Conference -- I think it was two years ago, on the problems of liquid industrial waste disposal in Ontario.

Q. Mr. Turner, have you made any estimate of the volumes of liquid industrial waste that are generated in Ontario each year, requiring disposal at some sort of facility?

A. I have made many attempts at this. I have estimated the volumes, starting originally back in 1974 -- I inherited the problem, so to speak. At that time from whatever sources were available, and there were no official records of volumes at that time, but through the co-operation of industry, people in the disposal industry, general knowledge of what is being disposed of, where, an estimate was made that there were approximately forty million gallons of liquid industrial waste requiring disposal in the province.

There have been previous estimates done by various private companies and they all seem to be in that order of magnitude, to the best of my knowledge.

Now, could I just add one thing? That estimate of forty million gallons was divided roughly into the ratio of about twenty to twenty-five

million of inorganic waste and fifteen to twenty million of organic waste, and for the purposes of clarification we could say that organic wastes are those which can be disposed of by incineration -- just as an arbitrary method of classifying the various types of wastes.

Q. You prepared two briefs which were filed with this Board, Mr. Turner, and in the second brief which was filed in August of 1977, you prepared some material relating to the volumes of liquid waste that were disposed of, and on page three there is a table two, refers to data from the waybill system, Ontario Regulation 926-76, for April 1977.

Can you explain to us what this table refers to?

A. Well, perhaps I could go back a little bit in history.

In order to try to get a more concise estimate of the volumes of waste which in fact have to be treated and disposed of in the province, in 1976, the Ministry initiated a voluntary waybill system. This had nothing -- no legal basis, it was purely voluntary. We requested the co-operation of the industries

generating the waste and also the industries involved in the treatment and disposal of waste, to complete a form each time that they transacted some business and return this to the Ministry.

The reason it was not enacted under law initially was that we weren't quite sure how the system would operate and we felt it would be better to operate a voluntary system, work out the bugs, so to speak, and then once we knew we had a system that was effective, we could enact it under law.

This was done in November of 1976, when Ontario Regulation 926-76 was proclaimed. That regulation became effective on April the 1st, 1977. Under that regulation any industry disposing of a waste to an outside disposal source, is required to send a form back to the Ministry and on that form they have to provide information as to the quantity and the nature of the waste being sent out for disposal.

The method of describing the nature of the waste is not defined at this point in time. It is left up to the company to describe the waste in whatever way they see fit. It is the intention, obviously, to try and classify

it under Index number 1, 1A.

THE CHAIRMAN: Fine, thank you.

MRS. McCAFFREY: Q. Now, Mr. Turner, let's go back a bit. At this point in time we are talking about wastes that are generated and have to be disposed of by people, other than the people who generate them?

A. Correct.

Q. Can you address yourself to the question of why the people who generate these wastes can not, or do not, or are not required to dispose of them themselves?

A. I think under the Environmental Protection Act, everybody is required to dispose of their waste in a safe manner that will not do any harm to the environment. However, because of the special nature of these wastes, it has been in the past and probably still is uneconomic for individual companies to undertake treatment and/or disposal. As a result of this, there has grown, over the past few years, a waste treatment disposal industry, as a separate industry, and this industry has essentially undertaken to accept these wastes from the generating industries and treat and/or dispose

of them in an appropriate manner.

Q. What makes it uneconomic for people generating the waste to dispose of them themselves?

A. There are a variety of reasons -- I may not be able to cover them all, but some of them are the volumes generated are generally too small to make a viable investment into a treatment and/or disposal system. The nature of the waste quite often is - - the compounds and materials contained in the waste are such that the treatment processes would be very complex and not the type of thing that a normal industry would want to get involved with.

The other thing is that quite often the wastes are discharged on a very random basis, for example, when a tank is cleaned out, which may be once or twice a year, or even less frequently than that, quite often there is a large amount of material that has accumulated in the bottom of the tank and this has to be either treated and/or disposed, and it really, in general, is not in the economic interest of a company to install the facilities to do that, when in fact they can retain the services of somebody in the treatment or

disposal industry to do it for them.

Q. Where are we in terms of our ability to cope with these volumes of liquid industrial waste at the present point in time? Is the situation well in hand or are we in a difficult situation at the moment?

A. I will try to answer the question specifically. The Province, as a whole, is in a rather difficult situation, particularly the southern part, the more industrialized part of the province. I think a little historical review might be in order here, just to bring the thing into perspective.

Prior to about 1970, or the late 1960's, waste were traditionally disposed of by two methods in this province. One was by depositing them as liquids in landfill sites, and the other, perhaps more volume was involved here, was by the use of disposal wells in the general Sarnia area or Lambton County.

Some problems arose with the use of high pressure injection disposal wells in Lambton County in the late 1960's, and as a result the Ministry became concerned -- it was not this Ministry at that time, it was the Ministry of Energy,

Mines and Resources, and I believe the Waste Management Branch. It subsequently became the Ministry of the Environment.

As a result of that, the Ministry decided to effect a regulation which essentially prohibited the use of high pressure injection wells for disposing of liquid industrial wastes. A similar regulation, or perhaps the same regulation also called for phasing out the use of low pressure or essentially gravity injection wells, and going by memory here, I think the date called for was the 1st of April, 1974, so essentially the regulation said that after April 1974 there will be no disposal of liquid industrial waste into the Detroit River geological formation in the Lambton County area other than brines which arise from a process known as cavern washing. I don't think it's pertinent to go into.

That regulation was enacted. They were not alternative facilities available to handle the wastes so the Ministry was obliged to enact a further regulation which allowed the use of the wells to continue until the end of 1974.

Subsequent to that, there was

still not alternative facilities available, and through a mechanism known as a program approval where the volumes of waste were controlled, one well operated by one disposal company was allowed to operate for the years of 1975, 1976, under diminishing volumes and at the end of 1976 the Minister refused to renew the program approval allowing the use of that well. That well effectively then was shut down on December 31, 1976.

In the interim there still had not been any alternative facilities developed in the Province.

Q. So where does that leave us now in 1977?

A. At the present time, the facilities available for disposing of these wastes in the Province of Ontario consist of two incinerators operated by a private company, Tricil Waste Management Limited. There was a third incinerator in Hamilton operated by a company called Interflo. It shut down operations earlier this year. I believe it was April. It may have been a little later on. Those incinerators can essentially handle the organic materials that are available for disposal. For the inorganic

materials, most of them are being disposed of by landfilling into two major sites, one being the Beare Road landfill site in Toronto, Scarborough, Metropolitan Toronto, and the second one being the Ottawa Street landfill site in Hamilton.

Now I will get into this a little later. There are some special arrangements with respect to what is going on at Ottawa Street.

There are other landfill sites accepting relatively small quantities of waste throughout the Province and in addition, the two incinerators in operation are also handling what are essentially inorganic wastes and as a result there are problems with the operation of the incinerators. As a result of all of this, there is a desperate need in the Province for facilities to treat and/or dispose of inorganic industrial liquid waste.

Q. Could you review for us, just by listing them initially, what the possibilities for handling liquid industrial wastes in the Province of Ontario are?

A. I think that can best be done by putting that exhibit up, if you would, please.

Q. Now, Mr. Turner, we have a chart ---

A. Before we get to that, could I just briefly list, if you like, the options?

Q. We will come to this exhibit in a few minutes, Mr. Chairman.

A. I think, Mr. Chairman, the point I would like to get across to the Board and to this hearing is that whatever we do with respect to trying to treat and/or dispose of liquid industrial waste, sooner or later we have to in actual fact dispose of something. As I see it the options available to us in the Province for treating these wastes can be briefly listed as follows. Recovery, reclamation and re-use. Now those things are all to some extent synonymous but they are all terms that are used in the industry and I purposely put them all in. Landfilling, incineration, various types of physical, chemical treatment, solidification, which is popularly know as chemical fixation, deep well disposal and any combination of any of those essentially.

Q. Could we deal first

then in some detail with what is available to us for recovery?

A. Yes. I think it is fair to say it is popularly believedthat all wastes can be recovered, and from a technical point of view I would have to agree that there are scientific and technical processes available to recover almost anything in the chemical sense. However, most of these processes do not have an application in the industrial field because of the economics of them. What I am saying is, in general, it is my belief that the recovery of materials from liquid industrial wastes is under the present scheme of things in this Province, generally uneconomic, therefore, there has been very little effort made by industry to, in fact, recover materials.

There are processes available for recovering most of the heavy metals from plating industries and things of that nature. Now to give you some examples of recovery and re-use that are, in fact, in operation in the Province, one example which, I am sure, the Chairman will understand is pickle liquors from the treatment of steel plating in the steel industry

are, in fact, now being used for phosphorous removal at sewage treatment plants. This represents a situation of taking a waste which has some particular virtues and utilizing it for the removal of phosphorous. The oil industry down in the Sarnia area has developed a system whereby they can upgrade caustic soda which formerly was a waste, and they have been successful in selling this to the pulp and paper industry for use as a raw material. There are some other companies reclaiming iron salts from pickle liquors. Those are the ones that immediately come to mind in the Province.

I have been approached by companies wishing to establish facilities for reclaiming oils, for reclaiming silver, for reclaiming zinc, so I just mention this because there is an interest throughout industry in reclaiming but in general these things don't tend to get off the ground because of the poor economics of the situation.

Q. Could we talk about, next, landfilling as a method of dealing with liquid industrial waste?

A. Landfilling of liquid

something which is ninety-nine percent efficient in removing but still have a hundred thousand parts per million coming out at the end and I don't think that would be acceptable.

In the case of the process being discussed here, to the best of my knowledge, the quality of effluent that it is anticipated will come out of the process is acceptable in the framework I've just discussed.

Q. Having reviewed all of the alternative methods of waste disposal, can you tell us whether there is any way of disposing of liquid industrial waste now where you don't have some final residue that has to be put somewhere?

A. I think this is the point that I would like to stress, that with the technologies that are available today for treating and disposing of liquid industrial wastes, it appears to me that you are faced with the option of having to dispose of something from the processing of this in some manner or other, and the manner or the ways available to you are either to put it into the air, to put it into the water, to put it into the land, or to put it underground through a deep well disposal system or cavern, or

something of that nature. I do not believe that there are any processes available which can completely destroy, if you like, liquid industrial waste so you end up with nothing that you have to dispose of or get rid of in some way or another.

Q. So we are faced with a choice?

A. We are faced with a choice and I think you are going to, whenever you are faced with a choice you are going to have technical people who disagree. There will be people who say disposing of it into the water is not appropriate. It's more appropriate to put it into the landfill. That becomes a matter of technical opinion.

MRS. McCAFFREY: Mr. Chairman, I think I have completed my questions of this witness-in-chief.

THE CHAIRMAN: Well, I think we will adjourn for lunch and come back here at 1:30.

---Luncheon adjournment 12 o'clock.

E. W. C. TURNER, resumes

THE CHAIRMAN: Mr. Turner, you are still under oath.

THE WITNESS: Yes, sir.

---CROSS-EXAMINATION BY MR. FORESTELL:

MR. FORESTELL: Q. Mr. Turner, in the course of your discussion with my friend, Mrs. McCaffrey, this morning, you indicated there were certain economical considerations as to industry looking after their own individual waste. That it's perhaps not economical for a small industry to have a disposal plant on its premises. Is that correct?

A. Yes. I think I prefaced it by saying under the present scheme of things in the Province as they now exist.

Q. Now ---

MRS. McCAFFREY: Mr. Chairman, I am unable to hear over here.

MR. FORESTELL: Sorry, I will speak louder.

Q. Is it reasonable, in your opinion, to think that each industry in the Province should provide its own disposal facility,

large and small?

A. I would have to answer no because based on my experience in dealing with industry in the Province over the past ten years or so, I would question the competence of a number of the smaller industries to provide the degree of technical staffing that would be necessary to operate their treatment disposal facilities. So in my opinion I would expect that the larger companies could handle this matter but many of the smaller ones probably could not with their existing staff and whether or not they would be prepared to hire a special staff is a matter of discussion, I suppose.

Q. Let me ask you another question, then. Would I be correct in assuming that from the standpoint of the Ministry, bearing in mind the answers you have given to the first two questions, that from a policing standpoint, it would be easier for the Ministry to police a central location rather than fifty or sixty small individual disposal plants?

A. Oh, I think the answer to that is unquestionably yes.

Q. Now the economic factor

of waste disposal, is that in your opinion a serious consideration in the industrial world?

A. Yes. It is as serious as any of the other considerations involving manufacturing and processing.

THE CHAIRMAN: I'm sorry. We're having a little difficulty hearing you.

THE WITNESS: Sorry about that.

MR. FORESTELL: Q. Mr. Turner, this is perhaps rather new and you may or may not be aware of it, but in the Globe and Mail this morning there is an article concerning the tour of Mr. Davis, the Premier, in Japan; a newspaper article dealing with what Japan has told Mr. Davis as to why they don't want to invest and one of those items was the very strict environmental regulations that exist in the Province of Ontario compared to other jurisdictions. Are you aware of that?

A. No. I'm not aware of that.

Q. Now, Mr. Turner, turning to this particular area, if the industrial park was on full stream at the moment in the

"clean" brine solution of 1-2 percent dissolved solids. The impact of discharging solutions of this quality to large bodies of receiving waters is likely to be insignificant."

We will stop there. Now, Mr. Turner, bearing in mind the proposal has been made to the Ministry, the standard for effluent that has been suggested in the applicant's case, and I think you're familiar with that, is it your opinion that that paragraph would apply to the applicant's proposals in this instance?

A. Yes.

Q. Are, in your opinion, sir, disposal, hazardous waste disposal plants of this nature and other natures an essential ingredient to the industrial strength of this Province?

A. I am not sure I am qualified to answer that.

Q. Well, you may not be.

A. I don't know whether I can answer that question directly. I think they are an essential part to continuing operation and

industry, and whether that means they are essential in the sense that you phrase the question, I would have to leave open.

Q. They are essential to the continuation of industry in this Province?

A. Yes.

Q. And in a manner that is economical enough for industry to compete in the world markets, again, insuring safety to the environment?

A. Again, that is something I'm not really qualified to answer.

MR. FORESTELL: Very well. Thank you. I have no further questions.

THE CHAIRMAN: Mr. Cline, I will leave it to you people over there which one goes first.

MR. CLINE: Thank you, Mr. Chairman.

---CROSS-EXAMINATION BY MR. CLINE:

Q. Mr. Turner, I would like to direct some preliminary questions to you relating specifically to your position in the Ministry and I would like to get some background on the Ministry, and also some background on the

the question. When an application comes in, is it circulated to all the branches within the Ministry?

A. I can't answer because it's not really my area. I know what happens but I don't really think I'm the appropriate person to answer that question. I would willingly do so if you would like me to.

Q. Well, will there be evidence available on that particular point?

A. Well, I would think that Mr. Bell,who is the Senior Approvals Engineer who handled this, could answer this more appropriately.

Q. Now, in your written brief, on page 2 of the first brief that was filed, paragraph 2, you state

> "The remainder of the wastes were either being deposited in landfill sites or exported to the U.S. for treatment and disposal. Some wastes were also probably being disposed of illicitly into municipal sewer systems, farmer's fields or surface waters."

Can you tell me how much it would cost per gallon now to dispose of liquid industrial waste?

A. Officially, I have no knowledge of this because the disposal companies, in general, are reluctant to tell but from talking to companies who use their services, I would have to give you a range at the moment of, let's say, ten to thirty cents a gallon with probably the majority being in the twenty cent per gallon range at the present time.

Q. Would that include transportation to the site?

A. It may or it may not. I'm not trying to be devious here but it really depends, can I use the term, the deal, that is made by the disposal company with the particular company who is generating the waste.

Q. Now you may not be able to answer this and if you can't, perhaps you could direct me to who would be able to answer it. Has there been any calculations within the Ministry with respect to the cost?

A. I'm sorry. I didn't hear you.

Q. Have there been any

calculations made by the Ministry that you are aware of as to cost per gallon that will be required to be charged to make this a feasible proposition?

A. Yes.

Q. Can you enlighten us as to what cost calculations the Ministry has come up with?

A. Well, the Ministry hasn't but the Ministry has seen the cost analysis that has been done by the company.

Q. Is that information available?

A. I don't know. I do not know if it is part of the submission or not.

Q. Do you know how much the cost will be, based on current prices?

A. I know, but again I don't know whether it is right for me to disclose that here.

Q. I've heard no objection from the company. I think it is important, Mr. Chairman ---

A. My recollection of the original proposal, and I have to qualify this

by saying that things may have changed. I am not aware that they have but the original proposal, as I understood it, was that if the company could get 13.5 cents a gallon for, I think it was five million gallons but I would have to qualify that. I believe the company felt that the operation would be viable. Now you have to remember that that calculation was made some two years ago, and since that time there has been a general increase in the cost of disposal, so I am not sure what the figure would be or whether the company would intend to change that figure.

Q. Would you not agree with me that the cost factor of the ultimate disposal was a very critical question that this Board has to examine?

A. I think the cost factor is very critical to the whole problem of the disposal of liquid industrial waste, yes, but I don't know how the Board is going to get the information to enable it to examine this point, frankly.

Q. Would you agree with me that if the cost becomes prohibitive from the point of view of expense, you are going to have

with you. Do you have a copy in front of you?

A. Yes. Which one are you referring to?

Q. The one I have is headed at the top, Index Number One, Assessment of Alternatives Available, prepared by you.

A. Yes.

Q. Page 5 is the first page, the third line, the subheading there has to do with landfilling?

A. Yes.

Q. I think we can all agree, all of us, both the applicant, all the people at this table including your own counsel, can agree that from the information that is available to us that landfill, the type of disposal of liquid waste on landfill sites is probably the least best of any alternatives available to us. That's fair to say?

A. Yes.

Q. The problem we have now is that that technique has virtually saturated the available sites, now we have to look for other alternatives?

A. I think that is true

in the case --- I wouldn't suggest all of the landfill sites that are currently accepting waste are, in fact, saturated, but I think the point is that they all lend a potential problem or could potentially pose problems in the future.

Q. I understand what you said earlier the main problem that would be considered there is the problem of liquid leachate of some of those contaminants being carried off by surface or sub-surface water to adjacent areas, into water courses?

A. Correct.

Q. Now you indicated in your own brief, landfilling is basically a short-term, temporary solution and you also indicated on the last line of page 5 that:

"Once contamination of groundwater occurs, it may be extremely difficult, if not impossible, to stop."

I take it those statements are still valid?

A. Yes, I believe they are.

Q. Now we have heard a lot from day one on this proposal about the term

put it, and you try to make sure the chemicals that you know will react in some manner which is undesirable are not put together and this sort of thing.

Q. From what science has available, what knowledge is available, we're obviously not going to have substances mix which could cause an explosion. For instance, there are substances which can cause fire?

A. Or react and cause poisonous gases, this kind of thing. This is the idea behind it, yes.

Q. But there is no doubt, is there, that some of the substances, which are placed in the landfill site are what is commonly termed toxic substances, harmful substances?

A. No.

Q. It's a storage place for toxic substances?

A. Yes.

Q. So, in effect, if we have a supposition again, if the precautions with respect to those storage sites are not properly looked after, then you are going to have exactly the same problems that you have with standard

landfill sites, the leaching of the toxic substances?

A. Except that perhaps the statements were made there, that the landfill sites in common use today are perhaps not constructed appropriately to handle liquids. They are primarily constructed to handle domestic wastes and there are a number of sites which were constructed in the past which, by today's standards, would be inappropriate. If we set out to design a landfill site today, then the potential is always there, but in constructing the site appropriately, you minimize the potential.

Q. Well, I think you've hit upon the point exactly; in fact, in your position as a independent person here, you can agree with me that potential, the potential for the same kind of harm, the contamination of the groundwater for instance which you indicate is practically impossible to remedy. That's a potential problem on this site?

A. Yes.

Q. I take it also, you described four or five basic systems this morning?

A. General concepts.

Q. Exactly, general concepts, I agree, and I take it from what you told me, or told the Board, that all of those systems, no matter which one you choose, has some problems built into that system which have to be overcome?

A. Yes.

Q. In other words, at this point there is no failsafe or no foolproof system that is known technologically that we can use to deal with these wastes?

A. Yes, in the sense that you have to get rid of something at the end of all of this, somewhere, somehow.

Q. Now the impression I got from your evidence this morning, and you went through your four or five general systems, was that while basically they were landfill, incineration, chemical treatment, deep waste disposal and the kind of combination of systems such as the one we had here, and we discussed them in terms of economics; you discussed them in terms of possible and probable problems involved with the particular systems but is it not true, sir, there are other systems that work,

presently economically viable, that come under these general headings, as you mentioned this morning, you didn't go into them this morning?

A. Oh, definitely, yes.

Q. What are they?

A. Well, there isn't time to expand on them but the whole thing really revolves around the available market and in Ontario, I suggest, that with forty million gallons of waste available and potentially more if you wanted to bring some of the waste that would go into Metro sewer systems into this discussion, and most or half of that, or forty percent of that being organic material which is incinerated, what you are left with is the volume which is not attractive, say, to the private sector to put in reclamation type of recovery system, compared to the volumes that you would have south of the border where three hundred million gallons is not an uncommon volume to deal with in a heavy industrialized area.

Q. Yes, but, sir, let's take your example of south of the border. Let's say we take, for example, the State of Texas which I would assume in terms of industrial output would

viable proposition down there?

A. But I suggest to you that does not apply to inorganic waste. You can only oxidize the organic contaminants in that, and that would be in this scheme of things under chemical treatment.

Q. So now we have one economically viable way of dealing with one large category kind of waste we're going to be dealing with at this plant. Now let's take Europe, for instance. If you move across the Atlantic to Europe, I would take it that the industrial output of Europe, the kind of waste they are dealing with in various countries in Europe will be quite considerable, more than in the Province of Ontario, but do you know what direction they are going in a general way in Europe these days as far as dealing with these kinds of wastes are concerned?

A. Yes. There is thrust, obviously as there is in Ontario, towards reclamation recovery where possible, and there have been some strides made in this direction.

Q. What about solidification or ---

A. Well, the company that

has the patents to that process and, in particular, the silicate solidification process is trying to establish the operation in Europe. Now I am aware there are other solidification processes which are perhaps better termed encapsulation that are being used in Europe, yes.

Q. As I understand it, because of the situation here, because of the lack of the land, because of the lack of open space, the kind of thing we are used to dealing with here in our system where we have great vast tracts that are available, they have gone in a completely different direction, they have virtually given up on this type of system using a discharge system or burial system. They have gone over pretty well to the solidification type of systems. Is that your understanding from the literature?

A. I would not quite agree with that. I have been party to a committee under NATO, CCMS, I can never remember what they stand for, but committee for betterment of mankind or something or other, and the United States and Canada jointly are involved in this as is Germany, Belgium, Italy, and so on, and I was asked by the

Federal Government to attend and observe on one of these meetings when they came to this country and to Washington, and my impression from that meeting and subsequent discussions with the Federal people associated with that committee, is that all countries face a similar problem, and that landfilling is still by far the major, or the main method of disposing of these types of wastes, and everybody agrees that it shouldn't be and everybody agrees that the thrust should be in other directions, and there have been steps taken in Germany to try to initiate this and I know that there are plants operating in Germany that do recover salts from plating operations and so on and so forth, but I think the problem is that the economic climate, the land availability, the whole approach to life, the lifestyle and everything is different and I have to agree that we should perhaps be going other routes but at this time in the scheme of things as they exist in Ontario, this type of proposal has merit.

Q. But they have a problem over there, as I understand, that as you have discussed, land is at a premium and if we talk about industrial land around here in the Province

A. Yes.

Q. The remaining belt seems to be along the St. Lawrence itself, up in the Eastern Region?

A. Yes.

Q. So I take it then that I can safely say that the kinds of clay we are looking for are generally found in (a) generally populated areas of Ontario; (b) generally industrial areas of Ontario; (c) close to large bodies of water; is that fair?

A. Yes.

Q. So I go back to Mr. Cline's question, if you were sitting in the Ministry and someone came to you and said find us a suitable location from the one main factor that you keep coming back to, which is permeability of soil, I take it that you could find, at least the potential is there, to find a myriad or a host of potential sites that have water accessability, high degree of impermeability, relatively low gradients, as far as change in level is concerned, and close to populated or industrial areas. Is that so?

A. Yes, that could

probably indicate many sites.

Q. So what I am getting at, is the site we have here is not critical in that sense. In other words as far as the type of soil is concerned in this location in relation to industry it intends to serve, that this particular site is not critical on those counts?

A. No, but it does fall in the same category.

Q. Pardon?

A. It does fall in the same category.

Q. Exactly, I don't say it doesn't, but the impression I have in listening to various witnesses over the course of the hearings is, that we have been lucky enough to find the site, let's not lose it, but in fact on those criterion there is no problem with finding a site if we just use those criterion to start with?

A. Yes.

Q. Now the other thing that bothers me about permeability, yourself and everyone else who has come up and given evidence-in-chief and in particular for the Ministry, because

obviously I don't expect the company to bring this up but I do expect the Ministry to, the only time that what is commonly referred to as secondary permeability that has been mentioned, is on cross-examination.

Now, I would like to ask you first, we have been dealing with figures of permeability for clay soils and I take it what we have been dealing with is primary permeability, is that right?

A. Yes.

Q. Now can you explain to us what primary permeability is?

A. Primary permeability is the permeability of the material as it sits in nature. Secondary permeability is caused by additonal geomorphic processes, whether it be fracturing or drying out or losing certain properties, introducing additional factors in there.

Q. When you say primary permeability as it exists in nature, I don't think that is really fair. Is what you mean to say that primary permeability presupposes or assumes that you have a homogeneous soil with no cracks in it. In other words the particles are relatively the same space from each other in a

given volume?

A. Yes.

Q. What we commonly refer to as either firm or compacted clay?

A. Yes.

Q. When we talk about secondary permeability, what are we talking about there?

A. Cracks, fissures and solution channels.

Q. I understand from what you said in cross-examination that one way you could have those cracks is by drying out of the soil?

A. Yes.

Q. And that certain particles cling together and certain others don't, you have these cracks or fissures?

A. Yes.

Q. Do you know of your own experience and the experience of the Ministry what the condition of the soils in the Nanticoke area are with respect to cracks and fissures?

A. No, I don't.

Q. Do you know whether or not the Ministry has in its possession, or has available to it a report prepared by the Steel Company of Canada and by Texaco with respect to the cracking or secondary permeability of soil on their sites which are close to this site?

A. I have not read the reports but I know there are reports, some reports, I don't know the content of them.

Q. So if I put it to you that that report comes to the conclusion that many things that Stelco intended to do on the site cannot be done because of this problem with cracking of the clay soil, would you know whether or not that was true?

A. I would not know if it was true.

Q. Has the Ministry been working with Stelco or with Texaco with respect to installations on the clay soils in the industrial zone here at Nanticoke?

A. Yes, they have been but I personally have not been.

Q. Who has been the hydrologist on those discussions, do you know?

A. Yes.

Q. As a matter of fact he repeated that several times?

A. Yes.

Q. The point I am making is, doesn't it become extremely critical and especially to use the Hughes' type of approach to know where the water table is?

A. Yes.

Q. And we don't know where the water table is?

A. Yes.

Q. So at this point, this point in the procedure we have 2 basically different systems and we do not know whether they can be used or not. The Hughes' one cannot be used if the water table is at 20 feet, that is my understanding?

A. Yes, that's true.

Q. Can the company's proposal be used if the water is at say 8 feet, a 15 foot lagoon, 15 foot sludge lagoon, could you use that type of system as proposed by the company if the water table is at 8 to 10 feet?

A. Well, Mr. Kuhn

indicated that no, but I can indicate, I believe it can be if you put a collector system beneath the site as per indications of the company.

Q. Well then you would agree with me Sir, that Mr. Kuhn says no, there is some disagreement in the scientific community as to whether or not that could be done?

A. Yes, in different fields, yes.

Q. If there is disagreement on that point surely we should have more information available to us now, to determine which one of these two major systems is actually going to be used on the site. Would that not seem reasonable?

A. It seems reasonable, yes.

Q. So the way it stands now, we have an Environmental Assessment Hearing with respect to the company's proposal, which may or may not be acceptable in any sense of the word, if the water table is not discovered to be below a certain level. Isn't that where we stand at the moment?

A. Well, there are

differences in that opinion or information. As I indicated in my evidence, I do believe the water table to be within 10 feet, but it is just my opinion.

Q. But isn't that an issue that should fairly come before the Board and the scientific data should be available so we can assess which one or which group of opinion within the scientific community is the correct one. I mean at this point we have a disagreement among experts, don't we?

A. Well, experts in different fields,but there is disagreement between experts, yes.

Q. Now Sir, you indicated a preferable method of monitoring this system, would be to have what I call the 4-corner monitors as opposed to the upstream and downstream monitors the company proposes?

A. Yes.

Q. Now, is it not so that the 4-corner monitoring, its success would depend largely on the direction of flow of the sub-surface water?

A. Yes, the 4-corner

monitoring in my opinion, well it would give you the slope of the surface of the -- potential metric surface and again I indicated there may be other observation wells necessary.

It has been my experience that if we suggest additional observation wells, these would be placed in.

Q. Let's take the 4-corners for a start.

A. Yes.

Q. We determine, you say that by putting those in you can determine the direction of flow, is that correct, of ground water -- I am sorry, sub-surface water?

A. Yes, the direction of the flow in the aquifer, not the total ground water flow system.

Q. In the aquifer?

A. In the upper bedrock, that is what I suggest.

Q. So if we had 20 feet of clay, no aquifer in that 20 feet, you are not going to discover the flow with your 4-corner models?

A. No, you would be

monitoring the major aquifers in the bedrock.

Q. And assuming you could even monitor the major aquifers in the bedrock there would be no guarantee that those 4-corner monitors could pick up the flow of contaminant that escaped from these lagoons, in other words the plume?

A. That's correct, because in bedrock it is difficult to predict anything like that. The bedrock flow is controlled by solution channels and fracture systems and crevices and these could be similar to, what is alluded to underground streams or what have you. In other words zones of higher permeability and even with 4 holes you may miss that zone of higher permeability where the most water is flowing.

Q. In the type of bedrock we have here, the fractured slurried type rock, it is a special problem here, is it not?

A. It is not necessarily special, but it is a possible problem yes, because we do have solutioning here and this is indicated by the flows in Nanticoke Creek, the fact that they disappear and in other words reduce, and Lynn River, Black Creek, all these are -- I should say

Black Creek and these tributaries, these all go over bedrock and you find stream flow disappearing, so it does happen in the ground water flow system too.

Q. I believe it was your report, it may not have been, that the bedrock comes closer to the surface as you get closer to the creek?

A. Yes, it does.

Q. So if we have out-cropping, the likelihood is the outcroppings or where that bedrock comes out and the seepage comes out with it would be very close to the Nanticoke Creek. That is a likelihood, not a certainty?

A. Yes, that's assuming the ground water flow direction is from the site towards the creek, but quite often the levels as recorded in the wells are several feet or in the few tenths of feet down into the bedrock surface, so the suggestion may be that the creek is actually flowing out or at least flowing towards eastward through the bedrock.

Q. Now you can appreciate my problem, Sir, the questions I have been asking

you all along, both myself and you have had to make assumptions all along the way?

A. Yes.

Q. Because we don't have the facts?

A. Yes.

Q. Aren't those facts something we should have in order to know (a) what kind of a system we are going to have now we have two systems and (b) what kind of monitoring and what kind of safety devices we have to have?

A. Yes, it would clear the picture.

Q. As a matter of fact the 4-corner monitors that you have proposed could actually end up being a hazard rather than a help because it might give us a false sense of confidence, not monitoring anything and then the pollutant coming out say in the middle between 2 or 3 monitors?

A. It is a possibility, what you don't know won't hurt you type of thing.

Q. Really that is the

into, the water table, the location of it?

A. Yes, I would try to determine the position of the water.

Q. Would you agree with me we don't know where the water table is in this particular site?

A. Within how many feet?

Q. Within any certainty whatsoever.

A. Well, I think, it may not be the proper way to put it, I could give you 70-30 odds that it is within 7 feet --- 9 feet of the surface.

Q. Can you tell me under oath that you know where the water table is?

A. No, I don't, any better than a statement such as that.

Q. Now, the direction of flow of the ground water. Is that important?

A. Yes, in this particular case. If --- again I could think of sites where it would not be important, but in this particular case you would eventually want to know where the ground water is moving.

Q. Now, I am thinking

back to our hypothetical situation where you are going to make a recommendation on this and I am interested in knowing whether you would be concerned about the flow of the ground water. Whether you consider that of sufficient importance to want some kind of information available?

A. In almost every case you would want some sort of information on the flow of the ground water.

Q. What about water budget?

A. In almost every case you would want to know something about the water budget as well.

Q. What about permeability of the soil?

A. You would want to know, have some idea of the permeability of the soil. You are specifically referring to an industrial waste disposal site.

Q. Yes. What about the gradient?

A. Well that would come in with ground water flow and you would want to know something about gradients.

Q. What about surface

drainage?

A. Yes, you would want to know about surface drainage.

Q. I believe you indicated in your evidence-in-chief you are concerned about the amount of leachate that would be produced from the site?

A. Yes.

Q. You would want some preliminary figures relating to that?

A. I would think so, but this is primarily on behalf of the applicant because they are the ones who are going to pump it out and treat it, so they would be very interested in knowing how much they have to treat and I suppose the Ministry in general would want to know, what the Ministry would also want to know is this I guess, so you would need a water budget and you would need to know how much leachate was going to be produced.

Q. I think it would be important also to know what was going to happen to the leachate?

A. Yes.

Q. Over the long term.

Now, based on the application before the Board, the proposal that is submitted, do you in your assessment feel there has been sufficient information brought before the Board relating to ground water and flow thereof?

A. Well again, we are getting back to the question, I don't know how much information the Board needs to make a decision. There is no end to the amount of information of this nature that you can gather. You continually gather and gather and at some point, again I am not an expert on the system either, but I assume the Board makes the decision that they have enough information to do this.

I don't know how much they want. I know how much has been gathered and I can more or less give you my opinion as to whether it is useful for a preliminary estimate of whether the site is likely to function, as designed or as we anticipate it will function.

Q. Are you talking about the applicant's design or your design?

A. My design or the conceptual design, and the applicant's design as well.

Q. All right. Can you put yourself in the position to this Board to indicate whether there is sufficient data before you to make a decision?

A. Again, at what point -- there is enough information for me to make some assumptions and based on those assumptions, say that a conceptual design of this nature will trap or confine the leachate in this site forever, provided certain things are done. I don't know whether this is sufficient for the Board. I don't know whether I can help you, I don't know how to answer this any other way.

You could spend 50,000, a hundred thousand dollars more in finding out the hydrogeology on this site to the nth. Now, I don't know whether this is expected or wanted or whatever. In my opinion if the assumptions that I have made are correct, the site will function as I have suggested it will function. If these assumptions are wrong, for example, if the first test bore shows that the water table is down beneath the base of the site, what I have said here will not work.

Q. Correct, on your

proposal?

A. On my proposal it will not work, it is just that simple.

Q. You have also indicated in your evidence to Mrs. McCaffrey that in your assessment the proposal as submitted by the applicant is not satisfactory?

A. We get into this business of trying to confine leachate at a site above the water table and again my assumption was that this material will never completely bio-degrade and under these circumstances, if the site is above the water table, whether or not there is a plastic liner, eventually everything in it will leak out slowly.

Now I do not know whether this is a lot of leakage or a little bit of leakage, I don't know whether that would be acceptable or not acceptable, but it is one of those things that people will argue about, you know you can argue about how much leakage you will get for a long time. I thought it was simpler to resolve this by putting in an underdrain and finding out hydrogeologically and at the same time getting a positive monitoring system and developing a

Q. You said that the applicant's proposal has a number of unknowns, that was the expression you used. Could you list what these are?

A. Well they don't know how much will leak out the bottom of the site, the quality of the material that will leak out.

Q. Would you slow down, Sir.

A. They don't know the quantity or the quality of the leachate nor the amount that that leachate will be attenuated. Incidentally now I have forgotten they are going to put a plastic liner in there and I suppose, the applicant suggested if the landfill becomes stable before the liner degrades then my previous statements don't mean a thing.

I hate to throw confusion into it, but if their liner works and their landfill degrades within the liner, then there is not a problem with groundwater contamination. Now, I don't know that their liner will retain its integrity until the landfill stabilizes. That is something I don't know.

Q. What are the prospects

A. It would work, I guess the principal disadvantage you get, in my opinion, to the plastic liner is again keeping in mind my assumptions, one that the landfill will have to be controlled forever, in other words it is not going to biodegrade before the liner biodegrades and this sort of business. Then if the liner holds for 20 years it will be 20 years before you find out if the hydraulic confinement is working the way you expect it to work, so there is a disadvantage in that respect, in that I would like, again this is personal, I would feel that the quicker we found out about whether this sort of a system was going to function as we expect it to function, the farther ahead we are.

In other words if we can find out we have problems within the first few years, we can rectify the problems much easier than if we find out in another twenty years.

Q. Now, on page 5, Mr. Forestell mentioned 'Other Comments and Questions'. He emphasized the words,

"...proper operation of this facility would include:"

and I am wondering if you could go through the list,

THE CHAIRMAN: We will take our afternoon break.

--- Recess at 3:30 p.m.

--- Upon resuming.

THE CHAIRMAN: Could we come to order please. Mr. Thibideau?

CROSS-EXAMINATION BY MR. THIBIDEAU:

Q. Dr. Hughes, the problem that I am having, I suspect the Board and certainly the people here are having at these hearings, we have been hearing about conceptual designs, engineering drawings, final drawings and so forth. The problem is we are trying to discover, one of the things we are trying to discover is what kind of information is required up to the point of what I might call preliminary approval, where you can take a chance so to speak and put a facility on the site and then fine tune that facility after it is on the site and the problem I have, frankly in your own

evidence and in other evidence is determining how much information by way of testing and scientific data is required to reach that firm concrete preliminary design, so you can go into the site and work from there, and I make the assumption, certainly my submission to the Board will be that it is the kind of information up to that point, that the Board is entitled to.

Now, if we make that assumption and we just define it as the kind of information that is required up to and including the point where you have a firm, if you want to call it preliminary concept or preliminary design, what kind of information would be required at that point.

Perhaps to put it a different way. If you, in your field, lived next door to the site what would you feel safe with when you knew that the next day they were going to go in and start working to develop the site. What kind of information would be needed at that particular point in time as opposed to the fine tuning later on.

So with that in mind, if we could have that as a general concept of my questions to you, I would like to ask you as we have asked

other witnesses, and the reason I want to ask you is because I understand you are one of the most expert people in your field in Canada, let alone the Ministry and that is why I feel your opinion is important.

What I want to know is, I got the impression dealing with the applicant's design, not your design, dealing with the applicant's design, that there were certain situations in which this design would not even be considered as viable. At one point in the hearings we discussed having it in a swamp, another point today we discussed having it where there was an aggregate of sand soils and the kind of design they have would not be appropriate there.

Now, obviously when you make those kind of decisions, whether it is acceptable in a swamp or a clay belt, you are making those decisions based upon certain fundamental principles and science and I am trying to get at what those fundamental principles are.

Now, I gather from your evidence that the permeability of soil would be a factor in this design at this site, am I right there?

A. Yes. Incidentally, --

well all right, yes.

Q. I am sorry, I don't want to cut you off because any information you can give me I want.

A. I assume you are thinking of the water table being at the level Mr. Bryck suggesting it is at. The high water table, under those circumstances the permeability of the soil will influence the amount of collection, the amount of material and using their design we are getting into the plastic liner. I am sorry, do we want a plastic liner that will last forever or not.

Q. Well the evidence we have to date, Sir, and you haven't been here during the whole hearing, the evidence we have to date from the company's' own plastic liner men is the best guesstimate and that is what it is, because we do not have a full life liner used at this point. There has been liner use in Chem-Trol facilities in the United States. It had been in existence, I believe the evidence was 7 years and they are still working, so by definition the conclusion was drawn that they work at least 7 years.

The best information we seem to have

A. Yes.

Q. Now, soil attenuation. Is that a critical issue in the company's proposal?

A. Well again, the company presumes or the applicant presumes, if you accept the applicant's assumptions, then a lot of these questions you are asking do not become that important. For instance, if you accept the assumption that the waste will be reasonably inert before the liner stabilizes and the water table is up near the surface and that we can continue to pump this and still confine it hydraulically, then the fact that there is fractured clays underneath is less important.

Q. I agree Sir, as a theoretical concept, but maybe we have forgotten what we have already laid down as the ground rules, that the material that is going into this site has a life that is longer than the liner that is used to retain it. We are talking in the order of something like 50 years at the minimum.

A. Yes.

Q. So everyone can agree with you Sir, that if the toxicity has a life

of 3 weeks then we don't have a problem, but that is not what we have here. The best evidence we have before the Board is the toxicities in terms of decades.

A. That's what I assumed.

Q. So if we have that scenario, does then attenuation become a critical issue?

A. Can we confine it hydraulically. Is the water table shallow and can we keep pumping this out forever.

Q. I think you used the correct words when you used the word assumption, but let me go down the list. You have indicated where there is a reasonable guess as to the water table, 8 to 10 feet?

A. Yes.

Q. That is as you put it a reasonable guess, not a definite scientific fact at this point?

A. No.

Q. What about the ground water flow gradient. Do we have any data whatsoever about where the water is flowing to, hard data?

A. Hard data, no.

Q. Do you have any hard data on soil attenuation, the ability of the soil to hold ---

A. Hard data, no.

Q. Any hard data on the permeability of the site?

A. Well, ---

Q. We know there is Haldimand clay there.

A. In all probability the permeability of the materials at the site are low. I don't think --- in the sense you are saying hard data, no.

Q. You see my problem is as I indicated earlier this morning, my information is that there is a serious fracturing problem in that particular area of Haldimand clay and if that is so, then for instance Mr. Morton's questions to Mr. Virland this morning, Mr. Virland's answer becomes very qualified when he talks about certain permeabilities and so forth. When he gives his answers he forgets about the secondary permeability we are talking about.

Now assuming, and we have to assume at this point, we don't know whether this secondary

permeability is a factor or not, can we say with certainty that the permeability here on the site is satisfactory?

A. No, we cannot say --- well, I guess you would have to answer no, we cannot say for sure that the permeability is satisfactory because we do not know what it is.

Q. Now, I will be kind and take off the water table. If we are left with the ground water gradient, the soil attenuation, the permeability and the knowledge we have of them at this point, would you advise a client or would you advise the Ministry to approve of the actual installation of the facility on the site prior to determining these factors?

A. Well, again it is a hypothetical question. I don't advise them in that respect. Before they actually put waste into these sites, I would think that there would be as I say, the additional information gathered on the hydrology of the sites.

Now, where the issuing a permit comes into this, I would like to avoid answering that again because I don't know at what point a permit is issued. I do not even know the

on the ratio. It has to meet the Ministry of the Environment criteria and that is what I am primarily concerned about.

Q. What I was concerned about is, let's assume that it does not?

A. Well, I have already covered that.

Q. But at the time you recommended the hearing, you didn't give any consideration to that contingency?

A. No, I would say I have not.

Q. Now, the landfill portion of the project relies substantially on clay. Did you examine the secondary fracturing properties of clay?

A. No.

Q. Are you aware that there are problems of secondary fracturing of clay?

A. No, I am not.

Q. Now, Dr. Hughes and yourself had some varied opinions on the use of liners and once again I assume that you have had an opportunity to peruse Dr. Hughes' report

with respect to liners?

A. In Dr. Hughes' report I understand that he does not advocate the use of liners.

Q. Based on his finding is there any comment that you wish to make with respect to your finding vis-a-vis his finding?

A. My feeling is that with toxic materials, I feel or would feel safer with a liner where I can collect leachate, whereas with Dr. Hughes' proposal, I have not seen this particular type of operation operating and you know, I cannot really comment on the safety of his operation because I don't really know whether it will work or not.

Q. The proponent's proposal, as I see it, would necessitate, and you can comment if I am wrong, a substantial maintenance period. Is that correct?

A. You mean after completion of the site?

Q. Yes.

A. Yes, also Dr. Hughes' proposal will need maybe just as much maintenance.

Q. All right, so based on

Q. Are you telling us that you feel there may be a gas problem?

A. Yes, and like any other normal landfill site it would have to be properly vented.

Q. How about an odour problem?

A. If there is an odour problem, the only thing that you can do with the odour problem is either you can collect the gas or raise the vents high enough that you disperse the gas. I have not considered the gas itself to be an odour problem.

Q. Now when you made your recommendation to Mr. Caplice, that he convene a hearing of this Board, were you in possession of any estimates of ground water inflow in the waste?

A. No.

Q. Were you in possession of any estimates of surface infiltration into the waste?

A. Yes, we had from the proponent, estimates of th amount of infiltration.

Q. Did you have any

definition of the position of the top of the zone of saturation?

A. No.

Q. Did you have any meaningful contingency plans which could be implemented in the event the contaminants were detected in the underdrain beneath the landfill?

A. Yes, I had two contingency plans in mind, the first one was the collection underneath the lagoons at the lysimeters and the second one was to have wells drilled down gradient from the site for the second line of defence, shall we say, to detect leachate.

Q. Did you have any definition of the ground water flow system?

A. Only what was in Mr. Bryck's report.

Q. And you are aware Mr. Bryck indicated in his evidence that he felt his report was incomplete?

A. Yes.

Q. Did you have any information in your possesion relating to the effect of the installation on the flow system?

A. Which flow system?

Q. Surface.

A. As a matter of Ministry policy installations cannot affect the, what shall we say, the upstream water or watershed. The installation must be designed in order that the land up gradient from the site can be properly drained.

Q. Did you have any of this information available to you?

A. No.

Q. Did you have any information available to you on the effect of ground water flow and the effect this facility would have on it?

A. On ground water flow.

Q. Yes.

A. No.

Q. Did you have any hard data available to you as the time required for stabilization of the waste in the landfill?

A. No, nobody has any data on that. That data is just not available.

Q. Did you have any data available to you as to the anticipated variation

of the quality of the leachate that will be produced?

A. No.

Q. Did you have any information available as to the quantity of contaminants that will be on the surrounding earth materials, absorbed on the surrounding earth materials?

A. There will be no contaminants absorbed on the material if you are using liners. The contaminants are within the liners.

Q. Did you have any information as to the amount of dilution of contaminants in the bedrock aquifer and in the overburden?

A. Could you repeat that question please.

Q. Did you have any knowledge as to amount of dilution of contaminants in the bedrock aquifer and in the overburden?

A. I assumed with the liners that there would be no contamination in either place, either in the clay or below the clay.

Q. Did you have any information relating to a contingency plan in the

event that natural attenuation does not prove to be sufficient to dispose of the waste?

A. Yes, in my report the last item, I said there, that if there was a contingency plan that wells would then have to be put down to depth to collect the contamination underneath the site.

Q. Could you detail for me what experience you have had with plastic liners?

A. I personally have not had any experience with plastic liners.

Q. Can you detail for me what experience you have had with aerators?

A. I have seen a number of them in operation at different plants, but I have not, you know I have not designed them.

Q. Have you seen aerators used in lagoons with plastic liners?

A. Yes.

Q. Where is that, Sir?

A. That is at Uni-Royal in Elmira.

Q. To your knowledge have they used aerators for the stripping of ammonia?

A. No, they are not

using it for the stripping of ammonia, that is at least as far as I know they are not.

THE CHAIRMAN: That wasn't the question, was it?

MR. CLINE: Q. Do you have any experience with the stripping of ammonia with aerators as proposed here?

A. No, I personally do not.

Q. Does anybody in the Ministry have that experience?

A. I can't answer that question, I don't know.

Q. Has there been any monitoring, effective monitoring done in this area since this proposal has been received by the Ministry?

A. In which area?

Q. In the area of this facility.

A. Has there been any monitoring?

Q. Any monitoring.

A. Not that I am aware of.

MR. CLINE: Thank you, Mr. Chairman.