the till is overlain by lacustrine sediments mostly sand. This granular layer is typically a black deposit grading toward the lake from a thin veneer of sands to sandy silts near F.

An average hydraulic conductivity of 3 X 10^{-6} centimetres per second was assigned to the combined lacustrine sands and clay silt till overburden found south of Site F."

Q. Mr. Beechinor, I have some questions that relate to that later on. Let me carry on for a moment back to actually the point Mr. Sobanski raised. If we look at Figure 4 -- sorry -- and again turn to HC-20, unit 3 in your HC borehole 4.

DR. KINGHAM: You've just lost us there.

MS VIGOD: Q. H-220, unit 3 in borehole HC-4. Again I believe your testimony the other day was that the elevation was 125 to 110 for a thickness of 15 metres.

MR. BEECHINOR: A. Where are we now? We

are at HC-3?

Q. HC-4, unit 3, your weakly-massive unit.

A. I tried to make some notes of what I was saying.

Q. Actually I wrote down your elevations as you were giving testimony.

DR. KINGHAM: That essentially means for the record where those bold green lines march off to the left and you are saying that the record was from elevation 110 ...

MS VIGOD: ... to 125.

MR. BEECHINOR: That is right.

MS VIGOD: Q. Again, if we look at Figure 4, we see that your unit 3 is modelled at 20 metres thick. This is your unit that you claim slows down groundwater flow?

MR. BEECHINOR: A. Unit 3 is which?

Q. Your weakly-fractured massive shale unit.

A. No, it was modelled at 15 metres.

Q. It is in Figure 4, and we just went through this, it is 20 metres thick. I am just looking at your ...

A. I can demonstrate the thicknesses

we used for the models. I think I've done this before. If you go to page 107 of the text. Start with page 106, Figure 12, if you look at the information at the top of the page, the model thickness for the weathered shale was 20 metres. Turning over the page to 107, Figure 13a, the model thickness for the weakly-fractured shale unit is 15 metres.

Q. So am I correct then that for the FLONETS, the FLONETS model you used 20; is that correct?

A. No, I don't even think that is correct. I think at the north if you scale it off -- I was scaling it off the other day. At the north end of the site I think it is 18 metres and around the centre of the site where we made the pick for the contaminant model it is about 15 metres and decreases I think even further towards the south end of the site.

Q. But, Mr. Beechinor, on Figure 4 where we have the thickness on the left-hand side and I will accept your differentiation between FLONETS and contaminant transport, it says we have the 20 metres, 15 metres and 20 metres. My understanding is that you should rely on this Figure 4 as your FLONETS model information.

A. I think what you've said is you can rely on this to give a conceptualization, a visual aid to the reader of the hydrostratigraphic units that we were identifying.

DR. KINGHAM: We are understanding you to have said that the 15 metres that appears in your model in Figure 13a of this exhibit had to do with the model for contaminant migration?

MR. BEECHINOR: That is right.

DR. KINGHAM: Is the 20 metres that appears at the bottom of page 49 then the thickness you used in the FLONETS? I think that is the question.

MR. BEECHINOR: I think in general it is 20 metres. If we go to, say, the interrogatory for Weir & Foulds, at the north end ...

MS VIGOD: Q. Mr. Beechinor, it is two parallel lines, isn't it, in Figure 4?

MR. BEECHINOR: A. Yes.

Q. With the 20-metre thickness?

A. I think at the north end of the site where we utilized for the finite element model it is about 20 metres. I think if you actually scale it off it is about 18 metres. If you move down to the centre of the site just north of HC-4 on the finite element grid showing the hydrostratigraphy, we -- if you did scale off the elements at that location, I believe that the thicknesses for the fractured and weathered shale unit, unit 2 is about 15 metres and the thickness of the weakly-fractured shale is about 15 metres, perhaps up to 16, 17 metres at that location.

Q. All right.

A. What we had also done, keep in mind, is we did some sensitivity analysis varying the thicknesses of these units to see how much difference it actually did make. We felt comfortable that varying the thickness by one or a few metres does not substantially change the calibration. In fact when we did some gross changes to the thickness we got a much worse match.

Q. All right, Mr. Beechinor, let me move on. Just finishing off HC-4, the highly-fractured unit and I believe this point has been made that the unit, your unit 4 in HC-4 goes from elevation 110 to the base of that borehole and is therefore four metres or greater. I believe you have testified to that.

A. We are at HC-4?

Q. Unit 4.

A. Unit 4? All right, the highly-fractured shale unit.

Q. Elevation 110.

A. Yes.

Q. Down to the base of that borehole.

You don't have a line under it because it ends in that unit?

A. It ends in that unit.

Q. In other words it is greater than four metres?

A. It could be. It could be.

Q. We have had this discussion, from your model at that point in the middle of Figure 4 it is depicted as zero?

A. That is right. That is our interpretation that it thinned out and pinched out somewhere in the centre of the site. I believe in the interrogatories to the Canadian Environmental Law Association you suggested that maybe it extends all the way to the north end of the site. We tried that in the simulation and we didn't get a better calibration with that. Even if that were the case I don't think I would have too much difficulty in accepting that. The highly-fractured shale unit went right to the north end of the site.

Q. If we look at -- I would just like to finish with HC-6 in H-220. Again, looking at your massive unit, your unit 3 and the elevations you gave in testimony were from 118 to 109 for a total of nine metres.

A. For HC-6 I have said -- what have I said?

Q. One eighteen to 109 for your unit 3, the weakly-fractured massive shale.

A. No; I think for the weakly-fractured shale unit it was my understanding that I had indicated -- at HC-6 we are talking about?

Q. Yes, we are.

A. One eighteen to 109, is that what you said?

Q. That's exactly what I copied down. All right, my question here is; as you appreciate, that nine metres is both thinner than either your contaminant transport model of 15 metres or your FLONETS model somewhere in the vicinity of 20 metres?

A. I would agree with that and again the thicknesses of the units are based on what we interpreted thicknesses to be at the centre of the site.

Q. But when we are talking about groundwater flow would you agree with me that you are not using either a representative number or a conservative number in your model?

A. I think we are using a representative and conservative number. That is why I chose the centre of the site, it may be thinner at the south end of the site.

It may be thinner at the south end of the site, it may be thicker at the north end of the site.

Q. Again, I am still -- I am trying to get a picture of your actual field data and your model. Mr. Beechinor, I would like to turn to a discussion of your pumping tests.

A. I am going to let Mr. Sobanski -- I think he has reviewed more recently than I the pumping test results so I am going to have Mr. Sobanski take that.

Q. I am going to be referring to your pumping test results in Appendix 10 of Exhibit H-40A and Drawing 2 helps us with these pumping tests. I would like to start -- my understanding is that you chose the locations of the pumping tests based on various high permeability zones you had delineated through some of the WAT series and your HC-3 wells.

MR. SOBANSKI: A. That is partially the story. We certainly had seen evidence of that. We were looking, though, at the purge well concept when we put in pump well No. 1. It was also put in there because a lot of -- you have a large data base sitting there available to monitor. Putting monitor wells in rock is not a cheap proposition and we are sitting there among a whole nest of wells that we can use as monitors for our pumping test. To me it made eminent test sense that that would be where we would conduct one of these tests.

Q. Now, my understanding is that pumping well No. 1 is located -- that is the one located near MB-13. I guess we also have those locations in the interrogatories.

A. Yes.

Q. If we look at -- I am going to ask you to turn to the Morrison Beatty 13 drawdown results in Appendix 10, four pages in Appendix 10.

A. Yes.

Q. You confirm there that we see the high values of the permeability in Morrison Beatty 13-2, 3 X 10^{-2} and then Morrison Beatty 13-3, 4.3 X 10^{-2}. So there your high permeability ...

A. Again, that is based on a thickness here of one foot thick.

Q. We have therefore in fact a ten-metre zone of permeability of 10^{-2} according to this pump well result?

A. I'm not sure -- no, that wouldn't be the conclusion you draw. The results there indicate the way it is calculated is that you have two feet of that permeability.

Q. Then if you -- where this unit is

confirms to your H-220, unit 4; is that correct, your highly-fractured unit?

A. Yes, that is right.

Q. There were no packer or rising head tests done in this Morrison Beatty well I believe?

A. I don't recall them doing any. It wouldn't be possible for us to do because they constructed the wells.

Q. Let us look then at Morrison Beatty 16 in Appendix 10. Again this is in relation to your pumping well 1, the second page into your Appendix 10.

A. Yes.

Q. Again we see high permeabilities of 1.3×10^{-2} at MB-16-2 and at MB-16-3, 1.2×10^{-1}, very high permeabilities?

A. Yes.

Q. Now, I would like to turn for a moment back to the Morrison Beatty report, the Phase 3 report and if you could turn to the appendix at the back and I am looking at the appendix at the back called field permeability tests. Do you have that?

A. Not yet.

Q. No pages on this report either. Appendix C, field permeability.

A. Appendix C, yes.

Q. Would you confirm that if we look at OW-16-17 and 20-21 we see that those are the same wells as your Morrison Beatty 16-2 and 3, they are the same elevations, they are the same well?

A. Yes.

Q. If we look at the permeabilities we see that in OW-16-17 in the Morrison Beatty report we have a permeability of 2.35 X 10^{-5}?

A. Yes.

Q. And OW-16-21 shows a permeability of 5.9 X 10^{-7}?

A. Yes.

Q. That same well, in your pumping test, the latter one gave a permeability of 1.2 X 10^{-1}?

A. Yes, that's right.

Q. You have said many times that the pumping tests are a more reliable test because they deal with a larger area of the rock; is that correct?

A. We have also said that for some reason Hvorslev doesn't seem to be working in this zone and, yes, I feel that the pumping test is more reliable.

Q. Yes.

A. We have had this problem on several other wells. You have taken Mr. Beechinor through wells

4 and 6 as well. The Hvorslev doesn't seem to indicate the downward gradients indicate that there is a zone there.

Q. And then your pumping test in fact confirmed a permeable zone?

A. Yes, I have mentioned -- I think I felt in some ways we were lucky on this one because without this pumping test we would have come through with a prètty traditional interpretation of this site as has been given to date. This became, to us, the key to the interpretation of the layered system.

Q. Mr. Sobanski, I would just like to continue with pumping well test No. 1. We see the -- I guess the other well with the result is the WAT-7 series. We find that at the fifth page in Appendix 10. Do you have that?

A. Yes, I do.

Q. Again, for all those WAT wells -- I'm not going to read all the numbers but we see that again it is a very high permeability, 10^{-2}, 10^{-3} zone.

A. Again though, based again on one foot of thickness for this fractured layer. We had some discussion on that that it could be lower than that.

Q. It would be then if you are using that interpretation, all those tests would fall within the same general range; right?

A. They have about a five-foot packed-off interval. We have assumed a foot here. If you applied just on these individual tests a different thickness, then we would be dealing with one-fifth of the value shown here.

111A Q. That covers off the testing for pump well No. 1. So, just in sum at that point we see that these results in a fair number of wells have a high permeability. As you have said, the Hvorslev results from Morrison Beatty had shown a lower permeability but these later pumping tests showed a higher permeability zone?

A. I think we should understand too that the WAT series wells, these were the wells that did respond. There were others at shallower depths that did not respond to the pumping test. We monitored the entire nest of 12 piezometers and these were the ones that were showing some indication of response.

Q. Okay. Now, I would like to look at pumping well test No. 2 and HC-3 is the well with the drawdown there. First of all, you would agree that on Exhibit 220, HC-3 extends into your unit 4, highly-fractured zone?

A. If I could have just one moment to

get our location fixed.

Q. If you can find HC-3, it's right beside that.

A. I just want to refresh my memory for a minute where we are at on the site.

Q. Western central.

A. Yes, okay.

Q. Again on Exhibit H-220 you would confirm that that extends into your unit 4, hydro-stratigraphic?

A. No, this is just in the weathered unit.

Q. If you look at the bottom of HC-3, that extends, does it not, into your unit 4 zone? It is shown on your figure.

A. I am sorry, we are talking HC? Yes, it extends into the ...

Q. If we look at -- this is actually -- if we look at -- just keep that page in Appendix 11 here and we see that the -- if we can look at the packer test in Appendix 11, the first page of Appendix 11 in H-40A.

A. Just give us a moment, please.

Q. Do you have those?

A. Yes.

Q. I am just looking at -- these were, I understand, the packer tests that caused you to consider the pump tests. We see the results, 8.7×10^{-4}, 9.1×10^{-4} and 8.9×10^{-4}?

A. Yes.

Q. Now, I want to first of all -- and those are at the elevations listed across that page. I won't read them at this time. If we look at Exhibit H-220 ...

A. Yes?

Q. ... you will see the top of unit 4 is at about 113 metres? Do you have that?

A. At HC-3 are you referring to? It would be about, the way I am reading it off here, the top of unit 4 would be about 111.

Q. All right, let us use that, somewhere in that vicinity. Would you agree that the lowest elevation of the packer test with the high permeability results is about 124.8, looking at your Appendix 11?

A. Yes.

Q. That would be a difference of about 13 metres?

A. Yes.

Q. So in fact those HC-3 packer tests are way above unit 4, are they not?

A. Yes, they are. They are in the weathered shale.

Q. Again, there was a rising head test done near the elevation of unit 4 and we see that again in Appendix 11 at elevation 109.8 to 111.3?

A. I'm sorry, these numbers are coming so fast.

Q. HC-3-85 we are still on and I'm looking at the rising head tests.

A. Yes.

Q. Again, can you confirm that that was in your unit 4, your highly-fractured zone?

A. For which?

Q. The 109.8 to 111.3.

A. That is the 1.7 X 10^{-7}?

Q. Yes.

A. Yes, that is right.

Q. So, you would confirm that this is the only well in your HC series that permits a direct comparison of packer, rising head and pump testing? That is my conclusion after looking at all the data.

A. I am not sure. I should point out though that when you look again -- if you look at the packer test here and if you look at the pumping test at No. 2 there is a thickness correction factor required again. The thickness that I have used here is one foot to calculate the K value. In the packer tests it is not used as one foot, it is used as the entire packed-off interval. Unfortunately because of the way it is done these aren't directly comparable. I can work out the appropriate number for you if you like on what the pumping test indicates and what the packer test indicates and put them on a comparable basis by taking thickness into account. If you like I can do that. If you see the differences here, one is 10^{-3} and one is about 10^{-2}. So, if the difference in the packed-off interval is ten feet that would take it into account. In other words the pumping test results would be reduced by a factor of ten and it would put them into the range of the packer test permeability.

Q. Again not the rising head test where we saw 1.7×10^{-7}?

A. No, the rising head tests are obviously different here. But I should point out though that again the 10^{-7} is now not in a comparable zone. You have taken us from the upper zone, the weathered shale of unit 2 where we have just discussed the pumping test and the packer test and now you've thrown in 1.7×10^{-7} which is in zone 2 that is lower, so you are making a wrong comparison.

Q. I am comparing your rising head test in unit 4 which is your highly-fractured unit.

A. Those other tests, these pumping tests weren't carried out in that unit. They were carried out two units higher.

Q. All right, let us -- let me just finish off with HC-3. If we look at appendix 10, back into the drawdown results and we see the three results for HC-3a, 3b and 3c ...

A. I am sorry?

Q. Appendix 10, the pumping well 2 results.

A. Which graph are we on?

Q. We are looking at nine pages in. The title is "Pumping Test No. 2 Time Drawdown Data for HC-3 Series Observation Wells."

A. Yes, that's right.

Q. Now, what I am trying to do is look at the elevations of those three wells on your H-220. Can you confirm that the bottom of HC-3a falls into the top of unit 4?

A. Yes, it does.

Q. And the 3b falls near the top of unit 3, do you see that?

A. Two is in the bottom of unit 2

according to Mr. Beechinor.

Q. Do you see that 125 is your boundary between 2 and 3?

A. It is more like 124 now that there is a scale on here.

Q. I believe your evidence -- it's okay. If we look at your 3b which is 124.2 to 126.7 falls near the top of unit 3; am I not correct there?

A. Mr. Beechinor says that the bottom of the piezometer is at 125. If it is at 125 that would put it in the bottom of unit 2.

MR. BEECHINOR: A. It is in the bottom of unit 2.

DR. KINGHAM: Are you talking about the same thing? I believe Ms Vigod asked a question about HC-3b which shows an average of 123.5 metres above sea level.

MS VIGOD: Q. That's right. Could you confirm?

MR. SOBANSKI: A. We seem to have a discrepancy here, if we could have a moment to check.

DR. KINGHAM: Is this a good time to have lunch?

MS VIGOD: Yes.

DR. KINGHAM: Will we try for 1:30?

MS VIGOD: I would appreciate that.

--- Luncheon recess at 12:20 p.m.

--- Upon resuming at 1:43 p.m.

DR. KINGHAM: Thank you. Please be seated. All right, Ms Vigod.

MR. BEECHINOR: Mr. Chairman, you asked me to check the elevation of the screen settings just before lunch. I have done that if you wish that information. There was another lettering scheme used, A, C, B. A is observation well No. 1. I am taking this from Appendix 4 in the hydrogeologic report. At HC-3-85 the well denoted A on the pumping test information was observation well 1. It has a screen setting of 109.8 to 111.3. Observation well 2 is the one denoted C in the pumping test information. It has a screen setting of 125.1 to 126.6. The other one, B, OW-3, should have shown on the pumping test data a screen elevation of 128.7 to 130.2.

DR. KINGHAM: So that means if I understand this -- just let's get this straightened out. If we turn back to Appendix 10, is that what you are suggesting?

MR. BEECHINOR: That's right.

DR. KINGHAM: To I believe what was the ninth page, the HC-3 series observation wells?

MR. BEECHINOR: That's right.

DR. KINGHAM: You are saying that the numbers which appear in Appendix 4 beside HC-3-85 for the screen settings, top and bottom, should correspond to the numbers in Appendix 10?

MR. BEECHINOR: That is right, Appendix 4.

DR. KINGHAM: Your evidence is that the numbers in Appendix 4 are correct and those in Appendix 10 should be changed?

MR. BEECHINOR: That is right.

MS VIGOD: Q. Sorry, Mr. Beechinor, just for clarification, could you just go through to Appendix...

MR. BEECHINOR: A. You can all see it on Exhibit H-220.

DR. KINGHAM: Just to make sure the record is clear, Ms Vigod, that would mean that HC-3-B on Appendix 10 of the time drawdown data for HC-3 observation wells, HC-3-B should then read from 125.1 to 126.6; is that what you are telling us?

MR. BEECHINOR: No, H ...

DR. KINGHAM: I said B.

MR. BEECHINOR: I am giving the elevation for the HC-3 one.

MR. ESTRIN: Which one are you looking at?

MR. BEECHINOR: I will do this again from the top. A, observation well A you see there is ...

MR. LEDERER: Maybe the thing you could do is take a felt pen and write it down.

MR. BEECHINOR: Is that helpful?

DR. KINGHAM: That is the way I had understood it from the start. You have taken the numbers from Appendix 4, observation well construction details which you have now shown on this flip chart; OW-1, 109.8 to 111.3 as being pump test A. That is indeed the same as appears in Appendix 10. OW-2 which showed always 125.1 to 126.6 in Appendix 4, you wish that now to appear beside HC-3 in the pumping test No. 2, instead of 124.2 to 122.7 which appeared there formerly?

MR. BEECHINOR: Yes.

DR. KINGHAM: Finally you have taken the numbers 128.7 to 130.2 off Appendix 4 and those are the numbers which you would like to have appear beside pump test ...

MR. BEECHINOR: B.

DR. KINGHAM: I see you have put down A, C, B now.

MR. BEECHINOR: Those are the corresponding letters to the observation wells. The only one that was changed was B actually.

MR. SOBANSKI: Maybe I can help. I don't

know whether I can. On page 9 if you look at the pumping test drawdown, on the left-hand side we have OW-HC-3-A, B and C. Change the first one, HC-3-A to HC-3-1. The second one which is HC-3-B, change to HC-3-3. The bottom one HC-3-C, change to HC-3-2.

DR. KINGHAM: That certainly is a change.

MR. SOBANSKI: Now, on the right-hand side we have HC-3-A, change that to HC-3-1 again. That stays the same other than the 1. The depths stay the same. HC-3-B, change to HC-3-3. Just like we did on the left-hand side but the depth now changes to what is shown there. It is shown as 124.2. It changes to 128.7 and 130.2. So, 128.7 to 130.2.

Finally, the last one, finally HC-3-C changes to HC-3-2 and the depths stay the same.

DR. KINGHAM: Thank you very much.

MS VIGOD: As you can imagine that does created a bit of confusion.

MR. SOBANSKI: For us as well.

MS VIGOD: Q. I would ask if you could, please, overnight locate your field notes as to how these A, B and C got changed to 1, 2 and 3 so we can clarify that that is ...

MR. SOBANSKI: A. I wouldn't mind checking it myself because of that depth change.

MR. BEECHINOR: A. It is a numbering scheme our field technician had at that time.

Q. If we could have that undertaking for tomorrow then.

MR. SOBANSKI: A. Somehow it wasn't converted to the other system.

Q. Now that I understand and I am sure you will correct me if I am wrong, we have HC-3-A which remains the same. We have this highly-permeable unit which is found in unit 4. There is the pump test results. Is that right?

A. We have reported all of our information to you. HC-3-A or HC-3-1 which is the deep piezometer, we have reported the data but we are not really very sure of that information. We had a change, the well was monitored from time to time, very periodically and we had a change really in the last point. We are not sure whether that was a true reading or not. It is of course in the deep zone while the pumping test was carried out in the upper zone. We tend not to believe it. For example, the difference between the base of the pumping well, the base of the pumping well and that piezometer is only in the order of about ten metres or so, ten or 12 metres. One would have expected that if there was a connection vertically of some sort we would have had a very rapid response because it in fact is closer than the observation wells in the upper unit which are at a distance of only about 14 metres or so. We have given all of our data here and we have given an interpretation for it but the top curve we don't really believe because we think the last point is a spurious point that was never verified.

Q. Mr. Sobanski, I guess my question is what are we to believe in all of this? First of all we are dealing with H-220 and these results and now you are telling us that you don't believe these tests in here. Mr. Sobanski, let me ask you this; is the reason you don't believe this result which is the pump test result because it would show the fact that there is a response through your unit 3, your 10^{-7} zone?

A. Oh, no. If that happened it would be quite feasible. It is quite feasible. We have talked about vertical fractures in these units. We have said that there is a hydraulic continuity from the upper to the lower unit. That wouldn't be an impossible interpretation of the data. We are just saying that when you look at, for example, the transmissivity is very high. It is nearly 10^{-1} which would indicate that you would get a very rapid response. Yet if you look at the storage coefficient of that unit, 1.6×10^{-2}, that's a very high value, it's like a water table case. So, where we have just one point like that to give us an indication that there might have been a change, actually the previous one, first of all there was no response at all for 90 minutes and then we plot a potentially small response at 120. Then there was no monitoring at all until the end. Essentially the curve was flat other than the last point. However, if it were, given this low storage coefficient, when you look at the other storage coefficients of 5 X 10^{-5} and another value of 10^{-5} ...

Q. Mr. Sobanski, you do agree that there is a possibility of, as you said, vertical fractures and some connection in those units?

A. Yes, there is. We have said this all along that these zones would be connected from place to place by vertical fractures and this is how some of the water gets down.

Q. Mr. Sobanski, let me just finish off with this pumping well 2. First of all, if we accept your new values, my understanding is that your 3-A well is in unit 4 and now your 3-B and 3-C wells would be in unit 2?

A. The number -- the A well would be, or which is No. 1 now, would be at the top of unit 4.

Q. Yes.

A. The other two wells are located within unit 2.

Q. Yes. Just a brief comment on that. Your unit 2 zone which you have modelled at 10^{-5} in which we have seen the higher permeability rates in your pump test here and also that packer test at HC-4 which showed a 10^{-3} rate, my question is, why wasn't the higher permeability rate modelled for that unit?

A. It wouldn't make a great deal of difference in modelling the weathered unit at a higher value. The transit time through that unit at 10^{-5} is very rapid. Whether -- if we have a horizontal permeability of 10^{-2} it is just going to mean that even less water will get down because these are horizontal permeabilities. In fact more will move laterally.

Q. Mr. Sobanski, let me finish up this pumping well. You did get a response at PW-6-86. It is the same as your OW-2-86. If you look in the interrogatories, it is located 19-1/2 metres in the pumping well. I believe you will find the log for that pumping well test at about six pages in.

A. Yes, I see that.

Q. It is seven pages in in Appendix 11 and we have pumping well 2-86.

A. Yes.

Q. Again, if we plot, we see the high permeability of 4.3 X 10^{-2}. If we plot that on the unit Exhibit 220, do we again see that somewhere between unit 2 and the top of unit 3?

A. I'm sorry, we see which?

Q. We see that pumping well result?

A. No, that would be in unit 2.

Q. The bottom of unit 2 there?

A. It's in the bottom of unit 2. It's in the weathered zone.

Q. Again that would show some connection between that unit 4 and unit 2?

A. No, no. That well PW-6 is located essentially entirely within the upper unit 2. It just slightly penetrates, it is a metre or so into unit 3.

Q. Mr. Sobanski, just before I leave this pumping well test, if we look on your H-220 and look at HC-3, the result you don't believe is written, I believe at the bottom of that well we see the 5.9 X 10^{-2}?

A. Yes, that's right. It was put on -- it was certainly put on the map.

Q. Now, finally, let us look at

pumping well 3 and we see a response at WAT-5. That will be again in Appendix 11. That is actually the second-last page of your chart there. You are anticipating my question I see.

A. No, I'm just trying to get a location fixed in my mind as to where we are on the map. I can't anticipate your questions yet, you haven't asked any.

Q. My question is, first of all, if we look at WAT-5-1 which we see at elevation 122.4 to 120.9 and the permeability of again 4.6 X 10^{-3}, would I be correct that that is in the top of your unit 3? I believe it shows as such on your Exhibit 220.

A. Just give us a moment, please. You want to know which unit WAT-5-1 is in?

Q. Yes.

DR. KINGHAM: Can you tell us where we find PW-3 on H-220?

MS VIGOD: I am looking at -- TW-3 is the same as PW-3.

DR. KINGHAM: Thank you.

MS VIGOD: Q. That is correct that TW-3 is the same as PW-3?

MR. BEECHINOR: A. I am sorry?

Q. TW-3 is the same as PW-3?

A. TW-3, yes, that is right.

MR. SOBANSKI: A. If I may, Mr. Beechinor will explain.

Q. Right. Now, am I correct that WAT-5-1 is located at the top of unit 3 at a depth of 6.2 metres?

MR. BEECHINOR: A. I have noted on WAT-5 on H-220 where we got the effects in the WAT wells in the two upper WAT wells, the base of that effect at the WAT-2 well is where we made the contact between unit 2 and unit 3.

Q. And you are looking at WAT-5-1 or WAT-5-2?

A. WAT-5-1 and WAT-5-2.

Q. Are you saying both of them are at the base of that?

A. One of them is above the other.

Q. That's right, the bottom one I read as being at the top of zone 3.

A. If you look at Exhibit H-220 where we have broken, it is straddling the contact, I guess WAT-2 is straddling the line where I made the interpretation between hydrostratigraphic unit 2 and hydrostratigraphic unit 3. It is indicating what we feel is the hydraulic conductivity of unit 2. If you recall the top of the contact between hydrostratigraphic unit 2 and hydrostratigraphic unit 3 at HC-6 was about 118.

Q. So, again, this is 10^{-3} and you have modelled your unit as a higher unit?

A. I think if you recall what I said this morning when we were doing the coring and sampling, we were looking for permeable zones to instrument. So, our analysis of hydraulic conductivity is biased to the permeable zones. These are isolated units of permeability within the hydrostratigraphic unit 2.

Q. I guess my problem though is a number of these wells seem to be at this interface between units 2 and 3 which goes from a permeability of 10^{-5} to 10^{-7}. If your pumping wells are showing 10^{-3}, 10^{-2}, that is quite a delineation you are making there.

MR. SOBANSKI: A. Yes, but you are not -- you aren't testing with those the poorly permeable unit. These wells are testing the weathered zone within the upper weathered unit. These were the reason they were tested as we said originally. We had had some zones on the packer test that indicated zones of high permeability so we decided to look at it to get a better value for it.

Q. Now, Mr. Beechinor, Mr. Sobanski, can we agree that everywhere, to finish up this pump test, where we have pumped we have been getting in fact zones of high permeability and in fact at all three pumping well tests. I guess my question is didn't you feel that it would be important to do other pumping tests, for example, at around HC-4 or in the middle of the landfill to in fact see whether the areas weren't in fact more fractured under the site?

A. Some of the areas are inaccessible to water well rigs. That is why there aren't water well rigs in these areas. The terrain is too severe to bring a 20 or 30-ton rig into the area on wheels. So you can't put a water well rig into many of these areas.

We tested where we could get it and what we thought was important at the time. In hindsight you always wish you had more information. I don't know of any site that has ever been investigated that can't be challenged and you wish you had a few more holes. You know, we did three pumping tests on the site. We looked at the two units that we thought had the most permeability. That was the upper weathered shale and we looked at the deeper zone which is the, what we are calling for lack of a better term, the highly-fractured unit. We ran pumping tests in both of the zones that we thought had hydrogeologic significance here in terms of their permeability.

Q. Okay.

A. We didn't run a pumping test certainly on anything that is totally tight, it would be a waste of money.

Q. Mr. Beechinor, Mr. Sobanski, I would like to go on to the tritium testing which I guess is your next area of evidence which you used to get your hydrostratigraphic units.

As we have seen, the tritium data is a useful indicator of how groundwater has travelled. This would be particularly true of the site where we have these downward gradients, the general usefulness of the tritium tests.

A. The usefulness we believe for tritium is it is a fairly new technique to start with. The usefulness is in attempting to take water, water that is pre-1952 or so and water that is post-1952. The first tests were about November of 1952 by the U.S.

Q. I would like to just turn to your results in Appendix 12.

DR. KINGHAM: You mean Figure 12 from H-40 or Appendix 12? Figure 12.

MS VIGOD: You are right.

DR. KINGHAM: Or do you mean Drawing 20?

MS VIGOD: I think it is also in Appendix

12, small Roman Numeral iii.

Q. I would like to just also look at your -- the borehole logs for HC-5 and HC-8. If we start with HC-5 in Appendix 2, if we look at the sheet 1 of HC-5, we see the depth of the overburden is eight metres; is that correct?

MR. SOBANSKI: A. Yes, about eight metres.

Q. We just check HC-5 in the log -- sorry -- HC-8 in the log and we see that the depth of overburden there is about five and a half metres?

A. Five point seven is what we have put in.

Q. Five point seven, okay. We have seen based on your permeability information that you are estimating the permeability of the till to be about 1×10^{-7}?

A. That would be the unweathered till. It would be 1×10^{-7}.

Q. Your Figure 4 summary lists 1×10^{-7}?

A. That would be for the unweathered till.

Q. Am I right then that the maximum flow rate through the till is about, at that permeability, would be about 30 millimetres per year, about 1.2 inches? If we just take 1×10^{-7} and multiply that out?

A. I don't know. I would need all the factors before I could put that number on it.

Q. At a gradient of one, 1×10^{-7}?

A. A gradient of one?

Q. Yes, and times 60?

A. Just a second. Oh, so we now have centimetres per second in the unweathered?

Q. Times 60 to get to centimetres per minute?

A. That is first of all -- that is Darcy velocity, that is not a velocity. What you have given me is not a velocity.

Q. What would the velocity be per year?

A. What would the velocity be at that per year if we ignored the possibility of a weathered zone? So we want to divide that by about 0.3 X 60 X 365 X 1440, about ten and a half centimetres per year.

Q. If we were looking for evidence that tritium had moved since 1952 over the 35 years since 1952, at those flow rates, the till would serve to block or slow the groundwater flow downward, would it not?

A. To some extent. We've got a

weathered zone there to deal with as we have at the other site, so probably the 10^{-5} line which is going to be essentially removed by the landfilling operation. We've got a weathered zone there that is maybe five or six metres deep.

Q. Mr. Sobanski, my first question is since you have chosen two places to do your tritium test where there is a fair amount of till relevant to the majority of the site, would it have been more helpful, since we are looking for movement through the shale and we agree that the till is -- the till will be removed, to have conducted those tritium samples in wells where there is little overburden cover just to get an understanding of the flow through the shale?

A. If we might just have a moment, please. I don't know, I'm not sure how to answer that. My recollection was and Mr. Beechinor can correct me on this because he is the expert on the field activity, we selected what we considered to be nests that we thought were in very good shape. We did not construct tritium wells specifically on this site as we did at Site D. The costs here were very high when we decided to do tritium. So, to drill new holes was very expensive and time-consuming. Let me finish, please. We conducted the tritium tests on these wells before we had resolved the hydrostratigraphy. So they were done -- actually the tritium here was done before we did the hydrostratigraphy.

Q. Yes, but, Mr. Sobanski, we are talking about a site that is predominantly shale and we are looking to see where the tritium is going through the shale. You had other wells such as HC-4 or 2 that newer wells were located where there is little soil cover. Would it not have made more sense ...

A. Not necessarily. You could have argued the other way. If I had taken them just in the shale, you would have said "Well, why didn't you do them in the overburden?" This profile here on HC-5 shows that it has reached over 30 metres, so it certainly is getting down there.

Q. But, Mr. Sobanski, if we are looking for, if you like, certainly a conservative case and we are looking to see -- we know the engineering that most of the till is going to be taken off and most of the site is shale. I am just going to say should we have looked at those other wells or would it have been more helpful?

A. I don't know.

Q. All right. You did do your tritium testing at Site D I believe showed that the tritium hadn't moved further than five metres through till at that site. Actually, Mr. Sobanski ...

A. I think I should mark mine too. We had estimated it to have moved somewhat in excess of five metres.

Q. Okay, that is fine.

A. Something in the order of six metres.

Q. Now, let me look at your result for HC-5 in Appendix 12 and we have seen -- we have stated that it has moved approximately 30 metres and your conceptual flowpath which you describe in your report on page 97 to 102 is essentially downward through the fractured shale and weakly-fractured shale and then laterally to discharge through the highly-fractured shale?

A. Yes, that's right.

Q. The velocity, the downward velocity through the fractured shale is 250 metres a year and the downward linear groundwater velocity through the weakly-fractured shale according to your calculations is 0.3 metres?

A. Yes, under the assumptions that have been made there, yes.

Q. I guess here is where I have some

problem. On your Figure 4 we saw -- you projected the thickness of the weakly-fractured unit being 20 metres and if we had this tritium going through this thick unit would it have only flowed about, as you said what, ten centimetres times 35 years?

A. I believe my evidence was that I had taken this tritium profile and I had run the numbers through making the assumptions we have made and assumed that the top and the base of the units as interpreted and found that using these values I could get the material down to a depth of 30 metres.

Q. I am sorry, I am going to do this one again. If you had the velocity of 0.3 times 35 metres you would have it flowing down 10.5 metres and that would suggest ...

A. I'm sorry, which number are we looking at now? First of all we know it's weathered down to six metres or so. So it flashes through the upper six metres, then it goes through a couple of metres extra of till and then into a fractured medium.

Q. We are talking about -- we accept that. We are talking about the weakly-fractured shale.

A. And at HC-5-85 it is only in the order of seven or eight metres thick.

Q. HC-5 is now five to seven metres

thick, seven to eight metres thick?

A. It is ...

Q. ... seven to eight metres?

A. Something in that order.

Q. Mr. Sobanski, I saw that too. Would you agree with me that the actual data where we have this eight-metre-thick zone in unit 3 at this well would explain why the tritium has entered the highly-fractured unit as you have just said?

A. Yes, I gave that in evidence before I believe.

Q. My problem is, going back to the model, why did we use a 20-metre thickness for this unit if we are trying to be conservative in predicting flow rates? Why when this unit is supposed to be the barrier are we using a 20-metre-thick unit instead of the measured eight-metre-thick unit which corresponds to the tritium data?

A. We have explained that we used an average condition for the modelling which is taking into account a slice from north of the site all the way down to Hamilton Harbour. We have a grid that has been established for that and we have had to input parameters into the grid that are slightly different than field conditions at specific points. It's just the nature of the model. We have no choice, we have to jog it to jog it around various nodes in order to make it roughly horizontal. In some places it gets a little too thick and in other places it's a little too thin.

Q. But, Mr. Sobanski, in your contaminant transport model it is that figure of 15 that actually determines the velocity. There is not a range, we don't see a conservative figure being plugged in that model, yet we have tritium data and permeability data and other data showing us that this unit may be eight-metres thick.

A. As I say, we looked at what we felt and what Mr. Beechinor felt was an average condition. I shouldn't say Mr. Beechinor. It was many people involved in it. It was an average condition, an average case that was looked at. If it seems to fit the empirical data that we are finding at the landfill sites, we haven't seen gross contamination from those sites in about the right time frame. What we are dealing with now is one well and saying why didn't we use this. The interpretation of this site is a bigger thing than looking at an individual data point.

Q. We have looked at a number of wells and seen that that unit may be thinner than the one model?

A. In some places it is thinner, yes, it is.

Q. As well we have seen that this corresponds to an explanation of how the tritium got into that unit at this well, another piece of information.

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A. When you run through the model, part of it, the model has predicted pretty much what we've seen in the tritium too at this time. Since the Bayview site went in there could be contaminants down at 403.

Q. Mr. Sobanski, first of all ...

A. It fits reasonably well.

Q. Are we talking about the model in your report now or your new model?

A. We are talking about the model in the report and we are talking about the chemical model that Mr. Feenstra did. They all come together in roughly the same time frame.

Q. Then this new model, H-221, which you said you think is a better fit, you would agree that that model where you plug in permeabilities of 10^{-8} would certainly not gibe with some of this tritium data we've seen and some of this other data about the thickness of the zone?

A. I could make it gibe very easily. Given hydrogeological uncertainties it could be made to gibe very easily. We know we don't have a good fix on effective porosity in these zones. Change the effective porosity now of the weakly-fractured shale unit to 0.01 instead of 0.1 and all the numbers fall in line again.

Q. That's another factor.

A. I regret that that is the way it is. You have handed me a paper to review that says pretty much the same thing. We don't have a handle on fracture porosities. That includes glacial tills. We can't apologize for it, we just don't have the information. We have to make some educated assumptions and in this case we have provided a model that fits the empirical data that we have in that field. The sites have been sitting there since the 1950's, one of them. We are using that to help us and see whether the model is realistic. The model could be. For example, if we assume that Hewetson's chemical data are correct for a moment and we have some traces of organics down at the property boundary, it would roughly fit the model that we have put in to the Board. We have tried to tie all this in in a reasonable manner but we can argue all of these numbers because they are just not possible even in fractured tills to come up with an exact number.

Q. Just to finish off the tritium, we have discussed the tritium results from HC-8 earlier. Basically I guess -- would the conclusion there be that a suggestion that the bedrock conditions are highly variable?

A. The bedrock conditions no doubt are variable.

Q. Ms Hewetson conducted the tritium analysis on samples from the area and she presented the results of about 50 analyses from various depths. Again, her results found post-1952 water to depths of about 30 metres.

A. I believe that her numbers showed that, yes.

Q. Again, that would correspond to the elevations that you are finding in your highly-fractured unit? I believe you plotted some of her results on your H-220.

A. Certainly we have tried to interpret it. Ms Hewetson also had some trouble with her tritium data. She found it to be strange. Mr. Feenstra may be dealing more with it. I'm not sure whether he is or isn't. We found -- our curve was smoother than Ms Hewetson's in HC-5. Her curve, for instance it is a more classical curve of what you would expect for a tritium profile. Hers was a little more erratic. She was finding tritium in unit 4, the zone we have identified as a highly-fractured unit. For example in WAT-5 and she had some in Morrison Beatty 12. She also had some even in deeper depths, Morrison Beatty 16 is another one. Mr. Beatty is pointing -- I am getting tired. Mr. Beechinor is pointing out that she found it in Morrison Beatty 16 as well and mainly on that fractured unit. Certainly there are higher concentrations that she did at shallow depth. There were some other shows at deeper depths as well in the more massive unit below the so-called regional unit at the bottom which would be zone 5 here although it is not numbered.

Q. Mr. Sobanski, you confirmed that Ms Hewetson you said collected over 50 results and many were duplicates. She as well had used both conventional piezometers as well as her multi-level piezometers for the tritium?

A. Yes, she had, she had used both and she had used some of the Morrison Beatty wells.

Q. I would just like to turn to page 72 of your H-40 report, 72, and you see the second paragraph starting with: "While the results ..."?

A. Yes, I do.

Q. "While the results indicate that there is a moderate degree of variability in the depth of penetration of post-1952 water the data suggests a general decrease in tritium concentration locally. Previous tritium samples taken near the Bayview Landfill Site by Hewetson yielded somewhat inconclusive results regarding the vertical distribution of 3H. While many more locations were sampled, much of the data indicated increasing concentrations of tritium with depth. This could be a result of very complex network fractures or from bias introduced during the monitor, installation or sampling phase."

My question is in light of the fact that she has, as we have discussed, 50 examples, duplicate results, your results showing 30. metres. I suggest the tritium shows that this would be the result of a very complex fracture network?

A. Certainly there are complexities to fracture systems. Mr. Feenstra I hope will be addressing some of this in more detail. I may be wrong but Hewetson had indicated that her tritium results indicated that. We found a more traditional type of a curve than she did. I am not discarding her data or anything like that. There are complexities in shale, there is no question about that.

Q. But you had done a limited sample, a tritium sample?

A. We did it because of the complexity of the results that were obtained by Hewetson. Now, when you run your own tests and you find a more classical type of a curve it leaves you in a bit of a quandary as to what the original results meant. When we say, well it has no tritium in it all and you've only got an upward gradient. You've got locally tight rock which can happen. The other one says that it is a nice, smooth curve, declining with depth. We've got a series of tests that were done in wells, they were done differently, they were done for the permeable zones and we have come up with sort of a classical curve. Then you say the Hewetson data is bouncing all over the place and we're not sure why. Is it because of the complexities, is it because of the construction of the wells? I'm not sure.

Q. Again we can discuss ...

A. I'm not arguing that fractured rock can have complexities in the flow system. The saving grace on the site is the delineation of the flow system southwards, you know where the water is going to have to move. It can't move up onto the Niagara Escarpment.

Q. Mr. Sobanski, you have already mentioned porosities. As we have discussed, your flow velocity equation looks at both your permeability and gradient divided by porosity?

A. Yes.

Q. As we have stated, I guess the smaller the porosity, the faster the flow?

A. Right.

Q. We see on page 97 your effective porosities. This is in your report, H-40 and the values range from 0.1 to 0.001.

A. Yes.

Q. Considering that variability can have a large effect on flow velocities, my question is, how were your porosity numbers determined?

A. We have been through this several times but they are estimates. They are estimates, nothing more than that. We don't have any data to base exactly what that fracture porosity is. It fits reasonable well with what we are seeing in the Hewetson data, the velocities of our contaminant transport model are reasonable with respect to that model. Where I explained that in weakly-fractured shale, I felt that because we were seeing so few fractures in that material that for all intents and purposes I chose to treat it as though we were using nearly a matrix porosity. It isn't a matrix porosity, using matrix porosity it would have been somewhat higher than that but it is pretty well my decision to say that we would use in that zone a relatively high porosity value, although it may have some fractures. There were so few fractures in it that I did not feel it was too important because the flux through the few that there may be should not be large.

Q. Mr. Sobanski, did you consider using, for example, the method proposed by Snow to determine the fracture porosity in a more rigorous way rather than just doing an estimate?

A. I am not sure that Snow is rigorous. I advised the Board that I really haven't used the method. You come backwards at a fracture aperture and I couldn't apprise the Board of whether or not it was a good method or not. I have not used it personally.

Q. You have not used it although the method has been around?

A. That's what I said to the Board, we have not used it.

Q. Okay. Now, your weakly-fractured unit which we have said is your least permeable shale unit has your largest assumed porosity. The highly-fractured unit has a much higher permeability, yet a much lower porosity. Now, if the porosity of the weakly-fractured shale is much lower than assumed, wouldn't this increase, an increase in flow velocity?

A. I think I just explained that on why I did it but, yes, if you increase or if you decrease the effective porosity you would increase the velocity.

Q. Now, Mr. Sobanski, I have referred you earlier or gave you earlier this week a paper from the Technology Transfer Conference on the evaluation of contaminant velocity in low permeability fractured shale.

Mr. Sobanski, first of all, I would ask if you have had a chance to take a look at that paper?

MR. SOBANSKI: A. Yes, I have.

Q. Are you familiar with the three authors of the paper, Mr. Blackport, Hydrogeologist?

A. No, I am not. I know his name.

Q. Mr. Sudicky I believe who helped you on your model?

A. I haven't met Dr. Sudicky but I know his name as well.

Q. And Dr. John Cherry who we all know?

MR. LEDERER: Who we feel we all know!

MS VIGOD: Q. Again, this is a paper given at the Technology Transfer Conference in 1986. I would ask you to look at the -- first of all, the last paragraph on page 339 and 340.

DR. KINGHAM: Do you wish to enter this as an exhibit then? WB-226.

MR. LEDERER: If nothing else it is a matter of formality for the record. Perhaps someone could explain to us what the Technology Transfer Conference is. At the moment this is just a paper. It is a paper which was a proceeding of that conference by people whose names Mr. Sobanski recognizes, who we all recognize one name. We've got to have a little more.

--- EXHIBIT NO. WB-226: Excerpt from paper entitled "Proceedings Technology Transfer Conference, December 8 & 9, 1986" by R. Blackport, E.A. Sudicky and J.A. Cherry

MS VIGOD: Q. Mr. Sobanski, are you familiar with these Technology Transfer Conferences that are held every year under the auspices of the Ministry of the Environment?

MR. SOBANSKI: A. Yes, I am.

Q. In fact you receive the proceedings of these conferences from time to time?

A. Yes, from time to time.

Q. All right. If we turn then to page 339, just reading from that paragraph:

"One of the most important steps in the prediction of the extent to which groundwater contamination will occur at municipal landfills and at other waste disposal sites is the determination of the average velocity of non-reactive contaminant migration in groundwater. In our investigations of groundwater contamination, we have found that the greatest difficulties and uncertainties in contaminant velocity measurements and predictions occur at sites on fractured bedrock. For example, hydrogeologic investigations performed on the Queenston shale at Bayview Park landfill site have shown that this shale has a relatively low apparent hydraulic conductivity (i.e. low permeability) except at very shallow depth where weathering is an obvious cause of higher permeability. This finding of generally low permeability is consistent with previous studies of this shale in the Burlington-Hamilton area. Our investigations of the Bayview Park site have also shown, although not in an entirely conclusive manner, that the velocity of migration of non-reactive contaminants in this low-permeability shale is relatively large. This leads to the expectation that very large contaminant plumes can develop in fractured shale under conditions of relatively low contaminant mass flux through the shale."

Mr. Sobanski, can you comment on that paragraph?

MR. LEDERER: Just a minute. Now we have a proceedings of something, I gather it is actually something that Mr. Tidball can confirm this, it is a conference put on each year by the Ministry of the Environment and is conducted by them for people who carry on Ministry of the Environment funded research. Now we have a general comment about some of that research without any indication as to the nature of the tests, the kind of data that was relied on and we are going to have Mr. Sobanski comment on it. With the greatest of respect, I am not sure at this point that this should have been admitted as an exhibit at all. It's here now and my argument at the end of the day is it's going to have to be given relatively little weight. It is just a statement. I don't think it is proper to ask Mr. Sobanski to comment on a statement.

MS VIGOD: Q. Mr. Sobanski, this relates to the Queenston shale on the Bayview Park site which we have been looking at; is that correct?

MR. LEDERER: If it relates to Bayview Park at all, our investigation of the Bayview Park. What is that? What are we talking about?

MR. SOBANSKI: I have a couple of problems here with that whole thing. First of all it says "at sites on fractured bedrock." "Sites", I don't know what they are referring to as "sites." Because now they refer to Bayview Park which is a site. Now, which sites is he referring to? He says he is looking at more than one. So, I don't know what his experience is based on, number one.

Number two, he says that the shale has an apparently low hydraulic conductivity except at very shallow depth. I disagree with him entirely on that statement because we have proved that at depth there are permeable zones. So he is wrong on that statement.

He has shown, not in an entirely conclusive manner, that the velocity of migration is relatively large. I would say that the chemistry doesn't lead to that conclusion. The chemistry that we have looked at previously and Mr. Feenstra will talk to that in more detail has not demonstrated to my satisfaction that we have an abnormally large plume considering that the site has been going for over 30 years at Bayview Park.

MR. LEDERER: Could I also -- again I must try and add some substance to my objection to all of this.

DR. KINGHAM: We did note your objection and we do understand the point you are making about the weight that might be given to an exhibit where we have not had the opportunity to examine or cross-examine personally.

MR. LEDERER: If I may just point out to you, sir, that on the top of page 341 under the heading "Study Site" we have a statement here:

> "A site on Petro-Canada property in Clarkson, Ontario was selected and a preliminary phase of drilling and instrumentation has been performed."

On that score, that is completely the nature of my objection. We don't know what we're talking about. Mr. Hodgson points out that the next statement indicates that this isn't on Queenston shale at all but on Dundas shale.

MS VIGOD: Q. Mr. Sobanski, the passage I referred you to on page 339 respectively refers to investigations performed on Queenston shale. My question is: Mr. Sudicky, one of the authors of this report, who assisted you with your modelling work came to this conclusion. I was wondering, had you had any discussions with him as to his conclusions.

MR. SOBANSKI: A. Dr. Sudicky did not review our final report. We discussed it with him as he went. He did not know the final calibration to my knowledge.

Q. Do you know whether he then accepts your model and the results?

A. No, I don't.

Q. Did you have him review that?

A. No, we did not.

MR. ESTRIN: Mr. Chairman, I also wish to rise with respect to supporting Mr. Lederer's objection because there is no evidence as to what investigations, how Bayview Park, by which, if any, of these authors has been done at any point in time. I have done, in preparation for this hearing, I have tried to make up a reasonably extensive review of pertinent literature. I am not aware that Dr. Sudicky or Ray Blackport have themselves made any investigations at

Bayview Park. The only inference I can draw is that this is something that Dr. Cherry may have had some connection with and in fact his investigations, if any, were largely I believe ones that Betty Hewetson carried out and so we are probably getting a very indirect link back to something that perhaps Ms Hewetson did and perhaps Dr. Cherry didn't have a great deal to do with it, if anything at all, personally in the field.

So, I really wonder and I have to share Mr. Lederer's objection. At this point I'd be very, very, very cautious having admitted this document and I take it it has been admitted, as to putting any reliance whatsoever on such statements as "Our investigations of Bayview Park ..." have shown anything because until we hear some direct evidence that Dr. Cherry, Sudicky or Ray Blackport have made an investigation or what they are, I don't think the Board should even look at that.

DR. KINGHAM: We note your objection and that of Mr. Lederer. We had already decided to admit this as an exhibit and we made the observation with respect to the weight that we can give it in the absence of the authors in terms of examination, cross-examination.

MR. ESTRIN: I think it is perfectly proper for my friend over here to ask the witness about statements that other people have made but the Board clearly understands that -- as to whether or not he can agree with the statement, the stuff that happens to be in here that purports to relate to an aspect of the problem of which there is no evidence.

MS VIGOD: Q. Mr. Sobanski, as you are aware, the rest of the report deals generally in a more theoretical manner with the issue of porosity and if we just -- I would just like to return to the concluding remarks found at page 348, 348 in this exhibit, WB-226. The statement that:

> "The manner in which contaminant velocities are currently predicted in shale is close to guess-work."

I guess my question to you is do you agree with that statement?

MR. SOBANSKI: A. They go back on page 345 to also say:

> "...there are no generally-accepted methods for determining values of n."

Do I agree if it's guesswork, yes, to some degree I do. I hope that when I do it is called educated guesswork.

Q. So I guess as we have discussed and I think you did mention this briefly, the porosity number which of course affects that equation that you have given estimates on is a number that does have a certain amount of variability?

A. Yes, we have discussed this ad nauseam I think. I still am not satisfied in some regards on the whole issue because we can have very small, effective porosities and in fact be losing very small amounts of fluids like a fracture that may be so fine that a cupful could traverse a hundred metres in a very short period of time and yet the amount of leachate escaping from the site would be very, very small. I would like to see the issue examined from a point of view of flux as opposed entirely just to concentrations. I have looked at this and I would like to say that the methods that are being utilized on this site are very similar to those that we instituted for Site F. I felt somewhat gratified and hoped that they were employing some of our techniques. They have changed their well construction.

Q. Mr. Sobanski, I am going to be moving on to a new topic. Perhaps, Mr. Chairman, we could take our afternoon break.

DR. KINGHAM: We will take a 15-minute break.

--- Recess

DR. KINGHAM: Thank you. Please be

seated. Ms Vigod?

MS VIGOD: Thank you, Mr. Chairman. Actually I am reminded, I think this would be an appropriate time if we could just deal briefly with those undertakings from yesterday before I leave today.

Q. Mr. Beechinor, I believe first of all you were going to get us a copy of those logs for the test pits. Do you have those?

MR. BEECHINOR: A. Yes, I do. They are here. I will have to get them. We had better hold on for a moment here.

MR. ESTRIN: I was also interested in those and I told Mr. Lederer that they were available and he would make arrangements to make copies this afternoon and we will all have them.

MS VIGOD: Q. The next undertaking was to confirm whether there was a native till or sand and gravel in the well construction.

MR. BEECHINOR: A. I checked the original well construction logs that our geologist prepared last night. We find that around the well screens silica sand was used. Between the bentonite seals we used a medium sand obtained from a local sand and gravel distributor. That is the reference to native backfill.

Q. So it's not native from the site?

A. If you recall we are quarrying rock here so we are in fact taking away the samples so there was no native cuttings to put back into the core hole.

Q. Then you were going to confirm that the thickness of the seals actually used were in the range of 0.6 to 4.0 with most less than the 1.8-metre range?

A. I can confirm we checked the 1985 wells and 1986 wells and the range of the bentonite seals I came up with was 0.7 to 4.0 metres, average about 2 metres.

Q. That's fine. The last question, undertaking I believe was in regard to the accuracy of the Neptune meter.

A. Yes. I did call Mr. Policy of All Terrain Limited to ascertain what the accuracy of that instrument was. He indicated to me that that is -- that the Neptune instrument was obtained from the City of Waterloo. That is the same instrument he uses for all the hydrogeologic consultants for this purpose. The accuracy is down to the litre. You can measure the litre on the gauge and you can interpolate to the 0.5 litre between the increments.

Q. That is what our understanding was and I may have a question on that later but that is confirmed now?

A. Right.

Q. Now, I would like to turn to the area of your computer modelling and my understanding is that it was calibrated to fit the water levels observed in the field and I think we have heard that the distinct changes in water level, the large head drops over short distances which helped you to put together your configuration of the model; is that fair?

MR. SOBANSKI: A. No.

Q. No? Okay.

A. At least I don't think I heard that right.

Q. That your model was calibrated?

A. The model was used to generate heads and compare them to the field data once we had developed our hydrostratigraphic model.

Q. In your opinion, the general character of the flow system, in other words the area of recharge, discharge and lateral flow is represented accurately by the model?

A. I don't know that I would say it is exactly accurate. We have exhibited downward gradients where there are downward gradients and lateral gradients where there are lateral gradients. We did not demonstrate in the field the upward gradients of the discharge zones. We have had to infer that indirectly.

Q. I guess I would like to just explore that a bit further. If we look at the water level data in Appendix 5 in H-40A, I would just like to look at your ...

A. Appendix 5 in H-40A?

Q. It is the second page. Do you have that?

A. Just give me a moment, please. Yes, I have.

Q. If we look at the water levels in HC-11 you would see that the deep piezometer is about 92.09 and the water level in the shallow piezometer ...

A. Could you just hold on a second, please? HC-11?

Q. Yes.

A. Yes.

Q. The water level in the deep piezometer is about 92.09 metres and the water level in the shallow piezometer is about 89.48 metres. You would confirm that that is -- indicates an upward gradient at that well?

A. At HC-11? Yes, that would indicate a slight upward gradient in that location.

Q. In your Figure 6 on page 62, your model, page 62 of H-40 ...

A. Yes.

Q. ... would it be fair to say that you predict the water level in the vicinity of HC-11 at 89? Actually, Mr. Sobanski, I think I can be of a little more assistance. If we look at your H-22, your model where we now have these calibrated ...

DR. KINGHAM: Is that H-22?

MS VIGOD: I'm sorry, H-221.

Q. We can still keep our hand on the computer simulation so we can see where those wells are located.

DR. KINGHAM: Being page 62 of H-40?

MR. SOBANSKI: If I can just have a moment. We're in a dreadful mess on this table. Do you have an extra copy?

MS VIGOD: Mr. Lederer, Exhibit H-221. The problem is we have bits of information all over the place.

Q. We see there actually your calibrated model which we have heard you say, that is the model that is in the book in H-40; do you see that column? I am looking at your second page, the flow model.

MR. SOBANSKI: A. Yes.

Q. We see there the actual calibrated results for the model in H-40. Is that third column the calibrated model?

A. Yes.

Q. If we look down to HC-11, we see 89.48?

A. Yes, that's right.

Q. Then that predicts a water -- basically a lateral flow at that point?

A. Yes, it does.

Q. The field data shows an upward gradient?

A. Yes, a slight upward gradient.

Q. Again, if we look at HC-14 which is -- again, if you look at Appendix 5 in H-40A ...

A. Yes.

Q. Can you confirm that at that piezometer that there is in fact a downward gradient?

A. Yes, both in the field and in the calibrated model.

MR. LEDERER: Which number is that?

MR. SOBANSKI: HC-14.

MS VIGOD: Q. And in HC-15, we also see a downward gradient?

DR. KINGHAM: Was that HC-15?

MS VIGOD: HC-15.

MR. SOBANSKI: Yes.

MS VIGOD: Q. And in HC-9, we also see a downward gradient?

MR. SOBANSKI: A. It is very flat in the upper three piezometers. It is essentially lateral in the upper ones and then there is a small drop in between piezometer 2 and piezometer 1.

Q. All right. Now, in our discussion of the discharge zone, this zone is shown both on, I guess Figure 6 and as well we have your configuration found in the CELA interrogatories, Exhibit H-85. That is the very last page of the interrogatory. Do you see that?

A. Yes, I do.

Q. It appears to us that you have estimated this zone to be about 500 metres; is that about right, the discharge zone?

A. We have put in -- it was something in that order.

DR. KINGHAM: Would you repeat the number? It is estimated to be ...

MS VIGOD: ... 500 metres.

DR. KINGHAM: Five hundred metres long

deep, left to right?

MR. SOBANSKI: That would be 500 metres wide I believe.

MS VIGOD: Q. Now, if we looked at those three boreholes we were just discussing with the downward flow, could you confirm that there indicates that there is downward flow between the 403 and the railroad tracks and this in fact is the area you have indicated both as a discharge zone on the model and on the interrogatories?

MR. SOBANSKI: A. No, these wells that you have just discussed are just essentially south of Highway 403, where we have a nearly lateral flow, if we look back at HC-15.

Q. I believe we just confirmed that HC-15 was a downward gradient.

A. Just slightly downward between the water table and the third piezometer, piezometer 3. If you look from piezometer 3 to piezometer 2 or piezometer 1, we go down in order; 109.99, 109.42, 109.35. That is nearly horizontal flow. It is only slightly downward.

Q. Mr. Sobanski, could you point those piezometers out to the Board on Figure 2? I believe it is Drawing 2 under there. I believe it is under your 220. Mr. Sobanski, would you agree that, for example, HC-9 would be right in that -- appears to be in your discharge zone, as marked on the interrogatory?

A. Approximately. This isn't exact, it is just an illustration that says general configuration of discharge zone.

Q. Generally also in HC-15 and 14 which runs basically in the same line as HC-9 would again be in that general area?

A. Yes, just on the edge of it.

Q. Now, Mr. Sobanski, is it fair to say that we don't have any field evidence of an upward gradient in this area? We either see a slight downward or a lateral? We don't see any evidence of an upward gradient?

A. We have the indirect evidence of the swampy area and the conductivity that I mentioned.

Q. Not in the piezometers?

A. Let me finish. We have other information that I advised the Chairman of when I came back from my field trip. Certainly when I visited it in December, a year or so ago, there was evidence of a lot of discharge. When I went back on Father's Day there was not much evidence of continuous discharge of 28 cubic metres per year per metre. So there was indication from that that if the discharge zone is there, it isn't as strong as indicated by this model.

Q. Mr. Sobanski, for the field data that we do have in the piezometers, does this indicate...

A. From the piezometers, no, that is right.

Q. We have already discussed the fact that we have seen a discharge gradient in the vicinity of HC-11. Could you point out HC-11 for the Board?

A. HC-11 is located down by the golf course, on the north end of the golf course which would be something in the order of 1.1, 1.6 kilometres from the landfill.

Q. That of course is south of your railway track?

A. Yes.

Q. Again, if we look at HC-12 in Appendix 5, can we again confirm that the vertical gradient is also upwards?

A. Not quite. To some degree. The upper two are horizontal essentially. The lower one has a slight upward gradient. It is half a metre in 20 metres.

Q. Again, with these two findings of a slight upward gradient in this area, might we conclude that the discharge zone might extend further south?

A. Possibly. There is some discharge indicated as potentially occurring in those areas.

Q. In fact then where we really don't have much hard data in the piezometer data to substantiate the location and extent of your discharge zone as we have discussed, we have seen some downward gradients in the area you describe as discharge and we've seen some upward discharge gradients in an area to the south into more of the community area?

A. Well, we are getting closer to the lake so we expect the flow system to start to do a turn-around. We are seeing the effects of the regional gradients in that area. It is still essentially horizontal with some small upward gradients but we are now looking at the regional system. What we have seen is the wedge of rock that is being compressed -- "compressed" isn't the right word. It's being thinned as we go further south so water is sort of piling up within the unit and some of it is trying to come out. We would expect that in the regional system.

Q. I would like to move on to another topic. We have talked about your pathways for leachate leaving the landfill and we have seen -- okay, we have also seen an indication that your weakly-fractured massive shale is your dominant unit which controls migration. Now, I would like to discuss your leachate underdrain system. If you look at page 127 of H-40 and we have discussed your infiltration rate of 305 millimetres per year and we have discussed the quantity of leachate exfiltrating the site would be approximately between 13.7 and 22.6 millimetres per year. You find those figures on page 127,

A. Yes.

Q. The difference between these figures, your 305 millimetres and your exfiltration, your 13.7 millimetres and 22.6 is about 291.3 to 284.4 millimetres of leachate; correct?

A. In that order.

Q. That would be about 93 ...

A. The last number you gave me?

Q. Two eighty ...

A. It should be 282.4.

Q. That's right, 282.4. That is what I have. You would agree that those figures are within your range of your 93 to 96 per cent of the total infiltration?

A. Yes, that's right.

Q. It is then suggested, that is without an underdrain system in place?

A. That is with the underdrain system

in place because it says "the resultant capture efficiency of that system" is so much.

Q. Then I refer you back to page 74. Here you have indicated -- on page 74 you have indicated that the downward flow for recharge underneath the site, under current conditions, that is without the landfill, is about 13.7 to 22.5 millimetres?

A. Yes.

Q. Those figures are essentially the same as the 13.7 to 22.6?

A. I think they are probably the same number. I have tried to undertake to find out why there was a difference but I think they are just using a range of values that were calculated by the two methods.

Q. Am I correct then that it appears that under natural conditions the recharge rate is the same which occurs when the leachate drains are installed?

A. Yes.

Q. Therefore, the drains don't alter the recharge rate beneath the landfill? In other words, the capture efficiency of the drains is really actually close to zero?

A. No. No, the capture efficiency of the drains is still very high. It doesn't stop the groundwater component but it picks up all of the components that would have gone off as runoff and toe discharge.

Q. This is my understanding, that basically those drains are catching what would otherwise run off to the side?

A. That's right.

Q. The actual capture efficiency of what would normally recharge into the ground is in effect zero?

A. That's right.

Q. I had a very difficult time ...

A. That's why I say we can't overcome those vertical gradients at the site. By digging the site deeper you chase the water to the water levels.

Q. Then comparing D and F on this point ...

A. D and F?

Q. Sites D and F. Site F in terms of the recharge, the underdrains are zero per cent efficient while at D with the operation of a hydraulic trap, we have a possibility of 100 per cent efficiency in terms of capture?

A. In terms of groundwater? In terms of groundwater, yes, that is right.

Q. Now, in terms -- back to Site F.

In terms of the true efficiency of the drains we are really looking at this excess leachate and looking at aspects of mounding and various other operational factors?

A. Yes, it is still the efficiency of the tills. They are capturing, still, a great deal of leachate.

112A

Q. But they may not be up to 93 to 96 per cent efficiency in terms of some of those other factors?

A. I'm sorry, I don't understand that.

Q. That some of the leachate may have to be collected by perimeter drains, the underdrains wouldn't necessarily capture that high percentage?

A. We're talking about the total system capturing something in the order of 93 to 96 per cent of the leachate that will be generated at the site. Some will escape to the groundwater flow system and we can't stop that.

Q. Is that correct that 93 to 96 per cent is how much is available to capture that much; right?

A. I'm having a little trouble.

Q. Okay. That is the amount we have

discussed that doesn't get into the water system and would be available for those drains to collect?

A. That is the amount that doesn't get into the groundwater system, yes.

Q. Now, you considered the use of a liner to reduce the volume of leachate which would enter the groundwater system?

A. Yes.

Q. I believe this is discussed on pages 130 and 131 of H-40 and your conclusion is that the natural rate of leakage beneath the site is about 10,000 cubic litres a year. Is that correct?

A. That is what that number says.

Q. Actually we were trying to conceptualize what this looked like and I hate to use a baseball analogy now but ...

A. Why not?

Q. ... would this be about the length and width of the baseball field at the CNE filled with leachate to George Bell's waist?

DR. KINGHAM: Are we going to have evidence on the height of George Bell?

MS VIGOD: Q. Let's say one metre.

MR. SOBANSKI: A. I have no idea.

Q. Now, you ...

A. We had tanker trucks the other day, I understood those.

Q. The idea of a clay liner of one-metre thickness, I believe you stated that that would reduce that rate to about 4,400 cubic metres per year?

A. I have to read this.

Q. That is page 130.

A. Just give me -- page 130?

Q. Page 132.

A. Just give me a second to read this over. Yes, I have re-read it now.

Q. Perhaps -- could I just go back one minute and perhaps you could just indicate to us how you did get the 10,000 cubic metres a year.

A. You would have to count up I believe the flow tubes on the site itself, divide by the site length or rather multiply by the site width.

Q. So you are saying with a liner you would cut that leakage by about half?

A. Yes.

Q. You say the reason the liner doesn't cause a larger reduction of the leakage rate is that the rate of leakage, the leachate migration out of the base of the landfill is controlled by the low permeability of the weakly-fractured massive shale unit?

A. No. Come back to that one again. It says here:

"The difference in capture efficiency between 10^{-7} and 10^{-8} centimetres per second liners is only about 50 per cent because the 10^{-7} centimetres confining layer acts to underdrain the 10^{-8} centimetres liner."

Q. If we look back to page 131, the second paragraph, it says here, the first sentence:

"The rate of exfiltration to the intermediate depth flow system in the highly-fractured shale unit is controlled by the overlying weakly-fractured massive shale unit which has a hydraulic conductivity of about 10^{-7} cm/s."

A. That's right.

Q. So the permeability of this unit that has this influence...

A. It turns around when you put a tight layer on top of 10^{-7}, the whole system flip-flops. In other words, in its natural condition it is acting as a natural liner.

Q. That's right.

A. Put a tight liner on top of it and

it acts as an underdrain.

Q. That's fine but my question though is if the permeability of this weakly-fractured unit was not 10^{-7} but, for example 10^{-6}, then the leakage rate would also be about ten times higher. So we would have this 100,000 cubic metres, we would be over George Bell's head.

A. Way over. If that layer were 10^{-6} by all means we would have -- we would be moving ten times as much water. We would -- we could also be seeing tremendous velocities to the property boundary and I don't believe that those are demonstrated by the chemistry at the site.

Q. But let us look at how you -- I would like to just look briefly at how you determined that 10^{-7} permeability which is certainly key.

A. I have advised the Board. It was estimated, that was the best we could do with it to simulate the conditions in the model.

Q. But first of all we have had some discussion about the terms of the fact that the actual unit measured was thinner than the thickness you used in your model and I won't go into that again.

A. At some locations it is thinner.

Q. All right. Now, if we want to

assume, let us assume for the moment that your unit does occur between your 105 and 125-metre elevation, that would be your 20-metre unit.

A. Yes.

Q. On page 52 of your report, Exhibit H-40, you have indicated at the top of the page:

> "The weakly-fractured massive shale unit is a complex unit in that it occurs throughout the investigated shale sequence and exhibits variable, but generally low hydraulic conductivities."

You say that 10^{-7} is considered to be conservative but representative. Now, I would like to look at your permeability data in Exhibit 11 in H-40A -- Appendix 11, I am sorry. We are just looking -- if we can look through boreholes 1 to 8 which are either within or immediately adjacent to the proposed landfill area...

A. Could you direct me again to the appendix, please?

Q. Appendix 11.

A. Yes.

Q. You would agree with me that boreholes 1 to 8 are the boreholes within or adjacent to the proposed landfill? After that we are off further south of the landfill?

A. That's right.

Q. At 1 to 8.

A. Yes.

Q. You can see there are a total of 23 packer and rising head tests conducted in these bore-holes ...

A. Yes.

Q. ... between the 105, 125-metre elevation range?

A. I am not sure exactly how many there are but in which range again, please?

Q. The 105 to 125-metre range.

A. How many did you say?

Q. Twenty-three packer and rising head tests.

A. I can't convert that immediately without going through the whole table.

Q. Can we just check them off quickly?

DR. KINGHAM: Your limits were 105 to 125?

MS VIGOD: One-0-five to 125.

Q. Start at HC-3-5.

MR. SOBANSKI: A. If I could just have one moment, please. Starting at HC-3, I think we would be closer to say it is between 110, it is dipping, actually. It is changing. You would have to look at the individual logs. It is not good enough to say that because you lose nearly five metres or more going across the section in terms of elevation. I can't accept that as the criterion. I would have to work them out.

Q. Mr. Sobanski, where in the individual logs do we get an indication of where this unit occurs?

A. I'm sorry?

Q. Where in the logs you just referred to do we get an indication of where this unit occurs? We are using figures that we thought were established along the way here.

A. It turns back to Mr. Beechinor again but we have talked about Exhibit H-220 which is the interpretation. What I am saying is you can't just generalize and say "Well, Mr. Sobanski, taking anything from 125" because as soon as I get over as far as No. 7 I am at 120. It is dipping, so I can't accept your premise that it occurs on this drawing between 105 and 125. I also know that when we get over to the pumping test it is occurring at an elevation of about 100. So it is not good enough.

Q. Well, Mr. Sobanski, what I am trying to do is get an understanding of how you developed this figure of 10^{-7} for that unit. I think the Board...

A. That's fine, we can do that but I can't accept that premise to develop it.

Q. Do you want to start with 110 to 125?

A. I can't accept anything. We would have to work through the logs and see which ones are in the unit. Before you start it though keep in mind we have said over and over again, the zones that we instrumented were those with the high permeability in all cases. We did not instrument the solid rock. In every case where we instrumented we looked for fractures, we looked for mud and that's what we instrument . So we instrumented the permeability.

Q. Mr. Sobanski, then how do we -- we have a lot of data here. We have this Appendix 11. There is a lot of information on rising head and packer tests, tests done in the field. Certainly my look at these permeabilities suggests a more permeable zone somewhere in the range of 10^{-5} to 10^{-6}.

A. In terms of those tests we had some Hewetson data that said there was very low permeabilities in the solid rock and we tried it. We had our own packer tests which didn't take any water which was very low permeability, in the order of 10^{-8}. I advised the Board this zone gave us a lot of problems and we relied on the model to give us an average value when it simulated the results. We used about 10^{-7}. We could not obtain from our data base the permeability of that zone because it was too variable. We have gone through that about two or three times.

Q. So it is too variable and you couldn't use this field data to get a permeability?

A. That's right because we were dealing with some tests, because we instrumented the permeable zones, we are dealing with 10^{-5}, 10^{-6}. We were getting results from packers that were essentially zero. That is a big range.

Q. Mr. Sobanski ...

A. We simulated this with other types. In the model we simulated things like 10^{-8} layer and it doesn't give us as good a fit as a 10^{-7} layer.

Q. Mr. Sobanski, could you look at H-220 and could you take -- let us just do one borehole, HC-3, and can we look at your unit 3 and determine how we can get a permeability of 10^{-7} out of those alternating pink and yellow zones that I see there?

A. I don't understand this because I have told you the answer to your question already that the value is assumed. You can go through these one at a time but I've told you we have instrumented the permeable zones.

Q. My question, Mr. Sobanski, is you have placed a lot of reliance on this zone. This is the barrier to the recharge getting through.

A. You can look at it in the logs and see it. You can see it in the colours.

Q. You have no indication.

A. Yes, you do, you see the cores. You can see the rock that is solid.

Q. We have a lot of other information that you say we shouldn't take into account these rising head and packers?

A. We have taken into account, that's what I'm telling you but the zone is highly variable. We instrumented the permeable parts. Where we used packer tests in the harder zones we got no permeability.

Q. Mr. Sobanski, how did the tritium get through then?

A. Tritium can get through cracks in the material. There is some vertical communication we have talked about. At 10^{-7} it can find its way through with fracture porosities.

Q. What I get out of this is that we have seen no field data in the rising head or packer tests that lead you to this 10^{-7}. The tritium results show that the tritium is moving through. You have estimated this 10^{-7}, calling it conservative but in fact if we have even one order of permeability different, based on some of the actual field data that we are seeing, then we have a much faster flow-through system.

A. You would have a faster flow-through system but again your empirical data from the site does not support that, number one, nor does the model. It will not model properly if you change those values.

Q. In that scenario you would also have, as we discussed, a larger volume flowing through as well?

A. Yes, I would expect to see lots of leachate in the monitoring wells and we are not seeing that.

Q. Now, Mr. Sobanski, in regard to some of your tests where you had this zero observed flow-through, you have indicated now that the Neptune water meter you were using was down to a one litre and then I believe though you can estimate down to 0.5 litres?

A. Yes.

Q. Those are the packer tests results we see of zero at HC-6. Now, my understanding of that Neptune meter is that you wouldn't be able to estimate a permeability lower than 10^{-6} with those kinds of specifications.

A. Our geotechnical people this morning advised us that they could measure down in the field to 10^{-8} with the equipment we use. We have made some efforts to find what type of a meter this is in terms of its construction. If it is positive displacement as has been indicated to us by Neptune itself then it would be extremely accurate. I know I have had experiences myself of just leaking plumbing in the house that has cost me considerably, something that I didn't know about and couldn't see.

Q. Mr. Beechinor, have you ever done a packer test yourself?

MR. BEECHINOR: A. I think this was the first packer test I was involved in. That is why I relied on our geotechnical staff to actually perform the test but there was also some concern about whether or not they could be leaking. We paid careful attention to installing the packers on zones that were unfractured so that there wouldn't be any bypass or leakage around the packers.

Q. We just heard a minute ago that you put those tests in zones of fracture.

A. We are talking about the packer

test we conducted at HC-6 where we got the zero fluid into the formation. We were packing -- our packer material was against unfractured rock. There was no leakage.

MR. SOBANSKI: A. It's obvious if they got zero input that there was no leakage around the packers.

Q. I would like to turn to another area now. We had a number of questions from Ms Cronk through a long line of questions on the fact that a number, a large number of reports have been commissioned in regard to the Burlington and Bayview sites.

A. I'm sorry, I'm having difficulty hearing you.

Q. Ms Cronk took you through a long line of questions to establish that a number of reports had been commissioned in regard to both the Bayview and Burlington sites as well as Site F and there was some indication that this data came to similar conclusions about this site. I would just like to look at one or two points in some of these other reports. Mr. Sobanski, do you have a copy of the Burlington report with you, the buff-coloured report? I have an excerpt of the pages I will be referring to.

MR. LEDERER: Mr. Chairman, just to make

this clear, this is in effect a second excerpt of a report that has been produced before this Board. This is the report that was prepared in support of an expansion of the present regional landfill at Burlington, the one which is next to Site F, the hearing conducted in 1984, the first excerpt exhibited as B-217. It may be that if we are going to continue with exhibiting that this ought to be made A or something.

DR. KINGHAM: I am easy. Do you want to call this B-217A?

MS VIGOD: I'm in your hands on that.

DR. KINGHAM: We'll call it B-217A.

--- EXHIBIT NO. B-217B: Excerpt from Hydrogeological Study - Burlington Landfill Site, dated March, 1984

MR. McQUAID: I think it had better be B-217B. We will have to go to the next letter.

DR. KINGHAM: We will make it B-217B although I can't find this map. Did we all have a copy of the map B-217A?

MR. McQUAID: It was the large map that I put the red diagonal on.

DR. KINGHAM: I recall it well.

MR. HODGSON: Shouldn't it be Exhibit WB-217B?

MS VIGOD: Mr. Chairman, before I go on,

this is something you never want to happen. My secretary appears to have mixed up the numbers on two pages. So perhaps we will leave it. I will go back and come back to that in a while. I apologize.

DR. KINGHAM: We will reconsider this all tomorrow morning, both the number ...

MS VIGOD: I will provide everyone with a new ...

Q. All right, Mr. Sobanski, I will move on to a different topic to speed things along. We have had some discussion about the attenuation capability of this shale. You have indicated that you believe the shale has good attenuation capabilities. If we could just refer to page 99 of H-40. If we see the first paragraph, you have a reference to the CEC which is the cation exchange capacity. There is a statement that they are relatively high values for the CEC of the shale bedrock at about 65, that is milli-equivalents per hundred grams?

MR. SOBANSKI: A. Yes.

Q. My understanding is that you say it has a high capacity to take positive ions out of solution, is that basically ...

A. Yes.

Q. If we look to Appendix 3, if we

show your analysis, Appendix 3, Exhibit H-40A ...

DR. KINGHAM: Little Roman ii?

MS VIGOD: That's right.

Q. We're at Appendix 3, little Roman Numeral ii.

MR. SOBANSKI: A. Bear with me for a moment. Yes.

Q. Do you have that?

A. Yes.

Q. If we turn to this appendix we can see there is a little asterisk halfway down the page and then we see an analysis was conducted on a crushed sample less than 80 mesh 0.177 millimetre size. Do you see that?

A. Yes.

Q. My understanding then is that what you did to do this analysis was that you took the rock and passed it through a seive and then tested it with, for example a solution with metal with a known concentration and you have the known weight of the rock and you see how much metal goes out of solution and ends up on the rock.

A. I think I will just defer this if I can to Mr. Feenstra. His firm conducted the analysis.

Q. Do you have ...

A. He can give the best analysis for it.

Q. All right, we will leave that. Mr. Feenstra may be here for a while. I would like to refer now to your information about local water wells.

A. At last I can pass the microphone over to Mr. Beechinor.

Q. You have discussed your walk and talk surveys that you made of local water wells and I was interested in how you did this survey. Did you knock on any doors, did you define a certain geographic limit and then go out and investigate water wells or ...

MR. BEECHINOR: A. I think the process is described in the report. First of all, we researched the water well records on file with the Ministry of the Environment and could not come up with any locations downgradient of Site F. Subsequent to that I met with a resident of Aldershot, Mr. Chumley. He had previously reported or someone in the process reported that there were some uses in the Aldershot area of some older wells. So, we tried to track those down. I think Mr. Chumley at that time, I think we're talking September of 1985, indicated that the six wells he knew of and I understand Mr. Chumley was, if he is not now -- I have seen him at the hearing -- if he is not now he then was very active in the citizens groups so I went to speak to him about where these wells might be. He was able to identify where six were. Then we started knocking on the doors of those six and from that we got information that there were some additional locations that we should check out. I believe in total we came up with 13, 13 wells. Of those we found in the final analysis that three of them were being used for human consumption. These wells were all a kilometre or more away from the site. Two of them were being employed as -- for some limited summer use, for gardening use in the summer. The remaining wells that we uncovered at that time were either not in use or filled in or abandoned.

Q. Now, Mr. Beechinor, you would agree of course that it is important to ascertain the water resource and users downstream of Site F as with any other site?

A. Certainly.

Q. I am showing you -- I believe I had provided you with this earlier -- a survey done by our expert and I would like to distribute this at this time.

MR. LEDERER: Before anyone looks at it I think I'm required to say I don't object particularly to it going in. It is customary for things to be done in this way as long as it is understood that for it to have any probative value we will have to have some proof. The chart at the end is very simple to understand but then on it it has a professional name. The survey at the front is called the survey done by our expert. To the rest of us that doesn't have an awful lot of meaning at this point. So I think it has to be made clear that until we understand how this survey was done it will have to be subject to further proof. As long as that is the understanding this is filed under I have no objection.

MS VIGOD: Mr. Chairman, I think you will appreciate we will be bringing evidence on that survey and I think that at this point rather than waiting until June ...

MR. LEDERER: June of which year?

MS VIGOD: ... that the other parties and we also would want Mr. Beechinor to comment on this survey. We will of course be proving this later on.

DR. KINGHAM: In view of Mr. Lederer's objections if you exhibit it, we will proceed on that basis.

MS VIGOD: Q. Mr. Beechinor, on the last page you see a printout from the firm Barringer Magenta. I believe that is the same firm that did your chemical results in your report?

MR. BEECHINOR: A. Some of the results.

Q. If we can just for the time being, if you will allow me to explain that the box part of that printout which says Site F data is in reference to, if you like, the survey done on Site F, that other material refers to other work done for Mr. Bowen's firm, if we can accept that for the moment. I would ask you, as well you will see on the preceding page a map with the location of the wells and the owners' address marked on; do you see that?

A. Yes.

Q. Can we just confirm that generally we see two wells, 7 and 8 upgradient of the site; do you see that?

A. Those are two of the 17 there.

Q. That's right. The rest of the 17 wells are located downgradient of the site?

A. Not necessarily.

Q. Located south of Site ...

MR. SOBANSKI: A. I might just say before we leave 7 and 8, we had better look at No. 8 because it says it's a cistern as opposed to a well. That isn't a well, it's a hole to collect water, so it's not a well at all.

Q. All right, it's just for the purpose of trying to establish that two samples were taken up-gradient of the site.

A. That will be groundwater, not run-off.

MR. BEECHINOR: A. I do know this as well, that wells Nos. 4 and 5 are the same wells, are they not?

Q. They are a duplicate sample of that well. We wanted to run a duplicate.

A. Are we saying at this point that we are talking about 16 wells -- 15?

Q. Actually, Mr. Beechinor, you will see that well 4 is marked on there and you are correct there isn't a well 5, it is a duplicate.

A. So we're talking about 14 wells south of the site.

Q. You will see if you look on the first two pages, you will see that a number of the wells have in brackets a number. If you see, for example, well 3, you will see chloride reading of 28 and in brackets 75?

A. Yes.

Q. The sulphate 65 and in brackets 87?

A. Chloride 28 and 65.

Q. Twenty-eight and 75. If you see a

note on the following page, the bottom of the summary, that those brackets refer to the wells sampled by yourselves as well?

A. That's right.

Q. So we in fact are still left with two of your wells?

MR. LEDERER: I don't understand how you get that from the note. Mr. Beechinor has very quickly agreed but I would like you to explain how you get that out under the notes. I have four notes, Roman Numerals I through IV. The first one deals with sampling conducted June 27, '87. The second is all analysis performed by Barringer Magenta Limited, Rexdale, Ontario. No. III is referring to an accompanying figure for locations and No. IV is Trow Hydrology Consultants' number, it refers to Trow Hydrology Consultants Limited, well number, Appendix 9 and Drawing 2. I don't see a relation between those notes and the brackets.

MS VIGOD: Perhaps I can clarify that.

Q. If you see in the second column of that summary, you will see THCL number; do you see that right at the top, you have your well number and then you see THCL number and the heading?

MR. BEECHINOR: A. Yes.

Q. If you look down to well 3 you will

see 43 HC?

A. Yes.

Q. That would be your number, your well number?

A. That is correct.

Q. So, if we went to Appendix 9 we would find these chemical data, that is if you want to double-check that?

A. Why don't we double-check that?

Q. Fine. Do you have that?

MR. SOBANSKI: A. Yes, we are just checking it.

MS VIGOD: Mr. Chairman, perhaps we could make this an exhibit at this point.

DR. KINGHAM: Yes.

MS VIGOD: WB-227.

DR. KINGHAM: WB-227, subject to further proof.

--- <u>EXHIBIT NO. WB-227</u>: Summary of Water Well Sampling

MR. BEECHINOR: The only information I find lacking is for your well No. 16 which is the same as our well No. 42 HC. You didn't report the chemistry that we have for that well. The chloride should be about 52 and the sulphate should be about 52.

MS VIGOD: Q. That's fine. In general,

first of all, you would confirm or at least from this document that the conventional parameters that were looked at here, that the chlorides, that the chlorides and sulphate readings are well below drinking water standards. The one exception happens to be a new well upgradient of the site, that is well 7 is the only one that shows an exceedence?

MR. SOBANSKI: A. Yes.

Q. In fact those levels are quite low. It is quite good water, you agree?

A. Yes, it is, yes, it's not too bad. The one upgradient, we would expect that at the depth that was given he may be into the shale. That is on No. 7. I would say it's in the well in rock although it is in shale, 35 metres deep. So he is getting into the shale quality water.

Q. The other well south of the site we see a fairly good water and just to meet Ms Cronk's concern you would be able to confirm that on the Barringer Magenta results the chlorides are all -- are very low?

A. Yes. I would need some advice on what the nitrogen is, though, the nitrate and how that is being reported.

Q. But if we are looking at the

chlorides and sulphates we see pretty good water. Mr. Sobanski, again as you see in the charts, the comment we see that a number of residents have no municipal supply, at least the first two wells used for everything?

A. The first two, 1 and 2 have no municipal supply, used for everything, used for drinking on Bowen No. 3, uses for drinking No. 4. Nos. 4 and 5 are the same well. No. 6 is used for property sold. It is commercial. I am surprised they would be using that groundwater. They are on a pipeline. It's on King Road there and there is a pipeline right in front of them. I am surprised they use that well. No. 7, that is a farm well to the north of the site. No. 8 is a cistern which is not a well. No. 9, it says no municipal supply. We identified that one I believe. No. 10, gardening supply which we had down as summer use only so I believe that would fit the pattern. No. 11, it says uses for everything. It wasn't one of our wells. No. 12, it says uses for everything. No. 13 says drinking. No. 14 says drinking. Fifteen says drinking. Sixteen, nothing, no comment or on 17 as to what the uses are on those two wells.

Q. Mr. Sobanski, you would then agree that there is in fact a water resource here south of Site F?

A. Yes. I think we have talked about the fresh water rind. I would still say I would need some advice on the nitrates in those wells as to how they are being reported, whether they are being reported as nitrogen or nitrate.

Q. We will deal with that in our evidence.

A. Because if it is being reported as nitrate or as N, nitrogen, then they would exceed the Ministry's criteria. If it is as NO_3 as indicated in the upper column then it would not exceed the Ministry's drinking water quality criteria.

Q. We will certainly call evidence on that but the chlorides and sulphides that you measured would it be fair to say in these wells that we are seeing a fairly good resource and that people are using it for drinking purposes?

A. Yes, that's right. It is reasonable quality water and when we get up into the shale above the site we are seeing again a situation similar to what we discussed before. We have got a rind that is in equilibrium with the existing sites upgradient and with a very poor water quality at depth. It has been sitting there for 10,000 years or so and they say equilibrium condition of good quality water on top of poor quality water.

Q. Okay, Mr. Sobanski, we will leave that and we will be calling further evidence on this.

Finally -- actually we are coming to an end here -- just briefly we have had -- Mr. McQuaid had referred you to the green comparative report, Exhibit H-14.

A. Yes.

Q. I don't even think you really need it. If you feel you need it ...

A. I'm not sure. I had better not take any chances.

Q. Just looking at your letter and my question is that if we are striving -- I put this as an assumption to you -- that we are striving to a goal to limit the impact off-site of these two proposed landfills. I believe you stated that at Site D with the hydraulic trap working we should be collecting 100 per cent of the leachate and in that case the trap is part of the operating plan that will go in at the beginning when the landfill is put into place. In the case of Site F we have indicated that with the under-drain system operating at its full capacity, it is still going to -- we are going to have this five per cent approximate leakage into the rock. Mr. Sobanski, I believe your evidence was that if you added pu. and other contingencies to Site F you would then b to make it close to 100 per cent. Is that my understanding?

A. Yes.

Q. You would agree that -- would you agree that D would then appear to be a better site as it would require one less layer of engineering to achieve containment on-site?

A. There is one less layer at D required to achieve containment as proposed now.

MS VIGOD: Thank you, Mr. Chairman. Those are my questions and subject to dealing with that...

DR. KINGHAM: You are going to reprimand your secretary overnight and bring us a new copy in the morning. I hope he doesn't get upset. Thank you very much. We will resume tomorrow at 9:30. Mr. Lederer?

MR. LEDERER: Thank you, sir, I apologize. Two matters before the Board adjourns. Counsel met this morning looking for some way to see whether or not we might be able to shorten the hearing and certainly my understanding of where we were when we finished was that we might congregate again tomorrow. I am speaking now of just counsel. I am wondering if, whether or not the Board might be prepared to convene at 10:00 rather than 9:30.

THE CHAIRMAN: We would certainly encourage you on that effort. We are also thinking along similar lines as well.

MR. LEDERER: I might just indicate to the Board I have one other problem. It is the sort of thing that is going to happen from time to time in the course of the hearing. We have had to make a reasonably quick adjustment, the fact that -- two comments -- the fact that we won't be calling Mr. Feenstra next. It has always been our understanding that I would be responsible for reply to this examination. Unfortunately it's going to be necessary for me to be in Ottawa at some time tomorrow evening and I won't be able to stay through here tomorrow. At the same time, Mr. Chrysler would be our next witness and Mr. Hodgson would take responsibility for that. The idea of, in one night, explaining reply, including the preparation of Mr. Crysler is a daunting task to say the least. What we are asking, it is going to be a significant moment here in any event, that this matter adjourn at the end of the reply of Mr. Sobanski tomorrow rather than any attempt to start Mr. Chrysler. I understand, sir, that you have questions for these gentlemen. I presume the other Board members do as well.

I doubt if we're going to lose much time that way. If the Board is two hours or in excess of that, we have an hour or so we're going to have for reply, plus more information from Ms Vigod and as the day expands I don't think we're asking for too much but it would give us a measure of comfort to know that we didn't need to have Mr. Chrysler here.

DR. KINGHAM: Your suggestion is to bring Mr. Chrysler on Tuesday morning? Fine with us. We will start tomorrow at 10:00 when we will finish re-examining Mr. Sobanski.

--- Adjournment at 4:30 p.m.

CERTIFIED CORRECT

P. D. McQueen

. . . . . (page 8800 follows) . . . . .