UNITED STATES DISTRICT COURT

DISTRICT OF MASSACHUSETTS

Civil Action
No. 82-1672-S

SKINNER, D. J.
and a Jury

ANNE ANDERSON, ET AL

V.

W. R. GRACE & CO., ET AL

Sixty-Eighth Day of Trial

APPEARANCES:

Schlichtmann, Conway & Crowley (by Jan Richard Schlichtmann, Esq., Kevin P. Conway, Esq., and William J. Crowley, III, Esq.) on behalf of the Plaintiffs.

Charles R. Nesson, Esquire, on behalf of the Plaintiffs.

Herlihy & O'Brien (by Thomas M. Kiley, Esq.) on behalf of the Plaintiffs.

Hale & Dorr (by Jerome P. Facher, Esq., Neil Jacobs, Esq., Donald R. Frederico, Esq., and Deborah P. Fawcett, Esq.) on behalf of Beatrice Foods.

Foley, Hoag & Eliot (by Michael B. Keating, Esq., Sandra Lynch, Esq., William Cheeseman, Esq., and Marc K. Temin, Esq.) on behalf of W. R. Grace & Co.

Courtroom No. 6
Federal Building
Boston, MA 02109
9:00 a.m., Wednesday
June 25, 1986

Marie L. Cloonan
Court Reporter
1690 U.S.P.O. & Courthouse
Boston, MA 02109

THE COURT: Good morning, ladies and gentlemen. Good morning, counsel. Sorry for the delay this morning. It was my fault, the fault of the traffic situation. I spent a great deal of time on the bus on the Turnpike this morning.

Go ahead.

JOHN GUSWA, Resumed

DIRECT EXAMINATION CONTINUED, By Mr. Keating

Q Good morning, Dr. Guswa.

A Good morning.

Q Could you come over once again to the area of the jury.

Yesterday before we concluded, you described the development of the groundwater flow model?

A Yes.

Q And you further described how you developed what you call the chemical transport model?

A Yes.

Q Now, did you use these models to determine how far chemicals could have traveled from the Grace site within specified periods of time?

A Yes, I did.

Q What did you determine for the distance the trichloro-ethylene could have traveled from the Grace site?

A For trichloroethylene, I calculated distances of travel for three different periods of time from the time the chemicals

would enter the groundwater system. And for trichloroethylene -- The three periods of time that I calculated were 11 years, 19 years, and 25 years after the initial time of entering the groundwater system. At the end of 11 years, trichloroethylene would have moved a distance of 750 feet, or slightly less than 750 feet. For 19 years, the distance would be less than a thousand feet. And for 25 years, the distance is less than 1100 feet.

Q Now, how did your models enable you to make those determinations?

A The process that we go through is we take the parameters that control groundwater flow and chemical transport. We're using those as the basis for the analysis. I made the designation or assumed a release of three and a half gallons per year of TCE to the groundwater system for a specific period in time. I then instructed the computer model to calculate the concentration, chemical concentration of TCE at different distances from the source area for different periods in time.

Q Now, have you prepared an exhibit which describes what you have done regarding trichloroethylene?

A Yes, I have.

Q Let me show you, Dr. Guswa, a chalk which has been marked G-972 and is entitled, "Calculated Concentration Profiles for Trichloroethylene." Could you explain to the

jury what that chart represents?

A Yes. The left axis is the calculated concentration for the chemical. The horizontal axis is the distance from the source block. You may remember that our three-dimensional model has a series of blocks or grids. The location of zero is the center of the block into which I have instructed the model where the chemicals entered the groundwater system.

Q Can you remind us what you used as the center of the block for purposes or in relation to the Cryovac site?

A Yes. This represents the drainage ditch on the south side of the Cryovac building near the vicinity of Wells G-14 and G-15.

Q And what does this axis represent along the bottom?

A The axis is the distance along a flow line from that source block toward Well H or toward the Aberjona River Valley, center of the valley.

Q What is the distance between the source area and the nearest of the wells, which is Well H?

A Approximately 2500 feet.

Q Could you continue?

A Yes. There are three curves, if you will, shown on this graph. Each one represents the calculations of concentration along this distance for these periods in time. So if we were to block out, for example, the upper two curves here, this would be a concentration profile that exists in

the ground as a result of putting three and a half gallons of chemical into the ground every year. And this is the time of 11 years after that release started.

Q Could you just with reference to that particular line -- This is the bull's-eye?

Yes, the double circle bull's-eye line.

Q Would you describe to the jury what this bull's-eye line for the 11-year time period represents?

A This represents the concentration of TCE in the source block after 11 years. This represents a downgradient concentration in each of these individual bull's-eyes represent the concentration at different distances downgradient from the source block. And we can see that this curve is tapering off and disappearing at approximately 750 feet. This is 800, this is 600. So somewhere in here, the curve reaches zero.

Q And is the concentration of the trichloroethylene also reducing as it flows along that particular curve?

A Yes. The reason for the dilution is the fact that we have rainfall that is entering the ground and mixing with the water that has originated on the Cryovac plant. We also have lateral inflow of water from the sides, say in the vicinity of, say, Washington Street and a little bit south of Washington Street. We also have the dispersion that is occurrin as the chemicals spread laterally and vertically in the ground.

In fact, we can look at this line, and this line does in fact represent the center line of the contaminant plume so that if we were to move laterally and vertically through that, the concentrations would be less. This is the line of maximum concentration.

Q Can you tell us, Dr. Guswa, what the line which represents the 19-year period shows?

A Yes. The 19-year period is represented by the black dot. In the source block we have a concentration of 4,750 parts per billion, and we have a decreasing concentration as we move away from the source block, and we calculate a zero concentration at approximately 900 feet, or less than a thousand feet from the source area.

Q So that after 19 years, according to your opinion, the trichloroethylene would have traveled less than 1,000 feet

from the source area?

A Yes, that's right.

Q Will you now tell us what your diagram tells us about 25 years from the time of the disposal of the chemicals into the groundwater?

A We have a calculated concentration from the source block, and the reduction concentration as we move away, and the point of zero concentration is somewhere between a thousand and 1200 feet, or approximately 1100 feet.

Q Now, is this diagram, "Calculated Concentration Profiles," is that a standard diagram or standard form of diagram which are used by hydrogeologists in determining concentrations and distance of travel of particular contaminants?

A Yes, it is.

Q Will you tell the jury why the document is entitled "Calculated Concentration Profiles"?

A Because that is in fact what we're showing here, and that is the profile of the concentration of a particular chemical, the maximum line of concentration, if you will, as we move from the source area along the center of the plume.

Q Now, it has underneath the title, the parentheses "R equals 3.8." Will you please tell the jury what R equals 3.8 means?

A Yes. The R refers to the retardation factor or the relative velocity of the chemical with respect to water.

Remember yesterday I went through a little description of the different parameters, and one of them which was chemical dependent is the retardation factor. Chemicals are absorbed onto the site. They don't move as fast into the water, and hence, we incorporate this retardation into our analyses.

Q Is there a range of appropriate retardation factors which could be used for trichloroethylene?

A Yes. As I mentioned yesterday, we have to consider the bulk density. We consider the porosity. We consider the preferential absorption of the material. All these factors go into calculating a retardation factor, and a retardation of 3.8 is at the low end of the range for TCE or trichloroethylene for this particular region.

Q And when you say it's at the low end of the range, can you just tell us what you mean by "the low end of the range"?

A By that I mean it is the lowest retardation, it has the least effect in slowing down the movement of the chemicals.

Q What values did you use for the hydraulic conductivity of the materials through which the chemical contamination traveled in your model?

A The calculation process resulted in a hydraulic conductivity assignment for each of the geologic materials we were talking about, the ground outwash and various others.

The ground outwash deposits, I used the value of 113 feet per day for hydraulic conductivity. For the kame deposits I used the value of 38.8 feet per day. Let me just check this. For the swamp deposits I used the value of 18 feet per day. And for the fine grained outwash I used the value of 8.3 feet per day. And for the ground moraine deposits I used the value of .75 feet per day.

These numbers resulted from, one, the initial assignment of values based on literature information, reviewing of the logs, and professional judgment. But they also resulted -- the final numbers resulted in the calibration process or the reality check of the groundwater flow model.

Q Now, did you make similar calculations for the distance that perchloroethylene could have traveled from the source area over specified periods of time?

A Yes, I did.

Q Can you tell the jury what you determined to be the distance that perchloroethylene could have traveled from the source area over the specified periods of time?

A Perchloroethylene has a higher tendency to absorb onto the sediments, therefore, has a higher retardation factor, and for 11 years I calculated that perchloroethylene would have moved less than 150 feet from the source area; at 19 years, less than 300 feet; and at 25 years, less than 500 feet.

Q Could you note on that exhibit, Dr. Guswa, perhaps over on the right-hand side, the --

A I left my marker over there.

Q Go ahead.

Would you note on this exhibit on the right-hand side the distances and the time that you determined for the perchloroethylene?

A I think what I'll do is I'll just put TCE on here also just to summarize.

Q Fine. That will be fine.

(Witness writing on diagram.)

Q Now, I'm going to ask you whether you made similar calculations for trans?

A Yes, I did.

Q And why don't you tell the jury what you determined for the distance that trans could have traveled from the source area, and if you would, could you write that on the exhibit as well?

A Yes. The distance trans would have moved in 11 years is less than 800 feet; in 19 years, less than 1300 feet; and in 25 years, less than 1600 feet. Trans has a lower retardation factor than either TCE or perc.

A little code I'm using here. I'll put my abbreviation for the chemical name and then the number on the bottom, if you haven't figured it out, is the number of years

that I've calculated the distance.

(Witness writing on diagram.)

Q Having made those calculations, Dr. Guswa, what do you conclude from this analysis?

A Conclude that even if chemicals were released to the groundwater system in 1960, the day the plant opened, they could not have traveled -- they could not have reached Well H which is 2500 feet away from the source area.

Q And they could not have reached Well --

A By May of 1979.

Q By May of 1979. Nor could they have reached it within the 25-year period that you have also used on your calculations?

A That's correct.

Q Now, I would like to show you a cross-section from your three-dimensional model and ask you if you would indicate on that particular model the distances which the complaint chemicals could have reached in traveling from the source area. I just would like you to show the jury, and with regard to the topographical map that underlies the middle layer of your three-dimensional model, if you would indicate where the source area is and where in your opinion is the farthest point from the source area that the contamination could reach even in 25 years.

A Okay. The source is right here. (Indicating). 25 years for the tetra or perc, approximately that distance. That's the perk 25 line. It's approximately in that range.

For the TCE, approximately here and for the trans approximately here.

Q And if you would, would you point out to the jury once again where on that diagram are Wells G and H?

A This is Well H, this is Well G.

Q I would also like you, if you could, Dr. Guswa, on that diagram where you have different kind of materials, if you'll indicate the permeability figures that you used that you testified to a few minutes ago, the permeability or the hydraulic conductivity figures?

A For the coarse-grained outwash, the yellow material, 113 feet per day; for the fine-grained outwash, the orange material, 8.3 feet per day; and for the ground moraine, 0.75 feet per day.

Q Are there other hydraulic conductivity figures that you use that are not subsurface material on this particular chart that you could just write down? Why don't we just have the record clear.

A For the kame deposits, 38.8 feet per day. Swamp deposits, 18 feet per day.

Q You have assigned, as you've testified and as you've indicated on this diagram, a specific hydraulic conductivity figure for each specific subsurface material that you encounter and the contamination traveling you would encounter leaving the Grace site?

A Yes.

Q Why, sir, do you not merely take some average figure of all of these hydraulic conductivity values and use that average figure in arriving at the hydraulic conductivity values for the area between the Grace site and Wells G and H?

A Principally if we're talking about a trip from Point A to Point B and we're traveling at different velocities along that trip, we need to know how much time and what velocity we're traveling in each section of that trip. And the Judge's statement this morning sort of illustrates that. He spent an awful lot of time on the bus this morning trying to get here, which delayed him. Similarly, the low permeability of the ground moraine deposits slows down, it affects the travel time from the Cryovac plant. It is moving through low permeability and it is moving at a slow rate. The permeability between the two locations is not appropriate.

Q Now, do you feel that a so-called one-dimension model is an adequate method to analyze the travel time for chemical contamination from the Grace site within the Aberjona River Valley as you understand it?

A No.

Q And will you tell the jury why you do not believe that a one-dimensional model is a suitable methodology or a sutiable method to analyze the travel time of chemical

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contamination from the Grace site in the Aberjona River Valley?

A There areseveral reasons, but there are two principal ones. The first is the geologic variability, the difference in hydraulic conductivity of materials that exist between the Cryovac plant and Wells G and H are the most fundamental control on the movement of water and chemicals. Secondly, a one-dimensional model does not allow for consideration of the effects of water pulled in from other sources, such as the river, or such as lateral flow from upgradient.

Q Will you tell the jury, Dr. Guswa, why you have confidence in the conclusions that you have reached concerning travel time or travel distance of contaminants from the Grace property?

A Yes. First of all, I am confident that I have made an exhaustive review of the available information and developed a good understanding of the hydrogeologic conditions within the Aberjona River Valley. Secondly, I've used the most powerful and sophisticated tool that we have available so that I could incorporate those important factors into my analysis. Thirdly, I have rigorously tested that model through the three-stage calibration process using 119 wells for which we have water level measurements to check the reality -- to do the reality check on the model. And fourthly, in addition to using what I consider to be the

best estimates of parameters, the chemical transport parameters, I have also done an extensive analysis using other combinations of parameters, some of which are extremely unrealistic and unreasonable, and still conclude that chemicals could not have reached Wells G and H by May of 1979 even if they had left the day the plant opened.

Q I take it, Dr. Guswa, that the calculations that you use -- and I don't know that we have mentioned this -- are mathematical calculations which are fed into a computer?

A That's correct.

Q And that the results that you have testified to are actually results which are printed out from the computer based upon the input into the computer and to the computer program and to the modeling process that you've already described?

A That's correct.

Q Could you resume your seat.

(Witness complies.)

Q Now, you have determined that the chemical contamination which was found in Wells G and H in May of 1979 did not come from the Cryovac site?

A That's correct.

Q What, sir, is your explanation for the presence of contamination in Wells G and H in May of 1979?

A That there are other sources for that contamination.

Q And can you tell the jury what you mean by other sources for that contamination?

A There are several pathways by which chemicals could have reached Wells G and H.

Q And how do you determine what are the pathways by which chemical contamination could have reached Wells G and H?

A In order to understand how the chemicals would have reached Wells G and H, we'd have to understand where the water that is pumped from G and H comes from.

Q And where, Dr. Guswa, does the water which is pumped from Wells G and H come from?

A There is flow of water within the aquifer from the east where the Cryovac plant is located, but also the north and from the west as it moves down the valley. This water originates within a six-square-mile watershed north of Wells G and H.

Q And within the six-square-mile watershed which exists north of Wells G and H, where, in your opinion, does most of the water come from that is pumped from Wells G and H?

A Most of the water comes from the river.

Q You said yesterday that in your opinion a substantial amount of the water which was pumped from Wells G and H came from the Aberjona River?

A That's correct.

Q Can you tell the jury what other mechanisms or what other

sources of water within the Aberjona River -- excuse me -- within the Aberjona Valley in addition to the river could be sources of contaminated water to Wells G and H?

A One source would be groundwater flow parallel to the Aberjona River as the groundwater moves from the north to the south through the center of that bedrock valley.

Q And that would be --Just to direct your attention to the diagram or the photograph on your left, you're talking about groundwater which would be flowing from a northerly direction down towards Wells G and H?

A That's correct.

Q All right. So in addition to the river and in addition to the groundwater flowing from the north toward Wells G and H, what other mechanisms are there within the Aberjona River Valley which could have placed contaminated water in Wells G and H?

A A third source would be exfiltration or flooding of the sewer system itself.

Q And could you tell the jury what the mechanism of the sewer exfiltration is which could get contaminated water into G and H?

A Yes. The red line represents the two sewers that run north-south parallel to the Aberjona River. It has been known that at times of high rainfaill or flooding or high sewer flow, that the manholes on some of those sewers have

been popped up, popped open, and that the sewerage has spilled out from the sewers onto the ground. And it has actually happened within the area between Salem Street and Olympia Avenue. And once that material falls on the land surface, it is either falling on the marshy area of the Aberjona River and spreading laterally on the marshy area or else it is falling onto the ground and entering into the ground. Either way it will get into the ground in response to pumping of Wells G and H and move laterally to Wells G and H in response to that pumping.

Q In addition to the river, to the groundwater under the river, and to sewer exfiltration, tell us, if you will, of another source of contaminated water to Wells G and H and what the mechanism is by which that contaminated water reaches Wells G and H?

A A fourth mechanism would be the historic flooding of the Aberjona River. As I mentioned, there is a six-square mile watershed located north of Wells G and H. This area has been known to flood. And particularly since the construction of the industry complex and draining of Mishawum Lake, the frequency of flooding and the magnitude of flooding has increased in the last 10 years. And the flooding, the increased rainfall and runoff goes out the drainage ditches, floods the lagoons. Any chemical storage in the lagoons will overflow and be mixed in with the water flowing down the valley during this period of increased storm runoff. And

the only place that material can spread out is in the Aberjona River Valley next to Wells G and H. And we now know -- or I know and I hope that everyone else knows, that the Aberjona River is not a single little river flowing down through the valley but is a rather wide marshy area several hundred feet wide; and when that is flooded, that whole area is flooded. Any chemicals in that water will also be spread laterally in that area. And once it is distributed uniformly or non-uniformly in that area, the wells are pumping, they will pull that water into the ground; and if it has chemicals in it, the chemicals will get into the wells.

Q In addition to the river, the aquifer, the sewer exfiltration and flooding, is there yet a fifth mechanism by which contaminated water could get to Wells G and H?

A Yes. If there are local sources of contamination within the area of influence of the pumping wells, they may contribute to the contamination in Wells G and H.

Q Now, is it your opinion, Dr. Guswa, that any of these mechanisms, any of these five mechanisms that you've just described, could be a source of the contaminated water which was found in Wells G and H in May of 1979?

A Yes.

MR. SCHLICHTMANN: Objection.

THE COURT: What is the basis of the -- Will you tell me the basis of the objection?

MR. SCHLICHTMANN: "Could be."

THE COURT: Could I have the question?

(Question read.)

THE COURT: Objection sustained.

Q All right. Is it your opinion, Dr. Cuswa, that any of these five sources of contamination that you have information or you have evidence, that any of these five sources of contamination in fact contaminated, in your opinion, at least to the degree of certainty that you would want as a hydrogeologist, the wells in May of 1979?

A I'm confused by the question.

Q All right. Let me rephrase the question.

Are you satisfied that any of the five mechanisms that I've just described, considering the investigations that you've made of this area which I will get to in a moment, that any of these five mechanisms could have been the mechanism by which contaminants reached Wells G and H in May of 1979?

MR. SCHLICHTMANN: I think the wording is crucial to the objection.

THE COURT: Sustained.

Q Do you have an opinion as to whether any of these mechanisms were in fact the source of contamination?

A I don't know that any particular mechanism was the exact source of contamination.

Q But in your opinion these are mechanisms that existed in the valley throughout the period of time that Wells G and H were pumping?

A That's correct.

Q Have you reviewed prior investigations of contamination along the Aberjona River?

A Yes, I have.

Q And have you, in the course of that investigation, reviewed information which sets forth what the traditional indicators of industrial pollution are along the Aberjona River?

A Yes, I have.

Q And have you reviewed information which indicates those traditional sources of industrial pollution within the water which was pumped from Wells G and H?

A Yes, I have.

Q And have you prepared an exhibit which shows those traditional indicators of industrial pollution for Wells G -- for the waters pumped from Wells G and H?

A Yes, I have.

Q Could you come over to the area of the jury?

Let me show you, Dr. Guswa, a diagram which is noted as G-974, and I would ask you to take a moment and describe to the jury what that diagram depicts.

A This diagram is intended to illustrate the water, the general quality of water as determined by the basic inorganic parameters that were typically analyzed for water supply systems as early as the 1960s, what that water consisted of,

and to compare it to water which is in a non-industrialized or a pristine environment.

Q So the numbers and figures that are on the right hand of the chart are actual measurements of the water, of the contamination of the waters which were pumped from Wells G and H in a period from October of 1963, which was in fact before the first well was installed, until September of 1979?

A That's correct.

Q And the diagram on the left side of the sheet indicates an area -- perhaps you could describe that again -- where those particular figures were taken and why you used that in comparison to the waters from Wells G and H.

A Oak Bluffs is on Martha's Vineyard. This is a test well that was installed as part of a water supply exploration program on Martha's Vineyard, and this represents or is intended to represent probably the best natural water that one could drink. There are no external influences on the quality of the water. This represents sort of a natural groundwater where it is not affected by man's activities.

Q Can you tell us what this particular diagram reflects?

A There are several traditional parameters that were analyzed for as part of a water quality testing program. The normal procedure in the installation of a well field would be to do some initial test work to evaluate the hydraulic property of the area, and also to take some water

quality samples as a preliminary screen to evaluate the suitability of the water for drinking purposes.

Subsequent to a well field being in operation, there would be periodic samples, water quality samples collected and analyzed by the State of Massachusetts at the Lawrence Experiment Station and reported to the state or the town, and reported to the state as an indicator of the quality of the water which is being supplied by those pumping wells.

The typical parameters included sodium, chloride, nitrate, nitrite, which is a different form of nitrogen, ammonia, which is also a nitrogen species, iron, manganese, sulfate, specific conductants, and total chloroform.

Some of these parameters are analyzed. For instance, iron and manganese are analyzed primarily because of the water treatment problems, not because they are a health hazard but because they create objectionable colors to the water. They'll turn your shirts yellow and they'll stain your sinks because of the iron and manganese.

The other parameters have been used by people like myself as an indicator of industrial pollution.

Q Now, why are those parameters used in your profession as indicators of industrial pollution? And perhaps you could direct the jury's attention to specific chemicals in this regard.

A Chloride and sodium, high concentrations of chloride and sodium, and these are high concentrations of chloride and sodium, result from several mechanisms. One, highway salt is a cause of some concentrations. It is also characteristic of landfill leachate, and is also characteristic of industrial waste water discharge.

There is also known to be a high constituent in the Aberjona River quality, and that's indicated in the hydrologic atmosphere. Nitrate and nitrogen forms are generally not naturally occurring species, particularly the nitrate. It is unusual to find nitrate in water.

Q Where do the nitrates come from?

A One of the principal sources would be fertilizer. The places that you find nitrates are under stockyards in the Midwest of the United States. You find nitrates under golf courses where there's been a lot of fertilization. You find nitrates in -- as a result of decomposing human or animal waste such as piggeries, such as sewage treatment plants. You also find nitrates associated with munitions plants, and you also find nitrates associated with various chemical industries.

Q In all of the testing data that you indicated on the chart for that period of time, there were nitrates found in the drinking water that came from Wells G and H?

A That's correct.

Q Why don't you continue.

A Sulfate is not naturally -- the only occurrence of sulfate is usually as a result of decomposition of a mineral we call gypsum. It is unusual to find sulfate in natural groundwater. When we see concentrations of sulfate this high, that is a first flag that we have a source of industrial pollution nearby.

Specific conductants is an indicator of the gross composition of the water as it relates to ionic species, charged ions. You know, if you know hydrogen, H_2O, water, that's hydrogen with a plus sign and oxygen with a minus sign. When we have these mixed in the water, some have plus signs and some have minus signs, and they combine to give us a specific conductant reading.

This is a high number for specific conductants and is an indicator of industrial pollution.

Q All right. With regard to the calculations that have been taken from the Aberjona River well fields, the G and H well field, would you tell us, Dr. Guswa, why that data of these materials in the drinking water at Wells G and H tells you that this is the result of industrial pollution?

A The early parts of my investigation was to review this kind of information and summarize the chemistry of the water for Wells G and H, and based on my experience of a practicing groundwater hydrologist, in looking at these kinds of materials

my first reaction was "These people are drinking wastewater." It is the characteristic constitutents that you find are not naturally occurring. They are the result of some kind of human caused activity, either highway salt pile, industrial waste discharge, manure piles, or is so typical of industrial waste contaminated groundwater.

Q You've indicated a presence of sulfates in the water pumped from Wells G and H.

A Yes.

Q Are you able, in the context of the Aberjona River Valley, are you able to trace those sulfates to a particular source?

A As I mentioned, sulfate is not naturally occurring. Sulfates are found in the wells. There is evidence -- there is information regarding Stepan Chemical Company and citing them for discharge of high sulfate waste.

Q Let me show you, Dr. Guswa, two pages from the report of Mr. Cady which has been already introduced in evidence, and ask you if you could just use these two enlargements of those pages to describe to the jury what you mean when you say that the location of National Polychemical is, in your opinion, a source of the sulfates that are found in Wells G and H?

A These samples were collected from the Stepan Polychemical area, from the drainage ditches that were flowing from the

property and ultimately discharging to the Aberjona River. These materials had chloride concentrations of 500 to 2,000 sulfate concentrations of almost 2,000 to -- it looks like about 6,000, 5,750. We have nitrate concentrations of 54.

Q Now, in addition to the nitrates and the sulfates and the chlorides, were there other indications of industrial pollution found in the waters pumped from Wells G and H?

A Yes. Another indicator is chloroform. Chloroform is a form of bacteria that also is directly associated with decomposing organic matter such as waste.

Q Anything else?

A Nitrogen species, the sodium and the chloride, those are --

Q Was arsenic ever found in the waters pumped from Wells G and H?

A Yes, it was.

Q When was arsenic found in the waters pumped from Wells G and H?

A There was a sample of Wells G and H made in 1979, September of 1979, that detected arsenic.

Q Is arsenic a naturally occurring substance that one would expect to find in drinking water?

A No.

Q Do you have an opinion as to what would be the potential sources of arsenic which were found in Wells G and H?

MR. SCHLICHTMANN: Objection.

Q Yes.

THE COURT: I'll permit that.

Q You may answer.

A Yes, I do.

Q Would you please tell the jury.

A Yes. There are two locations that I think could be the source of the arsenic. One would be the arsenic lagoons located in the Stauffer Chemical area. If they were transported down to the vicinity of Wells G and H, they could have been pumped into the wells.

Secondly, there was a dump in 1971 for about 150 barrels on Olympia Avenue. One of those barrels was sampled and analyzed and contained 1,000 parts per million of arsenic.

THE COURT: What was the date of that, please?

THE WITNESS: Pardon?

THE COURT: What was the date?

THE WIT NESS: That was in 1971.

Q Can you do the mathematics for us, since we're used to thinking in terms of parts per billion, and tell us what 1,000 parts per million is in parts per billion?

A One thousand parts per million is one million parts per billion.

Q Now, Dr. Guswa, what is the significance to you as a hydrogeologist to finding these industrial contaminants in the waters of Wells G and H?

A To me, this is a second indication of the hydraulic connection between the river and Wells G and H. All of these reports that I have talked about refer to discharges of these chemicals, these trial chemicals to the surface water bodies, to the drainage ditches, to the Aberjona River, or disposal on the land, Olympia Avenue near the Aberjona River. These chemicals show up in Wells G and H. These chemicals are not natural groundwater chemicals. These chemicals could only have come from the river itself.

Q Now, does the presence of these contaminants in the waters of Wells G and H provide to you evidence that other contamination associated with the Aberjona River also got into Wells G and H?

MR. SCHLICHTMANN: Objection to form and

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substance.

MR. KEATING: I didn't hear you, Mr. Schlichtmann. I'm sorry.

MR. SCHLICHTMANN: Objection to the form and to the substance.

THE COURT: May I have the question back, please.

(Question read.)

THE COURT: The ground of your objection, Mr. Schlichtmann?

MR. SCHLICHTMANN: Form, leading; and substance, "could".

THE COURT: Substance what?

MR. SCHLICHTMANN: "Could", again. Speculation.

MR. KEATING: I'm asking his opinion, your Honor.

THE COURT: I understand.

MR. KEATING: As an expert.

THE COURT: I'll permit the question.

MR. KEATING: Is the objection overruled, your Honor

THE COURT: Yes.

Q All right. You may answer.

A Could I have it read back again.

(Question read.)

A The fact that these chemicals got into Wells G and H doesn't preclude that if there were any chemicals in the Aberjona River, they also would have gotten into Wells G and H.

Q Now, have you reviewed data about the complaint chemicals in this case that were found in the river or in areas associated with the Aberjona River?

A Yes, I have.

MR. SCHLICHTMANN: Your Honor. Objection. May we see you at the Side Bar on this issue?

THE COURT: Yes.

CONFERENCE AT THE SIDE BAR AS FOLLOWS:

MR. SCHLICHTMANN: The objection is that in light of his answer that he doesn't have an opinion as to the sources of contamination to Wells G and H, I think that we can't get into this particular area, unless he has the opinion. Then he's trying to do it sideways. If he has an opinion---

THE COURT: He has stated an opinion that substantial amounts of water pumped by Wells G and H was river water. Now the question is being asked were there sources of the complaint chemicals which were in the river water, in effect.

MR. SCHLICHTMANN: Yes. But I think it has to be put in the context of his previous answer. He says he doesn't have an opinion that the river was one of the sources.

MR. KEATING: He does.

MR. SCHLICHTMANN: He named the mechanisms. He named all of them. "Do you have an opinion whether in fact they were a source." He says, "I don't know." So until he has that opinion---

THE COURT: The question now is whether they were sources which would adequately explain the presence of this stuff in the river. I think that is appropriate.

MR. SCHLICHTMANN: In the river?

THE COURT: In the river water. And he said the river water went into the wells.

MR. KEATING: And he said the groundwater would flow down to the wells.

THE COURT: He hasn't identified specifically groundwater. But he said that -- First he said 50 percent, now he says most of the water was river water -- maybe most is 51 percent, I don't know.

MR. SCHLICHTMANN: That's the standard. I'll take 50.

MR. KEATING: Fifty I think is what he's saying.

6

THE COURT: So now the question, as I understand it, is dealing with river water. Now if you want to get off into groundwater flows from here and there, you might have more of a problem, but right now you're still with river water.

MR. KEATING: Just so we -- We might as well clear this up right now. He's with river water, but he's also with the east drainage ditch which is part of the river And he's also with complaint chemical contamination which is found in various locations next to the river. That is why I asked him about either in the river or associated with the river, which in his opinion would either flow into the river because of the watershed or would be part of the aquifer, move down towards Wells G and H.

MS. LYNCH: Or would be picked up because of flooding.

THE COURT: Well, now you're getting into more and more---

MR. KEATING: I think all of these are potential, your Honor. No one did the testing -- He doesn't want to say that the 200 parts per billion in May of '79 definitely came from here or definitely came from here.

THE COURT: Tell me, while we're at this, was the water pumped through Wells G and H during the pumping test in '85, '86 tested?

MR. SCHLICHTMANN: Yes.

MR. FACHER: December you're talking about?

THE COURT: December, January.

MR. FACHER: Chemical tests?

THE COURT: Chemical tests.

MR. FACHER: Yes.

THE COURT: And what did it show?

MR. SCHLICHTMANN: Contamination of the water of these chlorinated hydrocarbons. The same chemicals and the same ratios.

MS. LYNCH: No. Decreasing TCE, increasing perc.

THE COURT: They were all there, the four we're down to?

MR. SCHLICHTMANN: Yes.

THE COURT: Four for him, three for you.

Well, I think if you limit it to the river and the tributaries and stuff that would flow into the river up above, I think it is a proper examination. Now, that certainly ought to be separated out.

MR. KEATING: Separated out from what?

THE COURT: I think you ought to isolate that in your question.

MR. KEATING: River or into the river?

THE COURT: Yes.

MR. KEATING: All right. Fine.

THE COURT: And I'll deal with that one first because that one is okay. When you start going into miscellaneous groundwater flows from here, there, and everywhere about which he says he has, as you say, he has no specific opinion, then we get into problems. But I'll take those up one at a time, depending on what your question is.

MR. KEATING: Let me just say this. I guess what's good for the goose is good for the gander. We've got chemical readings that Mr. Drobinski and Dr. Pinder testified about in wells that are between our site and Wells G and H, none of which occurred before May of '79, all of which are '81, '82, '83, the readings. These are inferences that I think you're going to permit Mr. Schlichtmann to argue to the jury, permit the inference that is the descending scale to G and H and all that from our site?

THE COURT: Yes.

MR. KEATING: Now I am asking for the same consideration concerning locations of contaminated groundwater in other areas which are sources.

THE COURT: If he can give an opinion that in his opinion they came from there, fine.

MR. KEATING: That is what he will do.

THE COURT: He just said he can't.

MR. KEATING: He can't tell you and I don't think, frankly, Mr. Drobinski---

MR. SCHLICHTMANN: Dr. Pinder.

MR. KEATING: Either would have had the chutzpah to say the particular 200 parts per billion in May of '79 came from particularly this well and at this particular time.

MR. SCHLICHTMANN: He didn't. He testified as to the sources. It seems, what he said -- maybe I'm wrong -- he said that he can't identify -- He identified the mechanisms, but he couldn't say these were sources for the G and H pollution.

MR. KEATING: He can't say in May of '79 the 200 parts per billion definitely came from Stephan Chemical, definitely came from this, but they're all potential sources of pollution, they're all within the hydraulic area that moves down the river, and that his -- As he said in his opinion, that any one of them could have been the potential sources of contamination which I thought---

THE COURT: Well, as usual, my little pea brain works on a very low scale, and I have to take one question at a time.

MR. KEATING: Fine.

END OF CONFERENCE AT THE BENCH.

Q (By Mr. Keating) I'm not sure if I asked you this before, but if I didn't I'll repeat myself. Have you caused an exhibit to be prepared showing locations where trichloroethylene was found either in the Aberjona River or in the areas leading into the Aberjona River?

A Yes, I have.

Q Would you show us that, please.

MR. KEATING: Your Honor, this is a chalk, it is G-975. It is similar to the diagram -- this is just so you understand -- the photograph that Mr. DeFeo used last week. It has some differences. But it looks much like it.

Q Could you tell the jury, Dr. Guswa, what that particular photograph represents?

A Yes. This is a 1973 aerial photograph of the Aberjona River Valley. The approximate locations of Wells G and H and the Cryovac plant, the Aberjona River and its tributaries to the north.

Q What are the blue areas that are hatched, have hatch marks across them or lines drawn across them?

A They represent swampy or marshy areas.

Q So just directing the jury's attention to the area north of Salem Street where Wells G and H are---

A The Aberjona River flows through the center of this marsh area and spreads out laterally within the extent of this blue area.

Q Now, let me show you an overlay, which was used when Mr. DeFeo testified last week, and that is marked G-877, and can you tell the jury what that overlay represents?

A This overlay includes some of the industries which are located north of Wells G and H within the drainage basin of the Aberjona River.

Q Now, let me show you a further overlay. Now, I show you an overlay marked G-977, and before you identify what that overlay depicts, could you just put on the board these legends and then tell the jury what the legends are and what the overlay depicts?

A The first legend or explanation indicates the first overlay, which was the one that indicated the industries or some of the industries located north of Wells G and H within the Aberjona River drainage basin.

The second, the red dotted and triangled overlay is an indication of locations where trichloroethylene has been found within the surface water system, meaning the river itself and the tributaries or the drainage ditches which lead to the river north of wells -- well north of Salem Street in the Aberjona River Basin.

Q Would you tell the jury, Dr. Guswa, the areas in which trichloroethylene has been found in the surface waters north of Wells G and H or north of Salem Street and describe to the jury what that overlay depicts in terms of the

concentrations and location of these sources of trichloroethylene?

A Yes. There are several sources of information for this overlay. The red circles represent information that was contained in one of the FIT reports, the E&E FIT report regarding the east drainage ditch.

Q Can you just make -- You may need a pointer.

A I have one.

Q Could you just go through and point out to the jury these particular locations?

A The east drainage ditch runs parallel to and on both sides of the railroad track, Boston and Maine railroad track, down to approximately Hall's Brook. The name East Drainage Ditch was assigned because it was east of the Olin Chemical Company.

There are additional sewer samples or samples collected out of the sewers and those are represented by these red triangles; this information is either in an EPA memo or FIT reports. And there's another sewer sample report of a midnight dumper, and that concentration is reported down here.

A We also have a soil sample for Hemenway Trucking, the barrel area located on the banks of the Aberjona River, and that was found -- the samples were, I guess, gotten in February of this year. Each of these dots represents a sampling point for which trichloroethylene was detected during this investigation of what was called the east drainage ditch. And in some cases we have actual laboratory analysis values because these samples were sent to a laboratory for quantification of the concentration of trichloroethylene.

The others report a relative ranking of concentration, low, medium and high, based on an EPA screening analysis that they used. The low represents concentrations of one to 500 parts per billion. Medium is 500 to a thousand parts per billion. And high is greater than 1,000 parts per billion.

Q Could you take us, Dr. Guswa, on a trip down the Aberjona River and show us where these concentrations occurred and what the concentrations were?

A Yes.

Q In certain parts?

A Yes. There's a chemical industry, Raffi & Swanson, located just north of Eanes Street, and that's located on the side of the drainage ditch. The concentration reported was in the medium range, which is 500 to a thousand parts per billion.

MR. SCHLICHTMANN: We're talking about what specific chemical?

THE WITNESS: Trichloroethylene.

A And we come down past National Polychemical Company or Olin Chemical Company, or what used to be called Stepan Chemical. There were places where trichloroethylene were detected, numbers as low as 14 to 23. We have the countification of numbers to 100 parts per billion a little bit south of the Olin Chemical Company.

We get across from the E. C. Whitney Barrel Company the three J, called the EPA's Js, its approximation, meaning -- I'm not sure how much there is, but there is indication of three parts per billion of trichloroethylene, as well as less than 10. We have the source that were sampled just opposite the E. C. Whitney Barrel property as well as the Whitney Barrel storage area.

Then we have a whole storage of samples where TCE was detected opposite New England Pigments and Resins, and adjacent to that was the East Storage Dump, and these were detected in this drainage ditch.

MR. SCHLICHTMANN: What were the amounts? Could we have the concentrations?

Q If you know the concentration, why don't you give the concentration.

A The concentrations, the L meaning a sample indicated 1 to 500 parts per billion, and M meaning 500 to a thousand parts

per billion, and H meaning greater than a thousand parts per billion.

At the Woburn dump, an indication of 500 to greater than a thousand parts per billion, surface water body adjacent to the Woburn dump, an indication of greater than a thousand parts per billion in that surface water body. Adjacent to Woburn Barrel at the confluence of Hall's Brook several samples indicating below TCE concentration, meaning one to 500, the quantification of one sample, 13. Then there is a surface water sample collected at the end of Mishawum Lake, the drainage river area here where the Aberjona River goes under Mishawum Road, and that had less than 10 parts per billion. And at the south end of just north of Salem Street there were two samples collected with 27 and 30 parts per billion of TCE from the surface water.

Q Now, all of these readings that you just referred to the jury are within the surface of the Aberjona River Valley as it extends north from Wells G and H?

A That's correct.

Q And all are sources, in your opinion, of contamination to Wells G and H?

A That's correct.

Q Now, was there any evidence of perchloroethylene or trichloroethylene found at any of the barrel companies that are along the Aberjona River?

A Yes.

Q And can you tell the jury where those concentrations of trichloroethylene and perchloroethylene were found?

A Well, at the Woburn Barrel there was concentrations of trichloroethylene found. Also at Whitney Barrel there were concentrations of trichloroethylene found, and in addition, there was a barrel dump on the Hemenway Transport property where trichloroethylene was found.

Q Now, within the river itself, no matter how you define it, the map or the narrow band or whatever within the river itself, was there trichloroethylene found?

A Yes.

Q And will you tell the jury again -- perhaps you already have -- but where within the river itself was the trichloroethylene found?

A There were three low cases, one at approximately Mishawum Road, a less than 10 parts per billion, two samples collected north of Salem Street, 27 and 30 parts per billion.

Q And also within the drainage ditch, samples found within the drainage ditch?

A Oh, within the drainage ditch, yes, 13 parts per billion at Hall's Brook just south of the Woburn -- no, at Hall's Brook. 22 to a hundred within the drainage ditch between National Polychemical and New England Pigments and Resins, and

14 to 50, a range of 14 to 50 just south of Raffi & Swanson in the drainage ditch.

Q Now, have you brought with you, Dr. Guswa, an example -- Incidentally, is this information that you just referred to, these chemical results, contained in what are known as FIT reports?

A Yes.

Q And a FIT report is a report which is prepared by and does what?

A Prepared by Ecology & Environment, which was an EPA contractor, to do field investigations of waste disposal sites or suspected waste disposal sites, as an attempt to help the EPA set their priorities in which sites would need immediate action for cleanup.

Q Are the calculations that are recorded in these FIT reports calculations and readings that you as a hydrologist rely upon in forming your opinions?

A Yes.

Q All right. Now, I want to show you an analysis from the United States Environmental Protection Agency, dated February 21, 1980, that is an analysis referring to Stepan Chemical Company. Can you show the jury where Stepan Chemical Company is on your map?

A Yes. Stepan, it's Olin, National, and Stepan Polychemical. They were multiple owners of the same facility. Excuse me,

sequential owners, not all at the same time.

Q Using this enlargement of the results of chemical testing by the EPA as an illustrative example of the data that you have taken into consideration in the preparation of that overlay, can you show the jury how the data is represented on the test sheet?

A Yes. This is an indication of the sample number, the location of the sample, east drainage ditch upstream of Stepan, which means it's located up here; and we have a reported value of trichloroethylene, 10 to 50 parts per billion. That in fact is this sample right here.

Q Is there any other chemical that you located there besides the trichloroethylene?

A Yes. There was also found 1,1,1-trichloroethane, and that was found at a concentration of 10 to 50 parts per billion also.

Q You mentioned earlier that there was a test of the river water in the vicinity of Salem Street which revealed the presence of trichloroethylene?

A That's correct.

Q Did the FIT report concerning Stepan Chemical set forth the conclusion as to where the trichloroethylene found at Salem Street came from?

A It was the FIT report regarding the east drainage ditch, and it did.

Q And what did it say?

A It said that the likely source -- that the east drainage ditch was the likely source of the TCE concentrations found in the surface water at Salem Street.

Q Now, I want to show you --

THE COURT: Excuse me. What was the level of concentration found in the water at Salem Street?

THE WITNESS: 27 and 30 parts per billion.

Q I want to show you an enlargement, Dr. Guswa, of a page from the FIT report prepared by the Environmental Protection Agency concerning the conclusion that you just reached, and I would like to have you read, if you would, to the jury what the report concludes as to the source of the trichloroethylene that was found at Salem Street.

A Okay.

"Concentrations of trichloroethylene were consistently detected at and south of Sampling Point 10," which is in this area here, but I'll get my map to confirm that. "Highest concentrations were detected on the east side of the railroad tracks. Abutting the railroad tracks on the east side are E. C. Whitney & Sons, Incorporated, a barrel reclaiming operation, and a storage area for the Whitney Barrel Company, also a barrel reclaim operation. Large quantities of drums and tanks are stored on these properties. (See Figures 13 and 14). Leakage of liquids from these

facilities may be the major source of trichloroethylene contamination of the east drainage ditch."

The next paragraph reads: "Low levels of trichloroethylene were also detected in Hall's Brook upstream of its confluence with the east drainage ditch. Several culprits leading into Hall's Brook were noted during sampling, three parts per billion of trichloroethylene was detected at the entrance of Hall's Brook -- the entrance to Hall's Brook storage area. Trichloroethylene has been detected in the Aberjona River as far as three miles south of Hall's Brook storage area (Appendix D). The east drainage ditch and Hall's Brook are very likely the sources of that contamination."

Q Now, the area which is three miles south as referred to in that chart is where?

A Here. (Indicating).

Q Salem Street?

A Yes.

Q Which is an area south of Wells G and H?

A That's correct.

Q Is it your opinion, Dr. Guswa, that the aquifer beneath the Aberjona River has been a source of transport for complaint chemicals?

A Yes.

Q And will you tell the jury why you reached that conclusion?

A Because the aquifer flows parallel to the river in the

course of drain materials, it is the course of drain materials in the center of the valley, and the groundwater and surface water systems are in close connection throughout the valley, and the chemicals that are in the surface water get into the groundwater system and they travel through the groundwater system as well as the surface water system.

Q And the direction of flow of the groundwater system going from the area at the top of this photograph going down towards Wells G and H is what, sir?

A Is from north to south.

Q Up there past Wells G and H?

A That's correct.

Q Now, -- I'll leave that here for a moment.

You mentioned earlier flooding as a mechanism to get contaminated water into Wells G and H?

A Correct.

Q Have you made a study of the flood history in the Aberjona River Valley?

A Yes, I have.

Q Before you tell us what that history revealed, I want to ask you a couple of questions about the Aberjona River, and you've referred to this earlier, but is the Aberjona River, particularly in the area of Wells G and H, a thin ribbon of water which passes by Wells G and H?

A No, it is not.

Q Will you describe, sir, for the jury what is the nature of the Aberjona River as it passes down south of 128 and south of Olympia Avenue towards Salem Street?

A Between Olympia Avenue and Salem Street the Aberjona River is in fact a marshy, swampy area that spreads out laterally for several hundred feet because it is backed up behind Salem Street at the topographic high at Salem Street.

Q I want to show you a photograph marked G-979 and ask you if you could tell me what that photograph represents? What is this a photograph of?

A This is a photograph of Monitoring Well S-89 adjacent to Well H and the Aberjona River itself.

Q Now, where is S-89 and Well H, if you can show us on this?

A S-89 is adjacent to Well H.

Q In other words, it's within this little circle that's here?

A That's correct. It's within 50 feet of Well H.

Q All right. Now, when, sir, was this photograph taken?

A This was taken about two weeks ago when some of my people that work with me were collecting a peat sample from the Aberjona River.

Q Does this photograph represent the river as it exists within the area of Well H without regard to flooding?

A Yes.

Q And is this picture a fair and accurate representation of what the Aberjona River in the vicinity of Well 89 looked like two weeks ago?

A Yes.

MR. SCHLICHTMANN: No objection.

MR. KEATING: I'd like to offer this, your Honor. I think there's no objection.

THE COURT: I hear no objections. It's admitted.

What's the number of it?

MR. KEATING: G-979.

(Photograph admitted in evidence as Defendant Grace Exhibit G-979.)

Q Now would you tell the jury, Dr. Guswa, what G-979 tells you about the river and the width of the river in the area of Well H?

A Well, this picture is taken standing at the edge of the water, the edge of the Aberjona River, if you will, and approximately 30 feet from Well H. And we have used the term river to describe the Aberjona River. Used the word river. But it maybe is not clear to everyone that the river is not a thin strip, sinuous channel that flows between Olympia Avenue and Salem Street, but is in fact a very wide, very shallow surface water body, and that this water is approximately four inches or six inches deep at this location here. And this condition is representative of what the river was like most of the time. And when Wells G and H are pumping, we're not only talking about inducing flow of water out of the main river channel but we are talking about pulling and dewatering this portion of the river, sucking this water directly into the ground. In fact, I believe we've already heard testimony to that effect regarding what happened the day of the pump test.

Q Now, that has to do with the cracking ice?

A Yes.

Q This does not represent the river at flood time?

A No, it does not.

Q Now, have you prepared an exhibit which shows what the

flood history has been within the Aberjona River Valley?

A Yes, I have.

Q I show you what's been marked as G-973, Dr. Guswa, which is entitled, "History of Flooding in the Aberjona River from 1940 to 1983," and ask you to tell the jury what that chart represents.

A Yes. This chart was prepared on the basis of information that we obtained from the U.S. Geological Survey. In addition to asking for the basic stream flow information, we asked for the information they had on the flood frequency of the Aberjona River. That is a separate -- It's based on the same stream flow information, but it's a separate compilation of that information and it reflects the stream flow or the flooding flow of the Aberjona River, the peak flow, if you will, the maximum flow of the river for each year from 1940 through 1983. So this represents, within any one year, what was the maximum flow of the river as measured at the gauging station just north of the Mystic Lakes in Winchester.

And we can see that in the early 1940s, its peak flows were in the 300 cubic feet per second range, but in May of 1979 the flood waters, flooding of the Aberjona River was flowing at about 1300 or 1350 cubic feet per second. That's to be compared with the normal flow of the Aberjona River, which is about 20 cubic feet per second.

Q What is the reference to 10-year flood and 50-year flood

and 100-year flood?

A This is part of the statistical analysis that the Geological Survey does to indicate the frequency of the probability of having this much water -- that is what this dot is -- flowing in the Aberjona River. So by a 10-year flood, it means that once every 10 years you would expect the flow of the Aberjona River to be 600 cubic feet per second. For a 50-year flood, it means once every 50 years you would expect the flow of the Aberjona River to be equal to or exceed 1000 cubic feet per second. And this is based on analyzing the historic record of the stream flow.

Q And how about with respect to the 100-year flood?

A The 100-year flood, meaning once every 100 years, you would have a flood equal to or flow of water equal to 1200 cubic feet per second.

Q Now, when, Dr. Guswa, did the 100-year flood of the Aberjona River take place?

A In January of 1979.

Q Four months prior to the date that Wells G and H were closed?

A That's correct.

Q Now, what in your professional opinion as a hydrologist is the effect of the flooding of this Aberjona River Valley -- either in the January '79 flood or in any of the times when this diagram indicates flooding occurred -- what is

your opinion as a professional hydrologist as to the impact of those events on contamination in Wells G and H?

A Flooding is a very rapid and very probable mechanism for transporting chemicals found north of Olympia AVenue, as far north as the end of the drainage basin, south to the vicinity of Wells G and H.

Q Is the W.R. Grace facility, incidentally, within the flood plain of the Aberjona River?

A No, it is not.

Q Are Wells G and H within the flood plain of the Aberjona River?

A Yes, they are.

Q Now, have you reviewed information concerning chemicals which were found in the ground at the Hemingway site?

A Yes, I have.

Q And we don't have a map here -- I think the jury has it in mind any way -- but where is the Hemingway site where the chemical contamination was found in relationship to Wells G and H?

A It is located on the western bank of the Aberjona River, slightly north of Well H.

Q Have you visited the site where the barrels were found on the Hemingway property?

A Yes, I did.

Q How close were those barrels to the Aberjona River, to

the marsh waters of the Aberjona River?

A Some of the barrels were in the river.

Q In your opinion, sir, would a flood such as the 100-year flood of January 1979 have reached the site where the Hemingway barrels were found?

A Yes, it would.

Q Could the flood waters, having reached that site, carry the contamination to the vicinity of Wells G and H?

A Yes, it could.

Q Have you, sir, compared the fingerprint of the chemicals which were found at the Hemingway site with the fingerprint of chemicals which were found in Wells G and H in May, 1979?

A Yes, I have.

Q And will you tell the jury, sir, what you have concluded by comparing the chemicals found at the Hemingway site with the chemicals found in the water which was tested at Wells G and H in May of 1979?

A The comparison of the chemicals found at the Hemingway property versus what was found in the wells in May of 1979, there's a close correlation between those two types of chemicals and indicates to me that Hemingway barrels, the chemicals found there, are a possible source of the contamination to Wells G and H.

MR. KEATING: Your Honor, I don't have too much more with Dr. Guswa, but I think longer than it would

test everyone's patience for a recess. This is a convenient time.

THE COURT: All right. We'll take the morning recess.

(Recess.)

THE COURT: All right.

Q Dr. Guswa, at one point this morning I asked you about the amount of water that came from the Aberjona River that was pumped from Wells G and H.

A Yes.

Q G or H or G and H. I might have used these words you used, "Most of it, a substantial portion."

A Yes.

Q Could you clarify that for the jury?

A Yes. When the wells are not pumping, there is no water going to the wells from the river. All the groundwater is discharging into the river. When the wells start pumping, they are pulling water from the river into the ground.

Now, it takes a while for that water to reach the well because it has to move through the ground a certain distance; and in this case, I think it is probably two months to reach Wells G or H. It takes two months for the river water to actually reach the water itself.

As the wells continue to pump and if they continue to pump, approximately half of the water that is pumped out of the wells comes directly from the river. But in the event that the wells only pump one month, they still have pulled the river water into the ground. If they shut off for a period of time, that water still stays in the ground, and then when the wells are turned on again,

they pull the water that is close to them, which is the groundwater, which used to be in the river a month ago, but we spend our lives studying such things, but it is a difficult concept to get across and difficult to say whether it is exactly 50 percent or 40 percent, but the average is about 50 percent of the water that is pumped from the wells comes from the river.

Q Thank you.

Now, are there -- You mentioned when you listed the mechanisms of contaminated water to Wells G and H, I think you've gone through four of them now. The fifth one that you had mentioned earlier was the groundwater within the vicinity of Wells G and H.

A Yes.

Q Right.

Are there monitoring wells within the vicinity of Wells G and H which show the presence of complaint chemicals?

A Yes.

Q And can you tell us what some of those wells are that show the presence of complaint chemicals and where those wells are located?

A Yes.

Q Would you like to use a diagram?

A Yes, please.

Q All right. Why don't you --

MR. KEATING: This is, your Honor, G-952.

Q Why don't you, Dr. Guswa, for the record, identify that chart which we used yesterday.

A Yes, this is the water level elevation map for January 3rd or the end of the pumping test. There are many wells that have the complaint chemicals, many monitoring wells have indications of the complaint chemicals in them.

Well S-86, for example, which is located south, approximately 400 feet south of Well G, and along the drainage ditch which drains from New England Plastics -- let me dig through my chart here -- has been sampled for chemicals by EPA, and, in fact, in December of 1985.

Q S-86, there? (Indicating).

A S-86, yes.

In March and April of 1985, S-86, there are several wells at S-86, there were concentrations of TCE as well as tetrachloroethylene down in those wells. The range found in S-86 was from as low as three, with one of the Js, meaning an approximately value, to as high as 78, also with a J, meaning approximate.

Q Are these parts per billion?

A I'm sorry, yes, parts per billion.

Tetrachloroethylene concentrations ranged from 12 to 56. One of those, the 56 number, is also

an approximate concentration.

Q Are there other wells that you would point out to us in the vicinity of Wells G and H that showed chemical contamination?

A Yes. Well S-88, which is located between Wells G and H, located approximately 300 feet west of Well H and slightly south of Well H, was also sampled during the same time period as Wells 86.

Just for clarification, the EPA, in fact, did three rounds of sampling, April, May and June of 1985. The April and May results had been released and the June results had not been released yet.

Q What did the EPA find at S-88?

A For Well S-88, the shallow well had 14 parts per billion TCE, and the medium and deep well, both in the unconsolidated material, had approximately 50 parts per billion. One was 50 and one was 56, and they had less than 10 parts per billion each of 1,2-trans and tetra.

Q Any other wells that you can point out to us?

A Well S-72, which is located left of the parking lot of Hemingway Trucking had also been sampled.

Q What did the sample of S-82 show?

A S-72.

Q I'm sorry, S-72.

A S-72 showed a range of TCE concentration of from less

than five to approximately 20 parts per billion. 1,2-trans concentrations basically not detected, and minor concentrations of tetra.

Q Any other wells that you can point out?

A S-84.

Q S-84 is located here? (Indicating).

A Yes, east of Wells G and H and intermediate between the two wells.

S-84 had approximately -- the three clusters, the three wells in the cluster, the range, if you average out the range, it is approximately 20 parts per billion of TCE, approximately 10 parts per billion of 1,2- trans, and approximately 20 parts per billion of tetra.

Q Any other wells, Dr. Guswa, that you want to point out?

A Yes. Well S-77, which is located on the western side of the Aberjona River.

Q Is that located on Aberjona Auto Parts, do you know?

A Yes.

Q Where is that located?

A It is located on this area marked "Pile, Aberjona Auto Parts."

Well S-77 had TCE concentrations of as low as five to as high as 370 with an estimated value of the 370 and the 349 as apparently direct reported value of TCE. 1,2-trans concentration, approximately 120 parts per billion,

and including what appears to be an enormously high average, the tetra was approximately 30 parts per billion.

Q Any other wells that you want to point out?

A No. I think that gives the general pattern of a pervasive distribution of the complaint chemicals within the Aberjona River Valley.

Q Now, are those wells that you pointed out wells which are in locations in which the water, the groundwater, would get to Wells G and H?

A Yes. Four, it's fairly clear they are within the cone of influence in G and H.

The fifth, Aberjona Auto Parts, is within the cone of influence of G and H.

Q It's in the cone of influence because it's upgradient, or why do you characterize that as in the cone of influence of G and H?

A It's hydraulically upgradient of G and H, and these are groundwater gradients from that well toward G when it's pumping.

Q And do you consider the presence of those chemicals in those wells within the cone of influence of Wells G and H a source of contamination of complaint chemicals to Wells G and H?

A Yes. They could be representative of localized sources of contamination or just the generalized sources of contamination within the whole valley.

Q Dr. Guswa, you have reviewed five mechanisms of sources of contamination to Wells G and H. The Aberjona River?

A Yes.

Q The aquifer beneath the Aberjona River?

A Yes.

Q The sewers and the sewer exfiltration?

A Yes.

Q The flooding and flood waters within the Aberjona watershed?

A Yes.

Q And finally, the ground water within the immediate vicinity and within the cone of depression of Wells G and H?

A Yes.

Q In your opinion, sir, is one or more of these mechanisms a probable source of the contamination that was found in May of 1979 in Wells G and H?

A Yes, it is.

MR. KEATING: Thank you, Dr. Guswa.

I have no further questions, your Honor.

THE COURT: Questions?

MR. FACHER: I have some questions, your Honor.

CROSS-EXAMINATION, By Mr. Facher

Q Doctor, do you mind standing up again. Most of my questions relate to some of these exhibits.

Why don't we start with the last one you had.

MR. KEATING: It's right over here.

MR. FACHER: And we'll need three stands.

Q Doctor, just to orient ourselves, we're looking at a diagramatic sketch of the property, we're looking at the end of the pumping test chalk that you prepared, and we're looking at the aerial photograph, all of which I hope show the same property.

Now, just to orient ourselves, will you point out Hemingway on all three of these diagrams?